

# Adaptive Urban Intervention in a Wetland: A Study from Hamidchar, Bangladesh

Mohammad Zahid Hossain, Nishan Barua, and Nusrat Sultana

**Abstract**—Over the last few decades the on-rushing surge of population created an urban structural instability across the under developing parts of the globe like Bangladesh. For instance, due to over population and urban sprawl the current development pattern of this country is culminating in filling up wetlands, changing the course of lakes, narrowing down in some cases killing rivers for urban development leaving the urban health in the face of a disastrous future. The concern for implementing an adaptive sustainable strategy that interacts with wetlands and rivers in the field of urban landscape should be prioritize as the burning question that need to be answered. This paper will be emphasizing on the strategies & guidelines to restore a riparian wetland through imputing wetland sensitive technique saving the riparian edge as well as creating a value of this wetland by suggesting some urban programs that will not only provide recreational value but also provide economic benefit to the local people. In this research there will be a sole intention to develop sustainable and riparian sensitive guidelines which would especially be applicable for riparian wetland development that leaves least impact on nature and promote the adjacent community life and wellbeing of urban health.

**Index Terms**—Riparian wetland, restoration, sustainable strategy, urban intervention.

## I. INTRODUCTION

Hundreds of rivers and their tributaries are holding this small piece of land like a web and acting as the source of agriculture, transportation, occupation, food, electricity, beauty, tourism, and unique tradition. But as a result of urban sprawl, the developers are filling up wetlands beside riverfront and erecting concrete structure, slum encroachment, dumping industrial pollutants everywhere which results in stuck of tidal creek mouth further creating crisis of supply water, pollution and extinction of certain species in riverine wetland. In this scenario, this paper intended to focus on the strategies to treat a riverine wetland in the context of urban intervention with adaptive guidelines and proposals as well as way to restore a wetland without interrupting it bio diversity and existing features. So, there are two types of layering need to be developed or described first of all the layer of adaptive strategies for urban intervention and then from a site analysis of a riverine wetland interconnecting those strategies to

restore the wetland and generating proposals that could increase the value of this wetland in an urban context rather than being crime zone, pollutant dumping zone and creating awareness of protecting river. The main focus is to develop the wetland as natural retreat inputting public recreational activity, community benefitted function, landscaping impacting minimally the existing wetland condition and also natural embankment system and integrating the canal creek for easy water transportation.

## II. URBAN WETLAND SCENARIO

### A. Urban Wetland

“Reference [1] shows Urban wetlands are those that have survived historical development around which urbanization gradually took place or that are newly constructed in an urban setting.” Urban wetlands play viable role to make city livable. During the time of heavy shower and storms urban wetlands absorb excess rainfall, reduce flooding and minimize subsequent infrastructure and economic damage. They also act as a natural filter against pollution to improve water and air quality, and help moderate extreme city temperatures. By managing sustainably wetland can generate exceptional environmental, social and economic values and benefits. Generally, the benefits a wetland can provide follows as –habitat of biodiversity, climate modification, tourism, recreational, culture and heritage, educational and human wellbeing.

### B. Threats to Existing Wetland

Human habitat and urbanization process evolved around wetlands over the years. Gradually this process of uncontrolled urbanization put the wetland condition and their bio diversities on the face off certain inevitable threats. Wetland located to urban and urban fringe certainly going through the consequence of unsustainable and not adaptive intervention of urban growth. Especially developing countries like Bangladesh this condition is much more severe. Here they are usually not included within urban planning decisions and are often not the responsibility of a single agency, thus leading to poor governance. The main threats to urban wetlands include:

- Draining and infilling for housing or other developments
- Loss of biodiversity by conversion to open public parks and recreational lakes
- Solid waste and waste water pollution
- Channelization of rivers and streams
- Hydrological disconnection of the wetlands from watercourses
- The use of hard infrastructure solutions rather than green infrastructure

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- Invasive species resulting in the loss of native species

### C. Strategies to Adapt in Wetland

Ref. [1]” The following principles are recommended for decision-makers planning for urban and peri urban development that may impact on wetlands

- Maintain the wetlands
- Promoting the use of wetland
- Involving local communities
- Consider the eco diversity of a wetland
- Minimal intervention and sustainable infrastructure development where needed without alienating an existing wetland from its own features

The following practical measures are recommended for urban developers and wetland managers

- Restoring wetland by promoting or linking up with urban functions or as part of urban amenity to serve communities.
- Conserving the existing flora, faunas.
- Increasing and promoting the value of wetland in an urban scale.
- Integrated planning benefitting both the life of adjacent communities and wetland eco structure.

## III. METHODOLOGY

The study process followed through sequential and integrated stages from choosing a study area to develop guideline and proposals. The outcome of the study will be to develop perimeters and a ubiquitous approach to generate guideline and proposals which could act as a combined assemblage to restore & promoting the values of the wetland both environmentally, socially and economically.

### A. First Phase

Choosing an existing wetland and for a riverine country like Bangladesh wetland at the edge of river is much more frequent and urban sprawl and growth most commonly flourished up from this point. Site surrounding data which consist of location map, land use map, socio economic evaluation, site topographic image, tidal range chart and overview of the site from onsite visiting, observation, interviewing with local communities.

### B. Second Phase

Analyzing the data basis on SWOT (strength-weakness-opportunities-threat). Figuring out the points need to be optimized.

### C. Third Phase

In this phase, work flow continued to integrate existing strength and opportunities with adaptive urban intervention strategies to restore and promoting the values of the wetland to develop guideline and proposals for implementing at the final stage.

## IV. SITE STUDY

### A. The Site

A riverfront wetland site located to the west of river Karnaphuli in Chittagong city of Bangladesh is proposed for

recreational development by the Chittagong Development Authority. The site is at the edge of the second largest city of the country which has a complex semi urban development pattern with fishermen colonies, factories and industries, Chittagong sea port, open lands and continuous river views. A marine drive has been proposed by CDA along the bank of the river in order to facilitate tourism and also to protect the area from tidal and flash flood. That also poses a threat to the existing ecosystem and lifestyle of fishermen and their relationship with river.

### B. Location

“Fig. 1” The site is located on the south east bank of the Karnaphuli River, Chittagong.



Fig. 1. Location map.

### C. Site Surrounding

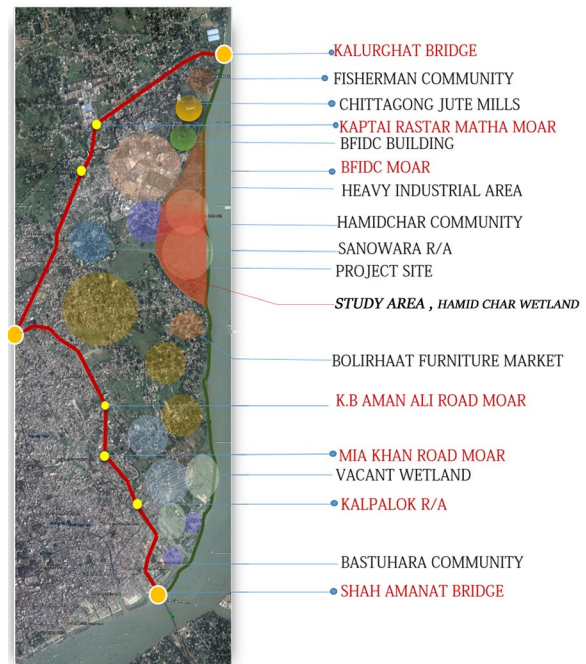


Fig. 2. Site surrounding.

“Fig. 2” The entire riverbank of Karnaphuli has several river deltas which are known locally as ‘Char’ areas. These river deltas or Chars are usually full of tidal creeks which facilitate the entire Char to experience different water level in

different period of day and year. The proposed site is such a river delta. The site is bounded by navigational creeks and separated from the main land by those creeks. There is a fishermen colony to the west of the site and the river Karnaphuli is to its east. There are three bridges near the site to cross the river.

**D. Land Use Pattern**

“Fig. 3” “Reference [2] shows the entire riverbank is proposed by CDA as a Marine Drive road and there would be several parks and recreational developments to encourage tourism in this area.” The designated site is proposed for a recreational development according DAP (Detail Area Plan) of Chittagong development authority.

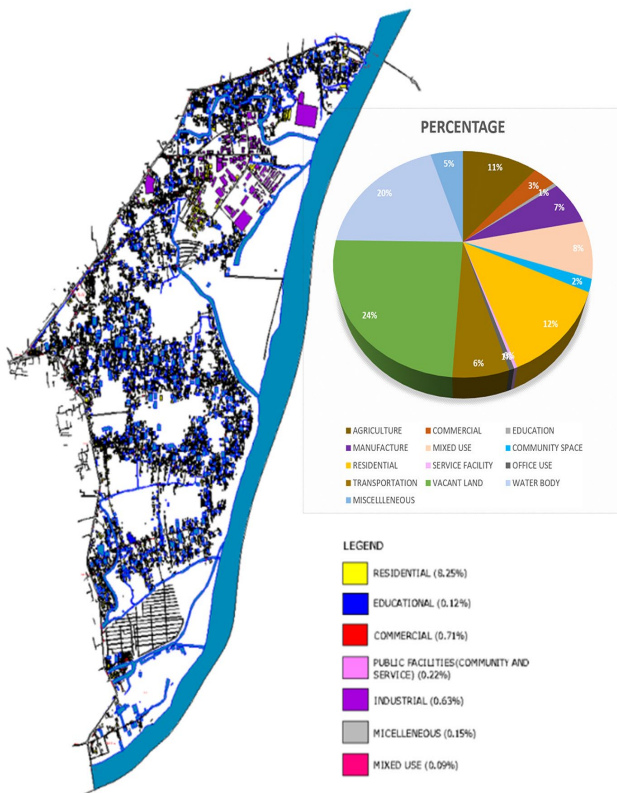


Fig. 3. Land use map.

**E. Socio-economic Condition of Adjacent Communities**

Dense commercial activity has been established along the road over the period in this area. Decades of inactivity & employee revolt forced most of the industries to shut off and now most of them are abandoned. Backward of the study area mostly occupied by low income group of people, fisherman community and a large portion of people deprived from adequate health & educational facilities around the study area. Heavy industries are frequently seen further east of the Hamidchar wetland. Commercial strips along both side of the road developed and occupied mostly by low income community and the industry workers. From BFIDC circle there are 25-30 large factories running on which had been established both side of the road over the years as well as a number of medium industries are also joined in production pipeline. Backwards of the respective study area this paper emphasizing on is occupied by Hamidchar community. Number of migrant people from other parts of the country also

gathered and most of them lost their land by disaster, river erosion or other issues or just for a better life expectation. But currently those people are living a low line of social status. Above all of these there are no prominent educational, recreational facilities for local children.

**F. Site Characteristics**

“Fig. 4” The entire site is a 251-acre swamp grassy land, crisscrossed by tidal creeks [3]. “Reference [4] shows the site is in average 2 m-4.5 m high from the sea level and sloped towards the river.” “Fig. 5” The river bank of the entire site area experience tidal flood twice a day. The creeks perform as drainage system for the main land in monsoon. Some of the creeks including the bounding creeks are navigational and all of them overflow in monsoon and also in daily tidal effect. The combined effect of the heavy monsoon and high tide may inundate the entire site under 6-8’ of water.



Fig. 4. (Crisscrossed creek ) (Tide table : Chittagong,Bangladesh 22.3333° N, 91.8333° E. Retrieved from, n.d).

TIDAL RANGES (The tides are semi diurnal with prominent diurnal effect)	
At Patenga Khal no-18	1.5m – 5.5m
At Khal no-10	1.5m – 4.8m
At Sadarghat	1.2m – 4.2m
At Kalurghat	1.0m – 4.1m

**KALURGHAT AUTO TIDE STATION**

HIGHEST			LOWEST		
Ht(m)	Time	Date	Ht(m)	Time	Date
5.57	14:20	24/07/17	-0.50	22:00	28/02/17

Online check: <http://stormcentral.waterlog.comsn/public/cpahydrography2>

Fig. 5. Tidal range chart from port authority (Chittagong port authority tidal range.2018).

**G. Site Images**



Fig.6. Panaromic views.



Fig. 7. Existing site scenario.

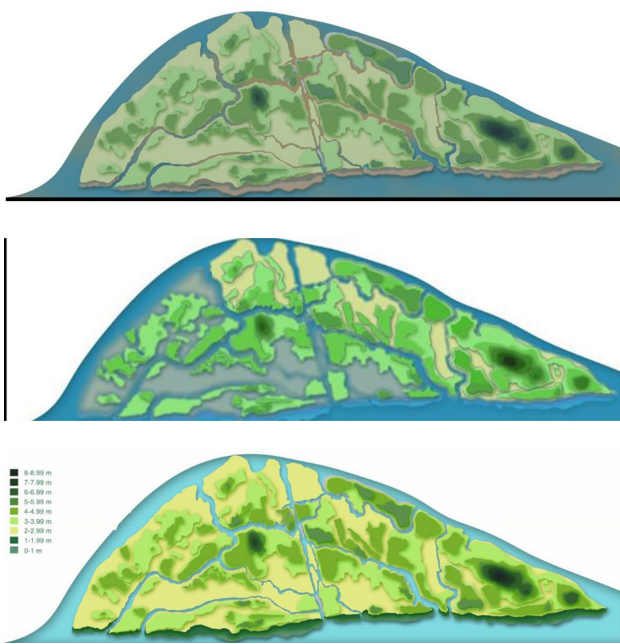


Fig. 8. Digital elevation map.

#### H. Dry & Wet Season Conditions

“Fig. 8” shows Digital elevation mapping of the site shows at dry season canals and creeks remain muddy while at wet season these creeks over flow and a portion of this wetland remain submerge under water.”

### V. SWOT ANALYSIS

#### A. Strength

- Riparian wetland in the midst of a rapid urban sprawl acting as breathing space.
- Habitat of a riparian based eco diversity.
- Source of low land crops agro products for adjacent low income group people.
- Canal and creeks channelizing the water flow.

#### B. Weakness

- Prone to over flooded in the monsoon season.
- Weak roadside connection with adjacent communities
- No embankment system has been introduced
- Degraded land value over the period as being used as industrial dump site day by day.
- Creeks and canals are getting.

#### C. Opportunities

- Could be a potential source of water-based tourism in the midst of haphazard urban planning.
- Adaptive strategies and measures can further help to flourish the eco diversity will up rise the urban health of the city
- Developing community promoting functions and programs will eventually promote the value of the wetland as well as the life the communities.
- Tourism, cultural and heritage hub.
- Implementing natural embankment system will reduce the risk of over flooding as well as maintaining the riparian edge relation and eco system of the wetland.

#### D. Threat

- Infilling of canals by industrial wastage seriously damaging the wetland health
- Creeks passed through the wetland getting stuck day by day increasing the risk of flood.
- Ecological degradation and downward trend to chance of growing crops on this wetland.
- Animals and plants habitat on the face of serious risk as the encroachment of illegal slum housing approaching day by day.

### VI. GUIDELINES & PROPOSALS

#### A. Developing Programs to Activate the Wetland

“Fig. 9” The study intention was to develop recreational facilities as well as programs to intercorporate the site with local surrounding and activating the wetland as public realm moreover as part of increasing up wetland value. The concept is to generate program from the conditions and problems that needed to be resolved where defined. It is a common method in wetland architecture to create a concept to use as a tool for creating a framework for the fundamental idea and to help to answer design related questions.

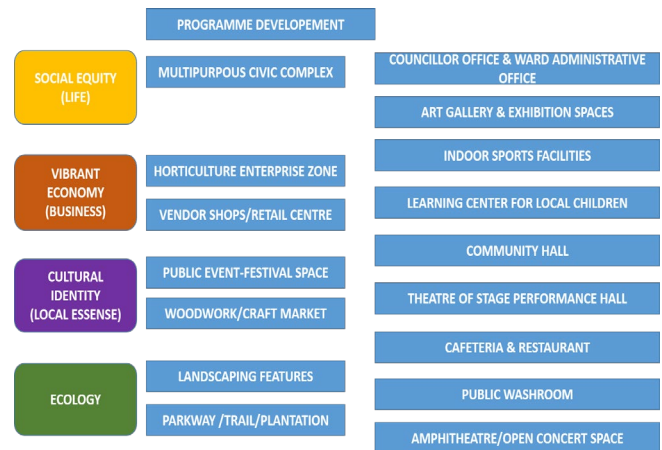


Fig. 9. Schematic programme development chart.

#### B. Application of Riparian Buffer Technique

“Reference [5] “Fig. 10” shows Riparian buffers are the grasses, grass-like, forbs, shrubs, trees or other vegetation growing along streams.” These plants control erosion and help filter and keep water clean. Cropland fields shouldn’t be planted right up to a stream’s edge where the soil is generally more fragile and subject to erosion. “Reference [6] “Fig.11” shows the riparian buffer should be no less than 75 feet at its narrowest, with three zones of buffer from the stream edge inland.” The zonal divisions follow as such:

- The first zone should be undistributed forest to provide food, shade for the water body, and slope stability.
- The second zone should consist of managed woodland that allows for infiltration, filtration of sediment and nutrients and nutrient uptake by plants.
- The buffer area on the upland side should include a sheet flow of rainwater runoff to maximize vegetative and soil contact with the runoff.

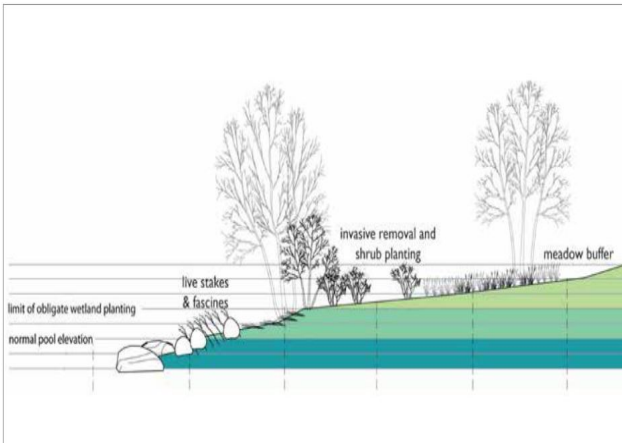


Fig. 10. Typical section of riparian buffer.

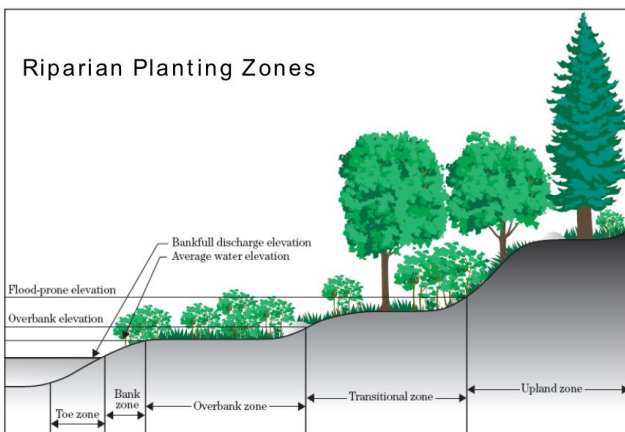


Fig. 11. Buffer zone plantation technique.

### C. Landscape Technique to Implement

The landscape should provide a special and comfortable sense of place at the river's edge, providing character and identity to the adjoining districts and neighborhoods. The landscape should be shaped by the topography that historically defined the natural and urban form. The landscape should provide erosion control, riverbank stabilization, storm water management, and relief from urban heat islands.

### D. Target Groups to Involve

The main target groups of visitors to the Hamid char wetland Site should be members of the general public of all ages without special knowledge. By having such a broad approach, the information provided needs to be readily comprehensible for all these groups with different needs.

- Residents of Hamid char and Chittagong as a recreational area.
- Visitors/tourists for outdoor activities.
- Men and women in the fishing business.
- Tourists (national and international).

### E. Design Guidelines

- The additions used will be made of sustainable material as far as possible with low impact on the sensitive environment. They shall also fit in aesthetically and highlight the area's distinctive landscape type and assets.
- The area should continue to attract schools, tourists and the local public.
- The site should offer a wide range of activities,

preferably, to give everybody, visitors and hosts, the possibility to experience the nature.

- By consciously placing a nature trail, highlight the qualities in the landscape to enhance the experience for the visitors.
- Increase awareness and interest in science, the nature and its conservation.
- Adding public seating and gathering places with interesting designs, with the purpose to fit into the area. As far as possible local craftsmen should make them in materials from the village.
- Site-specific architecture inspired by elements in the village.
- By strengthen the ecotourism mark of the site, inspire people in the village to take the initiative to start small businesses in the same sector.

### F. Plantation Strategies

“Fig. 12” Indigenous plants can be used as great buffering system to create natural embank system. For this respective site of Hamid char as a riparian wetland we developed the method of buffering layer integrated with Bangladeshi plants and trees. Not only they can play role in protecting erosion of wetland bank also increase the eco diversity of natural fauna condition of the existing wetland. Further they will act as habitat of the wetland fowls and reptiles and to increase their growth.



Fig. 12. Proposed plantation strategy at study area(source-authors).

### G. Overall Visualization of the Proposals

Here's a conceptual visualization of treating the existing site as per intervention strategies and techniques discussed in this study. “Fig. 13” A masterplan that could be encourage to adapt and integrate the wetland as a resource of urban scenario by promoting the wellbeing of communities, restoring it from degradation, activating the wetland by means of generating educational, cultural, community benefitted functions and attracting tourist. Here the intervention of urban demand will happen not to alienate it from its existing features

rather act as a valuable part of urban health with keeping intact the ecology and habitat of wildlife.

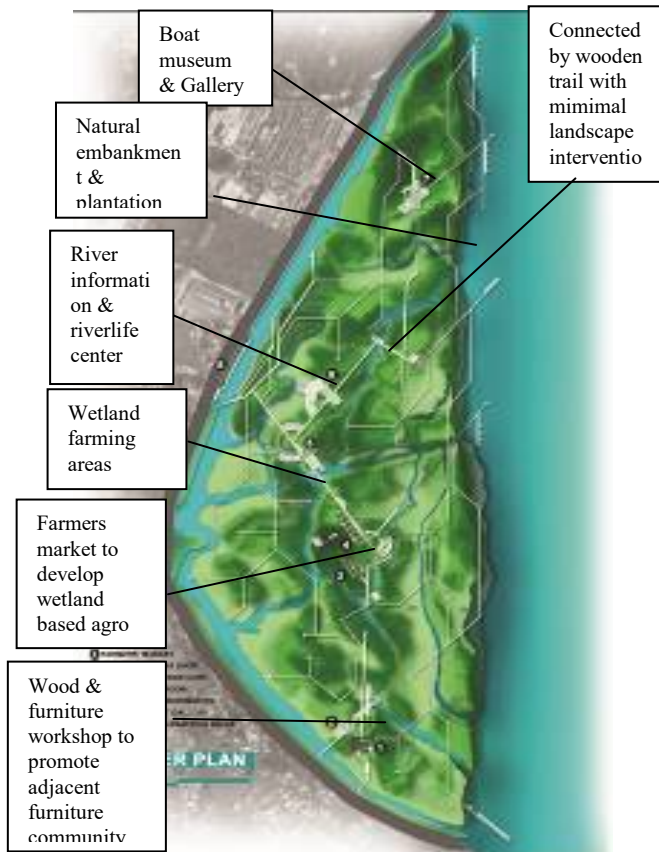


Fig. 13. Overall visualization of master plan(source-author).

#### CONFLICT OF INTEREST

The authors declare no conflict of interest.

#### AUTHOR CONTRIBUTIONS

MZH initiated the study work, topic selection, conducted the survey resource collection moreover further conceptualized the overall study process and program development. Also wrote manuscript of the research work. NB filtered and analyzed all the data, critically checking of survey outcomes. NS Checked the relevancy of data, design evaluation. All authors reviewed the final work.

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