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RESEARCH ARTICLE

SPATIO TEMPORAL CHANGES IN THE DEMOGRAPHIC SURFACE OF HAORA DISTRICT IN INDIA:
AN ENQUIRY IN THE 21st CENTURY

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ABSTRACT

An important aspect of demography in the world is the uneven pattern of distribution within a system. The concept of population change or population growth is often used to predict the change in number of inhabitants in a particular territory within a particular time. Almost each and every developing country has experienced this change of population and this is very true in case of India also. Being a part of the developing world, West Bengal one of the most populous states of India, is no exception in this regard. The declining trend of mortality, fertility, and also the 1971 partition has added to the agony of population growth. In addition, the process of industrialization and urbanization in different pockets of West Bengal shows the changing attitude of demographic expression and this changing attitude would help to widen the view point of the geographers to establish the fact of decentralization. So, the present investigations try to unfold the spatial distribution of population and also spot the light on the changing nature of demographic pattern by recognizing the spot height of demographic relief in the geographical territory of the Haora district.

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INTRODUCTION

Recent decades have witnessed increasing demographic dynamism especially in the less developed realm of the world. Demographic change in a particular time follows the location pattern of an area and also follows the change in social and cultural characteristics. Population growth has its special importance as it helps to unfold demographic dynamism of a region. Thus, understanding the population growth is very crucial because it influence all other characteristics of population and also help to understand the entire demographic dynamism of a region (Chandna, 2004). In India, the visual investigation of census in the last decades reveals the reality of increasing trend of population growth which results in population explosion and this populous condition brings a change in demographic relief of the country. West Bengal is one of the states in India which have also experienced this reality. In 1991 West Bengal, for the first time came into existence for the distinction of becoming the most densely populated state in India (Guchhait, 2005) where Haora district has experienced the heterogeneous form of population growth since the beginning, especially after 1971. Haora one of the most industrialized and urbanized district of West Bengal which has experienced the same explosive nature of population growth. This actually is the result of natural tendency of movement of people from rural to urban and also for the

partition of Bengal. Point to be noted, this explosive nature of the Haora district bears its imprint along the north eastern part as it is situated in the inner core of the Kolkata Metropolitan Region. But over the time the canvas of population distribution has changed and it shows its gradual diffusion towards its periphery due to space saturation in the most urbanized portion of the district. The visual interpretation of 2011 census of India reveals the changing pattern of demographic surface. So, this paper will try to unfold the changing spatio temporal attitude of demographic surface from the very urban core to its surrounding, accelerating the suburbanization process.

Area under Study

The area under study is the Haora district of West Bengal (earlier Howrah) which lies to the west of the river Hooghly. The name of the district Howrah may have been derived from *hawor* which means a vast swamp. Geomorphologically, this area is formed by the process of sedimentation by the Hooghly Bhagirathi river system whose main branch flows along the eastern part of the district, named as Hooghly river (Census of India, 1961). This district lies between the latitude 22°12' N and 22°48' N and 87°50' E and 88°23' E. This is a triangular tract of the country which has two sub divisions, named Haora and Uluberia, two municipalities, namely Bally and Uluberia and one big corporation i.e. Haora Municipal Corporation (H.M.C) which is considered the heartland of the district.

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Haora District: at a Glance

The district of Haora is an important centre of industry and a centre of rapid growth and development in West Bengal. At present, things are changing here rapidly, but the present is more or less dependent on the past, so lets take a look at the history of this district. Actually, Haora was a low and marshy land, covered with dense forest which was certainly inhabited later by the huge influx of population for its location along the west bank of the Hooghly River. The city of Haora even before 500 years was a trade centre which became important with the arrival of the British Merchants (KMDA, 2005). Additionally, the 1971 Bengal's partition has added an extra energy in the growth of population of the district. To take an account from the year 1901 till 1991 the increasing trend of population has remained same and it is spatially concentrated at the eastern part of the district. According to 2001, Haora Municipal Corporation (H.M.C) alone had more than one million populations and very interestingly the urban belt is lying along the same river belt extending from Uluberia Municipality in the south to Bally Municipality in the north of the district (KMDA, 2005). So, the north eastern part of the district along the Hooghly River bears positive growth rate with high population density and this urban agglomeration is mainly due to great industrialization over here. Haora forms one of the most densely populated districts with 3306 per sq km in 2011. It ranks 9th in sharing population with respect to the total population of West Bengal and in respect of population density also Haora ranked 2nd after Kolkata in West Bengal.

The city of Haora has recorded extreme population density even from the first Indian census of 1872. So, this situation denotes that Haora is one of the most crowded districts of the state as well as of the country. Here, now 63.38 percent of the total population is living in the urban areas. Actually rapid rate of rural to urban migration is an added cause for this rapid rate of population growth. Not only this but decreasing trend of birth rate and death rate are also responsible for encouraging the population growth over here. Demand of job, education etc. mainly has concentrated around the large cities and the metropolis. That is why over the time, the increasing population makes these large cities packed which help them to loss their carrying capacity due to the space saturation. For this specific reason, recent decades have experienced the population spilling from the urban core to the periphery. There is a tendency for the residents of Haora Municipal Corporation to move towards the other blocks (mainly semi urban part) in the district and this is the beginning of a new chapter of population dispersal in Haora district. This process ultimately influences the suburbanization process which leads to the expansion of urbanization away from the urban core of the district. The increasing number of census towns (not having urban administration) from 51 in 2001 to 135 in 2011 is another reflection of deconcentration which also indicates a homogenous growth of the blocks as well as of the district.

Objectives

The objective of this paper is concerned with the spatial and temporal pattern of population distribution and its changing pattern over the last decade. The present investigation critically unfolds the reality of changing population surfaces with identification of its spot height. The first part of the investigation shows the trend of population growth and the second part is concerned with capturing a view of changing demographic pattern.

MATERIALS AND METHODS

For analyzing the overall growth pattern at macro as well as at micro level in the studied district, the block wise census data has been taken into consideration. To unfold the reality related with dynamic growth of population with respect to urban unit, data related with temporal change of population, changing spatial concentration of census towns have been taken from the District Census Handbook, Census of India for several years (starting from 1961 to 2011) for analysis. Block level map has been obtained from the District Census handbook 1961. It should be pointed out here that prior to 1981, Haora district did not have the intra district divisions or blocks like Amta I- Amta II, Bagnan I- Bagnan II, Uluberia I- Uluberia II and Shyampur I- Shyampur II. So, to maintain the uniformity in the analysis, this intra district division has not been maintained prior to 1981. Rather, the blocks are used as units according to the requirement of the analysis of data. This article discusses the reality of population change in the first half considering blocks with municipal units and the second half is considering blocks excluding municipal units. But to maintain the parity in the analysis, Haora Municipal Corporation (H.M.C) has been taken into consideration but it is treated as an exceptional urban unit. For the purpose of the analysis, the changes in the area of the

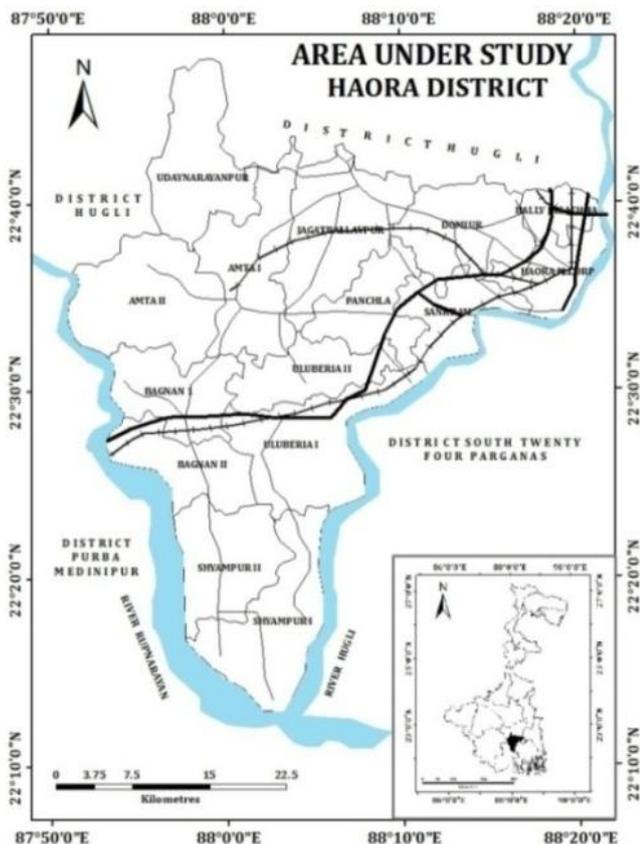


Fig. 1. Administrative set up of Haora District (Prepared on the basis of map of Census Handbook of Howrah District, West Bengal, 1961)

blocks in the different census year have been taken into consideration. Many mouzas (smallest rural administrative unit) have been reclassified and also declassified with the blocks, some are merged with the municipality, have brought under lens to maintain the parity.

These reclassified and declassified related data has been obtained from the relevant Census report from 1961-2011. A block level map of the Haora district has been georeferenced in Arc GIS 9.3. A polygon layer has been built to vectorise all the blocks of the district and also line layers have been built to vectorise the rivers and roads. Point layers have been prepared to vectorise the urban centres which have been derived from the Google Earth after identifying their location over there. Not only this, in order to quantify the different aspects of population dynamics, system component technique has been applied. Population Density map has been prepared to identify the spatial distribution of density. Mean centre of population is located to understand its changing pattern of demographic nature and for this a simple form of equation has been used to justify it i.e. Mean of $X = \frac{\sum(X*P_{**})}{\sum P_{**}}$ and Mean of $Y = \frac{\sum(Y*P_{**})}{\sum P_{**}}$, where P_{**} is the population of a particular year, X and Y is the co-ordinate of centroid (cm). Therefore magnitude of shift = $\sqrt{\{(X_1 - X_2)^2 + (Y_1 - Y_2)^2\}}$.

RESULTS AND DISCUSSION

Spatial Expression of Population Density

Considering block wise population database of the Census of India, 2001 and 2011, a relative change in density has been found in Haora district. The population density in both the year is very much concentrated in Haora Municipal Corporation (H.M.C) and also on the block of Bally Jagachha (previously called Bally Police Station) at the eastern part of the district. The density is comparatively higher along the network where connectivity and accessibility is higher and this lies at the eastern and central part of the district. In 2001, high density of population with urban characteristics was seen in some urbanized blocks of the district like H.M.C, Sankrail, Bally Jagachha, medium density was concentrated in Amta, Uluberia I, Domjur and Panchla and rest of the blocks were under the category of the less density scale (Fig.2a). Whereas on the other side the canvas was different in 2011, here with the above mentioned blocks, Jagatballavpur, Uluberia II, Bagnan have also experienced increasing population density in the decade which clearly indicates the defusing nature of population distribution in the district. So, it can be said that population growth in the blocks of the district was very much concentrated in the eastern part around the Haora Municipal Corporation which can be treated as magnetic pole of Haora. But from the last decade (2001-2011) the momentum of population distribution has changed due to space saturation in the urbanized part of the district. The increasing number of census towns which are located at the periphery are the best reflection of this changing pattern which shows a diffusing nature of the distribution (Fig.2b). Table.1 is also showing the distribution pattern of population density in the blocks according to the density criterion i.e. high, medium and low where temporal changes of blocks in respect of density has also changed. So, this can be understood that the gradual growth of the peripheral areas can rejuvenate the total urban system of the district which

should be included in the planning process for balanced growth and development. In addition to it, the increasing number of census towns due to the development of the inherent qualities of the blocks apart from the eastern part is another reason to increase the population density of the peripheral blocks of the district. Hence, it can be articulated that 2011 census shows the diffusing trend of population distribution which can be considered as the result of saturated situation of the eastern part of the district.

SPATIAL DISTRIBUTION OF POPULATION DENSITY OF HAORA DISTRICT (2001)

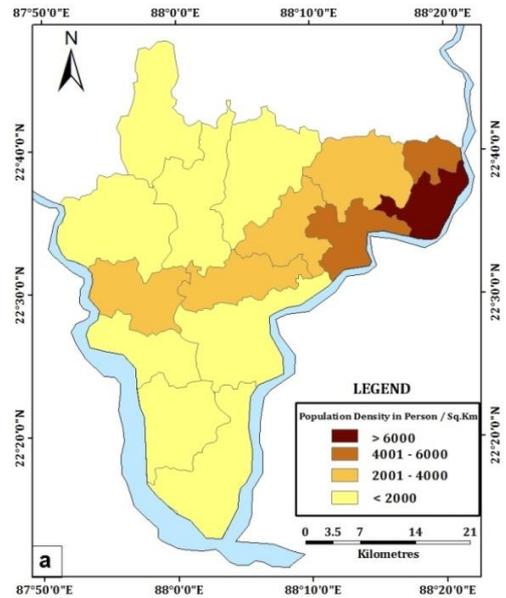


Fig.2a

SPATIAL DISTRIBUTION OF POPULATION DENSITY OF HAORA DISTRICT (2011)

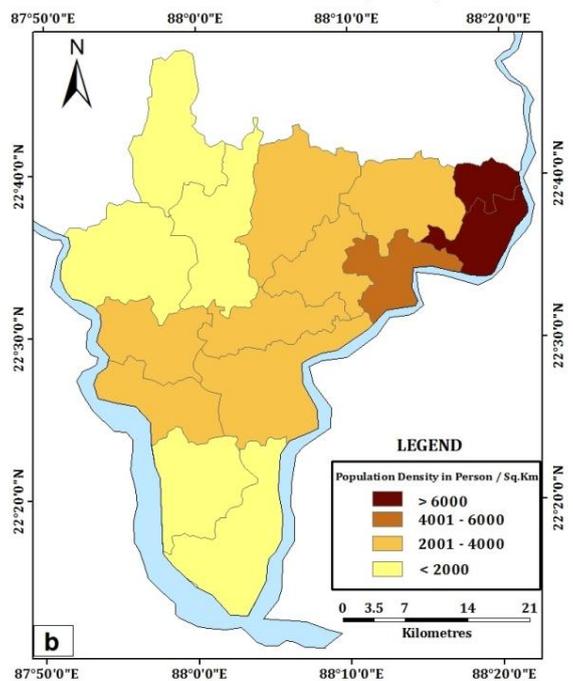


Fig.2b.

Fig.2a and 2b. Diffusion of the Population Density

Table 1. Block wise distribution of Population Density per sq.km in 2001 and 2011

Population Density per sq. km.	Blocks			Level
	2001		2011	
>6000	H.M.C		H.M.C, Bally Jagachha	High
3000-6000	Domjur, Sankrail, Panchla, Bally Jagachha		Domjur, Sankrail, Panchla	Medium
<3000	Shyampur I & II, Uluberia I&II, Bagnan I&II, Amta I &II, Udaynarayanpur		Shyampur I &II, Uluberia I&II, Bagnan I&II, Amta I &II, Udaynarayanpur	Low

Source: Calculated by the Authors from the database of the District Census Handbook, 2001-2011

Table 2. Block wise distribution of Allometry value in two different phase of census period

BLOCKS	1901-1961	1961-2011	BLOCKS	1901-1961	1961-2011
H.M.C*	1.5	0.861	JAGATBALLAVPUR	1.13	1.071
BALLY	1.019	1.869	UDAYNARAYANPUR	0.627	0.933
DOMJUR	0.654	1.268	AMTA	0.801	0.864
SANKRAIL	0.638	1.203	BAGNAN	0.897	1.059
PANCHLA	0.633	1.167	ULUBERIA*	1.105	0.734
SHYAMPUR	0.831	0.996			

Source: Calculated by the Authors based on the database obtained from the District Census Handbook, 1901-2011

Note: *highlighted red marks showing the declining Allometry (< 1.00) and bold letters are showing growing Allometry (>1.00).

Spatio Temporal Growth of Population: An Overview

After a cursory review, if we want to scrutinize the growth pattern of population of the Haora district, the application of System Component Technique will be the most appropriate one. This part aims to address the relative growth rate of the system (district) and its components (blocks). Actually, here the term 'relative' has been used as growth rate of the blocks (component) and is being compared with the total system means district (Dasgupta and Majumder 2011; Guchhait, 2005). This technique actually is an attempt to identify the population status of the individual blocks and to examine the population growth from 1901-1961 and 1961-2011. The relative growth has been identified through allometry with its value of unity, more than unity and less than unity. The unity which is also considered as isometry (1.00), denotes the balanced or symmetrical growth of population of the components (blocks) in respect of total system (district) here. Allometry can be positive and also can be negative but if the value of allometry is more than one (>1.00), it means gaining growth and less than one (< 1.00) indicates declining growth of the blocks is respect of the total system. To apply this a simple form of equation has been employed to justify it and that is $y = bx^a$ where y is component, x is the total system, a is allometry and b is the threshold value of growth. To perceive the relative growth rate, allometry value has been shown in Table 2 which is the calculative presentation of the Fig 3a and 3b.

Excluded

Fig.3a shows the population surface at the first span of the census period (1901-1961). It can be visualized from here that the gaining growth has been found along the eastern part of the district and the total district is being controlled by this part only which includes Bally, Haora Municipal Corporation where the allometry value is more than one. Maximum number of blocks here have experienced declining allometry which means that the blocks are not responding in development index like the whole district is responding, except for Jagatballavpur, Uluberia, Bally which consists the municipal unit with the exception of Jagatballavpur (although to maintain the parity in

calculation the municipal units and its population has been excluded) which holds the isometric condition. The response of Udaynarayanpur, Domjur and Sankrail is very poor and they are losing allometry where maximum blocks (Amta, Bagnan, Panchla, Shyampur) are declining in allometry value (< 1.00). On the other hand, Fig.3b shows the second span of the Census 1961- 2011, portrays a different canvas which shows the reverse picture of allometry in most of the blocks. In the earlier period those blocks were losing allometry remarkably; they are now gaining it and move towards positive allometry. The most striking feature is that the losing allometric value of Haora Municipal Corporation (0.861) and positive allometric value of the semi urban blocks which indicates the balancing condition between the blocks and the districts. From the Fig. 3a and 3b, it can be seen that in both the periods only the block of Bally (Bally Jagachha now) holds to the total system. Udaynarayanpur, stay at the same position and another noticeable thing is that the blocks which are associated with the municipal units like Uluberia, H.M.C, they are now losing their allometry. So, as a whole it can be understood that the eastern blocks which are more urbanized are becoming saturated for which the blocks of central, north central, western, southern blocks are going towards isometry condition with gaining allometry value. Domjur, Sankrail which were very poor in allometry status earlier, now they are experiencing growing isometry. So, from this it can be said that the trend of population growth and its spatial pattern is changing as the urbanization process is changing. The blocks (component) once with low allometry has turned 'U' with growing allometry value in 2011 which also indicates the space saturation phase of the most urbanized part of the district (system). It also denotes the diffusing trend and decentralization of population which indicates the peripheral growth and accelerates the process of suburbanization.

In the Table 3 the allometry of the blocks has been examined in a certain interval of time. It is very clear from this that some of the blocks lying at the eastern part of the district are showing either balancing or the declining trend of relative growth rate where in the other blocks like Domjur, Bagnan, Shyampur,

Jagatballavpur, etc are showing the increasing trend of allometry.

If we compare the allometry value in each and every block then it can be observed that Haora Municipal Corporation and the block of Uluberia are experiencing the waning trend of allometry with 0.938 and 0.847 respectively in 2011 which was in the stage of growing allometry in 1901-1981. It should be pointed out here that the block of Uluberia is also associated the municipal unit for which the allometry rate is declining after 1981. So, the sudden fall in allometry value after 1981 in these blocks, indicates the growing importance of decentralization. Over the time huge influx of population has been concentrated in the eastern part of the district which is the reason to make this part very saturated one. But over census period, after crossing its own carrying capacity population has started to disperse along the transport lines towards the western and southern part of the district.

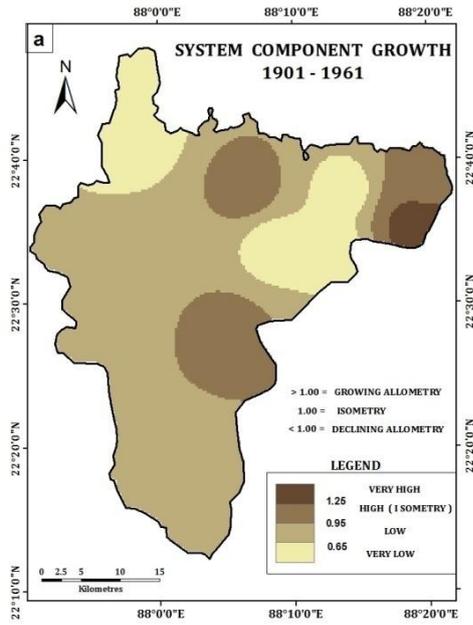


Fig.3a

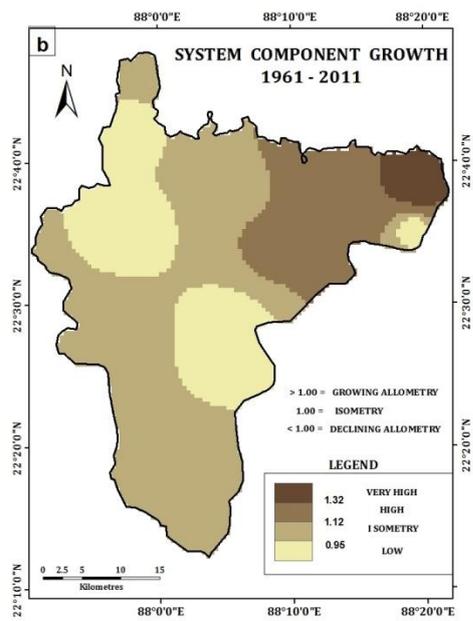


Fig.3a

Fig.3a and 3b. Changing expression of Relative Growth Rate from 1904-1961 and 1961-2011

Table 3. Block wise distribution of Allometry value in different phase of census period

Blocks	1901-1961	1911-1971	1921-1981	1931-1991	1941-2001	1951-2011***
Bally*	1.019	0.113	0.213	0.349	0.612	1.087
Domjur	0.654	0.741	0.87	1.025	1.189	1.298
Sankrail	0.638	0.678	0.863	1.057	1.164	1.207
Panchla	0.633	0.756	0.911	1.064	1.164	1.2
Jagatballavpur	1.13	1.081	1.069	1.009	1.092	1.142
Udaynarayanpur	0.627	0.762	0.871	0.957	1.009	1.018
Amta	0.801	0.783	0.783	0.801	0.767	0.725
Bagnan	0.897	0.955	0.99	1.016	1.091	1.103
Uluberia	1.105	1.063	1.044	0.939	0.875	0.847
Shyampur	0.831	0.896	0.927	0.96	1.029	1.041
Haora Municipal Corporation**	1.5	1.494	1.336	1.204	1.039	0.938

Source: Calculated by the authors from database acquired from the District Census Handbook of 1901-2011

Note: * In 1961 Bally become municipality and in 1971 it has been declassified.

** Haora Municipal Corporation is not under any block rather taken individually to maintain the parity.

*** Bold words and letters are showing the increasing Allometry value.

Dynamics of Population in Intra - Inter Block and Sub-Division level

The analysis of the spatio temporal dynamism of the phenomenon is the main thrust of a research. Probably this portion is very important to highlight on the issue of population distribution the inter - intra block and sub divisional level. Mean centre of distribution is the simple measure of the central tendency within a spatial distribution. The location of a point of interest can be defined with accuracy by the mean value of two coordinates, x and y (Sarkar, 2013). To justify this whole investigation, two tier approaches have been taken into consideration. These approaches are fulfilled to locate the mean centre of population while identifying its direction of shift within a definite territory of Haora district.

The first approach is for the micro level analysis. It is concerned with identifying the changes of mean centre of population, in the block level (including Haora Municipal Corporation) of Haora district. To solve this purpose Table. 4 has been calculated which shows the magnitude of shifting of mean value which indicates that the population domain has shifted in forward direction comparatively at a faster rate in the decade of 1981 – 2001 where as the decade of 2001-2011 has experienced backward shifting but at a slower rate with the value of 0.12 cm. Actually this indicates the preliminary phase of decentralization. Similarly, Fig.4a and 4b are the pictorial representation of the same which are showing the distribution of mean centre on temporal basis from 1981-2011.

Table 4. Estimated shifting rate of Mean Centre in Intra - Inter Block level

District	1981		1991		2001		2011	
	X	Y	X	Y	X	Y	X	Y
Haora								
Mean centre co-ordinate value (c. m *)	9.05	11.53	9.14	11.63	9.3	11.70	9.19	11.74
Magnitude of shifting (c. m)	1981-1991		1991-2001		2001-2011			
	0.1		0.66		0.12			

Source: Calculated by the authors based on the database of District Census Handbook, 1981-2011
 Note: *c.m: Centimeter

Table 5. Estimated shifting rate of Mean Centre in Sub Division level

Sub Division	2001		2011	
	X	Y	X	Y
Haora				
Mean centre co-ordinate value (c. m)	12.39	13.71	12.276	13.39
magnitude of Shifting (c. m)			0.22	
uluberia				
Mean centre co-ordinate value (c. m)	4.92	9.51	4.19	9.46
Magnitude of shifting (c. m)			0.73	

Source: Calculated by the authors from the database of District Census Handbook, 2001-2011
 Note: * c.m: Centimeter

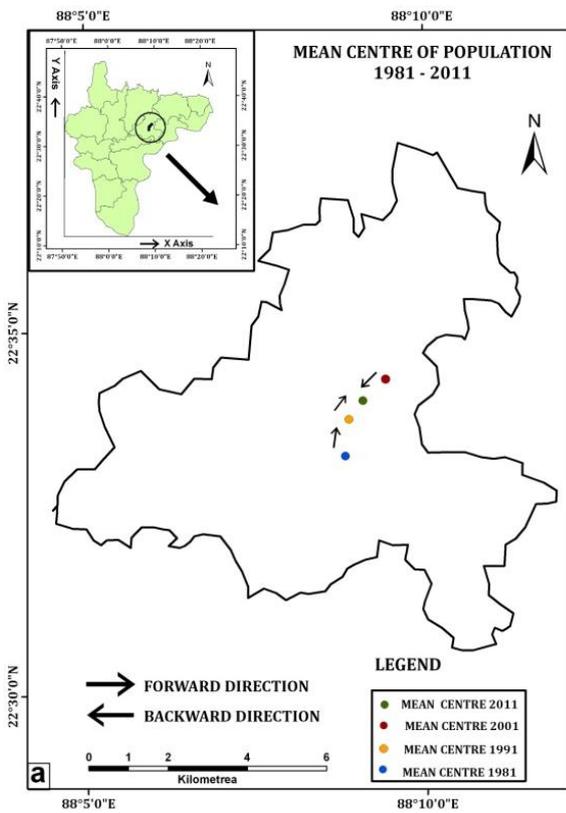


Fig.4a

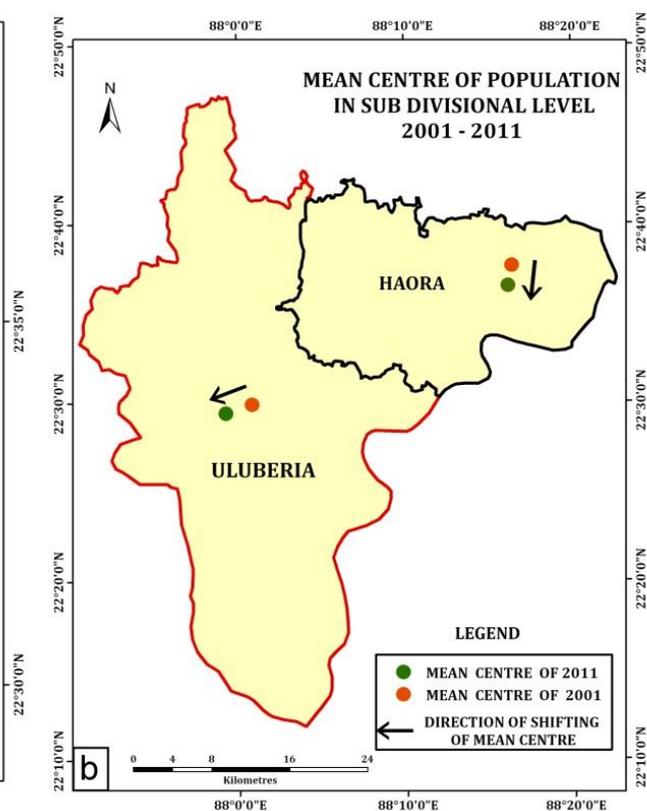


Fig. 4b

Fig. 4a and 4b. Changing Pattern of Population Profile in Intra - Inter Block and Sub-Division level

Fig. 4a indicates the shifting of the mean centre in forward direction in the decades from 1981-2001 and the reason behind this is most of the urban centres of the district are concentrated in linear pattern in Kolkata Metropolitan Area along the Hugli river. The Haora Municipal Corporation and the block Bally Jagachha are situated in the inner core of Kolkata Metropolitan Region and for that reason the backwash effect of this urbanized part is very intense over the whole system which pulls the maximum population towards the eastern part of the district. It should be pointed out here that the same gravitational force was active on the population drifting during

the time of partition of Bengal which also influence this population explosion. But on the opposite side of the coin, reverse (backward) shifting of the mean centre in 2011 indicates the other picture. It pin points the diffusing nature of population growth but at a very slow rate from the last ten years because most urbanized eastern part of the district have started to lose their carrying capacity due to its super saturated condition. It can be understood from this that the district is now on the way of suburban growth and development. On the other hand, for the better understanding of the spatial change, the second approach is also taken in grip which concerns the

location of mean centre with its shifting tendency in sub division level. To identify the reality Fig. 4b is showing the temporal and spatial shifting of mean centre in the two concern sub division, Haora and Uluberia. In both the sub division the location of the mean centre has shifted backward in 2011 in respect to 2001 but its relative position is in same place which indicates the slow rate of diffusion. The sudden 'U' turn of spatial distribution of population in 2011 has created an interesting landmark to identify the specific reason behind it. Actually the Haora Municipal Corporation acts as a magnet whose magnetic power is very high to pull huge population from the surrounding areas. Now, the spatio temporal changes of mean centre and its backward shifting in intra - inter block and also in sub division level has indicated the diffusing phase after nucleation which is considered as the dispersal effect of population growth. Table 5 also shows the same with magnitude of mean centres shifting. So, it can be visualized from the above discussion that this trend of population shifting reflects the birth of new rejuvenated secondary nodes or sub-centres through which demographic structure would begin a new chapter of population dynamics. So, at a glance it can be said that the time has come to uncover the potentialities of the unfocused part of the district which are staying behind the mask and suffering from identity crisis decade after decade.

Conclusion

Throughout the whole inquiry from the different angles of this study, following methods are applied here to understand the whole scenario of the demographic characteristics of the Haora district. Firstly, the spatial pattern of population density has been identified to know about the population structure of the Haora district. System Component Technique has been applied to understand the relative growth rate and also mean centre of population has been identified to investigate the distribution trend with its direction of the Haora district. From this analysis some features are identified that the population which was concentrated around a pivot area (Haora Municipal Corporation and Bally Jagachha Block) in the district that has started to relocate in its peripheral blocks. Actually, the eastern part of the district seems to be saturated moreover it is decaying as it located near to Kolkata which is considered as the growth pole of the West Bengal. The tendency of metropolitan residents to flee from central cities also indicates the initial phase of decentralization within the district boundary. In Haora district, this peripheral growth actually would help to identify the sub-centres which may help to uphold the whole district for its sustainable future along with the Kolkata Metropolitan Area.

So, as a concluding remark it can be said that the undulating demographic surface is being transformed into the homogenous form and is trying to reach the stage of stability on both macro and micro level.

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