



A SUSTAINABLE APPROACH TO WATERFRONT PLANNING AGAINST ENVIRONMENTAL HAZARDS

A highlight of a case study with the aim to shelter regions that are susceptible to environmental threats such as floods & storms

Mihir Saraf

Junior Architect
Manipal Academy of Higher Education
Dubai, UAE

Helly Dobariya

Junior Architect
Arvindbhai Patel Institute of Environmental Design
India

Abstract

The gradual intensification in the effects of global warming has become concerning as it impacts lives on an alarming level. This is a wake-up call for Urban Planners and relevant authorities to take action on this challenge before it gets worse. This paper focuses on regions that are prone to environmental hazards like flooding subsequently leading to water clogging. We address these problems by drawing inspiration from other successful projects in the matter which amalgamates into the final output or solution. The research culminates into a comprehensive framework that is developed based on the contextual and diverse issues both at regional and global level. It discusses both urban and social impacts of waterfront planning, taking primarily Bangladesh as the case study. The research methodology follows both quantitative and qualitative methods and concludes the main impacts of waterfront development to assure its sustainability.

Keywords: Global warming, Environmental hazards, Waterfront planning

1. Introduction

Water is one of the most vital natural resources that is necessary to ensure human health and civilization. India is fortunate to be able to call itself a water rich nation which possesses a number of rivers with great potential for recreation. Population growth, economic growth, urbanization and increased technology have transformed many Indian River systems from water industries into non-water industries. Waterfront redevelopment in India has taken place over the last twenty years. Some waterfront development projects have successfully included waterfront attraction projects, but many others have not succeeded. Improving riverbank beautification through landscaping is one aspect but cumulative environmental problems such as water pollution and flooding were identified as a main effect derived from waterfront development in the particular case study areas.

The waterfront may be a unique and irreplaceable resource; also, its boundaries are difficult to work out because they contain mixed use development which is comparatively homogeneous. This paper is based on three approaches: theoretical, applied and analytical study. The theoretical study tends to cover the concept of waterfront development, identifying sustainable waterfront development by learning about sustainable development principles, the quality-of-life indicators and place making criteria. This is followed by an applied study of disaster-prone region - Bangladesh; its context and potentials by the application of the sustainable Waterfront development approaches. Then the paper concludes the important recommendations to improve this area in order to achieve sustainable waterfront development.

1.1 Need of the study

The need of the study is determined by the various factors:

- Deteriorating conditions of urban rivers/water bodies
- Narrow public space
- Eco-efficiency
- Degrading local economy

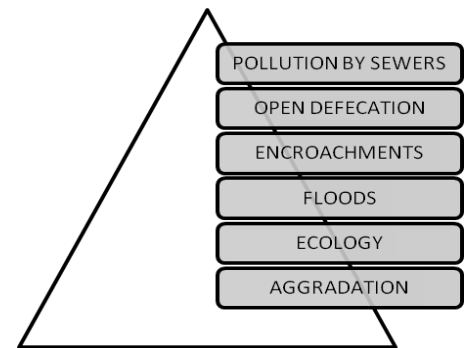


Figure 1: Factors affecting sustainable waterfront development

2. WATER FRONT DEVELOPMENT

An environmentally conscious approach for integration of the river/sea into the urban fabric development. There has been an appropriate consideration of the natural potential of the land for developing into a biodiversity zone for conserving the natural heritage of the river basin as well as the local and transient requirements of facilities at the city level, like large scale ecology trails of varying nature along with some recreational facilities.

2.1 Advantages of riverfront development

- Source of revenue for government –shops, restaurants, sport activities, Transportation, boating etc
- Development of tourism by offering a variety of attractions like water sports, entertainment arenas, parks, shopping areas, etc.
- Economic spin-off's – rise in the value of properties, acting as a catalyst for redevelopment and renewal of nearby places.
- Habitat protection and restoration -conservation of water in the river,
- Human/environmental connections, conservation and development of land,
- Conservation of flora and fauna
- Revitalizing the neighbourhood
- Creates a healthy and active urban environment.
- Flood control measures

3. Bangladesh: Ground Zero for Climate Change

One of the most vulnerable regions that is prone to flooding is – Bangladesh, due to the geography of the location. Located in South Asia, the region is densely populated with Dhaka (the capital city) having a population of 18 million alone. This deadly amalgamation of being a low-lying, coastal nation and densely populated is extremely risky to the welfare and lives of the inhabitants. The region is constantly inundated by disastrous floods but the 2020 floods by far were a game changer with nearly '1.3 million homes damaged, thousands isolated and hundreds of deaths'

The country is often referred to as 'ground zero for climate change' ranked sixth on the 2018 Global Climate Risk Index. Roughly 50,000 – 200,000 people are displaced each year due to riverbank erosion with thousands more fleeing whenever a major cyclone hits the coast. Besides complete destruction of infrastructure and livelihoods, high intensifying storms also lead to higher water/soil salinity leaving millions with little to drink or eat. By 2050, climate experts predict that approximately 17% of the nation's land will be submerged due to rising sea levels displacing about 20 million people.

Bangladesh is the epitome of bearing the brunt of climate change with flooding predicted to becoming more extreme due to cyclonic storms and rising sea levels. Flooding is predicted to get more intense and cover large areas affecting crops like rice and wheat declining by 27% and 61% as a result. Around 80% of the nation is flood plain with 'the majority of the country a meter or less above sea level'. The Prime Minister of Bangladesh called the rise in sea-levels as a "planetary emergency" which the nation has to bear the brunt.

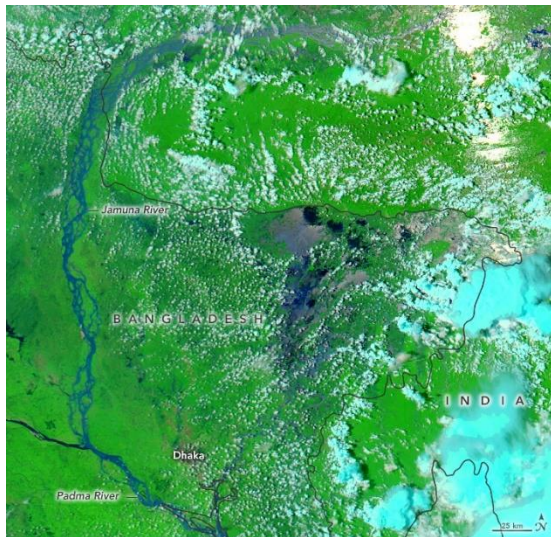


Figure 2: Intense flooding continues to wreak havoc in Bangladesh as of June 2020 (Source: UKinBangladesh)

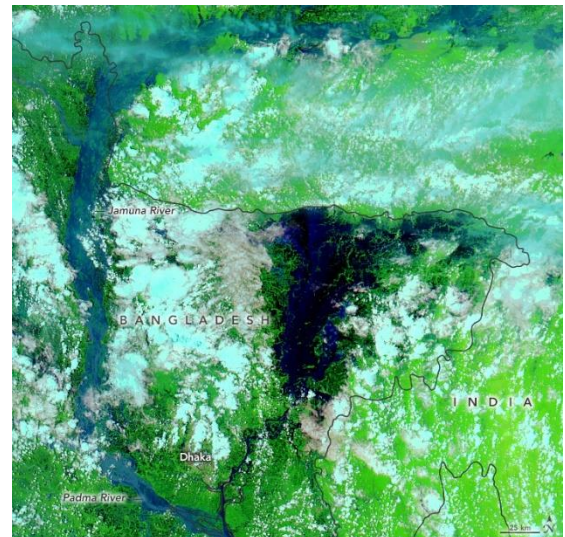


Figure 3: July 2020 (Source: earthobservatory.nasa.gov)

The above images show northeast Bangladesh as on June 2 and July 25 which are false-colored, are acquired on NASA's Aqua satellite, using a combination of infrared and visible light to make it easier to distinguish the boundaries between land and water. Water – navy blue/black; clouds – white/cyan; and vegetation – bright green.

The image on the right depicts the devastation caused by flooding during the monsoon season of July 2020. Monsoon rains typically cause a certain degree of flooding but this might be the worst in a decade.

As on July 31 2020, The Bangladesh Flood Forecasting and Warning Centre stated that the water levels along Jamuna river were at/above “danger level”. Close to a million homes were flooded and more than 600 sq. miles of farmland damaged across the country

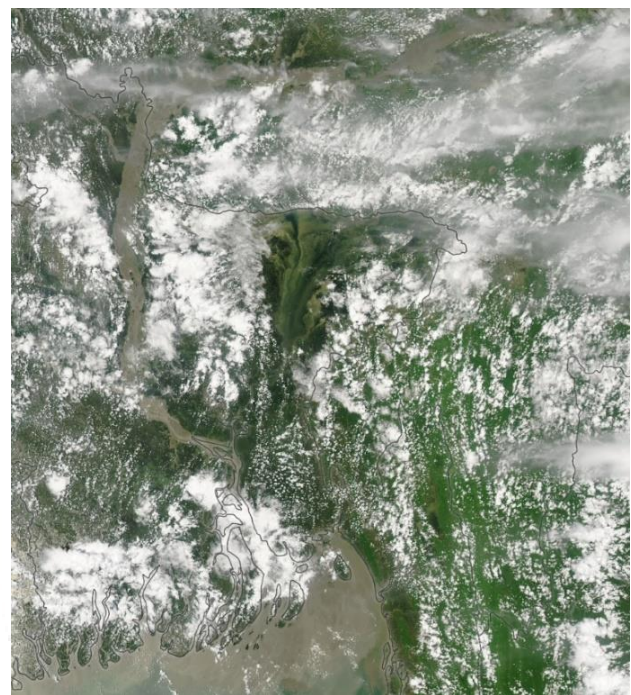


Figure 4: Natural color image -flooding as on July 25, 2020



Figure 5: Intense flooding continues to wreak havoc in Bangladesh (Source: UKinBangladesh)

Preparations were underway by government officials for monsoon season but recent disasters made preparations problematic. Flood protection structures such as dykes and embankments were already damaged from monsoon floods with the recovery cycle taking three to five years. Adding to this, the COVID-19 pandemic has exacerbated the situation and constrained response efforts.

Although past attempts/projects were carried out to make the country impenetrable to flooding, they turned out to be futile. Construction of embankments might have been a possible solution but that has just led to water rising faster observed in parts of south-west Bangladesh.

As per data gathered from researchers, ‘polders’ seem to have a mixed effect on flooding. They offer some degree of protection against storm surges but at the same time, has made monsoon flooding worse. In 2015, polders had lost 1-1.5m of elevation

Many indigenous farmers are against these structural interventions like dykes/embankments as it interferes with “autonomous adjustments”. This has engendered hostility to water-management interventions. All these cases clearly illustrate the failure that structural interventions have led to.

3.1 Traditional intervention

One approach that the settlements in Bangladesh favored was to be on higher ground and reserving the lower area for farmland. An area could be raised by excavating and elevating the land which is recognized as the “dig, elevate, dwell” approach. This approach allowed farmsteads to deal with everything but the worst storms. The settlers were able to ‘work’ with the flooding crisis by incorporating ponds which acted as reservoirs saving water especially during dry season.

During rainy season, when floods are more prone and inundate the streets, residents have adapted to it by travelling through boats making roads non-essential. The water eventually recedes as the season gets dry. Additionally, few roads in Bangladesh are made from a material that is able to withstand immense water inundation without affecting the road quality. Authorities need to take action and make sure more streets are built like these so that it is easier for inhabitants to adapt



Figure 6: Boat sales have dramatically increased in Bangladesh as a countermeasure against floods

Food protection, flood management, and land growth have all been related to indigenous people's adjustments to existing defenses, such as managed breaching of a polder to allow tidal waters and sediment in. Efforts by the government to control tidal rivers have also looked at similar approaches.

Although these interventions have proven successful and provided some degree of protection against environmental hazards, it is important to bear in mind that these were incorporated pre-climate change era. Climate change has been heightened ever since and exacerbated disasters like flooding and storms. In order to better adapt to the effects of climate change, it is consequential to further improve upon traditional interventions and incorporate sustainable strategies, which will be discussed further in the next section

Riverbanks, shorelines, riparian buffers, and river habitats are critically important when planning any riverfront project. Other important components of ecosystem function that should be considered include geology, morphology, hydrology, and land cover. Along the river, there are many opportunities for integrated regenerative design, storm water management, habitat restoration, public access, stewardship, and redevelopment.

4. Key Concepts

1. Dense Urban Development Buffer Zone

In a dense urban development, a buffer zone should include design and development techniques that will provide and enhance the following: integrated green infrastructure, storm water management practices, improved trail access, improved habitat corridor with increased vegetative types

2. Ecological Conservation and Open-Space Buffer Zone

For open spaces along the river, a buffer zone should include design and development techniques that will provide and enhance the following: provision of ecosystem services, ecological restoration, conservation and improvement of biodiversity, increased habitat corridor potential, improved public trail access, open-space amenities, and environmental education.

3. Riparian Buffer

The wider the riparian buffer, the more benefits it provides in terms of wildlife habitat, water temperature modulation, protection from nonpoint sources of pollution, flood mitigation, sediment removal, and bank stabilization.

4. Sand Dune System

This is a process which can be incorporated along the coastline which is a dynamic and natural solution that doesn't involve hardscapes or any structural interventions. The process uses nature to construct a landscape with a variety of topography, including existing dunes that have been overgrown with native vegetation. The dunes provide natural storm surge protection while also maintaining a diverse population of plant and animal species.

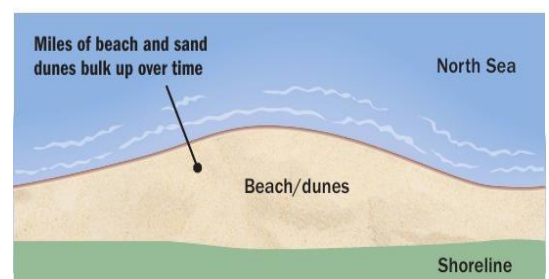
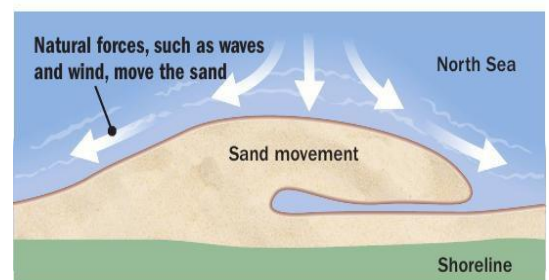
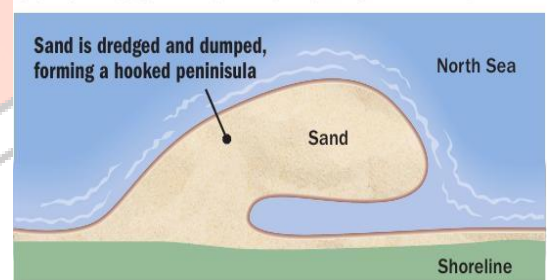
The image on the right explains the process of how sand is dumped along the shoreline, allowing natural environmental forces like waves and wind to move the sand. As time proceeds, the natural process will eventually abet in bulking heaps of beach/sand dunes.

In today's day and age, where climate change is causing catastrophic damage all over globe, particularly receding coastlines as a result of increased tidal waves/flooding, this process of dumping sand along the coast plays a vital factor in mitigating the effects of climate change on inhabitants.

The dunes formed as a part of environmental factors act as natural barriers against storm surges or flooding. Sand brought to the nearshore zone or beach raises the amount of sediment available locally. Since the sand must be dredged, transported, and then dispersed along the shoreline – often over long distances – mechanical spreading of pumped sand along the coast is common, but it can have a substantial ecological footprint and be really costly.

To reduce ecological damage and costs, the Dutch devised an innovative method of allowing nature to distribute the sediment instead, causing the processes that were previously responsible for erosion to now work on aiding to accrete the beaches, at least locally. Although the concept is not new, this was the first time a natural nourishment project of this scale was carried out.

Sand motor: How it works BIRD'S EYE VIEW



Source: Delft University of Technology

Staff graphic by DAN SWENSON

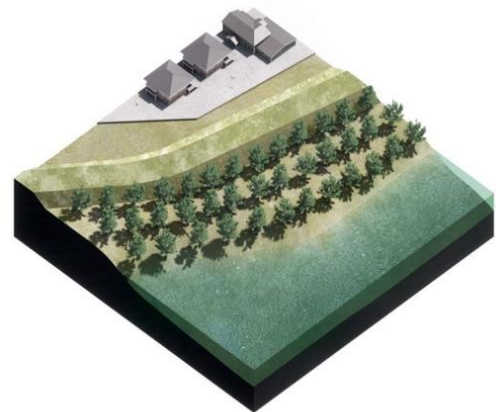
5. Sustainable interventions/strategies

Developing tidal parks serves an important social function by providing open space for cities. These shoreline edges and river inlets help to reintroduce tidal nature to urban waterfronts and riverbanks. Their gentle, sloping shorelines foster the growth of wetland plants, improving the natural environment and creating new habitat opportunities. Bicycle and Jogging paths can be integrated in this new invention of 'Tidal Parks' which supports a more sustainable mode of transportation and encourage outdoor activities.

Various flora species that are native to the region can be incorporated as well as those which require more water retention as it is along the coastal region where tides are more prone to occur.

This strategy also serves as a solution to any future pandemics as these are situated along the coast covering a wide stretch and away from the cities. More open spaces are encouraged as this ensures people to enjoy outdoor activities with the privilege of safety factor which is most critical.

Combining wetland forests with conventional earthen barriers in areas with low to moderate wave action can minimize wave heights while providing habitat value and promoting biodiversity. In order to reduce flood risk, dikes may be designed to include inundation-tolerant vegetation. Woody vegetation can minimize wave action on the protected dike with proper preparation and ongoing maintenance. To be successful, the use of wetlands forests necessitates a large amount of space as well as careful management.



These strategies are some of the solutions among many which can make a significant impact in curbing the effects of disasters such as flooding which disrupts countless livelihoods all over the world recurrently, thereby affecting the economy of the region as well. Citizens play an important role as well in bringing awareness to the government to take action based on countless concepts as discussed above which can still be implemented. World leaders need to take this seriously as these sustainable strategies will contribute to the growth of the nation and improve quality of life, especially among those who reside at the coastal areas who have to go through a great ordeal of having their livelihoods dislocated at any moment.

CONCLUSION

Urban and Landscape design when integrated provide resilient systems that work well and are less likely to fail when compared to hard engineering options that are imposed on cities by successes elsewhere. Every city is different and has different parameters to address. So it is imperative to create a customized solution after extensive analysis of historic factors that have formed the city. Planners and local bodies need to consider water infrastructure and not just land. Urban and Landscape urbanism need to be integrated beyond just greening pathways along roads. A century ago, water scarcity was unheard of as each village was self-sufficient and had its own tank, lake and water supply. Shrinking water bodies additionally can also lead to sea intrusion, low groundwater levels and increased flooding, hence the need to integrate them into a system.

The Government and Development authority are to be advised to take an immediate inventory of the condition of the areas of water bodies. Further approvals for development in the city need to follow stringent laws that would make it mandatory to adhere in strict accordance with the proposed waterfront master plan, ecological master plan as well as neighbourhood and zonal master plans that are proposed for water security.

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