Densification of Residential Areas in Dhaka: An Enquiry of Causes and Consequences to Address Approaches towards Sustainability

Submitted by

Syeda Jafrina Nancy

A thesis submitted in partial fulfillment for the Degree
of
Doctor of Philosophy

DEPARTMENT OF URBAN AND REGIONAL PLANNING
Bangladesh University of Engineering and Technology, Dhaka-1000, Bangladesh

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It is hereby declared that this thesis or any part of it has not been submitted elsewhere for the award of any degree or Diploma.

Syeda Jafrina Nancy

Dedicated to .....

my beloved parents

Acknowledgment

At first all praises belong to Almighty Allah, the Most Kindhearted and the Most Merciful, Benevolent to human being and their action.

I, would like to express my special appreciation and thanks to my thesis supervisor, Dr. Roxana Hafiz, Professor, Department of Urban and Regional Planning, Bangladesh University of Engineering and Technology, for her invaluable guidance and support. Her affectionate behavior, advice and helpful suggestions had been a great encouragement for accomplishing this task successfully. I am extremely grateful to her for encouraging my research and for allowing me to grow as a research scientist.

My sincere gratitude is reserved for all the respectable teachers of Department of Urban and Regional Planning and Department of Architecture, Bangladesh University of Engineering and Technology, Dhaka for their valuable suggestions and support.

Words cannot express the feelings I have for my parents for their constant unconditional support - both emotionally and financially. I would not be here if it not for you. I am especially thankful to my parents in-law for all their prayers and affection that sustained me thus far. I am highly indebted to my loving daughters for their patience, love and support which they bestowed on me unconditionally. Finally, I would like to acknowledge the most important person in my life – my husband Asif Ali Tunio. He has been a constant source of strength and inspiration. There were times during the past years when everything seemed hopeless and I didn’t have any hope. I can honestly say that it was his determination and constant encouragement that ultimately made it possible for me to see this project through to the end.

I, would extend my heartfelt thanks to the students of Department of Psychology, Jagannath University for their sincere co-operation in conducting the questionnaire survey of the research.

I would like to express my gratitude and sincere thanks to all the officers and staff of RAJUK, PWD, DSCC and DNCC for providing me with supportive materials of information and suggestions. A heartfelt thanks goes to my cousin Fatema who has been a great support throughout the study. I would also like to extend my gratitude to all my friends and collegues for their support and encouragement. Special thanks to Raihan, Rubel, Abdullah and Farhana who assisted me with the technical issues of my research, and incented me to strive towards my goal.

Finally, I recall the unforgettable support, extended by the residents of Uttara, Pallabi, Dhanmondi, Banani, Gulshan, Wari and Luxmi Bazaar which has been substantially helpful for the study. Without their support, the study would not be completed. So, I would like to express my indebtedness to all those for their kind co-operation and friendly support.

Abstract

Densification is a widely practised strategy of the recent years to achieve sustainable compact city by restraining urban sprawl. As one of the fastest growing Megacities with a population of about 14.3 million, the residential areas of Dhaka have been transforming through a continuous process of densification to accommodate the ever increasing population. This research investigates the present densification process in Dhaka and enquires about its causes and consequences. Dhaka had to experience a huge deficit of housing stock after Independence due to the influx of refugees and rural migrants. Failing to fulfill the housing demand till the 1980s the government allowed densification of the existing residential areas through vertical expansion. The ongoing densification process is rapidly transforming the residential areas vertically with an intensification of commercial activities. As a result of this vertical transformation a host of crises both in urban and neighbourhood scale started emerging which includes traffic congestion, lack of open space, sense of belonging, safety and security, inadequate ventilation, solar access in the built forms leading to the deterioration of the living environment and putting the sustainability of the residential areas at stake. Due to the scarcity of land densification seems to be a practical option for Dhaka to achieve sustainable development but the densification of residential areas of the city does not seem to have accrued the claimed benefits yet. On the contrary the overall livability of the residential areas seems to be deteriorating day by day. So the central question placed is what errors beset the current densification process and how it is hampering the sustainability of the residential areas?

Through a descriptive and exploratory approach, and by review and deduction of archival and secondary documentary resources, supplemented by empirical evidence from case studies, this thesis traced, analysed and described the current development crisis associated with the densification process of the residential areas of Dhaka and tried to delve in the depth of the problem to identify the probable causes and consequences of the ongoing densification. The seven case study areas chosen reflect variation in locational characteristics, settlement pattern, age, density and socio-economic differentiation. The research adopted a mixed methods approach using both qualitative and quantitative data and the intention was to understand the densification process in their environmental contexts inclusive of the locational, spatial, social, economic and political dimensions through the analysis of various density attributes and inhabitants' experiences. The findings indicated that the overall densification of the residential areas of new Dhaka in terms of physical density is still in an optimum stage except those of old Dhaka. An examination of the trend of densification of the selected case study areas since the last four decades sheded light on the nature and intensity of redevelopment activities the city underwent during this period. In evaluating the sustainability of the residential areas the most visible and serious negative impact of the ongoing densification had been found on the urban transportation system rather than the livability of the residential areas. Perception of density among the residents was found to vary greatly depending on personal, socio-economic, environmental and spatial factors. Respondents displayed higher level of satisfaction despite the inadequate and improper provision of various physical attributes of the built environment in relatively high density residential areas. High density was found to be positively associated with health problem, safety and security, social cohesion but demonstrated negative association with accessibility of public transport, amount of living space, open space, aesthetic appeal, visual and acoustic privacy of the residential areas. Through developing a better understanding of the socio-economic and spatial manifestations of the ongoing densification process this research encouraged a way of thinking that supports the creation of contextual policies paramount to the sustainable development of residential areas of Dhaka.

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ABBREVIATIONS

ADB	Asian Development Bank
BBS	Bangladesh Bureau of Statistics
BRTA	Bangladesh Road Transport Authority
CMLA	Chief Martial Law Administrator
DAP	Detailed Area Plan
DCC	Dhaka City Corporation
DHUTS	Dhaka Urban Transport Network Development Study
DMDP	Dhaka Metropolitan Development Plan
DMA	Dhaka Metropolitan Area
DNCC	Dhaka North City Corporation
DSCC	Dhaka South City Corporation
FYP	Fiscal Year Plan
GDP	Gross Domestic Product
IMF	International Monetary Fund
PWD	Public Works Department
RAJUK	Rajdhani Unnayan Kartripakka (Capital Development Authority)
REHAB	Real Estate and Housing Association of Bangladesh
SAP	Structural Adjustment Policy
SP	Structure Plan
SPZ	Spatial Planning Zones
STP	Strategic Transport Plan
UAP	Urban Area Plan
WB	World Bank

GLOSSARY

BLOCK: An area of land within a subdivision that is entirely bounded by streets, or by streets and the exterior boundary or boundaries of the subdivision or a combination of the above with a river or lake

BUILDING SETBACK LINE: A line delineating the minimum allowable distance between the property line and a building on a lot, within which no building or non moveable landscaping shall be placed except as otherwise provided.

CITY CORPORATION: It includes city corporation area declared by the Ministry of Local Government.

PLOT: A parcel of land which is approachable by a public street or private access road and any other approved means of access with the necessary accessible width can be defined as a plot.

MAHALLA: Lowest urban geographic unit having identifiable boundaries.

WARD: Smallest administrative urban geographic unit comprising of mahallas and having ward council institution.

Chapter 1: Introduction

1.1 Introduction

One of the most serious challenges that face Bangladesh is high population growth; and this most true for its capital city, Dhaka. This thesis is an attempt to investigate the densification process applied to accommodate the ever increasing population of this city and consequently the problems that overwhelmed this city. Dhaka has been termed one of the most dense, most polluted, most congested, most unlivable cities of the world – not just once, but several times. The research has been taken at a time, when the causes and consequences of such densification process, planned or otherwise, has raised serious questions regarding the sustainability of the city, particularly, that of its residential areas. The consequences of such densification process have affected lives in ways that are beyond expectations and as such, undesirable. Some of these issues are addressed in the thesis. To begin with, a brief historical account of Dhaka is given to understand how the problems evolved and then draw ways towards an in-depth study.

Dhaka the capital city of Bangladesh is one of the fastest growing megacities of the world with a density of 23,234 people per square kilometer (World Population Review, 2016). The city bears a legacy of four hundred years and have undergone through a series of shifting political status and dramatic changes in its population throughout the history. But since its emergence as the capital city in 1971 it had to face a huge influx of rural migrants pouring in on a regular basis. Within four decades of its inception Dhaka witnessed a radical increase in population which constitutes about 40% of the total urban population of the country and 6% of the entire national population. Due to its unique geographical constraints the city could not spread horizontally which caused a scarcity in the inventory of buildable land. Consequently the city had to grow vertically to accommodate the escalating demand of housing and other facilities which in turn increased the density. By 2011 the population of the city reached 14.7 million with one of the highest densities in the world. (World Popultion Review, 2016). But the way through which the city has densifyed has made the urban systems particularly that of transport and utility infrastructure unmanageable and inadequate. The city dwellers are struggling to thrive amidst the horrendous traffic congestions, power shortage and flash floods on a regular basis. This poses a question to the densification process the city has been going through.

In the face of land scarcity and a large and fast growing population that needs to be accommodated – there is sometimes little option left but to densify existing land uses which leads to the process of densification as it can be seen in the case of Dhaka. Densification is also linked to the fact, that the world population is increasing independently of what we do to restrain it, therefore smart strategies for future densification of cities are crucial for the construction of sustainable built environments (Pedraza et.al 2008). So densification has become a widely used strategy particularly in the planning of Megacities. Given the scarcity of buildable land and unprecedented population growth the city development authority in Dhaka adopted a process of densification in order to accommodate the increasing population. As the outcome of this strategy did not deliver the desired benefits therefore, the initial questions raised here is, what densification process did they adopt? And, how far they were successful in their endeavor? These are some of the key questions among various others that are raised in this research, as the city authority as well as city dwellers are perplexed by its outcomes. It seems that the densification process in Dhaka was applied with a broad brushstroke without a sensitive planning strategy taking account of local contexts of the residential areas. This in turn has raised questions about the densification process adopted for the various residential areas of Dhaka as the benefits accruing to the dwellers were few and far between.

The term “Densification” has originated from the concept of “density” which has varying perceptions depending on different disciplines under different context. However, in the context of planning density it denotes the amount of built space in terms of dwelling units in a given area. Planners typically use density limits to control development intensity or occupancy. Therefore, “Densification” can be referred to as the process through which higher density is attained. In the domain of urban planning densification is regarded as the strategy or instrument with which urban compaction is achieved. The term came into use in the planning arena from late 1980s with the concept of “Compact City” and has since become an important agenda in planning policies around the world for sustainable urban development (Lupala, 2014). In some of the recent studies on sustainable city models, especially in the compact city, increasing the urban density inside the existing urban areas is a crucial step when it comes to sustainable development (Jabareen, 2006). However, it can be a questionable policy where inner city areas are already very dense, therefore higher density is not an absolute concept, but a relative one (Jenks and Burgess, 2000). This infers that the creation of sustainable urban areas from further densification needs careful evaluation of the existing densities of the areas concerned.

Densification should be applied under conditions that help to reduce urban sprawl as well as promote the urban areas towards sustainabilty. In order to address these issues, it is important to limit densification of areas where maximum densities has already been reached as well as focus on further development of the specific areas where there are no major densities and urban containment can still be achieved. In this way, the process of strategic densification can be undertaken according to particular urban contexts. A failure to address this issue can lead to ever-expanding cities which consume more natural areas and grow until urban systems, like public transport, infrastructure facilities become unsustainable. Some of these symptoms are already evident in Dhaka. The residential areas of Dhaka already densified or currently undergoing the process of densification are faced with a host of urban problems which puts its densification process under question. This makes Dhaka, a crucial and important case for study. This research, therefore intends to investigate the causes and consequences of the ongoing densification process for the purpose of attaining sustainability of the residential areas, as well as, construct a helpful database and putting forth possible solutions and recommendations for planners and policy makers.

In this regard, Chapter 1 presented a background and significance of the research problem which are divided into 10 sections. Following the Introduction, Section 1.2 discusses the background of the urban crisis. The gap of knowledge and the research problem is stated in Sections 1.3 and 1.4 respectively which leads towards formulating the research questions. Sections 1.5 and 1.6 outline the research questions and objectives accordingly. The rational of the research is discussed in Sections 1.7 and 1.8 briefly outlines the methodology. Section 1.9 presents the organization of the thesis followed by a conclusion.

1.2 Background of the Study

This section narrates how the problems evolved from the densification process adopted for the residential areas of Dhaka, and the need to investigate these problems to attain solution towards sustainability of these areas. Residential density became a matter of concern in the urban planning of Dhaka ever since it became the capital of a sovereign country after independence. Looking back historically it can be seen that the city was faced with a challenge of accommodating a sudden and huge influx of refugees after partition from India in 1947, when Dhaka became the provincial capital of East Pakistan. The then Government made a prompt respond to this housing crisis by undertaking several housing estates in areas like Azimpur, Motijheel, Lalmatia and Mohammadpur along with township projects for building future housing in areas like Dhanmondi, Gulshan and Banani during 1950s and 1960s respectively (Afsar, 2003). The second wave of housing crisis emerged after independence of Bangladesh when Dhaka had to experience an unprecedented growth in its population chiefly due to rural migration. By the early 1980s the Government realized its inability in fulfilling the total housing demand and changed its role from a direct provider to that of a facilitator, under the Neo-liberal Housing Policy perspective (Ghafur, 2010).

Adopting this policy allowed the state to withdraw itself from direct production and provision of housing and promoted the private sector in the production of housing (formal and informal sector) and land development. As housing was left to the care of the private sector, the provision of housing was largely guided by the market forces. The real estate developer appeared in this scene in the early 1980s and responded to this demand with a motivation of profit maximization. Their objective was attained by building multistoried housing blocks on limited land resources following the post World War II European housing development with increased residential density. Moreover the trend of densification through vertical expansion was further reinforced when Government after mid 1990s legalized this practice by allowing the maximum building height up to six stories. There was internationally a shift in the policy context guiding changes in urban form and promoting the compact-city paradigm with rising prominence of addressing sustainable development during the late 1980s. Sustainability concerns were first centered on environmental degradation (World Commission on Environmental Development, 1987). However, the term got acknowledged later with the three-pillared concept of environmental, economic and social sustainability. Much of the focus in planning has been on the environmental aspect of sustainability and associated goals of reducing energy use, land consumption and the need to travel, resulting in the calls for greater densification (Bramley & Power, 2009:30).

The sustainability paradigm was a prime concern on the urban planning agenda as it was linked with fast increasing global population, in spite of efforts to restrain it, and the failure to address this issue was consequential to ever expanding cities leading to the birth of megacities, encroachment of surrounding agricultural land and overstrained urban systems. Therefore to avoid such disastrous situation from happening the planning of megacities in developing countries, tended to adopt strategies like densification in line with the Compact City concept. During the 1990s when western urban planning was exploring the apparent benefits of socially beneficial, economically viable, and environmentally sound urban development through the practice of newly emerging concepts like compact city, urban compaction developing countries seemed to be unaware of these new ideas. Accordingly the densification of the residential areas of Dhaka was not a properly researched contextually appropriate application of this strategy rather was the outcome of a set of decisions taken in response to solve the immediate crisis. Therefore, the urban compaction of the residential areas of Dhaka that took place in the following years followed no strategic densification policy aimed towards ensuring the sustainability of the residential areas. The authorities, along with the vertical expansion also initiated policies for horizontal expansion of the city to accommodate the ever-growing population.

Sprawl tends to occur through horizontal expansion of development but in case of Dhaka sprawling could not take place in its true sense due to two major factors firstly by the topographical constraints placed by the surrounding rivers and secondly due to the lack of adequate infrastructure. The city was restrained from expanding sidewise along the east-west axis as it is bounded by the rivers, Turag, Balu and Shitalakhya as well as also by the low-lying, flood plains on both sides. Growth towards the south was also restricted partly by the River Buriganga. Therefore, the growth of the city was directed towards the north with the formation of a number of planned residential townships along the north-south transport corridor. Most of these planned residential areas were developed during the late 1950s till the early 1960s under the East Pakistan regime. These projects were carried out under Dhaka Improvement Trust (DIT) (now Captial Improvement Authortiy, RAJUK) and were conceived according to the planning initiatives of the first formal Master Plan 1959 of Dhaka. The land use allocations for these residential areas had many shortcomings including lack of provision for supporting facilities. But as these areas were sparsely populated then this issue was not of a great concern to the inhabitants who mainly constituted of the elite class and diplomats.

From the 1990s onward, transformation of these residential areas, through densification, started with the development of predominantly vertical expansion leading to concentration of people in these areas and consequently increased the density. This simultaneously brought alongside unprecedented pressure on the infrastructure system including roads and utility services, such as electricity, water, gas, etc. (Nahrin, 2008). Dhaka ranks among the 10th worst large cities in the world in provision of infrastructure according to the Economic Intelligence Unit (EIU)'s annual ranking of 140 cities worldwide (EIU 2016). Moreover the Government's erratic decision of allowing mixed use development along both sides of the main transport corridor without appropriate policy measures contributed to the proliferation of a range of commercial activities which accelerated the rapid transformation of these residential areas into mixed use zones. In addition, the approval of bye laws permitting the conversion of the road front residential plots into commercial land use initiated the emergence of a wide range of commercial activities of varying scale on both sides of the transport corridor forming continuous commercial strips (Nancy, 2004). In the absence of proper monitoring and development control policy these commercial activities eventually penetrated into the residential areas in the form of mixed use or independent commercial setups through violation of law. Residential areas, designed and developed by public authorities during the last two decades, have been transformed into mixed-use zones, with residential cum commercial establishments.

The commercial facilities range from schools to universities, physicians chamber to specialized hospitals and diagnostic centers, small scale departmental stores to big box shopping malls and small firms to high rise real estate corporate offices. Most of these activities are not compatible for residential environment and the number and scale of these commercial activities had exceeded beyond the bearing capacity of these areas in terms of traffic load and infrastructure. The scale and provision of these facilities are of city scale where the neighbourhood scale would have sufficed. As a result the serenity of the residential areas is constantly being hampered through the unwanted traffic which creates severe congestion during the peak hours. Moreover, residents show an increasing propensity towards dependency on automobiles due to the lack of walkable pedestrian paths as well as safe and secured streets environment. In addition, the mushrooming of high rise structures with booming commercial facilities attract people from all over the city which further deteriorates the traffic situation of the residential areas. With respect to the initial population size of these residential areas, the existing open spaces were quite inadequate according to existing space standards. With the ongoing densification of these areas the loss of open space further intensified. The residents became deprived of community spaces necessary to enhance social interaction and foster the sense of belonging. Due to lack of adequate open spaces children have to spend more time indoor rather than engaging themselves in healthy outdoor physical activities promoting sound physical and mental health. As a result, the overall quality of life is degrading. Furthermore, inappropriate physical planning and piecemeal urban development in the megacity have also triggered various environmental hazards of which flash floods and water logging are the most pervasive (Dewan, 2013; Alam and Rabbani, 2007). Whilst Dhaka's peculiar geographic location makes it particularly vulnerable to (Bromley et al. 1989), unplanned urbanization has accelerated the degree of vulnerability of flood, particularly in the recent past (Dewan and Yamaguchi, 2008; Islam, 2005). Hence, the ongoing densification has put the sustainability of these residential areas under question. However, density, when guided by efficient urban management, can bring about positive impacts such as reducing travel distances, therefore lessening emissions, consequently curbing down local and global warming. In this regard, Acioly and Davidson (1996) suggest that the sustainability benefits can be gained only when guided densification accompanied with good urban management system is devised.

Although the concept of high density brings negative connotations, such as overcrowding, unhealthy, crime breeding zones, etc. (Fuerst & Petty, 1991), but it is not always necessarily true. Hillman (1996) concedes that living at higher densities will have implications for individual lifestyles, but need not necessarily be negative. By cutting down fuel consumption of individual automobiles, he argues, urban residents can enjoy, amongst other things, lower transport expenditure, less pollution and lower heating cost. Densification with an intensification of mixed use is considered to be an effective tool in achieving sustainability for the inner residential areas as it reduces travel distance thus reducing emission, bringing vitality to the urban life. Encouragingly these claims are not limited within theoretical premises but their practical implications can be supported by a number of examples of successful initiatives implemented around the world. Curitiba, Hong Kong, Singapore, Cape Town, Johannesburg and many other European cities can be counted among the best examples of cities where planned densification strategies have proven to be the main impetus of good urban planning and sustainable development. Cities of developing countries have much higher densities than their counterparts in developed countries. Population density indicates the degree of land scarcity or its abundance. Rapid increase of population aggravates the inadequacy of urban land resources, and pronounced land scarcity generates intensive competition over access to land use. Optimal land utilization to maximize provision of building space and urban facilities become critical issues for the urban planning agendas of Asian cities. Therefore urbanization in the context of high population density inevitably makes compact cities a necessity rather than a choice.

Zhu (2011) points out that compact city can be a favorable solution if densification and urban compaction can be tackled through the intelligent use of its two parameters, i.e. plot-ratio (total building floor area divided by site area) and site-coverage (the land area covered by buildings divided by site area). Through an effective combination of these two parameters high density can be managed in a way that could lead to the desired benefits of good living environment. In addition to it the political and social viability of densification measures has also to be considered. In view of the above discussion, the radical transformation that occurred in the planned residential areas of Dhaka in the last 25 years is clearly an outcome of 'unguided' densification process. This makes Dhaka an urgent and fascinating research subject in the context of examining the impact of density on sustainability. The ongoing process of densification cannot be conceived as an independent phenomenon of urban planning but evolves in tandem to underlying social, economic and political forces in play in the urban arena of Dhaka. The point of departure for this research is, therefore, to provide an in-depth understanding of the transformation taking place in the residential areas of Dhaka brought about by the present process of densification and the interplay of various forces and their subsequent effects on livability and sustainability of the residential areas.

1.3 Knowledge Gap

Densification has been widely accepted as a strategy for developing countries to control growth management in a sustainable way. The process of densification is related with the notion of density which varies with socio-cultural preferences as well as the demographic characteristics of any area. In order to get the claimed sustainability benefits the strategy needs to acknowledge the socio-cultural, economic and political context along with the demographic characteristics of the concerned area prior to its implementation. An extensive literature survey reveals that no such studies have ever been undertaken by the concerned authority before implementing the strategy in Dhaka. Only a couple of researchers have worked on the densification issue in the context of Dhaka. These studies on densification of formal housing are focused on house types, livability issue, rental structure and provision of infrastructure. One of them Satu (2014), had examined the livability of dense urban neighbourhoods in Dhaka but did not explore the causes of densification from socio-economic perspective. The work of Sadeque (2013) focused the rental structure to the dense neighbourhoods but did not address the planning issues. As addressed by the the extensive literature review, lack of studies thus leaves a gap in the literature in terms of research that specifically examines densification as a holistic process with its inherent causes and effects on residential environment in conjunction with sustainability imperative. Moreover there has been a lack of empirical research assessing the current situation of the residential areas of Dhaka in terms of density attributes in the block level of the residential areas and associated sustainability benefits. This research intends to bridge this knowledge gap for the benefit of all, especially the policy-makers, decision-makers and city administrators. It also attempts to fill the knowledge gap in relation to the actors (government and private sector) involved in the ongoing densification process. Furthermore this research identifies the social, economic and political forces influencing the densification process in the context of Dhaka, which is yet to be another contribution to the existing knowledge regarding the transformation of residential areas especially in providing professionals with contemporary knowledge about the factors worth considering before formulating any policy framework for guided densification.

1.4 Statement of the Problem

This section intends to narrate how the problem(s) stated in this thesis came about and the need for an immediate investigation to stall the unwanted impacts of densification and the need to attain sustainability for the residential area of Dhaka that has been densified or going through a densification process. The population started to grow at a higher rate since 1971 when Dhaka became the capital of independent Bangladesh. The prominence of the city draws people from all over the country and population of 1.2 million at the eve of independence swelled to about 14.5 million by 2011 (BBS Community Series, 2012).The population density of Dhaka is believed to have reached around 34000 people per sq. km., making Dhaka among the most densely populated cities in the world. With an average household size of 4.9 persons (Seraj, 2012), Dhaka is now growing at an unprecedented rate accommodating more than 600,000 people per year (CIA-The World Fact book). Up till now, about 65% of the total growth of population is due to migration. At this situation it is assumed that every year more than 120,000 household units are required to be housed, in Dhaka (6th FYP). To meet the housing demand of Dhaka, the city authority decided to develop the existing residential areas through vertical expansion. Government allowed the private sector to assist in the redevelopment activity of the housing sector. The developers started to build multi-storied buildings in joint venture with the landowners. This partly solved the housing problem especially for the middle and upper middle income group but the low income group was left out.

The developers' urge in maximizing profit soon turned the demand led densification into market led densification. Involvement of the private sector with minimum government intervention made housing a commodity of speculation rather than shelter in the capitalist mode of economy. As developers are motivated by the urge of profit maximization they are least concerned about the liveability and other environmental consequences associated with the wellbeing of the people. Consequently the market forces promoted densification to take place in unprecedented speed giving rise to a multitude of urban problems including declining livability, traffic congestion, water logging, infrastructure failure etc. The apparently unguided form of densification was not able to provide the claimed benefits of compact urban form like reduced vehicular trips, shorter journey time, increased social interaction, less fuel consumption etc. On the contrary it is making the residential areas increasingly uninhabitable thereby putting a question mark on their sustainability. If this trend of densification is left to continue unchecked it would further deteriorate the livability of the residential areas while pushing the urban systems on the verge of collapse. Acknowledging the urban crisis stemming from the unguided densification process this research therefore intends to endeavor a clear understanding of causes and consequences of the ongoing densification which would contribute to form the knowledge base that would benefit the policy makers and researchers in the field of planning with guidance in formulating effective densification policies for Dhaka.

1.5 Research Questions

In view of the above discussion, the following research questions and objectives are proposed:

Research Questions

1. How residential areas in Dhaka were planned and what principles were followed for their development?

    i. What standards, if any, were followed for the densification of existing residential areas of Dhaka?
    ii. Which authority or who decides such development?

2. How have the Urbanization Policy and other relevant policies (i.e. National Housing policy, Mohanagar Imarat Nirman Bidhimala, 2008, Building Construction Rule 1984 etc.) of Bangladesh waived away development crises facing the residential areas?

    i. Consequently, are these policies well-equipped to deal with the housing crisis in Bangladesh, more specifically, that of Dhaka?
    ii. What forces regulate and guide densification process in Dhaka?

3. How has the densification process been affecting livability, comfortability and sustainability of residential areas of Dhaka?

4. How can the densification led problems be addressed to contribute to a better understanding of densification towards making residential areas of Dhaka sustainable?

1.6 Objectives

The objectives of this research are:

a) To investigate the trend of residential area planning and standards followed in densification of residential areas in Dhaka.
b) To gain an understanding of the underlying causes guiding the forces and actors regulating and planning the densification process in the production of housing and development of Dhaka.
c) To identify a list of sustainability indicators to monitor or track the consequences of densification process and evaluate progress towards sustainable residential area development.

These objectives are interrelated. They all seek to realize an understanding of the transformation processes of residential areas of Dhaka through densification, to reveal the changes taking place in spatial qualities with regard to livability and sustainability; and to explore the link or connection, between densification process and the social, economic and political factors as its guiding forces.

1.7 Rationale of the Study

The densification of the residential areas plays a defining role in the overall growth pattern of Dhaka city. Compact urban form with high density is supposed to solve many challenges faced by the cities of developing countries with focus to transport and urban functioning. Dhaka is no exception in adopting the compact city idea in the face of scarcity of buildable land. Though the idea of sustainable development through densification and compact form has found its way in the realm of urban planning of many western cities from late 80s but the policy makers of Dhaka was not familiar with the idea until recently. Consequently the densification of the residential areas so far took place reflects the outcome of an unguided growth management. The insufficient planning legislation allowed the densification to occur in an uncontrolled manner in the residential areas without any consideration to the subsequent local environmental consequences of traffic, noise and air pollution. The success of densification process involves careful assessment of the physical characteristics of the built environment including the layout, road network, block arrangement, infrastructure as well as the natural features and demographic characteristics of any area. Inadequate knowledge bases on the factors promoting densification and its probable impact on sustainability have restrained adoption of effective planning intervention. Research is therefore, necessary to evaluate the effect of current densification process on various aspects of sustainability and to learn from the past errors besetting it to assist in formulating effective future growth related control mechanism. This research aims at providing this empirical knowledge and in addition it will try to shed light on the possible causes of densification from socio-economic and political perspective.

1.8 Research Methodology

In this section, the research field in which the thesis is set is described briefly, relating to the research questions and objectives of this study narrated previously. Accordingly the key words of this research are residential area, densification and sustainability. These key words along with the research methodology are discussed elaborately in Chapter 3.

It is an exploratory research using both qualitative and quantitative data and the intension is to delve into the depth of the problem to gain a better understanding of the problem and seek sustainable solutions.

Based on the 3 research questions presented in Section 1.5 their objectives have been determined. Therefore, to meet the objectives of the research set out in section 1.6, mixed methods approach has been adopted for data collection and analysis.

The method used to obtain answer of the first research question includes the field survey based on studying and documenting the density characteristics of the built forms of the study areas. The answer of the second research question came from an extensive review and analysis of existing body of literature and policy documents aided with in-depth interviews of key personals to probe into the causes of the densification phenomena. In line with the third research question the consequences of densification on sustainability has been explored through a questionnaire survey in the selected sample study wards.

From the very early stages of the research, an extensive literature review has been carried out. The undertaking is important to utilize previous works done on densification both on local and global context to establish a theoretical framework in the subject of the study and analyze the existing policy documents to seek the policy gaps. The intention of the review is to understand and decide on concepts and issues relevant to the study. In general, the methodology involves in comparing 7 cases tudy residential areas which would present a virtual slice through the city in terms of location, built form and density. The residential areas Wari, Luxmi Bazaar, Dhanmondi, Banani, Gulshan, Pallabi and Uttara with varied density profile were selected from inner, middle and peripheral location of the city respectively. Major part of the analysis was based on primary sources of data collection comprising of both quantitative and qualitative data. The primary data were collected using two methods:

First a physical field survey, documenting built form, settlement pattern and land use; second a questionnaire to collect data related to residents' perceptions of densities, socio-economic data and many other aspects related to living condition as well as sustainability of the residential areas. Satellite imagery and maps were analysed to determine the trend of densification in each of study residential areas. A set of indicators have been developed to for the research to assess the density attributes as well as various selected aspects of social, economic and environmental sustainability and determine their relationship with density. Density of the residential areas were taken from the density profile of DAP 2010. The varying densities of the residential areas help to investigate the impacts of density on various aspects of sustainability.

Other Data collection tools used include informal interviews, photographic registration, observation, measurements and map preparation. Analysis was carried out by using statistical software SPSS 17 and MS Excel 2007. The information derived from questionnaire survey was analyzed through simple descriptive statistical tools (frequency distribution, correlation test etc) in order to assemble or reconstruct the data in a meaningful and comprehensive manner and was presented in the form of charts, tables, graphs, etc. Simple correlation test was run to determine the relationship between density attributes and selected aspects of social, environmental and economic sustainability. The process of densification as well as the physical density attributes of the study residential areas were studied by producing layers of maps using GIS, AutoCAD 2007 and Sketch Up Pro 2015.

1.9 Organization of the Thesis

This thesis has been organized into 7 Chapters. Chapter 1 introduces the problem area, research questions, objectives and rationale of this study.

Following the Introductory Chapter, Chapter 2 provides a comprehensive literature review conducted to obtain the information needed for pursuing the objectives of this research. Information was obtained from books, academic journals, government and institutional reports, and websites. The literature review helped to highlight issues and gaps that exist with previous research, particularly regarding densification and development of planned urban residential areas of Dhaka. In line with the study aim it outlines the theoretical components of densification as well as explores the various aspects of livability, sustainability, sustainable development and their ways of assessment in the context of residential areas that underpins the theoretical framework for this research.

Chapter 3 underpins the methodological approach with the research questions and objectives. It provides details of data collection strategy and analysis. This Chapter also elaborates the issues of research design which includes choice and justification of the adopted research method with a brief discussion of the sampling method and the demographic and physical characteristics of the seven study sample wards of Dhaka. The Chapter also provides the analytical framework and list of indicators regarding the density attributes and selected aspects of sustainability which has been developed based on the theoretical framework of the research. The indicators were used to assess the various aspects of sustainability and density attributes as well as determine the relationship between density and sustainability in the study residential areas. The Chapter ends with stating the issues of reliability, validity and limitations faced in this research.

Chapter 4 presents findings of empirical investigations from the 7 case study residential areas of Dhanmondi, Banani, Gulshan, Pallabi, Uttara, Wari and Luxmi Bazaar. It investigates the characteristics and trends of densification through examining the various density attributes from the selected study areas of Dhaka. The empirical evidence provides an insight of the recent and prevailing densification pattern as well as the planning decisions shaping them. The Chapter concludes with a cross case analysis on the findings of the study areas.

Chapter 5 focuses on the consequences of densification through examining the density attributes from the perspective of the residents aided by findings of the questionnaire survey and interview. It also investigates the relationship between density attributes and the selected aspects of social, environmental and economic sustainability. Finally the Chapter presents a synthesis of findings regarding the impact of density on selected aspects of social, environmental and economic sustainability and ends with concluding remark.

Chapter 6 investigates the causes of densification through a critical evaluation of selective key policy documents and literature, for the purpose of this research. This is complemented with the information collected from interviews of key personals of various agencies and institutions relevant to the research field. The Chapter examines the policies, strategies and institutional frameworks to identify the loopholes which act as barriers in the prevailing planning and development process in formulating a guided densification strategy to promote sustainable development of the residential areas of Dhaka. In the process it further explores all relevant legislation and policies in order to determine any policy gap in these regulations regarding densification strategy, as well as review the relevant documentation on densification. This includes a critical overview of current Dhaka Metropolitan Planning policies on the subject matter trying to indicate areas of conflict and areas of strength where appropriate legislative measures to device densification strategy can and should be applied.

Chapter 7 concludes this thesis by drawing together the major findings of the research. The first part of the chapter briefly reiterates how the main objectives in line with the research questions have been met. The second part discusses the main implications in addition with several planning recommendations. The last part discusses the scope for further research and presents the conclusion.

1.10 Conclusion

The Chapter briefly discusses the ongoing densification process of Dhaka and the threat it is posing on the sustainability of the residential areas. In line with it states the research problem. Based on the knowledge gap identified through literature review the Chapter sets the research questions and its objective. These research questions would be the guiding framework for investigating the phenomenon and in working out effective solutions to mitigate the situation in the following Chapters. On a broader level of the relevant problems which the research will attempt to contribute to, within its limited scope, is in identifying and understanding the causes and consequences of the ongoing densification to form a knowledge base which would contribute to achieve sustainability of the residential areas through providing guidance in formulating effective densification policies for Dhaka.

Chapter 2: Literature Review and Conceptual Framework

2.1 Introduction

Chapter 1 outlined the problem to be dealt in this thesis, research questions that need to be addressed and objectives set out for the study. Chapter 2 intends to outline the conceptual framework through which the objectives of this study are to be achieved. In this regard, a discussion on densification is necessary to delineate the potentials and obstacles of the densification process. The challenges embedded in the coordination of urban development, urban management and governance in promoting densification becomes mandatory. Densification of existing residential areas to accommodate increasing population and the transformations that were wrought in the living environment has created various problems as mentioned in Chapter 1. An obvious outcome of the transformations indicates that residential areas of Dhaka have in fact created very well-designed housing units, but the living environment is far from satisfactory.

This Chapter introduces theoretical approaches to gain a clear understanding of the key concepts including density, livability, sustainability and related topics. The various perceptions and understanding of density will be explored first, followed by an overview of sustainability and livability explaining the similarity and difference between these two terms. Findings based on previous studies are discussed to elucidate factors that contribute to how people perceive residential density. In addition, this Chapter summarizes fundamental attitudes of those supporting or opposing high density. Furthermore, it highlights how sustainable development is defined today and the reasons of concerns that have shifted the paradigm of conventional development to sustainable development. However, before looking at how densification, or in some instances, urban compaction, is achieved and applied across the globe, one needs to understand the impetus behind this global movement and the basic theoretical underpinnings of this movement which will be explored in this Chapter. Together, these observed perceptions and attitude, several key texts particularly regarding the conceptualization of sustainability, the perception and measurement of density and the use of social, economic and environmental indices to represent the sustainable characteristics of inner city residential areas are discussed that provide the conceptual framework for the methodology proposed in this research project,

2.2 Densification and the Urban Compaction Movement

Rapid urbanization since 1950 has exerted tremendous pressure on urban development in many cities and has been confronted with the scarce supply of land in urban areas. Thus, densification has become an important agenda in planning policies around the world. High-density development has consequently been a topic of increasing interest worldwide; it represents different notions in different countries, across different cultures and to different people. Attitudes towards high-density development are diverse. Some people acknowledge the merits of high density and advocate urban compaction, whereas others criticize the drawbacks and argue strongly against it.

The movement towards more compact cities is driven by the need for more sustainable human environments and urban sustainability. High residential density is an important element of the compact city concept alongside mixed land uses, well-connected urban layouts, and easily accessible public transport networks. The Compact City Movement has evolved as an answer to the ever spreading sprawling tendency of cities and support for this movement has increased throughout the developed and developing world. “This concept has emerged primarily in response to the widely acknowledged need to find more sustainable models for the towns and cities of the developed world” (Burton, 2000, p1969). A range of definitions has been developed for the idea of the ‘Compact City’ but all of these have the same gist of relatively high density, mixed use developments, which promote and enhance efficient public transport systems and increase the quality of life of residents in cities across the world.

However, the major focus of this study is the densification component which is a means to achieve urban sustainability. Therefore, it will be examined and explored in the context of sustainable development imperative, as it is not an isolated issue.

2.2.1 Understanding Density and how it is measured

In the context of planning, density is the amount of development within a given area. As part of a long-range planning process, stakeholders often discuss the most desirable densities for different areas of their communities. On a day-to-day basis, planners often have to determine the minimum and maximum density for a particular development site as allowed under the zoning ordinance. Planners typically use density limits to control development intensity (e.g., height, bulk, setbacks). Excessive density, particularly if poorly designed, can result in inadequate daylight, reduced open space, increased parking demand, and even a lack of privacy. On the other hand, insufficient density can lead to problems in supporting neighborhood-serving retail and services, difficulties in offering a wider range of housing options, and an inability to provide the critical threshold of population necessary to support public transportation. In recent years, planners have been asked to set minimum densities to ensure that sufficient development intensity exists to meet these and other planning goals.

The concern over density has been overwhelming despite ambiguity around people’s understanding about it. The concept of ‘density’ has varying perceptions depending on different disciplines under different contexts. The various perspective of density mainly stems from the multitude of definitions of the term arising from different field of studies including – physical, psychological, social and environmental (see James, 1967; Rapoport, 1975; Correa, 1985; Newman and Kenworthy, 1989; Burton, 1992; Breheny, 1992; Acioly and Davidson, 1996; and Rådberg, 1996). This Chapter attempts to untangle the intricate concepts of density according to two perspectives – namely, physical density and perceived density. A thorough comprehension of these two distinct dimensions of density will serve as a basis for understanding the meaning of high density. Hopefully, this theoretical overview will establish the ground for the discussions in later Chapters on the design of high-density cities with respect to the social and environmental issues.

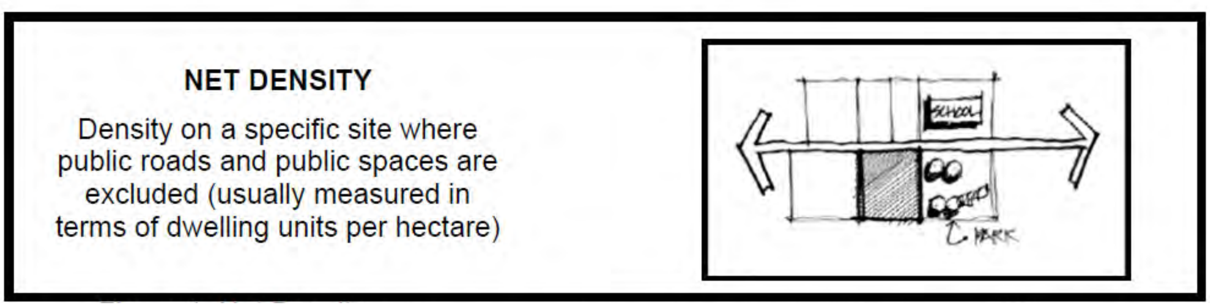
Physical density is a numerical measure of the concentration of individuals or physical structures within a given geographical unit. It is an objective, quantitative and neutral spatial indicator. Density when expressed as a ratio of population to land area can vary significantly with reference to different scales of geographical unit. In terms of physical measurement, density embraces a broad range of definitions namely – net density, gross density, residential density, site/plot density and regional density. In town planning, measurement of physical density can be broadly divided into two categories: population density and building density. Population density is expressed as the number of people or household per given area, while building density is defined as the ratio of building structures to an area unit. Residential density is the ratio of a population to residential land area.

Within the domain of urban planning, residential density can be further classified in terms of net and gross residential densities based on the definition of the reference area. The most popular measure of density is net residential density. This is because it is easier to measure and it is found to be more accurate than gross residential density. Net density is also always higher than gross density and can be increased more easily. The accompanying diagrams illustrate the concept of net, gross density in terms of plot sizes, number of units and average number of people per unit. Other elements, which directly influence net density, are town-planning controls such as coverage and minimum plot sizes. The measure of density of any plot excluding the public roads is known as site/plot density. These are, however, variables which could change. Further, the higher the net density, the lower the gross density. The reason for this is that the increase in population in a specified area requires additional social facilities and amenities, which occupy greater amounts of land. Therefore, the gross density would decrease. If no social facilities were provided in that specified area, the net and gross densities would be equal. Residential densities are therefore dependant on the percentage of land allocated for non-residential uses and also on the efficiency of the layout. Therefore, if one component increases or decreases, the other would automatically increase or decrease (as illustrated overleaf).

NET DENSITY

This is the population or built space (in terms of houses, habitable floor areas spaces) divided by the land covered by dwellings and their gardens, any incidental open space (e.g. children's play spaces, or parking space for visitors) and half the width of surrounding streets but excluding local shops, primary schools, open spaces and other types of development (James, 1967:552).

Figure 2.1 : Net Density

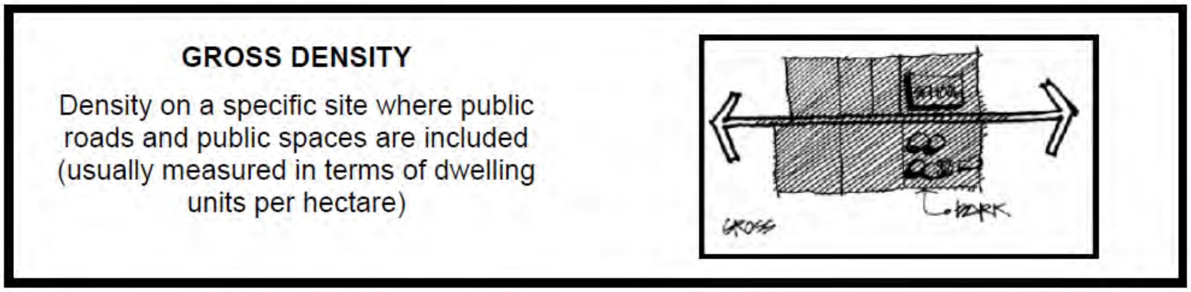


Source: Guideline Document for Higher Density Residenitial Development, Tanzania, 2005

GROSS DENSITY

This is the population or built space or floor area divided by all the land covered by dwellings and gardens, roads, local shops, primary schools and open spaces but excluding urban uses such as secondary schools, town parks, and town centers. Gross density is an intermediate environmental measure linking dwellings with the sort of facilities one would normally be able to walk to (James, 1967:552). Nevertheless, in practice, it is difficult to clearly define the extent of these residentially related areas. This inconsistency of inclusion leads to great ambiguity in gross density measurement and, in turn, makes comparison difficult.

Figure 2.2: Gross Density

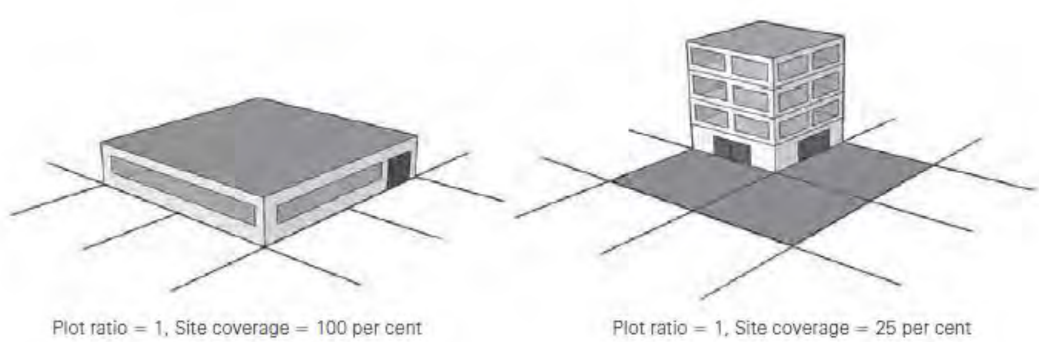


Source: Guideline Document for Higher Density Residenitial Development, Tanzania, 2005

OCCUPANCY DENSITY

Another measure of population density is the occupancy density which refers to the ratio of the number of occupants to the floor area of an individual habitable unit. The building density can be described from two perspectives – floor area ratio (FAR) and site coverage. Floor Area Ratio is a unit of density referring to the ratio of total gross floor area of a development to its site area. In housing and urban design, density has been measured in terms of floor area ratios, plot coverage and dwelling units per specified area (Alexander, 1993). Site coverage represents the ratio of the building footprint area to its site area.

Figure 2.3: Built forms with the same plot ratio but different proportions of site coverage



Source: Cheng, 2010

As mentioned earlier the Net density gives the most accurate measure of density in context of urban residential areas. It is possible to measure the net density of relatively smaller settlements through personal initiative but when the net density of large scale residential areas is required the researcher has to rely on census data. The study residential areas of this research deal with sample wards of considerably larger scale whose ward wise net density data were not readily available from any secondary sources. So facing this difficulty of measuring density this research has to take in account the gross density data for studying the impact of densification.

As Acioly and Davidson indicates: *"the size of plot, the amount of plot which can be built up (plot coverage) and the height of the building (floor space index or Floor Area Ratio) give the dimensions of* *the most visible aspect of density: the amount of space which is built"*. (Acioly and Davidson,1996:7). Therefore, FAR is of great relevance because it shows the actual intensity of development of the settlement. In the procedure of actual calculations of built density (FAR) for all the projects, actual site and architectural plans have been used. For all cases, coverage of the area are measured and called "site coverage". These are measurements for the "site" which is the actual area of the plot in which a housing complex is built on, and in all cases included the addition of half of the width of the surrounding streets.

2.2.2 Perceived Density

The other distinct approach in understanding density is the perceived density which is far more complex concept. Perceived density emphasizes the interaction between the individual and the environment; therefore, it is not the actual physical density, but the perception of density through this man-environment interaction that matters. Furthermore, perceived density not only addresses the relative relationships between individual and space, but also between individuals in space. In order to distinguish between these two different aspects of perceived density, the concept of spatial density and social density were introduced. Spatial density refers to the perception of density with respect to the relationship among spatial elements such as height, spacing and juxtaposition. According to Churchman (1999; p. 390) social or perceived density is 'an individual's perception and estimate of the number of people present in a given area, the space available, and the organization of that space'. The difference between spatial and social density is that the former stands for the actual number of people in a given space while the latter is 'created' by people in the space and both are experienced differently (ibid). Social density can be described as the interaction between people. It involves the various sensory modalities, the mechanisms for controlling interaction levels such as spacing, physical elements, territorial boundaries, hierarchy, the size and nature of the group involved, its homogeneity and rules for behavior, in which all of these qualities affect the rates of social interaction (Chan, 1999).

In the urban environment, the perception of density has been found to be associated with the built form and certain urban features. Rapoport (1975) outlined the importance of a list of environmental cues, which are thought to have effects on perceived density; these hypothesized factors include building height-to space ratio, building height, space openness, space complexity, the number of people, the number of street signs, traffic, light level, naturalness of the environment, and the rhythm of activity. Based on these parameters, Rapoport notes that environments having the same number of people may therefore have different perceived densities and it may even be argued that areas with fewer people may be perceived as dense (Rapoport, 1975:133-141).

Interesting findings have also come out of field research conducted at University of California at Berkeley. Graduate students of the College of Environmental Design did the work as a part of the course, "The Urban Environment.' A series of study in suburban communities conducted on a number of physical characteristics for their effect on perceived density found that perceived density is partly dependent on the amount of space between housed, the size of the front yard, variety of house styles, and views from the neighbourhood. Street width contributes mildly to the perception of higher density, and street trees do not affect perception noticeably, in other words, the less uniform the block, the lower the perceived density.

A more in-depth study conducted by the class in 1990 investigated the physical attributes that affected density perception at three different streets in San Francisco, chosen for having similar measured density (35-47 DU/Ac) but varying amounts of physical articulation in terms of the following attributes:

- Building articulation
- Variety of window and door pattern
- Architectural detail
- Typologies
- Street furniture
- Materials and colour variation
- Irregurlarity of facade silhouette

The results indicate that more single-family dwellings, more space between buildings, and smaller buildings on the street were signifiers of lower density. On the other hand, taller buildings, little space between buildings, large number of apartment buildings, and large number of windows were signifiers of high-density. Interestingly, architectural details associated with single-family homes contributed towards a lower perceived density. This implies that regulations should focus on the visual impact of a development rather than the aggregated density represented by the concentration of dwellings per acre. The practice of regulating for façade articulation, proportioning and coverage of windows, signage, etc. is commonly used for the regulation of commercial buildings, which can be used as a guide for the regulation of larger residential buildings. As a supplement, or perhaps an alternative, to existing regulations of density, building size and not density should play a more central role in impact mitigation. This is quite a logical solution if visual impact is more differentiable than density. Another significant finding of the report is that residents of dense areas were less concerned with the density of other seemingly dense neighbourhoods, ranking their own neighbourhood as the densest twice as frequently as others who do not live in their neighbourhood. This finding is consistent with Rapoport's theory, that when people are cognizant of social network and aware of the neighbourhood complexity, this feeds their perception of density in the neighbourhood.

By and large, research to date indicates that the perception of density is related to certain environmental cues; however, it is important to keep in mind that besides physical characteristics, individual cognitive and socio-cultural factors are also prominent, especially with respect to the notion of high density. There is not an explicit definition of high density; it varies from culture to culture and from person to person. The meaning of high density is a matter of perception; it is subjective and depends upon the society or individual's judgement against specific norms. Hence, societies or individuals of different backgrounds and under different contexts come up with different definitions of high density. For example, in the UK, residential development with less than 20 dwellings per net hectare is considered low density; between 30 to 40 dwellings per net hectare is considered medium density; and higher than 60 dwellings per net hectare is considered high density (TCPA, 2003). In the US, low density refers to 25 to 40 dwellings per net hectare; medium density refers to 40 to 60 dwellings per net hectare; and high density refers to development with higher than approximately 110 dwellings per net hectare (Ellis, 2004). In Israel, on the other hand, 20 to 40 dwellings per net hectare is considered low density, and 290 dwellings per net hectare is considered high density (Churchman, 1999).

Many people's perception of higher-density development does not mesh with the reality. Studies show that when surveyed about higher-density development, those interviewed hold a negative view. But when shown images of higher-density versus lower-density development, people often change their perceptions and prefer higher density. In a recent study by the National Association of Realtors and Smart Growth America, six in ten prospective homebuyers, when asked to choose between two communities, chose the neighborhood that offered a shorter commute, sidewalks, and amenities like shops, restaurants, libraries, schools, and public transportation within walking distance. They preferred this option over the one with longer commutes and larger lots but limited options for walking. The 2001American Housing Survey further reveals that respondents cited proximity to work more often than unit type as the leading factor in housing choice. Such contradictions point to widespread misconceptions about the nature of higher-density development and sprawl. Several of these misconceptions are so prevalent as to be considered myths.

The "myth" may relate to the methods used by some urban form researchers to make conclusions about the most sustainable urban form. Researchers such as Newman and Kenworthy (1996) have compared different cities using average density calculations to characterize the whole of the city as either compact/dense or dispersed. A common criticism of such an approach is the use of density calculations (measured as either population per area or residential dwellings per area) to represent different urban form types. Such large scale density calculations do not address the variations in density or form that exists within the large aggregated areas being calculated. There are also differences in land use patterns, physical design, social characteristics, and ecological conditions among places with the same overall density (Neuman, 2005 pp 21).

There are at least four aspects contributing to the misperceptions evident in the literature that are associated with people's negative reaction about high density:

1. Biases in policy and regulation,
2. Difficulty in measuring density;
3. Emblematic usage of density to imply different concerns; and
4. Lack of research on the impacts of higher-density housing.

In fact, some of these aspects have been around for more than three quarters of a century.

2.2.3 Effects of High Density

The positive outcomes of the high density debate can be listed as the following. Land is always a scarce resource in urban development; high building density, by providing more built-up space on individual sites, can maximize the utilization of the scarce urban land. High building density, therefore, helps to reduce the pressure to develop open spaces and releases more land for communal facilities and services to improve the quality of urban living. High people density, by providing a greater number of users, would sustain the use of the mass transit system and thus improve its efficiency and viability. High building density can help to protect the countryside and agricultural land from urbanization. On the other end of the spectrum, high building density, which is usually in the form of high-rise clusters, may impede the potential of building integrated renewable energy systems. The proximity of people and places brought about by both high building and people density offers a high degree of convenience for work, service and entertainment. In considering the advantages and disadvantages of high density, the distinction between building and people density has to be observed. In order to maximize the benefits of high density, thorough and comprehensive planning strategy is essential; otherwise, high-density development can lead to severe social and environmental problems. Good planning is important; but as to what makes good planning of high-density cities is another question.

Density and social interaction/social capital

High density is considered to increase the possibility of social interaction as people are in closer proximity to each other. The evidence regarding density and social interaction is inconsistent. Wood et al. (2008) examined the relationship between the development of social capital and observed indicators of walkable neighbourhoods (see above). They found that the built environment has small but positive effects on the development of social capital, but that the quality and type of destinations was as important as the quantity of walkable destinations. Mason (2010) also investigated the hypothesis that urban sprawl increases social stratification of communities and can negatively affect levels of trust, undermining social capital. She found that residents living in traditional compact neighbourhoods did display higher levels of trust but the environment was insufficient to overcome the negative effects on trust produced by income inequalities. Socio-economic indicators and demographics are, therefore, important influences on social capital, and health, but as Wood et al. (2008) note that these factors are less amenable to transformation than the potentially modifiable built environment. Promoting mixed tenure or mixed income communities may go some way to mitigating to negative neighbourhood effects. However, McDonald et al. (2008) in their "review of reviews" found evidence that the dislocation between work, home and amenities produced negative effects on health and wellbeing, and that social capital diminishes with increasing time spent in cars.

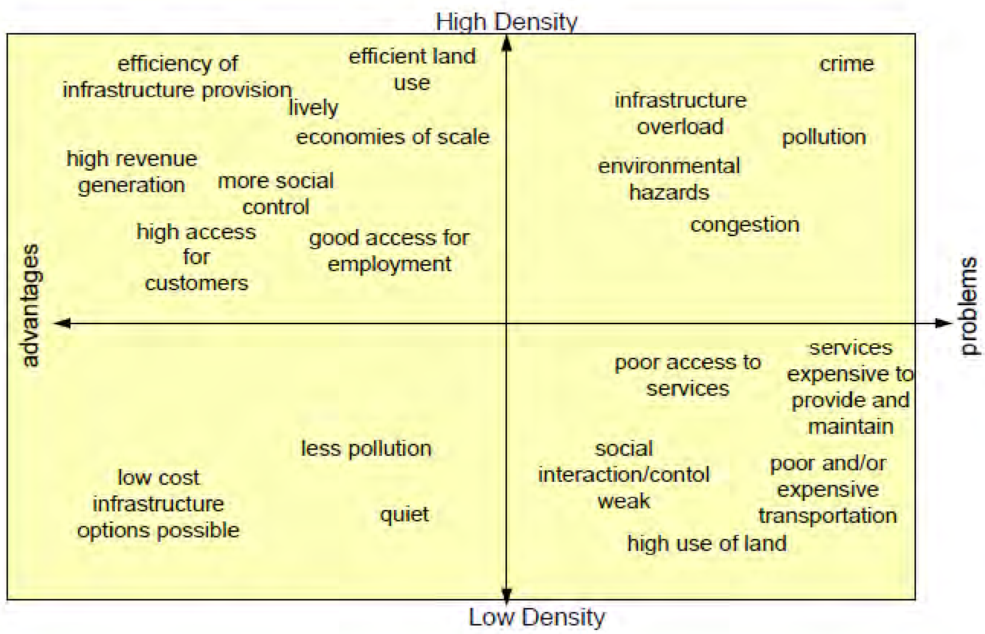
High density of population is to be associated with anti-social behaviors such as criminal conditions and infirmity (Michelson, 1970). Especially the experimental studies during the 1960s focuses on proving the relationship between overcrowding and anti-social behavior patterns by indicating its real results, such as decreased productivity, medical pathology and social disorganization. (Howard, 1976) In these studies there is a direct link between *density* and *crowding* and they are used interchangeably. Falsification of such claims comes from Stokols' socio psychological model on crowding phenomena. He points out that density denotes a physical condition, limitation of space. Despite the fact that crowding is a multi-dimensional phenomenon characterized by spatial, social and personal factors. Therefore, density and crowding should be distinguished from each other (Stokol, 1972). For Haughton and Hunter, arguments against high-density living fall to environmental determinism,

"High density does not necessarily equate with overcrowding, there being a world of difference between high-density living in high-rise residential blocks with low numbers of people per room, and overcrowding in low-rise shanty town developments, with high numbers of people per room." (Haughton et al., 1994: 82-83).

Additionally, international comparisons on crime rates also indicate that, large and much denser European and Asian cities including poor and dense Bombay/Mumbai have lower violent crimerates than less dense cities in America. Thus, higher crime rates can be related with specific cultural, political and economic conditions, rather than urban density (1000 Friends of Oregon, 2003b). Currently prevailing stance towards density issue is in favor of medium to high densities in the literature. Although it can be differently interpreted for a range of societies with separate urban cultures, high-density generally admitted as a positive aspect for the urban way of life.

Acioly and Davidson (1996:6) noted the advantages and disadvantages of high and low density as as they argued that high density assures the maximization of public investments including infrastructure, services and transportation, and allows efficient utilization of land. They also argued high density settlement schemes can overload infrastructure and services and put extra pressure on land and residential spaces, producing crowded and unsuitable environments for human development. On the other hand, low densities may increase per capita cost of land; infrastructure and services, affecting the sustainability of human settlements, and producing urban environment that constrain social interactions. Those advantages and disadvantages are summarized in Figure 2.4

Figure 2.4: Advantages and Disadvantages of High vs Low Density



Source: Adapted from Acioly C. and Davidson F., 1996

No single density (high or low) would be suitable for all situations and contexts. Each parcel of land being considered for any means of densification would have a number of variables, which would influence the level of density that could be achieved. Issues to be considered in the application of density policy are summarised as follows:

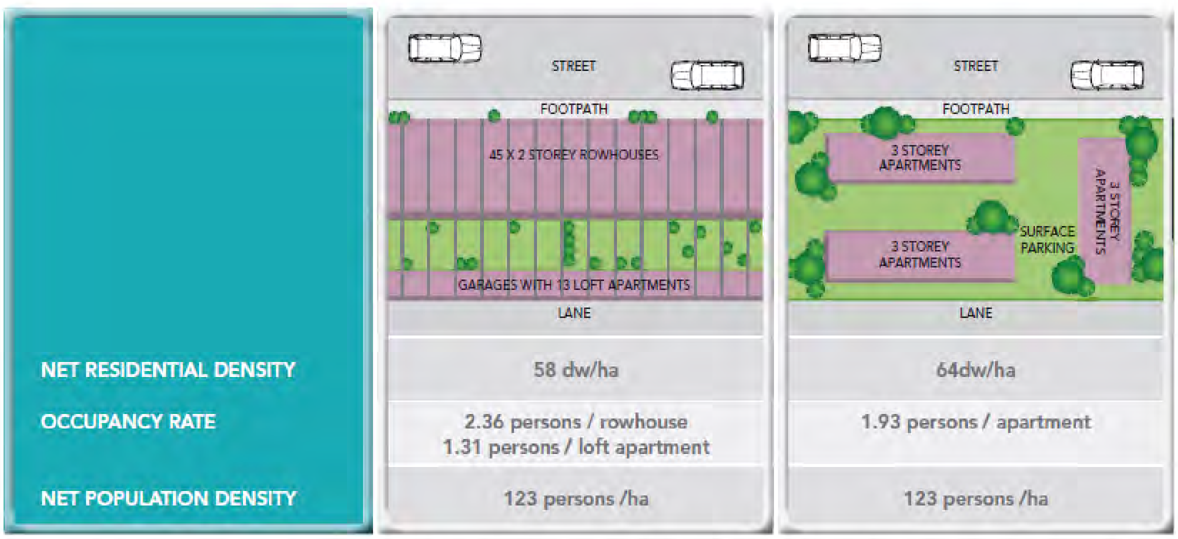
- The cost, availability and location of land
- Transportation and accessibility
- Socio-economic issues (household sizes, lifestyle)
- Environmental considerations
- Cultural issues
- Political position of government (local and national)
- Infrastructure planning (availability)
- Geological Constraints – especially dolomitic areas

The criteria or issues listed above should inform a development in terms of density decisions and how densification should be applied in certain areas. The context of an area will determine the appropriate density.

2.2.3.1 Relationship between Net Residential Density and Number of Occupants

Higher net residential density does not always equal more people. Occupancy rates will vary for different residential building forms. Apartments usually have fewer occupants. This means that a higher net residential density does not always guarantee a higher population density. The example on the next page demonstrates that if you had a 1ha site (made up of a 8,150m2 development site plus a street component of 1,850m2) and you planned to develop it with 45 two storey row-houses (each 5m wide) and 13 loft

Figure 2.5 : Same density with differing house forms



Population density depends on occupancy rates I Different house types and net residential densities can yield the same population density, due to varying occupancy rates.

Source: Residential Density Guide, Landcom, 1991

apartments above garages, this would yield a net residential density of 58dw/ha. At an occupancy rate of 2.36 people/row-house and 1.31 people/loft, this would result in a net residential density of 123 people/ha. The same site could be developed with 64 apartments in three storey buildings and would yield a higher net residential density of 64dw/ha. But because the occupancy rate for apartments is lower (1.93 people per apartment), the net population density would remain at 123 people/ha. In this case, a higher density development would house the same overall number of people.

2.2.3.2 Relationship between Building Types and Net Residential Density

The same building type can yield different net residential densities. A three storey apartment building on can yield a net residential density of 70dw/ha. But the same building form and height located on a smaller inner-urban site (one which has no setbacks) could yield up to 100dw/ha.

Figure 2.6: Same building type with different net residential densities

Source: Residential Density Guide, Landcom, 1991

2.2.3.3 Relation between Road Area and Net Residential Density

The smaller the land area allocated to roads, the higher the net residential density for the same land area. Narrower streets, longer blocks and fewer rear lanes often result in an increased net density. This is because street and block design directly impacts on dwelling forms. Designers should be aware that if you narrow public roads, this may reduce available street parking which may, in turn, lead to a requirement for more on site parking. For housing types with surface parking, this would most likely reduce net residential density.

2.2.3.4 Relation between Housing Type and Density

High density areas are often linked with low income while low density areas are linked with high income. It is assumed that the inhabitants of high density urban areas tend to live in smaller plots or dwellings, will have limited resources and will tend to have difficulties to access education, health, housing and basic public services. A social and economic profile that would differ radically from the inhabitants of low density areas where plots and houses are usually much bigger. This highlights the direct linkage between density and housing typology, urban standards and social economic development. As a routine, urban designers commonly use population density as a measurement reference, referring most of the time to gross population density. Apparently, Figure 2.5 provides some indications of implications of design decisions.

While keeping the same plot size of 125 m^2 and net population density of 400 inhabitants/ha, and varying the percentage of land allocated to residential use, one verifies that the net housing density (80 dwellings/ha) and the total land for residential use (12.5 ha) remain unchanged as the result of keeping the same plot size. As the percentage of land allocated for residential use increases (up to 65%), the total land needed to accommodate this population decreases drastically and the gross population density increases up to 260 inhabitants/ha. Thus increasing density should lead to an optimal use of essential development inputs - land and infrastructure. The decision on the trade-off between public and private domains has been made - it is acceptable that 60 to 65% of land allocated for residential use in a human settlement should lead to efficiency - however the urban standards will be also relevant, whether there will be wide roads or not, if local green areas and recreational spaces are concentrated or spread. Final costs will also depend on whether services are incrementally executed or ready-made.

If we decide to predefine 60% of land allocated for residential use as the criteria to accomplish settlement layout efficiency but varying the plot size to accommodate the same population, both housing and population densities increase and there is a substantial decrease in the total residential land and the total land needed. Decreasing the plot size at a ratio of 2.7 all densities will be increased at the same ratio. Thus the plot size determines most of outcomes. The smaller the plot the highest the density and less land is required to accommodate the same population. The question now is whether the plot size is culturally acceptable and financially marketable and again whether the urban standards respond to efficiency

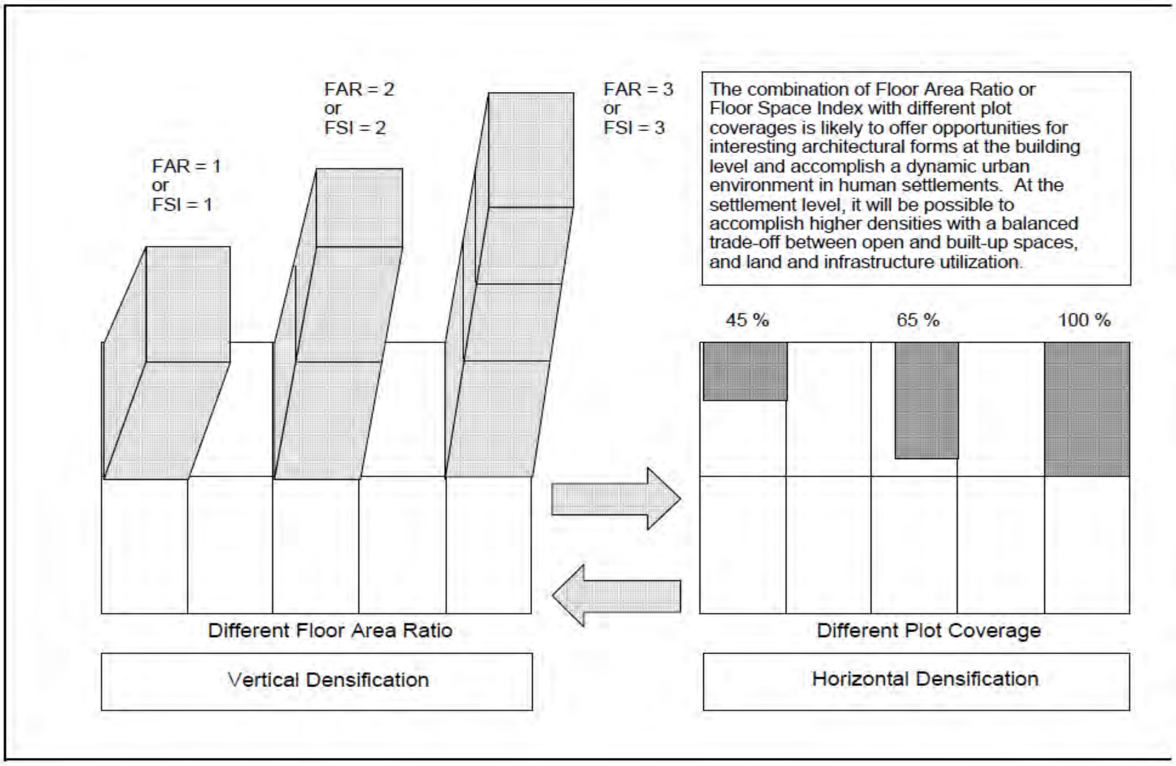
Table 2.1: Relation Between Floor Area Ratio and site coverage

Population					Land		*High rise housing*					Low rise housing				Settlement
Total Population	Persons per Household	Total Households	Gross Density (persons/ha)	Net Density (persons/ha)	% Residential Land	Individual Plot Size (sqm)	*Flat size (sqm)*	*Number of floors*	*Flats per floor*	*Number of blocks*	*Block size (sqm)*	Housing Density	Net Housing Density	Total Residential Land (ha)	Total Land Needed (ha)	Settlement Type
5,000	5	1,000	140	400	35%	125						28	80	12.5	35.7	Low rise - 1dwelling p/plot
5,000	5	1,000	200	400	50%	125						40	80	12.5	25.0	Low rise - 1dwelling p/plot
5,000	5	1,000	260	400	65%	125						52	80	12.5	19.2	Low rise - 1dwelling p/plot
5,000	5	1,000	120	200	60%	250						24	40	25.0	41.7	Low rise - 1dwelling p/plot
5,000	5	1,000	250	417	60%	120						50	83	12.0	20.0	Low rise - 1 dwelling/plot
5,000	5	1,000	333	556	60%	90						67	111	9.0	15.0	Low rise - 1 dwelling/plot
5,000	5	1,000	1,167	3,333	35%		*50*	*4*	*20*	*12.5*	*1,200*	233	667	1.5	4.3	High rise - 80 flats/block
5,000	5	1,000	1,667	3,333	50%		*50*	*4*	*20*	*12.5*	*1,200*	333	667	1.5	3.0	High rise - 80 flats/block
5,000	5	1,000	2,167	3,333	65%		*50*	*4*	*20*	*12.5*	*1,200*	433	667	1.5	2.3	High rise - 80 flats/block
5,000	5	1,000	2,000	3,333	60%		*50*	*4*	*20*	*12.5*	*1,200*	400	667	1.5	2.5	High rise - 80 flats/block
5,000	5	1,000	2,500	4,167	60%		*50*	*5*	*20*	*10.0*	*1,200*	500	833	1.2	2.0	High rise - 100 flats/blocks
5,000	5	1,000	3,250	5,000	65%		*50*	*6*	*20*	*8.3*	*1,200*	650	1,000	1.0	1.5	High rise - 120 flats/block

Source: Residential Density Guide, Landcom, 1991

requirements. If high rise housing alternatives are applied then the situation changes completely. Using a four storey high building with 20 flats of 50 m^2 per floor and increasing the percentage of land allocated for residential use, net population and housing densities remain unchanged but gross densities increase dramatically. In comparison to the low-rise solution, this alternative consumes far much less land but all infrastructure and services will be extremely concentrated. The case of Hong Kong shows this very well. The urbanized area occupies only 10% of the territory as a result of government policy towards high-rise high density developments that reach up to more than 5,000 persons per hectare. The settlement layout will be decisive in the definition of the trade-offs public-private domains, the amount of green areas, distance between buildings, parking places and the availability of infrastructure. Higher densities in this case imply an extensive use of the available land on one hand and on the other hand, it places a heavy occasional load on existing infrastructure like electricity supply, drainage, sewage and pavement for parking. In principle high densities are beneficial for water supply and sewerage networks. High density is not advantageous in relation to the electricity network since the increase and concentration of consumers will demand more strength for the system and eventually more power stations. High-rise multi-family buildings will place a demand for more public and open space.

Figure 2.7: Relation Between Floor Area Ratio and site coverage



Source: Residential Density Guide, Landcom, 1991

This brief discussion of this section highlighted the multidimensional aspects of density and how it should be handled when applied in the built environment to produce the desirable positive outcome. It also underlines a need to understand the way in which density is interpreted, both in theory and in practice, and its impact on the form and subsequent sustainability of a place. Within the context of Dhaka, the lack of consensus between theory, policy and practice arguably points to a requirement for residential densities to be examined on a case-by-case basis according to the policy in place at the time as well as the particulars of the place itself. In terms of further understanding density, the factors of sustainability and liveability need to be explored which is discussed in the following section.

2.2.3.5 Density & Urban Design Issues

Urban Design plays an important role on a number of scales of development in urban settlements and living environments. However, irrespective of the scale of application, it is always concerned with the nature and quality of the spatial relationships within human communities and their environment (i.e. be it with respect to economic, social or ecological relationships). It is always concerned with the performance of the environment for people.

- ✓ At the macro level (i.e. city, town and/or large precinct levels), it is about translation of strategic economic, social and environmental planning policy into integrated urban spatial systems of land use, activity and movement. It is about the structuring of urban areas in terms of efficient and sustainable functional relationships between various land uses and activities in space and time.

- ✓ At the micro level (i.e. city or town block, neighbourhood and/or street and building level), it is about the creation of high performance urban environments made up of distinctive neighbourhoods, streets, buildings and public and private spaces and places.

- ✓ At this level, its role is identifying and articulating the nature and effectiveness of the relationship between public and private space and the nature of the relationship between built form and open space

Urban Design can thus play an important part, firstly, in understanding the impacts of density on the living environment and secondly, in designing environments to accommodate the needs of communities living in different density situations.

2.3 Paradigm Shift from Conventional Development to Sustainable Development

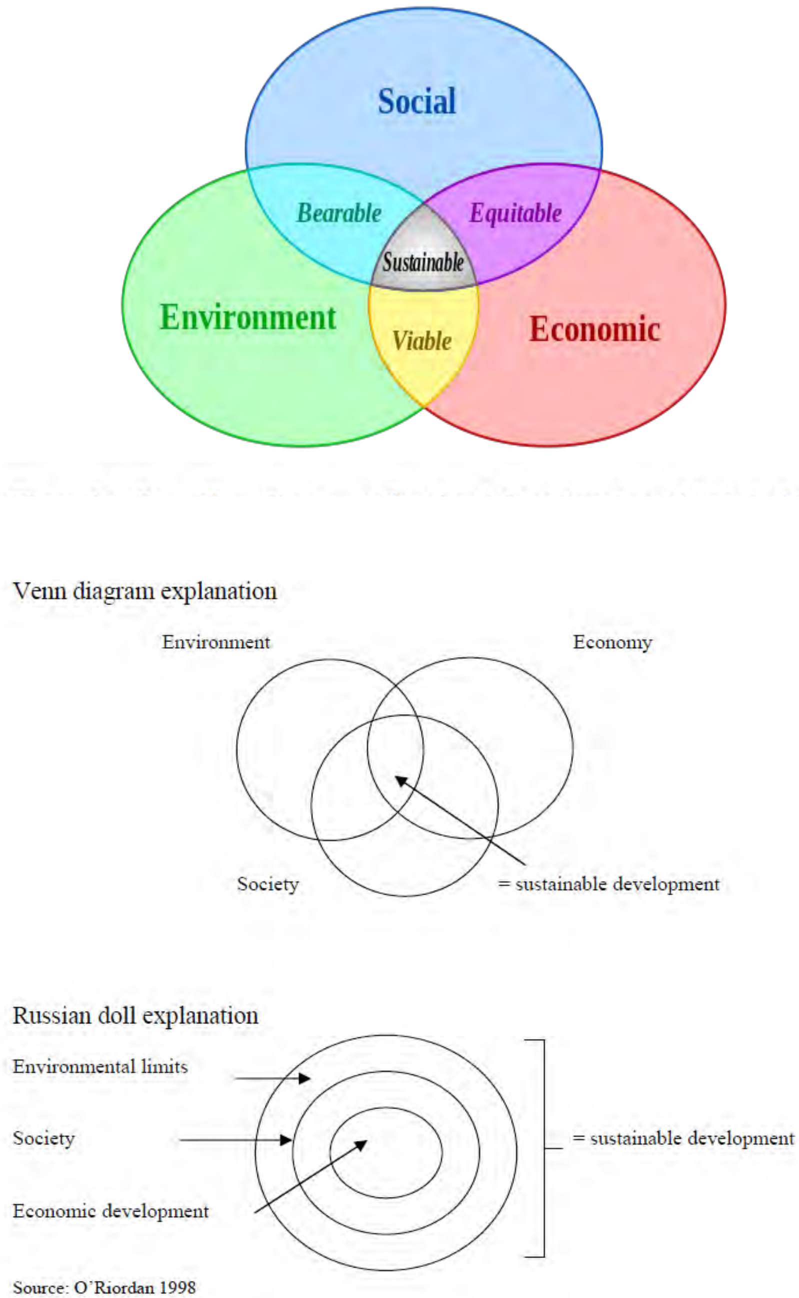
2.3.1 Sustainability and Sustainable Development

The concept of sustainable development has permeated mainstream thinking over the past two decades and had become a globally embraced new paradigm of development. Towards the end of the 1980s, the term sustainable development became more common and with the report "Our common future" written by the World Commission on Environment and Development, also called the Brundtland Commission (after Gro Harlem Brundtland, the Commission's Chairman) and published in 1987. In this report the commission states that:

> *"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs."*

The Brundtland approach has been criticized for being anthropocentric as well as too accepting of existing economic systems and the concept of continual economic growth. Since the conclusion of the Brundtland Commission two competing notions of strong and weak sustainability have dominated the theoretical debate on sustainable development. Loosely speaking, strong sustainability argues that we must live within the environmental and ecological limits that the planet clearly has. The strong sustainability assumption states that some amount of nature must be conserved in order to sustain well-being. Weak sustainability argues that humanity will replace the natural capital we have used, and that we depend on, with human-made capital. Theorists virtually unanimously agree that the latter has formed the conceptual basis for sustainable development.

Figure 2.8: Three Pillars of Sustainability (From Venn Diagram to Russian doll explanations of Sustainable Development)



Source: Adapted from O'Riordan, 1998

To a large extent sustainable development can be seen in terms of distributional justice. However, also total demand (i.e. the ways in which the world's population is able to meet its "needs" and "wants" is important). The extent to which these 'needs' are met indicates the level of human well-being. But human well-being depends not only on (basic) 'needs': the extent to which the 'wants' or preferences of people are met, is also important when assessing well-being. Further the term sustainable development and sustainability implies today three different aspects or dimensions of sustainability, namely social, economic and ecological or environmental/ ecological sustainability. Those dimensions are the basic element of sustainability and sustainable development (Munier 2005, Basiago 1999). Consisting of these three pillars, sustainable development seeks to achieve, in a balanced manner, economic development, social development and environmental protection.

Conceptually, there has been some movement towards greater sophistication of understanding, as demonstrated by a move from simple Venn diagram explanations for the interactions between the economic, environmental and social pillars of sustainable development towards a 'Russian Doll' or embedded model of understanding (O'Riordan, 1998; see Figure 2.8). The Russian doll model upholds the basic principle that all economic activity should be bent towards social progress and that this must be achieved within environmental limits. It, therefore, suggests a slight move away from the 'weak sustainability' model that was originally put forward by Brundtland towards a more eco-essential approach. Among the various models depicting sustainability the interlocking (Venn diagram) and concentric circle Models (Russsian Doll Model) are most popular methods of interpretating the various dimensions of sustainability. It should also be noted that the Economic and Environmental aspects of sustainability take on a more quantitative character and materially evident , whereas the Social aspect is qualitative and non-physical and depicted by such terms as, livability, sustainability, comfortability, satisfaction, sense of belonging, pride, etc. It is when the Economic and Environmental aspects are bent towards human welfare or well-being that the Social aspect is achieved.

2.3.2 Sustainable Urban Development

Although the general sustainable development debate has been going on for quite some time, it was not until the 1990s that it was commonly applied to cities (Hardoy *et al.* 2001, p. 339). While concerns with principles of harmonious relationships between humans, their settlements and the natural environment have long been central to the *planning of cities (Blowers 1993, Hall et al. 1993), the opportunity that cities provide in* explicitly promoting sustainable development goals has only been recognized more recently. The importance of participation in decision-making is highlighted by for example Mega and Pedersen (1998) and Jenks (2000).

> *"A sustainable city is one which succeeds in balancing economic, environmental and socio-cultural progress through processes of active citizen participation"*
> (Mega & Pedersen 1998, p. 2)

However, realization of visions of a sustainable city depends on cities being able to identify the issues and approaches best suited to their particular needs and circumstances. As the city develops, circumstances may change, as will the strategies for promoting sustainability goals. Even within cities priorities may vary and thus it is important that each city identifies context-specific strategic initiatives to promote sustainable development at the local scale. Planners are in a privileged position to identify a wide range of options for future development of cities, as they are constantly involved in a process that uses strategic thinking and future visioning as tools for strategy-making (Healey 2007, pp. 282-286).

2.4 Livability and Sustainability

Throughout the literature reviewed, it is found that there is a conceptual overlap between livability and sustainability. While several studies used these concepts interchangeably (Allen, 2010; Rue, Rooney, Dock, Ange, Twaddell, and Poncy, 2011; Sanford, 2011), a greater number of resources referred to livability and sustainability as separate and discrete concepts. The following analysis compares and contrasts livability and sustainability.

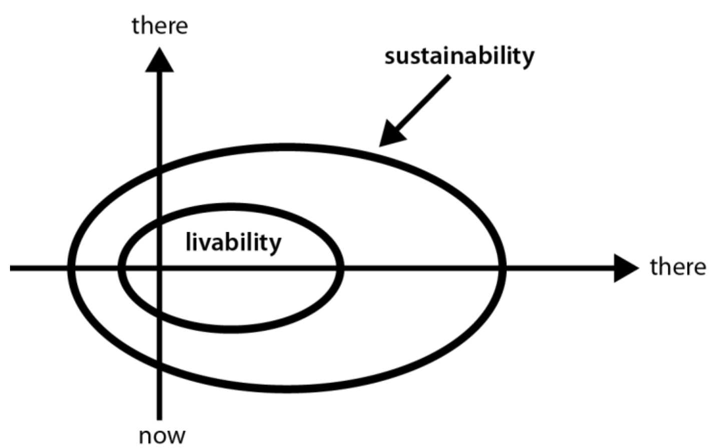
Sustainability

As mentioned earlier the most commonly used sustainability definition was created by the 1987 United Nations' Brundtland World Commission on Environment and Development. The Commission defined sustainability as meeting the needs of the present generation without compromising the ability of future generations to meet theirs. Despite the difficulties in defining the broad goal of sustainability, in its most basic sense, it clearly derives from an ambition to better reach collective aims of society. It is also referred to as the triple bottom line concept, because it includes considerations for the economy, the environment and social quality of life as illustrated in Figure 2.9.

Livability

Based on the literature reviewed, livability emerged as a way to describe tactics that local governments and regional planning organizations use to achieve the kind of sustainability goals described by the Brundtland Commission. Within this agreed framework a plethora of definitions for livability have been formed by various organization some of which have been presented below: *Livability* refers to the subset of sustainability impacts that directly affect people in a community, such as economic development, affordability, public health, social equity and pollution exposure at the present time. Though possessing

Figure 2.9 : Relationship between livability and sustainability



Source: Howley, Peter, Mark Scott, and Declan Redmond. *2*009

similarity in definition in terms of impacts the major difference between livability and sustainability is the scale and time period of their operation. Livability refers to the acceptable living condition of a built environment at *present* while sustainability is concerned with the existence of that living condition of the built environment in *future*. (Fig 2.9)

How they differ & How they are similar –Both livability and sustainability support economic development and environmentally sustainable travel options, and address social equity issues and human health. Though both the concepts are applied for achieving similar outcomes, they differ in terms of their scale and time of operation. Livability addresses community-level economic development, public health, social equity and pollution exposure while sustainability is concerned with the global level environmental implications. Livability is more concerned in improving the present condition of the environment rather than long term future environmental impacts.

Livability may be less focused on larger environmental goals and provide more specific and detailed strategies to improve transportation choices, accessibility, lower transportation and housing costs, coordinate federal policies and investments, and support existing options on a neighborhood and community level. Unlike the community specific goals of livability definition sustainability focuses on long term global goals for improving water and air quality, reducing climate impacts, decreasing green house gas emission, and increasing energy efficiency to sustain human society without harming the natural environment. So despite the conceptual overlap between livability and sustainability appearing throughout the literature, they support a discrete but complementary role.

2.5 Interdependencies between density and sustainability issues

Several recent studies suggest that strategies for more compact urban development through higher densities can have both positive and negative effects on a sustainability agenda (eg, Bramley & Power, 2009; Howley *et al.,* 2009; Lin & Yang, 2006). In the UK, Bramley and Power (2009) found that while denser, more compact urban form offers improved access to services, it was also frequently linked with higher levels of resident dissatisfaction and higher incidence of neighbourhood problems such as crime, litter, and traffic. Thus urban form is associated with trade-offs between disparate dimensions of sustainability. A previous study in Wales by Senior *et al.* (2006) provides similar conclusion suggesting that given the option, owner-occupier households prefer semi-detached and detached homes in suburban areas over options in higher density mixed-use areas.

The findings of Howley *et al.* (2009) on neighbourhood satisfaction in new apartment developments in central Dublin imply that while the public may support sustainability principles, people perceive high density as compromising quality of life. Quantitative results indicate a greater degree of neighbourhood dissatisfaction in high-density residential areas than was present nationally. Qualitative results from their study, however, suggested that people's main concern was not necessarily high-density itself but rather other elements of the physical environmental such as litter, pollution, lack of greenery, noise, traffic, parking, and access to services. The authors concluded that achieving sustainable urban form requires more than simply increasing residential densities. Planners must work to create environments that meet both sustainability and liveability objectives (Howley *et al.,* 2009).

This overview examines the relationship of density and sustainability in terms of built environment, from the economic, environmental and social-equity perspectives. According to Jenks and Jones (2010) the sustainability goals are clearly linked to the preferred measures of compact city development, namely densification and mixed use development. The relationship between residential density and sustainability is complex. Studies linking high density development with sustainability have had mixed results (Jenks *et al.,* 1996). While some authors identify density as a critical element of sustainable urban form (Jabareen, 2006), others question planning's over-reliance on a primary operational measure (Neuman, 2005; Berke & Conroy, 2000; Gordon & Tamminga 2002).

Though compact city claims to be beneficial and in reducing automobile trips and promoting walking scholars like Hall (2001: 201) in his review of empirical studies on the effect of urban form on transportation, noted that findings from many studies were 'not consistent' and were often 'confusing'. Neuman (2005) also asserts that many studies have focused on one parameter of travel, such as distance or time, rather than making broader assessments. Guiliano (1995: 3) similarly noted that 'the precise relationship between transportation and land use continues to elude us'. Burton's (2000) study of compact, high-density urban form in mid-sized English cities indicated that increased compactness can have both positive and negative effects on social equity. While increased compactness was associated with improved public transit use and better access to commercial amenities, it was also likely to be related to four negatives aspects: less domestic living space, a lack of affordable housing, increased crime, and lower levels of walking and cycling.

Nonetheless increases in density should be considered as part of coordinated land use plans, rather than in isolation. There are many possible co-benefits from land use policies that encourage higher residential densities, concentrations of employment, shopping, and service destinations, and infrastructure and urban design that make non-motorized travel modes (e.g., walking and bicycling) more attractive options. Increases in non-motorized travel might bring health benefits, and there is evidence that land use characteristics, including higher residential density, are associated with increased walking (Boarnet, Greenwald, and McMillan, 2008; Boarnet et al., 2011). However, this should be handled cautiously, as increases in walking might partially compensate for reductions in other kinds of physical activity, and so health benefits may not scale one-for-one with increases in walking (Rodriguez, Khattak, and Evenson, 2006). The shifting of trips from motorized to non-motorized modes will also have positive impacts on local and regional air quality. More generally, the land use elements associated with non-motorized travel are often associated with vibrant neighborhoods, and hence might be associated with resident satisfaction. Yet density by itself may not be the most important variable for community livablity. According to Song and Knaap (2003), factors such as street connectivity, transit access, and pedestrian access to shopping were associated with higher house prices, which is consistent with those neigbhborhood characteristics being more valued by home buyers, but density, after controlling for those other factors, had a small but negative association with house prices.

Ideally, a well-designed compact city should be able to achieve all of the above-mentioned forms of sustainability benefits; as a result, the compact city becomes an all-encompassing concept for urban planning practices (Dempsey & Jenks, 2010, p. 119). Density is an issue that touches many other sustainability issues. For example, national, local and site-based policies and guidance point to the strong connections between density and good design, suggesting that a well-designed development allows for higher densities, which in turn bring vitality and viability to a place (DETR, 2000). Higher densities also help to shape an area by influencing the design of streets, spaces and the placement of services and amenities in a sensitive manner (DETR, 2000, 2001; Llewelyn-Davies, 2000). In addition, policies demonstrate that density is related to maintaining an existing residential area's character, reducing travel, affordable housing and efficient use of land (DETR, 1998).

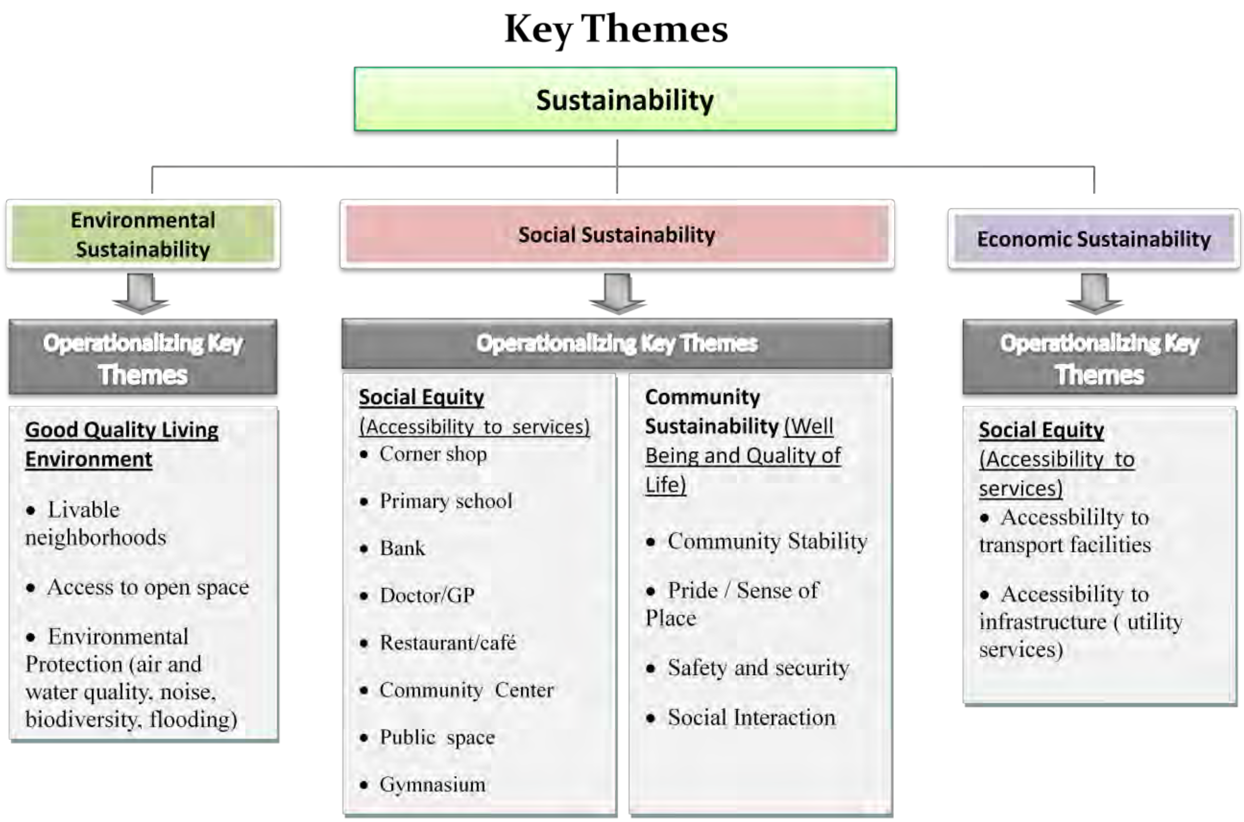
In sum, a brief review of the literature indicates that the link between density and sustainability is complicated. Although higher densities may contribute to achieve sustainability benefits when applied with caution, but otherwise high-density housing can have negative implications for residents.

2.6. Sustainable city and sustainability indicators

Indicators are important in holding governments and communities accountable to their sustainability targets and goals (Newman & Jennings 2008). Indicators provide data to guide policy-making and allow for comparisons to be made across municipalities and regions. The impacts and challenges of sustainability policies and plans on the urban environment can also be shown through indicators (Munier 2005).

2.7 The Conceptual Framework of Research – Operationalizing key terms

Figure 2.10: Operationalizing key themes of sustainability



Source: Author. 2014, Adapted from Jones et al., 2010a, p. 244, Bramley et al., 2010

Indicators are most useful in sustainability planning when linked to sustainability thresholds or targets. Thresholds are scientifically determined points where the state of things will change dramatically. Targets are often determined by policy makers or through public consultation and point to levels that must be met in the future if sustainability goals are to be reached. There are a number of issues associated with the selection, use and reporting of sustainability indicators. Since the theoretical and practical basis of planning is rooted in the understanding and shaping of the built environment, it is important to consider the link between urban form and dimensions of sustainability and how these terms can be operationalized in the pursuit of empirical research.

In recent years, the stated goals of economic as well as *social* sustainability have appeared with growing frequency in policy documents, including within the field of planning (Bramley *et al.*, 2006:2). Social sustainability rests on the assumption that if urban forms are considered unacceptable to people, they cannot be sustainable; social justice, social inclusion, social capital, and social cohesion are at the core of this concept (Jones et al., 2010a, p. 244, Bramley et al., 2010). Compact cities that are densely built and have mixed land use are anticipated to create a better quality of life by creating more social interaction, community spirit, and cultural vitality; this is due, in part, to the proximity to services, work, shops, public transportation, and the opportunity for walking and cycling that compact cities provide (Jenks & Jones, 2010, p. 9). Moreover, the positive impacts of compact cities are also thought to reduce crime and to lower levels of social segregation (Burton, 2000).

Table 2.2: Relationship between dimensions of Density and aspects of Sustainability

Aspects of social sustainability that are affected by physical density	**Aspects of social sustainability that are affected by perceived density**	**Aspects of social sustainability that are affected by physical and perceived density**
• Accessibility to community facilities • Health of the inhabitants	• Community sustainability and social interaction • Sense of safety	• Amount of living space
Aspects of environmental sustainability that are affected by physical density	**Aspects of environmental sustainability that are affected by perceived density**	**Aspects of environmental sustainability that are affected by physical and perceived density**
• Accessibility to open space • Access to daylight • Visual Discomfort by surrounding buildings	• Noise	• Satisfaction of the residents' with the livability condition of their neighbourhood
Aspects of economic sustainability that are affected by physical density	**Aspects of economic sustainability that are affected by perceived density**	**Aspects of economic sustainability that are affected by physical and perceived density**
• Accessibility to transport facilities • Accessibility to infrastructure (utility services)		

Source: Author, 2015, Adapted from Demsey, 2012 and Dave, 2009

Therefore it can be said that for the social elements of sustainability, the built environment can enable healthier lifestyles and greater community cohesion through design. It can also contribute to a greater sense of wellbeing. Key factors that are assumed to be responsible for social well being include equity, understanding, diversity, inclusion, quality of life, opportunity and individual empowerment. In relation to the built environment, social equity means paying attention to the nature and extent of accessibility to services and facilities in a given area (Dempsey et al, 2012, p.94). Social sustainability can therefore be summarized under two broad perspectives: accessibility and quality of life. This research evaluates social sustainability from these two perspectives. In order to measure these two key factors the major aspects of sustainability related to them have been identified to form the observable sustainability indicators. The conceptual framework for this research tries to operationalize the three dimensions of sustainability namely, social, environmental and economic sustainability in terms of the built environment perspective which is summarized in Table 2.2. Sense of community is more related with the psychological attachment and belonging to a place as well as a measure of the degree to which an individual is motivated to participate in the betterment of the community. Finally, resident satisfaction is an important measure of individual interpretation of quality of life/livability and the level of stability in the community.

When it comes to the economic dimension of sustainability, a city's economy is determined by the operation of commercial property and housing markets, its transport infrastructure, and the distribution of incomes and age structures (Jones et al., 2010b, p. 160). The economic sustainability has been evaluated from the perspective of transportation and quality of services (water, electricity, gas, sewerage and disposal of waste). Environmental sustainability combines the status of the physical environment with the effects of the use of natural resources. The environmental sustainability is evaluated from the two interlinked aspects of environmental protection and neighbourhood livability. All these aspects of social, economic and environmental sustainability are then expressed through a set of sustainability indicators selected from secondary sources which are discussed in Chapter 3.

As discussed earlier the density can be conceived through two dimensions: physical and perceived density. One of the chief objectives of this research is to evaluate the impact of density on the sustainability of the residential areas. Therefore in order to measure physical density the most appropriate density indicator of residential area should be selected which, is the net residential density. But due to the unavailability of this data for the study sample wards the available ward wise gross residential density and residential population density measure have been selected for this research. Both these data have been collected from DAP 2010. The residential population density has been calculated based on the ward wise projected population of 2015. The method of selecting the indicators has been elaborately described in Chapter 3.

2.6 Conclusion

This Chapter underpins the theoretical premises regarding the concepts of density and its implications in the context of sustainable urban development. The various aspects of urban compaction and sustainability have been critically discussed through evaluating the impact of densification on cities from the sustainability perspective. In addition the link between sustainability and livability has been established through exploring their similarities and differences in terms of spatial and temporal dimensions. Then the concepts of density and sustainability are explained from the urban planning context and operationalized into key themes to form the conceptual framework for this research. These key themes are then translated into a set of relevant indicators for the selected aspects of sustainability which are discussed in the Chapter 3. Based on these conceptual interpretations of the key terms the ongoing densification process has been evaluated in the following Chapters.

Chapter 3: Research Methodology

3.1 Introduction

In the first Chapter the research questions and objectives of this study have been outlined with a brief introduction of the methodology. Chapter two provided a critical discussion about the existing literature which helped to set the theoretical framework relevant to this research. This Chapter therefore firstly focuses on the theory that underpins research methodology and is followed by the methods adopted to conduct this research according to the research framework. The research processes have been elaborately discussed in line with the research objectives. The Chapter also points out the methods and instruments used for selecting and analyzing the transformation of residential areas through densification. It describes methods used to capture the densification processes, people's views in relation to observations on how they perceive density in terms of their current living environment and its ensuing impact on livability. This chapter outlines how the research was designed as well as gives reasons for the selection of research methodology and why they are considered suitable for approaching the research objectives.

3.2 Selection of Research Strategy and its Rationale

The term methodology refers to a way to seek answers and deal with problems. Methodology represents the underlying theory and analysis of how research does or should proceed and traditionally is influenced by the research discipline. Assumptions, interests and purposes shape the choice of methodology adopted (Blaxter, 1997). In order to understand the process of densification a systematic approach is needed to explore the perceptions and attitudes of the inhabitants and other stakeholders regarding the changes taking place in their built environment and what are causing these changes thus identifying the potentials and possible risks associated with the transformation process. Understanding the process of densification of the residential areas in Dhaka is a complex process and calls for an exploratory descriptive explanation of the phenomenon.

Exploratory research is characterized as flexible a versatile and often represents the front end of total research design when the researcher defines the research problem. Exploratory research helps to determine the most appropriate research design and data collection methods. The methods traditionally adopted at this stage include expert surveys, pilot surveys, secondary data and qualitative research (Wisker, 2001). Descriptive research is used to describe market characteristics or functions, data and characteristics about the population or the phenomenon being studied. Descriptive research answers the types of questions those says, *who, what, when, where and how* and is characterized by the prior formulation of specific hypotheses and preplanned and structured design. Descriptive research provides facts; nonetheless, it cannot explain what caused a situation. Explanatory research in contrast, seeks an explanation of a situation or a problem, traditionally but not necessarily in the form of causal relationships, and explains patterns relating to the phenomenon being researched (Robson, 2005).

The focal point of the thesis is on the densification strategy which is postulated as a means of transforming the residential areas into sustainable settlements. The appropriate questions are 'how' and 'what' is taking place in relation to the application of this strategy on the planning of residential areas. The focus, therefore, is a combination of descriptive and exploratory accounts towards understanding the process, problems and outcomes of densification in the residential built environment transformation. The process of densification involves a chain of actions and their actors. The analysis of the transformation and subsequent changes in the residential environment and spatial qualities need to be examined through the analysis of primarily qualitative socio-cultural data with primarily quantitative physical density data. As this involves analysis of both quantitative and qualitative data the mixed methods research design approach seems to best match the research problem. Thus the mixed methods research methodology have been considered and selected as an appropriate research strategy.

Creswell defines the Mixed Methods research design as:

> *Mixed Methods research is both a method and methodology for conducting research that involves collecting, analyzing, and integrating quantitative and qualitative research in a single study or a longitudinal program of inquiry (Creswell, 2003)*.

A mixed methods approach is advantageous in which the researcher tends to base knowledge claims on pragmatic grounds (e.g., consequence-oriented, problem-centered, and pluralistic) according to Creswell (2003). It employs strategies of inquiry that involve collecting data either simultaneously or sequentially to best understand research problems. The data collection also involves gathering both numeric information (e.g., on instruments) as well as text information (e.g., on interviews) so that the final database represents both quantitative and qualitative information. The purpose of this form of research is that both qualitative and quantitative research, in combination, to provide a better understanding of a research problem or issue than either research approach alone. The mixed methods design seems to best serve the purpose of this research as the intent of this design is to form a better understanding of the densification process as an approach towards sustainability of the residential areas of Dhaka Mega city through exploring its causes and consequences.

The mixed methods research methodology has been identified to evolve into 40 types of designs in literature by Tashakkori and Teddlie (2003). The designs have been differentiated by the level of prioritization of one form of data over the other, by the combination of data forms in the research process (such as during the collection or analysis phases), and by the timing of data collection, such as whether the quantitative and qualitative phases take place concurrently or sequentially, and if so, in what order (Creswell, Fetters, and Ivankova 2004; Datta 2001; Johnson and Christensen 2004; Tashakkori and Teddlie 2003). In order to summarize the numerous design types methodologists like Creswell, Plano Clark, et. al (2003) have integrated mixed methods research and classified into 4 major types which are the Triangulation Design, the Embedded Design, the Explanatory Design and the Exploratory Design.

Triangulation mixed methods procedure is a one-phase design in which researchers implement the quantitative and qualitative methods during the same timeframe and with equal weight. For its single-phase timing it is also known as the “concurrent triangulation design” (Creswell, et al, 2003). It generally involves the concurrent, but separate, collection and analysis of quantitative and qualitative data so that the researcher may best understand the research problem. The researcher attempts to merge the two data sets, typically by bringing the separate results into one overall interpretation. According to Patton (1990) triangulation design brings together the differing strengths and non-overlapping weaknesses of quantitative methods (large sample size, trends, generalization, etc.) with those of qualitative methods (small N, details, in depth). This research employs the triangulation mixed methods design as it involves collecting different but complementary data on the ongoing densification phenomenon which best matches research questions. In this study an elaborate questionnaire survey was administered exploring the relationship between density and various aspects of sustainability with their negative and positive association. Concurrent with this data collection qualitative data comprising of interviews with the relevant officials and stakeholders will complement in exploring the underlying causes of densification.

The triangulation mixed methods research are further classified into four variants which are the convergence model, the data transformation model, the validating quantitative data model and the multilevel model. This research follows the convergence model. According to Creswell (1999) the convergence model represents the traditional model of mixed methods triangulation design where the researcher collects and analyzes quantitative and qualitative data separately on the same phenomenon and then the different results are converged (by comparing and contrasting the different results) during the interpretation. Researchers use this model when they want to compare results or to validate, confirm, or corroborate quantitative results with qualitative findings. As this study is based on an array of multiple types of qualitative and quantitative data of variedly different formats, the transformation of these data into a single type for analysis and interpretation is not possible. Rather the convergence model which allows the different results of multiple data type to merge by way of comparing, contrasting and corroborating into an overall interpretation to about a single phenomenon better suits the objectives of this research. As the purpose of this research is to deliver a valid and well-substantiated conclusions about the densification of residential areas the convergence model is found to be most relevant for this study because the quantitative survey results about density and sustainability aspects needs to be converged with their qualitative focus group findings as well as the secondary data analysis findings to better understand the causes and consequences of densification.

3.3 The Research Framework

As mentioned in Section 1.3 in order to investigate the causes and consequences of densification of residential areas in the context of Dhaka three research questions have been set. As the research questions encompass broad area of enquiry an objective has been set against each research question to facilitate in data collection and analysis. In order to fulfill the objectives the research has adopted the mixed methods approach utilizing the triangulation convergence model which allows the results of quantitative and qualitative analysis to merge during the interpretation. The research framework is illustrated in Figure 3.1. The method of data collection and analysis for each of the objectives is discussed below:

The methodology for obtaining the first objective regarding the first research question is fulfilled through field survey and observations in the study areas. Data regarding current land use pattern, spatial organization, and house types of the case study sample wards were collected through field survey. This was complemented by the analysis of satellite images in a chronological order to determine the trend of densification. In addition a block level survey was conducted to examine the densification processes of the study areas through analyzing the density attributes of built forms. In the procedure of actual calculations of built density (FAR) for the housing blocks, site measurement as well as base maps and Google Earth satellite images have been used. For all cases, building footprint is measured and called "plot coverage". The summation of total plot coverage of all the houses within a block is denoted by "block coverage". Recordings of the interviews of residents were used alongside notes and policy documents, which helped create a more holistic and complex understanding of the areas being studied.

In order to meet the second objective in line with the second research question data from secondary sources were collected and subsequently analyzed following several methods. Academic literature and policy documents were examined, whilst comparing and contrasting arguments, to help draw conclusions about the role of socio-economic and political forces responsible for the ongoing densification process. In-depth interviews with focus groups were conducted where qualitative data was collected using a semi-structured interview utilizing open-ended questionnaire complementing the secondary data analysis. The focus group interviews and discussions helped to identify organizational, administrative, political factors which partly explain the causes of densification. In order to frame the analysis of the qualitative data collected from interviews key arguments were identified, annotated and compared to construct a meaningful interpretation of the causes of the ongoing densification phenomenon.

For the attainment of the third objective associated with the third research question first, a questionnaire survey was administered in the seven case study sample wards of Dhaka. The questionnaire survey used multiple indicators, which were developed for the research to measure the levels of social, environmental and economic sustainability. The residential areas of the sample wards with differing densities were found appropriate to evaluate and the compare the impacts of density on various aspects of sustainability. Second, informal interviews to collect data related to residents' perceptions of densities, socio-economic data and many other aspects related to living condition as well as sustainability of the residential areas.

3.3.1 Methods of Data Analysis and Presentations

Simple, understandable and transparent methods were used to analyze the data. The initial analysis used simple correlations (Pearson's and Kendall's) to examine the basic relations among different variables as shown in Figure 3.2. This analysis was carried out to answer the third objective of this research which was to establish the relationships between the key variables of density and each selected aspect of social, environmental and economic sustainability. Figure 3.2 explains the analytical process in relation to the relationships that were examined. As shown in Figure 3.2 the physical density measurement – gross population density as well as that of perceived density indicators of the neighbourhood – and each of the selected aspects of social, environmental and economic sustainability, were examined to assess the impacts of density on sustainability of the selected residential areas. Each sustainability impact was examined individually using the same methods, to have control over the variables as well as the process. A5 point Likert scale ranging from very dissatisfied, dissatisfied, moderately satisfied, satisfied and very satisfied was adopted to serve as measuring instrument for residents' satisfaction level of the various built environment components of residential satisfaction.

Finally in alignment with the mixed methods triangulation convergence model all the results derived from separate analysis of quantitative and qualitative data are compared and corroborated to form a well substantiated interpretation to gain a contextual understanding of the causes and consequence of densification in the residential areas of Dhaka.

Fig 3.1: The Research Methodology

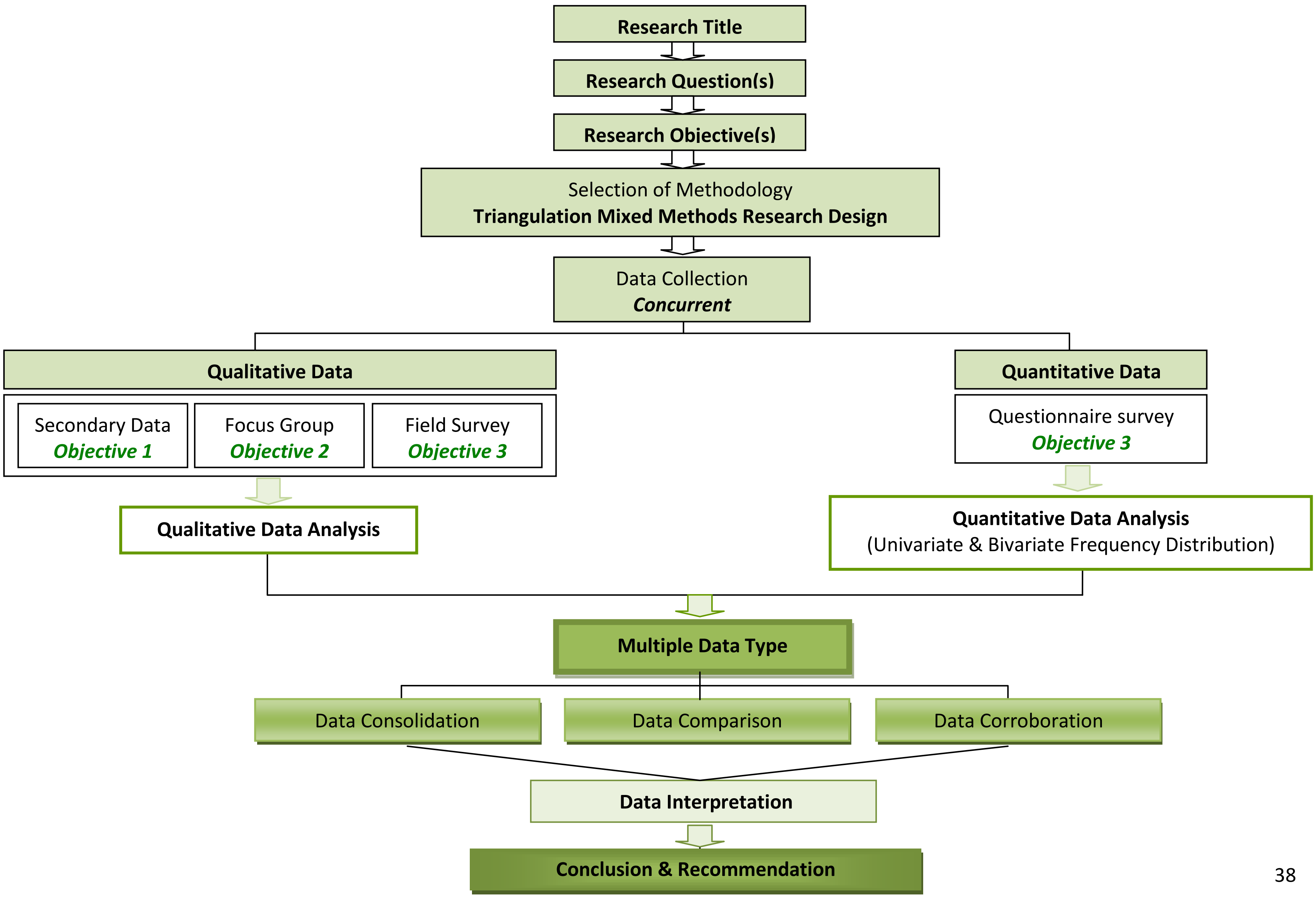


Fig 3.2: Analytical Process

Indicators of Environmental Sustainability

1. Neighbourhood Livability
- Perceived neighbourhood in terms of attractiveness, architectural character, well maintained buildings, Average number of park per 1000 people, outdoors, parking facilities, cleanliness, privacy

2. Access to daylight
- Percentage of households with rooms having inadequate daylight or in which lights have to be put on during the daytime.
- Percentage of plots in which the residents are having visual obstructions from surrounding buildings.

3. Environmental Protection
- Measured level of noise within the area
- Perceived problem of noise pollution within the neighbourhood

Relationships between physical and perceived density to indicators of each aspect of environmental sustainability are examined.

Indicators of Economic Sustainability

1. Accessibility to Transport Facilities
- Availabillity to public transport facilities
- Average distance to nearest daily use transport nodes

2. Accessibility to Utility services
- Well maintained infrastructure

Relationships between physical and perceived density to indicators of each aspect of economic sustainability are examined.

Density Indicators

Main Physical density indicators
- Gross population density/ward

Main Perceived density indicators
- Residents' perception of their neighbourhood in terms of space between buildings (*crowding of buildings)*
- Residents' perception of their neighbourhood in terms of number of people (*crowding of people)*
- Residents' perception of their size of home (*crowding within dwelling)*

Relationships between physical and perceived density to indicators of each aspect of social sustainability are examined.

Indicators of Social Sustainability

1. Accessibility to community facilities (ensuring social equity)
- Average distance to nearest daily use shopping center, vegetable/grocery market, health facilities, primary school, mosque, bank, community centre, Gymnasium
- Average number of shopping centers, vegetable/grocery markets, health facilities, primary schools, mosques, banks, community centres, Gymnasiums per 1000 people.

2. Amount of living space
- Floor area per person
- Perceived level of satisfaction with the size of home.

3. Health of the inhabitants
- Self-reported health of the residents in terms of number of family members having stress related or pollution related or no health problems.

4. Community stability
- Perceived number of social contacts (knowing people) within the neighbourhood
- Perceived number of informal chatting with neighbours.
- Involvement in various community activities at various levels in the last 12months.
- Perceived friendliness of the neighbourhood.

5. Sense of safety
- Perceived safety within the neighbourhood during daytime.
- Perceived safety within the neighbourhood after dark.
- Perceived vandalism in the neighbourhood.

The intervening variables were controlled while examining the relationships.

Other Intervening variables

Socio-demographic variables
- Location of the neighbourhood within the city
- Type of ownership
- Years of residency in the neighbourhood
- Family Income
- Level of Education

Building Form variables
- Building form
- Building Type
- Average number of flats/ buildings
- Floor area/ family
- Site Coverage
- Average number of floors/ building

3.4 Selection of Indicators

Based on the theoretical underpinnings discussed in Chapter 2 the relationship between the aspects of density and sustainability has been established and presented in Table 2.3. Therefore on the basis of each aspect of social, environmental and economic sustainability the following lists of indicators have been developed:

As discussed earlier in Chapter 2, social sustainability in its broadest sense can be understood through the concepts of social equity and wellbeing of the society. The social equity of the residents can be achieved through ensuring the equal accessibility and availability to amenities, while wellbeing of the society depends on health, amount of usable space, social cohesion, protection of the overall neighbourhood and community. In relevance with the characteristics of study areas these aspects have been translated into a set of measurable indicators. Therefore, a total of 24 indicators presented in Table 3.1 have been selected for this research to assess the social sustainability of the residential areas.

Table 3.1: List of social sustainability indicators

Aspects of social sustainability	**List of indicators**	**Number of indicators**
Accessibility to community facilities	• Average distance to nearest daily use shopping center, vegetable/grocery market, health facilities, primary school, mosque, bank, community centre, Gymnasium • Average number of shopping centers, vegetable/grocery markets, health facilities, primary schools, mosques, banks, community centres, Gymnasiums per 1000 people.	16
Amount of living space	• Floor area per person • Perceived level of satisfaction with the size of home.	2
Health of the inhabitants	• Self-reported health of the residents in terms of number of family members having stress related or pollution related or no health problems.	3
Community stability	• Perceived number of social contacts (knowing people) within the last 12months. • Perceived number of informal chats with neighbours • Perceived friendliness of the neighbourhood.	3
Sense of safety	• Perceived safety within the neighbourhood during daytime. • Perceived safety within the neighbourhood after dark.	2

Sources: Adapted from Angel, et, al., 2010, Dave, 2009; Neighbourhood Sustainability Indicators Guidebook, 1999; Seattle Sustainable Neighbourhoods Assessment Project, 2014.

Environmental sustainability can be achieved from on environmental equity that puts forth focus on equitable provision of access to green and open space (Demsey, 2012). Environmental sustainability also ensures human benefit through utilizing natural energies (sunlight, airflow etc) and protecting from man made pollution. So accessibility to open space and protection from environmental pollution are two basic aspects associated with the environmental sustainability of the built environment. For this research these key aspects have been translated into 11 indicators (Table 3.2) to assess the environmental sustainability of the study areas. Residents' satisfaction towards livability is also a important measure of urban form which has been assessed in terms of perceived attractiveness, architectural character, well maintained buildings, parking facilities, clean environment, privacy of the residential areas.

Table 3.2: List of environmental sustainability indicators

Aspects of environmental sustainability	List of indicators	Number of indicators
Accessibility to open space	• Average number of parks per 1000 people	1
Access to daylight	• Percentage of plots with adequate daylight or plots with lights have to be put on during the daytime. • Visual obstruction by surrounding buildings	2
Environment Protection	• Perceived problem of noise pollution within the neighbourhood • Measured level of noise within the neighbourhood	2
Residents' satisfaction about the livability condition of the residential area	• Perceived residential area in terms of attractiveness, architectural character, well maintained buildings, parking facilities, clean environment, privacy	6

Sources: Adapted from Angel, et, al., 2010, Dave, 2009; Neighbourhood Sustainability Indicators Guidebook, Mineapolis, 1999; Seattle Sustainable Neighbourhoods Assessment Project, 2014; In-depth Report: Indicators for Sustainable Cities, 2015.

From the literature survey it is seen that economic sustainability can be understood through equitable access to transport and infrastructure facilities. This research therefore selects these two aspects for developing the 6 indicators as presented below in Table 3.3. These indicators have been developed based on the list of indicators developed on the relevant aspect in various previous studies.

Table 3.3: List of economic sustainability indicators

Aspects of economic sustainability	List of indicators	Number of indicators
Accessibility to Transport Facilities	• Availability to public transport facilities • Average distance to nearest daily use transport nodes • Income level of the residents • Land price in the neighbourhood	4
Accessibility to infrastructure (utility services)	• Well maintained infrastructure	1

Sources: Adapted from Stewart, 2010; Neighbourhood Sustainability Indicators Guidebook, 1999; Neighbourhood Sustainability Indicators Guidebook, Mineapolis, 1999; Seattle Sustainable Neighbourhoods Assessment Project, 2014.

As discussed earlier the density can be conceived through two dimensions: physical and perceived density. One of the chief objectives of this research is to evaluate the impact of density on the sustainability of the residential areas. Therefore in order to measure physical density the most appropriate density indicator of residential area should be selected which, is the net residential density. But due to the unavailability of this data for the study sample wards the available ward wise gross population density measure have been selected for this research. Density statistics have been collected from DAP 2010. The gross population density of 2015 has been calculated based on the ward wise projected population of 2015.

Table 3.4: List of physical and perceived density indicators

Physical density	**Measuring capacity** • Gross population density • Floor area ratio	**3**
	Measuring physical form • Site coverage • Average number of floors per building	**2**
Perceived density	**Measuring external crowding** • Average number of floors per building • Residents' perception of their residential area in terms of space between buildings (measuring crowding of buildings)	2
	Measuring internal crowding • Residents' perception of their size of home (measuring crowding within dwelling)	1

Sources: Dave, 2009; In-depth Report: Indicators for Sustainable Cities, 2015. Residential density: Guidelines for planning authorities. Dublin: TSO, 1999.

Table 3.5: List of intervening indicators

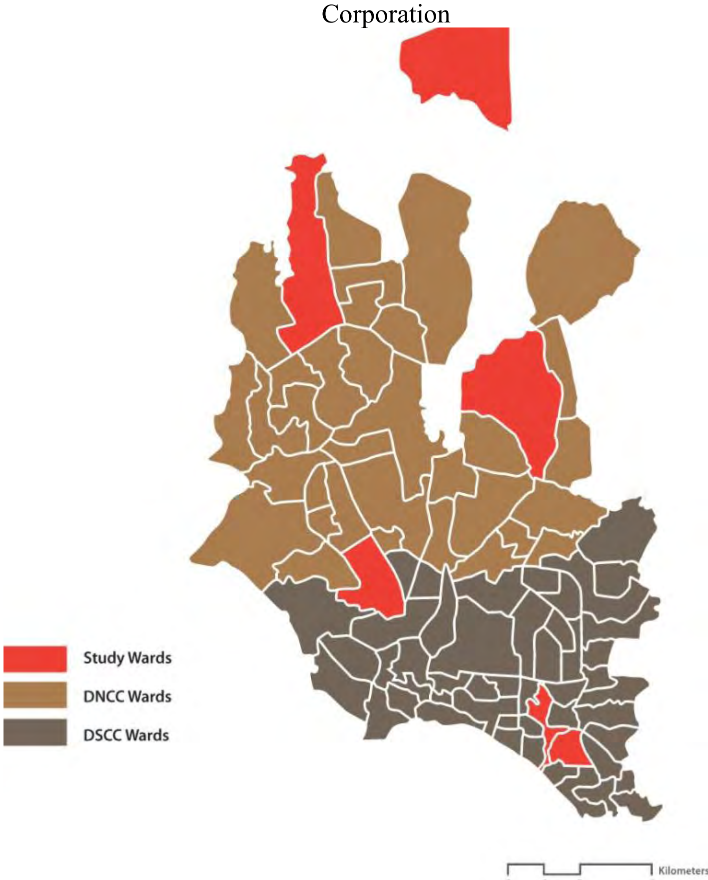
Intervening variables	List of indicators	Number of indicators
Socio-demographic	• Type of ownership • Years of residency in the neighbourhood • Household monthly income • Level of education • Age of the neighbourhood	5
Mix of use	• Percentage of residential land-use	1
Building Form	• Type of the Built Form • Height of the Building	1 1

Sources: Neighbourhood Sustainability Indicators Guidebook, Mineapolis, 1999; In-depth Report: Indicators for Sustainable Cities, 2015.

As socio demographic and urban form variables are found to play significant role on the density and sustainability of any area a list of indicators for these intervening variables has also been formed to assess their impact on sustainability where necessary (shown in Table 3.5).

3.5 Selection of Sample Sites

Figure 3.3: Study wards in Dhaka North and South City Corporation



This research takes the Dhaka City Corporationarea (DCC) as case study. DCC including both Dhaka South and Dhaka North City Corporation currently constitutes of 93 wards. There are 57 and 36 wards under DSCC and DNCC respectively. As the research primarily deals with the densification issue the density measures at various spatial levels are necessary to determine for which the boundary of an area needs to be clearly demarcated. For this purpose the smallest administrative unit of the city represented by ward is considered appropriate. Six wards demarcated as residential areas with differing densities, settlement age and locational attributes have been selected as sample site areas. These are Dhanmondi Residential Area (Ward 49), Banani Model Town (Ward 19 Part1), Gulshan Model Town (Ward 19 Part 2), Pallabi (Ward 6), Uttara Model Town (Ward 1), Wari (Ward 77) and Luxmi Bazaar (Ward 78). While Wari and Luxmi Bazaar represent the old city core, Dhanmondi, Banani and Gulshan are located in the central part and Pallabi and Uttara in the outlying part of the city. Based on their location these sample wards provide a virtual slice through the city and therefore is representative of the city's overall density pattern. Luxmi Bazaar follows the indigenous pattern of settlement while Wari was the first planned residential area of Dhaka (Ahmed, 1986). Dhanmondi, Banani, Gulshan and Uttara are planned on grid iron pattern street network ensuring better connectivity and accessibility within the plots whereas Pallabi has a mixed type of road network system. Initially these residential areas were low-density, low-built forms (1-2stories), followed by mid rise built forms ranging between 3 to 6 stories and later a transformation towards vertical expansion (above 6 stories) took place which is contributed towards the densification of these areas. And, this continued to be the prevailing trend of growth for the city. Figure 3.3 shows the selected wards with their location within the Dhaka city.

3.6 Methods of Data Collection

It has been pointed out that greater confidence can be exhibited in research findings if the findings are derived from more than one method of investigation. In this regard, qualitative data is useful for understanding the rationale behind those relationships revealed in quantitative data. Qualitative data may also suggest directly those theoretical insights to be strengthened by quantitative data (Jick, 1979). The use of both qualitative and quantitative data collection techniques, known as 'methodological triangulation' (Kane, 2001; Robson, 2005), adds greater depth and scope for achieving the aims and objectives of the research in a more positive and meaningful way. In addition, 'methodological triangulation' increases the validity of the research findings (Richardson, 2000). Therefore the data collection strategy of this research adopted both the qualitative and quantitative approaches.

In this research both the quantitative and qualitative data were collected concurrently. The quantitative data from the questionnaire survey and field survey of density attributes provided this study with essential statistics, while qualitative data from interviews and field notes enriched the research discussion developing a better context for interpreting the results obtained from statistical data. For a detailed study of causes of the densification process, the actors in the process, their views on government intervention as well as market dynamics on transformation of the residential areas were studied. Before commencement of the research, a pilot study comprising the responses of 100 participants was carried out in the case study sample wards. Results from the pilot study were used to improve upon questions which were put forward to residents in the final survey.

A summary of the aspects and methods of investigation is given in Table 3.6. It is a single phase research design where both quantitative and qualitative data collection is conducted concurrently. The first phase entails literature review that leads to developing a theoretical framework to understand the key concepts. The initial part of the research involves discussions and fairly lengthy interview sessions with purposeful samples comprising of city administrators, officials and planners from RAJUK, PWD, DCC, etc. to gain an understanding of the role these institutions play in the provision of housing for the residents of Dhaka. A guideline was drafted listing the topics and open-ended questions to be raised during the interviews. The statutory policies and building regulations were scrutinized in detail to identify gaps that seemed to produce various problems, and this formed the mainstay of this research. It also comprised of discussions on densification policy in the local and global context, environmental and

Table 3.6: Summary of research issues and methods used

Research Issues	Literature Review	Analysis of documents	Key Person Interview	Interviews	Field Survey	Analysis of Maps and Drawings	Photograph Elicitations
Concepts of Density, Sustainability, Livability and Sustainable Development and urban compaction	V						
Trends of Densification in case study areas (wards)	V	V	○	○		V	
Analysis of Density attributes, (building types, open spaces and space use, land use pattern)					V	V	V
Selection of sustainability indicators	V						
People's views about ongoing densification and quality of life (Consequences of Densification)				V	○		○
Critical evaluation of the planning laws and regulations of the case study residential areas		V	V	○		V	○
Role of various Stake holders & Planning Agencies	V	V	V				
Opinions and views of the professionals about ongoing densification process in the case study residential areas			V				○

Key: V signifies that the method was important

○ signifies that the method was used to supplement other methods contextual policies and various density measures of residential areas followed by their relation to sustainability issue. This was accompanied with in-depth interviews comprising of open ended questions targeting planning professionals, policy makers, real estate developers, etc. to gather qualitative data regarding their opinions towards prevailing planning laws and role of relevant government institutions about the ongoing trend of densification. This part helped to gain an understanding of the forces and actors involved in the production of housing in Dhaka.

For the second part a stratified random sampling close ended questionnaire survey was conducted in the sample study areas that helped to determine the responses and attitudes of the participants towards physical and perceived notion of density in relation to livability of the residential areas. In addition informal interviews with the residents were also held to substantiate the responses of the questionnaire survey. The field survey conducted for this research was simultaneously guided by the conceptual framework of the thesis, and an open-minded view, stemming from an exploratory research approach. Through the field survey in sample wards information regarding physical trait, such as, quality of space, street condition, types of dwellings, setback space, building height, etc. were collected and supplemented with photographs, portraying the existing situation wherever needed.

3.6.1 Interview with focus group

The principal aim of this research concerns the views of the relevant professional people on the issue of density and its subsequent effect on sustainability of the residential areas of Dhaka city and how the densification process took place. The dynamics of the development process of residential areas in the context of Dhaka from distinct perspective of individual stakeholders, developers, local authority planners, architects and state regulators were collected through in-depth interviews where the viewpoints were compared and represented through extensive interview quotations. This interview method has been preferred rather than the distant administration of questionnaires. They were semi-structured, starting with the same interview guide but adapting it to the interviewees' interests and their professional roles. The interviewees included representatives of the city planning authority (e.g. RAJUK, DCC and PWD), in addition to several local actors such as real estate developers, politicians, planners, architects and local administrative and technical personnel in order to understand the following research questions:

1. How residential areas in Dhaka were planned and what principles were followed for their development?
    - iii. What standards, if any, were followed for the densification of existing residential areas of Dhaka?
    - iv. What authority or who decides, such development?
2. How the Urbanization Policy and other relevant policies (i.e. National Housing policy, Mohanagar Imarat Nirman Bidhimala, 2008, Building Construction Rule 1984, 1996 etc.) of Bangladesh waived away development crisis facing the residential areas?
    - iii. Are these policies well-equipped to deal with the housing crisis in Bangladesh, more specifically, that of Dhaka?
    - iv. What forces regulate and guide densification process in Dhaka?
    - v. Who are the actors in the densification and transformation process?

vi. What are the existing laws and regulatory measures and how practice differs from planning?

Given the time and resource constraint 15 individuals were selected to be interviewed based on their professional relevance and interest to urban planning. Open-ended questions which are conducive to the qualitative data collection have been raised so as to provide an opportunity for the interviewees to formulate and elaborate their views on specific issues that were presented to them. It also provides an opportunity for the researcher to probe specific responses with reasonable detailing. Cohen and Manion (1989) observe the advantages of open questions as:

- Allowing the researcher to probe so that one may go into more detail
- Encouraging rapport.
- Allowing the interviewer to make an assessment of what the respondents really believe.
- Providing room for flexibility in terms of the format of interviews.
- Enabling the interviewer to test the limits of a respondent's knowledge.

In-depth interviews were tape recorded to provide a sound base for the respondents' answers while facilitating referencing and citation during report writing. A research assistant assisted in taking notes to complement what the main researcher has been writing. Where necessary, additional information was obtained through telephone interviews and questions posed in e-mail correspondence. The interviews were particularly important in gathering respondent's view which would reflect the significance of densification strategy as a component of sustainability goals in the current planning practice of Dhaka while also providing important contextual knowledge regarding planning procedure. A list of the interviewee's is given below in Table 3.7.

Table 3.7: The Interviewee type and quantity interviewed

Interviewees	**Quantity interviewed**
Professionals of City Planning Authority (RAJUK, DNCC, DSCC, PWD)	6
Planners	3
Architects	3
Property Developers	2
Urban Academician	1
Total	**15**

3.6.2 Field Survey

Field surveys were conducted to collect primary data regarding elements of urban form building i.e. building types and height, setback spaces, plot coverage, block coverage, street pattern and condition, quality of open space, land use pattern to prepare an updated database of the study areas. It was also observed and investigated whether the placement and height of the buildings were appropriate for the provision of adequate daylight, proper ventilation, privacy, safety and security etc. These aspects are assumed important in discussing the issues of sustainable development in relation to the density of residential areas. Observations were captured as field notes. There were running commentaries against the field notes. The running commentaries were in the form of concepts or notions about relationships, cross-case comparisons, anecdotes and informal observations.

3.6.3 Analysis of Document

Another method used includes analysis of documents. Concerning the usefulness of documents, Yin (1984:81) contends that documentary information is likely to be relevant to most case study topics. Further, he includes administrative documents as part of documentary evidence. Included also are formal studies or evaluation of the same site under study, newspaper clippings and other articles appearing in the mass media. Along with the policy documents, building construction rules and regulations, government archival records comprising of minutes of the meetings, written reports, circulars, proposals and progress reports regarding the study areas presented a rich source of information for this research.

3.6.4 Analyses of Plans and Maps

Plans and maps provided essential inputs in the analyses of house types, forms, plot layout and configurations, floor area ratios and setbacks. Base plans, Master plans and detail areas plan were gathered from PWD, DCC, Rajdhani Unannayan Kartripakkha (RAJUK) and other relevant organizations. Calculation of plots sizes, plot ratios, houses sizes, plot coverage, floor area ratio was made possible through analyses of maps and plans. Standard base maps of scale 1: 2500 were acquired and enlarged to working scales of 1:1000 and, where necessary, to the scale of 1: 500.

3.6.5 Photographic Elicitations

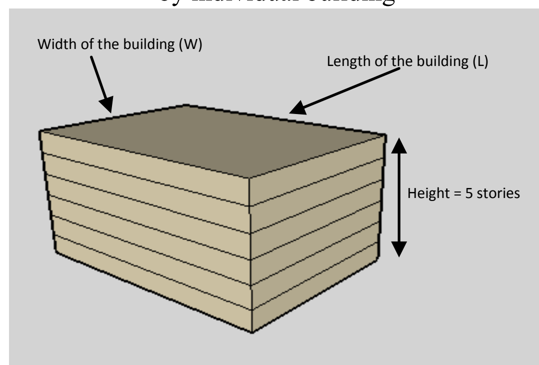
Photographs are sometimes more rich in graphical details and they capture situations that are sometimes very hard to describe, experience and or imagine. Photographs were also taken to document real life living conditions and spatial qualities. The photographs were taken systematically in different parts of the study areas including the streetscape, use of open spaces, traffic situation and the indoors of certain households to visualize and analyze the usability of the space and the overall environmental quality of the place.

3.6.6 Analysis of Aerial Photographs/ Satellite Imagery

The aerial photographs of the study areas were collected from the ‘Google Earth’ which served as reliable data source for calculating the building block size, plot sizes, setback and open spaces. The ‘ruler’ tool of the ‘Google Earth’ was used to measure the dimensions. Aerial photos or satellite imagery of the planned settlements from 2001, 2004, 2010 and 2016 were collected and analyzed indicating housing development in the study area. The periodic photographs show changes which have taken place in individual buildings and the distribution of houses which are the physical products of housing transformations. Aerial photos provide a basis for establishing trends in housing densification processes in the settlement. The measurement procedures are described as follows:

FAR Calculation procedure: Applied Procedure to calculate floor area ratio (FAR): The FAR indicates the ratio of built area and total land covered by the block. The area of total land coverage by the block indicates the area of block including half of its surrounding road width. The built area means the total floor area of all buildings which is based on the actual floor area including wall thickness of each structure, and multiplied by the number of floors. Figure 3.4 is showing the calculation of the total floor area of a building. The total floor area inside the block will be the addition of the total floor area of all buildings inside the block.

Figure 3.4: Calculation of the floor area occupied by individual building



Source: Author, 2015

In the Fig 3.5, Floor Area, A = L X W unit square
So, Total Floor Area occupied by this building,
A1 = A X 5 unit square (Since the building is 5 storeys)
If the total floor area of all buildings inside the block = A2 (Addition of the total floor area of all buildings inside the block) then
Floor Area Ratio (FAR) = A2/BA

3.6.7 Field Survey

Field survey helped to collect information about the selected blocks from study areas for detail studies regarding the house type, height, setback, plot coverage, physical density attributes, land use, architectural characteristics of built forms, environmental quality and traffic situation.

3.6.8 Questionnaire Survey

A questionnaire works as bridge of communication between the researcher and respondents. The questions are the vital elements which perform the actual interrogation. Rossi, Wright and Anderson (1983) treated a questionnaire as a set of instruments and stated that its success depended on how effectively the instruments could be handled. The accuracy and validity of data collected depend on the questions asked and the ways in which the respondents perceive and respond to them. Thus the

Table 3.8: Case study sample wards and their location, selection criteria and survey response

Ward No.	Name of the Ward	Location	Density	No. of Plots	Gross Pop. Density 2015 (projected) persons/acre	Number of households surveyed
78	Luxmi Bazaar	Inner core	High density	1200	737	271
77	Wari	Inner core	Medium density	989	477	248
49	Dhanmondi	Intermediate	Low density	1031	99	258
19	Gulshan-Banani	Intermediate	Low density	5054	81	66+251
2	Pallabi	Peripheral	Medium density	1088	492	245
1	Uttara	Peripheral	Low density	4302	144	258
					Total	**1623**

* Ward wise Density profile calculated from DAP 2010

construction of a questionnaire is a vital element. In this research 7 wards of Dhaka City Corporation primarily demarcated for residential settlements were chosen as sample sites for study. As there is a lack of relevant secondary data about the effects of density on inhabitants of the study areas upon which the research could be carried out, a rigorous and in-depth questionnaire survey was administered in order to gather responses/opinions of residents to identify what aspects of the densification impacting the built environment of their residential areas are either significantly valued or disliked by them. The questionnaire is made up of 5 parts comprising of household demography, residents' perception of density, and residents' perception about the aspects pertaining to social, environmental and economic sustainability. All these information do not vary significantly among households located in the same plot for their close proximity. Therefore, for this research the total number of residential plots in each sample wards is considered as the whole population for each ward and household per plot is focused as a unit of analysis. According to the Table 3.6 the total required sample size from all the sample wards was estimated to be (291+277+280+357+284+353) = 1842 households at the confidence level of 95% with marginal error of 0.05%. But access to households especially in the high class elite neighborhoods of

Table 3.9: Required sample size table

Required Sample Size†

Population Size	Confidence = 95%				Confidence = 99%			
	Margin of Error				Margin of Error			
	5.0%	3.5%	2.5%	1.0%	5.0%	3.5%	2.5%	1.0%
10	10	10	10	10	10	10	10	10
20	19	20	20	20	19	20	20	20
30	28	29	29	30	29	29	30	30
50	44	47	48	50	47	48	49	50
75	63	69	72	74	67	71	73	75
100	80	89	94	99	87	93	96	99
150	108	126	137	148	122	135	142	149
200	132	160	177	196	154	174	186	198
250	152	190	215	244	182	211	229	246
300	169	217	251	291	207	246	270	295
400	196	265	318	384	250	309	348	391
500	217	306	377	475	285	365	421	485
600	234	340	432	565	315	416	490	579
700	248	370	481	653	341	462	554	672
800	260	396	526	739	363	503	615	763
1,000	278	440	606	906	399	575	727	943
1,200	291	474	674	1067	427	636	827	1119
1,500	306	515	759	1297	460	712	959	1376
2,000	322	563	869	1655	498	808	1141	1785
2,500	333	597	952	1984	524	879	1288	2173
3,500	346	641	1068	2565	558	977	1510	2890
5,000	357	678	1176	3288	586	1066	1734	3842

The formula used for these calculations was:

$$n = \frac{X^2 * N * P * (1-P)}{(ME^2 * (N-1)) + (X^2 * P * (1-P))}$$

Where:

n = sample size

X^2 = Chi – square for the specified confidence level at 1 degree of freedom

N = Population Size

P = population proportion (.50 in this table)

ME = desired Margin of Error (expressed as a proportion)

Source: Research Advisors, 2006

Gulshan and Banani were not possible in many instances due security purpose. In many instances data had to collected from parents waiting in the local school premises. Besides this unavoidable circumstances with limited time frame and budgetary constraint a total of 1623 households were surveyed in this phase (see Appendix I for the questionnaire). Table 3.8 shows a sampling distribution in survey numbers by each sample wards.

Specific issues that were addressed include household social background data, general information on transformation of the housing, satisfaction level related to the concept of livability of the sample wards. Before administering the large scale survey, a pilot survey was conducted to refine the survey instruments and fine tune the study. For the data collection process, 10 students from the graduate students of the Department of Statistics (Dhaka University) and Department of Psychology (Jagannath University) were selected as Research Assistants (RA). They were trained for two days to enable them to collect data uniformly. Training covered as to how to make the initial contacts with the respondents, asking the questions, probing, recording the answers, and terminating the interview, etc. The entire questionnaire and field survey was conducted during September - December, 2015.

3.7 Sampling Methods

A sample may be defined as a portion or subset of a larger group called a population, which is the entire set of relevant units of analysis or data to be sampled. A good sample is a miniature version of the population (Fink, 1995). How well a sample represents a population depends on the sample frame, the sample size, and the specific design of selection procedures (Robson, 2005). The three characteristics of a sample frame that need to be evaluated are comprehensiveness, probability of selection and efficiency. The sampling method adopted by the researccher ideally represents the most appropriate means of data collection on a case-by-case basis.

Probability sampling is "a method of sampling in which the participants are randomly selected in such a way that the researcher knows the probability of selecting each member of the population" (McMillan, 2011). This basically means that each member of the target population should have a chance of being selected to be in the study. Contrast to this non probability sampling means some members of the eligible target population have a chance of being chosen for participation in the survey and others do not (Fink, 1995). The key benefit of probability sampling methods is that they guarantee that the sample chosen is representative of the population. However, there is no guarantee that a probability sample will produce overall more accurate results than a non-probability sample (Wisniewski, 2002).

Examples of probability sampling include: simple random sampling, whereby every sampling unit of the population has an equal and known probability of being included in the sample; systematic sampling, which occurs when samples are selected according to an interval after the first randomly selected sample unit; a stratified sampling takes place when the different strata of the population are determined and from each stratum random sampling is carried out dictated by analytical considerations; cluster sampling represents multiple levels of cluster where from each level samples are selected randomly (Blaxter, 1997; Nachmias, 1996).

3.7.1 Sampling Method Employed

A *stratified probability random* sampling method was employed in the questionnaire survey for selecting the households from the six sample wards of Dhaka. The sample wards were selected on the basis of location, density profile, built form type and settlement age where ward, 77 and 78 are house the oldest residential areas, ward no. 49, 19 and 18 represents new residential areas and ward no. 1 and 6 are among the more recently developed residential areas. These study wards are located in various part of the city offering a virtual slice through the city. Sampling was done by dividing the plots of the each sample wards into three broad chunks of area by location. These are: plots by the thoroughfare, plots in the middle section and plots along the outer section of the ward. The criteria were whether the houses are located near the street frontage or within the intermediate part or the outer part of the sample ward. This is considered important to find out densification trends in transformation along the street as well as participant's attitude in the peripheral, interior and road side of the settlement. Furthermore, an attempt had been made to select the households based on tenure characteristics, whether the houses are on rental tenure or for owner occupation.

3.8 Research Limitations

Most of the data at ward level necessary for the research were not readily available in Dhaka City Corporation. For example, most of the density measurements at ward level including households per hectare, net residential population density, households per building blocks, floor area per person, ground coverage were not readily available from secondary sources. As noticed by many previous researchers, this research also found that data availability is the biggest challenge for carrying out research in cities of developing countries (Richardson et al.2000). Since this research deals with the densification phenomenon it requires data regarding various measures of physical density. These measures constitutes a number of scales like gross density, net residential density, population density and are usually done through census administered by the government together with the inventory of housing stock. For this research the ward wise net residential density and net residential population density were required for developing an effective insight about the impacts of densification. But due to unavailability of these data from the secondary sources this research has to work with the gross density data instead of net residential density data which has been one of the major limitations of this study.

Another limitation was the sample size which was targeted to be 2000 but due to the time and budgetary constraint only 1623 responses could be collected. Again the research has addressed both planned and unplanned residential areas though the emphasis of the selection criteria was density. Among the selected study areas 6 are planned and 1 is unplanned which indicates a proportional imbalance. Due to time constraint the research could not include more unplanned areas which could have ensured a better comparison between the densification of planned and unplanned residential areas.

3.9 Reliability and Validity

In academic works, the reliability and validity of research is often discussed as a means of quality assurance. Validity refers to the credibility of the research, while reliability relates to the possibility to repeat the same study and obtain similar results (Yin 2003). For the purpose of ensuring reliability of results from this study three strategies were deployed. Firstly, a database was established for each case study area whereby information gathered from each sample ward was stored and built up. Each case study area (Wari, Luxmi Bazaar, Dhanmondi Residential Area, Banani Model Town, Gulshan Model Town, Pallabi and Uttara Model Town) had its own database where information was systematically ordered and stored. The first phase of fieldwork studies in these sample wards that involved land use, spatial qualities, settlement pattern, street conditions and layout etc. within case study areas provided a concrete base which assisted in the analysis of the questionnaire survey. Information gathered from interviews was also systematically documented.

Secondly, in order to ensure quality of data collected, only graduate field assistants were recruited. A two days workshop was conducted to explain among other things, the research objectives, method of data collection, introduction to the concepts, translation and interpretation of the difficult terms in Bangla used in the questionnaire. The main purpose of the workshop was to develop a common understanding on the questions and the translation. Answer sheets were scrutinized on daily basis so as to check the consistency in the type of responses, adequacy of the data collected and relevance of the questions. The third strategy was adoption of a coherent data collection method in all cases. For instance in analyzing various aspects of sustainability, the same sustainability indicators have been used. The application of the same variables for all cases facilitated cross-case analysis and pooling up results from these cases.

Triangulation of data is often used to increase the credibility and reliability of research and the findings presented (Yin 2003, Stake 1995). Triangulation allows one to identify aspects of a phenomenon more accurately by approaching it from different vantage points using different methods and techniques. Thus, throughout this work a range of different sources and types of data as well as data collection methods were used to reduce biases and distortions and increase the validity of the research. Besides a review of the literature, other methods for data collection included interviews, direct and indirect observations, field visits, pictures, maps and land use surveys.

3.10 Generalization

Generalization, an act of reasoning that involves drawing broad inferences from particular observations, is widely-acknowledged as a quality standard in quantitative research, but is more controversial in qualitative research. Though findings are based on data obtained from randomly drawn samples of sufficient size, the observations from the wards of New Dhaka do not generalize the observations of the old Dhaka ward. This is largely because of the socio-cultural and contextual difference of the case study areas which confer them to two discrete categories. So in terms of planning decision a common workable solution cannot be imposed to the entire city for the exercising sustainable densification strategy.

3.11 Conclusion

Based on the theoretical premises discussed in the previous Chapter, this Chapter has established the conceptual framework of the research. The research design and its analytical processes have been thoroughly discussed. In addition to justifying the selected methodology this research adopts the mixed methods approach to answer the research questions. First, physical density attributes have been selected to examine the densification process of the study areas. Second, to probe into the causes of densification methods like document analysis, in-depth interviews aid with semi structured questionnaire were selected. Third a set of indicators on the selected aspects of social, environmental and economic sustainability were developed to assess the consequences of densification from sustainability imperative. The primary data were complemented with data from the secondary sources namely satellite imagery, photographs and maps. The data collection method followed the concurrent triangulation model to increase its reliability. Data were compared and consolidated and analysis was done by using simple descriptive statistical analysis methods.

Chapter 4: Trends of Densification

4.1 Introduction

The previous Chapters have highlighted the theoretical premises and the methodological construct to investigate the densification process shaping up the residential areas in the city of Dhaka. This Chapter addresses the first research question: “How residential areas in Dhaka were planned and what principles were followed for their development?” through investigating the trend of densification in the residential areas of Dhaka. The Chapter consists of five sections. Following the introduction the second section sheds light on the overall urban growth pattern of Dhaka. The third section investigates the overall spatial pattern of the seven study areas chronologically to determine the distinct trend of densification for each of them. The fourth section examines the effects of densification processes on the spatial organization of the study areas by selecting 4 blocks from each study area and investigates the resulting effects in terms of plot coverage, floor area ratio, overall block coverage, spatial patterns, observations, measurements, map analysis, interview with the local residents were the key methods employed in gathering data. The fourth section summarizes the findings of this Chapter in a form of cross case analysis followed by concluding remarks.

4.2 The Urban Growth Pattern of Dhaka

According to the recommendation of Caminos and Goethert (1978), efficient percentages of land use distribution for city conforms to nearly 60% of the urban land dedicated for residential use and the rest 40% for other uses like commercial, institutional facilities and street network. So residential development actually determines the way the city would be configured. In order to understand the growth pattern of any city we need to see how the dominant land use i.e. residential areas of the city organize themselves which eventually dictates the urban form. Planning literature has suggested a number of growth models regarding the formation of city…just to name a few, the concentric city, linear city, sector theory, garden city concept, multiple nuclei concept, radial city and so on. But none of these theories alone can explain the way the city of Dhaka has developed. However, the growth pattern of Dhaka bears some resemblance with the linear and multiple nuclei concept partially. Linear city actually follows a transport corridor for expansion while according to the multiple nuclei theory city keeps on expanding following the emerging new nucleii in a sporadic manner. Looking back historically we can see that Dhaka is a city of unpredictability where its growth largely owes to the legacy of its shifting political status and the constraint of natural features. The city started its journey as a small township along the river Buriganga in 1600 A.D. with an area of 1.59 sq. km. The convenient location of Dhaka in the centre of a riverine delta not only assisted in strategic control but also facilitated trade and commerce. The network of rivers connecting the town to the rest of the country soon upgraded its status to a vibrant trade center where the initial urban development in the form *mohallas* took place (Ahmed, 2012), usually focused around its central marketplaces or *bazaar*. Dhaka was traditionally known to be a city of 52 markets and 53 lanes (*Bawanno bazaar tipanno gali*) which also points the importance of market places as the primary impetus of city’s growth rather than guided by a predefined network of streets or lanes. In earlier times the expansion of the city tended to follow the river bank as it was the primary mode of transportation for goods. The river maintained its importance till the Mughal period though a road was built from the old city center upto Fulbaria by the Mughal rulers to facilitate internal connectivity. The Mughal did not have any specific plan for city expansion but the city expanded towards north because of the existing low-lying flood planes in the other directions which are not suitable for any development (Kabir, 2012). With the shifting of capital to Murshidabad under the British occupation Dhaka entered a period of decline. The population shrinked and the city also reduced in size keeping its development process to a halt. The city revived once again when it was made the capital of Bengal.

After two decades of economic recession the city could not recover its past glory all of a sudden. The artisan based economy was badly oppressed during the British period and consequently the river based transportation lost its importance. As the colonial fathers were interested in a faster transportation system for exporting the local resources and ensuring smooth revenue collection, they focused on developing land based transportation network aided by building metal roads and later installing the railway tracks. Consequently the trend of urban development which originated following the riverine route also shifted its path and started expanding along a land based transportation network which eventually dictated the physical growth pattern of the city. Thus the sweep of colonialism left its imprints on the growth pattern of the city at its wake. As the city is bounded by Buriganga in south-west, Bangshi and Turag in north-west, Balu in the north-east and Shitalakhya in the south-east the only option available for its expansion is towards the northern territory. The flood flow zone along the east-west axis does not provide suitable land for development therefore the city could not spread side wards. Guided by the site forces the major transport corridors started developing towards the north directing the growth of the city northwards. During the Pakistan period in order to provide housing to the increasing urban population of Dhaka new residential areas were proposed along these major thoroughfares with distant settlements far from the city core which were initially conceived as self sustained satellite townships. But due to the lack of vision and planning considerations regarding the supporting social infrastructure necessary for their self-sufficiency, these settlements could not develop into self-sufficient townships rather became incorporated with the city fabric gradually with the rise in population.

The distinct trend of growth of Dhaka therefore, seems to follow the transport axes providing accessibility to new areas primarily assigned for residential land use. The concern for amenities and supporting facilities always seemed to come as a later addition in response to demand often through self initiated efforts of the inhabitants rather than the city planning authority. The formation of new CBDs (Motijheel, Kawran Bazaar, Gulshan-Banani) also followed these transport corridors in response to the demand of the newly formed residential areas. So the city did never expanded in adherence to a predetermined land use plan but has spontaneously developed through dispersed chunks of residential turned mixed land use activities along the routes led by the major thoroughfares. This axial pattern of growth following the major transport routes radiating from the historic core have become the trend of growth for Dhaka. This trend is also confirmed through the acquisition of land by the developers for future residential and commercial development along the *Eastern Bypass road* which is still underconstruction. The same trend can be observed in the development pattern which is currently taking place along the newly constructed *Kalshi road* in the north east part of Mirpur thana. Most of these areas were low marshy land occupied with slums. But as the proposal for *Kalshi road* was set forward developers grabbed most of the land lying besides the road for future development and with the completion of the road these long left vacant lands are fast transforming into residenitial settlements predominated by mixed use high rise buildings. Therefore, it can be said that the present megacity is more of an outcome of spontaneous growth guided by its transport corridors and supplemented by piecemeal planning measures rather than a predetermined comprehensive planning decision. This type of urban development does not confirm to any of the known

Table 4.1: Population density and Household Nos. of selected Thanas

Thana	Sutrapur (Old Dhaka)			Dhanmondi			Gulshan			Pallabi			Uttara		
Area	4.38 sq.km.			4.34 sq. km.			53.59 sq.km.			17 sq. km.			36.91 sq. km.		
Year	**2012**	**2001**	**1991**	**2012**	**2001**	**1991**	**2012**	**2001**	**1991**	**2012**	**2001**	**1991**	**2012**	**2001**	**1991**
Density per sq.km.	81,234	74,892	70,202	38,853	29,710	20,691	35,640	12987	5250	63,493	45763	21,412	33,316	9,350	2,928
Household Nos.	35,9012	29,0567	49,286	38,345	27,789	33,451	60,278	34721	14595	143000	11954	10621	39,140	23,997	19,413

Source: BBS 1991 and 2012

N.B. Each Thana comprises of several wards among which the study wards belong. Sutrapur Thana comprises of study wards no. 77 and 78 (Wari and Luxmi Bazaar); The study areas Banani and Gulshan falls within the jurisdiction of ward no. 19 which belongs to Gulshan Thana.

urban growth form theory but has a unique axial pattern of growth following the path of the available transport routes which is more akin to the Southeast Asian cities.

4.3 The Trend of Densification in Study Areas

In Dhaka densification is found to be happening in three ways: firstly by replacing the low rise buildings with mid or high rise buildings, secondly by building new mid or high rise buildings filling the vacant plots and thirdly by encroaching open spaces and wetlands and developing the land for future housing projects. Intially around the late 90s redevelopment activity in the existing low rise buildings used to take place in the form of extension, alteration and addition but in the later phase redevelopment is practised through replacing the low density low rise houses with high density high rise buildings. By 2005 The result of the redevelopment activity in the form of above 7 storied high rise buildings were found all over the city irrespective of the location as conformed through a study conducted by Strategic Transport Plan for Dhaka (STP 2005). In addition to this redevelopment activity the densification process is complimented through the intensification of commercial activities in the residential areas which in turn attracts business, employment opportunity and people with significant rise in the land value. The increase in the number of households and the increasing population density of the study areas complement the rate of residential densification which can be seen from Table 4.1. However, this trend of densification through development and redevelopment seems to be taking place all over the city but in different pace and time depending on the availability of transportation facilities. The following sub section presents an insight into the trend of densification of the study residential areas. Field observation and analysis of satellite imagery have served as the key source of information to analyze and illustrate the variation in the overall trend of densification of the study areas. As Google Earth does not provide satellite images prior to 2000, the information regarding the earlier period has been collected from former surveys and informal interviews with the older residents of the study areas based on their recollection.

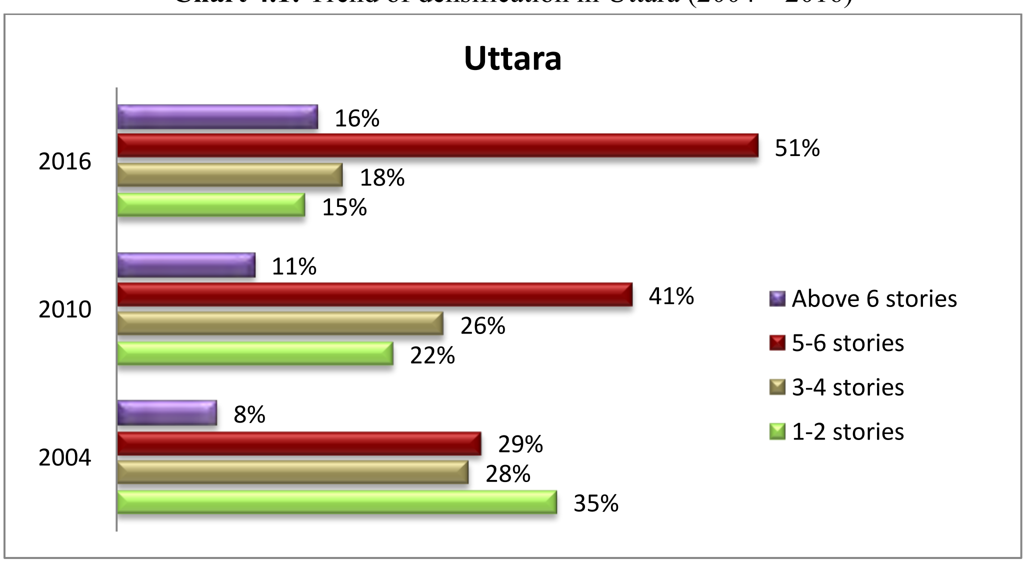
The height pattern of neighbourhoods is an important indicator for studying densification for which there requires a clear classification between various house types in terms of height. From the international researches it has been seen that the concepts of low, mid and high rise buildings vary a lot across countries, districts and even within the neighbourhoods of the city itself. These concepts are also found to be evolving with the ever changing context. This can be observed in case of Dhaka too. During the 60s the landscape of Dhaka was predominated with single storey houses when any 4-storied building was considered to be high rise in relation to them. The term was later referred to the 6-six storied walk up buildings of the next decades and continued till 2008. However, from 2008, buildings above 10 stories equipped with elevators were commonly perceived as high rise buildings (Hafiz, 2000). Nevertheless, the term needs to be defined formally in the planning standards for Dhaka where another discrepancy was observed. The MINB 2008 proposes any structure over 10 stories (33 meters) as high rise while the Fire Service Code and Department of Environment (DoE) of Bangladesh considers buildings above 6 storied (20 meters) as high rise. Most importantly the buildings which are above 6 stories were built after 2008 and the term “high rise” is frequently used for these buildings at present. So there remains a lack of consensus about the term in the existing Building Construction Rules. However, as mentioned earlier the definitions of these terms are contextual where it can vary in different districts even within the same city at the same time. While there are no universally accepted definitions for these terms, the following distinctions are considered for this research:

1-2 stories = low rise,
3-6 stories = mid rise (walk up stories) and
Above 6 stories = high rise buildings.

4.3.1 Uttara

Uttara retained its quiet suburban character well into the 1990. The area started densifying in a faster pace from around 2007 for the influx of migrants settling here for good connectivity with the rest of the city. From the field survey and satellite image analysis the pattern of densification in Uttara indicates that the area was dominated with 1-2 storied building (35%) in 2004 which decreased to 22% and 15% in 2010 and 2016 respectively. Around 51% of the landscape is now dominated with 5-6 storied buildings with 16% housing buildings above 6 stories. From 2004 to 2016, much of the vacant plots and 10% of existing low rise (1-2 storied) buildings were wiped out for this transformation to the generation of 6 and above 6 storied buildings. The transition from low rise to high rise buildings became faster from 2010 to 2016. The number of mid rise buildings have also substantially decreased from 28% to 18% at present. The trend indicates an upward thrust with the redevelopment activity of buildings above 7-14 storied residential buildings with commercial and mixed use buildings not less than 10 to 14 storied high. The intensification of commercial activities seems to be more concentrating along the secondary roads though not all of them are declared as commercial zone. The commercial facilities that are infiltrating the inner blocks of the residential area primarily comprises of educational institutions ranging from schools to universities. With a shortage in the overall open space and redevelopment activity of high rise buildings the area is heading towards forming a dense settlement. But with 15% of the plots still vacant the densification of Uttara has reached an intermediate stage of development which is found quite acceptable by its residents.

Chart 4.1: Trend of densification in Uttara (2004 – 2016)



Source: Field survey, 2016 and satellite imagery

The overall densification pattern of Uttara indicates that densification goes hand in hand with the intensification of commercial activities in the area. Both the transformation of low rise and intensification of commercial activities along the primary and secondary roads seem to be taking place simultaneously though the infiltration of large scale commercial activities in the inner blocks is still low. Densification on eastern side of *Dhaka Mymensingh Road* is more intense than the western side owing to the earlier completion of eastern sectors.

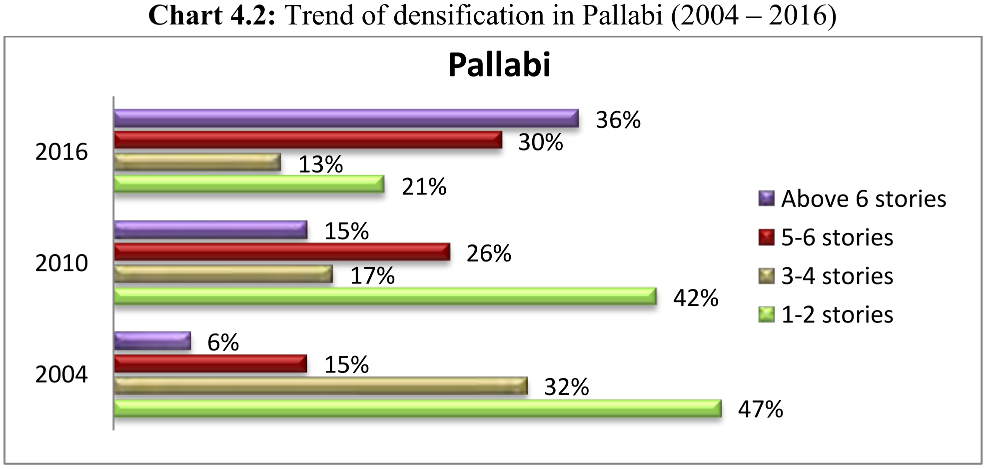
Figure 4.1: Emergent commercial high rise buildings of Uttara along primary road (*Dhaka Mymensingh Road*)

Figure 4.2: Emergent high rise mixed use buildings of Uttara along secondary road (*Garib– E-Nawaz Avenue*)

4.3.2 Pallabi

The area is located in the northern periphery of city and served with well connectivity with the city core. The area maintained a low population profile which kept the house rent relatively cheaper than other areas of Dhaka. All these factors worked as a pull factor for the middle and lower middle class to migrate and Pallabi became a preferable location for new settlers. The natural forces together with economic benefit of the developer built housing initiated the redevelopment activity of 6 and above 6 storied in the area after 2001.Even in 2004 the area predominantly housed low rise (47%) and mid rise (32%) dwellings. The

Chart 4.2: Trend of densification in Pallabi (2004 – 2016)



Source: Field survey, 2016 and satellite imagery

high level of building activity started after 2008 leading to a rise in the number of taller buildings. In 2010 around 15% of the area is housed with above 6 stories and another 26% with 5-6 storied buildings.

Around a quarter of the single and double storied buildings were phased out by 2016 through the redevelopment activity of the area in the form of high rise buildings. At present buildings above 6 stories constitute 36% of the total building stock closely followed by number of 5-6 storey buildings (30%). The area still has a few vacant plots in the existing blocks while more 40% plots are vacant in the rear side of the area known as Pallabi Phase II. With all these vacant plots Pallabi is still at the infancy stage of densification at present.

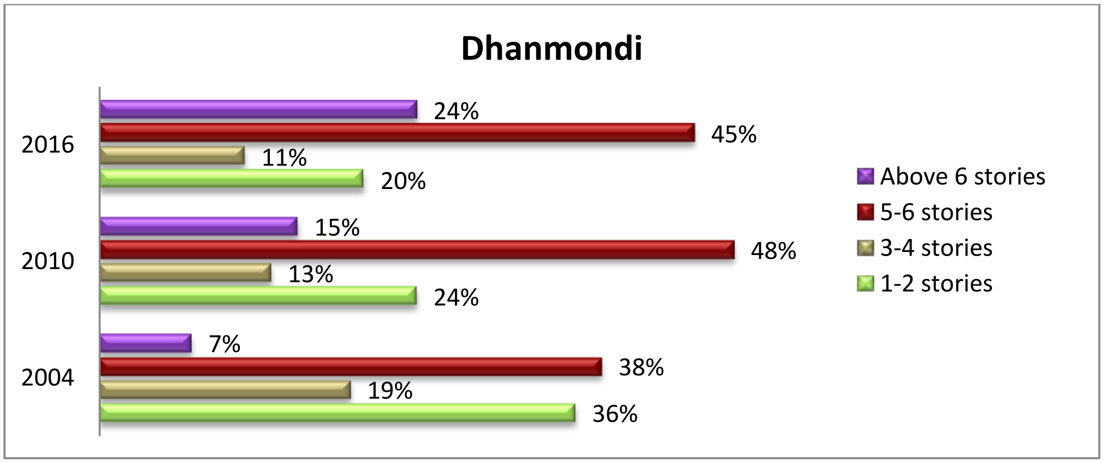
In Pallabi the overall trend of densification does not seem to follow the intensity of commercial activities rather most of the transformation of low rise house forms in the inner blocks seems to have taken place before the advent of commercial activities.

4.3.3 Dhanmondi

Dhanmondi conceived its name from the words *Dhan* (Paddy) + *Mandi* (Bazaar) as the area was covered with vast paddy fields during 1940s (Alam, 2007). Dhanmondi was designed as a planned residential area under DIT (Dhaka Improvement Trust, now RAJUK) in 1950s for the affluent section of the society with an average plot size of 14400 sqft (1 *bigha*). The area initially had 810 plots which later subdivided to 1131 (Alam, et al 1986) , 1085 (PWD, 1999), 1328 (Hashem, 2000) in 1986, 1999 and 2000 respectively. The plots were laid out in a grid iron pattern having roads 150 feet, 45 feet and 30 feet wide. From its inception in the 1950s Dhanmondi remained a as low density residential area which gradually filled up in the successive three decades. Survey carried out by Islam and Khan (1964) noted that in 1961 that 72.9% buildings were single storied, 89.1% dwellings were single-family households, and 78.3% dwellings had large lawns. In 1962 not a single building was more than three storied (Shumi, 2006).After 1971 the population of the Dhanmondi started increasing gradually filling up the remaining vacant plots. One of the senior resident of the area recalled that the only tall building of Dhanmondi during the late 70s was the three storied Polish Embassy which was later demolished. According to a survey in 1984, there were no more vacant plots left in Dhanmondi by mid 80s.

It was found that the numbers of one storey buildings were 27.24%, two storey buildings were 51.34 % and three storey buildings were only 3.54% at that time (Alam, et al 1986). Land owners initiated the redevelopment activity through adding 2-3 floors to their existing single storey buildings during this period. Dhanmondi started densifiying from early 90s which escalated by the end of the decade. Before 1990 there were no 6 storied buildings in Dhanmondi. In the DMDP Structure Plan 1995-2015, Dhanmondi was acknowledged as residential area which has further potential for densification and can continue to provide sites for offices, commercial development and residential uses in 4-6 floor developments (DMDP Structure Plan 1995-2015, p-36). During this period the single and double storied buildings started transforming into 5–6 storied building. This transformation was first seen along the *Mirpur Road* where 5-6 storied commercial (*Gano Shasto hospital, Lucky Plaza, A.R. Center etc.)* buildings were increasingly replacing the low rise structures.

Chart 4.3: Trend of densification in Dhanmondi (2004 – 2016)



Source: Field survey, 2016 and satellite imagery

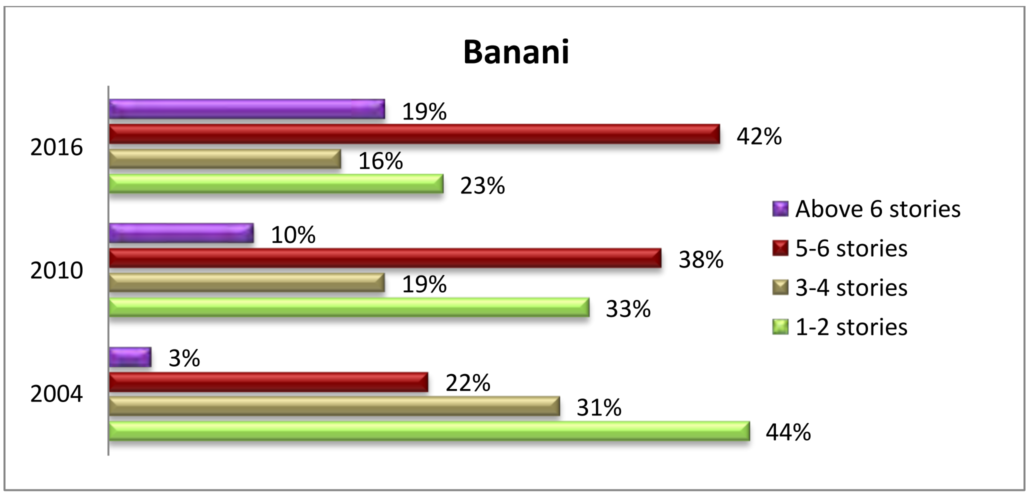
As all the plots on both side along *Mirpur Road, Road No.27(old*) and *Satmasjid Road* were legalized for commercial use through the government circular of January, 1996 , around 70% of plots along *Mirpur Road* and 45% plots along Road No. 27(old) was filled up with 5-6 storied high commercial buildings by the end of the decade. The first 6-storied modern shopping mall *Rapa Plaza* was built in the late 90s in the corner plot of *Road No. 27(old)* and *Mirpur Road* violating the BNBC rule 1993. *Satmasjid Road* was late to follow this trend where only 10% single and double storied residential houses were partially converted for commercial use. From the analysis of satellite imagery it was found that about 38% plots were occupied with 5-6 storied buildings and another 19% with mid rise buildings by the year of 2004. A survey conducted in 2004 also confirmed this figure which indicated that among the 1166 plots of Dhanmondi 37% of them were having 6-storied buildings (Majumder, 2004). As the developers' activity intensified in the area there was a boom of 6-storied buildings by the start of the millennium which kept on inflating to 38%, 42% in the year of 2004 and 2010 respectively. As the height restriction was abolished in 2008, high rise residential and commercial buildings of 10–14 stories started showing up haphazardly all over the area. The roadside of *Satmasjid and Road No. 27(old)* are being found subjected to this trend where tall commercial towers are gradually invading its skyline. At present 24% house forms of Dhanmondi is occupied with 10-14 storied, 45% with 5-6 storied, 11% with mid rise and 20% with single or double storied dwellings. The construction of taller buildings (10-14) seems to be the present trend which is likely going to outnumber the 6-storied buildings soon if kept unchecked. However the intensity of these new generation taller building is mainly observed along the thoroughfares of the area bringing drastic changes in the streetscape. The densification process of the area is approaching fast towards saturation with its aggressively increasing traffic load attracted by the commercial activities of the area.

The overall trend of Dhanmondi indicates that the densification of residential buildings in terms of number has a tendency to follow the intensity of commercialization activities in the vicinity. As the number of commercial activities along the streets increased so did the transformation of adjacent low rise house forms into high rise buildings.

4.3.4 Banani

Densification started in Banani later than Dhanmondi. Banani was dominated with single and double storied houses with a few mid and 6-storied buildings in the late 80s. Densification started from late 90s by gradually filling up the road side plot with high rise commercial buildings along *Kemal Ataturq Avenue.* By 2001 a continuous commercial strip had formed along the *Kemal Ataturq Avenue* with commercial activities infiltrating the inner blocks of the area. Same trend of commercialization was also observed along Road No. 11 but at a relatively slower pace than *Kemal Ataturq Avenue*.

Chart 4.4: Trend of densification in Banani (2004 – 2016)



Source: Field survey, 2015 and DNCC ward map and satellite imagery

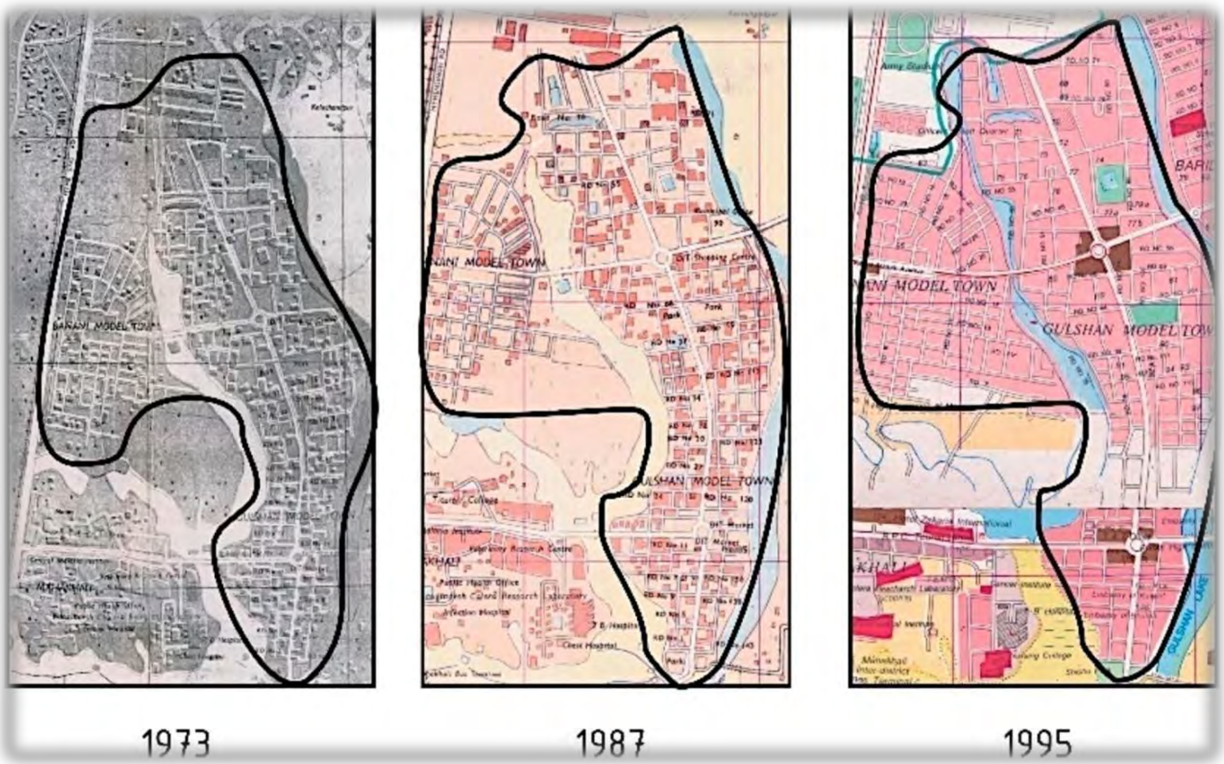
The redevelopment activity of 6-storied residential buildings was also gradually increasing which caught up pace in the following years due to the transformation of the area as an emerging CBD. As a result the inflow of commuters increased in the area which eventually escalated the redevelopment activity. By 2010 around 38% of the plots housed 6-storied buildings while another 10% was occupied with 10-14 commercial towers. Meanwhile commercial activities were intensifying the area in a spontaneous manner. Acknowledging the potentiality of the area developers initiated more redevelopment activity. As a result another 10% of the remaining 1-2 storied building were phased out by 2014. With the height restriction abolished the redevelopment activity was directed towards building higher than 6 stories which is currently reflected by the percentage of taller buildings in Banani which has increased from 3% in 2004 to 10% in 2010. At present the around 19% house forms of Banani is dominated with tower blocks of 10-12 stories, 42% with 6 stories, 16% with midrise and the rest with single or double storied buildings. Though densification started in Banani later than Dhanmondi but the pace of densification seems to be comparatively faster than Dhanmondi.

Unlike Dhanmondi the overall trend in Banani indicates a more or less uniform spread of densification throughout the residential area apart from the concentration of commercial activities along the primary and secondary roads. This is perhaps the result of infiltration of commercial activities within the blocks which is more intense than Dhanmondi.

4.3.5 Gulshan

Gulshan was founded as a planned model town in 1961 with its own Pourashabha (*municipal corporation*) which was abolished later in 1982 (Ghafur, 2006). The area was originally built with the purpose of being solely residential, however, in the following years it was gradually taking the form of mixed use zone. Gulshan is a now a serene residential area and also a burgeoning city centre with shopping malls, offices and embassies of diplomatic missions, as well as residences.

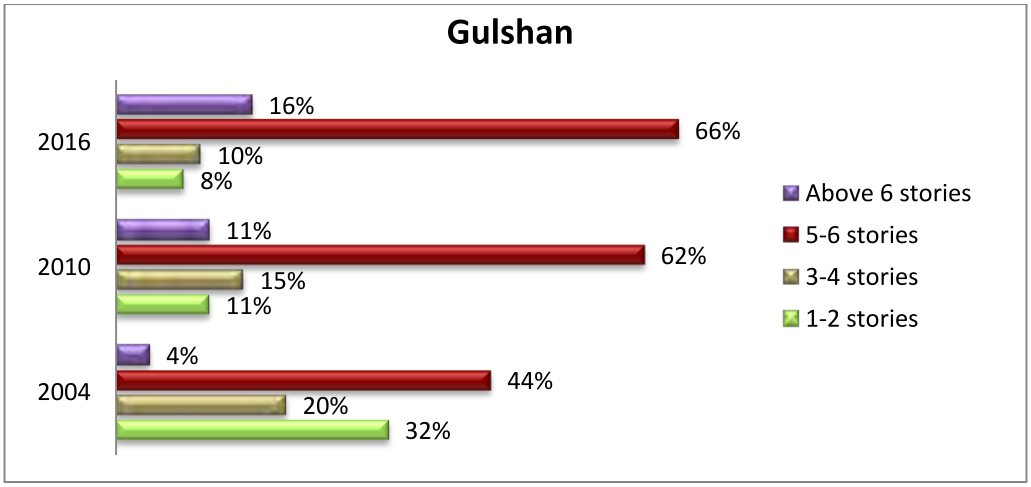
Figure 4.3: The sparse densification pattern of 1973 and 1987 in Gulshan



Source: Ahmed , 2008

However, densification started at a later phase in Gulshan as it was meant for the elite class and was sparsely populated with independent single storey houses that stood far from each other during the 70s. The area rose to prominence when the diplomatic zone was shifted here by the mid 90s and since then the area had seen an upsurge, in the number of high rise commercial as well as mid rise residential buildings. As the area gradually earned the reputation of a thriving commercial activity center with offices, universities, super markets, brand outlets, boutiques, ice cream parlours which are open past midnight the job opportunity increased and so did the traffic. Consequently commuting people who used to do job in the area started to seek shelter in this area. This demand together with the profit earning desire of the developer and the plot owner introduced the redevelopment activity of high rise buildings in Gulshan which gained momentum after 2007. The single storied buildings were wiped out drastically from 32% in 2004 to only around 8% by 2016. In the year 2004 there was a higher proportion of 5-6 storied (44%) in comparison with Banani and Dhanmondi. However due to the high land price and rent only high and higher middle classes could afford to settle down here. By the year 2010 there was a boom of building 5-6 storied dwellings which was followed by high rise buildings (above 6-storied) which was around 11%. At present buildings above 10 stories are dominating the densification trend which stands as isolated towers within around 16% of the area. However, the current state of densification in Gulshan is seems to be relatively faster than that of Banani. As the average plot size of Gulshan is relatively bigger redevelopment activity is taking place partially in these plots where there is still ample space left for future construction.

Chart 4.5: Trend of densification in Gulshan (2004 – 2016)



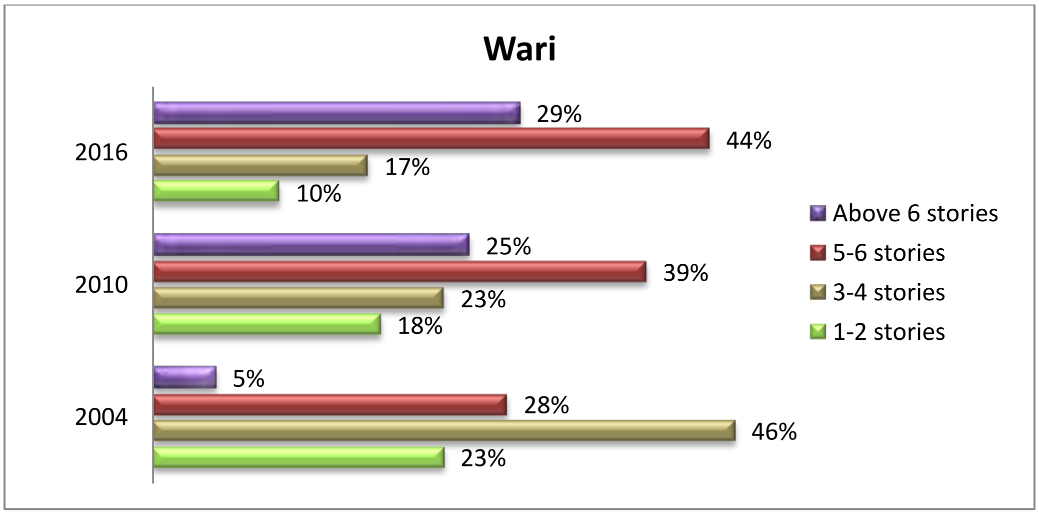
Source: Field survey, 2016 and satellite imagery

4.3.6 Wari

Wari was one of earliest planned residential areas of Dhaka dating back to 1884 and was named after the British Majestrate Mr. Wyer. The area was developed with grid iron pattern road network and plots (not less than a *bigha*) were distributed among the elite and Hindu bureaucrats with the condition of constructing houses within 3 years of allotment (Alam, 2007). The area was then dominated with houses conforming to non European style, austere type 1 storied dwellings which bare some resemblance with the indigenous courtyard village houses. This transition of house form reflects the changing taste of the educated middle class (Dutt, 1922). Only a handful of 2 storied could be observed. Most of these houses had very spaceous rooms with ample spaces dedicated to flower gardens and surrounded by boundary walls (Mamun, 1996). The area never lost its importance since then and was first high class residential areas of Dhaka. Densification started much earlier in old Dhaka than new Dhaka. Wari has the reputation of a posh residential area dating back to the colonial period which never lost its importance. Again the proximity of the area from the CBD Motijheel also worked as driving force for densification. However, densification in Wari started later than Luxmi Bazaar around early 90s. Migrants from all over the country usually seek rental accommodation in old Dhaka for its comparatively cheaper rental structure. Recognizing this profit earning opportunity land owners of Wari responded to the developers' initiated redevelopment activity and in joint venture started transforming Wari from low rise to high rise residential area. By mid 90s near 40% of the area was occupied with mid and high rise buildings of 6-7 stories. With the increase in density the commercial activities also intensified which made the area a more lucrative location for the migrants. This even escalated the redevelopment activity and by 2001 around 55% of the area was filled with high rise buildings. The area was going through rapid densification from 2004 onwards. At present around 29% plots are occupied with high rise buildings above 6 stories, 44%

with 5-6 stories, 17% with mid rise and 10% with low rise buildings. The percentage of single and double storied dwellings have declined from 23% in 2004 to 18% and 10% in 2010 and 2016 respectively. The subsequent subdivision have fragmented the blocks of Wari into diversified shape and size which has made the high rise development very dense here. Densification of Wari is on the verge of saturation at present.

Chart 4.6: Trend of densification in Wari (2004 – 2016)



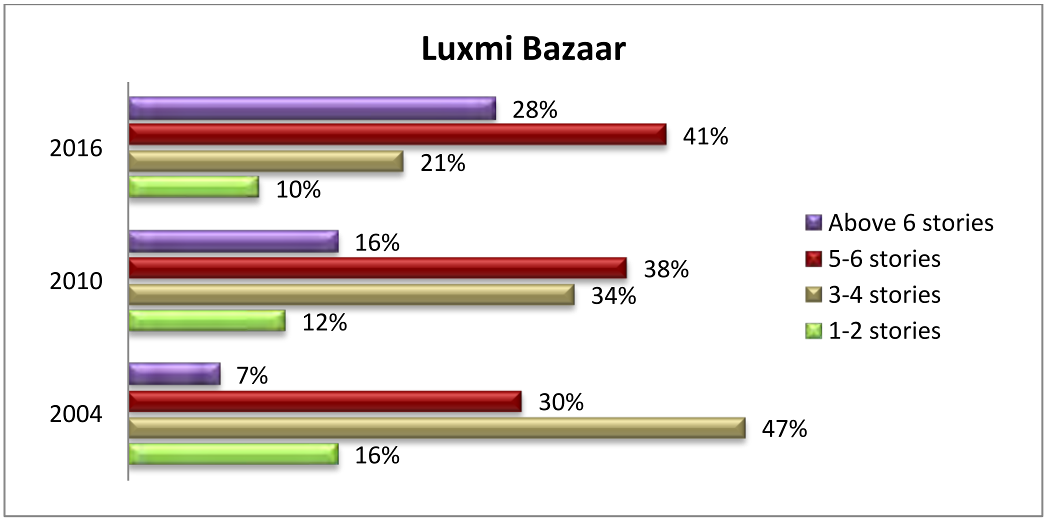
Source: Field survey, 2016 and satellite imagery

The overall trend in Wari indicates transformation of residential dwellings followed by intensification of commercial activities.

4.3.7 Luxmi Bazaar

The area of Luxmi Bazaar has been one of the oldest habited settlements of Dhaka bearing the legacy of the various historic periods. The area was initially known as Mia shaheb Maidan after Mia Shaheb Abdur Rahim Rizvi of Kashmir who settled down here in 1730. Later it was renamed as Luxmi Bazaar after the Hindu deity Lakshmi devi in 1890 by a Hindu influencial dewan of the East India company (Alam, 2007). The area was never abandoned due its proximity to the Shadharghat port and the commercial hub. The settlement pattern has always been compact owing to the spontaneous organization of streets contributing to blocks with a diversity of shapes and size. Often the blocks have no identifiable boundary due to the numerous narrow alleys and cul-de-sacs running through them. The small blocks of this old city core are an iconic part of its urban form which used to provide a number of benefits including a friendly pedestrian environment and frequent breaks in the street wall that helped to provide light and air in the low rise dwellings. Luxmi Bazaar was originally habited by Kolkata based Hindu merchants who migrated to India after partition and exchanged or sold their properties to the Muslim migrants. So from 1947 onwards Luxmi Bazaar became the residential area of the elite Muslims. Majority of these Muslim migrants were well educated. The area was then dominated by single storied introvert courtyard houses with ample space in the surrounding. It also had a handful of 2 storied colonial houses. The population of the area grew substantially the following two decades due to natural growth. But after independence there was a significant rise in the population both due to natural growth and in-migration. As a response to this a good number of single storied dwellings started to transform into double stories through incremental development and retrofitting. By the end of 80s the settlement was getting dense as people were infilling any leftover pocket spaces of their plots with additional rooms and redevelopment activity was also observed in the form of few mid rise buildings popping out in the horizon (interview of a local senior citizen, Jan 4, 2016).

Chart 4.7: Trend of densification in Luxmi Bazaar (2004 – 2016)



Source: Field survey, 2016 and satellite imagery

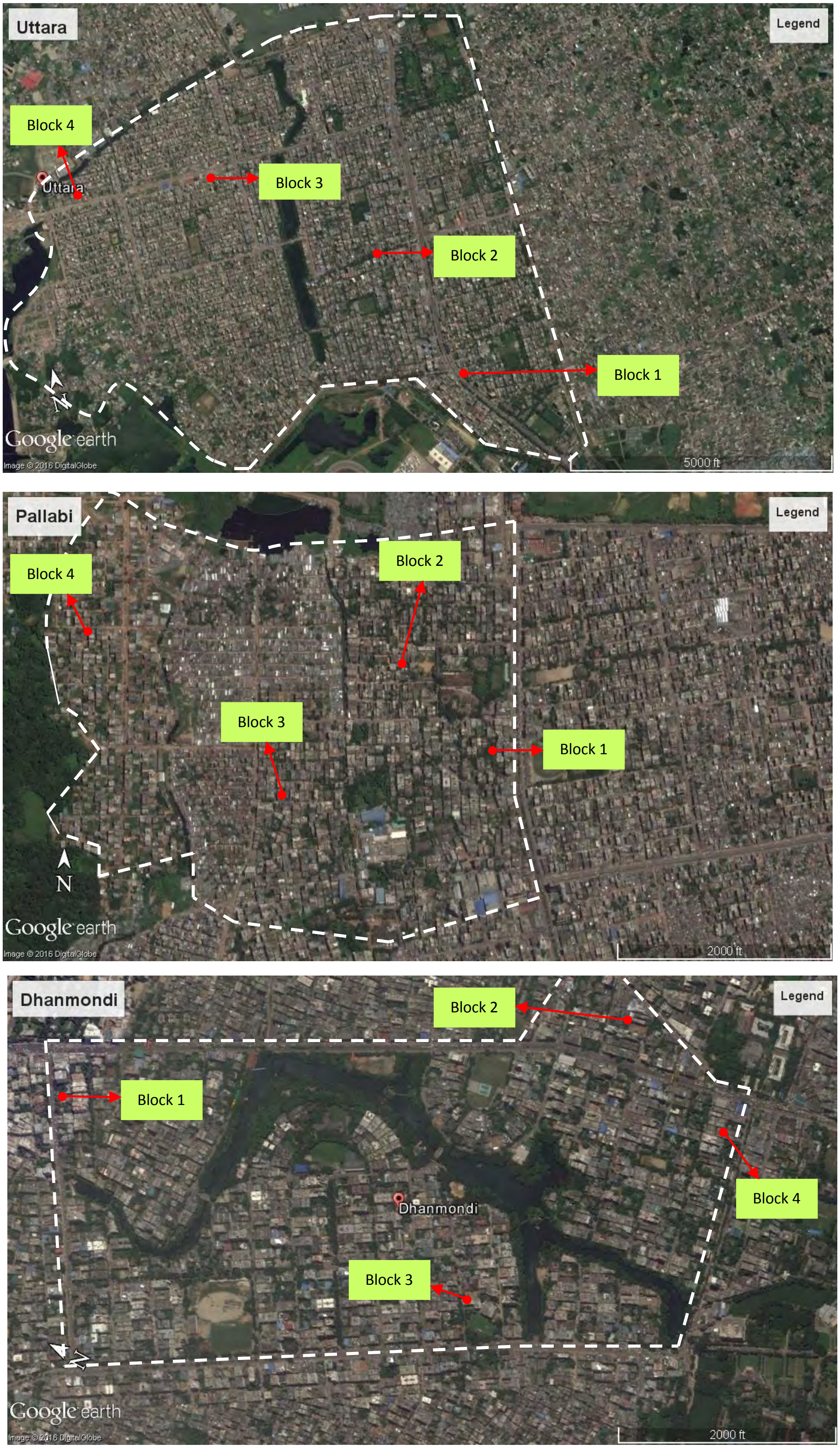
Old Dhaka continued to be an important commercial hub which attracted migrants from all over the country to seek employment and refuge here. In addition the fourth generation of the native dwellers also contributed to increase the density of the area. All these factors contributed to rapid transformation of the area from low rise to mid rise (3-6storied) dwellings which gained momentum mid 90s. By 2000 about 70% of the single and double storied houses were phased out by high and mid rise buildings. The area had reached its optimum level of densification by 2001. From 2004 to 2010 the percentage of low rise dwellings decreased even further i.e. from 16% to 12%. On the other hand from 2004 there was an upsurge in the number of 6-7 storied buildings as people were incrementing their houses by constructing additional floor upon their existing mid rise dwellings. Taking the advantage of weak monitoring people was already violating the height restriction of 6 stories which took full pace after 2008. Within the next five years there was a boom in the number of high rise buildings above 6 stories dominating the skyline of Luxmi Bazaar pushing it to the threshold of saturation. With the increasing density the development pattern was getting too dense which made a number of the affluent educated families sell their land to the local businessmen and move out to other areas. The area continued to be the hub of commercial, cultural and educational facilities which attracted migrants for both employment opportunities and accommodation. Grabbing the opportunity of profit making the local landowners predominantly businessman by occupation initiated the redevelopment activity of high rise (above 6 stories) buildings in the area. This implies that most of the densification carried out in old Dhaka during the first stage of redevelopment activity was a response to demand rose from the natural increase of population. But the redevelopment of the latter stage is largely initiated by the urge of profit making of landowners as well as developers and thereby guided by the market forces. At present the area is dominated with around 28% of high rise buildings above 6 stories followed by 30% of 5-6-storied 47% mid rise and the rest 10% with low rise houses. The narrows alleys got filled up with high rise buildings increasing the density manifold times and making old Dhaka one of the densest settlements of the world. Densification has reached the saturation stage in Luxmi Bazaar at present.

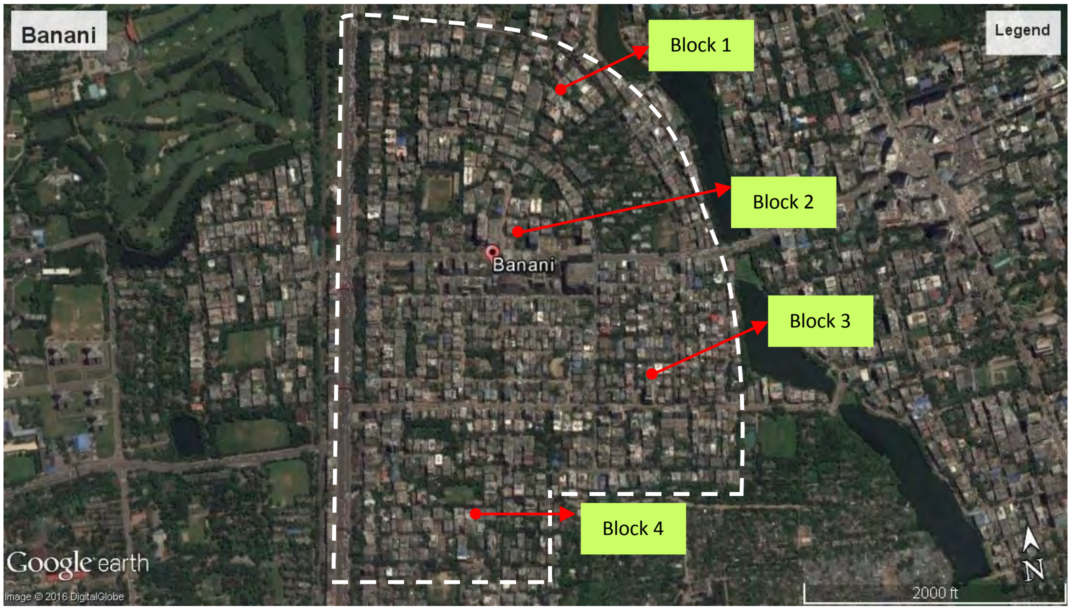
The overall trend of densification in Luxmi Bazaar suggests that redevelopment activity has started long before the intensification of commercial activities. The area is densifying regardless the development pace of commercial activities. Commercial establishments are found to be concentrating along the *Shubas Bose* primary road. Infiltration of commercial activities within the residential blocks is negligible.

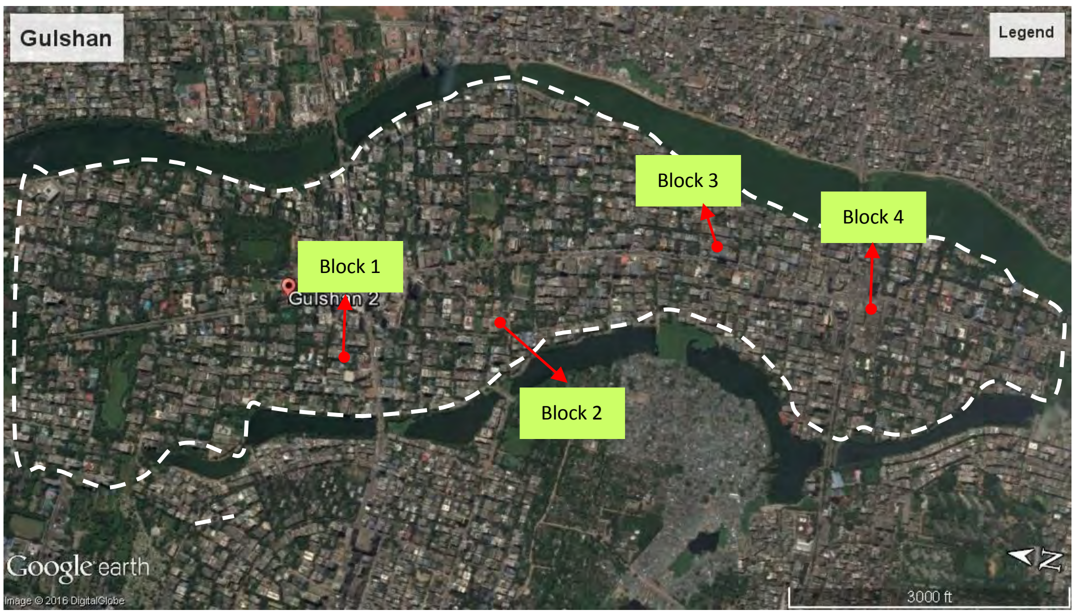
4.4 Spatial Organization of the Study Areas

The aim of this research was to examine densification processes currently taking place through the redevelopment of residential areas in Dhaka which is considered as a strategy towards achieving compact city development and ensure sustainability. As mentioned in Chapter 1 and 4, seven wards of varied density and age from the inner, intermediate and peripheral location of Dhaka City Corporation (DCC) have been selected for data collection and analysis. While the older settlements of the inner Dhaka (Luxmi Bazaar and Wari) have one of the highest densities with densely packed building forms, similar spatial characteristics are increasingly emerging in the relatively new settlements of Dhanmondi, Gulshan, Banani, Mirpur and Uttara. In these residential areas buildings were and are being transformed in terms of form and uses from residential to commercial, office and other functions. As mentioned in the earlier section 4 blocks from each study ward was selected for examining building densification process in detail. But as the old residential area of Luxmi Bazaar is characterized by organically developed road net work the physical boundary of any block was literally difficult to demarcate. So instead of blocks 3 lanes with the road facing plots flanking on both sides of the lanes were selected (as shown in Fig 4.4 & 4.5) to conduct the detailed studies which are presented in the following sections.

Figure 4.4: Location of case study blocks in study areas




Banani
Legend
Block 1
Block 2
Banani
Block 3
Block 4
Google earth
Image © 2016 DigitalGlobe
2000 ft
N


Gulshan
Legend
Block 3
Block 4
Block 1
Gulshan 2
Block 2
Google earth
Image © 2016 DigitalGlobe
3000 ft
N

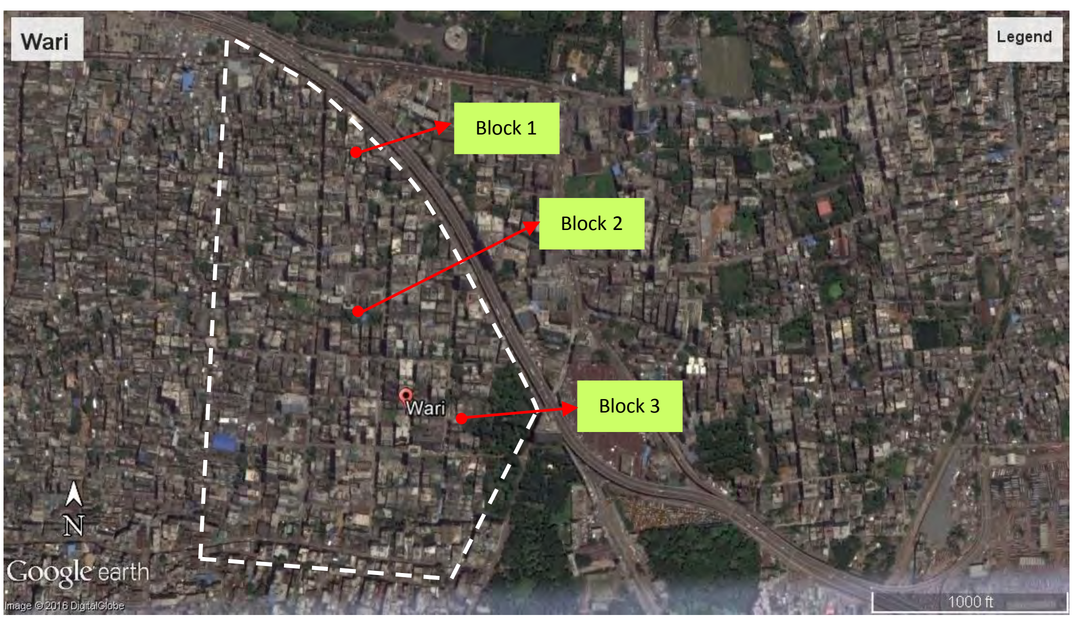

Wari
Legend
Block 1
Block 2
Wari
Block 3
N
Google earth
Image © 2016 DigitalGlobe
1000 ft

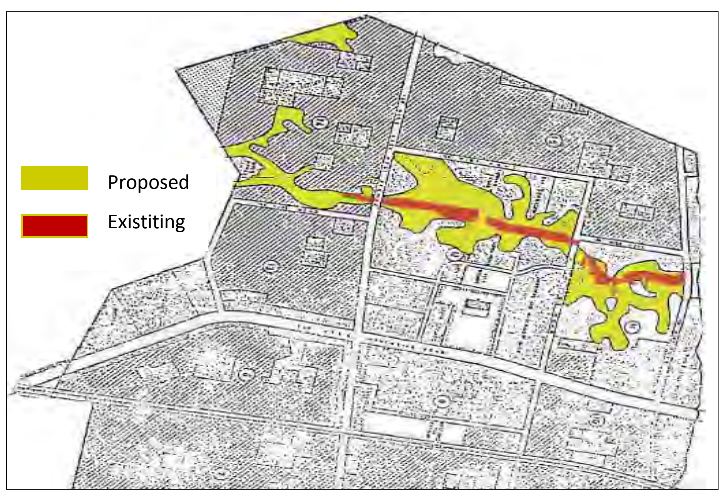
Figure 4.5: Location of case study lanes in study area no. 7 (Luxmi Bazaar)

4.4.1 Study Area 1: Ward No. 1 - Uttara Residential Model Town

Land use Pattern and Building Guide lines for Uttara

Uttara was conceived as a satellite town with the aim to decongest the inner city and was targeted for housing the low and middle income group. In 1965 DIT acquired 2344 acres of flood free high land in the northern peripheral area of Dhaka connected through a major north south corridor defined by the *Dhaka-Mymensingh road*. In the original plan around 53% of the land area was designated for residential accommodation and 47% for civic administration, light industries and recreation, playfields. But political intervention later resulted in deviation from the original plan where more plots were developed at the expense of the existing open spaces. Inspite of the Open Spaces and Wetland Protection Act 2000, much of the Uttara lakeside open spaces were converted into plots in this process while open spaces of sector 1 was sold to developers by RAJUK (Nilufar, 2013). Consequently the original number of plots were subdivided into 4302 serviced plots and distributed in 5, 7.5, 4 and 3.25 *kathas* (1 *katha* = 720 sq.ft.) to upper middle income govt. officials. The

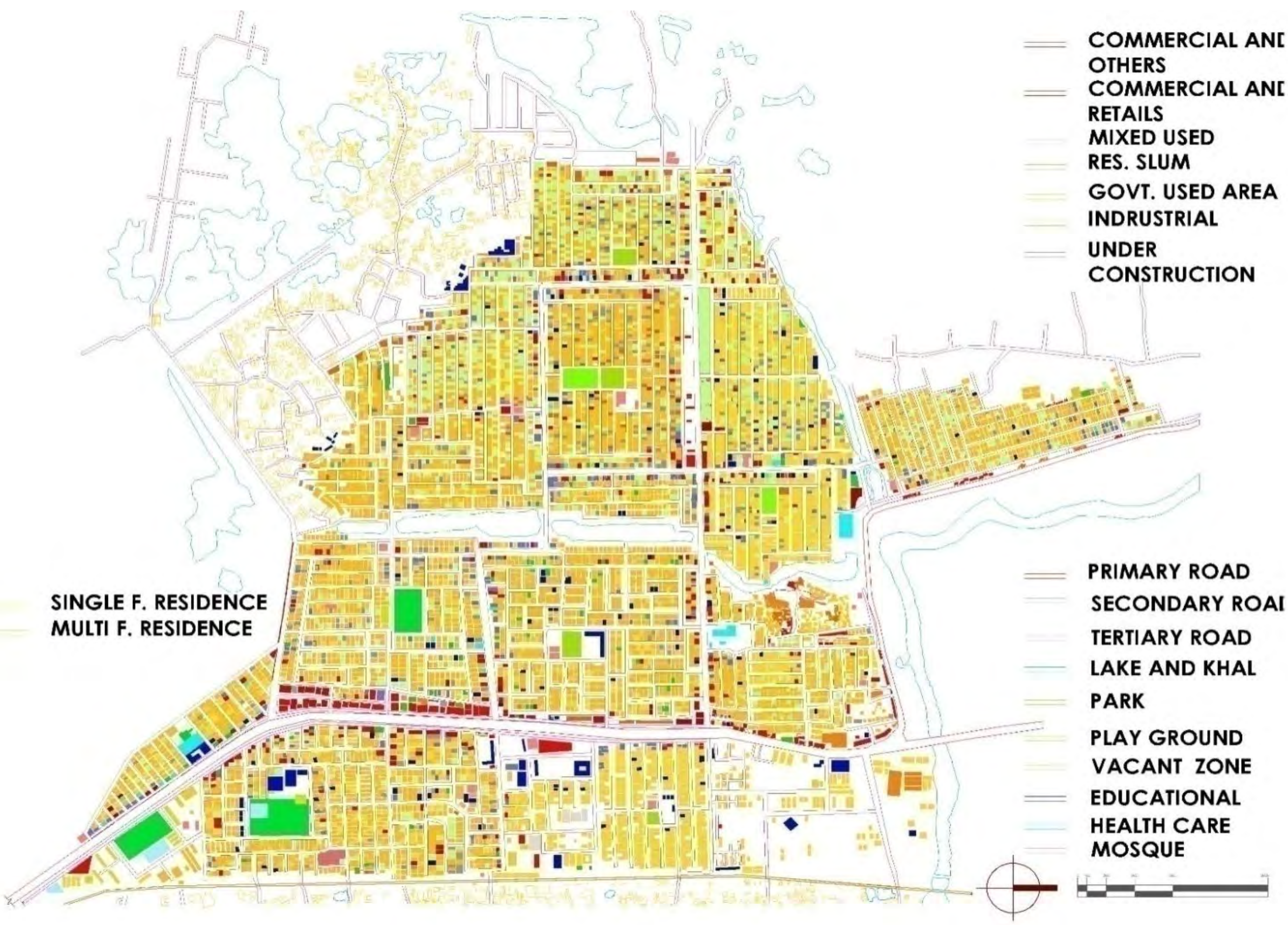
Fig 4.6: The encroachment of water body, Uttara



Source: DCC, 1990

initially intended low income group was left out. Uttara is divided into 14 sectors, starting from sector 1 to sector 14. Originally it was planned that the odd-numbered sectors (1, 3, 5, 7, 9) were to be situated on the west side of *Dhaka-Mymensingh Highway*, and the even-numbered sectors (2, 4, 6, 8) on the east side. Due to increase in population, new sectors were planned but this order was not upheld and they were all developed on the west side. Uttara Residential Area (3rd Phase)-(15-19) project is now underway. The grid iron street pattern of Uttara has organized the western part of the area into elongated rectangular blocks with more than 44 plots per block distributed equally in two rows. However the eastern part has balanced rectangular blocks with relatively larger plots. The provision for commercial facilities were assigned to a narrow strip of land along the primary road which later turned out to be insufficient and the entire road front blocks of *Dhaka*-*Mymensingh Road* was then designated for commercial development.

Figure 4.7: Land use map of Uttara



Source: Field Survey, 2015

With the establishment of linkage to Mirpur, the secondary road of *Sonargaon Janapath* (80 feet wide) grew in importance and eventually was declared by the authority for commercial setup along this thoroughfare. At present there are three commercial roads in Uttara: *Dhaka–Mymensingh Road* (primary road), *Jashimuddin Avenue*, *Sonargaon Janapath* along which commercial set ups are established. The intensification of commercial activities first took place along the primary road and then later along

Jashimuddin road and *Sonargaon Janapath*. In the recent years the secondary road of *Ravindra Sharani* has also been undergoing the invasion of commercial activities though it is still not declared as commercial zone.

Changing landscape of building heights in Uttara

Most of the allottees belonged to the affluent class, government officials and off shore residing nationals who had kept their allotted land vacant for over a decade for speculation and future construction after retirement. As a result more than half of the plots remained vacant till late 70s. By that time dispersed low density on both side of the primary thoroughfare could be seen. Only the sectors 1 to 9 were sparsely habited mostly with tin shade row houses and single storey houses. By 1984-85 the access roads as well as the installation of electricity and water supply were completed in all the sectors which exacerbated the constructions of 2 storey buildings in this area. Up to 80s the area was still sparsely habited for its size and predominated with 1-2 storey houses. Higher building construction activity was initiated from 1990s when the country's policy encouraged the investment of private sector in real estate development. The plot owners opted to construct multi storey buildings in collaboration with private developers facilitating profit maximization for both the parties. Although the buildings could not go beyond 6 stories as there was a height restriction imposed by the civil aviation authority. The emergence of this trend diminished the construction of single and two storied buildings and by 2001 about 67% of the vacant plots were occupied with 6 storey buildings.

Figure 4.8: Emerging high rise commercial buildings along the secondary street of Uttara

Figure 4.9: Jagged skyline of Uttara

The rapid transformation started taking place from 2014 as the promulgation of MINB2008 eliminated the height restriction of the area with the introduction of FAR. This rule motivated a rapid redevelopment activity in the area with taller buildings reaching up to 12 to 14 stories breaking the continuous skyline of 6 storied buildings dominating most of the blocks. At present many buildings are being transformed from typically single storey residential to multi storey commercial, residential and mixed use functions. Redevelopment trend is relatively fast in the blocks with more vacant plots and also in plots adjacent to the secondary roads both permitted and unpermitted for commercial activities. This pattern of development contributes to a generation of scatterdly developed vertical habitats (7-14 storied) amidst the arrays of low rise and 5-6 storied buildings in Uttara (Table 4.1)

Table 4.2: Trend of building height change in Uttara (2004 – 2016)

No.of	Block 1			Block 2			Block 3			Block 4		
Stories	2004	2010	2016	2004	2010	2016	2004	2010	2016	2004	2010	2016
1	1	2	3	4	2	2	-	-	-	-	-	4
2	1	2	2	3	4	2	2	2	2	-	-	-
3	3	3	2	2	3	3	-	-	-	1	1	1
4	-	1	1	1	2	1	1	1	1	-	-	1
5	2	2	2	2	4	4	1	1	1	-	3	4
6	5	5	5	2	2	2	7	8	16	-	5	20
7	-	-	2	-	-	-	-	5	9	-	4	9
8	-	-	-	-	-	1	-	3	3	-	1	1
9and above	-	-	1	-	1	4	-	-	2	-	1	1
Total	**12**	**15**	**18**	**14**	**18**	**19**	**11**	**20**	**34**	**1**	**15**	**41**

Source: Field survey August, 2016 and satellite imagery
Note: Total No. of Plots in Block 1 = 18, Block 2 = 20, Block 3 = 44, and Block 4 = 54

In the four blocks where detailed studies were conducted, the number of 6 and above 6 storey houses were 5, 2,7 and 0 in Block 1, 2, 3 and 4 respectively in 2004 which turned to 5,3,16 and 11 in 2010 and 8, 7, 30 and 31 in 2016. From Table 4.2 it can be seen that the vacant plots of the study blocks gradually started filling up from 2004 leaving still 1, 10 and 13 plots vacant in the Block 2, 3 and 4 respectively. The single and double storey houses of Block 1, 2, 3 are partially phased out and replaced by 6 and above 6 storied buildings. However, the vacant plots of the peripheral blocks like Block 4 is subjected to construction of high rise buildings from 2010 and onwards. In general terms it can be said that the number of vacant plots ranges from 1-13 in about 18% blocks of Uttara at present. The large number of vacancy in the peripheral blocks until 2008 indicates that densification started relatively at a later phase in Uttara i.e. after 2014.

Floor Area Ratio (FAR)

The maximum floor area ratio for older buildings observed in Block 1, 2, 3, 4 ranges from 0.3 to 5.6 while in Block 3 the highest FAR observed for new building was 9. The approved ratio of older buildings ranges from 4.2- 4.8. This is a case of violation of the approved ratio set by the BCR 1996. On the other hand the newly constructed buildings have a floor area ratio ranging in between 4.8 to 5.9 which is slightly in deviation from the permissible range of MINB 2008 (see Appendix II). Out of 112 surveyed in Uttara the number of mid and high rise buildings built according to the new FAR rule are 55 where 6 are commercial and the rest are residential buildings.

Table 4.3: Floor Area Ratio of Blocks 1, 2, 3 and 4 Uttara (2016)

FAR	Block 1	Block 2	Block 3	Block 4
0.1 – 0.5	-	1	-	4
0.5 – 1.0	2	-	-	-
1.0 – 1.5	1	3	-	-
1.5 – 2.0	2	1	-	-
2.0 – 2.5	1	2	-	1
2.5 – 3.0	-	2	-	-
3.0 – 3.5	1	-	1	-

3.5 – 4.0	2	3	-	1
4.0 – 4.5	-	1	4	13
4.5 – 5.0	5	-	6	17
5.0 –5.5	1	1	11	-
5.5 – 6.0	2	1	8	4
6.0 – 6.5	1	-	4	-
6.5 – 7.0	-	1	1	-
7.0 – 7.5	-	1	-	-
7.5 – 8.0	-	-	-	-
8.0 – 8.5	-	1	-	-
8.5 – 9.0	-	1	-	-
Total	**18**	**19**	**35**	**40**

Source: Author's calculation; Field survey January, 2016

Plot coverage

Field work results from Uttara indicate that the majority of the plots with 6 storied buildings had higher plot coverage of 75% - 80% which is over and above those recommended in the setback guidelines of BC Rules 1996. While the recommended maximum coverage was 70 percent, results from field observations indicate that out of a total of 112 plots surveyed, 27 of the older buildings had 81 to 90 percent, 47 new buildings had 71- 80% percent and the rest had 61 to 70 percent coverage. In general 40% of the surveyed buildings had the plot coverage exceeding the ratios recommended in both 1996 and 2008 BC Rules. This high coverage is mostly evident in 60% of plots where buildings were constructed before the introduction of FAR. Even 10% of the recently undergoing construction buildings are still following the former setback rule as their plan had been approved before the promulgation of MINB 2008. According to the guidelines construction work has to be started within 3 years from plan approval otherwise new approval is required. But the belated construction of these earlier approved buildings indicates another violation of law. Four blocks had been selected for detail study in terms of block coverage which are discussed in the following:

Table 4.4: Plot coverage in Uttara

Plot coverage (%)	Number of Plots	Percentage
50 or less	3	2.61
51-60	6	4.21
61-70	32	27.8
71-80	47	40.8
81-90	27	23.4
91-100	-	-
Total	**112**	**100.0**

Source: Field Survey, 2016

Land Coverage at block level

In terms of land coverage at block level, Block 1 had the highest coverage of 76.3 percent followed by Block 2 with 73 percent and Block 3 and Block 4 with 61.6 and 57.8 percent respectively. Overall the blocks of Uttara show a modest coverage because some blocks still have a few number of single and double storied dwellings with less horizontal extension while a significant number of plots in many blocks are still vacant which reduces the overall land coverage at block level. The plot coverage and building types for each study blocks are clearly visible in the detail block study presented below:

Table 4.5: Land coverage at block level in Uttara

Block	Total area (sq.ft)	Total built up area (sq.ft.)	Land coverage per block (%)	Average Block coverage
1	79200	60480	76.3	67.9%
2	36000	27360	76	
3	126360	77922	61.6	
4	64800	48060	57.8	

Source: Field Survey, 2016

Block 1 is located in Sector 4. Sector 4 belongs to the eastern side sectors of *Dhaka Mymensingh Road* which were populated earlier than the other sectors on the opposite side of the road. Out of 17 plots 16 plots have buildings built during the mid 1990s. 5-6 storied high rise buildings are predominant in this block with a few 1-2 storied houses. The tallest building (9 storied) is under construction and maintains the recommended FAR with a ground coverage of 65%. All the other mid rise buildings have plot coverage of 80% in compliance with the BCR 1996. These ratios are again over and above the recommended coverage of 70% according to 1996 BC Rules.

Table 4.6: Net Residential Density and Net Residential Population Density at block level in Uttara

Uttara		
Block	Net Residential Density (NRD) units /hectare	Net Residential Population Density (NRPD) persons /hectare
1	201	886
2	97	850
3	135	767
4	316	982

Source: Field Survey, 2016

Block 2 consists of a vacant plot, one under construction, 3 mixed use, 6 commercial buildings, one commercial cum residential building and 8 residential buildings of 6 storied high. Out of the 19 buildings two are newly constructed 14 storied commercial buildings, two high rise (12 and 9 stories) residential buildings and the rest are low and mid rise. The two newly constructed tower blocks and the 9 storied residential building are following the FAR rule where the rest of the older residential buildings are having plot coverage of 72% to 90%. Most of the older mid and high rise buildings are having a plot coverage exceeding the ratios recommended in the former setback rule of 1996. The zoning ordinance along the secondary street of *Ravindra Sharani* does not permit commercial uses as yet. But owing to the insufficient provision of commercial land use in the

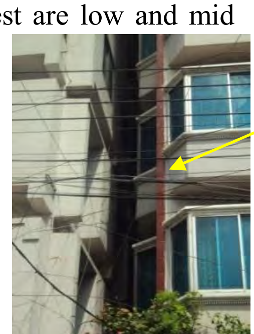



Figure 4.10: Dark alley between buildings

master plan of the area, many of the influential plot owners had acquired the permit of land use conversion through plot by plot basis in the pretext of demand or through exerting political influence on the local authority. These findings indicate that building developers and plot owners are not adhering to guidelines as stipulated in the master plan as well as in the former building construction rules. However Block 2 has one of the lowest net residential density (97 units/ hectare) due to increased number of commercial and mixed use buildings.

Block 3 is dominated by mid and high rise buildings where there are two commercial towers under construction in the two corner plots causing obstacle in the visual continuity. Out of 44 plots (6 *kathas*) 22 plots are occupied with 6-7 storied buildings, 12 plots have buildings of older construction while 9 plots are still vacant. In terms of plot coverage the present pattern indicates 65-70% in case of MINB 2008 abiding buildings and a highest of 80% - 90% in the older houses. These ratios are again beyond the prescribed level. This type of elongated block layout with linear plots usually does not give much provision for sunlight penetration and contributes to compact development. The higher plot coverage however does not create a harmonious living and working environment for poor environmental considerations like inadequate solar access, airflow and privacy without adequate ventilation and solar access.

Figure 4.11: Block 1, Uttara

Figure 4.12: Block 2, Uttara

Figure 4.13: Block 3, Uttara

Figure 4.14: Block 4, Uttara

Block 4 is located in the peripheral part of sector 12 surrounded by access roads of 18 feet on the north and south while two access roads of 24 feet wide on the east west side.. This block has 54 plots out of which 13 are still vacant. The block is dominated with 6-7 storied residential buildings forming a continuous skyline at a uniform height. This arrangement of similar height buildings, however results in loss of privacy between two justaposed buildings as well as the rear apartments are deprived of the active street frontage. Around 97% of the buildings have two units per floor making the net residential density relatively higher i.e. 316 units per hectare than the other study blocks. The continuous skyline results in casting shadow on the adjacent access roads and causing dark alleys even during afternoon. The plots are of 3.25 *kathas* which are the smallest plot sizes available in Uttara and avails higher plot coverage around 80% according to FAR. The small plot sizes have limited flexibility in designing functionally sound high tall buildings despite the freedom in height. This might be a reason for most of the recently constructed buildings of this block to be of 6-7 storied with plot coverage of 70-80%. Six plots have a maximum coverage ranging from 83% to 85% which is a violation of the law. Only 14 buildings out of 41 have maintained the provisions of MINB 2008 properly while the other have slightly violated it specially through raising the height of the front porch and guard box. But although the mandatory open space is left in most of the new building front it does not seem to have much noticeable impact on the overall block density as majority of the buildings are of six storied high. The side setbacks are narrow enough for sunlight to permeat in the interior rooms. Though the rectangular plots allow greater exposure on the east and west but the closely juxtaposed buildings of similar length is culminating into problems associated with limited capacity for ventilation, view and privacy. Moreover the narrow passage ways formed between the buildings are actually creating negative dead space which cannot be used for vegetation either. Majority of the development activity in this block started after 2011 for its peripheral location from the commercial centre as well as for the late extension of the secondary road of *Sonargaon Janapath.*

Spatial growth pattern in Uttara

The emerging spatial growth pattern of Uttara depicts that the residential area is heading towards a compact settlement of buildings with varying height, size and plot coverage. Around 10% plots are still vacant and another 10%-15% of plots are housing 1-2 storied houses. Although the trend in densification is in line with the view to maximize open space, the compactness of the older buildings closely

Figure 4.15: Closely juxtaposed buildings forming uniform skyline

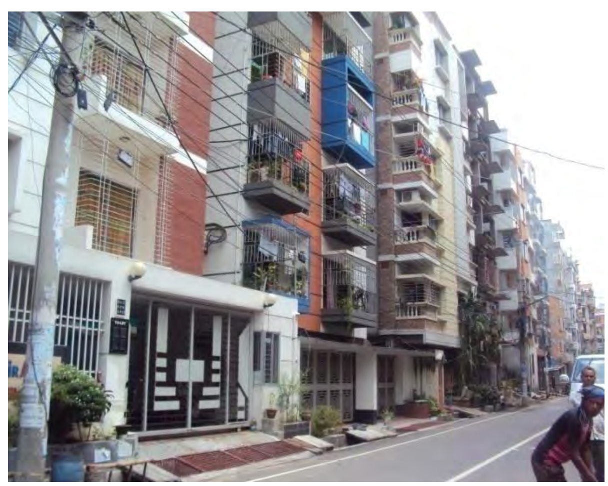


Figure 4.16: Mandatory open space is covered with roof of the extended porticos

The emerging spatial growth pattern of Uttara depicts that the residential area is heading towards a compact settlement of buildings with varying height, size and plot coverage. Around 10% plots are still

vacant and another 10%-15% of plots are housing 1-2 storied houses. Although the trend in densification is in line with the view to maximize open space, the compactness of the older buildings closely juxtaposed to each other is resulting into poor spatial qualities of the indoor living environment in majority of the blocks. This problem has been further intensified owing to layout of the blocks where the block lengths are too long housing more than 20 plots in a row. This type of block layout reduces the plot frontage and leads to cramped development. The fact development is taking place plot to plot basis two types of skyline seems to be emerging where blocks along the primary roadside are forming an informally broken vertical skyline pierced by 10-14 storied commercial and mixed use towers in irregular intervals and the inner blocks having more or less an uniform skyline formed by 6-7 storied residential buildings. Overall such a spatial development pattern contributes to a jagged skyline of the area. The tower blocks are casting shadow on the adjacent buildings and streets causing dark corridors. This spatial growth is not sustainable when spatial quality requirements of visual, indoor sun lighting, skyline, space between buildings and cross ventilation are taken into consideration. Densification is still in its infancy stage in the sector 5, 10, 12 and 14 but in the rest of the 11 sectors it had reached the ‘optimum stage’ with the proliferation of commercial setup acting as a catalyst to the densification process.

4.4.2 Study Area 2 : Ward No. 6 – Pallabi

Land Use and Land Use and Building Guide lines for Pallabi

Figure 4.17: Land use map of Pallabi

Source: DNCC, 2014

The residential area of Pallabi was built in 1950s under the site and service scheme. The real estate company Eastern Housing launched one of the first developer initiated housing projects in Pallabi through construction of single storey detached European housing in the serviced plots on the western side of the primary road (*Haroon Molla Sarak*). These houses were sold to the affluent middle class. At that time most of the area was vacant with a few single storied permanent structures and the rest with sparsely located semi permanent tin shade houses.

Changing landscape of building heights in Pallabi

Pallabi remained a low density settlement with predominantly 1 or 2 storied buildings up to 90s. The increasing land price and rent structure of the inner city residential areas worked as a push factor for the lower middle class and middle income class to seek affordable houses in the peripheral location. The well connectivity and ease of transportation also promoted this area as a preferable location for settlement. The growing demand of rental accommodation of the migrating people initiated redevelopment activity in this area which was profitable for the local property owners. By 2001 almost 60% of the single storey houses were phased out and 4 - 6 storied buildings were gradually filling the landscape. The increasing population gave rise to the demand of amenities and services. This demand was tackled through a change in the function of the buildings where more mixed use and commercial buildings were haphazardly built all over the area. These functions included shopping malls, banks, clinics, physician chambers, dentist chambers, coaching centers, primary and secondary and restaurants. Commercial strip development along the major thoroughfare *(Begum Rokeya Sharoni and Haroon Molla Sarak)* intensified.

Figure 4.18: Informally broken skyline of Pallabi

Table 4.7: Trend of building height change in Pallabi (2004 – 2016)

No. of	Block 1			Block 2			Block 3			Block 4		
Stories	**2004**	**2010**	**2016**	**2004**	**2010**	**2016**	**2004**	**2010**	**2016**	**2004**	**2010**	**2016**
1	7	7	3	1	1	2	-	-	-	7	10	13
2	8	6	5	13	6	4	2	2	2	2	4	4
3	4	4	4	4	3	4	1	2	2	-	1	1
4	2	2	2	3	3	3	2	2	2	-	3	6
5	-	-	-	1	4	3	-	-	-	-	-	-
6	1	2	2	-	5	5	2	5	8	-	5	8
7	-	-	2	-	-	2	-	1	6	-	-	-
8	-	-	-	-	-	2	-	-	-	-	-	-
9and above	-	1	4	-	-	-	-	-	1	-	-	-
Total	**22**	**22**	**22**	**22**	**22**	**25**	**7**	**12**	**21**	**9**	**23**	**32**

Source: Field survey August, 2016 and satellite imagery

Note: Total No. of Plots in Block 1 = 22, Block 2 = 26, Block 3 = 24, and Block 4 = 52

From 2008 and onwards the trend of constructing high rise mixed use and commercial building of 10-14 stories has drastically transformed the streetscape into a informally broken skyline. The commercial and mixed use high rise buildings along the road front predominantly houses offices, banks, hospitals, diagnostic centers, shopping malls, colleges and garments factories. The changing landscape of Pallabi and the intensity of commercial development can be largely attributed to the existing good transportation facilities through public transport. The establishment of *Kalshi* and *Mirpur Ceramic Road* further enhanced the connectivity with the northern and eastern part of the city providing shorter commuting distance. While the majority of the house forms in Pallabi are still mid rise (4 – 6 stories), commercial as well as residential and high-rise buildings of 10 to 14 stories are emerging increasingly filling up the vacant plots of the inner blocks. This pattern of isolated high-rise buildings pose a threat of privacy to the surrounding low and mid rise houses because people in the high-rise buildings can have a view of indoor and outdoor activities taking place in the low and mid rise houses. If this trend will continue unchecked, the challenges of loss of privacy, blocked cross ventilation and sun lighting will be more apparent.

Floor Area Ratio (FAR)

The floor area ratio for older buildings observed in Block 1, 2, 3 and 4 ranges from 0.3 to 5.9 while in the new buildings it ranges from 4.8 to 6.3. Most of the older buildings have clearly violated the maximum approved ratio of 4.8. One building in plot 6 of Block 1 has floor area ratio of 9 which is a serious of violation of the approved ratio set by the BCR 1996. On the other hand the newly constructed buildings have a floor area ratio ranging between 4.8 to 6.3 which is within the permissible range of MINB 2008. Out of 98 surveyed mid and high rise buildings built at different time periods only 14 are recently constructed buildings while others are older construction following the BCR1996. The number of the new buildings is quite lower than the older ones which implies that the ratio of mandatory open spaces left according to the new FAR rule cannot have the desired benefits in the block level where the aggregate open space is still less than 30%.

Table 4.8: Floor Area Ratio of Blocks 1, 2, 3 and 4 in Pallabi

FAR	Block 1	Block 2	Block 3	Block 4
0.1 – 0.5	-	2	-	6
0.5 – 1.0	3	-	-	6
1.0 – 1.5	1	4	2	-
1.5 – 2.0	3	1	-	5
2.0 – 2.5	5	7	2	2
2.5 – 3.0	1	1	2	1
3.0 – 3.5	1	-	-	4
3.5 – 4.0	-	-	-	-
4.0 – 4.5	-	2	-	1
4.5 – 5.0	2	5	4	5
5.0 –5.5	-	1	6	-
5.5 – 6.0	2	2	3	1
6.0 – 6.5	2	-	1	-
6.5 – 7.0	-	-	-	-
7.0 – 7.5	-	-	-	-
8.0 – 8.5	1	-	-	-
8.5 – 9.0	1	-	-	-
Total	**22**	**25**	**20**	**31**

Source: Field survey January, 2016

Plot coverage

Fieldwork results from Pallabi indicate that the majority of the plots having 6 and above 6 stories buildings had higher plot coverage over and above those recommended in the guidelines of BC Rules 1996. While the recommended maximum coverage was 70 percent, results from field observations indicate that out of a total of 124 plots surveyed, 3 plots had above 80 to 90 per cent and 57 plots had above 70 to 80 percent coverage. One 9 storied building had plot coverage of 100 percent (Table 4.9). In general terms, about 89 percent of 5-6 storied buildings constructed earlier according to BC Rules 1996 had plot coverage exceeding ratios recommended in the standards. These findings indicate that building developers did not adhere to guidelines as stipulated in the development guidelines (BC Rules 1996 and MINB 2008). In case of Pallabi around 45% plots are already occupied with older construction of 6 storied buildings in the roadside and inner belt (Pallabi-Extension area) while the peripheral belt (Pallabi Phase -2) has 70 percent of its blocks still vacant. The recent FAR adhering buildings are filling in the pockets as a patch work. Except the open space in the front, the side setback are still inadequate and the effect of this excessive plot coverage is culminating into problems associated with limited capacity to attend emergency measures such as fire rescue, poor ventilation and poor sunlight in the interior rooms.

Fig 4.19: 90% plot coverage allowing almost no setback space, Pallabi

Table 4.9: Plot coverage in Pallabi

Plot coverage (%)	Number of Plots	Percentage
50 or less	1	1
51-60	6	6
61-70	31	31.3
71-80	57	57.5
81-90	3	3
91-100	1	1
Total	**99**	**100.0**

Source: Field Survey, 2016

Land Coverage at block level

The results of field survey indicates that Block 2 has the highest land coverage of 70% followed by Block 1,3 and 4 with a land coverage of 69.1%, 67.7% and 47.6% respectively. Based on the block survey the average block coverage turns out to be 63.9 in Pallabi. Overall the figure suggests that Pallabi has a modest land coverage in terms of block which is desirable for environmental benefits for the time being as this modest land coverage is the result of the existing low rise building with low plot coverage and the few vacant plots within the blocks. Detail block survey provided below presents more information regarding the house types and plot coverage.

Table 4.10: Land coverage at block level in Pallabi

Block	Total area (sq.ft)	Total built up area (sq.ft.)	Land coverage per block (%)	Average Block coverage
1	86400	59760	69.1	69.9%
2	90000	63000	70	
3	79200	53640	67.7	
4	187200	89280	47.6	

Source: Field Survey, 2016

Block 1 is a roadside block facing the primary road (*Haroon Molla Road*) of the ward which is declared as a commercial road by the government. It was one of the oldest habited blocks of Pallabi dominated with an array of prototype modern single storey dwellings during the mid 60s. These houses were developed by Johirul Islam one of the pioneering developer of the country. Around 34% of the single storied buildings of this block were extended to mid rise buildings around the late 90s through self initiative of the land owners and by 2010 about 60% of the low rise houses were phased out with developer constructed high rise buildings. Most of the earlier built mid rise structures had a plot coverage of 50%-60%. But as most of the road facing mid rise residential dwellings have incorporated mixed use function by constructing separate shops in the front of the main house or transforming the ground floor for various commercial activities the overall plot coverage have increased to 75 to 82 percent. While the more recently constructed high rise buildings have maintained the recommended FAR except one building. This 9 storied mixed use building is having 100% plot coverage which is a violation of law. The high rise buildings of this block are casting shadow on the adjacent plots and blocking the view.

Table 4.11: Net Residential Density and Net Residential Population Density at block level in Pallabi

Pallabi		
Block	Net Residential Density (NRD) units /hectare	Net Residential Population Density (NRPD) persons /hectare
1	215	882
2	196	846
3	204	880
4	127	561

Source: Field Survey, 2016

Block 2 is predominantly residential with a 6 storied primary school and a government water pump station in the corner plot. Out of 26 plots 12 plots are having high rise buildings of 5-8 stories. 7 plots have 1-2 storied dwellings while the rest are occupied with mid risers. The block is surrounded by tertiary roads of 8, 10, 12 and 10 feet wide along its north, east, south and west side respectively. Only 5 of the newly constructed high rise buildings are adhering to the FAR rule and the rest have higher land coverage than the recommended level. This block is also having problems associated with ventilation, sunlight and privacy in the closely juxtaposed high rise buildings. The high rise buildings are casting shadow over the adjacent low rise houses and enchoaching their privacy. Furthermore the school traffic during the peak hour causes traffic jam and hampers the serenity of the neighbourhood.

Figure 4.20: Block 1; Pallabi

Figure 4.21: Block 2; Pallabi

Figure 4.22: Block 3; Pallabi

Figure 4.23: Block 4; Pallabi

Block 3 is located the middle part of Pallabi which is known as Pallabi-Extension area. It has 24 plots with 4 plots still vacant and 2 under construction. The block is surrounded by 12’ tertiary road on all the four sides and plots are rectilinear in shape. Around 74% of the plots is occupied with mid and high rise structures. Out of 18 high and mid rise buildings 14 are constructed before 2008 and the rest of the 4 buildings are constructed within the last 6 years with plot coverage of around 70% maintaining the FAR rule. Among the former 11 buildings, 8 are having a plot coverage of around 85% percent which is beyond the recommended level of BCR1996. The narrow side set backs are causing dark alleys in between buildings and trapping heat. The block is predominant with residential function with only one boutique and a tailor shop in one of the building. The house forms in Block 3 are dominated by 4-6 storied houses forming a uniform skyline. The only tallest building of the block is 9 storied. The block is densely packed owing to its house forms of uniform height and higher plot coverage contributing to uncomfortable indoor living especially in hot and humid climatic conditions of Dhaka.

Block 4 is in the peripheral location (Pallabi Phase II) of the ward and is still sparsely populated with single storied linear structures housing mainly retail shops of building materials (cement, rod, hardware, tiles) and a few grocery and stationary shops. Out of 32 plots 5 plots are vacant and 9 other plots are partially vacant. The block has only a couple of few 4-6 stories houses. Land coverage at the block level is 47.6 %. Most of the single storied structures are shops. All mid and high rise buildings are having plot coverage of 80 percent. Only two under construction high rise (7 and 6 storied) buildings are maintaining the recommended FAR. High rise buildings occupy only 13.4% of the total number of plots of this block. With an irregularly placed house forms of diversified height the block is having an abruptly broken skyline.

Spatial growth pattern in Pallabi

Although the skyline of Pallabi is still dominated by low and mid rise buildings, isolated cases of high-rise buildings are protruding as obelisks breaking the skyline amidst the cluster of mid rise buildings. Around 75% of the buildings which were built before 2008 have a high coverage of 80% to 90% which is far above the recommended level. The FAR rule has been followed by 28% of the buildings which have been constructed after 2008. Some older blocks are found developed with rows of mid rise buildings sharing the side external walls of the adjoining building leaving no side setback space. In terms of block coverage, the present pattern indicates a coverage ranging from 85% to 90%. This pattern is evident in the frontal section of the ward while the Rup Nagar area which is located in the middle part of the Ward is dominated with medium density row houses and tin shaded *kutcha* houses. The peripheral belt of the Ward which also belongs to the *Eastern Housing company* has 38% of its plots still vacant, 23% occupied with single storied semi permanent structures while the rest are occupied with 4-6 storied buildings. Land coverage in Block 1, 2 and 3 indicates an optimum level of densification while in Block 4 densification is far below the optimum level. So from the field observation it can be inferred that in general only 40%-45% of the ward area has reached optimum densification while the rest is still in its infancy stage with ample provision for further accommodation.

4.4.3 Study Area 3 : Ward No. 49 – Dhanmondi Residential Area

Land Use and Building Guide lines for Dhanmondi

Dhanmondi was designed as a high class residential area by PWD. DIT acquired land in 1950 along the north south corridor of Mirpur road and allotted serviced plots in 5,8,10 and 20 *katha*s (14400 sq.ft.) basis to govt. officials. The minimum plot size to be sold was not less than 5 *katha*s (1 *katha* = 720 sq ft) which was considered affordable for the high income class. Public Works Department (PWD) laid out the Master Plan of the residential area with 1000 plots (15–33 decimals) and building construction not more than 3 stories were allowed according to original plan. Starting from 1970s single storey residences accommodating high profile political leaders, ministers residences, embassies started to emerge, which defined the status of the area as diplomatic zone. By that time the area could be characterized as low density settlement dominated by more or less evenly dispersed single storied houses. The only multi storied building was the 3 storied Polish Embassy during this period. Other than the residential use 9.2% of the entire area was designated for open space and playground, 9.2% for water body, 0.9% for mosque and 0.9% for school making it a posh picturesque neighbourhood. Dhanmondi Boys High School was the only school of the area. There was a restriction on commercial activities for maintaining the security of the diplomatic zone. President Ata-ur-Rahman first flouted the law in 1985 by building the Garden Market in Dhanmondi on road no. 7 modifying the regulation for sanctioning 20 feet depth from the road front for commercial uses (Ahmed et.al, 2009). This encouraged other inhabitants to construct more commercial establishments.

Starting from 1985 commercial uses seemed to emerge in Dhanmondi of varied scale and type in a haphazard manner. These include retail shops, small groceries, Chinese restaurants etc. The diplomatic status of the area contributed in a price hike of the land value of Dhanmondi. The locational attribute of Dhanmondi along one of the major transport corridor was favourable for further development activities but the high land price due to its diplomatic status was keeping out the middle class to invest here up to late 80s. So taking into consideration the growing demand for incorporating this prized location into the spatial structure of the city which would in turn facilitate the development activity, the diplomatic zone

Table 4.12: Land Use of Dhanmondi Residential Area

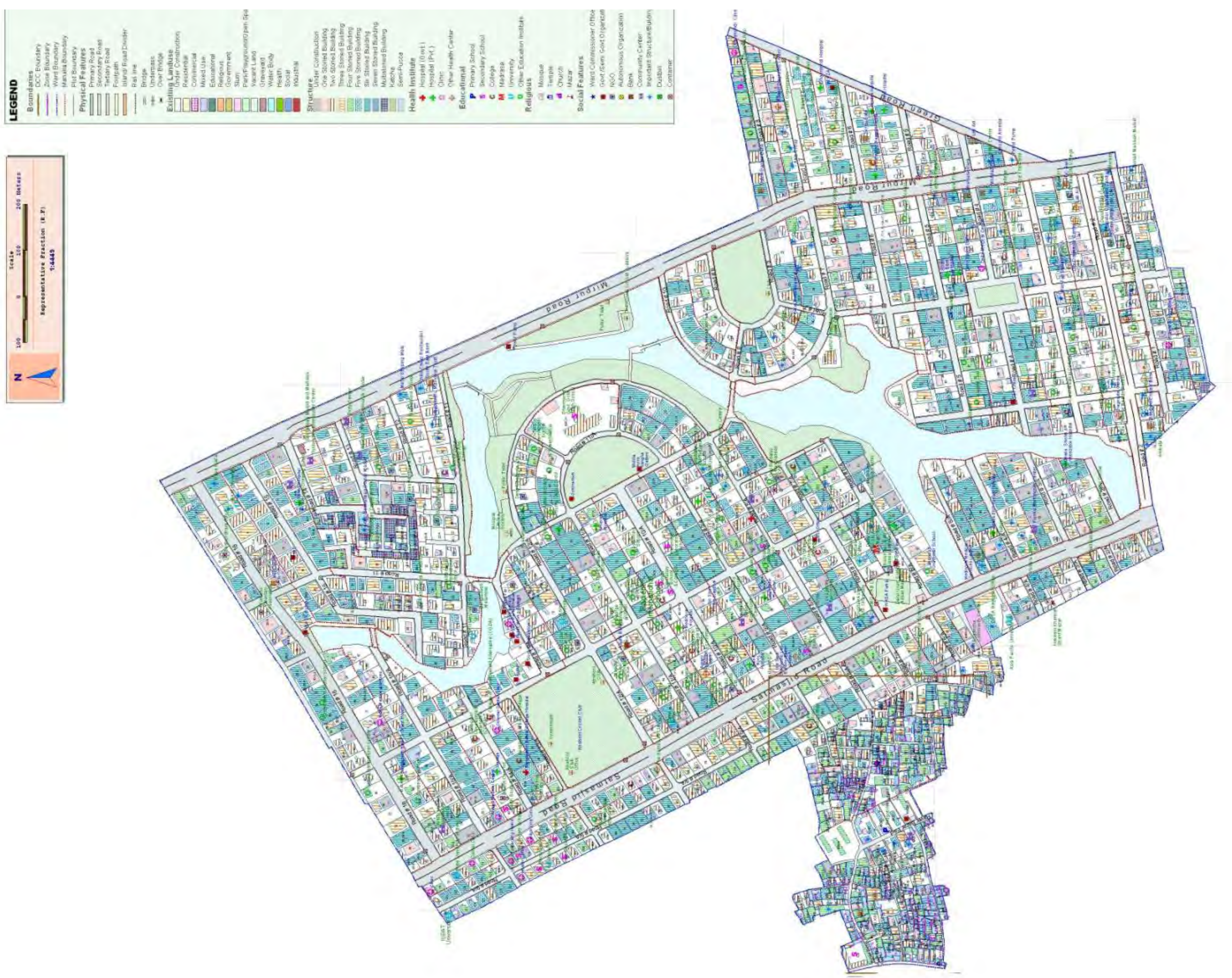
Land Use	Area (acre)	Area (%)
Total residential area (plot)	298.3	61.4
Roads	89.6	18.4
Water body	44.6	9.2
Park and playground	44.7	9.2
Mosque	4.7	0.9
School(public and provided in the original plan)	4.4	0.9
Total Area	**485.9**	**100**

Source: Public Works Department, 1958

was shifted to a peripheral location by 1990s. This decision initiated a change in the landscape of Dhanmondi with a boom of 6 storied buildings in the following decade which is largely attributed to the decrease in land value and developers' involvement in the housing sector encouraged by the neo-liberal policy model of the government. In absence of a guiding framework for building redevelopment, the land use change, height restrictions were determined by using Government Notices, Orders and Circulars (see Appendix II) issued by the PWD and Ministry of Housing and Public Works during the period of 1995 to 1996. The bye law for subdivision of the plots laid out for Dhanmondi further accelerated the construction of 6 storied buildings. As government does not allow subdivision of plot below 5*katha* (335 sq.m.) in planned residential areas the second and third generation land owners of Dhanmondi have to sell or construct multi storied building with apartments with individual title for all the beneficiaries. This law of land subdivisions induces apartment housing to be a solution to get rid from the complicated situation of tenancy in common. Moreover the present land holders (successors of the original owner), who are economically obsolete finds agreement with the developers to be an easy solution for redevelopment

(Afrin et al., 2012). The large number of mid rise buildings constructed as per Building Construction Rule 1996 soon turned the area from low-density into mid density settlement. The PWD Circular 1st May 1996 (see Appendix II) provided the permit of commercial activities compatible to neighbourhood scale on all the plots on both sides of *Mirpur Road, Satmasjid Road* and *Road No. 16(old 27)* with 15% “Conversion Fee”. As a road fronts were soon occupied with commercial activities. The changing landscape of Dhanmondi was largely attributed to the increase in land value following the establishment of the modern shopping malls and hospitals like *Rapa Plaza* and *Ganoshasto Bhaban*. The height limitation to 6 stories with no restrictioon the number of flats was allowed according to the decision taken by the Jahiruddin Committee in 1996 and notified through circular (see Appendix II). As a result the overall density increased 3 times than initial density with higher density along the primary roads gradually decreasing inwards. Driven by these catalysts the growth pattern of Dhanmondi changed drastically in the decades to follow whereby the proportion of single storey houses diminished to 42% and further down to 65% in 2000 and 2004 respectively (Author’s calculation from satellite imagery). In the face of growing demand

Figure 4.24 Land Use Map of Dhanmondi



Source: DSCC, 2011

and the weak enforcement of guidelines the commercial activities of varied scale and nature started infiltrating into the inner blocks other than the permitted road fronts. This type of commercial invasion is causing discomfort in the living condition by generating huge traffic snag. In 2008 with the introduction of FAR and elimination of height restriction further increased the density. The area is currently undergoing another phase of transformation where the 6 storied buildings are increasingly being replaced by12 to 14 storied towers of mixed use functions.

Changing landscape of building heights in Dhanmondi

During 1970s the posh residential area was predominantly a low rise low density settlement surrounded by green spaces and water body. Most of the plots had 1-2 storied house form with ample space in the front and backyard for gardening. The pattern started changing towards mid rise buildings since late 80s and the rapid transformation took place in the following one and half decade forming a matrix of 6 storied building in the regular blocks laid on the grid iron pattern road network. From 2008 the uniform continuous skyline of 6-storied buildings have started breaking haphazardly with 12 to 14 storied towers of mixed use and commercial functions particularly along the primary and secondary roads of the area. But this trend can also be seen emerging in some of the inner blocks facing access roads of 18-24 feet width. At present the recent redevelopment activity with the adherence to FAR rules are promoting to build higher through replacing the 6 storied building with high rise tower blocks. Moreover the subdivision of the bigger plots has facilitated the construction of a cluster of high rise buildings in the original plot which in turn contributed to the increase of the residential density.

Figure 4.25: The skyline of Dhanmondi

Table 4.13: Trend of building height change in Dhanmondi (2004 – 2016)

No.of	Block 1			Block 2			Block 3			Block 4		
Stories	2004	2010	2016	2004	2010	2016	2004	2010	2016	2004	2010	2016
1	10	5	6	-	-	-	5	2	1	5	4	4
2	4	8	3	1	2	2	4	2	2	6	4	3
3	3	2	2	1	1	3	2	4	1	3	1	1
4	-	-	-	1	1	-	1	1	2	1	1	1
5	-	-	-	1	1	1	-	-	1	4	4	4
6	4	4	6	1	9	11	5	6	6	6	10	11
7	1	1	1	-	-	-	-	1	1	-	-	-
8	-	-	-	-	-	-	-	-	-	-	-	1
9and above	-	4	6	-	-	1	-	1	5	-	2	4
Total	**22**	**24**	**24**	**6**	**8**	**18**	**17**	**17**	**19**	**25**	**24**	**29**

Source: Field survey January, 2016 and satellite imagery

Note: Total No. of Plots in Block 1 =18(initial) and 24(present) 24, Block 2 = 9 (initial) and 18(present) , Block 3 = 12(initial) and 19(present), and Block 4 =17(initial) and 29(present)

Floor Area Ratio (FAR)

From the field survey the observed Floor Area Ratio (FAR) was found ranging from 2.50 to 6.25 in Block 1, 2, 3 and 4. For plot area above 5-6 *katha* the recommended maximum Floor Area Ratio for residential buildings is 3.75 and 3.50 for residential cum commercial uses according to MINB 2008. And for larger plots (Above 9-10 *katha*) the maximum recommended FAR is 4.00 and 6.00 for buildings residential and commercial buildings respectively. One 6 storied building on the corner plot of Block 3 had a Floor Area Ratio of 6.3. Though the building is constructed before 2008 but still the higher horizontal extension is a case of violation of the approved setback standards of BCR1996. Further observations in the areas zoned for residential cum commercial revealed an average Floor Area Ratio that ranged between 4.8 to 9.1in the newly constructed buildings. This indicates the lack of monitoring to ensure the compliance of the recommended FAR according to MINB 2008 (Table 4.14). Out of 95 buildings surveyed 14 are found to be recently constructed.

Table 4.14: Floor Area Ratio in of Blocks 1, 2, 3 and 4 Dhanmondi

FAR	Block 1	Block 2	Block 3	Block 4
0.1 – 0.5	7	-	1	1
0.5 – 1.0	3	1	1	3
1.0 – 1.5	3	2	1	3
1.5 – 2.0	-	1	-	3
2.0 – 2.5	-	4	1	1
2.5 – 3.0	-	-	1	-
3.0 – 3.5	-	2	2	2
3.5 – 4.0	-	3	1	1
4.0 – 4.5	1	-	1	1
4.5 – 5.0	3	5	5	4
5.0 –5.5	1	-	-	5
5.5 – 6.0	-	-	1	-
6.0 – 6.5	-	2	1	1
6.5 – 7.0	1	-	1	-
7.0 – 7.5	2	-	-	1
7.5 – 8.0	2	-	1	-
8.0 – 8.5	2	-	1	-
8.5 – 9.0	-	1	1	-
9.0 – 9.5	-	-	-	3
Total	**25**	**21**	**20**	**29**

Source: Author’s calculation, Field survey January, 2016

Plot coverage

Results from field observation revealed that around 52.4% of the plots had a plot coverage ranging between 71- 90% while 17.9% plots with low rise houses have a modest coverage of less than 50 to 60%. The rest of the plots with new constructions are having the mandatory open space of 25% (rain soakable ground) around the building. Only a few plots had higher coverage ranging from 91 to 100 percent which constitute a portion of the older buildings built before 2007. Again this shows the tendency of the land owners and developers to utilize plot coverage exceeding the recommended standards motivated by the urge of profit maximization.

Table 4.15: Plot coverage in Dhanmondi

Plot coverage (%)	Number of Plots	Percentage
50 or less	7	11.4
51-60	4	6.5
61-70	16	26.2
71-80	18	29.5
81-90	14	22.9
91-100	2	3.27
Total	**61**	**100**

Source: Field Survey, 2016

Land Coverage at block level

In terms of land coverage at block level, the present pattern of Block 1 and 2 indicates a modest coverage of about 65.2 and 63 percent respectively. Nevertheless the average block coverage is found to be 72.6%. This is because there exists still a significant number of single and double storied dwellings and most of the recently constructed high rise buildings are following the MINB 2008 properly.

Table 4.16: Land coverage at block level in Dhanmondi

Block	Total area (sq.ft)	Total built up area (sq.ft.)	Land coverage per block (%)	Average Block coverage
1	792000	516600	65.2	72.6%
2	115200	55080	63	
3	184400	158760	86.1	
4	230400	175840	76.3	

Source: Field Survey, 2016

Block 1 provides a glimpse of the changing trend in terms of building function. This block had initially 18 plots (20 *kathas*) which was later sub divided into 24 plots. As being located along the secondary road (Road No. 27old / 16new) Block 1 has been declared as commercial zone in 1996 through government circular (see Appendix III) and about 54.5% of its buildings had been transformed from residential to residential cum commercial uses since then. Out of 24 plots 14 plots are dominated with high and mid rise while the rest are still occupied with 1-2 storey houses. This however still creates a harmonious living and working environment with visual impressions within human scale. But the harmonious environment of this block is in a vulnerable state as the invading trend of densification is likely to transform the low rise houses into high rise buildings soon. Furthermore the high rise commercial buildings overlooking the adjacent low rise buildings intrude the privacy of these houses. Most of the new high rise buildings are comply the FAR rules with a plot coverage ranging from 60 to 70 percent while the older constructions had violated the BCR 1996 rules. As the emerging trend indicates that the blocks of the first and second row of this block are likely to transform into high rise commercial and residential high rise buildings in near future which would further intensify the loss of privacy and ventilation.

In Block 2 the original 9 (20 *kathas*) plots have sub divided into 18 plots. Out of 18 plots 15 are occupied with mid and high rise buildings, and the rest of the 3 plots with low rise buildings. In terms of plot coverage Block 2 indicates a pattern with a highest 78%-80% which is causing encroachment of privacy and blockage of ventilation and sunlight in the interior rooms. The block has a 4 storied school, karate training center and a heritage site (Shahi Eid Gah and 6 storied mosque). The school is not a permissible land use here and neither the design of the residential building confirms to the design requirement of a primary and secondary school. The access roads around this block are 18-20 feet wide which are sufficient for the traffic caused by the school during peak hours. Furthermore significant portion of the effective of width of the access roads around the school serves as surface parking for the school buses which even worsens the situation.

Table 4.17 : Net Residential Density and Net Residential Population Density at block level in Dhanmondi

Dhanmondi		
Block	Net Residential Density (NRD) units /hectare	Net Residential Population Density (NRPD) persons /hectare
1	72	331
2	100	924
3	164	757
4	165	763

Source: Field Survey, 2016

Block 3 is located in between the primary (*Mirpur Road*) and secondary road (*Green Road*). The block had 12 blocks initially but later sub division resulted into a total of 19 plots. Out of the 19 plots, 8 plots are having land coverage between 80 to 90 percent housing 4 to 10 storied buildings. The other 3 plots are undergoing the construction of 10-13 storied high rise buildings complying to MINB 2008 while the older buildings did not adhere to the setback rules of BCR1996 with a land coverage ranging between 80 to 90 percent.

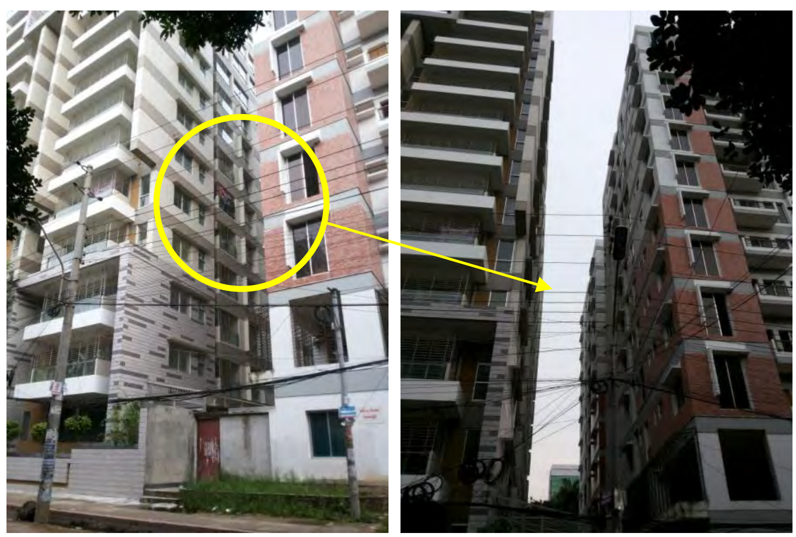


Figure 4.26: Requisite side setbacks maintained according to FAR between newly built high rise buildings blocks, Block-4, Dhanmondi

Block 4 has one of the highest levels of densification with 80% of its plots occupied with 4-13 storied buildings. In terms of land coverage Block 4 indicates 76.3% with individual plot coverage ranging between 30-85%. Out of 29 plots 13 earlier constructed 4-6 storied buildings have higher plot coverage around 85% and 4 of the newly constructed buildings are having plot coverage ranging from 68% to 75%. This indicates a violation of both old and new law. The subsequent subdivision had created three rows of buildings in 30% of the plots. As this block is facing Road No. 2 and Mirpur Road along which commerctial land use is permitted several commercial buildings occupy the road facing plots. But along the other side of the row which isfacing the access road there is a university housed in a residential 5 storied building which not a permissible use for this row. The block is dominated by 5-6 storied buildings with three newly constructed 14 storied residential apartments in the middle. These towers have followed the recommended FAR leaving ample setback spaces around. But still these high rise towers are casting shadow on the nearby road and adjacent houses which is resulting into lack of sunlight and privacy to the adjacent buildings.

Figure 4.27: Block 1; Dhanmondi

Figure 4.28: Block 2; Dhanmondi

Figure 4.29: Block 3; Dhanmondi

Figure 4.30: Block 4; Dhanmondi

Spatial growth pattern in Dhanmondi

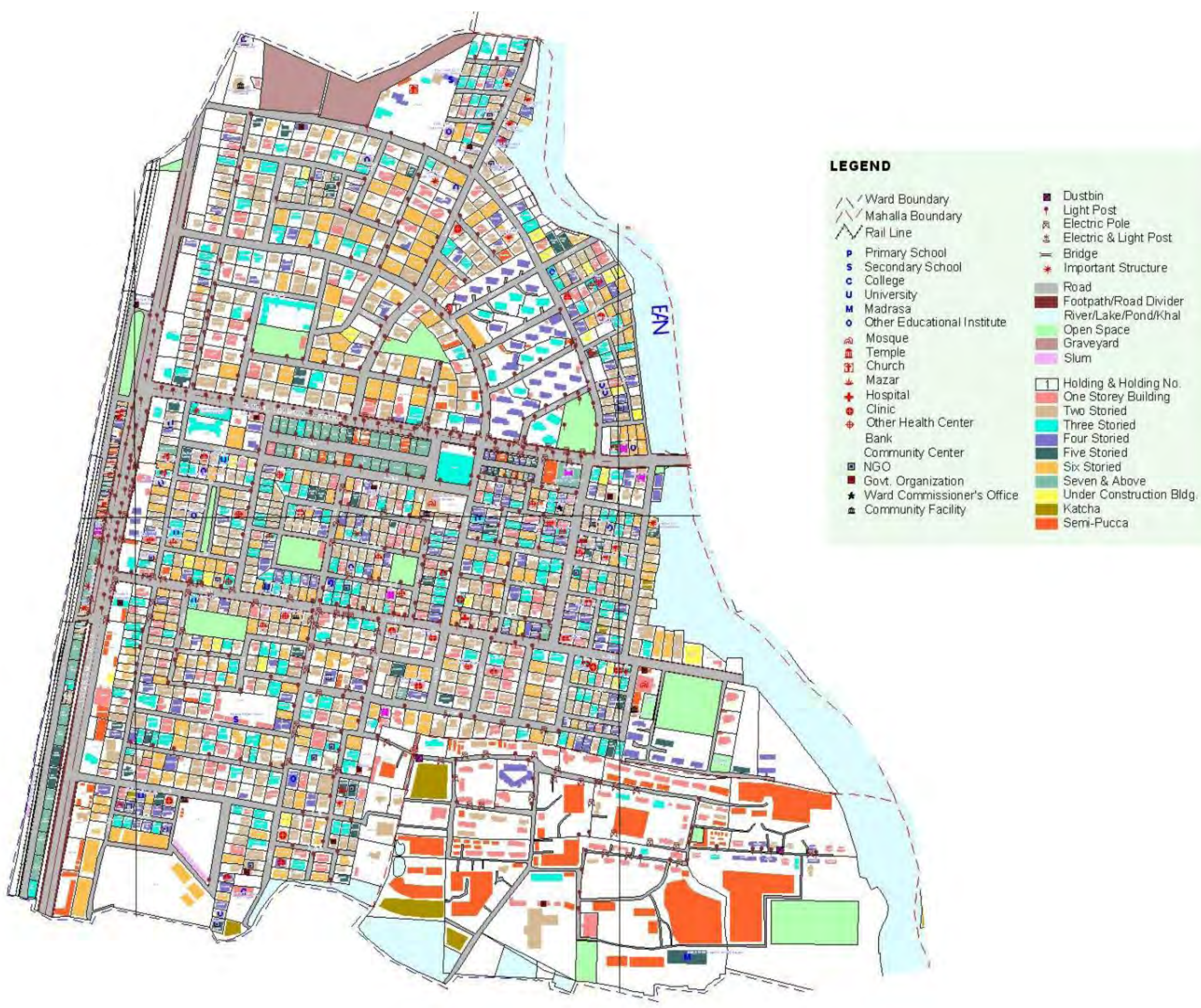
The emerging spatial growth pattern in Dhanmondi depicts a uniformly compacted form of settlement with continuous belt of high rise towers creating a buffer zone between the major transport arteries and the inner predominantly residential blocks. The trend of building high with transformation of function is particularly emerging in the peripheral blocks along the primary (*Mirpur Road*) and secondary roads (*Satmasjid Road*, Road No. 27 and Road No. 2) at a faster pace rather than the inner blocks. These tower blocks mainly houses commercial functions of varied nature and scale which are not compatible with neighbourhood requirement. But in absence of a redevelopment plan for this area land use transformation has occurred and still taking place through plot by plot basis and the current guidelines are insufficient to control this practice. Property owners are taking the advantage of weak enforcement of law and the growing demand of the inhabitants have resulted in the infiltration of illegal construction of commercial facilities all over the area. The resulting landscape has become a collage of varied functions embedded in the fabric of predominantly residential use. As a result the area is suffering from environmental consequences as well as unbearable traffic situation particularly at the peak hours.

4.4.4 Study Area 4: Ward No. 19 – Banani Model Town

Land Use and Building Guide lines for Banani

Banani Model Town was designed as a high class residential area in 1964. The grid iron street pattern of Banani forms medium-sized rectangular blocks with a few balanced trapezoidal blocks along the lakeside where street pattern has to deviate from straight lines to huge arcs respecting the topographical features. The plot size of Banani ranges from 5 to 12 *kathas.* The sub division law of Banani does not allow plot sizes below 5 *kathas (3600sq.ft).* The road side blocks along *Kemal Ataturq* and Road No. 11 have been declared for commercial establishments by government in order to fulfill the growing demand for supporting facilities. But the extent and scale of these supporting facilities have now exceeded neighbourhood scale transforming the residential character to a buzzing business district.

Figure 4.31: Banani Land Use Map



Source: DNCC, 2014

Changing landscape of building heights in Banani

During the 70s the area was dominated by sparsely located single storey buildings with ample setback space. By the turn of the decade the land value of this area increased initiating a redevelopment activity which resulted in the emergence of 4-6 storied buildings. The height limitation imposed on this area by the civil aviation authority was also eliminated for shifting the airport. By the end of 90s 18% plots were vacant and 55% of the single storey buildings were phased out. With the increase in density the demand for community facilities and amenities also increased. In the absence of any comprehensive redevelopment guideline the local authority had to respond to the demands for supporting facilities through government notices and circulars. This includes the bye law of converting the primary roadside plots into commercial use. This resulted in forming a continuous commercial strip with towering blocks on both sides of the primary road of *Kemal Ataturk* and Road No. 11. The scale of these commercial establishments was beyond the scale and requirement of the neighbourhood. Moreover the weak enforcement of guidelines further commenced the intensification of commercial activities in the inner blocks which was a violation of the law. The MINB 2008 guidelines facilitated the construction of building high beyond 6 stories which is resulting in the emergence of a new generation of higher residential buildings replacing 10% of the remaining low rise buildings. All these unguided development activities has taken a toll on the traffic situation and disrupting the serenity of residential environment.

Figure 4.32: Informally broken skyline of Banani

Table 4.18: Trend of building height change in Banani (2004 – 2016)

No.of	Block 1			Block 2			Block 3			Block 4		
Stories	2004	2010	2016	2004	2010	2016	2004	2010	2016	2004	2010	2016
1	2	1	-	3	2	1	3	2	-	13	2	-
2	5	3	2	7	4	2	5	3	2	2	2	2
3	1	2	1	1	2	2	-	1	3	3	4	5
4	-	-	-	-	-	-	2	4	4	1	3	4
5	-	-	1	-	-	1	1	1	2	1	1	2
6	-	3	3	-	3	5	-	1	2	3	8	9
7	-	-	-	-	-	-	-	-	-	-	-	-
8	-	-	1	-	-	-	-	-	1	-	-	-
9and above	-	1	2	-	-	-	-	-	-	-	1	3
Total	**8**	**9**	**10**	**11**	**11**	**11**	**11**	**12**	**14**	**23**	**21**	**25**

Source: Field survey January, 2016 and satellite imagery
Note: Total No. of Plots in Block 1 = 10 , Block 2 =11 , Block 3 = 12, and Block 4 = 25

Floor Area Ratio (FAR)

The observed floor area ratio for older buildings in Block 1, 2, 3 and 4 ranges from 0.7 to 5.4 while the maximum permissible ratio of older buildings for is 4.8. The older buildings seem to violate the approved ratio set by the BCR 1996. But the extent of deviation is relatively lower than Dhanmondi. On the other hand the newly constructed buildings have a floor area ratio ranging between 4.5 to 7.5. Out of 58 surveyed mid and high rise buildings built at different time periods only 8 buildings are having a FAR within recommended level of MINB2008. Among these 8 buildings one was commercial buildings and the rest are residential.

Table 4.19: Floor Area Ratio for Blocks 1, 2, 3 and 4 Banani

FAR	Block 1	Block 2	Block 3	Block 4
0.1 – 0.5	-	-	-	-
0.5 – 1.0	1	-	1	1
1.0 – 1.5	2	1	-	1
1.5 – 2.0	-	1	1	1
2.0 – 2.5	-	2	2	3
2.5 – 3.0	1	1	-	5
3.0 – 3.5	-	-	4	-
3.5 – 4.0	-	2	-	1
4.0 – 4.5	2	1	1	4
4.5 – 5.0	1	-	1	-
5.0 –5.5	-	-	2	7
5.5 – 6.0	-	2	-	-
6.0 – 6.5	1	1	1	-
6.5 – 7.0	1	-	-	-
7.0 – 7.5		-	-	-
7.5 – 8.0	-	-	-	2
Total	**9**	**11**	**13**	**25**

Source: Author's calculation, Field survey January, 2016

Plot coverage

Out of 58 plots surveyed around 58.7% of the 6 storied building constructed before 2008 have been found violating the prescribed plot coverage with a higher degree of deviation (i.e. 83%-95% plot coverage) 24.1% old buildings were found to follow the setback rules of BCR1996 with slight variation. Only 13.8% of the recently constructed buildings adheres the FAR rules in terms of plot coverage.

Table 4.20: Plot coverage in Banani

Plot coverage (%)	Number of Plots	Percentage
50 or less	-	-
51-60	2	3.4
61-70	8	13.8
71-80	14	24.1
81-90	22	37.9
91-100	12	20.7
Total	**58**	**100**

Source: Field Survey, 2016

Land Coverage at block level

The results from the field observation it is found that out of four blocks three of them show a high land coverage ranging from 82 to 87 percent while Block 1 exhibits modest land coverage of 60.1%. The average block coverage is found to be 78.2%. The results indicated that most of the blocks of Banani is filled up and the older buildings are having higher plot coverage than the recommended level BCR1996.

Table 4.21: Land coverage at block level in Banani

Block	Total area (sq.ft)	Total built up area (sq.ft.)	Land coverage per block (%)	Average Block coverage
1	45885	27576	60.1	78.2%
2	67680	55656	82.2	
3	69120	59040	83.3	
4	158400	138240	87.3	

Source: Field Survey, 2016

Despite the FAR rule in effect the smaller percentage of plots adhering to this standard does not seem to provide a significant impact on the overall land coverage at block level which should be around 60%-65%. Only Block 1 has been found having the desired level of block coverage where most of the high rise buildings are newly constructed and adhering MINB 2008. Detail of the block survey is presented in the following:

Block 1 is a serene neighbourhood dominated by high and mid rise buildings. Most of the high and mid rise buildings are having plot coverage ranging from 53% to 75%. The rest of the two houses are 3 and 2 with plot coverage of 46% to 35%. There are 6 high rise building and 5 of them are maintaining ample side set back (10-12 feet) that contributes reduced perceived density which makes this block visually appealing also reduces the lack of provision for sunlight, ventilation and privacy. The block has one of the lowest land coverage (60.1%) in Banani.

Table 4.22: Net Residential Density and Net Residential Population Density at block level in Banani

Block	Net Residential Density (NRD) units /hectare	Net Residential Population Density (NRPD) persons /hectare
1	385	1809
2	113	533
3	161	758
4	213	1004

Source: Field Survey, 2016

Block 2 is located next to commercial strip of *Kemal Ataturq Road*. This block is also dominated by high and mid rise buildings with plot coverage ranging from 66% to 85%. One of the low rise buildings have found to have a high plot coverage of 85% while the under construction building also displays a plot coverage higher than the recommended standards. The rest of the buildings are complying the rule. It has a 6 storied university in its corner plot. The plot was dominated with low rise dwelling in 2004 and redevelopment activity started from 2009 in this block. Due to the proximity of this block from the Banani Super Market as well as the presence of the university the 20 feet wide access roads around it are always subjected to traffic jam.

Block 3 is located along *Banani Road 11* which is declared as a commercial road. Consequently the plots facing the road front are housing commercial and mixed use buildings and the rest of the plots are predominantly of residential use. Among the 12 buildings of this block only two buildings are abiding the

FAR rule. The block has one of the highest land coverage (83.3%). The tallest building of this block is 8 storied. The predominance of 4-6 storied buildings of this block forms more or less a uniform skyline.

Block 4 displays the highest block coverage of 87.3 percentages. The block originally had 22 plots but later subdivisions have resulted into 25 plots at present. Out of 25 plots 21 plots are having 3-6 storied buildings while 2 plots have 9 and 10 storied buildings under construction. There is only 2 double storied building and one of them houses commercial function. Majority of the buildings have higher horizontal extension (80%-90%) that accumulates into problem of natural ventilation, solar access and privacy in this block. The two tower going under construction is likely to intensify this uncomfortable situation by further blocking sunlight on the adjacent road and blocks.

Spatial growth pattern in Banani

At present around 78% of the plots of Banani are housing 6-8 storied houses with the road front having even higher stories of commercial buildings. The skyline in most of the areas is fairly a continuous horizontal line with two parallel high ridges formed in the middle of the area by the two commercial strips

Figure 4.33: Surface parking on the street of Banani

Figure 4.34: Skyline of the commercial strip along Kemal Ataturq

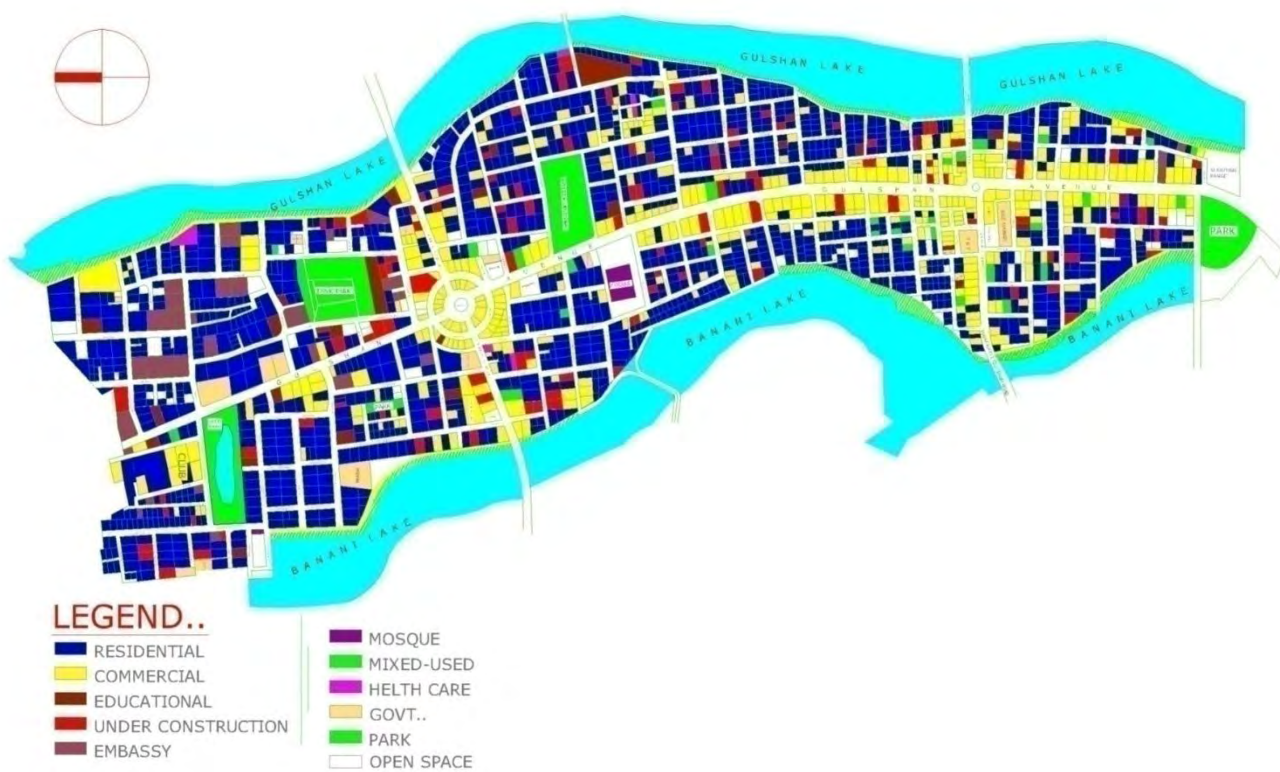
respectively along the *Kemal Ataturq* and *Banani Road no. 11*. This type of skyline results in the obstruction of view in the adjacent blocks and also causes problems in terms of ventilation and privacy. The commercial strip dominated by 20 storied high rise buildings also forms a heat island to the adjacent blocks immediately behind it. As commercial strips houses commercial activities beyond the residential scale they contribute to traffic congestion and lack of adequate parking facilities. Half of the access roads of the commercial blocks are always occupied with surface parking. The haphazard infiltration of commercial activities in the area keeps most of the roads blocked with surface parking reducing the effective width of the road which exacerbates the traffic congestion. The emerging pattern indicates that Banani will soon reach the saturation stage if this trend of building high is left to continue unchecked.

4.4.5 Study Area 5: Ward No. 19 – Gulshan Model Town

Land Use and Building Guide lines for Gulshan

Gulshan was founded as a planned model town in 1961, while the neighboring Banani Model town was founded in 1964 (Ahmed, 2008). Gulshan is planned in grid iron street pattern with balanced rectangular blocks. These blocks are divided into relatively larger plots than Banani. This area was planned and developed in the early sixties to provide residential accommodation for the high and higher-middle income people of Dhaka City. Gulshan Model Town occupies the greater part of Dhaka North City Corporation Ward No 19. The area as such is not that big nor did the original plan intend to accommodate more than one family per plot which comprised of varying sizes from 8 decimal to 24 decimal (4.84 – 15 *kathas*). During the 90s the area acquired the status of a Diplomatic zone as all the embassies were shifted here resulting hike in the land price. Since then the area has seen an upsurge in the number of high-rise buildings, restaurants, residential areas, modern shopping malls and ice-cream parlors which are open past midnight. The independent houses of the early 1970s that stood far from each other in Gulshan area are on the verge of extinction due to the commercial boom of high rise habitats. The commercial activities in the area have intensified to such scale that the old residents are claiming that it is not a serene residential area any more.

Figure 4.35: Land use Map of Gulshan



Source: Field Survey, 2015

Due to status symbol Gulshan became a preferable location in terms of housing for the social elites. Though the area was initially dominated by very low density but its status attracted more and more high income class to seek refuge here. This resulted in the wave of constructing 6-storied buildings by the developers during 90s. Like Banani this residential area also had to face the lack of amenities for its increasing population. This demand scenario was compromised by adopting piecemeal planning decisions periodically. But due to corruption and deficiency in enforcing these guidelines the area is having sporadic development of commercial facilities all through besides the permitted development along the primary road. A recent survey by RAJUK (2016) has identified 350 such illegal commercial establishments of various scales within Gulshan which indicates the tendency of the developers to violate the rules for profit maximization.

Changing landscape of building heights in Gulshan

Figure 4.36: Jagged skyline of Gulshan in 2015

The results from field observation and analysis of satellite imagery indicates that single and double storied low rise dwellings of Gulshan has undergone rapid transformation during the period of last 10 year. In the first half of this period 6 storied buildings started to emerge while there was significant of number of vacant plots and low rise dwellings. This wave of 6 storied buildings were quickly taken over by the new generation of tall commercial buildings of above 10 stories which were built around the two roundabouts and along the primary road connecting them. At present this trend of building higher can be seen in the high end luxury apartments of Gulshan which are popping up from most of the blocks forming a jagged skyline over the horizon.

Table 4.23: Trend of building height change in Gulshan (2004 – 2016)

No.of	Block 1			Block 2			Block 3			Block 4		
Stories	2004	2010	2016	2004	2010	2016	2004	2010	2016	2004	2010	2016
1	4	1	1	3	2	-	4	-	-	2	2	6
2	2	3	1	2	2	2	2	2	1	7	7	-
3	1	1	1	-	-	1	-	-	-	1	-	-
4	2	2	1	-	-	-	-	1	1	-	-	-
5	1	1	2	-	-	-	-	-	-	-	-	-
6	2	5	5	4	4	4	2	4	4	4	5	5
7	-	-	-	-	-	-	-	1	1	-	-	-
8	-	1	2	-	-	-	-	-	-	-	-	-
9and above	-	-	1	-	-	2	-	-	1	-	2	4
Total	**12**	**14**	**14**	**9**	**8**	**9**	**8**	**8**	**8**	**14**	**12**	**14**

Source: Field survey January, 2016 and satellite imagery

Note: Total No. of Plots in Block 1 = 14, Block 2 = 8, Block 3 = 8, and Block 4 = 14

Figure 4.37: Informally broken skyline of Gulshan in 2009

Figure 4.38: More or less uniform skyline of Gulshan in 2003

Floor Area Ratio (FAR)

The maximum floor area ratio for older buildings observed in Block 1, 3 ranges from 0.8 to 6.1 while in Block 2 and 4 it ranges from 0.6 to 5.1. The maximum permissible ratio of older buildings is 4.8. This is again a case of violation of the approved ratio set by the BCR 1996. The newly constructed buildings are found having a floor area ratio ranging in between 6.3 to 9. Deviation from stipulated range is also observed here. Out of 41 surveyed mid and high rise buildings built at different time periods the number of buildings having a FAR within recommended level of MINB2008 was only 19 where 2 are commercial buildings and the rest are residential.

Table 4.24: Floor Area Ratio for Blocks 1, 2, 3 and 4 in Gulshan

FAR	Block 1	Block 2	Block 3	Block 4
0.1 – 0.5	-	-	-	1
0.5 – 1.0	1	1	-	1
1.0 – 1.5	1	2	2	2
1.5 – 2.0	-	-	-	3
2.0 – 2.5	1	1	-	-
2.5 – 3.0	-	-	-	-
3.0 – 3.5	2	-	-	1
3.5 – 4.0	1	-	1	-
4.0 – 4.5	5	-	1	-
4.5 – 5.0	-	2	1	3
5.0 –5.5	1	1	2	1
5.5 – 6.0	-	-	-	-
6.0 – 6.5	1	-	1	1
6.5 – 7.0	-	-	-	-
7.0 – 7.5	-	-	-	1
7.5 – 8.0	1	-	-	-
8.0 – 8.5	-	1	-	-
8.5 – 9.0	-	1	-	2
Total	**14**	**9**	**8**	**16**

Source: Author's calculation, Field survey January, 2016

Plot coverage

Results from field observation revealed that out of 43 plots surveyed around 51.1% of them had a plot coverage ranging between 61%- 75%. Most of the plots with new constructions are having the mandatory open space of 50%. Only 30.2% plots have a higher coverage ranging from 81 to 88 percent which constitutes a portion of the older buildings. Again this shows the tendency of having plot coverage exceeding the recommended standards being in practice from the 90s.

Table 4.25: Plot coverage in Gulshan

Plot coverage (%)	Number of Plots	Percentage
50 or less	6	13.9
51-60	2	4.6
61-70	13	30.2
71-80	9	20.9
81-90	13	30.2
91-100	-	-
Total	**43**	**100**

Source: Field Survey, 2016

Block 1 is one of the quiet and serene residential neighbourhoods of Gulshan with 14 plots including 11 high and midrise, 2 single and double storied buildings and one under construction high rise building. In 2004 the number of 1-2 storied buildings in this block was 6 which turned to 4 in 2010. Most of the mid and high rise buildings were constructed within the period of 6 years from 2004 to 2010 and have a plot coverage ranging from 70 to 88 percent. It seems that the older constructed buildings have violated the BCR 1996 rules while the new constructions are in compliance with MINB 2008.

Table 4.26: Net Residential Density and Net Residential Population Density at block level in Gulshan

Gulshan		
Block	**Net Residential Density** units /hectare	**Net Residential Population Density** persons /hectare
1	184	831
2	242	1090
3	188	846
4	215	970

Source: Field Survey, 2016

Block 2 is one of the early inhabited blocks of Gulshan with large plot size of 10.22 *kathas*. Out of 8 plots the number of 1-2 storied houses was 5, 4 and 3 in 2004, 2010 and 2016 respectively. There is 11 storey apartment building in the corner plot cast shadow over the nearby road and encroaches the privacy of the adjacent low rise buildings. One plot is reserved as Ansar Camp with no permanent structure. The plot coverage of the high rise buildings ranges from 75 to 85 percent. Around 56.2% of the plots of this block is densified with mid and high rise buildings.

Block 3 was predominated by single and two storied houses up to 2004 where out of 8 plots only two plots had one 5 storey and 6 storey buildings respectively. By 2010 the number of high and mid rise buildings became 5 and in 2016 the number has turned to 6. Densification has rapidly occurred in this block within the last 5 years. The high rise buildings have plot coverage ranging between 80 to 95 percent making the side balconies overshadowing the adjacent building. Though three of the high rise buildings have been constructed in the recent years but high plot coverage indicates that their plan was approved prior to the promulgation of MINB2008. MINB was first introduced in 2006 but became operative from 2008. During this period of confusion of two parallel rules i.e. BCR 1996 and MINB2006 in effect land owners took advantage of the situation. These buildings are good example of this malpractice. However in either way the plot coverage ratios followed are still above the recommended standard. Only the 7 storey building currently under construction has a plot coverage of 67% which is within the recommended level of FAR.

Figure 4.39 : Block 1 ; Gulshan

Figure 4.40 : Block 2 ; Gulshan

Figure 4.41 : Block 3 ; Gulshan

Figure 4.42 : Block 4 ; Gulshan

Block 4 is situated along the Gulshan lake and facing primary road (*Bir Uttam Mir Shaukat Ali Sarak*). The front rows of the blocks along both side of this primary road are permitted for commercial function. Accordingly a newly constructed office building, a show room and restaurant are housed in these plots. The block contains one the largest plots of Gulshan that varies from 15 -8.5 *kathas*. The road front plots are comparatively smaller in size. Out of the 13 plots there was a gradual decrease in the number of 1-2 storied buildings which was 10, 8 and 6 in the years 2004, 2010 and 2016 respectively. The 1-2 storied houses were replaced by 6 storied building up to 2008 but after that the remaining low rise buildings are being replaced with high rise buildings of 10-14 stories. There are 4 high rise buildings of 10-11 storied which maintain plot coverage around 70% in compliance with MINB 2008. There is a primary school in this block which is not a permitted use as the existing residential building has been turned into commercial use without legal conversion of land use.

Land Coverage at block level

From the field observation it can be seen that Block 3 and 4 are having one of the highest land coverage ranging from 74.6 to 78.1 percent while block 1 and 2 displays a modest coverage of 63%-66%. The overall average block coverage (65.9%) indicates that there is still sufficient open space left in the blocks which is due to the culminated effect of three factors – existence of vacant plots, presence of low rise dwellings with less land coverage and most of the buildings are adhering to the FAR rule properly.

Table 4.27: Land coverage at block level in Gulshan

Block	Total area (sq.ft)	Total built up area (sq.ft.)	Land coverage per block (%)	Average Block coverage
1	115200	76320	66.3	70.3%
2	58867	33112	56.2	
3	58424	47469	81.2	
4	149760	116352	77.7	

Source: Field Survey, 2016

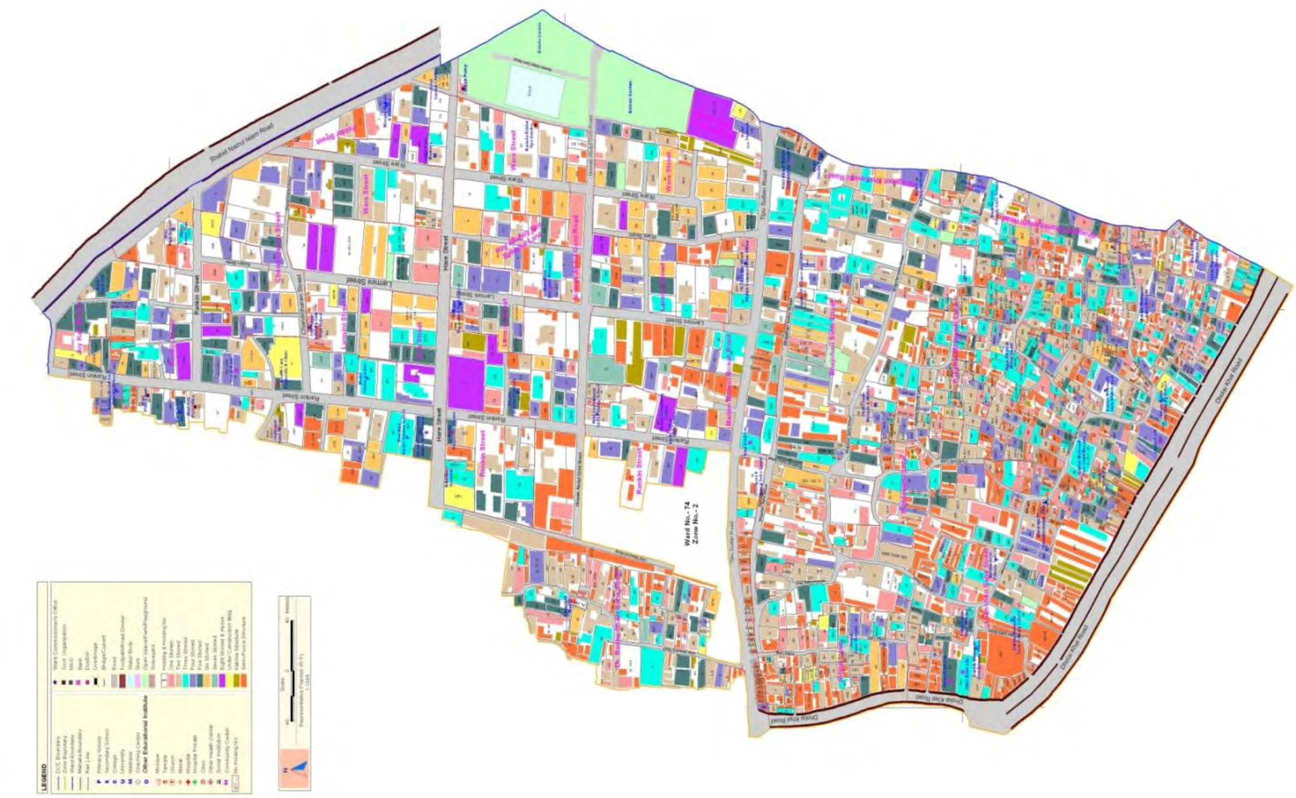
As densification started in Gulshan relatively later than the neighbouring Banani there are a considerable percentage of 1-2 storied buildings still remaining in most of the blocks. Furthermore the construction of 6 storied buildings started after the 1990s as the area was upgraded to the status of Diplomatic zone. But the densification pace was not that fast which left many plots vacant till 2004. The location was still preferred by the elites who choose to build and live in detached single or double storied house. But with the increase in the number institutional and commercial buildings the area gradually rose to prominence as commercial hub which attracted people from all over the city. By 2006 the trend of building high got momentum as most of commuting people were seeking refuge through rental accommodation in the area to avoid the hassle of daily commuting to workplace. So after 2007 the wave of 10-14 storied high rise buildings adhering to the newly introduced FAR rule have started wiping out the single storied buildings as well as filling up the remaining vacant plots gradually. As a result, the current block wise land coverage in Gulshan is still relatively lesser than Banani.

Spatial growth pattern in Gulshan

From the results of the block survey it can be inferred that densification has been taking place in Gulshan at a relatively steady but slower pace as 20-30% of the plots are still having house forms of 1-2 stories. One of the notable things is that the redevelopment activity that has been taking place after 2010 comprises of buildings ranging from 8 to 14 storied high which are piercing the skyline abruptly at irregular intervals and thereby forming an informally broken skyline. Majority of the high rise buildings built according to BC 1996 rules displays plot coverage (80%-90%) far higher than the stipulated one. Only the new constructions which largely comprises of 10-14 storied high rise buildings adhere to the stipulated FAR with minor deviation. With the densification at pace infiltration of illegal commercial establishments have also taken place in the inner blocks over the past 10 years.

4.4.6 Study Area 6: Ward No. 77 – Wari Residential Area

Figure 4.43: Land use map, Wari



Source: DSCC, 2014

Land Use and Building Guide lines for Wari

The planning initiative of Wari was the first small scale planned area development taken by the British colonial rulers in Dhaka in 1879. The then Dhaka municipal committee took an initiative to develop a planned residential area at Wari. But they failed to execute the plan. Later, it was executed by the Dhaka district administration. The land of the entire area was acquired and straight grid pattern roads were laid down. The grid iron road network divided the area into large rectangular blocks of land ranging from 300’ X 500’. These blocks were initially divided into large plots ranging from 10–20 *kathas*. Later some of these big plots were subdivided or given to the developers for

Figure 4.44: Skyline of Wari

constructing high rise buildings. The area was well served with sewerage lines. The plots were of slighty irregular shaped ranging from 10 to 12 *kathas*. These bigger plots were subdivided in the later periods. From its inception the area was designated for the social elites and bureaucrats. This is the first planned residential estate of the country that became a high class residential area of the then Dhaka. The area has no special building guidelines except those applicable for the entire Dhaka .i.e. MINB 2008. But there is height limitation of 8 storied imposed by the government for this area.

Changing landscape of building heights in Wari

The initial house forms of this area were predominantly single storey dwellings with spacious courtyards in the front and back. During 70s the proximity of this residential area to the CBD of Motijheel made Wari a preferable location for rental accommodation. The opportunity of income and also the natural increase in the population acted as a driving force for the emergence of multi storied building (4-6 storied) in the late 80s. This trend was further intensified in the following decade of 90s with the developers' involvement and soon the skyline of Wari was dominated by high rise buildings. With the increase in density and rising demand commercial activities of various scales began to take place along the roadside of both secondary and tertiary roads. By 2010 the 75% of the plots were occupied with towers of 8-12 storied high though the approved height for this area is not more 8 stories. There is no open space in Wari except the Balda Garden which has controlled access. The Balda Garden contains many species of exotic plants but the high rise buildings built around made the survival of these plants for blocking adequate sunlight.

Figure 4.45: Emergent highrise buildings of Wari (2015)

Figure 4.46: Highrise buildings casting shadow on the street (*Rankin Street*) of Wari

Table 4.28: Trend of building height change in Wari (2004 – 2016)

No.of Stories	Block 1			Block 2			Block 3		
	2004	2010	2016	2004	2010	2016	2004	2010	2016
1	5	5	5	8	8	1	6	4	2
2	14	11	6	2	2	3	2	3	3
3	4	5	4	6	4	3	-	-	-
4	-	1	1	4	4	7	-	1	-
5	9	10	14	3	4	5	-	1	2
6	3	8	8	2	3	3	4	4	5
7	1	1	4	-	-	-	-	-	-

8	2	2	3	1	1	2	1	1	1
9and above	2	2	3	2	4	8	-	-	-
Total	**40**	**45**	**48**	**28**	**30**	**39**	**13**	**14**	**13**

Source: Field survey January, 2016 and satellite imagery
Note: Total No. of Plots in Block 1 = 46, Block 2 =39, Block 3 = 13

Floor Area Ratio (FAR)

The Floor Area Ratio of the blocks surveyed in Wari was observed to be ranging in between 0.7 to 5.6 in case of older buildings while the newly constructed buildings have a FAR ranging in between 7.2 – 9.6. One commercial building in Block 1 has a FAR of 14.4 .The maximum permissible floor area ratio for the area is 6 with a height limitation of 8 storied according to the MINB 2008. But majority of the buildings are found violating the recommended level of both the rules (BCR1996 and MINB2008).

Table 4.29: Floor Area Ratio for Blocks 1, 2 and 3 in Wari

FAR	Block 1	Block 2	Block 3
0.1 – 0.5	-	-	-
0.5 – 1.0	-	4	3
1.0 – 1.5	2	-	-
1.5 – 2.0	3	2	1
2.0 – 2.5	3	2	2
2.5 – 3.0	1	-	-
3.0 – 3.5	3	2	1
3.5 – 4.0	17	-	1
4.0 – 4.5	-	-	1
4.5 – 5.0	3	5	1
5.0 –5.5	2	1	4
5.5 – 6.0	3	-	-
6.0 – 6.5	-	-	-
6.5 – 7.0	-	-	-
7.0 – 7.5	4	5	-
7.5 – 8.0	-	-	-
8.0 – 8.5	3	1	-
8.5 – 9.0	1	1	-
9.0 – 9.5	-	-	-
9.5 – 10.0	-	1	-
Above 10.0	1	-	-
Total	**23**	**24**	**12**

Source: Author's calculation, Field Survey, 2016

Plot coverage

Fieldwork results from Wari indicates that around 43.8% of the high rise buildings in Wari are having plot coverage of 71%-80% and 41.8% have plot coverage ranging from 81%-90% which has resulted into a crammed housing condition. In many cases the distance between side balconies of two juxtaposed buildings have been found to be less than 2 feet. The tall towers are casting shadow both the streets and adjacent buildings forming dark alleys and heat islands. There is a serious intrusion of privacy, lack of cross ventilation and poor daylight access. This makes most of the indoor rooms to have electric lights on during day time.

Table 4.30: Plot coverage in Wari

Plot coverage (%)	Number of Plots	Percentage
50 or less	4	4.1
51-60	-	-
61-70	5	5.1
71-80	43	43.8
81-90	45	45.9
91-100	1	1.08
Total	**98**	**100**

Source: Field Survey, 2016

Land Coverage at block level

Results from field survey revealed that the land coverage at block level (85.1%) in Wari is one of the highest among the study areas which indicates that most of the buildings are having higher horizontal extension than the recommended level. From the field survey it was found that the blocks in Wari were quite larger in size than the blocks of new residential areas. So due to time constraint only three blocks instead of four have been selected for detail study whose findings are given below:

Table 4.31: Land coverage at block level in Wari

Block	Total area (sq.ft)	Total built up area (sq.ft.)	Land coverage per block (%)	Average Block Coverage
1	100823	83788	83.1	85.1%
2	89327	78161	87.5	
3	22492	19051	84.7	

Source: Field Survey, 2016

Block 1 is located between the primary road (*Dhaka Chitatagong Highway*) and secondary road (*Rankin street*) and tertiary road (*B.C.C. Road*). The block is characterized of irregular shaped and sized plots. It has commercial and mixed use function along it peripheral plots on three sides. The non residential function includes one school, a community centre, retail and brand outlets, hotel, restaurants and offices. The block is predominantly occupied with 6-8 storied buildings with a plot coverage ranging from 82% to 85%. The highest building of this block is 18 storied office building.

Table 4.32: Net Residential Density and Net Residential Population Density at block level in Wari

Wari		
Block	Net Residential Density units /hectare	Net Residential Population Density persons /hectare
1	133	616
2	284	1310
3	276	1269

Source: Field Survey, 2016

Block 2 is surrounded by a secondary road (*Rankin street*) and three access roads (*Road No. 15, Larmini street and Hare street*). This block has a couple of comparatively plots housing high rise mixed use buildings of 10-12 stories. It also displays one of the highest land coverage of 87.5% at block level. The block has two primary schools.

Block 3 is one of the smallest blocks of Wari and has relatively low land coverage of 84.7% than the other study blocks. Majority of the plots have 6 storied buildings and houses predominantly residential function. The highest building is 10 storied and the lowest is 2 storied which is a mixed building housing an art school. Due to the higher plot coverage buildings are devoid of adequate natural ventilation, day light and privacy.

Figure 4.47: Block 1; Wari

Figure 4.48: Block 2; Wari

Figure 4.49: Block 3; Wari

Spatial growth pattern in Wari

With a average block coverage of 85.1% and plot coverage ranging between 80%- 90% the spatial growth pattern of Wari represents a heavily dense settlement too compact to provide the requisite qualities of day light, ventilation, view, privacy and comfortable indoor living environment. Though the area is planned in grid iron pattern but the subsequent subdivisions have fragmented the blocks into diversified shapes and size forming many narrow cul de sacs to access these plots. The width of these narrow alleys ranges from 5'-7'. The effective width of the access roads are not more than 18 feet wide which poses a serious challenge for emergency evacuation in case of fire hazard or earthquake. The pattern of development in Wari seems to have utilized the maximum floor space with very scanty open space left for circulation particularly in case of the inner plots of the blocks. 12 storied high rise buildings are often found closely juxstaposed along cul de sac alleys of 6'-8' where the side balconies of the two adjacent buildings are just 1 to 1.5 feet apart. Due to the lack of proper redevelopment guidance and control from the concerned authority the historic posh residential area of Wari had turned into a compact settlement of crammed high rise buildings. The skyline of Wari tends to be more uniform because of the bulk of high rise buildings closely juxtaposed.

Figure 4.50: Very closely juxtaposed buildings, Wari

4.4.7 Study Area 7 : Ward No. 78 – Luxmi Bazaar Residential Area

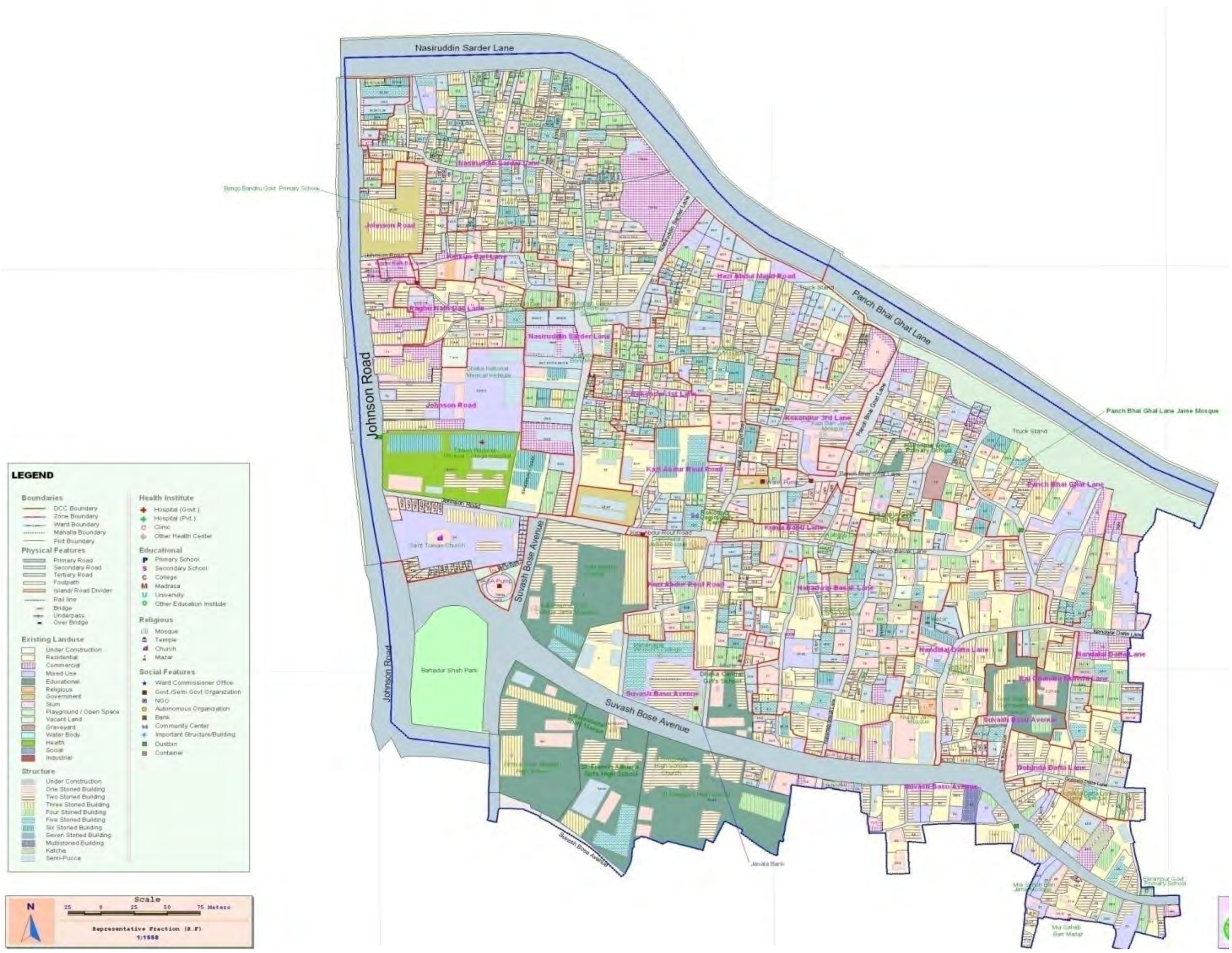


Figure 4.51: Land use map of Luxmi Bazaar
Source: DSCC, 2014

Land Use and Building Guide lines for Luxmi Bazaar

The area of Luxmi Bazaar currently within the boundary of Ward No. 72 is one of the oldest residential settlements which predates to the Mughal Period. The area can be characterized with a complex organically evolved pattern of narrow winding street network forming the boundaries of different neighbourhoods or *mohallas*. The self-organized street patterns of Luxmi Bazaar results into a mosaic of plots with a diversity of irregular shapes and sizes. There is a lack of open spaces. The only open space in the vicinity is the historic Victoria Park but it is in a poor condition for lack of proper maintenance. The area is a highly compact settlement dominated with high rise buildings ranging from 5-10 stories. In old Dhaka many structures constructed before partition of India, have been demolished and replaced with new buildings expanding both horizontally and vertically. Most of the buildings have been non-adherent to the Building Codes. However the area still posses some historic dwellings of distinct architectural style of the Colonial Period and are in a vulnerable state for lack of maintenance and preservation.

Changing landscape of building heights in Luxmi Bazaar

In the Colonial period the settlement was occupied by predominantly 1-2 storey houses. From mid 70s to 90s the 35% of the houses were transformed to 3-4 stories. Due to the proximity with the old CBD and educational facilities, this area has always been a preferable location for rental accommodation. From the late nineties high rise buildings of 6-8 stories with mixed function started to emerge. At present 80% of the area are covered with high rise buildings out of which 30% of the high rise structures constitute of 10-12 stories. Because of the irregularity of in the shape of the blocks some very narrow high rise blocks also have been evident amidst other high rise structures which are very much vulnerable to earthquake hazard.

Figure 4.52: Emergent high rise buildings in Luxmi Bazaar

Table 4.33: Trend of building height change in Luxmi Bazaar (2004 – 2016)

No.of	Lane 1			Lane 2			Lane 3		
Stories	2004	2010	2016	2004	2010	2016	2004	2010	2016
1	11	7	7	14	11	6	6	5	4
2	7	7	6	9	5	4	8	7	4
3	7	7	6	2	3	2	5	4	5
4	4	5	3	2	2	3	1	3	4
5	6	6	7	1	1	3	-	3	3
6	4	3	5	-	4	5	1	3	6
7	2	2	2	-	1	3	1	1	1
8	-	1	3	-	-	-	1	1	1
9and above	-	-	1	-	-	-	-	-	-
Total	**41**	**38**	**40**	**28**	**27**	**26**	**24**	**27**	**28**

Source: Field survey January, 2016 and satellite imagery
Note: Total No. of Plots surveyed : Lane 1 (Nandalal Dutta Lane) = 40, Lane 2 (Nobodip Bashak) = 26, Lane 3 (Panch Bhai Ghat Lane) = 28

Figure 4.53: Streetscape of Luxmi Bazaar (*Shubose Bose Road)*

Figure 4.54: The emerging buildings of Luxmi Bazaar

Plot Coverage

None of the roads are 60 feet wide which makes the application of FAR guidelines impraticable for this area. The survey results indicate that 77.6% plots are having plot coverage ranging from 81% to 90% while 9.6% plots have land coverage of 91%-100%. Many of these plots are facing roads which are 10-12 feet wide.

Table 4.34: Plot coverage in Luxmi Bazaar

Plot coverage (%)	Number of Plots	Percentage
50 or less	-	-
51-60	-	-
61-70	4	4.2
71-80	8	8.5
81-90	73	77.6
91-100	9	9.6
Total	**94**	**100**

Source: Field Survey, 2016

Floor Area Ratio (FAR)

The Floor Area Ratio of the blocks surveyed in Luxmi Bazaar was observed to be ranging between 0.9 to 5.7 in older buildings while the new buildings have FAR ranging in between 5.4 to 8. Both the older and newer constructions are violating the recommended FAR in greater extent. 90% buildings are found not abiding the setback rule. Even high rise buildings were found having sharing external walls in Nobodip Bashak Lane**.**

Table 4.35: Floor Area Ratio for Blocks 1, 2 and 3 in Luxmi Bazaar

FAR	Nandolal Dutt Lane	Panch Bhai Ghat Lane	Nobodip Bashak Lane
0.5 – 1.0	4	1	5
1.0 – 1.5	-	1	-
1.5 – 2.0	5	6	3
2.0 – 2.5	5	1	1
2.5 – 3.0	2	3	1
3.0 – 3.5	3	5	-
3.5 – 4.0	2	1	5
4.0 – 4.5	4	2	1
4.5 – 5.0	1	2	1
5.0 –5.5	4	3	6
5.5 – 6.0	1	2	-
6.0 – 6.5	1	-	1
6.5 – 7.0	1	1	1
Total	**33**	**28**	**25**

Source: Author's calculation, Field Survey, 2016

Land Coverage at block level

Results from survey indicates that Luxmi Bazaar has the highest plot among all the study areas which around 89.4%. This implies that almost 90% of the dwellings utilize the highest possible land coverage leading to a extremely dense settlement pattern. From the reconnaissance survey it was found that the spatial pattern of Luxmi Bazaar had inter woven tree like road networks with cul de sacs contributing to no defined block boundary. Instead of blocks the area is identified through the name of its lanes or streets. So for detail study instead of blocks three lanes with the first row of plots along both sides of them had been selected. The summation of all the plot areas is considered as the block area for this study.

Table 4.36: Land coverage at block level in Luxmi Bazaar

Lane	Total area (sq.ft)	Total built up area (sq.ft.)	Land coverage per block (%)	Average Block coverage
Nandolal Dutta Lane	140296	112629	89.2	89.4%
Panch Bhai Ghat Lane	101937	89500	87.8	
Nobodip Bashak Lane	90064	82138	91.2	

Source: Field Survey, 2016

The result of the empirical observation indicates that Nobodip Bashak Lane has one of the highest land coverage of 91.2% at block level followed by 89.2 and 87.8% in Nandolal Dutta Lane and Panch Bhai Ghat Lane respectively. Luxmi Bazaar is found to have the highest land coverage at block level among all the study areas.

Table 4.37: Net Residential Density and Net Residential Population Density along the road front plots of the study lanes in Luxmi Bazaar

Luxmi Bazaar		
Lane	Net Residential Density units /hectare	Net Residential Population Density persons /hectare
Nandolal Dutta Lane	128	643
Panch Bhai Ghat Lane	140	701
Nobodip Bashak Lane	220	1104

Source: Field Survey, 2016

Nandolal Dutta Lane was inhabitated by the elite class back in 1950s when this lane was predominated with single and double storied colonial style courtyard houses flanking on its both sides. The lane is having varied width along its length where the highest width is 20 feet and lowest is 15 feet. A significant portion of its residents were wealthy Muslim refugees who had migrated from India during partition and purchased property here through exchange system. Most of these Muslim residents were well educated

Figure 4.55: Nandolal Dutta Lane

Figure 4.56: Nobodip Bashak Lane

Figure:4.57: Panch Bhai Ghat Lane

and employed in public and private institutions (interview of a local resident, November 7, 2015). The residential density of the area increased substantially with the 2nd and 3rd generation of these inhabitants during the decade of 70s and 80s. With the increase in the number of family members people were extending their single storey houses by building additional floor, rooms and retrofitting. By the end of 80s decade a few 5-6 storied buildings started emerging by replacing the single and double storied dwellings. With the commencement of the fourth generation during the decade of 90s the redevelopment activity started with a faster pace with mid and high rise buildings. By the end of 90s around 80% of the single

and double storied houses have been phased out. At present only 2% of the single and double storied houses are remaining and high rise buildings of 8-10 are found to be under construction in some of the plots. Most of the new high rise buildings are having plot coverage above 80% where the older 4-6 storied buildings have plot coverage ranging from 88% to 89%.

Nobodip Bashak lane is characterized of meandering narrow lanes 5-8 feet spreading out various in directions. Starting from the primary road (*Shubas Bose Road*) the lane is 16 feet wide in its entry point and 12 feet in its narrowest part. Both side of the lane is dominated with 5-6 storied buildings with a

Figure 4.58: Narrow 5 feet alleys of Nobodip Bashak lane

Figure 4.59: Indequate penetration of sunlight

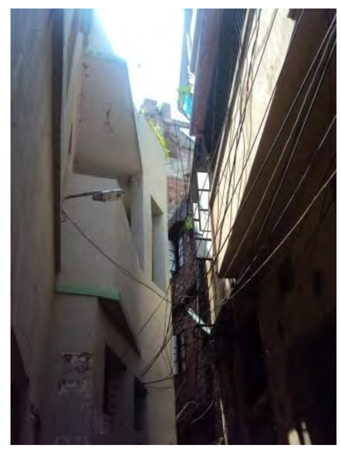


Figure 4.60: Very close juxtaposition of buildings

maximum 1.5 feet setback between two buildings. In some cases the distance between the balconies of two buildings are found to be less than 1.5 feet while in other case two adjacent high rise buildings are found to share the same external wall (Fig 4.48 and Fig 4.49). The alleys are extremely narrow often 4 feet wide with open drainage on both sides. These alleys are only used as pedestrian pathway while 5-6 storied buildings are frequently found flanking along them. Various occupational groups reside here but a significant portion of them belong to the service sector. There are a couple of mixed use buildings in the entry point and a 4 storied mosque in the middle of the lane. The plot coverage of the buildings range between 80 to 90 percent in some case even more. With the highest plot and block coverage the high rise dwellings of this dense neighbourhood is having the minimal solar access and natural ventilation.

Panch Bhai Ghat Lane is dominated by mid and high rise buildings all along its length. There is a 6 storied mosque and 2 storied government primary school (*Rokonpur Primary School*) along this lane. With plot coverage ranging from 81%-87% the buildings of this neighbourhood are also devoid of adequate sunlight and privacy.

Spatial growth pattern in Luxmi Bazaar

The plots of Luxmi Bazaar show a wider range of variation in terms of plot sizes and shapes. This is due to the fact that the area has been developed informally. In addition, sub division of the plots were not regulated, but has been undertaken by informal subdivision process largely guided by Muslim inheritance law. The fact that plot sizes in Luxmi Bazaar are relatively smaller than those of new Dhaka, unguided redevelopment has led into crammed housing with highly compromising condition in terms of sunlight, cross ventilation and privacy. The settlement has already reached the saturation stage with tall buildings forming a densely packed maze like urban fabric. And if this trend is allowed to continue the already inadequate infrastructure are likely to fail with other serious environmental consequences. The means of access defined in BNBC for fire rescue operation should not be less than 4.8m or 14.74 feet. But in many places the width of the web like narrow streets of Luxmi Bazaar are below this standard which makes the settlement more vulnerable to fire hazard. The lack of open space and evacuation routes is likely to cause massive proportion of casualties in case of natural catastrophes like earthquake.

4.5 Cross Case Analysis

This section compares the density attributes of the study wards and discusses the emerging issues of the present densification process. The aim is to get an idea of the density pattern and its impact on the spatial qualities of the settlements. The density attributes have been categorized under three perspectives namely the house form characteristics, plot characteristics and density characteristics. House form characteristics are analyzed through the variables of building height, building use, building form while plot characteristics are studied through plot size, plot ratio, plot exposure and density characteristics are defined through population and housing density, land coverage at plot and block level and floor area ratio.

4. 5. 1 House Forms

House form is characterized through the variables of building height, building use and building form which are analyzed in the following:

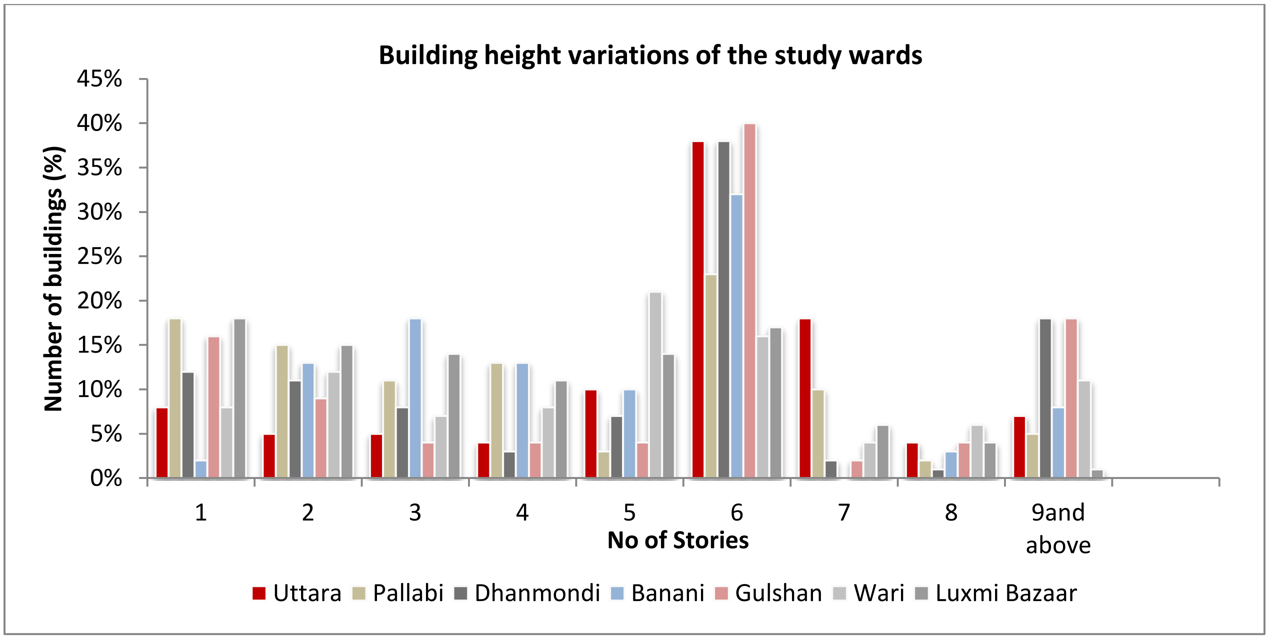
4.5.5.1 Building Height

In general the empirical observation suggests that a major part of the study residential areas are dominated with 5-6 storied buildings. Though the redevelopment activity of high rise buildings are more pronounced in all of the study areas but there is yet a considerable number of low rise (1-2 stories) houses remaining in

Fig 4.61: Sharing external wall Nobodip Bashak Lane

these areas. Out of 194 houses that were studied in Luxmi Bazaar and Wari, 31 and 20 were low rise

Chart 4.8 : Variation in building height of the study areas

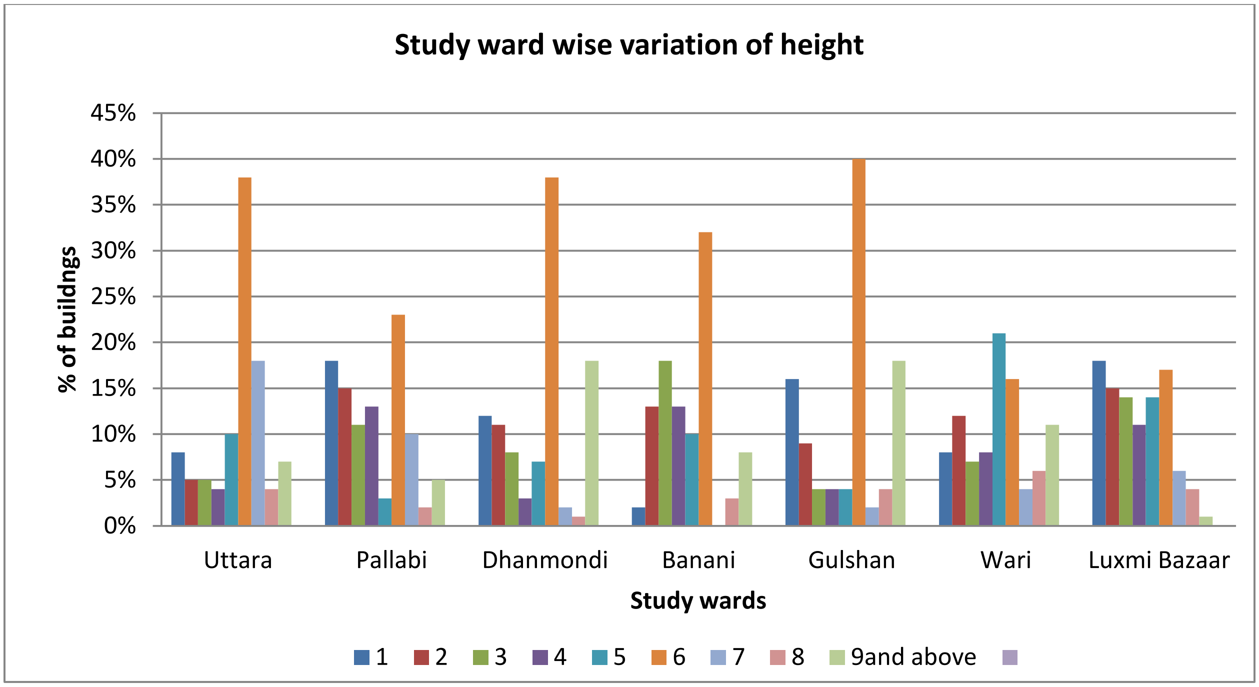


Source: Field survey, 2015

(1-2 storied), 52 and 51 (3-6storied) were mid rise and the remaining 11 and 22 were high rise (above 6 stories) buildings respectively. The residential areas of new Dhaka also show a considerable variation regarding building height where the major part of the building stock is dominated with 6 storied buildings. From the blocks studied, Gulshan seems to have the highest proportion of 6 storied buildings followed by Dhanmondi and Banani. Dhanmondi, Gulshan and Wari have a greater percentage of buildings above 9 stories than other study areas. The lowest number of low rise buildings found in Banani implies that transformation is quiet speedily taking place here. At present the emerging high rise buildings (above 9 stories) ranges around 7%–33% of the houses studied in the study areas. Dhanmondi Banani Gulshan and Uttara seem to be undergoing the redevelopment of high rise buildings above 9 stories in a faster pace than other areas. The redevelopment activity towards building high in the residential areas is partly linked with the uses and demands that arise in the settlement and partly to the market forces.

Since old Dhaka has always been the buzzing centre of commercial and cultural activities new demands for commercial, office and residential space have prompted property owners to redevelop single or double storied houses into high rise apartments. The fact that majority of the land owners do not have the financial capacity to redevelop houses they commit in joint venture with the developers. Again many former land owners also sell their land to the developers due to problems faced with sub division, various land disputes and migrate elsewhere. So a part of the redevelopment activity of old Dhaka can also be attributed to a kind of gentrification process led by the market forces. On the other hand the emerging high rise buildings of new residential areas of Dhaka are largely a result of the market forces rather than the demand. As the private property developers respond to the demand with an intention of maximizing profit the spatial and environmental qualities seem to be suffering the consequences. The marginal role of the concerned authority in regulating planning control is also responsible for such redevelopment activity.

Chart 4.9 : Area wise variation in building height in study areas



Source: Field survey, 2015

The spatial organization of an area changes with the intensity of development whose impact is visible in the skylines of the urban area. Therefore the effects of densification on the spatial organization of the study areas have been investigated by studying their skylines. Field observation indicates that the skyline of residential areas of both new and old Dhaka is changing more dramatically from 2008 than it has in the past decades. Before 2008 the restriction on height contributed to a more or less uniform skyline which is still evident in some parts of the residential areas untouched by recent construction activity. But at preset most of the commercial, mixed use and residential buildings are only heading ever more skyward, which is resulting into a jagged skyline in the residential areas of Dhaka in general. However, in residential areas with comparatively low and medium density like Uttara, Pallabi, Gulshan, and Banani buildings with varying heights make the jaggedness more strikingly visible whereas in Denser areas like Wari, the skyline tends to be more uniform owing to the close juxtaposition of similar height tall buildings. Nonetheless the commercial strips along the transport corridors of the study areas form a uniform skyline with an array of similar tall height buildings amidst the jagged urban fabric of the residential areas.

4.5.5.2 Building use

One general observation from all the case study wards is the transformation in building uses from typical residential to commercial uses with the increasing density. The transformation in terms of number and use in old residential areas were gradual and arising from the demand but in residential areas of new Dhaka the pace of transformation seems to have surpassed the demand of the area and currently catering the demand of the city. Almost all the buildings of planned residential areas primarily housed residential function with a handful of corner shops. But later due to the increase in population the demands arose for supporting facilities which changed the building uses from residential to residential cum commercial, educational institutions, hospital and other commercial uses. Since most of the new residential areas are served with good accessibility the demands for commercial and residential spaces prompted property developers into building high rise mixed use apartment buildings. This is linked with the profit driven endeavor of both the land owner and developer. The expansion of commercial activities has presently turned these new residential areas into thriving city centers.

Table 4.38. : Building uses in the selected blocks of the study wards

Location	Dhanmondi	Banani	Gulshan	Pallabi	Uttara	Wari	Luxmi Bazaar
Residential	59	48	42	69	95	65	84
Commercial	13	3	3	12	12	11	-
Mixed use	2	6	-	5	4	18	10
Educational	8	1	1	1	-	3	1
Health	4	-	-	-	-	-	-
Religious	1	-	-	-	-	-	3
Total	**87**	**58**	**46**	**87**	**111**	**97**	**98**

Source: Field survey, 2016

Emerging as predominantly residential areas, Dhanmondi, Banani and Gulshan of new Dhaka has grown to commercial centers with building uses changing from typical residential to residential cum commercial. This trend of transformation began with buildings along the primary roads which have been extended to accommodate increased space demand for groceries, restaurants, stationery shops, hair dressing salons, beauty parlours, boutique, pharmacies etc. A few buildings of Dhanmondi were being redeveloped into three storied for school accommodation and restaurants in the initial period. Later the redevelopment activity of these residential areas took a faster pace creating spaces for offices, banks, hotels, general and specialized hospitals and other commercial purposes by transforming low rise house forms into high rise buildings. However, the transformation of building use did not limit itself along the main thoroughfare but gradually proliferated in the inner blocks of the residential areas. Pallabi and Uttara are following the same trend though the proliferation of commercial activities has not yet taken place in the inner blocks in an alarming rate. The large scale commercial activities along the primary roads call for adequate number of parking spaces. But the present parking provision is quite inadequate causing surface parking in a haphazard way which results in traffic congestion along the main transport arteries. The building uses in the blocks surveyed have been summarized in Table 4.38.

During the Pakistani colonial period almost all the buildings of Wari were primarily used for residential purposes with only a handful of buildings accommodating corner shops. Presently with the increasing density the demands for supporting facilities has been catered through the changes of building uses from residential to commercial, warehouses, banks, offices, residential cum clinics, boutiques, brand outlets etc along the Rankin and Larmini street. Building uses in Luxmi Bazaar are still predominantly residential with grocery, pharmacy and tailoring shops being opened to provide the daily necessities within a few residential houses. The large scale transformation of building use has mainly taken place along the *Shubhash Bose* road which has been a commercial hub from antiquity. The intensity of commercial activities along this road have increased through the introduction of modern fast food shops, chain super markets, offices and shopping arcade. These new building uses play a significant influence to the changing house forms that result from extensions, redevelopment and modifications. Due to the consolidated nature of the settlements of old Dhaka lacking vehicular access the large scale commercial activities could not spread in the inner blocks.

Figure: 4.62 : Trends of commercialization in the study areas

Source: Field Survey, 2015

4.5.5.3 Building Form

Regarding built form three major types of built forms were identified in the new residential areas of Dhaka which included single or double storied detached house, box type 3-6 storied mid rise buildings with traditional facade and emerging high rise buildings (above 6 stories) with modern elevation treatment. The detached house type usually has spaceous front yards, the mid rise buildings have very

Figure 4.63: Types of Building Form in the study areas

Emergent high rise 6+

Uttara

Gulshan

Gulshan

3-6 storied mid rise buildings

Uttara

Uttara

1-2 storied low rise buildings

Uttara

Dhanmondi



Wari Wari Luxmi Bazaar

Heritage buildings

tight set back space all around while the third generation of high rise buildings have relatively larger open spaces in the front. In addition to these three types one more type of house form was found in old Dhaka which has archeological value and conforms to the various architectural styles of colonial period. Old Dhaka still has a good number of these antique house types most of which are used as ware houses with poor or no maintenance while others are in dilapidated condition awaiting to be demolished. The old city core has also a number of neighbourhoods with houses of distinct architectural style like *Shakhari Potti*, *Farashganj* etc. These antique house forms bear the legacy of the bygone period of the city and therefore deserve to be restored. Old buildings where possible should be allowed to be rehabilitated with new functions which could in turn help to refurbish the old city core increasing economic opportunities for the local.

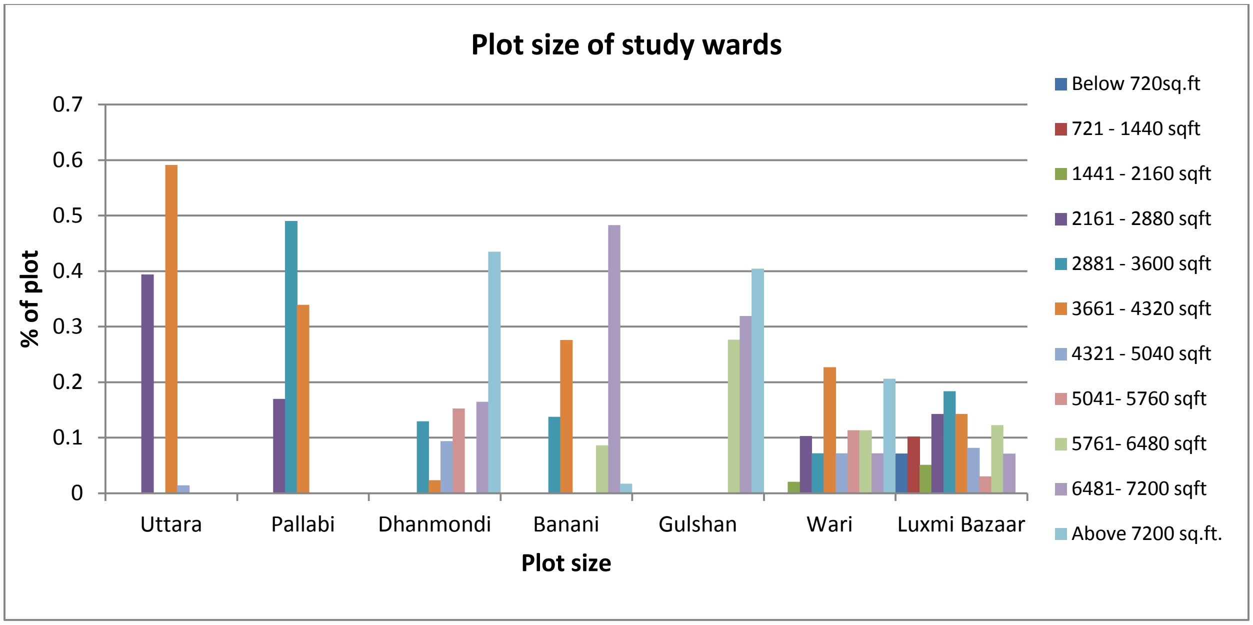
4.5.2 Plot characteristics

Plot configuration, that is the size and the shape, influence the form of houses as well as the density of settlement. Plot characteristics of the study areas are discussed in terms of three variables which are plot size, plot ratio and plot exposure.

4.5.2.1 Plot Size

There is a considerable variation in the plot sizes when the case studies areas of new and old Dhaka are compared. There is a wide range of variation in the plot sizes of old Dhaka while variation is found to be relatively less in the new Dhaka. These variations are related to the planning nature of the settlement whether it was informally developed or formally planned. Even though in the formally planned old residential area of Dhaka like Wari, a high variation in plot sizes is observed which is a result of the unregulated process of land subdivision. The informal subdivision process of Luxmi Bazaar has resulted into plot size below 20 sq.ft. This type of subdivision process takes place due to a number of factors. For instance, the smaller land parcels of Wari are mostly due to the willingness of the landowner to subdivide and sell their original big chunk of land for lack of financial capacity to redevelop. Again majority of the smaller land parcels of Luxmi Bazaar continued to get smaller through informal subdivision with the increasing number of inheritors. The smaller plot sizes are linked with higher density which provides affordable size of housing for the lower and middle income group and thus is found to be socially acceptable in old Dhaka.

Chart 4.10 : Variation in plot size of the study areas



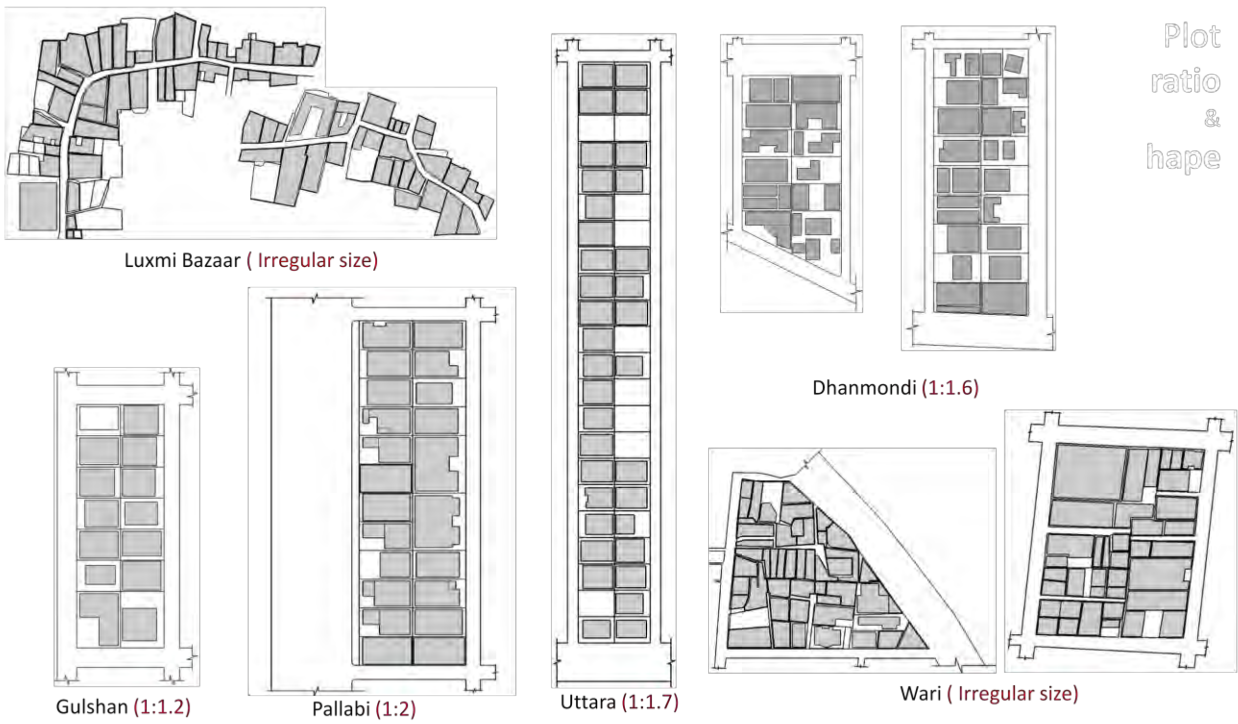
Source: Field survey, 2016

The reason for less variation in plot size in the new residential areas of Dhaka is due to the ceiling imposed on subdivision process by the government in many of the planned residential areas. Consequently Dhanmondi, Banani and Gulshan does not have any plot below 3600 sq. ft.(5 *katha*), while in Uttara and Pallabi the minimum size of plots distributed by the government was 2340 sq.ft. (3.25 *katha*). Bigger plot sizes offer more flexibility in design of high rise buildings which also attracts the market forces to undertake more redevelopment activity in these areas. These bigger size plots are related to the lavish standards of the higher middle and higher income group. The comparatively larger size of plots of Gulshan catering the lifestyle of the higher class will continue to maintain a low level density but may not be economic in terms of provision of infrastructure and maximum utilization of land.

4.5.2.2 Plot ratio

Plot ratio refers to the proportion of plot and width to depth which is an indicator of the shape of the plot. The block layout needs to take into consideration the shape of the plots for efficient management of infrastructure. In this respect large squarish plots with 1:1 are not as efficient as rectangular blocks with 1:1.5 or 1: 2 ratios. On the other hand plots with 1:3 or 1:4 ratios are too linear to provide good ventilation and solar access and thus face difficulty in designing building. The blocks of Dhanmondi and Pallabi have rectangular plots ranging between 1:1.6 to 1:2 which helps to achieve good spatial qualities in the interiors while the blocks of Banani and Gulshan have larger plots with more squarish shape approaching 1:1 ratio which is good for design but tends to be uneconomic in terms of service facilities requiring unnecessary stretching of utility lines. Uttara has a greater number of rectangular plots (1:1.7) in around half of its block arrangements. Though the plot ratio is desirable but in case of the smaller size plots (3.25 *katha*) too many plots in a row leave 80% of the buildings blocked on three sides which deteriorate the spatial qualities. The blocks of Wari are large and squarish which constitute a large number of plots with diversified plot ratios resulting into an agglomeration of square, rectangular and elongated plots. The inner plots of these blocks are devoid of exposures which result in congested buildings. Due to the irregular shape of the plots the plot ratio could not be established in case of Luxmi Bazaar.

Figure 4.64: Variation in the plot shape and size of the study residential areas



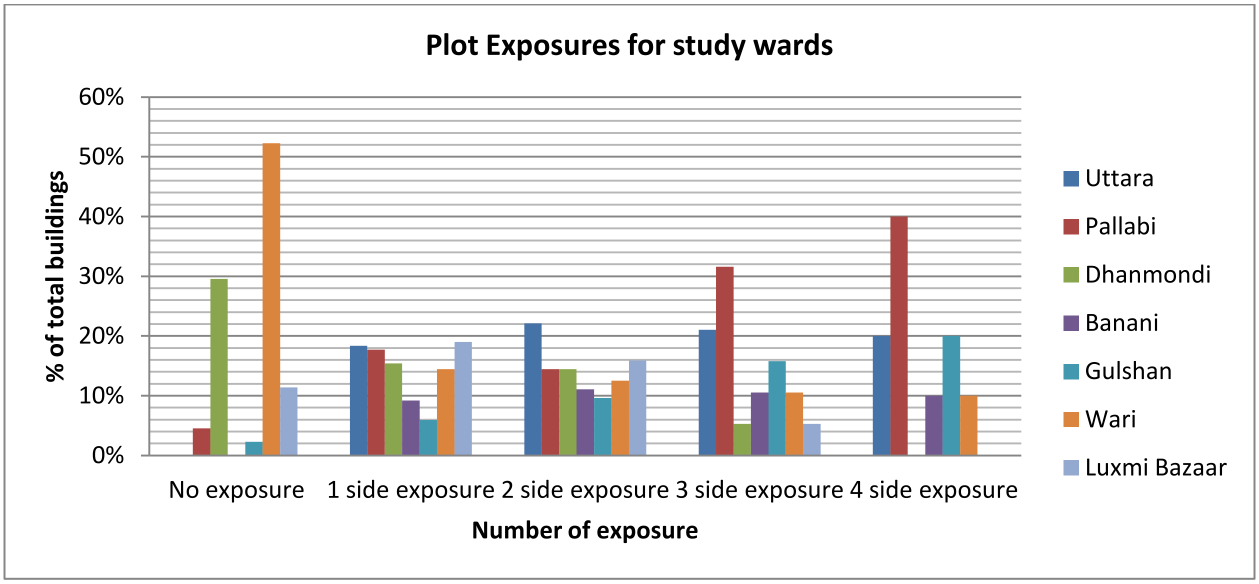
Source: Field survey, 2015

The block layout also guides the intensity and pattern of development which can be attributed to the resulting dense development to some extent. The blocks of the new residential areas were planned in grid iron pattern to make driving easier while the winding street pattern of old Dhaka suggests the self organization of blocks without a central planning approach. Usually planned rectangular shaped blocks are supposed to maintain a balanced ratio between the number and shape of the plots. Too many subdivisions (usually more than 20) within a rectangular block tend to make the individual plots smaller and linear in shape. This reduces the plot frontage as well as flexibility in designing multistoried buildings with habitable floor space This type of blocks were observed in Uttara, Pallabi and Banani while Dhanmondi and Gulshan had balanced blocks with large plots. Another thing is note worthy that although the initial block layout of Dhanmondi with large plot size were balanced but the subsequent subdivision that occurred in the later phase had resulted into three to four rows of plots where the inner plots are subjected to very nominal exposure which again undermine the spatial qualities of the built forms in them. The same problem is observed in Gulshan too but in lesser extent. On the other hand there is a significant diversity in the layout of blocks and architectural styles in old Dhaka especially that have preserved historic neighbourhoods or other culturally distinct *mohallas or paras.* The blocks of old Dhaka with their diversified shape and size facing narrow streets are not suitable for high rise constructions which not only destroy the character of the area in terms of aesthetics and livability but also leads to cramped housing condition.

4.5.2.3 Plot Exposure

The plots having more exposures are supposed to allow more surfaces of the built form to be exposed for sunlight and ventilation. Under this assumption the plot exposures of the study areas have been analyzed. Empirical observations from old Dhaka show that around 51% and 11% of the plots studied in Wari and

Chart 4.11: Variation in plot exposures of the study areas



Source: Field survey, 2016

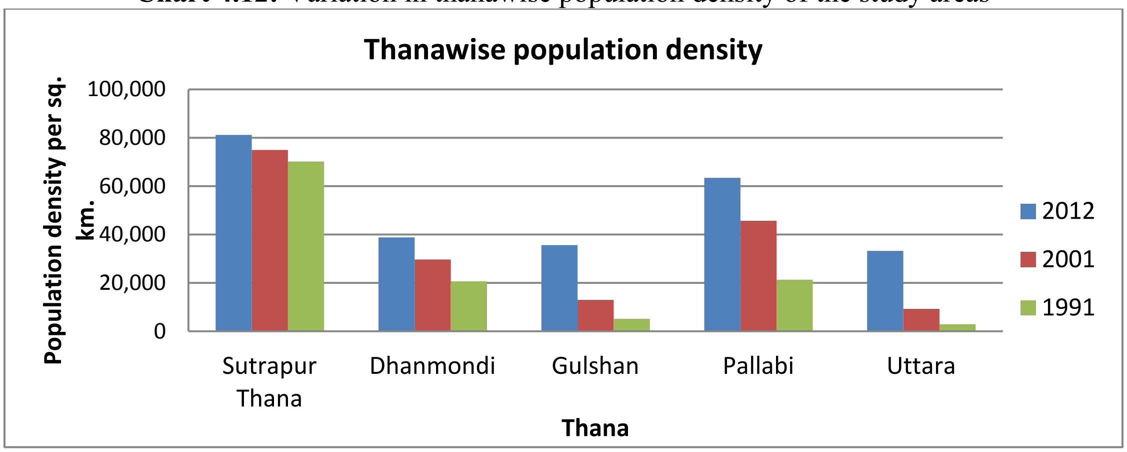
Luxmi Bazaar have no or limited exposure to one side, 14% and 19% had one exposure, 13% and 16% had two exposures, 11% and 5% had three exposures respectively. Among the plots studied only one plot in Wari had four exposures while there were no such plots in Luxmi Bazaar. The original plot layout ofnew residential areas of Dhaka ensured at least one full exposure for every plot but later due to the subdivision a few plots have ended with no exposure or very marginal exposure on one side. In Dhanmondi, for example, out of 92 plots studied, 13 had almost no exposures while in Pallabi and Gulshan 5 and 2 plots were found having no exposures respectively. As the residential areas of Wari and Luxmi Bazaar are too consolidated with compact development, the limited exposures for more than half of the plots have resulted into uncomfortable living condition in terms of ventilation, solar access, visual and acoustic privacy. The views are also obstructed due to congested buildings. The situation is mainly attributed to extensive development of buildings with covering almost the entire plots that have barely left space for alleyways or streets. Since development in these settlements take place informally, individual tendencies towards high plot coverage does not take into consideration the need for plot exposure. Many of the neighbourhoods in Luxmi Bazaar and Wari does not have any vehicular access but approached with very narrow alleys ranging from 4-5 feet which are further limiting the number of exposures of the plots. The lack of adequate plot exposure also contributes in deteriorating the spatial and living qualities of these areas in comparison with the residential areas of new Dhaka.

4. 5. 3 Density Characteristics

Density has been taken in this reasearch as the principal quantifiable ‘indicator of difference’ between housing developments that are similar in other respects. How land is subdivided and occupied is of ultimate importance and that is why densities become an important parameter. Whether land is squandered or efficiently occupied will basically depend on the standards used for roads and plots. The size, the width, length or depth and shapes of plots, plot coverage regulation and dimensions of roads will significantly affect ultimate density (Acioly, 1993). Therefore, five main variables have been used to characterize density across cases. These include population density, housing density, occupancy rate and type, floor area ratio, and land coverage at plot and block level.

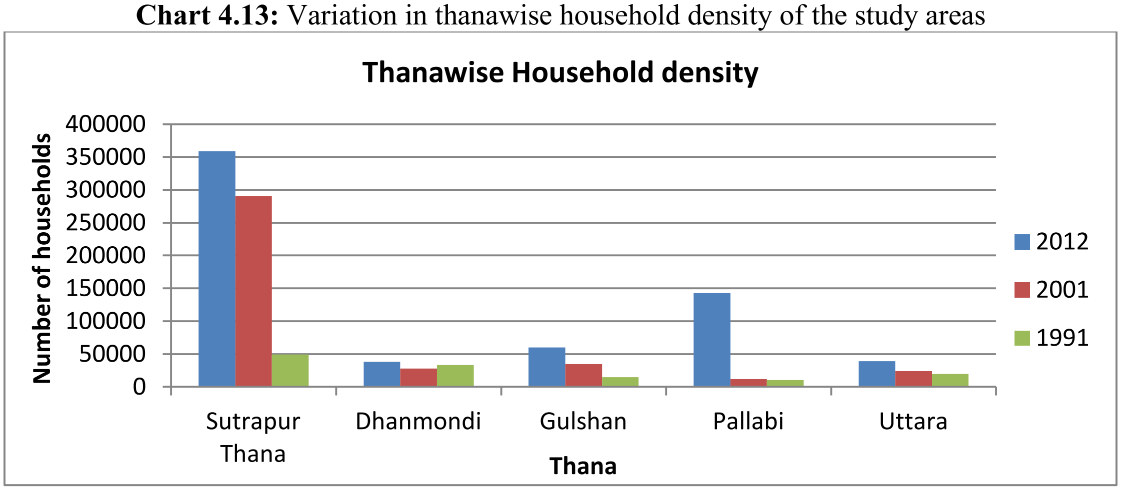
4.5.3.1 Population and housing density

Chart 4.12: Variation in thanawise population density of the study areas



Source: BBS, 2011

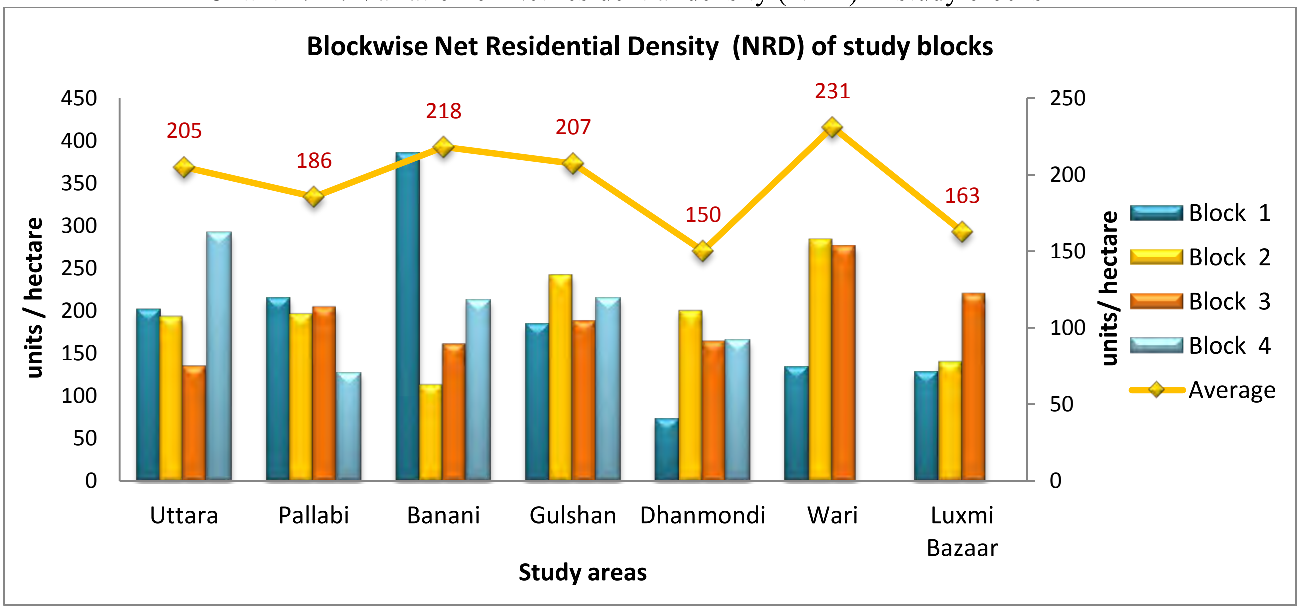
Chart 4.13: Variation in thanawise household density of the study areas



Source: BBS, 2011

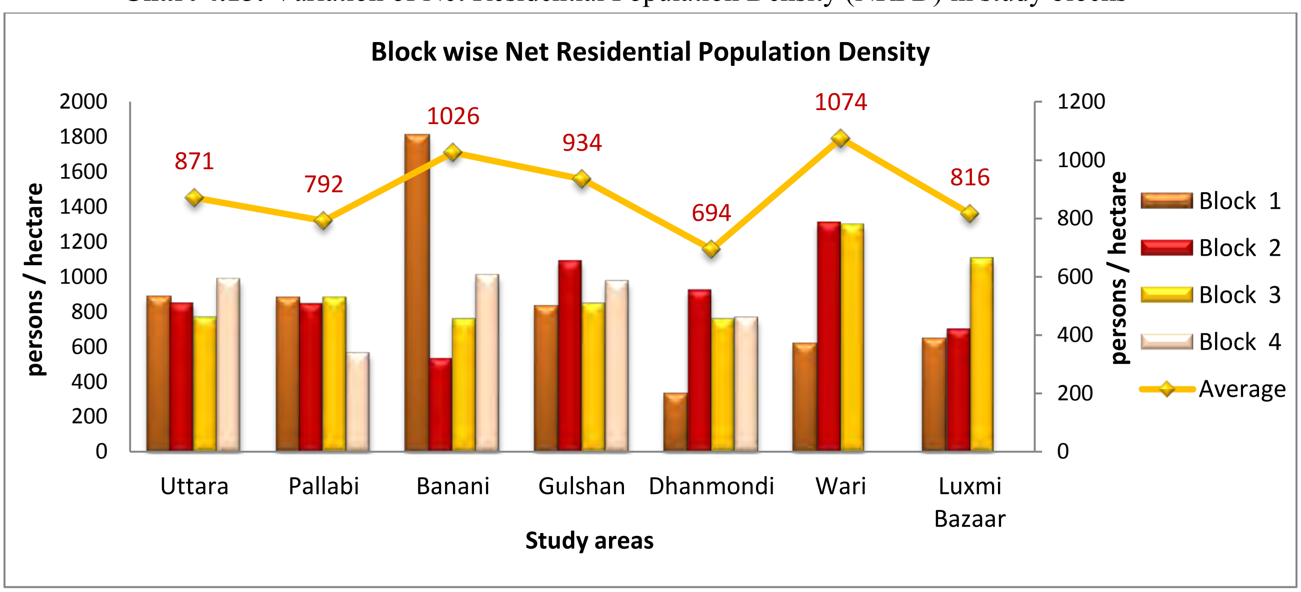
Due to the unavailability of secondary data the ward wise population density of intra census period could not be compared. Instead the thana wise population density is considered which gives an idea of the density pattern in the study wards. Population wise Sutrapur thana comprising of the study wards Luxmi Bazaar and Wari have the highest population density which is followed by Pallabi thana having medium density. Dhanmondi, Banani and Uttara thanas are having comparatively lower density. In case of household numbers Pallabi seems to experience a sudden leap in terms of housing stock from 2012 where the number of households were proportionately increasing with the population density. The population density of Gulshan and Uttara seems to have gone drastically high in 2012 in comparison with the other study areas. The upgraded status of Gulshan as the emerging CBD could be a reason for this rise in density while the low and affordable rental structure of houses facilitated with good transportation system could be the main impetus for the rise in density in Pallabi thana.

Chart 4.14: Variation of Net residential density (NRD) in study blocks



Source: Field survey, 2015

Chart 4.15: Variation of Net Residential Population Density (NRPD) in study blocks

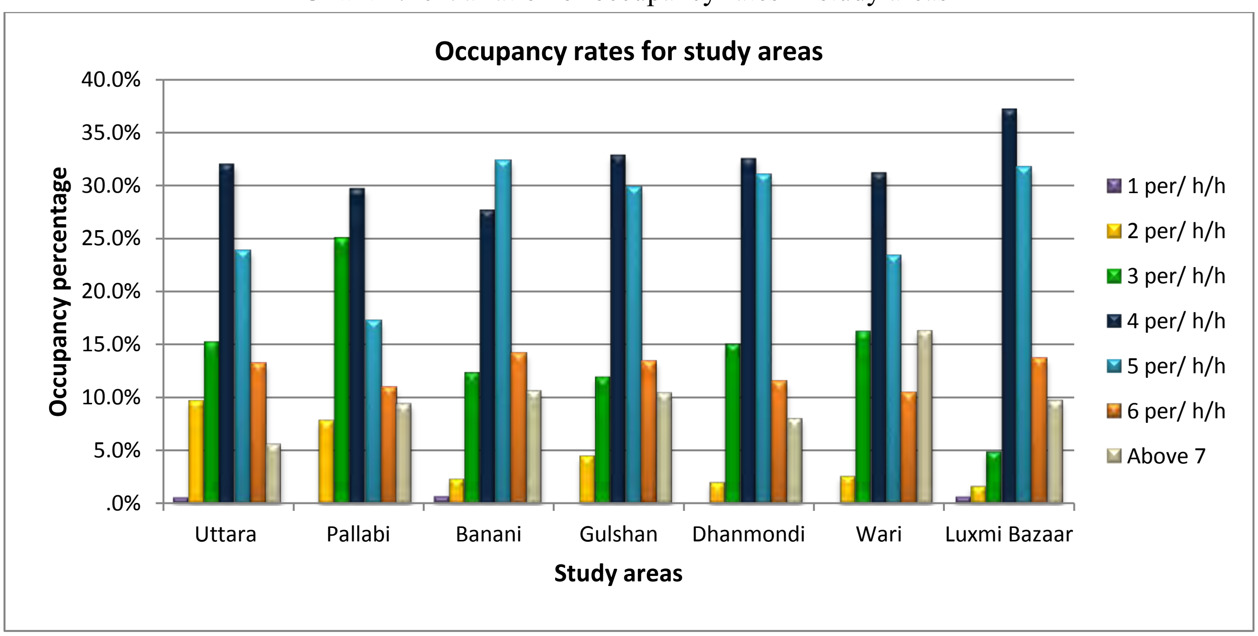


Source: Field survey, 2015

Results from the empirical study of the selected blocks seems to be consistent with the thana wise population density data where Wari has the highest net residential population density, Banani and Gulshan with medium density and Pallabi and Uttara with relatively low density. When the number of housing units is taken into consideration, which implicitly influences occupancy and population density, the new residential areas of Dhaka reveals moderate densities in comparison to other developing countries. For instance, housing density for high rise apartments of the Housing Development Corporation (HUDCO) in India is 600 units/ hectare, in Itamaraca project in Brazil is 40 units/hectare and Jamaican sites and services project 44 units/ hectare (Acioly and Davidson, 1996; Areanas Gomez, 2002). The highest observed housing density in Uttara, Pallabi, Banani, Gulshan and Dhanmondi are 291, 215, 385, 242 and 200 units/ hectare.

Similarly, the block wise highest Net residential population of Uttara, Pallabi, Banani, Gulshan and Dhanmondi was found to be 1006, 1077, 1925, 1211 and 1000 persons per hectare. However, the estimated Net residential density (NRD) as well as the Net residential population density (NRPD) shows an unusual low density in Dhanmondi and Luxmi Bazaar. This is due to the higher number of commercial buildings existing in the study blocks of Dhanmondi which were not taken into account while estamitating the net residential density and population of Dhanmondi. Due to the consolidated quality of the settlement as well as the ambiguity of block boundaries of Luxmi Bazaar the settlement had been studied in lane wise rather than block wise manner. As only the houses of the road front were considered while studying Luxmi Bazaar the net residential density of the area turned out to be low which would have been much higher if blockwise NRD and NRPD could be calcualted. However, the gross population density of this area is supposed to be one of the highest in Dhaka city that is 737 persons / hectare according to DAP 2010.

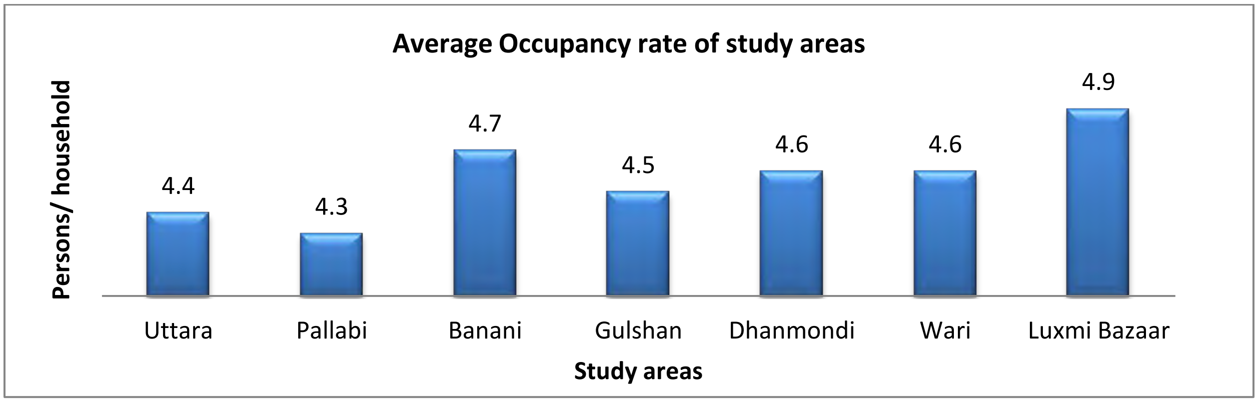
Chart 4.16 Variation of occupancy rates in study areas



Source: Field survey, 2015

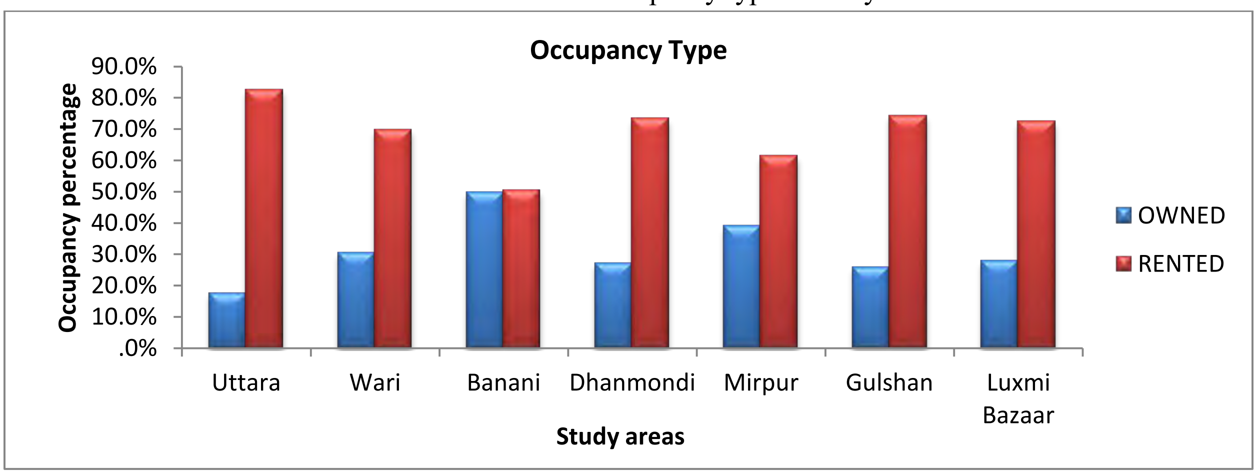
The highest average occupancy rate 4.9 persons per household (Chart 4.17) was found in the consolidated settlement of Luxmi Bazaar while the lowest concentration was found in Pallabi followed by Uttara. The average occupancy rate in the new residential areas of Banani Gulshan, Dhanmondi are found to be 4.7, 4.5 and 4.6 respectively. When occupancy types are examined across study wards (Chart 4.18) most of the households are found to be rented. Only Banani showed an equal proportion of rental and owner

Chart 4.17 Average of occupancy rates in study areas



Source: Field survey, 2015

Chart 4.18 Variation of occupancy type in study areas



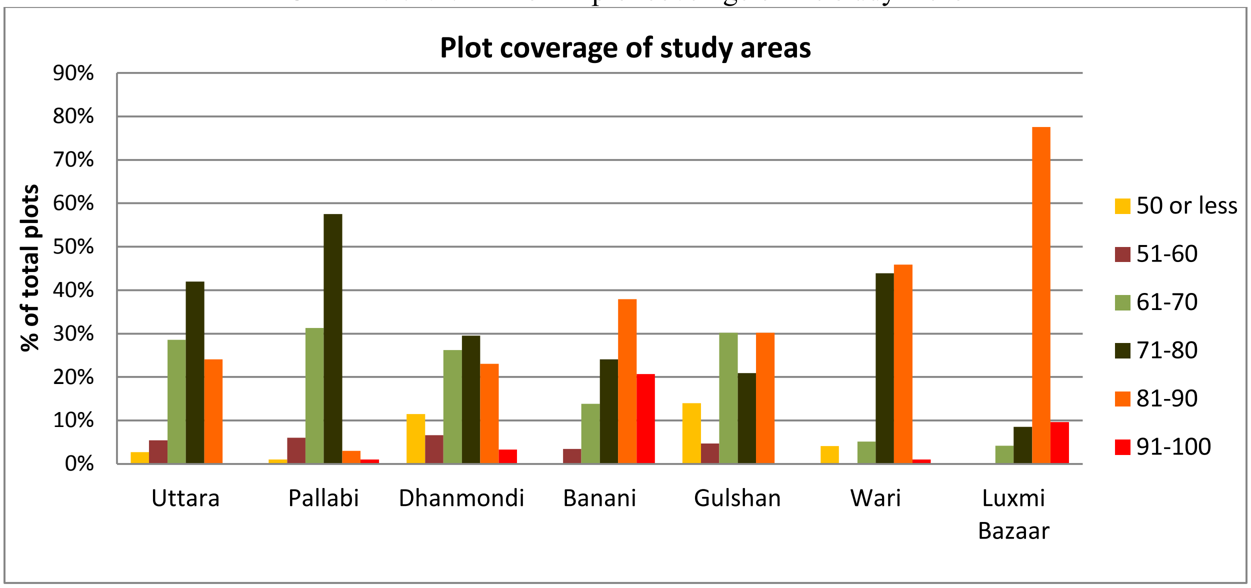
Source: Field survey, 2015

occupied type while Uttara has the highest rental occupancy. The overall higher percentage of rental accommodation observed in the study areas indicates that the ongoing densification is mostly due to the migrating population rather than the natural population growth of these areas. This implies that the driving force of densification in these areas is largely motivated by the owner as well as the developers' intent to use the house as a source of income through renting.

4.5.3.2 Plot coverage

When plot or site coverage was calculated across the cases, Luxmi Bazaar reveals the highest plot coverage ranging from 81% to about 100%. This is closely followed by Wari and Banani with plot coverage of 81% to 90%. Majority of the houses are noted having plot coverage ranging in between 71% to 80% in Uttara, Pallabi, Dhanmondi, Banani, Gulshan and Wari. Low plot coverage of 51% to 60% can be found only in a few houses (4% - 7%) in Uttara, Pallabi, Dhanmondi, Banani and Gulshan. Due to the highly consodilated development of Luxmi Bazaar no low plot coverage were witnessed in Luxmi Bazaar but in Wari only a handful historical and low rise houses still have plot coverage below 50%.

Chart 4.19 : Variation in plot coverage of the study areas



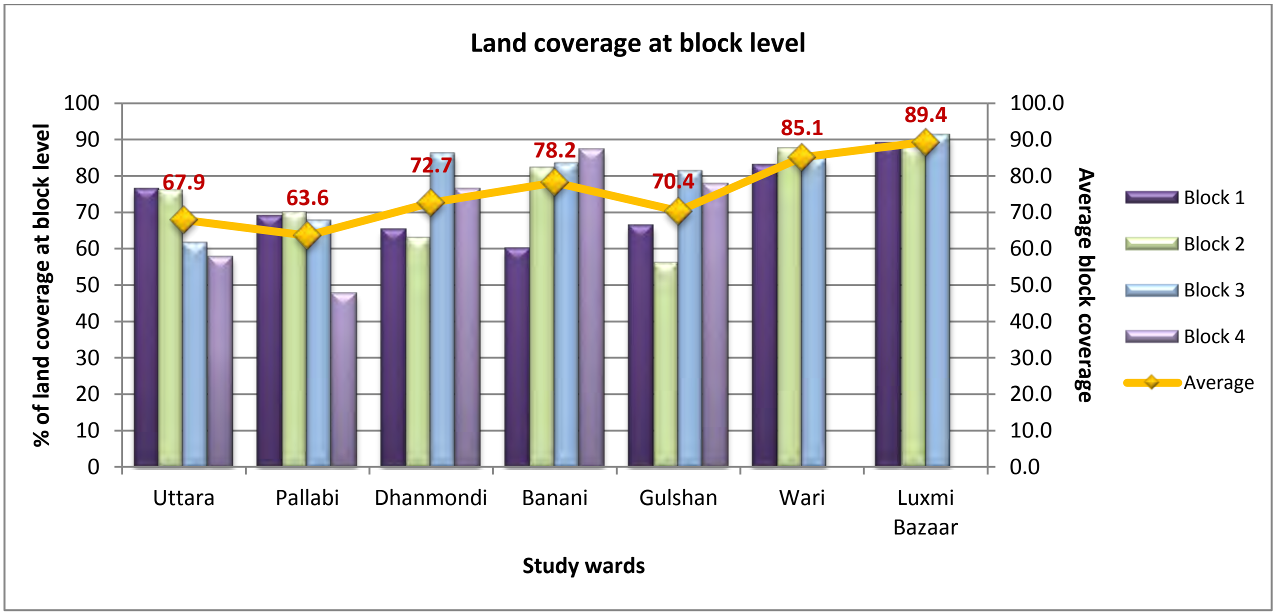
Source: Field survey, 2016

The findings indicate that even though the 50% mandatory open space prescribed in MINB 2008 being adhered in the newly constructed buildings but the number of such plots is much lower than the already built up plots with higher land coverage (71%-80%) according to the former set back rules of BCR 1996. As it can be seen from the block survey that even the blocks with half of the buildings adhering to FAR rule does not make much of a difference to the culminated open space of the overall block. Furthermore the mandatory open space along the road front (excluding the 20%-25% FAR exempted space) is also not much effective in increasing the road width or provide walk ways as it is found totally landscaped with low height retaining walls . Therefore, it only helps to provide nothing more than a visually appealing buffering space between the private and public realm. Again the terraced plant beds with thick retaining stepped walls keep a significant portion of the ground covered which even reduces the benefits the FAR rule was supposed to accrue. In case of access roads without footpaths if this open space is left unbounded by any low height retaining walls then it can serve as pedestrian walkways. Apart from this, some violations have been observed regarding following the MINB 2008 rule properly. The roof height of the FAR exempted areas including guard box, porch, parking and driveways have been found above the recommended level in most of the buildings along with slight deviation in the total amount mandatory open space. This deviation tends to be higher in irregular shaped plots especially in old Dhaka as in most cases the deviation cannot be detected through unaided eye. The side set back space between buildings is still inadequate in terms of receiving sunlight and maintaining privacy. The side and rear setbacks are narrow enough to be used for any meaningful function and also the view from side balconies and windows remains largely blocked. Furthermore they contribute in forming heat islands which raises the temperature of the interior rooms.

4.5.3.3 Land coverage at block level

Results from the survey further revealed that land coverage at block level varies quite significantly between old and new Dhaka. The highest average land coverage at block level is 89.4% found in Luxmi

Chart 4.20 : Variation in block coverage of the study areas



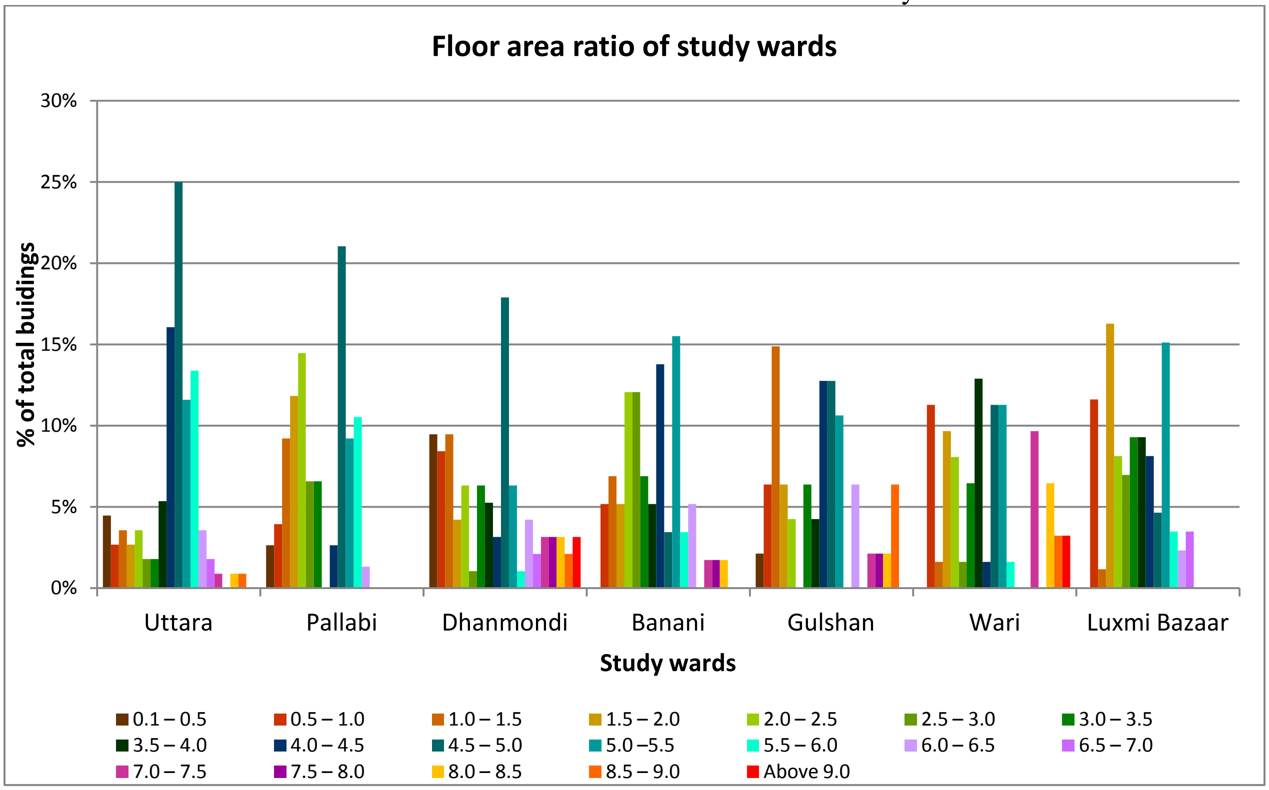
Source: Field survey, 2016

Bazaar and the lowest is found in Pallabi which is 63.6%.Wari has the second highest average block coverage of 85.1%. The comparatively high land coverage of old Dhaka at block level indicates that almost 90% of the dwellings are utilizing the maximum plot coverages which is far beyond the recommended level. This in turn is contributing to a very dense compact settlement. Dhanmondi and Banani has shown moderate block coverage which are 72.7% and 78.2% respectively. This implies that Dhanmondi still have a good number of low rise dwellings with comparatively low plot coverage while most of the recently constructed high rise buildings are adhering the MINB 2008. Banani seems to have a slightly higher block coverage than Dhanmondi where ideally it should be around 60%-70%. The higher block coverage of Banani is due to the presence of a large number of buildings not in adherence with the setback rules of BCR1996. On the other hand the lowest average block coverage of 70.4%, 67.9%, and 63.6% were found in Gulshan, Uttara and Pallabi respectively. This average low block coverage results from the existence of vacant plots as well as a good number of low and mid rise buildings with low plot coverage and compliance with the recommended FAR in the recently constructed buildings. However, the maximum observed block coverage in Uttara, Pallabi, Dhanmondi, Banani, Gulshan, Wari and Luxmi Bazaar was found to be 76.3%, 69.1%, 86.3%, 87.3%, 78.1%, 87.5% and 91.2% respectively.

4.5.3.4 Floor Area Ratio (FAR)

When the floor area ratio at plot level is considered, most of the residential areas range between 0.1 to 9.0 with Dhanmondi and Wari having less than 5% buildings with a FAR above 9.0. These are primarily the commercial high rise buildings. Overall majority of the buildings in new residential areas have a floor area ratio ranging in between 4.5 to 5.0. This indicates the existences of a high percentage of 5-6 storied buildings in these areas. Luxmi Bazaar does not have any buildings below 0.5 FAR. Apart from this the variation in floor area ratios of the study wards are quite staggering which implies to the presence of various house forms of various height.

Chart 4.21 : Variation in Floor Area Ratio of the study areas



Source: Field survey, 2016

Fieldwork results also indicate that most of the earlier constructed 6-storied buildings have a Floor Area Ratio (FAR) exceeding the recommended level of BCR1996. The maximum observed Floor Area Ratio of older residential apartment buildings in Uttara, Pallabi, Dhanmondi, Banani, Gulshan, Wari and Luxmi Bazaar was 5.9, 9, 6.4, 5.4, 6.4, 5.7 and 6.9 respectively. The permissible Floor Area Ratio for residential accomodation of these study areas ranges from 4.2 - 6 according to BCR 1996. The maximum observed FAR for commercial buildings were found to be above 9.0 in Dhanmondi and Wari. However, majority of the newly constructed buildings were found to be adhering to the prescribed FAR of MINB2008 with a few exceptions where there has been significant deviation from the approved level. On the other hand the deviation is much higher in the old mid rise residential areas rather than the new ones. Around 90% of the older construction buildings have found violating the BCR 1996 Rules in terms of setback and height. This situation has been caused by partly the weak enforcement of the guidelines and also the developers' urge to maximize use of plot for solely commercial benefit.

4.6 Conclusion

The Chapter analyzed the physical density attributes in terms of plot coverage, floor area ratio, land coverage at block level, height and spatial organization of the study areas in order to develop an understanding of the current state of densification with the threats it is posing on the residential areas. In addition with it the trend of densification for each study area has also been investigated to shed light on the ongoing densification process of Dhaka.

Variation has also been observed in trend of densification of the study areas. Results indicate that densification had started in old Dhaka earlier than the new residential areas. As the residential areas were built before the new ones migrants naturally used to seek refuge here. The other factor which drew migrants to these areas was the low rental structure, its importance as a commercial hub and also its proximity to CBD of Motijheel. All these factors worked as the driving force behind the increase of the population as well as the residential density of old Dhaka. Apart from this the lack of monitoring and appropriate development control mechanism contributed to the unguided densification of the area. Luxmi Bazaar reached the optimum level of densification by the 2001 followed by Wari in 2004. In 2001 Luxmi Bazaar had a higher percentage of mid rise buildings which were transformed to 6 storied building by 2004. Along with this transformation new high rise buildings of 6-7 storied were also emerging. But a significant increase in the number of taller building can be observed from 2009 which is still continuing leading the densification stage to the point of saturation in most of part of the areas. With the same speed of densification Wari has also attended the saturation stage.

In case of new residential areas the densification started first in Dhanmondi and was followed by Banani, Gulshan, Uttara and Pallabi respectively. These new residential areas started densifying as a response to various factors. Densification started in Dhanmondi from late 80s and got momentum by mid 90s due to the intensification of commercial activities here. By the start of the millennium there was a boom in the number of 6-storied buildings in Dhanmondi which increasing in the succeeding years with 36% and 48% in the years of 2004 and 2010 respectively. But there was transformation in the building height as taller tower blocks of 10-14 stories started emerging after 2008 which now increasingly outnumbering the 6 storied buildings. The same trend can be seen repeating in Banani though densification started later from 90s but had commenced more aggressively than Dhanmondi because of its upgradation as a CBD. At present both Dhanmondi and Banani are on the verge of saturation and would soon cross the threshold if the present trend continues unchecked.

On the contrary, the diplomatic status of Gulshan acted both as a pull and push for the initiation of densification. The reputation of Gulshan as a posh residential area attracted the intensification of commercial activities making it the next CBD in the line after Banani. At the same time land price of the area increased which helped in slowing down the densification process. This was reflected in the percentage of the high rise buildings in 2004, 2010 and 2016 which is comparatively than Banani or Dhanmondi. However, Gulshan seems to be catching up with the trend from 2010 with the emergence of a higher share of taller building above 6 stories.

Though densification started in Uttara and Pallabi almost simultaneously but the pace was higher in Uttara than in Pallabi. In Pallabi the percentage of 6 storied buildings were 15% and 26% in 2004 and 2006 respectively whereas Uttara had 29% and 41% of 6 storied building in 2004 and 2006 respectively. However the overall percentage of high rise dwellings are still comparatively less in Uttara and Pallabi than in other study areas of Dhaka. Together the good number of plots still vacant in Pallabi and Uttara indicates that both of these study areas are in the infancy stage of densification in comparison to the rest of the study areas.

Majority of the residential buildings in most of the blocks are found to be of 6-7 storied high which maintains a continuous skyline but often disrupted by isolated towers of higher heights in some of the blocks forming an informally broken skyline. These isolated towers not only cast shadow on the adjacent streets and plots but also encroaches the privacy of the adjacent low rise buildings. Moreover many of these tower blocks houses commercial or mixed use functions in blocks where the existing zoning regulation does not permit it. Again many residential buildings are transformed to house commercial functions without any regard to the compatibility or appropriateness of the structure. The development of supporting facilities and amenities was initiated as a response to the growing demand of the residents as the existing land use plan lacked to provide adequate facilities. But taking advantage of the weak development control the commercial facilities intensified beyond the requirement of the neighbourhood. This is adversely effecting the residential environment. No effective measures have still been taken to stop or ameliorate the situation. In the face of such uncertainty the trend of constructing unauthorized commercial and commercial cum-residential buildings is likely to be continued.

In the case of residential areas of old Dhaka, it was noted that the guidelines for building redevelopment are inadequate, and where availed, they are being violated with limited or no control of the concerned authorities. This has been revealed in terms of developers constructing buildings with more number of stories, more plot coverage and floor area ratios than those recommended in the guidelines. In old Dhaka plot coverages were found to be ranging from 80% -95% much higher than the recommended level. This practice was also observed in the residential areas of new Dhaka but to lesser extent. In Pallabi, Uttara and Gulshan the plot coverage of majority of the buildings were found to be ranging between 70%-80% while in Dhanmondi and Banani the plot coverage was found to be higher (70% - 90%). The upper limit of the range constitutes the older buildings constructed earlier. In a few cases of 100% plot coverage has also been found especially in Luxmi Bazaar and Pallabi. However, the excessive plot coverage causes buildings to be closely juxtaposed from one another reducing the side set back. This close placement of buildings especially in hot and humid climatic zones like Dhaka not only undermine spatial quality requirements for sun lighting, cross ventilation and view but also contributes to excessive use of electricity energy. People have to rely on mechanical aid for cooling and artificial lighting during day time because of the shadows casted by the adjacent tall buildings in residential areas of both old and new Dhaka.

Regardless of the various stage of densification observed in the study areas the ongoing trend of densification still poses the threat of both man-made and natural disaster on the residential areas of Dhaka such fire hazard and earth-quake. As it can be seen from the survey both the new and old residential areas are found to have an indiscriminate intermixing of various use such as residential, commercial and industrial in the same location with insufficient setback. This has contributed in substantial increase in net density which is quite high compared with other cities of Bangladesh. Most of the residential areas of the old Dhaka are characterized by narrow road system with width varying from 5' to 16' in most cases. Roads with such width would obstruct the entrance, movement and maneuver of fire service vehicles at the time of emergency as the minimum road width required for fire service entry is 19'. It has been already been seen in many cases that serious fire destruction can be caused from minor cases just because of the low mobility of the road system for rescue measures to reach on time. Though the road width is found adequate in the new residential areas but the roads remain choked with traffic due to the increased density of these areas which has also increased the number of local car owners as well. The traffic situation in the residential areas of new as well as the old Dhaka creates unexpected delay to for any rescue operation to reach on time. So without a proper density plan the ongoing densification process is making the residential areas of old and new Dhaka more fire disaster prone.

Nevertheless, Dhaka is placed among the twenty most vulnerable cities of the world according to Earthquake Disaster Risk Index of Stanford University (World Bank, 2013). Dhaka metropolis along with its surroundings is situated in the Seismic Zone 2 (BNBC, 1993), which has a basic seismic coefficient of 0.15g making the city more prone to earthquake disaster. The largely unguided densification process of Dhaka is creating high density blocks randomly spread out in the city mosaic which is likely to exert additional pressure on the already vulnerable bed rocks triggering a catastrophe anytime in future. A strong earthquake (ranging from 4.5 to 8 magnitude) affecting Dhaka may result in damage and destructions of massive proportion of city and may have disastrous consequences for the entire nation. So though compact development has certain advantages but the suitability of the densification strategy should be reconsidered prudently by the authority.

Table 4.39: Summary cross analysis of density attributes of the study areas

Issue	Uttara	Pallabi	Dhanmondi	Banani	Gulshan	Wari	Luxmi Bazaar	Emerging Issues
Building densification guidelines	Absence of any comprehensive densification guideline BCRules1996 provided building height and setback MINB 2008 provided setback and FAR for determining plot coverage and height Govt. circulars are used as guidelines for any modification in zoning	Absence of any comprehensive densification guideline BCRules1996 provided building height and setback MINB 2008 provided setback and FAR for determining plot coverage and height Govt. circulars are used as guidelines for any modification in zoning	Absence of any comprehensive densification guideline BCRules1996 provided building height and setback MINB 2008 provided setback and FAR for determining plot coverage and height Govt. circulars are used as guidelines for any modification in zoning	Absence of any comprehensive densification guideline BCRules1996 provided building height and setback MINB 2008 provided setback and FAR for determining plot coverage and height Govt. circulars are used as guidelines for any modification in zoning	Absence of any comprehensive densification guideline BCRules1996 provided building height and setback MINB 2008 provided setback and FAR for determining plot coverage and height Govt. circulars are used as guidelines for any modification in zoning	There was no scheme to guide building densification	There was no scheme to guide building densification	In new Dhaka developers were violating guidelines on coverage and FAR Weak enforcement of zoning ordinance resulted in infiltration of commercial activities all over the settlement. In Old Dhaka no set back and land coverage rule is followed. The smallest road width ranging from 5’- 8’ as well as the small and irregularly shaped plots makes the application of the existing FAR rules practically impossible to apply.

Changing landscape in building heights; Floor Area Ratio (FAR)	Rapid transformation started from 2009 Densification has reached 'optimum stage' in sector 2,4,6,8, 9,7,11 and 13 But densification is still in its infancy stage in sectors 5, 10, 12, 14 Recommended maximum FAR was 3.00 – 4.00 Observed maximum FAR was No height limitation Observed maximum height 14 stories	Rapid transformation started from 2009 Densification has reached 'optimum stage' in 40% of the area while the rest is still in its infancy stage Recommended maximum FAR was Observed maximum FAR was No height limitation Observed maximum height 14 stories	Rapid transformation started from 2009 Densification has reached 'matured stage' Recommended maximum FAR was Observed maximum FAR was No height limitation Observed maximum height 16 stories	Rapid transformation started from 2009 Densification has reached 'matured stage' Recommended maximum FAR was Observed maximum FAR was No height limitation Observed maximum height 24 stories	Rapid transformation started from 2009 Densification is still in its optimum stage' Recommended maximum FAR was Observed maximum FAR was No height limitation Observed maximum height 20 stories	Rapid transformation started from 2004 Densification has reached 'saturation stage' Recommended maximum FAR was Observed maximum FAR was Approved height 8stories Observed maximum height 14 stories	Rapid transformation started from 2005 Densification has reached 'saturation stage' Recommended maximum FAR was Observed maximum FAR was No height limitation Observed maximum height 12 stories	Developers were violating recommended standard in urge of maximizing plot use.

Plot coverage	**For buildings following 1996 BCR** Recommended maximum plot coverage was 70 percent Observed maximum coverage was 81% **For buildings following MINB 2008** Recommended maximum plot coverage was 60- 50 percent Observed maximum plot coverage was 78%	**For buildings following 1996 BCR** Recommended maximum plot coverage was 70 percent Observed maximum coverage was 100% **For buildings following MINB 2008** Recommended maximum plot coverage was 60- 50 percent Observed maximum plot coverage was 83%	**For buildings following 1996 BCR** Recommended maximum plot coverage was 70 percent Observed maximum coverage was 85% **For buildings following MINB 2008** Recommended maximum plot coverage was 60- 50 percent Observed maximum plot coverage was 82%	**For buildings following 1996 BCR** Recommended maximum plot coverage was 70 percent Observed maximum coverage was 98% **For buildings following MINB 2008** Recommended maximum plot coverage was 60- 50 percent Observed maximum plot coverage was 80%	**For buildings following 1996 BCR** Recommended maximum plot coverage was 70 percent Observed maximum coverage was 82% **For buildings following MINB 2008** Recommended maximum plot coverage was 60- 50 percent Observed maximum plot coverage was – 80%	**For buildings following 1996 BCR** Recommended maximum plot coverage was 70 percent Observed maximum coverage was 92% **For buildings following MINB 2008** Recommended maximum plot coverage was 60- 50 percent Observed maximum plot coverage was 85%	**For buildings following 1996 BCR** Recommended maximum plot coverage was 70 percent Observed maximum plot coverage was 100% **For buildings following MINB 2008** Recommended maximum plot coverage was 60-50 percent Observed maximum plot coverage was 90%	Developers were violating recommended standard in urge of maximizing plot use.
Land coverage at block level	If recommended guidelines were followed, land coverage at block level was supposed to be 75 and 80 percent for larger and smaller plot blocks respectively	If recommended guidelines were followed, land coverage at block level was supposed to be 75 and 80 percent for larger and smaller plot blocks respectively	If recommended guidelines were followed, land coverage at block level was supposed to be 75 and 80 percent for larger and smaller plot blocks respectively	If recommended guidelines were followed, land coverage at block level was supposed to be 75and 80 percent for larger and smaller plot blocks respectively	If recommended guidelines were followed, land coverage at block level was supposed to be 75 and 80 for larger and smaller plot blocks percent respectively	If recommended guidelines were followed, land coverage at block level was supposed to be 75 and 80 for larger and smaller plot blocks percent respectively		

	Observed maximum land coverage at block level 76%	Observed maximum land coverage at block level 70%	Observed maximum land coverage at block level 86%	Observed maximum land coverage at block level 87%	Observed maximum land coverage at block level 78%	Observed maximum land coverage at block level 88%	Observed maximum land coverage at block level 91%	
Spatial growth pattern	Jagged skyline due to varying building heights comprising of low, mid and high rise building (10-14 stories) along the primary and secondary roads. Most of the inner blocks have uniform skyline dominated with 5-6 storied buildings.	Isolated cases of tall building (10-14 storied) with predominant low and 5-6 storied house forms	Tall towers (10-12 stories) along the street forming more or less continuous skyline gradually receding towards the inner blocks.	Tall towers (14-24 stories) along the street forming more or less continuous skyline with predominant low rise buildings in the inner blocks	Informally broken vertical skyline with 10-14 storied buildings along the primary street with predominantly 6-8 storied buildings in the inner blocks	Closely juxtaposed tall towers amidst sparsely distributed mid rise forming a maze like growth pattern		Broken skyling leads to poor visual impression, unused spaces, informal vertical development and loss of privacy for low rise houses forms. The informal vertical skyline of Old Dhaka is forming crammed housing condition with dark alleys and uncomfortable indoor living condition in terms of cross ventilation, sunlight and privacy.

Chapter 5: Consequences of Densification

5.1 Introduction

The preceding Chapter helped in addressing the first research question by looking back historically into the development pattern of the residential areas to determine the trend of densification shaping the urban fabric of Dhaka. And secondly by examining the densification process through the resulting effects in terms of plot coverage, floor area ratio, building height, land coverage at block level and spatial organization of the study residential areas. The aim of this Chapter is to examine the impact of the current density (physical and perceived) on the selected aspects of social, environmental and economic sustainability of the residential areas of Dhaka through investigating the density attributes and aspects of sustainability of the selected sample wards. The selected sustainability aspects and density attributes have been discussed in detail in Chapter 3 with the methodological construct. Empirical data collected through the questionnaire survey, field survey and interviews of the residents from the sample case study wards are analyzed to address the second research question: "How is the densification process affecting livability, comfortability and sustainability of residential areas of Dhaka? "

Analysis is carried out in two parts. The first part contains the analysis of residents' perception about the existing density and each selected aspect of social, environmental and economic sustainability through assessing the responses from the questionnaire survey and comparing them with the informal interviews of the residents on the relevant aspect of the study areas. The second part of the analysis examines the relationship between density attributes (physical and perceived) and sustainability aspects by assessing residents' satisfaction level regarding the 11 selected aspects from the three spheres of sustainability individually and then examining the relationship of each aspect with the physical and perceived density attributes. Depending on the availability of data Gross population density of study wards has been selected for the physical density attribute. The gross population density of each study wards have been presented in Chapter 3. Perceived density is assessed from two levels which are perception about neighbourhood density and perception about dwelling density.

The Chapter comprises of 6 sections. Following the introduction the second section assesses the aspects of social sustainability of the sample wards which includes accessibility to community facilities, amount of living space, health of the inhabitants, community stability and social cohesion, and sense of safety. The community facilities of the wards are assessed in terms of number of the available facilities, average distance to the nearest available facilities and quality of service and the shortcomings of these facilities based on the residents' opinion. The provision of the amount of living space is investigated by comparing the average flat size per family, floor area per person and the perceived level of satisfaction regarding the size of the home. The self reported health problems of the inhabitants are assessed from the view point of the livability of the residential areas. In addition level of community stability and social cohesion is discussed from the perspective of perceived number of social contacts and informal chats, perceived friendliness of the neighbourhood and the self reported participation in various community activities. Residents' perception regarding the safety and security condition of the residential areas are depicted through the perceived level of safety during day and night and the perceived level of vandalism.

The third section discusses the environmental sustainability of the residential areas through assessing four selected aspects which are accessibility to open space, access to daylight, sense of privacy and satisfaction with the overall living condition of the residential areas. Privacy is assessed in terms of both acoustic and visual privacy from the perception of the residents as well as the measured intensity of noise and level of visual obstruction by the surrounding buildings. The satisfaction of livability condition is evaluated through the perception of the residents towards the attractiveness of the residential area, architectural character or style, maintenance of the buildings, and cleanliness of the neighbourhood.

The fourth section focuses on the two main aspects of economic sustainability which are accessibility to transportation facilities and infrastructure. Access to transportation facilities are discussed in terms of the availability of the public transport, average distance to the nearest bus stop, people's choice of mode of transport and the satisfaction level regarding public transport. Access to infrastructure is evaluated in terms of provision and quality of utility services.

Besides assessing the sustainability aspects individually one of the primary objectives of the analysis in this research was to explore the relationships between the key variables of density and each aspect of social, environmental and economic sustainability. Since the research deals with many variables only the most relevant variables were used for the correlation analysis which is presented in the fifth section. These findings are then interpreted and discussed in detail with their theoretical underpinning to provide an insight of the impacts of ongoing densification process in the residential areas of Dhaka which is followed by conclusion.

5. 2 Aspects of Social Sustainability

The key themes associated with the social sustainability and the list of social sustainability indicators (Table: 5.2) were mentioned in the Chapter 3. The evaluation of the aforementioned selected aspects of social sustainability (community facilities, amount of living space, health problems, community stability and social cohesion, and sense of safety) and residents' perception regarding these issues are explored in the following:

5.2.1 Accessibility to community facilities

Ensuring access to community facilities is a key factor in the development of socially sustainable communities. The vibrancy and social sustainability of residential neighbourhood is well recognized in contemporary planning literature as being related to a community's access to a range of business, social, cultural, healthcare, recreation and education resources. Providing these facilities at a local level, in convenient locations, increases their accessibility for users and reduces the need to travel. These facilities further raise quality of life through creating community cohesion, reducing isolation, reducing fear of crime and creating opportunities for information sharing and participation in community activity. But the threshold of provision of social amenities and facilities needs to be maintained to ensure the vitality of the residential areas. It is usually ensured through government land use policy with physical detail area planning and their managerial and financial capacity to distribute social infrastructure evenly among various parts of the city as well as within the neighbourhood. Community facility requirement of a neighbourhood is identified through needs assessment, audits of existing facilities and regular consultation with the key community groups. Beside these factors social and climatic condition and the economic activities of the locality are considered in determining the standards regarding the scale, size and type of public facilities set forth by the local development control authorities.

Optimum locations for future community facilities are also demarcated in detail area plan. Failure in assessing the real demand can lead to uneven distribution and haphazard planning of the community facilities which can become inefficient and ineffective and might adversely affect the residential character of any neighbourhood. The accessibility to existing community facilities in the sample wards are assessed by the following criteria:

5.2.1.1 Provision of community facilities

The research revealed that planned residential areas of Dhaka lacked the community facility planning in the very initial planning stage with respect to the anticipated incoming population and their associated demand of the community facilities. In the absence of proper community facility management and planning instruments the authority tried to solve the rising crisis by allowing community services to be developed in response to demand. Later the plots along both sides of the major thoroughfares were permitted for development as commercial strips. The standards for various community facilities provided in UAP and DAP states only the number and space requirement (see Appendix II) but do not suggest any guidelines regarding the selection of optimum location of each of the facility. Taking opportunity of the loop holes in guidelines and also lax development control measures the community facilities were not constrained within the commercial strips but started proliferating haphazardly within the residential areas. This trend of sporadic proliferation of community facilities are taking place regardless of the optimum location, real demand, and appropriateness of the built structure in terms of design and environmental concern. The resultant impact of such development trend is evident by means of over provision and under provision of some selected community facilities in the planned and unplanned residential areas of Dhaka.

The current community facility provision in the planned residential areas of new Dhaka covers a diverse range of services and activities including local corner shops, convenience stores, boutique shops, shopping malls, clinics, hospitals, diagnostic centers, GP chambers, schools, colleges, universities, banks, mosques, gymnasiums, community centers etc. From the survey it was found that the planned residential areas of new Dhaka (Dhanmondi, Banani, Gulshan, Pallabi and Uttara) have more than adequate number of some selected community facilities such as educational, shopping and healthcare facilities. The number of existing educational and healthcare facilities in the planned residential areas is multiple times greater than the actual requirement in compliance to planning standards. The situation is particularly alarming in case of Dhanmondi and Banani where there are 66 schools, 15 colleges, 16 universities and 53 hospitals in Dhanmondi while Banani houses 9 universities, and numerous primary and secondary schools (Field survey, 2016). Besides this there are 192 other commercial uses like shopping centers, banks, offices of various organizations in Dhanmondi. DAP prescribes one primary school (1 acre) for 15000 population and one secondary school (1 acre) for 23000 population and other facilities on ward basis requirement (see Appendix II).

Except the public schools and colleges most of the schools are of private ownership and accommodated in rental multi-storied buildings which were never built to serve the current purposes and are not in compliance with the given space standards of school. The huge number of educational, healthcare and other commercial institutions of these residential areas is not only catering the needs of the neighbourhood itself but also the city as a whole (Nancy, 2004). Similar development pattern seems to be occurring in Uttara too. To meet the changing needs initiated by the incoming population the number of private schools, colleges have increased noticeably within the last 7 years in Uttara which are at present serving mostly the neighbourhood needs. Some of these private schools are newly designed buildings which comply with the space standards set for schools. But the universities located here are mostly on rental accommodation with no campus and are catering students from all over the city. The number of private and public schools in Pallabi have not still exceeded the demand of the residential area but most of them are housed in multi-storied buildings not appropriate for school function.

In case of the old Dhaka, Luxmi Bazaar has more than 11 schools (primary and secondary) of reasonably good educational standard within the neighbourhood and colleges as well as university located within 1 km radius from the residential area. Around 70% of the school going children of this ward travel on foot to reach school which takes only 5-10 minutes while the rest uses rickshaw. However, in the planned area of Wari there is an under provision of primary and secondary schools within the ward itself and children of the affluent class of this area usually study in the English medium schools beyond their neighbourhood particularly in the locations of Motijheel and Dhanmondi which take about 10- 20 minutes to reach by car. The provision of educational institutions in Old Dhaka meets the standard subscribed in DMDP in terms of number and space requirement except in Wari. The shopping facilities of the residential areas of Old Dhaka (Wari and Luxmi Bazaar) seems to be adequate in terms of number and scale appropriate to neighbourhood requirement. The Luxmi Bazaar which used to be the Mughal trade centre still continues to function the same. However, the market place has evolved and adapted to the needs of the changing time by accommodating modern chain stores, fast food shops, and small scale retail market for clothes and electronic gadgets with the middle class residential areas surrounding it. Similar transformation has also taken place in Wari where continuous shopping strips mainly of retail shops, convenience and chain super stores has formed along the main arterial road (*Rankin street*). Responding to the ever changing consumer trends and demands, the traditional neighbourhood designed community retail shops of this area have been replaced by the market driven retail chain stores offering a wide range of goods and services and therefore has been happily accepted by the residents.

From the survey it was found that there is a general shortage of authorized municipal *kutcha bazaars* (kitchen market) in both the planned and unplanned residential areas of Dhaka which led to the formation of unauthorized kutcha bazaars in different locations of the study wards. For instance, there is no authorized *kutcha bazaars* in Dhanmondi where people need to travel to the nearby neighbourhoods (Jigatola, Rayerbazaar and Mohammapur) to avail the facility. But as the residents cannot find an authorized *kutcha bazaar* within half a mile walking distance from their houses a large portion of them has to rely on the roadsides unauthorized kitchen markets and also from the vendors of the neighbourhood for their daily kitchen marketing which is found quite satisfactory to meet their needs. But the quality of these unauthorized *kutcha bazaars* are very poor as they lack cleanliness, garbage disposal facilities, drainage provision, toilets and parking facilities. Furthermore they cause traffic congestion through encroaching the road. Currently the nearest chain super stores have become popular alternative sources for meeting the daily needs of kitchen marketing. In case of Wari there are two big kitchen markets (*Thathari Bazaar* and *Kaptan Bazaar*) within a distance of 5-10 minutes by rickshaw in addition with the chain super stores serving the area well. The number of mosques is found to be adequate where all of the study areas have at least one or two mosques within a radius of quarter to half mile from any point within the residential area.

5.2.1.2 Accessibility to community facilities in terms of distance

Overall most of the community facilities in the residential areas of old Dhaka are located within the walking distance. As the road structure of these dense areas of old Dhaka does not support cars most of the community retail and residential areas are closely intertwined making them accessible by foot. Majority of the facilities like local shops, educational facilities, mosques, vegetable markets are within 5-10 minutes walking distance in Luxmi Bazaar while shopping, health and other facilities more than 11 -20 minutes walking distance. According to the response of 52% of the old Dhaka residents the nearest available facilities are the local shops which are located within a walking distance of less than 5 minutes. In case of the residential areas of new Dhaka most of the educational, health and shopping facilities are located within 5-10 minutes and facilities like community centers and gymnasiums are located far beyond 10 minutes walking distance according to 55% respondents. Similarly in Wari facilities including shopping centers, health facilities, mosques and ATM booths are within 5–10 minutes and vegetable market, primary and secondary and community centers are more than 10 minutes walking distance. However, as the ward lacks adequate number of schools most of the inhabitants have to go beyond their wards to avail the facilities usually by rickshaw. A significant portion (33%) of the inhabitants who sends their children to the English Medium Schools of Dhanmondi use their cars.

On the other hand in Dhanmondi, Banani and Gulshan except local shops and mosques other community facilities are located beyond 10 minutes of walking distance. Uttara and Pallabi also have majority of the community facilities within 11-20 minutes of walking distance. Besides the local shops, mosque, vegetable market, shopping malls, Pallabi also has a good number of primary and secondary schools within the walking distance whereas Uttara has most of the health facilities beyond walking distance. Municipal vegetable wet markets are found to be located at the within 15-20 minutes walking distance in most of the residential areas both in old and new Dhaka residential areas. Most people use rickshaws to avail these facilities which take about 5-10 minutes. The sufficient numbers of mosques are usually community facilities are within the walking distance of 5-10 minutes in higher density areas while majority of the community facilities are located within 11-20 minutes walking distance in the lower density areas.

Table 5.1: Time required by the respondents to reach the community facilities

Time required by the respondents to reach the community facilities					
Wari	**Community Facilities**	**Less than 5 minutes %**	**5 – 10 minutes %**	**11 -20 minutes %**	**Above 20 minutes %**
	Vegetable and Grocery	2	11	87	-
	Shopping center	15	76	7	2
	Local shops	52	45	3	-
	Health facilities	5	49	35	11
	Primary school	2	27	38	33
	Secondary school	-	-	72	28
	Mosque	34	45	21	-
	Bank/ATM	5	53	42	-
	Community center	-	8	81	11
	Gym	-	7	18	75
Luxmi Bazaar					
	Vegetable and Grocery	21	45	34	-
	Shopping center	7	22	71	-
	Local shops	53	38	9	-

	Health facilities	3	13	57	27
	Primary school	42	51	7	-
	Secondary school	6	65	29	-
	Mosque	53	42	5	-
	Bank/ATM	2	63	29	6
	Community center	-	19	68	13
	Gym	-	5	58	37
Dhanmondi					
	Vegetable and Grocery	8	37	48	7
	Shopping center	10	14	71	5
	Local shops	35	47	25	4
	Health facilities	12	21	65	2
	Primary school	7	66	24	3
	Secondary school	9	23	68	-
	Mosque	15	51	34	-
	Bank/ATM	11	58	37	7
	Community center	3	5	87	9
	Gym	2	3	90	5
Banani					
	Vegetable and Grocery	11	38	51	-
	Shopping center	4	33	63	-
	Local shops	29	33	35	3
	Health facilities	9	34	55	2
	Primary school	8	23	62	7
	Secondary school	5	19	72	4
	Mosque	23	45	29	3
	Bank/ATM	15	29	52	4
	Community center	-	3	91	4
	Gym	7	16	13	64
Gulshan					
	Vegetable and Grocery	7	31	53	9
	Shopping center	11	36	49	4
	Local shops	23	39	28	10
	Health facilities	13	25	58	4
	Primary school	15	21	60	4
	Secondary school	5	38	54	3
	Mosque	25	39	35	1
	Bank/ATM	10	21	56	13
	Community center	7	14	79	-
	Gym	2	12	11	75
Pallabi					
	Vegetable and Grocery	36	51	13	-
	Shopping center	5	70	21	4
	Local shops	24	45	31	-
	Health facilities	13	38	45	4
	Primary school	7	57	36	-
	Secondary school	6	49	45	-
	Mosque	27	48	25	-
	Bank/ATM	14	27	55	4
	Community center	8	24	60	8
	Gym	10	19	22	44

Uttara					
	Vegetable and Grocery	15	63	20	2
	Shopping center	17	45	38	-
	Local shops	31	54	12	3
	Health facilities	7	22	67	4
	Primary school	15	52	31	2
	Secondary school	14	40	46	-
	Mosque	25	52	23	-
	Bank/ATM	13	27	53	7
	Community center	7	6	81	6
	Gym	5	15	34	46

Percentage is based on the number of responses.
Source: Field Survey, 2015

From the survey it is revealed that most of the community facilities like vegetable market, shopping center, schools, health facilities, community center, health facilities which are located within 5-10 minutes and are availed by both rickshaw and on foot. Facilities like local shop and mosques which are less than 5 minutes away are accessed on foot. But schools and health facilities when located within 11-20 minutes distance then around 24-30% residents use cars. The usage of cars are for reaching the school is relatively higher in Dhanmondi, Banani, Gulshan and Uttara where most people drop their children to school on their way to work. On the other hand nearly 40% of the residents of Luxmi Bazaar travel on foot to avail these facilities while the rest 60% uses rickshaws or motor bikes. The 70% residents of Wari find rickshaw to be easier and quicker mode of travel to reach destinations of 11-20 minutes as well as above 20 minutes while around 30% relies on their cars.

Table 5.2: Mode of travel used by the respondents to reach the community facilities

Community facilities	On foot	Rickshaw	Motor Bikes	Cars/MT
Vegetable Market	30	53	-	17
Shopping center	14	61	2	23
Local shop	70	30	-	-
School	21	45	4	30
Health facilities	11	65	-	24
Mosque	71	27	-	2
Bank/ATM	34	58	3	5
Community center	13	48	-	38
Gym	17	55	-	28

Percentage is based on the number of responses.
Source: Field Survey, 2015

5.2.1.3 Residents' Satisfaction with community facilities

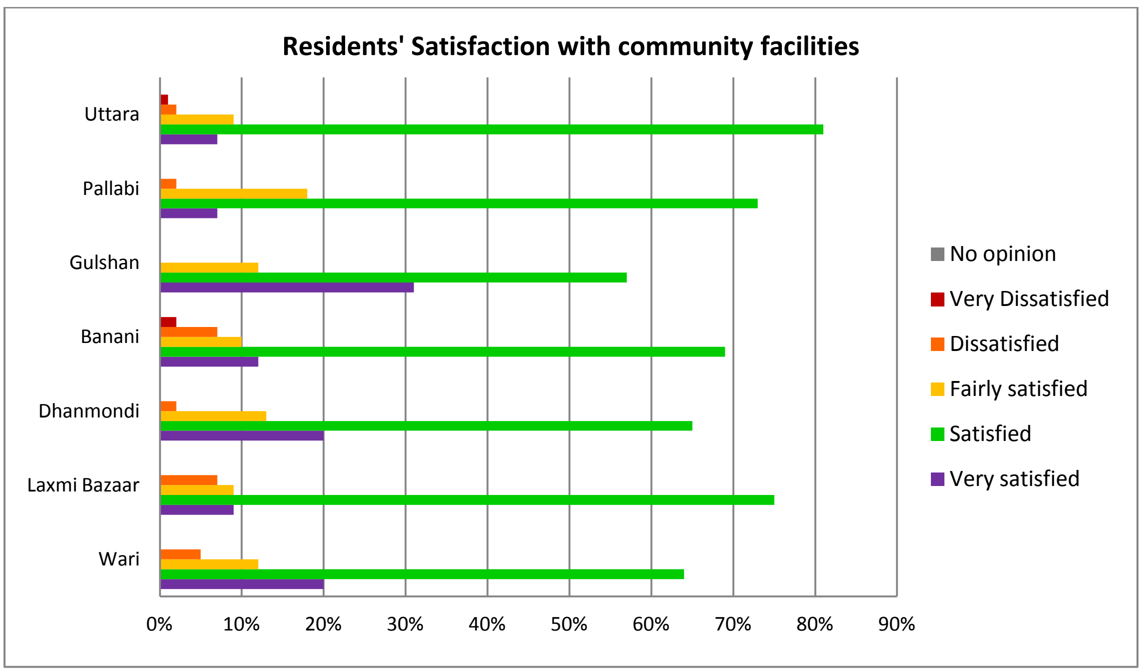
As most of these planned residential areas were initially designed without consideration of proper community facility planning the later provision of these supporting facilities sprang up from demand and helped to enhance the livability of these neighbourhoods. This explains the residents' high satisfaction level regarding community facilities but at the same time residents have shown high discontent towards the resultant traffic situation as expressed by the residents -

> *"I have been living in Dhanmondi from 1985. Earlier the area was more quite and serene but there was a lack of shops except a handful of local grocery shops in some of the street corners.*

We used to do most of our shopping from New market. The situation is quite different now where everything from daily food articles to luxurious commodities is available in the area and it is really a privilege. But though there is range of commercial facilities close around but due to the traffic jam which is almost always prevalent in the main roads it takes unnecessary longer time to reach any of these shopping centers or restaurants even by rickshaw. The situation is even worse if I decide to go by car as the lack of parking is another problem with these shopping centers and restaurants. So even though I wish to go out with my family for recreation in the evening I don't feel like going when I think of the traffic. This condition is really very disgusting and unacceptable." (Interview with a female bank employee, October 2015)

"My house is in Dhanmondi and I work in both Gulshan and Dhanmondi LabAid hospital in the morning shift and evening shift respectively. From my house any of these two destinations should not take more than 10 to 20 minutes to reach by car. But every day I have to spend atleast two hours or sometimes even more in the traffic congestion during the morning and evening peak hours which is totally unacceptable for me. I wonder how people would be travelling in this city after 5 years from now! "(Interview with a senior doctor, December, 2015)

Chart 5.1 : Respondents' opinion about satisfaction level of community facilities



Source: Field Survey, 2015

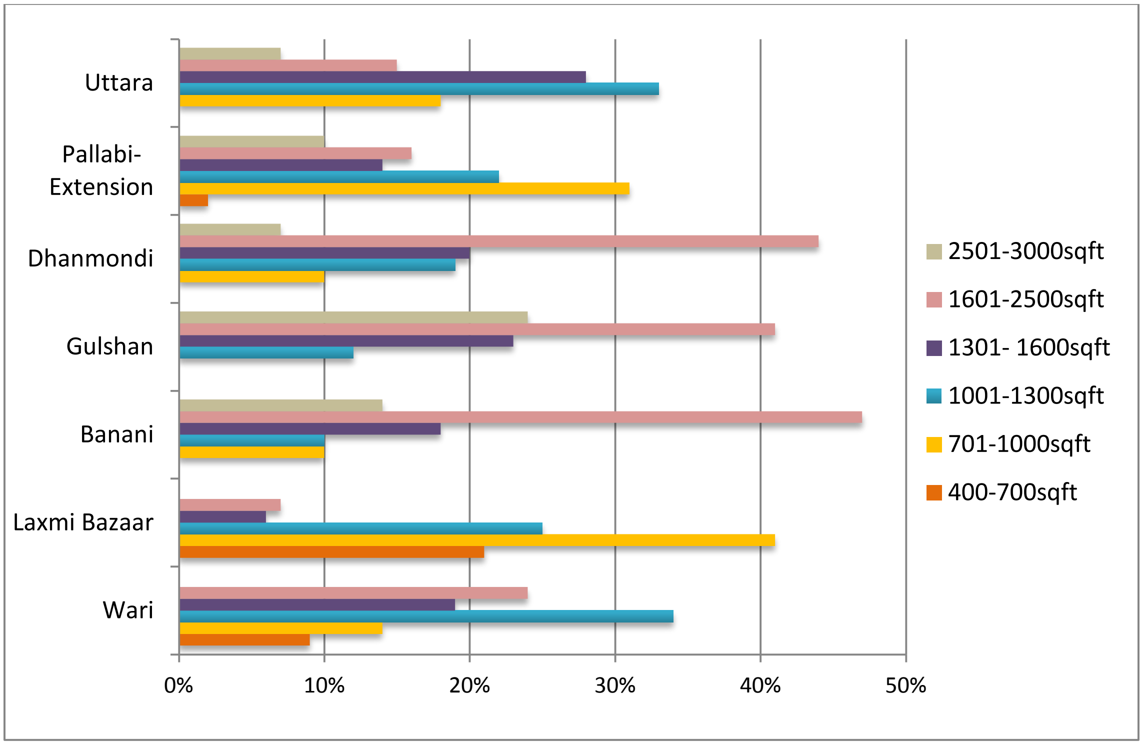
These frequent expressions of discontent from the residents indicate that though the current livability standards of the residential areas has enhanced with the provision of community facilities but not in the manner which can ensure the sustainability of these areas which is discussed in detail in section 5.4.

5.2.2 Amount of living space

The amount of living space is assessed in terms of floor area per person and residents' satisfaction about the size of their dwelling. The former one is a measure of the physical density the later one represents the residents' perception about density. The perceived density has been measured using three parameters i.e.

perceived neighbourhood density, perceived density between building through setback space and perceived density within the dwelling which provides an insight of the residents' perception of crowding.

Chart 5.2 : Size of flats of the respondents



Source: Field Survey, 2015

From the survey it can be seen that the dwelling size of the old Dhaka are comparatively smaller than the residential areas of new Dhaka where Luxmi Bazaar have the highest percentage (34%) of the lowest size dwellings (400-700 sqft). These are actually the half century old 2-3 storied red brick buildings where the lower floors are mostly rented to the female college and university students. Maximum dwellings of Wari are modern apartments of mid rise (6 – 8 stories) newly constructed building ranging between 1000-1600 sq. ft. The majority of the large size apartments (1601-2500 sqft and 2500-3500 sqft) are found in high class residential areas of Banani (48% and 14%) and Gulshan (41% and 24%) respectively. The proportion of largest size apartments (2500-3500 sq.ft.) is highest in Gulshan. Dhanmondi and Uttara has a relatively high incidence of medium sized flats (1000 – 1600 sqft) while Pallabi has a moderate proportion of small, medium and large size apartments with the highest number in the category of 701-1000 sq. ft. This is because Pallabi is a middle and lower middle income residential area where smaller flats are in constant demand for the affordable rent structure. Most of the land owners have redeveloped their original two storied single houses into 6- 10 storied house for financial gain. Maximum plots of Dhanmondi, Uttara and Pallabi range from 2340-3600 sq. ft. (3.25 - 5*kathas*). Usually the land owners take a entire floor for his own residence and subdivides the rest of the floors into economic size apartments which explains the existence of various size apartments in these areas. The minimum floor area per person in old Dhaka usually ranges from 80 sq. ft to 140 sq. ft. while in new Dhaka the average floor area per person is 200 –320 sq. ft.

The household income level also has a significant impact on the household densities as families with low income could only afford smaller dwellings, not only for ownership purposes but also for renting. A lack of affordability generally affects the amount of living space and results in less floor area per person and household crowding. In the case of Dhaka, less affordable housing and a smaller amount of living space are more an outcome of government policy and the highly active private sector whose primary goal is to maximize profit rather than creating quality living spaces.

5.2.2.1 Resident's perception of Density

Though a large segment of residents of Luxmi Bazaar have the minimum floor space per person but their feelings about crowdedness was not as expected. Nearly 91% of the inhabitants with an average family size of 5.5 members living in dwellings of 701-1000 sq. ft. find their dwelling size just adequate where only 5% feels it as a little bit crowded. This adaptation to lower floor space per person might be attributed partly to the years of residency of the inhabitants where around 52% are the 3rd generation of the original inhabitants. The other 38 percentile are mainly the migrants of varied occupational groups (students, service holders) from all over country who find this size of dwellings quite reasonable with their affordability. This could be a reason for similar reaction towards dwelling size from this percentile. The average number of dwellings in Wari is relatively bigger than in Luxmi Bazaar and around 65% of the inhabitants perceive their apartments as fairly spacious. Majority of the residents from mid density residential areas (Pallabi and Uttara) feels their dwelling size just adequate (49% and 67%) for their family whereas most of the inhabitants of low density residential areas (Dhanmondi, Banani and Gulshan) perceive their dwellings as fairly spacious as expected.

Table 5.3: Respondents' perception about their dwelling size

Respondents' opinion about dwelling size				
Location	**Fairly spacious**	**Just adequate**	**Little bit crowded**	**Too much crowded**
Wari	**65**	31	4	-
Luxmi Bazaar	4	**91**	5	-
Dhanmondi	**56**	39	5	-
Banani	**58**	39	3	-
Gulshan	**77**	23	**-**	-
Pallabi	32	**51**	17	-
Uttara	31	**67**	2	-

Percentage is based on the number of responses.
Source: Field Survey, 2015

Chart 5.3 : Satisfaction vs Income of the residents

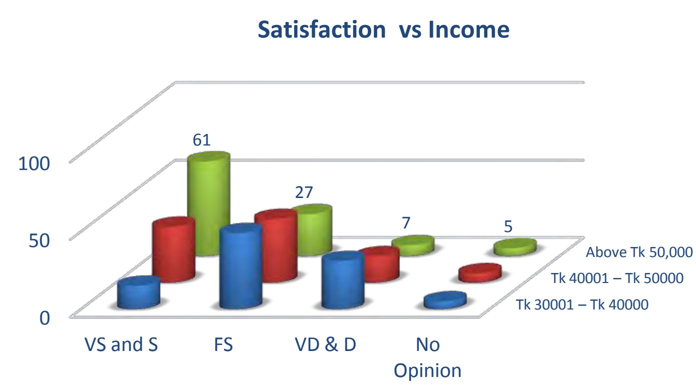


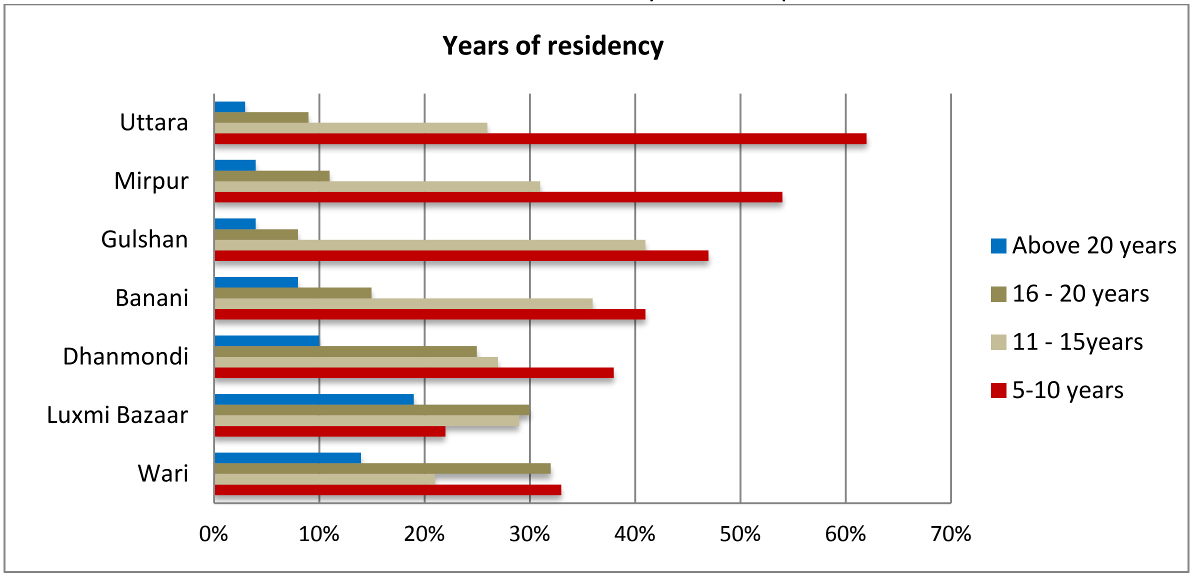
Table 5.4. : Per capita floor space of the study residential areas

Flat size (sq. ft.)	Wari			Luxmi Bazaar			Pallabi			Uttara			Dhanmondi			Banani			Gulshan		
	Freq.	(%)	Freq.	Freq.	(%)	Per Capita	Freq.	(%)	Per Capita	Freq.	(%)	Per Capita	Freq.	(%)	Per Capita	Freq.	(%)	Per Capita	Freq.	(%)	Per Capita
400-700	22	9	80	52	21	80	15	2	80	-	-	-	-	-	-	-	-	-	-	-	-
701-1000	32	14	140.2	105	47	140.2	77	31	140.2	40	18	140.2	26	10	140.2	25	10	140.2	-	-	-
1001-1300	80	34	200.2	63	26	200.2	54	22	200.2	74	33	200.2	49	19	200.2	26	10	200.2	9	12	200.2
1301-1600	43	19	260.2	16	3	260.2	35	14	260.2	63	28	260.2	51	20	260.2	44	18	260.2	15	23	260.2
1601-2500	57	24	320.2	18	3	320.2	40	16	320.2	33	15	320.2	113	44	320.2	119	47	320.2	27	41	320.2
Above 2500	-	-	-	-	-	-	24	10	500	16	7	500	19	7	500	37	14	500	16	24	500
Total	234*	100		254**	100		245	100		226***	100		258	100		251	100		66	100	
Average	200			200			250			284			284			284			320		

Source: Field Survey, 2015

Notes: * Of 248 surveyed households in Wari, 14 were excluded due to missing data
* Of 271 surveyed households in Luxmi Bazaar, 17 were excluded due to ambiguity of flat size data
* Of 258 surveyed households in Wari, 32 were excluded due to missing data

Chart 5.4 : Years of residency of the respondents

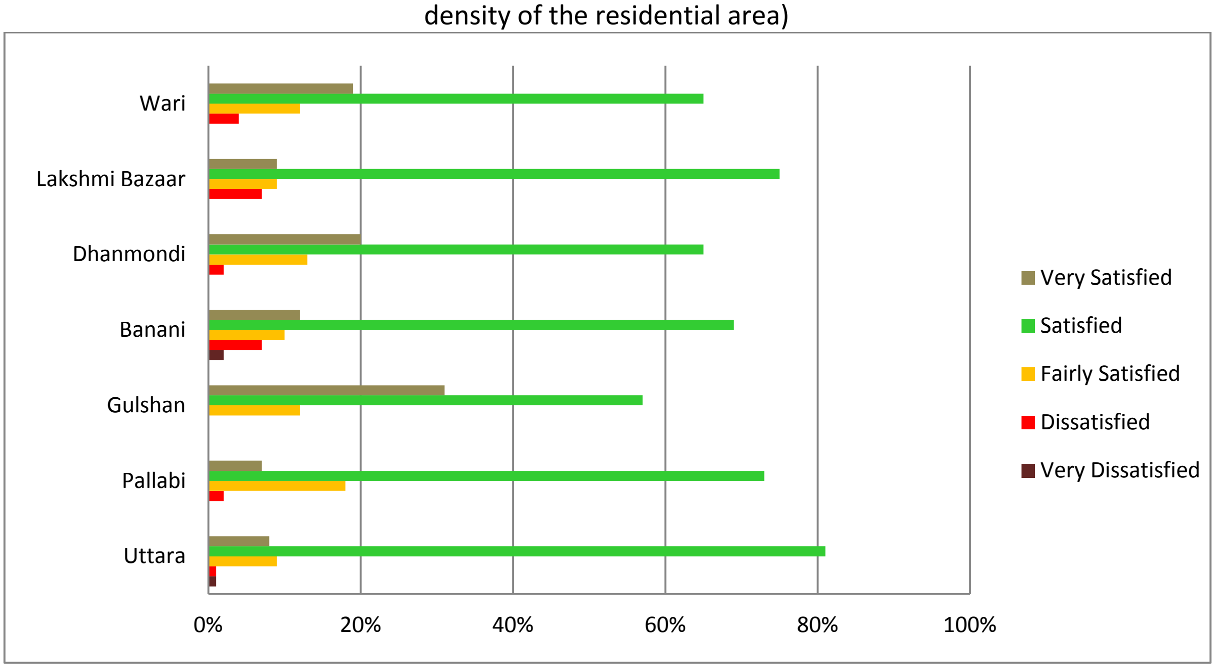


Percentage is based on the number of responses.

Source: Field Survey, 2015

Regardless of the variation of dwelling size in the study areas of differing density the perceived level of satisfaction towards the overall living condition display a higher percentile of residents' satisfaction. The overall negative response from all the study areas is quite insignificant. Factors like tenancy, years of residency and income level seems to have significant role on the satisfaction level. The owners seems to be more satisfied than the renters while the higher income level people has displayed higher level of satisfaction. Length of residency also shows a positive relationship with satisfaction level (see Table 5.4).

Chart 5.5 : Respondents' satisfaction about the living condition (in terms of size of their home and density of the residential area)



Source: Field Survey, 2015

Table 5.5: Respondents' responses regarding overall satisfaction level of the living condition of residential areas (in terms of physical and perceived density)

(percentage)

	VS and S	FS	VD & D	NO
Tenancy				
Owned	30	47	21	2
Rented	31	51	15	3
Length of residency (yrs)				
5-10	19	46	12	23
11-15	37	51	11	1
16-20	48	39	10	3
Above 20	51	64	9	4
Income				
Tk 30001 – Tk 40000	15	49	31	5
Tk 40001 – Tk 50000	36	41	17	6
Above Tk 50,000	61	27	7	5

Percentage is based on the number of responses.

Note: VS = Very satisfied, S = Satisfied, FS = Fairly satisfied, VD = Very dissatisfied, D = Dissatisfied and NO = No opinion

Source: Field survey, 2015

As shown in the Table 5.6 there has been about 85% and 90% of the buildings violating the setback rules in Wari and Luxmi Bazaar respectively which contributes to the dense fabric of these residential areas even further. Despite the close juxtaposition of buildings 46% of the residents of Wari feel that the setback space is okay while 67% of inhabitants of Luxmi Bazaar have complained of privacy being hampered. While there is a significant violation of setback rules in the study areas of New Dhaka too but on an average of 52% inhabitants feels that the set back space is okay.

Table 5.6: Violation of Rules

Sl No.	Thana	Violation of Rules		
		Building Height	Road Encroachment	Setback rules
1.	Luxmi Bazaar	68%	87%	90%
2.	Wari	65%	96%	85%
3.	Dhanmondi	12%	20%	31%
4.	Banani	14%	35%	42%
5.	Gulshan	16%	24%	33%
6.	Uttara	24%	56%	84%
7.	Pallabi	62%	98%	68%

Source: Field Survey 2015

Table 5.7: Respondents' opinion about setback space

(percentage)

Location	I feel it is okay	I have no problem about it	Hampers privacy	I do not like it at all	No opinion
Wari	46	22	26	4	2
Luxmi Bazaar	9	16	67	8	-
Dhanmondi	58	14	18	9	1
Banani	60	17	12	5	6
Gulshan	61	13	14	2	10
Pallabi	68	11	12	2	7
Uttara	61	18	12	4	5

Percentage is based on the number of responses.

Source: Field Survey, 2015

Around 46% of the inhabitants of Luxmi Bazaar do not like the neighbourhood density while 54% of the residents have expressed positive notion about the density. In Dhanmondi, Banani, Gulshan, Pallabi and Uttara around 36%, 31%, 44%, 57% and 56% inhabitants find the neighbourhood density as tolerable. Empirical observations found that most of the residents of the new residential areas are living in these areas for less than 10 years except Luxmi Bazaar and Wari where a significantly higher percentage of the residents are original inhabitants of the area (shown in Chart 5.6). The years of longer residency of the inhabitants of old Dhaka could be a reason for higher acceptance of the neighbourhood density as satisfactory. On the other hand most of the new comers of old Dhaka were found to be belonging to the migrating population from remote district towns and villages for whom the transition from rural to urban settings were taken as an upgradation of lifestyle. This mind set might be partially responsible for the overall higher percentage of satisfaction level of the respondents. The observation also shows around 46 – 58 percent (Chart 5.6) of the residents of new residential areas have migrated from elsewhere in Dhaka in search of better living standard, facilities and status. Therefore an upgradation in the type and nature of their new shelter also seems somehow to meet their optimum level of expectation. This might be keeping their satisfaction level high despite the various problems associated with the built environment of the new residential areas.

Table 5.8: Respondents' opinion about the perception of neighbourhood density

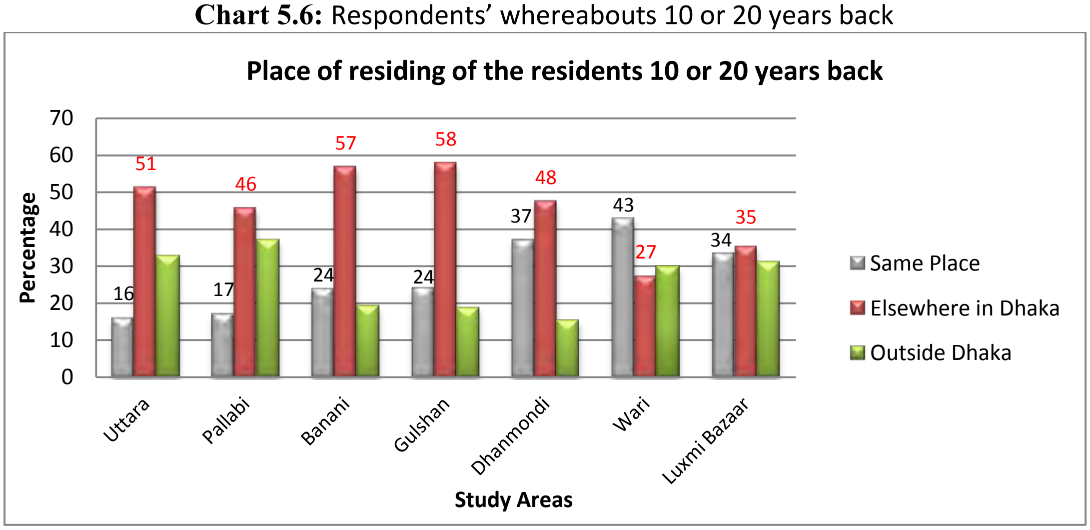
(percentage)

Location	I am fine with it	It is tolerable	I like it	I have no problem about it	I do not like it	It is intolerable	No opinion
Wari	38	49	-	9	-	-	4
Luxmi Bazaar	-	36	6	12	46	-	-
Dhanmondi	19	36	29	11	3	-	2
Banani	15	31	27	7	20	-	-
Gulshan	18	44	28	8	2	-	-
Pallabi	21	57	10	5	-	-	7
Uttara	27	56	11	6	-	-	-

Percentage is based on the number of responses.

Source: Field Survey, 2015

Chart 5.6: Respondents' whereabouts 10 or 20 years back



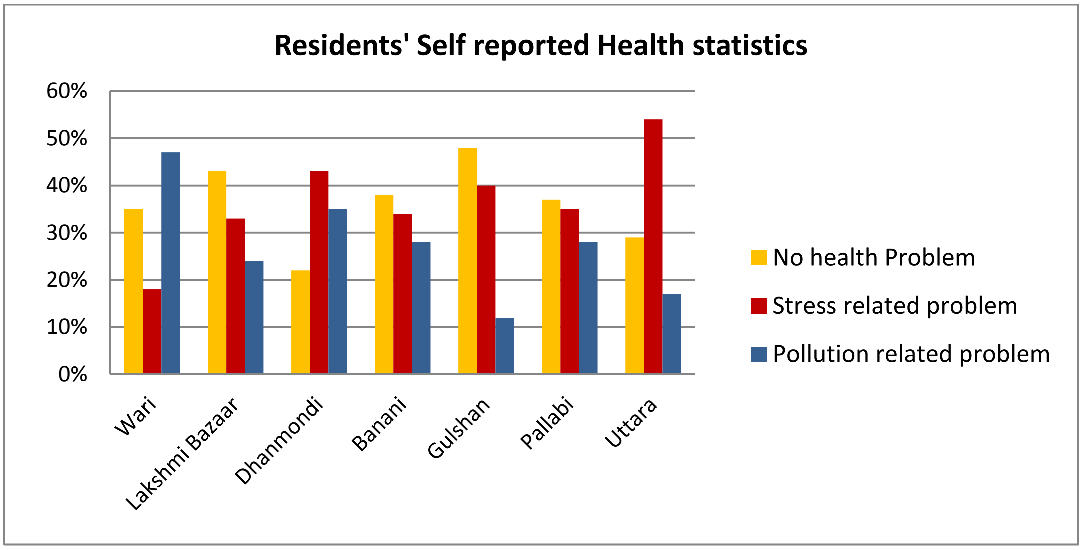
Source: Field Survey, 2015

5.2.3 Health of the residents

According to the self reported health problems of the survey, a significant number of households inhabitants from all the study areas have complained of at least one family member suffering from stress or pollution related diseases. In case of Wari there is a higher incidence of patients suffering from asthama while in Luxmi Bazaar people have complained more about stress related problems particularly blood pressure. Among the stress related problems patients suffering from blood pressure (avg. 50%) and diabetis (avg. 18%) are significantly common in most of the households of the study areas. Majority of the stress related patients belong to the age group of 20-45 comprising of largely male and female earning members, housewives and students. Although most of the households did not reported of obesity but the general observation suggested a different picture where a significant percentage of the young generation especially the children were found to be obese. The negative response is perhaps due to the unacceptability or reluctance of the parents to perceive their children as obese. Most of the parents of the obese children when asked acknowledged their children as healthy. However, t he obesity is more likely to be associated with the non-physical activities of the children. As discussed in Section 5.3.1 due to the lack of open space or playgrounds for physical activities most of the children tend to spend their leisure time in playing computer games or watching TV. The indulgence in the virtual games rather than physical sports not only affects the physical health but also impedes the mental growth of the children by making them hyper sensitive and self-centered. The second highest occurring disease to be reported is asthama which is basically caused by air pollution from the emission of automobiles. Headache is the second most reported pollution related health disorder among the inhabitants.

It is widely believed in various literatures that higher density and household crowding have an ill effect on health (Griesmayer, 1988; Leung, 1993; Pacione, 1997). But interestingly stress related health issues are found to be more dominant in the low density residential areas (Gulshan and Uttara) rather than the high and medium density areas. Gulshan is inhabited by high income group whose lavish lifestyle mainly conforms to sedentary activities. As suggested in literature sedentary lifestyle can cause stress related health problems like blood pressure diabetis and obesity which could be a possible reason for the higher incidence of such health problems in Gulshan. On the other hand Uttara is largely accommodated by higher middle income group whose lifestyle is scheduled predominantly in the pursuit of various urban necessities. This busy life schedule is more likely to cause stress which might be a cause for higher magnitude of stress related health problems in Uttara. Overall the increased number of stress and pollution related health problems of the inhabitants of the study wards indicate that the built environment and life style of the people could be one major influencing factor on wellbeing of their health. According to the Centers for Disease Control and Prevention's Task Force on Community Preventive Services, regular physical activity is associated with enhanced health and reduced risk of cardiovascular disease, stroke, Type II diabetes and colon cancer. The recommended amount of physical activity is thirty minutes of moderate-intensity activity five or more days per week. Walking is the most commonly promoted moderate intensity physical activity and other types can include biking, swimming and dancing. But there is either no or inadequate number of street scale urban development in the study areas which can promote walking, jogging or any other kind of physical exercise. Here the built environment's influences on health go beyond individual lifestyle choices. Since our neighbourhoods offer almost no open space and walkable streets people of Dhaka are deprived from engaging themselves into healthy physical activities. So people become more indoor dependent in terms of work, leisure and recreation. This sedentary lifestyle promotes physical inactivity responsible for various stress related diseases leading to premature death.

Chart 5.7 : Residents' self reported health condition



Percentage is based on the number of responses.
Source: Field Survey, 2015

The catalyst of blood pressure is stress and anxiety. People of this city in general are undergoing a urban lifestyle which is very demanding and competitive and where stress and anxiety disorder become inevitable. Within this context, if the built environment fails to provide a variety of sufficient open spaces which work as antidote to stress, then that community becomes more prone to stressful psychological state. This can, however, explain the high incidence of blood pressure in the most unlikely age group (25 – 40 years) of the study areas. The high income group is more devoted to sedentary jobs and automobile dependent mode of travel contributing to more physical inactivity which is reflected by the increased number of heart disease and blood pressure patients in the high income but low density residential areas of Gulshan, Banani and Dhanmondi respectively. In Wari and Luxmi Bazaar where inhabitants reported dissatisfaction towards the size of their dwelling, it can be said that perceived density, the crowding within the dwelling seems to have some degree of positive relationship with the stress related health problems of the residents.

Table 5.9: Self reported health related problems of the residents

Location	Health Related Problems						
	Stress related diseases				Pollution related diseases		
	Heart disease %	Blood pressure %	Diabetis %	Obesity %	Headache %	Asthama %	Nausia %
Wari	5	55	38	2	12	72	16
Luxmi Bazaar	17	52	27	4	37	41	21
Dhanmondi	6	67	23	5	3	69	28
Banani	4	64	30	2	14	73	14
Gulshan	30	48	21	2	53	32	13
Pallabi	5	42	40	13	13	62	25
Uttara	29	36	18	4	63	24	13

Percentage is based on the number of responses.
Source: Field Survey, 2015

The most commonly occurring pollution related disease is asthama which has been found in a higher percentage among the study areas. Children were found to be the most affected group. Vehicular emissions are known to be responsible for a considerable share of urban air pollution. In Dhaka city the major pollutants (SO_2, NO_2, and CO) from vehicular emission are 10 times greater than the WHO recommended standard (see Appendix II) and is accounted for more than 90 percent of air pollution. (Haq, 2009 and Randall, 2011). Except Luxmi Bazaar the study residential areas are mostly car oriented neighbourhoods where there is a concentration of vehicular traffic on regular basis. As the residents are constantly exposed to a high magnitude of air pollutants responsible for respiratory diseases, this can explain the higher incidence of patients suffering from asthama in these areas. From the literature it is known that urban form impacts active transportation and work-related and leisure-time activity. Built environment interventions promote physical activity which also helps in changing lifestyle behavior. But there is a serious lack of these considerations in design of the built environment of residential areas of Dhaka which already evident from the health condition of the residents. When a built environment fails to meet one of the basic needs of human society like sound health it can longer be considered sustainable from the sustainability perspective.

5.2.4 Community stability and social cohesion

Community spirit and social cohesion is the fundamental building block of social sustainability. Globalization seems to play a defining role in the current life style of the urbanites by making people increasingly technology dependent and too much absorbed in the virtual world of digital media based communication. The frequent and casual visits to relatives and neighbhours are being replaced by scheduled visits arranged by cell phone or text messaging. Nowadays people are more eager to make new social contacts and maintain the established ones through social communication websites like facebook, twitter and viber rather than relying on unplanned spontaneous informal meetings taking places in public spaces. Their communication pattern is becoming more and more globally oriented rather than locally focused. This diversion of attention from the immediate neighbours and the neighbourhood is the main barrier in forming social cohesion among the modern urbanites. The virtual mode of contact can speed up communication but cannot help to develop the social cohesion strengthened by these informal chats taking place on a regular basis in a variety of public places. Nevertheless the design and accessibility to public spaces also play a crucial role in inviting people towards a more rewarding way of socializing and therefore assist in establishing community sustainability.The survey result provides an insight of the communication pattern and the type of social cohesion existing in the study areas which is given in the following:

Table 5.10: Residents' opinion about the number of social contacts

Location	1- 5 neighbours	6 - 10 neighbours	11- 15 neighbours	Above 15 neighbours
Wari	8	44	31	17
Luxmi Bazaar	3	6	49	42
Dhanmondi	30	29	22	19
Banani	56	31	11	2
Gulshan	69	21	7	3
Pallabi	20	54	21	5
Uttara	65	18	10	7

Percentage is based on the number of responses.

Source: Field Survey, 2015

From Table 5.9 and 5.10 it can be seen that residents of Old Dhaka in general maintains a high number of social acquaintances with their neigbours. Luxmi Bazaar having around 80% of the inhabitants reported the neighbourhoood to be very friendly with 42% of the residents knowing more than 15 neighbours. This higher degree of social cohesion of the area still prevailing today may be attributed to the social and spatial configuration of its past legacy. As Luxmi Bazaar does not have any open space the neighbourhood streets, tea stalls as well as street corners have been traditionally used as place of socializing for the male. The urbanization pattern of the past decades formed by the low height buildings with shops in front façade facing the narrow roads even facilitated the street scale to be attractive for social gathering. Women used to socialize with their neighbours from roof tops of their houses as the conservative Muslim and Hindu society did not allow females to spend time outdoor. The close spacing of the building with almost no setback actually helped in communication of the women folks between households nurturing close ties with neighbours. This is better expressed from the interview of a senior citizen –

> *"I have been living in Wari for more than 48 years. When I was a girl we used play in the inner courtyard of our house with our neighbours' children. The houses were usually two storied then. My mother and grandmother used to spend leisure time in this courtyard during afternoon. Often the women folks of the adjacent household would go to their roof top and my mother used to converse with them from our courtyard. It was a nice friendly environment for the females. So the female folks did not actually feel the need of any public open space for informal social interaction. But now as my family have extended we have built this 8-storied building demolishing my parents' house. The high rise apartments do not offer that type of space or opportunity of social interaction. I feel pity for my grand children who do not find suitable outdoor spaces for playing and have to spend most of their time in the confinement of their house. "(Interview with a senior resident of Wari, November, 2015)*

It also somehow fostered a sense of security in the neighbourhood through the form of natural surveillance from the immediate neighbors of each household. The long term of residency of the inhabitants in Luxmi Baazar also helped in developing and maintaining this social capital. The respondents of Wari reported the neighbourhood to be (57%) moderately friendly with 44% residents having 6-10 social contacts within the neighbourhood. Despite a locality of old Dhaka there is a reduction in the number of social contacts in comparison with Luxmi Bazaar and also the neighbourhood is perceived as moderately friendly by the inhabitants. This could be partly to the fact that most of the low rise structures of this posh neighbourhood of the past are replaced by high rise buildings attracting a huge inflow of migrants from all walks of life. The self contained apartment culture cannot foster social contacts between the new migrants and the native neighbours easily as it was before in the low rise dwellings with few inhabitants. On the other hand there is a class distinction and feeling of overcrowding which acts as a barrier in developing social contacts between the migrants and original dwellers as pointed out by a resident of Wari -

> *"We have been living in Wari since our childhood. In those days the area was very clean and we used to play in the streets and the vacant plots nearby with the children of the neigbourhood. The people who used to live here belonged to elite social class and there was a healthy relation between the neighbours. But now most of those elderly people have passed away and most of their children have settled abroad or in other parts of the city giving their plots to the developer*

for constructing high rise buildings which they have given on rent. As a result the area is now filled with too many people from different social backgrounds with whom you cannot easily mix. More over there is no open space left where we can let our children to play which is depriving the new generation in developing the kind of bonding we used to share with our neighbourhood children." (Interview with a resident of Wari, November 2015)

(Percentage)

Table 5.11: Residents' responses regarding frequency of social interaction

Location	Less than 5	5-10 times	10-15 times	15-20 times
Uttara	63	19	12	6
Mirpur	48	37	10	5
Dhanmondi	59	25	13	3
Banani	67	18	11	4
Gulshan	72	17	8	3
Wari	6	48	37	9
Luxmi Bazaar	-	43	41	16

Percentage is based on the number of responses.
Source: Field Survey, 2015

Though high density has positive association with social interaction but the findings from Wari indicates that if people somehow feels crowded by the density, they tends to establish less social contacts (Table 5.9). On the other hand the residential areas of new Dhaka with lower density show relatively fewer numbers of social contacts. Most of the inhabitants have Dhanmondi, Banani, Gulshan and Uttara seems to be known to 1-5 neighbours and perceives the neighbourhood as moderately friendly. However, the number of social contacts which is about 6-10 persons in Pallabi is higher (64%) than the other study sample wards of Dhaka. Pallabi was designed as a middle class residential area and the new migrants of this area also largely belong to the middle or lower middle income class. People from similar income group usually share the same values and social status and find it easier to interact with others. This is most likely a reason for the development of comparatively higher degree of social interaction in Pallabi than in other residential areas of new Dhaka.

Table 5.12: Perceived friendliness of the residential areas

Friendliness of the neighbourhood			
Location	**Not Friendly %**	**Moderately Friendly %**	**Very Friendly %**
Wari	3	57	37
Luxmi Bazaar	3	17	80
Dhanmondi	4	79	17
Banani	12	69	19
Gulshan	11	81	8
Pallabi	5	64	31
Uttara	9	72	19

Percentage is based on the number of responses.
Source: Field Survey, 2015

Overall the survey reveals that the concept of social capital is more prevalent in the high density residential areas rather than low density residential areas of Dhaka. People living in older neighbourhoods with higher site coverage (90% - 100%) such as Wari and Luxmi Bazaar were found to have higher number of social contacts within the neighbourhoods. On the other hand new neighbourhoods in residential areas like Dhanmondi, Gulshan, Banani, Pallabi and Uttara the number of social interactions take place are comparatively fewer. Although result from correlation test between density and social cohesion indicated positive relation but in reality it would not be appropriate to attribute the development of social capital on density alone. Built form, design and provision of public spaces have a strong association with this aspect, as it was found that there was less informal chatting with neighbours in high rise apartments than in low rise dwellings. Again it was also found that inspite of having high density there is a considerable reduction in the possibility of desirable amount of social interaction, when the neighbourhood is perceived crowded by its inhabitants. The perception of crowding therefore leads to reduced community spirit and social cohesion. This scenario was clearly evident in the blocks with relatively higher number of high rise buildings (10-14 storied). Moreover the notion of class distinction and social status has also been found to be a factor impeding the development of social cohesion in the apartment culture.

Socio-demographic variables such as number of years of residing in the same neighbourhood was found to have a very strong positive correlation with the number of social contacts and the amount of informal chatting that residents had within the neighbourhood as evident in Luxmi Bazaar. The research had similar findings with the studies of Bonnes et al. (1991), who observed that the length of time residing in a place has greater effect on the resident's perception of spatial density than does the physical density. They also found that with the increase in the duration of residence, the inhabitants become more satisfied with the physic-static spatial density aspects of their residential area. This research found similar observations.

Table 5.13: Relationship between years of residency and number of social contacts

Years of Residency	1-5 neighbours	6-10 neighbours	11-15 neighbours	Above 15 neighbours
5-10	71	34	5	-
10-20	15	37	45	3
Above 20	-	24	67	9

Percentage is based on the number of responses.
Source: Field Survey, 2015

It is worthy to note that among the families living in the residential area for more than 20 years only the senior most member claimed to have known more than 15 neighbours. The younger members of these families are mostly acquainted to 6-10 neighbours. Due to the frequent arrival and departure of many new migrants even the families with 20 years residency is not able to maintain as many contacts as they used to in past as expressed by a senior resident of Dhanmondi –

> *"I came to live in Dhanmondi in 1974 after my marriage. Since then I have been living here with my family. We were familiar to most of the neighbours along our street at that time as there were only a handful of 1-2 storied houses with few families in our street block. Now most of those old houses are replaced with high rise buildings with many new families, new faces. Most of our earlier neighbours had either shifted with their adult children to other places or had passed away. So now after being in this place for around 41 years I do not know most of our new neighbours."(Interview with senior resident of Dhanmondi, December 2015)*

It was also found that family income plays an important role in social interaction and community cohesion. Households with lower family incomes had fewer social contacts within the neighbourhood, while families with higher incomes and living in high rise apartments had less informal chatting and were perceived as less friendly. Besides the building form the absence of neighbourhood open or public spaces is another major factor attributing to the reduced number of social interactions in the residential areas of new Dhaka. Though the busy life schedule of the urban people do not let them have much time for leisure but still design of neighbourhood should be encouraging people to spend more quality time in outdoor spaces. These outdoor spaces can be parks, informal sitting areas, play fields or some kind of “third places” (Oldenburg, 2001) where people meet, form trust and develop social capital. The people of urban neighbourhood are in need of these “Third places” which are locations outside of home and work, and open to the general public where people informally gather on a regular basis. Coffee shops, pubs and alleys, street corner sittings are all examples which encourage people to hang around longer to converse. Informal meetings are a pre-requisite for developing and latter maintaining social contacts in the most relax and undemanding way (Gehl, 1986) which in effect aids in developing social capital of a neighbourhood.

Socially, the recurring informal contact typical of third places can result in new acquaintances, friends and thereby is a key component of sustainable urbanism. From the survey it is found that the residential areas of Dhaka are well served with a wide range of chain stores (Agora, Meena Baazar, Swapno etc) fast food restaurants (KFC, Pizza hut, Helvetia etc) but this cannot help to promote the kind of social contact a convenience store or coffee shop run by the local can. It is because generally locally owned independent shops and stores know the community and “take an interest” and by contrast, “chain stories don’t get involved in the community”. Due to lack of these quality outdoor spaces or the third places the shopping malls of the neighbourhoods are used for passive recreation where most of the people come to spend their leisure time window shopping which cannot be a practical option for sustainable neighbourhoods.

Participation in community events

Community events in the study areas mainly included various religious, national and seasonal festivals like Milad Mehfils, Handicraft fairs, Durga Puja, Pohela Boishak, Pohela Falgun, Choitro Shronkanti, Ekhushey February (Language Martyrs’ day), Bijoy Dibosh (Victory Day), and local fairs of handicrafts etc. Besides this there are some sports tournaments organized by the local sports clubs but access and participation to these events are exclusively limited to the members. According to the self reported statistics of the respondents’ participation in the community events were found moderate in the study areas. The major reasons for the less involvement in community events were reported to be lack of time and the improper organization of these events. The lack of suitable open and community spaces were also identified as one of the reasons. For instance in Dhanmondi, other than the Rabindra Shorobor and lake side park there is no designed open space for community activities in the locality. Most of the existing playfields are illegally occupied by influential sports club and therefore, not available for public use. Apart from the national and religious festivals, there is a lack of social activities with a focus on leisure and craft related activities which also positively affects the participation of the residents.

5.2.5 Sense of safety

A review of the literature suggested that high density displays certain harmful side effects particularly through increasing the possibility of crime and social disorder (Wirth, 1938; Brown and Liu, 1999). While other scholars noted that population density, housing quality, and overcrowding are not the predictors of crime and other social pathologies of poor neighborhoods (Wilner, et al. 1962; Burns, 1970; Choldin, 1978). It is also argued that perceived safety increases with density, because the natural surveillance offered by more sets of 'eyes on the street' (Jacobs, 1961). This is again refuted elsewhere where it is pointed out that crime is higher in higher density areas where a sense of anonymity and detachment from activity outside one's own dwelling may dominate (Newman, 1972[1995]). Therefore the association between high density land use and crime has remained a nebulous concept so far. However, the findings of this research illustrated that the residential areas with high gross population density had a positive relationship with the sense of safety which indicating a low incidence of crime; while perceived densities are found to have significant negative associations with indicators of sense of safety.

The high level safety was also affirmed by the interview of the residents of the dense settlement of Luxmi Bazaar and Wari –

> *"We do not usually have any incident of mugging or theft because the theif or mugger is certain to get caught while he tries to run away through the alleys of our neighbourhood. There is a all time presence of people in the alleys and the local shopkeepers of the neighbourhood grocery and corner shops also keep a good eye on the strangers."(interview with a resident senior government official of Luxmi Bazaar, January 2016)*

> *"I cannot recall any incident of mugging or theft in my neighbourhood since I am living here. We feel very safe in that regard. Moreover there is the "Muchi Potti"* (cobblers' lane) *just beside my house where the cobblers' families have been living. Though they have their single storied houses along the lane but they use the lane for cooking, gossiping, playing and usually the male members sleep in the open alley at night. For their constant presence we feel extra safe both at night and daytime because no theif or mugger can get past them without being caught." (interview with a house wife of Wari, January 2016)*

Table 5.14: Perception of safety by respondents during day and night time

Time	Uttara	Pallabi	Dhanmondi	Banani	Gulshan	Wari	Luxmi Bazaar
Day time	83	79	87	86	85	91.7	98.1
Night	78	64	72	77	79	92	94.7

Percentage is based on the number of responses.
Source: Field Survey, 2015

The inhabitants of new Dhaka feel relatively less safe both during day and night time than the residents of old Dhaka. The existence of gated communities were found more predominant in the study residential areas of new Dhaka (Uttara and Pallabi) where the gates of each neighbourhood remain closed during late night. In the residential areas of new Dhaka the level of street crimes are higher due to the various characteristics of the residential areas. For instance, in Banani and Gulshan the presence of many bank and posh shopping malls ensures more money transaction which makes these places much targeted for hijacking and mugging. On the other, hand the lack of convenient stores and street activities makes them vulnerable for street crime. Inhabitants refrain from using the parks during night for the presence of drug abusers. Whlie Uttara and Pallabi both are gated communities, the security of Banani, Gulshan and

Table 5.15: Thana wise crime data base

Thana	Total Street Crime March - May 2015	Homicide and Robbery March - May 2015
Uttara	52	5
Dhanmondi	67	3
Gulshan	81	5
Pallabi	45	6
Wari	5	-
Luxmi Bazaar	4	-

Source: Uttara, Dhanmondi, Gulshan, Pallabi, Wari and Kotawali Police stations, 2015

Dhanmondi largely owes to the presence of security guards in each house and police check posts. However, the crime data indicates a higher incidence of homicides in the new residential areas which actually take place indoors. This might be attributed to the design of the high rise apartment buildings where there is a lack of visual connectivity. The incidence of crime in high-rise buildings often has to do with a lack of connection with the outdoor spaces surrounding high rise buildings as well as the residents of the building. Some studies show that the higher the building, the less of a connection individuals may have with the surrounding area, and therefore they feel less safe due to this disconnect (Gifford, 2007). The findings of Newman (1982) also asserted that high rise buildings offers less settings where the residents can be relatively free to respond to cues to increase social interaction and therefore reduces the opportunity of natural surveillance.

Table 5.16: Thana wise crime data base

Thana	Total Street Crime January-March 2009	Crime Rate (Crime/ Thousand population) 3 months data	Density of crime 3 months data
Uttara	61	0.92	10.20
Dhanmondi	75	0.39	16.52
Gulshan	152	0.80	14.76
Pallabi	44	0.10	2.45
Sutrapur	12	0.03	3.01

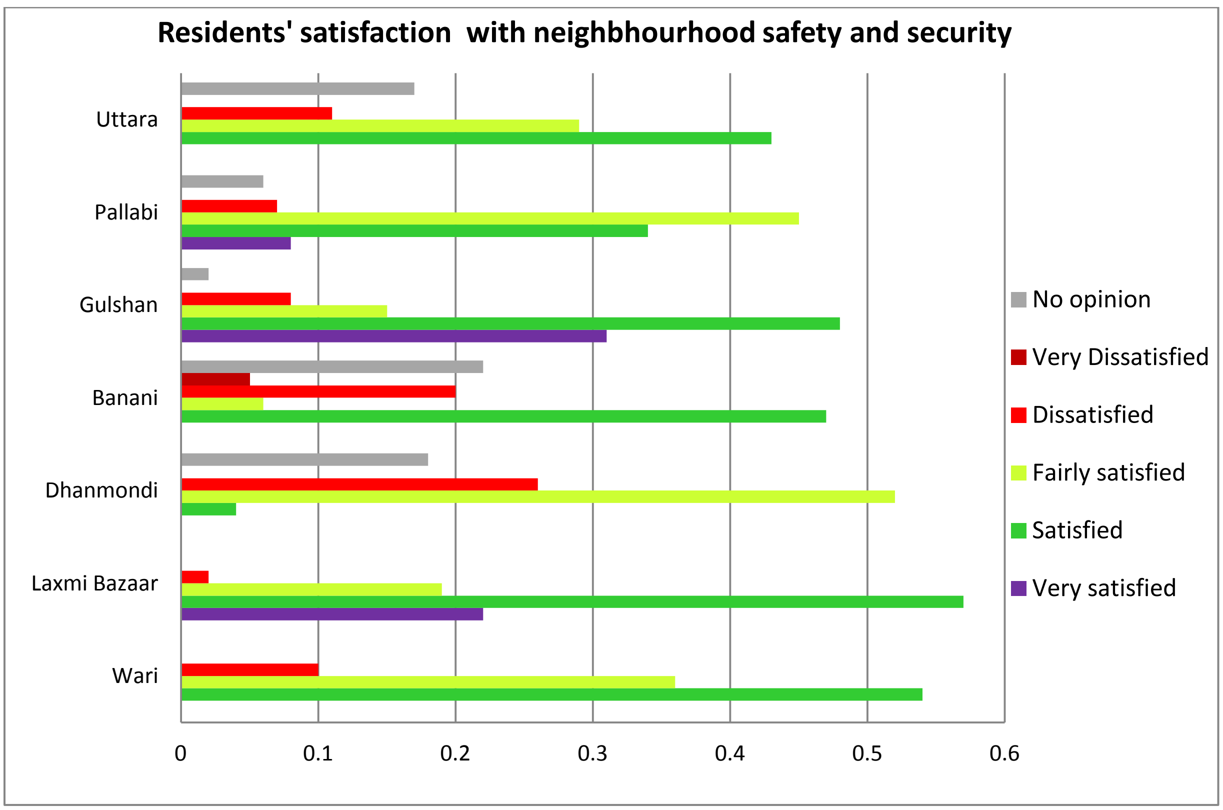
Source: DMP Headquarters, 2009; adapted from Choudhury, 2013

From the survey findings it can be seen that the residents of new Dhaka have shown a greater degree of dissatisfaction regarding safety and security condition than the inhabitants of old Dhaka. Among the new neighbourhoods a greater number of residents of Dhanmondi and Banani have reported their dissatisfaction regarding safety whereas Uttara and Mirpur have moderate response. The crime record of these areas also matches the reports of the residents. The incidences of mugging, theft are rampant in Dhanmondi, Gulshan and Banani, especially ladies are scared to go out alone even during the day time. Threat of robbery in these new residential areas induced high boundary walls often topped with barbed wires around the houses. The residents of Uttara have complained of theft especially through the windows of the apartments and robbery. This could be the reason of higher level of dissatisfaction in Uttara than in Mirpur where social cohesion is relatively better. On the other hand the posh status of Dhanmondi and Banani with commercial strips attracts the affluent shoppers from all over the city which could be a reason for the increased number of vandalism here. The crowdedness of these residential areas during daytime not only contributes to the feeling of safety but also increases the propensity towards crime. A previous crime data base on the study area thanas also substantiates the crime intensity of the new and old Dhaka.

The results from questionnaire survey indicate that satisfaction level of safety is comparatively higher in old Dhaka than the residential areas of new Dhaka. The residents of high density residential areas like Luxmi Bazaar and Wari reported having a higher degree of safety both during day and night time. The highest level of satisfaction (Chart 5.8) is reported from Luxmi Bazaar regarding the safety and security condition of their residential area. This could be attributed to the rich social capital and longer residency of the inhabitants which nurtured a sense of belonging and in effect developed a higher sense of responsibility towards protecting themselves, and preventing crime. This sense of responsibility, in turn have helped to nurture a natural but invisible vigilance system by the residents themselves monitoring the safety and security of their residential area.

Fig 5.1: Gated community; Uttara

Chart 5.8 Respondents' level of satisfaction about safety and security of the residential area



Source: Field Survey, 2015

The positive association of duration of tenure in the residential area with the sense of safety was also been asserted by the residents of other study areas as expressed by a resident of Pallabi -

> *"I have been living in this area since my birth. Though the area does not feel as peaceful as before because of all the new people coming here to live but still I feel no lack of safety because*

we have been familiar to most of the people of the neighbourhood from our childhood." (Interview with a resident teacher of Pallabi, December, 2015)

On the other hand, in Wari 18% of the inhabitants have shown dissatisfaction regarding safety while the rest have no complains. The perceived crowding of the neighbourhood could be the cause for the negative responses as expressed by one of the resident –

"There are too many high rise apartments along our street with too many new unknown faces around. The place is not like as it used to be before when there were a handful of families, all familiar to each other in some way. In our childhood we used to play in these neighbourhood streets and our parents did not worry about us because they knew that the children are always under the watchful eyes of neighbours. But now as I am not able to keep an eye on my children from my flat and not also familiar with most of the new inhabitants of my neighbourhood I do not feel that safe to let them play alone outside in the street." (Interview with resident of Wari, November, 2015)

This implies that neighbourhoods perceived as crowded, have more negative associations with perceived safety during daytime within the neighbourhood. High rise buildings with multi dwellings contribute to higher perception of density. Research reported that a less visible street from neighboring houses had more crime (G. Brown et al., 2004; Perkins et al., 1993) indicating the importance of surveillance system in neighborhood. Windows facing street, balconies or front porches where people can sit and provide eyes on street does not only give residents opportunities to have informal contacts with neighbours and helps in building local ties but also in the formation of natural surveillance (B. Brown et al., 1998; MacDonald & Gifford, 1989; Perkins et al., 1992, 1993). Generally all the apartments of high rise buildings cannot have street facing windows and balconies, and thereby the dwellers of high rise do not have the opportunity of building a natural surveillance as the low rise dwellers have. This contributes to a reduced

Table 5.17: Regularity of children going out to play in the study areas

(Percentage)

Location	Every day	2 – 3 days/wk	Rarely	Never
Wari	-	8	11	81
Luxmi Bazaar	3	15	13	67
Dhanmondi	5	10	9	76
Banani	-	7	15	78
Gulshan	-	6	21	73
Pallabi	5	12	15	68
Uttara	2	10	17	71

Source: Field Survey, 2015

sense of safety as can be seen from the expressions of the inhabitants of the study areas. The research also found that on an average only 3.75% children from the study areas go out to play regularly while 9.7% frequently and 14% rarely play outdoors and on an average not more than 7% of the parents are able to watch their children from their apartment while they are playing in the nearby open space (street, park, playground, inside the building premise).

Apart from the lower social cohesion of these neighbourhoods another probable reason could be the lifestyle of the occupants where a significant portion of the high rise neighbourhoods remain vacant during day time because of the increasing number of families with working couples residing there. The lower rate of occupancy during day time attributes to a reduced sense of safety for the inhabitants. The reported robbery cases mainly took place during day time when the occupancy rate of the apartments was lower. As mentioned in the previous section, high rise apartment culture has lower degree of social cohesion where residents in general are not much concerned or feel any responsibility towards what is happening to the neighbours next door makes the community more prone to bystander effect or "genovese syndrome" which work as catalyst for such vicious crimes. Furthermore the residents of high rise apartment culture tends to form social groups according to their income and status leading to centrifugal fragmentation of the society which in turn impede the development of social capital within the neighbourhood as a whole. This attitude increases the opportunity of crimes and thereby lowers the sense of safety and security in the neighbourhoods of new Dhaka where a lower degree of social cohesion is prevalent. This is reflected from the survey findings of Dhanmondi, Banani and Uttara where residents have shown relatively lower degree of satisfaction regarding the sense of safety.

The perceived crowding of people was also found to have a negative association with perceived safety after dark within the neighbourhood specially where there is inadequate street lighting. This situation was more common in Pallabi, Dhanmondi and Banani where people feel unsafe and vulnerable due to vandalism after dark due to the lack of street lights. This claim is also reflected through the high dissatisfaction level of the residents of these areas as shown in Chart: 5.8.

Income level also influences the sense of safety and security. Neighbourhoods with higher floor area per person and with higher family income reported feeling safer and less vandalized, as evident from the residents' responses in Gulshan. Despite the vandalism record is quite high which takes place mainly in the commercial strips along the primary road in Gulshan the neighbourhoods of the area have a higher reputation of being safe. Overall the survey finding suggests that though density is not the sole predictor of safety but high density if not perceived crowded has a positive influence in developing social capital and therefore helps to safeguard the overall security condition of the neighbourhood.

5. 3 Aspects of Environmental Sustainability

The environmental sustainability of the study residential areas are evaluated based on the aspects of accessibility to open space, access to daylight, environmental protection and satisfaction with the livability condition which are discussed in the following:

5.3.1 Accessibility to open space

Open spaces are the living rooms of urban neighbourhood where people can breathe, relax and get a relief from the monotony of urban life. These spaces are those to which reference is generally made in consideration of recreational facilities (Gallion,

Fig 5.2: Dhanmondi lake side park

Fig 5.3: Exercise activities taking place in open space, Dhanmondi .

1963). A great variation can be found in open spaces of urban areas ranging from, parks, plazas, squares, playgrounds, water ways, botanical gardens, zoological gardens, green belts providing passive as well as active recreation facilities. Urban open spaces need to be easily accessible for a lot of people, comfortable, and open for a minimum of 16 hours a day, 5 or 6 days a week, for people to drop by. In Dhaka there is a lack of open spaces which can invite people and increase the possibility of social interaction. Dhaka city's development plan recommends an average of at least 0.052 square meter for parks and 0.5 square meter for open green spaces per person (DMDP 1995), although World Health Organisation (WHO) and Leadership in Energy Environmental for Neighborhood Design recommend 9 and 20 square meters receptively. The open space standard

Table 5.18: Types of open space available in the neighbourhood

Types of open space available in the neighbourhood					
Location	**For Sitting**	**Social interaction**	**Park**	**Playground**	**Other open spaces**
Wari	-	-	-	-	v
Luxmi Bazaar	-	-	-	-	v
Dhanmondi	v	-	-	v	v
Banani	-	-	v	v	v
Gulshan	v	-	v	-	v
Pallabi	-	-	-	v	-
Uttara	v	-	v	v	v

Source: Field Survey, 2015

suggested in DMDP is far beyond the standard of any mega city. Open space recreation keep youngsters away from being derailed. “The 1950’s were marked by a major campaign against juvenile delinquency, and advocates of recreational open space often claimed that access to nature would help to ensure the healthy social development of children” (Rome, 1998). According to DMDP, 650 sq. m. of park or open space should be provided for 1000 people (DMDP, 1997b; pp – 14). In Urban Area Plan of DMDP, 4 acres/25000 persons is specified for parks while no standards have been suggested for playgrounds or other kind of open spaces (Appendix II). The most available open spaces in the study areas are parks and playgrounds. In Pallabi there are only two playgrounds and no parks. These playgrounds have restricted access and used mostly for sports activities of various sports clubs and also occasionally rented for arranging various musical concerts.

Figure 5.4: Rickshaw stand inside park, Banani

Figure 5.5: Gulshan park maintained but lacks visual appeal.

From the field survey it can be seen that the dense residential areas of old Dhaka (Luxmi Bazaar and Wari) have no open spaces at all. The only parks available in Wari and Luxmi Bazaar are Baldah Garden and Bahadur Shah Park respectively which are part of the national heritage and have controlled access. Therefore these are not considered as functional open space for the residents of the area. Earlier the lack of open spaces in the planned residential areas were not felt because according to the original master plan of these areas there was enough space inside each plot which could be used as small playground for children. But later with the sub-sequent sub-divisions of the plots these domestic open spaces vanished. At present Dhanmondi, Gulshan, Banani and Uttara have open spaces in the form parks, playgrounds and lake side development. But except Dhanmondi the major portion of the lake side of Gulshan, Banani and Uttara are not developed for public function, therefore remains unutilized. The serpentine lakeside park of Dhanmondi was developed for public gathering but now many accessible points of the lakeside have been closed to prevent the concentration of drug addicts and vendors in those places.

Figure 5.6: Lake side sitting arrangement, Dhanmondi

Figure 5.7: Well maintained park, Uttara

As the playgrounds are under the use and illegal control of various sport clubs they do not allow access to the general public. The 5 parks in Uttara serve only a small portion of the residents who reside within the walking distance (within 1 kilometer) of these places. In the initial plan of Uttara 47% of the land area

Table 5.19: Required time to reach the nearby park or playground (residents' responses)

(Percentage)

Location	5-10 minutes	11-20 minutes	More than 20 minutes
Wari	30	57	13
Luxmi Bazaar	-	-	-
Dhanmondi	25	51	24
Banani	10	71	19
Gulshan	18	77	5
Pallabi	33	55	12
Uttara	27	61	12

Percentage is based on the number of responses.
Source: Field Survey, 2015

was designated for civic and open spaces but to accommodate more area for residential use there was a reduction in the open space. The primary threat to existing public open spaces is encroachment by public and private entities. This practice has been identified in Uttara sector 1 park which has been sold out to private developers by the authority (Nilufar, 2001). Moreover illegal encroachment of the lake side and canals is still going on in form of building tin shaded mosques and other semi permanent structures in the newly developing sectors of Uttara. If the park or playground is located in the walking distance of the neighbourhood without crossing main road then most prefer to come on foot. For residents residing beyond 1/4mile radius from the park usually uses rickshaws or cars which takes about 10-20 minutes depending on the traffic pattern.(Table 5.19) It takes around 11-20 minutes to reach the nearest park and playground in most of the study areas as the survey results indicate.

In Uttara due to improper maintenance and uncleanliness it is found that in some areas respondents avoid going to their sector park rather prefers to go to the next nearest neighbourhood parks. Respondents whose houses are not located within the walking distance usually take rickshaws and the travel time depends on the pattern of route they take. The users of these open spaces are mainly teenagers, middle age and male and female residents and children. Most of the parks lack adequate lighting, park furniture and shelter from rain and sun. Access to majority of these parks lacks crossing aids such as zebra crossing, speed bumper, speed limit sign boards.

Table 5.20: Mode of transport to reach the nearby park or playground (residents' responses)

(Percentage)

Location	Walk	Rickshaw	Car
Wari	43	52	5
Luxmi Bazaar	-	-	-
Dhanmondi	31	49	22
Banani	24	53	23
Gulshan	18	35	47
Pallabi	26	72	2
Uttara	37	52	11

Percentage is based on the number of responses.
Source: Field Survey, 2015

The total existing open spaces of the study residential areas of new Dhaka are far below than the standard prescribed in DAP and DMDP. Even the prescribed standard which is 0.052-0.5 acre open space for 1000 population is also much less than the international standards practiced in other Mega cities of the world. According to Time Saver Standard the minimum standard for local parks for 1000 population is 2 acres. Due to the shortage of open space in study areas in new Dhaka, youngsters seem to be gathering in the tea stalls in the street corners and in the entry plazas of the neighbourhood shopping malls. The elderly residents use the lake side for morning walk. The children and women are the most deprived class as there is an acute shortage of playgrounds in all the study areas. Due to the lack of playground and open spaces a higher percentage of children are found playing inside the building premises, on the roof and on nearby roads (Table 5.21). Even the existing accessible playgrounds are not frequently used by the children as per the responses of the residents which indicated that as 93.8% of the parents cannot watch their children while playing they do not send their children out to play for security purpose (Field survey, 2015). Another reason is the fear of accidents as reaching the playgrounds need to cross one or two intersections of heavy traffic. A privately intiated practice of converting an entire apartment for kids' play zone on rental basis has been found to be a profitable business in areas like Dhanmondi and Uttara which highlights the desparate need of quality and secured play grounds for the children of the neighbourhoods.

Table 5.21: Percentage of children using various outdoor spaces for playing

Age	Inside the building premise	On the roof	In the neighbourhood playground	On the nearby road	Others
Below 5 years	-	11	4	-	83
5 - 10 years	65	9	12	21	-
11-16 years	15	2	11	14	-
16 – 18 years	3	-	10	15	-

Percentage is based on the number of responses.
Source: Field Survey, 2015

Around 78.2% inhabitants of the study areas informed of not doing any exercise activities. Only 21.8% reported of taking part in physical activities among which a significant percent were elderly people both male and female. Among the residents who do not use the neighbourhood open space for exercise majority of them complained of not having appropriate open space for jogging or other exercises. In Dhanmondi 34% of the respondents complained of the presence of too many outsiders in the places like Rabindra Shorobor and lake side recreational area. Around 22% respondents of Uttara complained about the presence of drug addicts and drug peddlers which keep them refrained from using the nearby open spaces.

Table 5.22: Residents' responses regarding not using the neighbourhood open spaces for exercise

Location	Lack of appropriate open space	Fear of snatch theft	Too many outsiders	Eve Teasing	Presence of drug addicts and drug peddlers
Uttara	63	11	3	1	22
Mirpur	67	8	3	5	12
Dhanmondi	37	12	34	8	9
Banani	53	18	21	4	4
Gulshan	58	18	13	3	8
Wari	100	-	-	-	-
Luxmi Bazaar	100	-	-	-	-

Source: Field survey, 2015

5.3.2 Access to daylight

The survey revealed that the rooms of the dwellings which are not having adequate daylight usually have windows overshadowed by adjacent high rise structures. As a result the incidence of solar access falls in a more obtuse angle which does not offer the desirable amount of illumination at daytime. So these rooms are in need of artificial light sources to get properly illuminated. This situation is more common particularly in building blocks located in the second and third row from the road front and the lack of solar access is not limited in case of utility rooms but also living spaces such as living room, dining and bedrooms. But interestingly on average 86% of the people does not have serious complaint about it. This might be partly because most of the households remain vacant during daytime as majority of the inhabitants belongs to the group of working couples, students or service holders who spend the better half of the day away from home. The households are therefore occupied by the housemaids or senior citizens during day time and they are generally not very bothered about this.

Table 5.23: Residents' perception about accessibility to daylight (Percentage)

Location	Households with rooms having inadequate daylight	Residents' opinion about inadequacy of daylight	
		Highly disturbed %	Not much disturbed %
Wari	41	22	78
Luxmi Bazaar	57	21	79
Dhanmondi	39	19	81
Banani	42	13	87
Gulshan	35	14	86
Pallabi	37	9	91
Uttara	33	11	89

Percentage is based on the number of responses.

Source: Field Survey, 2015

5.3.3 Sense of Privacy

The closely placed building in the residential areas impedes privacy causing visual and auditory intrusion as well as visual obstruction. Both acoustic privacy and visual privacy have been considered to examine the sense of privacy in the residential areas**.**

Acoustic Privacy:

Table 5.24: Respondents' opinion regarding noise pollution in the neighbourhood

Location	Measured level of noise (dBa)	Respondents bothered with noise pollution %
Wari	70	9
Luxmi Bazaar	75	10
Dhanmondi	78	21
Banani	71	14
Gulshan	69	12
Pallabi	72	18
Uttara	67	19

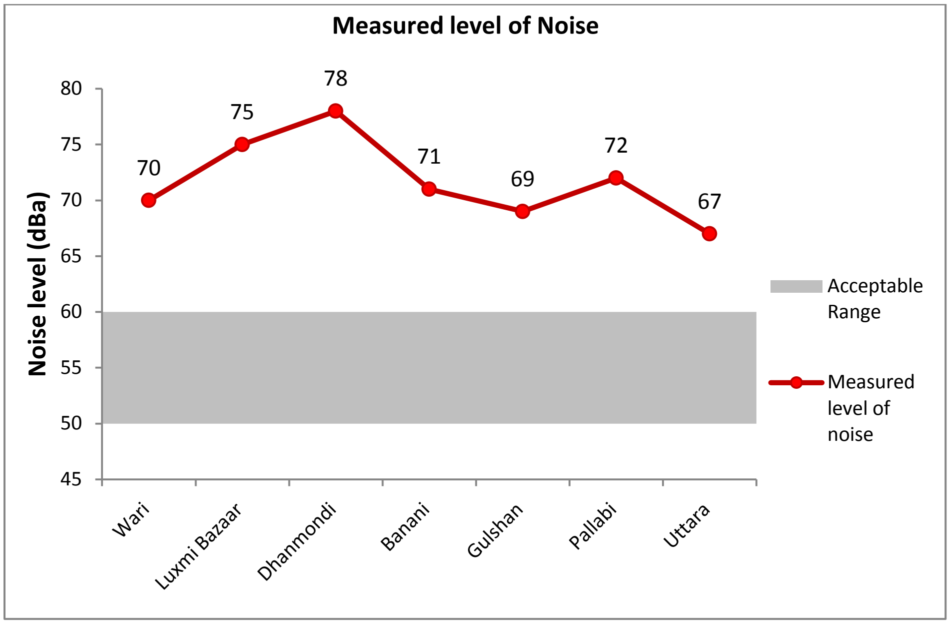
Percentage is based on the number of responses.

Source: Field Survey, 2015

The Environmental Protection Agency (EPA) in United States of America has identified a 24-hour exposure level of 70 decibels as the highest allowable level of environmental noise for all areas which will prevent any measurable hearing loss over a lifetime. Noises crossing this threshold may cause various health problems like hearing problem, hypertension, heart disease etc. However, Department of Environment, of Bangladesh has set the standard for allowable noise levels in residential area 50 dBa and for mixed use 60 dBa. From the field survey the average noise level of the study areas during daytime were found to be far beyond the expected level which is shown in Table 5.23. But interestingly on an average only 9% and 12% of the residents of the study areas of Old Dhaka and new Dhaka respectively complained against noise pollution. Among the residents who complained around 65% of the residents' of new Dhaka are disturbed by the noise caused from the non-residential uses particularly by the peak hour traffic of nearby schools, colleges and universities. Apart from this around 10% of the dwellers of street facing apartments find the noise from traffic of the adjacent roads very disturbing.

Other sources of noise mentioned by the residents of was the noise of construction work going on in the nearby plots and the noise of the generators during load shading. The residents of old Dhaka were found less disturbed with the noise generated from traffic rather they identified the noise of generators and construction works to be most disturbing. Though the close spacing of the buildings allows a significant portion of the dwellers overhear their neighbours' conservation but most of them did not consider the auditory privacy as a big issue.

Chart 5.9 Measured and acceptable range of noise in the study residential area



Source: Field Survey, 2015

Table 5.25: Respondents' opinion about the causes of noise in the neighbourhood

Location	Non residential use	Congestion	Others
Wari	42	5	53
Luxmi Bazaar	36	4	59
Dhanmondi	75	10	15
Banani	70	14	16
Gulshan	65	21	14
Pallabi	72	19	9
Uttara	68	21	11

Percentage is based on the number of responses.
Source: Field Survey, 2015

Visual Privacy:

Interesting observation was found regarding visual privacy in the study areas. The aspect of visual privacy was examined through the parameters of visual obstruction and access of day light. Both visual

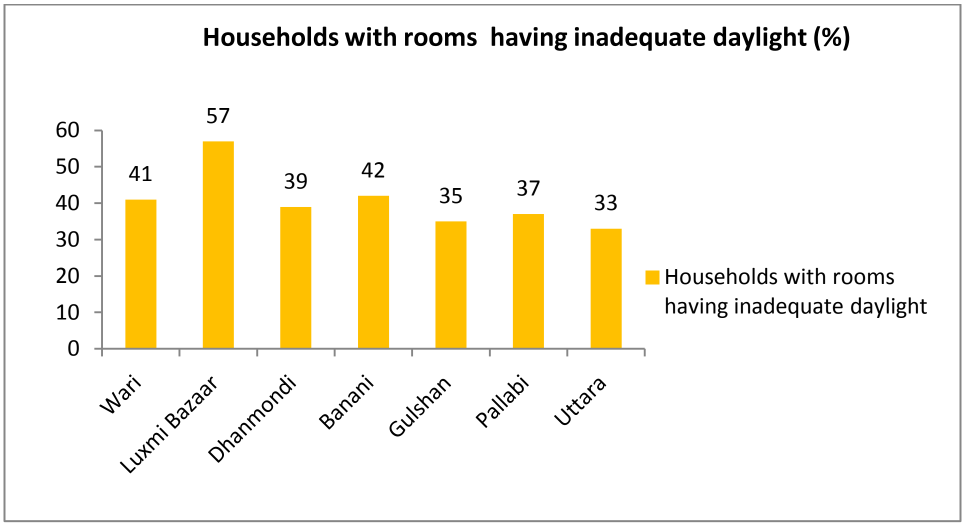
Table 5.26: Respondents' perception about visual obstruction

Location	Highly disturbed	Not much disturbed
Wari	52	48
Luxmi Bazaar	43	57
Dhanmondi	39	61
Banani	42	58
Gulshan	65	35
Pallabi	37	63
Uttara	33	67

Percentage is based on the number of responses.
Source: Field Survey, 2015

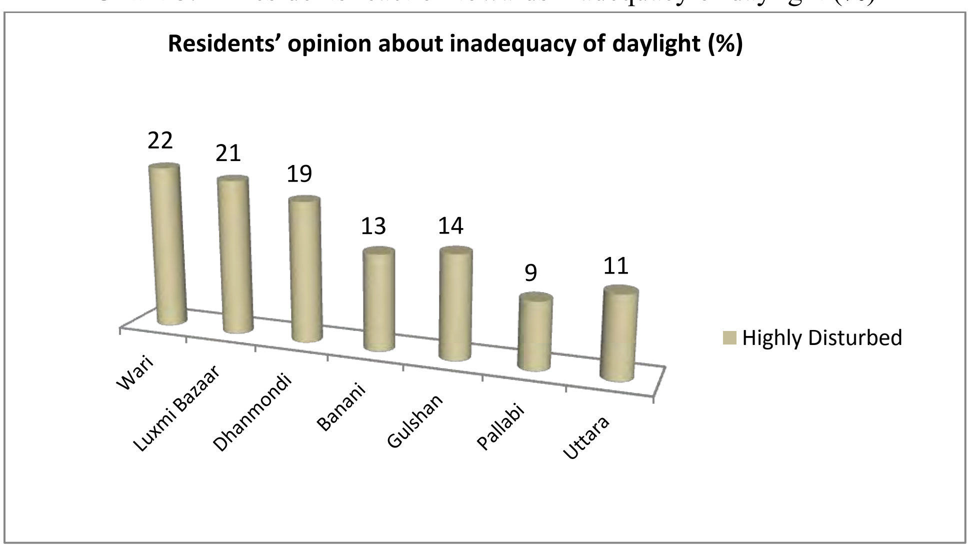
obstruction and access to daylight are inter-related issues and have a negative relation between them. While higher physical density is found to be positively related with these two aspects but the participants were not much disturbed with the deprivation of daylight and view.

Chart 5.10 Households with rooms having inadequate daylight in study areas



Source: Field survey, 2015

Chart 5.11 Residents reaction towards inadequacy of daylight (%)



Source: Field survey, 2015

Around 90% buildings in Wari and Old Dhaka are so closely located that visual intrusion of privacy and visual obstruction are commonplace to the residents but most of the residents display a greater degree of adaptability towards the situation and hardly feel it as a problem any longer. This type of unconcern was mostly found from the responses of the new migrated people to this area. Part of this desensitized attitude towards privacy concern might owe to the cultural and educational background of these migrants. Most of these migrants are less educated rural people with good business acumen. They naturally lack the awareness of such sensitive issues and somehow being overwhelmed by the sudden transition to urban lifestyle and therefore does not feel much disturbance from these sort of civic problems. But on the other hand many original inhabitants have expressed their dissention regarding the issue of privacy as a housewife who has been living here from her childhood commented:

> *"I have been living in this area from my childhood in our 3- storied high parental house. Earlier we had two storied buildings in the adjacent plots but now they are replaced by 10 and 8 storied buildings which are mostly rented to migrant people. The windows of the flat of the adjacent buildings are so close to my verandah that when someone spits the paan from the window it reaches my verandah and often stains the wet clothes that I have left there to dry which is very disturbing. I cannot use the roof for drying clothes either as most of the migrant people living in the upper stories lack the civic sense and frequently throw garbage on my roof top. My young girls have to keep the windows of their rooms covered by hanging curtains most of the time to maintain the visual privacy from the apartment of the adjacent building." (Interview with a resident of Wari, November, 2015)*

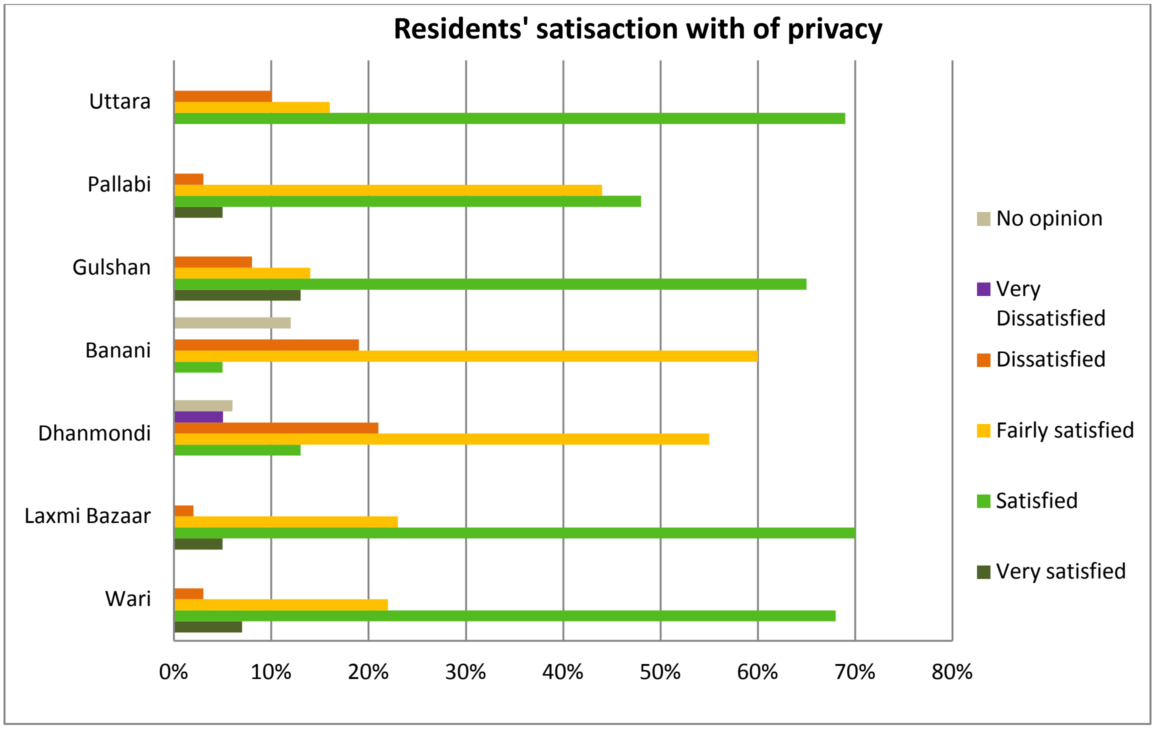
> *"Our family has been living in Luxmi Bazaar for over 3 decades. Our house was 3 storied and used to be the highest in this lane. We could see the roof tops of other houses from our windows and there was plenty of airflow. But now the neighbours had built high rise buildings on both side of our plot. We do not have the views anymore and lack of airflow too. Furthermore one of their bathrooms faces our kitchen which is the most irritating thing." (Interview with a resident of Luxmi Bazaar, November, 2015)*

Interestingly both the original and migrant residents of new Dhaka residential areas have displayed high level of acceptance regarding the lack of visual access. Studies have shown that visual obstruction in dense built environment impeding the eye to look far away causes myopic vision deficiency. The lack of awareness regarding the silent ill effects of visual obstruction, inadequacy of daylight and exposure to unacceptable level of noise seemed to have made the people remain desensitized towards these issues.

Satisfaction level of privacy

Although being so closely packed dwellings the residents' of Luxmi Bazaar has shown the highest degree (70%) satisfaction regarding privacy. Wari is second in the ranking. The higher incidence of satisfaction could be attributed to the long stay in the neighbourhood as well as the social cohesion resulting from that. Among the residential areas of new Dhaka Uttara ranks the first while Gulshan and Pallabi are the second and third respectively in terms of satisfaction. The lack of awareness, relatively lower density and similar social status could be the reason for the greater satisfaction. On the other hand the residents of Banani and Dhanmondi expressed moderate satisfaction while a significant portion (19% and 23%) of the inhabitants has expressed their dissatisfaction regarding privacy. When asked about the reason most of them have reported the lack of privacy due to the local neighbourhood traffic caused by the numerous outsiders coming to the residential areas for work, education and shopping as well as the new migrants of the area from various backgrounds. The dissatisfaction level of rest of the study areas is statistically insignificant. Overall the level of privacy seems to be acceptable in most of the residential areas both planned and unplanned except those where there is a greater concentration of commercial activities.

Chart 5.12 : Respondents' opinion about satisfaction level of privacy



Percentage is based on the number of responses.
Source: Field Survey, 2015

5.3.4 Residents' satisfaction with livability condition of residential areas

Besides the access to open space, solar and visual access and acoustic privacy the livability condition of a residential areas also depends on the perceived quality of the local environment represented primarily by the perceived attractiveness, maintenance, cleanliness and privacy of the residential areas which are assessed in the following.

The survey revealed that high density residential areas like Wari and Luxmi Bazaar were found less attractive in terms of architectural characteristics/style than low density areas. These residential areas are mainly chosen by the new comers for better connectivity with work places and educational facilities as well as affordable house rents.

Table 5.27: Perceived quality of the local residential neighbourhood environment

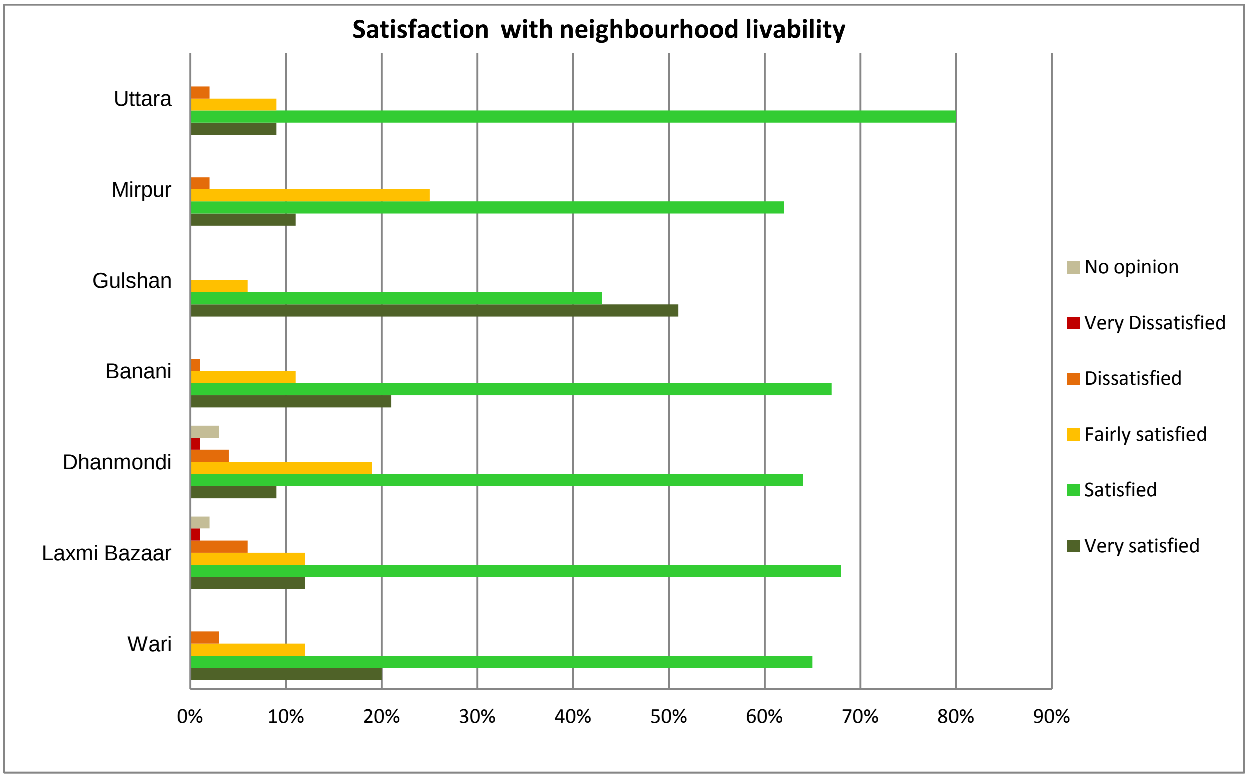
(Percentage)

Location	Cleanliness	Better connectivity	Attractiveness	Well maintained
Wari	17	47	21	15
Luxmi Bazaar	9	67	13	11
Dhanmondi	14	30	52	4
Banani	10	17	62	11
Gulshan	11	12	68	9
Pallabi	8	73	15	4
Uttara	15	54	21	10

Percentage is based on the number of responses
Source: Field Survey, 2015

High density is also found to have positive relation with connectivity which implies that high density areas are well supported by public transport. Factors like cleanliness, maintenance of the buildings and neighbourhood are related with the income level and social status of the occupants. In support of this, it was also found that residential areas with higher family income (Dhanmondi, Banani, Gulshan and

Chart 5.13: Satisfaction level of residents regarding the livability condition of their residential areas



Percentage is based on the number of responses.
Source: Field Survey, 2015

Uttara) had better maintenance and cleaner environment than the residential areas with lower family income and lower social status (Luxmi Bazaar, Wari and Pallabi). Even perceived density is found to have negative association with perceived attractiveness, maintenance of buildings, and cleanliness of the residential area. Around 70% of the inhabitants who perceived their residential area as dense felt negative about its attractiveness, maintenance and cleanliness. As it can be seen from the chart 5.6 the overall satisfaction level of the residents of the study areas is surprisingly quite high regardless the variation of physical density. Subtle variations can be observed in terms of the higher degree of satisfaction where a significant percentile (i.e. Gulshan 52%, Banani 21% and Dhanmondi 9%) of the residents of low density residential areas turns out to be *very satisfied* than the higher density areas. The variation in proportion of the dissatisfied residents among the residential areas of both old and new Dhaka is statistically insignificant.

5. 4 Aspects of Economic Sustainability

Economic sustainability of the urban areas depends on the provision of public infrastructure facilities that are mainly the transport facilities and utility services. For assessing the economic sustainability of the residential areas these two criteria have been selected which is discussed in the following:

5.4.1 Accessibility to Transportation Facilities

In this research higher population density is found to have positive association with public transport facilities in the context of Dhaka. The high density areas are better connected through public transport service in terms of average distance of bus stoppage and availability of buses. However density alone is not the factor that facilitates easy accessibility but the layout of road network also has a vital role to play as the residential areas which are laid along primary thoroughfare seem to have better accessibility. This is evident in case of Wari which even being a high density residential area does not have good accessibility to public transport system. As it is located far away from the major transport corridor the inhabitants have to travel long distances to reach the nearest bus stop which is located in Gulistan.

Table 5.28: Residents' opinion regarding the availability of public transport (Bus)

Location	Availability of Public Transport (Bus)	Non Availability of Public Transport (Bus)
Wari	18	82
Luxmi Bazaar	27	73
Dhanmondi	52	48
Banani	53	47
Gulshan	41	53
Pallabi	63	37
Uttara	61	39

Percentage is based on the number of responses.
Source: Field Survey, 2015

From analyzing the residents' choice of travelling mode it can be seen that due to the meandering intertwining street pattern of Old Dhaka which is not compatible for motorized vehicles the residents rely relatively more on non-motorized vehicles for travel purpose than in new Dhaka. The ownership of cars are also fewer in Luxmi Bazaar and Wari. However, Wari has comparatively more car owners than Luxmi Bazaar due to its grid iron street pattern conducive for car movement. But most of the people of Wari

Table 5.29: Average time required by the respondents to reach public transport stops

Location	No. of Bus stops	5-10 mins	11- 20mins	More than 20 mins
Wari	1	-	35	65
Luxmi Bazaar	1	21	45	34
Dhanmondi	3	18	43	39
Banani	1	15	66	19
Gulshan	3	8	70	22
Pallabi	2	21	71	8
Uttara	5	14	67	19

Percentage is based on the number of responses
Source: Field Survey, 2015

depend on other means of public transport rather than bus as the bus stop is not situated within 10 minutes of walking distance. From the survey it can be seen that only 23% office goers and 15% students are using buses as the chief mode of transport to reach their destination. As Wari does not have adequate schools 52% of the parents use rickshaw and 20% auto rickshaws as the primary means of transport to accompany their children to the schools of the nearby wards. A small percentage (8%) of the inhabitants whose children studies in English medium schools of Dhanmondi uses car. Whereas Luxmi Bazaar enjoys a whole range of educational institutions in close proximity within the radius of 1 km and around 72% students depend on non motorized means of transport (43% foot and 28% rickshaws). Majority of the female students of Jagannath University seek rental accommodation in the area of Koltabazar and Rokonpur of the study ward which are located within the walking distance from the university campus. From Table 5.30 it can seen that a higher percentile of the inhabitants of old Dhaka (Wari 57% and Luxmi Bazaar 72%) is dependent on non motorized means of transport while majority of the inhabitants of new Dhaka (Dhanmondi 76%, Banani 81%, Gulshan 85%, Pallabi 54% and Uttara 55%) are dependent on motorized transport for study travel purpose.

Table 5.30: Percentage of the inhabitants using various modes of travel for study purpose

Location STUDY	Non Motorized Transport		Motorized Transport		
	Walk %	Rickshaw %	Taxi/ CNG auto rickshaw %	Bus %	Car %
Wari	5	52	20	15	8
	57%		43%		
Luxmi Bazaar	43	29	14	12	2
	72%		28%		
Dhanmondi	3	21	25	14	37
	24%		76%		
Banani	4	15	14	20	47
	19%		81%		
Gulshan	4	11	22	6	57
	15%		85%		
Pallabi	8	38	8	36	10
	46%		54%		
Uttara	8	37	14	21	20
	45%		55%		

Percentage is based on the number of responses

Source: Field Survey, 2015

Most of the inhabitants of Luxmi Bazaar are businessmen by occupation whose business enterprises are located within Sutrapur and Kotawali thana. The business mainly includes printing, wholesale market of goods and small scale factories. So in order to reach their work places which are quite in vicinity to their houses most them travel on foot, by rickshaw or motorcycle. Only the 44% of the service holders who are employed mainly in various public, private and other corporate offices in the locations of Mohakhali, Motijheel and Farmgate rely on buses for their daily office trips. There are direct bus routes from the bus stop at Victoria Park to Mohakhali, Gabtoli, Elephant road, Farmgate, Khilket, Uttara, Gazipur, Savar and Jatrabari. BRTC bus services are not available in this area only private buses serve the routes. So the street and occupation pattern of the inhabitants of old Dhaka their lifestyle which is expressed through the interviews of the residents of Luxmi Bazaar-

"I have been working in the Judge court for the last 8 years. I live in Luxmi Bazaar. Every morning I take rickshaw which is easily available along my lane to reach the court. It takes around 15 to 20 minutes to reach the court if I catch the rickshaw by 7:20 am. Otherwise I might get caught in the traffic jam which usually starts taking place from 8:00 to 9:00am. The situation in the evening is quite different. I often have to face the traffic jam which is caused by the regular traffic of the launch terminal in Shadarghat at these hours. Sometimes the situation becomes so acute that rickshaws remain still stand for hours. In such case I usually cross through the traffic jam on foot and take rickshaw from the other side of Victoria Park…this saves a lot of time". (Interview with a resident of Luxmi Bazaar, September, 2015)

"I run a press in Hrishikesh lane. We have been living in Rokonpur since my grandfather built our house there. Usually I drop my daughter in Bangla bazaar school on bike before I get to work. In order to avoid traffic congestion we have to start early by 7:30am. Generally the trip does not take more than 10-15 minutes to reach my workplace after dropping her." (Interview with a resident of Luxmi Bazaar, September, 2015)

For other daily activities like buying vegetables, groceries and shopping people of old Dhaka (Wari and Luxmi Bazaar) relies more on walking and rickshaws. The wet markets of both new and old Dhaka are located within 11 – 20 minutes walking distance and are usually reached by rickshaw. Furthermore the the higher number of convenience stores and chain super markets like Agora, Meena Bazaar, Nandan attracts the residents to do their purchase of daily necessities and vegetables from here by using cars. The new residential areas were found with 18'-24' wide access roads. Much of these access roads did not have foot path. The ones which have footpath are having break ups in close intervals for providing vehicular entry to flanking residential or commercial plots. The frequent break ups in the footpath cause

Table 5.31: Percentage of the inhabitants using various modes of travel for work purpose

Location	Non Motorized Transport		Motorized Transport		
	Walk %	Rickshaw %	Taxi/ CNG auto rickshaw %	Bus %	Car %
Wari	5	27	35	23	10
	32%		68%		
Luxmi Bazaar	12	60	14	12	2
	72%		28%		
Dhanmondi	2	10	28	24	36
	12%		88%		
Banani	4	15	14	20	47
	19%		81%		
Gulshan	-	17	22	4	57
	17%		83%		
Pallabi	8	21	14	47	10
	29%		71%		
Uttara	8	31	14	27	20
	39%		61%		

Percentage is based on the number of responses

Source: Field Survey, 2015

inconvenience to the pedestrian traffic and discourage people from using them. The design of foot path is better in Banani where a separate by-lane runs along the foot path for providing access to the road facing plots and keeps the pedestrian flow uninterrupted. The residents of both Uttara and Mirpur relies more on the alternative means of public transport like rickshaws and auto rickshaws for their daily shopping. Daily activities like buying vegetables are mostly done by foot or by rickshaw (57% in Uttara and 51% in Mirpur) from nearby neighbourhood wet markets or street vendours. The increase in convenience stores and chain shopping malls (Agora, Meena Bazaar, Aroma Bazaar, Swapno, Stop n Shop etc) in the secondary roads of

Uttara since last 6- 7 years have made shopping of daily necessities easily accessible through rickshaws and by foot for the residents from almost all the sectors of Uttara. Overall the choice of travel mode of the residents of New Dhaka is quite in contrary to the Old Dhaka. People of these areas show a higher propensity towards using cars which is partly due to the planned street layout and partly for the unavailability of public transport or any other suitable public transit system. Dhanmondi shows a moderate use of cars, Banani has a relatively higher share of car users and majority of the residents of Gulshan are exclusively automobile dependent for almost all of their daily activities.

Dhanmondi is resided by upper middle class income groups who are using cars mostly for going to work (36%), study (37%) and shopping (41%) (Field survey, 2015). Though Dhanmondi is situated along a major thoroughfare of *Mirpur Road* but the bus routes and frequency of buses are not adequate to fulfill the demand. This problem was evident from the interviews of a number of office goers who cannot rely solely on the bus service for their daily office trips. A significant number of office goers who uses car also drop their children to school by car on the way to office which explains the higher incidence car usage for schooling purpose during the peak hours in this area. One of the reasons for the lack of public transport could be attributed to the process of development this area experienced. As Dhanmondi was conceived as a high class car oriented neighbourhood for housing targated for high class elites, diplomats and dignitaries, public transit system was not a concern in its initial planning. The only public transport BRT service was launched in 1960s in Dhanmondi which adequately served the locality then. But from 1990s as the area was increasingly inhabited by the upper middle and middle income group which raised the demand for public transport and other supporting facilities. The only school (Dhanmondi Boys School) of the area was not sufficient meet the growing demand. As a result more schools were constructed which gradually proliferated into large number of educational institutions of various scales. The posh character and convenient location of this area soon attracted other commercial activities mainly shopping and health care facilities including general and specialized hospitals. Offices and banks were also established but comparatively fewer than shopping, educational and health care facilities. The comparatively lower percentage of offices does not ensure regular inflow of office going commuters in the area. Most of the other commercial facilities of the area are usually availed by car owners from all over the city (Nancy, 2004). So the absence of a two way office going commuters could be a reason of negligence of the private transport companies to supply more buses in this route.

On the other hand, Banani and Gulshan still retain their status as high class residential areas and most of the residents have their own cars. The accessibility to public transport is better in Banani than Gulshan as it is located right along one of the prime arteries of the city (*Dhaka Mymensingh Road*). Furthermore Banani houses a higher percentage of offices than Dhanmondi which ensures a daily flow of commuter traffic to the area. In effect of this there are more private buses serving this route than Dhanmondi and the intersections of the area is subjected to heavy traffic congestion most of the time. The bus stop is located on the main thoroughfare which is far beyond the walking distance of the local residents. This is also a factor discouraging the local residents from using public transport.

Gulshan is exclusively a high class residential area with a diplomatic zone housing majority of the embassies. The bus service in this area is also inadequate and mainly used by the commuters from all over the city. The existence of diplomatic zone also discourages public transport service. As the upper class residents are more used to cars most of them are not bothered about the public transport of the area and remains oblivious about it which can be seen from a number of interviews of the residents of this area who have no idea about the public transport facilities of their residential area. From the Table 5.30 and 5.31 it can be seen that around 83%- 85% of the residents are car dependent for most of their daily outdoor activities.

Mirpur and Uttara are found to have good connectivity with the rest of the city through public transport system. More than 36 bus routes served by both private and public buses which regularly ply across the major thouroughfare of Dhaka Mymensingh road. Mirpur is a middle class residential area from where most of the people commute to Uttara, Banani, Gulshan and Motijheel regularly for work. From 2003 upto 2010 Mirpur and Uttara was served mainly by BRTC double deckers with a few private buses along this route. The good connectivity of Uttara gradually encouraged many offices and commercial activities to be established here. As a result the commuters to Uttara from Mirpur increased and this made Mirpur a preferable location for the private bus companies to provide more and more bus services along this route. The quality and frequency of BRTC service declined when the Volvo double decker buses were replaced by the new low cost single and bi-articulated buses and was consequently superseded by the private bus companies.

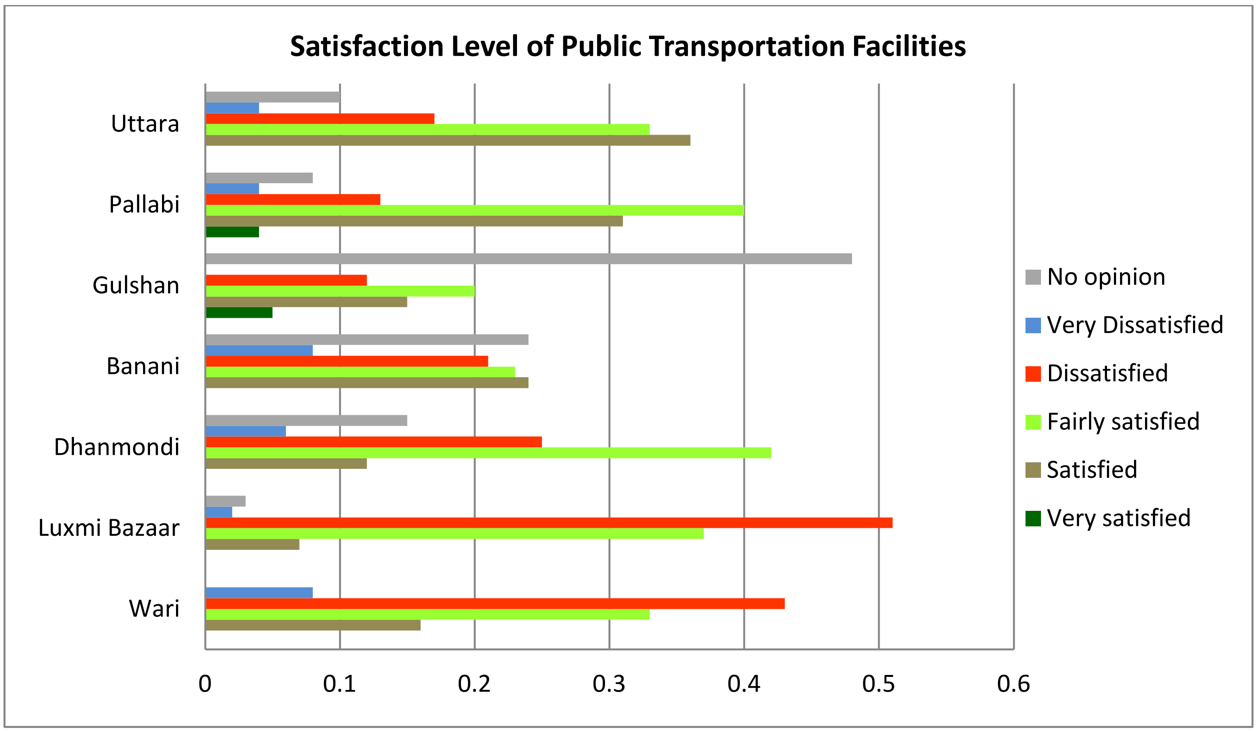
Residents' Satisfaction with Public Transportation Facilities

Regarding the satisfaction level of transportation facilities Wari and Luxmi Bazaar shows a contrasting opinion from the respondents. Despite both of the case study areas belong to old Dhaka, around 91% respondents of Luxmi Bazaar have expressed their satisfaction in various degrees, while in Wari only 51% have shown positive remark and rest are dissatisfied with the provision of public transport facilities. Both Wari and Luxmi Bazaar has one bus stop but it takes comparatively less time to reach the bus stop in Luxmi Bazaar (5-10 mins). In case of Wari there is no bus stop within the neighbourhood and the nearest bus stop is situated in Gulistan which takes around 15-20 minutes to reach. The distance of the bus stops is a significant reason for higher rate of dissatisfaction in Wari as confirmed by some of the respondents:

> *"I have to go to Dhaka university for my MBA classes. I wish to use bus service where the fare is comparatively lower than rickshaw. But the nearest bus stop is located in Gulistan which is quite far from Wari. So in order to avail the bus I need to take a rickshaw to get there first and then take the bus. But even reaching the bus stop sometimes it becomes difficult to ride the bus as it is most of time overcrowded. So the only choice left for me is rickshaw or auto rickshaw which is easily available within the neighbourhood but not a very feasible option. It is the same while returning home. I just wish for an affordable and comfortable mass transit system which could have lessened the sufferings of students like me." (Interview with a student residing at Wari, March 2015)*

Dhanmondi is served by 40 bus routes along the *Mirpur Road* with 10 routes along the *Satmasjid Road*. There are 3 bus stops, located respectively along Road No. 4, Shukrabad and in Jikatola. But from the survey it can be seen that for most of the residents (82%) the average time to reach these bus stops are more than 10-15 minutes by rickshaw. In addition, the frequency of these buses is not adequate to serve the demand. So people tend to use cars and other means of motorized vehicles to reach their destination on time. These factors can explain the relatively higher rate of dissatisfaction (25%) in Dhanmondi than other new residential areas of Dhaka regarding public transport.

Chart 5.14 : Satisfaction level of the respondents regarding public transport facilities



Source: Field Survey, 2015

The overall satisfaction level of Banani is 47% and overall dissatisfaction level is 29% regarding public transport. However, 24% of the respondents have not given any opinion. This is partly due to the affluent high class status of the residents who are mostly automobile dependent for their daily activities. The area is served by two bus stops located at the two far ends of *Kemal Ataturq Avenue* (Kakoli and Baridhara stop). Most of these public transports (bus, auto rickshaw, taxi) are used by the commuters and the local residents are least concerned about its provision. Beside car the local residents occasionally use other mode of transports like rickshaws and auto rickshaws for travelling within the neighbourhood with which they are found to be quite satisfied.

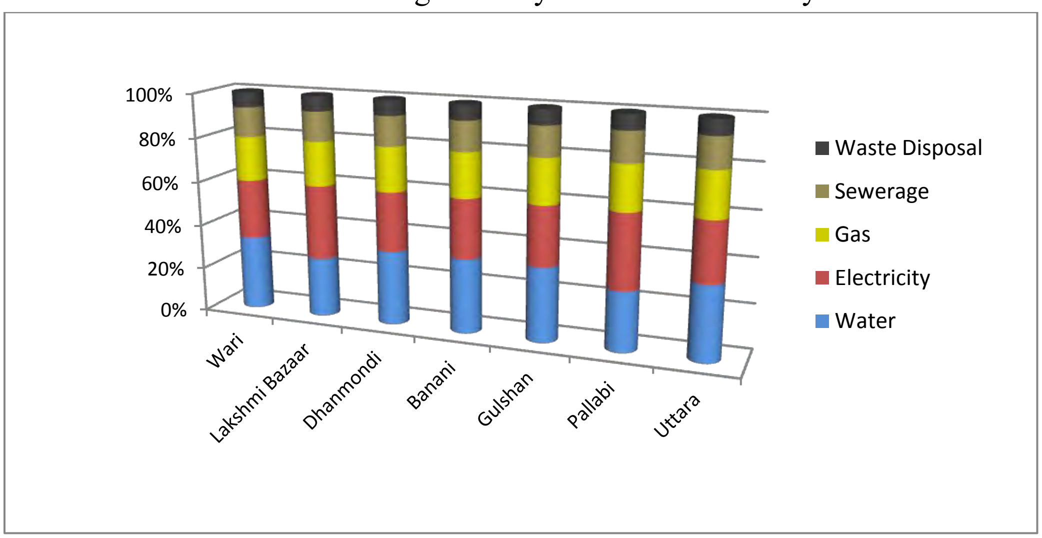
More or less the same scenario can be observed in Gulshan almost all the residents are car users and thereby do not depend on the public transport. As non user of public transport most of the residents (48%) was not able to give opinion about their satisfaction level regarding this issue. The well connectivity, provision and frequency of bus service have resulted in overall higher satisfaction level for public transport both in Pallabi (75%) and Uttara (69%).

The survey findings indicate that the road network pattern of the residential areas have significant impact on the provision of public transportation facilities as planned areas have better connectivity than unplanned areas. The satisfaction level in general reflects similar results where the residents of unplanned areas are found dissatisfied while residents of planned areas displayed higher level of satisfaction. But the other factors like the income level also influences the satisfaction level as the higher income groups are less dependent on public transport they are least bothered about its provision and quality. However, the accessibility to public transport in terms of distance from bus stops to the neighbourhood also plays an important role on the satisfaction level as it is clear from the example of Wari where despite being a planned residential area the longer distance to the bus stop prevents inhabitants from using public transport.

5.4.2 Accessibility to infrastructure

This aspect covers the utility service infrastructure which includes water, electricity, gas, sewerage services and waste disposal system of the study areas. Overall from the survey it was found that there is a significant infrastructure and service delivery gap across all sectors except water supply in majority of the study areas.

Chart 5.15 : Ranking of utility services in the study areas



Percentage is based on the number of responses

Source: Field Survey, 2015

From the observation it was found that regarding the availability and quality of the utility services water supply ranks the first place in all the study areas except in Luxmi Bazaar and Pallabi where residents have complained of the periodic irregularity in supply and quality of water. A major part of the water pipes in Luxmi Bazaar are 50 years old installed by DCC which needs to be replaced. On the other hand the residents of these areas have reported to have better service regarding electricity supply than water. However, frequent load shedding occurs in all the study areas which indicate that the demand of electricity is higher than the supply. Areas like Pallabi and part of old Dhaka (east) are not included in the sewerage system network which causes inconvenience to the inhabitants. The respondents of Dhanmondi, Gulshan, Banani and Uttara complained about frequent breakdown and blockage of the sewer system due to insufficient sewer line in terms of length and width and the frequent road digging for installation and repair of sewers. Again the frequent digging of roads also takes place whenever utility connections are given to a newly constructed building. The waste disposal service of all the study areas have been commonly reported to be in the least acceptable condition. There are open garbage disposal points situated along the arterial and access roads which pollute the surrounding environment. Overall the most of the residents of the study areas have ranked the power service in the second place while gas, sewerage and waste disposal service take the third, fourth and fifth place respectively in terms of accessibility and quality of the service.

5. 5 Relationship between density and sustainability aspects

The aim of the analysis carried out in this research was to explore the relationship between density and the selected aspects of social, environmental and economic sustainability of the study areas. The indicators related to physical and perceived density attributes and various aspects of the social, environmental and economic sustainability are shown in Table 3.2 and Table 3.3 in Chapter 3. The analysis process used simple correlations (Pearson's correlation) to examine the basic relations among the two sets of key variables of density and aspects of sustainability as shown in Fig 3.2. The correlation between the variables of density (physical and perceived) and the indicators of each selected aspect of sustainability was examined individually and then overall impact of density was determined from the average values of the indicators of each aspect. The results of the correlation analysis are presented in the Table 5.32 and followed by the interpretation of the findings.

Table 5.32: Relationship between density and aspects of social, environmental & economic sustainability

	List of indicators	Physical density relationship (ward wise - gross population density	Perceived density relationship		Overall impact of density
			Perceived neighbourhood density	Perceived density within the dwelling	
Social sustainability					
Accessibility to community facilities	Average distance to nearest daily use shopping center, vegetable/grocery market, health facilities, primary school, mosque, bank, community centre, Gymnasium	positive			positive relationship – higher density residential areas have better accessibility
	Average number of shopping centers, vegetable/grocery markets, health facilities, primary schools, mosques,	positive			

	banks, community centres, Gymnasiums per 1000 people.				
Amount of living space	Floor area per person	negative	negative		Negative relationship- higher density residential areas have less amount of living space
	Perceived level of satisfaction with the size of home	negative	negative		
Health of the inhabitants	Number of family members having a stress related health problem	positive	no impact	positive	Positive relationship – higher density residential areas have more stress or pollution related health problem
	Number of family members having a pollution related health problem	positive			
	Number of family members having no health problem	negative	no impact	no impact	
Community stability and social cohesion	Perceived number of social contacts (knowing people) within the last 12 months within the residential area	positive	negative	negative	positive relationship – higher density residential areas have higher number of social interaction but when the building or neighbourhood was perceived as crowded then number of social contacts are fewer.
	Perceived friendliness of the neighbourhood.	positive	positive	no impact	
	Percieved no. of informal chats with neighbours	positive	positive	no impact	
	Self reported participation in various community events in the last 12 months	no impact	positive		
Sense of safety	Perceived safety within the residential area during daytime	positive	negative	no impact	Positive relationship- higher density residential areas have higher degree of safety but when perceived as crowded by people the perceived safety was less during both day and night time, perceived vandalism was found having no impact with higher physical density
	Perceived safety within the residential area during night	positive	negative	no impact	
	Perceived vandalism in the neighbourhood	no impact	positive	no impact	

					but showed positive impact with perceived density
Environmental sustainability					
Accessibility to open space	Average number of park per 1000 people	negative			negative relationship- higher density residential areas have less accessibility to open space.
Access to daylight	Percentage of plots in which does not get adequate daylight during daytime and needs to keep lights on	negative			Negative relationship- higher density residential areas have less daylight and needs more artificial lighting during daytime.
Sense of privacy (Acoustic & Visual)	Perceived noise pollution	no impact	no impact	no impact	positive relationship- higher density residential areas have more noise pollution and visual obstruction but perceived acoustic and visual privacy displays no impact.
	Measured intensity of noise pollution	positive	no impact		
	Visual Obstruction by surrounding buildings	positive	no impact	no impact	
Satisfaction with the living condition of their residential area	Perceived residential area in terms of attractiveness	negative	negative	no impact	negative relationship – higher density residential areas were found less preferable in terms of attractiveness, architectural character, maintenance and cleanliness.
	Architectural character/Style	negative	no impact	no impact	
	Well maintained buildings	negative	negative	no impact	
	Clean environment	negative	no impact	no impact	
Economic sustainability					
Accessibility to Infrastructure facilities	Accessibility to public transport	negative			negative relationship-higher density residential areas have lower accessibility to infrastructure facilities
	Access to utility services	negative			

Source: Questionnaire survey 2015

From the analysis of the findings displayed in Table 5.31 it can be seen that most of the selected aspects of social sustainability is positively correlated with density. The aspects having positive relationship are accessibility to community facilities, health of the inhabitants, community stability and social cohesion and sense of safety. Accessibility of community facilities is found to be positively related with physical density of the residential areas which indicates that higher density areas have better accessibility to community facilities in terms of provision and distance.

The aspect of health of the inhabitants involves three indicators namely stress related health problem, pollution related health problem and no health problem. The relation between individuals suffering from health problems and density was found positive which signifies that high density residential areas have more health problems. However, only stress related health problems are found to have a significant relationship with the perceived density within the dwelling which indicates that if the house is perceived as crowded it tends to add to the stress of the inhabitants. This view is also supported by literature. The aspect of community stability and social cohesion in general was found having significant positive association with physical density where the inhabitants of higher density residential areas displayed higher number of social contacts and interactions. But contrarily when the higher density areas have been perceived as crowded by the inhabitants the number of social contacts and interaction was significantly decreased. Although the relationship between the participation of the inhabitants in community activities and the perceived density was positive but it was not statistically significant.

One of the reasons for lower rate of involvement was commonly pointed out by the respondents as lack of time while others held the mismanagement of these events responsible. The sense of safety was found to be strongly associated with the physical density indicating that high density residential areas have higher degree of safety both during the day and night time. But when the neighbourhood was perceived as crowded people seemed not to be feeling safe. The perceived vandalism was also found to be increased in relation to the perceived crowdedness of the neighbourhood during peak hours. Among the selected aspects of social sustainability only amount of living space was found to be negatively associated with both physical and perceived density of the residential areas which means, the higher the density the lesser the amount of living space available for individuals as well as less floor area per person. This observation also supports the literature, which suggested that areas with higher net residential densities or population densities are likely to have a lower amount of living space per person.

The relationship of density was examined against four aspects of environmental sustainability which are accessibility to open space, access to daylight, sense of privacy and satisfaction with the living condition of the neighbourhoods. The accessibility to open space and satisfaction with the living condition of the neighbourhoods was found negatively related with density while the other aspects had positive relationship. The negative relationships imply that higher density residential areas have less open space and also the higher density areas were found less preferable in terms of attractiveness, cleanliness, architectural character and privacy. The positive relationship between access to daylight and density signifies that dense residential areas need more artificial lights to be put on during day time and is subjected to higher degree of visual obstruction. The measured intensity of noise is positively associated with physical density but no significant correlation was found between the perceived level of noise and both physical and perceived density.

Among the aspects of economic sustainability only satisfaction of public transport was found to have negative association with physical density which implies that higher density areas are not well served with public transport while no significant association was found between density and infrastructure which implies that the provision of utility services (gas, electricity and water) in the residential areas have not yet gone beyond the threshold. However higher density is found to be negatively associated with the services like sewerage and garbage disposal of the residential areas of Dhaka.

5.5.1 Summary Findings

While summarizing the research findings of this Chapter, it is important to point out that though statistical method has many advantages but the results cannot always portray the real impact as it cannot visualize people's feelings, experience and perception towards a situation in practical context which are more subjective in nature. In order to investigate the consequences of densification process it is therefore, critical to recognize that the findings from the statistical analysis alone is not enough to produce conclusive results in understanding the impacts of such phenomenon on sustainability as it has been confronted by several contradictions reported by the respondents of the study areas. So in order to get the real picture of the impacts of densification statistical results from the correlation analysis (Tabel 5.32) were compared with the contradictions associated with each selected aspect of sustainability which is presented below:

Accessibility to Community facilities:

It was evident from the statistical findings that higher gross residential densities had positive impacts on access to facilities and amenities at neighbourhood level, which supposedly enhances the livability as widely supported by literature. Various theories have recommended that minimum level of densities is important to support local services and facilities (Gharpure, 1995; Burdett et al., 2004). But a closer examination of the study areas suggests that despite the adequacy of community facilities in the study areas their number, distribution and scale is not pertinent to the neighbourhood scale rather conforms to the city scale. From the field it was observed that the city scale provision of these facilities is therefore, inviting the city traffic into the neighbourhood on a regular basis. As reported by the respondents severe traffic congestion due to this unwanted traffic is a commonplace in these residential areas hindering the accessibility of the local residents to these facilities and amenities in terms of travel time and thereby hampering the quality of life. Most of the inhabitants usually avail these facilities through rickshaw which takes about 10-15 minutes. But due to the frequent traffic congestion these short trips takes exhaustingly more time which is totally unacceptable. So even though having adequate and sometimes over provision of these community facilities the local residents cannot accrue the full benefit from them. A standard for provision of community facility is provided in DAP 2010 but no directives have been suggested to implement it. However, it is usually ensured through government land use policy with community facility planning and their managerial and financial capacity to distribute social infrastructure evenly among various parts of the city. But in absence of such policy the provision of social infrastructures through private initiatives tend to cross or sometimes overlook the demand of the residential areas. So although the statistical analysis of this research shows a positive relation of density with this sustainability aspect but the planning considerations associated with the accessibility of the existing community facilities portrays a picture quite contrary to the sustainability requisites.

Community stability and social cohesion:

The statistical findings indicates that higher density residential areas have higher number of social interaction but when the building or neighbourhood was perceived as crowded then number of social contacts are fewer. Social cohesion in the community helps to build social capital which helps to sought out most of the community problems by themselves and provides social safety net to the individuals of the community. Social cohesion is developed through frequent informal social interaction which helps to cultivate trust and nurtures bonding among the neighbours. The research findings also revealed that the form of traditional bonding is still prevelant in the high density neighbourhoods of Old Dhaka but not very prominent in the neighbourhoods of new Dhaka. The cause of this diminishing status of the social capital in the new neighbourhoods may not be attributed to the density alone as indicated in the results of correlation analysis. The design of the built environment as well as the lifestyle of the residents is identified as important predictors hampering the formation of social capital in the contemporary neighbourhoods. In the pursuit of urban lifestyle, city dwellers have to spend a major portion of the day at work and traffic congestion which spares very little time for them to stay at home and socialize with neighbhours.

On the contrary people happen to spend more time with their colleagues rather than their neighbours. This facilitates in formation of social capital through *bridging* is increasingly replacing the *bonding* exercise which used to be a common practice previously in the traditional neighbourhoods. Even Globalization can be seen as a *bridging* exercise of social capital. However, some argue that the expansion of social capital in globalization has been done at the expense of traditional *bonding* of social capital, which is based on shared norms, values and cooperation among in-group members for common ends and this could be partly true in this case. *Bonding* and *bridging* in social capital can co-exist as long as they are in harmony and well-balanced (Putnam, 1998). But as revealed from the field survey results mentioned in Section 5.2.4 the inhabitants of the residential areas of new Dhaka are found to be more interested in the bridging exercise which tends to form various groups based on similar occupation and shared interests thereby results in a reduced level of social cohesion among the immediate neighbours. Apart from the lifestyle demands the urban design elements such as lack of open space, the design features of the multi dwelling buildings as well as the street designs do not provide the opportunity for social bonding. Under the circumstances the bonding exercise is found to be gradually diminishing and being increasingly replaced by bridging and linking exercises. The future consequences of this type of social capital are likely to lead towards centrifugal fragmentation in the society which is a major threat in developing social sustainability.

Sense of safety:

The findings of the research found gross population density to be positively associated with the sense of safety which indicates that the higher the density contributes to higher sense of safety as it was found very prominent in the dense residential areas of old Dhaka with relatively good degree of social cohesion. While in the new residential areas though people were found satisfied with the sense of safety but their security was achieved through the practice of gated communities rather than natural vigilance system provided by the neighbours like old Dhaka. Various researches have recognized the impact of social capital on safety issues of the neighbourhood. The results from new residential areas indicate though sense of safety is increased with high density but this is not helping in nurturing social bonding where vigilance is formed by the presence of people alone rather than any physical aid. The design of the apartment buildings which does not encourage informal social interaction in their narrow coridoors and small balconies could be another reason for this kind social isolation. This again suggest that built form characteristics, design and layout associated with lower social capital also contribute to the prevalence of reduced sense of safety and vice versa evident from in the findings of the study areas. Thus, it was found overall that higher density had positive association with sense of safety but if the area is perceived crowded then the relationship turns out to be negative. However, crowding within dwelling was found to have no relationship with indicators of safety.

Health of the inhabitants:

Despite the residents' overall higher satisfaction level regarding the living condition at differing densities, the self reported health statistics indicates an unfavorable result which questions the livability as well as the sustainability of these residential areas. Besides the overall positive association of high density with health problems the findings also revealed that a higher incidence of stress related health problems were found common in all of the study areas while pollution related problems were relatively higher in some of the new residential areas. As discussed earlier in the section 5.2.3 the cause of the stress and pollution related health complications can be traced to the design features of the built environment (amount of living space, lifestyle, lack of outdoor recreation spaces, dwelling design, vehicular emission etc.) of the residential areas. There is a growing body of literature which indicates that sedentary lifestyles have been increasing in recent decades leading to increased risk of Type II diabetes, cardiovascular disease, obesity and various cancers. The use of open spaces to promote physical activity is an important part of addressing these conditions in an urban setting. But from the survey it was found that old Dhaka residential areas are devoid of open spaces while the new residential areas have open spaces but still far below the actual need. The shortage of adequate open spaces, and especially green spaces, which promote healthy active lifestyle by providing an accessible, affordable and enjoyable place to be physically active could be one of the prime causes of higher incidence stress related problems in the study areas. Furthermore the prolonged exposure to the vehicular emission caused by the daily traffic in the neighourhoods can also be responsible for the increased pollution related health problems of the new Dhaka study areas. Since the built environment features and overall design show lack of consideration in promoting good health to the inhabitants the sustainability of the community as well as the residential area seems vulnerable.

Privacy

Although the observations revealed that the measured intensity of noise was above the residential threshold but majority of the residents did not recognize it a as problem. Similar responses were also found towards the degree of visual obstruction and loss of privacy caused by closely placed adjacent buildings which was quite high in the study areas. The reason of people's insensitivity towards visual and acoustic privacy could be the lack of awareness regarding the hidden ill effects of these factors on health. Needless to say, if people are left exposed to such unacceptable environmental conditions for a prolonged period of time then this would certainly impart serious physical and psychological impairment in the future generations putting the overall sustainability of the community at stake.

Access to daylight

High density is found negatively associated with access of daylight where most the apartments needs to keep the artificial lights on during daytime. This is more acute in the dense residential areas of Luxmi Bazaar and Wari than the new residential areas.

Accessibility to open spaces

The research findings disclose a negative association of gross population density with the accessibility to open space. In the current context of Dhaka it was found that higher density residential areas have less or almost no accessibility to open spaces. Insufficient, impracticable development (density) control and open space protection regulations, and to a great extent the role of market forces increasingly encroaching the open spaces, are responsible for Dhaka having the lowest amount of open space available for the residential areas. Furthermore, the pattern of planning, development and maintenance of the existing open spaces do not provide equitable access to all the inhabitants of the residential areas in terms of travel distance and time, suitability and diversity of usage. It has long been recognized that open spaces are important for our well-being. Exposure to open space, and green space in particular, is important in promoting restoration and relaxation, and reducing stress (Greenspace Scotland 2008). A number of studies have investigated the impact of green space on mental health. As far back as 1979, Ulrich found Americans' stress levels to be less after exposure to nature scenes, compared with urban scenes. In contrast to nature scenery, urban scenes lacking natural elements tend to work against emotional well-being, significantly increasing sadness, anger/aggression and fear (Ulrich RS. 1991). Besides this open spaces provide opportunities for a wide range of social interactions and pursuits that support community health and wellbeing. They allow people to interact with their natural environment and provide habitats for wildlife. The unconcern of the planning authority regarding these environmental issues would make the social, emotional, environmental well-being of the community vulnerable in the long run and in effect will make these residential areas unsustainable.

Accessibility to transport facilities:

Though literature suggest higher density areas are supposed to have better accessibility to public transport facilities but the results of this research has found higher population density having negative association with accessibility to transport facilities in the context of Dhaka. The residential areas of Wari and Luxmi Bazaar have one of the highest densities but do not have higher accessibility to public transport facilities in terms of average distance of bus stops, availability and frequency of buses. For both the residents of Luxmi Bazaar and Wari it takes about 20-25 minutes to reach the nearest bus stops and again has to wait for another 10-15 minutes as the buses are not that frequent or too much crowded. So the residents of old Dhaka relies more on alternative modes of both motorized and non-motorized vehicles like rickshaws, bicycles, motorcycles, auto-rickshaws and cars. On the other hand, the residential areas of new Dhaka with relatively lower density are found to have better accessibility to public transport facilities. Though the provision is not adequate and it takes about 15-20 minutes for majority of the residents of new Dhaka to reach the nearest bus stop but still the number of routes and frequency is higher than old Dhaka. As a result the satisfaction level of the residents of new Dhaka was found higher than old Dhaka regarding accessibility to public transport. Furthermore, the present condition of public transport in terms of service quality, frequency, excessive fare, over crowdedness, shortage of routes and frequency is not acceptable and therefore, does not ensure the sustainability of the residential areas in terms of the accessibility to public transport facilities. Due to the inadequacy and shortcomings of the public transport facilities people are compelled to rely on cars for their daily trips which is causing more fuel consumption, traffic congestion and vehicular emission harmful for the environment and the community.

Accessibility to utility services:

The accessibility of utility services was also found negatively associated with high density which indicates the high density residential areas are not still provided with adequate utility service. Though according to the theory of compact city high density ensures higher accessibility to utility services the opposite scenario has been observed in Dhaka. This indicates the overall shortage of utility facilities that is not able to meet the demand. So from the view point of accessibility to infrastructure both the transport and utility services have negative association with density which cannot ensure economic sustainability of these residential areas.

Amount of living space:

The respondent's amount of living space was also considered in the supplementary measures of urban form. Although the research found that higher density is negatively associated with the amount of living space and affordability of houses, but the respondents' attitude towards their dwelling space implied that this variable had only limited significance towards sustainability of community. However, the satisfaction level regarding dwelling space does not always rely on its size but the length of stay and the community cohesion which had a significant role to play. Perhaps due to these two factors the residents of old Dhaka despite living in small dwellings have displayed greater satisfaction in comparison to their counterparts in new Dhaka

However, in reality it would be inappropriate to attribute the production of smaller living spaces to high population density alone. In the context of Dhaka the Floor Area Ratio (FAR) restrictions, which allows extra height bonus for less ground coverage is one such factor. Due to the application of FAR there is less available built space which naturally reduces the per capita living space. This results in constructing smaller size apartments which has to compromise with the amount of living space. The application of FAR cannot be beneficial enough unless the occupancy density and amount of living space per person is considered. In addition the lack of sufficient open space in the neighbourhood promotes people to spend more time indoors. So the indoor space needs to be more spaceous in order to compromise the shortage of open space to some degree. But the private developers' concern is making profit rather than creating standard living space for the community.

5.6 Conclusion

The findings discussed in this Chapter show the consequences of densification based on the empirical study conducted in seven sample wards of Dhaka. On the basis of results from the analysis, it is evident that there is a wide range of consequences found in the residential study areas of differing densities. The findings reflect that traffic congestion, lack of public transport, lack of open spaces, thus the improper allocation of social infrastructure are the major visible consequences while health problem, social cohesion and people's lack of awareness regarding social and environmental problems are apparently the silent consequences of densification. The contradictions presented by the arguments in Section 5.5.1 signal an emerging urban crisis which questions the sustainability of the residential areas of Dhaka. Marx defines crisis as the manifestation of underlying problems. The emergence of this crisis can be identified through the residents' growing dissent stemming from a range of urban problems both apparent and hidden like traffic congestion, lack of open space, lower sense of safety, health complexities, diminishing state of social cohesion in the densifying residential areas of Dhaka. In view of the summary findings it can be said that the underlying problems of this crisis seemed to be deeply rooted in the current process of densification which is posing a threat to the overall sustainability (social, environmental and economic) of the residential areas of Dhaka. Though the current livability condition of the residential areas seems to be passing through more or less a tolerant phase but considering the growing intensity of the urban problems embedded in the very system of development process itself, the sustainability of these residential areas in the long run becomes quite questionable and uncertain. The magnitude of most these explicit and hidden problems of the dense residential areas seemed to be within the tolerable limit at present which makes them livable for the time being but if this trend of development keeps on continuing then the aggregate outcome of these multitude of problems will multiply and produce unbearable situation for the residents in near future. Under such circumstances, the livability of these residential areas will further decline questioning their sustainability. Overall the studies of this research are suggestive that although the statistical data shows a more positive result but the impact of this densification is far reaching which does not appear to be sustainable for the residential areas in the long run. So from the sustainability perspective the trend of densification of the residential areas does not appear to be sustainable at all.

Chapter 6 : Causes of Densification

6.1 Introduction

The previous Chapter has investigated the trend of densification of the study areas in relation to the emerging high rise buildings and also examined the resulting effects in terms of plot coverage, floor area ratio, block coverage and overall spatial patterns. Densification which the city is experiencing so far is more or less a recent phenomenon that gained momentum from the early 80s. This Chapter attempts to investigate how local authorities have handled and guided the redevelopment activity through this densification process which partly explains the causes of densification. In addition to this the role played by various socio-economic drivers as well as the political will in shaping the spatial pattern of the city will be discussed to address the second research question: "How the Urbanization policy and other relevant policies of Bangladesh waived away development crises facing the residential areas and what forces regulate and guide densification process in Dhaka?"

The Chapter consists of five sections. Following the introduction, the second section investigates the effect of various socio-economic forces often influenced by the shifting political drivers in shaping of the urban spatial pattern of the city. As planning policies and regulations play a major role in the guidance of urban development pattern besides the contextual drivers, the third section therefore analyzes the prevailing policies, planning instruments and machineries that serve as guidelines for controlling high density compact development. The fourth section focuses on the inherent weakness and organizational deficiency of the implementation process responsible for the growth management crisis of the residential areas of Dhaka. The fifth section summarizes the findings with concluding remarks. The policy documents, Master plans, academic studies, government and private statistical reports, academic studies, news paper clips and key personnel interviews have served as the key source of information for this Chapter.

6.2 The influences of socio-economic and political forces on urban growth

As discussed in the earlier section it is apparent that the ever changing socio-economic condition of different periods guided by the political will of the incumbent rulers acted as a major driver in determining the urban growth pattern of Dhaka. Though the British can be credited for making the first Master plan of Dhaka but significant transformation of the city as provincial capital can be witnessed from Pakistan period. The importance of Dhaka continued to grow after independence as influx of migrants rushed to the city which served as the sole economic hub of the country. The formulation and application of building regulations of various periods in addition to the socio-economic and political drivers have brought Dhaka to the present state of densification. In view of this development scenario the causes of densification has been investigated in the following through identifying the influences of various socio-economic and political forces on the city planning agenda within the application period of the dominant Building Regulations.

In addition to the influence of various socio-economic and political drivers the building activities within the metropolitan area of Dhaka has been regulated by the Building Construction Rules (BCR) formulated by the RAJUK (Capital Development Authority) as bye laws of the East Bengal Building Construction Act 1952. The Rules started in 1955 with only 5 lines of instruction on the backside of the application form. Gradually newer requirements were set-1 page in 1970, 3 pages in 1984, and 12 pages in 1996 (Rahman, 2011). BCR 1996 was reviewed several times and finally replaced by a newly reviewed bye law known as Mohanogor Imarat Nirman Bidhimala (MINB) 2008 which came into operation from 2008. These bye laws have a profound impact on the building activities rather than the overall planning rule which has brought Dhaka to the present state of densification. The following section therefore traces the development scenario of Dhaka through identifying the socio–economic and political forces within the application period of these three dominant bye laws: BCR 1984, BCR 1996 and MINB2008.

6.2.1 Development Perspective under Building Construction Rule (BCR) 1984

Before the formulation of the Building Construction Rule 1996, the only statutory policy guideline was the Master Plan 1959 which was conceived by the colonial rulers of East Pakistan Regime to absorb the sudden growth pressure caused by the migrating Muslim refugees from India after 1947. The plan was prepared following the post World War II British master plan style where the entire city was divided into a number of land use zones and was connected with a road network and other line services. These plans were rigid and did not consider the socio-economic issues of urbanisation in depth. It was basically a land use zoning plan serving as zoning regulatory measures prepared on a population base of the Provincial Capital. But the sudden emergence of Bangladesh as a sovereign state and the upgraded status of Dhaka as the National Capital turned the city to be the prime commercial hub of the country. This in turn brought an influx of rural migrants to the city. For this unanticipated population increase the land use allocation and development guidelines suggested in Master Plan 1959 proved to be incompatible and inadequate. The existing Master Plan needed to be reviewed in favour of formulating a new Master Plan for the city. But the newly emerged country under the leadership of Bangabandhu Sheikh Mujibur Rahman was faced with a host of economic and political challenges. Apart from the effects of 1970s cyclone the war ravaged country was faced with the challenge to restore its immensely deteriorating economy. The newly elected government had to focus on more serious issues like rehabilitation of millions of people displaced in 1971, organizing the supply of food, health and other necessities. Amidst all these crises the issue of city planning was subdued. The paucity of fund and a shortage of native expertise in the field of planning further delayed the formulation of the second Master Plan.

However during this period the city of Dhaka was stretched up to Azimpur, New market and Dhanmondi. Azimpur was developed for staff quarters which provided accommodation to the Public service employees while Dhanmondi was developed for housing the diplomats and elites. The residential areas of Banani, Gulshan and Uttara were considered as suburbs with most of the plots remaining vacant and no significant development was apparent till 1980 (interview of a senior resident of Banani, 2014). The old city core continued to be the prime urban area with CBD in Motijheel. The only Master Plan of 1959 was still in effect but little of the plan was adhered. For example the Mirpur area was developed for accommodating the rehabilitated population particularly the Muslim refugees according to the Master Plan. Futhermore the Master Plan conceived during the colonial occupation required a review as it was based on assumptions that became obsolete after independence. But when the average GDP growth prospect went down alarmingly to 1.5 percent due to extensive nationalization policy, the urbanization of the city met a stalemate. The precarious economic condition was further devastated by the deadliest famine of 1974 killing 1.5 million Bangladeshi people from hunger. The famine was a result of operational inefficiency of resource distribution, corruption and bureaucracy rather than food crisis which triggered major discontent against Mujib's government (Zafarullah, 1990). Amidst this increasing political and economic crisis no significant city development program was undertaken. The continuing economic deterioration and mounting civil disorder led to the government in adopting more strict control and undemocratic measures which ultimately caused the downfall of Mujib's government and transition of power to Martial Law Administrators in 1976. Thus the country fell into the grip of military control for a short period when the national economy was facing uncertainty.

Assuming the presidency in 1977 General Ziaur Rahman dismantled the martial law marking the transformation of Bangladesh's Government from the Martial Law Administration (MLA) to a democratically elected, constitutional one. There was a global rise of the neoliberal policy model in the sphere of economy and society which began in the late 1970s and was adopted by the developing countries in various stages. In Bangladesh this market-oriented liberalizing policy reforms were initiated around the mid-1980s with the support of IMF and the World Bank (Mahmud, et al., 2007). Adopting this framework means that "urban sector" is no longer just about urban housing, infrastructure, and municipal services delivery. It is also about economic growth, and job creation (e.g. ADB 1995; WB 2010). Two key features of this new paradigm are the emphasis on devolved local governance, and the reliance on the private sector. These features require a host of institutions and laws, secured land tenure, a capital market, and arrangements for private sector role in municipal services. With a view to overcome the declining economic condition the government embraced the neo-liberal policy model and introduced free markets. Overtime donor initiated privatization and structural adjustment policy (SAP) was adopted (Talabur, 2005). This helped to restore the badly affected economy of the previous regime for the time being and was reflected in the GDP which rose to 4.1 from 1.6.

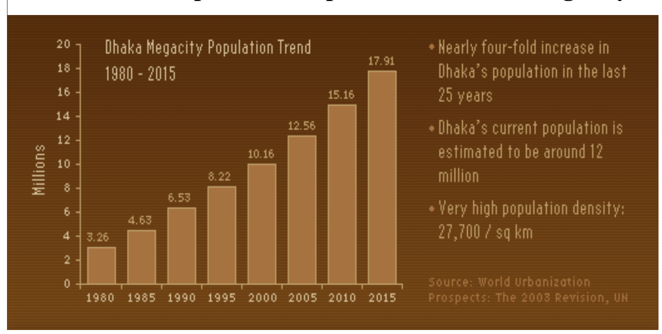
Along with crawling towards a democratic order, the civil-military bureaucracy ran and managed the state of affairs along with widespread and frequent criticism of the bureaucracy on the charges of corruption, lethargy and malpractice (Ahmed, 1995). A fresh Master Plan was long overdue but due to the persistant economic instability and administrative turmoil no remarkable initiative was made to evolve a mechanism for effective urban planning of the city during Zia regime. Dhaka continued to be the main economic hub of the country. The first commercial high rise building was constructed in Motijheel. Sangshad Bhavan in Sher-e-Bangla Nagar was completed and the developmental work of satellite towns were going on in a slow pace according to the Master Plan 1959. But as the planning considerations of 1959 Master plan was proven insufficient and it failed to provide an effective growth strategy for the city. However, one of the major contributions of this Master Plan was the laying of the 8 major road arteries that determined the future growth axis of Dhaka towards north. The developmental work again came to a pause due to political turbulence caused by Zia's assassination in May 1981.

The administration was immediately succeeded by President Justice Abdus Sattar for a brief period. The new government had to face a severe budget deficit to the tune of 4 billion Takas, and the International Monitory Fund (IMF) declared that it would not provide any more loans until Bangladesh paid down some of its existing debts. Citing the country's social, economic and political crisis, General Hossain Muhammad Ershad assumed the presidency in 1982, retaining his positions as army chief and CMLA. From August 1975 to December 1990, Bangladesh experienced the rule of two consecutive military regimes – Zia regime (1975-1981) and Ershad regime (1981- 1990). During this long 15 years, these two military rulers had tried to tinge their regime with civilian colour by holding elections and running the parliament. The autonomy instilled by them has left significant impact on the socio-economic condition of the country which is discussed in the following:

The 1980s decade was governed with political autonomy but with positive development in the economy. Right before the bloodless coup led by the Army Chief of Staff Lieutenant General Hussain Muhammad Ershad the country was going through great economic difficulty. Among his first actions were to privatize the largely state-owned economy (up to 70% of industry was in public ownership) and encourage private investment in heavy industries along with light manufacturing, raw materials, and newspapers. Foreign companies were invited to invest in Bangladeshi industry as well, and stiff protectionist measures were put in place to safeguard manufacturing. Bangladesh has been going through macroeconomic policy reforms along neoliberal lines since the late 1970s. The liberalization policy graduated in three steps in the mid 1980s, early 1990s and mid-1990s, steering Bangladesh's economic policy in a dramatically opposite direction. Subsidies in agricultural inputs have been gradually withdrawn since the early eighties (Ahmed, 1998). Several rounds of industrial policies saw more and more sectors opened up for private entrepreneurship while state-owned enterprises were privatized. As a part of the same package, import tariffs were reduced with profound impacts on the pattern and composition of the manufacturing sector in the country (Mahmud, 2004). All these steps initiated a change in the occupational pattern as more people were getting involved in the secondary and tertiary sector. The consequences of this occupational change was reflected in the urban planning of Dhaka as new CBDs along the north axis started emerging providing jobs for these emerging working class.

According to demographers Bangladesh entered the demographic window from 1990s which is defined to be that period of time in a nation's demographic evolution when the proportion of population of working age group is increasing and dependency ratio (ratio of dependents to working-age population) is decreasing. The demographic window of opportunity usually lasts for 30–40 years depending upon the country's fertility rate. In case of Bangladesh the demographic window will reach its peak during 2020s and will remain open until the 2030s according to the estimation of UN2010 (Chart 6.2). Consequently being the economic nucleus of the country Dhaka has already witnessed the unprecedented growth in its share of urban population due to natural growth as well as rural migration. This boost in the proportion of working age population subsequently led to a phenomenal increase in housing demand (informal and formal sector) of the city. This increasing demand for housing could not be ensured by the Government alone and had to rely on private sector. Being in the line of neo-liberalism policy model the government continued to maintain the role of facilitator rather than provider in case of formal housing sector.

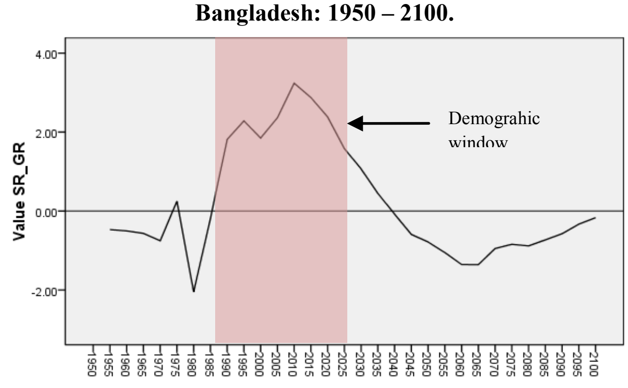
Chart 6.1: Population Explosion of Dhaka Megacity



Source: World Urbanization Prospects: The 2005 Revision, UN

The escalating demand for housing brought the attention of the investors in the real estate market. The prevailing sub division law did not allow land to be subdivided below 5 *kathas* in the formally planned residential areas. This posed a problem for dividing the land equitably among the legitimate heirs according to the Muslim law of inheritance which led the beneficiaries to find a solution through way of constructing multistoried buildings. In a multistoried building each

Chart: 6.2 Growth Rate of Support Ratio (Per cent) Bangladesh: 1950 – 2100.



Source: UN (2010). Medium Variant

inheritor gets a fair share in terms of the number of apartments which he or she can use for self accommodation as well as use the rest for rental purpose. Consequently more and more property owners of the planned residential areas started redeveloping their land or property into multistoried buildings which offered a means of both accommodation and profit making. Both the land owners and developers found this type of redevelopment activity beneficial and were engaged in deals of 40-60 percent share. From 1980 to 1990 the population of Dhaka doubled which further escalated the demand for housing and shelter. In the face of land scarcity the rising demand for housing was tackled through vertical development first introduced in Dhaka by the formal private developers in mid 70s. The business took off with five registered firms. The first high rise apartment was built in Siddeshwari which marked the initiation of apartment culture. As the main impetus of the real estate developers were undeniably profit making the upper income group (i.e. higher middle and middle income) became their target group for housing provision. Furthermore the inflow of foreign remittance from the off shore Bangladeshies contributed to this type of housing scheme as they found it profitable to invest in the real estate market where both land and housing were considered as a vehicle of speculation. Government's initiative in developing various satellite towns accelerated this process where majority of the allotted plots went under the ownership of the wealthy class to be harnessed as a means of speculation. As the developers' activity was getting momentum a gradual but steady rise in the population of the satellite towns of Banani and Gulshan could be observed from early 1990s while Uttara was still undergoing the development phase with most of its plots still vacant.

6.2.2 Development Perspective under Building Construction Rule (BCR) 1996

The decade of 90s witnessed the transition from autonomy to democracy following a mass protest that ends the long era of dictatorship. The first half of the decade (1991-96) was under the rule of the democratically elected Bangladesh Nationalist Party (BNP). Soon after assuming the power BNP was met with a host of challenges. Khaleda regime initiated a series of measures to liberalize the economy and the financial sector. The structural adjustment policy (SAP) of the World Bank and the International Monetary Fund (IMF) envisaged inter alia deregulation of the private sector, improvement of Government-Business relations and privatization of public enterprises. Thus a distinct shift in the role of the government was becoming more apparent from a regulator to that of facilitator in economic management (World Bank and Ahmed cited in Zafarullah, 1997:5 Part-4). This further fueled the involvement of private sector in housing supply. The small number of developers who started haphazardly in mid 1970s consolidated into more organized form under the umbrella institution of Real Estate and Housing Association of Bangladesh (REHAB) in 1991 with 19 members.

Despite a shift in the form of government, the country faced widespread corruption and sudden changes in economic practice in the years 1990-92. Besides, a host of natural calamities (eg. cyclone Cidar and subsequent flooding) also took a toll on the national economy. Consequently investors were not interested in investing during this economic recession. So, during this period the country faced a recession in the real estate market as well since Real estate is heavily dependent on investors. Amidst these political and economic crises little attention from the government was paid to the developmental works of the city. However, the long awaited second Master Plan DMDP 1995 was formulated at the end of the BNP administration when the government was facing a general strike aimed at forcing resignation of Prime Minister accused of corruption and competence. Against such a backdrop of political unrest and marginal time the government was not able to accomplish its implementation. There was again a change in the ruling political regime as Awami league wins the power seat after BNP's five years tenure. During the ruling period of Awami league (1996-2001) most of the policies suggested in the Structural Plan of DMDP 1995 was not carried out properly due to the absence of Detail Area Planning (DAP). Instead piecemeal planning solutions were worsening the city's growth plan. After the recession of 1990-92 the real estate business gradually took off. But due to the lack of a complete development planning package for the city the redevelopment activities of the private sector were concentrated in the planned residential areas like Dhanmondi and later spread to Banani and Gulshan without taking into account the infrastructure capacity and amenities necessary for supporting such development.

The haphazard construction of mid and high rise buildings initiated vertical growth within the city and the authority was faced with the challenge of providing adequate utility services to meet the demand of these vertical habitats. As the existing SP and UAP was not helpful enough to control the redevelopment spree that was taking place, RAJUK sought the aid of Building Construction Rules and framed the BCR 1996 which viewed a building only within its plot boundaries, using no tool other than setbacks and later imposed a height limitation of 6 stories based on road width and other few requirements for vertical development. Though better in many aspects than BCR 1984, the BCR 1996 did not take into account the environmental considerations of the building activities and therefore was a major cause of the emerging densification pattern i.e. the densely developed 6-storied high multistoried buildings all through the city in the later years. However the gradual increase in investment following the recession of 1990-92 resulted in a huge supply of this prototype vertical housing in the real estate market during 2004-06. As a result the land price shot up unrealistically making housing price beyond the affordability of the mass public. The real estate business attracted investors by providing lots of good products. Subsequently, it also attracted many new entrepreneurs who lacked relevant experience and adequate infrastructure backup to invest in this sector. However, the real estate sector was found adding incremental output in the real economy on the supply side, while also bringing up demand from newly-created employment and income, preserving real sector stability. This even strengthened the industry's existence as a major provider of housing.

By the time a noticeable transformation due to globalization can also be observed taking place in the socio-cultural sphere of the country. Advent of communication technology through launching of cell phones, satellite TV, and internet services at public disposal had an enormous impact on the cultural values, customs and living pattern of Bangladeshi people. Ahmad (2004) noted that the high intensity of invasion of the household is done by the global electronic media, particularly television. This was changing not only the thought process but also the living systems, consumption patterns, and even the very nature of such human desires as love and sexuality (Rahman, 2014). This cultural hybridization started from 90s and within a couple of years a visible change was evident in people's way of living. Behavioral pattern and lifestyles in Bangladesh got a new form influenced by Western culture. The reflection of invading Western cultural values and practices could also be observed in the family structure where the emergence of nuclear family was gradually outnumbering the traditional extended and joint family. Most of these nuclear families (parents and one or two children) prefer to dwell in apartments with two or three rooms. From the field survey 2014 nearly half of the apartments built by the developers in the study areas were found to be between 1,000 to 1,600 square feet which are ideal habitats for the emerging urban nuclear families. Besides economic condition this socio-cultural transition also worked as an influential factor that made urbanites of Dhaka particularly the higher middle and higher income group to adopt apartment culture quickly. On the other hand, only 2% of the residential apartments provided by the private sector are less than 700 square feet, which indicates that the real estate sector has not quite been able to address the low-income dwellings.

Nevertheless the apartment culture soon gained popularity within the affluent class for a number of reasons. Firstly, as mentioned earlier in this section, the prevailing sub division law of land promoted the new generation of property owners to opt for apartment construction which ensured them both shelter and a steady source of income. Secondly, the hike in land price and the cumbersome process of construction drifted away most people's interest towards preferring apartments. Thirdly, the redevelopment activities of the existing planned residential areas offered opportunities for the middle and higher middle income group of the old city core as well as other parts of the city to relocate into these high class residential areas with better facilities and connectivity in pursuit of improved lifestyle choices and status. Lastly the declining micro economic condition along with the inclination towards westernized life style worked as catalysts in changing people's preference from detached low rise dwelling to high rise apartment. Furthermore the visual appeal and living standard of the ready to use flats as well as the security and facilities offered in vertical habitats played a major role in the popularity of apartment culture. Moreover, the issue of safety and security of apartments is another factor for preference since it has been obligatory for an apartment building community to have a management consisting of the apartment owners responsible for the overall building. All these reasons have been shaping the apartment buyers' decisions and preferences. Again the significant number of absentee property owners i.e. the wage earners in Middle East and other foreign countries are also the potential buyers as well as investors and therefore a major contributing factor towards the increasing demand for apartments during this period.

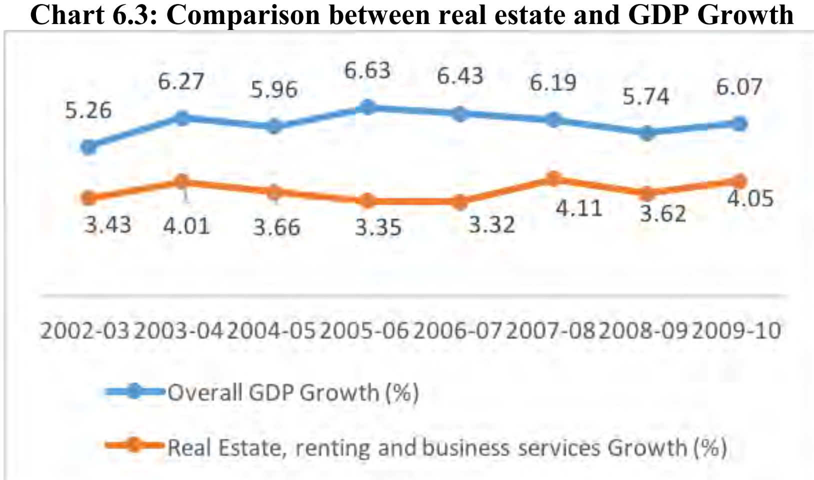
Hence three major factors namely, the lack of local planning guidance due to incomplete Master Plan Package (DMDP 1995), the lack of environmental consideration in BCR 1996 and the socio-cultural transition towards western values and lifestyle can be considered responsible for the densification that occurred in the residential areas during this period.

6.2.3 Development Perspective under Mohanogar Imarat Nirman Bidhimala (MINB) 2008

BCR 1996 rules were mostly framed by non-professional bureaucrats where the arbitrary requirements were not thoroughly researched in relation to developing a desired physical and climatic environment. Coupled with weak implementation, such inconsiderate rules could neither control unplanned growth and violations, nor give any direction towards the planned development of a burgeoning city. On the contrary these set of rules contributed in cultivating corruption, deteriorating the environment, enticing illegal construction, destroying neighborhood harmony, wasting space and resources, and endangering lives. Therefore the urge for an appropriate and modern rule was developing in the backdrop of some building accidents in the 1990s. The authority, though alarmed, could not overcome red tape and mindset to enact new rules and improve the enforcement procedures (Rahman, 2011). Meanwhile as response to the increasing demand of housing and shelter the real estate business kept on flourishing with an increased number of apartment builders appearing in the market. The sector showed a tremendous boost during the period of 2004-06 which indicates the intensity of market led densification (REHAB, 2007). Therefore by the first half of the new millennium the bulge of unguided building activity regulated only by BCR 1996 rules and carried out by the Market led densification left the residential areas of Dhaka mostly packed with 6 storied multistoried buildings which brought serious environmental consequences as well as urban crises.

Realising the environmental hazards and increasingly declining livability of the residential areas RAJUK once again tried to control the development through preparing a new set of Building Construction Rules known as Mohanagar Imarat Nirman Bidhimala with the aim of a greater interest i.e. sustainability of the city rather than benefits of individual plot owners. After several reviews, a gazette notification of the new Rule was made on 12 April 2006, which thus became mandatory for all concerned. However, this was not made operative until February 2007 while the BCR 1996 continued to be used. In the confusing situation with two parallel rules, vested quarters took advantage of the older rule that was supposed to be abandoned due to shortcomings mentioned above. Moreover, some of the provisions were in conflict with those in the Bangladesh National Building Code (BNBC) that was made mandatory in November, 2006. Thus two more major revisions of MINB were adopted subsequently as the 2007 and 2008 Rules respectively. With the abolishment of previous height restriction MINB 2008 introduced the FAR which would determine the height of the building in relation to the road width and plot size. The rule is applicable to all the areas of the Metropolitan Dhaka irrespective of any density limit. Hence, MINB 2008 paved the way for vertical expansion which initiated the emerging trend of building high rise buildings more than 6 stories. So from 2008 onwards a new generation of high rise buildings both residential and commercial started invading the horizon of the residential areas of Dhaka.

Chart 6.3: Comparison between real estate and GDP Growth



Source: REHAB, 2012

Though the national, urban and Dhaka population have been growing with declining rates, Dhaka metro went through an upward curve during the latter half of the last inter-census period of 2001-2011. It was observed that there was a sharp increase in in-migration during this time after 2005 (BBS 2011). In the period from 2006-08, due to the changed socio-political scenario all sectors of the economy, including real estate, showed declining trends during this time. Many novice realtors ceased doing business. After this situation ended, the economy took off again. People resumed investing and the real estate sector experienced a boom again during 2009-11. But this boom was unlike the previous one of 2004-06 and did not last long (REHAB, 2010). Despite the fluctuations the real estate sector made major progress during the period of 2005-2010. In fact, the real estate renting and business services have expanded every year from 2001-2010 due to sustained macro-economic stability. The Chart 6.3 shows the comparison between overall GDP (Gross Domestic Product) growth and growth of Real estate, renting and business services. This period witnessed an increase in price of the properties which boomed the real estate profit. By 2010 more than 1500 companies were active in the real estate sector with 1081 of them registered with REHAB (Seraj, 2012). Apart from the corporate ones there are also many other companies/individuals engaged in such development in smaller scale and selling apartments to friends and relatives only which is especially found in old Dhaka.

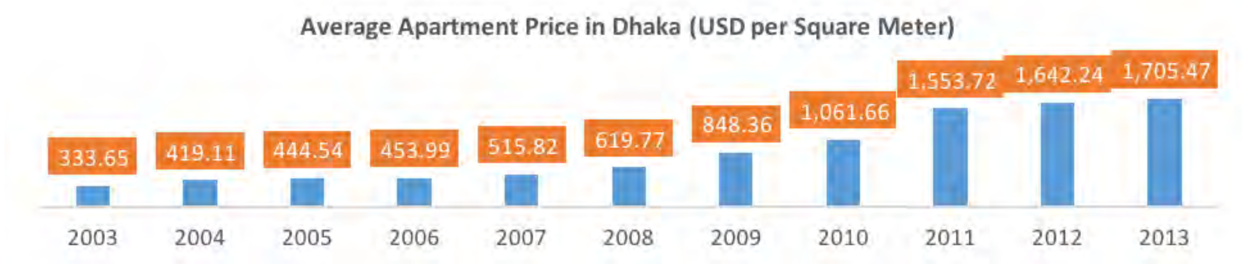
The land price increased in this period for a number of reasons. Government could not provide adequate infrastructure and facilities to the newly proposed sites of development in Dhaka due to the paucity of funds and visionary planning. Consequently growth was concentrated in the existing residential areas. As government had no control on land market the developers' led concentric nature of growth within the existing residential areas contributed to the price hike of land. Another potential reason which can be attributed for increase of land price is the land use conversion of residential plots to commercial use which was frequently taking place in the existing residential areas. There is sufficient evidence to support the linkage between land use regulation and housing affordability. Two recent Harvard University studies showed that land use conversion increased average housing prices between 1.3 and 4.7%, depending on the intensity of land use regulations in a county (Cho, Wu and Boggess, 2003). The price of land increased in areas like Dhanmondi, Banani, Gulshan after independence due to the above mentioned factors. Despite low level developers' activity in old Dhaka in early 80s the land price of old Dhaka remained considerably high for its importance as a commercial hub which always played a significant role in the regional and national economy (Islam etl, 2007). The price of the apartments escalated as a result of the raise in land price and associated building products. The price hike continued upto 2011 with prices of TK30000/ sq. ft. in locations like Dhanmondi, Banani and Gulshan. The per capita income has shown a rising trend since 2009, and it is higher than the trend in 2002. The growth rate of Real Estate, Renting and Business service sector has increased over the 2002-2010 period. However, compared to overall GDP growth, this sector expanded at a slower rate, which explains the downward trend in real estate as a percentage of overall GDP.

Chart 6.4: Land price trends of Dhaka

Source: Sheltech Survey, 2014

In the last four decades private developers have delivered more than an estimate 100000 units of apartments to the nation with an average of 9000 apartments each year (Sheltech, 2011). According to Bangladesh Bureau of Statistics, the construction sector accounted for a record 9.1% of GDP (Gross Domestic Product) in fiscal year 2012/13. But as the development activity carried out by the private sector was largely unguided, it contributed to uncontrolled densification of the residential areas leading to a host of environmental consequences. On the other hand it escalated the land price which peaked in 2011 forming an asset bubble that had a direct impact on the apartment price. Again the crash of the stock market had repercussion on the housing market as the affordability of the people suffered severely. This was coupled with the political unrest in late 2013 which dented the country's economic outlook, leading to lower consumer and investor confidence. All these factors melt down the booming business of the real estate. More and more apartments remained vacant with real estate facing a bank loan of 4212 crores. Apart from the overall economic condition the real estate companies could not get bank loans in a reasonable margin for real estate projects. As the asset bubble behaves in a symmetrical fashion in respect to time and price its reflection could be observed from the beginning of 2014 when the apartment prices started falling. In order to bounce back the real estate sector in business the government declared that people who have undeclared money can now invest in property to legalize it.

Chart 6.5: Upward trend of apartment prices in Dhaka (2003 - 2013)



Source: Sheltech Survey, 2014

Despite the political unrest that occurred in late 2013, Bangladesh emerged as the second favoured investment destination in South Asia after India. The US Government's 2013 investment climate statement for Bangladesh notes that the country presents promising business opportunities because it offers a "highly competitive labor force, an entrepreneurial business community and a resilient and steadily growing economy". The country was found different in projecting 7 percent growth for the FYP 2016 even with the lowest fiscal capacity.

2014 was an interesting time for real estate market. A renewed consumer interest could be seen stemming as a lot of people tried to take advantage of the low price property market situation and made more purchases than the preceding year. The country's economic development and rising standard of living were the key drivers of this change, according to property agents surveyed by Lamudi Real Estate online service. Top three key influences on the investment environment were 71% economic development, 36% rising standard of living and 32% infrastructure development. In the property market, whilst apartment remains the most commonly searched estate, there was an overall growth in search for all properties across the year of 2014.

In 2015, Bangladesh became the 4th fastest growing economy in South Asia, down one position compared to 2014 due to political uncertainty and unfriendly business policies. The growth of customer pessimism had strengthened where Dhaka had 20,000 apartments ready for sale, compared to 13,000 unsold apartments in 2013-14. Developers have been forced to reduce prices by 11 percent and land prices by 14.2 percent to entice customers. In contrast to only 17% rent requests for rent in 2014, the figures drastically became a 60-40 split between buying and renting in 2015 in the real estate market. Even though apartments are 26.92% cheaper than their peak in 2012 Dhaka remains the most expensive place to buy or rent property across the country. Though the demand for housing prevails, the bulk of unsold apartments of the real estate developers indicate that these luxurious high rise buildings are not built to address the overall demand but to serve their own ends which is profit making. This implies that the densification of the existing residential areas that gained momentum from 90s was largely a market led densification rather than demand led. Since motivation behind the private sector's housing is profit maximization they are the least concerned about the negative impacts which the unguided densification exerts on neighbourhood liveability and sustainability of the city as a whole. Though the contribution of real estate developers in the supply of housing is quite significant but this is accounted for just 30% of the urban population comprising of the well to do class. The vast majority of the urban population belonging to low income class still cannot afford a decent home and environment to live in. Clearly a political intervention has been long overdue to strike a balance between the two ends in order to serve the public interest. However, government had already taken some steps to rectify the situation by unlocking the liquidity in the banks formed by the asset bubble. The real estate sector is in a very precarious position in the current year (2016) given the difficult period it went through the year before. The pace of slow and steady growth was hampered by the political unrest which happened in the month of January 2016, significantly slowed down the whole economic engine of the nation.

Government in a measure to boost sales had halved VAT on small flats by 1.5% making them more affordable to middle income families and on larger flats increased by 50% to 4.5%. Additionally, Housing loan ceiling has been increased to Tk. 12 million from Tk. 10 million previously to support customers against rising construction costs. In order to decongest the residential areas the government has also taken initiative to evict all the illegal commercial setups from the existing residential areas. Though the eviction strategy is subjected to controversy and requires more insight but nonetheless the effort is praise worthy. All these measures seems to have positive effects on people's growing confidence and interest in buying apartments which was reflected on the leading real estate online portal of Lamudi website thorugh a increase in the percentage of property searchers in 2016 than in May 2016. According to Lamudi on site data most searched area is Mirpur, Dhaka, 29% of the property seekers are finding house in Mirpur area in 2016. Uttara is standing in second position as 25% of property hunters are searching property in this area which could be attributed to the well connectivity and reasonably affordable property price and rental structure of these two areas. The scenario was almost similar for first two places in 2014, where Mirpur and Uttara were in first and second place consecutively. With technological advancement through internet availability and government intervention as regulator the real estate sector can be utilized in developing residential areas to the benefit of both customers and developers.

The preceding Section 6.2 has provided an insight into the socio-economic and political factors working as the driving forces in the development and densification of residential areas of Dhaka. The following section will investigate the role of relevant planning policies and guidelines regulating the development process and how practice differs from planning and why?

6.3 Planning Policies and Strategies

The policies responsible for guiding and controling the urban development in Dhaka can be broadly divided into two categories: staturory planning policies and bye laws and regulations which are discussed in the following:

6.3.1 Major Statutory Planning Policies

Town Improvement Act (TIA) 1953 and Building Construction Act 1952 are the two major legislative measures upon which the planning machineries as well as the subsequent planning polices and development control rules have been formulated. Under the TIA 1953 the local authority of Dhaka Improvement Trust (DIT) was formed who chalked out the first Master Plan for Dhaka in 1959 for initiating a formal planning of the city.

Table 6.1: The major planning instruments used in controlling the development activity

1995 - 2010	2010 - present
Structure Plan (1995 - 2015)	Structure Plan 1995 - 2015
UAP (1995 - 2009)	(DAP 2010 – 2015)
Building Construction Rules 1996	-
Draft BNBC -1993, BNBC 2006, BNBC 2008	BNBC -2008
Imarat Nirman Bidhimala 1996, 2007	Imarat Nirman Bidhimala 2008

Source: Author 2015

Following the post World War II master plan style the Master Plan 1959 was prepared in map form for the entire DIT (the previous name of RAJUK) area with a scale of 1: 20,000 showing the proposed land use and infrastructure development. The fast expanding high density core and adjoining areas of Dhaka were shown in a second map with 1: 3960. The plans were accompanied with explanatory report describing the plan contents more elaborately with proposals and necessary administrative, institutional and legal measures for implementation of the master plan. These plans were rigid and did not consider the socio-economic issues of urbanisation in depth (Chaudhury, 2010). So in the post independence period of 1971 Dhaka had only one major policy document i.e. The Master Plan of Dhaka 1959 which was conceived by the colonial rulers of West Pakistan and was based on some assumptions which turned out to be obsolete in the post independence period. One of the major assumptions was the projected population on which the entire land use of the city was determined. But the phenomenal rise of population due to in-migration in the successive years not only upgraded the status of the city to Megacity but also formed a huge deficit in housing stock. This required an immediate review of the Master Plan which could not take place before 1995 due to the political and economic instability periodically hampering the planning process as discussed in Section 6.2.1.

The First Master Plan was targeted for a 20 years period from 1959 to 1979 on a population projection which turned out obsolete. The time lapse of more than 16 years between these two Master Plans resulted in haphazard spontaneous development throughout the city where the 1959 Master Plan was basically used as a zoning regulation. In 1987 DIT was converted into RAJUK and its jurisdiction area extended from 830 sq. km to 1528 sq. km. As the land use planning proposals of 1959 Master Plan was limited within the boundary of the former jurisdiction area it became obsolete for determining the land use of the newly extended jurisdiction area. In the absence of any zoning regulations for the newly defined areas under RAJUK up to 1995 densification took place all over city without any planning guidance. Development control was practised based on a series of bye laws, circulars, notices issued from time to time by the local authority. The impact of these planning instruments on the redevelopment activity of the study areas are discussed in the Section 6.3.4.

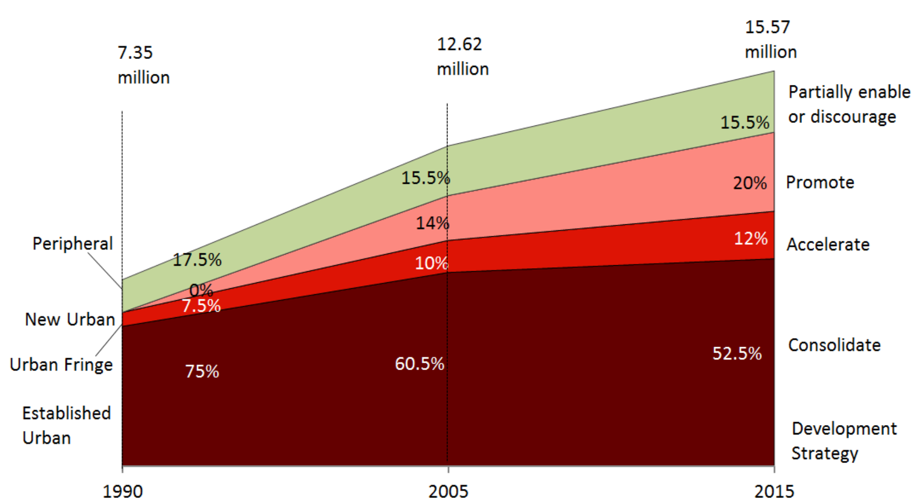
With a view to overcome the shortcomings of the previously practiced Master Plan, the Town and Country Planning Act 1968 of Britain introduced a new planning style called Development Plan with new form, content and procedure. It was later promoted by UN Habitat during 1980s. Therefore the Development Plan approach was adopted for preparation of the second Master Plan of Dhaka. Such planning package consist of a two tier hierarchical planning system comprising *structure plan* and subsequent *local plan*, together forming the development plan. Structure plan being a broader and more flexible of plan at strategic level, while local plan to be more certain, pertinent and detailed at local level. In 1991 with UNDP assistance, RAJUK launched the project of preparing the second Master Plan for Dhaka following Development Plan model. For Dhaka a two tier planning system - Structure Plan and Detailed Area Plan was proposed. But owing to the paucity of fund the project had to end abruptly without preparing the detailed area plan. However, as an interim measure the consultant prepared what is known as the Urban Area Plan (UAP) suggesting interim planning measures for the main city area. These measures were to be followed till preparation of the detailed area plan (Chaudhury, 2010). But the detailed area plan could not be undertaken till 2004, nine years after preparation of the Structure Plan. In 2004 RAJUK undertook a project to prepare detailed area plans for its entire area under DMDP, to be completed within two years. However, after long delay the project has been completed in 2010.

So from 1995 the second Master Plan came into effect which was a hierarchical package of three tiers: Structure Plan (SP), Urban Area Plan (UAP) and Detail Area Plan (DAP). The Structure Plan was a set of policy statements covering the broader issues of planning while Urban Area Plan provided some interim planning guidelines for special planning zones (SPZs) but the actual planning guidance in compliance to the structural framework at specific sub-areas (i.e. neighbourhood level) was supposed to be provided through DAP. But as mentioned earlier the Detail Area Plan was not prepared until 2010, 15 years from its expected date which further contributed to the unguided development taking place all over the city. Despite the belated arrival of DAP, there existed a lot of inconsistencies in its decisions which failed to provide a logical measures and planning guidance for Dhaka and was therefore partly responsible for the prevailing growth management crisis of the city at present.

6.3.2 Absence of Densification Strategy

There has been no comprehensive densification strategy proposed in the statutory planning documents other than prescribing a generic density figure ubiquitously applicable for all areas. The 1959 Master Plan suggest the density to be 200 persons/acre and net residential density of 334 persons/acre for an urban

Figure 6.1: Land Expansion Strategy in the DMDP, 1995-2015



Source: DMDP, 1995-2015

area of 320 sq. miles. As the next major statutory document Dhaka Metropolitan Area Intergrated Urban Development Project (DMAIUDP) 1981, which was a comprehensive basis for DMDP gives some considerable guidelines regarding the flood and drainage problem of Dhaka Metropolitan Area (DMA) but does not cover the density issue. The DMDP Structure Plan report identified the order of magnitude and the direction of anticipated urban growth and set forth a series of policy guidelines for achieving the overall plan objectives. It suggested to carry out the development of housing in both old and new residential areas (DMDP, 1997a; p.36) duing its enforcement period of 20 years but did not mention any recommended residential density or prescribe any guidelines for controlling the development intensity. Under this development strategy the old city core further densified and extended, while the residential areas of new Dhaka continued densifying with multi storied apartment buildings. The DMDP Structure Plan promotes dense urbanisation in the newly developed urban areas and partially enables or discourages peripheral land conversions (Figure 6.1).

The DMDP Urban Area Plan (UAP) set forth brief interim mid-term strategies for development management (DMDP, 1995, Vol II, P6) of DMA which suggests that current RAJUK practice of allowing 6 storey buildings in planned developed areas should continue: if high densities are to be permitted anywhere, it should be in areas where existing infrastructure provision is the highest. The practice is also appropriate in the context of anticipated density increases in existing area. In spontaneous growth areas, development up to 6 stories should only be permitted where it would not overburden inadequate infrastructure networks. Though it was a mid-term strategy (1995-2005) supposed to end in 2005 but it was valid until 2010 because of the absence of DAP. Despite having had a draft national housing policy from 1993, governments have been apathetic towards adoption of the policy over the last two decades. The policy has gone through at least five revisions and scrutiny by 25 government departments, since then but has yet to gain the seal of approval. However, in Government's Draft National Housing Policy 2008 there is currently no mention of minimum residential density standards and it is unclear whether they will be included in the final version. The insufficient density control guidelines with no regard to population planning and infrastructure availability contributed in the unguided densification of the residential areas.

The preparation of the Draft Report of Dhaka Structure Plan 2016-2035 has been completed by the Consultants of RAJUK (Saman-Han-A-Devecon-Sheltech) in March 2015 and currently undergoing the process of thorough and critical review before final approval of government. The report consists of 13 chapters with a Chapter dedicated to effective land use management for livable Dhaka. Another Chapter covers the issues of affordable housing for all. The proposed policies regarding housing and land use in SP 2016 - 2035 are elaborated in the Section 6.3.3.2.

Apart from these major planning statutes the other laws which are relevant for the density issues are the land ownership and land subdivision law. Freehold is the primary form of land ownership of Bangladesh enabling individuals and the private developers to own land permanently which could be acquired through purchase, inheritance, gift or settlement by the government (Satu, 2014). This gives the landowner the right to possess, use, mortgage, sell and bequeath the property other than development and construction of buildings which require government permission. According to the Muslim of Law of inheritance the land is subdivided among its lawful inheritors/beneficiaries that acts as the main law of subdivision practised in the country. Government has only one rule which does not allow plots to be subdivided below 335 sq.m. *(5 kathas)* in planned residential areas. All the planned residential areas of the city constitute only a small portion of the city while for the rest of the unplanned residential areas there are no such regulatory measures for subdivision. This results into the subsequent fragmentation of land into smaller plots and increase density. Since a vast portion of urban land is under public ownership government cannot acquire sufficient land for effective development activity.

6.3.3 Land use planning

The basic land use pattern for Dhaka city was established through Master Plan 1959 adopting a single land use approach. Thereafter land use guidance remained missing for a period of 16 years for the extended area under RAJUK jurisdiction. Proposal for land use zoning standard was first formulated in DMDP Urban Area Plan for an interim period which promoted a mixed land use approach instead of the single use pattern. The UAP proposals were supposed to be elaborated in Detail Area Plan (DAP) which became a subject of controversy. The land use planning at the strategic level (SP, UAP and DAP) along with their notable inconsistencies are discussed in the following:

6.3.3.1 Land use planning in SP and UAP

The 1995 Structure Plan divided Dhaka metro into 26 Strategic Planning Zones (SPZ) with thirteen land development management zones. For each of these land development management zones, three categories of land uses were indicated: permitted uses, conditional uses and uses requiring special review. The 1995 Urban Area Plan, as the second tier of the 1995 DMDP, proposed land use zoning following the policy guidelines of the 1995 Structure Plan. It suggested a concentrated and mixed land use development strategy. Residential development was permitted in two zones, namely in mixed land use planned and mixed land use spontaneous zones. Thus the planned residential areas as developed under the1959 Dhaka Master Plan also continued to possess non-residential uses such as office, commercial and other institutions as permitted on the plan. But the Structure and Urban Area Plans do not provide any land use zoning principles which could be applied to design subsequent development. There are contradictions and lack of clear definitions. The Plans demarcate broad areas for future development but inherent contradictions/loopholes have provided scope for manipulation and encroachment. Guidelines have been provided in the Plans, but there are no directives for implementing them; hence, the Guidelines have been ignored by the implementing agencies. The plans have become non functional and have limited relevance to resolving the present urban management problems.

6.3.3.2 Land use planning in DAP

The Detailed Area Plan (DAP) was conceived as the third and lowest tier of the DMDP planning hierarchy. However, due to institutional failures, lack of fund and inability to develop internal capacity RAJUK took up the DAP preparation project in 2004 and completed in 2010, fifteen years after the preparation of the DMDP. The DAP was prepared for the entire RAJUK area of 1528 sq. km, and not for selected SPZs as suggested in the structure plan. The Detailed Area Plan project area was divided into 5 groups and 11 locations on the basis of geographical location and settlement pattern. DAP has suggested a number of generic proposals for guiding the land use pattern of the city. Most of these plans are not based on any rational justification which in turn makes them frustratingly hypothetical in nature. Some of the proposals in relevance with densification are highlighted in the following:

DAP has proposed a density of 158 persons/ acre (Dhaka main city) through allocation of a huge amount of land for residential plots in outer Dhaka. The current density in main Dhaka is 800 persons/acre ranging from 235 persons/ acre (New Dhaka) – 3742 persons/ acre (Old Dhaka) To achieve the proposed density the main city needs to be decongested first about which DAP suggests nothing. Furthermore no consideration has been given for proper allocation of supporting facilities and infrastructure in the proposed residential areas which would simply contribute to traffic congestion in the main city as people would be commuting frequently for availing these services. DAP has set a disproportionately high portion of land (17% - 46%) for planned residential areas for the rich and middle class with relatively less emphasis on the lower class which would not only spoil the green areas, water retention areas, existing open spaces but also encourage inequity detrimental for social sustainability. DAP has also allocated open space far below the standards which threatens environmental sustainability. It has even failed to ensure citizens' needs for parks and other open spaces as per the city's development plan. The Dhaka Metropolitan Development Plan (DMDP) suggests that Dhaka City had 0.5 square metres of green space per capita in 1995 (RAJUK, 1995). But DAP suggested only 0.052 square metres of green space per capita, less than the number put forward in the DMDP (Bari & Efroymson, 2009). Over all the supply of open green space in Dhaka is much less than the WHO recommendation of nine square metres per capita.

Regarding the ongoing crisis of commercial infiltration in the residential areas, DAP proposed concentration of general public services into a number of designated areas without assigning how and from where space requirements for the services would be met. In connection to it has suggested to remove offices, hospitals, clinics and schools from Dhanmondi area. Removing these facilities would invariably increase demand for automobile access, leading to more congestion and pollution increasing journey time and affecting their accessibility to low income people. DAP has provided no assessment of traffic load generating from such concentration. Together it follows a car-oriented planning approach proposing to construct more and more roads, flyovers, elevated expressways and facilities for car parking increasing the modal share of car use and decreasing share of public transport which would only contribute to more fuel consumption, segregation and urban sprawl. The original Structure Plan involved a concentrated and mixed land use development strategy, which is preferable for many reasons to strategies involving single-use areas. Despite this, DAP has deviated from the original Structure Plan and opted instead for the land use policy of STP: the Growth Pole Scenario.

The deficiencies of DAP can be attributed to a number of factors involved in its preparation stage. Under DAP, no comprehensive data collection exercise was undertaken to estimate the overall land-use requirements for DMDP area. As a result, all the land use proposals of DAP are hypothetical in nature, providing no insight into how the actual land-use demand for various purposes will be met in future. DAPs are supposed to make detail guidelines and plans of small chunks of land not more than 2-3 hectares which would provide detail design guidelines regarding the plot wise occupancy type of the built structure and other design features compatible with character and neighbourhood scale. But what DAP is dealing here are enormous areas of land with no regard to neighbourhood scale resulting generic planning proposals which is just a reflection of land use plan based on hypothetical grounds. The total area of DMDP was divided into 5 sub areas and was assigned to 4 consultants for preparation of DAP. Prior to the assignment the consultants were not provided with the overall land use requirement of the city. In the absence of any directives, the DAP consultants appear to have limited understanding of land use distribution process which made them create their own estimations of land use regarding their study areas without any coherence to the whole.

Moreover the Terms of Reference provided by RAJUK were over-ambitious and the local consultants selected for this purpose do not appear to have comprehensive technical capability or the experience to complete the terms of reference. Another weakness that can be noted its preparation is the improper participatory approach –where public participation was at the level of Passive Participation, i.e. merely by informing people about different decisions made by the city authority. By ignoring the user perspective and socio-economic context no planning effort can be sustainable. Again this was coupled with inconsistent working methodologies as prior to assigning these tasks to the consultants, no attempt was made to set out goals, targets, objectives, standard criteria, verifiable indicators, data collection approach, working methodology and standard formats for presentation of outputs and reports. Consequently there are serious inconsistencies between the consultants, including the lack of a standard and coherent approach to problem identification, development of solutions and presentation of outputs. These are some of the prime reasons for the contradictory land use requirements of hypothetical nature presented in DAP. Hence DAP 2010 fails to provide any effective densification strategies based on rational study which makes its implication as development control tool very restrained and impractical.

The enforcement period of DAP 2010 has ended in 2015 but it will continue serving as a planning instrument till the publication of DAP 2016-2035. The government had commissioned two consulting companies in 2013 to prepare a Detail Area Plan for Dhaka for the period 2016-2035. An amount of the 26 crores has been sanctioned for the project. Dhaka is divided into two parts for the study. Part A of the work is given to Sheltech (Pvt.) Limited and the Decode Limited. The Part B of the work is awarded to Development Design Consultants Limited. (Interview with a town planner of RAJUK; Dec 23, 2015)

6.3.3.2 Land use planning in Dhaka Structure Plan 2016-2035

As the enforcement period of Structure Plan 1995-2015 has expired, RAJUK has prepared the 3rd Master Plan which is the Draft Structure Plan 2016-2035 and has given it for review and public consultation before final approval from the Government. Addressing the current trend of sustainable cities, the vision for Dhaka Structure Plan from 2016-2035 is ‘Making Dhaka a livable, functional and resilient metropolis respecting local, socio-cultural fabric and environmental sustainability’.

The FAR rule has been so far the only tool for development control to some extent but as it is applied in a plot by plot basis and few plots of any block in the existing residential areas are left vacant for such practice the benefits of FAR could not be fully achieved as revealed in Chapter 4. The FAR induced development control needs to be a zone wise application with prescribed density regulations to accrue the full benefits. This issue has been addressed in the SP 2016 – 2035 by proposing several policies and suggestions like policy for the encouragement of block-base and discouragement and gradually bringing end to plot based housing development practice by both Public and Private Sector Agencies have been recommended.

The other policy suggested regarding this issue is the concept of Planned Unit Development (PUD). Rather than focusing on individual parcel based development, to ensure planned and compact urban development, it is desirable to utilize Planned Unit Development (PUD). Planned Unit Development is a method of compact land development which promotes large scale, mixture of compatible land uses and dwelling types. It clearly departs from the old traditional application of zoning regulation by the plot or small block scale. The clustering of residential land uses makes it possible to provide public and common open space as well as some commercial spaces within the project site. This would enable more flexible and innovative design ideas to set in and must produce more livable urban spaces. So, compact development and Planned Unit development (PUD) techniques have been suggested to maximize the limited land resources and also to preserve the conservation areas of Dhaka Metropolitan Region.

One of the deficiencies that DAP 2010 had was ignoring the housing demand of the low income group which constitutes the major part of urban population. To address this issue several polices are provided like recommendation for the construction of low rent high rise (10-12 storied) public housing projects for low-income people near working place, CBD and around TOD areas, recommendation for existing dilapidated government owned quarters have to be demolished and rebuild high rise apartment to provide more housing to government employees. Policy has also been provided to ensure healthy and livable neighborhoods. However, the machineries to implement these policies need to be worked out in the next DAP 2016 -2035 which requires ample study at neighbourhood level with an updated inventory of data and should ensure that decisions regarding physical development of the city are made with maximum possible citizen participation and involvement.

6.3.4 Regulations and Bye Laws

The Building Construction Act 1952 empowered RAJUK to control and monitor all development and construction activities of Dhaka by framing appropriate bye laws. Consequently RAJUK had periodically promulgated various regulations and bye laws to direct and control the spatial development of city. The first bye law regarding this issue was the Building Construction Rules 1955 which was amended in 1970, 1984 and 1996 respectively. The other bye laws that followed were Private Residential Land Development Rule (PRLDR) 2004 and MINB 2008. The implications of these rules on the growth management and densification of Dhaka are discussed in the following:

***The Building Construction Rule 1996*:** The development control guidelines put forth BCR1996 were simply in the form of linear setback rules, site coverage, construction of garage, access to plot, provision of lift, land use in a plot by plot and case by case basis. The setback rules together with height restriction of 6 stories were the only growth management guidelines. By the end of 90s as the bearing capacity of old Dhaka in terms of density, services and infrastructure was reaching the saturation point, the densification was directed towards the residential areas of new Dhaka. The gradual formation of multiple CBDs from Motijheel to Kawran Bazaar, Mohakhali, Gulshan and Joar Shahara along the north south corridor helped

Table 6.2: Setback rules according to the 1996 Building Construction Rules for different sizes of plots

Plot size	**Mandatory open space**	
	At rear side of the building (meter)	**At both sides of the building (meter)**
Up to 134 sq.m.	1.0	0.8
From 135 – 200 sq.m.	1.0	1.0
From 201 -268 sq.m.	1.5	1.0
Above 268 sq. m.	2.0	1.25

Source: Building Construction Rules 1996

in the process of expanding the city. From the field survey it was found that 40%-67% of the buildings of the study areas of planned residential areas were 6 storied and 50 to 70 percent of them had violated the set back rules of BCR1996 in some ways. This partial violation of rules is found to take place in five ways particularly by the owners of the building. Firstly, by constructing floors more than it was permitted, secondly by covering open spaces as shown in the approved plan, thirdly by internal rearrangement of approved design without permission and fourthly by increasing floor space from the first floor and above by extending cantilever and lastly by changing its floor use without permission. As CBDs always work as catalysts for forming new settlements around them, they contributed substantially to the densification of the residential areas of new Dhaka in general. For forming new settlements along these transport arteries the developers started to acquire the cheaper low lands and wet lands for future development.

***Private Residential Land Development Rule (PRLDR) 2004*:** Since BCR 1996 alone was not sufficient enough for controlling the booming development activities of the real estate developers causing undesirable growth through unguided densification government felt the need to device some control mechanism for maintaining a desired form and density of the development projects. As a result Private Residential Land Development Rule (PRLDR) of 2004 came into effect with a gazette notification issued on March 1, 2004. This is a legal instrument for controlling land development in private sector housing in Bangladesh. It provides procedures and guidelines for land development protecting the environment and is applicable for those areas which are included in Master plan according to The Town improvement Act, 1952. Private residential land development rules 2004 provides a complete legal support for land development in private sector housing which permits 350 persons per acre though this standard is quite high compared with other megacities of the world. It had set *Space Standards for Urban Community Facilities in acres by Population size* with road hierarchy. A private residential land development project is considered suitable for living if the given space standards are followed.

This law had certain loop holes. The space standards set was too high for Dhaka city and the other requirements associated with desired density had technical difficulties to achieve. Again the punitive measures mentioned in PRLDR 2004 (sub section 2 of section 11) only provided that violation of the rule will be an offence and the authority shall take legal action. However, it prescribed no procedure for institution of legal proceedings, which needed to be addressed. Any legal measure was not prescribed in the PRLDR 2004 which could control the indiscriminate land filling in the flood flow zones and low-lying areas of the city by private sectors in the successive years. There was no provision of periodical revision of any project in PRLDR 2004. In Private residential land development rules there was limited provision of public participation. Therefore private developers were not willing to fulfill all requirement and standards in a land development project and consequently no private residential land development project has been approved by RAJUK ever since. But the private housing projects continued developing illegally protected by political interests of the incumbent ruling parties. The following table provides an overview of the policies and rules engaged in the urban growth management and densification as discussed in Section 6.3.4.

Table 6.3: Overview of urban growth management policies and rules of DHAKA.

Policy/Rules	Enforcement Period	Density Issue	Implementation Process	Implementation outcome
Planning Policy				
1. Master Plan 1959	1959 – 1979 (Remained in effect upto 1994)	Development of Satellite cities for decongesting inner city	Prescriptive	Remained largely unimplemented due to wrong population projection

		Single land use		
2. DMDP 1995 :	**1995 - 2015**			
i. Structure Plan	1995 – 2015	Mixed Land use and continued consolidation of existing R/As	Discretion	Mixed: problems & achievements
ii. Urban Area Plan (UAP)	1995 – 2005	Imposed height restriction of 6 storied, and density determined by the availability of infrastructure	Discretion	Mixed: problems & achievements
iii. Detail Area Plan (DAP)	2010 - 2015	Hypothetical proposals regarding density control	Discretion	Unsuccessful
Building Construction Rules				
1. PDLDR 2004	2004	Provided a prescribed density (350 persons/acre) & space standards	Prescriptive	Unsuccessful due to high standards and technical complexities
2. BCR 1996	1996 - 2007	Linear set back and height restricted upto 6 stories	Prescriptive	Partial success in controlling density by imposing height restriction
3. MINB 2008	2008	Eliminates height restriction, and imposes FAR	Discretion	Mixed: problems and achievements as density control tool.

Source: Author, 2016 Based on the Policy documents

Mohanagar Imarat Nirman Bidhimala (MINB 2008): To overcome the shortcomings of BCR 1996, RAJUK came up with the new rule of MINB 2008 after a series of amendment in 2006 and 2007 respectively. MINB 2008 abolished the height restriction and imposed development control by introducing Floor Area Ratio (FAR). FAR assists in development control based on plot size, road width and building height. MINB also has provided more authority to RAJUK, clear cut responsibility to monitor the development of the city, spread out the responsibilities to various actors, spell out the responsibilities of building designers, structural engineers, site supervisors and the penalties if they fail. Implication of FAR is supposed to promote sustainable benefits for urban areas through 4 basic considerations. First it would increase the percentage of green area, decrease solar radiation through a substantial reduction of paved surfaces, increase rain soakable ground for preventing water clogging and the rain water percolation in the ground would help raise the underground water table.

FAR for an area currently practised in Dhaka is translated at individual plot levels in terms of road width, plot size and occupancy type. Primarily there is a requirement of 40%-50% mandatory open space depending on the plot size. Within this 50% mandatory open space 25% needs to remain uncovered as rain soakable ground and the other 25% is exempted for using as parking, driveway and guard box but the maximum allowable height for these structures will not exceed 8 ft. But from the field survey it was observed that a significant percentage of the high rise buildings built in compliance to FAR do not follow these rules sincerely. There are deviations made by reducing the recommended mandatory open space and the height of the allowable structures within the front setback frequently found to be exceeding the allowable height. The minor deviation of the mandatory open space when practised in majority of the buildings within a block then the aggregate block coverage increases which is not effective in getting ultimate sustainability benefits of FAR as postulated earlier. The reason behind such practice is unarguably the urge of the developers' to maximize the floor space for profit earning. A practising architect also admitted this and remarked –

> *"As requirements for plan approval in RAJUK is submitted in hard copy the deviation from the recommended FAR cannot be detected by naked eye. And if the plot or the building is of irregular shape then manual calculation of the mandatory open space as well as the FAR becomes literally difficult. Apart from these there are some ambiguity in the clauses regarding the design of the FAR excluded areas which also helps in maximizing the floor space. In such case the CAD files are necessary to calculate the total built area accurately which is not a submission requirement. So by taking advantage of the situation such deviations are practised where the resulting development does not render the full benefits of FAR in most of the cases." (Interview of a practicing architect; May 22, 2015)*

Nevertheless, FAR Rule has been operative from 2008. But before this period nearly 85% of the plots in the residential areas of Dhaka were housing buildings constructed according to the previous setback rules. Even after 2008, there are many plots still under construction which are following the old rules because their plans had been approved before 2008 and the construction started late. Since government does not have any law against late construction of any vacant plot this type of development cannot be prevented. Again the provision of FAR is more generous for commercial establishments which would promote more residential plots to be converted into commercial one for maximizing the profit. RAJUK has very recently increased the land conversion fees 5.5 times to discourage such conversion. The outcome of this control measure is yet to visualize.

According to MINB 2008 the FAR recommendations are same for a given plot size all over the city which is leading to construction of high rise buildings anywhere within the planned residential areas without any considerations to the adjacent plots or the availability of community services and traffic volume. This is due to the absence of density zoning for the areas assigned to various land uses. The city requires a density zoning plan in terms of net residential density and gross density. At present there is no such density zoning which is the main obstacle in getting the promised benefits of FAR. Some of these considerations are given to large scale project but in absence of prescribed density regulations officials has to rely on the census density which has not been updated since 2001. This is reflected in the remarks of an academic who emphasizes the urgency of such plan –

"Currently FAR is practiced in Dhaka based on plot size and road width regardless of any area of the city. But the way desirable FAR for an area is determined worldwide is by estimating the number of users and therefore amount of utility services and amenties required in that area. Thus FAR for any specific area is determined on the basis of the availability of services and infrastructure facilities, traffic generation and road capacity. Therefore, it is an area based mechanism not individual plot based. So in order to accrue the full benefits of FAR it requires to be practised with the prescribed density zoning or regulation of the city. The sustainable model cities like Curitiba, Tshwane are the pioneering examples of this kind of planning. Such density zoning plans are formulated based on projected population, land use zoning, assessment of traffic capacity in the existing traffic corridors and available infrastructure of the area. This automatically helps in regulating the development in a balanced manner. The formulation of such density zoning plan is of utmost urgency for Dhaka before the ongoing practice of vertical habitats out numbers the remaining low and mid rise structures of Dhaka city." (Interview of an urban academic; March 09, 2015)

However, Deputy Planner of RAJUK confirmed that the issue of density zoning has been raised and the higher authority has suggested to include it in the next DAP 2016-2035 by the higher authority. Currently the preparation of the Density regulations is undergoing the survey phase which is expected to be completed within two years. (Interview with Deputy Planner of RAJUK, Jan 21, 2016)

6.3.5 Discrepancies between planning and practice

6.3.5.1 Planned Residential Areas

Conversion of the land use in the planned residential areas basically takes place as a response to meet the immediate demand. As the Master plans of the planned residential over looked the necessity of supporting facilities, land use conversion was initiated out of demand which was later legalized by the local authority through circulars, orders and notices. The rectification included the transformation of primary road side plots into commercial zone. This was the common practice in study areas of Dhanmondi, Banani, Gulshan, Pallabi and Uttara. The facilities to be included were listed but their scale or intensity was not mentioned in these bye laws. As a result supporting facilities beyond the neighbourhood scale started popping out and lack of monitoring led to the uncontrolled intensification of commercial activities within the residential areas. Development control was never based on density criteria which made proper demand analysis of the area impossible. Furthermore bribery and malpractices contributed to the uncontrolled infiltration of commercial activities.

Though designed as a planned residential area Wari lacked the same facilities but no circulars regarding necessary inclusion of amenities were issued for the area. Consequently there is no commercial activities allowed in Wari legally but commercial activities have taken place by converting the land use either in legal or illegal way. It is not possible to evict all these commercial setups as they are erected by influential people of the area who have strong linkage with political parties. However, authority needs to recognize the interdependence of residential neighbourhoods, commercial and educational centers. The commercial establishes not only provides the supporting facilities essential for sustaining any residential areas but also serves as employment centers for the neighbourhood residents. So before taking any drastic action like eviction of all commercial facilities from the existing residential areas the authority should sought a way to maintain the balance between the commercial and residential uses. Furthermore no eviction should be commenced before assessing the demand and traffic volume of that area. Nevertheless, in an attempt to discourage the commercialization of neighbourhoods government has recently increased land conversion fees by almost 7.5 times or 750 percent for converting plots from the category of residential to non-residential or commercial in the residential areas of more upscale areas of the capital like Gulshan, Banani, Baridhara, Nikunja and Uttara (Dhaka Tribune, 2013). The outcome of this strategy is yet to be seen.

However, RAJUK alone cannot be alleged for the uncontrolled infiltration of commercial activities since Dhaka City Corporation is supposed to provide urban amenities and social infrastructure as it issues trade licenses for carrying out any business. In developed countries trade license are issued consulting the chamber of commerce to determine the need for such facility in the intended neighbourhood. But DCC makes no such effort while issuing trade license. Though it has limited planning role but still it should check the appropriateness of any building for the intended occupancy type in compliance with the building code and approved plan. In absence of such necessary evaluation the present practice of converting any residential building for commercial use will continue and will over crowd the residential areas. If this practice has to stop then the city corporations have to be strengthened and empowered to undertake local planning and control functions in a transparent and accountable manner. Research needs to be conducted on what the residential areas need in terms of social infrastructure, and amenities.

6.3.5.2 Unplanned Residential Areas:

In unplanned areas of old Dhaka like Luxmi Bazaar the prevailing development control measures cannot operate mainly for three reasons. Firstly the road width of most of the areas is below the recommended level of FAR which makes it inapplicable for these area. Even where the road width permits majority of the plots due to sub division are smaller enough and if the land owner tries to apply the FAR rule then he has to give up more than half of his land leaving him a chunk small enough for any kind of habitable development. Under such circumstance FAR does not seem to be an effective and practicable development mechanism for organically developed areas.

Secondly FAR rule recommends the development control of such areas to be determined through considering the existing density of the area. But most of these areas do not have updated density profile upon which right planning decision could be taken. This again makes it difficult to control development.
Thirdly there are many disputes regarding the ownership, transfer of title, issues of vested property associated with most of the plots which make a high percentage of plot owners prone to not seeking any development permission from the authority prior to construction. The lack of institutional capacity of RAJUK fails to provide proper inspection and monitoring here. As a result 90% of the buildings are built on the edges of the plot or violating the setback and height rule in some way. The futile application of FAR was confirmed by a local developer of Wari who also shed light on the ongoing practice –

> *"The developer reported that in practice two separate plans are prepared…one for approval of the plan from RAJUK according to the requirement and recommended FAR of the area and the other one is the working plan according which the construction is carried out. The working plan is totally different from what has been submitted for approval. The deviations from the originally*

approved plan are done in the following sections, that is the height and FAR of the proposed building. In case of deviation of FAR the total floor space is much higher than the recommended guidelines, the mandatory open space usually ranges between 25%-30% and sometimes even below. In case of height in Wari the maximum permissible height is 8stories. But developers build new buildings beyond this height limit by showing an approved plan with back date when the law was not in force. Another form of deviation is made by first passing the plan of 8 storied and then resubmitting it for extension to 10 stories. Usually all these permission and documents are procured through bribery. The developers usually build higher foundation such as 12-14 stories for a 8 storey building, above which they gradually keep on adding stories through reapplying for height extension or procuring a back dated approved plan with the additional height. In case of smaller chunk of land if developer tries to maintain the FAR and mandatory open space recommended then actually there will be only one small flat of 800 sqft in a land of 2700 sq.ft (3.75 katha) which is not profitable for the owner and the developer. So it is impossible to abide by such rules."(Interview of a developer of old Dhaka ; January 21, 2015)

The large rectangular blocks of Wari are too wide almost square in dimension. This makes a problem when subsequent subdivision occurred in the later phases where a lot of inner plots were formed which could not have direct street frontage. These inner plots needed to have access provided with narrow alleys running through the front plots. In other cases quite bigger chunks of land (15–8 *kathas*) has been developed into grand high rise mixed use complexes. In many blocks the buildings of the inner plots are found quiet taller almost 12-14 storied high and the mandatory set back spaces around the edifices do not conform to the recommended standard causing narrow alleys around. The area of old Dhaka stretches from Saidabad to Lalbagh according to the jurisdiction of RAJUK. However, Wari area is much preferred among the buyers for its posh status. The apartment price ranges from TK 8000/sqft. to TK 6000/sq. ft. in Tipu Sultan Road and in Banogram it is Tk 5000-4000/sqft (Interview with a Wari based developer; July 1, 2015).

In case of Luxmi Bazaar a height restriction of 6 stories was imposed in the Building Construction Rule 1996. But now under MINB 2008 the FAR rule is enforced with the elimination of mandatory height restriction where higher height is allowed for bigger plots. In old Dhaka the FAR rule is applicable for the streets with a minimum width of 8'-3" or 2.5m. For plots facing streets below that width apparently falls under no rules as yet. Consequently development activities in such plots are taking place without any plan approval from RAJUK (interview with Deputy Planner of RAJUK; Jan 21, 2016).

However for any building having more than 40 units fall to the category of Large and Specialized Project which requires special development permit. This special permit is given by considering the density of the area as well as the impact the development would have on traffic. A substantial number of high rise buildings of Luxmi Bazaar fall in this category with a height of 10-12 stories. Regarding the planning practice in Luxmi Bazaar a local developer commented –

"In case of Luxmi Bazaar for 3 kathas of land with a road width of 18 to 20 feet a 8 storied building according to FAR rule can be somehow feasible. But if the land area is less, than the floor area has to decrease even further for getting the height bonus according to FAR which is no longer feasible for the land owner as well as the developer. So we practice this rule only in

papers but in reality no building is built according to the approved plan with the recommended floor space. Again for bigger chunks of land in old Dhaka the height bonus can go higher even upto 20 stories. For instance, the building of Jila Parishad in Raisha Bazaar, Dholai Khal is 20 storied high. There is a new proposed bye law under preparation for the development of plots facing 5ft road width in old Dhaka which will soon be gazetted by RAJUK. But at present more than 70 percent buildings which are constructed through private initiative do not seek permission from RAJUK. Only the developers initiated constructions have RAJUK approved plan but due to lack of inspection the construction is never executed according to the original plan and it is not an practical option for small chunks and irregular shaped land either." (Interview of an old Dhaka based developer; January 21, 2015)

The other rule which partially controls the redevelopment activity of old Dhaka is the preservation of heritage sites and buildings of Dhaka. Many of the streets of old Dhaka preserve a myriad of unique architectural styles which bears the imprints of Dhaka's past legacy. In order to preserve these national heritages government has published a list of 93 heritage buildings and 4 heritage sites notified through gazette on 12 February, 2009. According to this notice any kind of development should not commence within 250 m from the heritage buildings. It also prohibits any kind of renovation, repair, redevelopment or demolishment of any of these structures. But the bye-law does not suggest any measure to ensure their conservation which has given rise to the anxiety and anger of the residents as many of these structures are in vulnerable state prone to any kind of fatal consequences.

6.4 Deficiencies in the implementation process

Although DAP largely serves as a land use prescribing document there are still many areas where the land uses are not clearly defined. In such cases where land use is not clearly specified in DAP it is determined through the following process as described by a senior town planner in RAJUK –

"Whenever an application for land use conversion is received the standard procedure that RAJUK follows is to conform the proposed land use with the DAP assigned land use of that particular site. If it does not comply with the prescribed land use or the land use is not clearly mentioned in DAP then officials mainly planners are sent for site survey who prepare a report based mainly on the topographic features and demand analysis of the site. But usually they do not consider the density or traffic that might generate from such land use. The report includes site photographs and other physical information about the site but with no analytical studies or empirical insights. The findings are then presented in power point presentation in a board meeting chaired by the RAJUK Chairman and members from 7 organizations including WASA, DESCO, Fire Service, Department of Environment, BIP, IAB for evaluation of the proposed land use. These departments are supposed to scrutinize the suitability of such land use from their perspectives but usually they do not take the effort to get to such depth before giving their approval. If the decision turns out to be positive from the majority stakeholders the petition is approved and permission is given for proposed land use where the amendment is supposed to be included in the future review of DAP. The decision of the committee happens to be positive most of time and very rarely in negative. But in case of denial from the committee it is often seen that the

proposed land use has been implemented due to political influence."(Interview of a senior executive town planner of RAJUK; April 04, 2015)

Such ongoing practices indicate that owing to the insufficiency of DAP land use specifications decisions are still being made on piecemeal solutions with the aim of meeting the immediate need. Along with the introduction of FAR, MINB 2008 also provides the following development control mechanism for the proper execution and monitoring of any development activity:
During the construction of any building the builder is supposed to notify the authority 3 times in following stages about the progress of the work to avoid any future complication:

1. *Starting of foundation:* The authority needs to be notified when foundation work is about to start as foundation of buildings with basements are not allowed to be carried out during rainy reason. The rain water weakens the soil and displaces the footings therefore is likely to lead the building to collapse.
2. *Plinth level completion:* The second notification is due when the construction work has been completed up to the plinth level. This is necessary to avoid any major deviation or changes suggested in the advance level of construction.
3. *Completion of the building:* The final "Built plan" is submitted to endorse any minor deviations from the approved layout plan. Minor deviations which may take place during construction without any change in the TBA (Total Built Area) and design of vertical circulation core are subjected to endorsement.

Once 3 stages of construction activity have been completed in compliance with the regulations occupancy certificate is issued by RAJUK. Occupancy certificate needs to be produced for availing the utility services. If the above mentioned stages are sincerely followed and inspection is carried out in each of the stages then there is no scope of mal practice. But in reality the practice seems to differ a lot. Despite informing at various stages of construction work the inspections are not carried out due to insufficient man power of RAJUK or negligence of duty most of the time. Regarding obtaining the occupancy certificate it was found that due to lack of co-ordination among the utility service providers (WASA, DESA, TITASH GAS) developers manage to get the service connections without producing the occupancy certificate in most cases. So failing to execute the control mechanism of the 3rd stage effectively Government has now enforced a new rule by prohibiting the sale of apartments without acquiring the occupancy certificate.

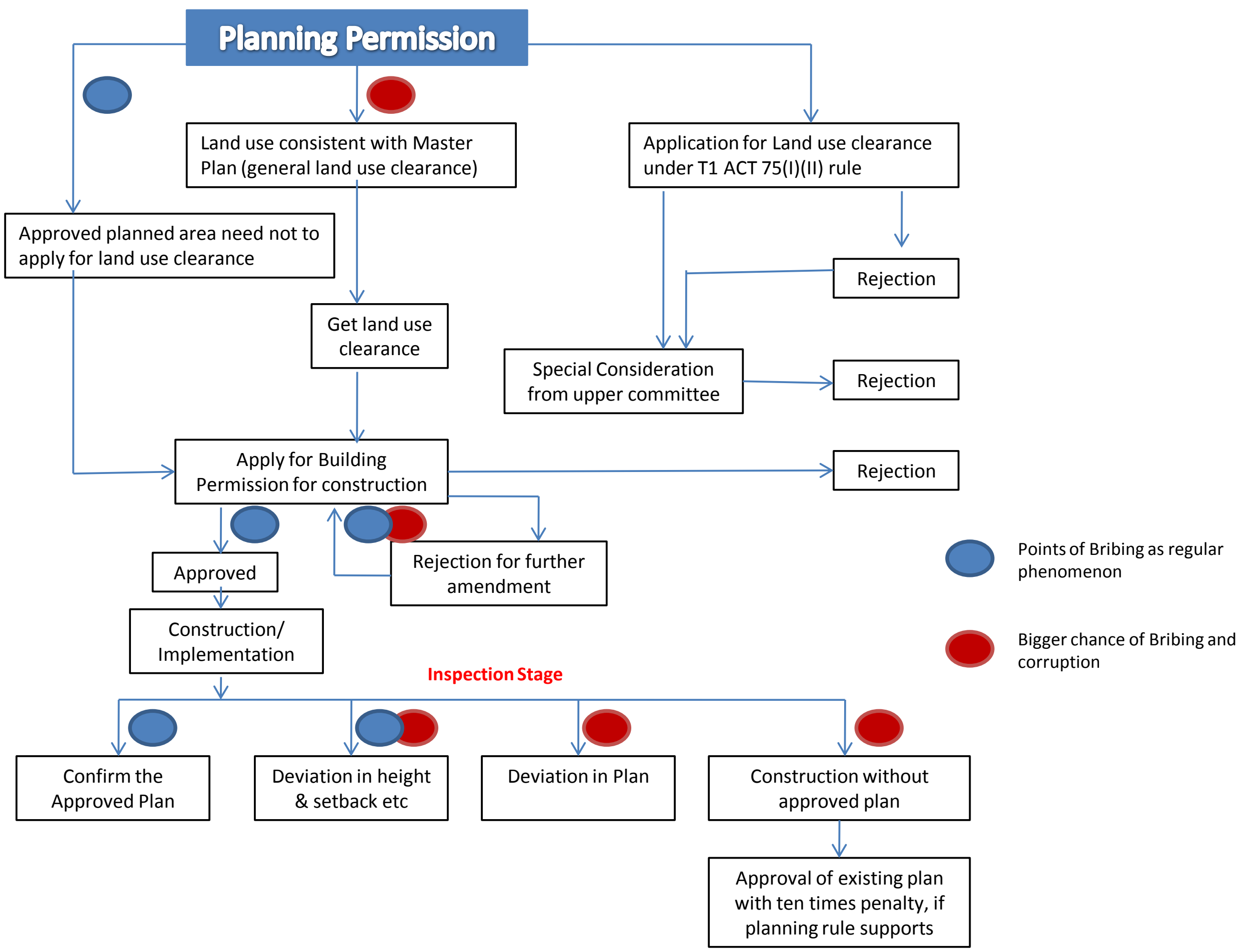
6.4.1 Shortcomings of RAJUK

Though RAJUK is the sole authority entrusted with the responsibilities of planning, development and development control of Dhaka city it failed to perform its duties properly leading the city to the grip of unguided haphazard urbanization. The failure of RAJUK can be attributed to the following factors:

6.4.1.1 Mal practices and Corruption

The pervasive corruption in the plan permission and land use conversion process is a great hindrance in the implementation of laws and regulations. RAJUK is alleged with corruption which prevails in every stage of planning and development process - from plan approval to execution. As a local authority one of the important functions of RAJUK is the plan permission process where it needs to check every detail on the proposed plan and defects, if any pertaining to prevailing bye laws, are pointed out for rectification before any plan is approved. The process is lengthy and cumbersome and not a single plan permission application moves without persuasion (Mahmud, 2008). If somebody tries to follow the general procedure then he has to face unnecessary harassment or time killing or missing of specific files or put objection on files which are the most common practice dealing the Authorized Sections of RAJUK. The complicated process of approval of plans seems to be an incentive for taking recourse to corrupt practices. Very often, it's a mutual corruption, between applicants and RAJUK officials as people want to avoid the hassle and get their job accomplished easily. There is also a syndicate of agents who assist in this deep rooted corruption in the plan permission process.

Figure 6.2: Points of Corruption in Land use Clearance and Building Permission Process



Source: Adopted from TIB Report, August 2007

This malpractice is continued in the inspection stage too where the inspectors accept bribes for not informing the authority about the deviations made from original plan such as setback, illegal road encroachment and height violations. In a survey conducted by Transparency International Bangladesh (TIB, 2007) the provisions of bribery at various level of the plan approval and execution process have been clearly identified and depicted in Figure 6.2.

Another reason of malpractice is that many of the RAJUK officials are developers themselves. Publicly RAJUK condemns the operations of the land developers, but many RAJUK planners have land development companies and act as consultants for the land developers. There is an internal support and financial linkage between the land developers and RAJUK planners, which help the land developers to bypass the regulations of standard layout design. The Real Estate and Housing Association of Bangladesh (REHAB) maintains a strong linkage with the political parties and their subsidiary organisations. REHAB plays a key role in influencing the political commitment to implement any public policy. Consequently Rajuk has failed to stop developers from carrying out their illegal private housing schemes, which is an institutional failure of a hugely debilitating kind (The Daily Star, February 2, 2016).

6.4.1.2 Institutional Capacity

Lack of skilled planning professionals was a drawback that RAJUK had to suffer from its very inception in 1987 which was primarily due to the absence of native planners in the newly liberated country. But after 46 years of liberation the scenario has not changed much though there is no shortage of native planning expertise at present. Instead of being strengthened, the Planning Department remains technically understaffed to this day. Currently there are about 12 planners working for the entire DMA area of 1528 sq. km. which is quite insufficient regarding the scale of area each planner is supposedly assigned to. Moreover there has been no updating or enhancement of qualifications of the current planners. Their notions of urban planning are techno-centric and dated, and complexities of social planning do not sit easily in their thinking. Equipped with such meager manpower RAJUK is not able carry out the responsibilities of preparing Master Plan or DAP as vested upon it. It also lacks the professional expertise and technical resources which make it rely on consultants to do the job as reflected in the preparation of DAP 2010. Furthermore, to complicate the situation the key positions of the top tier responsible for decision making are occupied with professionals from non-planning background who lacks the professional expertise in making effective decisions. The institutional capacity of the Monitoring Section of RAJUK is also insufficient to carry on regular supervision of development activities. There is about 7000-8000 applications for plan approval filed every year in RAJUK (The Daily Sun; July 3, 2011) and in contrast there are only a handful of field inspectors to monitor these projects which is quite an irrational ratio. The organogram of RAJUK needs to be reviewed and attempts had also been taken a couple of times but due to the time consuming bureaucratic process the efforts went futile as remarked by a planning official of the Plan Preparation Section in RAJUK –

> *"In past serveral Mayors had filed the application in the Ministry for modifying the RAJUK organogram which required persuasion by top hierarchy professionals of RAJUK. This type of major petitions requires to be delievered personally in the Ministry by the top level executives of RAJUK for drawing the required attention. But the top level executives who possess the Secretariate pass do not usually have enough time to go to the Secretariate for the purpose of pursuing these files. So the files remains stuck in the process and meanwhile the tenure of the Mayor ends. And then again the new elected Mayor may file a new petition regarding the matter and the same story repeats itself….leaving the job undone for all these years." (Interview of a senior planning official of RAJUK; April 04, 2015)*

However, despite all the lengthy bureaucratic procedure RAJUK had managed to upgrade its organogram from 1087 to 1980. A review of the organizational setup of RAJUK indicates that the division responsible for development has staff strength of about 50% of the total staff followed by the planning department with about 28% staff. However, within the planning division, only the planning department is primarily responsible for the DMDP plans and therefore for formulation of the DAPs. Though there are currently 51 approved staff for this department, in effect, there are only 20 planners in RAJUK to plan and also oversee the DAP planning process for an area as large as 1,528 sq.km. The ratio is still unrealistic for a megacity with a population surpassing 1.5 million.

6.4.1.3 Political Intervention

The planning and development activities are largely guided by the influential people having ties with political parties which makes proper execution of plans difficult in many instances. Many influential persons always try to influence in each and every processes of development discourse to keep their own interest rather than national and always try to make bound the officials of RAJUK to do according to their sweet wills. Private housing companies, government agencies and influential people are liable for the violation of the building construction rules. According to Dr. Sarwar Jahan, President, Bangladesh Institute of Planners (BIP), most of the local political leaders are developers or own land in the DMDP area. The local politicians are involved in land development and transactions which they cannot do if the DAP is implemented. They are strictly against the implementation of the DAP and are provoking the local people to go against it. (Morshed, 2013)

The business activities of the real estate were expected to be intervened by the successive governments in order to facilitate housing for all. For instance, in Malaysia, it is legally obligatory for the real estate developers to build 30% low cost housing units out of a whole range of real estate products they build. But regretfully no such steps have ever been taken here to regulate the activities of the real estate. On the contrary the pressure from the powerful real estate developers seems to have curved the political will. This type of malpractice is frequently evident in various commercialization endeavors carried out by the sector including the ruthless destruction of conservable wetlands and ancestral homesteads.

In some cases, even the Prime Minister's directives to halt the environmental degradation through wetland encroachments have been ignored. The government in early June 2014 approved the change of the Detailed Area Plan (DAP) to allow some private housing schemes to develop land on conservable flood flow zones in Rupganj, Turag flood plains and Baridhara of the capital. It happened despite the High Court in June 2011 having directed the authorities to scrap illegal projects, including removal of 75 other real estate projects (The Daily Star, February 2, 2014).

6.4.1.4 Lack of Co-ordination

At present, RAJUK is the key urban agency responsible for overall planning for the DMDP area in coordination with other sectoral agencies. It is clear that constitutionally the organisation has considerable power to be harnessed for systematic urban management. However in practice, coordination and sharing of information pertaining to planning and plan implementation between various agencies have been very weak and non-transparent. Though the mandate of RAJUK was to build such coordination between various other departments and local bodies and develop common strategies for urban development in Dhaka, RAJUK has been unable to perform its role in this direction because of absence of leadership.

6.4.1.5 Ineffective Penalization

Although there is provision of penalty for the violation of Building Rules and Regulation, RAJUK is found not taking the punitive measures against the perpetrators most of the time. One of the reasons is the lack of proper supervision and negligence of duty from the part of the inspectors. The other reason is that due political intervention many penalization processes cannot be carried out. Moreover, politicians who are in power, are reluctant to get active actions to control corrupt rehearses in public transactions (Khan, 2003). Again the magnitude of penalties is not adequate enough to work as an effective control mechanism. In other case the legal instruments for penalizing the offender are not clearly pronounced or developed which can be observed in case of PRDLR 2004 Rules. The lack of clearly stated punitive measures rendered the rule to totally unsuccessful.

6.5 Conclusion

The major findings from the analysis of this Chapter indicate that along with the influences of socio-economic and political drivers, weakness in the strategic and implementation level of the existing planning rules and legislations has been the prime cause for the unguided densification of the residential areas of Dhaka. The findings revealed that in the strategic level the land policy of Bangladesh is the first hindrance in regulating the development process. As the freehold land tenure system gives full right to the land owner to possess, sell, gift or mortgage land government has no control over the land. Again the subdivision of land according to Muslim Inheritance law allows the land to be fragmented into a number of parcels of varied size. Though the government has imposed a ceiling of 335sq.m (5 *kathas)* for subdivision in the planned areas but has devised no such law for the unplanned areas of Dhaka which is responsible for the diversified shape and size of land parcels in old Dhaka.

Besides the land policy the other strategic level policy that governs the development activity is usually the land use policy. In the context of Dhaka some deficiency was identified in the land use policy too. The basic land use pattern for Dhaka city was established in the first Master Plan 1959 for an area of 830 sq. km. But after independence RAJUK reclassified a large portion of land as urban within its boundary and thereby expanding the city area from 830 sq. km to 1538 sq.km. The land use of the extended areas was out of the scope of Master Plan 1959 and therefore was literally left without any land use zoning till the formulation of the 2nd Master Plan (DMDP1995–2015) 16 years later. The long absence of an updated Master Plan and absence of any development control strategy led to spontaneous and haphazard growth all over the city and also in the already developed residential areas. This problem was supposed to be resolved through the policy derivatives of DMDP Structure Plan (1995-2015). Regarding land use distribution both Structure Plan (SP) and Urban Area Plan (UAP) had adopted a mixed land use strategy instead of the single land use strategy of Master Plan 1959. But they did not provide any land use zoning principles which could be applied to design subsequent development. There were contradictions and lack of clear definitions. The Plans demarcated broad areas for future development but inherent contradictions/loopholes had provided scope for manipulation and encroachment. Thus loose planning guidelines and loopholes in the Structure and Urban Plans have allowed the urban encroachment of environmentally sensitive areas which include flood flow zones, wetlands and low-lying areas which act as sink for storm water runoff; natural drainage channels and canals.

As density is an essential tool to control development, density zoning is usually decided at the strategic policy level. But the density zoning was totally missing in both the Master Plans. The first Master Plan only prescribed a density of 200 persons/ acre which became obsolete due to population increase within its enforcement period. In the policy level the Structural Plan and UAP did not tackle the issue of density planning either. The Structural Plan merely suggested the continuation of densification throughout the whole planned period in both the older established urban areas and in those developed since the 1980s (DMDP, 1997a; p.36) while UAP proposed intensity of development to be determined upon the availability of the infrastructure facilities. Both the statutory documents have provided set of guidelines but did not provide any directives for their implementation. The Detail Area Plan (DAP) 2010 as the third tier of this hierarchical planning package also failed to provide any practicable density control guide as most its proposals lacked sufficient ground work and was hypothetical in nature. RAJUK follows a prescribed a density of 300 persons/acre which serves as the starting position of density planning as far as housing density is concerned.

After the strategic policies the next level of control mechanism works through framing bye laws. During the prolonged time lapse that took place in the enforcement of the strategic policies, RAJUK had to rely on bye laws, circulars and orders to control development activity. Building Construction Rule 1996 was the first bye law in this regard framed by RAJUK, which exercised development control through imposing linear setback rules and height restriction of 6 stories. Coupled with weak implementation this rule did not prove to be an effective tool to control the unplanned densification. With the urge of having a modern and appropriate tool to control development activity in a desired way RAJUK promulgated the MINB 2008 which introduced the concept of Floor Area Ratio (FAR). Floor Area Ratio manages the growth of the city by its rules of building coverage area, allowable floor space and relation among building height, road width and plot size etc. But the generalize application of FAR for all the areas of the city do not bring the desired result unless it is coupled with considerations of density, traffic load, character and socio-cultural dynamics of the residential areas. RAJUK also enacted the PRLDR 2004 Rule to control the development of the private residential projects. But due to over ambitious requirements and technical difficulties this rule was never followed. Along with the above mentioned gaps at strategic level, the research also identified gaps in the implementation level too. This mainly constitutes the violation of the laws due to RAJUK's weak supervision mechanism, inadequate institutional capacity, political intervention, lack of co-ordination, mal-practice and pervasive corruption. So it can be said that along with the socio-economic and political drivers, absence of proper densification strategy coupled with inappropriate rules and weak implementation process mainly contributed to the largely market led unguided densification of residential areas in Dhaka.

Among the socio-economic and political drivers the political turbulence and change in the administrative modes i.e from autonomy to democracy seemed to have affected the pace urban development. Global integration through neo-liberalism approach had enormous effect on the national economy and in turn on the densification process through the involvement of private sector in the housing market. The socio-cultural transformation of 90s also proved to be an important catalyst in the process. Motivated by the urge of profit maximization the demand-led densification was turned into market-led densification. The ongoing densification process largely guided by the market-force had neither shown any concern to public interest nor the environmental consequences of their development activity. The government failed to control the development activity due to inadequate regulations as well as weak implementation process discussed above. So with all these socio-economic and political forces working in the backdrop the absence of proper densification strategy coupled with inappropriate rules and weak implementation process mainly contributed to the largely market led unguided densification of residential areas of Dhaka.

However, the Structure Plan 2016-2035 currently under review has suggested some proposals to direct growth management in a controlled way and the issue of density zoning for the city is also underway the survey phase which is supposed to be included in DAP 2016-35. The detailed area planning process is incomplete, hence, there is still an opportunity to improve the process and achieve some of the desired objectives. Real value addition to the process can take place if the capacity for environmentally sustainable and socially sensitive planning is enhanced in RAJUK as it is the lead agency. Unless effective urban planning policies as well as densification guidelines are instituted and implemented, the poor quality of built environment and the plethora of urban crises will continue to undermine desirable urban development and redevelopment process in Dhaka city. The question that is worthy raising here is, what type of measures should be considered in densification strategy for the future development of city of Dhaka that will ensure optimal use of land and infrastructure without compromising spatial and liveability qualities as well as secure the sustainability of the residential areas. This question together with the key issues raised in the previous Chapters is the subject of discussion in the subsequent Chapter.

Chapter 7 : Implications and Conclusion

7.1 Introduction

The preceding three Chapters have discussed and interpreted the findings with their theoretical relevance to causes and consequences of the ongoing densification process in the residential areas of new and old Dhaka. This Chapter highlights the summary of the major findings in relevance to the research questions. It also discusses the different lessons learnt through the process of this investigation. The Chapter is divided in three sections. Following the introduction, section 7.2 presents the summary findings by addressing the research questions. The research contributes by drawing implications for growth management practice. The implications are especially important in light of the current uncertainty around the ongoing densification process of Dhaka and in connection to it some policy recommendations have been suggested in the section 7.3. The recommendations attempt to supplement current professionally based regulations with community established evaluation standards to better integrate community input and concerns into the regulatory framework. The aim here is to advice municipalities and developers on ways to obviate or overcome hurdles encountered in the development of higher density housing. The scope of further work to support the implementation of densification policy is discussed in the section 7.4. Finally, section 7.5 presents the contribution of the thesis followed by conclusion.

7.2 Summary Findings

The research was guided by three research questions. The purpose of this section is to present the major findings delineating the causes and consequences of densification in order by addressing the research questions.

7.2.1 Stages of densification and the current state of densification in the study areas

The trends of densification of the residential areas and their guiding principles were investigated to address the first research question: *How residential areas in Dhaka were planned and what principles were followed for their development?* The density attributes like plot coverage, floor area ratio, land coverage at block level, building height, spatial organization and building guidelines of the residential areas were further examined in detail to provide insight into the densification process currently responsible for influencing the planning and spatial form of the residential areas.

From its inception around 1600 as a Mughal centre of trade and strategic control the planning of Dhaka has undergone several phases mainly guided by political deliberations and topographic features. Owing to the continuous change of rulers the Dhaka experienced a series of transformation in terms of population and status which eventually placed it in the list of Mega cities at present. The city continued expanding its boundary with the changing political status which was determined partly by the topographic features as well as the extent of transport corridors. With the old city core reaching a saturation level in terms of density new planned residential areas started emerging along these transport corridors. The residential areas were planned without any consideration to amenities and services necessary to support them. Soon commercial facilities started developing initially in the form commercial strips along the transport corridors to support these residential areas forming CBDs in many places. In the later phase the commercial facilities intensified through infiltration in the residential areas. So the horizontal growth of city took place by following the transport arteries in a form of axial growth unlike any known urban growth model. So the horizontal expansion of the city has been directed by the path and extent of the transport arteries together with the geological features. Later due to the lack of a predetermined plan and development control guidelines spontaneous development of the city started taking place in the shape of urban infill and vertical expansion. This in turn increased the density of the residential areas manifold times.

Results of the field survey revealed that densification pattern differed in the study areas in terms of time and intensity. Among the study wards Luxmi Bazaar situated in the old city core started densifying first after 70s closely followed by Wari. Both of these areas attended the optimum stage of densification by early and mid 90s respectively. With expansion of the city northwards the densification was directed towards the planned residential areas of new Dhaka. These planned residential areas served with well connected accessible roads drew the attention of the developers. Dhanmondi was first in the line of new residential areas where densification started from mid 80s but gained momentum from 90s with the redevelopment activity of 6 storied buildings. The posh status of the area soon turned it into a hub of commercial activities boosting the densification process of the area. Due to the provision of good connectivity Banani and Gulshan attained the status of CBD which worked as the impetus for the densification of these areas. Though the redevelopment activity started relatively later in Banani but both Banani and Dhanmondi reached the optimum stage of density almost at the same time around 2004. Gulshan was left back in the process as its diplomatic status and high land price worked as a barrier in slowing down its progress.

Despite these obstacles significant redevelopment activity continued taking place in Gulshan which eventually pushed the area to the stage of optimum densification by 2010. The CBD status and high land price of Gulshan and Banani were the two most motivating factor that initiated the densification of Uttara and Pallabi. Together with these factors the growing commercial activities in Uttara and well connectivity of Pallabi also worked as a factor for their densification. At present both Pallabi and Uttara are in the infancy stage of densification but are subjected to rapid densification. All the study areas have undergone the densification process through three phases of redevelopment activity carried out through different periods in the successive decades ; first transformation to mid rise buildings by adding additional floors on the existing low rise house forms, second the redevelopment activity of 6 storied buildings and third the redevelopment of high rise buildings above 6 stories. Among these three phases densification of most of the areas are currently undergoing the third phase which is the most aggressive in the vertical transformation of the residential area. This is partly due to the absence of any comprehensive densification stratedy as well as the developers' profit making intention.

The first phase of the redevelopment of house forms was carried out through self built strategies of the land owner while the next phases took place mostly by joint venture of the land owner and developer. This was the result of two factors: the advent of the private developers in housing sector motivated by neoliberalism and the subdivision law. Government imposed a ceiling of 5 *katha* for subdivision of land in Dhanmondi, Banani and Gulshan which created problem in transferring the title of a single piece of land to its beneficiaries. But instead of selling the land if multi storied buildings are built on it than equal number of apartments can be distributed among its beneficiaries with individual titles. During 90s most of the landowners constituted of the second and third generations of the original landowner for whom construction of high rise apartment buildings with the help of developers became a practical option. The joint venture of the developer and landowner provided 40%-60% share of the newly built apartments to the developer. Grabbing the opportunity of profit making the private sector launched massive scale redevelopment activity with the maximum height limit of 6 storied buildings in the residential areas. This densification process led by the real estate developers soon pushed most of the residential areas towards optimum saturation stage by the advent of the new millennium.

The redevelopment activity entered its third phase with the elimination of the height limitation practised in association with Floor Area Ratio (FAR). With this phase of redevelopment buildings are heading even higher by gradually phasing out the remaining low rise buildings. So the redevelopment activity gave the developers to an opportunity to make profit and by default helped in solving a portion of the housing problem. With the slowing down of the national economy the business of the real estate sector also came to pause with a large number of unsold apartments. This clearly indicates that the densification taking place after 80s were largely market led rather than demand led. A number of factors contributed to this market led densification. Along with the economic reform and the lack of adequate development control guidelines and the transformation in the socio-cultural domain played a significant role in the acceptance of these new forms of vertical habitats. The advent of communication technology through cable TV, mobile phone and internet gave the people wide exposure to the western lifestyle and culture. Influenced by this New Age technology the young generation quickly adopted the western values and lifestyle which in turn helped in the flourishing of the apartment culture. The absence of proper densification strategy contributed to the unguided densification of the residential areas. This has led the residential areas to host of environmental consequences affecting their livability and in turn putting a question mark on sustainability of the residential areas.

In order to assess the density situation of the residential areas the physical density attributes in terms of plot coverage, building height, building occupancy type, floor area ratio (FAR), land coverage at block level have been examined in detail. The major findings from the investigation of the density attributes have been presented in the following:

In general majority of the older buildings were found having a higher plot coverage (80%-90%) more than the recommended level according to the set back rules of BCR1996 whereas by and large the newly constructed buildings have shown adherence to the MINB2008 Rules. But in comparison to the number older construction the new construction are fewer per block where the aggregate open space per block is not effective enough to accrue actual benefits of FAR. The effect of excessive plot coverage is culminating into problems associated with limited capacity to attend emergency measures such as fire rescue, poor ventilation and poor sunlight in the interior rooms. Fieldwork results indicate that most of the earlier constructed 6-storied buildings have a Floor Area Ratio (FAR) exceeding the recommended level of BCR1996. The maximum observed Floor Area Ratio in Uttara, Pallabi, Dhanmondi, Banani, Gulshan, Wari and Luxmi Bazaar was 6.4, 9, 6.4, 5.4, 6.4, 8.8 and 8.2 respectively. The maximum permissible floor Area Ratio of these study areas are 5.6, 6.3, 6.0, 4.2, 4.2, 7.0 and 7.0 respectively. On the other hand majority of the newly constructed buildings were found to be adhering to the prescribed FAR of MINB2008 with a few exceptions where there has been significant deviation from the approved level. Along with this majority of the newly constructed buildings are found in violation of the FAR rule in terms of height of the FAR exempted structures such as guard box, drive way, entry porch etc. This situation has been caused by partly the weak enforcement of the guidelines and on the other hand, developers' urge to maximize use of plot.

Results from the field study also found that there is a deficiency intrinsic to the block arrangement of the planned areas like Uttara, Pallabi and Dhanmondi. Majority of the blocks found in Uttara and Pallabi were too long in length constituting of more than 20 plots in a row. This not only reduces the direct road frontage of the plots but also results into no or limited exposure along the remaining three sides of the plot which are bounded on three sides by other plots of same size and shape. This type of plot does not provide much flexibility in design and results into poor spatial qualities of the indoor living environment. In Dhanmondi the later subdivision has caused 3-4 rows of plots in many blocks where the access to these rear plots are provided through narrow alleys across the front plots. The same scenario is observed in Wari where due to the greater depth of the blocks many plots of various sizes have formed in the inner part of the blocks. On the other hand Luxmi Bazaar has irregular shaped blocks with diversified shape and sized plots, most of which do not have direct linkage to the access road. The findings from field survey suggest that this inherent complexity in the block arrangement of the old Dhaka is not sustainable for high rise house forms especially when spatial quality requirements of visual, indoor sun lighting, skyline, space between buildings and cross ventilation are taken into consideration.

Nonetheless the average block coverage in the residential areas of new Dhaka is found to be 70.5% whereas in old Dhaka it is 87.2%. The highest average land coverage of 89.4% at block level was found in Luxmi Bazaar and the lowest in Pallabi with 63.6%.Wari has the second highest average block coverage of 85.1%. Banani and Dhanmondi had moderate block coverage of 78.2% and 72.6% while Gulshan, Uttara and Pallabi have one the lowest block coverage of 70.3%, 67.9%, and 63.6% respectively. Field work findings revealed that the open space of the blocks largely owes to the low plot coverage of existing low rise buildings as well as the vacant plots and to some extent to the few FAR abiding high rise buildings. But as the both the low rise buildings and vacant plots are subjected to redevelopment activity block coverage are unlikely to remain within the desirable level of 60%-70%. This is likely to lead the residential areas into cramped housing condition with adverse effect on urban spatial qualities.

Overall the emerging spatial growth pattern in the residential areas of new Dhaka depicts a settlement which is heading towards compactness with buildings of varying height, size and plot coverage. The ultimate result of this trend is already evident in the residential areas of old Dhaka where excessive compactness of buildings closely juxtaposed to each other is resulting into poor spatial qualities of indoor living environment as well as other urban crises like excessive load on infrastructure, unbearable traffic congestion, noise pollution, air pollution and other social and environmental consequences. The fact is that development is taking place on plot-by-plot basis, the skyline is broken depicting what can be called a "jagged landscape of towering obelisks".

7.2.2 Consequences of densification

The findings from the questionnaire survey based on sustainability indicators and results from fieldwork and residents' opinions were analyzed to address the third research question: *How is the densification process affecting livability, comfortability and sustainability of residential areas of Dhaka? Can these problems be addressed to contribute to a better understanding of densification and making residential areas of Dhaka sustainable?*

Literature suggests that a minimum density is required to support community facilities that raise quality of life through creating community cohesion, reducing isolation, reducing fear of crime and creating opportunities for information sharing and participation in community activity. It is also well recognized in contemporary planning literature that vibrancy and social sustainability of residential neighbourhoods is associated with a community's access to a range of business, professional, social, cultural, recreation and education resources. Providing these facilities at a local level, in convenient locations, increases their accessibility for users and reduces the need to travel. The research also supports this claim as the higher density areas were found with higher access to community facilities which is supposed to enhance social sustainability. Even though access to most of the community facilities have been found satisfactory in the old and new residential areas of Dhaka but the social sustainability is still under question as the accessibility to community facilities are hampered by excess traffic generation caused by the over provision and scale of these facilities. As reported by the respondents severe traffic congestion due to this unwanted traffic is a commonplace in these residential areas hindering the accessibility of the local residents to these facilities and amenities in terms of travel time and thereby hampering the quality of life. Most of the inhabitants usually avail these facilities through rickshaw which should generally take about 10-15 minutes. But due to the frequent traffic congestion these short trips takes exhaustingly more time which is totally unacceptable. So despite having adequate and sometimes over provision of these community facilities the local residents cannot accrue the full benefit from them.

Literature suggests that higher densities are likely to support higher social interaction in the case of developing countries because of their vibrant social patterns (Richardson et al., 2000). The findings of this research regarding community spirit and social interaction support this assumption. The statistical results indicate a positive relation between high density and social stability which means the higher density residential areas were found with high degree of social cohesion. Social cohesion is developed through frequent informal social interaction which helps to cultivate trust and nurtures bonding among the neighbours. It helps to reduce fear of crime and enhances the overall well-being of the community. The old residential areas were found to have more social cohesion than the residential areas of new Dhaka which cannot be attributed to the physical density alone. The years of residency as well as the occupation type could be a major factor for this prevailing form of social bonding.

There is a mix of various occupational residents residing in these neighbourhoods with a significant portion living for a long time. The percentage housewives are much higher in old Dhaka than in new Dhaka who spent much time at home and frequently interacts with the neighbours resulting in social bonding. Though the dense settlement of the old Dhaka results into where the life style of the residents of new Dhaka seems to be a barrier in forming social cohesion. Most of the family members of the residents of the new Dhaka are found to be service holders who spend most of the time in offices and find less time to socialize with neighbours. The fast paced urban lifestyle has drawn people to rely more on virtual interaction through cell phones, internet, social communication websites rather than real life social interaction. The lack of open spaces and community spaces within the building further encourages communication through bridging exercises rather than bonding. The design of built form has significant impact on social interaction as residents of high rise buildings are found to chat less with their neighbours than the residents of low rise houses. This suggests that, the design of the built form, layout and neighbourhood design had more influence on the perceptions and behavior of people than physical density.

In general high density was found to have positive relationship with the sense of safety. People of Uttara, Pallabi, Banani, Gulshan and Dhanmondi were found satisfied with the security condition as most of these residential areas are gated community well looked after by the neighbourhood community welfare societies. The activities of these community welfare organizations are to ensure security through maintaining night guard, neighbourhood gates, organize various seasonal festivals, fairs and celebrate national and cultural festivals. Although by and large there is no gate culture in the neighbourhoods of old Dhaka the security of the area is well guarded by the residents. Only a few cul de sac lanes along with new built high rise apartments are spotted having gates. But in comparison to the new Dhaka the residents of old Dhaka have expressed higher degree of satisfaction regarding the safety condition of their neighbourhoods. Crowding within a dwelling was found to have no relationship with indicators of safety. Thus, it was found overall that higher density had positive impact on satisfaction with the neighbourhood.

From the results it was found that high density is positively associated with health problems. Stress related problems were found to be highest in both old and new residential areas followed by respiratory problems. The presence of frequent traffic congestion contributing to the raised level of vehicular emission in the neighbourhoods is one of the prime reasons for respiratory health problems. On the other hand, the fast paced urban sedentary lifestyle, lack of physical activity could be the cause of the higher incidence of stress related health problems. Since the built environment features and overall neighbourhood design resulting high density settlements show lack of consideration in promoting good health to the inhabitants the sustainability of the community as well as the residential area seems vulnerable.

Some interesting results came up from the questionnaire survey as well as the informal interviews with the residents. Although the results from field survey indicate that there is high level of visual obstruction, lack of privacy and noise pollution in the residential areas of Dhaka detrimental to healthy living standards but when residents were asked about their opinion regarding these issues around 87% did not feel it as trouble. On the contrary most of them expressed a considerable level of satisfaction regarding the living environment of apartment culture. People’s tolerance to the existing level of residential density indicates that the prevailing density is still within the culturally acceptable level. The magnitude of noise and visual obstruction in the residential areas were found far higher than the desired level but surprisingly had no significant impact on residents’ perception. The seemingly insensitivity towards visual and acoustic privacy could be attributed to the cultural upbringing and the resilient nature of the people possessing higher degree of adaptability towards high density. Nevertheless it is widely accepted in literature that prolonged exposure to higher level of noise and visual obstruction results into various physical and psychological impairments. This again suggests that such form high density development does not promote sustainable living environment for the residents.

The research findings disclose a negative association of gross population density with the accessibility to open space. The old Dhaka residential areas have no open spaces where the new residential have open spaces much below than the standard. Insufficient, impracticable development (density) control and open space protection regulations, and to a great extent the role of market forces increasingly encroaching the open spaces, are responsible for Dhaka having the lowest amount of open space available for the residential areas. Furthermore, the pattern of planning, development and maintenance of the existing open spaces do not provide equitable access to all the inhabitants of the residential areas in terms of travel distance and time, suitability and diversity of usage. It has long been recognized that open spaces are important for our well-being. Exposure to open space, and green space in particular, is important in promoting restoration and relaxation, and reducing stress (Greenspace Scotland 2008). The unconcern of the planning authority towards these environmental issues would make the social, emotional, environmental well-being of the community vulnerable in the long run and in effect will make these residential areas unsustainable.

The observation of this research reveals that high density is negatively associated with accessibility of public transportation facilities in terms of availability of transports and average distance of bus stops in the context of Dhaka which implies that the overall ratio of the existing transport facilities is below the average demand of the Megacity. Though the overall provision is inadequate but still the accessibility to public transport facilities is comparatively higher in the lower density new residential areas than the higher density old residential areas. However, the present condition of public transport in terms of service quality, frequency, excessive fare, over crowdedness, shortage of route and frequency is not acceptable and therefore, does not ensure the sustainability of the residential areas in terms of public transport facilities. Due to the inadequacy and shortcomings of the public transport facilities people are compelled to rely on cars and for their daily trips which is causing more fuel consumption, traffic congestion and vehicular emission harmful for the environmental sustainability too. Access to utility services has found to have negative association with gross population density of the residential areas which indicates the inadequacy in the provision of the services. There is a shortage of mainly water and gas supply in the residential areas of old Dhaka while new Dhaka has comparatively good accessibility to utility services in terms of availability and quality. But the sewerage and garbage disposal system in both new and old Dhaka has been found unsatisfactory. So the high density of the residential areas are not having the advantage of better accessibility to infrastructure facilities as claimed by the proponents of compact city development. However, this claim is only valid when the existing infrastructure facilities are already adequate but in Dhaka the scenario is quite different with a shortage of existing infrastructure facilities.

Overall the findings of the research suggest that, for social aspects of sustainability, higher population density have positive impacts but in case of environmental and economic aspects there are negative impacts. Importantly, most of the negative associations of density were related to the perceptions of density, and therefore the built form, layout, design and amount of mix of uses of a neighbourhood, as well as socio-demographic variables such as family income and location, years of residency, were found to have an important role in achieving sustainability of the residential areas. The amount of floor space people have in their home was also found negatively associated with high density which contributes to the crowding effect within the dwelling. Despite the overall positive relationship between density and social aspects of sustainability the full benefits of high density cannot be achieved in the residential areas of Dhaka due to over provision of community facilities, lack of open space, over dependence on digital technology, fast paced urban lifestyle and design of the built form and the built environment discouraging informal social interaction. This in turn makes the social sustainability of the residential areas of Dhaka vulnerable too. All these consequences of the ongoing densification process of Dhaka are already indicating the emergence of an urban crisis leading to the declining livability and sustainability of the residential areas which is very likely to intensify with time. The challenge therefore is in integrating the specific beneficial elements of urban form into higher-density urban forms to try to create more satisfactory and socially propitious built environments that could also meet other goals of the compact-city.

The research reveals one unexpected finding that though the density attributes and other environmental consequences emphasized mostly negative impacts but the overall satisfaction level of the residents regarding living condition is surprisingly high. Besides factors like year of residency, three other factors seem to have significant influence over the satisfaction level. Level of income, is a crucial factor influencing people's opinion about satisfaction. Most of the respondents belong to the middle and higher middle income group whose average annual income is not sufficient enough for owning an apartment which opt them for rental accommodation. The overall affordability of the middle income group has also suffered from the recent stock market crash. Only a few of them can hardly manage to afford the smallest size apartments. Under such an economic condition the very feeling of living or owning an apartment itself counts for satisfaction. Real estate sales record and the interviews of the developers confirmed that the most demandable apartment size ranges from 1100 – 1700 sq ft (both buying and renting) and in response to the demand developers are more eager to produce smaller size apartments than large ones.

The observations aided by respondents' comments indicated that most of these apartments usually have very tight living space with inadequate ventilation and solar access. The service zone including kitchen and dining spaces are usually the most neglected ones which are devoid of natural lighting and ventilation. The living spaces are also quite small for an average family of 5 members. Though there are standards for various indoor spaces or rooms suggested in the MINB2008 rule but in reality there is almost none or little practice conforming to these standards. But due to the marginal affordability the middle class families still fill satisfied compromising with the given amount of living spaces of the ready apartments. The other factor responsible for high satisfaction seems to be rooted in the socio-cultural background of the respondents where a majority of them are found to be previously living in dwellings or areas with less modern facilities or lacked the look and charm of modern architectural design. As a significant percentile of the respondents happens not to be native dwellers of Dhaka but rural migrants for whom the visual appeal of these apartments along with the facilities satisfies their level of expectation. In addtion, the transition from indigenous introvert rural courtyard house types to introvert self contained apartments was somehow easier to adopt in terms of space organization for most of the migrants. Furthermore, the observation indicated that the lack of open space for socializing and entertainment in the residential areas was much compensated by the virtual social spaces created by internet, mobile and cable TV. So being engaged in the virtual space people tends to become increasingly desensitized to their surrounding spatial requirement of open spaces necessary for healthy life. This is perhaps another reason for the higher satisfaction level of middle income group towards their dwelling space as well as the overall residential areas.

7.2.3 Causes of densification

The findings from critical analysis of the policy documents as well as Building Construction Guidelines and key personal interviews address the second research question : *How the Urbanization Policy and other relevant policies (i.e. National Housing policy, Mohanagar Imarat Nirman Bidhimala, 2008, Building Construction Rule 1984 etc.) of Bangladesh waived away development crisis facing the residential areas?*

i. *Consequently, are these policies well-equipped to deal with the housing crisis in Bangladesh, more specifically, that of Dhaka?*
ii. *What forces regulate and guide densification process in Dhaka?*

As revealed in the earlier Chapters it can be said that planning of Dhaka has largely been guided by the political will and deliberation rather than pre-determined well sought out decisions of planners. The first Master Plan 1959 as devised under the colonial settings of Pakistani colonial rulers was aimed to govern the interests of the colonizers rather the public. Other than defining the land use pattern of Dhaka and proposing some planned residential areas with a prescribed density of 200 persons/acre but it did not suggested any densification strategy for the city. Furthermore the proposals were based on misdiagnosed population projection which was surpassed manifold times after independence. Moreover, the Master Plan 1959 was prepared based on the model of traditional British style master plan which primarily focused on the land use zoning rather than strategic policies. Consequently the Master Plan failed to draw any significant impact on the urban planning of Dhaka and eventually failed. As the enforcement period of the Master Plan was supposed to expire in 1979, government took the initiative of formulating a second Master Plan but due to the declining economic condition and turbulence of in the political arena the completion of DMDP1995 was possible 15 years later from the expiry of the first Master Plan. Though obsolete in the face of the growing population demand the first Master Plan 1959 served as the only guideline during this long absence of any updated development plan.

After independence when the opportunity first surfaced for preparing a pro-people democratic plan the authority had to rely on foreign planners for accomplishing the task as the newly liberated country was still lacking the necessary native resource persons, expertise and planners. As a result the Second Master Plan (DMDP 1995-2015) was prepared by foreign consultants in a form of hierarchical planning package based on new planning model known as development plan. As the foreign advocacy planners were not well acquainted with the local culture they did not take into consideration the demand and aspiration of the people which is an essential step in making any plan successful. The development planning package is supposed to contain a Structure Plan which comprises of policy guidelines and Detail Area Plans which are presented in Map formats. However, due to lack of funding the Detail Area Plan (DAP) of DMDP 1995 could not be prepared with the Structure Plan. The delay of DAP was compensated through the introduction of an interim planning package known as Urban Area Plan (UAP). Due to the time lapse of 16 years between these two Master Plans the extended urban areas beyond the jurisdiction of the 1959 Master plan was literally left without any land use plan. This gave ample time and scope for haphazard spontaneous growth to take place all over the city. Again the Structure Plan lacked democratic approach in its policy vision along with many other loopholes in its guidelines. The lack of well demarcated land use zoning and loopholes in the policy documents further paved the way for development activity through illegal encroachment of the wetlands by the private sector. On the other hand the land policy of Bangladesh allows freehold land tenure system which does not allow government right on the land other than developmental rights. As a result land parcels continues to get fragmented through the process of subdivision in accordance with the Muslim Inheritance Law. To exert some control over this subdivision process Government imposed 335sq.m. (5 *kathas)* ceiling on subdivision of land only in the planned residential areas of Dhaka. The limited control of land and subdivision law also contributed to the unguided densification of the residential areas.

Field survey and interviews with the key personal revealed that in Old Dhaka most of the densification had taken place without a redevelopment plan to guide the process. Land coverage at block level in the two of the study areas (Wari and Luxmi Bazaar) was noted to be ranging from 85.1% to 89.4% which was far above the recommended coverage of 70 percent. In Luxmi Bazaar around 98% and in Wari 88% of all buildings had plot coverage above the recommended ratio. These divergences were compounded by inappropriate development control mechanism assigned for these areas. The old Dhaka is a complex agglomeration of various types of areas with their distinct socio-economic and cultural characteristics. Most of these areas have organically evolved with an intricate labyrinth like road system while the few planned ones have grid iron pattern. Consequently varied irregular shape and size of plots had emerged out of this organic planning process housing single and double storied houses of distinct architectural characteristics. During the partition of 1947 a huge transformation took place in the ownership of the plots where there was a change of title as refugees exchanged their properties and also many properties were abandoned which was acquired illegally by the influencial locals. As a result various kinds of complexity regarding the legal titleship of these plots exist which tended the residents in redeveloping their plots without any permission from the authority. Majority of the buildings built before 2008 did not follow the DIT setback rules. Most of the roads in these areas are narrow enough for the FAR rule to be enforced effectively. All these factors complemented the unguided nature of densification in old Dhaka.

Nevertheless, there were gaps at the strategic level in Structure and Urban Plans regarding land use zoning. The Structure Plan proposed the continuation of development of residential areas with no directives for controlling the development intensity while Urban Area Plan (UAP) in compliance with the SP suggested the availability of infrastructure as the yardstick of density control. As UAP was supposed to work for an interim period the density control mechanism was expected to be included in the Detail Area Plan 2010. Meanwhile notable progress in the economic condition of the country took place due to introduction of the neo-liberalism policy model. As a result there was a rise in the activity of the private sector whose reflection could be observed in the housing sector too. The wave of redevelopment activity in the existing residential areas led by the real estate developers transformed the low rise buildings to high rise dwellings. Rapid transformation also took place in the socio-cultural sphere with the advent of communication technology. As a result people were increasingly drawn towards adopting the western life style and values which in turn helped in the wide acceptance of apartment culture. Along with the emergence of vertical dwellings transformation of residential buildings into commercial uses was also taking place as a response to demand of the increasing density.

All these above mentioned factors worked as catalyst to boom the business of the real state which reached the peak in 2010. The redevelopment activity led by the market force was largely unguided for the lack of proper development control mechanism. Due to the absence of any densification strategy and adequate development control measures transformation of low rise houses into multi-storey apartment buildings was taking place spontaneously in the residential areas which characterize the densification process of the city. The unguided high-rise constructions have been taking place in a random manner, sometimes in contravention of the existing development control legislation or by taking advantage of the loopholes in the legislation. The intensive utilization of land with commercial and residential accommodation as manifested in high land coverage and floor area ratio is linked with operating land market forces where the developers are vying for profit maximization through renting and selling of apartments. This can be viewed as the private sector's response to the demands of the residential and supporting facilities. Nonetheless this skewed development pattern has put the urban services under severe stress resulting into poor spatial and environmental qualities. With a view to ameliorate all these development related problems RAJUK took up the preparation of Detail Area Plan (DAP) and completed it in 2010 delayed by 15 years. As the Detail Area Plan (DAP) 2010 was not guided by any strategic level planning framework and lacked adequate ground work it failed to prove to be as an effective development control instrument. So the city continued to be within the grip of unguided densification process. During the long absence Master Plan and Detail Area Plan, RAJUK formed several bye laws in form of Building Construction Rules which were amended periodically to regulate the development control in the city. Building Construction Rule 1996 exerted some control over the ongoing densification process by imposing height restriction of 6 stories while the recent MINB 2008 has introduced the concept of FAR in association with road width and building height to control development. But in absence of contextually appropriate density zoning plan FAR is applied indiscriminately in all areas irrespective of the capacity of that area in terms of traffic generation, road capacity and provision of utility services. This is further contributing to the densification of the residential areas and intensifying pressure on transport and service infrastructure. It should be noted that the benefits of FAR cannot be fully accrued unless accompanied with density zoning regulations as well as the socio-economic dynamics of the residential areas.

Another problem responsible for the lack of development control lies within RAJUK itself. From the study it was seen that planning capacity in RAJUK, has not been strengthened as per requirement and to this day the Planning Department remains technically understaffed. There has been no updating or enhancement of qualifications of the current planners. Urban planning is practised by them with a techno-centric notion with no regards to the complexities of social planning. In fact they remain ill-equipped to design the preparation process of Master and other development plans like DAP. Consequently, the Terms of Reference are over-ambitious and not practicable. The technical resources allocated are inadequate and dated. The inadequate planning capacity, lack of co-ordination among other sectoral agencies, lack of vision, corruption and malpractice, political intervention, dual role of RAJUK as developer and monitoring body, accentuated the development control problem. Implementation of urban plans needs considerable co-ordination and collective design and decision making with all agencies working together. There are no stated mechanisms for co-ordination or any over-arching planning framework which would have enabled agencies to collaborate and co-ordinate their plans. The result has been fractured, haphazard and environmentally unsustainable urban densification in conflict with inadequate infrastructural development.

The Structure Plan (2016 – 2035) currently underway the review process has suggested some strategies to regulate and control densification through the encouragement of block based housing and Planned Unit Development (PUD). By and large structure plan is a political statement which needs to be translated into physical planning measures through Detail Area Plans. So detail area plans are of utmost importance for effective planning. The directives for implementation of the policies outlined in SP (2016 -2035) are hopefully to be worked out in detail in the next DAP 2016-2035 which is undergoing the preparation process at present.

7.3 Discusssion and Implications

The research has attempted to investigate the underlying causes responsible for the densification process through which Dhaka has been undergoing. In connection to it has assessed the current situation of the residential areas to identify the consequences of this process and evaluated the associated sustainability issues of the residential areas in order to have a detail understanding of the phenomenon. The findings are supposed to be useful for the policy makers to formulate effective density control strategies pertinent to the sustainability imperative of the residential areas. From the findings some drawbacks in the planning strategies have been identified for which the following policy recommendations have been suggested:

7.3.1 Density issue

The total DMDP area is 590 sq. miles (1528 sq. km) including surrounding areas of central Dhaka city. The urbanized part of DCC by 2015 covered a total area of 265 sq. km. with a population of 1.14 million and gross density of 27000 persons/ sq. mile. Around 54% of the urbanized area of DCC belongs to the inner city core and the rest 46% to the outer fringe areas. The formal settlements where 30% of the city inhabitants live occupies only 28% of urban area. In these settlements the gross density ranges in between 162 to 1474 persons per hectare depending on the age and location of the settlements. Again the density pattern varies largely between the older and relatively new formal settlements as indicated through the case study areas. Only the gross population density of Wari and Luxmi Bazaar was found to be relatively high while in the new residential areas of Uttara, Pallabi, Banani, Gulshan and Dhanmondi density was rather moderate. When compared with other developing countries these figures conform to the category of moderate density as well. For instance population densities in highly occupied settlements from different countries have been noted to be as follows; high-rise apartments in Hong Kong (5000 persons per hectare), high-rise apartments in Mumbai (3500 persons per hectare), Mexico (1442 persons per hectare), Jakarta (800 persons per hectare), Rocas and Santos Reis informal settlements in Brazil (350 persons per hectare) (Acioly and Davidson, 1996).

However, densification through redevelopment seems to be focused in these formal settlements resulting into achieving higher densities while the informal settlements with very high concentration of people develops in a patchy pattern in vicinity to these formal settlements. Given the fact that Dhaka is the sole commercial heart of the country people from all over the country will continue migrating to Dhaka for employment opportunities which would consequently give rise to the population density of both formal and informal settlement. But as noted from the case studies the densification of the formal settlements it is typically a market led phenomenon aimed at maximizing profit through renting while in informal settlement densification is more demand led. The observations also revealed that the increase in the density of the new residential areas is due to the internal migration of the city itself where around 53 percent of the residents of these new residential areas have migrated from various locations of Dhaka since the last 10 – 15 years. These internal migrations took place as a result for the quest of better accommodation, amenities, connectivity, proximity to workplace, transportation facilities and status. On the other hand the increase in density of the old residential areas owe to the natural growth as well as to the inflow of urban rural migrants who finds affordable shelter and employment opportunities in these areas.

There is a wider acceptance among the scholars about the advantages of higher densities which includes efficiency in terms of infrastructure provision and maintenance, economies of scale, efficient utilization of land, lively neighbourhood life, high levels of access to business for both employees and to markets and increased surveillance in the use of spaces (Acioly, and Davidson, 1996; Correa, 1985; Newman, 1972). However, the concept of appropriate density is a culturally bound phenomenon and its acceptance level can vary across different parts of the same city depending of the socio-economic dynamics of the residents. Previous researches have shown that the concept and acceptability of high density differs largely between the developed and developing countries. Results from the empirical observation revealed that the residential areas of Dhaka perceived as high density settlement are within the threshold of cultural acceptability of the residents. While 'higher' densities may be desirable, and accepted by the majority of residents according to this research, the main focus should be on policies that must take account the needs of different social groups. Higher densities should be designed to deliver the best possible quality of life, given the circumstances of residents. Higher densities can be delivered in many different forms and it is important that these forms match the needs and aspirations of various groups of occupants of various socio-economic statuses. Therefore priority should be given in determining the house forms which can optimize land use and infrastructure provision in a sustainable way.

In general housing in Dhaka was found to be normally developed incrementally till late 80s, depending on income and demand. The layout and infrastructure provision of the residential areas of Dhaka were planned based on the assumption that average development would extend to 2-3 stories within a 10-20 year period. In other words, density was expected to at least double and over time could reach 4 or more times the original level according to the Master Plans. But due to the unpredictable changes in the socio-economic and political climate the population density surpassed the estimated level. This posed a particular challenge in how to plan for layouts and infrastructure that can accommodate these changes in a sustainable way before assigning the responsibility of housing supply to the private sector. But in reality no such strategies were ever formulated which allowed the densification process to commence in an unguided manner mainly dictated by the market forces. The evidence of this market-led densification of residential areas of Dhaka is apparent through the high number of the unsold apartments as reported by the real estate companies. The loose guidelines and inadequate control mechanism allowed this unguided densification process being carried out and implemented irrespective of the infrastructure capacity and demand of the area. So the growth of Dhaka inspite of being characterized by mid rise development are showing the ill effects of unguided densification. Bangladesh is heading towards achieving the status of middle income country. Keeping this in mind in broad terms the challenge is to design a densification strategy that would deliver an environmentally sensitive, socially responsive and economically affordable housing to middle and low income families starting with incremental development, but having the provision of accommodating the changes that would take place within the next 20 years. There should be flexibility in design based on the local decision making which allows implementation to be responsive. A responsive area specific density planning intregrated with transportation and land use planning would aid in achieving the strategic city objectives rather than addressing issues in isolation. A Densification Policy is therefore, identified as a high priority to:

- Guide decision making with respect to density-related applications; Integrate, update and rationalize the existing studies into a single policy framework;

•Developing a spatial development framework on citywide density policy, as well as the ward-level spatial development plans as to the identification of areas of land use intensification;

• Guide the detailed planning and design of area wise local plans as well as density-specific plans; Space standards should take into account both internal and external spaces in density zoning. Density standards can be a useful tool for housing development in order to protect local character, ensure optimum use of land and to assist developers in preparing their proposals.

• Align density patterns, trends and proposals with the land use management regulations and infrastructural capacity; Taking into account local context, the utility services and public transport capacity, development should optimize housing output for different types of location within the relevant density range.

• Identify and put in place feasible mechanisms and processes (city wide to local scales) to support the appropriate implementation and management of higher densities.

7.3.2 Modification of existing planning rules and bye laws

The findings indicate, loose planning guidelines and loopholes regarding land use in the Structure and Urban Plans have initiated the haphazard spontaneous development and urban encroachment of environmentally sensitive areas which include flood flow zones, wetlands, natural drainage channels, canals and low-lying areas which act as sink for storm water runoff. The local area plans cannot progress unless these areas are clearly identified, demarcated and notified. To overcome this problem, the development of a DMDP Revised Land Use map should be of priority. This map should clearly demarcate the various land use and eco-sensitive areas and these should be notified. This action is required on top priority to ensure no more piecemeal development of land, filling of wetlands, destruction of agricultural lands, and continued haphazard growth of the DMDP Region. This comprehensive exercise should be undertaken immediately as the DMDP development with existing outdated Structure and DAP will not be comprehensive and will likely repeat mistakes of the past planning processes. This DMDP Revised Land Use Plan should be developed in consultation with all the sectoral and local planning bodies. Given the scarcity of buildable urban land densification is aviewed as a necessary step to promote the longer-term sustainability of Dhaka's valuable natural and urban environments. Development controls should be put in place to ensure the city develops according to the prescribed land use and intensity spelt out in the Structure Plan.

As discussed earlier in the previous Chapters the generalized application of FAR depending only on road width and plot size is not supposed to deliver the full benefits of environmental sustainability unless it is applied in conjunction with the density zoning and socio-economic dynamics of the proposed site. Value of FAR must be revised in accordance to the plot size, population size of that particular community and available utility services provisions on community. During determination of FAR value, it must be kept in mind. By and large it has been seen from the observations that the current development standards set by the FAR is not a practicable measure for development control in Old Dhaka. Development control measures should pay attention not to destroy the character of these historic neighbourhoods. The housing requirement of these overly densified areas should actually come from a planning brief prepared by the local authority in the context of a housing requirements analysis – much of that work at local level has been sadly lacking for both old and new Dhaka residential areas. However as the greater part of housing development is dependent on the private sector the state has to give them certain provisions for profit making while safeguarding the public interest. This can be done by imposing development control with flexibility through introducing various types of incentives. Incentives can be offered to the developers in terms of density bonus and eligibility of rental housing development in exchange of or certain percentage of units of the proposed development restricted for lower and moderate income households. More limited incentive can be given if there is a child care facility or open space, where the developer can receive a density bonus equivalent in square footage to the size of the child care facility or open space requirement. Other incentives may include granting an additional density bonus beyond the state mandate or approval of mixed-use zoning. The law should call for developers to pick the incentive they think is necessary, while giving provision to the city authority for rejecting the incentive by producing documents demonstrating a valid health, safety or environmental concern as to why that incentive is unacceptable. If the city does reject an incentive, the city must agree to a replacement incentive that is financially equivalent.

However, another potential challenge that is ahead of building redevelopment in all the new residential areas of Dhaka is the implementation of FAR rules by RAJUK with transparency. As revealed from the study the current trend of following the FAR rules in smaller plots does not make a meaningful difference to the overall open space of the urban fabric and living condition. Although the local proponents of the present FAR rules argue that the benefits of this FAR is supposed to be accrued some 30-40 years later when the current stock of older buildings will wear out and will be replaced by the new generation of FAR abiding buildings but they are not essentially taking into account the tentative population growth and the changing demand and taste of that time. So this assumption could be misleading in getting the desirable urban environment. However, a noticeable up gradation in the spatial quality might be achieved if FAR can be practiced by combining two or several adjacent plots together to create a big open space shared by both or all the plots of the block for social and neighbourood activities. This kind of approach has been taken in some other neighbouring countries like Singapore to keep green spaces at ground level for community activities [Urban Redevelopment Authority, 2012].

The residential areas of old Dhaka reflect the city's historic development pattern. Century-old Colonial homes are still found in many parts of old Dhaka. Densification should always follow the contextual attributes of sites. Refurbishment of the old city centre into a heritage realm in the authority of pedestrians might help to protect these heritage sites. Old buildings could be allowed to be rehabilitated with new functions, whilst the potentials of the public squares and open spaces like Victoria Park needs to be maximized by unlocking them for commercial, cultural and leisure activities. To avoid concentrated traffic in the city center, selected streets in the city center may be transformed into pedestrian walkways on which cars would be prohibited. This would attract more people to come to the old city center because they will be able to walk pedestrian streets, increasing the economic opportunities for local shops relative to streets with a predominance of car traffic. Innovative mechanisms like the provision of Transfer of Development right (TOD) for heritage buildings as well as other buildings of old Dhaka may help in preserving the character and regulate the density of the area. From the experiences of the other countries TOD is found to be an effective means which allows the transfer of development rights or building potentials from the existing sites to elsewhere in the city, if the infrastructure and services could cope with the increased built up area and higher density. The owners would pass the title of these buildings to the municipality in exchange of more floor space in another area. In the context of Dhaka where land is under private tenure TOD could be helpful in acquiring land for public service utilization.

Planning is a broad issue encompassing social, political, cultural, physical and environmental aspects. The success of urban planning lies in addressing the social injustice and understanding the political deliberation and consensus. In order to formulate plans governing public interest planners need to establish a mechanism for communities to participate in plan formulation and implementation. Most of the current densification process is promoted by profit making intension rather than solving housing problem and achieving sustainable urban development. It is in this area where government intervention can play a crucial role in regulating planning for safe guarding public interest. The developers' initiative needs to be checked and controlled by the government so that the residential areas do not become saturated and loose its livability. It needs socially conscious urban forms with social consideration. As revealed from the empirical observations the close juxtaposition of the buildings are not only undermining the thermal and daylight condition of the interior but also creating heat islands among the buildings. The block size and plot layout was found to be primarily responsible for this condition along with the inadequate development guidelines. However this implies the need for microclimate aware densification strategy applicable to block size urban development of Dhaka. Like Singapore interspersing high rise with low rise buildings can effectively reduce the sunlight and ventilation problem creating a skyline with more character and relieves the sense of a being a crowded space.

Another factor that was observed was the dominance of a development monoculture adopted by the developers which gives preference to the similar housing typology of high rise buildings for medium as well as higher density settlements. This monoculture of multifamily high rise housing not only restricts their affordability to a single socio economic group but also is one of the prime reasons of various built environment problems. As the developers' target is the high and middle income group there is an apparent reluctance to experiment with mixing of household sizes and types. The street frontages if varied in height by low rise houses alternating with mid and high rise houses or terraced high rise buildings can reduce bulk and perceptions of density. Government should promote schemes that embrace diversity of household type, and variations in external design also, which may predictably, generate a lively, vibrant community and also ensure equity.

7.3.3 Strategic Transportation Planning

Higher density developments when unguided may also be associated with problems of congestion, overloaded infrastructure, poor spatial qualities and urban inefficiencies which have been observed in case of Dhaka. The vertical expansion of the city has stretched an extent where disadvantages in terms of transport system and infrastructure provision are increasingly becoming unsustainable and beyond the limit of acceptable thresholds of city growth. From the empirical observations, the transport system has found to be the most affected in the current context of Dhaka. For efficient means of handling densification of developed areas a detailed densification policy aided with viable transportation system should be laid out first. Densification strategy when formulated needs to be integrated with transportation planning. The best practices of densification strategies around the world reinforce this fact. An example of successful densification practice is Curitiba where an structural axes for public transportation integrated with urban land use was created redirecting the city's growth from a concentric radial to linear pattern ((Rabinovitch, 1992; Pienaar *et al* 2005). Along this axes the density zones of differing densities were planned.

The city of Dhaka is deprived of an efficient public transport network system. According to Caminos and Goethert (1978) atleast 20%-25% of the urban land should be dedicated to road space to facilitate a smooth transport system in a modern city. According to the STP 2005 Dhaka has a road space of 9% of its total urban area, even after the implementation of the Dhaka Urban Transport Project (DUTP) and the Dhaka Integrated Transport Project (DITP), which is far less than the recommended standards. Further, the growth of road space has been slower than the growth of vehicles (80% in the last decade). In addition, according to the official records of DCC the mixing of different modes of transport i.e. both motorized and non-motorized transport (rickshaws 3,00,000 in number accounting for 15.2% of the traffic and occupying 73% of the road space) has been cited as a major reason for congestion in the city. The unguided densification has contributed to an acceleration in the number automobiles which is reflected in the figures of BRTA 2012. The figures indicate the increase in the number of cars from 4734 in 2004 to 10913 in 2011. The exceeding number of cars causes traffic congestion for prolonged hours. The congestion is further aggravated by incidences of on-street parking in absence of off-road parking spaces in the city. The problem of severe traffic congestion is found acute in all the study areas. Besides keeping records of the registered cars, there is a need for imposing a ceiling on the number of new cars allowed to be registered each year. This figure needs to be determined based on the road capacity to ensure a street and car balance. The present practice of constructing high rise buildings according to the FAR rule does not take into account the impact of the additional cars provided for each apartment which could be introduced through density planning based on the allowable road capacity of the respective residential areas. The Observations also indicated that the tendency of constructing of multi-storey buildings along the major transport corridors without adequate arrangements for parking of construction vehicles, storage of construction materials etc. in contravention to the building rules (BCR2006), has resulted in aggravating congestions on certain important corridors.

As the acquisition of land for road construction is onerous and impractical as most of the land in the inner city has already been built up and under the private ownership, innovative solutions regarding public transport and proper utilization of the existing roads need to be taken. From the observations it was found that there is a lack of public transport which compels the urban dwellers to use alternative mode of transports and making them more car oriented. A drastic increase in the number of registered private cars from 4734 in 2004 to 10913 in 2011 (BRTA, 2012) can be noticed in Dhaka which also substantiate this fact. On the other hand according to the Bangladesh Road Transport Authority, 2012 record, the number of buses through the period of 2004 to 2011 increased from only 1147 to 1318 buses which is highly inadequate for a Mega city like Dhaka. This is partly due to the inadequate road infrastructure as well as the monopoly of a handful of influencial private companies running the bus sector with the BRTA (STP, 2005). A study done by Alam and Habib (2003) showed that more than 60 percent of the roads of Dhaka are found to be congested for carrying 25 percent more traffic than their capacities and around 50 percent these roads are incapable of supporting a vehicular speed limit of more than 15 km/ hr during the peak hours.

Through the introduction of BRTs enabling connection to the entire city use of automobiles can be reduced. Furthermore, the provision of cars based on the estimated traffic load should be taken into account while determining the allowable net density of any neighbourhood which is absent in the current densification process. These strategies would in turn reduce the traffic congestion and will also solve other transport related problems like shortage of routes, overcrowding, high fare, quality of transport, shortage of bus stops etc which are evident in the study areas. Newman and Kenworthy (1989) had shown that public transport becomes viable at net densities between 90 to 120 persons per hectare (gross densities of 30-40 plots/ hectare) and walking becomes viable at a net density of 300 persons per hectare. The gross densities found in the study areas ranges between 81 to 737 persons per hectare which make these settlements viable for public transport. Furthermore, the geographical configuration of the city which allows linear development is suitable for mass transit system. Therefore, steps should be taken regarding solving the transport problem through planning and implementation of viable public transportation system. The Government already had planned for mass rapid transport system (MRTs) through introduction of elevated train system. However, the BRT service with designated bus lanes rather than the expensive elevated rail tracks could have been cost effective in terms of installation and operation. For funding public transports strategies can be formulated to sought developers' contribution.

Besides ensuring efficient transport system for a largely unplanned city like Dhaka, it is crucial to develop an accessibility network model of urban street and open space system to ensure a safe and rapid evacuation as part of post disaster management strategy. A growing body of research has showed that an accessible street network based on people's movement pattern and density and other morphological aspects such as land use, building density and distribution of public open space and shelter appeared to be a starting point for effective rescue and recovery planning (Ahmed, 2016). The proposed ideas may further impart awareness among the future design professionals, planners and urban designers to ensure a resilient city. A designed accessibility network would promote earthquake awareness including preparedness and mitigation programs within the community. A pre-planned evacuation plan for a locality would make them self-dependent in facing a disaster and enable them to cope with the adverse situation. Preparation of a contextual integrated evacuation plan calls for high priority especially for each and every locality in unplanned cities like Dhaka. The disaster management plans should be incorporated when place specific density zoning is prescribed. Local accessibility of street network, existing public buildings and open spaces would ensure a prompt and safe evacuation during a disaster and thereby reduce earthquake vulnerability of an unplanned city like Dhaka.

7.3.4 Infrastructure and service facilities

Density is an important factor when analyzing the provision of infrastructure and public service delivery in residential areas. There is an inverse relationship between density and infrastructure costs (Arenas, 2002). The fact that the growth of Dhaka is largely characterized by mid-rise apartment buildings with population density ranging from 81 to 737 persons per sq. km. (BBS, 2011) the city has expanded vertically in the face of limited provision of line infrastructure and social facilities. As a consequence to the pace of growth there is significant infrastructure and service delivery gap in terms of gas and water supply especially in the older parts of the city. For the serviced residential areas the water supply system that was installed earlier for low rise settlement became insufficient for the high rise apartments. The water pressure is too low to reach the upper floors. In order to compensate the shortage new high rise buildings have installed motors which pumps the water from the water mains to the underground reservoirs and in overhead tanks to ensure water supply to the upper floors. This type of provision exerts extra pressure on the sub soil water and results in lowering the water table which is unsustainable for future growth. In addition 40% of the residential plots of Dhaka do not still have connection to sewerage system and have to rely on on-site sanitation that is septic tanks and soak pits. With the rising consumption of water and production of sludge these septic tanks need to be frequently emptied which is not cost effective for the long run either.

Apart from the provision of infrastructure the other aspect related to its cost effectiveness is the way it is operated and maintained. This goal aims to make sure, firstly, that whatever service and infrastructure is produced is done so in a sustainable way i.e. the sources used is done keeping the long term sustainability in mind and the infrastructures built are sensitive to its surrounding environmental and social elements. Regarding this point considerable drawbacks were found in the operation and maintenance of the existing infrastructure system. Observations indicated that the digging of all types or roads for installation, repair and shifting of utility service lines throughout the year causes huge snag in traffic flow and creates traffic congestion most of the time. The authority can easily solve this problem by installing service ducts (5'x7') running beneath the foot paths which is largely practiced in western countries to avoid such hassle. These service ducts are usually 5'x 7' in dimension and contains all the utility lines in various service trays inside it. Being all the utility lines in a single duct installed beneath the road side or under pedestrian walkway keeps the vehicular road free whenever any kind of repair work needs to be done regarding the utility services. The survey revealed that most of the neighbourhoods in the new residential areas have footpaths where this system can be engineered. It would also diminish the need for installing the series of electric poles with exposed high voltage wiring which not only pose danger but also presents an ugly streetscape. This underground ducting would improve the visual quality of the neighbourhoods by offering a clear street view. Though there is a high installation cost involved in replacing the current system but merits of the system would optimize the cost in the long run by making the neighbourhoods more sustainable. Government can explore this system in their upcoming residential projects where there is ample road width accompanied with pedestrian walk ways for designing such system.

Regarding the amenities and social infrastructure, the empirical observation has indicted an over concentration of commercial facilities and community services which are unnecessarily attracting more traffic into the residential areas causing enormous traffic congestion. This is a result of the developers' as well as the owners' interest in maximizing profit. However, the need of the private sector's involvement in supplying housing cannot be underscored but at the same time market-led development cannot be trusted for producing rational land use in terms of residential and community facilities. Understandably, the profit maximizing intention of the private sector tends to ignore the demand of non-profit making uses such as land for recreation and spatial qualities within and around built environment. These types of deficiencies require state intervention through setting up rules for regulating the land market and ensure efficient land use. As the good accessibility of the planned residential areas have high potential for commercial undertakings rules need to be formulated for controlling and guiding the transformation and redevelopment activities. Zoning can have a significant role to play in determining the optimum requirement of service facilities and amenities in the residential areas and controlling the unintended impacts of over-allocating land for non- residential uses while maintaining spatial qualities. As the quality of open spaces rather than the quantity matters, the shortage of open spaces can be minimized through innovative design solutions like roof top play areas, weekly play streets etc.

7.3.5 Improving planning intervention and information system

The conventional Master Plan approach of Colonial periods with its prescriptive mode of guidance has long been replaced by the Developmental plans comprising of structure and detail plans. Structure plans are policy statements of discretionary nature while the actual planning guidance comes in the form of Detail Area Plans that reflects the Master or Structure Plan's strategic vision. These detail area plans needs to be formulated in conjunction with participation of the public. One of the major factors contributing the failure of the existing DAP was this lack of active participation from the residents along with discussions with the developers and stake holders. Most of the planning is prepared by the planners by sitting on municipality desks without going to the site and concerning the locals. Instead of the Top-down approach a bottom-up approach is more practical which requires planners to get to the field and get acquainted with the ground realities and more likely through setting up local site offices where they can conceptualize, modify and generate plans with collaboration with the residents who are being the directly affected group by its implementation. This decentralized mode of plan preparation helps to achieve more practicable, viable and environmentally sensitive plans. The current densification process in planned and unplanned residential areas requires close guidance and continuous monitoring if effective planning and coherent land use are to be achieved. Spatial or physical planning is a highly dynamic discipline, influenced and dictated by the ongoing and expected economic trend, social dynamics and changing politics and technology. All these parameters are characterised by temporal and locational attributes. So one-size-fits-all approach cannot be applicable in the overall spatial planning of Dhaka. For instance the empirically drawn evidence has shown the physical, social and spatial character of the residential areas of old Dhaka differs greatly from that of new Dhaka. Again the historic core within itself possesses a great variation in the physical characteristics of the neighbourhoods.

The residential areas of old Dhaka reflect the city's historic development pattern. Century-old Colonial homes are still found in many parts of old Dhaka which needs to be preserved, restored and perhaps put to some compatible use. Planning approaches should be proposed through consulting the stakeholders and public and should be aimed in retaining the basic existing pattern of these neighbourhoods and make minor adjustments to the house forms. Planning intervention should emphasize on redevelopment activity of the city core with socially conscious urban forms. Only ear marking these structures as heritage site is not enough unless proper planning initiatives are taken to revitalize them through comprehending the socio-economic context associated with them. The observations also revealed the lack of consideration towards socio-economic dimension resulting into ineffective planning solution which is evident through the futile application of FAR in the residential areas of old Dhaka. The current trends of densification shows that the private developers under the market forces are spearheading housing development processes in ways that does not care for the spatial qualities. Density targets can be useful planning tools at the beginning of a project and to measure outcomes at the end. But targets should not be applied as blanket controls but should leave provision for housing diversity that could deliver different densities along the way. Here planning should intervene in ensuring the delivery of socially conscious urban forms with social consideration which can be sustainable in the long run. RAJUK practices the density target of 300persons/acre for the development new residential projects. This 'one-size-fits all' density plans across large areas can work against intended design outcome as they can often be administered incorrectly without regard to the role that time plays in achieving the longer term vision. Problems can occur when an area-wide net residential density target is translated into one building type and used as the overriding development standard which is currently in practice in the redevelopment of the residential areas of Dhaka. As the right' density evolves over time density targets should be used as long-term goals, not generic, 'one-size-fits-all' planning controls. There is a need therefore, to revisit the whole planning in practice and evolve alternative approaches that are consistent with realities on the ground. As planners are more accustomed in delivering plans by sitting on their desks at municipalities they need to be frequently trained towards innovative approaches to respond to current problems more sensitively. Additionally, consultants with more appropriate skill sets need to be appointed. Plan formulation needs a team with better technical know-how, better understanding of the complexities of urban planning, and posses a critical approach to project execution and therefore can plan an effective densification strategy for the city of Dhaka.

The growth within the already developed areas has taken place in a random manner, sometimes in contravention of existing development control legislation or by using loopholes in the legislation. Thus, the overall problems noted above further reinforced the haphazard growth all over the city. This type of skewed development took place due to the deviations of Structure plan and whimsical decisions taken on the ground of personal interest backed by political influence. All these lax of rules and regulations promoted large scale corruption in every tier of the bureaucratic administration. The endemic corruption in the bureaucratic system literally made it impossible for planners to administer people oriented planning. After 45 years of liberation the country at present has no shortage in availability of competent resource persons (planners, architects, engineers etc) to carry out the planning job efficiently. But obstacle comes from the age old administration system where most of the government institutions are running with low human resources employed on the basis of a half century back requirement. So ironically despite the abundance of competent planners and resource persons seeking opportunities to be employed RAJUK and other relevant institutions suffers from lack of institutional capacity. The findings of the research further indicated that there is a significant amount of ambiguity and overlapping in function and inconsistency in policy derivatives which impedes the efficient delivery of development projects. For efficient operation of the development and planning instruments the whole planning system needs to be co-ordinated by one overarching planning municipal authority as seen in Malaysia, Singapore and Indonesia.

Another reason for ineffective planning interventions could be attributed to the low capacity of the local authorities in terms of manpower, competent resource persons, financial resources and equipment to deal with the vast scale and complexity of urban problems of the municipal areas. Part of this problem can be eased with the improvement of computer bases information management system. Geographic Information System (GIS) can prove useful for preparing spatial and social data base which comes handy in analyzing and preparation of context responsive plans. There is a need for establishing a data bank containing the updated statistics about various land related information at public disposal. An automated property register and a land information system allows the Municipality to provide any resident with information about building parameters, densities and development potentials of every single plot in the city. There should be readily available accurate data about various density measures as well as plot occupancy data which help in formulating various effective policies regarding densification. The automated system can also be introduced in the development cell of RAJUK that issues permit of all developmental works. It can in effect reduce the scope of corruption by decreasing human intervention and therefore increase the speed of the services. For instance the plan approval process currently involves the clearance from seven organizations which becomes a lengthy and cumbersome process for the clients. An automated system enables swift service delivery to the clients which would save them from the unnecessary hassle.

7.4 Scope of Further Research

The research has looked at the impact of density on the three dimensions of sustainability namely social, environmental and economic sustainability. But the growing body of literature is increasingly emphasizing on the fourth dimension of sustainability which is the cultural sustainability. Cultural sustainability is currently gaining a lot of attention in the scientific community and is recognized as the forth but the fundamental pillar of sustainability. As the aspects of cultural components are greatly subjective in nature researchers are having trouble in determining measurable indicators for them. Literature also informs that though difficult but converting the subjective aspects into measurable indicators is possible. Due to the range of complexity involved in assessing cultural sustainability this research did not considered it in its limited time frame. But in order to understand interaction between human and their built environment which is supposed to have significant impact on the shaping of urban built form cultural sustainability forms an impetus for further research to contribute to the limited body of knowledge. This research has been restricted to investigate the desirable physical aspects of sustainable design for higher densities. Technical aspects of sustainable design, particularly energy consumption and infrastructural service development needs further research to establish criteria for cost-effective methods, orientation and construction materials.

7.5 Thesis Contribution to Knowledege

The research contributes through a critical examination of the physical density attributes of the built environment of the residential areas of Dhaka as well as evaluating the residents' perception of the current density stage. It has presented the trend of densification of residential areas of Dhaka through investigating the historical development of the selected case study settlements. The thesis has examined the factors that deflect policy intentions from policy outcomes. An understanding of these factors will facilitate the future implementation of planning strategy and policy in a more sustainable manner. This study showed the relationship between density attributes (physical and perceived) and sustainability dimensions of the study residential areas which needs to be evaluated in order to work out contextual sustainable solutions in built environment design and visualise a sustainable future for Dhaka. The thesis outcomes have a practical application. The sustainability and density indicators represent a practical application and outcome from the research that can, after validation, be adopted, adapted and used by a number of statutory and non statutory actors.

7.6 Conclusion

The thesis has explored the densification process through tracing the causes from the planning history supplemented by the empirical case studies which demonstrated the trend of redevelopment activity of the residential areas of Dhaka city characterized by the ongoing densification process with their major consequences on the spatial and environmental qualities. In this thesis the densification process of the residential areas of Dhaka has been assessed in terms of physical and perceived dimensions of density. The objective measure of density is studied through net residential and net residential population density while subjective measure was evaluated from the perception of the inhabitants. Though the overall population density of Dhaka is one of the highest in the world but this density fluctuates grotesquely between the formal and informal settlements. However, similar distinction was also found between the formal sector residential areas of old and new Dhaka. The figures representing the net residential and net residential population density as found from the empirical observation can be classified as high density in case of old Dhaka but the density of the residential areas of new Dhaka is still found to be moderate in comparison to the other high density settlements of other developing countries. This fact is further reinforced by the unanticipated high degree of satisfaction level reported by the responses of the residents. This implies to an overall higher level of cultural acceptance of the respondents towards the prevailing density statistics. This higher level of cultural acceptance had significant linkage with the socio-cultural background and demographic variables like income, education, duration of residency etc. However, the research found that the density itself is not what is bothering the inhabitants directly but it is the by product of unguided density like the problems associated with overall mobility and transportation. Density itself is not felt as a critical problem yet to most of the inhabitants but other factors which is the likely outcome of unguided densification is causing the main discomfort.

The most visible negative impact of densification could be identified in two areas, one is in the urban system specifically the overstrained transport system and the other is in the design attributes of the built environment. From the observations, mobility of the people was found to be most badly affected due to the transport related problems like traffic congestion, lack of public transport, lack of pedestrian walkways, affordable fair etc. The transportation problem stemmed not only from the lack of vision for an integrated transportation planning but also due to the non adherence of the Master Plan resulting from endemic corruption. The problems were further aggravated by the uneven distribution of social infrastructure and commercial facilities which are once again the result of lack effective development control measure and land use zoning ordinances. Dhaka serves as the sole economic, administrative and cultural hub of the country and is estimated to be a city of 14.1 million people but the density surpass this figure during the daytime due to the commuters who commute to the city each morning for performing their jobs. This fluctuating density exerts extra pressure on the transportation system.

The built environment problems like the lack of open space, public social space, inadequate day light, lack of ventilation and privacy ranks the second place. Apart from these visible shortcomings a range of apparently invisible consequences could also be identified which included the lack of social integration which is a result of the lesser social interaction within the neighbours of the new residential areas of Dhaka. Besides the socio-economic dynamics and individual lifestyle preferences the occurrence of lower social interaction can be attributed to the design of the built environment as well. The lack of open spaces, public square and community spaces have made the current residential areas devoid of the breathing spaces essential for fostering physical and mental well being of the residents. Therefore, the designs are actually making the urban dwellers more indoor oriented and prone to occupy themselves with sedentary activities. As discussed in section 5.2.3 of Chapter 5 this type of confined lifestyle with very limited exposure to nature could be the prime causes of the significantly higher incident of stress related health problems found among the residents. The neighbourhoods with higher vehicular movement have a higher percentage of residents suffering from air pollution related health problems especially caused by the vehicular emission. Due to lack of awareness people remain oblivious regarding these issues and therefore are unable to apprehend the intensity of these implicit problems which are commencing in a relatively gradual pace. Though intensity of these problems cannot be felt instantaneously on the current livability condition but is likely to multiply beyond reconciliation in future which indicates to the unsustainable development approach of the ongoing densification process.

The rapid urbanization trends that characterizes the growth of Dhaka city have resulted into a high density vertical expansion concentrated within the existing city boundary. Besides the geographical constraints one of the main factors contributing to these consequences is the lack of proper planning intervention devised by the government to regularize and control the land market as well as the development activities led by the market forces. The vertical expansion of the city has reached an extent where disadvantages in terms of transport system and infrastructure provision are increasingly becoming unsustainable and beyond the limit of acceptable thresholds of city growth. The research therefore suggest to adopt an decentralization policy for the city which would help in building self sufficient township which would provide employment opportunities for the formal and informal sector relieving the main city from experiencing the burden of fluctuating density. This would help in stabilizing the overstrained transportation and infrastructure system to some extent. Along with the decentralization policy the research acknowledges the need of an integrated land use and transportation planning for the development of the city which could be implemented incrementally with a co-ordinated financial plan. The thesis has also suggested modification in the existing FAR rules which needs to be revised and formulated according to area specific density planning. Regarding the built environment physical density attributes represented by block layouts, plot size and shape was found to be a major reason for the degrading livability of the residential areas.

Empirical evidence drawn from the study also indicates the lack of effective enforcement and implementation of the master plans coupled with contextually sensitive detailed densification strategy that would have fixed the urban problems of the residential areas of Dhaka to a greater extent. It is therefore important for policy makers to formulate policies regarding the context and character of the urban areas rather implementing an overarching density control mechanism. For example the indigenous settlement pattern of old Dhaka and the formal settlement pattern of new Dhaka may not function under the same densification policy. There is a need to adopt higher densities strategies relevant to place, use and context within the city. Therefore the research findings suggest a need to revise the existing regulations related to density. Further it was found that the relevant planning authorities lack institutional and financial capacities to conduct proper urban planning and management. There is a lack of information data bank coupled with the lack of coordination among various stakeholders working in the housing provision and management sector and failure to sensitize the authority on the importance of community participation in formulating and implementing development plans for residential areas. Some of the recommendations suggested are that the legal framework needs to be strengthened and adhered to at all times; human and financial capacity be improved and automated data banks and information centre established.

Nevertheless amidst all these challenges and corruption scenario Bangladesh has managed to upgrade its economic status from 1970's 'bottomless basket' to the present 'world's tailor' role model which is considered as an economic paradox. This fact however reflects the resilient nature of the nation who had the strength to fight the odds and rise from the ashes repeatedly evident throughout the history. This positive trait can help overcome all the obstacles in the path of achieving a planned Dhaka out the current vulnerable situation. A strong political will motivated by the awareness of the people can help rectify the situation. The much needed consensus between the public and government can direct this city of rich legacy towards a sustainable future and prosperity.

In conclusion it can be said that given the scarcity of buildable urban land urban compaction through densification can be viewed as a viable strategy for the development of the residential areas of Dhaka but the policy makers should re-orient policy and planning approaches to effectively optimize land and infrastructure to ensure a sustainable growth of the city. It will be naïve to believe that the recommendations suggested in this study would be implemented in a short period of time to overcome the problems of the already developed areas. Yet the contextual densification policy should be in line to facilitate the private sector and city authorities to provide the basic infrastructure and optimize the use of existing services while containing the city sprawl. The demographic window of opportunity that has emerged since the 1990s will not last long and will not be repeated in the near future. The Government should therefore formulate sustainable densification policies to manage this demographic challenge efficiently which would in turn harvest better and sustainable economic growth. This research therefore hopes to serve as a grounding base for further investigations towards addressing the contextually appropriate densification strategy for a sustainable Dhaka.

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APPENDIX I

DENSIFICATION OF RESIDENTIAL AREAS IN DHAKA : AN ENQUIRY OF CAUSES AND CONSEQUENCES TO ADDRESS APPROACHES TOWARDS SUSTAINABILTY

Questionnaire for Residents

This questionnaire survey is for attaining information on the residents' opinion about densification and livability of the neighbourhood to be used for completing a PhD research that is being carried out at the Department of Urban Planning and Design in The Bangladesh University of Engineering and Technology. The findings will be used only for academic purpose. The identity of the respondents will not be disclosed in any manner.

Time and date:________________ Name and Location of the Residential Area:____________________

Section A: Information about the Built Form and physical and perceived density

1. Type of the building.
 Residential Mixed use
2. Height of the building : ……….
 1-2 stories 3- 4 stories 5 – 10 stories 11- 20 stories Above 20 stories
3. No. of Residential Floors……………………….
4. No of flats/floor in the building………………..
5. Size / Area of the plot…………………………square feet *(length x width)*
6. Total floor space of the building………………square feet *(length x width)*

7. Please specify the type of dwelling that you are currently residing in
 Detached house
 Apartment / Flat
 Duplex
 Other _____________

8. What is the ownership pattern of your flat? Owned Rented

9. If it is owned, from whom did you buy it?
 Private developer Individual seller Inherited Self-built Public housing
 Others, please specify____________

10. How long have you and your family been living in this neighborhood? ______years_____months

11. Where did you used to live 10 or 20 years back?
 Same place
 Elsewhere in _____

12. Where did you feel better? Current place of dwelling Previous place of dwelling

13. What did you like in your previous place of living?

- Low traffic
- Less Traffic Congestion
- Friendly Neighbours
- Local shops within walking distance
- Safe walkable footpaths
- Larger in size
- Peaceful Environment
- Open spaces / Playfield
- No crowd
- Very green

14. Why did you choose your current location as place of living?
    - Better and clean Environment
    - Better Transportation Facilities
    - Attractive Design of the buildings
    - Well maintained walkable neighbourhood

15. What is the area/size of your flat?

- 400-700 sq. feet
- 701-1000 sq. feet
- 1001-1300 sq. feet
- 1301-1600 sq. feet
- 1600 –2500 sq.feet
- 2501 – 3000 sq. feet

16. How do you feel about the size of your dwelling?
    - Fairly spacious for your family
    - Just adequate for your family
    - Little bit crowded
    - Too much crowded

17. How do you feel about the density/ crowdedness of the neighborhood?
    - I am fine with it
    - It is tolerable
    - I like it
    - I have no problem about it
    - I do not like it
    - It is intolerable
    - No opinion
    - Others, please specify________________________________

18. How do you feel about the setback space provided between the buildings?
    - I feel it is okay
    - I have no problem about this
    - Buildings are too close to each other which hamper privacy
    - I do not like it at all
    - No opinion
    - Others, please specify____

19. Please rank in order of importance, the factors that influenced you in the purchase of this apartment (1 = greatest importance, 7 = least importance)

Location	
Proximity to school	
Proximity to workplace	
Proximity to relatives living nearby	
Style / Design of the apartment/ building	
Availability of utility services	
Other (please specify and rank)	

20. Are you satisfied about the living condition of your neighborhood?
□ Very satisfied □ Satisfied □ Fairly satisfied
□ Dissatisfied □ Very dissatisfied □ No opinion

Section B: Residents' responses pertaining towards Social Sustainability (Social Equity and Community Sustainability)

Part 1: Accessibility to Community Facilities / Services

21. Please mention your most used community facilities within the walking distance from your home.

Types of Facilities	No of Facilities	Walking Time Distance from Home (in minutes)	Quality of service of the Facilities (poor/fair/good/very good)
Vegetable and grocery market			
Shopping center (eg. Agora, Meena Bazar, Big Bazaar etc)			
Local neighbourhood shops			
Health facilities			
Primary School			
Secondary/High School			
Mosque			
Bank/ ATM booth			
Community centre			
Gym			

22. From where do you do your most of the monthly shopping of essential food commodities?
□ Local neighbourhood shops □ Big Shopping Malls (e,g. Agora, Meena Bazar etc.)

23. Are you satisfied about the number and quality of community facilities of your neighborhood?
□ Very satisfied □ Satisfied □ Fairly satisfied
□ Dissatisfied □ Very dissatisfied □ No opinion

Part 2: Health of the inhabitants

24. How many of your family members are suffering from the following health problems?

Health Problems	No of family members
Stress related: Heart desease, Blood Pressure, Diabetis, Obesity etc	
Pollution related: Headache, Asthama, Nausia	
No health problem	

Part 3: Sense of community / Community stability and Social Interaction

25. Do you generally converse / interact with your neighbors when you meet them?
 Yes No

26. How often do you talk with your neighbors in a month's time?
 Less than 5 5-10 times 10-15 times More than 15 times

27. How many neighbours do you know within the neighbourhood ?
 1 – 5 neighbours
 6 – 10 neighbours
 11 – 15 neighbours
 Above 20 neighbours

28. Are your neighbours friendly?
 Very friendly
 Moderately friendly
 Not friendly

29. Do you like to be involved in the community activities (eg. Community welfare activities Pohela Boishak, Pohela Falgun fair and other social and religious festivals?
 Yes No

30. If Yes then, how many times you were involved in the community activities in the last 12 months?
Please specify: _____________________.

31. If No, then, what is the reason behind your non-participation in the community activities**?**
 I do not know the neighbors Too many people are involved in the activities
 I do not have time I do not feel interested
 The activities are not organized properly
 Others, please specify: ___________________________________

Part 4: Sense of Safety and Security

32. Do you feel safe in the street and public spaces during daytime? Yes No
If not, then what are the causes for that?
 Too many outsiders in the neighbourhood
 Safety and security measures are low
 Some places are used by drug addicts and drug peddlers
 Incidence of snatch theft, petty criminals, eve-teasing
 Risk of road accidents
 Others (Please specify)………

33. Do you feel safe in the street and public spaces at night? Yes No
If not, then what are the causes for that?
 Inadequate street lights at night
 Inadequate patrolling of police in the neighborhoods

□ Presence of drug addicts and drug peddlers
□ Incidence of snatch theft, petty criminals, eve-teasing
□ Risk of road accidents
□ Others (Please specify)………

34. Are you satisfied with the level of safety in the neighborhood?
□ Very satisfied □ Satisfied □ Fairly satisfied □ Dissatisfied
□ Very dissatisfied □ No opinion

Section C: Residents' responses pertaining towards Environmental Sustainability (Living environment of the neighbourhood)

35. What types of open spaces / outdoor spaces are available in your neighborhood?
□ For sitting only □ For social interaction □ For relaxation □ For exercise
□ Playground □ Playfield □ Others, please specify________________

36. What is the time and transport mode required to reach the open space and recreation spaces?

Facilities	**Required time to reach (mins)**	**Mode of transport**
Park/green space/ open space		
Childrens' playground		

37.What is the present condition of the open space?
□ Good □ Fair □ Poor

38. How often do your children go outdoors to play?
□ Everyday □ 2-3 days a week □ Rarely □ Never

39. Where do they go to play? (Code is given on the right side)
Below 5 years :…………..
5 – 10 years :…………….
11 – 16 years :……………
16 – 18 years :……………

1. Inside the building premise
2. On the roof
3. In the neighbourhood playground
4. On the nearby road
5. Others (Please specify)

40. Can you observe or keep an eye on your child while playing in the playground from your home window? Yes/No………

41. Do you do physical exercise like jogging/walking in the neighbourhood? Yes/ No …….
- If Yes, where do you exercise?
  □ Within the neighbourhood
  □ Gymnasium
  □ At home using exercise equipments
  □ Others (Please specify) ……………..

42. If not, what are the reasons ?
□ There is no appropriate open space for physical exercise
□ Snatch theft in the neighbourhood open space

□ Gymnasiums are expensive
□ Too many outsiders come to the open spaces
□ Eve teasing
□ Some places are used by drug addicts and drug peddlers
□ Others (Please specify)………………….

43. Is there traffic congestion in the neighbourhood? Yes/ No ……………
- If Yes, then what are the causes of congestion in the neighbourhood?

□ Increase of commercial buildings
□ High number of schools/colleges/universities
□ Through traffic in the neighbourhood
□ Others (please specify)…………

44. Do the nearest high-rise buildings create visual obstruction? Yes/ No…………..
- If Yes, then what is the level of disturbance?

□ Highly disturbed
□ No much disturbed

45. Do you feel disturbed by the surrounding noise? Yes/No………….
- If yes, then what is the level of disturbance?

□ Highly disturbed □ No much disturbed

46. What are the causes of noise around you?

□ Non-residential uses
□ Congestion
□ Others

47. Do you feel disturbed by glare from cars or glasses from surrounding buildings? Yes/No……
- If yes, then what is the level of disturbance?

□ Highly disturbed
□ No much disturbed

48. Do you have to put on the light during the daytime in any of your rooms? Yes/No………
- If yes, then what is the level of disturbance?

□ Highly disturbed
□ No much disturbed

49. Are you satisfied with the level of privacy within the neighbourhood?

□ Very satisfied □ Satisfied □ Fairly satisfied □ Dissatisfied
□ Very dissatisfied □ No opinion

Section D: Residents' responses pertaining to Economic Sustainability (Provision of Transport accessibility and infrastructure)

Part 1: Transport Accessibility

50. Which mode of transport do you use mostly for the following outdoor activities? (Car/ rickshaw / taxi or auto-rickshaw /bus / motorcycle/ bicycle / by foot)

Outodoor Activity	Mode of transport	Required time to reach (mins)
Work		
Study		
Shopping		
Buying vegetables and grocery		
Taking children to school		
Outdoor sports / recreation purpose		
Social interaction		

51. The approximate distance travelled from home to work is ____________ Kilometres

52. How many cars and parking facilities do you own in your building?
Number of cars___________________________
Number of parking space___________________

53. What is the average distance of your nearest daily use public transport node/ stop?...............

54. Can you always use your most preferred public transport? □ Yes □ No

55. If the answer is No, what is the reason for not using your preferred mode of public transport?
□ Excessively crowded □ Unavailability □ Ticket Fare □ Distant from home
□ Others, please specify__________________________________

56. Are you satisfied with the existing public transport facilities?
□ Very satisfied □ Satisfied □Fairly satisfied □ Dissatisfied
□ Very dissatisfied □ No opinion

57. If you are dissatisfied with the provision of public transport, what are the reasons?
□ Shortage of vehicles □ Unavailability of transport □ Excessively crowded
□ Less frequent/irregular □ High fare □ Distance from home to bus stop
□ Others, please specify__________________________________

Part 2: Provision of Infrastructure

58. Please rank in order of availability and quality of service offered in your neighborhood from the following list (with 1 being the most good condition and 5 being the least acceptable condition).

Availability and Quality of water	
Availability of electricity	
Provision and availabilty of Gas	
Sewerage service	
Disposal of waste	

Section E: Socio-demographical data of the respondent

59. Age group: □ 20-45 □ 46-60 □ 61-75 □ no response

60. Gender: □ Male □ Female

61. Status: □ Single □ Married □ Others

62. Education Level: □ Primary or lower □ Secondary □ Bachelor degree
□ Master degree □ Doctorate degree □ Non-education

63. Occupation status: □ Civil servant □ Private employee □ Freelancer □ Student
□ Professional career i.e.physician, lawyer □ Business □ Unemployed
□ Retired □ Housewife □ Other, Pls. specify

64. How many members in your family (including yourself)__________persons.

64.1 Number of female........persons male................persons
64.2 Age of family member
Less than or equal to 15 years old...........persons
16-30 years old......................persons
31-45 years old............persons
46-60 years old......................persons
More than 60 years old............persons

65. What is the monthly household income?

□ Below TK10,000	□ TK 30001 – TK 40000
□ TK 10001 – TK 15000	□ TK 40001 – TK 50000
□ TK 15001 – TK 20000	□ TK 50,001 – TK 100,000
□ TK 20001 – TK 30000	□ Above TK 100,000

Thanks a lot for your cooperation

APPENDIX II

Circular of May, 1995, Ministry of' Housing and Public Works

The authority imposed the following development control "measures for Dhanmondi Residential Area in May 1995:

Plots, adjacent to Mirpur Road may be used for commercial purpose up to 20 feet depth, with 15% "Conversion Fee". This rule also will be applicable for Road no. 16 (Old Road no. 27), Road no. 2 and "Satmasjid Road". No uses except those mentioned below, will be permitted:

a. *Books, Papers, Stationary and Medicine shops*
b. *Goldsmith, Watch and Spectacles shops*
c. *Antiques and Curio*
d. *Travel Agencies*
e. *Bank and Insurance*
f. *Show Room of Car and Filling Station*
g. *Office of Commercial Institution (with the permission of the Authority.)*
h. *Snacks Bar (not Hotel and Restaurant and Posh Restaurant)*
i. *Photo Studio*
j. *Show Room: Ceramic (with the permission of the Authority)*
k. *Electronics equipment.*
l. *Clinic: up to 10 beds (but not of Infectious disease)*
m. *Commercial uses for the requirements of the local community and that are socially acceptable may be considered to get permission.*
n. *Small shops for daily necessities may be considered to get permission with the condition that:*

- *Shops will have parking arrangement.*
- *The shops will face the road.*
- *The shops will maintain distance from footpath according to the rules.*
- *The plots allotted for residential use will apply to the authority and the buildings can be made usable for commercial purpose.*

According to another circular of January 1996, Ministry of Housing and Public Works, the authority withdrew the ceiling of dwelling density of 10 flats per bigha (33decimal). The circular also proposed:

a. *The maximum permissible number of storey in the buildings will six but the number of flats may be as much as is possible to be served by the service organizations.*

b. *The building shall have lift facilities and parking arrangement within the plot area.*

c. *The size of a subdivided plot shall not be less than 5 katha.*

In order to a specify guideline for use of land, plot subdivision, construction of apartment, transfer of' title, height of building for Dhanmondi Residential Area a committee of 16 members was formed in June 1995, known as, "The Zahir Uddin Committee" (June, 1995, Ministry of Housing and Public Works).

The committee decided that:

a. *Present rule of building height of maximum 6 storeys in Dhanmondi Residential Area would continue.*
a. *The service giving organizations would assess the problems providing services to increased height of building and will recommend to the ministry whether the heights of the buildings could be increased further. These organizations will assess the problems and their solutions at interval of 2.5 and 10 years. After receiving the opinions, of the service giving organizations the Ministry would call another meeting to take decision in this regard as soon as possible.*

APPENDIX III

Standards for Sound [1]

Sl. No.	Category of areas	Standards determined at dBa unit Day	Night
a.	Silent zone	45	35
b.	Residential area	50	40
c.	Mixed area (mainly residential area, and also simultaneously used for commercial and industrial purposes)	60	50
d.	Commercial area	70	60
e.	Industrial area	75	70

Notes:

1. The time from 6 a.m. to 9 p.m. is counted as daytime.

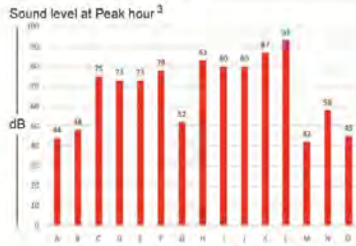
2. The time from 9 p.m. to 6 a.m. is counted as night time.

3. Area up to a radius of 100 meters around hospitals or educational institutions or special institutions/ establishments identified/to be identified by the Government is designated as Silent Zones where use of horns of vehicles or other audio signals, and loudspeakers are prohibited.

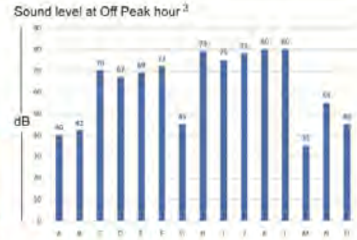
Comparative Examples of Noise Sources, Decibels & Their Effects [2]

Noise Source	Decibel Level	Decibel Effect
Jet take-off (at 25 meters)	150	Eardrum rupture
Auto horn at 1 meter	110	Average human pain threshold. 16 times as loud as 70 dB
Motorcycle at 25 ft (90 dB)	90	4 times as loud as 70 dB. Likely damage 8 hr exp
Freight train (at 15 meters); diesel truck 40 mph at 50 ft (84 dB); diesel train at 45 mph at 100 ft (83 dB)	80	2 times as loud as 70 dB. Possible damage in 8 hr exposure.
Conversation in restaurant, office, background music, Air conditioning unit at 100 ft	60	Half as loud as 70 dB. Fairly quiet

Sound level at Peak hour [3]



Sound level at Off Peak hour [3]



2.http://www.industrialnoisecontrol.com/comparative-noise-examples.htm

3.Source: Field survey

Table 1.5 Air pollutants in Dhaka City (March 2001) compared to WHO recommended standard

Compound	Hourly extreme µg/m^3	Times the WHO Recommended Standard
NO_2	601-714	>10
SO_2	300-500	>10
Particles	5-400	>15
Ozone	600-900	>5
VOC$_s$	783000	>50-100
Benzene	783000	>7-10
Toluene	200000	>10

Source
http://www.sdnpbd.org/sdi/international_days/wed/2005/data/atmosphere/air_pollutants_dhaka_compared_who.pdf accessed on 07.08.08

Planning standards for community facilities and open spaces as specified in the 1995 Dhaka Metropolitan Development Plan (DMDP)

SL. No.	Facilities	Standards
1.	Primary School	1 school per 15,000 population Area : 1 acre
2.	Madrasa	-
3.	High School/ Intermediate College	1 school per 23,000 population Area : 2 acres
4.	Degree College	-
5.	Park/Open Space	0.16 acre per 1,000 population
6.	Community Center	1 in each ward Area : 0.30 acre
7.	Health Center	Ward basis
8.	Graveyard	Ward basis Area : 5 acres
9.	Market	Ward basis Area : 0.03 acre
10.	Post Office	-
11.	Fire Station	-
12.	Police Out Post	-
13.	Mosque	1 for 3,000 population Area : 0.03 acre

Source: DMDP, 1997b

Planning standards for community facilities and open spaces as specified in the 2010 Detailed Area Plan

Table: Facility Standards at Neighborhood Level or for 12500 People

SL. No.	Facility	Quantity		Area		
		Min (No.)	Max (No.)	Minimum. for unit faciltity	Sub Class Total	Class Total (Acre)
1.	Primary School (Public or Private)	2	3	1 Acre		3
2.	High School (Public or Private)	1	2	1.5 Acre		3
3.	Open space			10 Acres		12
	i) Park/Children's park	1	2	.3 Acre	1 Acre	
	ii) Water body/Canal/Pond	As per Planner	1.5 Acre	6 Acres		
	iii) Play field	2	3	1 Acre	3 Acres	
	iv) Green/Vegetation/Water Front	As per Planner	0.5 Acre	2 Acres		
4.	Mosque and Maktab/Worship Places	2	3	0.2 Acre		0.6
5.	Library (central)	1	1	0.1 Acre		0.2
6.	Services			0.3 Acre		0.5
	i) Dentist/Doctor's Chamber	2	3	40 sq.m	120 sq. m	
	ii) Beauty Parlour	1	2	50 sq.m	100 sq. m	
	iii) Laundry	2	3	16 sq. m	50 sq. m	
	iv) Hair Dresser	2	3	12 sq. m	40 sq. m	
	v) Cyber Café/Internet service provider	1	2	50 sq. m	100 sq. m	
	vi) Photocopy/mobile/land phone/fax	2	2	12 sq.m	40 sq. m	
	vii) Computer based (word processing, printing etc) services	1	1	30 sq. m	30 sq. m	
	viii) Motor bike repair, vulcanizing etc. (optional)	1	1	50 sq.m	50 sq.m	
	ix) NMT repair service (Rickshaw, Bicycle etc)	1	2	30 sq. m	60 sq. m	
	x) Post Office/ Courier Services	1	2	20 sq. m	40 sq. m	
	xi) Sports/Recreational facilities (games, indoor games etc)	1	2	50 sq.m	100 sq. m	
	xii) Rickshaw/ Auto stand (General)	2	4	100 sq. m	400 sq.m	
	xiiii) Restaurant, Tea bar, Fast food	2	4	10 sq.m	100 sq.m	
7.	Solid waste transfer station (may also include small scale processing)	1	1	0.5 Acre		1
8.	Utility Facilities					1

RAJUK approved Floor Area Ratio (FAR) & Maximum Ground Coverage (MGC) for Residential and Commercial (office) building construction

SL. No.	Size of Plot		Residential Building			Commercial Building (office)		
	Square Meter	Katha	Width of Road (meter)	FAR	MGC %	Width of Road (meter)	FAR	MGC %
1.	134 sq. m. or less	2 katha or less	6.0	3.15	67.50	6.0	2.50	67.50
2.	More than 134 sq.m. upto 201 sq.m.	More than 2 katha upto 3 katha	6.0	3.35	65.00	6.0	3.00	65.00
3.	More than 201 sq.m. upto 268 sq.m.	More than 3 katha upto 4 katha	6.0	3.50	62.50	6.0	3.00	65.00
4.	More than 268 sq.m. upto 335 sq.m.	More than 4 katha upto 5 katha	6.0	3.50	62.50	6.0	3.50	62.50
5.	More than 335 sq.m. upto 402 sq.m.	More than 5 katha upto 6 katha	6.0	3.75	60.00	6.0	3.50	62.50
6.	More than 402 sq.m. upto 469 sq.m.	More than 6 katha upto 7 katha	6.0	3.75	60.00	6.0	3.75	60.00
7.	More than 469 sq.m. upto 535 sq.m.	More than 7 katha upto 8 katha	6.0	4.00	60.00	6.0	4.50	57.50
8.	More than 535 sq.m. upto 603 sq.m.	More than 8 katha upto 9 katha	6.0	4.00	60.00	6.0	5.50	57.50
9.	More than 603 sq.m. upto 670 sq.m.	More than 9 katha upto 10 katha	6.0	4.25	57.50	9.0	6.00	55.00
10.	More than 670 sq.m. upto 804 sq.m.	More than 10 katha upto 12 katha	9.0	4.25	57.50	9.0	6.50	55.00
11.	More than 804 sq.m. upto 938 sq.m.	More than 12 katha upto 14 katha	9.0	4.75	55.00	9.0	7.00	52.50
12.	More than 938 sq.m. upto 1072 sq.m.	More than 14 katha upto 16 katha	9.0	5.00	52.50	9.0	7.50	52.50
13.	More than 1072 sq.m. upto 1206 sq.m.	More than 16 katha upto 18 katha	9.0	5.25	52.50	9.0	8.00	50.00
14.	More than 1206 sq.m. upto 1340 sq.m.	More than 18 katha upto 20 katha	9.0	5.25	50.00	9.0	8.50	50.00
15.	More than 1340 sq.m.	More than 20 katha	12.0	5.50	50.00	12.0	9.50	50.00
16.	Any size	Any size	18.0	6.00	50.00	18.0	Non Restricted	50.00
17.	Any size	Any size	24.0	6.50	50.00	24.0	Non Restricted	50.00

1 sq.m. = 10.76 sft.

APPENDIX IV

Map 1: Uttara (Building Types)

Uttara

2004

2010

2016

Legend

- Vacant plot
- 1-2 storied
- 3-4 storied
- 5-6 storied
- Above 6 storied
- Commercial

Map 4: Banani (Building Types)

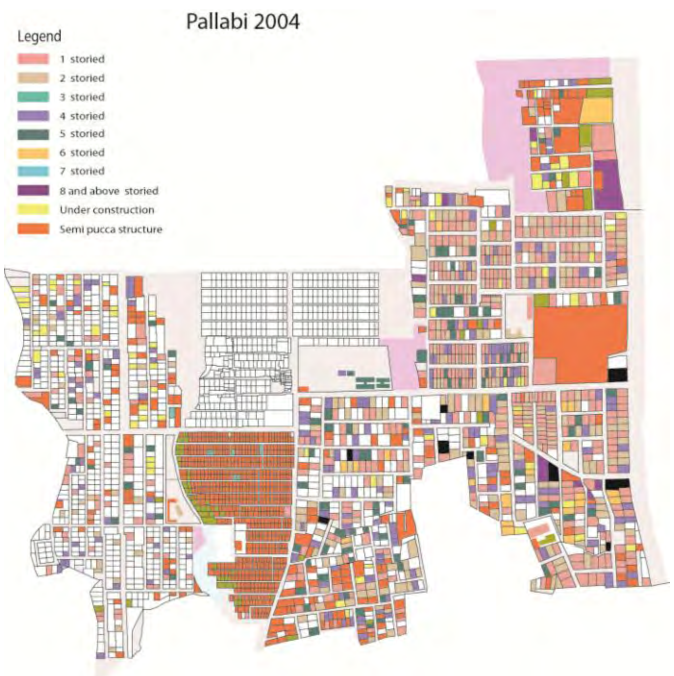
Banani

2004 2010 2016

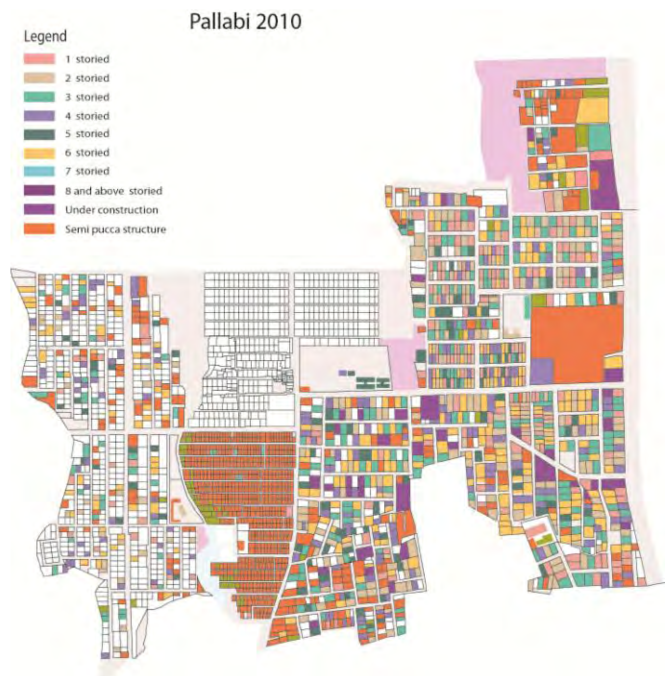
Source: Field Survey 2015 and satellite imagery

Map 2: Pallabi (Building Types)

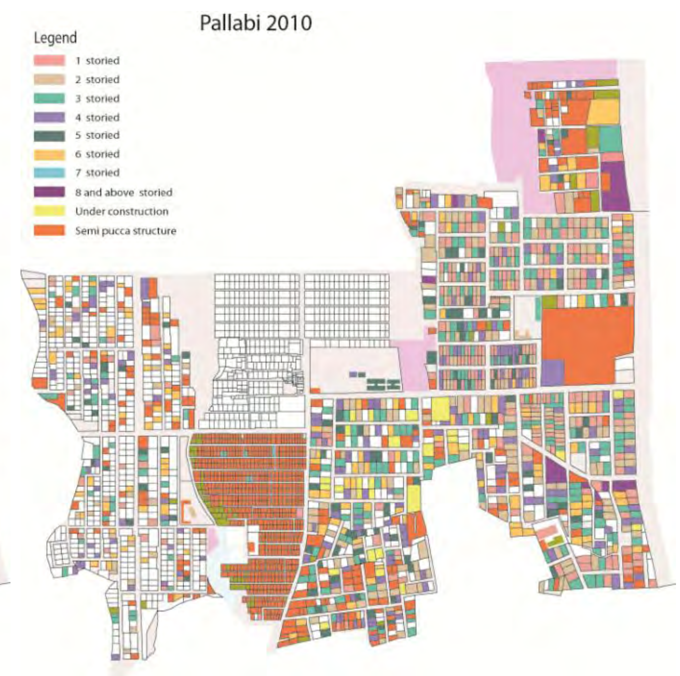
Pallabi



2004



2010

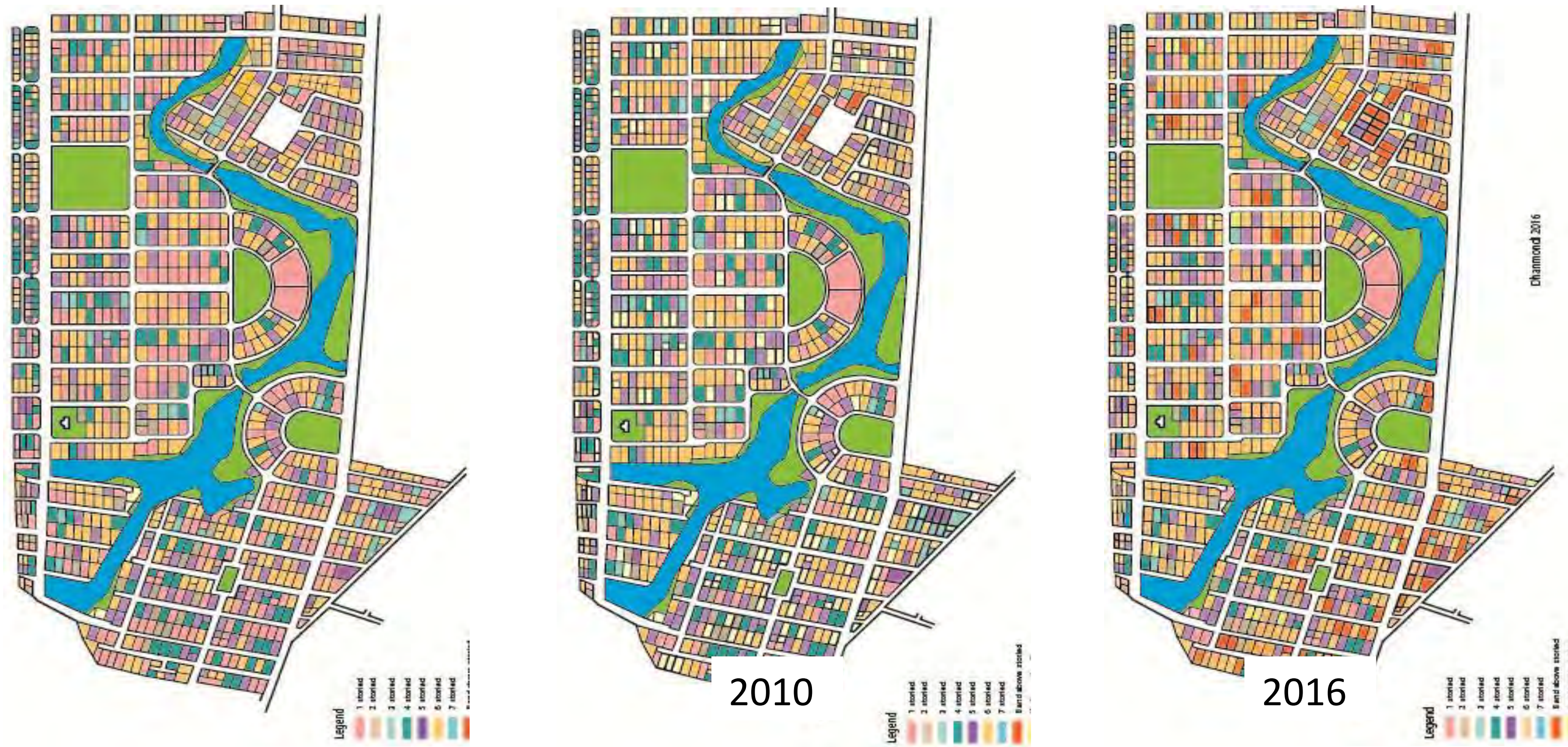


2016

Source: Field Survey 2015 and satellite imagery

Map 3: Dhanmondi (Building Types)

Dhanmondi

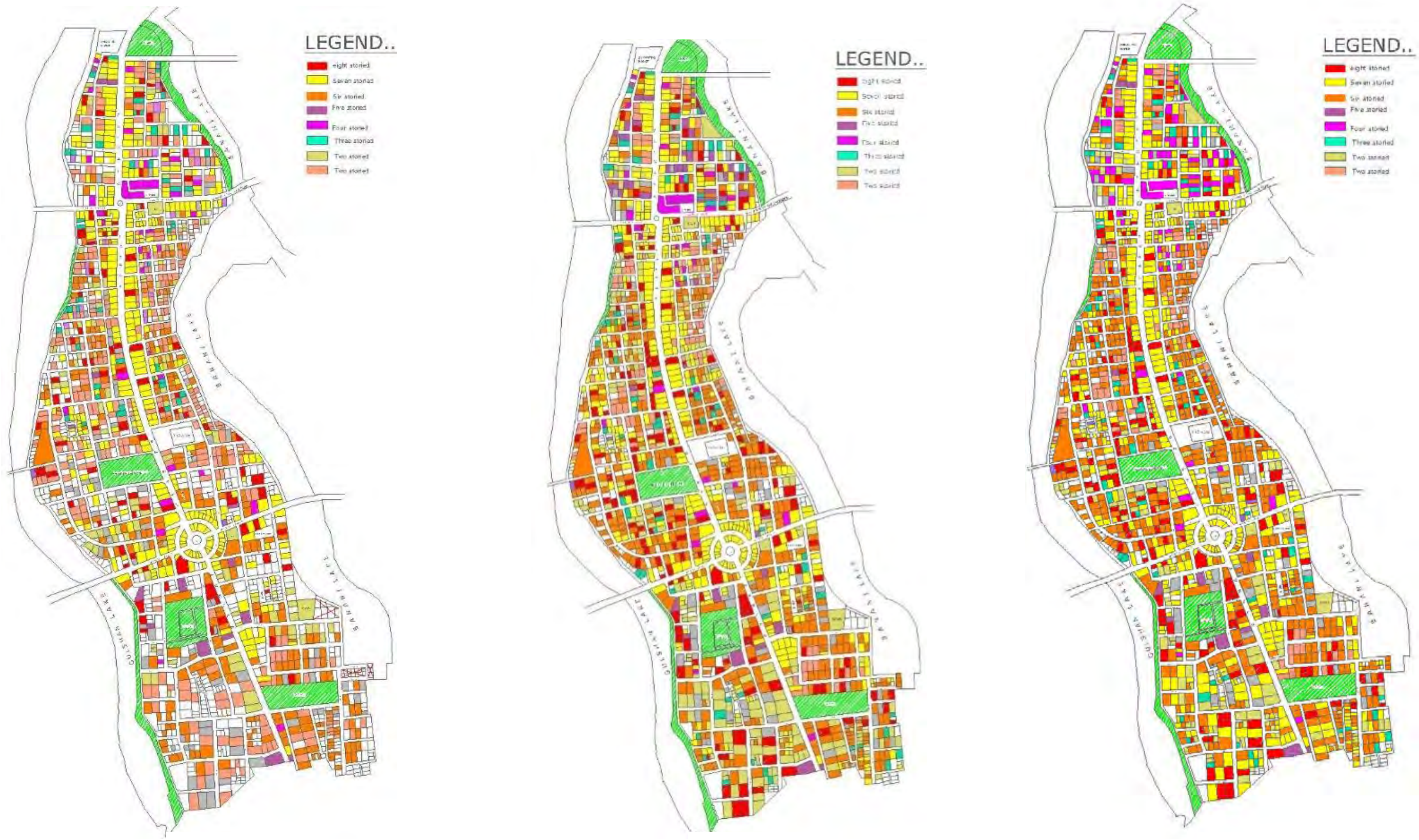


2004

Map 5: Gulshan (Building Types)

Source: Field Survey 2015 and satellite imagery

Gulshan

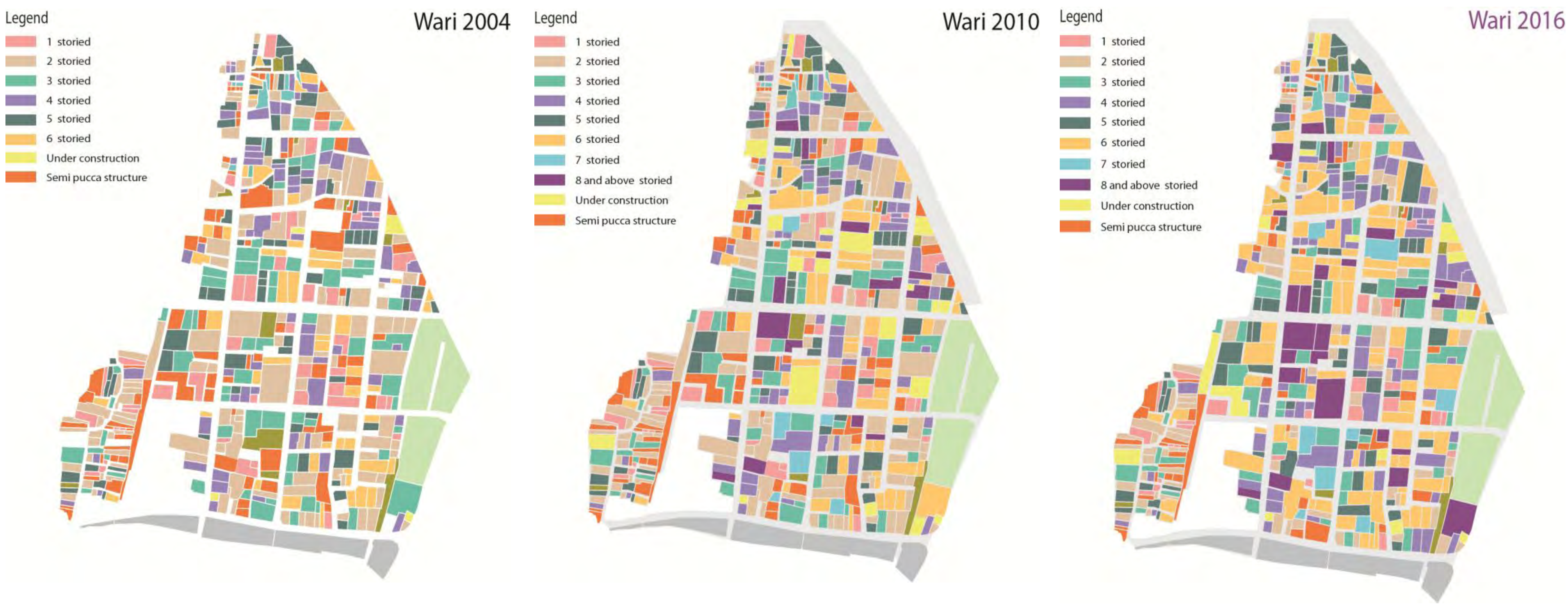


2004 2010 2016

Source: Field Survey 2015 and satellite imagery

Map 6: Wari (Building Types)

Wari

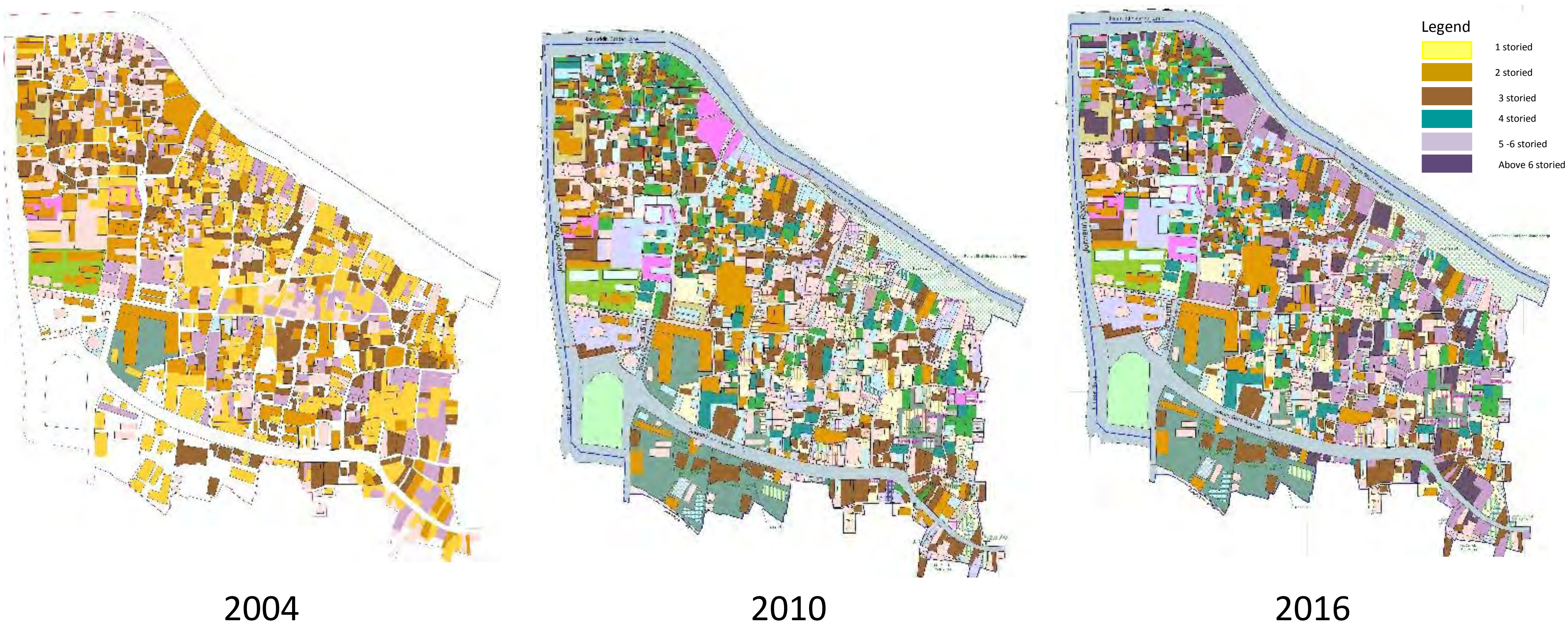


2004 2010 2016

Source: Field Survey 2015 and satellite imagery

Map 7: Luxmi Bazaar (Building Types)

Luxmi Bazaar



Source: Field Survey 2015 and satellite imagery

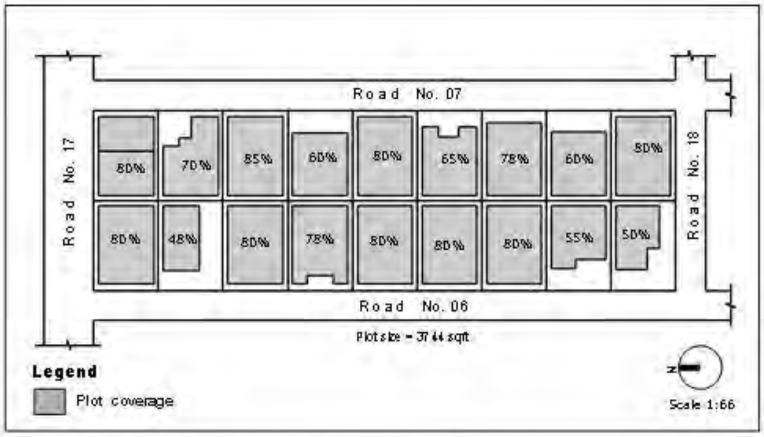


Fig 4.1 : Plot layout and plot coverage

Uttara
Block 1

Number of Plots = 18
FAR = 0.6 - 5.6 (old blds.)
FAR = 5.8 (new bld.)
(observed)

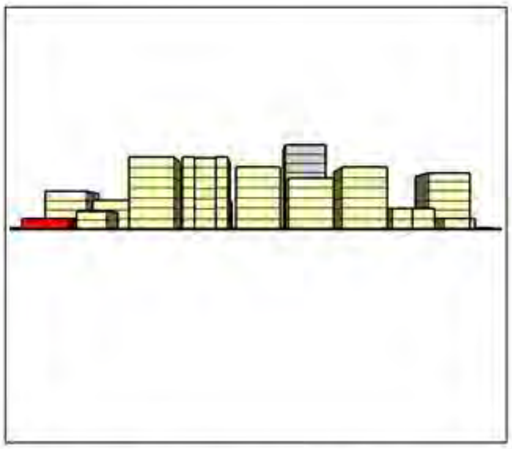


Fig 4.2 : Informally broken Skyline

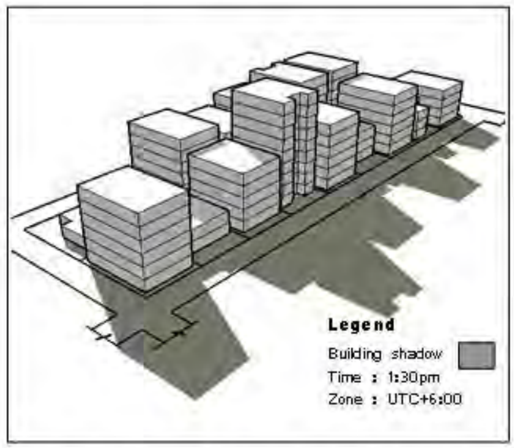


Fig 4.3 : Shadow effects on adjacent buildings and streets

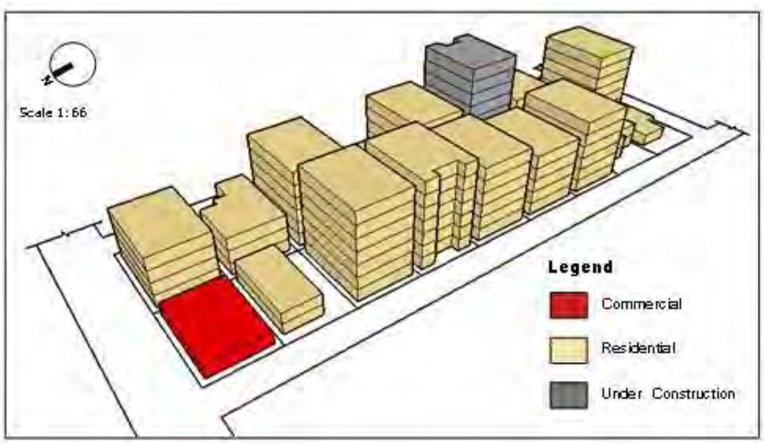


Fig 4.4 : Block coverage 76.3%; approved height unlimited

NRD = 101 units/ acre
= 201 units/ hectare

NRPD = 503 persons/acre
= 1006 per/hectare

* NRD = Net Residential Density
NRPD = Net Residential Popultion Density

Plate : 4.1

i

Uttara
Block 2

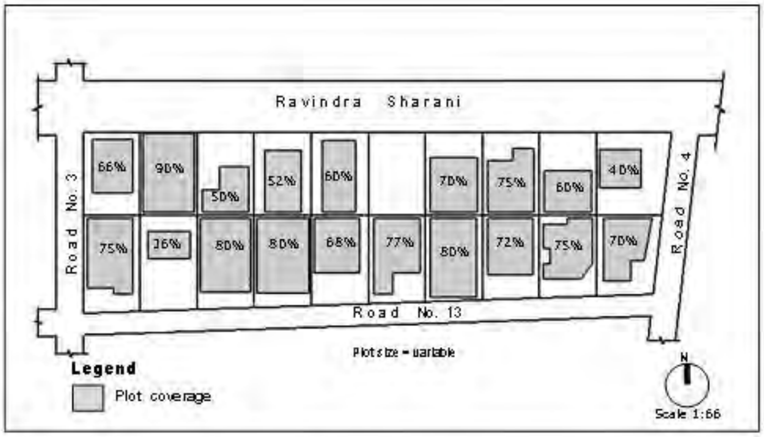


Fig 4.5 : Plot layout and plot coverage

Number of Plots = 20

FAR = 0.36 - 5.4 (old blds.)
FAR = 6 - 9 (new bld.)
(observed)

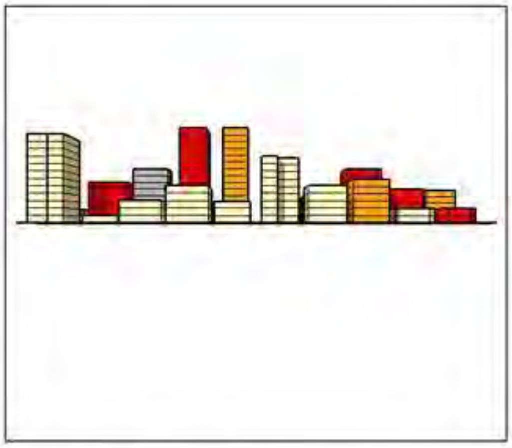


Fig 4.6 : Informally broken skyline

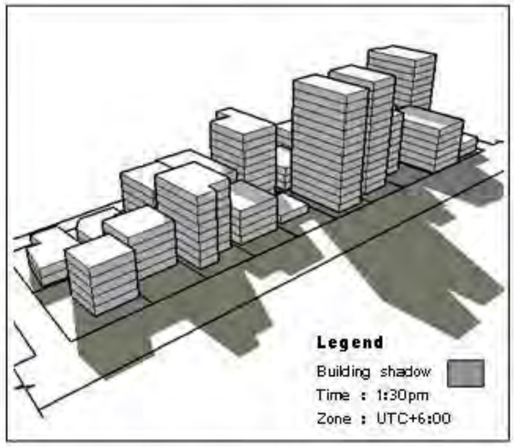


Fig 4.7 : Shadow turns the adjacent buildings and the road into dark alleys

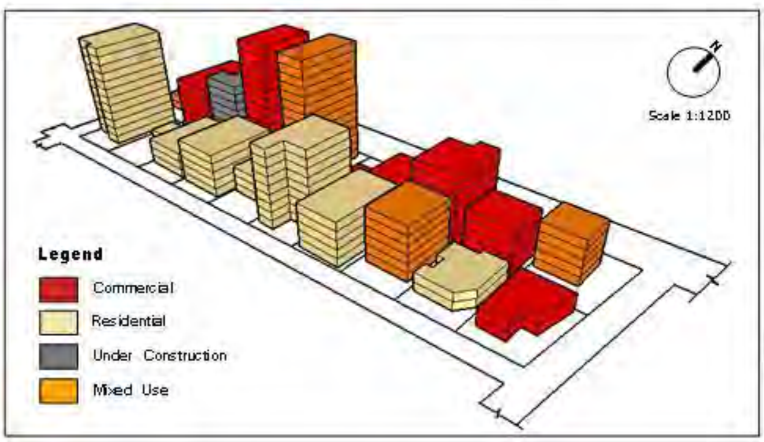


Fig 4.8: Block coverage 76%, approved height unlimited

NRD = 96 units/ acre
= 193 units/ hectare

NRPD = 483 persons/acre
= 966 per/hectare

* NRD = Net Residential Density
NRPD = Net Residential Popultion Density

Plate : 4.2

Uttara
Block 3

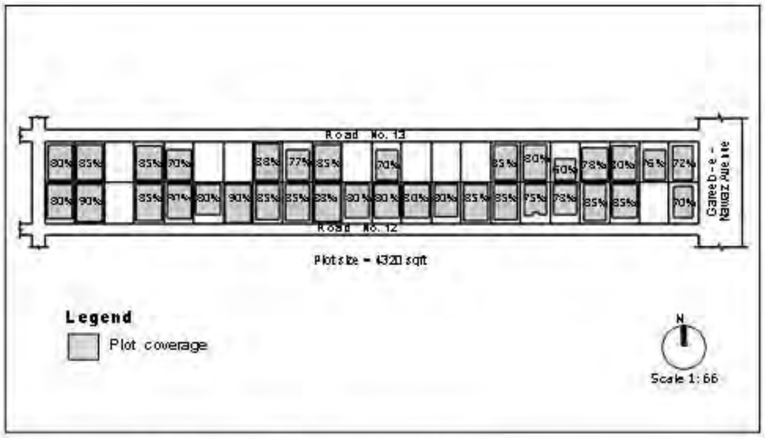


Fig 4.9: Plot layout and plot coverage

Number of Plots = 45

FAR = 3.5 - 5.9 (old blds.)
FAR = 5.8 -7.1 (new bld.)
(observed)

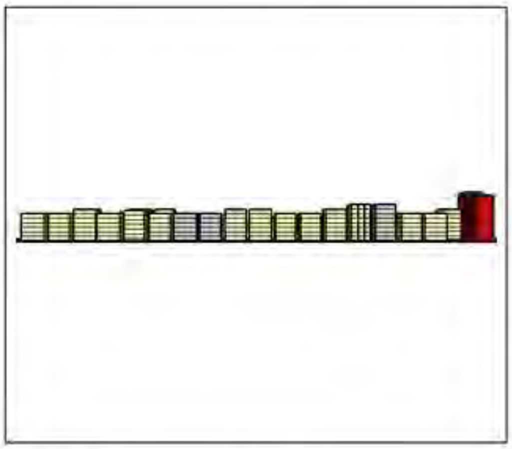


Fig 4.10 : Uniform Skyline

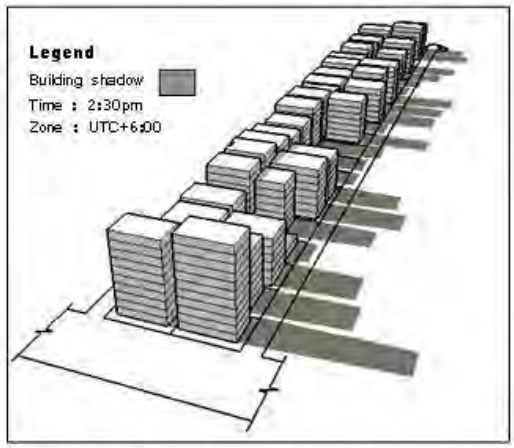


Fig 4.11 : Shadow cast through Uniform building height and narrow set backs blocking daylight penetration in three sides of the buildings

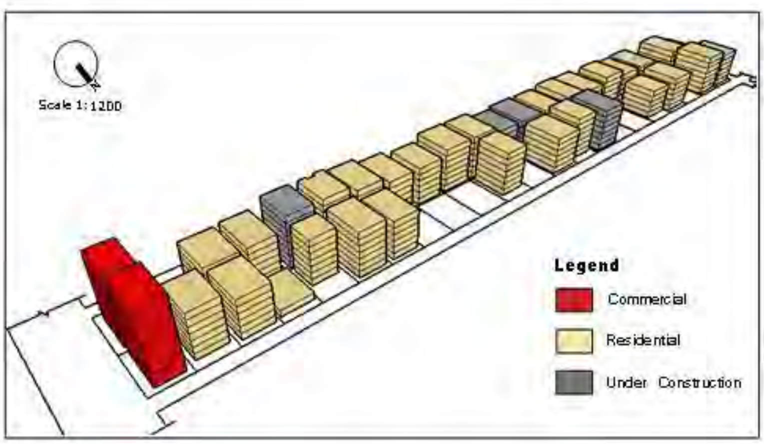


Fig 4.12: Block coverage 61.6%; approved height unlimited

NRD = 87 units/ acre
= 135 units/ hectare

NRPD = 436 persons/acre
= 872 per/hectare

* NRD = Net Residential Density
NRPD = Net Residential Popultion Density

Plate : 4.3

Uttara
Block 4

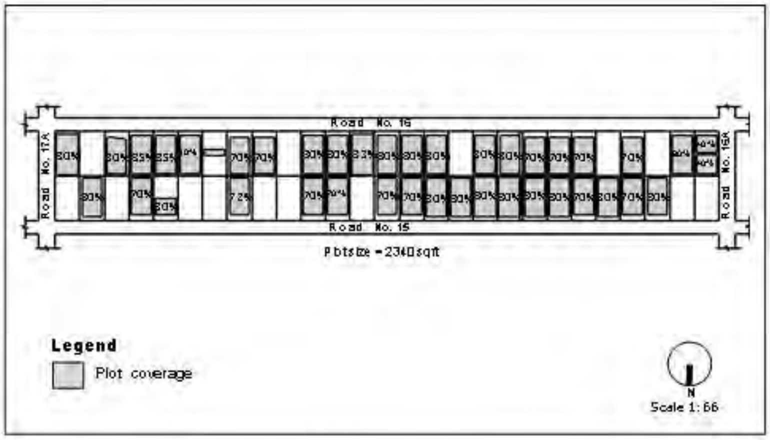


Fig 4.13: Plot layout and plot coverage

Number of Plots = 54
FAR = 0.3 - 5.6 (old blds.)
FAR = 4.8- 5.8 (new bld.)
(observed)

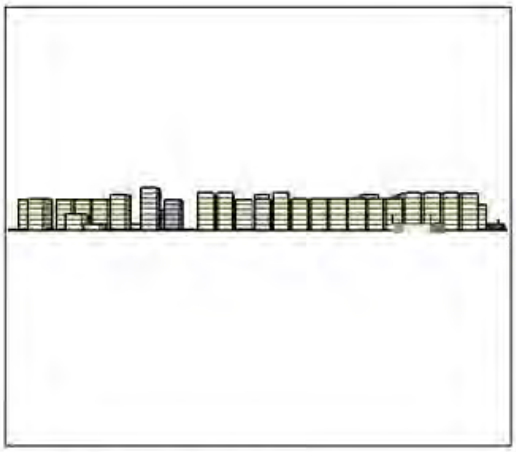


Fig 4.14: Uniform Skyline

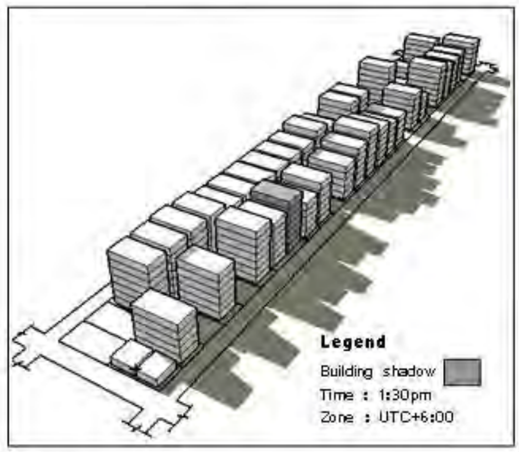


Fig 4.15: Inadequate daylight penetration, ventilation, obstruction of views and forming dark alleys.

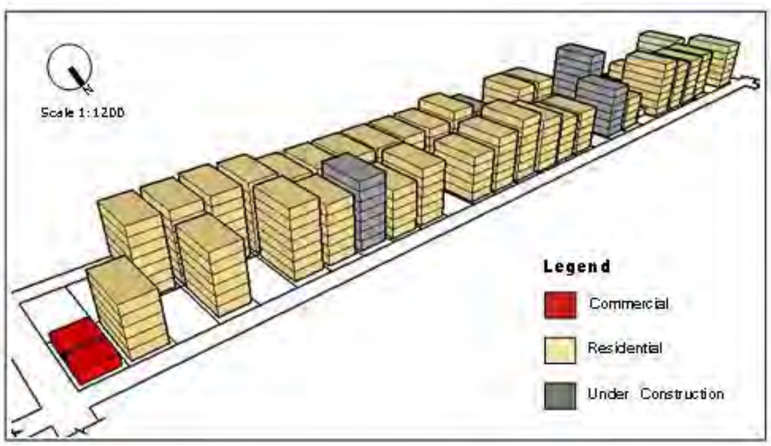


Fig 4.16 : Block coverage 57.8%; approved height unlimited

NRD = 79 units/ acre
= 159 units/ hectare

NRPD = 397 persons/acre
= 795 per/hectare

* NRD = Net Residential Density
NRPD = Net Residential Popultion Density

Plate : 4.4

Fig 4.17: Plot layout and plot coverage

Pallabi
Block 1

Number of Plots = 22

FAR = 0.6 - 5.4 (old blds.)
FAR = 4.9 - 6.3 (new bld.)
(observed)

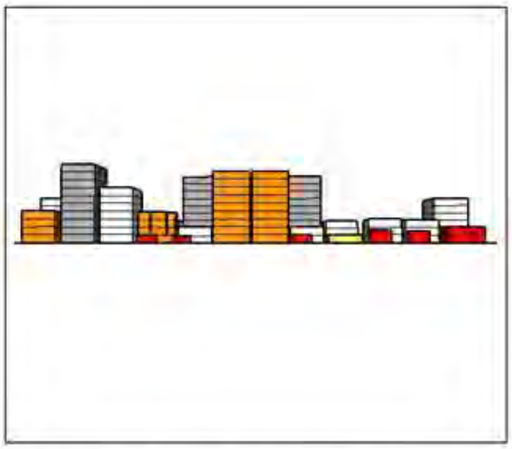


Fig 4.18: Informally broken Skyline

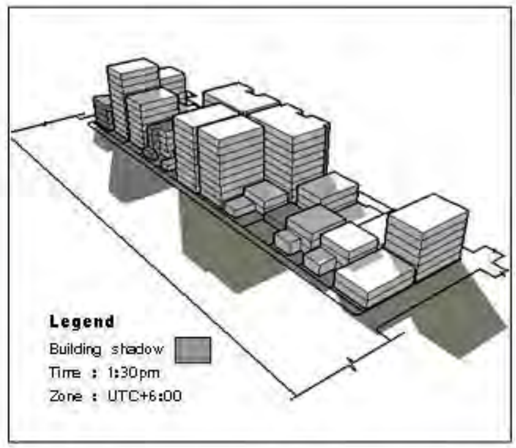


Fig 4.19: Tall towers casting shadows on the adjacent low rise structures obstructing ventilation and sunlight

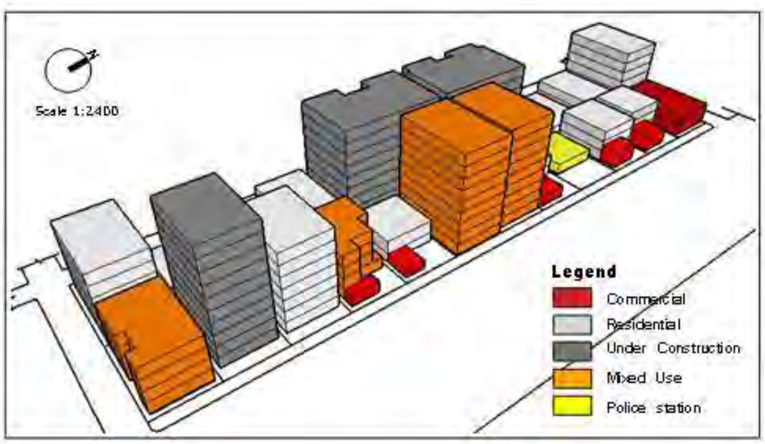


Fig 4.20 : Block coverage 69.1%; approved height unlimited

NRD = 107 units/ acre
= 215 units/ hectare

NRPD = 538 persons/acre
= 1077 per/hectare

*NRD = Net Residential Density
NRPD = Net Residential Popultion Density

Plate : 4.5

Pallabi
Block 2

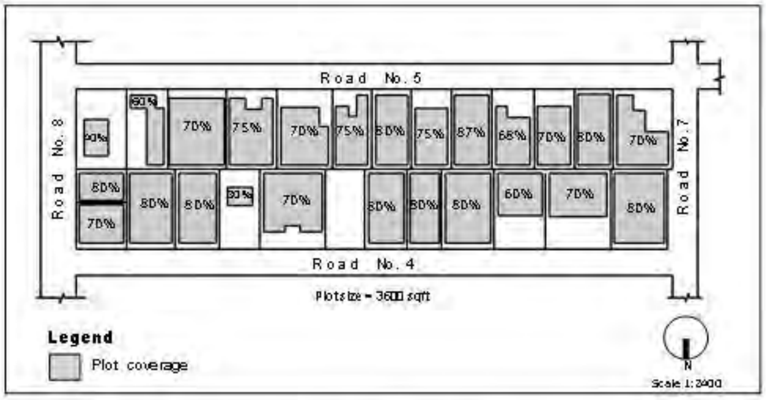


Fig 4.21 : Plot layout and Plot coverage

Number of Plots = 26

FAR = 0.3 - 4.9 (old blds.)
FAR = 4.8 - 5.2 (new bld.)
(observed)

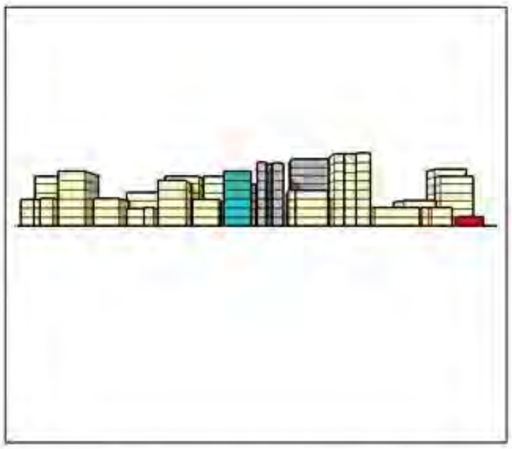


Fig 4.22 : Informally broken Skyline

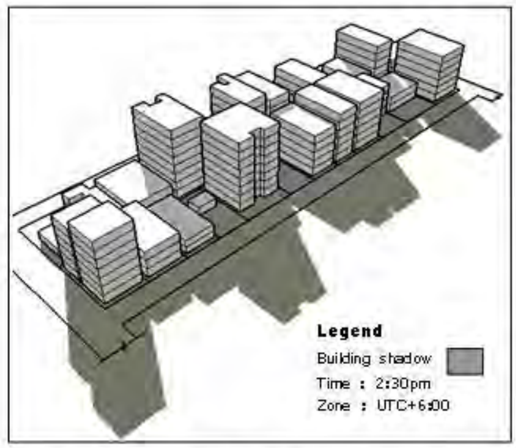


Fig 4.23 : Shadow effects on adjacent buildings and streets

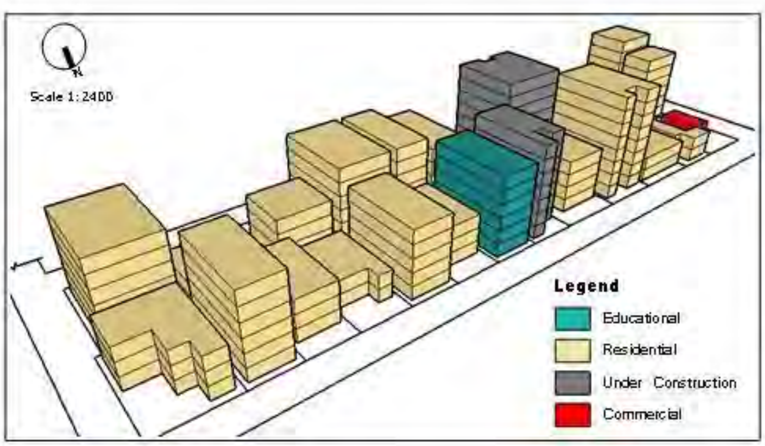


Fig 4.24 : Block coverage 70%; and approved height unlimited

NRD = 98 units/ acre
= 196 units/ hectare

NRPD = 492 persons/acre
= 984 per/hectare

* NRD = Net Residential Density
NRPD = Net Residential Popultion Density

Plate : 4.6

vi

Pallabi
Block 3

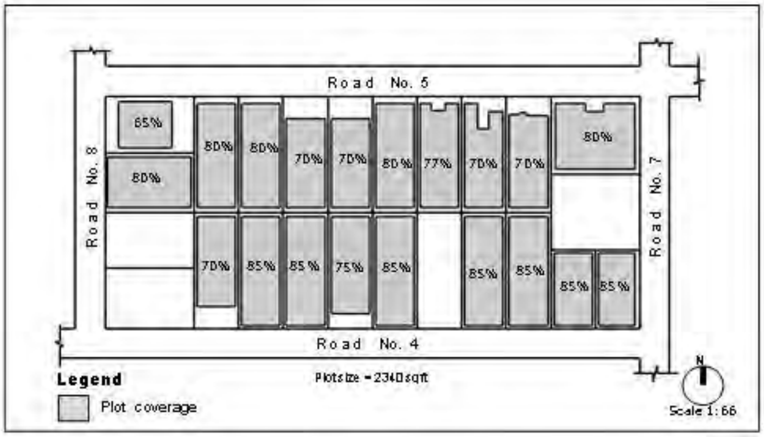


Fig 4.25 : Plot layout and plot coverage

Number of Plots = 24

FAR = 1.3 - 5.9 (old blds.)
FAR = 4.8 - 4.9 (new bld.)
(observed)

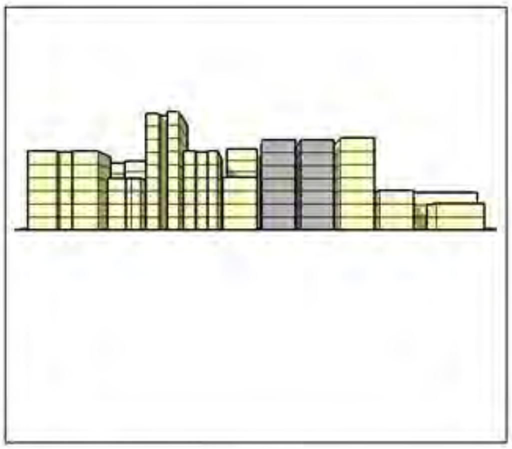


Fig 4.26 : Uniform Skyline

Fig 4.27 : Higher plot coverage and uniform height resulting into compact settlement causing blockage of sunlight, ventilation and view.

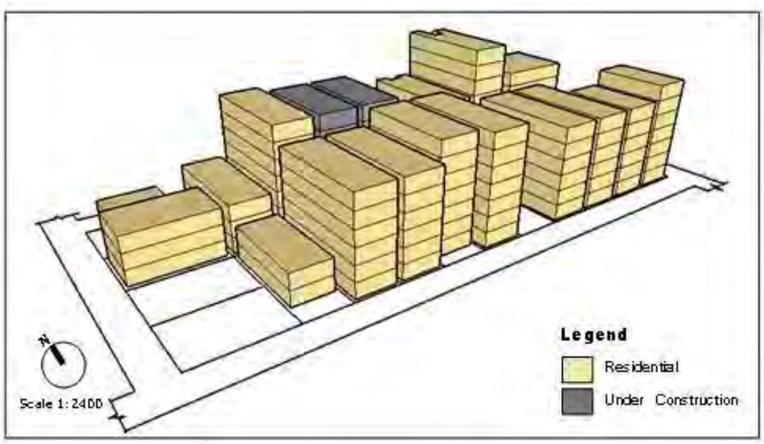


Fig 4.28 : Block coverage 67.7%; approved height unlimited

NRD = 102 units/ acre
= 204 units/ hectare

NRPD = 511 persons/acre
= 1023 per/hectare

* NRD = Net Residential Density
NRPD = Net Residential Popultion Density

Plate : 4.7

Pallabi
Block 4

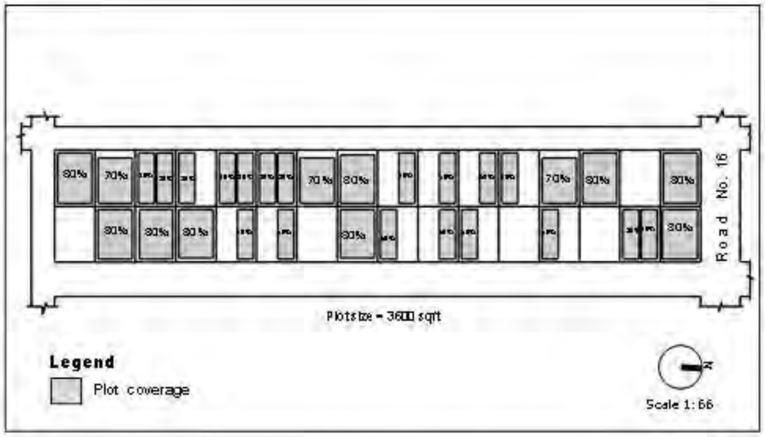


Fig 4.29 : Plot layout and plot coverage

Number of Plots = 36

FAR = 0.5 - 4.8 (old blds.)
FAR = 4.8 - 5.6 (new bld.)
(observed)

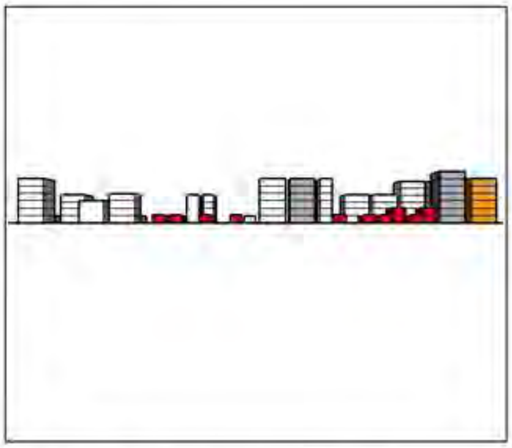


Fig 4.30 : Abrubtly broken Skyline

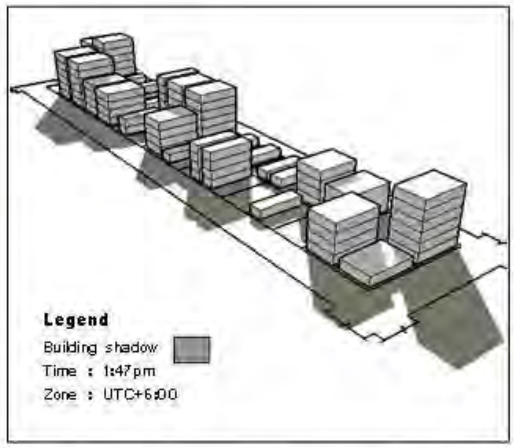


Fig 4:31 : High rise buildings casting shadows on the adjacent vacant plots and low rise buildings.

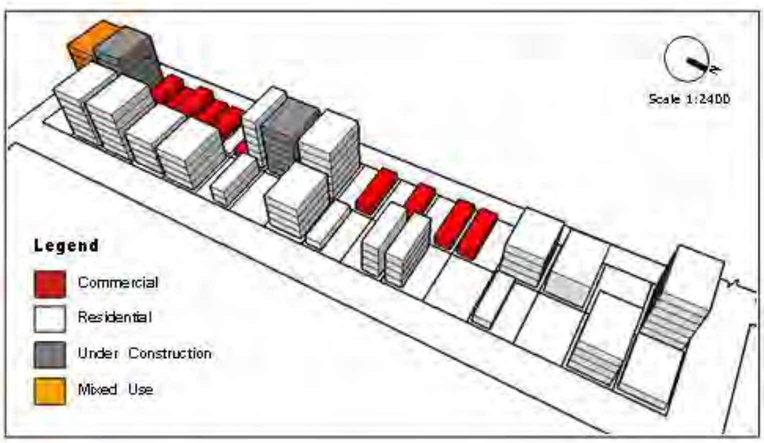


Fig 4.32 : Block coverage 47.6%; approved height unlimited

NRD = 64 units/ acre
= 127 units/ hectare

NRPD = 320 persons/acre
= 637 per/hectare

* NRD = Net Residential Density
NRPD = Net Residential Popultion Density

Plate : 4.8

Gulshan
Block 1

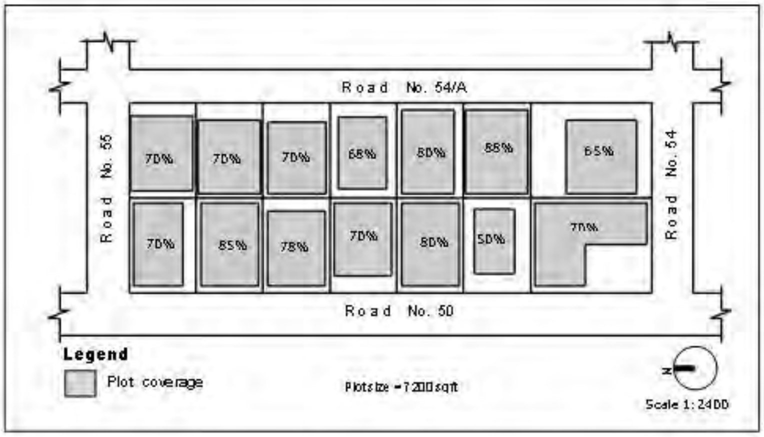


Fig 4.63: Plot layout and plot coverage

Number of Plots = 14

FAR = 0.7 - 6.4 (old blds.)
FAR = 4.2 - 7.7 (new bld.)
(observed)

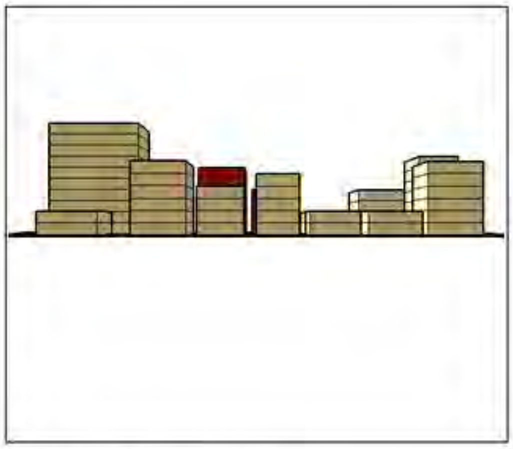


Fig 4.64: Jaggered Skyline

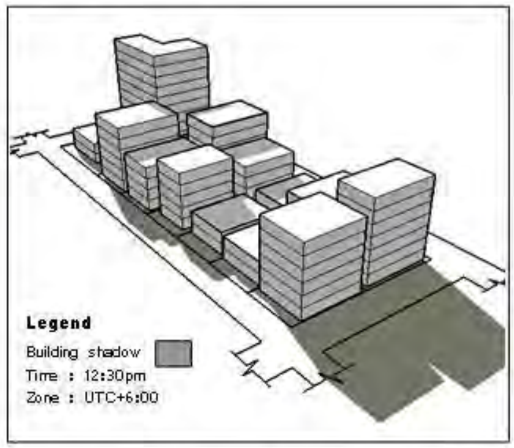


Fig 4.65: Shadow effects on adjacent buildings and streets

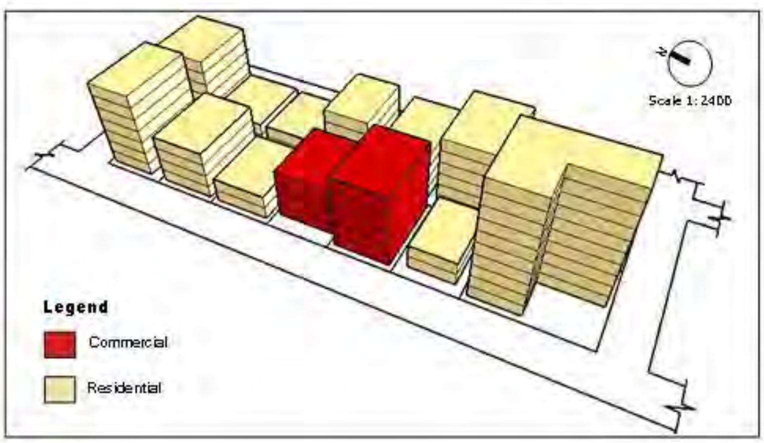


Fig 4.66 : Block coverage 66.3%; approved height unlimited

NRD = 92 units/ acre
= 184 units/ hectare

NRPD = 462 persons/acre
= 924 per/hectare

*NRD = Net Residential Density
NRPD = Net Residential Popultion Density

Plate : 4.17

xvii

Gulshan
Block 2

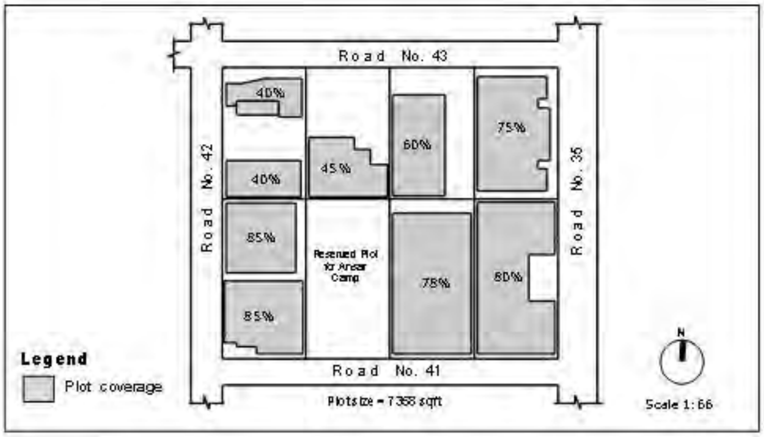


Fig 4.67: Plot layout and plot coverage

Number of Plots = 10

FAR = 0.9 - 4.8 (old blds.)
FAR = 5.8 - 8.5 (new bld.)
(observed)

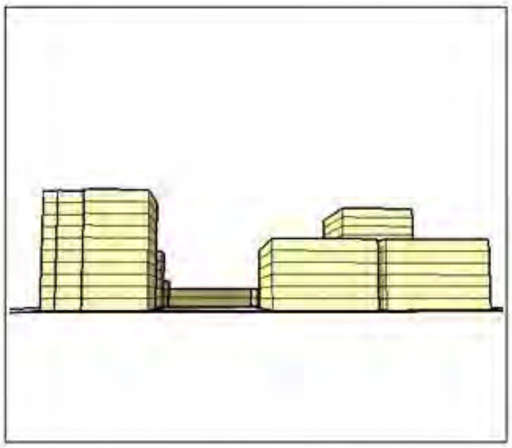


Fig 4.68: Informal Skyline

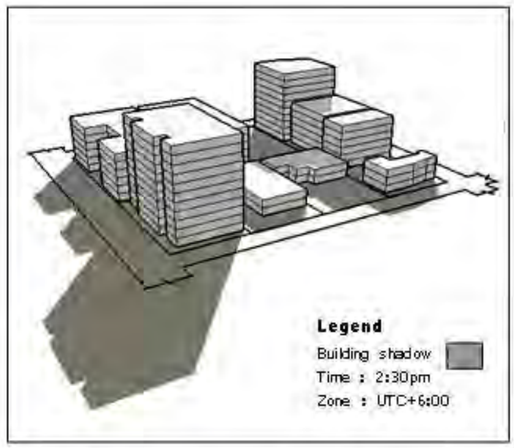


Fig 4.69 : Shadow effects on adjacent buildings and streets

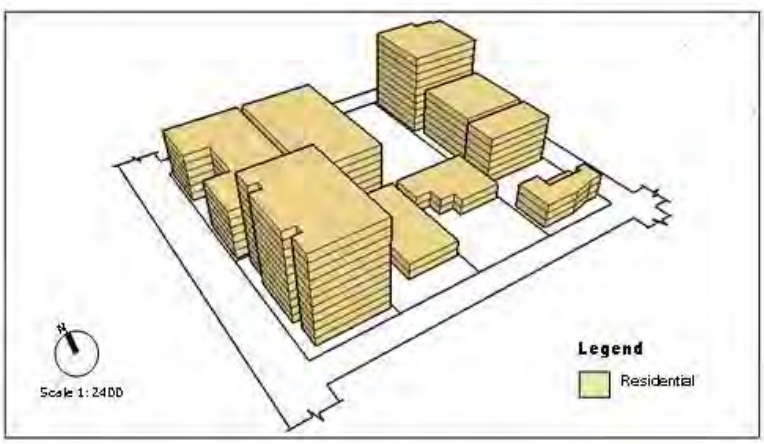


Fig 4.70 : Block coverage 56.2%; approved height unlimited

NRD = 121 units/ acre
= 242 units/ hectare

NRPD = 605 persons/acre
= 1211 per/hectare

* NRD = Net Residential Density
NRPD = Net Residential Popultion Density

Plate : 4.18

Gulshan
Block 3

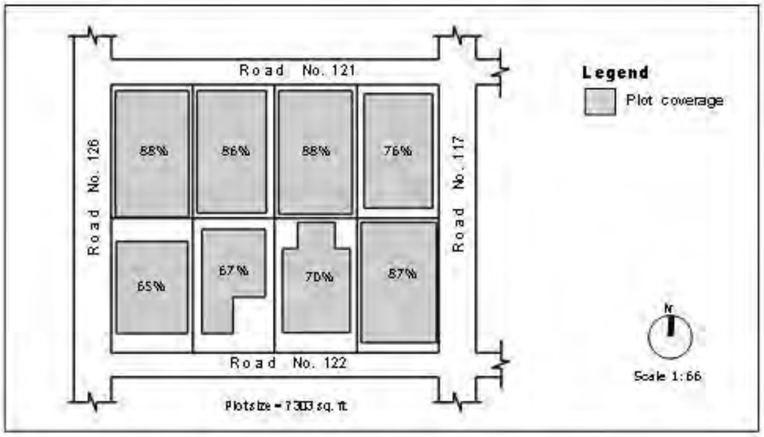


Fig 4.71: Plot layout and plot coverage

Number of Plots = 8

FAR = 1.3 - 6.1 (old blds.)
FAR = 4.0 (new bld.)
(observed)

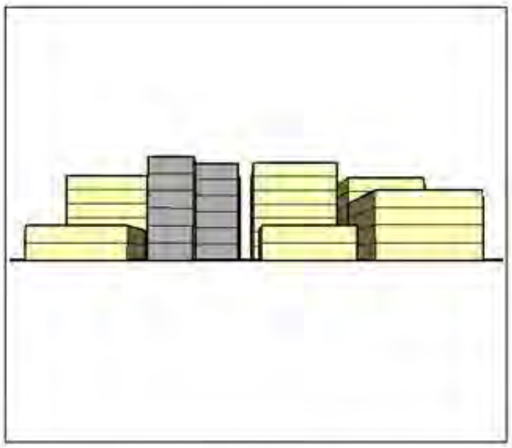


Fig 4.72: Uniform Skyline

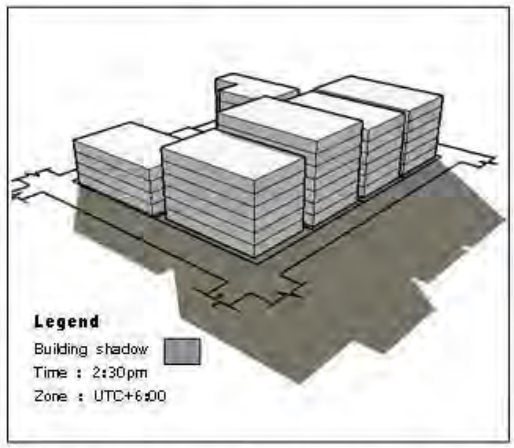


Fig 4.73: Shadow effects on adjacent buildings and streets

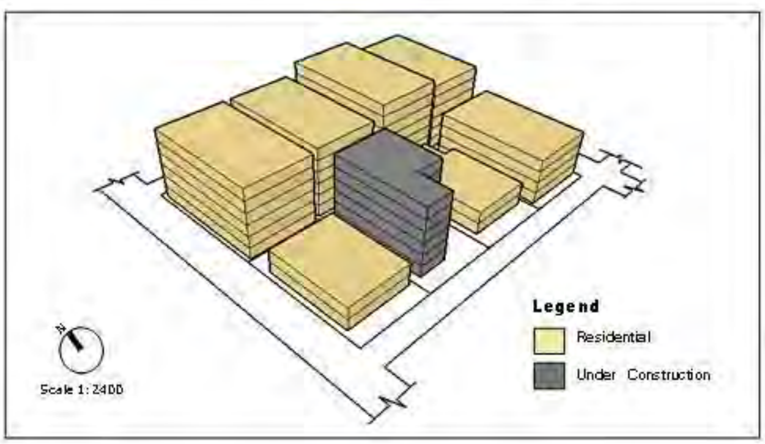


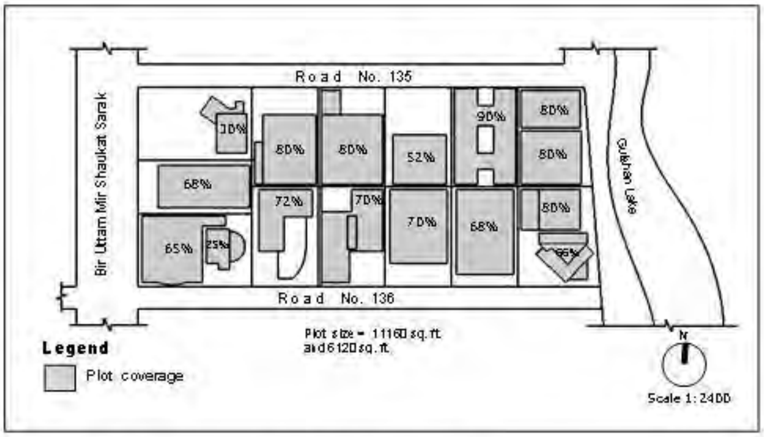
Fig 4.74: Block coverage 75.6% ; approved height unlimited

NRD = 94 units/ acre
= 188 units/ hectare

NRPD = 470 persons/acre
= 940 per/hectare

* NRD = Net Residential Density
NRPD = Net Residential Popultion Density

Plate : 4.19



Gulshan

Block 4

Number of Plots = 16

FAR = 0.6 - 5.4 (old blds.)
FAR = 5.5 - 9 (new bld.)
(observed)

Fig 4.75: Plot layout and plot coverage

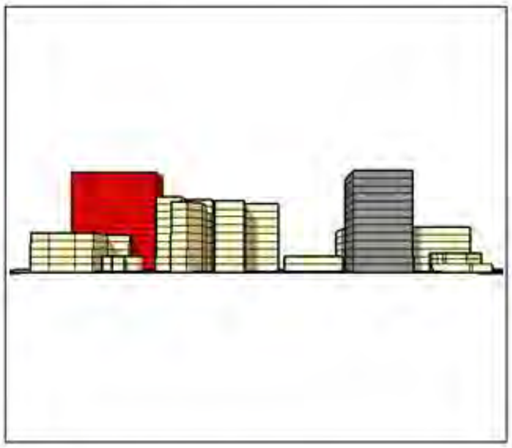


Fig 4.76: Informally broken skyline

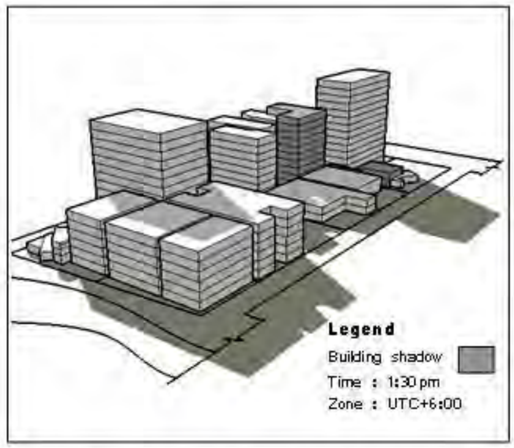


Fig 4.77: Shadow effects on adjacent buildings and streets

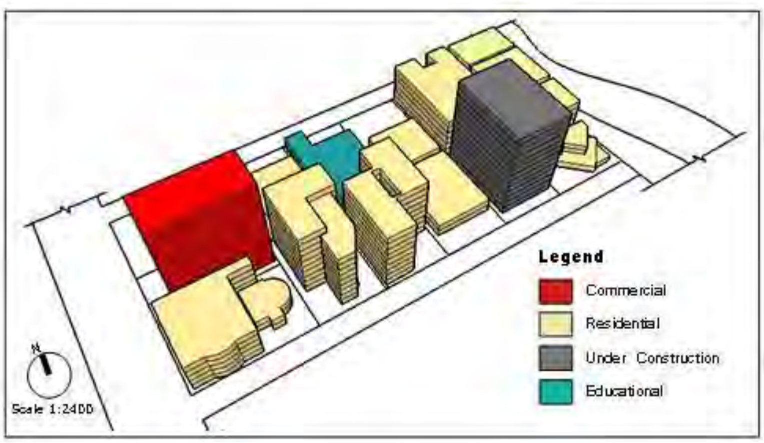


Fig 4.78: Block coverage 77.7%; approved height unlimited

NRD = 107 units/ acre
= 215 units/ hectare

NRPD = 538 persons/acre
= 1077 per/hectare

* NRD = Net Residential Density
NRPD = Net Residential Popultion Density

Plate : 4.20

xx

Dhanmondi
Block 1

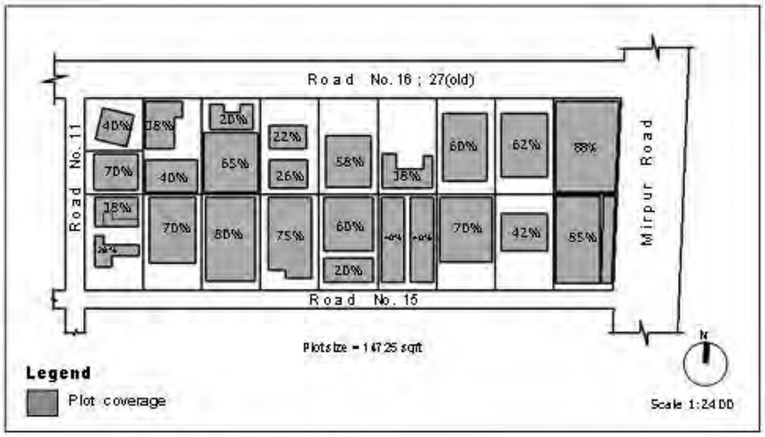


Fig 4.31: Plot layout and plot coverage

Number of Plots = 25

FAR = 0.3 - 5.2 (old blds.)
FAR = 7.2 - 8.2 (new bld.)
(observed)

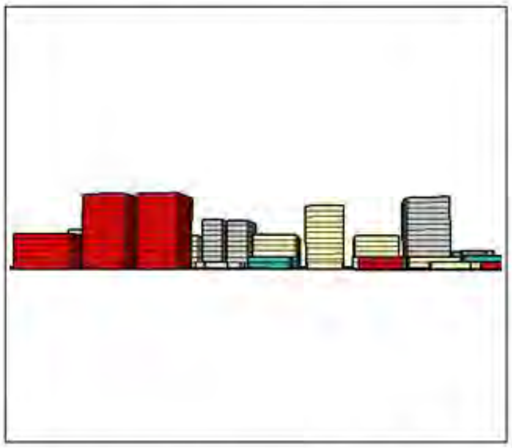


Fig 4.32: Jagged skyline formed by the still existing earlier low rise building

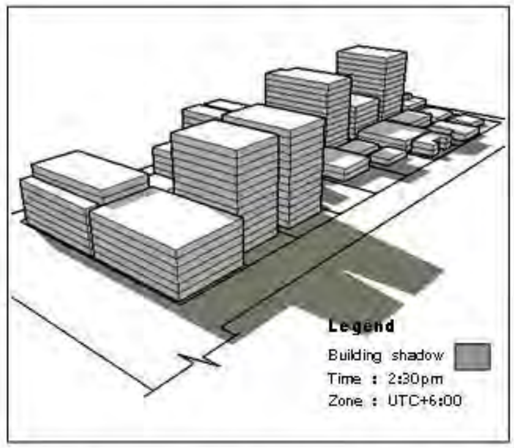


Fig 4.33: Shadow effects on adjacent buildings and streets

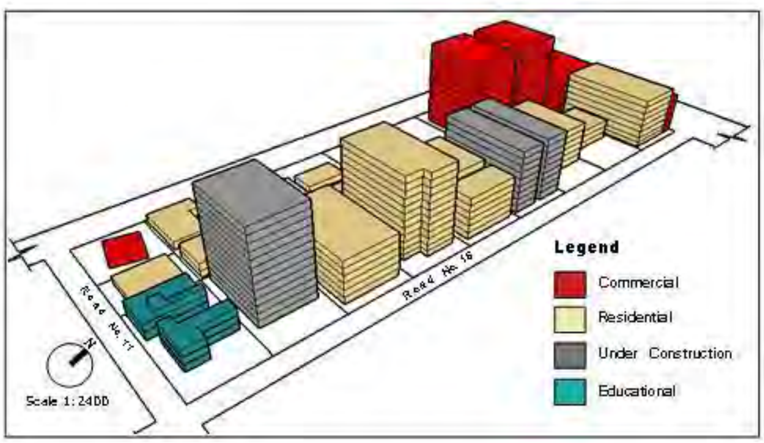


Fig 4.34: Block coverage 65.2%; approved height unlimited

NRD = 36 units/ acre
= 72 units/ hectare

NRPD = 180 persons/acre
= 360 per/hectare

* NRD = Net Residential Density
NRPD = Net Residential Popultion Density

Plate : 4.9

Dhanmondi

Block 2

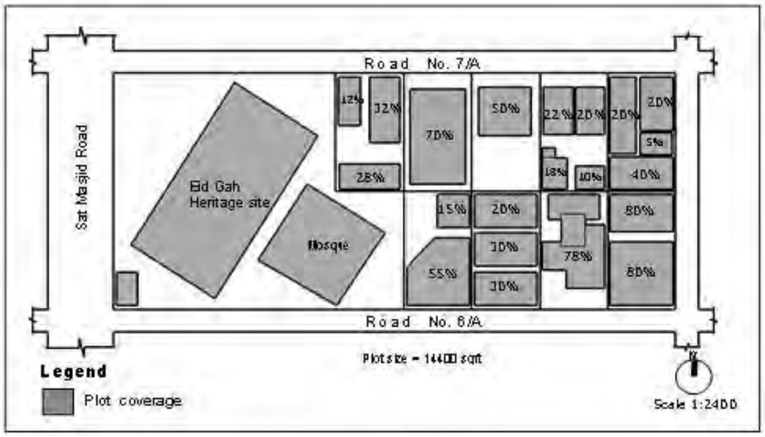


Fig 4.35: Plot layout and plot coverage

Number of Plots = 21

FAR = 1.0 - 6.4 (old blds.)
FAR = 4.8 - 9.1 (new bld.)
(observed)

NRD = 100 units/ acre
= 200 units/ hectare

NRPD = 500 persons/acre
= 1000 per/hectare

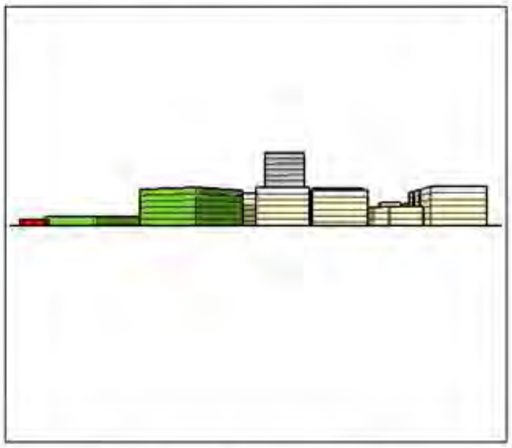


Fig 4.36: Informally broken Skyline

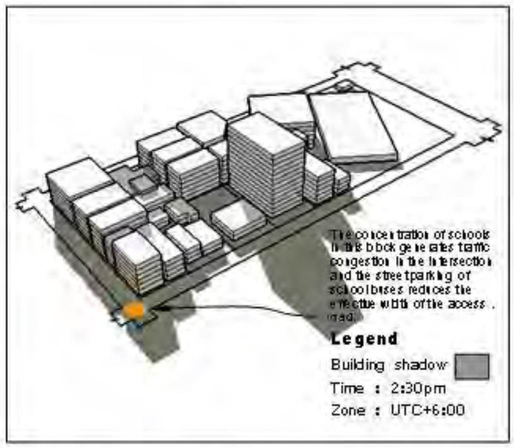


Fig 4.37: Shadow effects on adjacent buildings and streets

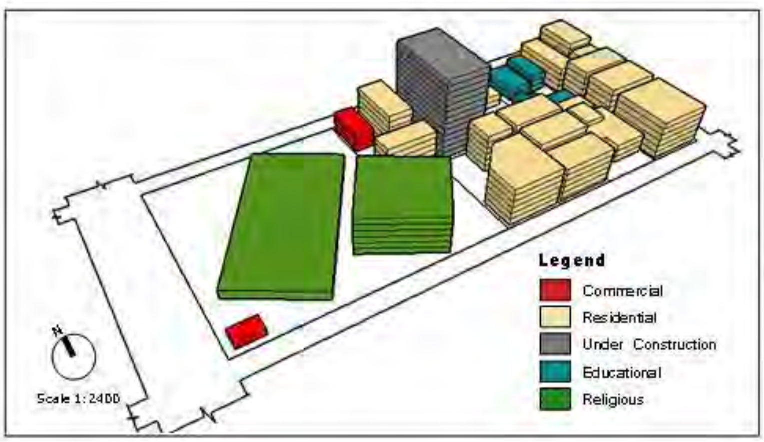


Fig 4.38: Block coverage 63% (exluding Eid Gah site); approved height unlimited

Fig 4a.:School buses parked on the steet

* NRD = Net Residential Density
NRPD = Net Residential Popultion Density

Plate : 4.10

X

Dhanmondi
Block 3

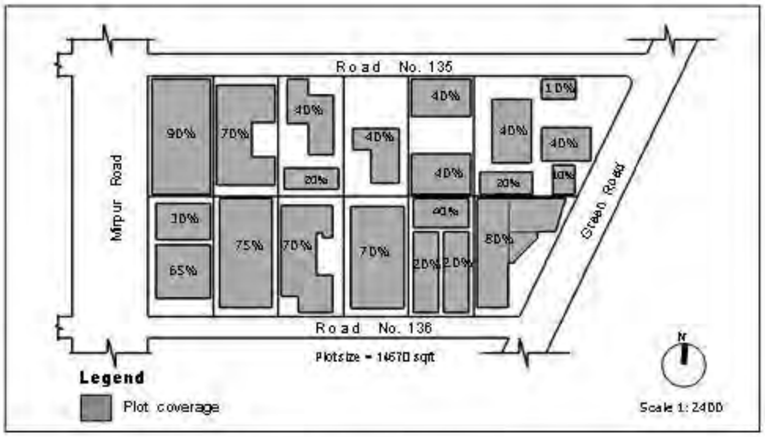


Fig 4.39: Plot layout and plot coverage

Number of Plots = 29

FAR = 0.5 - 6.3 (old blds.)
FAR = 4.8 - 8.8 (new bld.)
(observed)

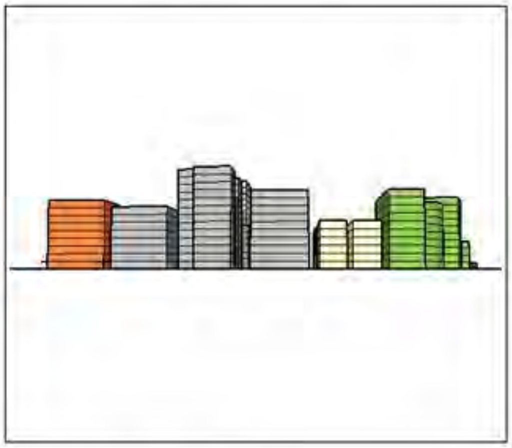


Fig 4.40: Jagged Skyline

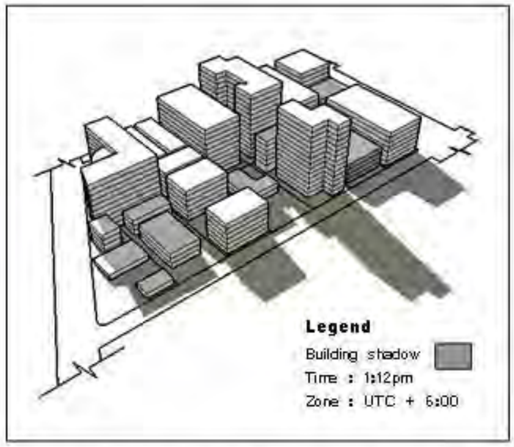


Fig 4.41: Shadow effects on adjacent buildings and streets

Fig 4.42: Block coverage 86.1%; approved height unlimited

NRD = 81 units/ acre
= 164 units/ hectare

NRPD = 408 persons/acre
= 823 per/hectare

*NRD = Net Residential Density
NRPD = Net Residential Popultion Density

Plate : 4.11

Fig 4.43: Plot layout and plot coverage

Dhanmondi
Block 4

Number of Plots = 29

FAR = 0.3 - 5.1 (old blds.)
FAR = 4.8 - 9.1 (new bld.)
(observed)

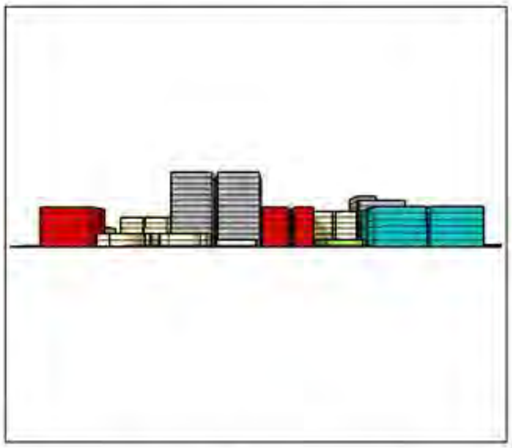


Fig 4.44: informally broken Skyline

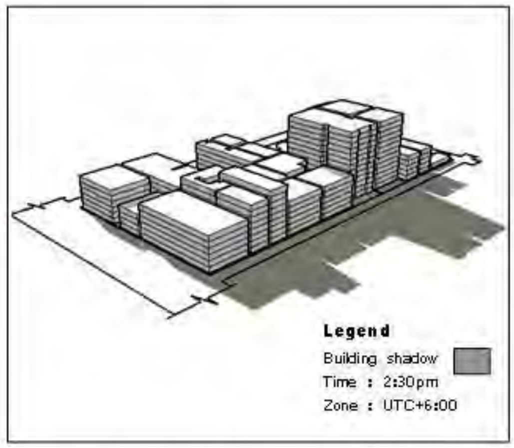


Fig 4.45: The assortment of varied height and higher horizontal extension of buildings resulting into dark interior rooms and devoid of natural ventilation.

Fig 4.46: Block coverage 76.3%; approved height unlimited

NRD = 82 units/ acre
= 165 units/ hectare

NRPD = 415 persons/acre
= 829 per/hectare

* NRD = Net Residential Density
NRPD = Net Residential Popultion Density

Plate : 4.12

Banani
Block 1

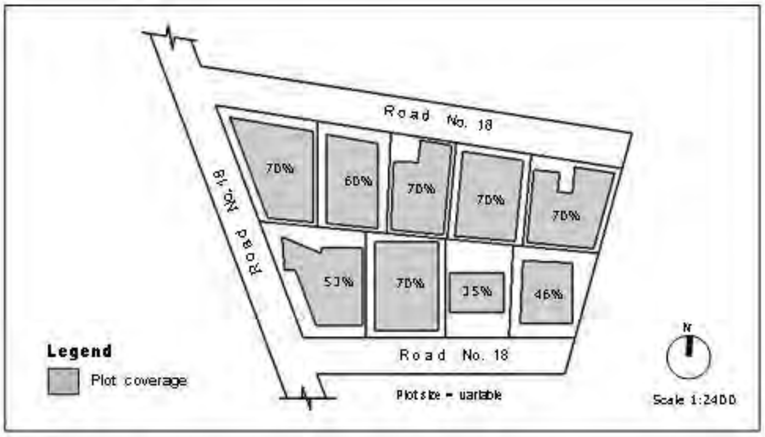


Fig 4.47: Plot layout and plot coverage

Number of Plots = 9

FAR = 0.9 - 4.2 (old blds.)
FAR = 4.8 - 7.0 (new bld.)
(observed)

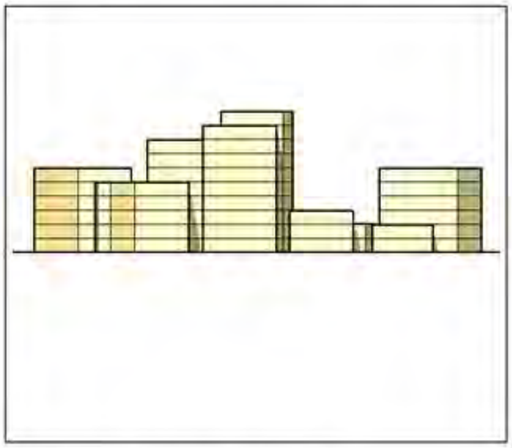


Fig 4.48: Abrubtly broken skyline

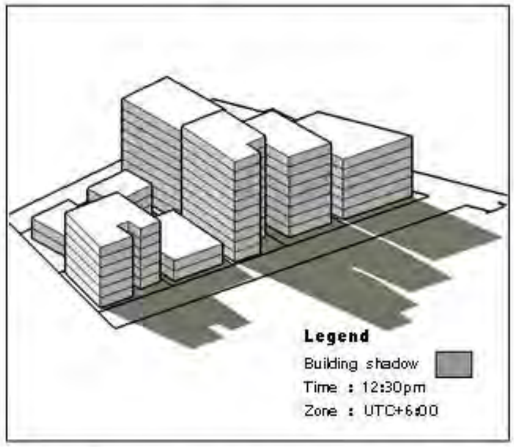


Fig 4.49: Shadow effects on adjacent buildings and streets

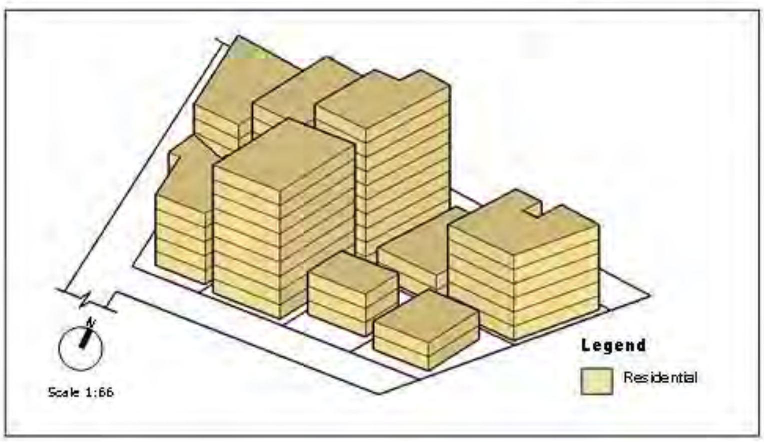


Fig 4.50: Block coverage 60.1%; approved height unlimited

NRD = 192 units/ acre
= 385 units/ hectare

NRPD = 962 persons/acre
= 1925 per/hectare

*NRD = Net Residential Density
NRPD = Net Residential Popultion Density

Plate : 4.13

Banani
Block 2

Fig 4.51: Plot layout and plot coverage

Number of Plots = 11
FAR = 1.4 - 4.2 (old blds.)
FAR = 6.4 (new bld.)
(observed)

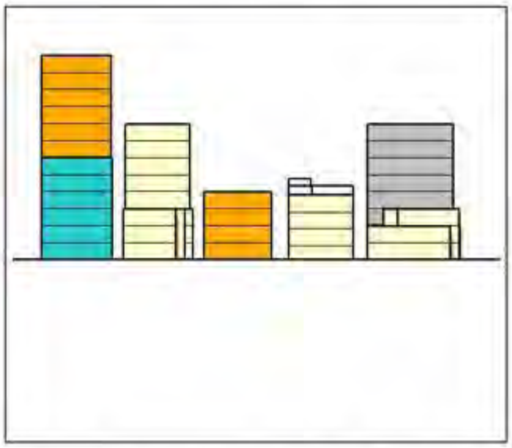


Fig 4.52: Uniform skyline with enough set back

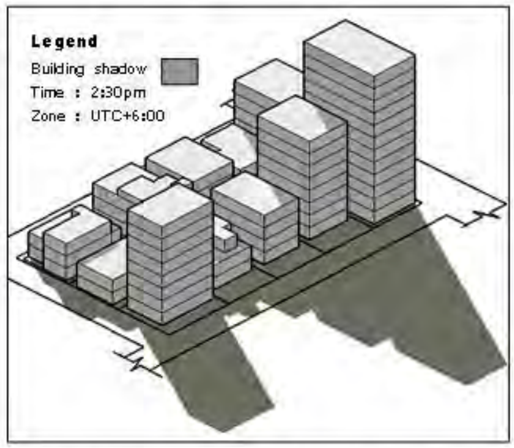


Fig 4.53: Shadow effects on adjacent buildings and streets

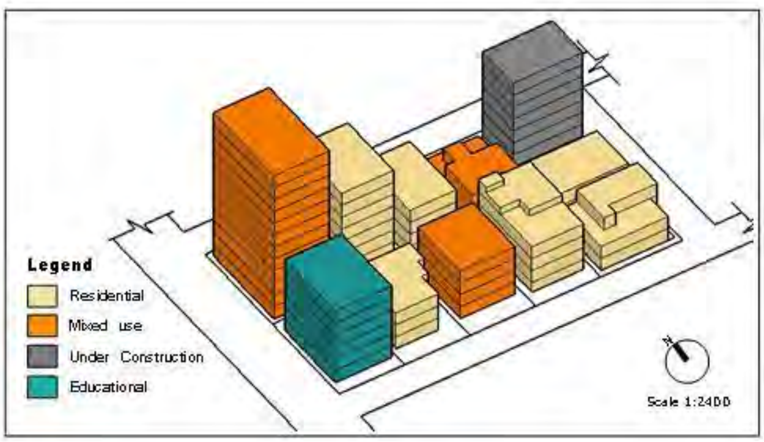


Fig 4.54: Block coverage 82.2%; approved height unlimited

NRD = 60 units/ acre
= 113 units/ hectare

NRPD = 300 persons/acre
= 567 per/hectare

* NRD = Net Residential Density
NRPD = Net Residential Popultion Density

Plate : 4.14

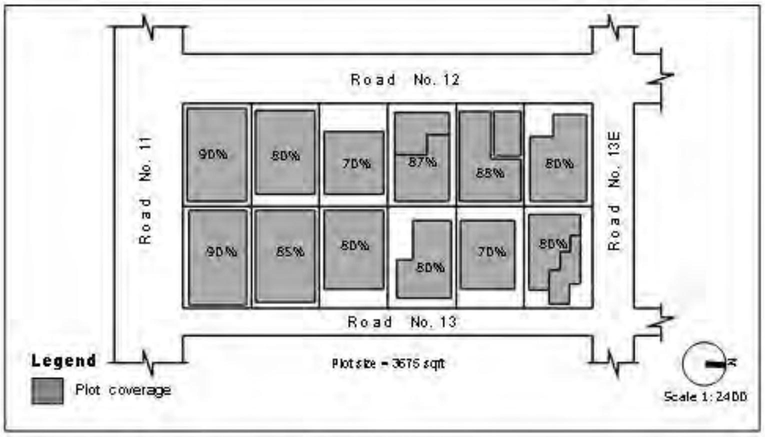


Fig 4.55: Plot layout and plot coverage

Banani
Block 3

Number of Plots = 13

FAR = 0.7 - 5.4 (old blds.)
FAR = 6.4 (new bld.)
(observed)

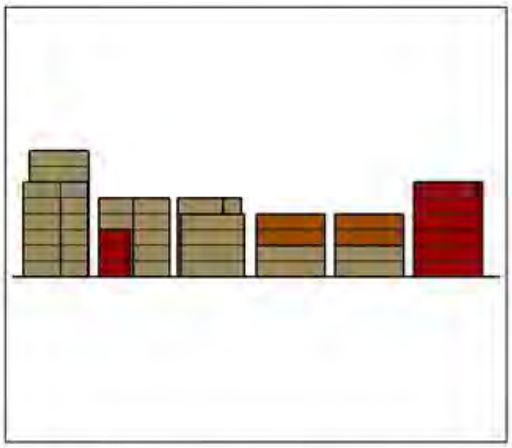


Fig 4.56: The prominance of 5-6 storied buildings have formed a uniform skyline blocking view, ventilation and solar access

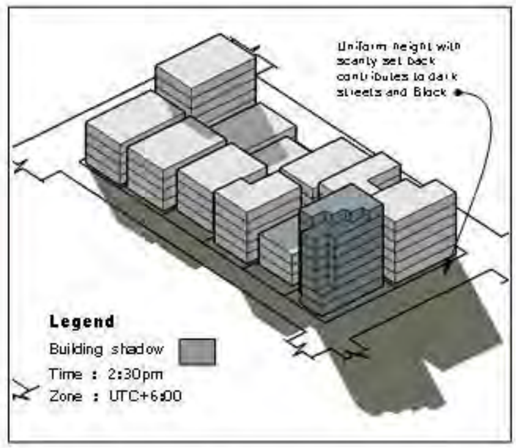


Fig 4.57: Shadow effects on adjacent buildings and streets

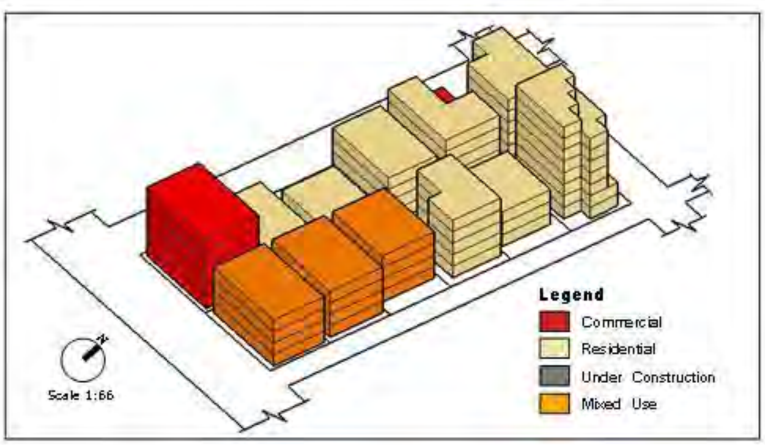


Fig 4.58: Block coverage 83.3%; approved height unlimited

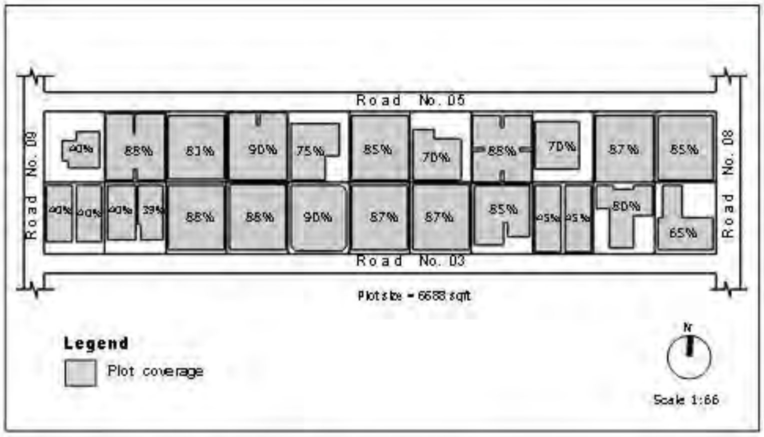
NRD = 80 units/ acre
= 161 units/ hectare

NRPD = 403 persons/acre
= 806 per/hectare

* NRD = Net Residential Density
NRPD = Net Residential Popultion Density

Plate : 4.15

XV



Banani
Block 4

Number of Plots = 25

FAR = 0.8 - 5.2 (old blds.)
FAR = 4.5 - 7.5 (new bld.)
(observed)

Fig 4.59: Plot layout and plot coverage

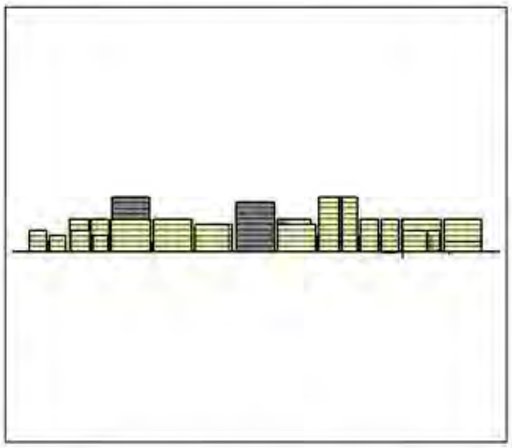


Fig 4.60: Informally broken skyline

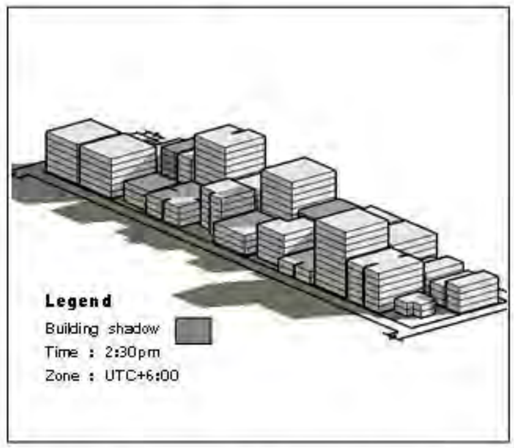
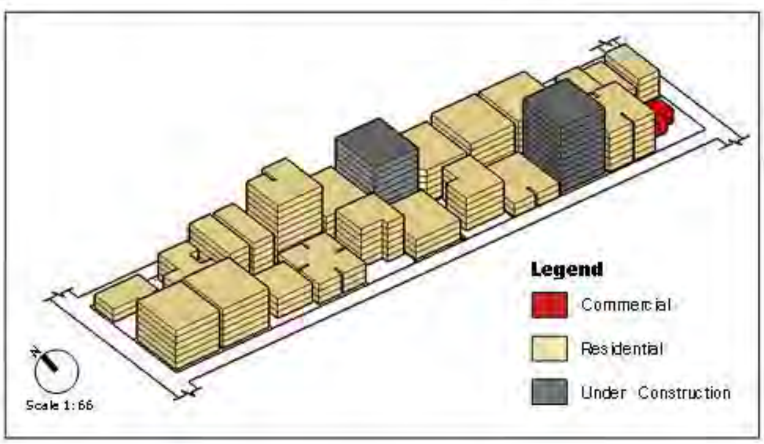


Fig 4.61 : Shadow effects on adjacent buildings and streets



NRD = 106 units/ acre
= 213 units/ hectare

NRPD = 534 persons/acre
=1068 per/hectare

*NRD = Net Residential Density
NRPD = Net Residential Popultion Density

Fig 4.62: Block coverage 87.3%; approved height unlimited

Plate : 4.16

Wari
Block 1

NRD = 66 units/ acre
= 132 units/ hectare

NRPD = 334 persons/acre
= 669 per/hectare

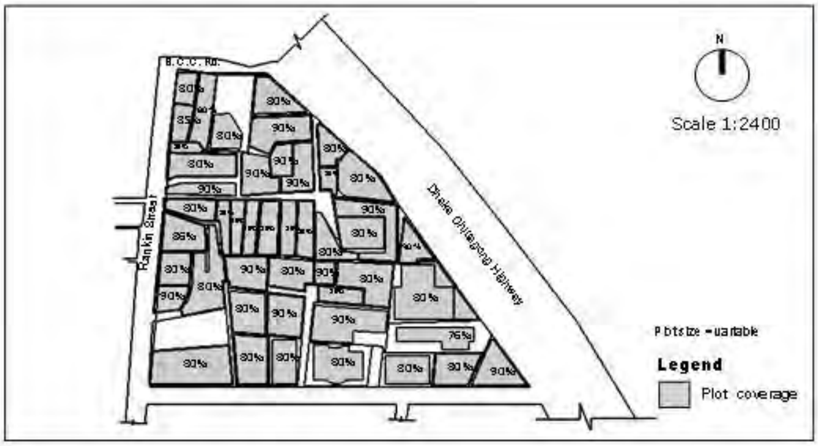


Fig 4.79: Plot layout and plot coverage

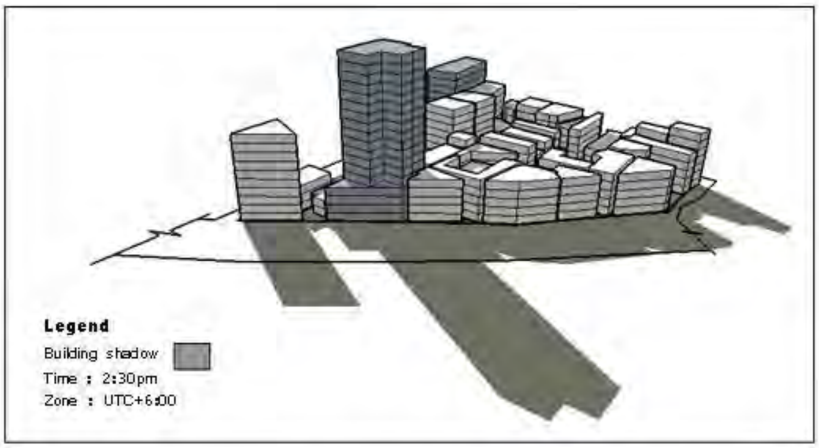


Fig 4.80 : Shadow effects on adjacent buildings and streets

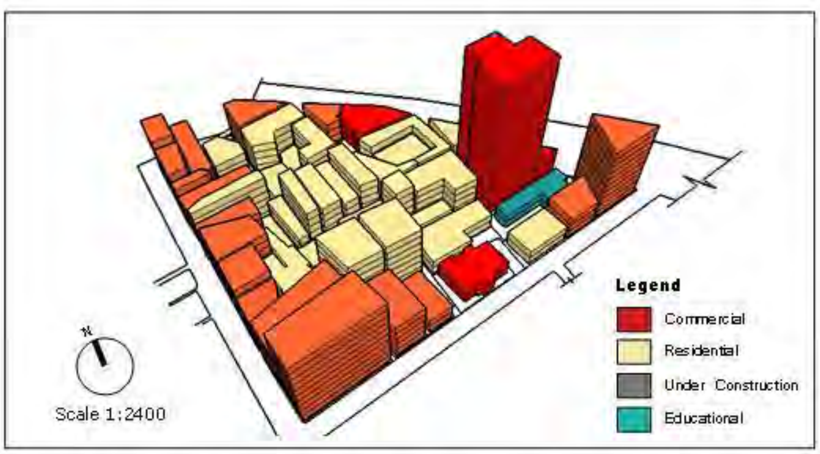


Fig 4.81: Plot coverage 85.8%, approved height 8 stories

Number of Plots = 46

FAR = 1.6 - 7 (old blds.)
FAR = 7.2 - 14.4 (new bld.)
(observed)

Plate : 4.21

Wari
Block 2

NRD = 137 units/ acre
= 284 units/ hectare

NRPD = 689 persons/acre
= 1423 per/hectare

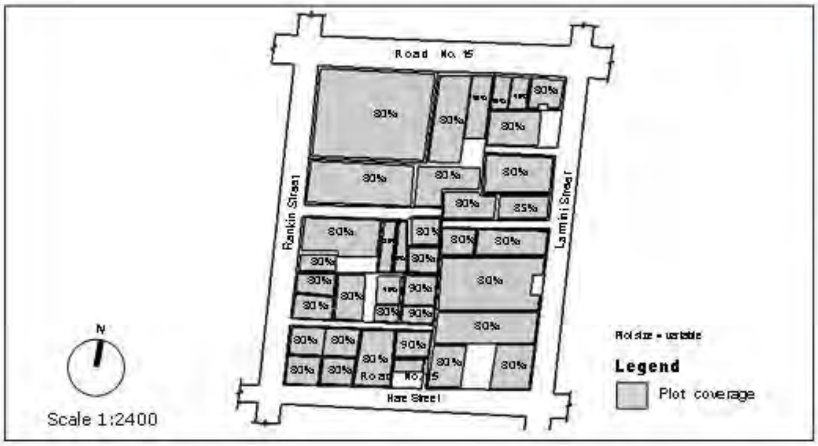


Fig 4.82: Plot layout and plot coverage

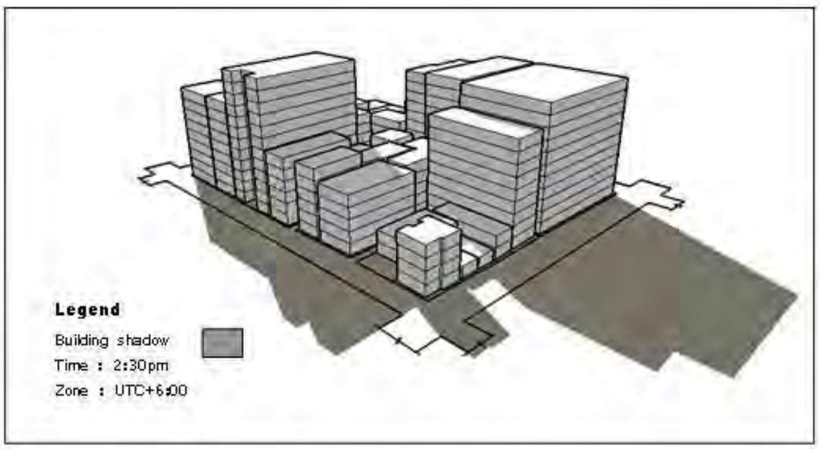


Fig 4.83: Shadow effects on adjacent buildings and streets

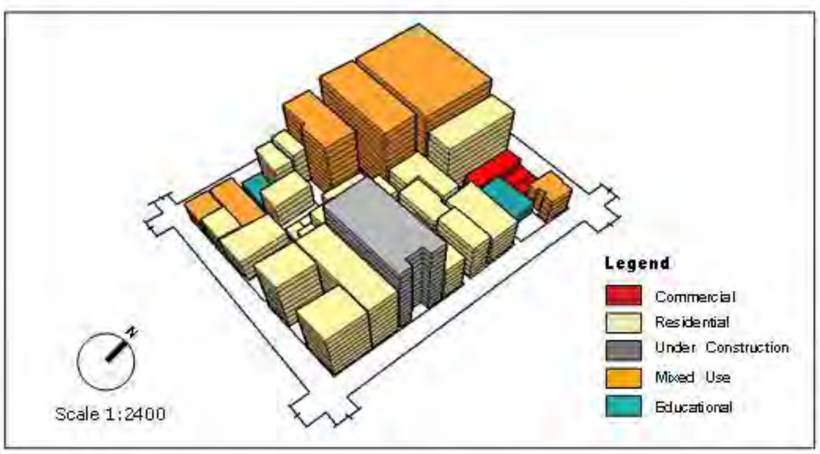


Fig 4.84: Block coverage 82.1%, approved height 8 stories

Number of Plots = 38

FAR = 0.8 - 5.7 (old blds.)
FAR = 7.2 - 9.6 (new bld.)
(observed)

Plate : 4.22

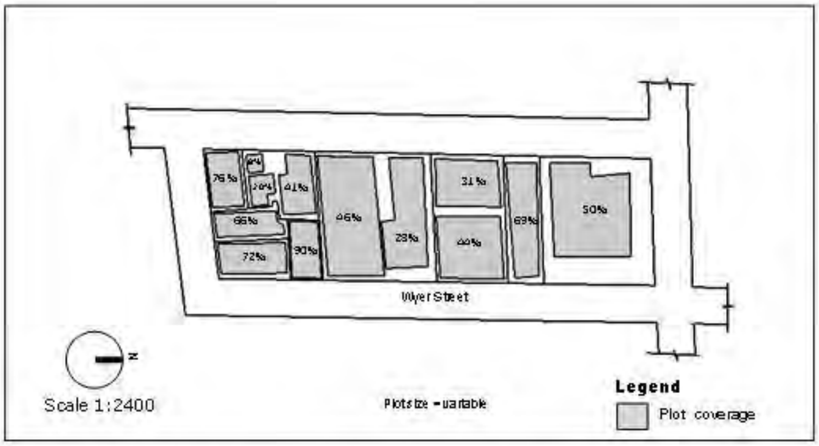


Fig 4.85: Plot layout and plot coverage

Wari
Block 3

NRD = 138 units/ acre
= 276 units/ hectare

NRPD = 690 persons/acre
= 1380 per/hectare

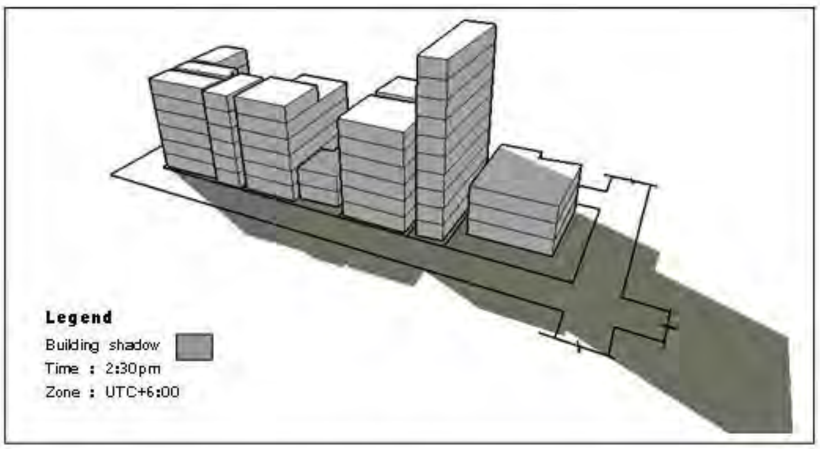


Fig 4.86: Shadow effects on adjacent buildings and streets

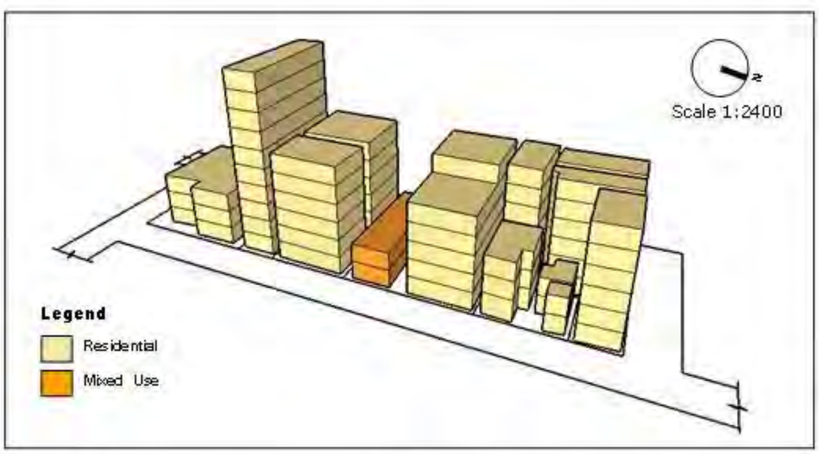


Fig 4.87: Block coverage 66%, approved height 8 stories

Number of Plots = 13

FAR = 0.8 - 5.5 (old blds.)
(observed)

Plate : 4.23

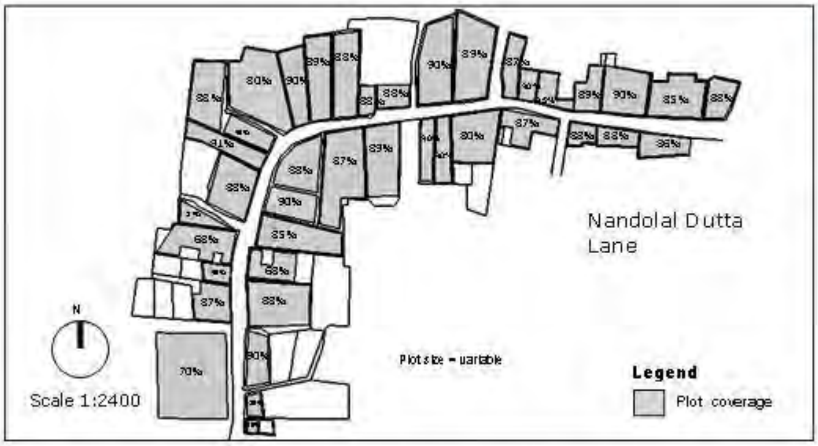


Fig 4.88: Plot layout and plot coverage

Luxmi Bazaar
Block 1

NRD = 64 units/ acre
= 128 units/ hectare

NRPD = 321 persons/acre
= 643 per/hectare

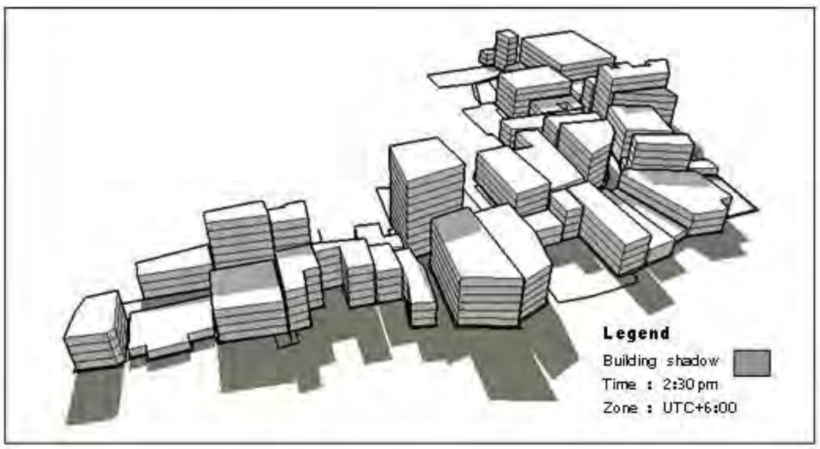


Fig 4.89: Shadow effects on adjacent buildings and streets

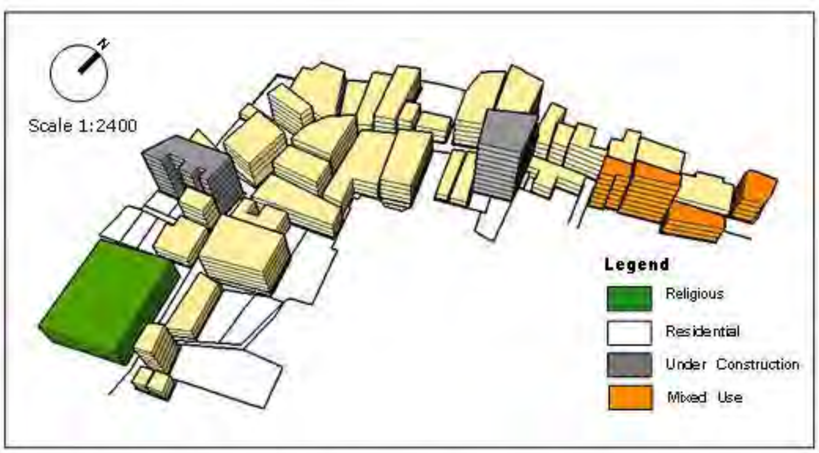


Fig 4.90: Block coverage 89%, approved height 8 stories

Number of Plots = 41

FAR = 0.9 - 5.7 (old blds.)
FAR = 5.4 - 8 (new bld.)
(observed)

Plate : 4.24

Luxmi Bazaar
Block 3

NRD = 109 units/ acre
= 220 units/ hectare

NRPD = 548 persons/acre
=1104 per/hectare

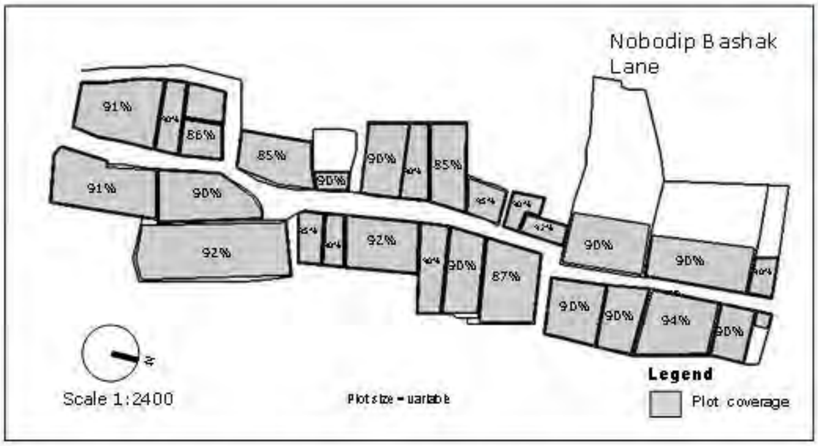


Fig 4.94: Plot layout and plot coverage

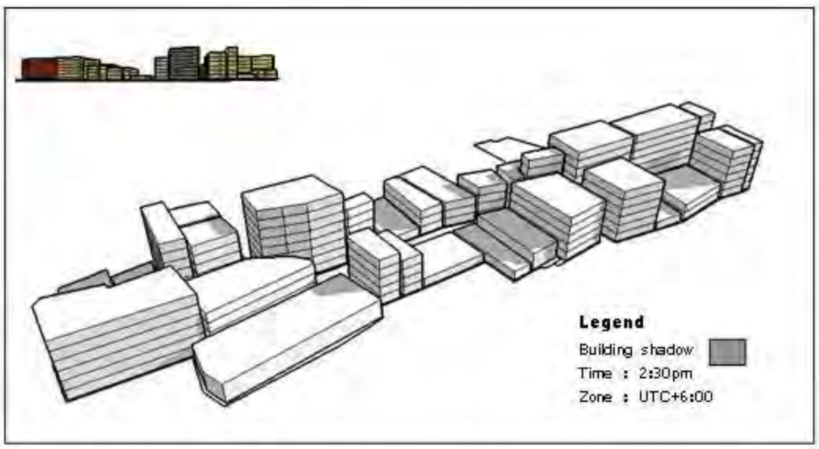


Fig 4.95: Shadow effects on adjacent buildings and streets

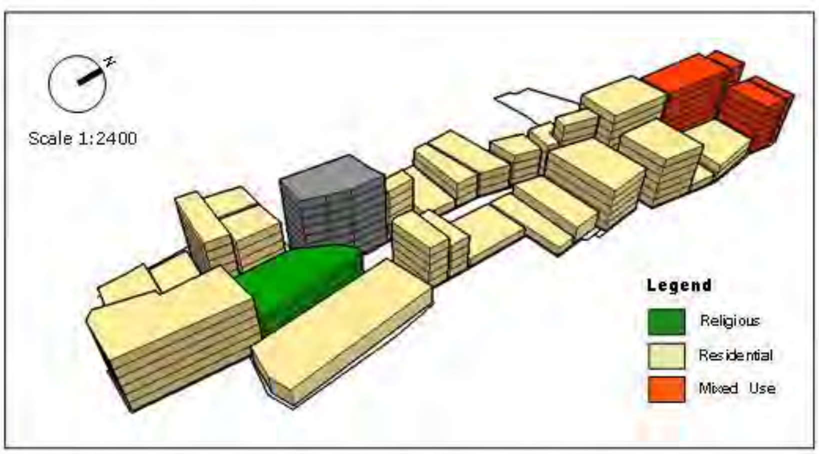


Fig 4.96: Plot coverage 91.2%, approved height unlimited

Number of Plots = 27

FAR = 0.9 - 5.4 (old blds.)
FAR = 6.3 (new bld.)
(observed)

Plate : 4.26

Luxmi Bazaar

Block 2

NRD = 69 units/ acre
= 140 units/ hectare

NRPD = 348 persons/acre
= 701 per/hectare

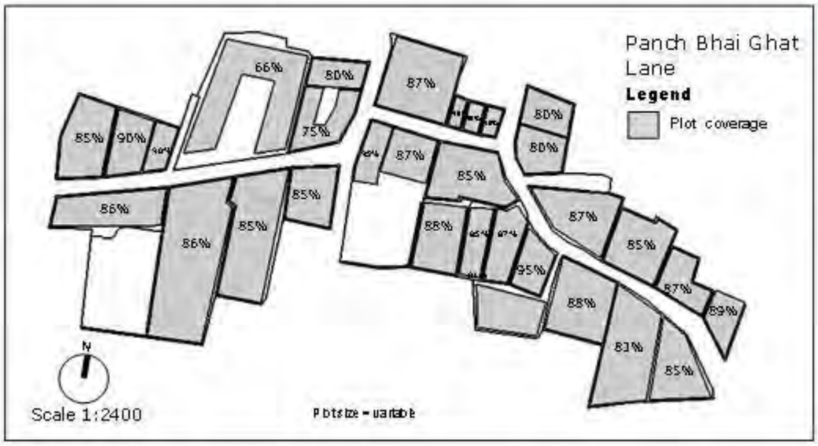


Fig 4.91: Plot layout and plot coverage

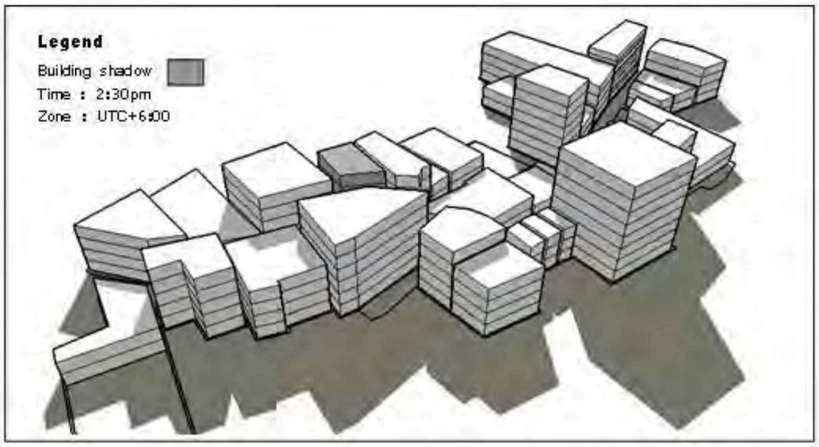


Fig 4.92: Shadow effects on adjacent buildings and streets

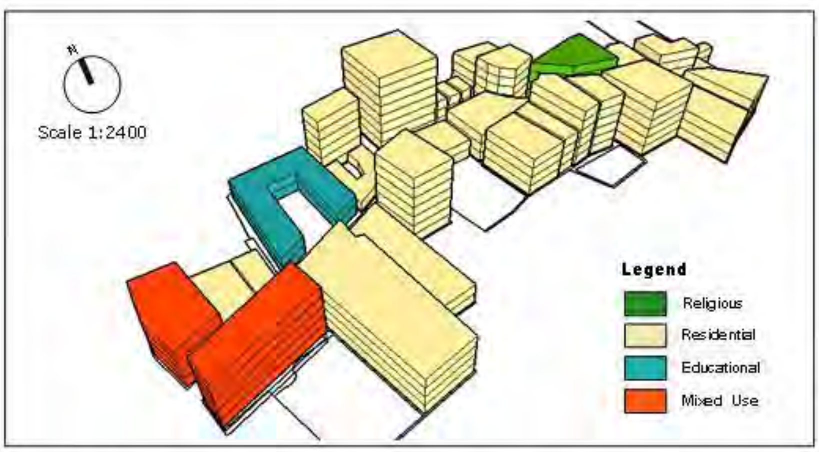


Fig 4.93: Block coverage 89.2%, approved unlimited

Number of Plots = 30

FAR = 1.3 - 6.9 (old blds.)
FAR = 5.8 (new bld.)
(observed)

Plate : 4.25