POPULATION GEOGRAPHY
ISSN 0256-5331 Volume 45(2) December 2023

Population Distribution of Agartala City and its Significance on Urban Planning and Development

Saptarshi Mitra[1], Stabak Roy, and Samrat Hore

To cite this article: Mitra, S., Roy, S., & Hore, S. (2023). Population distribution of Agartala City and its significance on urban planning and development. *Population Geography*, *45*(2), 47-64.

Abstract: Population distribution in an urban area is a critical decision-making factor for urban governance. Agartala, the capital city of Tripura, is the second-largest populated and fastest-growing city in Northeast India. This city is uniquely located in the extreme western part of the State of Tripura, extending between 23°45′N to 23°55′N latitudes and 91°15′E to 91°20′E longitudes, covering an area of 76.150 km² sharing an international boundary with Bangladesh. This paper analyses the distribution of the city's population along with its statistical measures and spatial structure based on the population data in 2018 of Agartala Municipal Corporation (AMC). Further, this paper analyses the causality of the population distribution of Agartala City. It has been found that road networks, marketplaces and educational institutes significantly impact the city's population distribution. It helps in the micro-level resource distribution and unit for sustainable development. It relates to the micro-level resource allocation and urban planning decision support system.

Keywords: spatial distribution, alternative synthetic indicator, population density, regional classification, border city

In urban planning and management, the nature of a city's population distribution is a key area of concern (Du et al., 2006). The urban area's distribution and population size dynamics are crucial to managing growth and mitigating the negative impacts (Decker et al., 2007). Population distribution measurement mainly focuses on spatial and categorical (Duncan, 1957). The spatial characteristics of

[1] Corresponding Author
Article:
Received: 09.02.22 Reviewed: 30.01.23 Accepted: 16.07.23

population distribution are considered in urban planning and management (Song & Prishchepov, 2017). The development of highly concentrated urban structures suffers from heterogeneous populations (Tsuboi et al., 2016). The heterogeneous population distribution is levelled with multifactorial issues like demographic attributes, socio-economic conditions, transport infrastructure, physical infrastructure, cultural landscape, land use pattern and development across space and time (Chi & Ventura, 2011). Spatial heterogeneity of population distribution has numerous impacts on urban sustainability (Zhou et al., 2016). About 50 per cent of the world's population is concentrated in six countries: China, India, the United States of America (USA), Indonesia, Brazil and Pakistan (Hackett, 2018). With a 73,899,804 population, China is the world's largest populated country (The Economic Times, 2020). According to the Census of India, 2011, India became the second-largest country after China regarding population size, with a population of 1.21 billion (Shaban et al., 2020). India is the fifth largest country in terms of urban inhabitants after the USA, Russia, China, and Japan (Eberstadt, 2010). Census of India, 2011 depicts that during the decade 2001-11, India's urban population growth was slightly higher than that of the rural population (Aijaz, 2021). Agarwal (2020) reported that 70 per cent growth had been found in urban areas. In India, there are more than 4000 cities and towns. A city's population growth depends on time and space (Tumbe, 2020). Haque and Patel (2017) show that those metro cities, especially the state capitals at the riverbank with better quality public services, grow faster than other cities.

Northeast India is uniquely located in the eastern fringe of the country with its dissentient physiographic features, dissonant social structure, and divergent cultural entity (Singh, 2006). The Northeastern region comprises eight distinct and diverse states of Arunachal Pradesh, Assam, Meghalaya, Manipur, Mizoram, Nagaland, Tripura and Sikkim (Roy & Mitra, 2016). This region was largely rural since pre-independence, but urbanisation has been faster in the last quarter of the 20th century (Khawas, 2005). The urbanisation process and the increasing urban population are not equally distributed in all Northeastern states (Tumbe, 2017). Sahay et al. (2015) stated that the Northeastern region is home to 45 million people or about 3.8 per cent of the country's total population, of which 68 per cent live in Assam alone. Guwahati Municipal Corporation (GMC) was established in 1974 with 34 wards and has risen to 60 (Desai & Mahadevia, 2013). The population of Guwahati Municipal Corporation increased from nearly three hundred thousand to 1.3 million in 2011 (Sahay et al., 2015). Agartala is the second most populated and one of the country's fastest-growing cities (Santra et al., 2018). Debbarma et al. (2018) show that the population of Agartala City is not equally distributed among 35 wards based on the data from the Census of India, 2011. As per notification (No.F.II-24/GL/OATH/AMC/2012/Vo-II/26335-427) of the Municipal Commissioner on 29th December 2015, Agartala Municipal Corporation (AMC) had increased to 49 wards from 35 wards, and population and area increased significantly. With the increased area and population, Agartala City evolved with a new distributional pattern of

population. The study's main objective is to determine the characteristics of population distribution and the causality of heterogeneous distribution.

Study Area

Agartala, the capital city of Tripura, is situated between 23° 45ˈto 23° 55ˈ N latitudes and 91°15ˈ to 91°20ˈ E longitudes (Fig. 1). The city is located in the flood plain of the River Haora and Kata Khal. The physiographic structure of Agartala City is saucer-shaped and characterised by Tilla (relatively high land) and Lunga (low land) topography (Sen et al., 2015). The Agartala Municipal Council was established long before, in 1874. In 2014, it was upgraded into Agartala Municipal Corporation (AMC), representing the local urban governance of Agartala City. Since its statehood, the city has become the centre of the state's administrative, political, cultural, and commercial activities. The city has become an essential border trading centre with international linkage with Bangladesh. The National Highway-8 passes through the city (Fig. 1). Maharaja Bir Bikram Airport [23°53'33.96" N and 91°14'37.81" E] is located about11.75 km northwest of the Central Business District (CBD) of Agartala City. The city is divided into four planning zones (North et al.) and shares the international border with Bangladesh on the western side. Jirania Rural Development (RD) Block, Mohanpur R.D. Block and Dukli R.D. Block are situated east, north, and south of the city. The total area of AMC is almost 76.150, with 5,26,292 people (AMC, 2018).

Materials and Methods

The study is based on secondary data collected from the Agartala Municipal Corporation (AMC) office in 2020. Very recently, the AMC area was extended in 2016. Also, AMC conducted the last population survey of Agartala City in 2018. Thus, we have considered the latest ward-wise population data (2018) and ward-wise area (2016) for the study instead of the 2011 Census of India.

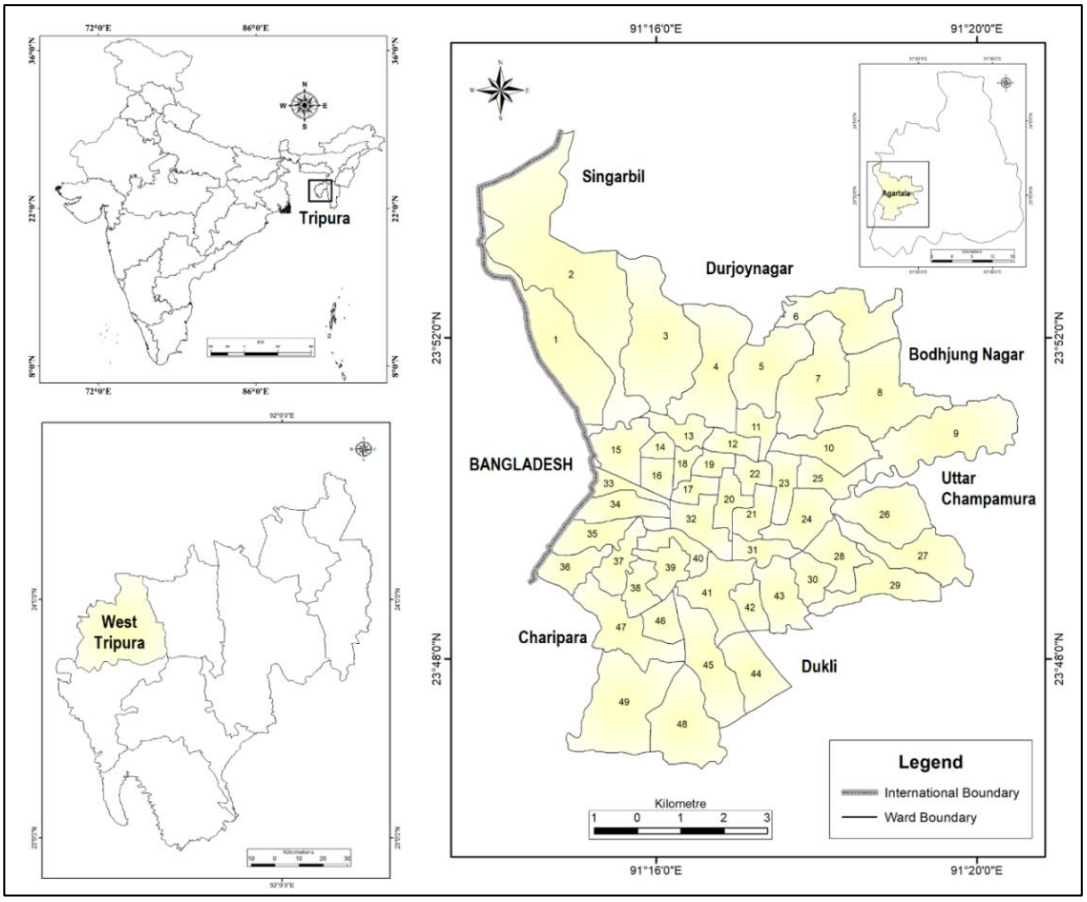
We have considered each ward's population, area, and population density as the study variables. At first, the normality of these variables' data observations is analysed through the Shapiro–Wilk test (Mishra et al., 2019). The Q-Q plot is a graphical tool for assessing the goodness-of-fit of observed data to a theoretical normal distribution (Velez & Correa, 2015). A graphical technique like the Quantile-Quantile (Q-Q) plot has also been applied for normality assumption. The degree of asymmetry (third central moment) and peakedness of datasets are carried out with skewness and kurtosis, respectively, using SPSS v26.

The non-normality of the data sets is observed through Shapiro-Wilk's test. Therefore, the existing Synthetic Indicator (Jaroca & Glinska, 2017) may need to be revised to classify the heterogeneity of data sets. A new Synthetic Indicator noted as an Alternative Synthetic Indicator (ASI) has been suggested here for those non-normal data sets, where the indicator is structured as the linear order of the median

(as a measure of central tendency) and mean deviation about median (as a measure of dispersion).

Figure 1

Location Map of the Study Area



Source: Prepared by the authors, 2021; Extracted from AMC Ward Boundary Map, 2016

Based on standardised data, the city has been classified into different classes. The Mean Centre of Population has been calculated and mapped using ArcGIS v10.7.1. The zonal distribution of the population has been measured using the Inverse Distance Weighted (IDW) method of interpolation (Wang et al., 2019).

Spatial distribution of different infrastructural facilities, i.e., road networks, marketplaces, and educational institutes, are mapped, and Spearman's rank correlation tests have been performed between population density and each of the above-mentioned infrastructural facilities to understand the role of infrastructural facilities on the distribution of population distribution in a city.

Results and Findings

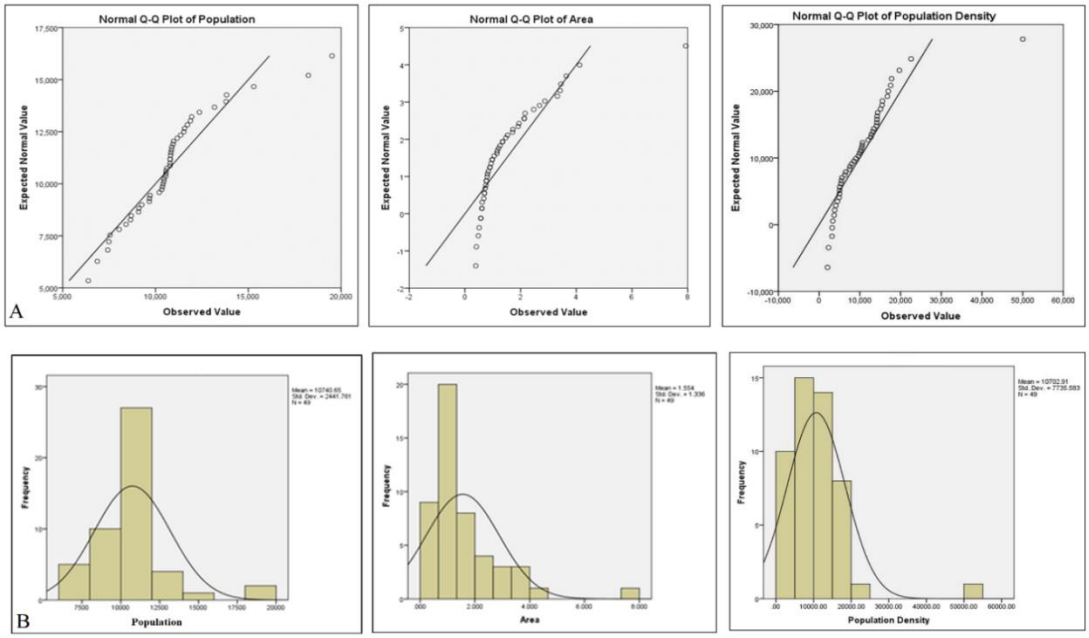
Following Shapiro-Wilk's normality test, it has been found that both the data of ward-wise population distribution (1.354) and area (1.239) are non-normal at a 5 per cent level of significance.

Shapiro-Wilk's test forward-wise population distribution shows the parameter is 0.878498, and the corresponding p-value is 0.00012 (<0.05). Since the p-value is <0.05, the data is assumed to be non-normally distributed. The area of wards is also found to be non-normally distributed. Shapiro-Wilk's parameter value of the area of wards is 0.739631, and the p-value is 0.00000005719 (<0.05). Similarly, ward-wise population density corresponding to the Shapiro-Wilk test parameter value is reported as 0.77716, and the p-value is 0.000033503 (<0.05).

The Q-Q plot also nullifies the normality assumption (Fig. 2 A). Skewness (1.43) of ward-wise population distribution shows the degree of asymmetry with right or positively skewed (long right tale), and kurtosis (Leptokurtic: 3.98) is positive and balancing to shift toward the tails. The distribution of ward area was also observed with positively skewed (2.67) and leptokurtic distribution (9.93), showing long heavy tails where the peak is low but a high peak with some values far from the mean (Fig. 2B). Similarly, skewness and kurtosis of population density are 2.808658 [(Positively skewed) and 13.050506 (Leptokurtic), respectively.

Figure 2

(A) Q-Q Plot for Normality Assumption (B) Skewness Plot for the Degree of Asymmetry of Population, Area and Population Density of Agartala City



Source: Prepared by the authors, 2021 using SPSS V26

The key factors are to classify the ward-wise heterogeneity of distribution of ward-wise population and ward-wise area in AMC. It is also considered that each ward's population density is a variable for classification through existing synthetic indicators and suggests alternative synthetic indicators. Population density has been efficiently measured to represent population distribution per unit area (population/km^2). Synthetic Indicator (SI) and Alternative Synthetic Indicator (ASI) classify population density.

According to SI, three (6.12%) wards, i.e.,14, 17 and 31 of Agartala City, have been categorised as very high-density population zones (Table 1). These three wards are scattered and distributed in the central part of Agartala City (Fig 3A). Further, it is observed that 17 (34.70%) wards of Agartala City have been categorised in a high population density zone. The wards are 12, 46, 33, 42, 18, 19, 11, 38, 16, 13, 21, 22, 40, 25, 23, 20 and 39 where population density varies between 10,703 persons per km^2 to18,438 persons per km^2 (Table 1). A highly dense population zone covers almost all the areas of the central part of the city (Fig. 3A). Ward No. 33, characterised by a very high population density, is stretched from the city's centre towards the border of Bangladesh on the west. Low-density population zone has been found in 27 (55.10%) wards of Agartala City which are 30, 36, 10, 32, 26, 37, 28, 24, 34, 43, 35, 41, 29, 15, 47, 6, 5, 27, 48, 45, 44, 7, 9, 4, 3, 8 and 49 (Table 1). The low-density population zone is normally located in the peripheral part of the Central Business District (CBD) as well as the marginal wards of the city (Fig. 3A). On the other hand, a Very low-density population zone is found in only ward number Two (2). Another one (1) is located along the city's northwest border (Table 1) because these are newly added. These areas were under gram panchayat, where most people were engaged in agricultural activities. Due to recent transformation, the need for other infrastructural facilities like connectivity, markets, and schools affects the population concentration.

Table 1

Classification of Population Density of Agartala City by Synthetic Indicator (SI)

	Method of calculating class	Class range	Characteristic of class	Number of the ward	% of ward
I	$z_i \geq \bar{z} + \sigma_i$	$z_i \geq 18438$	Very high density	14, 17 and 31	6.12
II	$\bar{z} \leq z_i \leq \bar{z} + \sigma_i$	$10703 \leq z_i \leq 18438$	High density	12, 46, 33, 42, 18, 19, 11, 38, 16, 13, 21, 22, 40, 25, 23, 20 and 39	34.70
III	$\bar{z} - \sigma_i \leq z_i \leq \bar{z}$	$2967 \leq z_i \leq 10703$	Low density	30,36, 10, 32, 26, 37, 28, 24, 34, 43, 35, 41, 29, 15, 47, 6, 5, 27, 48, 45, 44, 7, 9, 4, 3, 8 and 49	55.10
IV	$z_i \leq \bar{z} - \sigma_i$	$z_i \leq 2967$	Very low density	2 and 1	4.08
Source: Computed by the Authors, 2021					

Table 2

Classification of Population Density of Agartala City by Alternative Synthetic Indicator (ASI)

Class	Method of calculating class	Class range	Characteristic of class	Number of the ward	% of ward
I	$y_i \geq y + MD_{\bar{y}}$	$y_i \geq 15166$	Very high density	14, 17, 31, 12, 46, 33, 42, 18, 19 and 11	20.41
II	$y \leq y_i \leq y + MD_{\bar{y}}$	$9905 \leq y_i \leq 15166$	High density	38, 16, 13, 21, 22, 40, 25, 23, 20, 39, 30, 36, 10 and 32	28.57
III	$y - MD_{\bar{y}} \leq y_i \leq y$	$4644 \leq y_i \leq 9905$	Low density	26, 37, 28, 24, 34, 43, 35, 41, 29, 15, 47, 6, 5, 27, 48, and 45	38.78
IV	$y_i \leq y - MD_{\bar{y}}$	$y_i \leq 4644$	Very low density	44, 7, 9, 4, 3, 8, 49, 2 and 1	18.37
Source: Computed by the authors, 2021					

On the contrary, 10 (20.41%) wards, i.e., 14, 17, 31, 12, 46, 33, 42, 18, 19 and 11 of Agartala City have very high population density, among which six (60%) are located in the central part of Agartala City (Fig. 3B). Ward No. 33 is characterised by a high population density stretched from the centre of the city towards the border of Bangladesh on the west. Further, 14 (28.57%) wards of AMC have high population density, i.e. 38, 16, 13, 21, 22, 40, 25, 23, 20, 39, 30, 36, 10 and 32. Those wards are located adjacent to very highly dense populated wards (Fig. 3B). About 16 (38.78%) low, densely populated wards are found at the periphery of wards with high population density (Fig. 3B). Those wards are 26, 37, 28, 24, 34, 43, 35, 41, 29, 15, 47, 6, 5, 27, 48 and 45. Considering the zonal distribution of the city, 2 (13.33%), 5 (33.33%), 4 (26.66%) and 4 (26.66%) wards characterised by low-population density are found in the north, south, the east and western part, respectively of Agartala City.

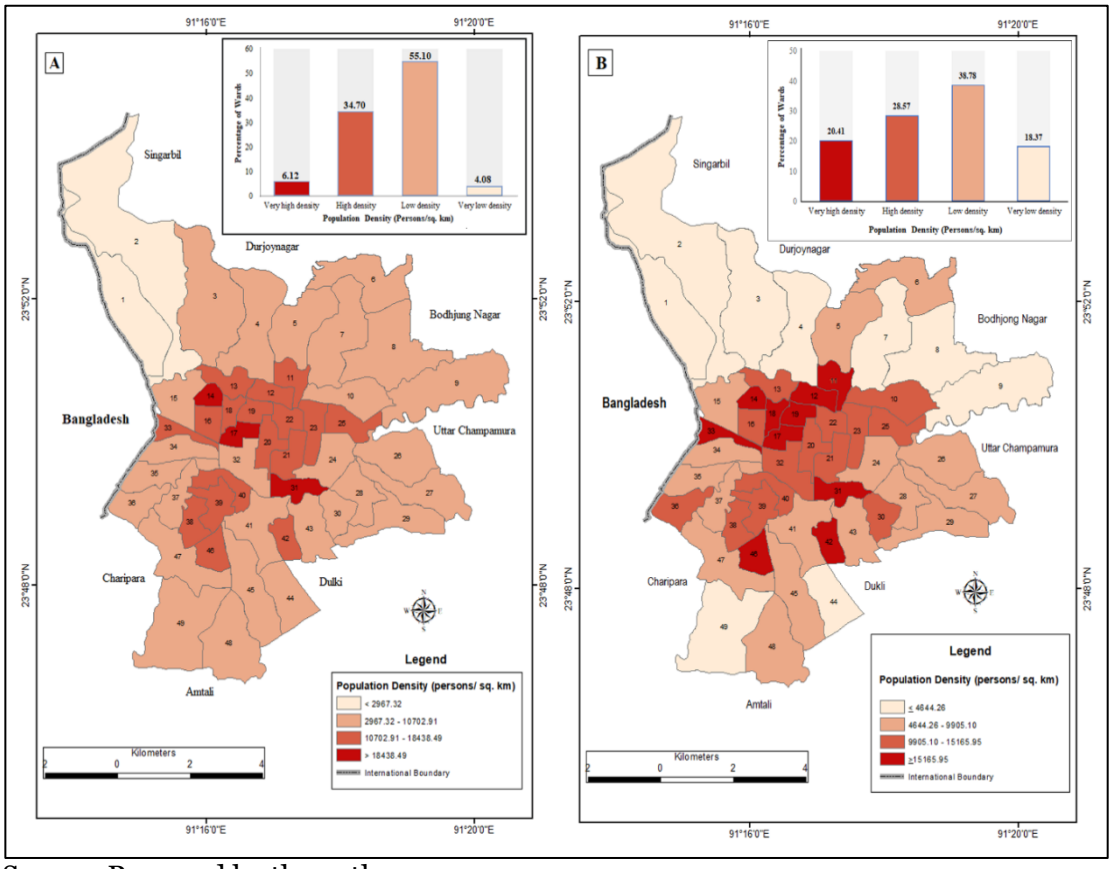
Further, Ward numbers 44, 7, 9, 4, 3, 8, 49, 2 and 1 of Agartala City have been observed to have a very low population density (Table 2). Among them, 7 (77.78%) wards, i.e., 1, 2, 3, 4, 7, 8 and 9, are located at the margin of Agartala City, especially in the northern part and the rest 2 (23.33%) wards, namely 44 and 49 are located in the southern margin of the city.

There is a significant range of disparities in classifying wards (Figure 3) through synthetic and alternative synthetic indicators. The weightage (percentage of ward distribution) range of classification is 51.02 (55.10-4.08) and 12.24 (30.61-18.37) through SI and ASI, respectively. The variance weightage is estimated and identified as V_{SI} and V_{ASI} for SI and ASI. Here V_{SI}= 598.0669 and V_{ASI} =42.6564. The gain in efficiency of ASI over SI is measured as $\frac{(V_{SI}-V_{ASI})}{V_{ASI}}$= 13.0205. It shows that our

suggested ASI is more efficient than the existing SI, and classifications of wards of AMC, as reported in Table 2, are more appropriate.

Figure 3

Ward-wise Population Density of Agartala City Through Synthetic Indicator (A) and Alternative Synthetic Indicator (B)

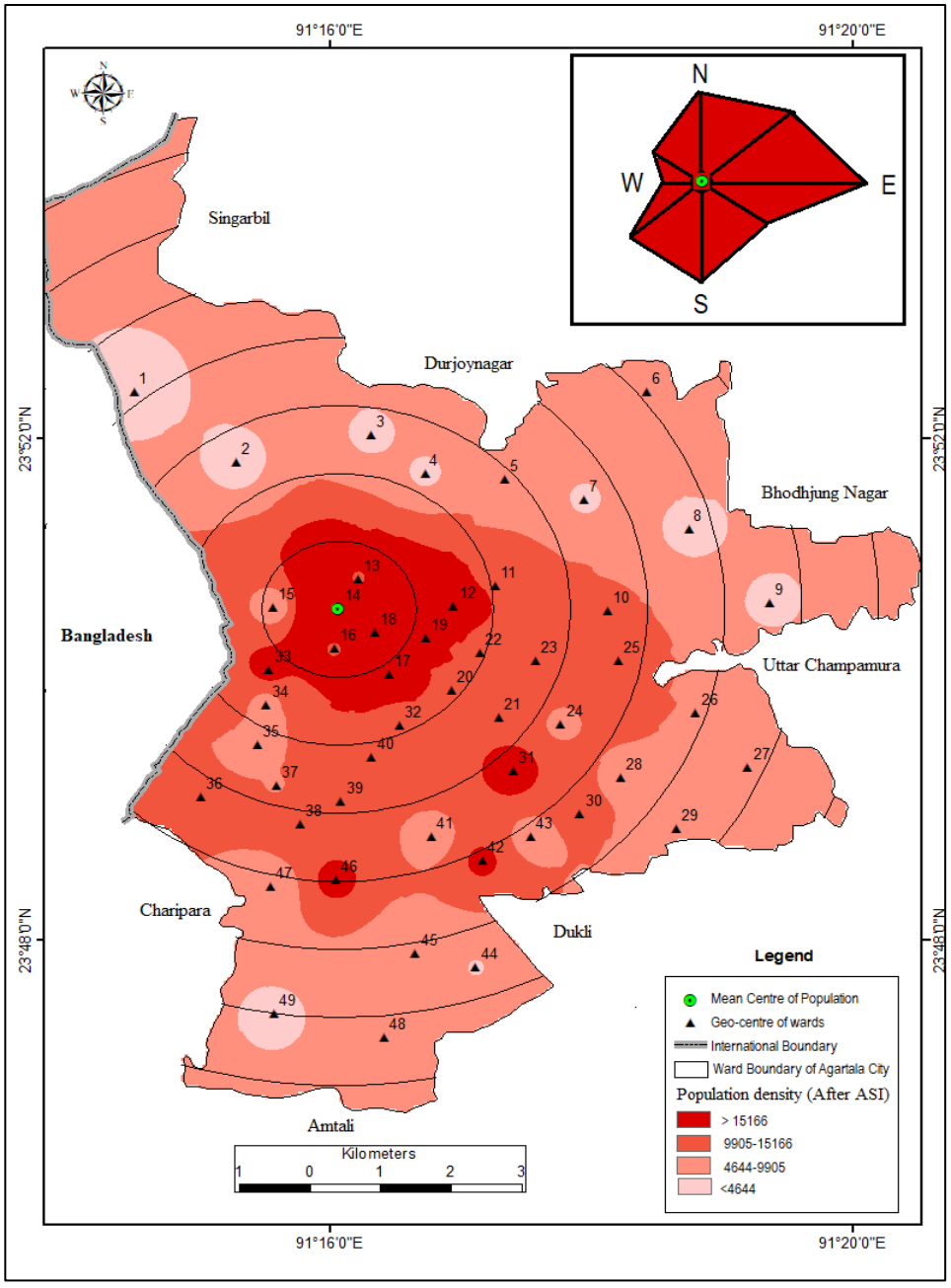


Source: Prepared by the authors, 2021

The spatial distribution of population density reveals that Agartala City follows a mono-centric population growth pattern (Fig. 4). The mean centre of the population is located in ward number 14. Ward number 14 (Ramnagar) is a planned residential area (planned almost 100 years back) encircled by road no. 7 and 9, i.e., Gangail Road and Ronaldsay Road. With increased distance from the mean centre, ward-wise population density has significantly reduced (Fig. 4).

Figure 4

Spatial Distribution of Population Density of Agartala City



Source: Prepared by the authors, 2021

Ward numbers 14, 17, 12, 33, 18 and 19 have very high population density, with more than 15,166 persons residing per sq. km. The area is located within 2 km from the mean centre of the city's population except for 31, 46 and 42 number wards

located in the further southern part of the city. Ward number 17 (0.510 km²) is the oldest part of the city. Most of the Ministers' and officers' quarters are in this ward. Further, Akhaura Road and Ronaldsay Road, the two major roads, are located in this ward. Ward number 31 (West Pratapgarh) is located on the right bank of river Haora, where the population density is 22,598 persons/ km². Ward number 12 is located on the northern bank of the Kata Khal River, with three significant settlement pockets: Krishna Nagar, Radha Nagar and Abhay Nagar. The VIP road is located at the centre of these wards. Ward number 46 is located on the south bank of river Haora, and NH8 move on the right side of the city where the population density is 17,572 persons per km². Matripalli [23°18'14" N and 91°16'18" E], Adarsha Pally [23°48'23" N and 91°16'12" E] and Milan Chakra [23°48'48" N and 91°16'12" E] are the main residential area of this ward. Integrated Check Post (ICP), Agartala [23°50'24.57" N and 91°15'1.33" E], located in the western part of ward number 33, which is the most important transit node between India and Bangladesh. TGA of ward number 33 is 0.570, where 9675 persons reside. Agartala-Akhaura Road is the main road of this ward. East Pratapgarh (ward number 42) is located on the northern side of the bypass of NH8, where the population density is 16,774. Ward number 18 is located on the south bank of Kata Khal. In ward number 18, both low and high-standard houses are found. Along the Kata Khal, a few slum settlements have been identified. On the other hand, high-rise buildings are observed along Ronaldsay Road, Harish Thakur Road and Pragati Road, and these areas combined contribute to high population density. Ward number 19 also experiences a very high population density of 15,469 (Fig. 4).

High population density has been found in the following wards, i.e., 11, 38, 16, 13, 21, 22, 40, 25, 23, 20, 39, 30, 36, 10 and 32. Ward number 11 (Ujan Abhoynagar) has been observed to have a high population density. The ward is located on the north bank of the river Kata Khal. Ward number 38 (A.D. Nagar) has been observed with 14,384 population. It has been observed that the population density of ward number 16 (Joynagar) is 14,247 persons/km². The mean population centre is within 1 km of the geocentre of ward 16 (Fig. 4). The Bhati Abhoynagar area falls under ward 13, where the population density is 14,216 persons/ km². With a 0.410 km² area and 6,378 population, ward number 21, with a high population density (14,191 persons/ km²), is located between River Haora and Kata Khal. Ward number 22 is adjacent to ward number 21, with its southern boundary and a population density of 14,096 persons/km². The TGA of ward number 40 is 0.770, where about 10,340 people reside per km². Geographically, this ward is located in the southern part of river Haora. Ward number 25 is located at the eastern fringe of Agartala City. The Dhalesware area and part of Kalyani are under ward number 25, with a high population density (13,200 persons/km²). Banamalipur area comes under ward number 23, which extends 0.84 km² Total Geographical Area (TGA) along with 10,784 population per km². Ward number 20 is between the River Kata Khal and the River Haora. The northern part of the ward was covered with the old settlement

pockets of the city like the Ujayanta Palace [23°50'14.40" N and 91°16'58.07" E] and its surrounding Laxminarayanbari and Jagannathbari area. On the other hand, Madhyapara is a comparatively new urban settlement area. The cumulative population of northern and southern parts makes this ward highly densely populated. Ward number 39 (East Bordowali area) has been observed to have a high population density (12,085 persons/km^2). NH-8 is moving from north to south from this ward. It has been reported that with a population density of 10,680 persons/ km^2, ward number 30 holds the 21st position among 49 wards of Agartala City. The population density of Ward 36 is 10,590 per km^2, located in one western part of the city. This ward shares about 0.64 km international boundary with Bangladesh. Inward number 10, settlements are scatteredly developed except the Reshambagan area due to the proximity of NH-8 and the location of the Inter-state Bus Terminal (ISBT) [23°50'11.72" N and 91°18'17.91" E]. The maximum area of ward number 10 is covered with agricultural land; apart from a few pockets, the population density is 10,404 persons/km^2. Ward number 32 was observed with a population density of 10,190 persons/km^2.

In Agartala City, population density is relatively low in 16 (38.78%) peripheral wards. These wards are 26, 37, 28, 24, 34, 43, 35, 41, 29, 15, 47, 6, 5, 27, 48 and 45. About 53 per cent of wards are located at the city's outer fringes except 15, 24, 26, 34, 35, 37, 41 and 43. The population density in those wards varies from 4,644 to 9,905 persons/ km^2 (Fig. 4). In Aralia (ward No. 26), about 9,707 people reside within the area of 0.98 km^2. Jogendranagar market [23°48'57.87" N and 91°18'27.80" E] and surrounding areas in ward number 28 have 9,017 persons/km^2. Similar results have been found in other wards of this group, where population density is between 8,882 and 15,707 persons per sq. km (Fig. 4). The maximum number of wards is between 1.5 km and 5 km away from the city's mean centre.

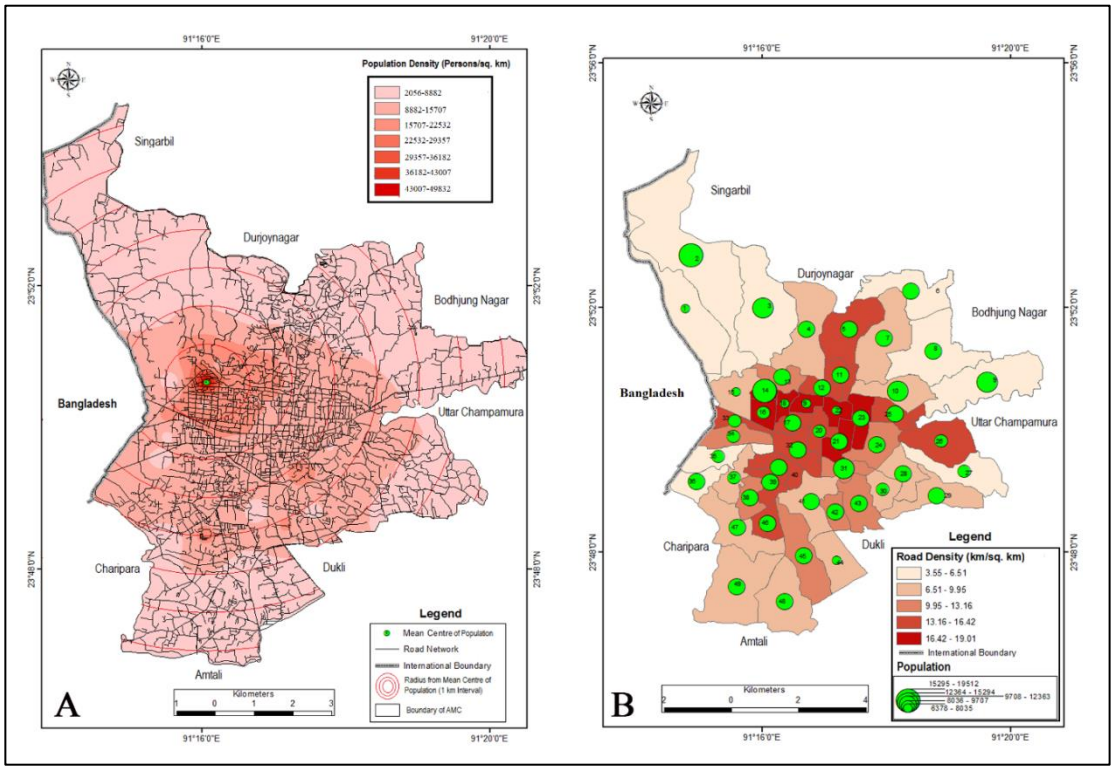
Very low population density is found in the few pockets of 44, 7, 9, 4, 3, 8, 49, 2 and 1, where population density is below 4,644 persons/km^2 (Fig. 4). Locational factors and lack of road network are the major reasons for very low population density in those wards.

It has also been observed that the international border between India and Bangladesh plays a significant role in the centrality model of population distribution (Fig. 4). The natural development of the centrality model has been restricted due to the location of the Indo-Bangla International border.

Road networks are the primary factors affecting urban development patterns (Roy & Ciobotaru, 2023; Iacono & Levinson, 2016). The average road density of Agartala City is 11.512 km/km^2. The highest road density (19.018 km/km^2) is found in ward number 16 of the city, where population density is also significantly higher (14,248 persons/ km^2).

Figure 5

(A) Spatial Distribution of Road Network (B) Road Density and Population Distribution of Agartala City



Source: Prepared by the authors, 2021; Data extracted through GPS Survey, 2020-21

It has been found that the road network is very high in the surrounding areas of the mean centre of the population (18.854 km/km²). On the other hand, the road network becomes thinner towards the city's outer circuit with a proportional reduction of population density (Fig. 5A). In the central part of Agartala City, the road network has a relatively higher population density. It has been observed that road density is normally higher in the central part of Agartala City (Fig. 5B).

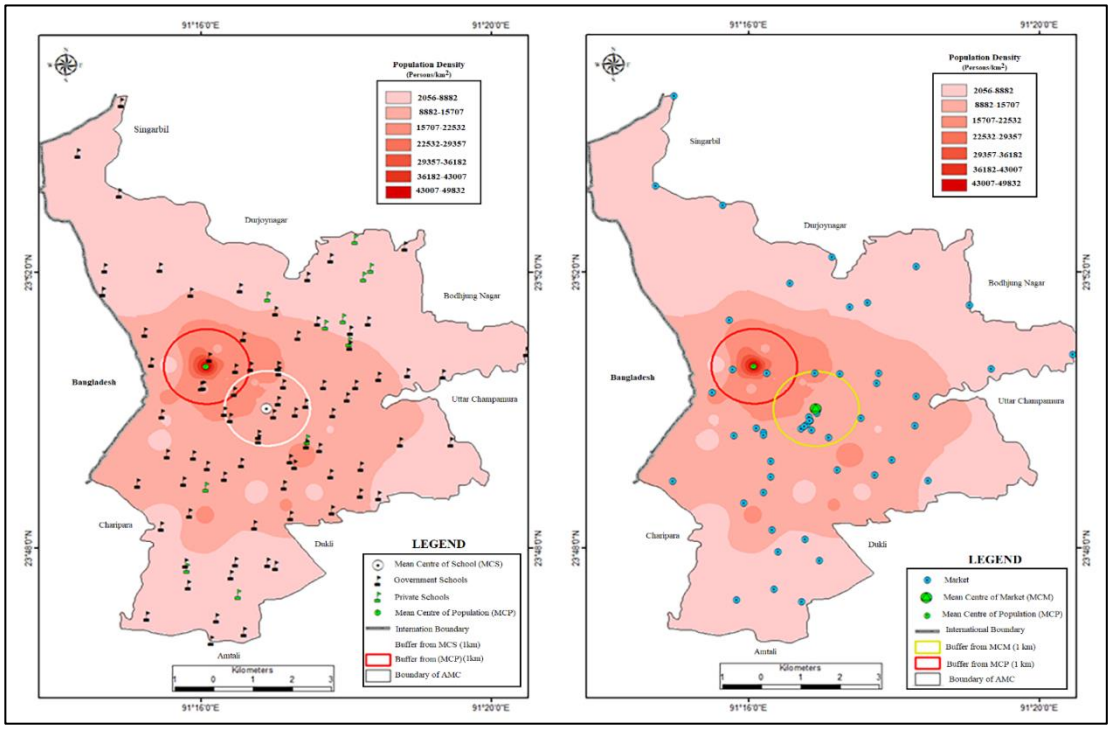
Educational institutions, especially schools, play a pull factor in population concentration. It has been found that most schools are located near the CBD area of Agartala City. Few private schools are established in the northern part of the city due to the availability of land (Fig. 6A). Few new settlement areas like Nandan Nagar [23°52'25.42"N and 91°19'48.91"E], West Noabadi [23°51'53.60"N and 91°19'0.28"E] has been developed nearby these schools.

On the other hand, the market also plays a significant role in population concentration. Most of the big markets are located in the central part of the city, where the road network is comparatively higher. The population of the wards close to the CBD area tends to increase compared to wards away from the CBD area. Still, the

difference in the population increase of neighbouring wards has been visible for some time. The reasons may vary. It may happen due to the location of those wards, distance from the school, market, workplace place, quality of communication, and other infrastructure. A comparative study may enlighten as reasons.

Figure 6

(A) Spatial Distribution of Schools (B) Markets with the Population Distribution of Agartala City



Source: Prepared by the authors, 2021; Data extracted through GPS Survey, 2020-21

Concerning the city, the degree of connectivity is also considered a variable representation of the road network. A correlation test has been performed and reported to find the correlation between the road network (degree of connectivity) and population density (Table 3). In Agartala City, population density and degree of connectivity have a significant negative correlation (Table 3).

It has also been observed that in Agartala City, schools and markets are primarily located in the central part of the city (Table 3). Few private schools are established in the northern part of the city (Fig. 6A). New settlement concentration may shift towards the north. Three significant markets, namely Maharaj Ganj Bazar, Battala Bazar and Lake Chowmani Bazar, are located in ward number 21, 16 and 19, respectively, and the corresponding population density of those wards are 14,191,

14,248, and 15,469 persons/ km² depicts that market is an influential factor of population density (Fig. 6B).

Table 3

Spearman's Rank Correlations Between Population Density, Degree of Connectivity, Schools and Markets

			Population Density	Degree of Connectivity	Schools	Markets
Spearman's rho	Population Density	Correlation Coefficient	1.000	-.377**	-.378**	-.205
		Sig. (2-tailed)	.	.008	.007	.157
		N	49	49	49	49
	Degree of Connectivity	Correlation Coefficient	-.377**	1.000	.305*	.268
		Sig. (2-tailed)	.008	.	.033	.062
		N	49	49	49	49
	Schools	Correlation Coefficient	-.378**	.305*	1.000	.309*
		Sig. (2-tailed)	.007	.033	.	.031
		N	49	49	49	49
	Markets	Correlation Coefficient	-.205	.268	.309*	1.000
		Sig. (2-tailed)	.157	.062	.031	.
		N	49	49	49	49
**. Correlation is significant at the 0.01 level (2-tailed).						
*. Correlation is significant at the 0.05 level (2-tailed).						

Conclusion

Agartala is the state capital, the most densely populated area, and has a heterogeneous distribution. The classification of heterogeneity has been measured by an Alternative Synthetic Indicator and found efficient compared to the existing one to measure population distribution. With the increase in population, the distributional pattern has also changed significantly. The causalities of unequal population distribution mainly depend on the road network, especially the connectivity and the proximity of markets and schools. The recent planned development phase is marked by opening up the educational institutions in the city's outer circuit, the industrial zone on the outskirts, and infrastructural facilities reshaping the urban settlement pattern as a human landscape.

Population distribution is the most crucial decision-making factor for resource allocation, allotment and apportionment, which helps in policy decisions.

Efficient population distributional measures have been required for a more solicited decision support system. The suggested Alternative Synthetic Indicator (ASI) is a more efficient measure of population distribution over the existing Synthetic Indicator (SI). An Alternative Synthetic Indicator (ASI) is a preliminary decision support system for resource allotment and urban planning and development policy decisions. It also helps to classify the direct influence area with the degree of population density and infrastructural development with future prognostication.

Acknowledgement

This publication resulted (in part) from the research project supported by the Department of Science and Technology, Ministry of Science and Technology, Government of India. The project entitled "*Identification, Assessment and Model Building of Urban Morphology using Geospatial Techniques: A Study of Border City Agartala"*(File No. NRDMS/UG/S.Mitra/Tripura/e-10/2019 (G) dated 15.05.2019)**.** The content is solely the authors' responsibility and does not necessarily represent the official views of the DST, New Delhi.

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Authors:

Saptarshi Mitra
Assistant Professor, Department of Geography and Disaster Management, Tripura University, Suryamaninagar- 799022, India.
Email: saptarshitmitra@tripurauniv.ac.in

Stabak Roy
Institute of Socio-Economic Geography and Spatial Management, University of Gdansk, 80-309 Gdańsk, Poland.
Email: stabak.roy@ug.edu.pl

Samrat Hore
Department of Statistics, Tripura University, Suryamaninagar 799022, India Email: sam.stat724@gmail.com