

Urban Heat Island Effect in Dhaka City: An Analysis of the Dhaka Structure Plan (2016-2035)

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Abstract

Urbanisation leads to the introduction of urban planning since many environmental concerns including the urban heat island effect (UHI) are attributed to uncontrolled urbanisation. Qualitative research using secondary data was carried out in the article. It is found that Dhaka city is on average more than three degrees Celsius warmer than peripheral areas, paving the way for the phenomenon of the UHI effect. Although all development or master plans focused on the expansion of Dhaka into a civilised and modernised capital city with abundant green and open spaces, none of them considered the influence of the UHI phenomenon. Particular attention was drawn here on the Dhaka Structure Plan, 2016-2035. The findings indicated that proper urban planning addressing enough space between buildings, plantations of trees and population density must be ensured to decrease the intensity of heat islands.

Keywords: urban, heat, island, effect, Dhaka, plan, city

1. Introduction

Numerous urban environmental problems are attributed to rapid urbanisation and population increase (Nam, 2015). One of these is the urban heat island (UHI) phenomenon, which alters the urban climate relative to the surrounding rural areas. Dhaka city is experiencing an urban heat island effect due to anthropogenic factors, a lack of greenery, and overcrowding (Tabassum, 2024). With more than 165 million people living there, Bangladesh is one of the world's most densely inhabited nations (BBS, 2022). Along with Chittagong, Khulna, and Narayanganj, Dhaka tops the list of cities in the nation experiencing rapid and uncontrolled urbanisation. In September 2021 Bangladesh Red Crescent Society and Bangladesh Meteorological Department (BMD) jointly completed a research, titled, 'Feasibility Study on Heatwave in Dhaka' (United States Environmental Protection Agency, 2024). In that research, the researcher identified 25 areas of Dhaka as Heat Islands, such as Mirpur, Basabo, Gabtoli, Farmgate, Jatrabari, Uttara, etc. It is found that in the past 25 years, Dhaka has shown an increase in UHI intensity (0.21 °C each decade). The average daily maximum UHI intensity is 2.15 °C, and the average UHI intensity is 0.48 °C.

In addition, a survey conducted by the Centre for Atmospheric Pollution Studies (CAPS) reveals that the average temperature in Dhaka in 2017 was 33.04 degrees Celsius (the Dainik Jonokontho, 2024). It is 36.96 in 2024. While there are many factors contributing to global warming, one of

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the most important is arbitrary urban planning. The study shows that the average temperature of Dhaka North City Corporation and Dhaka South City Corporation in 2017 was consecutively 33.39 and 33.50 degrees Celsius. After seven years, in 2024, the average temperature in the north is 37.38 degrees Celsius, and in the South, it is 36.54 degrees Celsius. Accordingly, the average temperature increased by 3.51 degrees as shown in Table 1.

Table 1: Descriptive analysis of the temperature difference found in Dhaka in 2017 and 2024

2017	Dhaka North City Corporation	33.39 degrees Celsius
	Dhaka South City Corporation	33.50 degrees Celsius
2024	Dhaka North City Corporation	37.38 degrees Celsius
	Dhaka South City Corporation	36.54 degrees Celsius

According to a study, published in February 2022 in Springer's Theoretical and Applied Climatology under the title "Changes in Urbanisation and Urban Heat Island Effect in Dhaka City,"(Dhaka Structure Plan, 2016-2035) the coolest site outside of Dhaka and the warmest position inside the city had daytime and nighttime temperature variations of approximately 5°C and 7°C, respectively.

All these statistics reveal that Dhaka city has slowly turned into a heat island, which has created a difference in the land surface temperature between Dhaka and its surrounding areas. This article, therefore, endeavours to focus on the heat island effect in Dhaka city and how this effect is addressed in the last development plan, named, Dhaka Structure Plan (2016-2035) in order to overcome loopholes found in the previous plans.

The paper is organized as follows: Section 1 provides introduction. Section 2 specifies the objectives of the study. Section 3 embraces literature review. Section 4 provides methodological procedure. Section 5 talks about revisiting historical background of development plans of Dhaka city and urban heat island effect. Section 6 addresses Dhaka Structure Plan, 2016-2035 (DSP, 2016-2035) and Its Challenges. Section 7 focuses on DSP and mitigation strategies. Finally, the paper concludes in section 8.

2. Objectives

There are two kinds of heat islands: atmospheric and surface (Amorim, Dubreuil, and Amorim, 2021). These vary in their formation processes, identification, or measurement methods, effects, and, to some extent, accessible cooling strategies (Jabbar, Hamoodi and Al-Hameedawi, 2023). The main mechanisms influencing the UHI are four in number: a) the reduction in evapotranspiration due to a loss of vegetation and water bodies, b) the increase in anthropogenic heat release from human activity (i.e., vehicle use, heating and cooling of buildings), c) changes in albedo from buildings, and d) trapping of radiation in the 'urban canyon'(Oke, 1981). The first and last ones of contributing factors of the UHI are directly linked to development plans, and the study analyses these two causes from the perspective of the DSP. Therefore, the objectives of the article are the following three:

- To understand Dhaka's urban heat island effect
- To know how development plans have failed to address properly Dhaka's urban heat island impact.

- To provide suggestions on the basis of the findings of the present study for ensuring the well-being of the Dhaka city dwellers.

3. Literature Review

Temperatures in cities are rising because of climate change. Urban temperatures are further increasing because of the heat-storing building materials, principally concrete and asphalt, since these materials store heat during the day and release it at night, thereby making the city warmer than the surrounding areas.

Destructive urbanisation is the main reason for the urban heat island effect in Dhaka city. The UHI effect is created in areas where buildings are densely packed (Shmaefsky, 2006). Buildings are being constructed haphazardly in Dhaka as a result of its fast-growing population and for their growing demand for housing. Most of the high-rise infrastructure in Dhaka is built with inefficient ventilation and narrow streets. The buildings absorb more heat because of construction materials, dark surfaces, and air conditioning, which all create a heat-trapping environment.

Besides, the urban canopy is the area surrounding higher structures that traps heat reflected by a building (Masson, 2006). When an urban canopy forms, UHI is made worse (Nuruzzaman, 2015). Furthermore, the wind speed is decreased because of the nearby structures. Consequently, the conventional cooling effect decreases. Thus, the effect is amplified as the trapped heat cannot be released (Rajagopalan, et al., 2008). In addition to all of the above, the lack of greenery makes Dhaka islands of higher temperatures relative to outlying areas (SCISPACE, 2022). Green areas, which are the natural cooling mechanism, are lacking in cities because of the replacement of pavement and buildings (Aram, 2019). Even on a scorching summer day, the heat island effect raises the temperature in urban hotspots where heat is trapped (The Daily Star, 2023). As far as keeping spaces within two buildings is concerned, RAJUK is required to monitor the construction of any infrastructure. It must be ensured that there must be enough free space and channel to circulate the wind. As a result, the impact of the urban microclimate will be lessened.

The causes of the UHI phenomenon, which are analysed above, are interrelated to the development plan, and the heat island effect can be remedied by the proper mapping and execution of these plans. The available previous literature provides a comprehensive understanding of the characteristics of UHI effect in Dhaka city, but in depth discussion about UHI effect is not found in the development plans framed during British period, Pakistan period or after liberation. Rajdhani Unnayan Kartripakkha (RAJUK), which has been set up under the Town Improvement Act of 1953 (TI Act), creates land use plans, supervises plan implementation, regulates development, and manages the development of Dhaka under the following four legal mechanisms: i) The Dhaka Structure Plan (DSP) of 2016-2035; ii) The Town Improvement Act, 1953; iii) The Rules for Building Construction, 1996; and iv) recently approved the Building Construction Rules, 2006. None of the previous studies comes up with concerns about any of the above four legal powers of RAJUK in connection with the UHI effect in Dhaka. The first aspect, the DSP (2016-2035), motivates, therefore, the present study.

Following the first Structure Plan and Detailed Area Plan (DAP) expiration, the second Structure Plan and DAP's preparation got underway on schedule in 2014–2015. In 2017, the DSP draft was ready for approval. Together, the mayors of Dhaka (Dhaka North City Corporation (DNCC) & Dhaka South City Corporation DSCC, Narayanganj, and Gazipur) as well as the then Works

Minister, denounced the plan and its recommendations. They all requested that it be replanned and that more public input be gathered. However, it is not finished; instead, RAJUK created a new DAP (2016–2035) based on this draft DSP, and they held a public hearing on it during the COVID-19 epidemic. The Plan's recommendations were then criticized by a number of professional associations, including the Institute of Architects (IAB), the Institute of Engineers (IEB), the Institute of Planners (BIP), the Bangladesh Environmental Lawyers Association (BELA), the Real Estate Housing Association of Bangladesh (REHAB), and the Bangladesh Land Developers Association (BLDA). Followings are the challenges of this DSP.

Based upon the above discussion, it appears that materials are available concerning the heat island effect in Dhaka city. Nevertheless, nothing is found regarding the past and present development plans and their impact on Dhaka city. The article endeavours to speak of the relationship between development plans and heat island impact in Dha city and accordingly provides suggestions. These suggestions do not fix a parameter and are liable to change due to the changing circumstances of the society.

4. Data and Methods

4.1 Study area

Dhaka city offers nearly eight percent of the jobs in the country, and 31.9 percent of the urban population of Bangladesh. The number of inhabitants of Dhaka has risen to more than 50 percent in the preceding ten years. Again, there is a dearth of parks, playgrounds, lakes, cultural zones, and community centres in Dhaka city (The Daily Star, 2021). Parks and open space in Dhaka city consist of less than 1.0% of its land. Furthermore, it is found that infrastructure is built in Dhaka city without keeping any space surrounding the buildings (Sameen, and Razzaque, 2016). All these statistics encourage the author to select Dhaka as a study area. The Chittagong Development Authority formulated its first master plan in 1961, the Khulna Development Authority in 1966, and the Rajshahi Development Authority in 1984. Sir Patrick Geddes mapped out the first advanced plan in 1917 for the growth of Dhaka city. This initial endeavour for flourishing and making a livable Dhaka city led the author to choose Dhaka for analysis. Dhaka city means Dhaka Metropolitan Region, which has one thousand, four hundred and thirty-two square kilometer area according to the Dhaka Structure Plan (DSP) 2016-2035.

4.2 Sampling design and data collection

The article is based on qualitative research. Qualitative research methods used in the article include content analysis by reviewing of scholarly literature, published writings and planning policies. The early part of the research develops through review of relevant literature, an evaluative framework against which the urban heat island effect of Dhaka city from the context of Dhaka Structure Plan 2016-2035(DSP,2016-2035) has been assessed. Further, the present study looks into all the previous plans that had been framed for Dhaka city since 1917. As far as urban heat island is concerned, it then compares this against the DSP, 2016-2035.The study is conducted by using data from secondary sources. For secondary data, the research relies on policy documents, books, theses, newspapers, journal articles, and the web.

5. Revisiting Historical Background of Development Plans of Dhaka City and Urban Heat Island Effect

A development plan is described in section 5 (c) of the Building Construction Act 1952 and in section 73 of the Town Improvement Act 1953 as a master plan made and approved under any law for the time being in force for the uses of any land in any place within Bangladesh. Section 74(3) of the Act of 1953 states that advancement plans must be framed in consonance with the master plan.

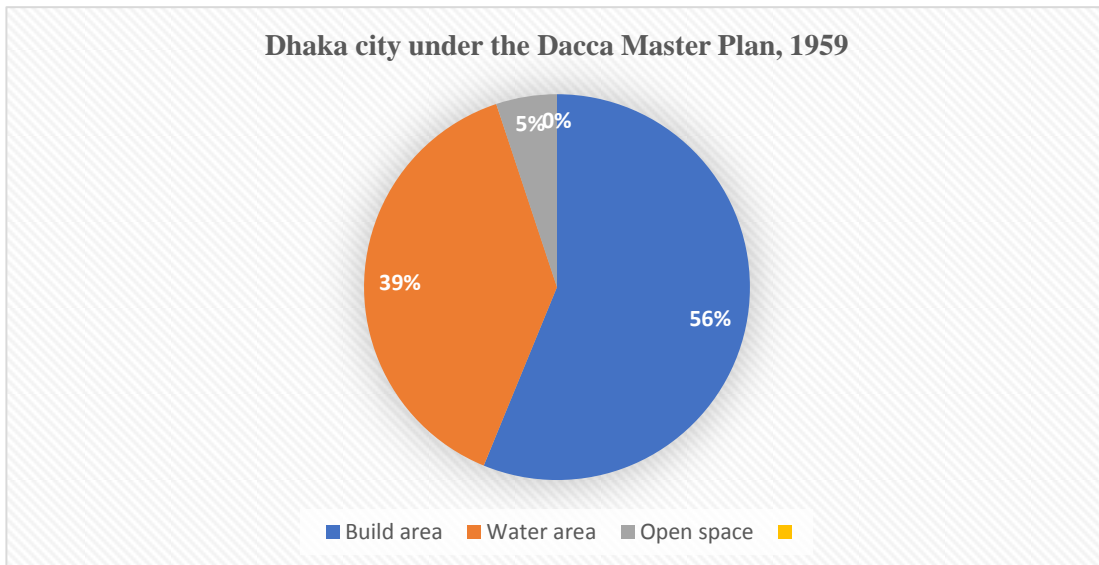
The first master plan for the Dhaka city, known as the DACCA Town Planning Report, 1917, had been made to fulfil some objectives: a) To take into consideration the concerns of river bank erosion (Iqbal, 2014). b) To carry on the development activities which were initiated after the Partition of Bengal in 1905. In line with the objective of this plan, part of the space-making and greening process was done by experts from the Kew Gardens, especially in the spacious Ramna Park (Chowdhury, 2006). c) To address the issue of the general decline of water bodies (Iqbal, 2010).

Geddes was especially concerned with protecting Dhaka's natural canal system, which he calculated to be roughly 25 miles long. He suggested that the canals could be a site for horticultural development, water parks, and public amenities. In terms of the river Buriganga, he felt that the very heart of all open spaces in Dhaka was its riverfronts. To him, it was not a question of great expenses, but “merely of that appreciative and constructive collaboration in which the painter’s eye goes with the planter’s hand” (LJUN, 1917). Following Geddes' assessment, Dhaka saw extraordinary planned expansion. Geddes' recommendations were not followed, since a large portion of the wetlands vanished during the development of the late British Dhaka. Patrick Geddes' emphasis on the smaller water spaces such as canals was left unheeded. With this, the opportunity was missed to integrate the built environment of modern Dhaka with small water spaces, which would be preserved and used, and would work as an integral part of the drainage and urban life. Nevertheless, the development of spaces that followed the report of Geddes remains the most picturesque part of the city. Though the clause ‘heat island’ was not used in the report, it grasped the spirit of urban heat island. The report recommended the preservation of rivers and vegetation surrounding the rivers so that they would work as open spaces, which work as mitigation strategies for the heat island effect.

The second master plan, known as the Dacca Master Plan, was prepared in 1959 for twenty years from 1958 to 1978 for the planned growth of Dhaka city. The Dacca Improvement Trust (DIT) was formed in 1956 under section 3 of the Town Improvement Act of 1953 to improve the urban conditions of Dhaka city. Rajdhani Unnayan Katripakka was substituted for the Dhaka Improvement Trust by section 6 of the Town Improvement (Amendment) Act, 1987 (Act No. XXIX of 1987) and its jurisdiction was expanded to include the entire Dhaka metropolitan area. The plan suggested that the provincial governments of Central and East Pakistan should implement a strategy of redirecting government institutions and industrial businesses to other East Pakistani towns instead of Dacca, except those whose presence in Dacca is crucial for administrative purposes. This is a good recommendation since population congestion and more concrete buildings cause the heat island effect, and the city planners anticipated it in 1959. They

emphasized the disperse of development outside of Dhaka. The idea of the second capital, known as Ayub Nagar by the Pakistani government at the time and later renamed Sher-e-Bangla Nagar, developed from these shifting policy movements and currently forms an administrative region of the city, where Louis Kahn's renowned parliament building was being built. The British created forest settings in Dhaka through the Geddes Report of 1917 and Sher-e-Bangla Nagar's surroundings saw the creation of some water areas during the Pakistani era. These were the examples of integration with nature and the modernist built-environmental portrayal of the beautiful forested and aquatic scenery of Eastern Bengal. But this plan failed to pay heed to preserve water bodies and green belt. No mention about heat island effect is found in this plan of 1959.

Chart 1: Scenario of land surface of Dhaka city under the Dacca Master Plan, 1959



Source: DSP, 2016-2035

The first city improvement strategic tactical plan in Bangladesh was the Dhaka Metropolitan Area Integrated Urban Development Project (DMAIUDP), 1981. It pulled up two issues for future Dhaka city expansion. The project laid stress on agriculture as the heart of the financial system and considered water transport as the chief means of communication since Bangladesh is a riverine country. The second concept emphasized peripheral urban development in such a form that it would reduce travel distance and connect a broad compass of economic activities. Both concepts were later thrown away considering those as impractical. There was no discussion of the heat island impact in this project of 1981.

Afterwards, the initial Structure Plan drafting started nearly ten years later. Since the current TI Act contains neither a Structure Plan nor a DAP, the project known as the ‘Dhaka Metropolitan Development Plan (DMDP, 1995-2015)’ incorporates the 1996-approved Structure and Urban

Area Plans without amending the Town Improvement Act, 1953. Although it was believed that the planners had learned from past mistakes, this was not the case. The main query is how the RAJUK created the new plan packages (Structure Plan, Urban Area Plan, and DAP) in the absence of the Town Improvement Act, 1953 amendment. Additionally, the current DAP (2016–2035) preparations made the same errors.

Though there were no specific strategies for preventing the heat island effect in the UAP of 1995–2005, indirect measures were shown. UAP placed a strong emphasis on land zoning, which means that land designated for one purpose, such as forestry, cannot be used for another. It also addressed infrastructure projects, such as roads, water supply, sewerage, and drainage systems. All these significantly impact UHI effect by reducing surface water runoff, incorporating green infrastructure, reducing surface heat, and maintaining water bodies. These measures ultimately protect the nature of land and the valid utilization of land. The first DAP of 2010–2015 proposed for urban decentralisation. Urban decentralization could reduce traffic congestion, improve the air quality, and create more green spaces leading to a better quality of life. Though DAP has shortcomings, urban decentralisation can help reduce the severity of the UHI effect and contribute to more livable and sustainable urban environments.

Due to numerous violations and departures from the authorized Structure and Urban Area Plans, the plans also became contentious from the standpoint of professional ethics as well as statutory requirements. Not a single project had been started or completed in accordance with this DAP (2010–2015); instead, the Interministerial Review Committee suggested that the land-use plan provisions of that DAP be changed in order to approve a few large-scale residential projects, such as Bashundhara, Jolshiri, Police Offices Housing, and two or three other housing projects for government officials, including the Boat Club on the banks of the river Turag. In addition to calling it ‘a misleading act of the policymakers, urban experts questioned how the review committee could permit the conversion of water bodies and flood flow zones to urban residential zones. In addition, although RAJUK is the primary agency for Dhaka's planning and development, there are currently roughly 22 ministries and 51 agencies participating. It goes without saying that the problems are made worse by giving the DNCC & DSCC, Narayanganj and Gazipur City Corporations, more planning authority. There are simply no authorities that have the administrative capacity to handle the city's growing population and area. In this sense, it appeared that attempts to reform DNCC & DSCC as well as RAJUK were now ineffective. For instance, RAJUK's one-window strategy for granting building permits for construction failed. Numerous factors contributed to its failure, including the deeply rooted plurality in municipal planning and administration. Without doing thorough research, the Dhaka City Corporation (DCC) abruptly split into the DSCC and DNCC, causing anarchy in urban management and administration.

6. Dhaka Structure Plan, 2016-2035 (DSP, 2016-2035) and Its Challenges

6.1 The DSP: inadequate response to intrusion

This strategy acknowledges that encroachment by both public and private entities poses the biggest threat to the stock of public open space. Dhaka Uddyan, which was a part of the main

flood zone (Low-lying areas around lakes, ponds, and other significant bodies of water are referred to as flood zone), is now under the central urban area (CUA) of the current structure plan. The question stands herein as to how long the plans will allow for these kinds of unapproved developments, given how pitifully the supervising authority is failing to stop them in the first place. These unauthorised developments through occupying open spaces are creating heat islands in Dhaka city and must be destroyed at any cost to set an example so that no more such developments would take place in the future. In this regard, the High Court Division's order in 2011 for the removal of the BGMEA headquarters on the Hatijheel will work as an example (The Daily Star, 2016). However, these areas, if kept open, would work as open spaces with vegetation and prevent the trapping of radiation in the "urban canyon", which blocks natural wind flow that brings cooling effects for the heat generated from human activities.

6.2 The DSP: chaotic urban structures due to lack of decentralisation and growth management programs

It is found from the Dhaka Structure Plan (2016-2035) that modern Dhaka is also the outcome of spontaneous rapid growth without having any prior or systematic planning. Since independence, the urban population of Dhaka has grown at an estimated rate of 4% annually, whereas the national population has grown at a rate of 2.2% annually (Hossain, 2022). The primary drivers of this migration to metropolitan regions are pull factors like employment and educational facilities (Amazon, 2011). This migration is creating overpopulation in Dhaka city and necessitates the region to expand haphazardly to meet housing demands. Haphazard construction of urban infrastructures without keeping spaces between the two buildings, for vegetation and water bodies is turning Dhaka city into a heat island.

However, growth management plans typically limit the quantity of new construction permitted as well as the timing and phasing of new construction (Mandelker, 1997). They also regulate new development to avoid damage to environmental areas. Until it can implement a growth management program, a municipality may put a stop to new construction. The plan for 2016-2035 determines the course of future expansion, but it fails to address the phasing of new construction, the idea of quotas, or the imposing of moratoriums on new development. All of these need to be included in the present master plan to create a smart Dhaka and effectively manage the city's growth.

6.3 The DSP: lack of performance by authorities

Detailed Area Plan (DAP), the lowest tier in the three-level planning exercises of the Dhaka Structure Plan of 2016-2035, is a local-level plan that provides the proposed land use zoning, infrastructure, and utility services. RAJUK itself had grossly violated the Dhaka Metropolitan Development Plan (DMDP), 1995 and the present DAP. RAJUK is a planning organisation by mandate, but it has evolved into a development organization (The Business Standard, 2020). In the case of private developments, the real estate developments don't take place overnight; when RAJUK reacts, it is too late. Publicly, RAJUK condemns the operations of the land developers, but it is said that many RAJUK officials have land development companies or act as consultants

for the land developers (Detailed Area Plan (DAP): Why It Does Not Work? 2013). There is an internal support and financial linkage between the land developers and RAJUK planners, which helps the land developers to bypass the regulations, e.g., standard layout design (Mowla, 2016 and Detailed Area Plan (DAP): Why It Does Not Work? 2013). RAJUK officials must be under severe punishment if they are involved in any financial transaction contrary to the interests of its mandate.

Because there is a demand for land, it is profitable to develop and construct on it, and this threatens the existence of environmentally sensitive areas. In this regard, RAJUK must be given the independent power to enforce the plan. Moreover, strong control mechanisms or police power of the institutions has to be given to relevant authorities to prevent encroachment of water bodies and open spaces. Only then the reckless construction of urban infrastructure leading the city to heat islands through their contribution would be stopped.

Besides, under the Building Construction Regulation, 2008, there is an Urban Development Committee, of which the Real Estate and Housing Association of Bangladesh (REHAB) is a member. This is a conflict of interest or against fair judgement. The REHAB maintains a strong linkage with the political parties and their subsidiary organisations (Detailed Area Plan (DAP): Why It Does Not Work? 2013). It plays a key role in influencing the political commitment to implement any public policy. The government must address this issue of conflict of interest, amend laws, and perform accordingly.

Indeed, the plan is not beyond criticism, since it fails to take note of the drawbacks of the earlier plans and development schemes, whatever we say. It has entirely discarded the DMDP of 1995. Besides, it is unsuccessful in coordinating local and municipal authorities or city corporations. Furthermore, the advancement scheme of 2016-2035 has been made in such a way that real estate businesses could be promoted at any cost. This plan ceases to address environmental concerns and to be implemented like other plans, though it provides a lot of hopes and aspirations to the city dwellers.

7. DSP and Mitigation Strategies

7.1 Rapid urban expansion and lack of dispersion

The DMDP for the span of 1995-2015 was drawn up for thousand, five hundred and twenty-eight square kilometre area for the projected one crore fifty-five lakh and seventy thousand residents by the year 2015 (Islam, 2009). Keeping the area intact, the Dhaka Metropolitan Region's 1,432 square kilometre area is to be developed for twenty years with the help of the DSP, 2016–2035. It is suggested in the DSP that RAJUK would take control over an additional ninety-six square kilometres, as well as an expanded portion of Gazipur City Corporation and the remaining portion of Dhamsona Union of Savar Upazila. The population was projected in the DMR area at around two crore and sixty lakhs by 2035. This plan reveals that emphasis has been placed on city expansion and population concentration in Dhaka city without taking into consideration environmental concerns.

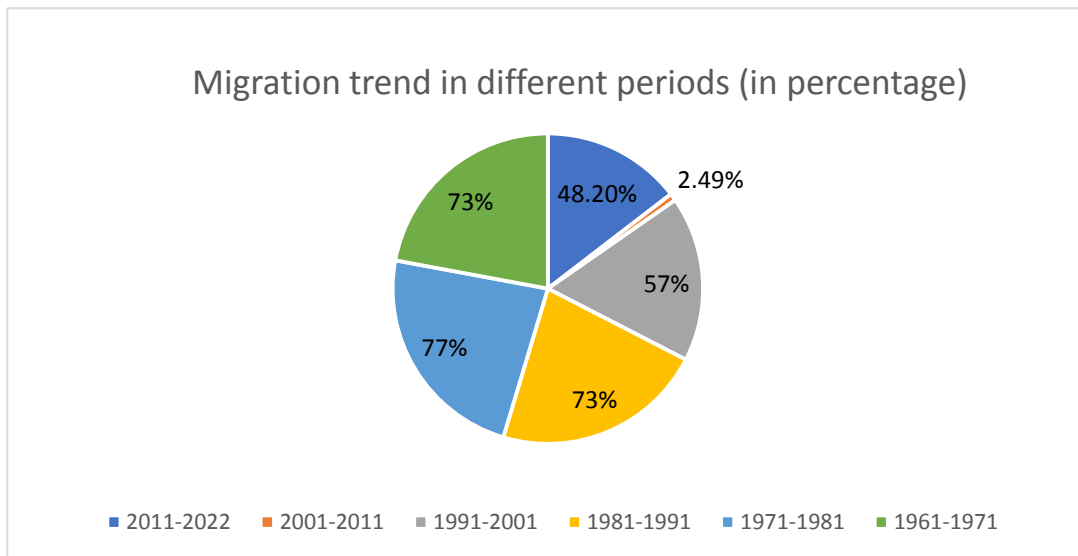
Table 2: Expansion of Dhaka city and population concentration shown in three master plans

Name of the master plan	Area of Dhaka city	Population of Dhaka city
The Dacca Master Plan of 1959	751.097 square kilometres	8,16,000
The DMDP of 1995-2015	1,528 quarekilometres	1,55,70,000
The DSP of 2016-2035	1432+suggested for an additional 96 square kilometres	2,60,00000

Source: DSP, 2016-2035

According to the Global Liveability Index 2023 report, Dhaka has been ranked 166th among 173 livable cities globally (The Dhaka Tribune, 2024). This position has remained unchanged since 2022. In fact, migration accounted for the population growth of Dhaka city. Pull factors, such as employment and education opportunities, are the main reasons for the shift to urban areas. Further, things have taken a very serious turn lately due to climate disruption.

Chart: 2 Migration trend of Dhaka city in different periods



Source: DSP, 2016-2035

Decentralisation is an urgent need for Dhaka city to stop gathering huge people herein, since the increased population needs increased housing. This decentralisation will prevent the haphazard construction of new infrastructure without leaving spaces between buildings; for vegetation and water bodies. It will also reduce the encroachment on open spaces, water retention areas, and flood zones, and help decrease migration. In turn, it will prevent Dhaka city from turning into a heat island. In this regard, only the offices and other institutions, whose existence is a must for the functioning of the country, are required to be kept in Dhaka, and all others, including industries, have to be shifted to divisional and district towns so that fewer people feel the need to move to the capital. Since no master plan will be fruitful without the dispersal of different bodies, institutions,

commercial factories, industries, etc., this initiative has to be taken first to prevent Dhaka city from turning into a heat island. The ongoing DAP (2022-2035), which has been framed for making Dhaka city livable, has to emphasise this decentralisation through bringing revision.

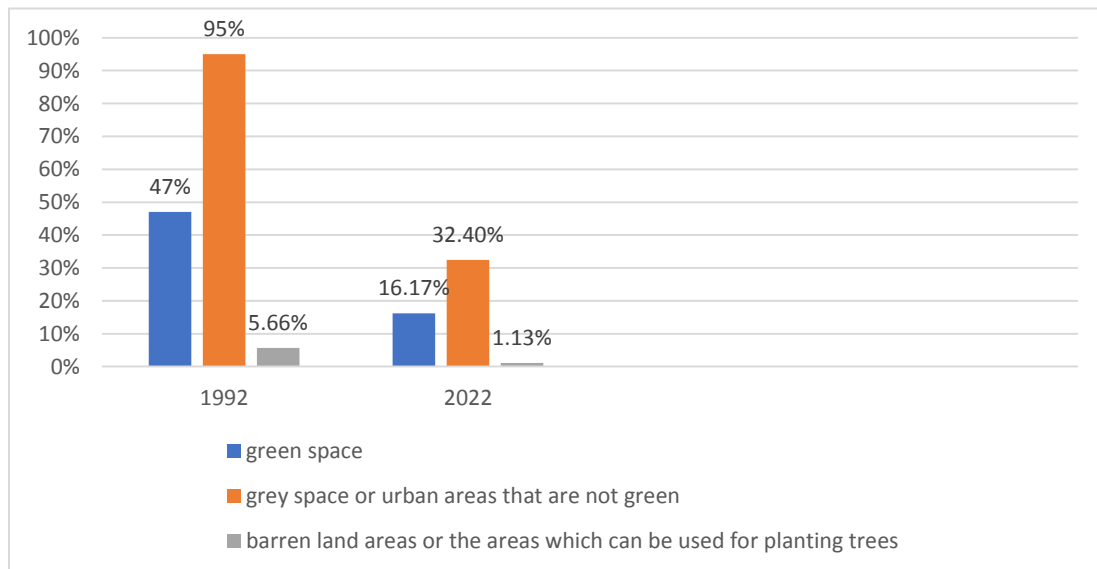
7.2 Negligence to protect open places

Vegetation is the most versatile tool for managing microclimates (Nowak,2002). It has to be promoted to protect Dhaka city dwellers from the unendurable impact of the heat island effect as an adaptation strategy. Green living and cool roofs are required to be used to reduce indoor temperatures in residences lacking air conditioners. Guidelines have to be inserted in the development plan for the vegetation and the installation of green roofs on buildings, since all the master plans framed to date have not focused on this issue. Green roofs can absorb heat and act as insulation for the building to combat the heat island effect.

Additionally, evapotranspiration is used to lower the surrounding air temperature. Since vegetation restoration is a key mitigation strategy, the placement and type of vegetation need to be carefully considered to ensure the maximum cooling potential during heat waves. This approach, which combines environmental issues with the diversified uses of buildings, is at the heart of sustainable planning and design and needs to be incorporated and applied soon.

One of the challenges facing Dhaka city's development plans is managing commercial activities without harming open areas. It is found that if DAP 2004-2010 were executed, there would be only 0.328 acres of land per 1000 people, which is far below any other densely populated cities in the world. This DAP has proposed to acquire 1590.6 acres of open spaces, which are to be kept open for future use, from public organisations and some from private landowners.

Chart 3: Scenario of land surface of Dhaka city in 1992 and 2022



Source: DSP, 2016-2035

Furthermore, maps of Dhaka rarely show how many actual open spaces there are. There are only 1142.42 acres of open space in the Dhaka Metropolitan Region (DMR) that fall under the recreational category, compared to 6962.54 acres of open space across all categories, including vacant and underutilised land, in the DAP's current land use. Inconsistent definitions and classifications of open spaces have led to these oddities. Open spaces are being lost over time as a result of various interest organisations abusing these flaws in the planning process. Consequently, it is necessary to classify open spaces and identify the appropriate implementing authority for each class. Besides, it is discovered that after completing certain processes, a place will become open. To be dealt with under this category in Bangladesh, open space must first be designated as "open space" under section 2 of the Parks, Wetlands and Open Spaces Conservation Act 2002 by an authority and approved by a gazette notification. The definition is operational rather than self-explanatory. Many places in Dhaka city have still not been duly defined, though they are fulfilling the criterion of open spaces. However, because of this, undefined open areas are constantly in danger of being taken over, and the entire stock is kept secret. Demarcating the current supply of open space on a map is, therefore, crucial for protection and other required actions.

The greatest threat to the stock of public open space and aquatic bodies is recognised to be encroachment by both public and private enterprises. To stop the invasion of open spaces and water bodies, relevant authorities must be granted strong control mechanisms or police power over the institutions. Only then they would be able to avoid appropriating open areas and contributing to the careless building of urban infrastructure that causes heat islands in the metropolis.

There must be some alternatives looked for to increase the number of open places. Considering their visual attractiveness and actual lack of open space, river banks and lakeside areas must be incorporated to be transformed into recreational places. Merely having them there is insufficient; sufficient measures must be implemented to make lakeshores and riverbanks appealing to urban residents. The local plantations there would surely be the most obvious to relax. Thus, this would also function as a heat island effect mitigation approach.

Again, some large-scale open spaces, like, the Old Airport and Central Jail areas are occupied by respective ministries. Opportunities for much-needed open space with vegetation and other auxiliary public services, such as parks, playgrounds, and leisure spaces with greenery, must be made available in these locations.

7.3 Paying no attention to the disappearance of water bodies

One of the challenges of planning aspects in Bangladesh nowadays is the extensive loss of water bodies. Besides, the present Dhaka structure plan (DSP) addresses that Dhaka City is surrounded by rivers and khals, which are mostly unutilised, since the water system's significance as a commercial nerve line rapidly diminished from the period of the expansion of the railway. As the focus shifts away from Buriganga and the other four rivers surrounding Dhaka city, so do the internal smaller streams and canals that serve as tributaries of the Buriganga and other surrounding rivers. The lack of public support and government upkeep for the Dhaka water bodies significantly impacted Dhaka's future urban planning. The importance of all sorts of water bodies

has to be reverted and brought into our daily lives; only then will their conservation be possible. The navigability of the encircling waterways will enlighten the old heritage of Dhaka and enhance the riverine recreational facilities in a great way. Besides roads, bulk goods can be transported to different consumption areas through waterways. Consequently, the transportation costs of different goods and road traffic will be reduced. Therefore, steps have to be taken to preserve rivers and the greenery that surrounds them to create open spaces that serve as ways to lessen the effects of the heat islands. Water parks, public amenities, and horticultural development must be located along canals. All these proposals have to be incorporated under the three heads, namely, whole reclamation at any cost, dredging-assisted partial upkeep, and full upkeep, in the master plan to mitigate the effects of heat islands.

7.4 Urban planning and its implementation: discord, omission of duties, and conflict of interest

The DSP outlines six purposes of land use planning, and the fifth one concerns environmental issues. It is mentioned in the plan that climate change is affecting Dhaka in two ways. One of them is heat island problems. The causes of the heat island effect are not identified in the plan. Chapter 9 of the plan, titled, 'Protecting Natural and Healthy Environments', incorporates objectives and implementation tools for environmental sustainability. It envisions harmonising between economic development and environmental sustainability, but how could it achieve the goal through preserving natural areas, like, rivers, khal, forests, parks, etc., establishing more parks and green linkages, protecting designated flood plains, conserving areas that are richest in biodiversity, and research that is not mapped out.

Again, preserving the city's natural environment and managing development must be given high priority and acted accordingly to lessen the impact of heat islands. Nowhere in any of the plans is it mentioned that the concept of sustainability has to be applied to cities. A system is sustainable from an environmental perspective if it can be sustained over an extended period without, for example, depleting the resources it depends upon (Mills, 2010). It reveals that the natural resources and ecological systems we depend upon are deteriorating rapidly, and this gives rise to higher temperatures in Dhaka city than in the countryside. The right address of these issues, which may mitigate the heat island effect, and the effective implementation can help fight the heat island effect in Dhaka city.

Besides, growth management initiatives, as for example, the idea of quotas, the phasing of new buildings, or the imposition of moratoriums on new development, need to be included in the DSP of 2016–2035 through revision to create a smart Dhaka free from the hotter temperature than the surroundings and effectively manage the city's growth. A municipality has to be delegated the authority to halt new buildings until a growth management scheme is framed.

It needs to be here that to make a sound master plan, city planners must work with professionals in many other disciplines since the planners must analyse the social, political, and environmental impact before assembling complex data to make predictions. Furthermore, as much as there is a need for planning and design practitioners to be knowledgeable of climate, there is an onus on climatologists to be aware of the context within which planning and design practice occurs (Mills,

2006). Further, the development plan is based on local government and local politics. This has two implications. First, decision-makers are typically laypeople. The authorities adopting the plans with which land use practitioners work are local government officials, and sometimes they are elected from a pool of just a few hundred registered voters (Hawkins, 2021). Second, because the plan is political, the decision-makers, whether they admit it or not, pay attention to the identity of applicants and parties opposed to applicants. Candidates and elected officials in local government frequently have intimate personal ties. In this regard, urban planners need to be experts in the field of city planning on the one hand, considering the liveability of the city a high priority, and on the other hand, to be free from bias while working.

Nevertheless, the Plan of 2016–2035 failed to bring city corporations or local and municipal authorities together. It completely disregarded the 1995 DMDP. The scheme has been made in such a way that real estate businesses could be promoted at any cost. As noted earlier, the land developers and RAJUK planners have a financial and internal connection that enables the land developers to get beyond the rules (Detailed Area Plan (DAP): Why It Does Not Work? 2013). Besides, REHAB has a significant impact on the political will to carry out any public policy. The government needs to resolve these conflicts of interest, change the legislation, and act appropriately. In addition, everyone who breaks the law deserves exemplary punishment, regardless of their status, level of authority, or political affiliation. The impacts of heat islands cannot be prevented in the city without strict restrictions being enforced, since the DMDP 95 and DAP have been flagrantly broken by RAJUK, the municipal guardian.

Execution must be made to ensure a balance between protecting the environment, the interests of the Dhaka city dwellers, and economic development. It is further recommended that the city corporations prepare a ward-based action area plan in light of the proposals noted above. Above all, the revised DSP (2016-2035) based on the above-noted suggestions, if implemented, would make Dhaka city livable and mitigate the effects of heat islands.

8. Conclusions

The physical structure of Dhaka city reveals that all the development plans have not been partly implemented and remain only in written form. New development plans are framed after a certain period on a routine basis, irrespective of the implementation of the plan. In fact, a master plan is not a binding legal document and is not passed by the legislative body of a country but by the Planning Commission. Therefore, a development plan has to be passed by the Parliament of the country to make it effective and to control the uses of land, the kinds of land uses permitted in each area, construction structures, size and width of structures, open spaces, footpaths, roads, etc. In addition, the guardian of the city, known as RAJUK, has to be equipped with the power of its implementation and of imposing fines, criminal charges, injunctions, etc. for its violations.

To prevent the transformation of existing urban fabrics towards a more liveable and sustainable future (Sharifi, 2015), mapping a good master plan is essential. Besides, the uses of land must be controlled in the country by the concerned authorities, and in this regard, clauses mentioning permitted uses of land and environmental protection measures promoting vegetation have to be

inserted in the land title deeds. Above all, implementation is a must for any advancement plan to fight the heat island effect. It is a matter of regret that our nation's leaders have altered or are obligated to alter the approved master plan as well as the plans for other projects. President Ayub Khan of Pakistan approved the first master plan for Dhaka in 1959–60, and he was the first to alter it (The Daily Sun, 31 May 2025). Due to the involvement of several West Pakistani businessmen who lived in those areas, Ayub Khan established the BaitulMukarram Mosque on the northward expansion of the North-South Road. Additionally, he deviated from the Master Plan's recommendations by establishing the parliament complex in the Firm Area of Tejgaon rather than at the Keraniganj (Jinjira) location across the Buriganga River.

Such departures from the plan to reality have become increasingly common since then, both in Pakistan and even in independent Bangladesh (The Daily Sun, 31 May 2025). The master plan's provisions have also been disregarded in the planning of numerous housing and infrastructure developments, and khals, canals, and other open areas have been filled in, demolished, or transformed for other purposes (The Daily Sun, 31 May 2025). However, there were certain "poor" ideas or "shortsightedness" in Dhaka's urban design, such as keeping cantonments or other such settlements in the inner city, which is now a "throat-shore" in the city's growth and improvements.

Also, the government of the country must not permit any infrastructure putting the safety of the people in danger. In addition, development plans categorising uses of land have to be framed in consonance with the concept of environmental sustainability. The state development plan must state how local governments will while executing the state development plan, fight the hotter temperature than the outlying areas, and there must be a mitigation strategy related to coordination between the local government and state government. The local government needs to be financially facilitated to carry out this objective of the state development plans. Moreover, changes must bring in the institutional and environmental governance framework and the greater involvement of concerned stakeholders in decision-making. The master plan of the country must address all these aspects.

However, the community needs to be involved as well to reduce the heat island effect. Raising awareness about the heat island effect and encouraging the community to plant trees, maintain green spaces, and energy-efficient practices are also alternatives to fight the trapping of heat in cities. Besides, green roofs reduce urban heat island effects among several ecosystem services it provides in urban areas (Oberndorfe, 2007), since this effect can be reduced by increasing albedo or by increasing vegetation cover with sufficient soil moisture for evapotranspiration. It is found that a regional simulation model using 50% green-roof coverage can reduce temperature by as much as 2°C in some areas. Green roofing must be compulsorily done by the building owners, and RAJUK has to supervise this. Adequate provisions have to be introduced accordingly in the development plan, besides the concepts of green networks, green belts along water bodies, and urban and peri-urban forestry and greening.

Therefore, increasing the urban greenery and decreasing hard-landscaped urban features, like streetscapes and vast hard-covered open spaces, can cool down existing precincts. A fine

distribution of urban greenery has to be ensured to mitigate the UHI at the precinct scale. As we observe World Environment Day, we must unite to set a standard for urban development so that we can combat the rising temperatures to build a greener environment for generations to come.

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