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Rethinking for the Land: Challenges & Landscape Planning & Design Opportunities for the Flood-Affected Land of Shahzadpur, Sirajganj

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Abstract

Several researchers have explored how landscape planning and design can effectively mitigate floods and leverage flood benefits in flooded land. However, these landscape planning opportunities are rarely used and rarely discussed in research areas. Generally, the people who live in flood-prone areas are economically dependent on this land. Hence, they come back repeatedly after every flood for their livelihood. For instance, Bangladesh, which suffers from floods due to its geographical location and topographical characteristics, has yet to learn about the opportunities available for landscape planning & design. In this research, Shahzadpur Upazila situated near the Jamuna River is considered a case, is the most vulnerable and flood-prone area in Sirajganj. Every year around 20000 people are suffering more or less in Shahzadpur. Many of them are obliged to do temporary migration and start from nothing all over again. Government management response commonly involves riverbank erosion treatment and non-government organization (NGO) funding only for installing tube wells and toilets. Moreover, the importance of bringing back resiliency in those lands is diverting backward due to a lack of knowledge and attention. Due to many challenges, the research focuses on only landscape planning & design before architecture. This paper presents a strategic framework that will discuss the challenges that need to be overcome and the opportunities to address each. The following three landscape planning strategies are discussed to reduce flood damage: raising the land, creating wetlands, and using agriculture as a buffer. Along with this, a mixed-method approach will shortlist the opportunities according to the villager's needs in terms of implementation. The approaches will introduce the possibilities coming with floods and bring back resilience to the land again.

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Keywords

Landscape design, Landscape Planning, Flood, Resiliency, and Wetland design..

1. Introduction

A flood is a natural disaster that occurs when water covers dry land. It's caused by heavy rainfall, melting snow, levee failure, or storms. The excess water accumulates in ponds, lakes, or abysses, causing them to overflow and drown surrounding areas. Floods can cause extensive damage to structures, roads, islands, and power lines. Floodwater can also pollute water sources and lead to waterborne diseases. Crops can be destroyed, transportation disrupted, populations displaced, and lives lost. According to the report on the mortal cost of rainfall-related disasters from 1995 – 2015, about 2.3 billion people were affected by flooding encyclopedically between 1995 and 2015 (Wahlstrom & Guha- Sapir, 2015). On the other hand, floods can have positive impacts on land fertilization and agriculture. Despite the periodic flooding, people tend to settle on floodplains because of the economic and environmental benefits they provide, such as food, new growth, and irrigation. Flood-prone areas can coexist with floods by creating a sensitive

landscape design that mitigates damage and fully activates the area, but flood factors must be analyzed before adopting effective measures. Among all the multiple, complex, and interrelated two factors that induce and influence flooding are source factors and human factors. Source factors include weather, hydrology, and pathway factors including river, land, and topography (Schanze, 2006). However, the weather factors are the main factors that mostly affect floods with heavy or sustained precipitation, snowmelts, and other extreme hazards.

In Bangladesh, there are 230 rivers including 57 transnational transboundary rivers. That is why it is called the land of rivers. Ganges (Padma), Brahmaputra (Jamuna), and Meghna are the largest fluvial systems in the world. Except for some northeastern and southeastern corridors, the topography of the country is primarily flat. There is a change in elevation from 3 to 90 meters above Mean Sea Level (MSL) on the land (BUET '88 CLUB, 2010). Still, Bangladesh is prone to floods due to its location, weather conditions, and topography. The country frequently experiences floods, with around 30 to 35 percent of its land surface being flooded each year during the wet monsoon season (Milliman et al., 1989). These regular floods are seen as beneficial for Bangladesh as they provide essential moisture and fertility to the soil through the deposition of alluvial silt (UNEP, 2001). Agriculture contributes 35% to the GDP and employs 63% of the labor force. However, it faces challenges due to high food demands, agricultural land issues, and population lifestyle. Effective landscape planning and design can mitigate flood damage and maximize potential. Limitations in flood predictability must be acknowledged. Evaluating flood-exposed elements is crucial. This study proposes resilient landscape interventions and analyzes a specific village, Haat Pachil. The goal is to promote harmonious coexistence with floods.

1.1 The background

Floods have a tremendous impact on both our environment and society. The havoc they wreak on cities includes the destruction of drainage systems, resulting in the unfortunate spillover of raw sewage into our precious water bodies. However, amidst this gloom, there is a glimmer of positivity. Floods, in their peculiar way, contribute to the environment by spreading nutrient-rich sediment onto the topsoil, enriching it, and nurturing its fertility (Wikipedia, 2009). The resilient district of Sirajganj in Bangladesh is an area notorious for its perpetual struggle with floods. While the entire district isn't equally vulnerable, certain upazilas hold a more precarious position due to their geographical location. These include Chauhali, Kazipur, Sirajganj Sadar, Belkuchi, Ullahpara, and Shahjadpur, where the impact of floods is felt the strongest. Sirajganj, year after year, braces itself for the onslaught of flooding. Among the notable episodes in its history are the severe floods of 1949, 1956, 1961, 1962, 1966, 1968, 1974, 1979, 1987, 1988, 1996, 1998, 2002, 2004, 2007, and 2008, etched into the collective memory (NDP, 2007).

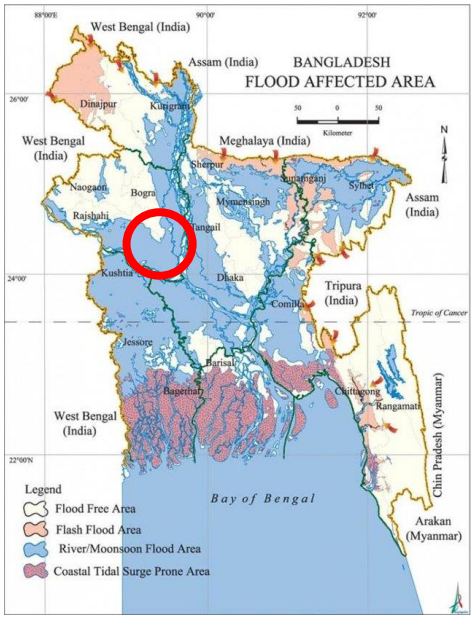

Fig 1. Flood Map of Bangladesh with red marked area

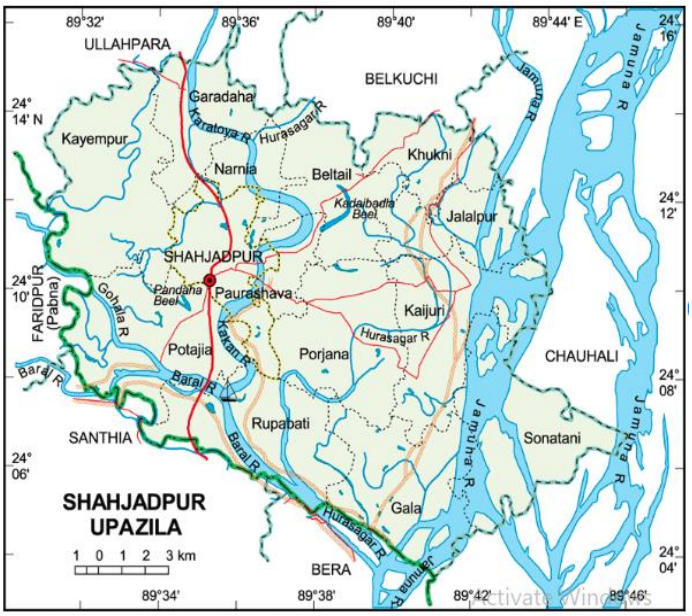

Fig 2. Map of Shahzadpur Upazila of Bangladesh indicating Shahzadpur, Sirajganj location, source: BanglaPedia

The focus of the study is a village called Hat Pachil, situated in the Kajuri Union of Shahzadpur Upazila, Sirajganj. This union has a population of 54,765 (as per the 2001 census) and is located between 24°6' and 24°12' north latitudes and 89°40' and 89°44' east longitudes. Hat Pachil is one of the twenty villages in the union which is located on the banks of the Jamuna River and is currently facing the dual challenges of flooding and river erosion. Unlike the neighboring villages, Hat Pachil is not protected by the constructed dam. Hence, the selected site experiences both flooding and river erosion, while the other villages only deal with flooding. There has been a newly constructed dam built in 2020 to safeguard the land from erosion and flooding. The dam's elevated height has been determined based on the analysis of flood data from the past 100 years. The village in the case study is vulnerable to natural disasters, putting its residents at risk. The images show the village's location in relation to the dam and the housing patterns within both areas.

Fig 3. The village of Hat Pachil is located near the Jamuna River, close to the Kaijuri Badh dam which is mentioned.

Fig 4. Dwelling pattern outside of the dam in the case study village Hat Pachil, Kaijuri

Fig 5. Dwelling pattern inside the dam in the same

Most of the land in these two villages is cultivable and privately owned. The landowners either lived here for most of their lives or migrated here and bought lands to start anew. The main occupation is farming, with other jobs including weaving, fishing, labor, rickshaw pulling, and small business. However, the land is at risk due to natural hazards and a lack of backup plans, leaving people and land unprepared to adapt to the environment. The residents here must either relocate or purchase the higher ground. The rainy period of the year lasts for 8.5 months, from March

1 to November 17, with a sliding 31-day rainfall of at least 0.5 inches (source: weatherspark.com). The month with the most rain in Sirājganj is July, with an average rainfall of 8.1 inches. There are two crop-growing seasons in flood-prone Sirajganj district, Kharif (May-October) and Rabi (November-April). During the Kharif season, rice and maize are the predominant crops cultivated in the region. Conversely, during the Rabi season, potatoes and wheat are the main crops grown in the area. (Md. Nazmul Haque, Kaniz Fatema and Md. Ashikur Rahman Joy, 2022).

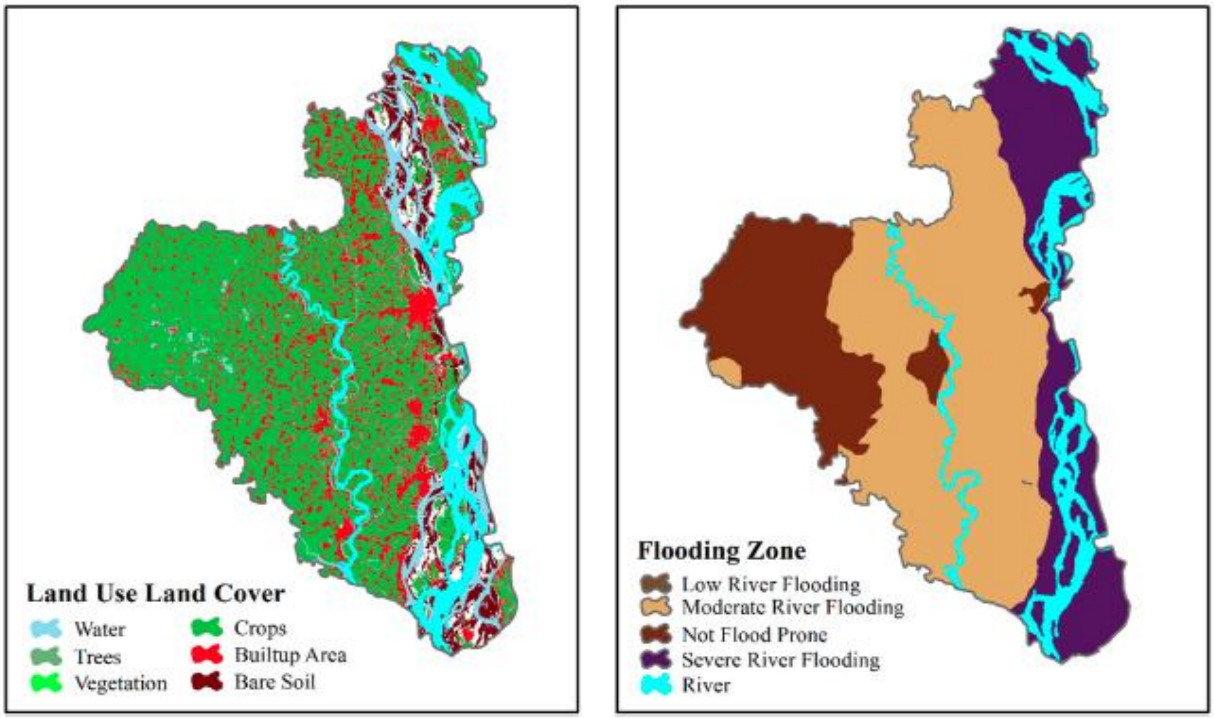

Fig 6. The land use and the flooding zone of Sirajganj district, source (Crop suitability analysis by adopting geospatial algorithm: a case study of Sirajganj district (flood-prone area) in Bangladesh, 2022)

Even though there is an increasing chance of losing the land gradually in upcoming years to the river, they constantly choose to come back to the place every year. Insights into their decision-making process to choose the land raised two of the important criteria that are unavoidable and need to be discussed. Therefore, this research aims to introduce only landscape design solutions that meet villagers' main criteria as part of their decision-making process before abandoning their land. The main research question of this study is ‘What are the main reasons for deciding to return the land, and what can be done to support the process?’ The two aspects are economic and social criteria which contribute to the decision-making process.

1.2. Economic criteria

Most villagers farm their land, but erosion by the river has caused some to lose their land. Those who have lost their land work as tenants in the same community or other fields. During the rainy season, they can work as fishermen, boatmen, or laborers in the main town. Relocating costs their savings, and the same amount of farming land is given to every household in relocation projects, which is very minimal compared to what they had before. Thus, they lose their financial security and identity in the new place. Temporary migration costs them money, time, and strength, instead of saving for a standard of living.

Another important economic consideration is there is a special occupational community in the case study village Haat Pachil who are traditional Taat weavers. This is a family business and an important profession in Shahzadpur Upazila. The weaver house generally has a small workshop beside their home where they make local clothes and sell them in all markets locally and in other cities. Local people work in their workshops. Thus, they contribute to the local and national economy. They are slightly economically improved by the others who are laborers and farmers, and fishermen. But in the rainy season, the workshop needs to be closed for the raised water flooding their yard. For them

leaving the land means leaving their identity behind. For those who can manage to buy some land on the closer higher ground their only purpose is to hold on to their family business and not lose economic stability.

1.3. Social criteria

The social factors of village life are intertwined with both occupational and relational values among neighbors. Many residents have lived in the same village for generations, surrounded by close friends and relatives. Moving to a new place would mean leaving behind not only a familiar neighborhood but also strong emotional and psychological connections to the land and its people, beyond just economic reasons. Community participation is a major thing in these neighborhoods. The people with no earnings can work in other fields and their workshop or at their home as a helping hand. Starting a new life in a different location can feel like being born anew. So, it is noticeable that when they are moving to another place together as a neighborhood because they are psychologically and financially dependent on each other. The vulnerability among them is only understandable by those who have suffered from disasters.

1.4. Aim and Objective

Living with floods is an inescapable reality of life as they are a natural phenomenon that cannot be completely eradicated. The occurrence of floods leads to the erosion of riverbanks and adjacent land, putting flood-prone areas at risk of eventual land loss. However, despite this, landowners persistently return to their land if it remains for economic and social reasons. This cycle of flooding and gradual land loss forces them into temporary migration, negatively impacting their economic and social well-being. The main objective of the study is to identify the challenges regarding their economic and social consideration and address affordable opportunities, particularly landscape design solutions. It is crucial to keep in mind that the people in the selected village are low-income individuals who are farmers, fishermen, laborers, and weavers who are constantly dealing with disasters. Addressing other flood management may not be their top priority as it requires a considerable number of financial resources. Nonetheless, properly understanding their land would help them manage the timing of land loss due to natural processes. Effective flood management requires identifying flood-prone areas, implementing early warning systems, and minimizing potential damage through proactive measures. However, this requires funding and involvement from authority figures and politicians. On the other hand, landscape design and planning interventions can be done on their land. To successfully attain the objective, it is imperative to take the following steps:

- Recognize the economic and societal obstacles the villagers face and find first-hand solutions they can implement immediately.
- Finding accurate landscape designs that are both environmentally sustainable and financially feasible for the Hat Pachil village after analyzing other local and international case studies.

2. Methodology and Materials

The study employed a comparative case study research methodology. Using multiple data collection methods in case study research allows for comparison between cases and a more comprehensive understanding of the issue (Campbell, 2010; Yin, 2014). Hence, this research utilized a comparative case study approach to suggest landscape design opportunities in the village named Hat Pachil, Shahzadpur, Sirajganj. To compare how the practices can be implemented, one national and one international case study is analyzed which offers different types of solutions to address the flood problem. Furthermore, both these case studies are chosen to analyze the first-hand landscape solution they offered to bring resilience.

The primary data collection methods were document analysis, semi-structured interviews with the villagers focusing on their priority based on their economic and social considerations, and site observations. Face-to-face interviews with the villagers who are suffering from natural disasters provided valuable insights into the decision-making process factors. Site observations complemented the other two data collection methods and enriched the gathered qualitative data. The interview analysis and the document record identified the challenges and gave the landscape intervention idea.

3. Findings

3.1 Case Studies Description

Cluster village

The first case study is a resettlement of dam dwellers in four villages in Bangladesh through the development of cluster villages where the whole village was built on raised land. The ground level of this cluster village is 3 feet or 900 mm above the highest flood level. The implementing authority was Practical Action, an international development group that collaborates with people living in poverty. The village area was 500 decimals (1 decimal is equal to 1/100 of an acre or approximately 40.46 m²). The population was 342 (In a population of 1710) displaced vulnerable dam dwellers have been re-homed in 4 cluster villages with livelihood support. The targeted community was the vulnerable poorest people living beside the dam in the area, such as the landless, displaced, widows, the old, and beggars. They were selected by the community through a well-being ranking methodology.

The cluster village is made collaboratively; people excavate soil and sand from one area to build an earth platform. This is done in the dry season, from December to April. The hole where the soil/sand is excavated creates a reservoir that is used by the community for various livelihood initiatives such as fish farming, duck rearing, floating gardens, etc. The cluster housing site is free from the risk of flooding and erosion. Land developed by dumping earth considering the highest flood level of the previous 40 years and future factor of safety. 5 decimal lands consider each family for their housing, vegetable cultivation, cow, sheep rearing, fish culture, future extension, plantation, and other purposes.

Figure 7: A completed cluster village with a center pond for community fish culture.

Figure 8: Husband and wife standing in front of their new house.

Facilities were placed around several small courtyards in the cluster called sub-cluster. Locally available materials and resources involving the local community and other stakeholders. The living space of the dwellers was designed considering their family size and future population and it was done after learning and doing methods. They are considering sub-clusters under the cluster village to create more interaction among the settlers.

Seattle High Point Project, West of Seattle

This project began in 2003 and was completed in 2009. The primary aim is to control runoff and rainwater by establishing porous surfaces and swales. According to records, the system has successfully prevented local flooding

since its completion. The Seattle High Point Project combined medium and small-scale management methods. The runoff is reduced and filtered, then runs into the retention pond. High Point accounts for ten percent of runoff into Longfellow Creek. The use of porous pavement on streets and sidewalks retains some runoff and absorbs rainwater into the ground. The swales along the streets and sidewalks are usually six feet wide and one foot deep with grass and gravel which can also help retain water and absorb it into the earth. Finally, the gradual slopes direct the remaining runoff toward the retention pond. The retention pond controls the water entry and exit. The water in the retention pond will be filtered and then released into the creek. In other words, it will reduce water emission impact on the creek habitat. The High Point project utilizes vegetation and other materials as natural filtration to reduce rainwater runoff.

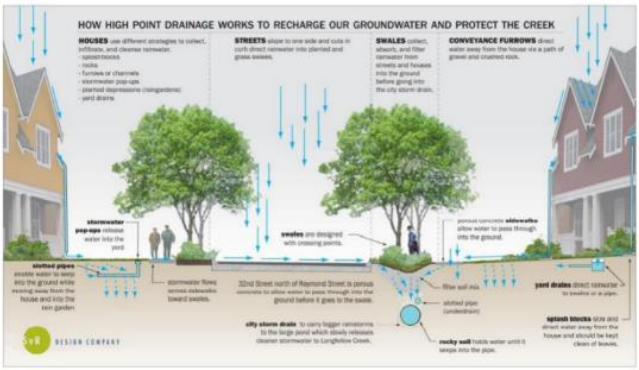

Figure 09: Drainage Diagram.Seattle High Point Community

Figure 10: Swales in Seattle High Point.

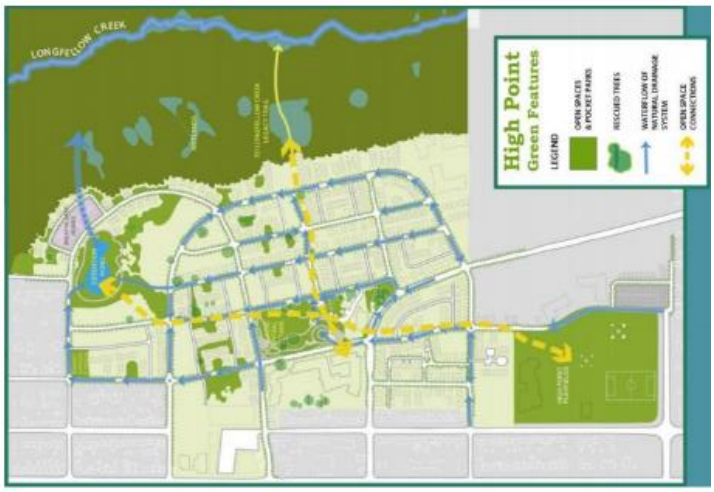

Figure 11: High Point Site Plan, Seattle Housing Authority

3.2. Case studies analyzed and observed

Location and immediate flood-resilient approaches have been important in two developments. The projects focused on different income groups and areas but both solved local flood issues through landscape solutions. In Bangladesh, low-income groups implemented economical and feasible solutions like creating mounds, central ponds, and farming land as buffers. In Seattle, a retention pond, creek, and gradual slope were designed, which is easy to maintain and can be used for other requirements. The two chosen case study shows how small-scale management can affect a housing area and people. Based on the relationship with natural processes, flood control interventions can be classified into three main types, as outlined by Ngai et al. (2017): Resistance to natural processes, Management of natural processes, and working with natural processes. Natural process interventions focus on stabilizing or reinforcing natural processes. They include measures such as assisted recovery and restoring the functioning of natural processes. In some cases, the emphasis is on allowing natural processes to proceed without interference. In low-lying areas with inadequate flood discharge capacity, extending flood storage and detention areas along rivers has proven to be a feasible, cost-effective, and efficient flood control measure.

In this study, the interventions primarily focus on managing and working with natural forces. Take necessary landscape planning on existing agricultural lands, manage the flood water, store sediment, and use the water thoroughly throughout the year. The next step is to work with the existing built system by raising the land but with proper precaution and buffer, creating necessary land layers, and creating a wetland, and green buffer. By strengthening the land people can live on the land longer and hold on to their socio-economic status.

3.3. Site Analysis:

The study focuses on the village named Haat Pachil in the Kaijuri union of Shahjadpur upazila, which is currently experiencing the destructive impact of natural disasters. The union is located between 24° 6' and 24° 12' north latitudes and between 89° 40' and 89° 44' east longitudes. The village is now 60 acres and around 3200 people live here with approximately 300 households. The annual precipitation rate in the area is approximately 1300 mm.

Fig 12. Site location and site surroundings

Fig 13. Site situation during dry, rainy, and flood season

45% of the land is agricultural land but only revenue is 3% out of that. Out of the 50 surveyed households in Haat Pachil village, 90% have only one earning member, with an average household income of 12000 BDT in 2021. Most households consist of 4-5 members, while a significant portion lives in thatched or tin-shaded houses. Of the people who are on the land side 20% of people have made their house plinths higher with brick floors.

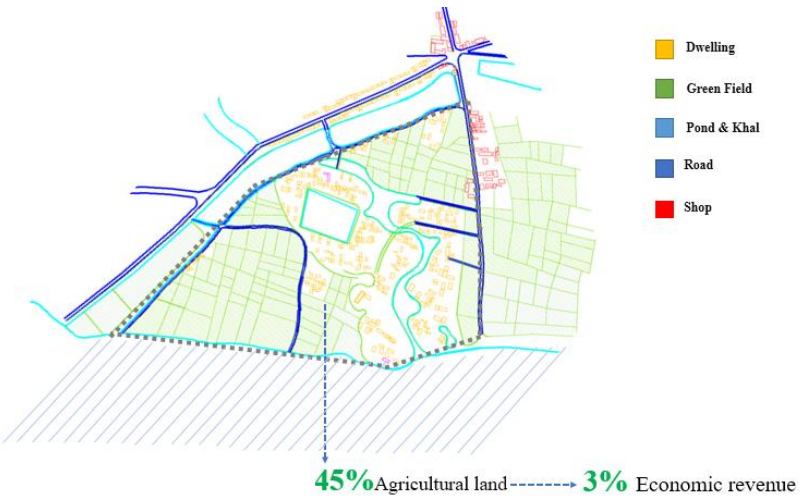

Fig 14. Hat Pachil village site mapping drew in Autocad addressing the land use in a different color

Many families, particularly those with low incomes, have faced multiple temporary migrations due to flooding and river erosion. The riverside household is forced to leave the house during a disaster and these lower-income families settle in temporary squatters established on government land acquired for embankment construction. Higher-income households typically buy land away from the riverbank for resettlement.

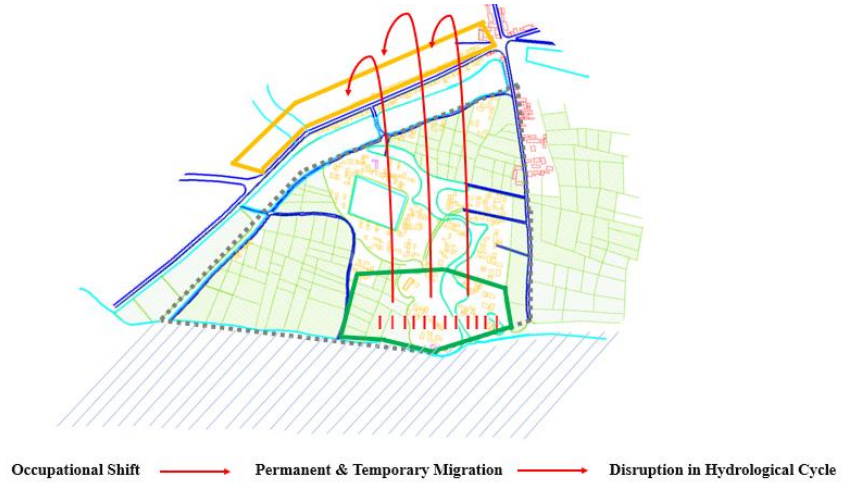

Fig 15. Migration tendency of the riverside households

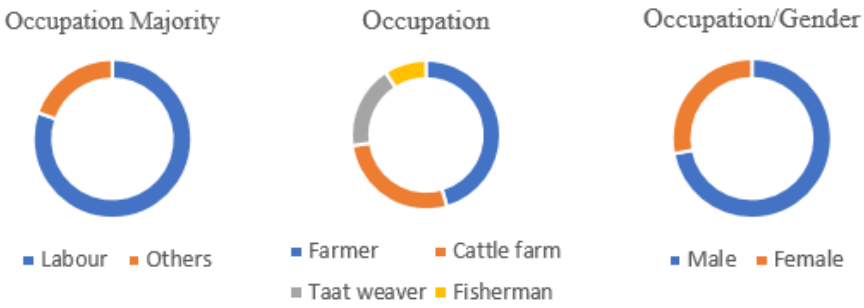

Fig 16 Occupation ratio between the professional change and gender

Due to frequent temporary migrations, most of the population has shifted to working as laborers in others' agricultural fields. This occupational shift is driven by continuous land loss and poverty. The locals primarily rely on individual efforts and community participation for adaptation. Landowners in the agricultural sector often rent land from others for cultivation. Approximately 25% of the respondents have experienced a shift in their profession, but 12% have not incurred any loss of income during their migration. Although the construction of embankments around 2010 provided a sense of security for higher-income households, financial constraints have hindered their completion. It is important to note that embankments alone cannot effectively protect riverbanks unless additional landscape measures are implemented. Most affected families have not received assistance from NGOs or organizations and primarily rely on individual adaptation strategies. The impact of migration on the livelihoods of lower-income individuals is substantial. Some landowners have transitioned to alternative sources of income without experiencing a decline in earnings. Erosion-affected families have faced significant losses in agricultural land, and limited efforts have been made to provide financial support or implement protective measures due to budgetary limitations.

3.4 The questionnaire survey:

The villagers participated in semi-structured qualitative interviews. Although the participants had different occupation and income groups, their response was proportionately positioned with similar challenges, principles, and decision-making criteria for their developments.

Risk and economic loss are concerning.

The villagers know the criticality the land can face during disasters, and they will lose their land over the years. Despite all the concerns they were asked what they wanted as a sufferer. They stated that they did not rely on government funding and non-government funding because the process is lengthy and time-consuming. They want

some feasible decision that will hold their land as long as possible so that they can have enough time to save money for their future in different locations. Few of them stated that they want to live on the land as long as there is one inch of their land available.

Choosing the right practice

The decision-making process is highly influenced by the practice offered to them. Few of them who are economically stable comparatively are willing to spend money to have a resilient practice in their land. But the people who are very low income and have no fixed income source want something where they can work as labor. They preferred something that would have immediate action and would have work in both seasons. So choosing their existing land practice would be the most promising and feasible practice to be resilient. In the work-and-learn process, villagers will participate in designing their own landscape against flood.

Existing practice increases profitability

In order to introduce a new problem, villagers chose their existing practice. They are familiar with the learning and after implementation, the practices are used in other ways which are also low maintenance and no extra effort to learn, and cost-efficient. Villagers agree to participate in the implementation process of the existing practice in a better way to increase productivity and profitability.

4. Detail landscape design recommendation:

Programs:

1. Raising the land
2. Creating wetlands
3. Using agriculture as a buffer

4.1 Raising the land:

Due to the growing population, living space is scarce. Most households have 5-6 members and there is an economic disparity between them. Families with better financial conditions live on higher ground and have more courtyard space and space for their livestock. Some families share a courtyard, and those living by the riverside have scattered houses with no planning.

Fig 17. Existing mound situation

Fig 18. proposed elevated mound and retention pond in between each island

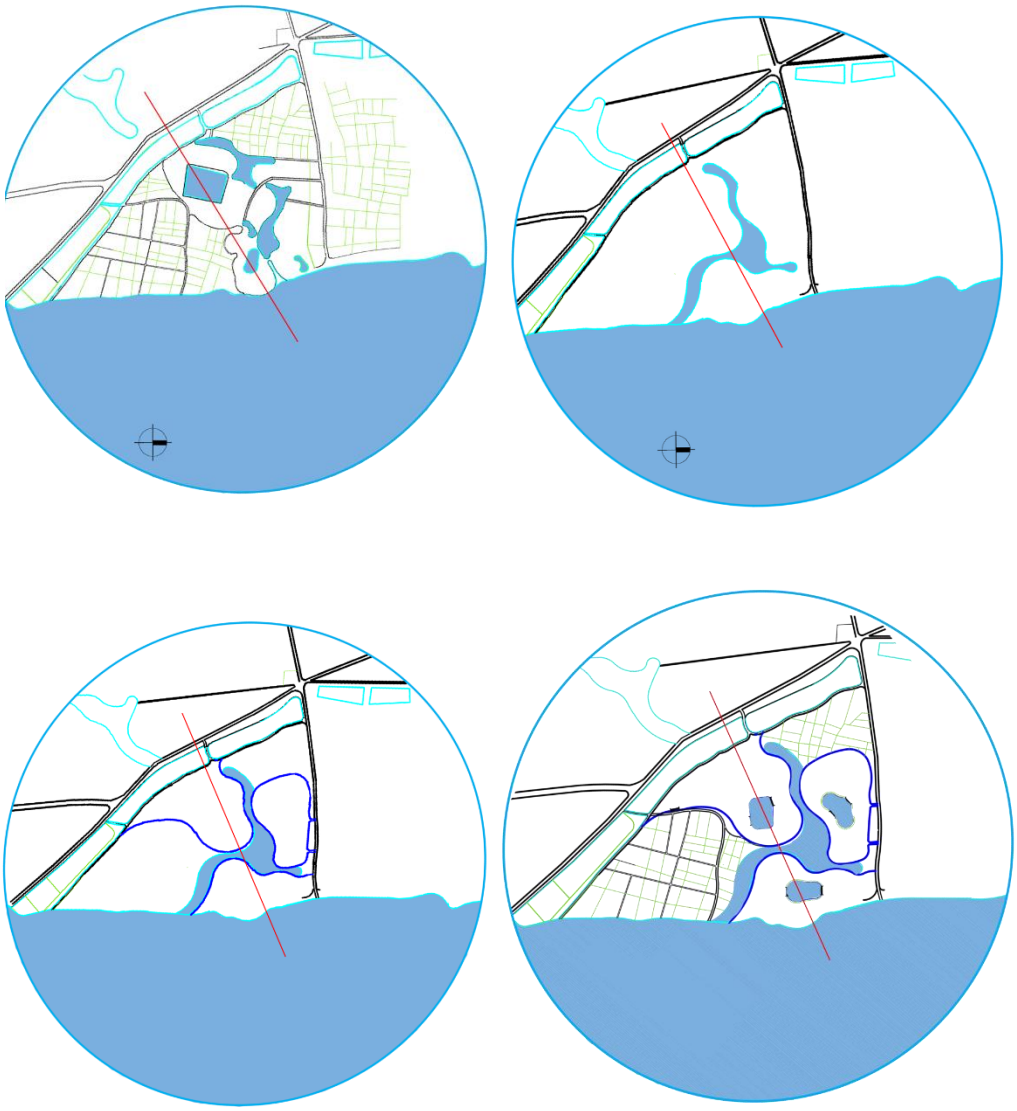

Fig 19. The gradual design of the proposed elevated island with a wetland and central pond

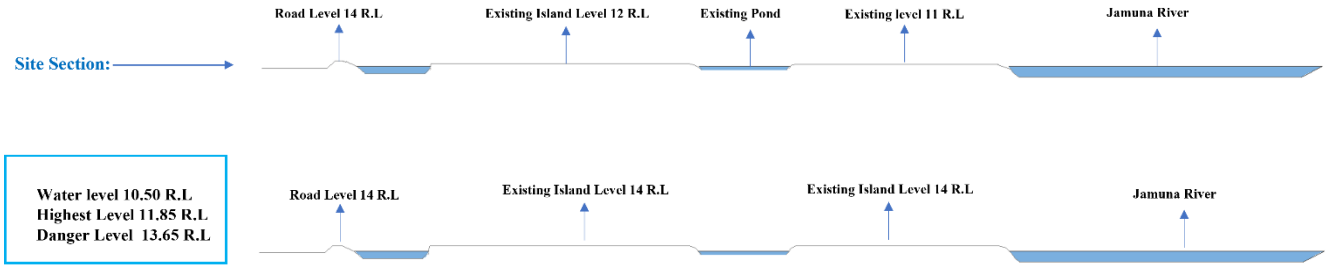

Fig 20. The existing site R.L Level and proposed island R.L level compared to the river.

4.2 Creating wetlands:

The land currently has scattered water bodies that are not utilized effectively. In the new landscape design, these ponds and water bodies will be connected and integrated into a cohesive system. During the dry season, some of these areas can be used for agriculture purposes, while during the rainy season, they can serve as floating gardens and water storage areas. The addition of layers of land will help regulate surface runoff and maintain water levels. People can benefit from these wetlands by engaging in activities such as fishing and using the wetlands as water pathways for boats.

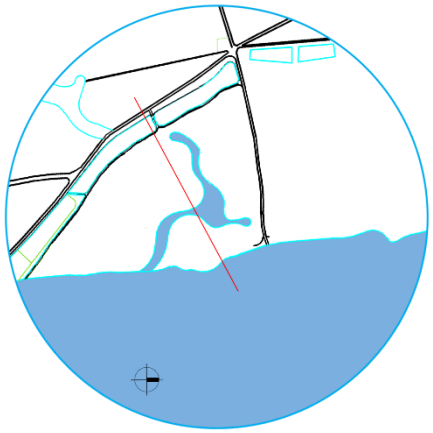

Fig 21. The proposed wetland connecting all the existing waterbody

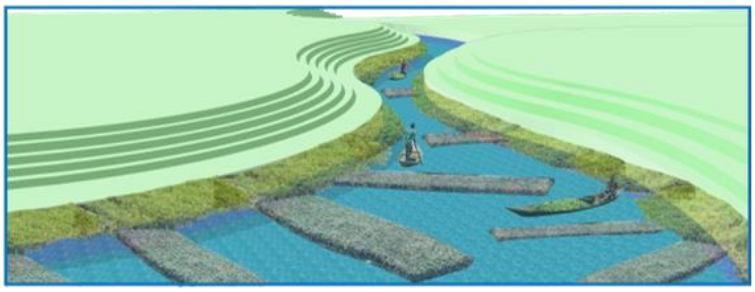

Fig 22. The proposed wetland with a floating garden in the rainy season

Fig 23. The proposed wetland with agricultural practice during the dry season

Fig 24. The proposed wetland is a water path, fishing pond

4.3 Using agriculture as a buffer:

The plan is to use agricultural land as a buffer and riverside land will have multiple layers of green barriers with a water creek between them. This aims to slow down the flow of surface runoff water. The green buffer protects the soil and regulates the movement of water. Layers in agricultural land will impede surface water, retaining it in wetlands or water creeks for year-round use. Floodwater is stored in flooded adjustment fields, with green barriers slowing down water runoff, while the water creek between them functions as a wetland.

Fig 25. The agricultural buffer surrounding the living land and natural creek barriers along the bank of the river strengthen the soil and create biodiversity.

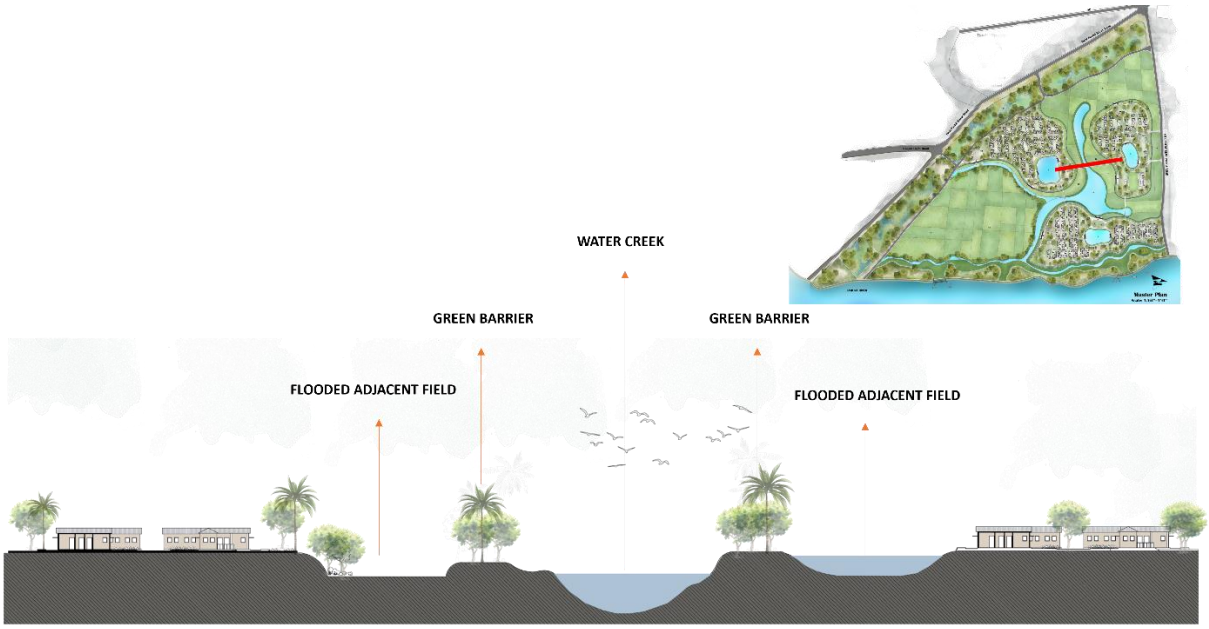

Fig 26. Creating a green barrier beside the wetland & designing a flooded adjacent field will store surface water and take the flood benefit.

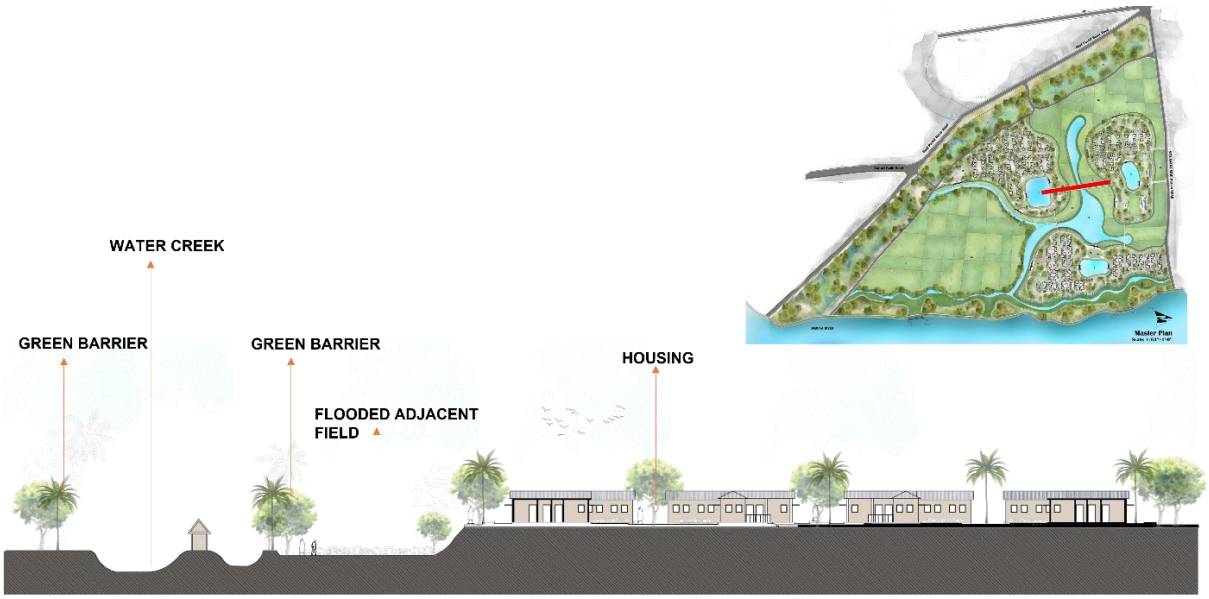

Fig 27. The small and narrow water creek design will drain the surface run water, making them slow and storing water for farming the land.

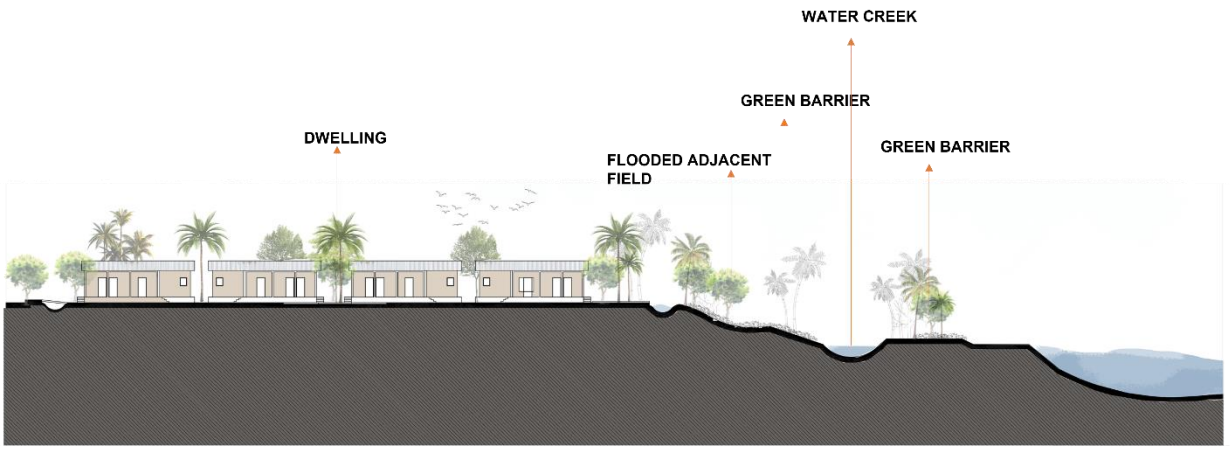

Fig 28. The riverside land should have two layers of green barrier with an agricultural buffer to reduce land loss and to trap the water at different levels

5. Discussion

Economic considerations contributing to decision making

The design proposed idea is mainly based on the economic consideration of the people who participated in the decision-making. The proposed landscape solution is decided through a constructive questionnaire, face-to-face surveys, and site visits. The main purpose of the study is to introduce a cost-effective landscape solution for low-income vulnerable people. The macro-level flood management requires funding, authority approval, manpower, and supervision for a certain period. However, working with the natural processes allows the community to engage in decision making how to solve the problem. The main concern was that people were constantly losing their monthly and yearly savings to move to a newer place. But with the new landscape approaches require community participation. It is a work-and-learn process. The necessity of the land to change and the necessity to protect the land is only acquired when the community participates with their knowledge. Through community participation, they will save labor costs. The three landscape designs are only chosen because they are already in practice. But with effective measurement and purposes, the land can fight better against flood and erosion. Choosing previous practices effectively will require awareness and community participation but no extra investment and no training cost.

Social considerations contributing to decision making

Cost-effective and feasible landscape practices will buy time for their land against flooding. The main social concern is to start afresh at a new place with a new identity. An average expected crop will be returned with better land. That will create more opportunities for jobs, for building infrastructure which will strengthen the community. To ensure a sustainable cost-effective resilient community there is a need to shift the focus from the economic focus of developments towards the rejuvenation of their landscape practices. The villagers here have an extra emotional connection but they have minimal effort to increase the land benefits. They were dependent on the resources but took minimal steps to achieve them at the next level. They were looking for available funding which is only for some tubewell construction or toilet construction. The authority did not think through how landscape practices in a better way can minimize surface run water. Choosing the right practices will allow the villagers to have their economic and social benefits.

6. Limitations

This study has a few following limitations:

-The proposed landscape design is to create an adaptive environment that can effectively cope with flooding, rather than directly addressing the hazards posed by elevated water levels.

- Some implementations need funding from the local authority or non-governmental organization

- Landscape intervention in a rural context costs more time as it is eco-friendly and cost-effective.

- This study only focuses on landscape design and planning before any architectural design solutions.

- Only focused on a particular area, so applicability on other land areas might need minor changes

7. Conclusion:

Bangladesh faces increasing flood threats. This paper presents the concept of “landscape resilience” to mitigate risks and damages. The strategy includes adapting and integrating existing processes to effectively respond to different flooding events. Given the importance of agriculture to national growth, urgent measures must be taken to protect land and people’s livelihoods. The paper aims to address flood-related problems from a landscape planning and design perspective, and present landscape interventions as solutions. A design model was developed for an existing village to demonstrate how interventions can be effectively implemented with minimal impact on low-income people’s land. The study also examined existing settlement approaches to develop an acceptable design. The site location was considered in the design process, and modifications may be necessary for different locations.

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The authors declare that there is no competing interest.

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