

Sustainable High-Rise Residential Building Development in Dhaka City

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Abstract: Efficient space utilization is essential due to urbanization, population growth, and urban sprawl, necessitating smart land use and vertical growth. Sustainable design serves as a benchmark for promoting responsible urban living. Over the last few decades, there is a pressing need for socially and environmentally sustainable high-rise residential building development to ensure healthy and comfortable urban settlements within limited space. This paper aims to examine aspects and strategies for such development. It is based on data collected from a household survey to assess residents' living conditions in residential high-rises and from in-depth interviews with professionals that further provided valuable insights. It was found that the majority of the respondents supported high-rise development, while 66% of professionals recommend high-rises with six or more stories in Bangladesh, emphasizing environmental sustainability. Based on the findings a set of comprehensive strategies are proposed, focusing on current living conditions, and specific social and ecological aspects. The findings offer a potential model for promoting socially and environmentally sustainable high-rise housing in cities with diverse socioeconomic background, contributing to a more sustainable urban future.

Keywords: Dhaka, Sustainable City, High-rise Residential Development, Social and Environmental Strategies

01. Introduction

The primary requirement for living a good quality of life is to establish sustainable and healthy communities. With the Earth's land being limited and the population growing at a rate of 1.05% annually, nearing 8 billion people (*World Population Clock: 8.1 Billion People LIVE, 2023*), It is crucial to find ways to accommodate this expanding population while ensuring a healthy and comfortable living. Sustainable housing plays a key role in meeting this need, and vertical development stands out as a promising solution to address the challenges of population growth (Wong, 2004) (Akristiniy & Boriskina, 2018) (Ips, 2022). Moreover, B Maleki et al. (2019) stated that global urbanization, scarcity of land, and rising land prices are the major factors to increase the need for high-rise residential development. Bangladesh, a developing nation, faces a significant challenge due to its burgeoning population and acute land scarcity, particularly in densely populated urban centers like Dhaka. This rapid population growth poses a considerable obstacle to maintaining a sustainable urban environment. To ensure that city residents enjoy a healthy quality of life and to foster a more sustainable future globally, it is imperative to embrace

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sustainable development strategies. In this backdrop, this study aims to investigate some social and environmental aspects and outline strategies for socially and environmentally sustainable residential high-rise development in Dhaka City.

Concept of Sustainable high rise building development

According to the Council of Tall Buildings and Urban Habitat, a structure is categorized as a high rise if it exceeds the height of surrounding buildings or possesses a slender profile that creates the illusion of a towering skyscraper. In the Context of Bangladesh, as per the Bangladesh National Building Code, a structure that is comprised of 10 or more stories is classified as a high-rise building (BNBC part 3) (Dipta et al. 2023). Moreover, according to the Fire Service and Civil Defense, residential buildings with six or more stories are classified as high-rise structures (Raju, 2019) (*Fire Safety Rules in New Building Code Weaker, Review Sought*, n.d.). There exist two distinct definitions of high-rise buildings practiced in Bangladesh. Sustainable high-rise buildings consider an overall approach that integrates and balances multidimensional issues (socioeconomic, cultural, environmental, etc.) (Bragança, 2010; Akristiniy & Boriskina, 2018) and ensures the functional adaptability of future changes (*The Future of the City*, n.d.). Additionally, Bahareh (2019) noted that sustainable development represents a significant shift in comprehending the interplay between human beings and the environment, as well as the relationships among humans themselves.

3. Defining Sustainability

According to the United Nations, sustainability can be defined as the capacity of forthcoming generations to fulfill their own needs while preserving the capability to fulfill the needs of the current generation. There are generally three pillars or dimensions of sustainability (Maleki et al., 2023): Environmental sustainability, which considers elements including water, energy, greenhouse gas emissions, trash, vegetation, contaminants, and contamination; Economic sustainability, which takes into account factors including construction costs and materials, utilities, property costs, upgrades and major replacements, and resale value and finally Social sustainability which considers factors such as safety, security, appearance, accessibility, efficiency, future changes, and viability for future generations. Residents' satisfaction with living in high rises is also measured by these three dimensions. However, it is found that a significant proportion of large-scale constructions are erected with minimal consideration for sustainable development and other related approaches (Baiz & Hoskara, 2021).

3.1 Social Sustainability

Social sustainability pertains to how individuals, societies, and communities coexist, attain developmental objectives, and perceive their physical boundaries and territory as a unified entity. Mahdavejad et al. (2014) defined social sustainability as a systematic approach aimed at establishing sustainable and prosperous communities that enhance the overall welfare of individuals by comprehending their requirements from the environments they inhabit and operate in. The critical aspects of social sustainability, according to Maleki et al. (2023) are social equity, health and safety, a skilled workforce, and supportive communities, which are necessary for sustainable social development. Furthermore,

Bahareh (2019) highlights that social sustainability encompasses various factors that are essential for a fulfilling life, including justice, health, safety, comfort, aesthetics, security, children's development, and social identity. Agyemang et al. (2017) investigated the social acceptability of high-rise buildings in a Ghanaian city based on efficient use of space, health, multi-functionality, aesthetics, aerial view, accommodation, and resiliency. An important issue raised in this context is visual privacy. It is significantly impacted by building distance, community space, open spaces for social interaction, and the lack of open space for children. Open space, Security, accessibility, acceptability, apartment-size spaces for social interaction, and interaction with the neighborhood are considered the indicators of social sustainability (Soebarto, 2016).

This paper will develop strategies considering such aspects in the social dimension; building height, open space, social interaction, safety and security, affordability, availability of amenities, and inclusiveness.

3.2 Environmental Sustainability

According to the U.N. Environment Program, environmental sustainability "reflects making personal decisions that ensure an equal, if not better, way of life for future generations." This concept involves establishing relationships with the environment that can maintain long-term environmental quality and prevent the depletion or degradation of natural resources.

Aspects of environmental sustainability, as abstracted by Soebarto (2016), include thermal comfort, natural ventilation capability, proper waste management, secure on-site handling and storage of hazardous waste, buildings equipped with trash chutes, recyclable waste bins of the proper size, recycling, and returning recovered materials to their proper places. Further, open spaces, waste containers for non-recyclables of the proper size, the passive solar system, green roofs and walls, windows, seismic characteristics, and the minimization of ecological harmfulness are also part of environmental sustainability.

Maleki et al. (2023) highlighted four broad aspects of environmental sustainability, namely climate, water, natural resources, and biodiversity. Lazar & Chithra (2021) illustrated additional criteria, including sustainable sites, energy efficiency, pollution reduction, material conservation, and waste management.

This paper, specifically considers natural ventilation, waste management, ecology, fire safety and earthquake resilience, and pollution-free as environmental aspects to develop strategies for environmentally sustainable high-rise residential building development.

4. Study Area and Methods

This study was conducted in Dhaka, the capital and most populous city of Bangladesh, with a population of 8.5 million across an area of approximately 1,353 sq. km (Dhaka - the Capital of Bangladesh, 2022). The study was based on data collected through questionnaires and interviews with key stakeholders involved in high-rise residential development in Dhaka. This study collected data from 384 people who are living in high-rise residential buildings and conducted Key Informant Interview (KII) of 15 professionals.

The participants included residents of high-rise buildings and professionals such as architects, planners, engineers, real estate developers, and government officials. The professionals were drawn from organizations such as The Institute of Architects Bangladesh (IAB), The Institute of Engineers Bangladesh (IEB), and the Bangladesh Institute of Planners (BIP) with at least five years of professional experience, and authorities from RAJUK, DNCC, DSCC, and a reputable real estate company. The study adopted a qualitative analysis approach, using thematic analysis to synthesize the findings from the questionnaires and (KII).

5. Result and Discussion

This discussion section consists of two parts: the first one discusses the living conditions in Dhaka's high-rise buildings, while the second includes expert opinions. The focus is on stakeholders' perceptions, suggestions, challenges, recommendations, and overall experiences in residential high rises, whether positive or negative. Architects, planners, engineers, real estate developers, and government officials each bring unique viewpoints from their respective fields. To accommodate these varied perspectives, the Key Informant Interview (KIIs) question structure was designed to ensure common ground among all participants. The survey questionnaire and KII format focused on social and environmental aspects.

Regarding demographics, 45% of the respondents were women, and 55% were men. Most respondents (91%) were between 21 and 30 years old, while 7% were between 31 and 40, and 2% were over 40. Among the respondents, 69% graduated.

5.1 Building Height:

In response to the questions regarding people's preferred floor, it was found that the majority of the respondents (about 70%) preferred floors between 6-10, while 20% preferred floors 10-15, only 8% favored the ground to the 1-5 floor and 2% chose above. Those opting for upper floors cited better ventilation and lower pollution, while those favoring lower floors valued easier movement and access.

Stakeholders were asked about their preferred height for high-rise residential buildings in Dhaka, as there was some confusion about what constitutes a high-rise. According to the responses, 66% of stakeholders considered six stories or more as high-rises in the context of Dhaka. However, all of the respondents shared a common concern which was fire safety.

5.2 Open space:

Dhaka city is known for its limited open and green spaces. When asked about type of open spaces their community requires most, a majority of respondents (56%) said that they would like more green spaces such as urban forests while 23% preferred more playgrounds and 11% desired more parks.

Stakeholders were surveyed on the availability, adequacy, and challenges of open spaces in Dhaka city. The unanimous consensus was that there is insufficient open space, even within some government projects that generally adhere to construction regulations like setbacks. However, privately owned projects often exhibit regulatory violations, contributing to the problem.

5.3 Social Interaction: According to the findings 91% of residents reported a lack of space for social interaction in the high-rise buildings with the professionals sharing the same concern. They proposed utilizing rooftops for communal gatherings and adhering to the DAP's (Detailed Area Plan) open space regulations. They also indicated that residential high-rises could offer sufficient space for social interaction and that the number of parks and playgrounds could increase by incorporating these high-rises into urban planning.

5.4 Safety and Security

In response to questions asked regarding existing safety and security provisions, 63% of people responded that they felt safe and secure in the high rise residential buildings. According to the respondents, for ensuring safety and security, they appoint community night guards and 24-hour guards to their building with some technical support such as CC TV cameras.

5.5 Affordability and Equity: From the data analysis it was found that all participants expressed dissatisfaction with the affordability of high-rise residential apartments across all income levels. This finding was also found to be endorsed by the professionals in the field. As a solution, these experts considered constructing a variety of apartment sizes, with some advocating for price adjustments based on income brackets.

5.6 Availability of Facilities: According to the study, everyone living in high-rise residential buildings does not get all amenities. However, all respondents reported receiving their water supply (from WASA), while nearly 87% had access to gas services. 98% of respondents had proper sanitation, 97% had sewerage systems, and 91% had parking facilities. However, 59% reported insufficient open or recreational spaces. When asked if they would be willing to pay for additional amenities, 58% said they would, while the rest indicated they would not.

Professionals were asked about the availability of amenities in residential high-rises in Dhaka and what improvements were needed. While they noted that there is no shortage of water in Dhaka, however, they lamented that the city faces challenges in providing safe drinking water due to high levels of contamination and pollution.

5.7 Inclusive Design:

According to the study 80% of respondents affirmed that their buildings had enough ramps, handrails, and elevators to accommodate residents, particularly the elderly and disabled, while the rest of them disagreed. When asked if they believed building designs should cater to the elderly and disabled, an overwhelming majority—87%—supported the idea.

To assess residents' willingness to pay for specific design elements and amenities, participants were asked if they would cover the costs to make buildings more accessible for the elderly and disabled. It was found that a 79% expressed their readiness to pay for these changes. Additionally, 91% of respondents were open to participating in training programs that cover topics like fire safety, earthquake preparedness, efficient use of utilities, and proper waste management.

5.7 Pollution and Waste Management

Form the study it was found that 95 percent of respondents reported having fire extinguishers in their buildings, while 80% indicated the presence of fire alarms. However, only 30% had sprinklers installed. Unfortunately, 95% of residents said they lacked emergency exit ramps or doors for safe evacuation. On the other hand, Professionals mentioned that most current high-rise developments in Dhaka are designed with consideration for fire and earthquake safety.

5.9 Natural ventilation

The research indicated that 64% of respondents reporting their buildings had no adequate natural ventilation. According to professionals, the upper floors generally get better ventilation. In this connection they recommend adhering to the Building Construction Rules and the Detailed Area Plan (DAP) during construction, as this can help ensure proper ventilation and natural lighting.

5.10 Ecological Balance

Ecological balance is a critical priority that must be safeguarded for environmental sustainability. Professionals recommend that these considerations be integrated into the development process. Compliance with environmental and development-related legislation should be maintained not only for high-rise buildings but for all types of construction projects.

5.11 Advantages and Disadvantages of High rise living

In the research one open-ended and one close-ended question was posted to respondents to get responses about the advantages and disadvantages of living in residential high rise buildings in Dhaka city based on their experiences. According to their responses, about 70% said they enjoy certain aspects of living in high-rise residential buildings. Among the benefits, they highlighted ample natural light, good ventilation, a better view, less noise, less pollution, and more security.

However, respondents also reported some disadvantages of residing in tall residential structures. About 30% of respondents mentioned drawbacks related to high-rise apartment complexes. The most commonly reported issues were fire safety concerns and the inconvenience of using stairs when elevators are unavailable due to power outages or others.

5.12 Challenges of Developing High-Rise Residential Buildings

In response to a question asked to professionals about the challenges they encounter in their work the real estate developers, in particular, mentioned that they face significant hurdles in project implementation. Often, when they attempt to comply with building regulations, they encounter various obstacles. These can include political interference, which can complicate the approval process. Another major challenge is corruption, which is so rampant that it often makes even straightforward tasks exceedingly difficult to complete.

To address the existing issues, a question was posed to professionals seeking their recommendations. The majority emphasized the importance of integrity and proposed measures to curb corruption. They suggested that honesty should be a guiding principle in all endeavors. Additionally, they advocated for reducing pollution and enhancing tree planting initiatives to protect the ecosystem, recommending practices such as "vertical gardening" and "rooftop gardening." This group prioritized environmental preservation. Another significant recommendation involved raising public awareness and urging the government to take greater responsibility for promoting sustainable practices.

It was found that a notable (73%) share of respondents endorse the development of high-rise residential buildings. They argue that this approach is the only viable solution to meet the housing needs of Dhaka's growing population. However, among all the professionals, there is dissent from three urban planners and one government official who are entirely opposed to high-rise development. They contend that constructing more high-rise buildings could encourage further population growth in the city, exacerbating existing issues.

Professionals were queried about their approach to maintenance after completing a development and whether they had any specific plans or recommendations for long-term upkeep. The majority indicated that post-project maintenance is typically managed by the developer or relevant authority for the first one to two years. However, beyond this initial period, responsibility for maintenance falls to the homeowners, who must handle the matter privately. Respondents attributed the authority's limited involvement in ongoing maintenance to financial constraints. They acknowledged that there are no explicit restrictions on the maintenance of residential high-rise building developments.

5.2 Findings

The study offers a comprehensive view of living conditions and expert opinions on high-rise residential buildings in Dhaka. A key demographic insight is that the majority of respondents (91%) were between 21 and 30 years old, suggesting that high-rise living appeals to younger populations. Preferences regarding building height showed a majority (70%) favoring floors 6-10, with upper floors appreciated for ventilation and lower floors for accessibility. Open spaces remain a significant concern, with 56% of respondents calling for more green areas. The study also revealed that safety and security measures were relatively common, with 63% of residents feeling secure.

However, fire safety remains a challenge, with 95% of respondents lacking emergency exits and only 30% having sprinklers. Affordability is another major issue, with all stakeholders expressing dissatisfaction with high-rise apartment costs. The lack of natural ventilation in many buildings (64%) was noted, while ecological balance and environmental sustainability were deemed critical by professionals, emphasizing the importance of compliance with environmental laws.

Support for high-rise development was considerable, with 73% of respondents endorsing it, although dissenting voices raised concerns about increasing population density and associated issues. Maintenance issues also emerged, with post-project upkeep typically falling to homeowners after initial developer support. The experts pointed to political interference and rampant corruption as significant hurdles in project implementation, suggesting the need for integrity and measures to curb corruption. Recommendations for

managing these challenges included promoting environmental preservation, reducing pollution, and implementing innovative practices like vertical and rooftop gardening.

6. Strategies: Socially and Environmentally sustainable Residential High rises

Considering the opinions of experts and the current living conditions in high-rise residential buildings, particularly concerning certain social and environmental sustainability aspects, this study proposes several strategies for socially and environmentally sustainable high-rise residential building development:

6.1 Socially Sustainable Strategies

Building height and open space: Considering building height and ensuring adequate open space for high-rise residential in the context of Bangladesh.

Preferred strategy;

1. The building height for high-rise residential should be 6 stories and above.
2. The open space should be at least 25%.

Social Interaction: Increasing the amount of social contact among building inhabitants

Preferred strategy;

1. To promote contact among the residents, the lobby must be well-lit and naturally ventilated.
2. The rooftop can serve as a gathering place and outdoor play areas
3. Community space must be provided.
4. Maintain the number of parks and playgrounds followed by DAP.

Inclusiveness: Promoting elderly and disabled-friendly design features.

Preferred strategy;

1. The structure and the flats must contain the essential design elements in accordance with the BNBC regulations and railings in bathrooms and toilets for the elderly and disabled.

Affordability and Equity: Ensuring affordability and equity,

1. Apartments ought to be built in a variety of sizes.
2. The level of house rent and apartment prices should be set according to income brackets

Availability of Amenities: Creating a better living environment, make sure the utility and community facilities for residents have the features and amenities that occupants prioritize based on their needs.

1. The cost of basic needs should be a minimum.

2. All facilities to be present in the neighborhoods as followed 30 neighborhood facilities listed in DAP.

Safety and security: Promoting safety and security.

1. Security guards at the entrance to the building must be provided, installation of cameras in the public areas, corridors, stairs, lift, lobby, and monitored regularly.
2. A multi-hazard approach should be used in the design of buildings to take into account all significant dangers as well as the possible effects of seismic forces.
3. All of the buildings' units should be equipped with burglar alarms.

Awareness program: Promoting awareness to occupants,

1. The government and the building management should encourage the residents to take part in fire safety education and training programs.
2. The government and the building management should encourage the residents to take part in training and education programs on emergency preparedness for natural catastrophes.
3. The government and the building management should encourage the residents about effective waste management.

6.2. Environmentally Sustainable Strategies

Natural Ventilation: Ensuring natural ventilation.

1. Follow setback rules.
2. The open space should be at least 25%.

Waste management: Ensuring proper management of household waste.

1. The building site should incorporate allocated areas with three different bins for effective waste collection.
2. Active participation of government and the building management in effective waste management.

Ecology: Preserving Ecological Balance

1. Strictly avoid development in ecologically sensitive areas.
2. Follow the rules of “Mega City, Divisional Town and District Town’s Municipal Areas Including Country’s All the Municipal Areas’ Playground, Open Space, Park, and Natural Water Reservoir Conservation Act,200” during construction.

Fire Safety and Earthquake Resilience: Ensuring fire safety in the buildings

1. Emergency fire safety alarm and equipment has to be installed in each building.
2. Building construction and materials should be used with the concern of earthquake resilience

3. Active participation of government and the building management to take part in fire safety education and training programs.
4. A multi-hazard approach should be used in the design of buildings to take into account all significant dangers as well as the possible effects of seismic forces.

Pollution Free: Lessening the pollution and preserving the city's natural environment.

1. Planting Trees, rooftop gardening, vertical gardening

Building Maintenance

Regular monitoring and maintenance are crucial to extending the lifespan of any development. A key aspect of ensuring consistent building maintenance is to establish a clear plan for upkeep. Regular maintenance is critical, especially for safety-related systems like fire-fighting equipment and elevators

1. Building authorities should implement a comprehensive maintenance schedule.
2. Establishing a monitoring unit to evaluate user satisfaction and the condition of building services.
3. Maintenance schedules should be designed with a long-term perspective.
4. Building operations staff should be required to undergo relevant training to ensure they are equipped with the necessary skills and knowledge

7. Conclusion

The study underscores the pressing need for socially and environmentally sustainable high-rise residential building development, particularly in densely populated urban centers like Dhaka. By synthesizing insights from residents and experts, the study identifies key challenges and proposes comprehensive strategies to address them. Socially sustainable strategies emphasize the importance of building height, open space, social interaction, inclusiveness, affordability, availability of amenities, safety, security, and awareness programs. These strategies aim to foster vibrant, inclusive communities that prioritize the well-being and satisfaction of residents across diverse demographics. On the environmental front, the strategies focus on natural ventilation, waste management, ecological balance, fire safety, earthquake resilience, and pollution reduction. By integrating these considerations into the development process, the aim is to create living environments that minimize environmental impact and promote long-term sustainability. Moreover, the importance of ongoing building maintenance cannot be overstated. Establishing clear maintenance plans, monitoring systems, and training programs for building staff are essential for ensuring the longevity and safety of high-rise developments.

Overall, the study underscores the imperative of adopting a holistic approach to high-rise residential development, one that balances social, environmental, and economic considerations. By implementing the proposed strategies, stakeholders can work towards creating healthier, more sustainable urban environments that enhance the quality of life for current and future generations.

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