Samarawickrama, Sumanthri, et al (eds), 2019, "Re-evaluating Space across disciplines": *Proceedings of the 12th International Conference of Faculty of Architecture Research Unit (FARU), University of Moratuwa, Sri Lanka, December 03, 2019 Colombo* pp. 420–428. ©

THE GRAND CANAL
Envisioning Water Urbanism as the Basis of Metropolitan Resilience of Dhaka City

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Abstract
Dhaka, which has grown into one of the world's largest megacities, shows a very rapid rate of expansion in population, economy, and infrastructure. While River Buriganga in the south, River Turag in the west, Tongi Khal in the north and River Balu in the east define the boundaries of today's populous metropolis, history indicates that over 50 canals once flew through the city, helping its drainage of storm water and providing inland waterways. Dhaka has lost most of its myriad waterbodies, low-lying areas and the continuity of its canals, due to either poorly planned or unplanned land use development. As a result, dwellers have become increasingly prone to acute waterlogging, also leaving the city vulnerable to groundwater depletion, earthquake, and severe traffic congestion. Among disasters, Climate Change and Urban Heat Island effect have also come into play. The paper discusses the idea of "Water Urbanism" integral to the core development policies of the city; and water as the major driver of urban design, cityscape and urban ecology creating a firm platform for the city's overall resilience. The primary task to initiate this idea is to identify lost canals and connect waterbodies – gifting Dhaka much needed green corridors, groundwater recharge, natural storm water flow and better protection from disasters. This task can be accomplished with proper masterplan and surgical interventions with minimum demolition. The overall methodology of this research can be termed as a Case Study, comprising data collection from literature and field survey, GIS map survey, interviews– based on inductive reasoning method. This multidisciplinary study culminates in the proposal of "The Grand Canal" – a blue network across the city that will ease the city's environmental problems and provide useful transit corridors.

Keywords: *Water Urbanism, Urban Resilience, Blue Network, Urban Ecology, Urban Design.*

1. Introduction

Dhaka, the capital of Bangladesh, is one of the world's largest megacities with a population of 20,283,552 in its core area of 306.5 square kilometres and a density staggering of 23,234 people per square kilometre (World Population Review, 2019). It is located in central Bangladesh, on the eastern banks of the Buriganga River. The city lies on the lower reaches of the Ganges Delta where tropical vegetation and moist soils characterize the land, which is flat and close to sea level (Hough, 1995). The city has a distinct monsoonal season, with an average of 105 days of rain (Weatherbase, 2019). This 400-year-old city used to take advantage of its topography to handle this huge amount of rainwater, maintaining a balance between the life of inhabitants and the natural watercourses. Once characterized by numerous freshwater natural *khals* (canals) and wetlands, Dhaka has, over the decades, turned into a city of waterlogging and drainage congestion. The inland drainage conveyance *khals* have, in effect, become wastewater drains discharging into the peripheral rivers resulting in gross pollution of these rivers (PSCMEF, 2010).

The unplanned natural and man-made landscapes of Dhaka have always prioritized the grey structural elements which gradually created major urban problems like severe traffic congestion, groundwater depletion, effects of climate change and earthquake-vulnerability. As rapid urbanization requires more infrastructure for housing, business, and transport networks, the demands for such development are generally being met through the development of natural land areas (e.g., water bodies, cultivated lands, open spaces, etc.), which ultimately results in a considerable reduction in the open and green areas of this region (Kong, 2006; Swanwick C, 2003). Growing evidence suggests that this consistent loss of natural habitat is not only making the city vulnerable to natural hazards such as flooding (Ashraf M. Dewan, 2008) but that it is also reducing the quality of life (Amin SMN, 2008). In particular, the gradual extinction of waterbodies and other open spaces is reducing biodiversity and turning Dhaka susceptible and inflexible.

The paper holds the perspective of 'Water Urbanism' as one unified idea to improve the overall ecology and environment of the city. Integrated to the core development policies of the city, water urbanism for Dhaka envisions a 'Water Network' termed as 'The Grand Canal' as the major driver of urban design, cityscape and urban ecology creating a firm platform for the city's overall resilience. This paper takes the case of Dhaka and delineates a design proposal that takes relevant problems into account and mitigates them through macro and micro interventions to form a continuous blue corridor. For Dhaka, a way to achieve resiliency could be through reviving and connecting the lost inland canals (*khals*) as well as the waterbodies and fusing water-based urban activities with it for sustainable development and wellbeing of the inhabitants. Natural arteries will strengthen the city's capability to prepare, respond and recover from significant multi-hazard threats with minimum damage to public safety and health, economy and security in the megacity. With few studies addressing the critical evaluation of Dhaka's water systems and their possibilities, this paper addresses a crucial research gap while focusing on:

- Finding traces of existing and lost waterbodies of Dhaka
- Investigating the possibility of a plausibly connected water stream through Dhaka city promising major impact despite minimum disruption to existing infrastructures
- Proposing *The Grand Canal* designed to influence policy-making and strategic planning, while gifting the city a new route of navigation, decreased temperature, a means to combat climate change, sufficient groundwater recharge facility to reduce earthquake hazard risk and green corridors to revive the lost ecological affluence in Dhaka.

2. Methodology

This paper is a case study of a design solution, which addresses the current geopolitical landscape of Dhaka City and comes up with a solution called *The Grand Canal* – a water network as the basis of the overall resiliency of Dhaka. This paper justifies the design solution from the facts and information collected from a range of materials and background studies by the inductive reasoning method. This accumulates information essential for design-decisions in a number of parts as follows:

Table 1: Step-by-step Work Procedure

Steps	Method	Materials	Target
Step 1	History & Background study	a. Geological and topographical maps study	To identify the three-dimensional quality of the surface, specific landforms and its transformation through the ages
		b. GIS map study	To identify and characterize the existing structures, open spaces, and waterbodies
		c. Historical Map study	To identify the growth pattern, transformation, and lost waterbodies
Step 2	Investigation / Survey / Evaluation	a. On-site Survey of existing waterbodies & structures	To evaluate the existing waterbody's location, nature, physical conditions and connection with the adjacent structures or people
		b. Identify Problems	To identify the level of encroachment, its effect and reasons behind
		c. On-site Survey of Lost waterbodies	To evaluate the lost waterbody's location, year of extinction, conversion type and way to revive it
Step 3	Policies & Action plans	a. Study previous Detailed Area Plans [DAP]	To understand, predict and rationalize the failures of the strategic development plans for Dhaka Metropolitan Area
		b. Study Draft	To understand future development

		Structural plan [2015-2035]	plans (housing & other infrastructures) for Dhaka Metropolitan Area and identify proposals for waterbodies, canals and open spaces
		c. Study Policies and strategies	To understand the policies applied in Dhaka specifically for water-related issues
		d. Study Flood Action Plans [FAP]	FAP2 & FAP8 still work as the major catalyst to convert the canals into roads and build dams to protect Dhaka from river flooding. Understanding the details of the plan was a prerequisite
Step 4	Delineation of the proposal	a. Masterplan Preparation	To identify and propose a feasible masterplan and connection cumulating the outputs from the physical surveys, literature reviews and future legislative proposals
		b. Surgical study & intervention	To ensure minimum disruption to the existing habitat, micro level surveys were conducted to identify and propose a feasible blue corridor.
Step 5	Feasibility Study	a. Minimum demolition	The proposal was checked 3 times through physical surveys to ensure minimum demolition of existing buildings

2.1. HISTORY & BACKGROUND STUDY

Since establishment, Dhaka has grown inorganically. The patterns of aerial expansion and the urban form of Dhaka have been largely dominated by the physical configuration of the landscape in and around the city, particularly the river system and the height of land in relation to flood level (Islam, 1996). There are two dominant general patterns in the historical evolution of Dhaka (Nilufar, 2010): old Dhaka or the historic core and new Dhaka or northern expansion. Dhaka is surrounded by *Buriganga* in the south, *Turag* in the west, *Tongi khal* in the north and *Balu* in the east. *Khals* of Dhaka used to be connecting channels of rivers surrounded by the greater Dhaka district (Shahjahan, 2013) and wetlands. Over 50 affluent canals once used to flow through the capital. Most of these water channels have been fully or partially choked while the rest are under serious threat. Historical references indicate that Dhaka was crisscrossed by 3 main rivers (Mamun, 1993). *Rajdhani Unnayan Katripakkha* (RAJUK) has a list of 20 lost canals that once flowed through. Almost half of the canals are gone and the remaining 26 are struggling for their survival too (The Daily Star, 2016), as they have lost their flow, blocked by either roads or unauthorized structures.

The phases and consequent changes over the years (Afghan Period, *Mughal* Period, British Period, Pakistan Period, Bangladesh Period) have shaped Dhaka to its present structure. Dhaka's growth filled many low lands on the eastern and western sides, owing to a scarcity of land and consequent rise in its price. It is alarming to find that the yearly rate of loss of wetland during 1999-2003 periods was 5.67 percent whereas during 1989-1999 period; yearly rate of loss was 1.23 percent. (Islam, 2006). Several reports mentioned that the well-connected *Panthapath canal* in central Dhaka was covered by building a box culvert during 1988 by JICA. It used to connect *Dhanmondi Lake* in the west with *Hatirjheel* in the east of the city-centre (Figure 1). Landfills destroyed the whole eastern portion of the *Begunbari Khal* connecting *Hatirjheel* to *Dhanmondi* lake system (Mamun, 1993).

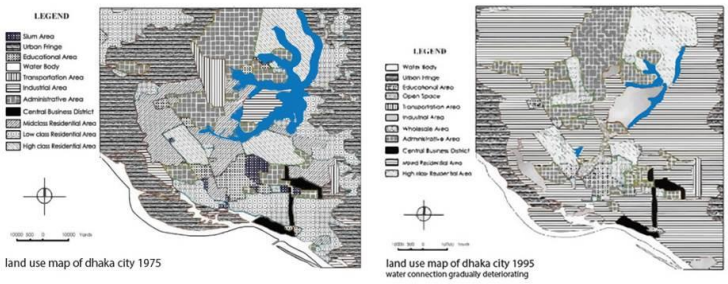
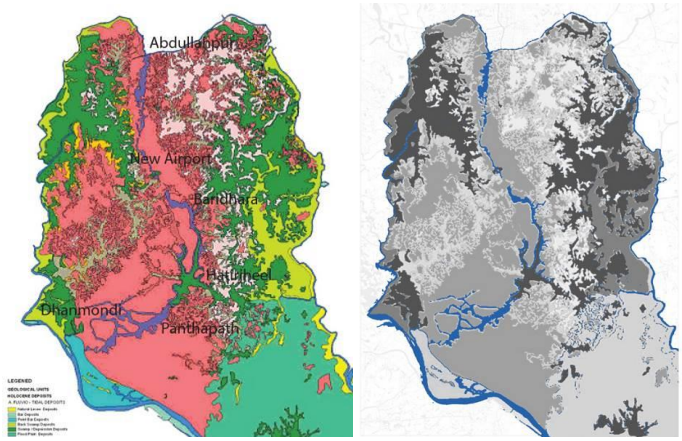


Figure 1, Existence of Panthapath canal and development (*Source: DCC*)



Figures 2 & 3, Geological Map 1953-1954 and Evidence of N-S water connection *(Source: 2. Geological Survey of Bangladesh; 3. Author)*

2.2. SURVEY & EVALUATION

Dwellers of Dhaka City face a plethora of urban problems identified through literature and field surveys. Some major problems are analysed as follows:

2.2.1 Waterlogging

Dhaka faces two types of flood: internal flood due to rainfall and external flood due to the rise of river water level. Dhaka faced major floods in 1954, 1955, 1970, 1974, 1980, 1987, 1988, 1998 and 2004. Flood plains and wetlands at the fringe areas used to swamp during heavy rainfall which helped to store and later drain out the excess water to the surrounding rivers through the topographical character of Dhaka. But insensitive policies, Flood Action Plans (FAP) and rapid urbanization together destroyed the natural course causing floods followed by severe waterlog for 4-5 days. 85% of the city (depth .3 to 4.5 m) was inundated during 1988 (JICA, 1991 and 1992). After the completion of FAP in 1998, almost 56% and in 2004 50% of the city was inundated (Alam, 2003). Land development through landfilling processes in the low-lying areas is causing a drastic reduction in water storage. Construction of embankments through low-lying areas without providing adequate drainage facilities has caused internal flooding adversely affecting the residents in those areas (Alam, 2003).

2.2.2. Groundwater Depletion and Earthquake Vulnerability

Dhaka currently relies on groundwater to meet the need for safe water with approximately 80-90% of it coming from this source solely. Dhaka Water Supply Authority (DWASA) is extracting more than 1800 ML/d of groundwater. However, the estimated sustainable and safe extraction is approximately a conservative figure of 600 ML/d (DWASA, 2011). As a result, earthquakes could strike the city as the groundwater table is going down 2-3 meters gradually due to a massive withdrawal of the water (Dhaka Mirror, 2012). If the rate of the discharge continues the groundwater level will go below 80m in some major parts causing major ecological problems (IWM & BADC, 2009).

2.2.3. Traffic Congestion

In the last 10 years, the average traffic speed in the capital has dropped from 21 km/hr to 7 km/hr which is slightly above the average walking speed, according to a report published by the World Bank. The traffic congestion in Dhaka eats up 3.2 million working hours per day. Opinions from experts illustrate that traffic jams could be abridged significantly with some low-budget projects such as introducing water transport facilities or coherence between the strategic transportation plans. Although Mass Rapid Transit will improve the scenario, integrating alternate modes of transport with an easier and simpler construction process is also mandatory for an effective outcome.

2.2.4. Climate Change

The city is less than three meters above sea level and many of the city's slums and informal settlements are located in the areas assigned for flood drainage which are exposed to chronic waterlogging. Specialists predict that river flooding and monsoon rains will become more frequent and intense due to human-induced climate change, putting extra pressure on flood prevention and drainage infrastructure. It will also cause heavy storms and erratic temperatures. Dhaka has recently recorded its highest temperature of 42.3 degrees Celsius.

2.2.4. Physical Survey

Through studying historical maps, sewerage maps, GIS maps, and data, two distinct continuous connection of canals have been traced inside Dhaka. The shorter one stretching from west (*Buriganga* river) to east (*Balu* river) and the longer one from the south-west (*Buriganga* River) to north (*Turag* river). Both of these connections crisscrossed the city but have lost their course by the time. The longer connection can be predicted to create bigger impact in the city. Along the selected route, three physical surveys were carried out thoroughly both in dry (February and March) and wet (August) seasons in different parts of Dhaka. The city, along its north-south axis, was divided into 9 zones which were then surveyed for 12 days in total (Figure 4).

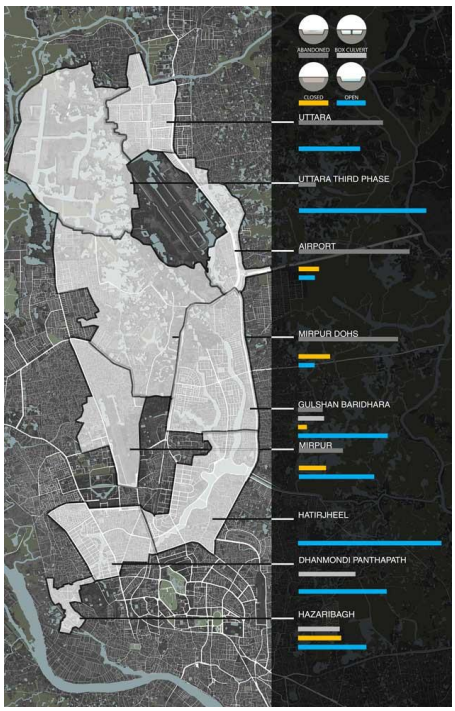


Figure 4, Survey results in 9 zones throughout Dhaka. *(Source: Author)*

The survey shows that a large portion of Dhaka's core area is restricted by Military bases and two airports. In the south-west portion, most of the canals have been converted to box culvert. In northern region the wetlands have been filled with sand to meet future housing needs. The large waterbodies in *Hatirjheel* and *Gulshan* lake at the centre works like the blue heart of the city. In the surveyed zones,

12% of the water channels have been closed with box culverts, with 32% abandoned due to negligence or encroachment and 56% still open having adequate flow of water (Figure 4). But, all the canals carry sewerage water for which the water quality is very poor and is unable to create impact around. In some cases, the channel is open but inaccessible due to inappropriate planning, mistreating the canals as back and neglecting the space throwing wastes due to lack of ownership and maintenance.

2.3. STUDY OF POLICIES

From the birth of Bangladesh in 1971, several strategies and policies to protect the canals and wetlands have been taken by the Government and its concerned authorities like Dhaka City Corporations, DWASA, Water Development Board, etc. In 1992, DMDP (Dhaka Metropolitan Development Plan) proposed control of land development within designated flood plain areas in order to avoid obstructions of water flow. Flood Retention areas were designated in order to ensure that they remain capable of fulfilling their primary function of water storage at times of flooding. But, similar strategic proposals at different times have always failed to retain the wetlands of the Dhaka Metropolitan Area due to corruption and poor administration.

Flood Action Plans [FAP 2 and FAP 8] in 1988 and 1992 proposed box culverts covering the canals in the city and dikes with pump stations beside the rivers to create roads and get rid of external flooding from rivers. Though it reduced external flooding to some extent but has incurred a potential threat for Dhaka. Little rainfall can often be the cause of the internal flood, because of which people of low-lying areas get stuck for several days damaging the lifestyle, economy, household and other infrastructures.

Structural Plan 2016-2035 shed some limelight to retain the waterbodies by providing some legit guidelines along with typical policies. But, the plan is still in a draft phase waiting to be approved for more than 5 years now. It proposed a blue-core at the centre of the city connecting Dhanmondi Lake, Hatirjheel, Gulshan-Baridhara Lake and a sub-blue-core in the north-west part of the city.

2.4. DELINEATION OF THE PROPOSAL

The whole city was surveyed several times to find the best possible route for the connection. Though 67% of the wetlands have already been converted to build entities but the current hydrological map extracted from GIS shed limelight to this research.

Three possible routes were identified starting from the south-west portion named *Hazaribagh* area to *Abdullahpur* area at north of Dhaka. Each of the routes was then surveyed again to identify the obstacles in the plausible route (Figure 5).

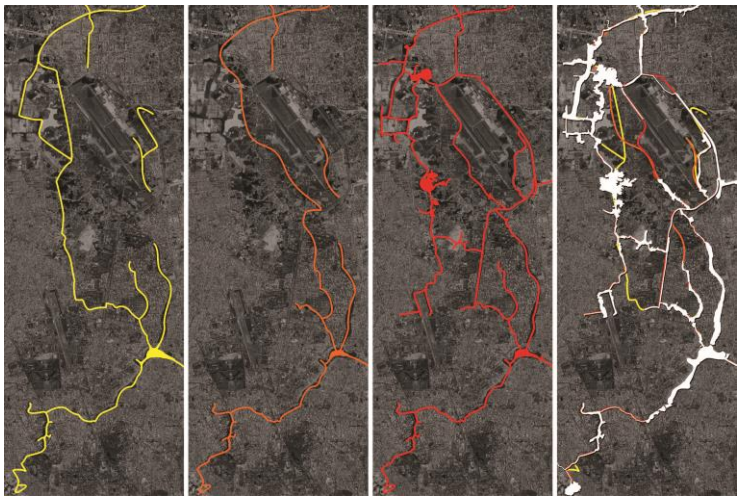


Figure 5, Possible water connections and superimposed scenario. *(Source: Author)*

Finally, from the superimposed routes a continuous connection is selected having the least interruption in the existing setting. Major demolition has to be done in Panthapath box culvert and government staff quarters at the *Chairmanbari* area. The final route is being termed as '*The Grand Canal*'. The Grand Canal is proposed to be approximately 35 km long. This is deemed as the most feasible option with minimum demolition and construction, having two branches and chunks of retention areas. The proposed canal starts from *Hazaribagh Bai* lane. The route is as follows:

Branch A: (Southwest) *Buriganga River* > *Hazaribagh Bai Lane* > *Hazaribagh Box Culvert* > *Tannery Area* > *Pilkhana Area* > *Dhanmondi Lake* > *Russel Square* > *Panthapath Box Culvert* > *Hatirjheel* > *Banani Lake* > *Karail* > *Chairman Bari* > *Airport Road* > *Nirjhar R/A* > *Matikata* > *Shaheen Lake* > *Uttara 3rd Phase* > *Abdullahpur* > *Turag* (North)

Branch B: (Southwest) *Buriganga River* > *Hazaribagh Box Culvert* > *Dhanmondi Lake* > *Panthapath Box Culvert* > *Hatirjheel*> *Gulshan Lake* > *Gudaraghat* > *Kalachandpur Road* > *Baridhara DOHS* > *Airport Road* > *Airport Area* > *Uttara Sector 1* > *Uttara Model Town* > *Abdullahpur* > *Turag* (North)

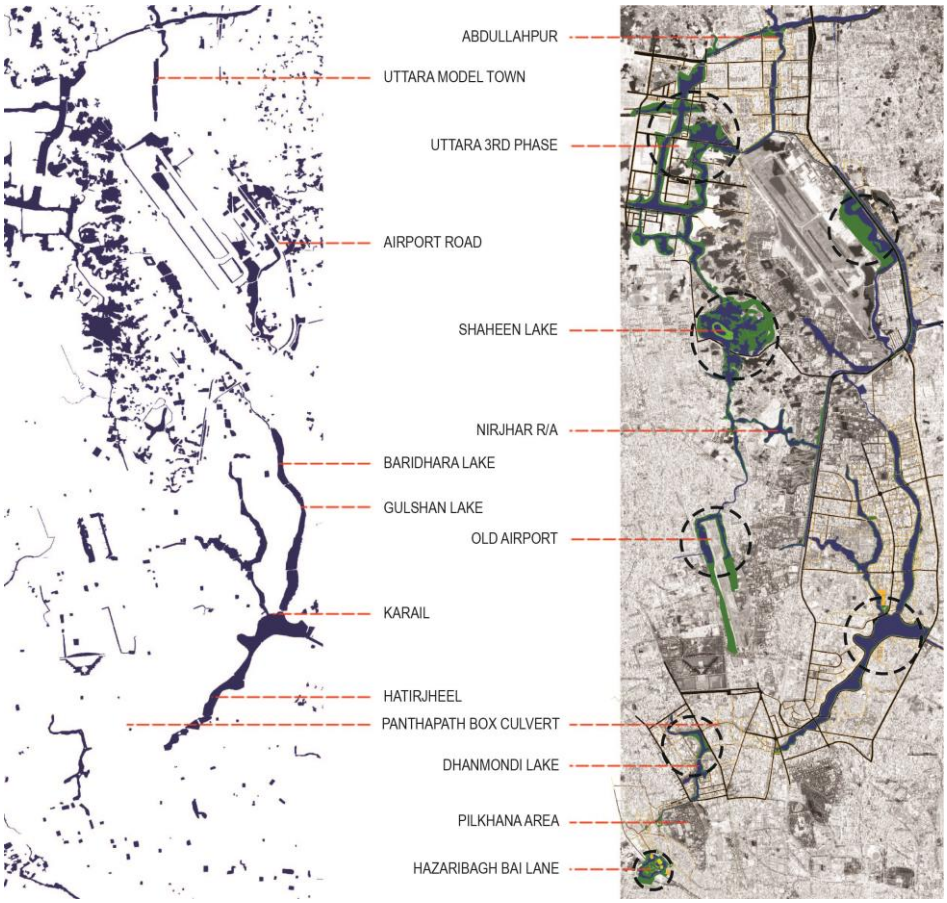


Figure 6, Existing and Proposed Water Profile (*Source: Author*)

4. Conclusion

Rigorous studies and meticulous surveys have set a strong backbone for the given proposal. *'The Grand Canal'* will function as an influential phenomenon for future growth and development policies of Dhaka. It will reduce traffic pressure on existing roads significantly, reduce temperature up to 4-5 degrees, minimize the impact of climate change, enhance quality of habitat for dwellers as well as for other species, reduce waterlogging, eliminate adverse effect of waterlog, recharge more groundwater, provide adequate recreational areas and facilitate the city with so many other benefits that we cannot even

imagine. This proposition could be implemented jointly by city authorities such as RAJUK, DWASA, DNCC, and DSCC, as per their best interests, and to the best interests of their citizens.

No matter what it costs – time, money or life – we are building layers of concrete flyovers through densely populated residential areas, elevated expressways filling up water bodies, MRT vanishing all the trees in the median of the city, BRT causing much congestion, new roads demolishing buildings and private lands, new residential and CBD areas filling all the wetlands, strong promenades, and dikes to protect so-called highlands. On the contrary, this research shows the path for a much easier, feasible and ecological solution. This masterplan is proposed only with the requirement of demolishing a few box culverts, some tannery industries in *Hazaribagh*, four government buildings at *Chairmanbari* area and a partial demolition in some congested areas like *Panthapath* and *Uttara Sector 1*. It is constructible with lower cost, time and hustle than the development plans we are currently executing. This study could be useful for city authorities, urban designers and researchers and could pave the way for further research on the urban ecology of Dhaka. We have been destroying our city for a long time now. It needs some time to get cured. Let's invite nature, the root to lead this process. Let's start to believe a liveable city like it was before. Let nature take place here. Let the channels flow.

5. Acknowledgements

Our heartfelt gratitude goes to Prof. Dr. Khandaker Shabbir Ahmed, Tasneem Tariq, Maherul Kader Prince and everyone at the Department of Architecture, BUET.

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