Urbanization and Urban Growth Dynamics:
A Study on Chittagong City

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Abstract

The process of urbanization is a universal phenomenon. All countries are prone to this because of increasing population and economic development. Urban growth refers to an increase in total urban population. The size of urban population growth in the next four decades, especially in developing countries will be massive. Thus rapid urban growth introduces new urbanization challenges when resource is limited. Urbanization has been globally recognized as an effective engine of economic growth and socio-cultural development. Rapid urban growth has created huge demands on urban utilities and services as well. The negative consequence of rapid urbanization has occurred massive scale urban environmental degradation. For this research Chittagong city corporation area has been selected as a study area. Pairwise ranking is used to rank a list of urban growth factors in priority order. Holden method has been used in this research for identifying the percentage of population growth and Percentage of unorganized urban growth which is related to urban sprawl. Urban growth pattern has been identified by some growth indicator methods such as Moran Coefficient, Shannon's entropy, and Geary's coefficient. All spatial and temporal data is collected from secondary source. GIS and Remote Sensing approach has been used for data exploration to indicate urban growth pattern and land use change. Understanding the urban growth pattern would help in addressing the present and future needs of a city. This will further help in preparation of effective planning and management strategies for controlled and systematic urban growth both at regional as well as local level.

Background of the study

In the world concentration of population and economic activity in urban areas are increasing rapidly. The increased number of people who live in towns and cities is known urban growth (UNICEF, 2012). Urbanization is a process through which increasing proportion of people living together in a concentrated locality having public utilities (Murtaza, 2012). All countries are prone to this phenomenon mainly responsible due to the increase in population growth (Tamilenthi et.al 2011). Population is a unique character of a city. There are now more than 300 cities around the world with populations greater than one million (Allen, 2014). The size of urban population growth in the next four decades, especially in developing countries will be massive (Islam, 2013). Thus rapid urban growth introduces new urbanization challenges when resource is scarce.

With over 150 million people Bangladesh is the world's seventh most populous dense

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country (UN, 2014). The population of the country is not likely to stabilize or begin to decline before 2060, when it might be 230 million, with more than 70 percent being urban (Islam, 2013). With rapid urbanization urban physical expansion takes place fast and more areas in agriculture and forests get converted to built-up areas. Rapid urban growth has made heavy demands on urban utilities services also. The worst negative consequence of rapid urbanization on a massive scale within a city is in the form of degradation of the urban environment (Islam, 2013).

For this research Chittagong city has been selected as a study area. Chittagong is an ancient city dating around 2200 years old (Ashraf, 2013). Like shanghai, Chittagong could be a city with two towns on the two sides of the karnafuli river (Ashraf, 2013). Assume hypothesis that the city is growing as population increased. Moran Coefficient, Shannon's entropy and Geary's coefficient are used for urban growth pattern identification. Holdern method has been used to understand the extend of urban growth as a result of population growth and unorganized urban growth.

Research Objectives

To obtain the goal of urban growth pattern identification, the study is examined with two specific objectives. At first it was to identify the most significant urban growth factors using pairwise ranking method then to identify urban growth pattern of the study area using three growth pattern indicators methods.

Research Methodology

The dynamic phenomenon of urban growth could be understood with population density profile, land use change analyses. Pairwise ranking has been used to identify the most dominant urban growth factor. Urban growth pattern is identified by Shannon's entropy, Moran and Geary coefficients methods. Required data was collected through field survey, Bangladesh Bureau of Statistics (BBS) office, and data from different organization which was analyzed by Arch GIS 10.1 and ERDAS Imaging 10.0. For identification of growth pattern secondary data is used such as population data (Ward wise), employment data, land use data and Landsat 5 & 7 satellite images.

Urbanization Process in Chittagong City

The 21st century is the century of the cities of urbanization (Hall and Pfeiffer, 2001). Urbanization as the process of transition from a rural to a more urban society is increasing rapidly and will continue during the next decades, especially in many developing countries (Rouf, 2011; UNFPA, 2007).

Figure 2 illustrated the trend of population growth of Chittagong City. Population of the city is increasing very rapidly. As rapid urban growth started to take place as increased people have created tremendous pressure on the urban utility services.
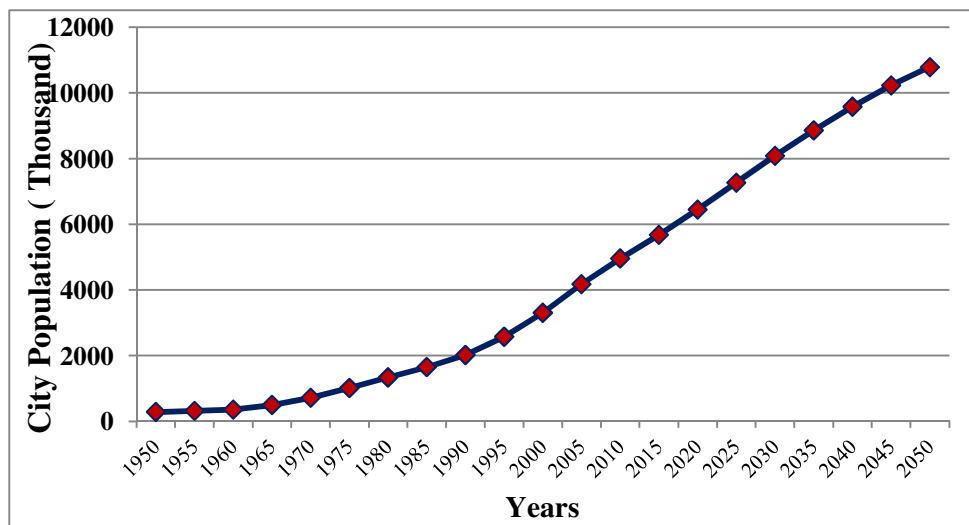
Source: World Urbanization Prospects, 2009 and Prepared by authors, 2015
Fig. 2: Trend of population growth of Chittagong City

Urbanization in Bangladesh has some spatial characteristics (Islam, 2013). Chittagong alone has nearly 30.8 % of the total urban population. The population of the Chittagong is not likely to be 107.76 million in 2050, with more than 56.4 per cent (%) being urban area.

Table 1: Percentage (%) of urban population of the total population in Chittagong

Year	Percentage (%) of Urban Population of the Total Population	Year	Percentage (%) of Urban Population of the Total Population
1950	4.3	2005	25.7
1955	4.7	2010	28.1
1960	5.1	2015	30.8
1965	6.2	2020	33.9
1970	7.6	2025	37.4
1975	9.8	2030	41
1980	14.9	2035	44.8
1985	17.5	2040	48.7
1990	19.8	2045	52.5
1995	21.7	2050	56.4
2000	23.6		

[Data source: World Urbanization Prospects, 2009 and Prepared by authors, 2015]

Density profile of CCC

 Average density in Chittagong city is 142 persons per hectare. Figure 4 illustrated population density profile. The higher is the density the lowest is the land consumption

per capita (Acioly, 1996). Beyond 3000 meter there is increased in density. This happens because planned residential areas are located beyond 3000 meter distance from CBD.
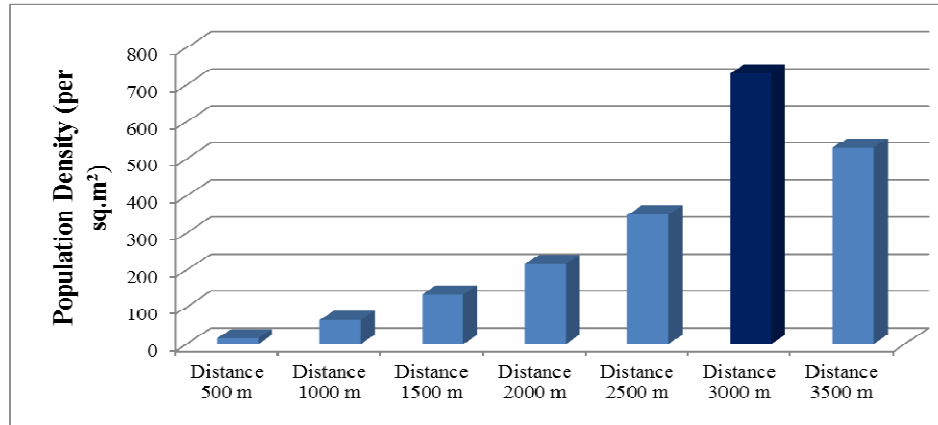
Source: Prepared by authors, 2015
Fig. 4: Population Density Profile for CBD (Agrabad)

Urban Growth Factors in Chittagong City

The causes of urban growth are quite similar and highly interlinked. There are also some of the causes that are especially responsible for urban growth. For example population growth may result in coordinated compact growth or uncoordinated sprawled growth (Bhatta, 2010).

Population Growth

The first and foremost reason of urban growth is increase in urban population (Bhatta, 2010). Beside natural population growth, expansion of the job market in Chittagong and consequent large-scale in-migration of people from rural areas percentage of Chittagong city population, in terms of total population, is also increasing gradually. If this trend continues, then the city population will reach approximately 10.8 million in 2050 (Bayes and Yiaser, 2013).

Economic Growth

Expansion of economic base (such as higher per capita income, increase in number of working persons) creates demand for new housing or more housing space for individuals (Boyce 1963; Giuliano 1989; Bhatta 2009b). Chittagong is the commercial capital of Bangladesh because of 50% of the total revenue earning of the country where Dhaka share 37% revenue (NBR, 2001). . This also encourages many developers for rapid construction of new houses. Rapid development of housing and other urban infrastructure often produces a variety of discontinuous urban developments (Bhatta, 2010). Industrialization and employment generation in Chittagong is advancing like Shanghai, china (Ashraf, 2013). More over credit and capital market also contribute urban growth. Credit and loan facility, low interest rate, etc. are also responsible for rapid urban growth in advance (Clawson, 1962; Lessinger, 1962).

Industrialisation

Industry requires providing housing facilities to its workers that increases impervious surfaces rapidly of countryside. Chittagong is the export hub of Bangladesh and it grosses more than $20 Billion from export (Yunus, 2014). Big conglomerates such as M. M. Ispahani Limited, A K Khan & Company and James Finlay etc. are located in the bank of Karnaphuli River; more over Chittagong Export Processing Zone is ranked the 3rd most competitive industrial zone in the world. The transition process from agricultural to industry is causing urban growth (Bhatta, 2010).

Transportation Development

Roads are commonly considered in modelling and forecasting urban sprawl (Cheng and Masser 2003; Yang and Lo 2003). As the population of the city began to grow extensively, the Chittagong Development Authority (CDA) has undertaken transportation master plans to ease the traffic congestion in Chittagong. Under this plan the CDA along with the Chittagong City Corporation have constructed some flyovers and expanded the existing roads within the city. Increasing transportation facilities, city become more concentrated and more urban growth happened (Harvey and Clark 1965).

Physical Geography

The Chittagong city is known for its vast hilly terrain that stretches throughout the entire district. Sometimes the city growth is caused because of unsuitable physical terrain (such as rugged terrain, wetlands, mineral lands, or water bodies, etc. (Harvey and Clark 1965; Barnes et al. 2001) but hill cutting is dominate in Chittagong city area especially low income people in Motijorna hill (chisty, 2014).

Government Developmental Policies

CDA along with the Chittagong City Corporation has taken some housing development project that may cause discontinuous development in Chittagong city.

Development and Property Tax

Generally, the costs involved in development of community-infrastructure and public services are higher in the countryside rather than the city which makes development look artificially cheap and encourages urban expansion (Brueckner and Kim 2003; Ottensmann 1977).

The most dominant urban growth factor identification

Analytic Hierarchy Process (AHP) is one of multi criteria decision making method to derive ratio scales from paired comparisons where pairwise ranking method is a structured method for ranking a small list of items in priority order. This research conducted by pairwise ranking method to identified the most dominant urban growth factor. Following table 2 give an idea about pairwise ranking among different growth factors. Here 1→8 refers high to low influence and 8→1 refers low to high preference. The preference for most priorities factor score by three authors of the study. For example, score 7 obtained by population growth and its rank is 1.

Table 2: Pair-wise ranking method to identify most important urban growth factor

	Factors	1 Population Growth	2 Economic Growth	3 Industrialization	4 Transportation Development	5 Physical Geography	6 Govt. Development Polices	7 Development and Property Tax	8 Legal Disputes	Score	Ranking
1	Population Growth		1	1	1	1	1	1	1	7	1
2	Economic Growth	1		2	2	5	6	2	2	4	4
3	Industrialization	1	2		4	5	3	3	3	3	5
4	Transportation Development	1	4	4		5	4	4	4	5	3
5	Physical Geography	1	5	5	5		5	5	5	6	2
6	Govt. Development Polices	1	2	3	3	5		6	6	2	6
7	Development and Property Tax	1	2	3	4	7	6		7	1	7
8	Legal Disputes	1	2	3	4	5	6	7		0	8

Source: Prepared by authors, 2015.

Results and Discussion

From the first objective discussion, there is easily identified the urban growth factors. Pairwise ranking mentions population growth is the main responsible factor for urban growth in Chittagong and legal dispute has less contribution on it. Holdern model also shows the physical growth in the Chittagong City from 2001 to 2011 is 51.33 % as a result of population growth and 48.46% as a result of unorganized urban growth which is related to urban sprawl and horizontal growth. From the second objective discussion, the three methods gave more or less same results. The following table 3 gave an idea about the result calculated by three growth indicators methods.

Table 3: Urban growth pattern of Chittagong in 2011

Method Name	Data used	Result	Growth Type
Shanon's Entropy	Build-up area	3.71	Occurrence of dispersed type growth development
Geary's Coefficient	Ward wise Population data	0.53	Towards urban sprawl
Moran Coefficient	Average population or employment data	1.28	Random scattering

Conclusions

Pair wise ranking among different growth factors gave an idea about what factors have most contribution for urban growth. Increased urban population is the first and foremost reason of urban growth by which the Holdern model has been shown that 51.33 % as a result of population growth. Therefore, urban growth of Chittagong city has been identified by three growth indicator methods. More or less same result shows Chittagong

city growth is dispersed type growth but towards urban sprawl. A visual observation by remote sensing approach also gave a pictorial idea of urban explanation of Chittagong city at different years. Buildup area is increasing as vegetation cover decreasing. So it is high time to manage city growth. The study will contribute to generate new knowledge for future master plan as well as detailed area plan of Chittagong city.

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