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Regional Analysis of Urban Sprawl in Bangladesh

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Abstract

Bangladesh, one of the largest countries in the world in terms of population, is characterized by rapid urbanization and growth. Alongside the remarkable rate of urban growth (in terms of population and GDP), the urban area in Bangladesh has been seen to expand horizontally, which is popularly termed as urban sprawl. Urban sprawl is the expansion of the geographic extent of cities and towns, resulting from factors including population growth and migration which have led to overcrowding, traffic congestion, added pressure on urban utilities like gas and water, larger informal sector, and unplanned slums and squatter settlements. This study explores the causes and consequences of urban sprawl and further identifies that the number of urban households, literacy rates and urban poverty relate positively to urban sprawl in Bangladesh using Census data from 1981-2011. Finally, this study identifies that urban population and population density are significant factors in explaining urban sprawl at the regional level in Chittagong, Dhaka, Khulna and Barisal divisions using a panel approach. While coefficients for urban population and literacy are positive, the sign of population density is negative, implying vertical expansion or economizing of land space in certain parts of the cities. As the availability of data remains a major drawback in the analysis of this urban problem, the approach is novel and presents further scope. It is expected that the interpretation from this research will add value to urban planners and decision makers, for policy decisions.

Introduction

Urban facilities, living standards, and other attractions make urban areas subject to constant inflow of people, especially in a developing country, like Bangladesh. Hence, the dynamism of an urban area and the prevalence of an urban sprawl make it difficult for urban planners to approach the situation from a policy perspective. By definition, an urban sprawl refers to the expansion of the geographic extent of cities and towns. Results from ongoing urban expansion are both positive and negative, and the underlying factors are complex. This study attempts to analyze the relationship between certain factors that cause urban sprawl in general, and in the context of Bangladesh using data from Population and Housing Census 2011 (Bangladesh Bureau of Statistics, BBS) and World Bank. Furthermore, the study looks at analyzing some of the factors causing urban sprawl at regional level in Chittagong, Dhaka, Khulna and Barisal divisions using panel analysis, like population and literacy.

Literature on Urban Sprawl

Urban growth is the transformation of vacant land or natural environment to residential, industrial and infrastructure development which most often happens in urban fringes (Shenghe and Sylvia, 2002). In this process, there is a shift away from agricultural production to industrial-based activities, often leading to productivity gains from

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industrial production. The definition of urban sprawl seems to be debatable according to past literature. While Frenkel and Ashkenazi (2008) establish urban sprawl to be a temporary phenomenon, Stathakis and Tsilimigkas (2014) claim the difference between urban sprawl and urban growth is that urban sprawl is a type of urban growth, which is often unplanned, and scattered. Wassmer (2008) writes urban sprawl to be a low-density development, often scattered in structure. Several studies identify outward expansion of cities to be accelerated mostly in developing countries (Knox, 1995 and Myllyla, 2001).

Over the years, researchers have used different techniques to account for urban sprawl. Galster et al. (2001) developed a complex index characterized by density, continuity, concentration, clustering, centrality, nuclearity, mixed use, and proximity. Popular choices of measuring sprawl include density, land use and land area. For the purpose of this study, land area will be used. Fulton et al. (2001) found in a study of every U.S. metropolitan area that if land is consumed at a faster rate than population growth, sprawl is likely to increase. The report also identifies public water and sewer systems, and large immigrant populations to be a major cause of urban sprawl in the United States.

A number of analytical and statistical urban models have been developed based on theory, where some models explain urban growth patterns and others predict future urban growth. When trying to understand the spatial consequences of urban growth, dynamic modelling approach is more popular (Rafiee et al., 2008). Geographic information science has also evolved spatial modelling approaches.

Early models of the monocentric city showed a distinct central business district (CBD) surrounded by residential land (O'Sullivan, 2002). Decentralization of economic activities, transportation systems and the advancement of technology played a significant role in the demise of many monocentric cities. Muller (1981) introduced the concept of multi-centered metropolis where suburbs had become self-sufficient in terms of economic activities, employment, and educational services.

To understand growth dynamics in Dhaka, Pramanik and Stathakis (2016) used a self-modifying cellular automata Slope, Land use, Exclusion, Urban extension, Transportation and Hillshade (SLEUTH) model with the help of satellite images from 1989 to 2014. The results propose an additional 20 percent of the metropolitan area to be converted into built-up land by 2030 and the trend of sprawl to prevail in the north and north-west directions of the city.

Most studies find sprawl to be a process which should be abridged, as the development is most often a problem (Torrens, 2008). However, there remains a gap in literature as to analyzing the impact of urban sprawl, and determining whether the process can be termed as positive or negative. There is little empirical evidence to justify the impact of urban sprawl and most research tends to state the opinions of the researcher in this context.

Brueckner and Fansler (1983) provide significant evidence that population, agricultural land value per acre, average household income, and two different variables for transportation cost in the urbanized areas account for most urban sprawl, where all variables except transportation cost were significant. Song and Zenou (2006) used GIS methods for several counties and found that higher property taxes result in smaller cities.

Increased property tax rates indicate a higher cost for housing leading to decreased home sizes, and increased population density, and a reduction in urban sprawl. While this study on Bangladesh and its four regions, called divisions has similar objectives, the number of independent variables is limited due to the absence of data.

Causes and Consequences of Urban Sprawl

This section features a brief discussion of the causes and consequences of urban sprawl based on literature review and empirical observations on Bangladesh.

Causes

Mills and Lubuele (1991) present an idea that people have moved away from city centers because of all the social problems involved leading to expansion in the fringes. The most common causes of urban sprawl include population growth, rural-urban migration, the rise/lack of household income, underpricing of infrastructure and more. A common characteristic of most developing countries like Bangladesh is rapid population growth, which continuously exerts pressure on urban housing and urban facilities causing either vertical (taller buildings) or horizontal (sprawl) expansion. High birth rates also call for greater investment in healthcare and educational facilities and boost overall economic consumption.

Disparities in opportunity (employment), attractiveness of urban services (healthcare, education, etc.), and natural disasters are few of the causes for rural-urban migration. Regular influx of people to the cities like Dhaka also creates pressure on the urban area. While many flock to cities in hopes of higher earnings, few succeed leaving others no hope but the urban informal sector. In an already densely populated city, inflow of migrants, mainly the urban poor, require low-cost settlements, and these low-cost settlements are usually unplanned, unhealthy, lack proper safety standards and are located near the urban fringes.

While some people in developed countries prefer to occupy larger sized lot spaces near the outskirts of town, the urban poor in developing countries can only afford small housing units in fringe areas. Hence, while lot spaces further away from city centers may be more attractive and expensive in developed countries, spaces further away from city centers in developing countries are usually less costly and the last hope for many. These expansions in urban fringes may also be due to the underpricing of certain fringe services and because of easier land acquisition due to the absence of proper planning and monitoring.

Consequences

The consequences of urban sprawl are large in number. Land encroachment due to illegal occupancy, unplanned settlements, and land filling, can be grouped as unhealthy practices that threaten the natural landscape and lead to a loss of agricultural capacity. Soil-sealing results in fragmentation or loss of natural habitats and unplanned squatter settlements near waterbodies leads to water pollution, loss of biodiversity, and a rise in water-born diseases, all of which are severe causes of concern hindering economic prosperity.

With most of the expansion happening without proper provision and guidelines, these unplanned settlements pose safety concerns, placing a large population in vulnerable

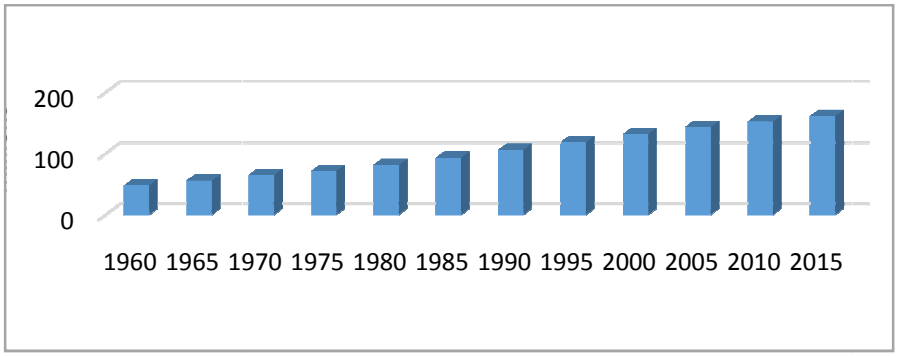
living conditions. These settlements also exert pressure on the demand for urban utilities such as gas, water, electricity, sanitation, transportation, solid waste management and much more.

Rising levels of urban sprawl would also require increased provision of infrastructure and transportation to meet the daily demands of the population. Inefficient transportation system, security concerns, and lack of urban services has discouraged many of the affluent from settling in outer parts of the cities. Large Investments in roads and flyovers to ease intercity connections would need to become a priority to develop a well-managed sprawl, and transportation projects like the Metro-Rail and Bus Rapid Transit would be crucial alongside investments in security, education and healthcare. Inefficient transportation system has been an important reason of discouraging the affluent section of our society to dwell in outer part of the major cities in Bangladesh.

Until now, the main causes of urban sprawl in Bangladesh include rural-urban migration, (due to better job opportunities, urban services like healthcare and education, urban recreation such as shopping and entertainment, landlessness or homelessness from natural calamities), high population growth rate, lower land prices in urban fringe areas, lack of monitoring and regulation and more. All of these add to the expansion of the urban boundary, leading to overcrowding, traffic congestion, below-standard living, and a larger informal sector. Ultimately these consequences add pressure on urban utilities like gas and water, placing those living in unplanned slums and squatter settlements in concerning conditions. While it could be argued that urban sprawl is facilitator of economic growth through induced economic activity, its potential to benefit is heavily reliant on proper regulation and planning. Expansions in the urban fringes could generate more employment opportunities, stimulating potential growth to Bangladesh's Gross Domestic Product (GDP).

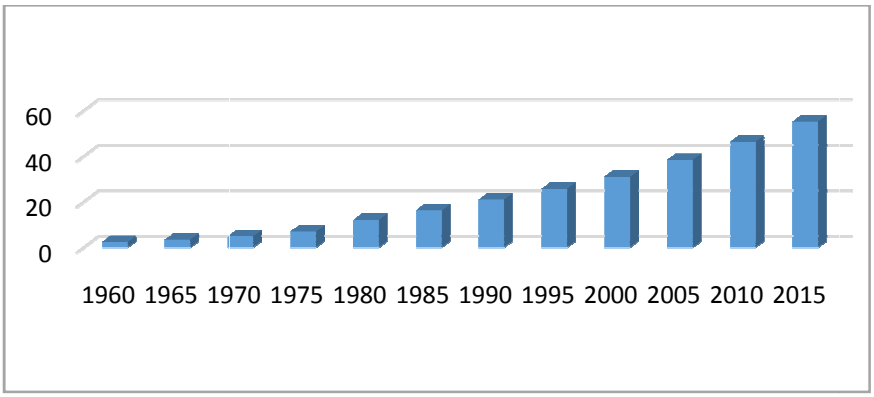
Urban Population Distribution in Bangladesh

Being among the Worlds' most populated countries, Bangladesh is also home to some of the most populated cities in the World. Since 1960, the population of Bangladesh has more than tripled (Figure 1) and the urban population has grown at an even more astonishing rate from approximately 2.5 million in 1960 to 57 million in 2016 (Figure 2).



Source: World Bank (Based on United Nations Population Divisions World Urbanization Prospects)

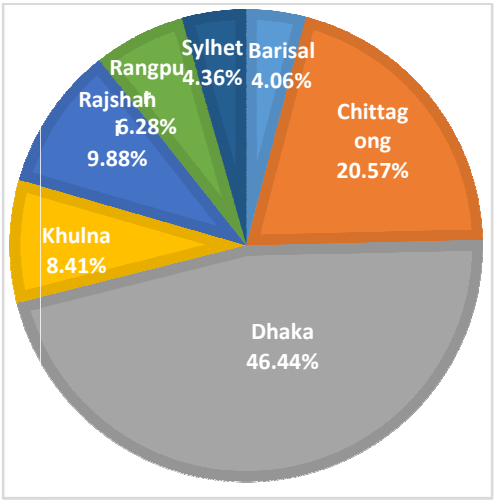
Figure 1: Population of Bangladesh (1960-2015)



Source: World Bank (Based on United Nations Population Divisions, World Urbanization Prospects)

Figure 2: Urban Population of Bangladesh (1960-2015)

Figure 3 depicts the division-wise share of urban population in 2011. A report on the level of urbanization reveals that Dhaka Division is ranked the highest in all censuses for the level of urbanization, while Sylhet Division is ranked the lowest (BBS, 2014). Chittagong, the export hub of Bangladesh, follows Dhaka in holding the second largest share of urban population. The regional distribution of population in Bangladesh is influenced by its geographic conditions and economic opportunities. For example, the mix of plains, haors and hills limit growth of economic activities and population in certain areas in Sylhet Division, while the huge potential of economic growth in Dhaka and Chittagong attract population concentration.



Source: Population and Housing Census 2011, BBS

Figure 3: Division-wise share of Urban Population, 2011

Dhaka, the capital of Bangladesh, is expected to be one of the five largest cities of the world by 2025 and its population and urban growth in recent decades is one of the

highest in the world (Pramanik and Stathakis, 2016). As Dhaka attracts a significant amount of rural–urban migrants from all over the country in hopes of better job opportunities, better educational and health services (Islam, 1999), prevalence of unplanned urbanization, urban poverty, growth of urban slums are seen to be critical urban problems that require serious governmental policy attention and practical actions (World Bank, 2007).

While expansion in area of a city can be the reason for population growth, the opposite may hold true as well. According to BBS Census, total urban land area of Bangladesh doubled from 1981 to 2001. However, urban land area is seen to have declined in the 2011 Census report, mainly due to definitional changes of urban area. The definition of urban area (used from1981 to 2001) included city corporations, municipalities, upazila headquarters, growth centers, cantonment and urban agglomerations adjacent to large cities, also known as Statistical Metropolitan Area (SMA). However, in 2011, urban areas covered only city corporations, paurashavas, upazila headquarters and cantonment area. During the period of 2001 to 2011, only two divisions, namely Sylhet and Barisal have experienced a rise in total urban area (Table 1) despite definitional changes. Table 1 provides a summary of basic statistics of the urban areas in Bangladesh.

Table 1: Division-wise summary of urban population statistics

Aspects/Divisions	**2011**	**2001**	**1991**	**1981**
Urban Area in sq. km.				
Bangladesh	**8867.42**	**10711.89**	**9577**	**5230**
Barisal	665.69	630.82	-	-
Chittagong	2462.29	3251.63	-	-
Dhaka	2093.47	2998.6	-	-
Khulna	1104.36	1261.8	-	-
Rajshahi	1193.04	1253.98	-	-
Rangpur	872.92	897.3	-	-
Sylhet	475.65	417.76	-	-
Urban Population				
Bangladesh	**33563183**	**29255627**	**20872204**	**13227625**
Barisal	1361943	1162775	935352	730086
Chittagong	6905480	6022650	4245656	2993885
Dhaka	15584835	13364520	9137817	5383271
Khulna	2822121	3041699	2323789	1737369
Rajshahi	3317022	2808131	2092354	1179105
Rangpur	2109071	1868314	1455447	1019187
Sylhet	1462711	987538	681789	493060
Urban Households	**7502040**	**6035144**	**3789338**	**2254213**
In-migration Rate to Dhaka (%)	**2.49**	**2.13**	**5.54**	**7.62**
Urban Literacy Rate (all ages)	**59.4**	**51.7**	**40.3**	**34.8**

Source: Population and Housing Census 2011, BBS

In the process of rapid urbanization in cities, like Dhaka and Chittagong, many physical attributes of urban areas have been adversely affected due to inadequate planning interventions. Open spaces, parks, water bodies have been transformed to built-up land to accommodate housing facilities and economic activity, and continuous rural-urban inflow has amplified traffic congestions, unplanned settlements, water logging and pollution. Irrespective of the definitional changes in urban area, there is visible expansion along the urban fringes in cities like Dhaka, and it is critical to deduce the factors causing these expansions in order to implement meaningful policies.

Data and Methodology

Apart from analyzing past literature, and identifying the causes and consequences of urban sprawl, this study goes further to identify how factors relate to expansion of urban area in Bangladesh. The first part of the analysis looks at correlation between urban area (in sq. km.) and number of urban households, literacy rates for all ages, urban poverty rate, for the years 1981, 1991, 2001 and 2011. Data for urban area, number of urban households and literacy rates are taken from Bangladesh Bureau of Statistics (BBS) Census report, while data for urban poverty is taken from World Bank database.

The second part of the analysis looks into three factors of urban sprawl in Chittagong, Dhaka, Khulna and Barisal Divisions by applying fixed effect panel estimation. Panel estimation uses both cross-sectional and time-series data, and fixed effects estimation accounts for individual characteristics of the divisions that may impact the predictor or outcome variable. Data for urban population (in millions) and population density (per sq. km.) were taken from the Population and Housing Census, BBS and data for literacy rates (%) were taken from District Statistics (BBS, 2011).

Findings

Simple correlation analysis between Urban Area and three other variables are presented in Table 2. These correlation coefficients suggest that the number of urban households, literacy rates and urban poverty exhibit moderately positive correlation to urban area. Number of urban households shows the strongest positive correlation with urban area among the three. However, the causal relationship or the direction of the causal relationship cannot be deduced from correlation analysis.

Table 2: Correlation with Urban Area

Variable	Correlation Coefficient
Number of Urban Households	0.660649
Literacy	0.607457
Urban Poverty	0.535034

Using fixed effect panel analysis for Chittagong, Dhaka, Khulna and Barisal Divisions, it is seen that urban population and literacy rates have a positive impact on urban area, while population density has a negative impact (Table 3). Data for urban population (in millions) and population density (per sq. km.) were taken from the Population and Housing Census, BBS and data for literacy rates (%) were taken from District Statistics, BBS.

Table 3: Results from Division-Wise Panel Analysis

Variables	
Urban Population	2.225686 (.8170344)*
Population Density	-.0051325 (.0016388)*
Literacy	.0975292 (.0610059)

Note: Standard errors are in parenthesis; *significant at 10%

Results indicate that urban population is a significant cause of urban sprawl among these four divisions. As more and more housing is required to accommodate the rising urban population, expansion near the fringes is inevitable. Production, consumption and other economic activities are also likely to increase from higher urban population, which also means more space is required to carry out such activities. Hence, the expansion of industrial production and emergence of factories near urban boundaries are results from increased demand from the growing population in urban areas, mostly because of rural-urban migration. Literacy rates, although insignificant, add to urban sprawl as better education is one of the causes that attract rural-urban migrants. Evidence shows that rural-urban migrants tend to consist of a lower income group, which seek lower living costs that are available in urban fringes. Population density is seen to have a negative association, meaning population growth is increasing without much expansion in the urban boundaries. This could be a result of vertical expansion as opposed to horizontal expansion, or economizing of land space occupancy of households, possibly due to increasing land rent.

Limitations

The most significant limitation of this study is the absence of available data and more precisely, data availability at the divisional level. Census data is available mostly for 1981, 1991, 2001, and 2011, leaving huge gaps in the dataset. Both time series and panel analysis becomes difficult and yearly data is required to present more accurate findings. While Census data is available for major urban indicators like urban population and urban literacy, the sample size taken for each census report has varied throughout the decades. Definitional changes also break continuity in the meaningfulness of the data. Finally, several other factors that have been previously identified by scholars as potential explanatory variables could not be included in this study, due to lack or absence of data.

Conclusion

Positive economic progression of Bangladesh over the past few decades will continue only if problems like urban sprawl can be controlled. For that to happen, a sound policy framework alongside proper monitoring and controlling authorities is essential. Being one of the largest countries in the world in terms of population and population density, Bangladesh is bound to face certain problems of urbanization. However, land-filling, filling of water bodies, slums and squatter settlements, unauthorized settlements, may

add to the problem. Urban sprawl in major cities of Bangladesh is evident and results from factors including population growth and migration, which have led to pollution, traffic congestion, power outages, larger informal sector, and unplanned slums and squatter settlements. This study identified urban population and population density as significant factors in explaining urban sprawl at the regional level in Chittagong, Dhaka, Khulna and Barisal divisions using a panel approach. It is expected that these results will prompt urban planners and decision makers to make sound policy decisions. Policies need to be directed towards controlling population growth, may be through family planning campaigns or limiting rural-urban migration, as well as controlling the population density of urban areas possibly through institutional decentralization and housing programs at the regional level with proper land use planning.

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