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Housing In The Haors: Adapting To Flood Prone Landscapes Of North-Eastern Bangladesh

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Abstract: *Bangladesh is one of the most disaster-prone countries in the world. Floods are foremost among them. A haor is a wetland ecosystem in the north eastern part of Bangladesh which physically is a bowl or saucer shaped shallow depression, also known as a back swamp. During monsoon haors receive surface runoff water from rivers and canals to become vast stretches of turbulent water and causes flood. This study portrays the living condition of flood prone haor areas in Bangladesh and the vulnerable community in these areas. A haor region has been chosen for this study where flood affect the most. This study has focused on existing homes in the selected study area and the process of building and maintaining a system to face frequent flash flood. This study aims to find ways to make structures more resistant to facing flood and less prone to flash flood effects. The necessary information was gathered by asking various related questions to the people from the survey area. By studying the site map and analyzing the previous flood data, the strength, weakness, opportunities and threads are sort out of the selected haor area to guide a sustainable housing design for the general people of the area as well as all 'Haor' area. This paper is an endeavor to depict the picture of housing and social life and livelihoods of Haor community in Nikli of Kishoreganj district of North-Eastern region of Bangladesh. It assessed the socioeconomic condition, livelihood patterns, risk and uncertainty of Haor housing.*
Keywords: *Housing, Haors, Flood Prone Areas, Vulnerability, Affordable housing.*

1. INTRODUCTION

Bangladesh's water scaping is flowing across the country like veins, breathing life into its each and every corner with lush green and rich biodiversity of life. This wetland ecosystem has blessed us with several haors located on the north east region of Bangladesh. Haors have unique beauty of its own as it comes into full glory with an abundance of clear blue water in the rainy season while spreading hues of green around its vast territories in the winter. Among these Haors, Nikli haor is a one with tantalizing natural beauty with glistening clear blue water spreading its territory so vast that the villages that the villages appear to be dotted around the haor like island far away. These Haor homesteads have distinct characteristics with flourishing biodiversity that people live on. These wetlands of Bangladesh have been subjected to rapid degradation due to population pressure, massive withdrawal of water for irrigation, and a number of other anthropogenic and natural causes. Thus, there is genuine and urgent need of undertaking efficient and sustainable management of wetland resources of the country.

2. LITERATURE REVIEW

2.1 Definition of Haor

Haor, a back swamp or bowl-shaped large tectonic depressions located north- eastern region of Bangladesh between the natural levees of rivers and may comprise a number of Beels (Rana et al., 2010). Large areas of Sunamganj, Sylhet, Habiganj, Maulvibazar, Netrakona, Kishoreganj and Brahmanbaria districts of Bangladesh are covered by many Haors. There are 373 Haors which cover an area of about 1.99 million ha and accommodate about 19.37 millions of people covering around 43% of the total area of Haor (Jakariya and Islam, 2017; Abuodha and Woodroffe, 2006; BHWDB, 2012).

Haor Mapping

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District	Total area in ha	Haor area in ha	No. of haor
Sunamganj	367,000	268,531	95
Sylhet	349,000	189,909	105
Habiganj	263,700	109,514	14
Maulvibazar	279,900	47,602	3
Netrakona	274,400	79,345	52
Kishoreganj	273,100	133,943	97
Brahmanbaria	192,700	29,616	7
Total	1,999,800	858,460	373

Table no 1: Number of haors in different districts

Fig no 1: Haor mapping

Haors are basin like structures where water remains stagnant or flash flooding condition during the months of June to November (Sarif et al., 2016). These basins also act as a natural reservoir by regulating water flows of the Meghna river system (Rahman et al., 2016). Heavy rainfalls and onrush of water from the upstream Meghalaya hills in India causes inundation of Haor crop lands each year.

2.1.1 Geography of Haor

The haor basin is an internationally significant wetland ecosystem that is spread throughout Sunamganj, Habiganj, Moulvibazar districts, Sylhet Sadar Upazila, as well as Kishoreganj and Netrokona districts beyond the core haor area, in a nation where wetlands make up one-third of all land. There are 400 haors and beels in this area, ranging in size from a few to several thousand hectares.

There are 80,000 square kilometers of haor-type wetland environment in Bangladesh. The Indian hill ranges that border the haor basin are Meghalaya to the north, Tripura and Mizoram to the south, Assam and Manipur to the east. Due to the subsidence of the tectonic Dauki fault, this area is low. Subsidence is still occurring in the haor basin's geological depression at an estimated rate of 20 mm annually. It has sunk by about 10 m in certain spots during the past few centuries. According to some specialists, the territory is further divided into three zones based on morphology and hydrology norms.

2.1.2 Differences among haor

Haor Name	Netrokona	Kishoregonj	Habigonj	Sylhet
Location	Dharmapasha, Mohanganj,Ma dan, Jamalgonj, Kaliajhuri. Tahirpur, Bishambarpur	Tarail,Karimganj, Nikli, Austagrm, Mithamon	Lakhai, Baniyachag, Sulla, Dirai,	Shunamgonj, Dowara bazar, Chhattak, Companygonj, Gowainghat, jaintapur, kanairghat, beanibazar, fenchuganj, Rajnagar, maulovibazar,
Geography	Near the Meghalayan border. Five main rivers- Kangsha, Someshawri, Dhala, Magra, Teorkhali. Part of Surma-Meghna River system.	Hill ranges of India-Meghalaya in the north, Assam in the east.	This part of Bangladesh is characterized by alluvial plains which are dissected by various connecting rivers, streams, and lakes; it is vulnerable to both flood and drought. The land is devoted mainly to agriculture due to its fertile alluvial soils	Tan guar Haor is one of the largest Haor in Bangladesh. A typical Freshwater swamp forest can be seen on the right side and the Khasi Hills of the state of Meghalaya in India can be seen in the background
Origin	Surma-Meghna River System.	Floodplains of Meghna	Assam hilly area.	Assam hilly area.

Table no 2: Differences among haors

2.1.3 Haor land and habitation

The haor regions' lands can be divided into the following groups:

a) **Homestead:** To provide for their families, the haor people cultivate two types of land: Bhita (inside the homestead) and Bisra (property adjacent to the homestead area).
b) **Kanda:** Sites that are slightly higher than agricultural fields but lower than homesteads are known as kanda.
c) **Agricultural field:** Typically, flat and used to grow crops.
d) **Kuri:** A location that is mostly used for fisheries and is submerged during the dry season.
e) **Roadside areas**

Settlement History

The communities in the haor region are closely clustered and constructed on the natural levees (locally known as kandas). Because no habitation is permitted beyond the levees, the haor settlements are very big. The satellite communities are built distance from parent villages during the dry farming season, deep inside haor beds. The village buildings are removed after harvesting and before flooding to be carried back to parent communities with the harvests.

Government holdings (khas land), especially wet fields, are increasingly being transferred to private hands in Bangladesh as a result of the lack of arable land. As a result, the majority of haors and beels have now been sold or leased to private individuals for dry-season farming. The Haor Development Board Ordinance (Ordinance No. IX of 1977), which governs this transfer, is directly supervised by the Ministry of Land Administration and Land Reforms' Revenue Department.

2.1.4 Haor homesteads

Fig no 2: Settlement history of haor area

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Housing by GOs & NGOs	Local housing practice	Local house examples
Gable and hipped both type of roof commonly used in this area	Local self-built houses are mostly single storied and hipped roofed type.	 Thatch house
Communal raised plinth is a common feature.	RCC post and metal/wooden frames are dominant in structure.	
CGI sheet is the most used building material for roofing and walling.	CGI/plain metal sheets are used as wall and roofing material.	 Mud house
Use of bamboo mat as walling material.	Windows are absent in most of the houses.	
Bamboo/RCC post both are used as structural element.	Maximum plinths are kutcha.	 CGI sheet house
Thatch as roofing can be seen in some houses.	Bamboo mats/ tarpaulins are used under roofs in order to mitigate the heating	

Table no 3: GO/NGO/Local practices of haor homesteads

2.2 Guidelines from Ministry of Housing and Public Works

The suggested model house in the Haor area has a layout and physical structure that is quite similar to that of the flood-prone area, with just a few variations that reflect the way of life of the Haor locals. A few of the steps justified for the more stable mode of occupancy of the inhabitants include avoiding exit hatch on top levels, linear plans with service space at one end, and avoiding house models for smaller floor areas. The climatic factors which should be taken into account when designing are Flash Flood, nor westerly, tornedo windy waves (Afal), embankment erosion, monsoon flooding, humidity and northern winter wind. (Source: Ministry of Housing and Public Works).

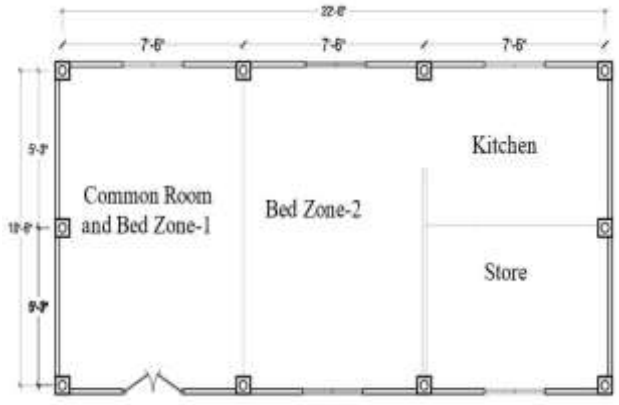

Fig no 3: Proposed model house plan

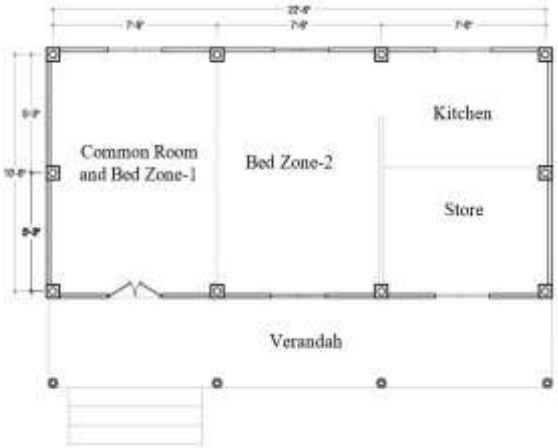

Fig no 4: Plan with additional veranda

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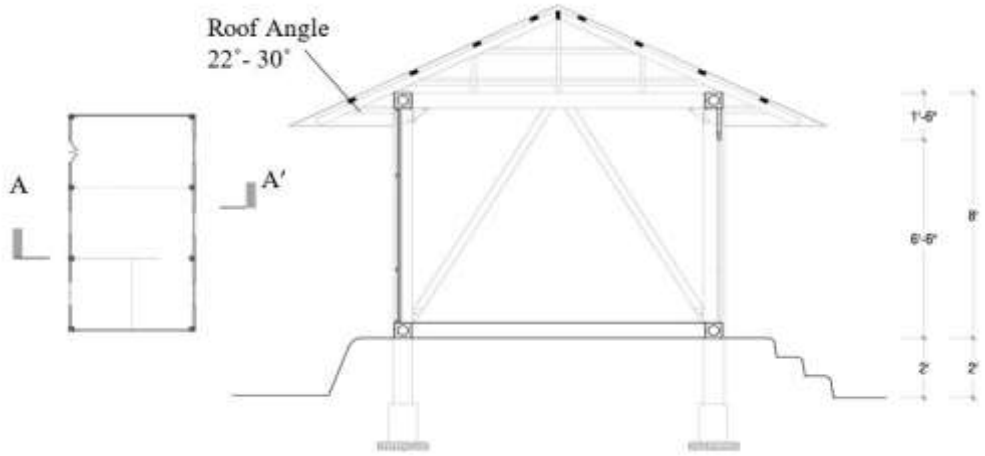


Fig no 5: Section AA'

Formation of house module- lower structure

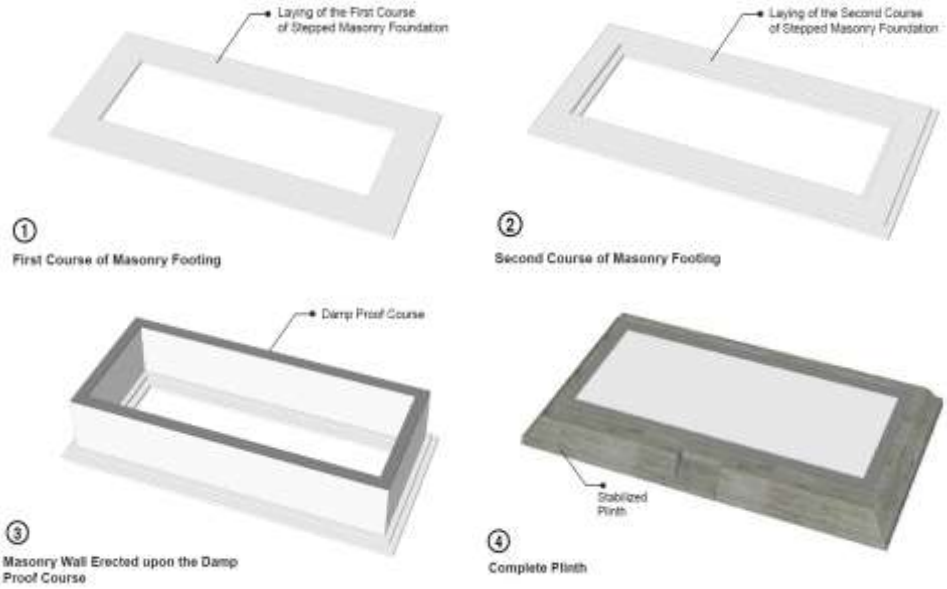
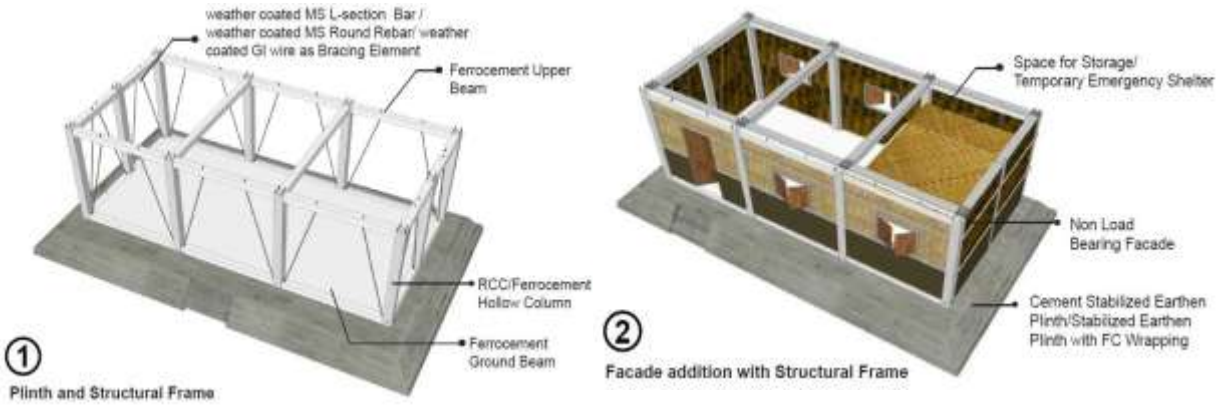


Fig no 6: Lower structure formation of house module

Formation of house module- upper structure



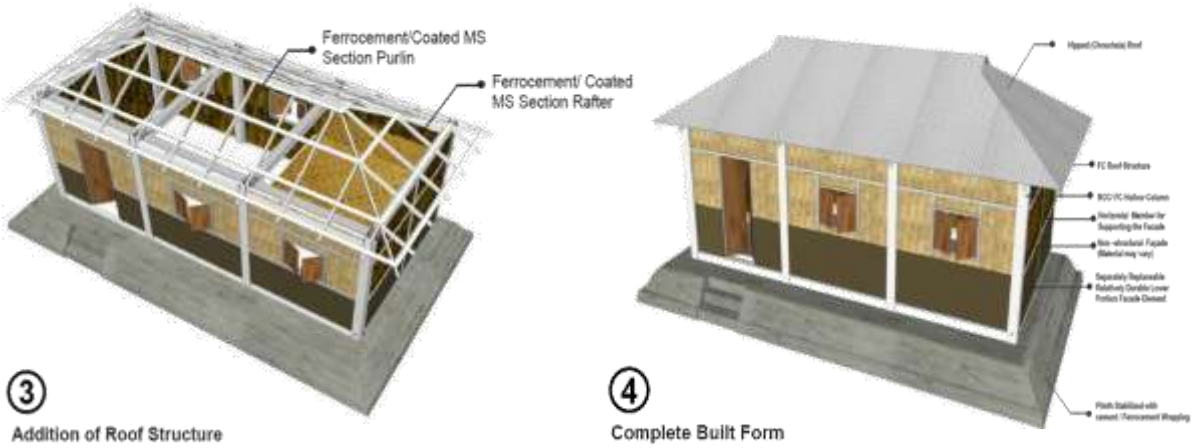


Figure no 7: Upper structure formation of house module
Source: Ministry of Housing and Public Work

2.3 Flood in Bangladesh

A flood is an overflow of water that submerges land that is usually dry. Floods are often caused by heavy rainfall, rapid snowmelt or a storm surge from a tropical cyclone or tsunami in coastal areas. (WHO).

2.3.1 Factors of flood

Flooding may result from more rain than usual. The 1988 flood in Bangladesh is believed to have been caused mostly by an above-average **monsoon downpour** in the Ganges-Brahmaputra-Meghna drainage system (GOB and UNDP, 1989; Brammer, 1990). Within a two-week period, the three major rivers' flood peaks coincided, resulting in a dramatic rise in water level that affected almost the whole nation (GOB and UNDP, 1989; Brammer, 1990). While the 1988 flood's cause may have been explained by the **synchronization of flood peaks,** this theory falls short in explaining why there has been a general increase in the frequency of low frequency floods in recent years, including those that happened in 1974, 1984, 1987, and 1991. These are the Short-Term Causes of Flood. There are several long term causes of flood as well. Currently, sea levels are rising everywhere (Pilkey et al., 1989). Rivers that overflow at bank full stage might generate more flooding if the land's elevation decreases. Around Bangladesh's coastline, the rate of **'Local relative sea level rise'** is 7mm per year (Emery and Aubrey, 1989). **Sediment** must amass at a rate that is fast enough to keep up with the rate of sea level rise if land is to be protected from the effects of a rising sea. Only a few data points indicate that Bangladesh's coastal areas have accumulated silt at an average rate of 5 to 6 millimeters per year (mm), which is insufficient to keep up with the sea level rise (Khalequzzaman, 1989). Because of this, net land elevations must have been falling over time, increasing flood inundations. Due to the weight of the large sediment layer, most deltas sag. **Compaction and subsidence** lower land elevation relative to rising sea levels (Pilkey et al., 1989). It may be presumed that Bangladesh's delta is likewise undergoing subsidence and compaction based on our understanding of processes functioning in other deltas. Rivers can no longer carry as much water and exceed their banks as a result of **riverbed aggradation.** The riverbed has widened by up to 5-7 meters in recent years between the Indian borders and where the Ganges meets the Brahmaputra (Alexander, 1989b). In Bangladesh, riverbed aggradation is so severe that changes in riverbed level can be seen over the course of a lifetime. For instance, the Old Brahmaputra, which is currently an abandoned river, was only passable for steamers around 30 years ago. **Deforestation in the upstream region** contribute to catastrophic flooding in the downstream areas, like Bangladesh (Hamilton, 1987; Reuters, 1988; Alexander, 1989a). On the other hand, a river's downstream flow velocity is decreased when it is **dammed**. Bangladesh's agriculture, navigation, environment, and hydrodynamic equilibrium have already suffered greatly as a result of the Farakka Barrage on the Ganges (Shahjahan, 1983; Siddiqui, 1983; Broadus et al., 1986; Khalequzzaman, 1989). The topsoil on farmed ground is easily removed by surface drainage. This surface **soil erosion** lowers the height of the ground, which in turn makes local floods more intense. Bangladesh's land heights must have fallen through time as a result of farming. (Dregne, 1987; Thapa and Weber, 1991; Sharma, 1991). (Alexander, 1989a). Bangladesh's flooding issue must have become worse as a result of this **rapid industrialization and urbanization**. There is a longer delay between heavy rain and peak stream flow before urbanization. Urbanization reduces the lag time, increases peak flow, and compresses total run-off

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into a shorter time period, creating ideal circumstances for severe flooding. For instance, floods are nearly six times more often now than they were before urbanization in a city that is entirely served by storm drains and where buildings and roads occupy 60 percent of the ground area (Pipkin and Cunnings, 1983). **Seismic and Neo tectonic activities** also creat flood. Bangladesh's northern areas are prone to earthquakes (Morgan and Mclntyre, 1959). River channels in the region are being impacted by neo tectonic processes (recent shifts in the Earth's crust). According to Morgan and McIntyre (1959), such neo tectonic activity is taking place in the Madhupur and Barind tracts. The majority of the most recent floods have occurred roughly at the same time as seismic activity. **Greenhouse effect** is also responsible for flood. Low-lying coastal communities will experience a much more significant rise in sea level should the greenhouse effect materialize (Milliman et al. 1989; Gable and Aubrey, 1990). Such a rise in sea level will have a significant impact on Bangladesh (Broadus et al., 1986; Khalequzzaman, 1989; Ali and Huq, 1989; Brammer, 1989; Hossain, 1989). The greenhouse impact will also make it rainier and stormier, which will make the flood problem worse.

2.3.2 Floods in Haor Region

A flash flood is referred to as a flood that is caused by significant or unneeded precipitation across a very small area in a short amount of time. The water level rises and falls rapidly with little to no climatic gauge or warning, causing an instant flood. Flash floods frequently occur in areas where the geology of the upstream bowl is typically steep and the focus time of the bowl is somewhat short.

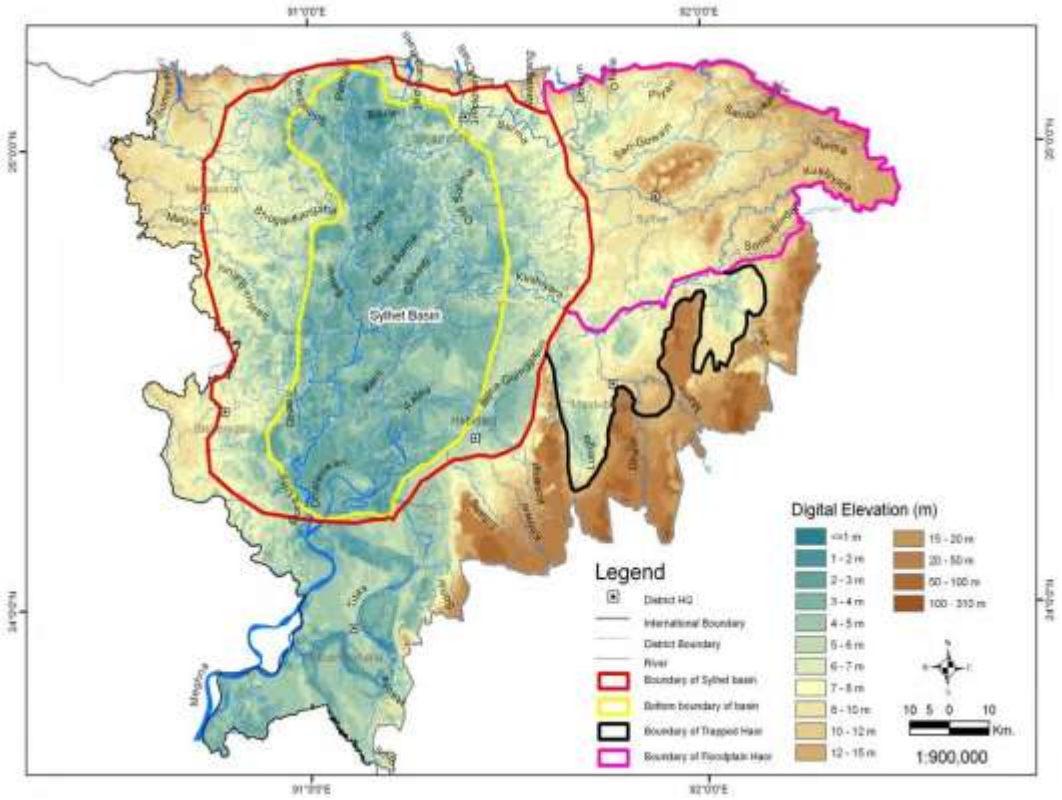

Figure no 8: Deeply flooded haor basin and river marked as aqua color in north-east region of Bangladesh (Source: CEGIS, 2010)

Flash floods typically occur in Bangladesh's north-east, south-east and Chittagong region. Flash floods are always occurring in the northern Haor regions due to the outrageously flamboyant nature of the streams and unforeseen extraordinarily high precipitation in the district. (Source: Causes and Consequences of Flash Flood in the North-Eastern Part of Bangladesh: A Case Study on Tahirpur Upazila of Sunamganj District).

2.3.3 Causes of flash floods in haor region

- The unusually high uplands that border the Assam and Meghalayan slopes run in India cause the flash floods in the Haor region, which continuously cause massive harm to the standing Boro yields, lives, and property.

- Our Haor is situated at the base of the Meghalaya Mountains, therefore whenever significant precipitation occurs in that rugged area, the water first arrives and hits the Haor region.
- One such reason for the flash flood is geomorphology. The Haors are essentially swamps, and the purpose of this zone's flash surge is due to the water stream bearing to the lower land.
- The northeastern region of Bangladesh, in particular the districts of Sunamganj, Sylhet, and Netrakona, is one of the country's desolate or low-lying areas. The majority of the streams in these areas originate in the nearby inhospitable region of the neighboring country India.
- When India's bumpy district experiences excessive precipitation, water quickly rushes through a variety of streams and channels toward Bangladesh's Haor region. This floodwater not only carries water, but also a significant number of debris that originated primarily from the slope. This residue built up on the beds of the rivers and channels over time and reduced the transport capacity of the bulk of the water resources infrastructure in the Haor region.
- The result is that water effectively overtopped and caused rupturing at a few locations on the submerged bank when flash flood caused by abrupt considerable precipitation placed weight on the water asset's structure. Water eventually flows quickly into the haor.

(Source: Causes and Consequences of Flash Flood in the North-Eastern Part of Bangladesh: A Case Study on Tahirpur Upazila of Sunamganj District).

2.3.4 Impacts of flood in haor region

Flash floods have an impact on people's livelihood, their economy, and their overall assets in both positive and negative ways. Flash floods during the early and late monsoons frequently have a positive effect on fish output. For instance, early flash floods boost fish output because the water arrives sooner, covers more ground, and lasts longer. On the other hand, flash floods that occur early harm paddy output and flash floods that occur after a monsoon threaten vegetable production. (Source: Impacts of Flash Flood on Livelihood and Adaptation Strategies of the *Haor* Inhabitants: A Study in Tanguar *Haor* of Sunamganj, Bangladesh).

Other impacts can be noted as: Home and landlessness, Land erosion, Poor transportation system, Problem of education, Poor medical facilities and sanitation ▪Health hazards and sickness, Lack of women empowerment, Lack of alternative livelihood, Loss of crops etc.

2.3.5 Adaption methods due to flood in haor region

Adaptive measures have been being practiced in haor people to cope up with their day-to-day life. These methods include a spectrum of methods including changes in house structure.

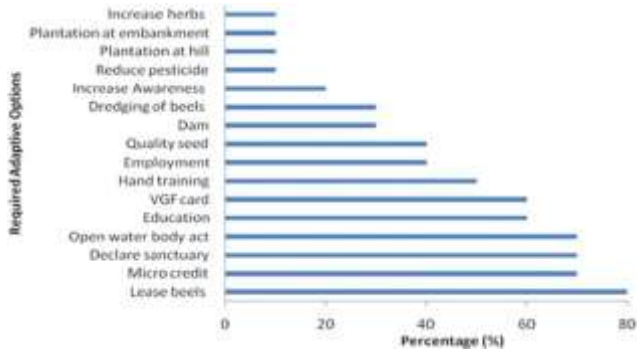

Fig no 9: Required Adaptive Options

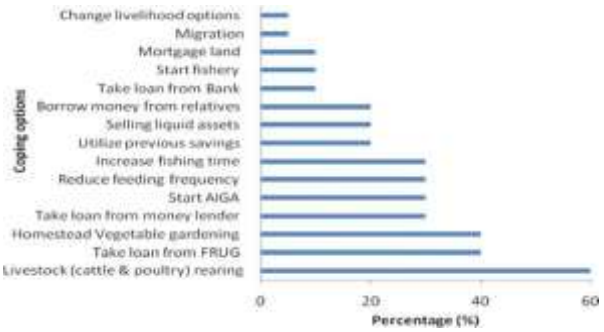

Fig no 10: Coping Options

2.3.6 Flood resiliency in haor region

CARE Bangladesh undertook a project in the 2007 fiscal year to construct a protection wall or embankment along the river's edge along with other pertinent infrastructures. "Homestead Protection Wall Building Project" was the project's name. Together, Bhairab Municipality and USAID5 funded this project. The following were the main characteristics of this site modification project:

- Land Elevation: Initially, land elevation was raised to render the area permanently free from riverine flooding. Sand and garbage were dumped on the area, raising it from its original level up to 14 feet (4.27 m).
- Protection Wall: To safeguard the village from riverine flooding and bank erosion, a 2 feet (60.96 cm) thick reinforced concrete wall was constructed around the land area. This wall has openings that allow rainwater and sewage to be drained away using an underground drainage system.
- Land Reclaimed from the River: While constructing the protection wall, more than 20% of the present land area was recovered from the riverbed. This extra property assisted in creating room for community amenities and access roads.
- Underground Drainage System: An underground drainage network was set up to drain off the waste water and rainwater, with the exception of the region inside the protection wall of the power distribution tower. Rainwater and sewage are discharged into rivers and canals through outlets in the protective wall by drains positioned beneath roadways.
- New Plot Layout: All of the space was reorganized with plots that were accessible by internal lanes, with the exception of the region enclosed by the power distribution tower's protective wall.
- Tree plantation: By the side of the river, Karoch trees were planted to withstand the wave of the flood, so that it doesn't directly affect the homesteads.

(Source: Factors and actors for enhancing community flood resilience: an experience from a river-side settlement in Bangladesh)

2.4 Disaster Resilient Structures:

Case Studies

For a better understanding of how homesteads are strengthened and protected from the vulnerabilities of floods, national and international case studies have been integrated in this study. These case studies have carefully reviewed existing flood impact on homesteads and synthesized it in order to illustrate how the case is relevant to the research challenge.

2.4.1 Disaster resilient bamboo housing in India Built by SEEDS

General Information

- Disaster type: Flood
- Location: Golaghat, Assam, India
- Type: Contemporary vernacular architecture
- Material: GI sheet, bamboo, wood, thatch
- Funded by: Godrej
- Completion year: 2018
- Built area: 23 square meter per house x 80 units

Fig no 11: Golaghat, Assam

SEEDS has built 80 bamboo houses as part of a community-driven flood response program in Assam, India. These houses faced two flooding seasons after construction and successfully survived, demonstrating the relevance of integrating indigenous knowledge with contemporary building technologies.

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Fig no 12: During flood

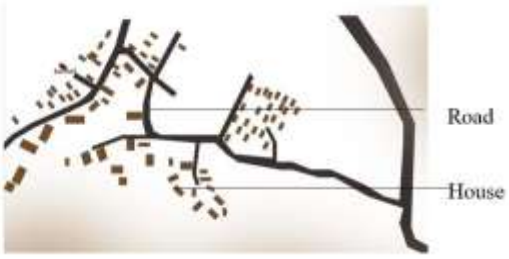

Fig no 13: Cluster map of SEEDS village

Flood resilient design

While the high stilt helps to cope with the annual flooding, its flexible joinery system allows the homeowners to shift the floor higher in case of over flooding – a unique feature that was adopted from the traditional practice of the region.

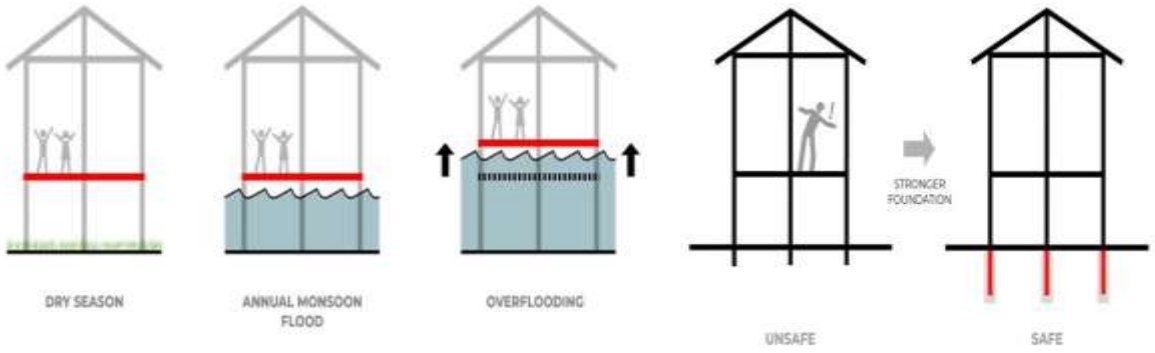

Figure no 14: Flood resilient design

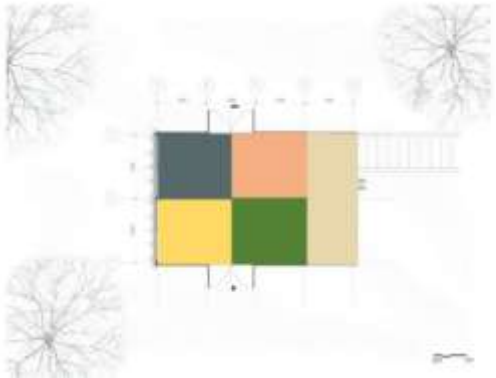

Fig no 15: Typical house plan

Fig no 16: Typical house Section

Material: Bamboo & Rattan, Cgi sheet: Two types: Bhaluka bamboo Jati bamboo. Stilt bamboo columns waterproofed with a rubberized coating; introduction of cross-bracings and use of indigenous tying techniques with rattan and bamboo dowels to make the structure resistant to lateral forces during floods and earthquake.

Fig no 17: Use of traditional material

2.4.2 Mishing village, India

General Information

- Disaster type: Flood
- Location: Majuli Island, Assam, India
- Geography: Surrounded by Brahmaputra rive
- House Type: Stilt house called 'Chaang Ghar'
- Community: Mishing community, Mongoloid tribes of Tibetan Burmese group

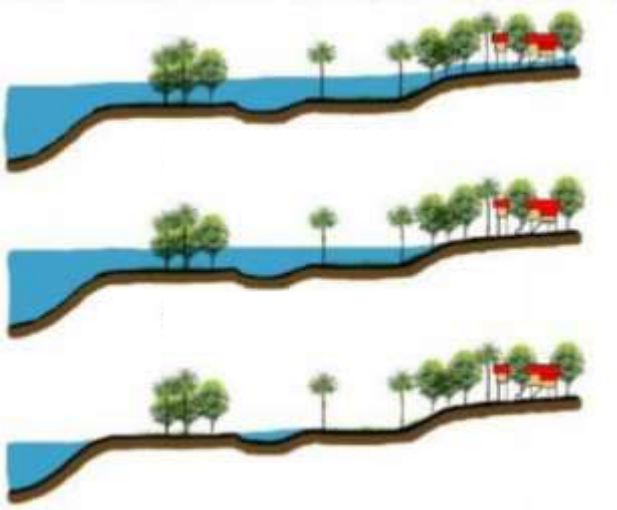

Fig no 18: Flood level

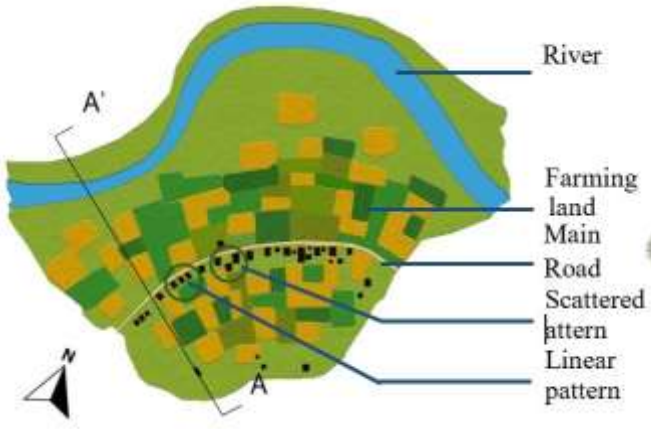

Fig no 19: Settlement Pattern

Fig no 20: Homestead

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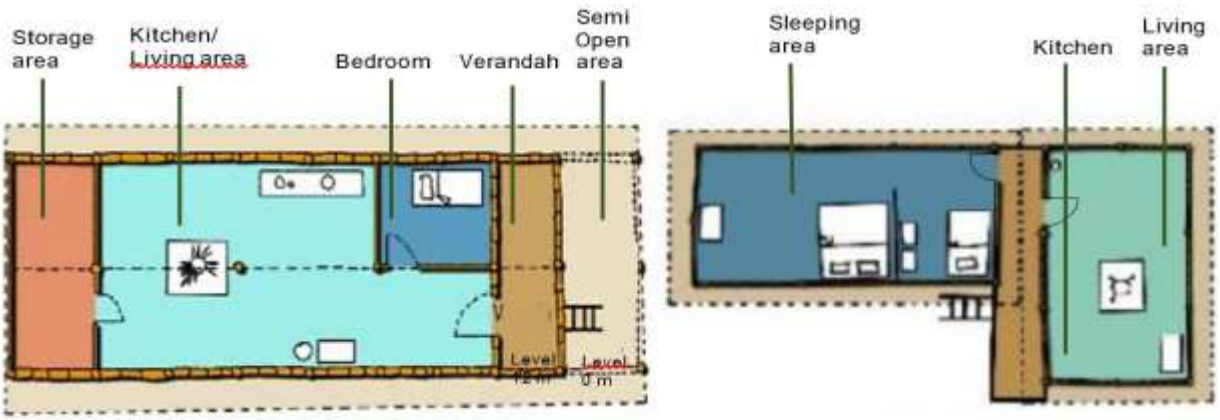
Unit types in cluster

1. Used for living **2. Used for annual food grain storage**



House Type-1 **House Type- 2**

Fig no 21: House Types, Materials and joints

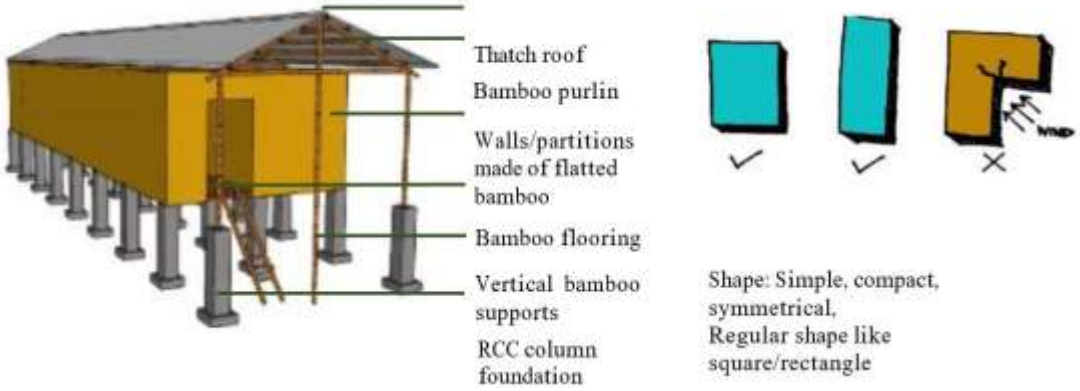


Fig no 22: Complete form

2.4.5 Findings from case study

Findings	Built by SEEDS	Mishing village, India	**Learnings**
Name	Disaster resilient bamboo housing in India Built by SEEDS	Mishing village, India	1. Typologies of disaster-prone stilt houses and their improvisation
Orientation of house	North south oriented	Every direction except west	2.Orientation difference due to local religious practices
House pattern	Stilt house with rattan wall and CGI sheet roof	Stilt house with flattened bamboo weaved wall and thatch roof	3.Availibility of sustainable material and their craftsmanship of local structural joint
Openings	Large opening window	Small opening window	4.Windflow of riverine area
Cluster type	Irregular pattern	Scattered and linear	5.Community linear household practices

Vegetation	Areca palm used protection	No significant tree is used for protection	6. Soil quality for and river erosion
Community	Farming community	Mishing community	7.Influence of livelihood

Table no 4: Findings from case study

3. Methodology

Combination of both qualitative and quantitative method has been taken where collection of primary and secondary information has thoroughly analyzed for getting a better understanding of the housing scenario and its vulnerability. Study of typologies of vernacular housing in North east is carried out and also to find different strategies to withstand the flood. The findings will be incorporated in the final outcome. Initial stage includes site studies and vernacular housings materials and details. Collection of secondary information has been done from various government and private institution to understand flood situation in Kishoreganj haor area and different factors affecting built forms.

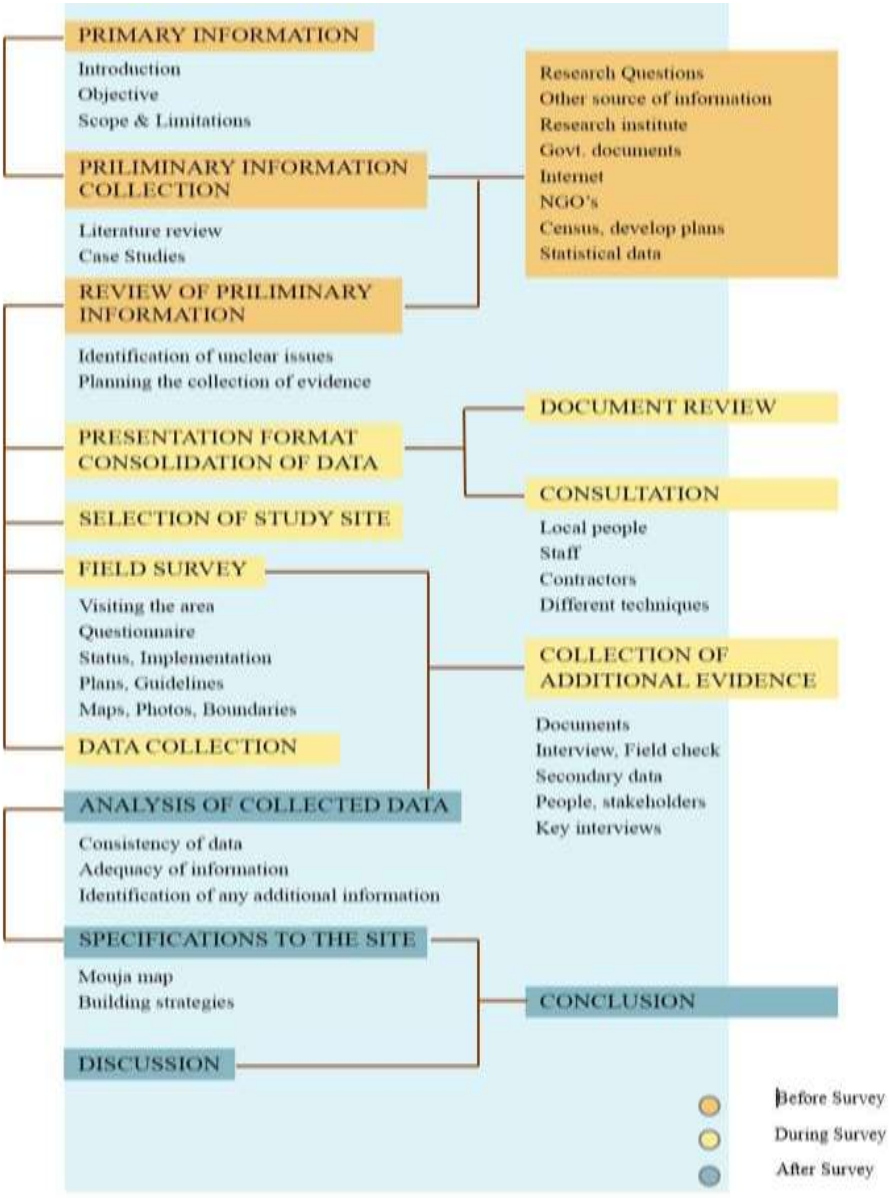


Table no 5: Methodology

Primary Data Collection	Methods of Data collection
Stakeholders	Primary survey
Local People in targeted areas	Questionnaires
NGO workers	Audio, Video recordings

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Guides	Measure Drawing of each house
Monks in Satras	Key person interview
Government offices	Observations

Fig no 23: Survey Works

4. Discussion

4.1 Site Introduction

Fig no 24: Map of Kishoreganj

- Ashtagram upazila is an isolated upazila surrounded by Hawar. Location of Ashtagram upazila towards southeast from Kishoreganj.
- Geographical location: 24.16 degrees north latitude and 91.07 degrees east longitude.
- Seasonal influence: Seasons bring huge impact on the inhabitants' lifestyle. The yearly timeline can be divided into:

1. Dry season: Haor water recedes in Kartik month (October to November). It takes 1.5 months to recede the water, then 'Jala Dhan' is harvested for 1.5 months and later, 'Boro Dhan' for 3 months.
2. Wet season: For approximately 6 months, the whole haor region remains under water. People then shift to fishing profession and move by boat.

4.2 Site Selection

Baroichar is a village under Austagram upazilla which is at 10 mins distance from Austagram Sadar. It is divided into several cluster of homesteads named 'Chorga /Krisnanagar' and 'Khopar Chor'. Surronded by rivers on both sides this piece of land gets many cultivable lands in the dry season.People living in this village are kind and hardworking but they're deprived of many basic municipal facilities. There are two political parties in this area but when it comes to the welfare of the village, they get along for making the decision best for the village.

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Site selection reasons

1. Khas land – There are sufficient amount of khas land in this area and that too in proper placement where the clusters of homesteads are prone to grow.

2. Relocation- Many families in this village do not have land of their own and thus they're living a quite disadvantaged life. For this reason, if proper facilities are provided people have agreed for relocation.

3. Population- The people are of second generation are their families are growing further. The current uplifted land cannot hold this increasing amount of people.

4. Amenities- There are not any bazar or haat in this area, people have to go too far to sell their items and buy some daily necessities.

4.3 Settlement History

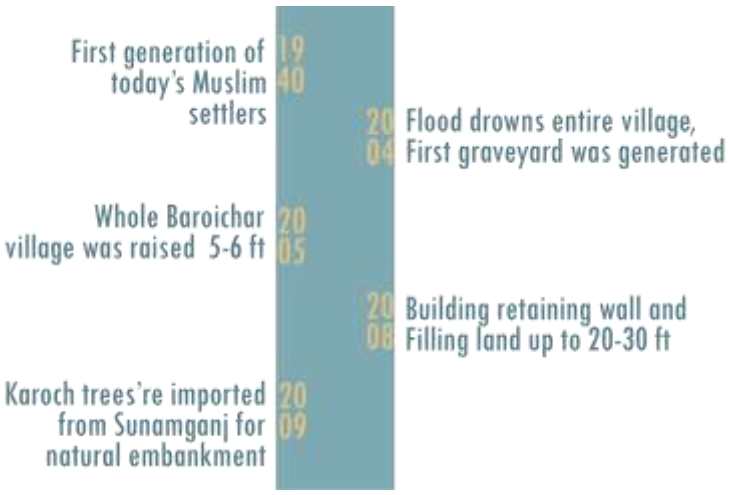

Fig no 25: Settlement history of Baroichar village

4.4 Environment

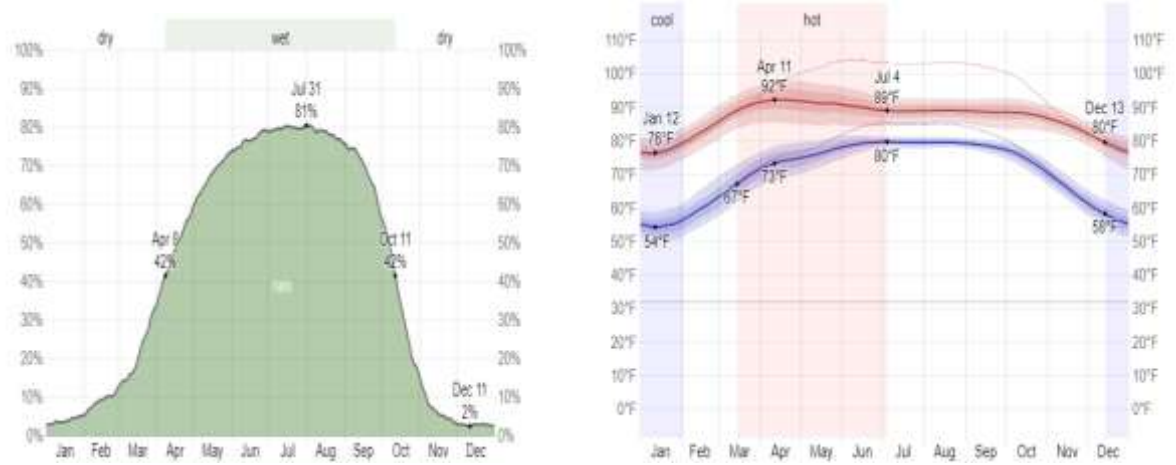

Fig no 26: Temperature and precipitation chart

4.5 Vegetation

Tree Name		Tree Name	
Hijol (Barringtonia acutangular) Used for soil & river erosion.		Pulm (Prunus domestica) For food.	
Karoch (Dalbergia reniformis) Used for soil & river erosion.		Dholkolmi (Ipomoea carnea) For cattle food & soil erosion.	

Rain tree (Samanea saman) Use for rafter framing, furniture & doors.		Water hyacinth (Eichhornia crassipes)	

Table no 6: Vegetation in Baroichar

4.6 River map

Fig no 27: River mapping around the site

4.7 Site Accessibility

Chittagong to Austagram

Fig no 28: Accessibility to Austagram

Austagram to Baroichar

Fig no 29: Accessibility to Baroichar

4.8 Cluster Zoning

Fig no 30: Settlement pattern of Baroichar

4.8.1 C luster with Shared Courtyard, Scattered Pattern

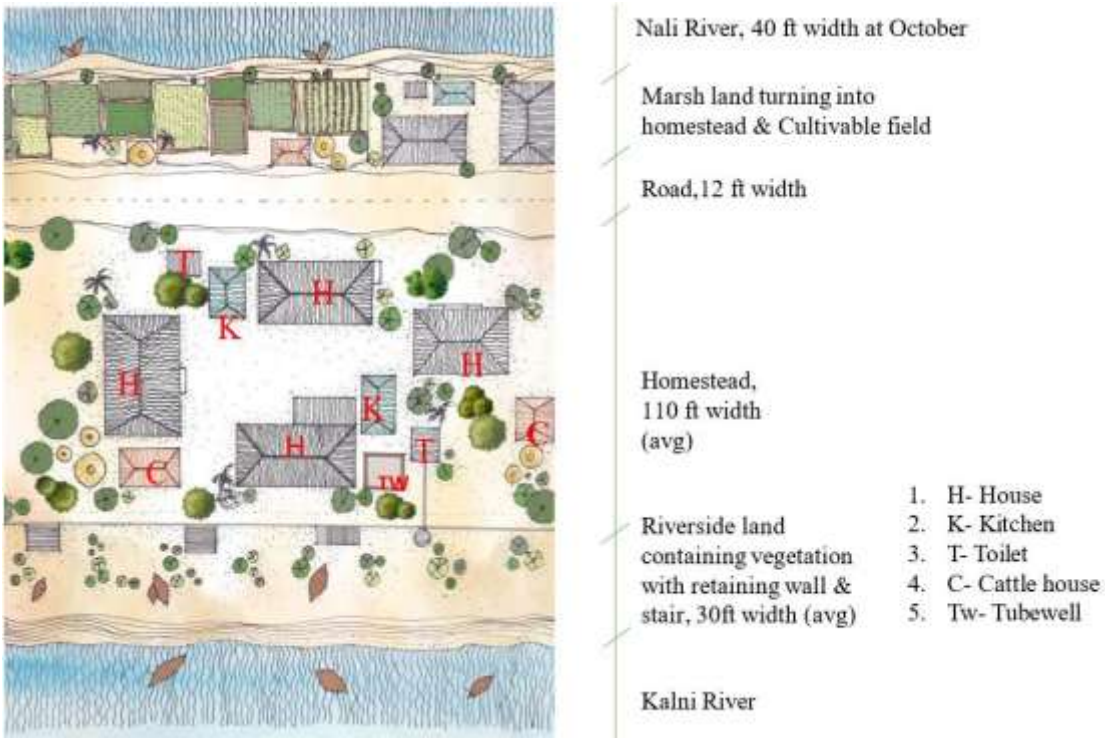

Fig no 31: Cluster example 1

4.8.2 C luster without Shared Courtyard, Linear Pattern

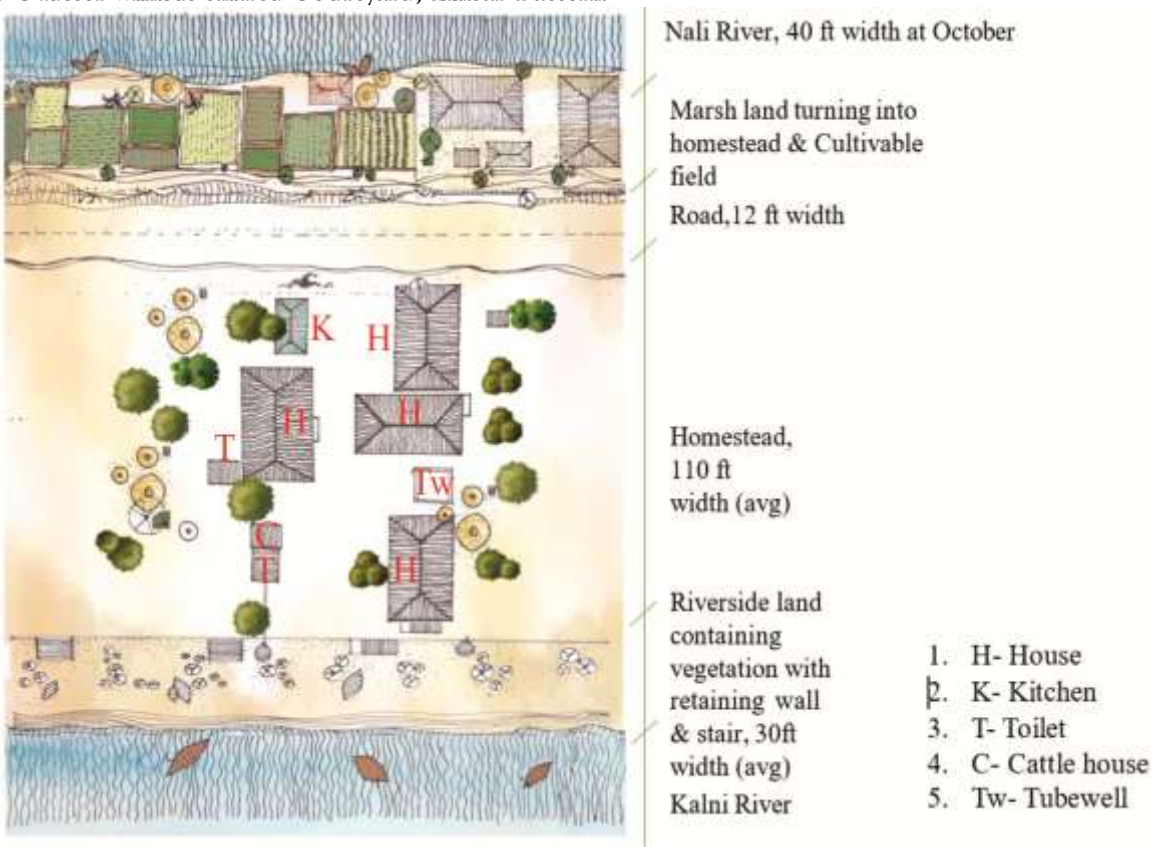

Fig no 32: Cluster example 2

House Type -1

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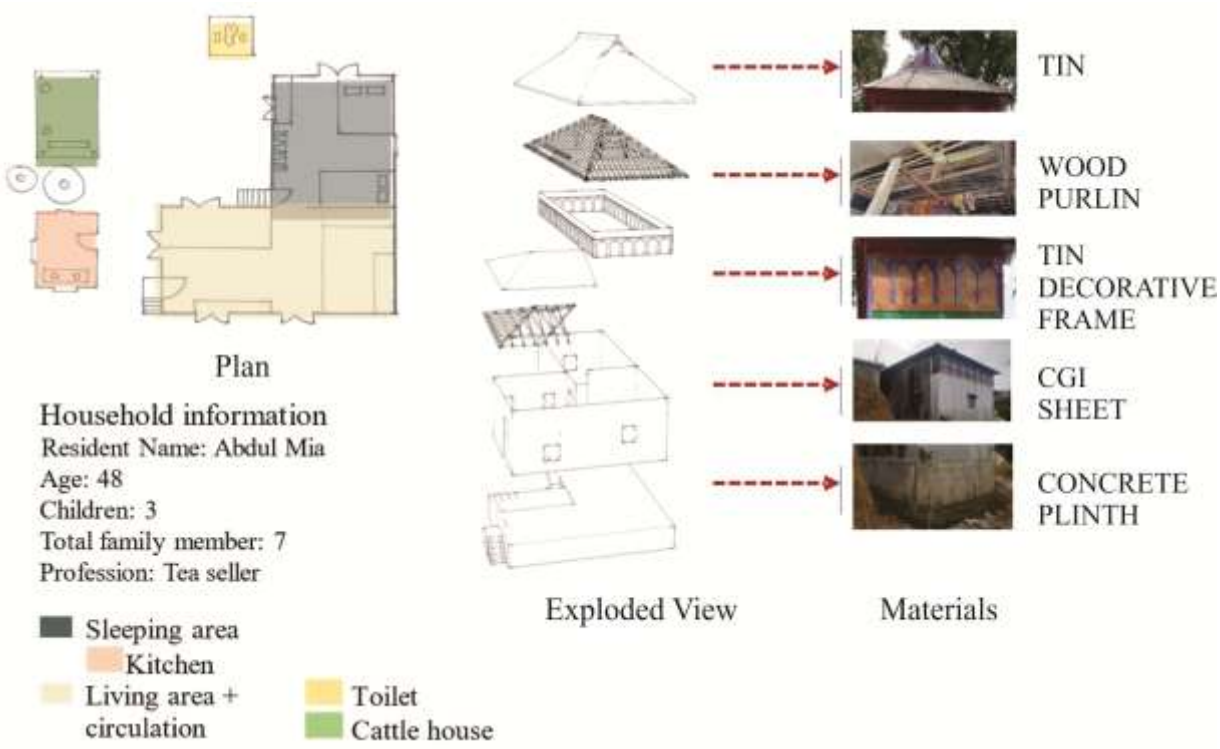

Fig no 33: House Type-1

House Type -2

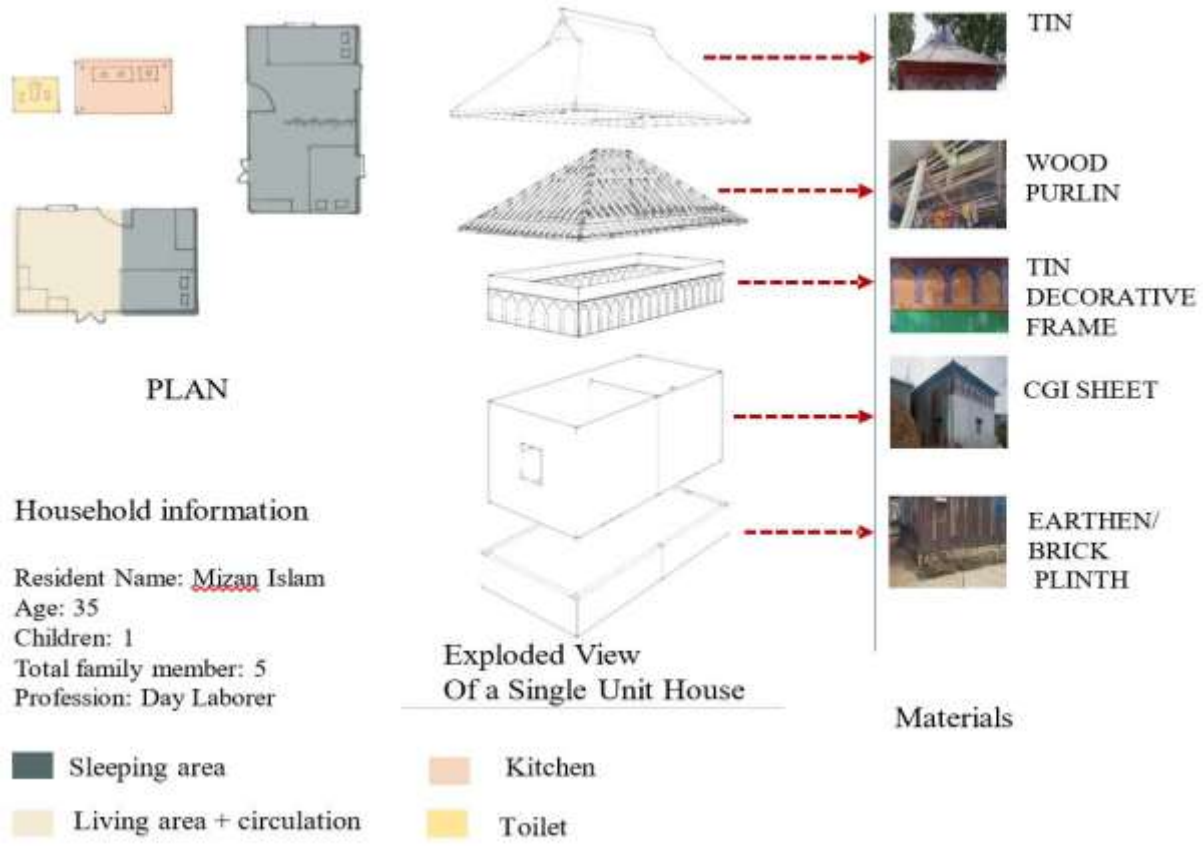

Fig no 34: House Type-2

Other House Types

Fig no 35: Other House Types

4.9 Sections

The section presented here shows the different water level in different seasons. During wet season the road gets submerged in water and the only transportation is different sizes of boat while during dry season the road is travelled by auto and CNG.

Fig no 36: Cluster example 1

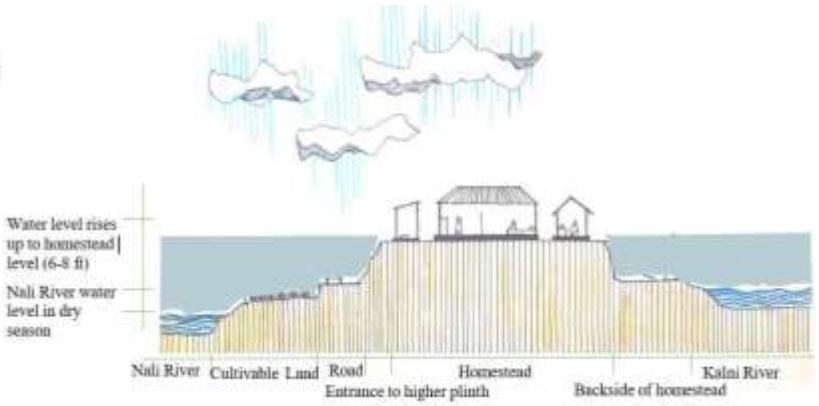

Fig no 37: Section AA

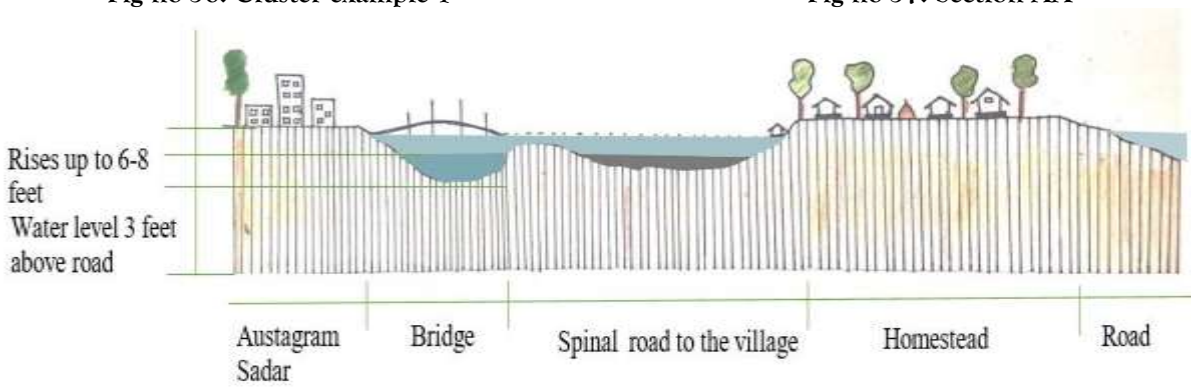

Fig no 38: Section BB

4.10 Structure and materials

House

Houses have different plinth types and roofing materials.

Roofing: Mainly tin roofing, comes with design templates in case of well-off households. The templates are locally called **Jhalot**.

Semi pucca House with earthen plinth

Pucca house with pucca plinth

Semi pucca house with brick plinth

Fig no 39: Building Materials

Outdoor kitchen

Kitchens are placed outside for many families and aren't usually of higher plinth. Hence they get drowned during wet season.

Rubber sheet material Locally called 'Burmese'

Outdor cooking beside cattle house

Metallic decorated sheet with Burmese roofing

Fig no 40: Kitchen structure materials

4.11 Local Practices

Associated with inhabitants' lifestyle

The whole village is provided with stairs from the higher earthen mound on the south side of the map. There are a total of **10 sets of stairs** along the south wing. The land besides the stairs is covered with **Karoch** trees provided by CARE in 2009.

Fig no 41: Retaining wall with stair

4.12 Amenities

No other specific amenities rather than the Primary school within Muslim para, associated with an adjacent mosque. Hindu Para has one prominent Kali mandir. For daily commodities, clinical services, business, people go to Austagram sadar.

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Fig no 42: Location of Amenities

Fig no 43: Local Amenities

4.13 Utilities

Fig no 44: Local Utilities

4.14 Social activities

There are very few recreational activities in the survey area. The activities in among Muslim Para and Hindu Para are quite different in nature. In Muslim para's recreational activities are daily prayer at Mosque, yearly waz mahfil, Students' sports in the nut-fields, 6 tea stalls for daily gathering, Nouka baich in an interval of 5-6 years. Puja celebration, Kirtan, Small daily gathering are found in Hindu para.

4.15 Demographic Data

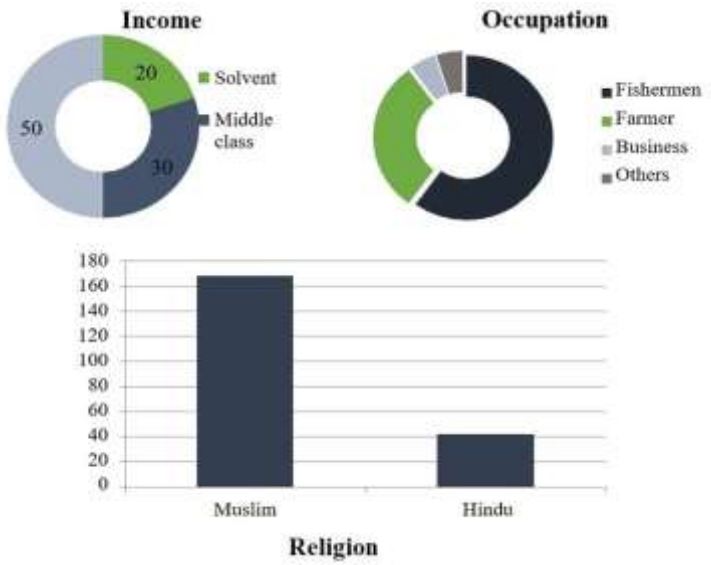

Fig no 45: Demographic charts

4.15 Demographic differences between income range

Criteria	Livelihood	Layout	Socialization	Recreation	Monthly Income
Abdul Mia	Tea seller	Shop module added to homestead.	Own tea stall.	Watching TV at tea stall.	12,000 tk
Siddiqur Rahman	Previous union Member	Shoe business in Dhaka.	Living room at house.	Political Gathering at nearby haat.	50,000 tk
Kirondo Das	Fisher Man	Fishing in surrounding area.	Watching TV & others	Kirton.	5000 tk.
Julekha	Farmer	Farming at surrounding area.	Inviting people at home.	Wajj Mahfil & Muhram.	2750 tk.

Table no 7: Demographic differences between income ranges

4.16 SWOT Analysis

The following table show the Strength, weakness, opportunities and threats of the survey area.

Strength	Opportunities
1. Connected to Austagram sadar by road 2. Availability of open space 3. Primary school presence 4. Strong harmony between different religious groups 5. Cultural diversity	1. Water transportation 2. Extension of economy 3. New community 4. More municipal facilities
Weakness	**Threat**
1. By road transportation is not available all time 2. Prone to flash flood and inundation 3. Poverty 4. Lack of municipal facilities	1. Sudden inundation 2. Hailstorm 3. Insects 4. Lack of proper embankment

Table no 8: SWOT Analysis

5. Findings from site survey

5.1 Structure Based

Criteria	Baroichar
Community	Majorly fishing/farming community
Orientation of house	North south oriented

House pattern	Stilt house with rattan wall and CGI sheet roof
Openings	small opening window
Cluster type	Irregular pattern
Vegetation	Karoch tree and kolmi tree used for embankment protection
Disaster vulnerability	Flash flood and hailstorm and attack of insects
Road network	seasonal change of vehicle change

Table no 9: Structure based findings from site survey

5.2 Socio-Economic Based

Criteria	Baroichar
Livelihood pattern	Alternate occupation because of seasonal change
Literacy rate	Mostly illiterate people Children are subjected to child labor
Amenities	Scarcity and unavailability of municipal facilities
Land ownership	Visible exhibition social hierarchy
Lack of public gathering space	No other gathering space available except tea stall
Women empowerment	No other activity except household management during wet season
Social awareness	Indifferent towards social position and economy

Table no 10: Socio-Economic condition based findings from site survey

6. Conclusion

The distinct characteristics of haor homesteads and their periodical livelihood change is very much apparent in the lives of Baroichar people. These kind hearted people with low literacy rate are unaware of their rights shackled by the helplessness of not obtaining land ownership. The habitation pattern is their identity with different type of plinths expressing the socio-economic hierarchy. The paper describes their vulnerability through household activity and the structural characteristics of their house, economic status, and livelihood strategy of Baroichar. The findings also reflect broader comments from studies on disasters and development that increasingly emphasize the long-standing awareness of community-based approaches. The haor area is in urgent need of flood resiliency development otherwise these people will continue to lose their everything to take on the vulnerability of the disaster. The intensive study on the specific study area shows the housing conditions against natural vulnerability like flood and helps to guide a sustainable housing design for the general people of the area as well as all 'Haor' area.

Acknowledgements

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References

- Khalequzzaman, M. (1994), Recent floods in Bangladesh: Possible causes and solutions. *Natural Hazards*, *9*(1–2), 65–80. https://doi.org/10.1007/bf00662591
- Khalil, G. M. (1990), Floods in Bangladesh: A question of disciplining the rivers. *Natural Hazards*, *3*(4), 379–401.
- Tajwar, K. M. A. H. I. R. (2019). Causes and Consequences of Flash Flood in the North-Eastern Part of Bangladesh: A Case Study on Tahirpur Upazila of Sunamganj District.
- Hossain, M. S. (2013). *Flood damage and risk assessment model in the haor basin of Bangladesh | Semantic Scholar*.

- Monwar, M.M., Mustafa, M.G., Khan, N.A. *et al.* Indigenous Adaptation Practices for the Development of Climate Resilient Ecosystems in the Hail Haor, Bangladesh. *Glob Soc Welf* **5**, 125–136 (2018).
- Chowdhooree, I. and Islam, I. (2018), "Factors and actors for enhancing community flood resilience: An experience from a river-side settlement in Bangladesh", *International Journal of Disaster Resilience in the Built Environment*, Vol. 9 No. 2, pp. 153-169.
- Adger, W. N., S. Huq, K. Brown, D. Conway and M. Hulme. 2003. Adaptation to climate change in the developing world. *Progress in Development Studies*. 3(3):179–195.
- Rahman, M. M., K. I. Sajib and I. Alam. 2016. Impacts of Climate Change on the Livelihoods of The People in TanguarHaor, *Bangladesh Journal of Water Resource Engineering and Management*. 3(1): 1-9.
- Rana, M. P., M. S. I Sohel, S. Akhter and M. S. Alam. 2010. Haor based livelihood dependency of a Rural Community: A Study on Hakaluki Haor in Bangladesh. *Proceedings of the Pakistan Academy of Sciences*. 47 (1): 1-10.
- Khatun M., Rahman M.S. (2021), Study on livelihood of haor community in Bangladesh, *Bangladesh Journal of Agricultural Research*, June 2021
- Hossain, M. S., A. A. Nayeem and A. K. Majumder. 2017. Impact of Flash Flood on Agriculture Land in TanguarHaor Basin. *International Journal of Research in Environmental Science.* 3(4): 42-45.
- Sarif, S. M. K., M. H. Kabir, S. Sultana, M. S. Mahmud and S. Mahjabun. 2016. Socioeconomic Conditions, Agricultural Practices and Communication Status of the Vulnerable Haor People in Bangladesh. American Journal of Rural Development. 4(5): 100-104
- Standard Guideline for Rural Housing in Disaster Prone Areas of Bangladesh - Housing and Building Research Institute, Ministry of Housing and Public Works.
- *Floods*. (2019, Nov. 8). https://www.who.int/health-topics/floods
- https://www.cegisbd.com/
- https://www.designboom.com/architecture/seeds-disaster-resilient-bamboo-housing-assam-india-10-07-2019/