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# Searching Landscape Elements from Indigenous Land-Water Interface to Develop Integrated Landscape Framework for Water Sensitive Urban Design

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### Abstract

Dhaka, the capital city of Bangladesh, once had enormous water resources which played an important role in structuring settlement patterns and maintaining overall hydro-ecological equilibrium. Eastern Periphery, the essential spontaneous territory of the Dhaka Metropolitan Area (DMA) still have a traditional setting integrating natural landscape for production, transportation, open space network towards water sensitive urban development. But, city's present development activities for this part as well as the entire city do not respect the deep geo-morphological nature of the territory. Thus, the city failed to protect and integrate these essential natural water bodies with the built environment and creating adverse effects on flooding, waterlogging and other environmental conditions. To address the present urban crisis associated with water, it is essential to search for strategies to protect the mandatory water bodies and integrate those in the land development process. The traditional way of integrating natural land-water resources for hydrological-ecological performance is required to discover from the territorial settings and incorporate those through strategies. The physiographical characteristics of the land-water interface have a direct reflection of the regional hydrology. Therefore, this research aims to investigate the physical pattern and process of the water edge from the traditional settlement of the eastern fringe of DMA. A comprehensive framework will be developed to analyze the multiple samples from the study area to extract general landscape practices from the study area. Finally, the identified landscape pattern and processes will be suggested as urban design guidelines which will help in highlighting the possible ways of structuring waterside areas in such deltaic city towards water sensitive urban development.

*Keywords:* Land-cover change, Land-water interface, Spontaneous urban territory, Indigenous knowledge, Landscape framework.

## 1. Introduction

Bangladesh is a country situated within the world's largest delta at the confluence of low-lying flood plains of the Ganges (Padma), Brahmaputra (Jamuna) and Meghna Rivers. Consequently, around two-third of Bangladesh's surface area is a combination of rivers, canals, wetlands and flood plains, contributing to the Ganges-Brahmaputra-Meghna delta (Gain, et al., 2017). Dhaka, Bangladesh's mega-city capital is no exception to the general perception of the nation. The city is on the higher ground at the southern edge of an alluvial old terrace in a low-lying region. At a strategic position regarding the water-routes of the country, the city is bounded by the Balu River on the east, Turag River on the west, the Buriganga River on the west and south and the TongiKhal on the north. The edges of the high lands are surrounded by marshes and old river beds. The city is also located in the tropical region where monsoon causes huge rainfall during a major part of the year which naturally drains by the gravity drainage through stream-river networks, and wetlands work as natural retention storage (Sultana, et al., 2009). Therefore, the built-environment along with the cultural and economic character of Dhaka has been shaped following the water system of its land. Abundances of the natural water system create a unique relationship between land and water, which is quite evident throughout the landscape of the region. As a result, this territory is characterized as water civilization, where the water bodies act for social, environmental, economic purposes. Hydrological issues are driving forces for shaping the settlement pattern and its entire infrastructure for both urban and rural settings and historically 'living with water' has become a cultural norm for this locality (Ashraf, 1997, 2012).

Eastern periphery of Dhaka Metropolitan Area (DMA) is located on the eastern part of the city bounded by ProgotiSharoni in the west, Balu River in the east, TongiKhal in north, north-east and Dhaka-Narayanganj-Demra (DND) Road down at south (Figure 1). Geographically the eastern periphery area of DMA is low in topography (2m-5m Public Works Datum-PWD) (DAP, 2010), and gradually slopes towards Balu river. This part is nested with huge natural canals, water bodies and natural landscape. These hydrological infrastructures and land-water resources all together work as detention, and retention basins and works as a natural drainage system for the city during monsoon. Before 1970, the

eastern periphery of DMA was mostly low laying areas and a few village -like homestead existed there (Jahan, et al., 2013). Most of the parts were flooded during monsoon and the rest of the year the areas were used for agriculture purposes. From the development pattern of the eastern periphery in Figure 2, it has been observed that the local people of this area still integrate the natural water bodies with their settlement and utilize the land-water interface with various landscape practices following local resources.



Figure 1. Location of Eastern Fringe and Study Area in DMA

In the present population pressure, urban growth and associated environmental degradations have raised the emergence of proper utilization of natural resources. David (1988) advocated that the sustainable development model requires sound land-water integration that can make the best use of natural resources to meet human demands, without destroying their sustaining base. It requires a better understanding of territorial settings to incorporate the local knowledge into the development process. Whereas, the traditional settlement within the natural landscape ensures optimum utilization of water bodies for the various purpose by traditional practices and ensure overall hydro-ecological benefits. Therefore, it requires searching for local landscape character of land-water integration from spontaneous traditional settlement. The integrated land-water relationship is crucial for the present development practices in providing solutions to water problems, landscape protection and environmental enhancement.

#### 2. Potential Natural Land-water Interface in the Spontaneous Development

The land-water interface also termed as riparian buffer is the transitional area between land and water that contains a mix of trees, shrubs, grasses and wildflowers. In its natural setting, this is a vegetated strip of land that "buffers" the water body from human impacts and activities and is a primary defence in the protection of waterways (Castelle, et al. 1994, Naiman et al. 1993, Naiman et al. 2010). These strips of land are comprised of vegetation (trees, shrubs, grasses and herbs), soils and topography that regulate in-stream ecological and hydrological processes. The soft landscape in the natural land-water interface creates a green-blue infrastructure that plays a crucial role to maintain environmental issues in the built-up areas. Thus, these natural land-water interface contributes to the enhancement of human health, inhabitant's quality of life and sustainable development. The natural land-water interface in connection with the natural bodies has delivered a wide range of hydrological and ecological services which can also be fulfilled for environmental and socio-ecological services.

## 3. Physiographic (Landscape) Elements to Analyse Land-Water Interface

Water is among the major morphogenetic (relating to or concerned with the development of normal organic form) agents characterizing landscape (Sabbin, 2017). In its natural condition, water efficiently performs environmental basic functions. Additionally, water is an ecological infrastructure that ensures hydrological, geological, biological, economic, social and cultural functions (Allan, et al., 2007). In the contact with land or built-up area, these functions shape their own regional identity, pattern and process by local inhabitants and frame local landscape patterns. In the development context, landscape elements and features in the water edge has various interpretations depending on the characteristics of the sites and the cities (Dong, 2004). Therefore, any landscape investigation should rely on accurate observation of the layers composing the territorial setting (McHarg, 1971). Sijmons (2009) suggested searching for appropriate spatial configuration of water, nature and built form of any location and that should lead to future perspectives for the built environment. Additionally, Tjallingii (1995), Tjallingii (1996) reiterated the essentials of investigating the regional fine-grained landscape elements of water management which are self-sustainable, self-responsible and self-resilient.

The theoretical basis to analyze the land-water interface can be established from Ian McHarg's (1971) publication of 'Design with Nature'. There the author emphasized that any place is the sum of historical, physical, and biological processes. It has been emphasized that the recognition of social values is inherent in the natural process of the regional landscape. McHarg (1971) suggested for the investigation of the study area on the basis of ecological resources that underpins the city, watershed approach to manage the land for development, investigate the tolerances and intolerances of the various environments to human use. He suggested a technique of mapping of different types like geology, ecology, surfaces and overlaying them to identify the pattern and process of human habitation over the natural resource. An alien of this approach, Tjallingii (1996) also developed set guidelines to search the management and utilization of water flow in the local landscape. This approaches suggested investigating the land-water relationship of any territory with reference to hydrology, landform, soil, subsoil, landscape process, water process, water cycle and identify the local pattern and process for sustainable, resilient water management. Following these well-established approaches and other contemporary disciplines, this part of the research has analyzed the physical geography of the land-water interface with its associated elements. The identified landscape elements under the physiographic feature of the land-water interface are given below in Table 1 and Figure 2.



#### 4. Integrated Land-Water Interface in the Spontaneous Settlement of Study Area

The study area, located in the upper eastern part of eastern fringe of Dhaka Metropolitan Area (DMA) has an area of 42 km<sup>2</sup> (approx.) (Figure 1). A large portion of this area is characterized with traditional homesteads embracing the natural productive landscape and water bodies through local practices and process. Particularly the peripheral area which are close to two rivers-Tongi river and Balu river, still have tradition landscape setting with built environment. From the fieldwork and map observation (Figure 3), it has revealed that, the traditional settlement with their spontaneous development create a sustainable land-water relationship. The locals use the existing natural resources efficiently with their local intelligence. The locals not only occupy the land for settlement, rather provide required

space for water which are essential in such geographical location. These spaces further fluctuated with the water levels by seasonal variation and local people incorporate environmental diversity within their settlement.

#### 4.1 Natural Water Resources

Except the west portion adjacent to the main road, the major segment of the study area was basically nested with huge natural water bodies. In the west part, the built-up area has developed through the conversion or filling up of natural water bodies which are evident from identification of enormous ponds within the settlement. But in the eastern periphery and middle south-eastern part still there are huge natural water bodies. There are around 8 sqkm (7.84 km2) of water bodies still present in the study area which is about 20% of the total study area (Figure 4). These water bodies basically consist of swamps/ marshlands, canals, ditches, lakes, ponds and rivers. These water bodies are also seasonally enlarged and reduced with their volume and activities. During rainy season approximately 60% of the area goes underwater. Among the water bodies, a large portion is occupied by marshland which converts into agricultural land in the dry season and in wet months these are used for aquaculture and vast water bodies for storing surface runoff. Working as a productive landscape in the dry months, the same water bodies are gradually sloped towards the Balu River in the east and Tongi Khal on the north and effectively drain the entire area naturally. As a whole, these natural water bodies act for total hydro-ecological balance in the traditional settlements that exist there.



Figure 3. The traditional settlement and its land-water relationship

## 4.2 Natural Land Resources

In addition to the natural water bodies, this area also consists of a huge natural landscape particularly the agricultural land. The local settlements in the peripheral area are largely surrounded by various local vegetation. The vegetation and the agricultural practices exist basically in the southern, eastern and partly in northern parts of the study area where the natural water bodies still exist. Though the agricultural practice is dominating the landscape pattern, there are also various local fruit trees, herbal plants, cultivated trees, herbaceous crops, shrubs, orchards and other seasonal vegetable production. The agricultural land consists of 9.58 km2 of land which is around 23% of the study area (Figure 5). Expanding agricultural land in dry season along with other native vegetation and plants, these natural landscape occupies a significant portion of the study area. In addition to food production for the local inhabitants, the natural landscape also contributes to the essential environmental, ecological, hydrological safeguard for the built-up areas.



## 4.3 Indigenous Settlement

From a geomorphological perspective, the case study area is an example of Pleistocene Madhupur Clay suitable for the built-up area and lots of alluvial low planes (wetlands) with landscape which are resulted from the overflow of the Balu River. As a result, this area is characterized by rural traditional setting sitting on the Madhupur Terrace and huge natural water bodies integrated with a unique productive landscape in low Madhupur tract, valley and floodplain. The study area was basically a finger-like rural settlement spreading through the entire area. During the 90's, it started to convert into an urban area and from 2000 to 2010 conversions has been accelerated. From the map produced by CEGIS (Centre for Environmental and Geographic Information Services) based on the satellite image, it is evident that even till 2010 the traditional settlements were covering more than 50% of the study area (Figure 6). Though it is disappearing rapidly, still there is a presence of traditional settlement in the middle south-eastern, eastern periphery and north-eastern periphery (Figure 7). The settlement in these areas is still integrated with the existing natural land and water resources in their own way. The surrounded agricultural land and water bodies are basically utilized for their production and water management purposes. The settlement follows the geological landform of Madhupur Terrace (high to middle) for building their houses whereas naturally depressed land like valley, marshland, low flood plain, high flood plain are used for seasonal production and for keeping the natural water bodies like river, khal, valley, channels undisturbed. While the entire city is struggling tough to maintain its hydrological, ecological and environmental quality, these traditional settlements in their own way are maintaining their sustainable and resilient living environment. The settlements in their traditional way of setting within the natural landscape have formed a unique cultural identity that can generate inspiration and guidelines for the present engineered way of city building. Intensive landscape investigation in such potential traditional settlement can help to explore the local practices and processes to interact with the natural resources.



### 5. Methodology of Sample Analysis

From the study area, 5 sample locations (1.25 kmX1.25 km) have been selected based on of visual observation and map analysis (Figure 8). The availability of land and water resources and their integration with the settlement have been assured during sample selection. Additionally, uninterrupted traditional landscape, as well as urban intervention, is also included in the samples to identify urbanization effects. The methodological approach applied during this phase focused on analysis of the land-water interface of the sample locations through mapping, overlaying, critical observation from field surveys and discussion with local inhabitants. This process helps to identify the underlying factors that led local practices for landscape elements generation which influences the integration of traditional settlement with natural water resources. In this phase, the research goal is to understand the processes and patterns of local landscape features to perform hydro-ecological functions and reveal their logic and identify their interplay. In each sample area, the structure and the dynamic of landscape components have been analyzed in detail. A thorough examination seems helpful to generate a correlation between traditional practices and general physiographic features of the land-water interface. The patterns and the processes are correlated with the seasonal variation and other related variables.

Methodology for sample analysis:

- Satellite Image and Map analysis (GIS mapping, Arial photograph survey)
- Field observation and Field survey
- Discussion with Local Inhabitants, Administrative Officials, Experts in the related field
- Secondary Data and Document Analysis.



Figure 8. Location of selected samples in study area.



## 6. Physiographic Analysis of Land-water Interface

From the selected samples, the land-water interfaces have been analyzed in terms of its area, width, slope gradient, slope length, surface condition/quality, and meanders to understand the local landscape setting. All these attributes have investigated with two basic seasonal variations of this region which affect the land-water interface significantly. These contribute to the diversity of soil conditions, vegetation variation, runoff control, sediment, nutrients and pollutant flow, wildlife movement and so on.

# 6.1 Area of Land-Water Interface (Buffer Area)

The volume of water bodies fluctuated with the seasonal variation thus influenced the land-water interface. It is required to tress the highest and lowest water level of the water bodies following seasonal variation. In this tropical region, two prominent seasons prevail about water volume- summer and monsoon, which have a huge impact on the land-water interface. In Dhaka along with Bangladesh, rain (rainy season) falls in the months from April to October and among them, August is the wettest month. The dry period (summer) of Dhaka is from November to January where December is the driest month. To identify the water edge in the wet season, the post-monsoon months: August – November (Monsoon: May-October) has been chosen and for summer season water edge pre-monsoon months: January-April has been selected. The Google Earth images have been observed for better images for both seasons. 15 September 2017 has been selected to identify monsoon season water edge images. And for the dry season, images of 25 April 2018 have taken to draw water edge. All these are then digitized (Figure 9) and analyzed in the ArcGIS for further calculation.

Table 2. Area of Land-water Interface in dry and monsoon and proportion of increase with seasonal					
variation					
Seasons/Samples	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5
Wet Season Area (acre)	135.97	76.49	65.65	104.61	61.39
Dry Season Area (acre)	148.92	159.19	218.22	209.02	224.54
Area Increase in %					
(dry season)	9.5%	92.5%	232.4%	99.8%	265.8%



Form the image and map investigation (Figure 9 & 11), it is understandable that the area of the land-water interface has changed drastically with the seasonal variation for all the samples except Sample 1. During the dry season, the area for the land-water interface increases significantly. From the area variation of the samples (Table 2 and Figure 10), it can be generalized that samples 2 & 4 are in similar character while samples 3 & 5 are in another same pattern in terms of area change with seasonal variation. Both samples 2 and 4 have experienced enlargement in their area in the dry season by almost 100% (Table 2), and in these samples the water bodies are classified by lowlands, marshlands having thin canals passing through them in the dry season. In monsoon, all the lowland and marshlands are converted to large and vast water bodies through reducing the land-water interface in sample 3 & 5 are increased by almost 250% and more in the dry season (Table 2). The water bodies adjacent to these samples are river and lowlands. The traditional settlements in these samples keep the larger area between the land and water bodies that indicates more sensitive attitude towards the natural flow pattern of water bodies and hydro-ecological functions. All the samples express the natural fluctuation of water level and their consequent reflection on the land-water interface within the

settlement. The higher the increase of the land-water interface also provides more land area for landscape variations by different agricultural production. Only in sample 1, where urban development occupies the traditional rural settlement, the area of interface does not vary significantly. Only 9.5% variation (Table 2) indicates the year-round water presence in this sample, which disrupts varieties of agricultural production with a seasonal water change. This sample is disconnected from the natural water network because of the illegal filling of water bodies. The less fluctuation of the area also uncovers a small proportion of land for agricultural practices. Even more, discussion with the local inhabitants from field survey discovered that the stagnant water bodies and their disconnection with the natural water network gradually polluting the water with surface runoff and becoming unusable for fish production and other water-related activities.

## 6.2 Width of Land-Water Interface (Buffer Width)

The width of the land-water interface is the lateral distance between the settlement's peripheral line and the water edge. It primarily affects the water quality of nearby water bodies. It is an important attribute in the issue of pollutant control and the water course's health (Gilliam et al., 1997). Depending on the types of water bodies, the buffer width may vary. This further varies even with the seasonal variations. The samples selected for analysis have various types of water bodies and the land-water interface width also varies accordingly. To investigate interface width, slope gradient, slope length; several sectional lines have drawn in every sample depending on landscape variables and the possibility of seasonal dynamics. Form each sample 10-20 sectional lines have been drawn which is positioned perpendicular with settlement, interface and water body. It has identified that between dry and wet season, the interface width varies drastically with variations. In the wet season due to the increase of water level in adjacent water bodies, the land-water interface shrinks and thereafter its width also reduces. The width of the land-water interface varies from a minimum of 15 meters to a maximum of 200 meters in a wet season among the samples (Figure 12). Additionally in the dry season, it extended from a minimum of 20 meters to 530 meters approximately (Figure 12). Among the five (5) samples, sample 1 has less interface width than the others. Whereas in other samples these widths are significantly different. The local process in sample 1 is replaced by urban development through land filling which has changed the topographical variations, therefore, long land-water interfaces with landscape variation are comparatively less visible. The graph of Figure 12 also indicates that these land-water interface width and their differences with seasonal variation are higher in the samples which are close to flowing water bodies like rivers. Buffer width in the samples having wetland, marshlands as water bodies are also high but the variation among them with seasonal changes is comparatively less. Long width of the land-water interface and high variation with the seasonal changes ensure diversified use of land-water interface for the various purposes specifically agricultural production. Variable width in the land-water interface also displays the topographical dynamics within the area. These attributes uncover diversified land in the land-water interface with seasonal variation and changing water level which generates various landscape patterns in the local practices. The wide, variable, and long interface areas contain various hydrological features, moisture contents, soil quality which ensures dynamic landscape uses of the sample locations.



## 6.3 Slope Gradient and Slope Length

The speed of water flow over the land-water interface, retaining nutrients and sedimentation on it depends on its slope gradient (NJWSA, 2000). Additionally, the stay of floodwater, various agriculture which are related to the water level, pollutants trap, contaminant holds are directly related to the length of slope in different levels from upland to edge of the water (Hawes, et al 2005). The steeper the slope, the higher the velocity of overland flow and the less time it takes nutrients and other contaminants to pass through the buffer, whether attached to sediments or moving in subsurface flow. Therefore, the nature of the slope gradient and its length generate the landscape pattern of that specific context. The researchers in this field suggested that steep slopes serve less value as a buffer or land-water interface and they defined 'steep' which varies from over 1:10 (10%) to over 1:2.5 (40%) slope (Wenger, 1999; Dindaroglu, et al, 2015).

To identify and calculate slope gradient and length, from each sample 10 sectional lines have drawn through the landwater interface crossing the settlement, water bodies and corresponding land-water interface. The sectional lines have been generated from the Digital Elevation Model (DEM) in 10-meter resolution in Arc GIS 10.3. The outcome of this is illustrated in Figure 13. From the sectional graphs (Figure 13), it has identified that among 50 sections more than 30 sections carry slope gradation ranges between 1:15 to 1:20 (7% to 5% and below this %). Other than these, some sections carry steep slope and a very mild slope. The steep slopes 1:10 and below (10% and above) are basically found in sample 1, where the traditional landscape is rapidly changed for urban development through landfills. Steep slopes also found in those sections where sudden depression occurred within the land-water interfaces like pools, ponds, depression areas. Whereas, very mild slope like 1:100 and more (1% and less) are found in the samples which have a wide riparian buffer and close with river and natural major water bodies. These indicate that the traditional practices do not disturb the landscape slopes of the land-water interface rather utilized these landscape features for agricultural practices.







Besides the slope ratio, slope length also effects the water quality of adjacent water bodies. Trapping the sediment, retaining nutrients, moisture content depends on the slope length inhalation to slope ratio. As like as slope ratio, the slope length for almost 50% of study area varies from of the 20 meters to 30 meters. Expect small proportion of slope length with 10m to 12m the rest of the sample carry large slope length with ranging from 150 meters to 600 meters. These attributes allow diversified landscape practices in the sample locations particularly which carry natural water resources.

## 6.4 Surface Roughness

Surface features such as coarse woody debris, rocks and boulders, vegetation, and other micro-topographic features affect overland flow (Johnson, et al, 2008). This attributes also manipulate water content, moisture infiltration and controlling pollutant into water bodies. Surface roughness also influences the effectiveness of buffer width. From the field survey, it has observed that almost all the samples carry surface roughness in the land-water interface. The slope of the riparian buffer contain soft permeable surface with natural vegetation, depression area and undulated topography. Depending on the soil quality, the local inhabitants' practice diversified agricultural practices in the land-water interface. With the seasonal variation, the land of the interface contains cultivated trees, highland crops, orchards, vegetables production, paddy cultivation, herbaceous plant and crops, perennial beels and haors. These practices develop various surface roughnesses and generate varieties landscape pattern. Observations from the field surveys in different seasons evident the surface roughness by landscape variations (Figure 14). Even the sectional

investigation over the samples (Figure 13) also establishes this rough surface quality of land-water interface for al sample location. The land surface does not slope smoothly and consistently towards the water bodies. These help to slowdown the surface runoff, increase moisture content of soil, pollutant traps with the interface, enhance and agricultural practices which requires various moisture content. The surface roughness features exists in the sample areas are woody and herbaceous vegetation, wetland vegetation, coarse-woody debris, wooden logs which slopes away from the water bodies.



Figure 14. Surface condition containing orchards, vegetation, crop cultivation, grassy, depressed, undulated surface observed in the field survey.

## 7. Knowledge from the Indigenous Setting for Integrated Landscape Framework

The detail investigation of this study reveals that the indigenous settlement contains substantial landscape diversity in terms of physiographic elements in their land-water interface. Area, width, slope gradient, slope length, edge condition of the land-water interface have much locational identity to be incorporated in the development practices in such deltaic region. The presence of various water bodies within the settlement ensures the hydrological balance with the climatic variation. Though these water bodies are disappearing very rapidly in the urban built-up areas, these indigenous settlements are integrating these with their local practices and knowledge. Depending on the types of water bodies, the settlements retain the land-water interface with varieties. The area as well as the width of land-water interface has changed variably which allow diversified landscape practices concerning moisture content and land availability with seasonal variation. In parallel to rain water collection capacity within the land-water interface during monsoon, these expanded interface area are used for various agricultural and aquaculture practices by the local inhabitants. Therefore, the variable area and width of the water edge allow hydrological and ecological services for the built environment.

The slope gradient of the water edge allows slow water increase and decrease of storm water before and after the rainy season respectively. These not only make aware the locals about the pre flooding, but the low sloped edge content and hold moisture for long in the soil. These penetrate the water into subsoil to recharge aquifer and allows multiple agricultural practices with require moisture content. The local inhabitants utilize the slopped water edge in various indigenous practices like stepped, earthen dike for crop production. The surface roughness in these samples is predominantly absorptive which allows water penetration to the subsoil, slowdown surface runoff, moisture content in the soil, ecosystem services. All these physiographic attributes of indigenous land-water interface have potential hydro-ecological services for water sensitive built environment.

Following the above investigation and discussion, the identified landscape elements that can be suggested in integrated landscape framework are given below:

**Element 1:** Ensure natural, wide and variable land-water interface.

**Element 2:** Area of the land-water interface need to be variable having ability to be expanded from 100% to 200% with the seasonal changes.

**Element 3:** The width of the interface can be extending from minimum 20 meter to maximum 500 meter depending with the types of water bodies.

**Element 4:** The slope gradient of the land-water interface can be varying from 1:20 to 1:100.

**Element 5:** The slope length can be 30 m for the majority chases which can be extend up to 500 meter in some segment.

**Element 6:** The surface of the land-water interface must be soft, rough, non-structural and permeable in most of the cases.

**Element 7:** Meandering shape in the interface need to be ensured.

# 8. Conclusion

In the present development practices, the land-water relationship is a forgotten term for the built environment. The huge intervention and alteration in water management, the natural hydrological landscape are eventually been controlled and altered. As a result, the natural order to establish relation of natural landscape with built environment are progressively replaced by human order and exposed to hydrological and ecological degradation. It has found that the hydro-ecological functions are enhanced or threatened with the changing condition of the riparian zone. To address the prevailing environmental crisis, it has been suggested for discovering ecosystem-based approach of that location for sustainable development and advocated for the best use of natural resources to meet human demand. The traditional indigenous settlement can potentially support a variety of hydrological and ecological features through creative and sound relations with the nature. The physiographic diversity of land-water interface of indigenous landscape need to be extracted and incorporated into the present development practices of that region to ensure water sensitive urban development.

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