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Growing Residential Built Density of Dhaka City – Causes, Consequences and Solutions: A Case Study on Mirpur Section 2 and Kazipara

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Abstract

Dhaka, the capital of Bangladesh is experiencing a dramatic transformation in residential built density due to the concentration of administrative, institutional, commercial, social, recreational, small-scale industries, and their associated housing facilities. Such transformation is visible in residential built footprint, originated from low rise and low density to high density and high rise developments. This study is an attempt to explore the phenomenon of growing residential built density in a planned area, namely, Section 2 and in an unplanned area, namely, Kazipara in Mirpur Thana of Dhaka. Here the residential density has been measured according to the basic theories of density which is expressed as a number of dwelling units per acre of land in case of both gross and net density. Moreover, for better understanding and visual effect, sky view factor (SVF) is used here as a parameter of built density. For this study a detailed physical survey of the study areas was conducted. To identify the causes and consequences of the growing built density, five factors i.e. demographic, social, economic, physical (urban planning related) and environmental are considered. The study focused particularly on the residential built density, its causes and consequences in a local scale. It is revealed from the study that residential built density in city scale differs substantially from local scale.

Introduction

Density plays an important role in shaping cities and functioning of cities. On the other hand, 'built density', the intensity of space taken up by the physical structure that makes up the urban environment is a relative term used to describe development. It is usually expressed as a ratio of dwelling units to land area. The measurement of built density is a step of planning process of residential areas. By measuring built density, it is possible to understand the existing condition of roads, buildings, dwellings, land uses, etc. Moreover, the difference of gross and net residential density helps to measure the scope of the future development or expansion of the existing area.

According to United Nations' (UN) report titled "World Urbanization Prospects: The 2014 Revision", Dhaka is the eleventh most populous city in the world with a current population of 1.7 crore and would become the 6th most crowded city by 2030 with a

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population of over 2.7 crore (UN, 2015). Present population density of megacity Dhaka is approximately 8573 persons per sq. km. and the growth rate of Dhaka city is 5% per annum (BBS, 2011). The total built up area in Dhaka city is 165.63 sq. km and the built up density is 55,530 people per sq. km. (UN HABITAT Urban Planning Discussion, 2010). There are two key reasons why Dhaka needs to look at its increasing residential built up density. The first reason is, "affordability" – simply put, Dhaka cannot afford to assume responsibility for any more new roads, pipes or other pieces of infrastructure and must consider ways to deal with the significant infrastructure deficit it has. Even if new development needed existing development pattern can't afford it. The second one is "environmental sustainability"- to gain the environment sustainability development, re-development and existing situation should be environment friendly. The built density measurement with microclimatic analysis can be effective to measure the planning needs. Dhaka is experiencing a dramatic transformation in residential built density due to demographic changes during the past two decades due to the concentration of social, administrative, institutional, recreational, small-scale industries, and associated housing facilities. The transformation is visible in residential built footprint, significantly due to the demand-driven and density-led market, originated from low rise and low density and transforming to high density high rise (Zaman, 2013).Due to rapid urbanization and higher population growth rate immense pressure on housing sector and associated facilities in Dhaka city is increasing day by day. The city is experiencing an increase in the rate of housing development as well as high residential built density. The built up area is increasing very rapidly in the city (Hasan, 2011). For this reason the dwellers are facing some problems in their living environment (Harun, 2013).

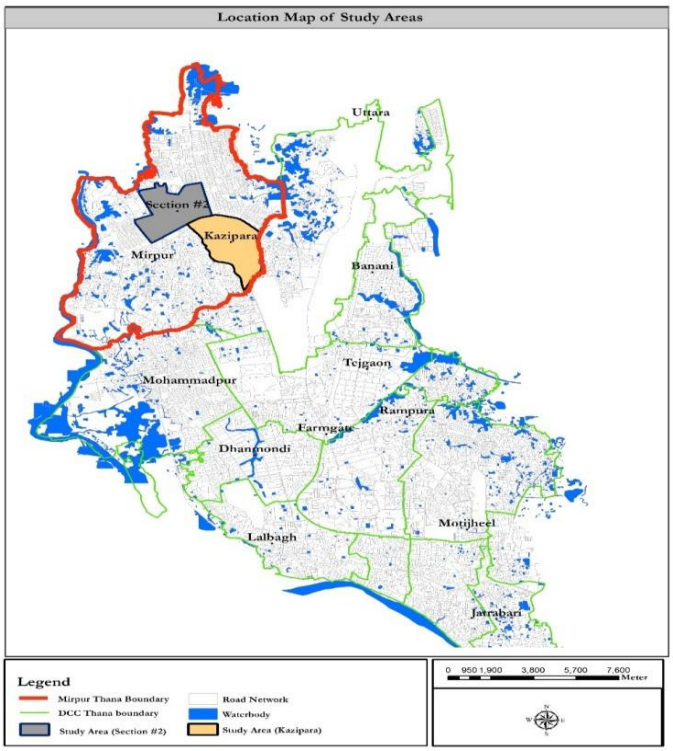
Considering the above circumstances, this study tries to undertake an in-depth study of residential built density in a planned area namely, Mirpur Section 2 and in an unplanned area namely, Kazipara of Dhaka city. To fulfill the aim of this research, the actual scenario of residential built density are depicted through measuring the residential built density and finding out the inherent causes and consequences of growing built density in the study area. Moreover, the estimation of residential built density of this study area can help to understand the existing condition and planning needs in the residential areas of Dhaka city.

Objectives and Methodology of the Study

This study aims to measure the built density of the study areas in order to understand the overall condition of growing built density in the residential areas of Dhaka city. It also tries to identify the causes and consequences of growing residential built density in the study areas. Finally this study attempts to recommend some specific guidelines regarding built density to ensure sustainable growth of the study areas as well as other areas of Dhaka city.

Mirpur Section 2 and Kazipara are chosen as study areas, which are located in the Mirpur Thana of Dhaka North City Corporation (DNCC) respectively in the planned and unplanned residential areas of Dhaka City (Figure 1). These areas were developed in the early eighties by the Housing and Settlement Directorate and National Housing Authority of Bangladesh to provide residential accommodation for lower and middle income groups of population in Dhaka City. Section 2 residential area is accommodating

58082 population and is mainly divided into ten blocks namely Block A, B, C, D, E, F, G, G1, H and CHA with 1978 plots (Aktar and Sikder, 2013). On the other hand, Kazipara residential area is accommodating 53669 population and is mainly divided into two parts namely, East and West Kazipara with 1962 plots (Saifuddin, 2011).



Source: Modified by the Authors from DNCC 2015

Figure 1: Location of the Study Areas in Dhaka City

This study is mainly based on primary information and empirical field level observation. In this study, physical observation survey was conducted to determine the existing scenario and to measure the built density. Here, the residential density was measured according to the basic theories of density which is expressed as a number of dwelling units per acre of land in case of both gross and net density by using ArcGIS 10.3. Moreover, for better understanding and visual effect sky view factor was used here as a parameter of built density. SVF was calculated at 5 points on the local roads of the respective study areas. A well-designed questionnaire survey was also conducted to find out the causes and consequences of growing residential built density in the study areas. For this purpose, firstly the respective study areas were divided into ten blocks (clusters) with help of cluster sampling method. Then a questionnaire survey was conducted in the randomly selected 15 households from each block (cluster) in the respective study areas. The total number of sample for this study was 300.

Residential Built Density: Some Important Concepts

Residential Built Density

Residential built density can be defined as the concentration of built-up structures in a residential area, amount of floor space available for occupation in a development expressed in the residential area of land on which it is built, the number of habitations per acre, plot ratio and other terms. According to Gardner (2011), "Built Density" is not simply a function of the height of buildings, however, but also depends upon the area that they occupy. A city in which buildings occupy a relatively small proportion of the total city area will have room to grow either vertically or horizontally (the latter of these represented by the process of street narrowing, or other forms of infill). According to Gordon (2008), "Built Density" is an intuitively simple concept, representing both the intensity with which an area is used or occupied and how limited the available local space is for an average resident.

Built Density Measurement

Built density of the study areas of Mirpur, Dhaka city is calculated by using the data of area, occupancy of the building, number of dwellings in the building etc. with the formula given by the Design Center for American Urban Landscape and Residential Density Guide of New South Wales (Australia):

Gross Residential Density (GRD) is the measure of housing density grossly. It can be calculated as:

GRD = Number of Dwelling or Lots ÷ Total Site Area (Acre)

Net Residential Density (NRD) is a measure of housing density expressed as dwellings or lots per acre and can be calculated as:

NRD = Number of Dwellings or Lots ÷ Developable Land (Acre)

Sky View Factor (SVF): Sky-View-Factor (SVF) is a parameter which can represent "Built Density" more accurately. According to Hong Kong Planning Department, SVF is, a geometric ratio that expresses the fraction of the visible sky at the observer's location. The SVF indicates the relationship between the visible area of the sky and the area covered by urban structures.

Sky View Factor Measurement: SVF uses the isoaire spherical projection (bottom-up) to evaluate the ratio of the visible sky area to the total area of the reference half sphere centered at the view point (observer). In this study 'Town Scope 3.2' software has been used to calculate SVF.

Findings of the Study

Built Density Measurement of the Study Areas: Table 2 shows the information on built density of Mirpur Section 2 and Kazipara. From the table, it is observed that the gross residential density in Section 2 is 83 Dwelling Units/Acre, whereas it is 108 Dwelling Units/Acre in Kazipara. On the other hand, in Section 2 the net residential density is 136 Dwelling Units/Acre, where it is 212 Dwelling Units/Acre in Kazipara.

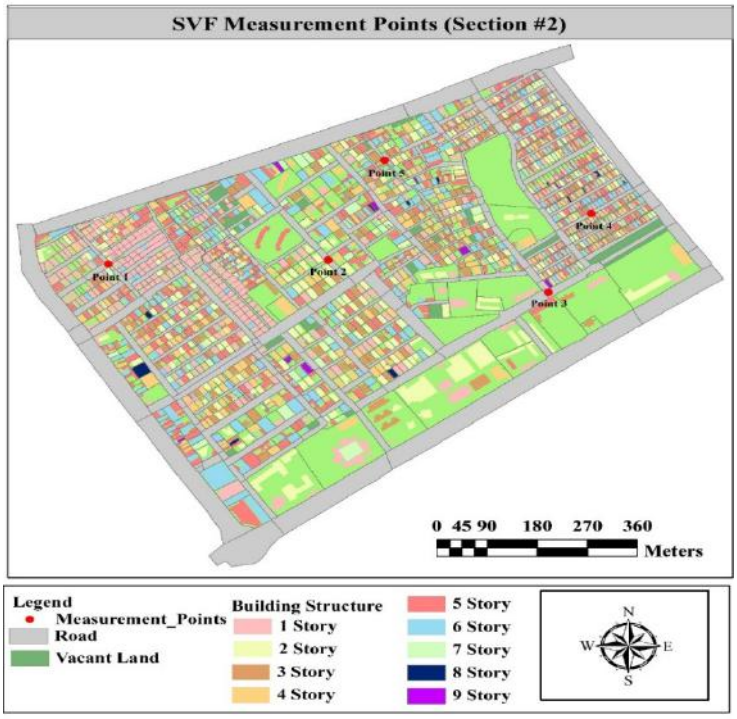
Table 2: Built Density Measurement of the Study Areas

	Section #2	Kazipara
Total Area	175.48 Acre	126.02 Acre
No. of Dwellings	14564	13610
No. of Buildings	2756	2732
Buildings Area	68.39 Acre	61.82 Acre
Developable Land	107.09 Acre	64.20 Acre
Gross Residential Density	83 Dwelling Units/Acre	108 Dwelling Units/Acre
Net Residential Density	136 Dwelling Units/Acre	212 Dwelling Units/Acre

Source: Prepared by the Authors, 2016 with help of Field Survey, 2015

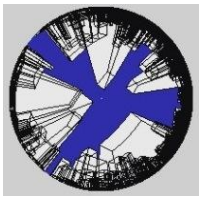
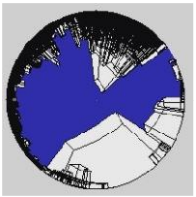
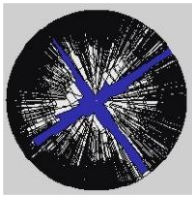
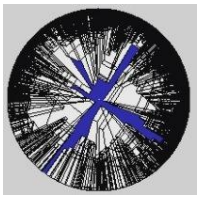
Sky View Factor (SVF) of the Study Areas

Sky View Factor (SVF) of Section 2: In the Section 2 residential area of Mirpur there selected 5 points randomly on the roads of the study area for measuring or calculating sky view factor. The selected 5 points for measuring SVF of Section 2 are shown in Figure 2. Among the points, the highest value is 43.0% at point 3 and the lowest value is 8.6% at point 5. The average sky view factor is 24.84%. The fish eye views and the values of SVF at 5 points of the Section 2 area are shown in Figure 3.



Source: Developed by the Authors, 2016 with help of DNCC, 2015 and Field Survey, 2015

Figure 2: Selected Points for SVF Measurement of Section 2

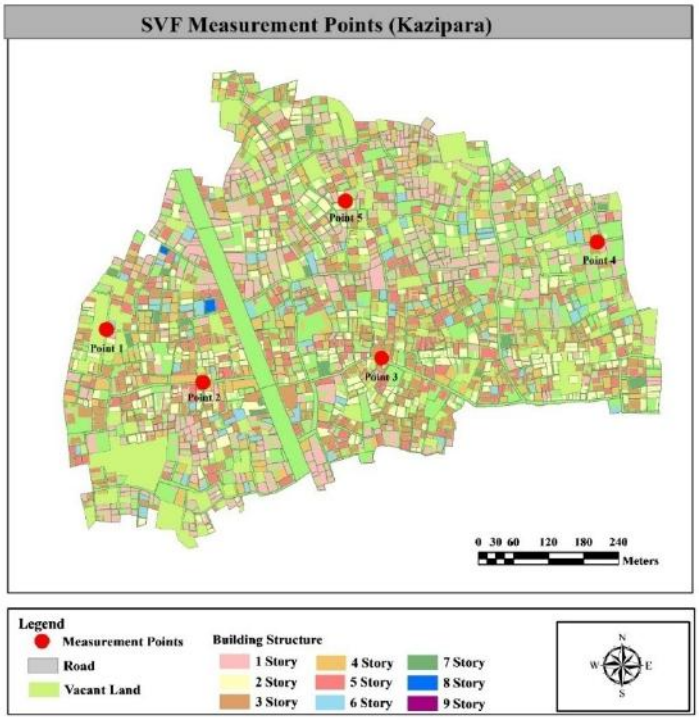
				
Point 1, 26.5%	Point 2, 34.3%	Point 3, 43.0%	Point 4, 11.8%	Point 5, 8.6%

Source: Calculation Output of Sky View Factor in Town Scope Software

Figure 3: Fish Eye Lens View Showing SVF of Section 2

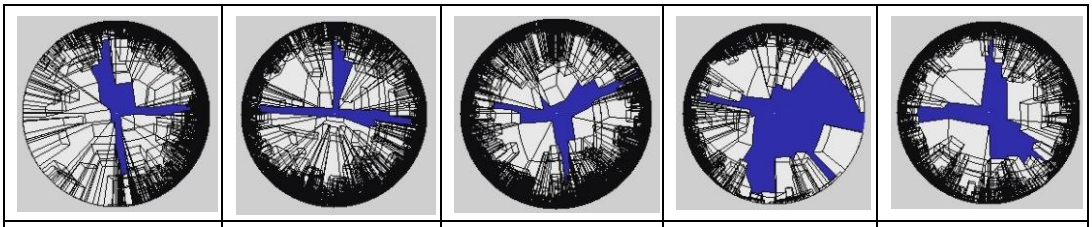
Sky View Factor (SVF) of Kazipara

In the Kazipara residential area of Mirpur, there are selected 5 points chosen randomly on the roads of the study area for measuring or calculating sky view factor. The selected 5 points for measuring SVF of Kazipara are shown in Figure 4. Among the points the highest value is 32.0% at point 4 and the lowest value is 7.8% at point 2. The average sky view factor is 14.56%. The fish eye views and the values of SVF at 5 points of the Kazipara area are shown in Figure 5.



Source: Developed by the Authors, 2016 with help of DNCC, 2015 and Field Survey, 2015

Figure 4: Selected Points for SVF Measurement of Kazipara



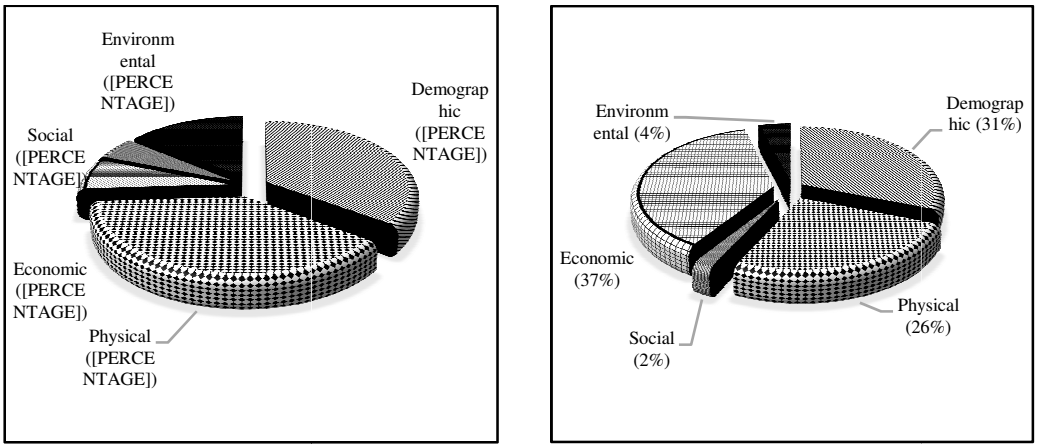
Point 1, 8.9%	Point 2, 7.8%	Point 3, 9.1%	Point 4, 32.0%	Point 5, 15%

Source: Calculation Output of Sky View Factor in Town Scope Software

Figure 5: Fish Eye Lens View Showing SVF of Kazipara

Causes of Growing Built Density in the Study Areas

The built density of both the study areas is increasing due to various factors. Figure 6 shows the residents' opinion (in percentages) about the factors responsible for growing built density in Section 2 and Kazipara study areas of Mirpur. Accordingly in case of Section 2 the physical and demographic factors are mostly significant and in case of Kazipara economic and demographic are mostly significant.



a) Section 2 b) Kazipara

Source: Field Survey, 2015

Figure 6: Factors of Growing Built Density in Section 2 and Kazipara

Table 3 shows the residents' percentages of the influencing factors that induce to the growth of built density in both the study areas. Accordingly physical factors like educational institutes, proximity of facilities, accessibility are highly influential factors of growing built density in Section 2, whereas economic factors like job or working place, land value, house rent are highly influential factors of growing built density in Kazipara. However, migration from inside Dhaka is significant for Section 2 and migration from outside Dhaka is significant for Kazipara as part of the demographic factor. Most importantly, social factors like safety, privacy and environmental factors like clean

environment, open space are insignificant factors for growing built density of both the study areas.

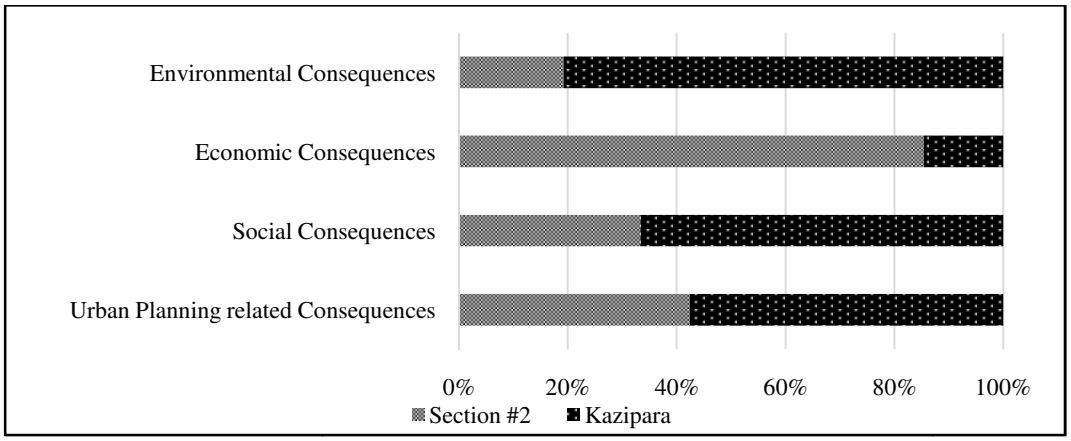
Table 3: Influencing Factors Responsible for Growing Built Density in the Study Areas

Factor	Resident's Opinion (%)	
	Section 2	Kazipara
Demographic Factor		
Migration (From Inside of Dhaka)	23	14
Migration (From Outside of Dhaka)	12	17
Physical Factor		
Utility Services Availability	3	-
Educational Institutes	13	14
Proximity of Facilities	9	8
Accessibility	14	4
Social Factor		
Social Interaction	2	2
Safety & Privacy	5	-
Economic Factor		
Job/Working Place/ Business	1	18
Land Value	1	2
House Rent	3	17
Environmental Factor		
Clean Environment	6	-
Open Space	3	-
Quality of Housing	5	4
Total	100	100

Source: Field Survey, 2015

Consequences of Growing Built Density in the Study Area

Without careful planning, growing building density patterns can be associated with several consequences. The growing of residential built density is creating some serious consequences in the study areas. Figure 7 describes the major consequences of growing built density in the study areas. Accordingly both the residents of Section 2 (39%) and Kazipara (53%) mentioned that the growing of built density is bringing urban planning related consequences significantly. Moreover the economic consequences are also relatively high in case of Section 2, whereas in case of Kazipara environmental consequences are also relative high.

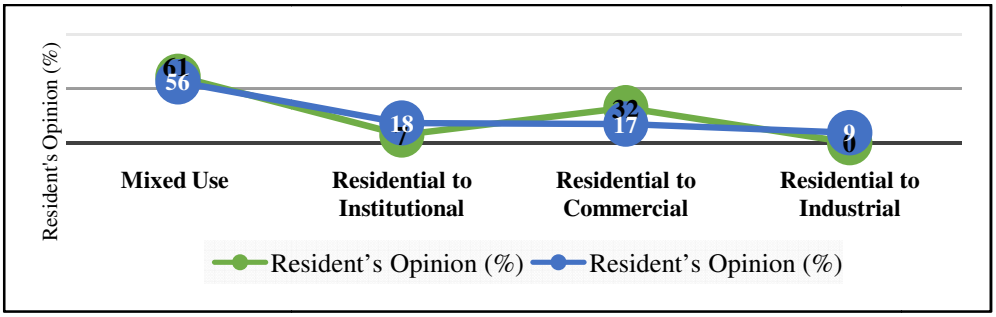


Source: Field Survey, 2015

Figure 7: Major Consequences of Growing Built Density in the Study Areas

Urban Planning Related Consequences

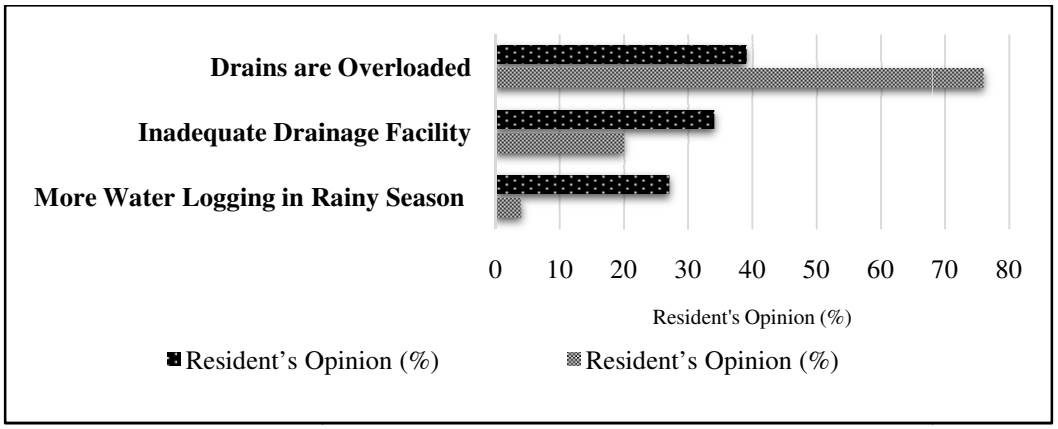
Transformation of Building Use: The growing of built density in any residential area brings some consequences in the building uses and prompts the transformation of building uses. Figure 8 describes the resident's opinion about the transformation of building use due to growing built density in the study areas. Both the residents of Section 2 (61%) and Kazipara (56%) mentioned that the transformation of building use is mostly mixed use transformation along with residential to commercial, residential to institutional and residential to industrial.



Source: Field Survey, 2015

Figure 8: Transformation of Building Use in the Study Areas

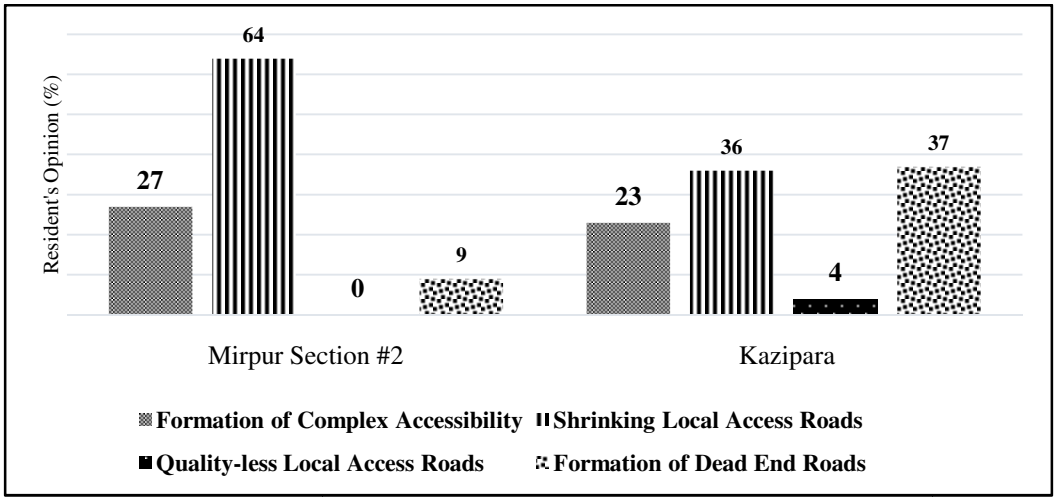
Changes Occurring in Drainage Situation: The growing built density in residential areas increases the built up areas and increases the growth of dwellers within the residential area. As a result some serious consequences in drainage situation are observed. The changes occurring in drainage situation and their opinion percentages from the respondents of study areas are shown in Figure 9. Majority of the respondents of both the study areas mentioned that drains are overloaded due to growing built density. However the drainage problems due to inadequate drainage facility, more water logging in rainy season are much more severe in Kazipara.



Source: Field Survey, 2015

Figure 9: Drainage Situation in the Study Areas

Changes Occurring in Accessibility of Buildings: The growing of built density in residential areas without careful planning creates some serious complications in the accessibility of the residential areas. Figure 10 shows the resident's opinion about the change occurring in accessibility of buildings due to growing built density in the study areas of Mirpur. Majority of the respondents of both the study areas mentioned about shrinking of local access roads. The other noticeable problems in accessibility of buildings in the study areas are formation of complex accessibility, formation of dead end roads, etc.

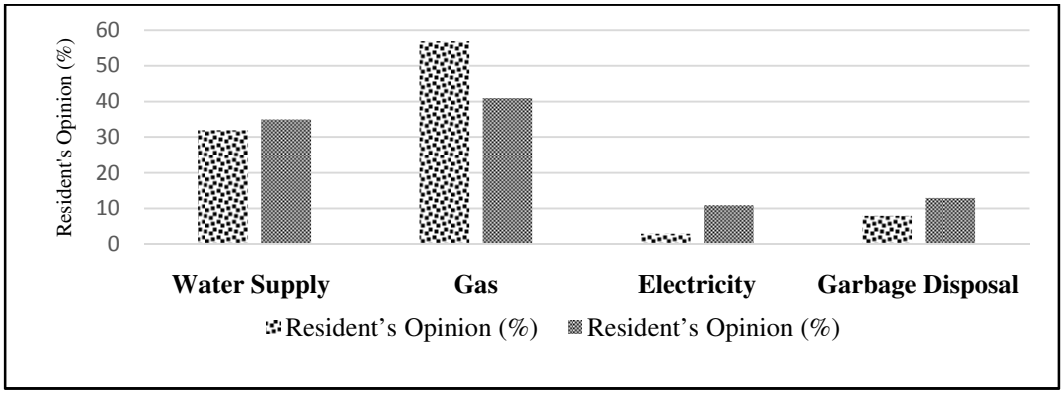


Source: Field Survey, 2015

Figure 10: Accessibility of Buildings in the Study Areas

Problems Related to Utility Services: The growing of built density in residential areas induces the growth of population within the particular residential area. As a result the demands for utility services increase and the pressure on using the utility services

gradually upsurges. Then problems may arise in utility service provisions. Figure 11 describes the residents opinion about the problems related to utility services resulting due to the growing of built density. Accordingly, majority of the respondents of both the study areas mentioned that problems in gas and water supply are much severe along with garbage disposal problem due to the growing of built density.



Source: Field Survey, 2015

Figure 11: Problems in Utility Services in Study Areas

Environmental Consequences

Pollution Related Health Problems: The process of growing built density in residential areas induces or increases the growth of population within the particular residential area. As a result some pollution related health problems are suffered by the residential dwellers. However in case of Kazipara, among the total respondents 27% and in case of Section 2, 7% mentioned that, they are facing pollution related health problems like-asthma, respiratory illness, cardio vascular illness, etc. due to inadequate access of sunlight, crowded buildings and lack of ventilation resulting from the growing of built density.

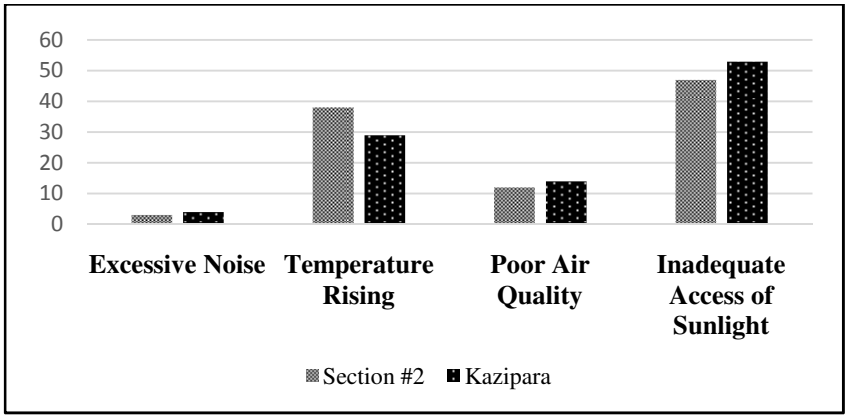
Problems in Microclimate: The growing of built density in residential areas without careful planning and in haphazard way can create some problems in the microclimate of the residential dwellers. Figure 12 shows the resident's opinion about the problems in microclimate of dwellers of study areas. In the case of both the study areas Kazipara and Section 2, majority of the respondents mentioned about inadequate access of sunlight and temperature rising problems due to the growing of built density.

Social Consequences

Occurrences of Criminal Activities: The growing of built density without careful planning increases the growth of population within the particular residential area. As a result some occurrences of criminal activities are confronted by the residential dwellers. However in case of Kazipara, 61% and in case of Section 2, 23% of the total respondents mentioned that, the growing built density is causing the increase of criminal activities like theft and robbery due to overcrowding of people and buildings.

Hampering of Safety and Privacy: The growing built density of the study areas hampers the safety and privacy of residential dwellers. As in the case of Kazipara, majority of the

respondents that is 93% and in the case of Section 2, 46% mentioned that the growing built density is hampering their safety and privacy condition due to overcrowding of buildings and lack of adequate space between buildings.

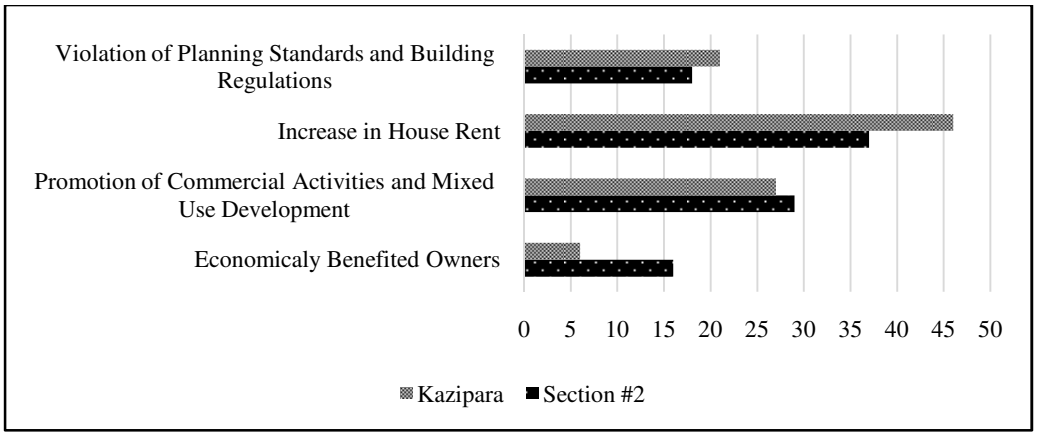


Source: Field Survey, 2015

Figure 12: Problems in Microclimate in the Study Areas

Economic Consequences

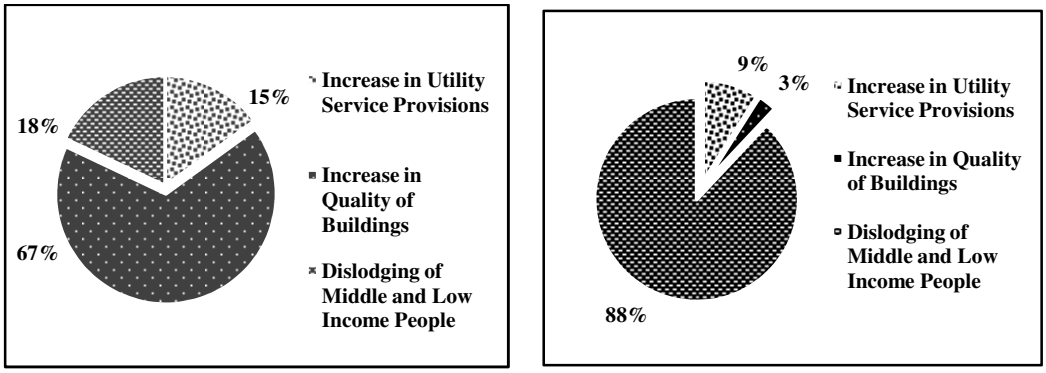
Increase in Land Value: The growing of built density sometimes induces the increases of land value within the particular residential area. Figure 13 shows the resident's opinion about the increase in land value due to growing built density in the study areas. Majority of the respondents of both the study areas mentioned that the house rent is increasing and as a result the owners are becoming economically benefited due to the growing of built density. However the promotion of commercial activities and mixed use developments and violation of planning standards and building regulations are also resulting in both the study areas of Mirpur.



Source: Field Survey, 2015

Figure 13: Increase in Land value in the Study Areas

Up Surging House Rent: The growing of built density sometimes prompts the up surging of house rent within the particular residential area. Figure 14 (a and b) shows the resident's opinion about the up surging house rent due to growing built density in the study area. As in the case of Kazipara, majority of the respondents that is 88% mentioned that, the up surging of house rent resulting from the growing built density is the reason of dislodging of middle and low income people from this residential area. On the other hand in the case of Section 2, majority of the respondents that is 67% mentioned that, the up surging of house rent is the reason of increase in quality of buildings.



a) Section 2 b) Kazipara

Source: Field Survey, 2015

Figure 14: Up Surging House Rent in the Study Areas

Recommendations

Following guidelines may be adopted to ensure sustainable growth of Mirpur Section 2 and Kazipara:

Law Enforcement: Strict application and enforcement of planning rules and regulation like- setback standard, floor area ratio standard, ground coverage standard, etc. should be ensured for constructing new buildings in the study areas. The building inspectors of RAJUK should conduct frequent, regularized and compulsory cross-checking or review of the building and site plan to check any kind of breaching, deviation or violation and if any breaching, deviation or violations are found, strong penalty should be imposed. The authority, RAJUK should have to reduce lacking of building supervision activities by engaging more relevant manpower for regular monitoring and supervision. RAJUK should engage more building inspectors for regular inspections of the buildings.

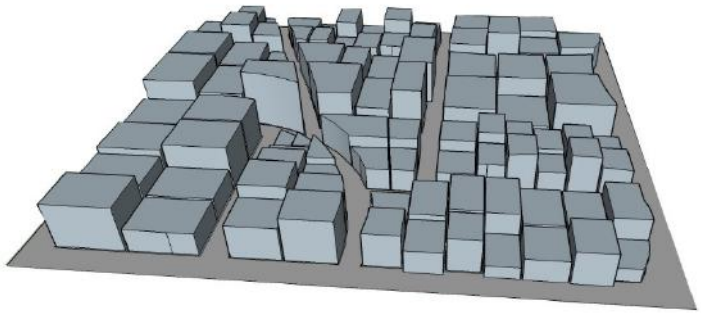
Restriction on Commercial and Mixed Use: Various types of commercial uses and mixed uses are practicing and establishing along with the surrounded four major thoroughfares of Mirpur Section 2 namely Mirpur Main Road, Zoo Road, Hazi Road and Stadium Road and internal access roads within the residential area as well. On the other hand, various types of commercial uses mostly for furniture, building materials, electronics, etc. and mixed uses are practicing and establishing along with the major connecting road Begum Rokeya Sarani and internal access roads of Kazipara as well. The increasing commercial and mixed uses are contributing the rapid growing of residential built density of Mirpur Section 2 and Kazipara, which are hampering the safety and

privacy of these residential areas to some extent. Such rapid commercial growth in residential areas should be restricted and controlled by imposing high tax on commercial establishments and mixed use of buildings and the authority, RAJUK should give a clear direction in the transformation especially for the residential to commercial transformation.

Restriction on Industrial Use: The major connecting road Begum Rokeya Sarani is basically the main linkage of Kazipara and almost all the industries located in Kazipara are linked with this main road. Most of these industries are manufacturing and processing industries. However the workers working in such industries are occupying the low rise buildings of Kazipara residential area. The good communication of Kazipara is attracting more ready-made garments to be located in this residential area. As a result the built density is growing very rapidly. Moreover the industries are polluting the surrounding residential environment. Therefore it is an urgent necessity to relocate the industries of Kazipara as soon as possible to resist the further growing of residential built density and to avoid the unwanted consequences of growing built density.

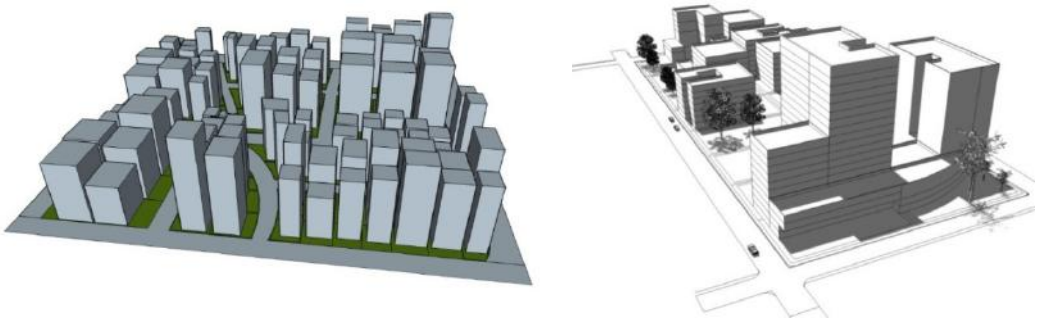
Removal of Illegal Occupancy: Mirpur Section 2 is a planned residential area. The internal roads within this residential area are laid out in a regular pattern and are well spacious with sufficient width. Moreover, there are some government vacant lands in this residential area which are kept for future road expansion or development. But some illegal occupancy is observed who are trying to grab such government vacant land and land from road side by constructing commercial structures. Such commercial structures should be removed and strictly reserved for the desired purpose.

Built Density Design: Since the rapid growing of built density in Kazipara residential area is making this unplanned residential area even more unplanned and tempting to lose the residential harmony and livability, therefore built density design through provisioning vertical growth by applying 'Floor Area Ratio (FAR)' can be a very effective technique to overcome the existing situation.



Source: Modified by the Authors, 2015

Figure 15: A Simulation of Existing Built Density Design of Kazipara, Mirpur (Without Application of FAR)



Source: Modified by the Authors, 2015

Figure 16: A Simulation of Proposed Built Density Design of Kazipara, Mirpur (After Application of FAR)

Redevelopment through Application of Plot Reconstitution Technique: Since the rapid growing of built density in Kazipara residential area is making this unplanned residential area even more unplanned and tempting to lose the residential harmony and livability, therefore plot reconstitution technique of land development can be a very effective technique to overcome the existing situation.

Conclusion

Dhaka city is the largest urban centre in Bangladesh with a rapidly growing market for housing. The mechanism of urban housing market is very complex. The value of land and real property is increasing day by day particularly in the residential areas like Mirpur. Appropriate measurement of planning needs can be helpful to meet this upgrading demand and for better living environment there need. There must have to consider the economic and environmental condition of area in the residential development and redevelopment which can be measured by built density. On the other hand, the residential area sometimes is having too much commercial building which causes the disturbance of privacy and reduces the quality of living environment. To address the need and problems of the residential area build density measurement can be very effective. Built Density measurement by using the GIS software and other technology can make the task of three dimensional (3D) analyses more accurate and easier. Sky-view-factor measurement on the other hand can help to understand the microclimate of any area and the existing condition of the orientation and density of building structures. Built density from different point of view such as economy, environment, and architecture can seem different. Planners should pay more attention on sustainable development. More research is needed in this field of built density, to strengthen the applicability of built density with SVF, or any other parameter, as a better tool to help the Government and planners to better shape the living environment to ensure sustainable growth of Dhaka city.

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