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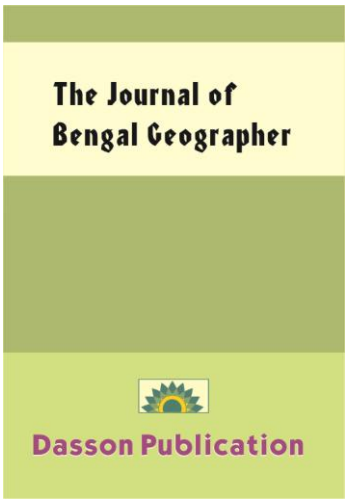

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Spatial-temporal analysis of urban functional development and its zone of influence: A micro level study of Barrackpore Subdivision, West Bengal: India

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Abstract:

R*egional development of an area is associated with its socio-economic facilities growth. The process of urban growth is also allied with regional development. The growth of number of socio- economic facilities and amenitiesinfluences the urban growth. So regional development, urbanization and socio-economic growth are interlinked to each other. The optimal growth of urban centres is governed by required facilities for being capable to the people. The hierarchical growth of urban centresin order of facilities makes regional disparities in ranking dimensions which is common problem in developing economy. As resultant, some of the ULB are having more number of the facilities while some of are fewer in facilities to their population size. To solve out this regional imbalances, a rational micro level planning model are need. The present study has been treaties toanalyze the Spatio-temporal variations on functional potentiality of urban centres and their growth and development from 1971-2011. Barrackpore sub division is known as industrial zone in north 24 parganas district of West Bengal. Since independence it was consists of 16 municipalities or urban centres. It is an attempt to find out the influential zone and hierarchical growth of each urban centre in two decades. It is tried to observe how the small urban centres have develop in a hierarchical order formationbased on functional weightage, how thegeographical areaare extendedbythe facility influences and lastly how it changes the socio-economic conditions. The relative ratio has been analyzed the functional level to get the adequacy and inadequacy of facilities in all urban centres.The finding indicates that in 1971 the ratio between facilities and population was more than in 2011. During the 40 years' time periods number of facilities was increased but it was less sufficient to support the increasing population needs in 2011. The range of zone of influences are reduces during the time periods due to the functional potentiality are improving in every small urban centres. The proper planning recommendation should be taken for inadequate urban centres; so that the regional imbalances would be reduce as well as the regional development will achieved.*

Keywords: *Urban centres, Functional importance and adequacy, Zone of influence.*

1. Introduction:

Urbanization is a complex process in terms of socio-economic transformation from rural to urban settlement(World Urbanization Prospects , 2018). Urbanization is also a development process froma central place to peripheral expanses. This process is a multifaceted by a set of goals, entities, infrastructure and interdependent activities (Tiwari et al., 1986). Socio-economic and cultural development of a region are testimony for the process of urbanization (Ali et al., 2008). Urbanization is a positive force for economic growth and human development as well. According to world urbanization report the trends of people living in the urban areas more than the rural areas. The world's urbanization rate has increased from 30% to 50%.It is observable that India is facing fast rate of population growth and Urbanization (Ali & Varshney, 2012).The urban population has being added 200 million from year 1990

to 2014 in India and it is expected to reach 814 million which is 50% of population by 2050.Delhi, Mumbai and Kolkata are the three populous cities in the world which ranking is 2, 6 and 14 respectively. Urban population of India is 410 million that makes the country second positions in the worldwide. The urbanization ratio is 32%, even the basic need of urban facilities and services are not well satisfied level. The investments are required to fulfillment of the infrastructure and services to meet the needs of growing urban population (World Economic Forum, 2015).The transition of urban growth occurs in India is fundamentally based on some structural transformations i.e, agricultural workers migrates into industrial and service sectors; steady shift from informal to formal manufacturing sectors (Colmer, 2011) and due to the movement of peripheral village population to small towns or cities by pulling factors of basic facilities and amenities (Ahmad & Ali, 2006). The urban centers is the facility hubs having different services like governmental activities, education, medical, transportation, communications, financial, industries, sectorial job opportunities and marketing of agricultural product to engineering goods which gets the region more economically developed (Hoselitz, 1971); (Mandal, 2000). The perception of urban sphere of influence has come from central place theory given by Christaller in 1933 (Christaller, 1998). City is a node point of development in which the linkage occurs between cores to hinterland(Mulligan, 1984).The urban sphere of influence of particular city over the surrounding neighborhood areas social-economic development depends on the pulling factors of that city (Wang & Zhao, 2000); (Kong, 2007) (Pan et al., 2008).The zone ofinfluences of the city is challenging to identify scientifically with their hinterland. The study of urban sphere of influences is worth full which can improve of central city's development process in terms of socio-economically and can establish of supporting policies (Deng et al., 2010).The spatial characteristics between cities and hinterland are representing.The fast economic growth has prompted the rapid motorization, associate environmental and social challenges as well (Schipper & Ng, 2004);(Sperling, 2003).

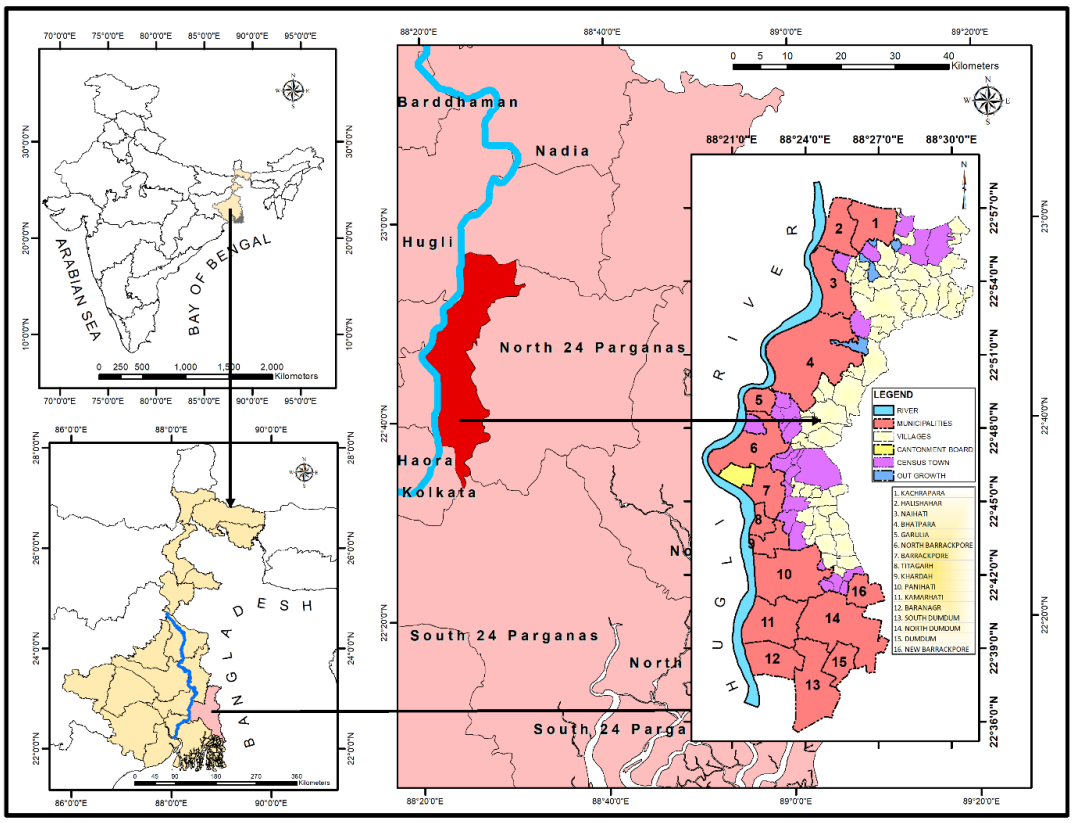
The main aims of the paper is to find out the functional hierarchy of urban Centres and their influences zone over the neighboring peripheral regions and regional socio-economic disparities among the ULB in the Barrackpore Subdivisional area. The logical approach behind to take the objective is that small urban centers still suffering from absence of development facilities which are not efficient to covers the large surrounding rural areas(Ali & Varshney, 2012). The small towns or urban Centresneed support to growup to their extreme potentiality that they can influencetheir development over greater distance of countryside.

2. Methods and Materials:

2.1. About Study area:

The Barrackpore is a subdivisional administrative (30154 hectare) which located along the left bank of Hooghly River with irregular longer shape in southern part of west Bengal. Geographically it is situated between 22° 36′ 00″ N and 22°57′00″N and 88° 21′00″ and 88° 83′00″ E (Figure. I). Regionally, the study area is sited in the southern part of the Ganga-Brahmaputra Basin. The tributary of Ganga River flows along the western part of the area. The geological condition reveals that two types of soil are found in this region i.e., very fine sands and silt types; another is alternate layers of sand, silt and dark grey clays those ages from middle to upper Holocene. Lithology condition of the study area are deltaic plain, Para deltaic fan surface, semi to unconsolidated sediments with inner granular porosity (CGWB & GSI;

http://wbwridd.gov.in/); As it is a deltaic plain; very deep, poorly drained and fine loamy soil are found with clayey surface and facing severe to moderate flooding (NBSS-LUP). The average elevation of Barrackpore subdivision is 25 m from the mean sea level (SRTM DEM data; earthexplorer.usgs.gov). The South-West monsoon brings rainfall here, although rain due to the western disturbances and North-East Monsoon also contribute small quantities towards the overall precipitation of the state. The rain fall range is up to 1570mm in normal rainy season. Temperature is fluctuated due to seasonally; in summer its range reaches above 40°C and in winter it's 10^0C. Administratively it has 2 community development (CD) block, 16 Municipalities or Urban Local Bodies (ULB) (Kanchrapara, Halishahar, Naihati, Bhatpara, Garulia, North Barrackpore, Barrackpore, Titagarh, Khardah, Panihati, Kamarhati, Baranagar, South Dum dum, Dumdum, North Dum dum and New Barrackpore), 14 Gram Panchayat, 53 villages, 1 cantonment board, 24 census towns and 13 police stations (Census of India: 2011). Kolkata Metropolitan Authority (KMA) has taken the whole Barrackpore Subdivision as a part of it.



2.2. Data used:

To fulfill the present research objectives, secondary information has been collected from 24 Parganas district census handbook year of 1971 and 2011andStatistical hand book report. SOI Topo sheet (F45K5 & F45K6) has been used to extracting boundary of the study area in GIS software.

2.3. Database preparation:

Two topo sheet maps of scale 1:50,000 (F45K5 & F45K6) by Survey of India has taken to delineate the boundary of the study area. These sheets were scanned and plotted by its coordinate system using Geo-referencing tool in ArcGIS software. The projection system is Universal Transverse Mercator Projection (UTM) and the reference ellipsoid is WGS 84. Rural and urban boundaries were extracted by digitization itself in Arc environment. The secondary data from various governmental reportshave been gathered and analyzed using different statistical formula to get the generalization of raw facts. The functional importance has been calculated based on a certain weightage to all facilities using the formula which is given below equations to getthe rank of each urban local body.

STEP-I: Mean Population Threshold (M_{pT})

The mean population threshold is an average population served by each facility (Maithini, 1986).The mean population threshold has been calculated using the formula of equation 1. It is the ratio between total population and number of facilities for a particular category of facility(Hagget & Gunwardena, 1965) in each ULB and for whole study area.

$$M_{pT} = \frac{P}{N_{fi}} (1)$$

Where, M_{pt}= Mean population threshold, P= Total population, and N_f= total number of facilities for functional category i.

STEP-II: Functional Weightage of Facility (WF_i)

To estimate the Functional Weightage for particular facility, the below equation 2 has been used.

$$WF_i = \frac{M_{pTi}}{M_{pT1}} \quad (2)$$

WhereWF_i= FunctionalWeightage of Facility of 'i', M_{pTi}= mean population threshold of facility 'i', and MpT1= lowermost mean population threshold.

STEP-III: Functional Importance or Composite Functional Score of ULB

The WF_i values are summed up for all facilities to estimate the Composite functional Score using the equation 3.

$$CF_S = \sum_{i=1}^{n} WFi \quad (3)$$

WhereCF_S= Composite Functional Score, WF_i= Weightage of function 'i' up to n number of facilities.

STEP-IV: Sphere of Influence.

$$S.I. = \frac{FI_{uc}}{FI_{sa}} * A \quad (4)$$

$$R = \sqrt{\frac{FI_{uc}}{FI_{sa}} * A}$$

Where, ***S.I.*** = Sphere of Influence for each ULB (sq km).FI_{uc}= Total functional importance of Urban Centres, FI_{sa}= Total functional importance of the study area. ***A***= Total area of the study region in (sq km). ***R***= Radius of circle representing the sphere of influences (in km).

STEP-V: Relative level of Functional ratio

The relative level of functional ratio has been derived to measures the adequacy or inadequacy of urban socio-economic services and amenities in relation to present population. Calculation of the ratio is as below using equation 5.

$$R_{rf} = \frac{P_s}{P_t} * \frac{F_t}{F_s} \quad (5)$$

Where, R_{rf}= Relative level of functional ratio between particular urban town and the study area. P_s= total urban population of study area, P_t= population of town, F_t= Functional importance of the town,F_s= Functional importance of the study area. If the range of ratio is less than 1 indicates to inadequacy and more than 1 indicates to adequacy of functions in the town (Ali & Varshney, 2012).

3. Result and Discussion:

3.1. Spatio-temporal growth analysis in Urban Centres-at a glance:

The urban Centers or cities are the hubs of governmental, commercial transportation and the place where people live and work(The World's Cities in 2018).Urban growth and development are not influenced by one single or autonomous factor but it's a Spatio-temporal phenomenon based on economic transformations.Table1 exposes that among the 16 municipalities the population growth rate fluctuations happened over the periods of times for each municipality. During 2011 over 1971 North Dumdum has reported as highest annual growth rate (290.06%) which are followed by Dumdum (265.99%), Khardah (195.80%) and Naihati (165.44%), where the lowest growth rate has experienced in Titagarh (32.11). During 1971-2011, it was sharpincrease in population growth rate for each municipality of the study area.Some of municipalities have extent their spatial boundary by encroaching of surrounding villages from 1971to 2011. Bhatpara, New Barrackpore, North Dumdum, Dumdum, Naihati and South Dumdum municipalities have increased their spatial boundary by 122%, 87%, 78%, 72%, 38% and 28%respectively (Table 1).

Table 1: Growth Rate of Population and Area, Barrackpore Subdivision, 1971-2011

Year/ Municipalities	Growth Rate in % (Population)	Growth rate in % (Area)
	1971-2011	1971-2011
Kanchrapara	64.50	0.0
Halishahar	81.32	0.3
Naihati	165.44	38.7
Bhatpara	88.53	122.3
Garulia	92.76	0.0
North Barrackpore	73.98	7.2
Barrackpore	57.69	0.0
Titagarh	32.11	0.0
Khardah	195.80	10.9
Panihati	154.88	0.0
New Barrackpore	136.36	87.9
Kamarhati	94.93	0.00
Baranagar	79.19	5.88
South Dumdum	131.34	28.90
North Dumdum	290.06	78.96
Dumdum	265.99	72.64

3.2. Mean Population Threshold andWeightage offunctional facilities:

The transformation from traditional society to modern life are depends on the essentiality of socio-economic facilities and its development. Different types of socio-economic facilities of a node point are serves to concentrate settlement around them. The aim of this study is to find out the functional importance of each facility though Mean Population Threshold estimation. This threshold range is determined by how each facility is served into an average population in the each ULB. Four domain types of facilities have been taken into study i.e., education, health, commercial or financial and recreation those are the important for human welfare and well-being. The mean population threshold and their relative functional importance of all 23 facilities have been listed in table 2. The functional weightage of each facility has been estimated by dividedof $M_{pt}$and the lowest M_{pt}. Higher $M_{pt}$of a facility have denotes that higher importance because it is less in number while lower importance having more in number of the facility. In the educational domain,Colleges (medical and engineering), universities and Polytechnique institute are having highest M_{pt}in both decades 1971 and 2011 as well in the total Barrackpore Subdivision. Primary schools are having lower mean population thresholdvalue and functional weightage (Table 2). T.B clinic are very less in number in the health facilities domain with higher threshold value of 599123 in 1971 and 317264.31 in 2011(Table 2). Financially or commercially nationalized banks are having M_{pt} of 56167.78 in 1971 and 19829.02 in 2011 which is less importance facility because it's having more in number rather than agricultural credit society and non-agricultural society. Lastly in

recreational domain, stadium is the higher important facility due to its rare in number of the study area (Table 2).

Table 2:Mean Population threshold and Functional Weightage of Facilities, Barrackpore Subdivision, 1971-2011.

BARRACKPORE SUBDIVISION							
Mean Population threshold and Functional Weightage of Facilities, Barrackpore Subdivision.							
		1971			2011		
Category of Facilities	Name of the facility	Number of Facility	Mean Population Threshold	Functional Weightage Of Facilities	Number of Facility	Mean Population Threshold	Functional Weightage Of Facilities
Educational Institute	Primary Schools	521	3449.84	2.46	1369	3012.74	2.57
	Middle/Junior/ Secondary School	80	22467.11	16.00	678	6083.24	5.19
	Senior Secondary School	192	9361.30	6.67	395	10441.61	8.91
	Degree Colleges	15	119824.60	85.33	26	158632.15	135.38
	Medical Collage	0	0.00	0.00	3	1374812.00	1173.33
	Engineering Collage	0	0.00	0.00	5	824887.20	704.00
	Polytechnique Collage	7	256767.00	182.86	2	2062218.00	1760.00
	Short hand Types	24	74890.38	53.33	81	50918.96	43.46
Recreational Facilities	Stadium	0	0.00	0.00	11	374948.73	320.00
	Cinema Hall	34	52863.79	37.65	36	114567.67	97.78
	Auditorium	14	128383.50	91.43	96	42962.88	36.67
	Public Libraries	132	13616.43	9.70	203	20317.42	17.34
Health Facilities	Hospitals	20	89868.45	64.00	24	171851.50	146.67
	Dispensaries	13	138259.15	98.46	266	15505.40	13.23
	T.B Clinic	3	599123.00	426.67	13	317264.31	270.77
	Health Centre	5	359473.80	256.00	37	111471.24	95.14
	McW	8	224671.13	160.00	33	124982.91	106.67
	Nursing Home	15	119824.60	85.33	28	147301.29	125.71
	Others	0	0.00	0.00	325	12690.57	10.83
	No. of Beds	1280	1404.19	1.00	3520	1171.71	1.00
Financial and Commercial Institute	Nationalized Banks	32	56167.78	40.00	208	19829.02	16.92
	Agricultural Credit Society	2	898684.50	640.00	3	1374812.00	1173.33
	Non Agricultural Society	7	256767.00	182.86	119	34659.13	29.58

3.3. Spatio-temporal Distribution of Facilities in Urban Local Bodies:

The main focus of the geographical research is to analysis the Spatio-temporal distributions of phenomenon or features over the earth surface. The homogeneity between features and facilities are very less across the region.(Ali & Varshney, 2012). There is a positive relationship between population growth and facilities development, because both are interdependent. The different socio-economic facilities are essential to fulfill people needs, desires and to sustain their livelihood. Table 3.1 and 3.2 reveals that based on population size, the 16 municipalities have been categorized into three categories in 1971 and into two categories in 2011(Figure II). Functional importance or composite function score has also been calculated for each size category. In 1971 five urban Centres comes under category-I level with more than 1, 00,000 and 54.35% urban population is lies in this category with 37.72% of CF_s (Composite Functional Score). Seven urban Centres were fall into the category-II with 36.20 % of urban population and 36.73% of the CF_s and remain four Centres had less than 50000 population in category –III level by 9.44 % of urban population and 25.53 % of CF_s(Table 3.1); (FigureIIa). The number of population has increased by the time period. In 2011 the urban Centres has classified into only two categories by the size of population. Fourteen ULB among sixteen had in category-I level with 95% of urban population and 97.27% of CF_S and remain two Centres were in category (Table 3.2); (FigureIIb). The relative ratio of advantage between population and composite score has been estimated to get the possibility of expanses of town in forthcoming days. Human settlements are generally used to concentrate towards the center of the town where the opportunities of socio-economic are very high. The pulling factors of these facilities are attracting people flow to accomplish the needs. Ali & Varshney in 2012 have been discussed in their published article on Aligarh district that if a urban centre having less population and more functional facilities; it is obevous more prospect to growth the town in future. If the ratio of advantages is < 1 then there is less probability of growth but if its more than 1 then it supposed to have more possibility to growth population and expanses due to more functional importance. In this comparative study between two decades reveals that in the census year of 1971 ratio of advantages was 0.69 for five urban centres in class –I size town; which is followed by class-II size (seven towns) with 1.014 of ratio of advantages and lastly class-III size (4 towns) by 2.70 value of ratio advantages (Table 3.1). So it was a possibilities to grow for class-II and III cities in upcoming census year. The observation in 2011(Table 3.2) reveals that 14 towns are having more than population one lakh with ratio of advantages of 1.02. Rest of two towns are carried 0.54 of ratio that indicates that there is less prospects to grow these two town.

Table 3.1 Population and facilities distribution in Classes of Town -Barrackpore Subdivision, 1971.

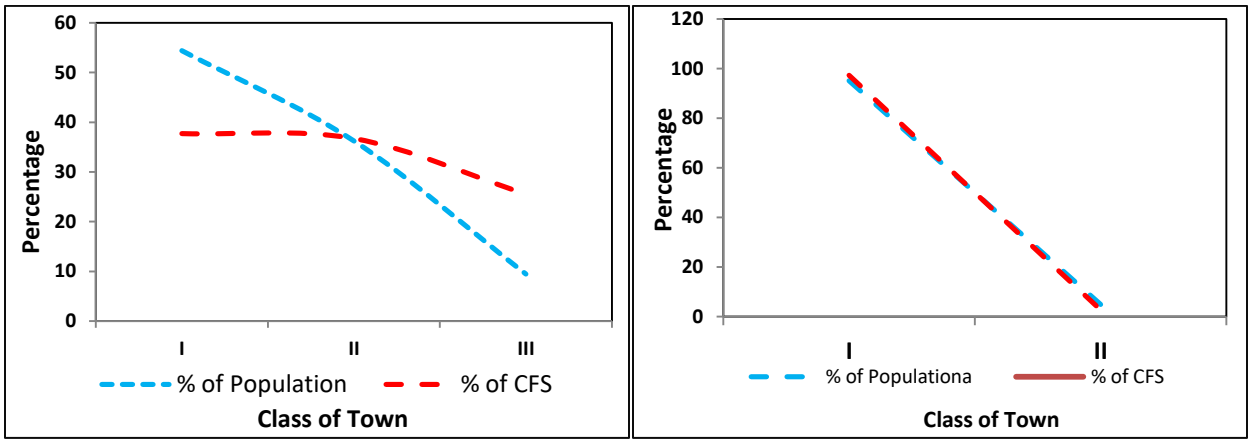
1971								
Name of ULB	Number of ULB	Class of Town	Population Size	Total population	Composite Functional Score (CF_S)	% of Population	% of CF_S	Ratio of advantages
Bhatpara, Panihati, Kamarhati, Baranagar,	5	I	> 1,00,000	833384	3171.96	54.35	37.72	0.69

South dumdum.								
Kanchrapara, Halishahar, Naihati, North Barrackpore, Barrackpore, Titagarh, North Dumdum.	7	II	5,00,00-99,999	555079	3088.76	36.20	36.73	1.014
Garulia, Khardah, New Barrackpore, Dumdum.	4	III	20,000-49,999	144825	2146.87	9.44	25.53	2.70

Table 3.2 Population and facilities distribution among Classes of Town- Barrackpore Subdivision, 2011.

2011								
Name of ULB	Number of ULB	Class of Town	Population Size	Total population	Composite Functional Score (CFS)	% of Population	% of CFS	Ratio of advantages
Kanchrapara, Halishahar, Naihati, Bhatpara, North Barrackpore, Barrackpore, Titagarh, Khardah, Panihati, Kamarhati, Baranagar, South Dumdum, North Dumdum, Dumdum	14	I	> 1,00,000	3089075	14383.72	95.01	97.27	1.02
Garulia, New	2	II	5,00,00-	162182	402.83	4.988	2.72	0.54

Barrackpore			99,999					



3.4. The hierarchical order of Functional Importance in each Urban Centres:

Functional importance is the total sum of allexisting facilities in a town which plays a role like pulling effects that attracts the people towards Urban Centres. The higher and lower functional importance of a town depends on the higher as well as lower order of facilities of that particular town. But there is a probability to convert a smaller town into bigger city. Functional importance are always denotes a qualitative approach of a town due to the gravitational pulling activity. The variation of importunacy of a town depends on several reasons like size of population, spatial area of a town etc. In this define study area the hierarchical heterogeneity of functional importance is noticed among the urban Centres. The pulling gravity is different in different towns. The pulling capacity of a city or towns are depends on the maximum or minimum number of facilities which that particular city are given. The functional weightage were increased for each urban centre during 1971-2011 (Table4).In 1971 the functional affects was less among the urban centres due to less number of facilities. Among the 16 towns the highest position was in Kamarhati and Barrackpore municipality of functional importance of 1913.21 and 1804.02 due to availability of all domain facilities which is followed by Khardah municipality of 1167.51. Kanchrapara, South Dumdum and Dum dum municipality and others had less functional importance with score of less than 1000. The lowest importance urban centre was Garulia with score of 32.5 which indicated that this is the least developed town (Table 5.1). But in 2011 functional weightage significantly is more than 1971 for each urban centre. Barrackpore, Panihati, Kamarhati stood at highest position with value of 1964.28, 1992.39 and 2587.31 which is followed by Dumdum, south Dumdum and Kanchrapara municipality (Table 5.2) and remain centre had score of importunacy less than 1000. Hence, Garulia is still lowest point of importance due to less of facilities.

The urban centres are categorized into four order formation in a hierarchical arrangement from highest to lowest score of functional importance in 1971.Kamarhati industrial zone and Barrackpore came under the first order of hierarchy. Khardah municipality only has been recognized under second order of hierarchy.

However three municipalities Kanchrapara, South Dumdum, Dumdum with functional score differs from 502-972 fall in the third order of hierarchy. Remain ten municipalities Garulia, Bhatpara, Halishahar, New Barrackpore, Titagarh, Panihati, Naihati, North Dumdum, North Barrackpore, Baranagar with functional score less than 502 are included under fourth order or lowest order of hierarchy of towns in the study area (Table 5.1); (Figure III) , but after 40 years it was huge increases in field of functional activities of facilities. It is observable that Bhatpara and Panihati ULB was experienced highest growth rate of facilities increases that indicates the process of development which taken by the ULB authority. Panihati and Kamarhati and Barrackpore have been documented as higher order with score of 2587.30, 1992.38 and 1964. Nine municipalities have been fallen under lower order of functional activities by the score of less than 708 (Table 5.2); (Figure III).

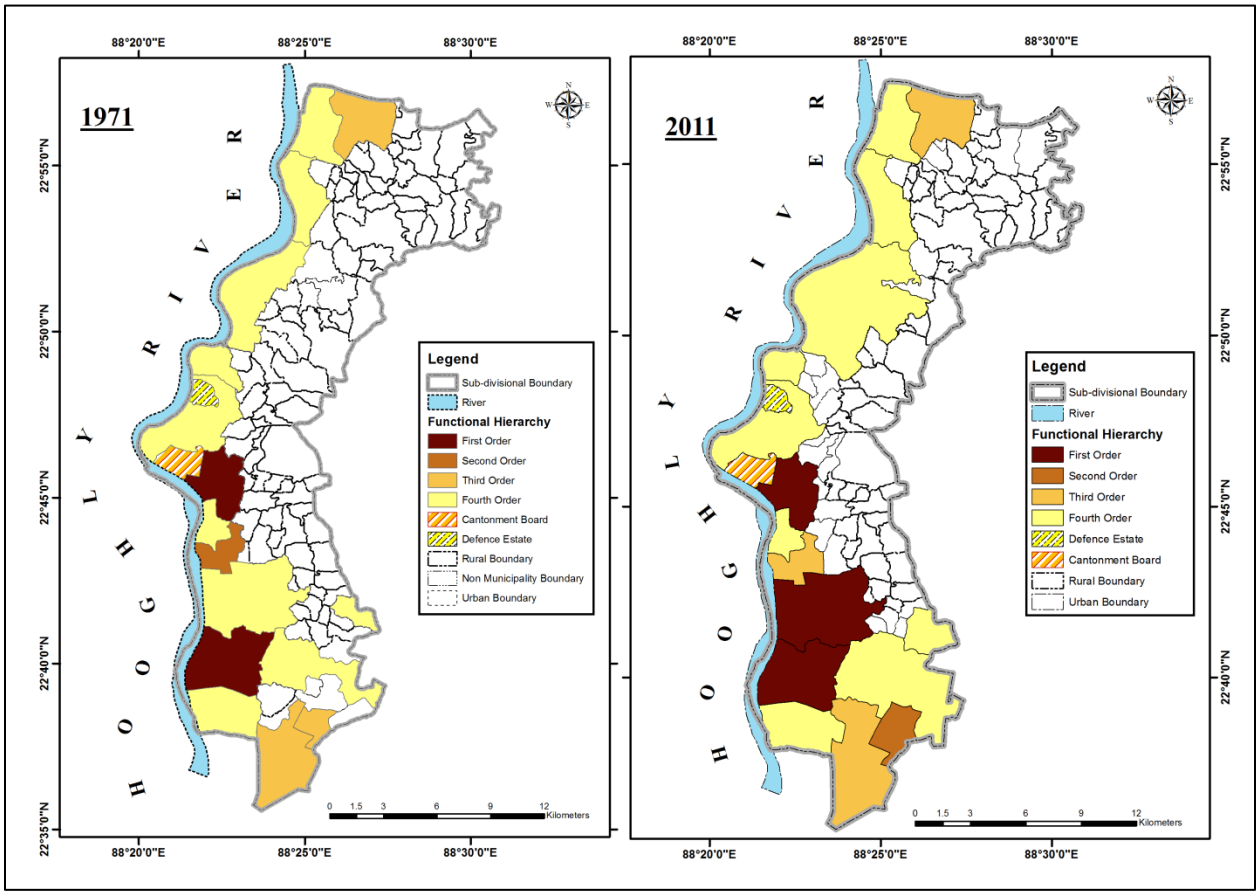


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Table 4.Functional Importance, Population, Relative Ratio and Sphere of Influence, Barrackpore Subdivision, 1971-2011.

	1971					2011				
ULB	Functional Importance	Total Population	Relative Ratio of Function	Sphere of Influence (SI) in sq.km	Radius of Influence	Functional Importance	Total Population	Relative Ratio of Function	Sphere of Influence (SI) in sq.km	Radius of Influence
Kanchrapara	529.96	78768	4.96	66.66	8.16	1331.27	129576	6.73	64.91	8.06
Halishahar	91.21	68906	0.98	11.47	3.39	376.77	124939	1.98	18.37	4.29
Naihati	153.85	82090	1.38	19.35	4.40	391.75	217900	1.18	19.10	4.37
Bhatpara	47.25	204750	0.17	5.94	2.44	510.32	386019	0.87	24.88	4.99
Garulia	32.5	44271	0.54	4.09	2.02	80.87	85336	0.62	3.94	1.99
North Barrackpur	212.71	76335	2.05	26.76	5.17	241.54	132806	1.19	11.78	3.43
Barrackpur	1804.02	96889	13.72	226.93	15.06	1964.28	152783	8.42	95.77	9.79
Titagarh	131.29	88218	1.10	16.52	4.06	371.46	116541	2.09	18.11	4.26
Khardah	1167.51	36679	23.45	146.86	12.12	925.81	108496	5.59	45.14	6.72
Panihati	131.69	148046	0.66	16.57	4.07	1992.39	377347	3.46	97.14	9.86
New Barrackpur	112.34	32512	2.55	14.13	3.76	321.97	76846	2.75	15.70	3.96
Kamarhati	1913.21	169404	8.32	240.66	15.51	2587.31	330211	5.13	126.15	11.23
Baranagar	467.55	136842	2.52	58.81	7.67	589.77	245213	1.58	28.76	5.36
North Dum Dum	165.7	63873	1.91	20.84	4.57	176.39	249142	0.46	8.60	2.93
Dum Dum	834.51	31363	19.60	104.97	10.25	1849.44	114786	10.56	90.17	9.50
South Dumdum	612.26	174342	2.59	77.02	8.78	1075.21	403316	1.75	52.42	7.24

Table 5.1 Hierarchical Order of Functional Importance in towns, Barrackpore Sub division, 1971

1971			
Hierarchical Order	Functional Importance of Range	Number of Towns	Town Name
First Order	> 1443	2	Kamarhati, Barrackpore
Second Order	973-1443	1	Khardah
Third Order	502-972	3	Kanchrapara, South Dumdum, Dumdum
Fourth Order	< 502	10	Garulia, Bhatpara, Halishahar, New Barrackpore, Titagarh, Panihati, Naihati, North Dumdum, North Barrackpore, Baranagar

Table 5.2 Hierarchical Order of Functional Importance in towns, Barrackpore Sub division, 1971

2011			
Hierarchical Order	Functional Importance of Range	Number of Towns	Town Name
First Order	> 1960	3	Barrackpore, Panihati, Kamarhati
Second Order	1335-1960	1	Dumdum
Third Order	708-1334	3	Khardah, South Dumdum, Kanchrapara
Fourth Order	< 708	9	Garulia, North Dumdum, North Barrackpore, New Barrackpore, Titagarh, Halishahar, Naihati, Bhatpara, Baranagar

3.5. Zone of Sphere of Influences:

City started to form from centre to spread over certain area which is the city's sphere of influence. Urban centres are the facility hub which provides the goods and services around the boundary areas and beyond it coverage. Population from surrounding areas is communicating to get the requirement of facilities. The people willing to travel a certain distance from the surrounding area to city to avail the important facilities only, so it called economic distance. If the town or city having the huge number of facilities, the peoples are being attracted from longer distance of hinterland of the cities. The present study has been adopted the V.L.S. PrakashRao's modified method to estimate the zone of influence of each urban centre (Rao, 1964). The table 4 shows that Kamarhati and Barrackpore municipality had the maximum distance of influence in Barrackpore Sub division with radius of influences 15.51 km and 15.06 km in 1971. Its influence ness was outer the subdivisional boundary and reached into others subdivisional territory of the same district and neighboring district as well with area coverage of 240.66 sq km and 226.93 sq km. Secondly Khardah municipality had the sphere of influence 146.86 sq.km with radius distance was 12.12 km. Garulia, Bhatpara, Titagarh and new Barrackporemunicipalities has been at the lower order of functional influence with radius of 2.02 km, 2.44 km, 3.76km and 4.06 km (Table 4).We canobserve in the table that the

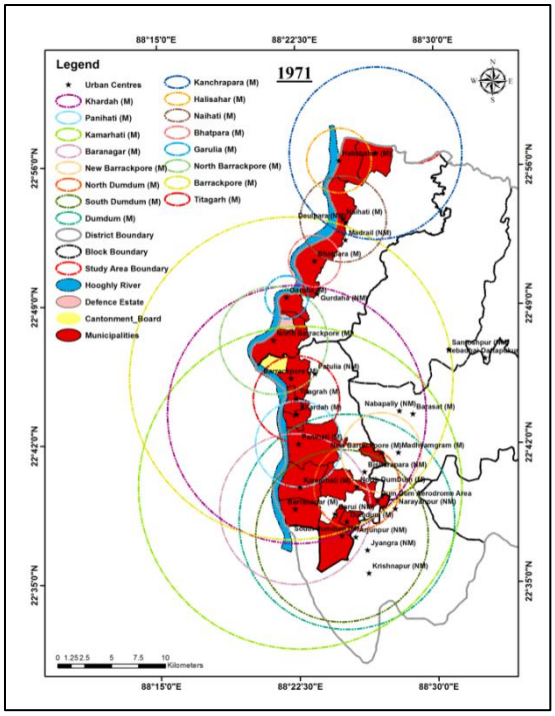
functional importance of the urban municipalities is increased though the increases of number of facilities in each domain during1971-2011which promote the centres to developed independently. The functional weightage increasesmeansits reflectsinthe cities or towns progress and expansion. The findings of this research from 1971-2011 that, each urban municipalities of the region had faced growth with more number of facilities which provides the more availability of services and amenities within the each town itself.The people of the urban centres are supposed to travelwithin thecentres to get daily facility as requirement. If all the urban centres are sufficient to offer all the basic services and amenities for the people that indicates people can inmigrate inside the town. The sphere of influences of the small urban local bodies are depends on total functional importance of region. In Barrackpore sub division the total functional weightage was 2439.73 after it's increased in 2011 as 6294.48.Therefore the small urban local bodies have had increased their total functional weightage also which can be decreases the zone of influence as well for some municipalities.Spatio-temporal study between time periods indicates that most of municipalities had experienced the decline the sphere of influence in distance. Because supplementary amenities growth of their neighboring ULB. Where, in 2011 Kamarhati, Panihati and Barrackpore municipality exerts services of facilities up to spatial distance of 11.23 km, 9.86 km and 9.79 km. Halishahar, Bhatpara, Titagarh, Panihati and New Barrackpore were expanded there influential zone during to study period. Garulia, North Dumdum, North Barrackpore, New Barrackpore, Titagarh, Halishahar, Naihati, Bhatpara had been identified as lower order of functionality (Table 4).According to the census data the hinter land areas of the urban boundaries, some villages has been converted into the census town which could provide the basic daily amenities for nearby smaller village Panchayat.

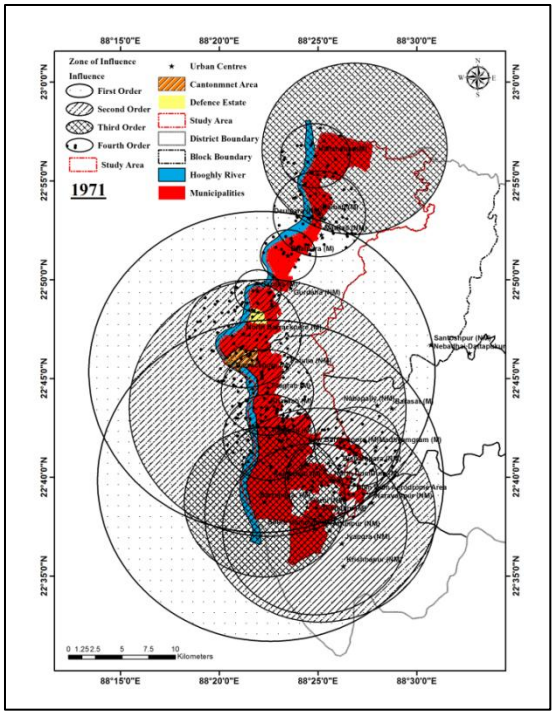
Table 6.1 Hierarchical Order of Influence Zone in towns, Barrackpore Sub division, 1971

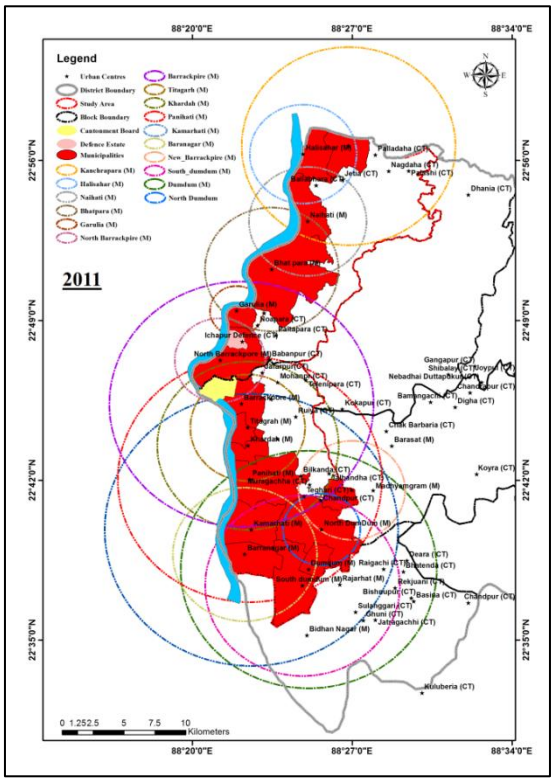
1971			
Hierarchical Order	Radius of Influence	Number of Towns	Town Name
First Order	> 12.2	2	Barrackpore, Kamarhati
Second Order	8.8-12.1	3	South Dumdum, Dumdum, Khardah
Third Order	5.3-8.7	2	Baranagar, Kanchrapara
Fourth Order	< 5.2	9	Garulia, Bhatpara, Halishahar, New Barrackpore, Titagarh, Panihati, Naihati, North Dumdum, North Barrackpore,

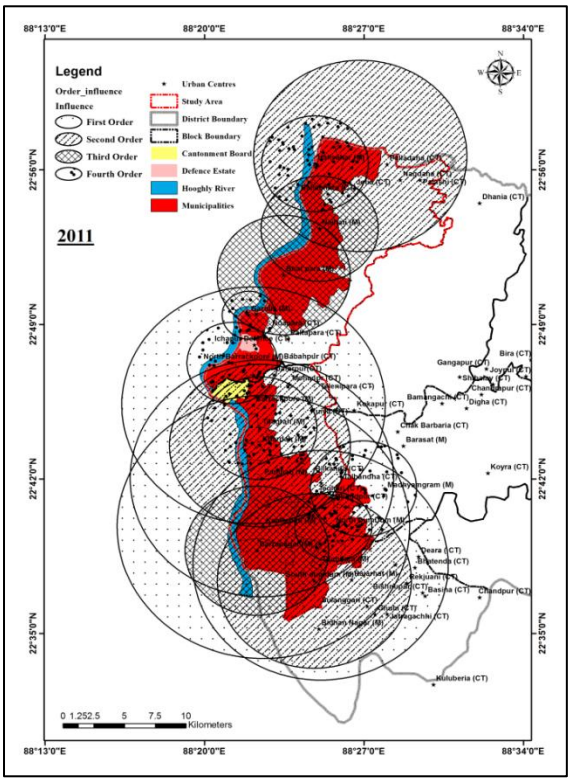
Table 6.2. Hierarchical Order of Influence Zone in towns, Barrackpore Sub division, 1971

2011			
Hierarchical Order	Radius of Influence	Number of Towns	Town Name
First Order	> 9	4	Dumdum, Barrackpore, Panihati, Kamarhati
Second Order	6.6-8.9	3	Khardah, South Dumdum, Kanchrapara
Third Order	4.3-6.7	3	Naihati, Bhatpara, Baranagar
Fourth Order	< 4.2	6	Garulia, North Dumdum, North Barrackpore, New Barrackpore, Titagarh, Halishahar.


1971
Legend
Urban Centres
Khardah (M)
Panihati (M)
Kamarhati (M)
Baranagar (M)
New Barrackpore (M)
North Dumdum (M)
South Dumdum (M)
Dumdum (M)
District Boundary
Block Boundary
Study Area Boundary
Hooghly River
Defence Estate
Cantonment_Board
Municipalities
Kanchrapara (M)
Halisahar (M)
Naihati (M)
Bhatpara (M)
Garulia (M)
North Barrackpore (M)
Barrackpore (M)
Titagarh (M)
Kilometers


Zone of Influence
Influence
First Order
Second Order
Third Order
Fourth Order
Study Area
Urban Centres
Cantonmnet Area
Defence Estate
Study Area
District Boundary
Block Boundary
Hooghly River
Municipalities
1971
Kilometers


Legend
Urban Centres
District Boundary
Study Area
Block Boundary
Cantonment Board
Defence Estate
Municipalities
Kanchrapara (M)
Halisahar (M)
Naihati (M)
Bhatpara (M)
Garulia (M)
North Barrackpire (M)
Barrackpire (M)
Titagarh (M)
Khardah (M)
Panihati (M)
Kamarhati (M)
Baranagar (M)
New_Barrackpire (M)
South_dumdum (M)
Dumdum (M)
North Dumdum
2011
Kilometers


Legend
Order_influence
Influence
First Order
Second Order
Third Order
Fourth Order
Urban Centres
Study Area
District Boundary
Block Boundary
Cantonment Board
Defence Estate
Hooghly River
Municipalities
2011
Kilometers

The circular form of influence of urban centres has been classified into four hierarchical orders in both time periods (Figure IV). The higher functional importance urban centres are having wider zone of influence within which the lower order of urban centres may come under. Here, in 1971, the people of Halishahar (lower order of function) area could commute for avail higher function to Kanchrapara. Naihati and Bhatpara were comes under the Kanchrapara municipalities influential zones. There were two higher order of zone i.e., Barrackpore and KamarhatiMunicipality. The Barrackpore municipality had influence upon Bhatpara, Garulia, North Barrackpore, Titagarh, Khardah, Panihati, Baranagar and up to New Barrackpore municipality. Kamarhati Municipality was in the top position as in provides the highest number of the facilities; that's why the zone of influence of this municipalities was up on Titagarh, Khardah, Panihati, Baranagar, South dumdum, dumdum, North dumdum and Dumdum urban centres (Table 6.1);(Figure IVa). The overlapping of spheres of influence was observed in the study area. South Dumdum, Khardah and Dumdum had a second order of influences the nearest urban centres. In 2011, the first order of influential zone was four namely Barrackpore, Panihati, Kamarhati and Dumdum Barrackpore had a wide range of area which supplies amenities and services within the radius distances that covers the second, third and fourth order of urban centres. Barrackpore buffers in Khardah, Kanchrapara municipality (second order); Bhatpara municipality (third order) and Garulia, North Barrackpore, Titagarh (fourth order) also.In beside Panihati, Kamarhati, Dumdum had a dominant area of influence over in South Dumdum, Baranagar, North dumdum and New Barrackpore etc. urban centres (Table 6.2); (Figure IVb).

3.6. Analysis of Functional adequacy Level and Planningrecommendation:

The relative ratio has been consideredto estimation of balance between populations and existing facilities in the urban centres. The range of ratio of above or below 1.0 is signifies the sufficient or insufficient of facilities for population. Through this relative ratio we can observe that how many urban centres are inadequately served the facilities to the population and how many urban centres have functional potentiality to appeal more migrants as probabilityof its further growth. In the Table 4 has showed thatduring 1971 decades among the 16 municipalities four had the inadequacy to serve the facilities among the population of the centres with value of less than 1. It was Halishahar (0.98); Garulia (0.54); Bhatpara (0.17) and Panihati (0.66).The lowest ratio of these municipalities reveals that the existing facilities do not sufficient or corresponding for the population size means it was a pressure of overburden of population on basic amenities and facilities and those could act as service centres for the inhabitants. Kanchrapara (4.96), Naihati (1.38), North Barrackpore (2.05), Titagrh (1.10), New Barrackpore (2.55), Baranagr (2.52), North Dumdum (1.91) and South Dumdum (2.59) were more than 1 value has potentiality to pull population and had possibilities to further growth based on amenities.The maximum relative ration was found at Barrackpore (13.72), Khardah (23.45), Kamarhati (8.32) and dumdum (19.60) urban centres had played as growth pole by attracting people from surrounding and neighboring areasby the providing sufficient number of facilities to fulfill the population demand and was also possibilities development their spatial expansion in future. Based on data from 1971, it is observed that some municipalities had prospectto growth their socio-economic structure and spatial extension in coming days. So, in 2011, the relative ratio between facilities and population was increases for Kanchrapara, Halishahar, Bhatpara, Garulia, Titagrh, Panihati, New Barrackpore etc. due to increase the number of

facilities over the decades. But still there is needed to increases the facilities number to accomplish the increasing population demand in present days. The relative ratio of Kamarhati (5.13) and Barrackpore (8.42) was decreased because of the number of facilities are less sufficient to achieve the demand of total number of population in town.The populations are increases than previous decades. Khardah municipality washigher value of ratio in 1971 but in 2011 it was decreaseddue to increases the number of facilities over the neighboring Panihati municipality. The highest relative ratio was in Dumdum municipality in 2011 that symbolizes there were adequacy of services to live up to population in town itself and neighboring as well. Bhatpara (0.87) and Garulia (0.62) was still lower order ratio and does not adequate to accompanied for the population. Inhabits of those towns are supposed to travel to adjacent higher functional zone areas.

Urban centres or ULB have to require the standard planning for regional socio-economic development in order to achieve the goal of human well-being. Some planning recommendations have been made for the urban centres which are (i) Urban growth should be going with the economic development; (ii) The location of facilities distribution should be easy to accessibility for the resident from place to place in the urban area; (iii) The equilibrium must be maintain in order as facilities available for the number of residence; (iv) According to the present census 2011, Bhatpara municipality and North Dumdum areas are class-I category town even though the ratio between population and facilities are very less; there needs to planning to encompass more facilities especially in order to get higher order allocation. Therefore the patron can be avail the facilities; (v) The transport connectivity should be available within the urban centresand it must be connected from higher order to lower order cities in the study area; (vi) Planning policy should be taken in such way that each urban may influence into all places of rural areas which can signifies their living standard and quality of life in the study area.

Conclusion:

This study has been taken as quantitative approach to analyze the functional importance of different urban centres and their zone of influences. Facilities and population distribution are the complementary to each other; both are concentrated in larger urban centres.If the cities have large number of facilities and higher functional importance which having more pulling effect to attract people from surrounding areas with greater chance of further growth in future. A town grows and expansion as a consequences of availability of services and facilities. It is also prove that sphere of influence increases the regional socio-economic conditions for the town. To achieve balanced regional socio-economic development, suitable planning recommendations should be adopted and implemented that urban influential zones must be covering the very corner of any rural part. Still there are need to improve the number of facilities to encompass of population demand. The household level study should be conducted to getthe level of living and quality of life inhabitance in each urban centre. Besides this quantitative micro level study on Barrackpore subdivision will promote to take planning formulation and policy to improve the quality of life and standard of living as well.

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