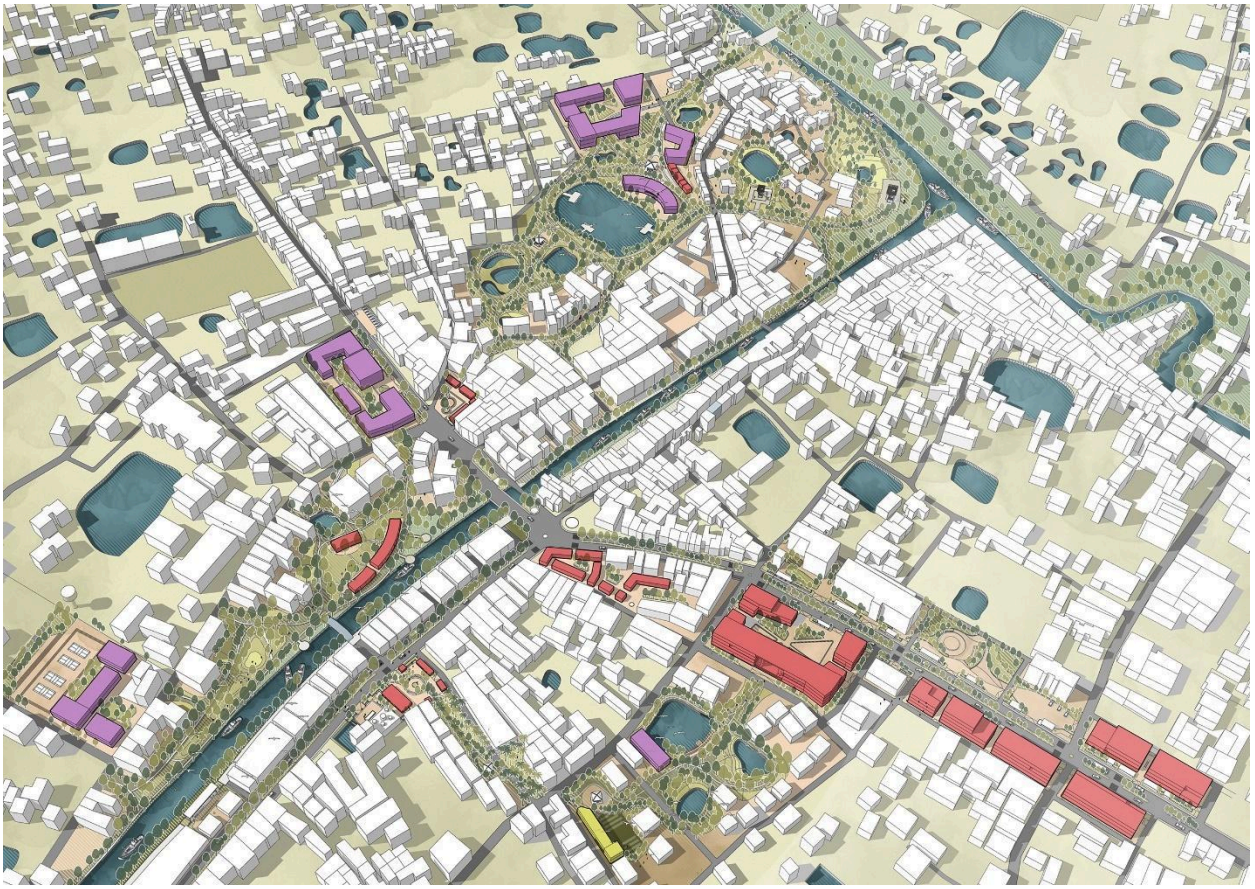
Sponsored Thesis Project Competition on

"RE-IMAGINING URBAN RIVERS"

Season- 3



Project Title: Reimagining the river front as a socio-economic interface - a case of Kakdwip.

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Thank you MAA

Debjyoti Saha

"Rivers have carved a diverse path through the temporal and spiritual experiences of humans throughout history. They have served as physical and psychological borders between nations, as well as demarcating mythological worlds and framing the birthplace of numerous civilizations."

- Zeller

KEY WORDS:

Riverfronts, Socio-economic, Social amalgamation, Ghats, Reconnect, Resilient, Riverine Biodiversity

ABSTRACT:

The Purpose of the project is reinventing the riverfront and canal front as a socio-economic interface by maximising its potential at the neighbourhood, city, and regional level. The Kalnagini Canal is one of numerous streams and canals that characterise the city's fabric, history, and future direction. The river is important to Kakdwip's character, but climate change and unsustainable
urbanisation trends threaten the delicate balance of environment and society, land and water. Flooding is a major concern in Kakdwip. Depletion of aquifers, saltwater intrusion, and coastal erosion These interconnected dangers are exacerbated by urbanisation. Canals that previously connected rivers have been concreted over. grey infrastructure that is contaminated or blocked by garbage The latest flash floods have highlighted kakdwip's social structures and local people' resilience as well as their compounded socioeconomic vulnerabilities. The Kalnagini River is hydrologically connected to the Hooghly River. These rivers and the aquifer constitute the city's primary supply of water on a daily basis. The monsoons replenish and refresh these resources.
However, modern building patterns, as well as the strong pressures of expanding population and development, undermine the connections between forests, water bodies, and the aquifer.
As a result, the plan will decide all of the previously described aspects, and it will aid in the implementation of a sensitive and nature-based solution system to construct the social, economic, and ecological balance.

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CHAPTER 01: INTRODUCTION PRE-THESIS

1.1 INTRODUCTION

Sundarbans is a mangrove zone formed by the confluence of the Padma, Brahmaputra, and Meghna rivers in the Bay of Bengal delta. It runs from the Baleswar River in Bangladesh's Khulna division to the Hooghly River, which flows through West Bengal's lower deltaic areas before joining the Bay of Bengal. The upper riparian zone of the river is known as Bhagirathi, and the lower riparian zone is known as Hooghly. It is made mainly of closed and open mangrove forests, agricultural land, mudflats, and barren terrain, with various tidal streams and canals cutting through it. One of the most significant parts of this region is at the south of West Bengal, with the city of Kakdwip and various canals connecting to it.

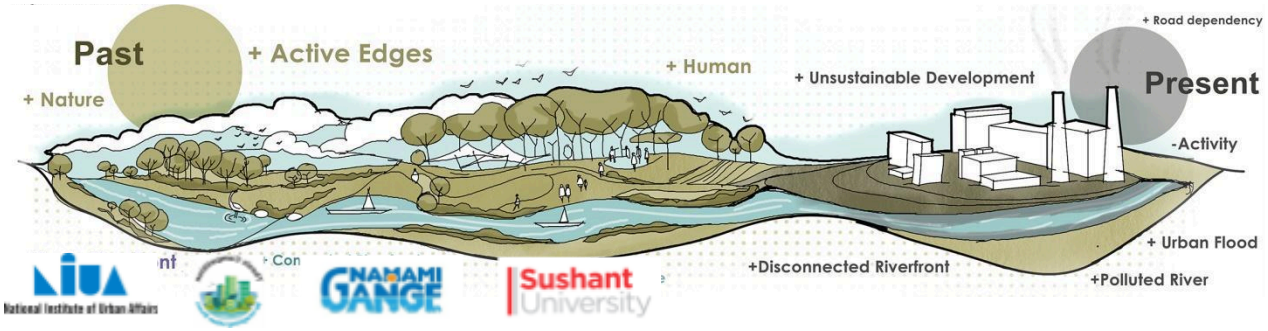
Sagar island is connected to Kakdwip via a ferry system, and every January during Makar Sankranti, a pilgrimage of approximately 300,000 people gather to take a holy dip at the confluence of the Ganges and the Bay of Bengal and offer prayers; therefore, during this time, the precinct of Kakdwip has been provided with temporary infrastructure to facilitate the visitors especially for the time; however, the river and associated activities are poorly maintained

throughout the year. As a result, the dynamic river edge with diverse activities gets detached from the area and the city, and ecological and social deterioration becomes a danger to economic improvement opportunities.

The canal kalnagini, which runs through the city of kakdwip, was once used as part of the mobility network to connect to other parts of the region or island for trade purposes. However, due to the development of roads, the canal and canal fronts are depleting, unmaintained, and encroached upon by heavy constructions. The current trend is extremely risky for the city since it is a catalyst for natural disasters such as floods. As a result, establishing a social connection to the waterfront is critical in order to support the city's growth.
Again, the city of Kakdwip is the only link to the important tourist spots of the southern Gangetic delta region and a prominent and emerging tourist hub of West Bengal, such as Bakkhali, Henry's Island, and Fraserganj, in order to strengthen the economic opportunity and reconnect the city life with its river edge in order to revive the depleting ecology and social quotient. It is critical to re-establish all river linkages to its urban precinct, which will eventually aid the city's ecological, social, and economic sustainability. Because the Sundarbans are in a low coastal zone, they are especially vulnerable to floods, earthquakes, cyclones, sea-level rise, and shoreline erosion, pollution, poor fishing practices and extreme weather events. By following the scenario mentioned above, the city of Kakdwip, Kalnagini canal and Hoogly / Muriganga River front are pursuing methodical growth.

1.1.1 Premise

The value of the river declined as a result of industrialization. It lost its principal purpose in the city due to better impending alternatives including the railway, road network, and other transportation methods the river front has been changed and since then the rivers have been treated badly. the city life abandoned the river front and start abusing the river. Hence the water holding capacity of the rivers has been effectively reduced, encroaching riverfronts by built structures. all these activities have been reduced the function of river effectively and leads to flood, flash floods. Due to the fragile nature of the river cities, it starts to decline economically and socially.



1.1.1.1 River City & Riverine culture

River City refers to cities located near rivers, which have historically been important for trade and transportation. Riverine culture refers to the way of life and traditions associated with living in or around river regions. Both concepts highlight the impact of rivers on the economy, lifestyle, and cultural identity of communities.

Figure 1: The evolution of riverfront [Source: Author]

1.1.2 Adverse evolution of Rivers - Cities - Human experiences

Adi ganga and the active river edge condition of old kolkata city near kalighat . Social interaction and business opportunity have been grown along the river side. Road ways become an important part of city later on and rivers are become the backyards of city. Edge condition in present day, worse experience of the water fronts and declining functionality. Detached canal and river fronts from the city. Deteriorating canal fronts in isolation. Present city condition and the human experience due to the negligence.

1.1.2.1 Case example of Kolkata

Adi ganga and the active river edge condition of old kolkata city near kalighat. Social interaction and business opportunity has been grown along the river side. Road ways become an important part of city later on and rivers are become the backyards of city.

Figure 2 : Kolkata Water front and activity [Source : Indian Eagle]

Edge condition in present day, worse experience of the water fronts and declining functionality. Detached canal and river fronts

from the city. Deteriorating canal fronts in isolation. Present city condition and the human

experience due to the negligence.

Figure 3 :Kolkata Water front Present Scenario[Source : DTE]

1.1.3 Urban Morphology of the river

Urban fabric with Natural Waterfront - comprising beaches, wetlands, wildlife habitats, sensitive ecosystems and the water itself. Urban fabric with Public Waterfront - including parks, street, vistas and waterways that offer public open spaces and waterfront views.

Figure 4: Urban fabric with Natural Waterfront [Source DNAINDIA]

Figure 5 : Urban fabric with Public Waterfront [Source : Curiosity]

Urban fabric with Working Waterfront - Urban Clusters of water-dependent, maritime and industrial uses Urban fabric with Redeveloping Waterfront - vacant and underutilized ledge properties suggest potential for beneficial change.

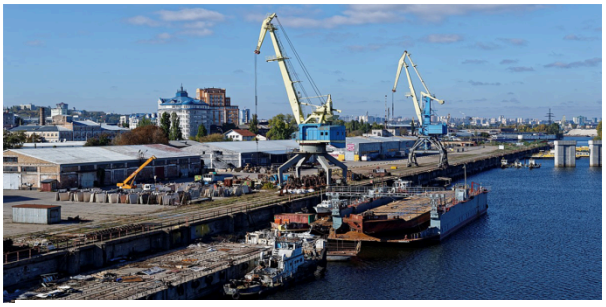
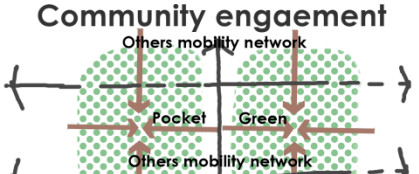


Figure 6 : Urban fabric with Working Waterfront [Source : en.wikipedia]

Figure 7: Urban fabric with Redeveloping Waterfront [Source: Scroll.in]

1.1.3.1 Comparison of urban morphology for a river and non-river city



1.1.4 Trend of urban water front development

Waterfront development has been driven by environmental protection, shoreline access, social amalgamation node, economic development, recreational, commercial and residential uses, and festival and water sports. In 1960s Massive waterfront development began and starts from boston. In 1970s Urban waterfront redevelopment bloomed, 1980s Accelerated and continued in the future.

Figure 8 : With River Approach [Source : Author]

Figure 9 : Without River Approach [Source : Author]

1.1.5 Evolution of the river city outside of India

1.1.5.1 Case example of Singapore (Rochor Canal)

Rochor Canal enabled cattle trading in Little India, leading to the development of cattle breeding in the 1880s and 1900s. The flood caused by a few hours of rain was common at the time. Redevelopment was started with Diversion Canal with urban boulevard, promenades, pedestrian bridges, terraces, sev- eral gardens and a community space.

Figure 10 : Evolution of Rochor canal [Source : ABC waters]

1.1.5.2 Case example of Bangladesh (Chaktai Canal)

Chaktai is one of the oldest commercial areas of Chittagong, the 'Business Capital' of Bangladesh. The historic Chaktai canal flows through the area, providing transportation and a waterfront public activity space. However, the dilapidated condition of the canal has interrupted frequent commercial activities and made the canal front inaccessible, unhealthy and uncomfortable. Visually connected pathways with the main road to facilitate circulatory and commercial activities.

1.1.6 Revolution in India – Ganga Action Plan

The Ministry of the Environment, Forests, and Climate Change originally proposed the Ganga Action Plan (GAP) to redirect, collect, reuse and recycle waste to enhance the quality of river water. It was implemented in 1986 to reduce pollution in the Ganga, but it was discontinued in 2000. Over the years, several projects have been started to address the Ganga River pollution problem. However, the Ganga action plan was launched as a 100% centrally financed program.

Figure 11 : Evolution of Chaktai Canal [Source : FARU]

1.1.6.1 Ganga Action Plan – Phase I (1986)

Primary intention of this plan was Interception and diversion of industrial and domestic sewage to sewage treatment plants (STPs).
Installation of STPs to treat sewage. Providing sanitation facilities to people residing near Ganga Installation of crematoriums. Afforestation. Public participation in cleaning the river. Money Allocated for this plan was 350 Cr .

Outcome - 35% of the sewage generated was tackled. Biochemical Oxygen Demand (BOD) came down from 12 mg/l to 4 mg/l. Only 160 out of 425 mld at Kanpur and about 100 out of 160 mld of sewage at Varanasi has been taken up for interception and diversion.

1.1.6.2 Ganga Action Plan – Phase II (1993)

Primary intention of this plan was Interception and diversion of industrial and domestic sewage to sewage treatment plants (STPs).
Installation of STPs to treat sewage. Providing sanitation facilities to people. near Ganga.
Installation of crematoriums. Afforestation. Public participation in cleaning the river. Money Allocated for this plan was 1498 Cr.

Outcome - 60% of the sewage generated. Biochemical Oxygen Demand (BOD) came down from 4 mg/l. 63 ST PS built.

1.1.6.3 Difference between Namami Gange and Previous Plan

For Namami Gange 20,000 crore. Launched 155 new sewage treatment projects. Laid stress on building crematoriums and toilets across The Ganga villages and towns. Headed by National Mission for Clean Ganga (NMCG). Involved states in planning & monitoring. Has a realistic deadline of 10 years.

1,848 crore in vested in previous plans .35 STPs planned across 5 states. No concrete structure to build crematoriums and toilets has been built. Headed by National Ganga River Basin Authority

(NGRBA) (Now defunct). Did not involve states holistically. Had an over ambitious deadline of 6 years.

1.1.7 Evolution of Indian River city and New City Image

1.1.7.1 Case example of Ahmedabad (Sabarmati River)

Urban agglomeration of the city Ahmedabad shows a extensive growth of the built-up areas inside the city. The Sunday market connected the city to its river front, strengthening its socio-economic state. The revival of river cities by restoring emotional connection by increasing functionality and sustainability.

Figure 12 : Evolution of Sabarmati River [Source :RTF]

1.1.7.2 Case example of Kochi (Mullassery Canal)

Kochi's Old trade history and connecting waterfront. Kochi's canals are unable to function due to development, leading to a threat to the community. The canal is used for sewage and waste dumping, providing a treat to people living at the edge. Increased in rainfall leading to flooding in the city due to poorly managed canals, affecting daily life. Enhance functionality of canal precinct and edge, connecting city people to canal.

Figure 13 : Evolution of Mullassery Canal [Source :EnteKochi]

1.1.8 Gap Analysis

Tier 1 and tier 2 cities in India have emerged as business destinations due to their industrial clusters, favorable business environment, and connectivity with major economic hubs. However, tier 3 cities face economic challenges as they rely heavily on industries such as fishing, agriculture, and allied services, which may not provide stable income opportunities. These cities often depend on neighboring cities for their livelihoods.

To address the economic instability in tier 3 cities, strategic planning is crucial.

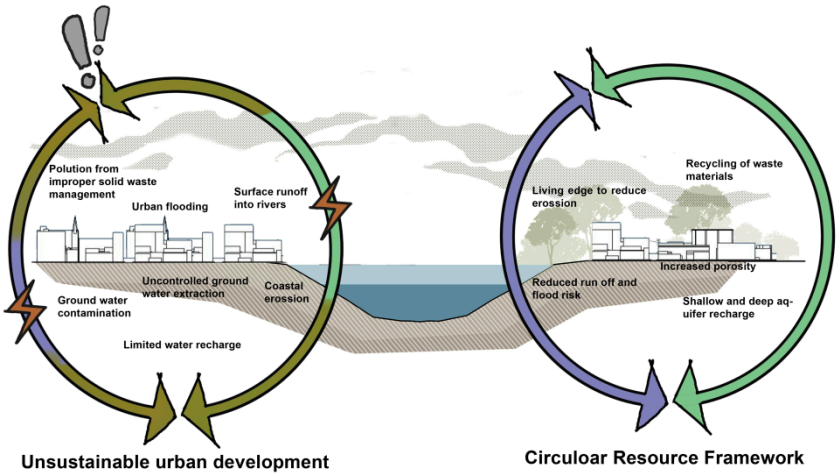


Figure 14: Urban Water Framework [Source: Author]

This involves developing a balanced approach that takes into consideration ecological, economic, and social factors. Ecological sustainability can be achieved by promoting environmentally friendly practices and preserving natural resources. Economic stability can be enhanced by diversifying the industries and attracting investments in sectors with growth potential. Social development can be fostered through the provision of quality education, healthcare, and infrastructure, creating a livable and healthy environment for residents.
Strategic planning should focus on creating employment opportunities, improving connectivity and infrastructure, and supporting local entrepreneurship. Collaboration between the government, local communities, and private sectors is essential to drive sustainable development in these cities. By implementing well-designed strategies, tier 3 cities can unlock their potential and achieve balanced growth in a way that benefits both the economy and the well-being of their residents.
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CHAPTER 02: SITE SELECTION AND BACKGROUND

2.1 RIVER CITIES ALLIENCE & SITE SELECTION CRITERIA

River Cities Alliance (RCA) was launched in 2021 as a dedicated platform for river cities across India to discuss & exchange information for sustainable management of urban rivers.
It includes cities from both the Ganga basin and non-Ganga basin states. Day by the count of river cities is increasing in the alliance. And in recent year West Bengal and UP are two states which has more cities joined with the network.

River sensitive Master plan making is the key to sustain the river cities. This Driving force & tools will help to build Kakdwip more river centric and the development will be funded by the Govt. of India.

In 2023 there are 45 more cities (Highest count from West Bengal) jointed with the National Mission. And has a target to allied with all possible important river cities in India. Hence there is an opportunity to develop an important river city - Kakdwip associated with the Adi Ganga River.

2.2 REGIONAL BACKGROUND & CONNECTIVITY

The Kakdwip Subdivision covers an area of 1390 square kilometers. It has a population of 1,008,653 people, resulting in a population density of approximately 730 persons per square kilometer. The decadal growth rate of the population in this area is 23%, indicating a significant increase in population over a ten-year period.

Sundarbans is a mangrove zone formed by the confluence of the Padma, Brahmaputra, and Meghna rivers in the Bay of Bengal delta. It runs from the Baleswar River in Bangladesh's Khulna division to the Hooghly River, which flows through West Bengal's lower deltaic areas before joining the Bay of Bengal. The upper riparian zone of the river is known as Bhagirathi, and the lower riparian zone is known as Hooghly. It is made mainly of closed and open mangrove forests, agricultural land, mudflats, and barren terrain, with various tidal streams and

canals cutting through it. One of the most significant parts of this region is at the south of West Bengal, with city of Kakdwip and various canals connecting to it.

Figure 15 : Map West Bengal [Source : Google]

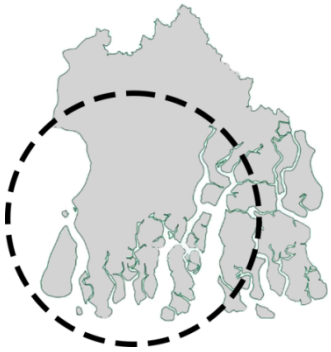
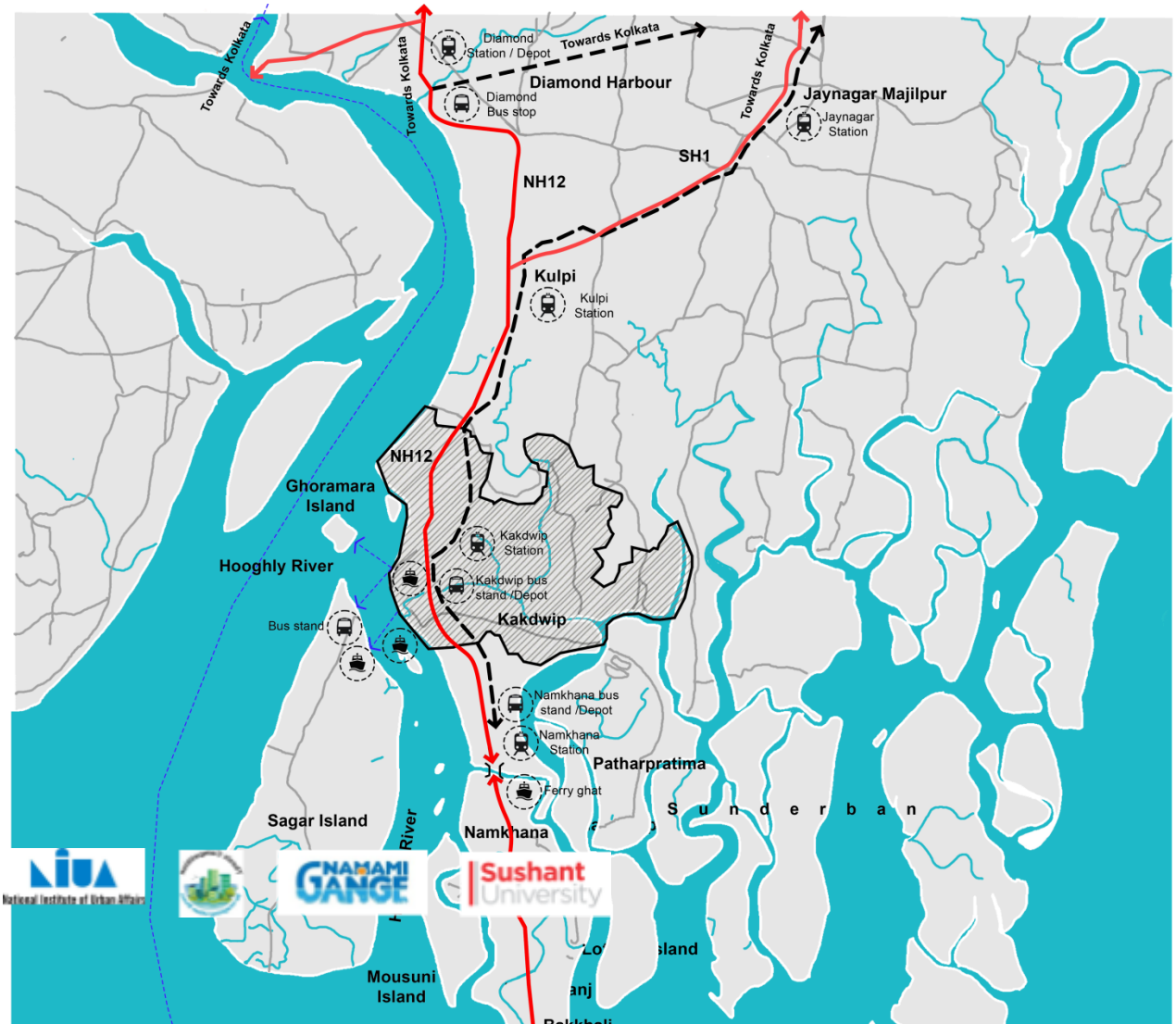


Figure 16 : Map of South 24 Parganas [Source : Google]

Figure 17: Map of Kakdwip Subdivision [Source : Author]

The Kakdwip Town is the gateway to the most of the sunderban region of tourist interest. The famous tourist places like Bakhali , Freserganj, Mousuni, Sundarban, Bhagabat pur are connected to the the kakdwip through inland and waterways connectivity. ganga sagar is a place for cultural, spiritual and religious interest is connected to the kakdwip though waterways. being an anchoring town for different parts of the southern region with an importance of cultural, spiritual, historical, ecological, and tourism interest. However, there is a lack of a sustainable planning approach, as a result of which the river life and social connect are declining day by day.



2.2.1 Sagar Island


Figure 19 : From spiritual destination to growing pollution centre
[Source : Zee news]

The Gangasagar Mela, a popular attraction in India, attracts 5.1 million visitors during its peak season in January. However, over tourism and pollution are significant issues that need attention. To address these challenges, strategies such as visitor management, infrastructure development, environmental awareness, waste management, collaboration among stakeholders, monitoring and regulation, and diversifying tourism offerings can be implemented. By adopting these measures, it is possible to balance tourism's economic benefits with sustainable practices, ensuring the preservation of the region's environment and cultural heritage.

2.2.2 Mousuni Island


Figure 20 : Mousuni island before and after the cyclone
[Source : mousunienjoypark]

In an ecologically fragile and sensitive area, the annual tourist footfall is around 10,000 visitors, with beach camping as the main attraction during the peak season from October to April. However, the area has faced significant challenges due to over tourism, floods, cyclones, and landslides, mainly due to improper planning and infrastructure development. To address these issues, sustainable tourism practices, ecological assessment and planning, disaster risk management, infrastructure resilience, community involvement, biodiversity conservation, and monitoring and evaluation are essential. By implementing these strategies, the area can protect its environment, engage the local community, and promote sustainable tourism practices for the long-term preservation of its natural beauty.

Figure 18: Kakdwip in a regional context [Source : Author]

2.2.3 Bakkhali


Figure 21 : Bakkhali sea beach pollution due to over tourism
[Source : Healhearth.in]

Bakkhali, a sea beach destination with an annual tourist footfall of approximately 100,000 visitors, over tourism and pollution have become significant concerns. Improper planning and increased pressure on the local community

have contributed to these issues. To address them, key strategies include sustainable tourism management, waste management, proper infrastructure planning and regulation, community engagement, ecological conservation, tourism diversification, and monitoring and enforcement. By implementing these measures, Bakkhali can preserve its natural beauty, reduce pollution, alleviate the burden on locals, and ensure a sustainable and positive tourism experience.

2.2.4 Fraserganj

Figure 22 : Frasergunj [Source :TOI]

In this tourist destination with an annual footfall of around 100,000 visitors, the key issues include floods, erosion, and the deterioration of historical built heritage sites. To address these challenges, strategies such as flood management, erosion control, preservation of built heritage, community involvement, disaster preparedness, sustainable tourism practices, and awareness and education can be implemented. By adopting these measures, the destination can mitigate the impact of natural disasters, preserve its natural and cultural heritage, engage the local community, and promote sustainable tourism practices.

2.2.5 Lothian Island

Figure 23 : Lothian island destroyed wild life due to cyclone [Source : Wikipedia]

The Sundarbans Reserve Forest, with an annual tourist footfall of around 20,000 visitors, is facing an identity crisis, challenges in tourism planning, and the impact of cyclones. To address these issues, strategies such as destination branding and promotion, sustainable tourism planning, infrastructure development, community empowerment, ecological conservation, disaster resilience, and collaboration and partnerships can be implemented. By adopting these measures, the Sundarbans Reserve Forest can establish a clear identity, protect its unique wildlife and habitats, improve tourism planning, and mitigate the impact of cyclones while benefiting the local community and ensuring long-term sustainability.

2.2.5 Bhagabatpur

Figure 24 : Bhagabatpur after the cyclone [Source : incredibleindia]

Bhagabatpur, known for its crocodile project, attracts approximately 20,000 visitors annually, with tourism peak throughout the year. However, the area faces challenges such as deforestation, cyclones, and issues related to tourism infrastructure planning. To address these issues, strategies including reforestation and habitat restoration, disaster preparedness,

tourism infrastructure planning, sustainable tourism practices. By adopting these measures, Bhagabatpur can protect its natural environment, enhance the visitor experience, and ensure the sustainable development of tourism while benefiting the local community.

2.3 CITY BACKGROUND & CONNECTIVITY

2.3.1 Context

The Block of Kakdwip as a whole is located in the Ganges Delta and is made up of 11 Gram Panchayats, which are part of the Sundarbans settlements and have both urban and rural communities. The majority of the kakdwip's economy is based on fishing, agriculture, and allied businesses.

The Kakdwip Block, within the Kakdwip Subdivision, covers an area of 252.7 square kilometers. It has a population of 372,191 people, resulting in a population density of approximately 1133 persons per square kilometer. The decadal growth rate of the population in this block is 27%, indicating a significant increase in population over a ten-year period.

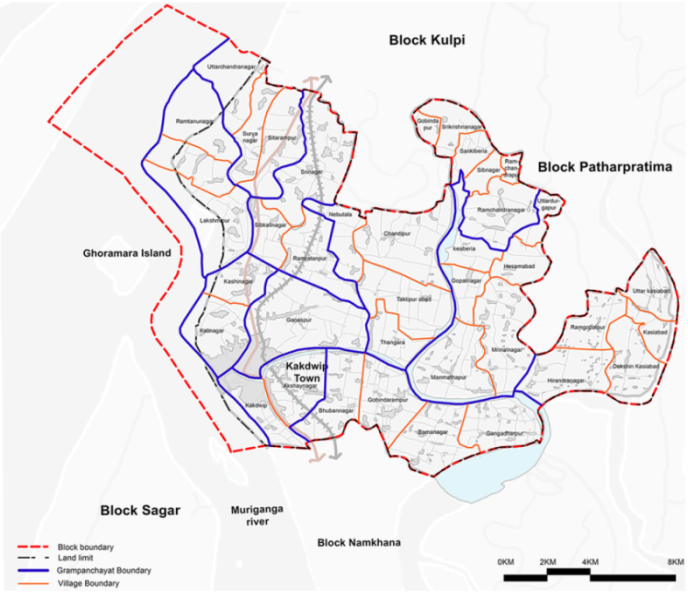


Figure 25 : Kakdwip Block Map [Source : Author]

The Notified City has an area of 46 square kilometers. It has a population of 134,453 people and a total of 38,533 households. The decadal growth rate of the population in this city is 30%, indicating a significant increase in population over a ten-year period.

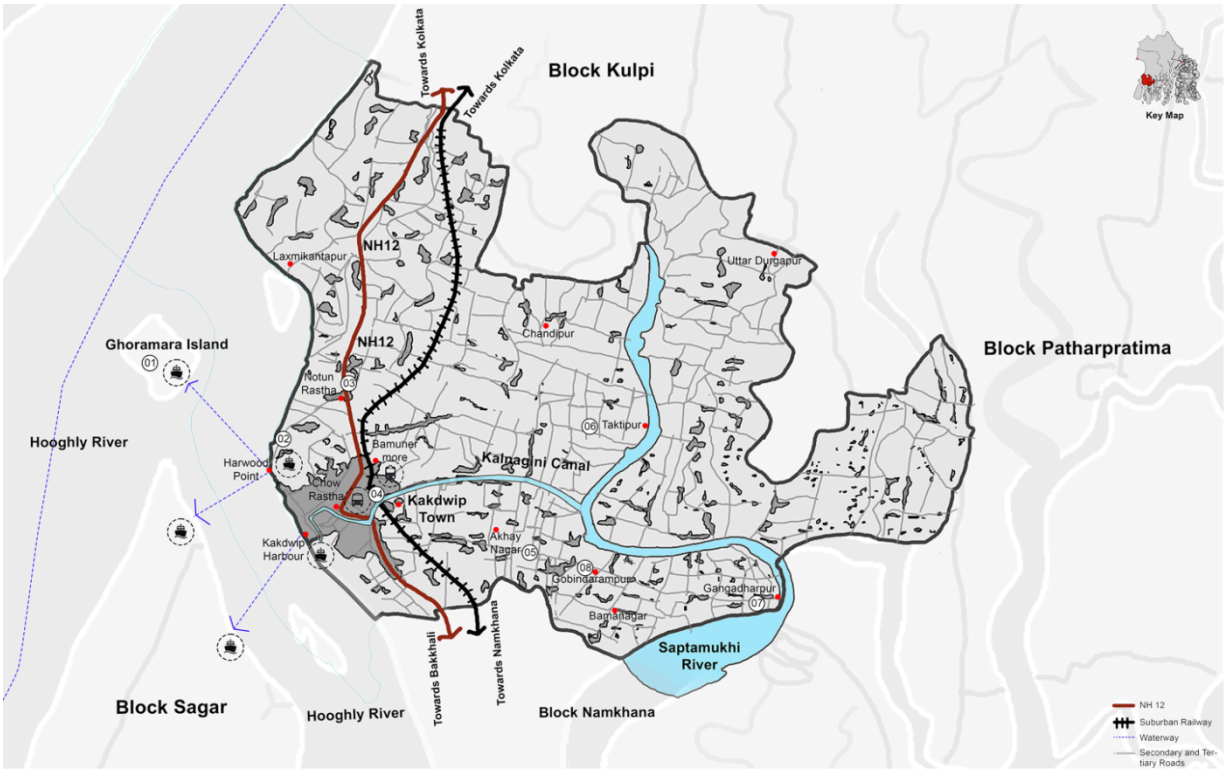


Figure 27 : Kakdwip Connectivity [Source : Author]

2.3.1.1 Ghoramara

Ghoramara Island is sinking due to rising sea levels and erosion, leading to the migration of its residents to Kakdwip. The sinking of the island underscores the impacts of climate change and the vulnerability of coastal communities. It highlights the need for urgent action to address climate change, implement sustainable measures, and protect affected populations. Efforts should focus on providing support and infrastructure for the relocated communities and implementing coastal management strategies to mitigate the impacts of rising sea levels.

Figure 28 : Ghoramara [Source : Google]

2.3.1.2 Harwood point

Harwoodpoint is a junction between Sagar and Kakdwip and serves as a leisure place for the people of Kakdwip. It

Figure 29 : Harwoodpoint [Source : Google]

offers a recreational destination where residents can relax and enjoy various activities. This scenic location provides opportunities for picnics and potentially water-based activities, allowing people from both Sagar and Kakdwip to come together and enjoy a peaceful environment.

2.3.1.3 Notun Rastha

Figure 30 :Notun Rastha
[Source : Google]

Notun Rasth is an important urban node situated between Harwoodpoint and National Highway 12, which serves as a primary road for Kakdwip. It plays a pivotal role in connecting these two key locations, facilitating the movement of people, goods, and vehicles in the region. Being an urban node, Notun Rasth likely features significant infrastructure, including transportation networks, commercial establishments, residential areas, and public facilities. Its strategic location and connectivity make it a vital junction for various activities such as commuting, trade, and social interactions, contributing to the overall development and connectivity of the area.

2.3.1.4 Kakdwip station

Figure 31 :Kakdwip Station [Source : Google]

Kakdwip Station serves as a major urban node connecting the northern and southern parts of the region. It plays a vital role in facilitating transportation and enabling the movement of people and goods. The station acts as a hub for commuters and provides access to various destinations. Kakdwip Station contributes to regional development by supporting connectivity and serving as an important transportation center.

2.3.1.5 Akshaynagar

Figure 32 :Akshatnagar [Source : Google]

Akshay Nagar serves as a transition node between the areas of Kakdwip, Gangadharpur, and Namkaha. As a transitional node, it acts as a connection point between these regions, facilitating movement and transportation between them. Akshay Nagar likely features infrastructure and facilities that support the smooth flow of traffic and the convenience of commuters traveling

between Kakdwip, Gangadharpur, and Namkaha. It plays a crucial role in enhancing connectivity and accessibility within the region, contributing to the overall transportation network and regional development.

2.3.1.6 Taktipur

Figure 33 :Taktipur [Source : Google]

Taktipur is a rural area within the Kakdwip block, known for its agriculture-dependent economy. The local community relies heavily on agricultural activities, including crop cultivation, livestock farming, and fishing. Agriculture serves as the primary source of livelihood for residents, with crops like paddy, vegetables, and fruits being cultivated. Livestock farming and fishing also contribute to the local economy. The rural setting of Taktipur emphasizes the significance of sustainable agricultural practices and highlights the strong connection between the community and the land.

2.3.1.7 Gangadharpur

Figure 34 :Gangadharpur
[Source : Google]

Gangadharpur is a peri-urban area near Kakdwip city, and its residents depend on Kakdwip for various needs and services. Being peri-urban means that Gangadharpur shares characteristics of both urban and rural environments. The proximity to Kakdwip provides advantages such as access to essential services, economic opportunities, and amenities. However, it also brings challenges related to infrastructure and urbanization pressures. Ensuring sustainable development and addressing these challenges are important for the well-being of Gangadharpur's residents.

2.3.1.8 Gobindarampur

Gobindarampur is a peri-urban area near Kakdwip city, and its residents depend on Kakdwip for various needs and services. Being peri-urban means that Gobindarampur shares characteristics of both urban and rural environments. The proximity to Kakdwip offers advantages such as access to essential services,

economic opportunities, and amenities. However, it also brings challenges related to infrastructure development and urbanization pressures. Sustainable development and effective urban planning are essential to address these challenges and improve the quality of life for Gobindarampur's residents.

Figure 35 :Gobindarampur
[Source : Google]

2.3.2 Blue and green network

The primary river of the city is either the Muriganga or Hoogly River. In the past, there were many canals and rivers that existed in the region but have now vanished due to urban growth and development. This phenomenon is not uncommon in urban areas, where the expansion of infrastructure and human settlements often leads to the alteration or disappearance of natural water bodies. The disappearance of these canals and rivers can have significant implications for the local ecosystem, water management, and the overall landscape of the city.

Figure 36 : Blue and green network
[Source : Author]

2.3.3 Connectivity

The city is connected to other blocks and Kolkata through National Highway 12 (NH-12) and a suburban railway network. NH-12 serves as a major road link, while the suburban railway network provides convenient transportation options. Internally, the city has a network of roads and water channels for efficient movement within the urban area. These transportation networks enhance connectivity, support economic activities, and contribute to the overall transportation infrastructure of the city.

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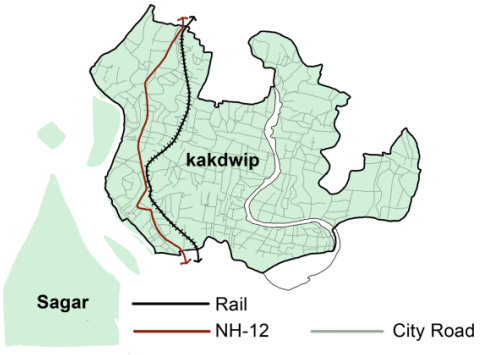


Figure 37 : Connectivity
[Source : Author]

2.3.4 Settlements

The south-western part of the block has experienced significant population growth and urban settlements due to its strong connectivity with major metro cities. The availability of efficient transportation networks has attracted people seeking better opportunities and access to urban amenities. This

growth highlights the importance of connectivity in shaping development patterns, but also poses challenges related to infrastructure and sustainable urban planning.

Figure 37.1 : Settlements
[Source : Author]

2.3.5 Community

The block of Kakdwip is home to both rural and urban communities, with residents relying on fishing, agriculture, and cottage industries for their livelihoods. Fishing is a significant economic activity, supported by the coastal location of Kakdwip. Agriculture plays a crucial role, with cultivation of various crops taking place in the fertile land. Cottage industries, such as handicrafts and small-scale manufacturing, also contribute to the local economy. The block showcases the close connection between the community and the land, emphasizing the importance of sustainable practices for long-term viability.

Figure 38 : Community
[Source : Author]

2.4 SITE SELECTION - DELINEATION - PRIMARY ISSUES

2.4.1 Context

Figure 39 : Existing structure of the site [Source : Author]

01. The entrance to the jetty Ghats in Kakdwip is congested and lacks proper planning, resulting in navigability issues. The congestion is caused by insufficient infrastructure and limited parking space, which leads to inconvenience for both locals and visitors. To address this problem, it is crucial to improve planning measures, enhance infrastructure, and manage traffic flow effectively. This can involve creating designated drop-off and pick-up points, expanding parking facilities, and involving relevant authorities and the local community in the planning process. By prioritizing these improvements, the congestion and navigability challenges at the jetty Ghats can be mitigated, providing a better experience for everyone involved.

Figure 40 : Ghat entrance [Source : Author]

02. The jetty ghat of Harwood Point in Kakdwip is currently in a deteriorating state, with no visible signs of improvement. This jetty ghat holds significant social importance as a gathering place for the city's residents. However, the lack of attention and improvement has led

to its deterioration, affecting the overall experience and functionality of this important social joint.

Figure 41 : Old jetty ghat [Source : Author]

03. Migrated people in Kakdwip have found employment in the brick kilns for brick-making, but unfortunately, they are living in dilapidated conditions. Brick-making is a labor-intensive industry, and these migrant workers often face challenging living conditions due to a lack of proper housing and basic amenities.

Figure 42 : Brick Kiln [Source : Author]

4. The Kalnagini canal in Kakdwip has been neglected and is being used as a dumping zone for the city. It is in an unmaintained and polluted state, posing environmental and health risks to the local community. The canal's water quality has been severely impacted by the dumping of waste and untreated sewage, leading to stagnant water and the potential breeding of disease-carrying organisms. To address this issue, it is crucial for the authorities to clean and restore the canal, implement proper waste management systems, and raise awareness among the community about the importance of maintaining its cleanliness. Collaborative efforts are needed between the government, community organizations, and residents to restore the canal and improve the overall environmental health of the area.

Figure 43 : Canal [Source : Author]

05. Improper planning of a dry fish factory in Kakdwip has resulted in the spread of unpleasant odors, particularly when the wind blows towards the city. This odor pollution affects the quality of life for the residents and creates discomfort. To address this issue, it is important for the authorities to enforce regulations and guidelines for the operation of the factory, including implementing ventilation systems and odor-control technologies. Regular monitoring, waste management practices, and community engagement are essential in mitigating the spread of odor and improving the living environment for the city's residents.

Figure 44 : Dry fish Factory [Source : Author]

06. The connecting links or bridges located at the heart of Kakdwip city are deteriorating, and the associated canal is polluted and encroached by buildings. This deterioration poses safety risks and inconvenience to residents. To address these issues, it is important for the authorities to

prioritize the maintenance and repair of the bridges while also addressing pollution and encroachment in the canal.

Figure 45 : Bridge [Source : Author]

07. The lack of available space for drop-off and pickup decks in Kakdwip, as well as the limited space for markets to connect to the water's edge, pose challenges to convenient access and trade in the area. The congestion and inconvenience caused by this space shortage affect residents, visitors, and businesses relying on water transportation.

Figure 46 : Market Ghat [Source : Author]

08. The canal edge along the Kakdwip Samsan is in an unmaintained and polluted state, while the ghat space lacks proper structure for its intended usage. The pollution of the canal poses environmental and health risks, while the inadequate design and maintenance of the ghat space limit its functionality. To address these issues, it is important for the authorities to prioritize the maintenance and cleaning of the canal, implement proper waste management systems, and develop the ghat space to enhance its usability. Collaboration between the government, local authorities, and community organizations is necessary to create a clean and accessible environment that preserves cultural heritage and provides a positive experience for residents and visitors.

Figure 47 : Samshan [Source : Author]

2.4.2 Connections

The site is well-connected to other parts of the city through both roads and waterways. The main road connection is NH-12, which provides convenient access for vehicles traveling to and from the site. This road serves as a primary transportation route, connecting the site with neighboring areas and facilitating the movement of goods and people.

In addition to the road network, the site is also connected through the Kalnagini Canal, which serves as a major waterway. The canal provides a means of transportation for boats and small vessels, enabling trade, commuting, and recreational activities along its route. It offers an alternative mode of transportation and contributes to the overall connectivity of the site.

The presence of both road and waterway connections enhances accessibility and promotes efficient transportation within the city. It provides residents and businesses with multiple options for traveling and transporting goods, contributing to the overall mobility and economic development of the area.

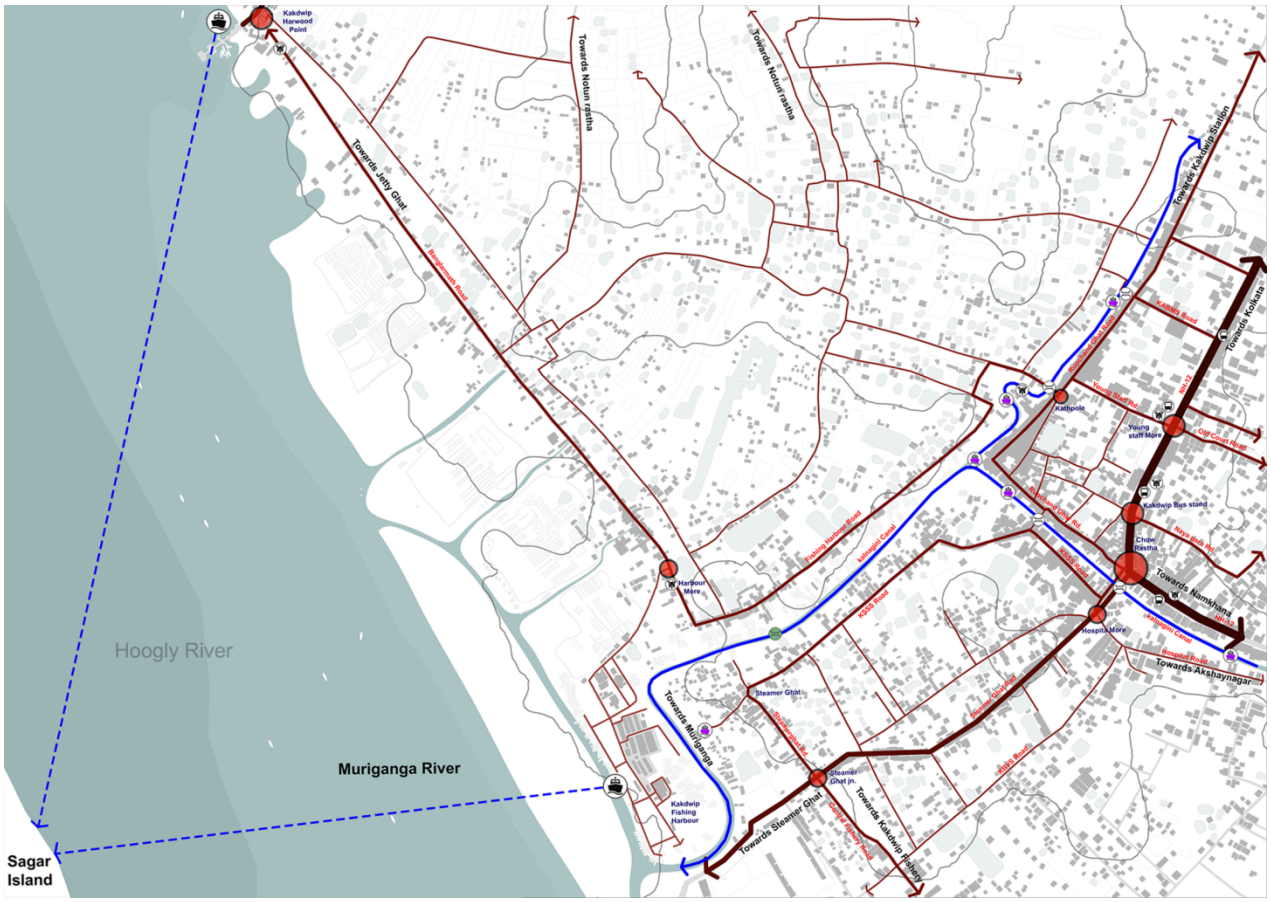


Figure 48 : Mobility Network map [Source : Author]

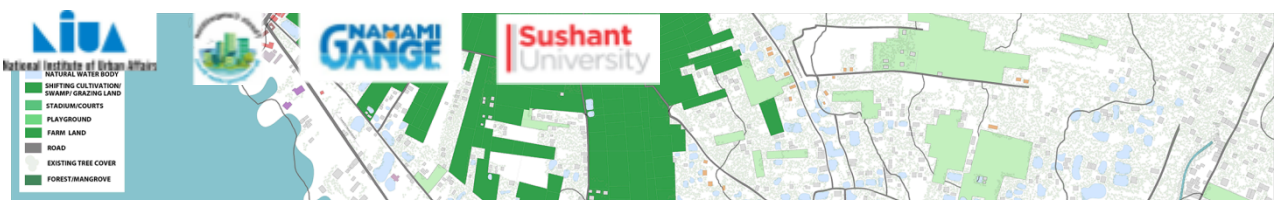
2.4.3 Open & public areas

The open lands in the city of Kakdwip are currently underutilized and unstructured, which hampers their potential for community development and recreational purposes. Additionally, a significant portion of the city's land is privately owned and has undergone gentrification, limiting public access and use.

The underutilization of open lands means that there is a missed opportunity to create community-level play areas, parks, and recreational spaces that can benefit residents of all ages. Such spaces are important for promoting physical activity, social interaction, and overall well-being within the community.

Furthermore, the concentration of land in private ownership and the process of gentrification can lead to limited public access to open spaces and green areas. This can have a negative impact on the livability and sense of community within the city.

To address these issues, it is essential for the local authorities and community stakeholders to prioritize the development and structuring of open lands. This can involve land-use planning, zoning regulations, and community engagement to ensure that open spaces are utilized in a manner that benefits the community as a whole.



2.4.4 Major Community

The major communities observed at the site level in Kakdwip are the fishing community and the market community. The fishing community plays a significant role in the local economy, relying on fishing as their primary livelihood. The market community consists of traders, vendors, and small businesses involved in the buying and selling of goods.

However, the market structure in Kakdwip is currently unorganized and growing in an unplanned manner. This lack of organization can lead to congestion, inefficiency, and difficulty for both sellers and buyers. It can also impact the overall aesthetic appeal of the market area and hinder its potential for economic growth.

To address these challenges, it is crucial for the authorities to focus on market planning and development. This may involve urban planning initiatives, zoning regulations, and infrastructure improvements to create a well-structured and organized market environment. It is important to provide adequate space, amenities, and facilities that meet the needs of both vendors and customers.

Figure 50 : Community mapping [Source : Author]

2.4.5 Neighborhood Residential

In Kakdwip, most residential buildings are constructed as G+3 structures, and the presence of stilts in these buildings is not commonly observed. This lack of stilts in buildings indicates an unplanned built environment and a deviation from building regulations.

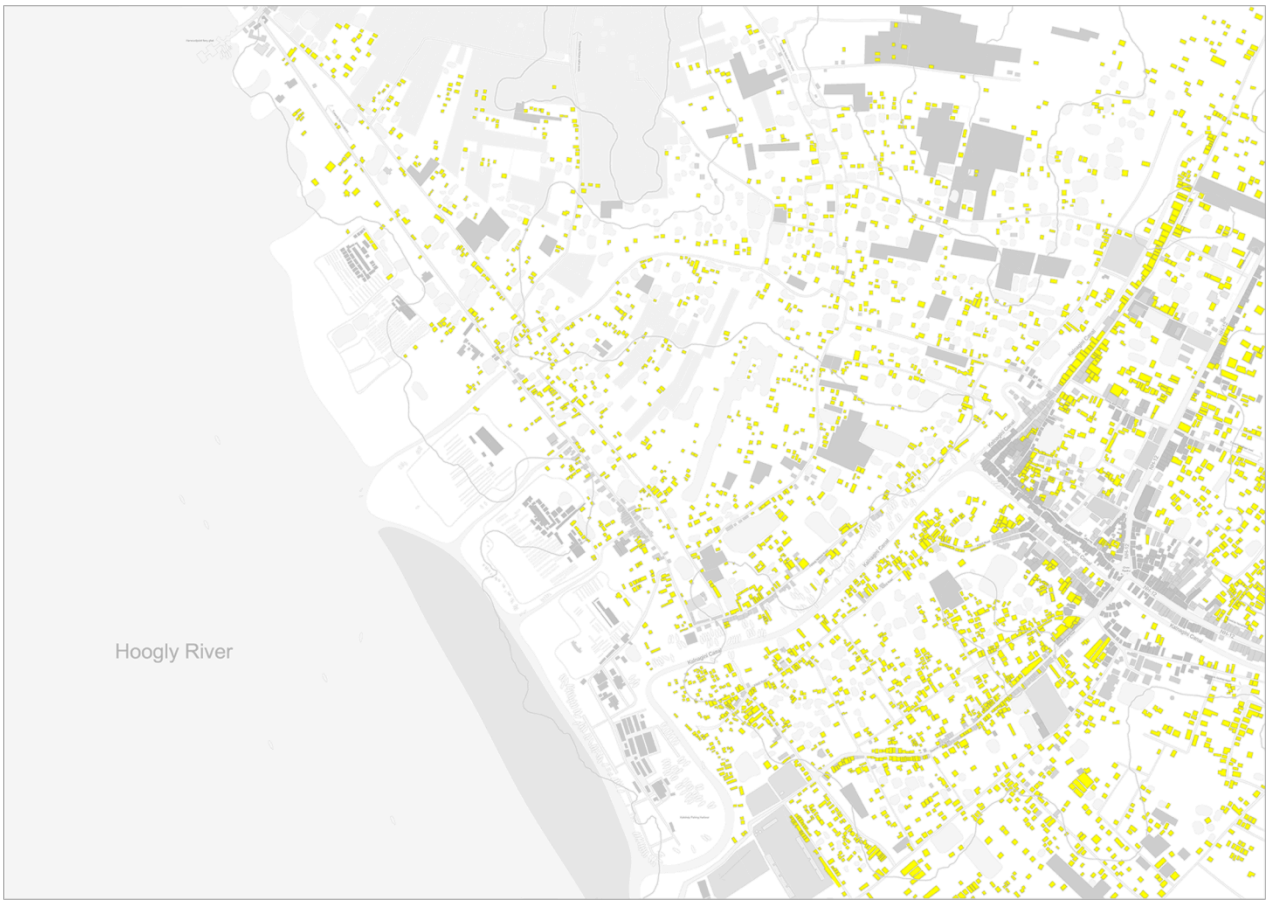
Building laws and regulations play a crucial role in ensuring safe and organized construction practices. Stilts, or raised platforms, beneath buildings can serve various purposes, including providing parking spaces, creating open areas, and allowing for better ventilation and drainage. Their absence in residential buildings suggests a disregard for these regulations and compromises in terms of safety and functionality.

To address these concerns, it is important for the local authorities to enforce building laws and regulations strictly. This includes conducting regular inspections, imposing penalties for violations, and promoting awareness among builders, developers, and residents about the importance of complying with construction standards.

Efforts should also be made to educate the community about the benefits of incorporating stilts in building design. This can involve providing incentives or offering guidance on proper building practices that prioritize safety, functionality, and sustainable development.

By ensuring adherence to building regulations and promoting well-planned construction practices, Kakdwip can enhance the overall built environment, improve safety standards, and create a more aesthetically pleasing and functional living environment for its residents.

Figure 51 : Residential Mapping [Source : Author]



CHAPTER 03 : HISTORY AND EVOLUTION

3.1 INTRODUCTION

Kakdwip is a community development block that forms an administrative division in Kakdwip subdivision of South 24 Parganas district in the Indian State of West Bengal. It is situated on the eastern banks of the Hooghly River. It is the headquarters of the Kakdwip subdivision. Kakdwip subdivision has 4 CD Blocks, those area Kakdwip,Namkhana,Patharpratima,Sagar. Kakdwip block consists of 39 villages and 11 grampanchayat . Connceted to Kolkata By waterway, Road and Railway. By road the distance from kolkata is approximately 100km.

3.1.1 Mention in Mahabharata: The Mahabharata mentions Bengali kings Chitrasena and Sanudrasena, who were defeated by Pandav king Bhima. It also talks about a folklore that Bhima was injured by a poisoned arrow and he came to the southern most parts of Bengal, called Patratal, to heal. The southern most parts of Bengal indicate towards the mangrove lands of the Sundarbans.
In a significant development of events, a third century civilization has been recently discovered beneath the surface of Gobardhanpur in Pathar Pratima Block, Sundarbans. The place has remnants of cauldrons and pots that would have been used to make herbal medicines.

3.2 HISTORIC TIMELINE OF THE REGION AND RELEVANCE OF KAKDWIP

3.2.1 Pre-history: Bengal is a 4,000-year-old civilization that thrived between the banks of Ganges to Brahmaputra and sustained itself with the riches of Gangetic Delta.

Figure 52 : Chandraketugarh [Source : MIG]

3.2.2 History : Greek traveler and chronicler Megasthenes referred to Bengal as Gangaridai in his book Indica (300 BC).Greek historian Ptolemy and Diodorus written about the gangetic delta region ,the river is called the Ganges which had a width of thirty two stadia, and a greater depth than any other Indian river and the community lived at that time in this region is Gangaridai. These are the group of warriors. Arguably, it was the might of the Gangaridai warriors that made Alexander retreat.

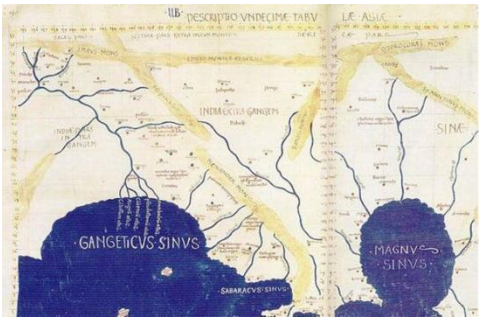


Figure 53 : Ptolemy,s Map
[Source : Wikipedia]

3.2.2 Medieval Era: Kakdwip is well-known because it is the setting for Kapalkundala and Nabakumar's deep love affair in Bankim Chandra Chatterjee's novel "Kapalkundala" from the early modern Bengali literature era.

Figure 54 : Behula & lakhindar
[Source :Wikipedia]

3.2.3 Bhuiyans (1600-Contemporary to Mughal): It is found that the actual ruler of the Sundarbans have been a Hindu Chieftain named Pratapaditya, who ruled from 1561 to 1611 A.D.His territories covered the greater part Bengal.

Figure 55 : Kingdom of baro Bhuiyans
[Source :Wikipedia]

3.2.4 British Rule: The independent rule of the Baro-Bhuiyans was ceded to East India Company in 1757 by the then Nawab of Bengal Mir Jafar.

Figure 56 : Post Nawab Bengal map
[Source :Wikipedia]

3.2.5 Pre- Independence: When the Tebhaga movement broke out in 1946, the peasant movement affected several areas of what is now South 24 Parganas. Kakdwip and Namkhana were the storm centers of the movement

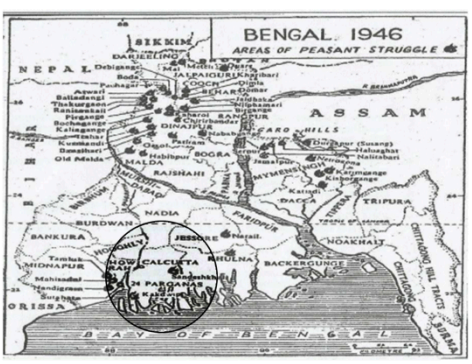


Figure 57 : Tebhaga Map & kakdwip
[Source :Wikipedia]

3.2.6 Post- Independence: During the Bangladesh liberation war in 1971 people fled from East Pakistan to India and majority of the people settled in West Bengal. On 1st March 1986, Twenty-Four Parganas district has been bifurcated into two districts - North Twenty-Four Parganas and South Twenty-Four Parganas.

Figure 58 : Migration & Bangladesh war
[Source :Wikipedia]

3.2.7 Modern Era: The city of Kakdwip Under the South 24 parganas district is the hub for the largest fishing industry of the Sothern region of Bengal.

Figure 59 : Kakdwip Fishing
[Source :Google]

3.3 HERITAGE

3.3.1 Natural Heritage: The Indian part of the world's largest mangrove ecosystem of Sundarban is mostly spread over the district South Twenty Four Parganas and Royal Bengal Tiger marks the symbol of this large forest.

Figure 60 : Sunderban
[Source :Google]

Figure 61 : Mangrove
[Source : Author]

3.3.2 Cultural Heritage: Kakdwip is a city known for its diverse arts and crafts, including clay dolls, jute handicrafts, kantha-patched cloth embroidery, and Manasa Ghat pottery. The city also hosts various fairs and festivals throughout the year, such as the Baba Thakur festival, Gajan, Gangasagar Mela, Bonbibi Puja, Shitala Puja, and

Figure 62 : Lord canning
[Source : Wikipedia]

Figure 62.1 : Jatar deul
[Source : Google]

Manasa Puja. These cultural expressions showcase the city's vibrant heritage and provide a platform for preserving traditions, promoting local talent, and fostering community cohesion.

3.3.3 Built Heritage: South 24 Parganas district in West Bengal is known for its rich built heritage, including notable landmarks like the Paternal House of Netaji Subhash Chandra Bose, Canning House, and Jatar Deul. These sites hold historical and cultural significance, reflecting the region's colonial past and religious heritage. Preserving and promoting these heritage sites is important for maintaining the district's cultural identity and attracting tourists interested in exploring its history.

Figure 63 : Ganga sagar mela House [Source : Wikipedia]

Figure 64: Gajan [Source : Wikipedia]

3.4 CHRONOLOGICAL HISTORY OF KAKDWIP

Prehistoric to 1600AD - Hunters and gatherers migrated to the northern part of India from Africa and Bengal in the Chalcolithic period, migrating to the fertile land of genetic pains to farm and build settlements. The sudden change in river course and drying up of river channels resulted in the death or decline of numerous settlements, including the Bagdi community, a Dravidian caste of Dravidian descent. Agriculture expansion and the creation of new lands resulted in the establishment of new settlements in the flooded fertile land of east and south Bengal.

Figure 65 : Migration [Source : Author]

1601-1800 - The actual ruler of the Sundarbans was discovered to be a Hindu Chieftain named Pratapaditya, who ruled from 1561 to 1611 A.D. His territories included the majority of what is now known as the greater Jessore, Khulna, and Barisal districts of modern-day Bangladesh, as well as large portions of the present-day South Twenty-four Parganas districts. Nawab Mir Jafar ceded the Baro-Bhuiyans' independent rule to the East India Company in 1757.

Figure 66 : 12 Bhuiyan Kingdom [Source : Author]

1801 – 1980 - The Tebhaga movement began in 1946 and the movement's storm centers were Kakdwip and Namkhana.During the Bangladesh liberation war in 1971, people fled to India from East Pakistan and settled in various parts of West Bengal. Due to the scope of business and trade through the river, a large number of people eventually came and settled in the southern part of the Gangetic delta region, primarily Kakdwip, Namkhan, Pathar, Sagar, and others.

Kak [Source : Wikipedia]

1981 – 1986 - On 1st March 1986, Twenty-Four Parganas district has been bifurcated into two districts - North Twenty-Four Parganas and South Twenty-Four Parganas.Kakdwip located on the southern region of South 24 parganas. Hence the city start to flourish depending on the riverine economical activities.

Figure 68 : Districts of S24pgs and N24pgs [Source : Author]

1987 – 1990 - The kakdwip is expanding through fishing, agriculture, and other related business activities. Harwood Point's old ferry ghat is used to commute to Sagar and other islands, and brick kilns are set up to construct roads. The rivers in the region are active, with the Hooghly, Kalnagini, Giyabati, and Saptamukhi rivers providing trade routes.

Figure 69 : Kakdwip map 1987-1990 [Source : Author]

1991 – 2001 - The Indian Railways built a railway line from Lakshmikantapur to Kakdwip in 2001. It is a Suburban Railway Station on the Main Line in Kolkata. It is administered by the Sealdah railway division of the Indian Railways' Eastern Railway zone. Kakdwip railway station is located beside Kakdwip-Namkhana Road in Kakdwip, South 24 Parganas district, West Bengal, India.

Figure 70 : Kakdwip map 1991-2001 [Source : Author]

2002 – 2011 - Kakdwip fishing port is located on the banks of the Muriganga River and is a significant full-service fishing port. However, it is in trouble due to the Kalanagani Canal being too deep and the lack of an ice mill. There is also no dry dock available for ship repairs.

Figure 71 : Kakdwip map 2002-2011 [Source : Author]

2012 – 2023 - National Highway 12 runs from its junction with NH 27 in Dalkhola to Bakkhali in West Bengal. It shifted the entire market community of Kakdwip city to the eastern side of the highway, resulting in a dense unorganized built environment.

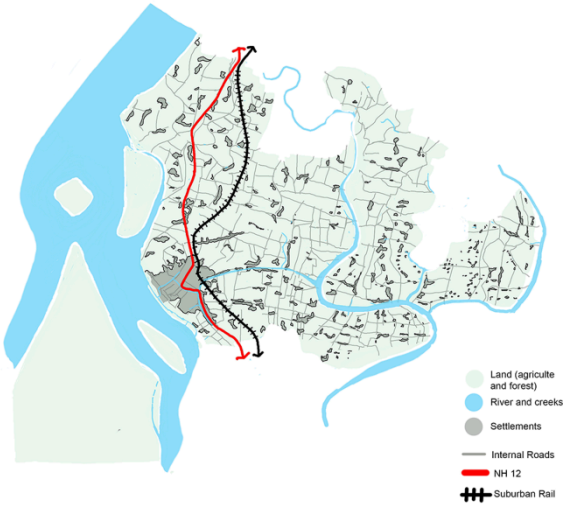


Figure 72 : Kakdwip map 2012-2023 [Source : Author]

CHAPTER 04: ECOLOGY OPEN SPACE AND MOVEMENT NETWORK

4.1 INTRODUCTION

For the understanding of the built and open space ratio the site has been divided into 3 zone. Where Zone 1 is has been shared by the Kalinagar village, Zone 2 is shared by Kakdwip, and the Zone 3 is shared with Ganeshpur The core city which is comes under zone 1 and 2 is majorly densely populated hence the availability and quality of open space is less. and from the regional analysis of the LU and LC map we can see that there is an almost 10% reduction in the green and open space. Due to the improper planning of the area the blue and the green network is affecting day by day and reducing extensively.

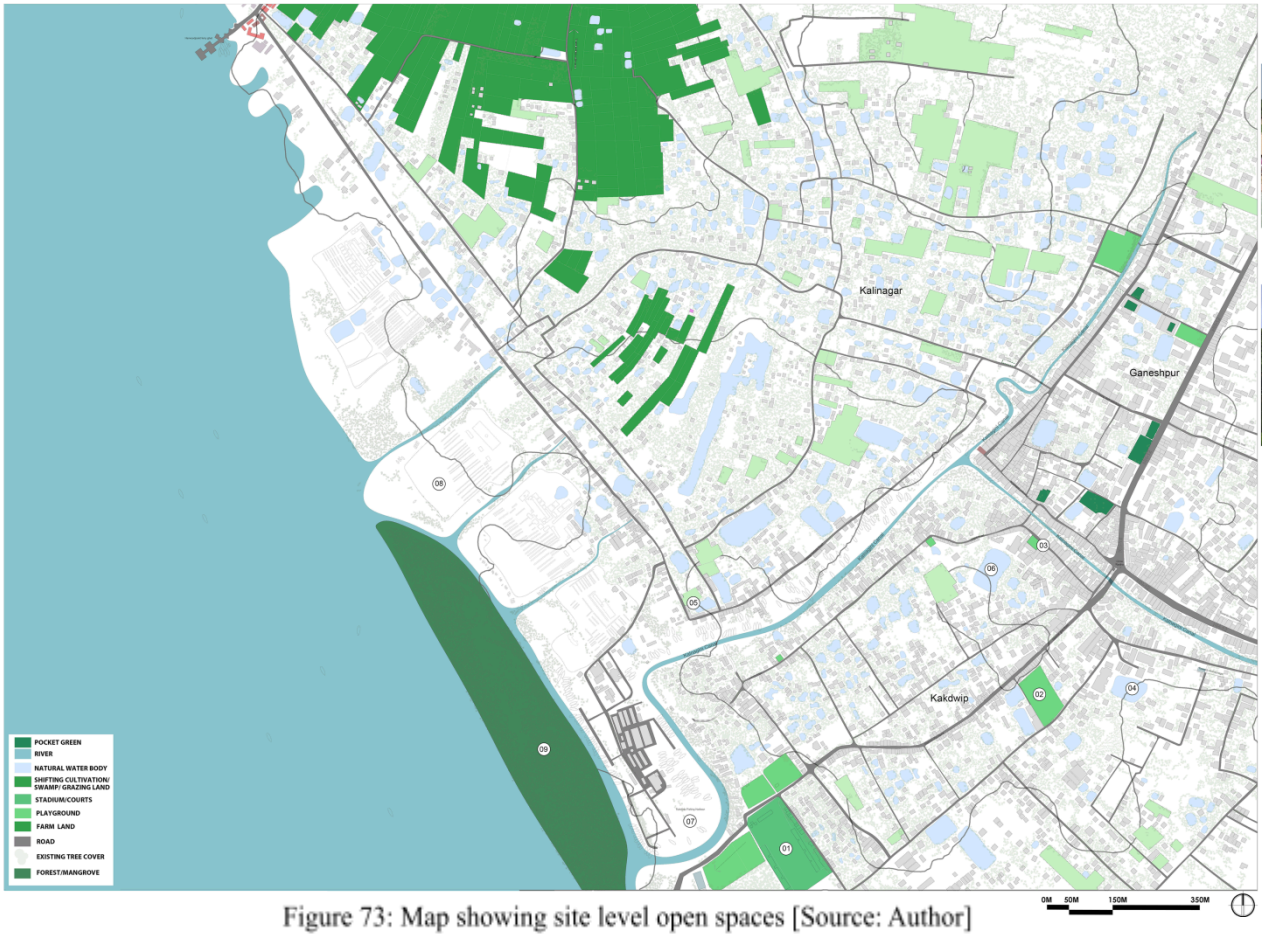


Figure 73: Map showing site level open spaces [Source: Author]

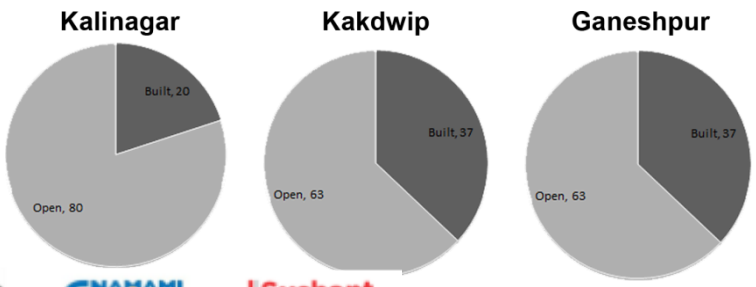


Table 01: Built & open distribution [Source: Author]

4.2 PRIVATELY OWNED ACCESSIBLE OPEN SPACES

Kakdwip Sports complex used for different types of sports activities. Kakdwip Bidhan Maidan used for sports activities and seasonal fair (Flower and book mela), puja ground. used as a neighborhood and school playground and fair and puja ground.

Figure 74: Kakdwip Sports complex [Source : Google]

Figure 75: Kakdwip Bidhan Maydan [Source: Google]

Figure 76: Banglar Math [Source: Google]

4.3 OPEN SPACES WITH RESTRICTED USAGE

Hospital pond unutilized and deteriorating. Narasingha Ashram field used for cultural and religious events. Banglar math pond, once used for fishing but now restricted.

Figure 77: Hospital Pond [Source : Google]

Figure 78 : Narasingha Ashram [Source - Google]

Figure 79: Banglar math Pond[Source : Author]

4.4 INACCESSIBLE OPEN SPACES

Kakdwip Fishing port, accessible is restricted to few groups of people. 50 - 70 years old Brick Kiln site used by mostly migrated workers from other states of India. Mangrove forest area are in accessible conserved area.

4.2 GEOLOGICAL EVOLUTION

The coastal areas near Kakdwip and other similar regions are experiencing land sinking due to the increase in sea water level and river water level. This phenomenon has resulted in several challenges, including the intrusion of saline water into freshwater sources, increased salinity of drinking water, and depletion of the groundwater table. To address these issues, coastal protection measures, water management strategies, and sustainable practices need to be implemented. These efforts aim to mitigate the impacts of land sinking, water salinity, and groundwater depletion, ensuring the long-term sustainability and resilience of the coastal communities.

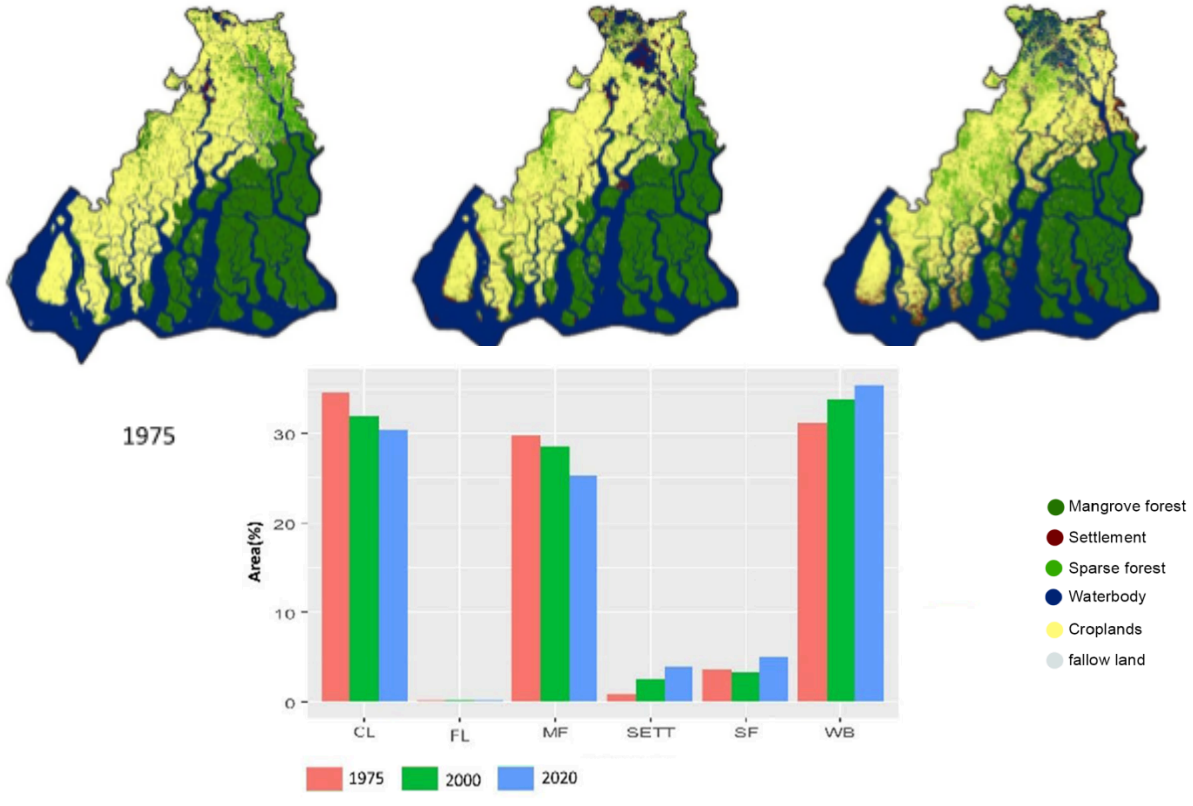


Table 02: Landuse and landcover graph [Source - Nature]

4.3 EXISTING FLOORA AND FAUNA

Flora: 1] Kankra, 2] Golpata, 3] Sundari,4] Goran, 5] Keora, 6] Ohundhal, 7] Passur

Fauna :1] Gangetic dolphin, 2] Gharial, 3] Olive back Logger Head Turtle,4] Gangetic soft-shelled Turtle.

These flora and fauna species play important roles in maintaining the ecological balance of the region's coastal and riverine ecosystems. They contribute to biodiversity, provide habitats for other species, and are integral to the cultural and ecological heritage of the area. Efforts to conserve and protect these species are crucial for the overall health and sustainability of the ecosystem.

Figure 84 : Falura nad fauna of sunderban [Source : Google]

4.4 HYDROLOGY

Ground water is depleting to a larger extent due the extraction of the ground water to meet the requirement of drinking water. Due to a huge increase in rain fall, in the time of monsoon the rivers and the creeks are filled with water and due to low holding capacity, if runs over the habitable areas.

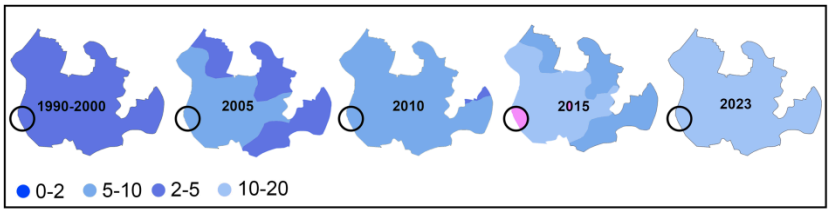


Figure 85: Ground water depletion [Source - Author]

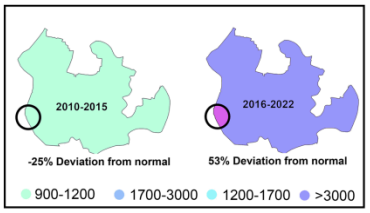


Figure 86: Rainfall [Source - Author]

Over the Years the no. of rivers and creeks of the Sunderban region is reducing. In the last 40 -50 years almost 70 to 80% of the natural drains has been vanished. Later on, the areas are covered with large number of built structures.

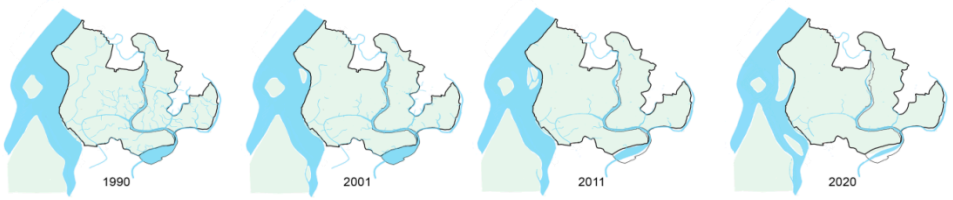


Figure 87: Evolution from river Creeks & nallahs [Source- Author]

4.5 MOVEMENT NETWORK

4.5.1 Site Level Connectivity

The city is connected to the Kolkata through Roadways, Railways and waterways. National highway 12 is the most important movement spine of this region which connects barrack pore in the north. The kakdwip city is again connected to the other island through waterways.

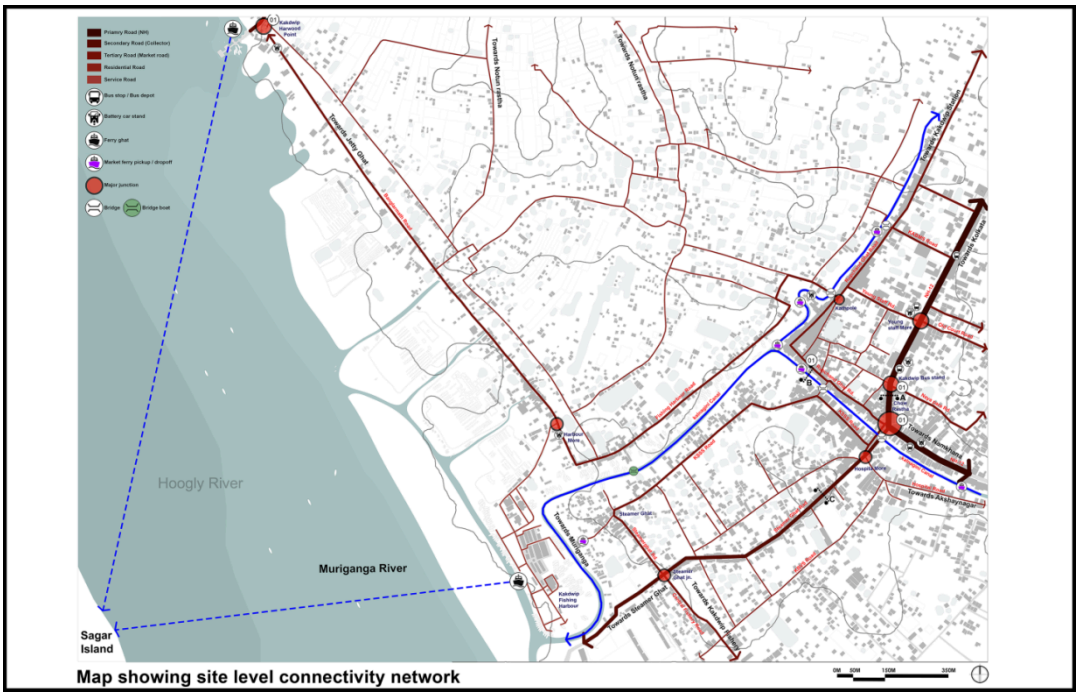


Figure 88: Site level Connectivity [Source - Author]

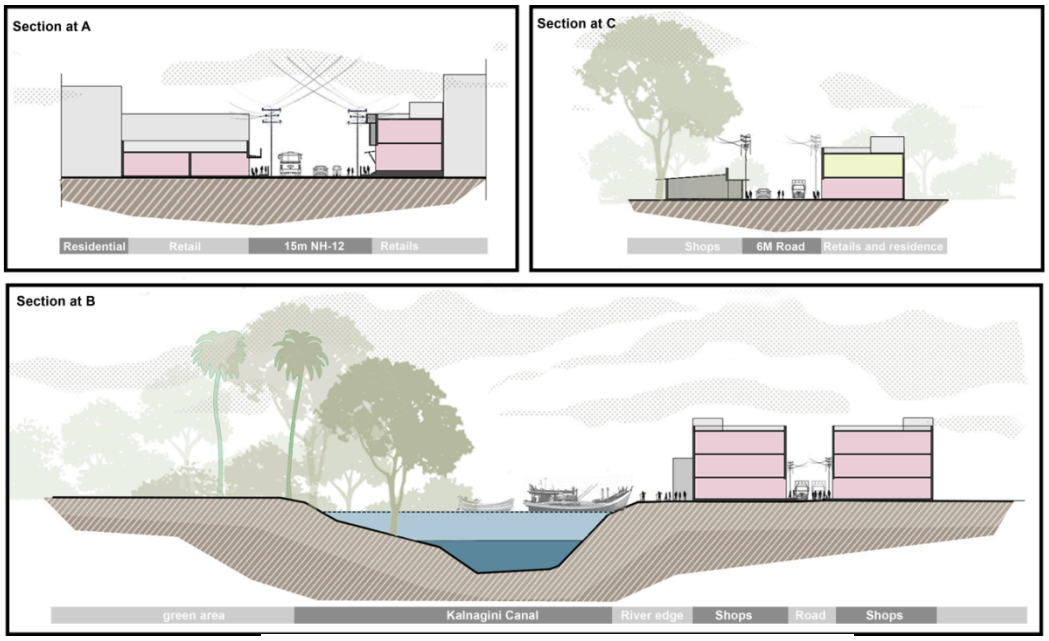


Figure 89: Road Sections [Source - Author]

4.5.1 Tourism Network

The national government of India has proposed various waterways tourism routes to enhance the economic and cultural structure of different regions, including the Kakdwip precinct. These routes aim to establish strong connections and promote tourism through waterways. One such route is from Kolkata to Sudhanaykhali, which serves as a regional water tourism system.
Additionally, an international tourist route from Kolkata to Dhaka has been proposed, aiming to foster relationships and attract international visitors. Another significant route is the longest one, stretching from Varanasi to Dibrugarh, passing through Bangladesh. This route encompasses 51 destinations and offers a 50-day travel time, covering approximately 2,300 km of water travel. Notably, this route also passes through the city of Kakdwip.

Figure 90: National and International Tourism waterways [Source - Author]

As a result, it becomes crucial to develop the Kakdwip region as a gateway to the Sunderban. This development will not only improve the living conditions for the city's residents but also contribute to an integrated and sustainable planning approach. By leveraging the opportunities provided by these tourism routes, the local economy can experience significant growth and prosperity.

CHAPTER 05: MORPHOLOGY – TYPOLOGY - ACTIVITY

5.1 SITE MORPHOLOGY

5.1.1 Figure ground Map Analysis

The central part of Kakdwip features a compact urban core, characterized by dense clusters of buildings, narrow streets, and bustling activity. The town is likely to have a mix of traditional and modern buildings, reflecting its historical significance and recent developments.

Moving towards the outskirts of Kakdwip, the density of buildings may decrease, giving way to more open spaces. These open spaces include agricultural lands, vacant plots.

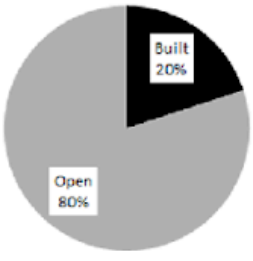


Table 03: Built & open ratio

Figure 91: Figure ground map [Source - Author]

5.1.2 Landuse Map Analysis

Kakdwip in South 24 Parganas district of West Bengal exhibits a diverse range of land uses. The town is characterized by scattered residential areas, with a mix of housing types. Commercial and retail zones are prominent, concentrated around the town center and major roads. Brick and

fishing Industrial zones exist on the outskirts at the Muriganga river side with supporting ice factories and other necessary warehouses. Surrounding the town are agricultural areas, contributing to the local economy. Open spaces and recreational areas provide leisure opportunities, while water bodies like rivers and canals enhance the natural environment.

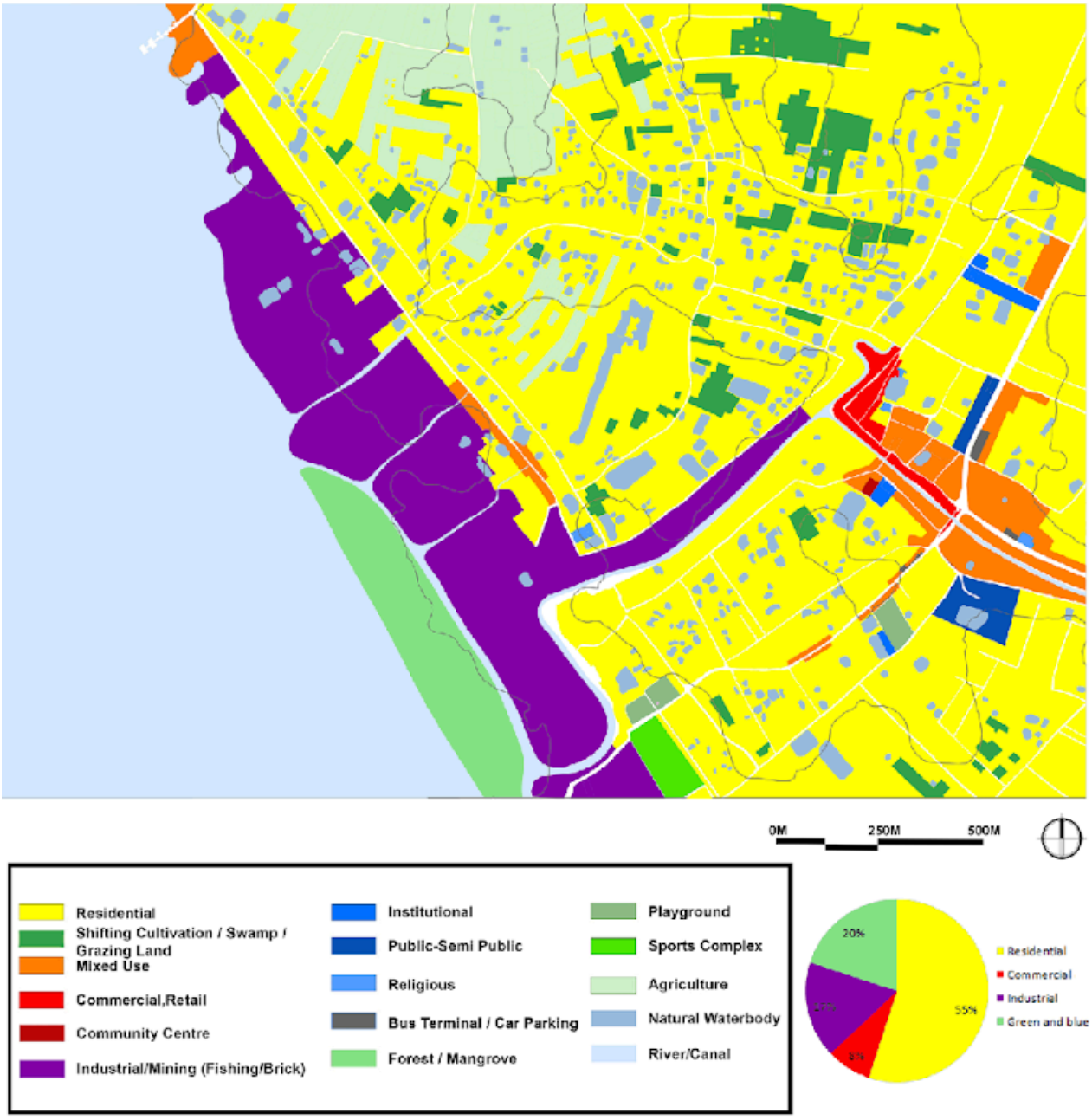


Figure 92: Landuse map [Source - Author]

Table 04: Landuse

5.1.3 Builtuse Map Analysis

Kakdwip in South 24 Parganas district of West Bengal has experienced organic growth of built uses without a proper master plan. This lack of planning has resulted in an uneven distribution of city amenities among the major three parts of the town. The built environment is likely to comprise a mix of residential, commercial, and industrial structures, reflecting the diverse needs

of the population. However, without a coordinated planning approach, the distribution and accessibility of essential amenities such as schools, healthcare facilities, parks, and transportation infrastructure may vary across different parts of the town. This highlights the importance of integrated and sustainable planning to ensure equitable access to amenities and improve the overall quality of life in Kakdwip.

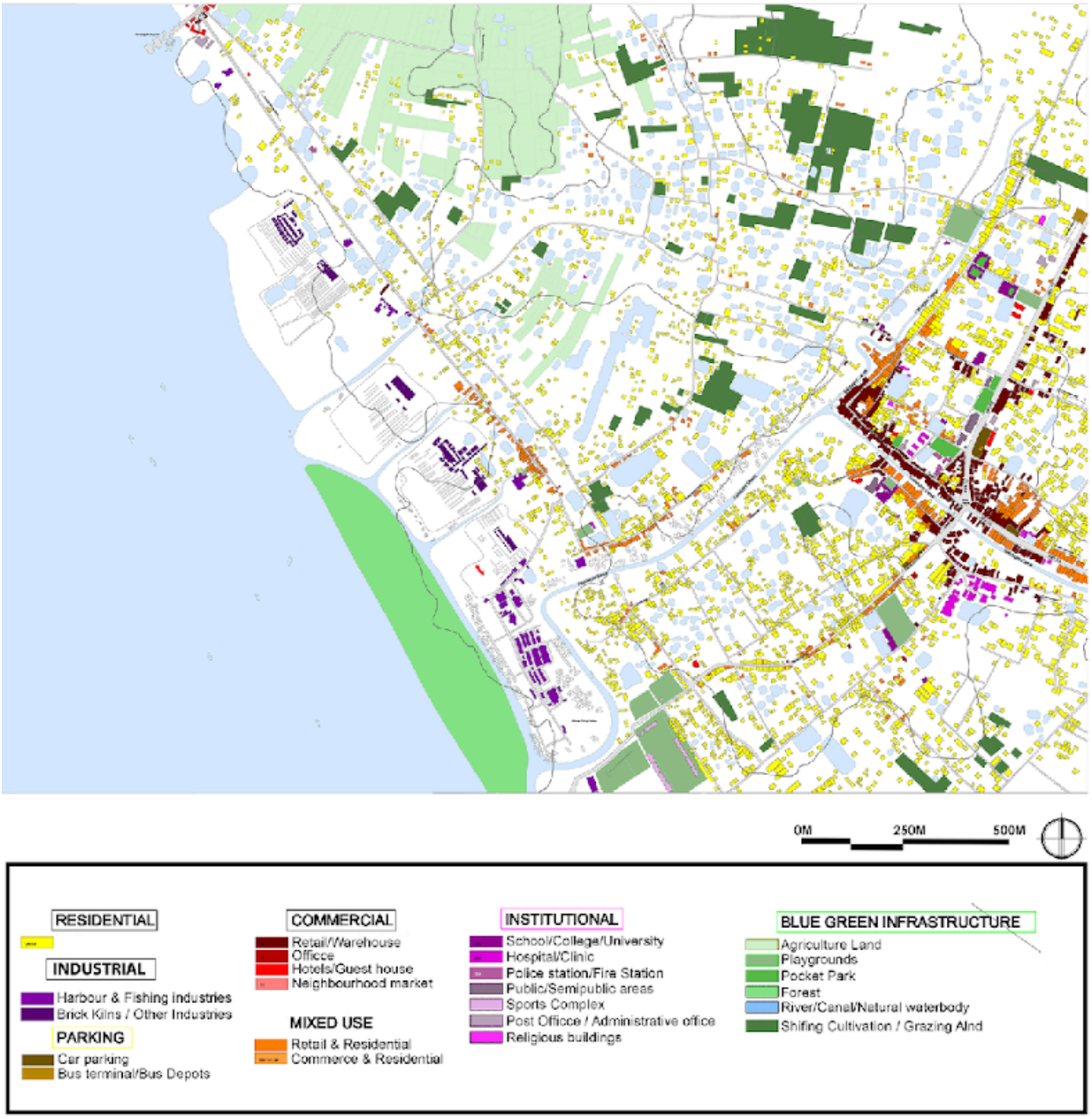


Figure 93: Built use map [Source - Author]

5.2 SITE TYPOLOGY

5.2.1 Market Typology

5.2.1.1 Rupchand ghat Bazar (Old market area)

Rupchand ghat Bazar area is the oldest settlements and the market of kakdwip. It's a Linear attached typology with retail and wholesale grocery,garments,cement,medical store etc. the building of this region are maximum 2 to 3 stories shared a narrow road of 4 m. The typologies of these market are different from new one. this market has front and rear side open as frontal part is connected to road and rear part is connect to rivers.

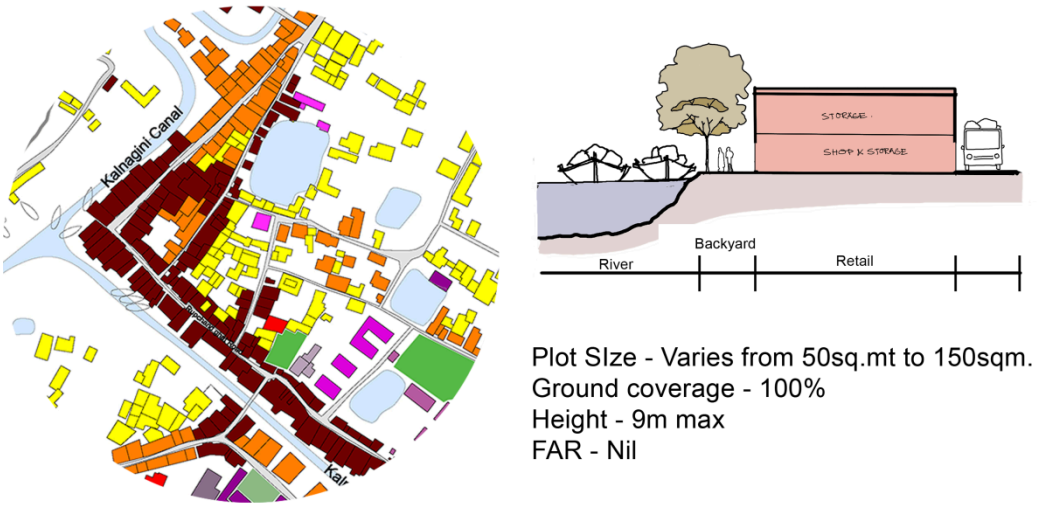


Figure 94: Rupchand ghat market typology [Source - Author]

5.2.1.2 Chow Rastha (New market area)

These markets are comparatively newer settlements and is of 2 to 3 stories. Linear attached typologies of different types of shops have been seen over here. This part is sharing a larger road width of 12 m. And is not open to the rear part.

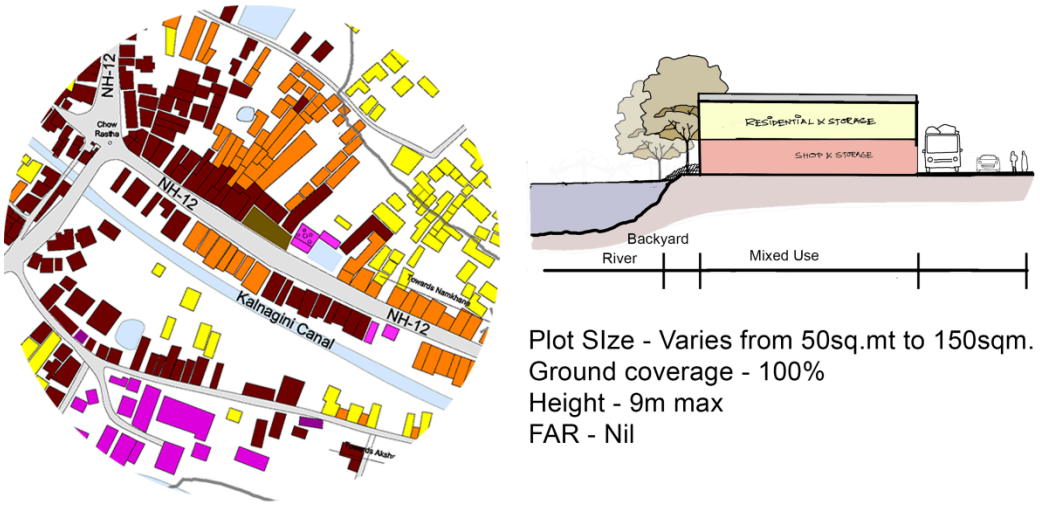


Figure 95: Chowrastha market typology [Source - Author]

5.2.2 Ephemeral typology

6.2.2.1 Temporary structures (Ganga Sagar Mela)

At the time of Ganga Sagar mela the Harwood point precinct has been filled with activities. many temporary Food kiosk, Mela shops, Temporary stay area for pilgrims and police has been made to accommodate the crowd.

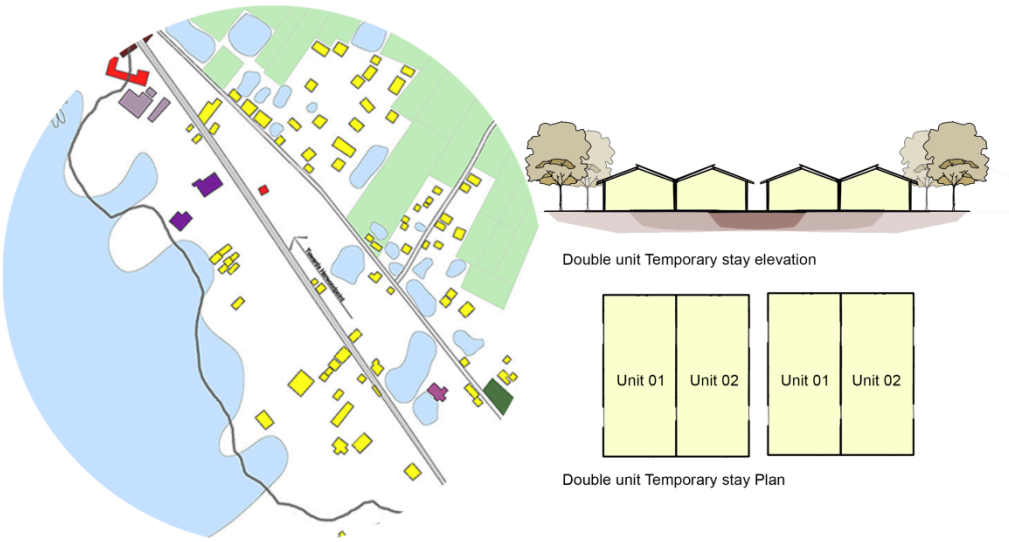


Figure 96: Ephemeral typology [Source - Author]

5.2.3 Residential Typology

5.2.3.1 Kalinagar settlements (Hut Typology)

These settlements are hamlet type scattered settlements. These settlements have no stilt and majorly are kaccha houses. The density of these area is very less.

Figure 97: Hut typology [Source - Author]

5.2.3.2 Subhash Nagar settlement (Detached typology)

These settlements are newer settlements guided with building regulations. These buildings are having a height of 6 to 9 m. these zones are having a detached residential typology with no stilts.

Figure 98: Detached typology [Source - Author]

5.2.3.3Ganeshpur settlement (Detached Typology)

Ganeshpur core city settlement area is the oldest area of settlement at the Kakdwip with dense and organic settlement pattern which maintains no building by -laws.

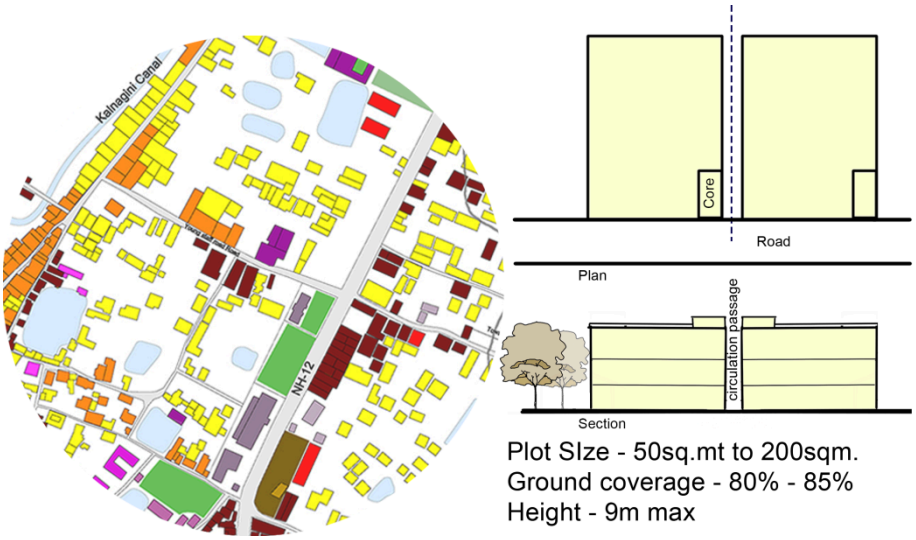


Figure 99: Detached Typology [Source - Author]

5.2 SITE ACTIVITY

5.2.1 Harwood Point

The harwood point area is so popular among the city people. it's a space for social meet. high degree of public ness has been seen in the evening time. Fishing boats also comes some time.

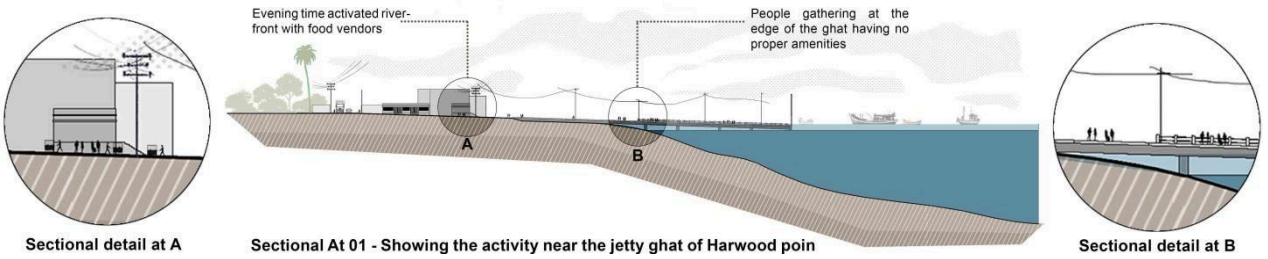


Figure 101: Harwood point [Source - Author]

5.2.2 Mela Ground

The area near Harwood point Jetty ghat is activated at the time of Ganga Sagar mela. Many Temporary Kiosk and tents have been placed during the time of mela.

Figure 102: Melaground [Source - Author]

5.2.3 Kalinagar Brick Kiln

There are many bricks kiln along the, muriganga river front. People from UP and Bihar Comes to the place for work. The place is become more active in the morning and evening.

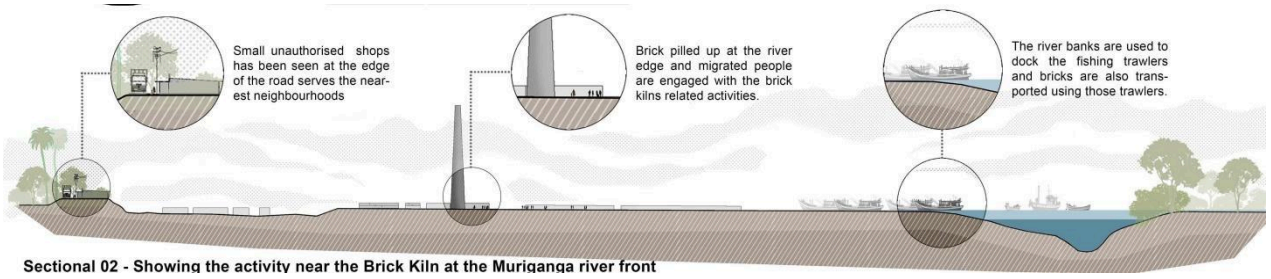


Figure 103 : Brick Kiln ,kainagar [Source - Author]

5.2.4 Fishing Harbor

The Fishing harbor is used by the fisherman and allied people for the fishing activity. The harbor is moderately active during the whole day. and based on season is become more active.

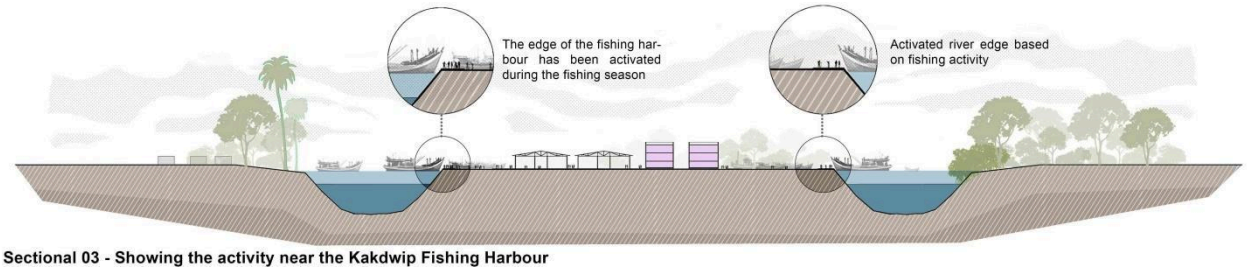


Figure 104: fishing harbor [Source - Author]

5.2.5 Fishing Neighborhood

The Fishermen neighborhood is moderately activated throughout the day. people living there are engaged with the fishing net making and boat repearing activities.

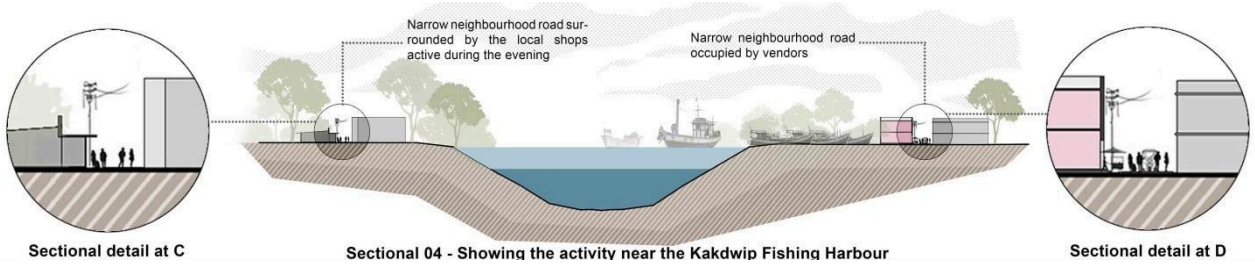


Figure 105: fishing neighborhood [Source - Author]

5.2.6 Rupchand ghat

The Rupchand ghat of old market area is activated in the morning and the area is more activated at High tide time. people engaged with the activities of drop-off and pickup of commodities.

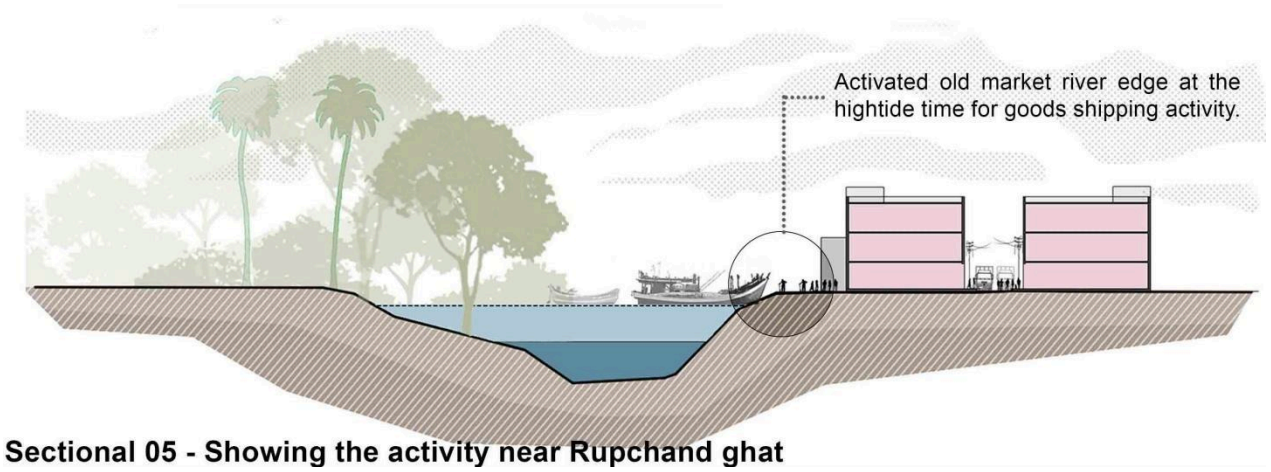


Figure 106: Rupchand ghat [Source - Author]

5.2.7 Bus depot

The Kakdwip Bus depot is activated during the day time from 5 am in the morning. Apart from bus depot activities. many food vendors have been seen selling fruits and fast foods.

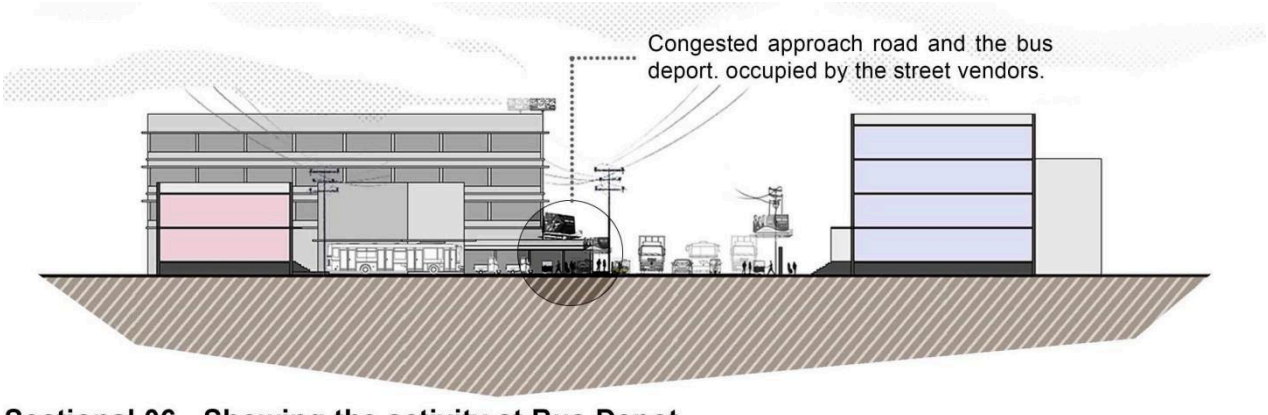


Figure 107: Kakdwip Bus depot [Source - Author]

5.2.8 New market

The new market area is the new hotspot for the activity. the market area is congested all the time with bus, auto and cars. During day time the road edge has been occupied by street vendors.

Figure 108: New market area [Source - Author]

CHAPTER 06: INFRASTRUCTURE ANALYSIS

6.1 PHYSICAL INFRASTRUCTURE

6.1.1 Water Supply

Majorly the source of drinking water at this region is ground water. Majority of individual households are having deep tube well bore for the ground water extraction. Due The rapid growth of population and the heavy extraction of the ground water leads to reduce the ground water level from 5 m to 20m in last 2 decades. The PHED of West Bengal govt. is also supplying piped water to the individual households by means of ground water schemes. Though the govt. has initiated the Surface water supply project for the other part of new urban areas.

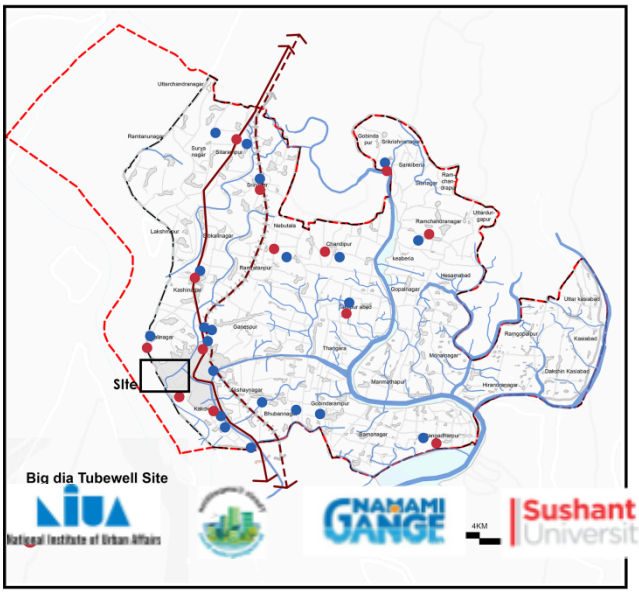


Figure 109: Water supply map [Source - Author]

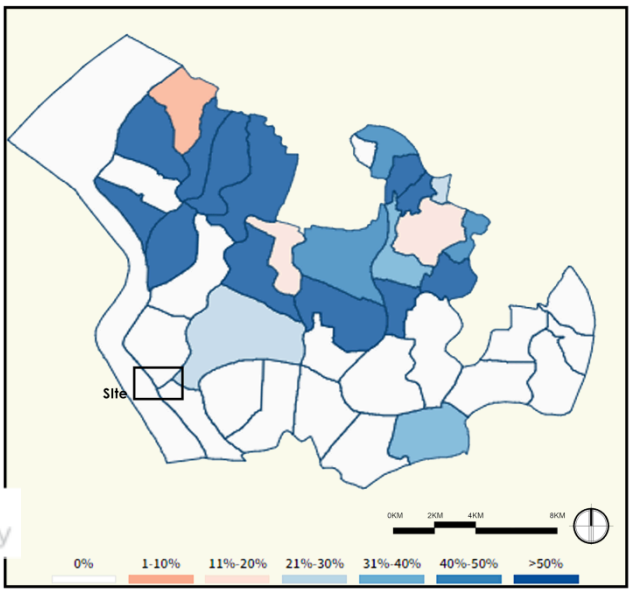


Figure 110: Status tap water supply [Source - PHED]

6.1.2 Drainage and Sewage

The drainage facilities in Kakdwip area of South 24 Parganas district in West Bengal are reported to be poor. The existing drainage system consists of concrete semi-covered drains located alongside the roads, which are used to connect households' sewage and drainage systems. Unfortunately, these drains are not equipped with proper treatment mechanisms, leading to untreated wastewater being directly discharged into nearby water bodies. This inadequate drainage infrastructure can contribute to water pollution, environmental degradation, and potential health risks for the community. Addressing this issue requires the implementation of effective sewage treatment and improved drainage systems to ensure proper disposal and treatment of wastewater, minimizing the negative impact on the environment and public health.

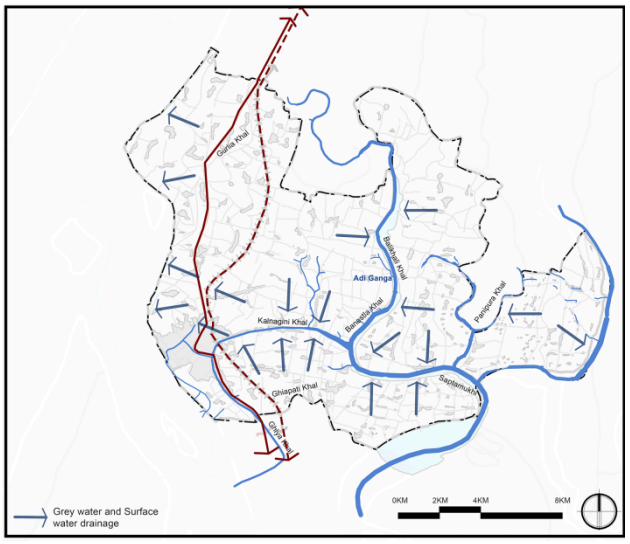


Figure 111: City Drainage network [Source - Author]

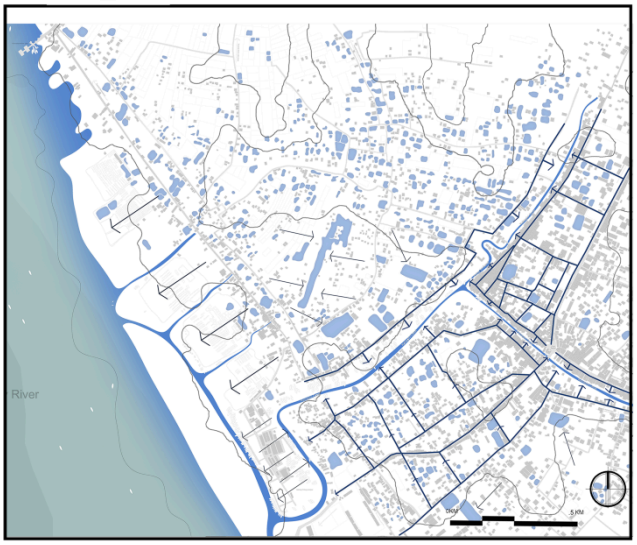
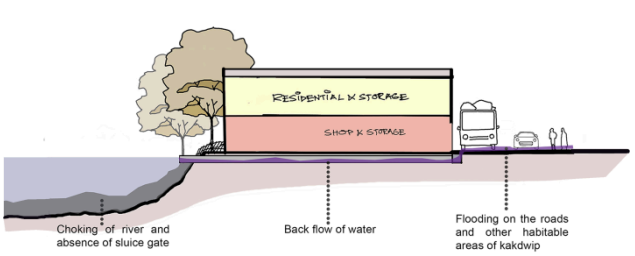
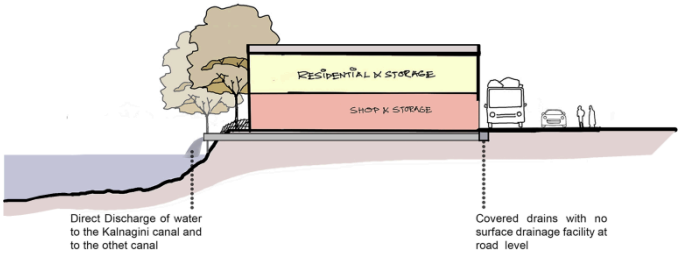


Figure 112: Existing waterbodies and drainage network [Source - Author]

The city faces Table 05: Water supply st

many difficulties during the monsoon season due to poor planning of the city's drainage and sewage system. City waste is dumped directly into the canal without separation or filtration, polluting the canal and rivers. The canal's capacity to hold water was eventually reduced. Flooding occurs in the city as a result of canal choking, and in the absence of a sluice gate, water flows from the canal through the drainage system, resulting in an urban flood.

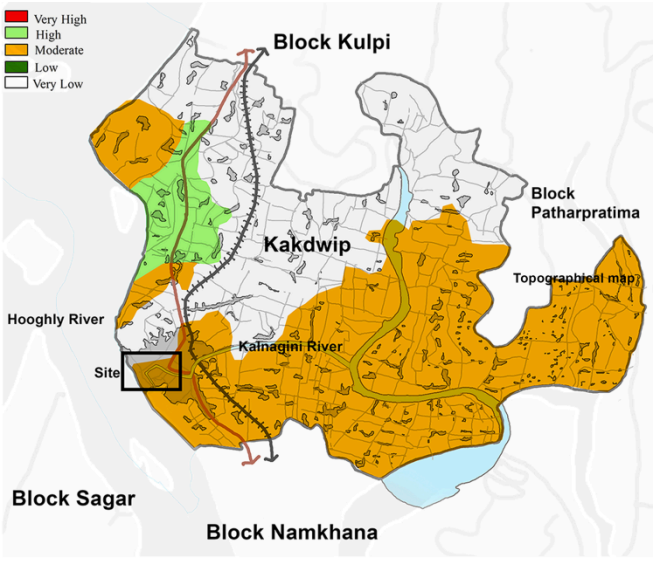




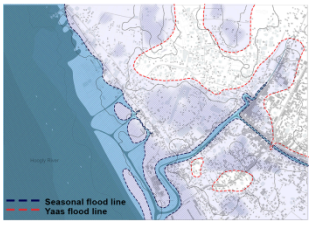
113 'o in city [Source - Author]

6.1.3 Flood Vulnerability

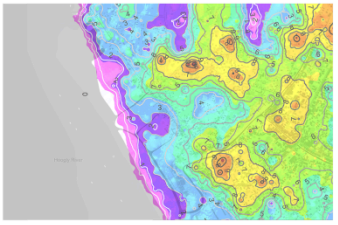
Almost 65% of the area are very vulnerable to flood. and almost 10% of the area are at high risk of flood. Due to the low laying area and unmaintained river and canal, the river and canal beds are filling up hence the natural water holding capacity is decreasing day by day and flash flood and cyclone is a frequent event for the city of kakdwip. Hence it is affecting livability of the city. Fragile nature of the entire region leads to produce economical instability which leads to unexpectable city life and social structure.



Flood vulnerability map of kakdwip



Flood plain and 2021 flooded area



Natural Topography

Figure 114: Flood map & topography map [Source - Author]

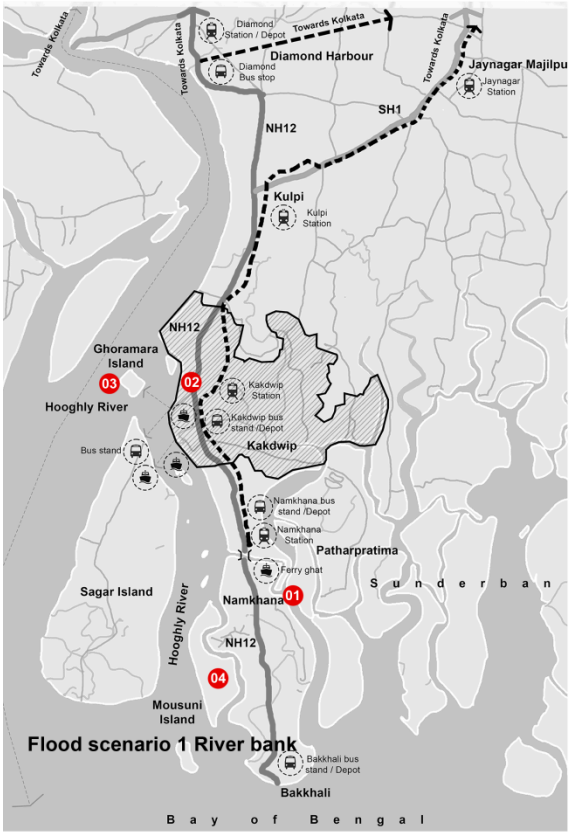


Figure 115: Flood affected area 2021 [Source - Author]

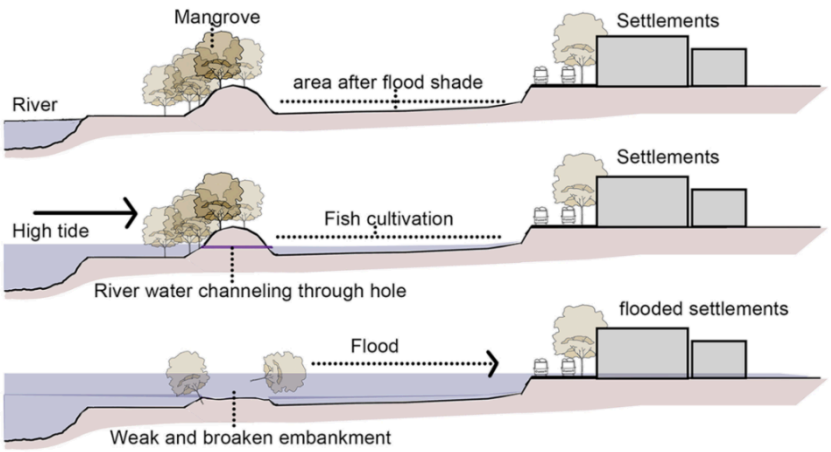


Figure 116: Flood scenario at the river edge [Source - Author]

6.2 SOCIAL INFRASTRUCTURE

6.2.1 Education

Lack of Professional colleges and educational centers to serve the existing demand. Students tend to migrated to the other cities for higher education. Heigharchy of educational centers are absent at city level. Abundance of primary & anganwari school with poor quality infrastructures and management.

6.2.2 Healthcare

Need of Super spaciality and primary healthcare facilities. people of this area are highly depending on the nearest cities for the healthcare facilities. Existing Govt. subdivisional hospital is overcrowding. For extreme emergency cases people tends to go to nearest hospital in Diamond harbor and then to kolkata.

6.2.2 Recreational and commercial

Kakdwip bazar roads are poorly maintained and narrow. Absence of parks and recreational centers at the city level. Informal adda (hangout zones) has been seen near the market places. Lack of recreational spaces at the neighborhood level.

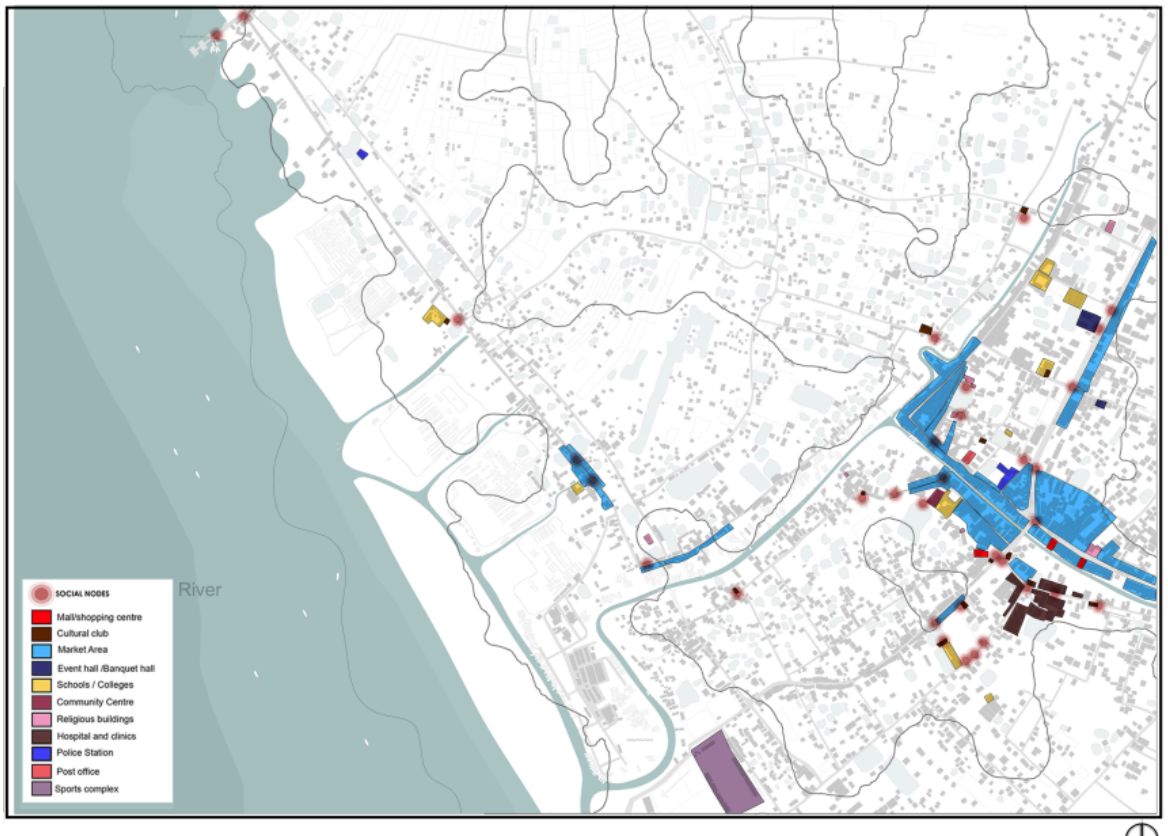


Figure 117: Map showing the existing social infrastructure [Source - Author]

CHAPTER 07: DEMOGRAPHY & HUMAN GEOGRAPHY

7.1 DEMOGRAPHY

Kakdwip Block, with an area of 252.7 square kilometers, is home to a population of 372,191 people. The population density in this block is approximately 1133 persons per square kilometer, indicating a relatively high population concentration. The decadal growth rate of 23% suggests a

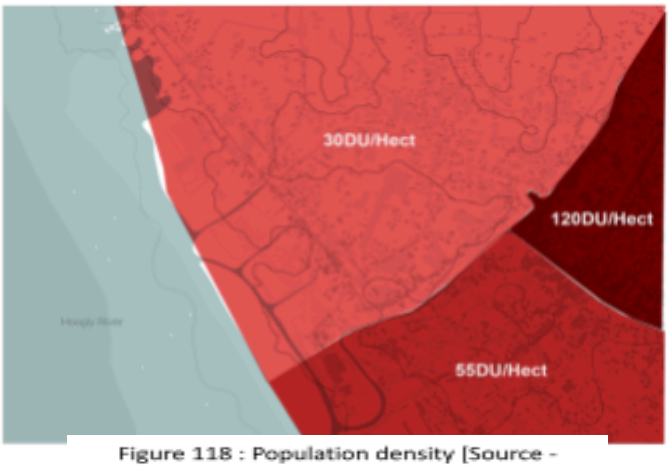
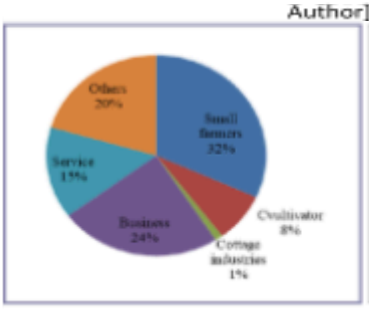
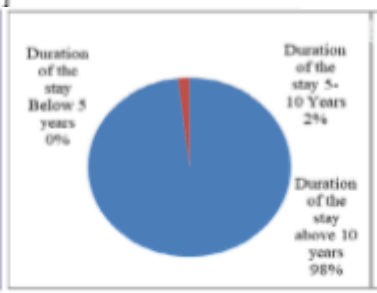


Figure 118 : Population density [Source - Author]

Table 06 : Occupation [Source - PJAEE]





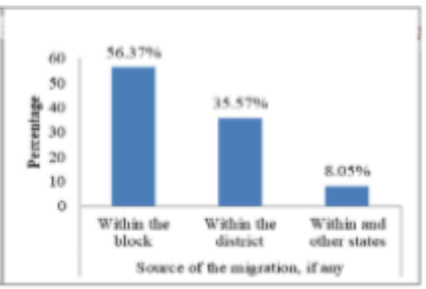


Table 07 : Demographic chart [Source - PJAEE]

significant increase in population over a ten-year period, reflecting the region's demographic dynamics and possibly the influence of factors such as migration, natural growth, and developmental trends. The high population density in Kakdwip Block highlights the need for efficient infrastructure, social services, and urban planning to ensure the well-being and sustainable development of the area.

Kakdwip heavily relies on agriculture and fishing as key drivers of its economy. However, these sectors are highly dependent on favorable weather conditions. Adequate rainfall, suitable temperatures, and other environmental factors are crucial for the success of agricultural and fishing activities in the region. Unpredictable weather patterns, droughts, or natural disasters can significantly impact crop yields and fish populations, posing challenges to the local economy and livelihoods.

While agriculture and fishing play a vital role in Kakdwip, inadequate social infrastructure can be a hindrance to the overall development of the region. Insufficient access to quality healthcare,

education, sanitation facilities, and other basic amenities can create difficulties for the local population. These limitations can lead to a lack of opportunities and force people to migrate to urban areas in search of better living conditions and job prospects. This migration can result in a drain of skilled labor from Kakdwip, affecting the local economy and contributing to urbanization.

The urban growth in Kakdwip may face challenges in terms of an unorganized city core and rapid densification. The expansion of urban areas without proper planning and infrastructure can lead to overcrowding, strain on resources, and inadequate provision of services. The haphazard urban growth can also lead to environmental issues, increased traffic congestion, and pressure on existing infrastructure.

To address these challenges, it becomes crucial for the local authorities and stakeholders to focus on comprehensive urban planning and development. Investments in social infrastructure, such as healthcare facilities, schools, and transportation systems, should be prioritized to improve the quality of life for the residents. Additionally, sustainable urban planning practices, including zoning regulations, green spaces, and efficient waste management systems, can help manage the rapid urban growth and densification in a more organized and sustainable manner.

Overall, while agriculture and fishing form the backbone of the economy in Kakdwip, challenges such as unfavorable weather conditions, inadequate social infrastructure, and rapid urban growth need to be addressed for the region's sustainable development and the well-being of its residents.

7.2 LIVE WORK PATTERN OF THE PRECINCT

Kakdwip, located in South 24 Parganas district of West Bengal, is characterized by a live-work pattern that revolves around agriculture, fishing, and traditional cottage industries. The region's rural setting is dotted with villages and agricultural lands, where the majority of the population engages in farming and fishing activities. Kakdwip's fertile land and proximity to the Bay of Bengal provide favorable conditions for agricultural practices and fishing. The local economy thrives on traditional livelihoods such as paddy cultivation, vegetable farming, and pisciculture. Additionally, cottage industries like mat weaving, rope-making, and handicrafts contribute to the economic diversity of the region. While the area offers limited employment opportunities, many individuals migrate to nearby towns and cities, such as Kolkata, in search of better job prospects. However, the sense of self-sufficiency is strong in Kakdwip, with households engaging in subsistence farming to meet their own food requirements. Communal living and social cohesion are also important aspects of the live-work pattern, as villagers often come together for activities like irrigation, community farming, and traditional festivals. In summary, Kakdwip's live-work pattern is deeply intertwined with agriculture, fishing, cottage industries, and a close-knit community, showcasing a unique socio-economic fabric.

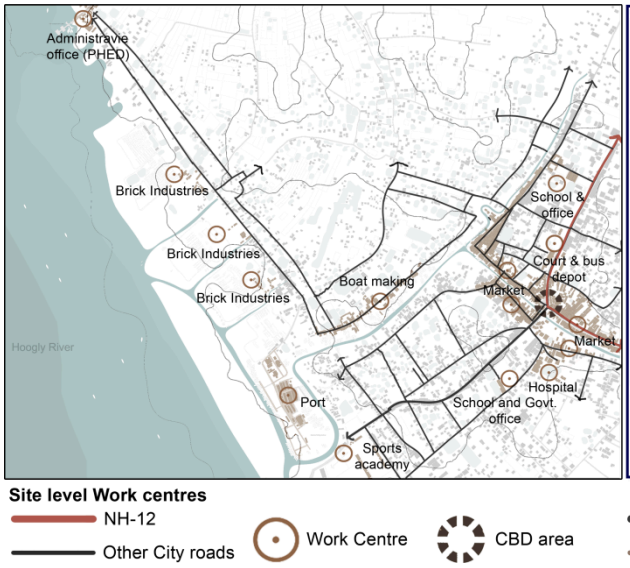


Figure 119: site level work centers [Source - Author]

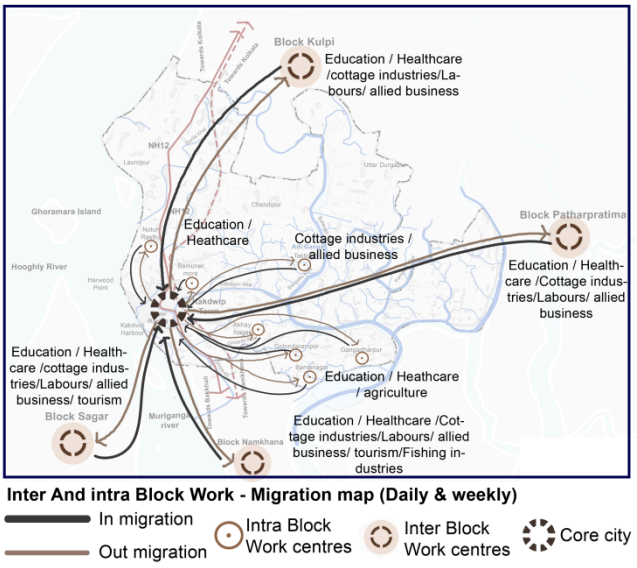


Figure 120: Inter and tra block migration – work map [Source - Author]

CHAPTER 08 : GOVERNANCE & BY-LAWS

The Kakdwip block is situated in the Ganges Delta region and comprises 11 Gram Panchayats, encompassing both urban and rural communities. It is surrounded by Kulpi block to the north, Namkhana and Sagar blocks to the south, the Hooghly River to the west, and Patharpratima block to the east. The proposed Kakdwip municipal body would include the areas of Ganeshpur, Kakdwip, and Kalinagar, with the administrative office located in Ganeshpur. The estimated population of the proposed municipal area is approximately 270,000 people, indicating a significant number of residents in need of essential services and infrastructure. Developing a municipal body can contribute to better governance, improved urban planning, and enhanced service delivery for the welfare and development of the community in Kakdwip.

A. State Guidelines of building construction along the river

1. Permissible Building Height: The maximum permissible building height within the river zone is 5 meters. This restriction helps maintain the visual harmony of the riverfront and prevents structures from obstructing the scenic views.
2. Stilt Building Height: Stilt buildings are allowed with a maximum height of 6.5 meters, including a 3-meter-high stilt. Stilt construction is often employed in flood-prone areas to elevate the habitable space above the flood level, providing protection against flooding and minimizing potential damage to structures.
3. Maximum Building Length: Buildings constructed alongside the river should not exceed a length of 20.00 meters. This limitation helps ensure a balanced and proportionate development along the riverfront and prevents the construction of excessively long structures.
4. Building Setback from High Flood Level (HFL): Buildings can be constructed at a distance of 15 meters from the High Flood Level (HFL) of the river. This setback requirement is crucial for safeguarding structures against flood hazards and maintaining a safe distance from the river during high water levels.

These guidelines aim to promote responsible and sustainable development along the rivers in West Bengal, considering factors such as safety, aesthetics, and environmental concerns. It is important for developers, architects, and property owners to adhere to these guidelines to ensure the long-term viability and resilience of buildings along the riverfronts.

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B. River Centric Urban Planning Guidelines (MoHUA)

1. Prohibited Activities Zone: The prohibited activities zone extends up to 500 meters from the highest flood level recorded in the past 50 years. Within this zone, certain activities, such as construction, are strictly prohibited to ensure the safety and protection of the area from potential flood risks.
2. Restricted Activities Zone: The restricted activities zone extends from the outer limit of the prohibited zone to a distance of 1 kilometer. In this zone, certain activities may be allowed, but they are subject to stricter regulations and scrutiny to ensure they do not have a significant adverse impact on the river and its surroundings.
3. Regulated Activities Zone: The regulated activities zone extends from the outer limit of the restricted zone to a distance of 3 kilometers. Within this zone, activities are regulated to maintain a balance between development and environmental considerations. Building

   construction and other activities are permitted, but they are subject to specific regulations, guidelines, and approval processes to ensure they are carried out responsibly and sustainably.

4. These zoning guidelines help in managing and controlling development along the rivers, taking into account the risks associated with flooding and the need to preserve the ecological balance of the river ecosystem. It is important for stakeholders to follow these guidelines to ensure the long-term sustainability and resilience of the riverfront.

CHAPTER 09: SWOT Analysis

9.1 STRENGTH

a. Strategic Location:

Kakdwip has the potential to become a gateway town to the Sunderban region, offering tourism services and accommodations for visitors. With strategic location and improved infrastructure, it can attract more tourists and contribute to the socio-economic development of the area. Collaboration and sustainable practices are key for realizing this potential and preserving the natural and cultural heritage of the Sunderbans

b. Historic Importance:

Kakdwip holds historical significance as the center of the Tebhaga peasant movement, which was a significant agrarian struggle in West Bengal. This historical legacy adds to the city's identity and highlights its role in shaping the socio-political landscape of the region. Additionally, the presence of Adi Ganga, one of the ancient distributaries of the Ganges, adds to the city's cultural and environmental importance. By promoting and preserving this rich history and natural heritage, Kakdwip can enhance its image and attract visitors interested in exploring the city's historical and cultural significance.

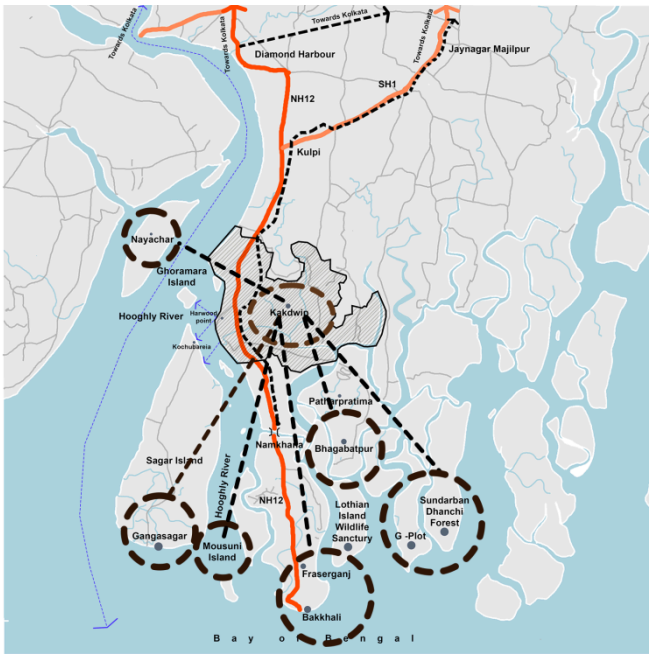

Figure 121: Kakdwip location map [Source - Author]

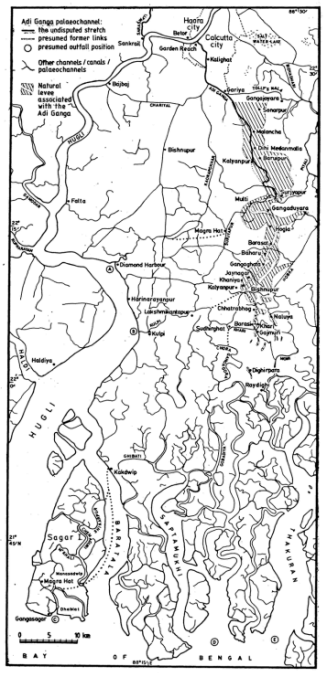

Figure 122: Adiganga Route map [Source – researchgate.net]

c. Canal & Community:

The existing market and fishing communities along the canal front in Kakdwip have the potential to foster a unique development pattern and create a synergy between economic activities. This can contribute to the overall growth and vitality of the town.

d. Natural Setup:

The existing Muriganga riverfront in Kakdwip has immense potential to act as the principal catalyst for development in the area. Its picturesque setting and natural beauty can attract tourists and visitors, leading to economic growth and opportunities for the local community. By leveraging the riverfront's assets, Kakdwip can enhance its tourism potential and create a vibrant and sustainable destination for both residents and visitors.

e. Ganga Sagar Mela:

The spiritual and cultural identity of Kakdwip is deeply intertwined with the Ganga Sagar Mela. This annual pilgrimage attracts a large number of devotees and visitors from various parts of the country, making it a significant event for the region. The footfall generated by the Ganga Sagar Mela presents a tremendous opportunity for the development of not just Kakdwip but the entire precinct. It brings economic benefits, promotes tourism, and showcases the rich cultural heritage of the area. By capitalizing on the spiritual and cultural significance of the Ganga Sagar Mela, Kakdwip can leverage this event to foster growth, create employment, and enhance the overall development of the region.

9.2 WEAKNESS

a. Poor Linkages & fragmented Road structure:

Kakdwip has experienced growth in isolation, primarily due to weak linkages within the land parcels. The city's road network lacks proper pedestrian facilities and adequate parking facilities, which hinders connectivity and accessibility. This has resulted in fragmented development and limited integration between different areas of the city.

b. Unstable City economy:

The fishing industry in Kakdwip is facing several challenges, leading to its deterioration and lack of organization. Factors such as changing environmental conditions, overfishing, inadequate infrastructure, and limited access to modern technology and equipment contribute to the struggles faced by the fishing community. Additionally, the lack of proper marketing channels and value addition opportunities further impact the industry's growth and profitability.

c. Squatter settlements and in migration:

The rapid increase in migration traffic in Kakdwip has led to unorganized and unmanaged living conditions in the city. The influx of migrants puts pressure on the existing infrastructure, housing, and public services, leading to overcrowding and inadequate living conditions. The lack of proper planning and management exacerbates the situation, as there is a limited availability of

affordable housing, sanitation facilities, and basic amenities for the growing population. This leads to congestion, environmental hazards, and a decline in the overall quality of life.

d. Poor city planning strategies with inadequate infrastructure facilities:

Due to the lack of city-level infrastructure in Kakdwip, people with economic stability are often inclined to move out of the city. The limited availability of essential amenities such as quality healthcare facilities, educational institutions, recreational spaces, and employment opportunities can lead to dissatisfaction among residents who seek a higher standard of living. Additionally, the inadequate transportation system and poor connectivity to major urban centers can further discourage individuals from staying in the city.

e. Unregulated Building construction and disintegrated canal structure:

The built environment in Kakdwip suffers from a lack of balanced composition between open spaces and built forms, primarily due to building law violations. The improper adherence to building regulations has led to uncontrolled and unplanned construction, resulting in a haphazard and disorganized urban landscape. The excessive construction of buildings without proper setbacks and spacing has reduced the availability of open areas, such as parks, playgrounds, and green spaces, which are essential for a well-balanced and sustainable urban environment. This imbalance negatively impacts the aesthetic appeal, functionality, and overall livability of the city.

9.3 OPPORTUNITY

a. Integration of city and canal:

The development of a fishermen's neighborhood in Kakdwip has the potential to integrate with the canal and enhance the overall urban environment. By providing the necessary infrastructure and amenities for the fishing community, such as boat docking facilities and processing centers, the neighborhood can support their livelihoods. Incorporating the canal into the neighborhood design can also create opportunities for water-based activities and economic growth. Preserving the cultural heritage of the fishing community is important, ensuring their identity and traditions are respected. This development can contribute to a balanced composition of open and built forms in the city, improving the overall quality of life and economic prospects in Kakdwip.

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b. Rethinking of market space with open spaces and street along the canal front:

The presence of a canal in Kakdwip offers an opportunity to develop social spaces that integrate with the existing market place. By creating well-designed public areas along the canal, such as promenades and parks, people can gather, socialize, and enjoy the waterfront environment. This integration can enhance the overall urban experience and contribute to the economic vitality of the market area. Proper planning and design considerations are essential to maximize the potential of these social spaces, ensuring accessibility, aesthetics, and sustainability.

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c. Strengthen the image of the city:

The regeneration of Kakdwip's city core presents an opportunity to revitalize key areas such as the ghats, fishing harbor, and introduce a river promenade. By enhancing these spaces, the city can promote cultural and economic growth. Redeveloping the ghats will create attractive riverfront public areas for recreation and community gatherings. Improving the fishing harbor will support the local fishing industry and provide better facilities for fishermen. Introducing a river promenade will offer a scenic walkway and opportunities for commercial and cultural activities. Overall, this regeneration effort aims to make Kakdwip a vibrant and appealing destination for both residents and tourists.

d. Development in ecotourism sector to strengthen the local economy:

The Ganga Sagar Mela and the existing natural setup in the precinct of Kakdwip provide a unique opportunity for the development of an ecotourism sector. The Ganga Sagar Mela, with its large footfall, can be a major attraction for tourists interested in experiencing the cultural and spiritual significance of the region. Additionally, the natural environment, including the river, mangroves, and wildlife, offers potential for activities such as bird-watching, boat tours, and nature trails. The development of ecotourism in the precinct can not only attract visitors but also create employment opportunities and stimulate the local economy. It will allow visitors to explore and appreciate the rich biodiversity and natural heritage of the area while contributing to its sustainable development.

e. Creating well-connected urban fabric:

Enhancing connectivity and introducing an inclusive road structure in the Kakdwip precinct can lead to holistic development. By improving accessibility and facilitating the movement of people, goods, and services, the different parts of the precinct can be integrated into a cohesive community. An inclusive road network would prioritize pedestrians, cyclists, and public transportation, promoting sustainable mobility and ensuring equitable access to essential services and recreational spaces. This approach has the potential to drive the overall growth and prosperity of the Kakdwip precinct, fostering a more connected and inclusive environment for its residents.

9.4 THREAT

a. Urban Flood:

Irregular flash floods and flooding in the Kakdwip precinct are caused by the loss of the natural drain network and the dumping of waste in the canal. The absence of a well-maintained drainage system exacerbates the impact of heavy rainfall, leading to waterlogging and subsequent floods. The canal, which should serve as a natural drainage channel, has been compromised by waste dumping, hindering its functionality.

b. Environmental degradation:

The brick industry and illegal fishing practices in the Kakdwip precinct contribute to land, water, and air pollution. These activities have a negative impact on the environment, including air pollution from brick kilns and the depletion of fish stocks due to illegal fishing practices. It is crucial to implement stricter regulations and promote sustainable practices to address these issues and protect the ecosystem.

c. Disconnected waterfronts and high-speed NH-12:

The broken ghats at the riverfront and inaccessible canal front in Kakdwip contribute to the depletion of social spaces in the city. These deteriorating and inaccessible areas limit the opportunities for public gathering, recreation, and community interaction. The lack of well-maintained and accessible social spaces hinders the overall livability and vibrancy of the city.

d. Unorganized mela precinct:

The Ganga Sagar Mela, with its massive and unmanageable footfall, poses a significant challenge to the degradation of the river, soil, and existing social spaces in Kakdwip. The influx of a large number of visitors during the mela puts immense pressure on the natural resources and infrastructure of the area. The heavy footfall can lead to soil erosion, pollution of the river, and damage to the surrounding environment. Additionally, the lack of proper waste management and sanitation facilities during the mela further contributes to the degradation of the social spaces.

e. Unorganized Burning ghat:

The Kakdwip Samshan Ghat, or cremation ground, is currently in a state of disorganization and lacks proper management. The lack of planning and maintenance has led to several issues, including pollution of the canal due to improper disposal practices. The unorganized nature of the canal edge hampers the smooth functioning of cremation ceremonies and the proper handling of waste generated during the process. As a result, the canal, which is connected to the canal edge, has become polluted over time.

f. Shallow aquifer depletion and contamination:

Groundwater contamination in Kakdwip is a significant issue caused by factors such as saline water intrusion and waste dumping near wells. The proximity to the coast leads to the intrusion of seawater into underground aquifers, affecting the quality of groundwater. Improper waste disposal practices further contribute to contamination.

CHAPTER 10: Case studies

10.1 CASE STUDY

Introduction: The below mentioned case studies has been identified to understand the parameters for analysis. The research site has been chosen as a canal and river combination. The canal runs through a dense urban area, and the rest of the site features various types of ghats along the major river. As a result, the Mullassery Canal case study (canal with dense city fabric) was chosen to understand its associated issues and potential solutions. Another case study of the Sabarmati riverfront (major riverfront with various typologies of ghats and public places) has been chosen to understand its related issues and potential solutions

10.1.1 Case Study 01 –

Project Name - REIMAGINING THE MULLASSERY CANAL PRECINCT, ERNAKULAM

Year -2020

Location - Downtown Ernakulam, Kochi.

Total length of the canal – 1.3 km

About the site - The Mullassery Canal Precinct is located in downtown Ernakulam and is part of Kochi's Central Business District (CBD). Historically, the Mullassery canal was built for inland mobility, connecting the backwaters to the Perandoor Canal to the east of Kochi.

10.1.1.1 Existing conditions:

The canal's total length is 1.3 kilometers, more than half of it is currently covered by concrete slabs used for on-street parking and dedicated vending zones. The land use pattern changes as we move from east to west along the canal's length. It is flanked by the city's most prominent educational institutions, heritage sites, major shopping avenues, street markets, warehouses, and formal and informal housing. The canal is surrounded by 1980s low-rise high-density development, which transformed the city.

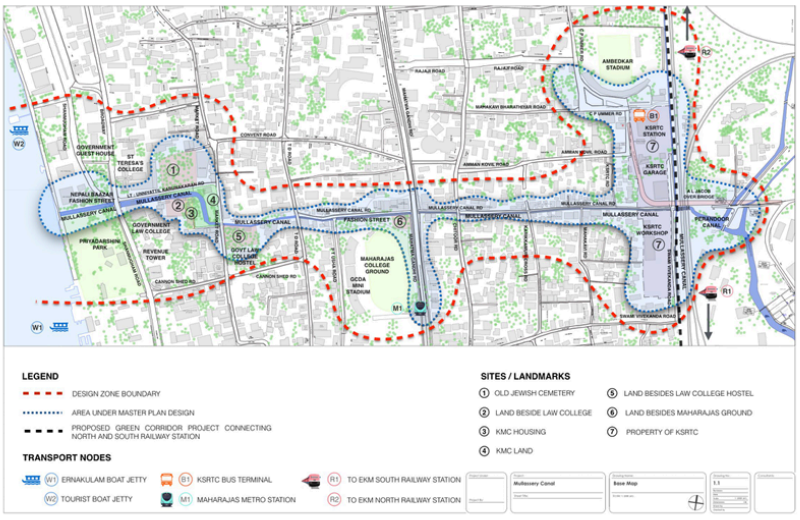


Figure 123: The site [Source - Entekochi]

Waterlogging and flooding - Mullassery being a tidal canal will experience flooding not only during monsoon, but also during the dry season.

Figure 124: canal condition [Source - Entekochi]

poor waste management and sewage disposal systems - Illegal waste dumping and direct discharge of untreated domestic wastewater has increased the organic matter in the canals leading the water bodies to experience eutrophic conditions.

Vulnerability of the neighborhood - Untreated sewage and solid waste dumped into the canals is making them breeding grounds for water borne diseases. Also, it is the low-income settlements that are the most vulnerable during flash floods, resulting in losses to health and property.

ecology, flora and fauna - Illegal waste dumping and direct discharge of untreated domestic wastewater in certain places leads to depletion of oxygen levels has also made the water more septic. The lack of oxygen impacts the aquatic ecosystem of the receiving water bodies.

Figure 125: canal condition [Source - Entekochi]

Mobility - Kochi's narrow roads are plied by buses exploiting the maximum speed limit making the streets hazardous for pedestrians. However, the zone lacks sufficient on-street activities with adequate lighting and infrastructure.

10.1.1.2 Proposal:

Adapt - Mullassery Canal is a strategic ecological spine linking the wetlands at the confluence of the Perandoor Canal to the Marine Drive waterfront. A network of green streets and open spaces has been proposed.

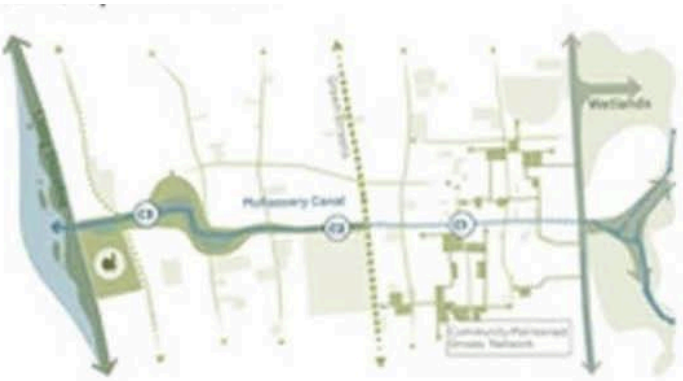


Figure 126: Landscape framework [Source - Entekochi]

Connect - Kochi's Mullassery Canal has been transformed into a continuous walkway and bike path. This bikeway connects to a proposed waterfront trail linking Subhash Bose Park to the Mangalavanam Bird Sanctuary.

Figure 127: Mobility framework [Source – EnteKochi]

Empower - Improvement of their neighborhoods and build inclusive communities by facilitating the formation of social networks. The canal's solid waste management serves as a proxy for several civic issues.

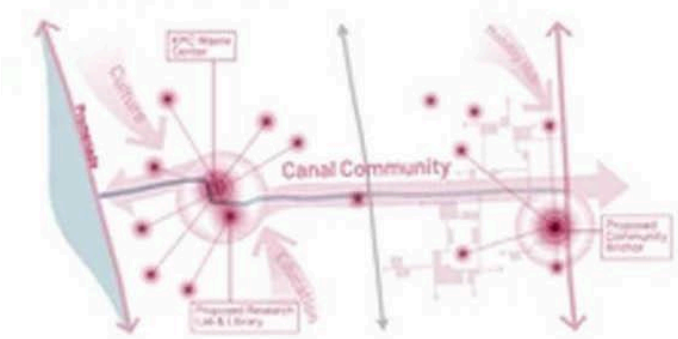


Figure128: Community framework [Source - entekochi]

Figure 129: Integrated development [Source – Ente kochi]

10.1.1.3 Analysis:

Ecology and resilient planning – The proposal green tail and open space network help to slows down runoff and recharges the aquifer and sustain its ecology.

Edge uses and linkages – Redesign of the public realm and mobility systems to improve access to the canal edge, transit, lively places and safe spaces.

Civic Responsibilities and communal engagement – Empowering the residents to manage and monitor natural resources like trees, rainwater, groundwater and solid waste management, allow various groups to strengthen their social ties and networks, resulting in a stronger sense of community.

Land use configuration – Building the awareness programme, resettlement of the people and repurposing of unused land has been done.

Mobility Network – Redesigning of the mobility network and open space network helps to include a set of important aspect of streetscape design as signage, parking facilities, drop-off zones, universally accessible design.

Riverine Economy – The overall development enhances the employment opportunity for the local people and the unnecessary use of govt. funds for the periodic revival has been avoided.

10.1.2 CASE STUDY 02 –

Project Name – REVIVAL OF SABARMATI RIVER FRONT

Year – Construction started from 2005

Location - Ahmedabad

Total length of the river – 109 km river runs across a stretch of about 55 km through Ahmedabad

Introduction and the site- Sabarmati Riverfront is a water front being developed along the banks of Sabarmati River in Ahmedabad, India. Proposed in 1960s, the construction began in 2005. Since 2012, the waterfront is gradually opened to public as and when facilities are constructed.

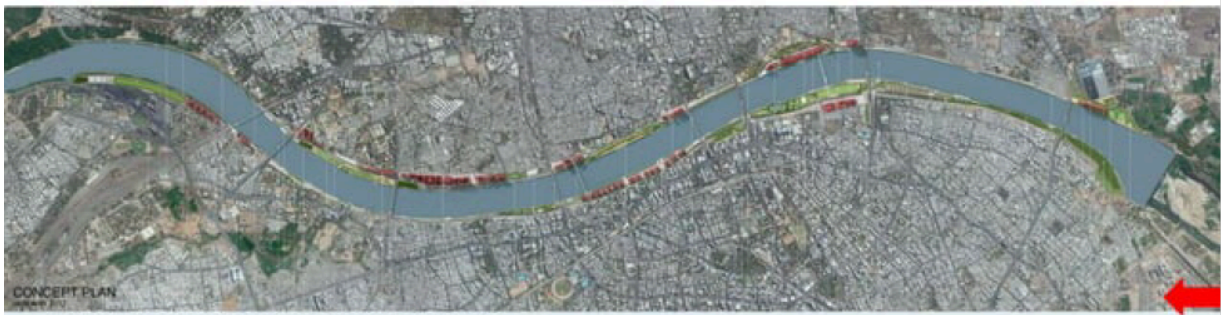


Figure 130: The site [Source - RTF]

10.1.2.1 Existing conditions:

Disconnected riverfront - The city life is disconnected with the riverfront leads to deplete the river and its associated activities.

Inadequate infrastructure - River front is lacking basic infrastructure facilities. River bed is not able hold water at the time of high tides due to lack of maintenance.

Poor waste management and sewage disposal systems - Sewage contaminated storm water outfalls and the dumping of industrial waste in the river posed a major health and environmental hazard.

Flooding - Excessive amount of soil erosion and flooding occurs every year for more than a number of times.

10.1.2.2 Proposal:

Reclaiming land, building flood protection walls, laying sewage interceptors.

Figure 131: Flood protection [Source - RTF]

Improving the access to the river front.

Figure 132: accessibility [Source - RTF]

Building public promenades, gardens and play fields and public facilities.

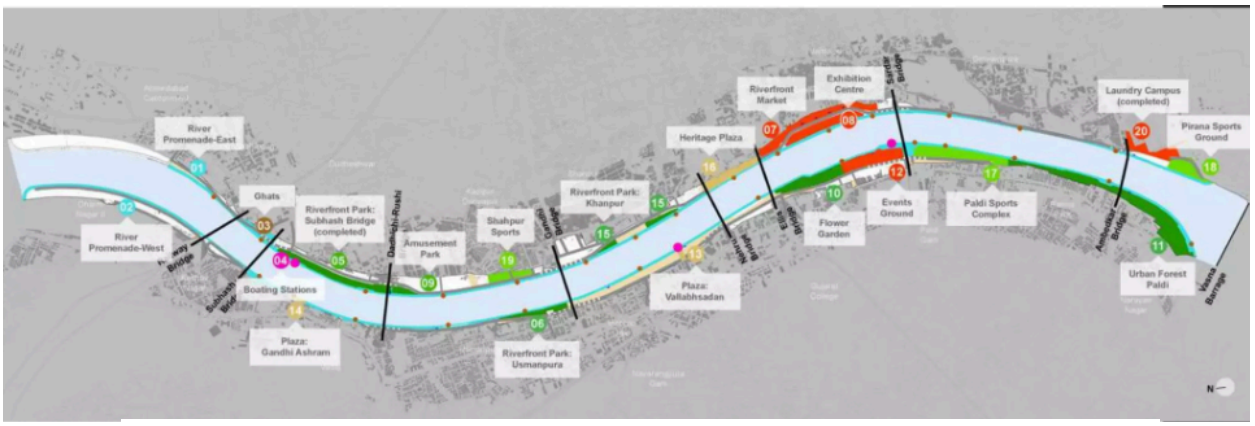


Figure 133: amenities [Source - RTF]

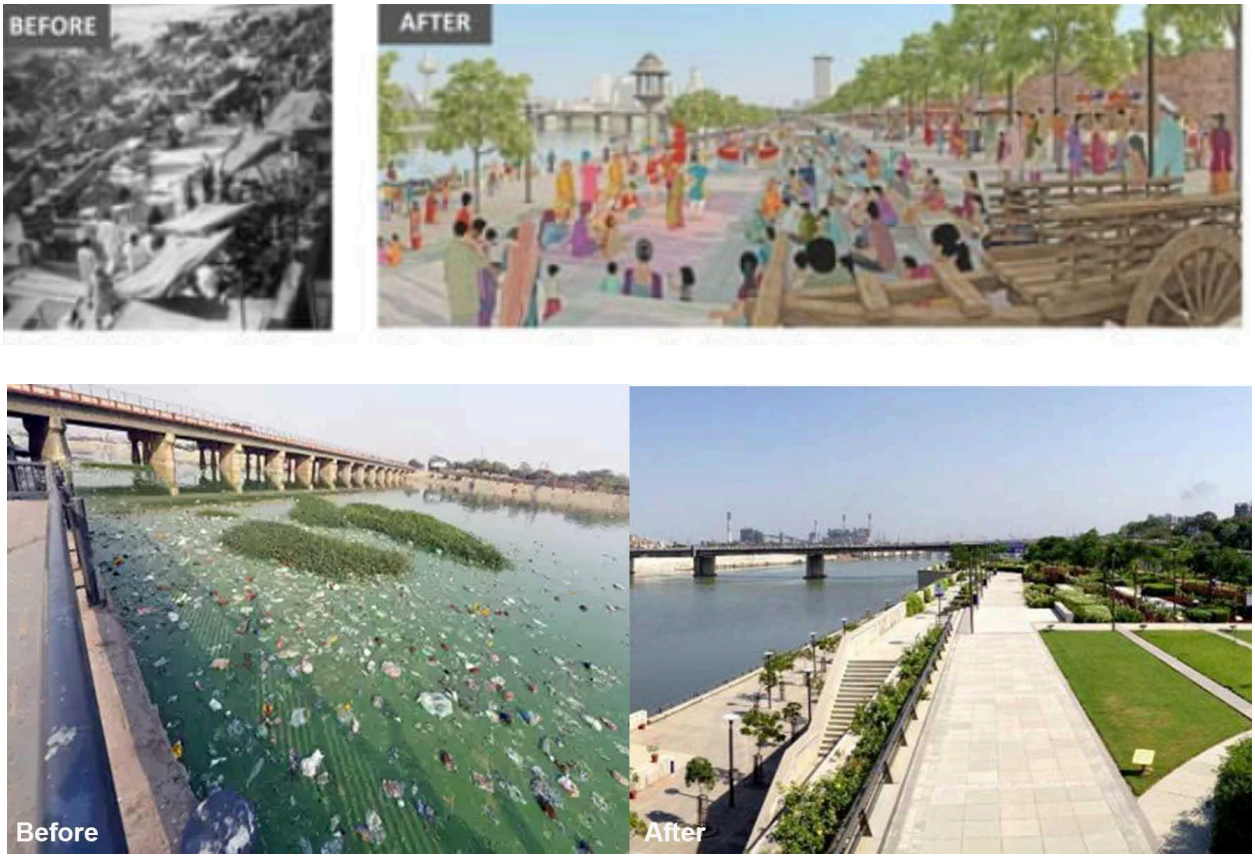


Figure 134: Revival of the Sabarmati River [Source - RTF]

10.1.2.3 Analysis:

Ecology and resilient planning – The construction of rcc walls and anchor slabs to prevent the river banks from erosion as well as from flooding. Construction of the sewage treatment plant on the both the banks help to reduce the river pollution.

Edge uses and linkages – The river promenade project aims to provide a 11.5-km long pedestrian walkway in the heart of the city Ghats, with access to the water at planned intervals. Boating Stations at the lower level enable water recreation and offer a water-based mode of public transport. Through replacing a largely private riverfront with an expansive public realm. It aims to provide a network of parks, waterside promenades, markets, cultural institutions, recreational facilities and commercial developments.

Civic responsibilities and communal engagement - Social Infrastructure rehabilitation and resettlement of riverbed dwellers and activities, creation of parks and public spaces, provision of socio-cultural amenities for the city. Sustainable Development through resource generation and neighborhood revitalization.

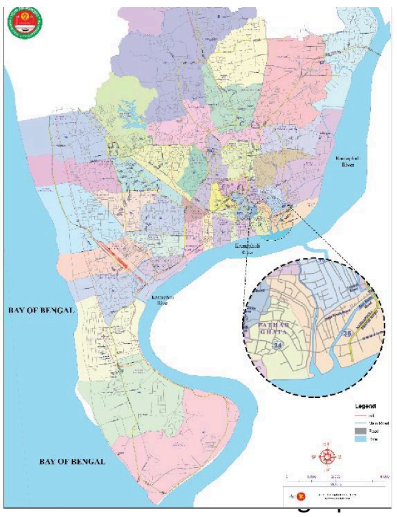
Landuse configuration - The reduction of the river bed from a variable width of 600-300m to fix width of 275m, thus reclaiming 185ha of land which is potential for development the structural road network, bridges and the possibility of providing adequate infrastructure.

Mobility Network – the overall mobility network has been strengthening with the development of the river edge linkages system and connecting those linkages to the city level road networks.

Riverine Economy - The development aims to be self-financing-to achieve its goals without relying on any funding from the government. A small portion of the reclaimed land will be sold for commercial development, to generate sufficient enough resources to pay for developing the riverfront and managing it.

10.1.3 CASE STUDY 03 –

Project Name – REVITALIZE A CANAL FRONT: A CASE STUDY ALONG CHAKTAI COMMERCIAL AREA OF CHITTAGONG, BANGLADESH
Year – 2018



Location - Chittagong, Bangladesh

Total length of the river – 6.9 km

Introduction and the site- The Chaktai Commercial Area site was chosen in the south-east corner of Chittagong City in Kotwali Thana and partially in Bakalia Thana. Chaktai commercial area is one of Bangladesh's oldest commodity hubs. This zone is home to approximately 3000 businesses and 5000 warehouses along the canal front and throughout the area. Both

roads and waterways connect to the site. Asadganj and Khatunganj roads enter this site directly and extend south to connect with the newly developed Marine Drive Road.

Figure 135: Site [Source - FARU]

Boats/vessels used to handle a large portion of business activities. This tradition continues today, but waterway transport has been reduced due to the expanding road network. However, this does not diminish the importance of the canals in any way.

10.1.3.1 Existing conditions:

Detrimental condition of chaktai canal - During low tide, boats transporting goods become stranded in the Chaktai canal. This Canal is losing navigability due to silt deposition and a permanent bottom (which affects water flow), which is impeding frequent boat movement and causing significant time and economic loss in this once-busy commercial area. As a result, sedimentation on the canal makes it impossible for boats to function properly, hampering loading and unloading activities. Furthermore, the dump of dirt, domestic waste, and toxic waste from commercial areas on Canal side roads, as well as the lack of a proper waste disposal system, created a hazardous working environment for workers and business owners.

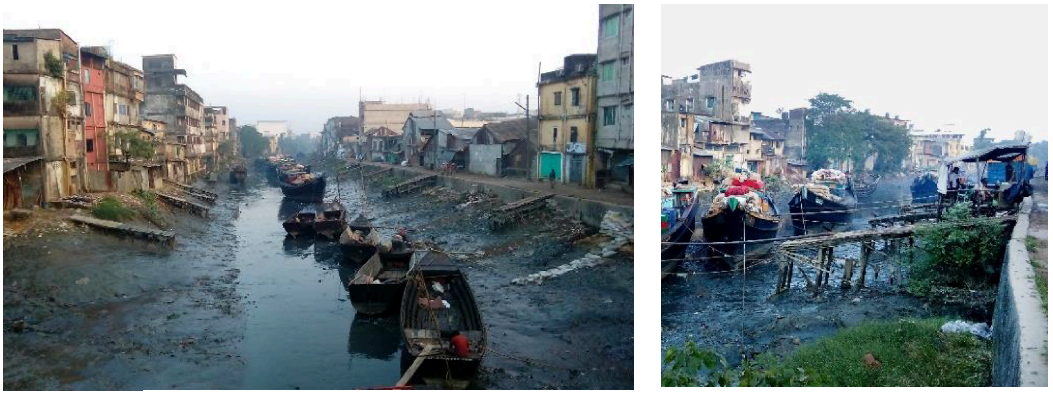


Figure 136 : Condition of boats during low tide [Source - FARU]

Poor waste management and sewage disposal systems & Flooding - The Chaktai canal, once regarded as the city's lifeline as the main drainage system for removing rainwater as well as the usual sewage outlet, has become clogged with solid waste and filth, as well as encroachments, resulting in overflow of rainwater flooding both sides from Bahadderhat to Chaktai Commercial Areas. The wholesalers in the Commercial space, which houses at least 3,000 businesses and over 5,000 warehouses, must endure rainy days during the monsoon season.

Figure 137: Water logging situation at rainy season [Source: FARU]

waterways [Source - Author]

Backyard of the city & losing its importance - Because most of the buildings overlook the view of the Chaktai canal, the canal front has become the backside of the main commercial area. As a result, the visual connection between the canal front and the building structures is lost. The historical building fabric of the Chaktai commercial area is also deteriorating.

Figure 138: Garbage disposal into canal [Source: FARU]

waterways [Source - Author]

Disconnected canal front & lack of social spaces - this situation is making it impossible for providing any kind of social interaction space along canal front. Lack of Harmony is seen between Commercial Activities along Canal and Social Interaction between the people living in Chaktai Commercial Area. Once, the canal front used to serve as the hub of social interaction for the people of Chaktai. But over time it has lost its appeal as an Urban Open Space because of illegal and unplanned developments, no concern for Human comfort and no responsibility to environmental preservation.

Encroachment - Unauthorized Building construction at canal front resulting in Canal width Reduction and lack of both Pedestrian Walkway & Vehicular Circulation. Walking through canal front has become difficult and Goods loading unloading from boats to truck is extremely complicated.

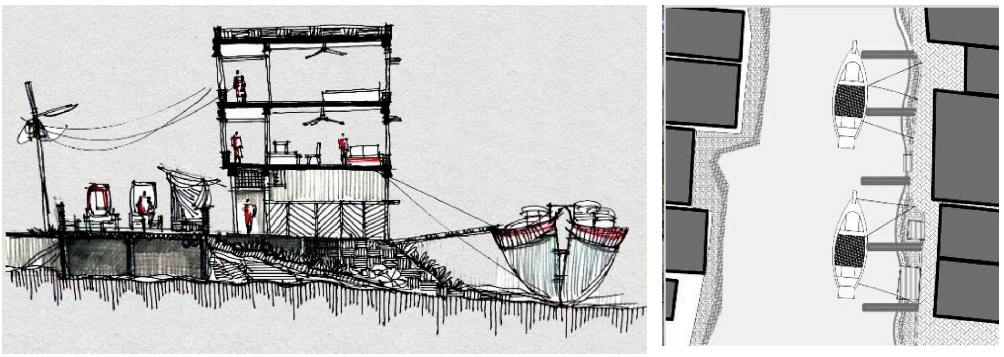


Figure 139: Illegal structures limiting pedestrian circulation [Source -FARU]

10.1.3.2 Proposal:

Revival of the canal: The canal should be restored by widening the width and excavating waste sludge from the bottom, breaking the permanent R.C.C. bottom of the canal and increasing depth (which will help in flowing canal water simultaneously), so that it may function properly, ensuring relentless waterway traffic.

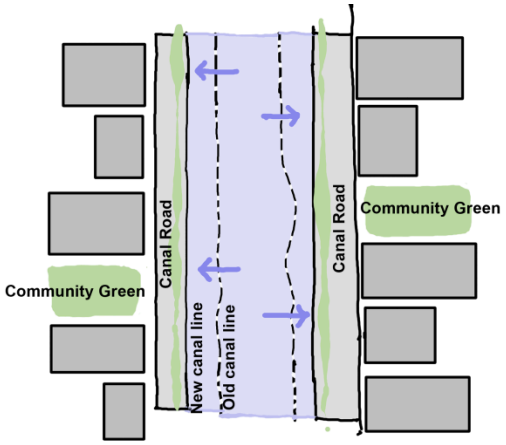


Figure 140: Reviving edge condition [Source - Author]

Revival of edge condition: the warehouses and shops beside the canal get the direct advantage of loading and unloading materials/goods. But traders on the other side can't get direct access from the canal. Special design considerations are required for transporting good in such case from the canal front. For instance, Illegal and Unplanned buildings constructed on canal edge should be evicted thus restoring the open spaces along the canal, making rooms for an urban passage along the canal front. In that place, permanent loading docks/jetties should be constructed on the canal for ease of access from boats/vessels. Also Truck landing spaces must have to be provided for smooth transportation.

Improved Connectivity and functionality:

The canal front walkway should be widened and be visually connected with the main road, so that it will be used for circulation and commercial activities. The buildings beside the walkway should be constructed/converted as canal facing warehouses/shops, same as the main road's frontage. It will also create sufficient environment for the canal front to be suitable for both functional commercial activities and Social Interaction between the residents and business

houses and workers. Provision of Pocket Urban Parks, Fruit/Newspaper/Grocery shops, Food shops at certain intervals, shaded walking spaces, resting spaces for labors and amenities (public toilet, small community center) will increase the living standards of the commercial space. Also, provision of green spaces will help a great deal to make this canal front more livable, once again. Moreover, the side streets/alleys connecting the canal access road and vehicular main road will be used as the access road for buildings in between them. They should have the minimum requirement of accessibility.

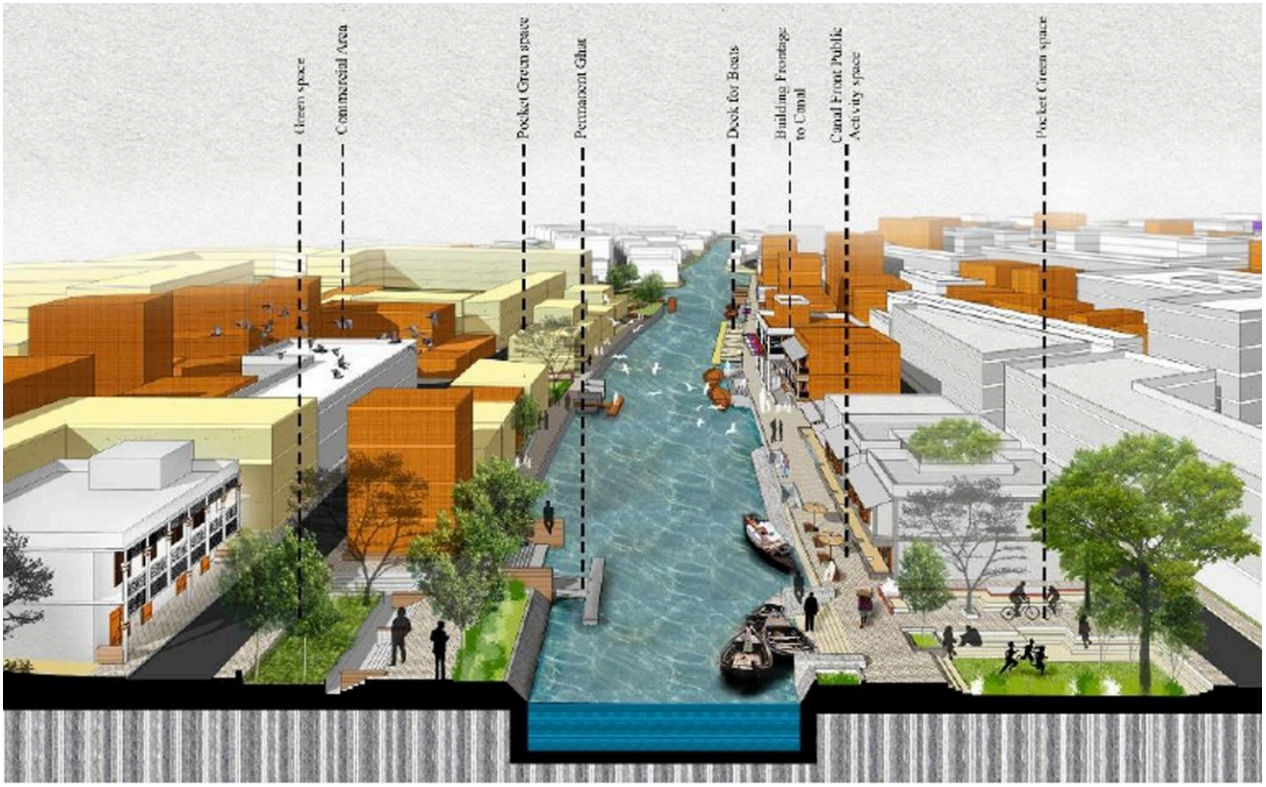


Figure 141: Proposed canal front [Source - FARU]

10.1.3.3 Analysis:

Ecology - Canal functionally has been increased through widening the canal width. RCC bottom has been removed and restored and naturalized.

Mobility and amenities – canal walkway width increase and visibility increase with road, hence improved commercial activities. over all accessibility of the precinct has been increased, trading ghats developed

Community – Waste collection network and disposal system has to be arranged in a community participation approach. Empowering locals by engaging them actively.

Economy - The overall development enhances the employment opportunity for the local people and the unnecessary use of govt. funds for the periodic revival has been avoided.

10.1.4 CASE STUDY 04

Project Name – REVIVAL OF ROCHOR CANAL

Year – 2013

Location - Singapore

Total length of the river – 1.2 km

Introduction and the site- The Rochor River is an urban stormwater canal that runs from Bukit Timah to the Marina Barrage. The canal runs mostly through dense urban areas and alongside stretches of high-traffic roads.

Figure 142: Site [Source – ABC Waters]

10.1.4.1 Before revival condition:

Disconnected riverfront - The city life is disconnected with the riverfront leads to deplete the river and its associated activities.

Inadequate infrastructure - River front is lacking basic infrastructure facilities. River bed is not able hold water at the time of high tides due to lack of maintenance.

Poor waste management and sewage disposal systems - Sewage contaminated storm water outfalls and the dumping of industrial waste in the river posed a major health and environmental hazard.

Flooding - Excessive amount of soil erosion and flooding occurs every year for more than a number of times.

Encroachment - Unauthorized Building construction at canal front resulting in Canal width Reduction and lack of both Pedestrian Walkway & Vehicular Circulation. Walking through canal front has become difficult and Goods loading unloading from boats to truck is extremely complicated.

Figure 143: Encroached canal edge [Source – ABC Waters]

2.1.4.2 Proposal:

Improved Connectivity - The Canal's new role is to serve as a 'tie' connecting the segregated enclaves and to provide a stronger sense of the Marina, the city, and its water edge. Rochor Promenade, a waterscape that combines both green, blue, and orange (human) elements, will soon be bursting with activities and life, accompanied by parallel pedestrian boulevards from the surroundings.

Improved water edge - the green belt offers a green corridor for fauna along the canal, enabling residents an opportunity to appreciate the wildlife at their doorstep. The design of the new Rochor Promenade is intended to bring people closer to the water edge.

Amenities and facilities - A layering system for the different city infrastructures of green, vehicular, pedestrian, culture is adopted so that the design can react flexible to the current conditions and programs while still being united as a whole.

10.1.4.3 Analysis:

Ecology - Flood control through widen and digging the canal. Rain garden introduced to recharge water and surface water pollution control.

Mobility and amenities – A 1.1km-long stretch of the canal has been transformed with an urban promenade, benches, lookout decks, new pedestrian bridges, and a seamless route for evening strolls.

Community – Interactive canal edge introduced to engage local people. Public participation to aware about the development need.

Economy - livability increase which triggered economic growth. The tourist attraction and residential footfall of the place has been increased. The more amenities have been added eventually to increase the local economy.

10.1.5 CASE STUDY 05

Project Name – Lao ji River an improved river front.

Year – 2011

Location – Taiwan

Total length of the river – 3.1 km

Introduction and the site- The Laojie River flows south-north through Taoyuan City for 37 kilometres. It has a catchment area of 82 km2 and is slightly tidal. The three-kilometer study route runs through the dense old city districts of Pingzhen and Chungli. The width is 35-80 m, and the depth is 1.35-4.72 m. The 725-meter-long culverted stretch is located in the central area, where extensive illegal privately-built constructions provided commercial and parking space, concealed water pollution, and rapidly drained the river water in 1997.

Figure 145: Site [Source - GOE]

10.1.5.1 Before revival condition:

Disconnected riverfront - The city life is disconnected with the riverfront leads to deplete the river and its associated activities. There is a lack of open spaces along the edge of the river.

Poor waste management and sewage disposal systems - Sewage contaminated storm water outfalls and the dumping of industrial waste in the river posed a major health and environmental hazard.

Flooding - Excessive amount of soil erosion and flooding occurs every year for more than a number of times.

Encroachment - Unauthorized Building construction at canal front resulting in Canal width Reduction and lack of both Pedestrian Walkway & Vehicular Circulation. Almost the canal is covered by buildings and culverts.

10.1.5.2 proposal:

Environmental - In addition to decontaminating the river and creating absorptive green spaces, the project seeks to end illegal wastewater discharge and improve environmental education.

Economic - The present value of land along the remediated river is 14% higher than it was before the improvement process began.

Health - 20 km of bicycle paths will be created along the river under the project, providing visitors with an attractive area in which to exercise.

Social - The improvement of the river is leading to a spike in tourism, as visits per month have risen steadily between 2012 and 2013.

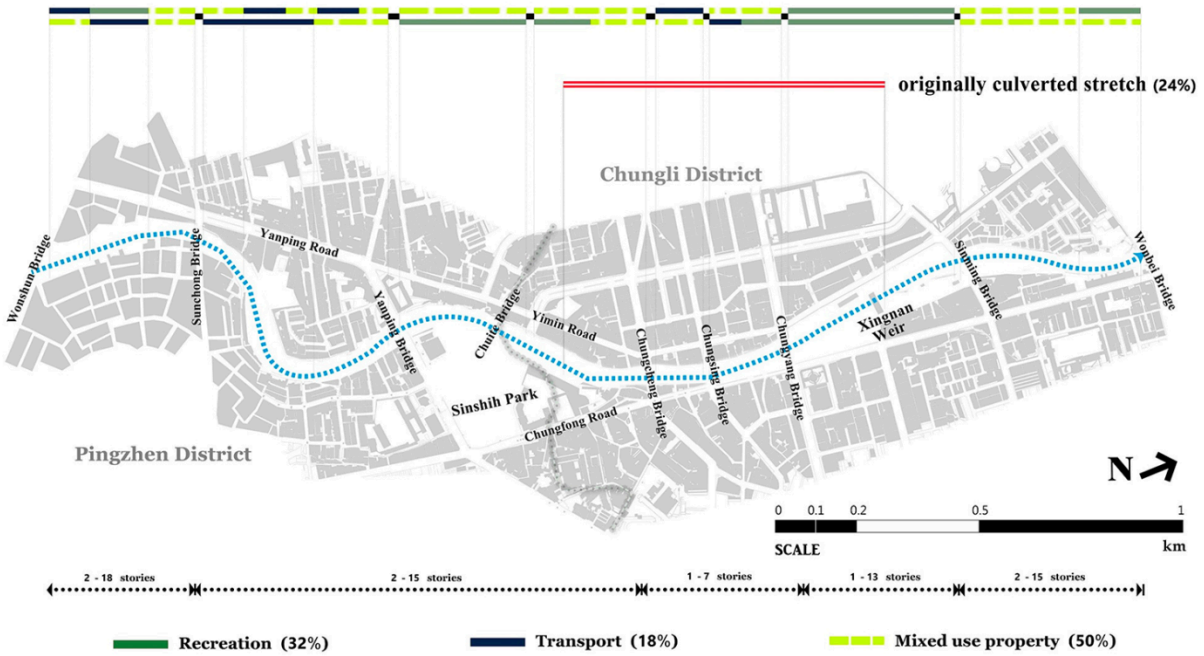


Figure 146: Proposal [Source - CYCU]

10.1.5.3 Analysis:

Ecology - Interceptor box culverts has been introduced for centralized sewage treatment. Improvement channel cross section to Prevent flood.

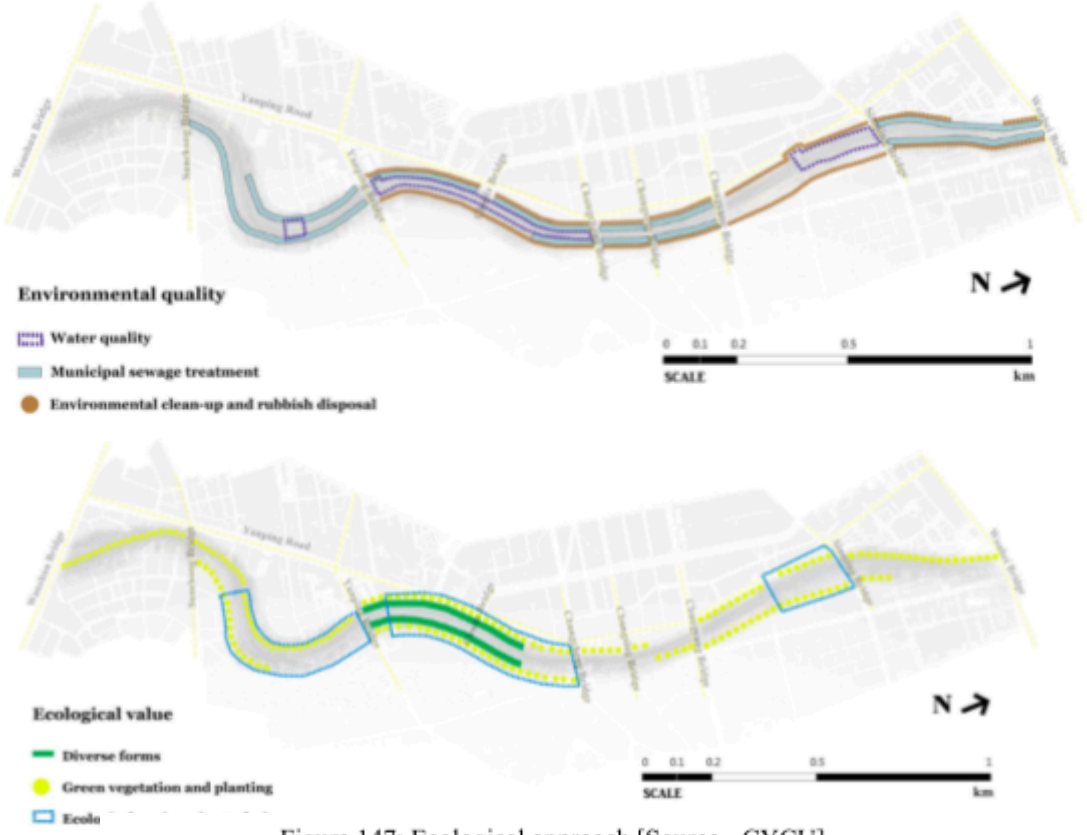


Figure 147: Ecological approach [Source - CYCU]

Mobility and amenities – A 3.6km circular scenic bicycle path and sidewalk along the Laojie River were constructed to promote green transit within the city. Introduced public open spaces to connect and socialize.

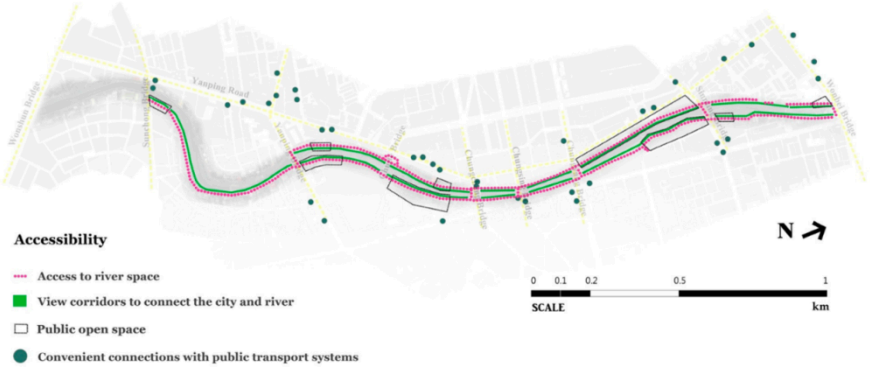


Figure 148: Accessibility approach [Source - CYCU]

Community – Establishment of River Education Center provided the opportunity for the community to know the history of the Laojie River as well as be aware of restoration and environmental studies specific to the river.

Figure 149: Amenities [Source - CYCU]

Economy - The project was a larger rejuvenation strategy for the entire city which brought in the values of resilience. livability, and also triggered economic growth.

Figure 150: Activities [Source - CYCU]

10.1.6 Inferences

To deal with the river and canal base issues every case example has followed almost similar parameters of improving ecology,connectivity,amenities and economy of the place. The important factor to consider is to engagement of the neighborhood and its people to the development, restoration and maintenance process of the river bed and the edge as it will effectively reduce the crime, unsocial activities and depletion of the river edge. But it has not elaborated the technical and sustainable solutions to maintain the BOD levels and other important nutritious elements which are important for the water and flora- fauna grow and live around it.phase wise planning and implementation would be effective in case of river front development.

10.1.7 Conclusion

The deteriorated river can be brought back to using the river's assets and converting the abandoned land of riverbed and nuisances in the city Centre into people's attraction, visitor's attraction, the introduction of infrastructure and recreational facilities, and remaking the city more livable in terms of environmental improvement and inclusive development. Throughout the study, we have seen various techniques that can be used to resolve any river-related issues that affect the economic development of a city, the upliftment of social integrity, and the revival of ecology.

CHAPTER 11: DESIGN DEMONSTRATION

11.1 VISION

"Reimagining Kakdwip as a Gateway to the Western Region of Sunderban by exploring the river and its tributary as a Key Element"

11.2 OBJECTIVE

11.2.1 Objective 01: Ecology

Enhancing the existing blue and greens through eco-sensitive planning strategies to develop a resilient urban precinct.

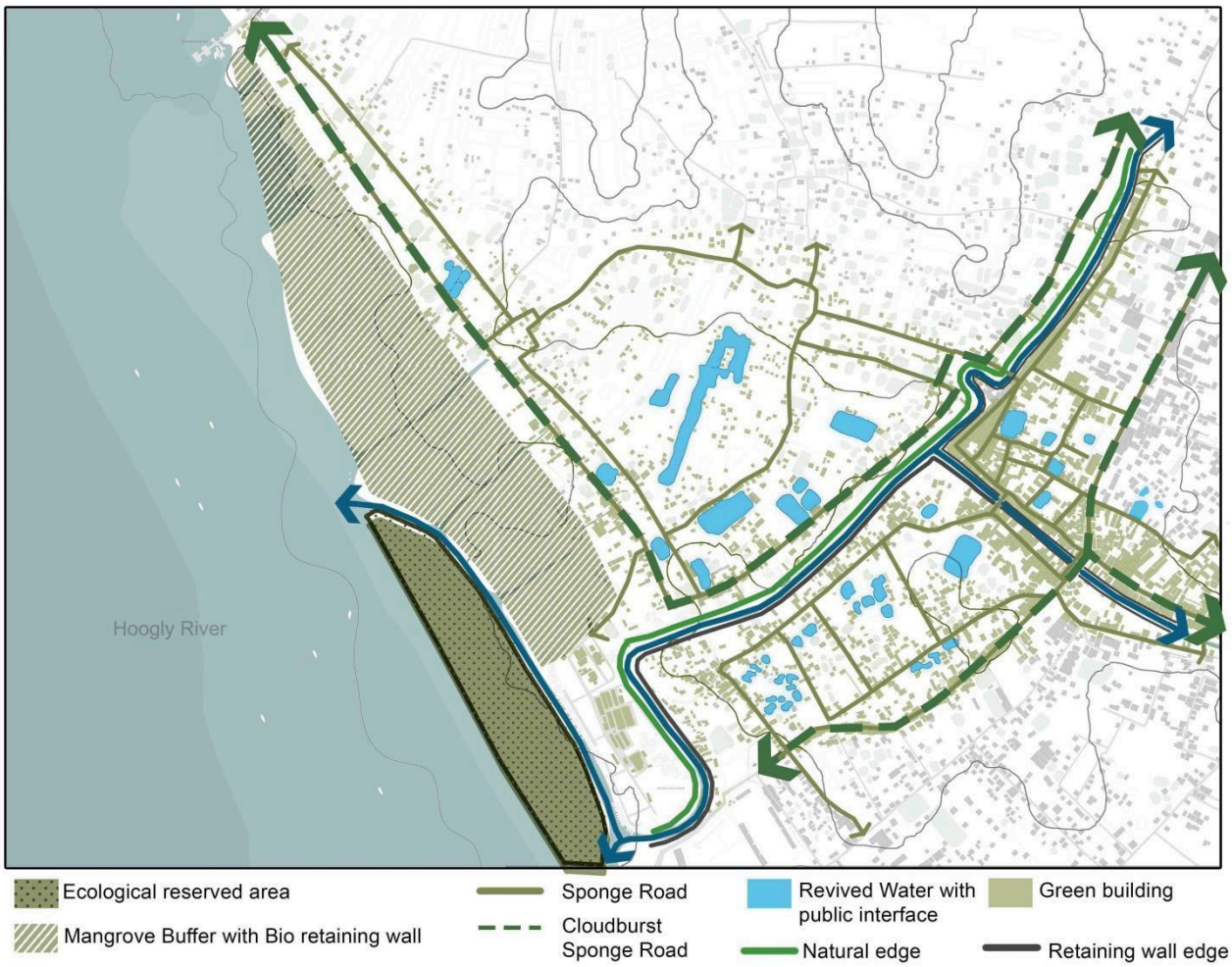


Figure 151: Objective 01 [Source - Author]

11.2.1.1 Strategy 01 - Restructuring the Canal and the river front to minimize the effect of flooding and pollution through direct discharge of sewage and waste through rejuvenating water interface as a face of the city.

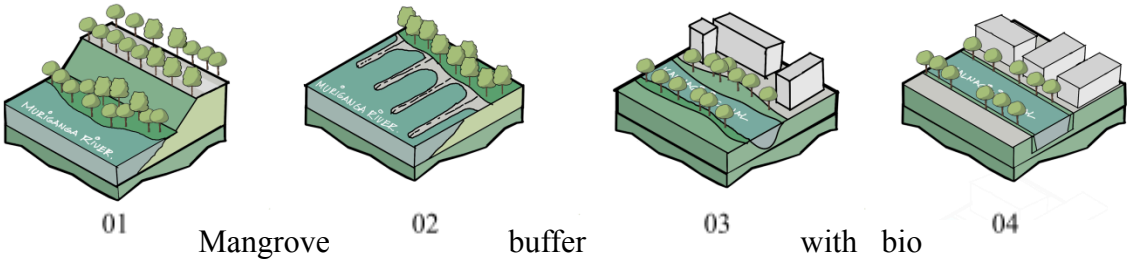


Figure 151.1: Strategy 01 [Source - Author]

(01) Mangrove buffer with bio retaining wall. (02) Introducing Breakwaters along the river edge. (03) Flexible green edge integrates with riparian zone. (04) Bio retaining wall & decentralized sewage and waste treatment units.

11.2.1.2 Strategy 02 - Enhancement of the existing water bodies and development of water squares as a catchment and aquifer recharge zone with public interface to increase the social cohesion at community level.

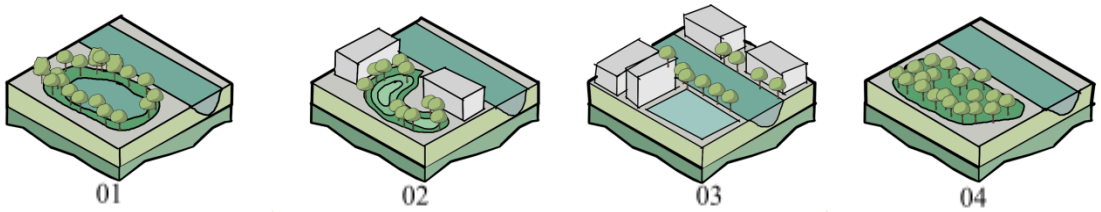


Figure 151.2: Strategy 02 [Source - Author]

(01) Existing water body with public interface. (02) Rain Garden. (03) Water square development. (04) Ecologically sensitive reserve area.

11.2.1.3 Strategy 03 - Redevelopment of the streets with the sponge framework to increase the permeability of the street surface and introducing shaded mobility corridor with integrating large foliage trees.

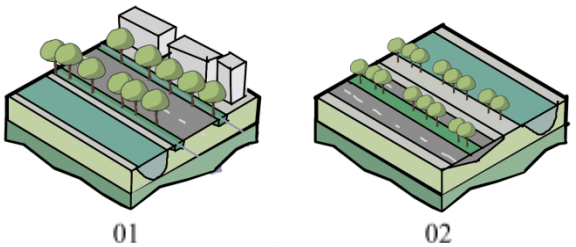


Figure 151.3: Strategy 03 [Source - Author]

(01) Bio swale with shaded pathways. (02) Sponge Street development.

11.2.1.4 Strategy 04 - Introduce an ecologically sensitive built environment to enhance the idea of eco sensitive planning (Complete urban water cycle and reduction of pollution).

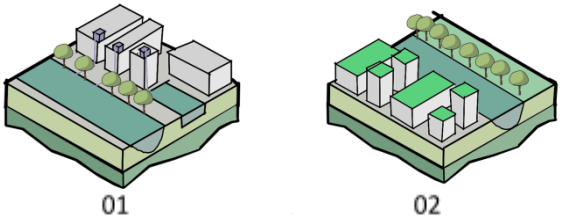


Figure 151.4: Strategy 04 [Source - Author]

(01) Rain water harvesting protocol and detention tank development. (02) Green roof protocol introduce.

11.2.2 Objective 02: Community

Restructuring the urban morphology along the canal - market area and fishermen neighborhood.

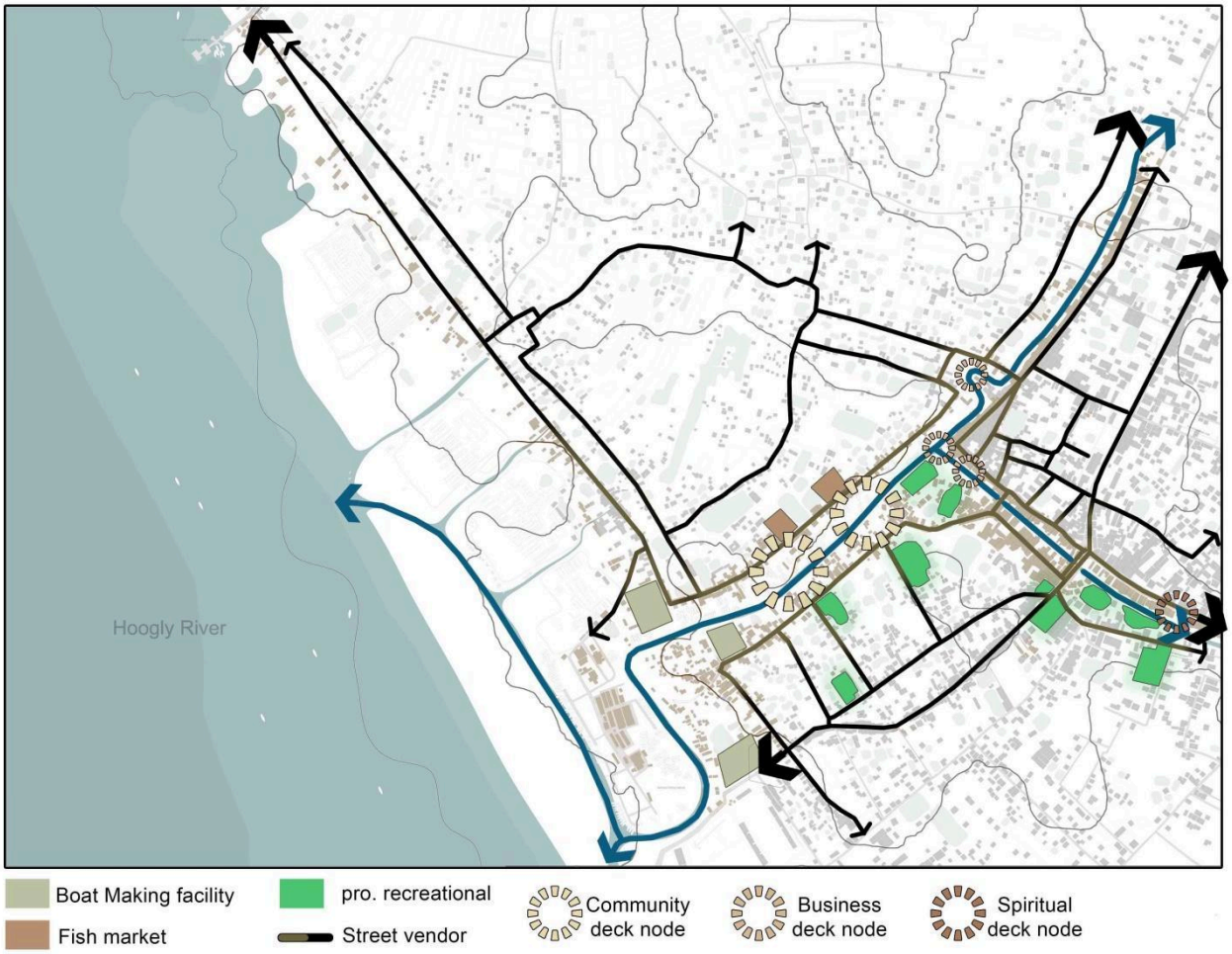


Figure 152: Objective 02 [Source - Author]

11.2.2.1 Strategy 01 - Activate the canal front through developing a diverse typology of ghats, decks and community spaces.

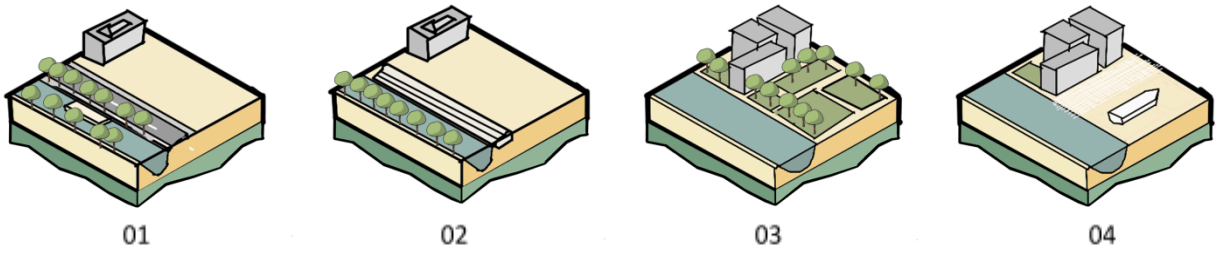


Figure 152.1: Strategy 01 [Source - Author]

(01) Market Ghat for drop-off & Pick-up and community deck space. (02) Redevelopment of Kakdwip Burning Ghat. (03) Encouraging Community Garden and urban farming. (04) Fishing net, Boat making and repairing community space.

11.2.2.2 Strategy 02 - Repurposing the available open spaces as social gathering spaces, public plazas and tourism magnets and integrating with the development stretch.

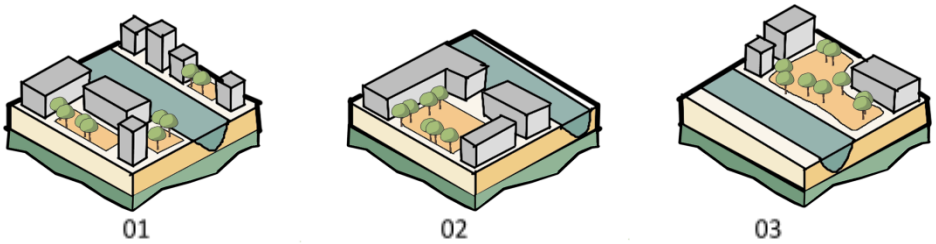


Figure 152.2: Strategy 02 [Source - Author]

(01) Neighborhood Pocket Park. (02) Public Plaza. (03) Activity Node with Tourism magnets

11.2.2.3 Strategy 03 - Activate the movement corridor along the canal front for safe access and celebrate the water.

(01) Active frontages with vending zones (eyes on the street). (02) Street lights and bench along the canal front (eyes on the canal)

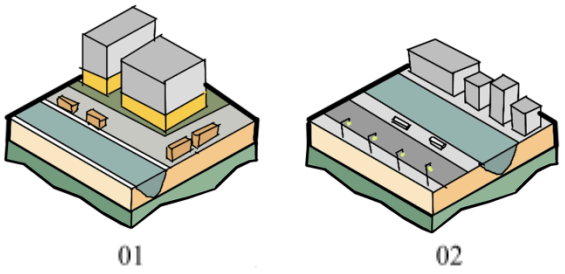


Figure 152.3: Strategy 03 [Source - Author]

11.2.2.4 Strategy 04 - Introduce community responsive and economically viable building typologies along the canal.

(01) Mixed-use and incremental housing typology development. (02) Development of Dry fish market.

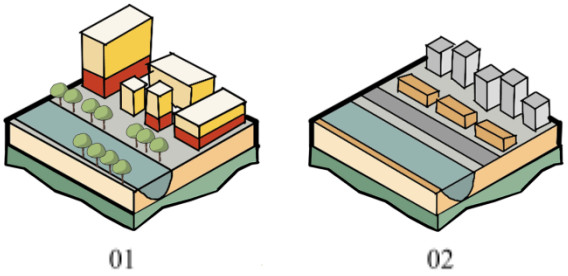


Figure 152.4: Strategy 04 [Source - Author]

11.2.3 Objective 03: Connectivity

Developing the seamless and integrated mobility network for holistic growth of the precinct.

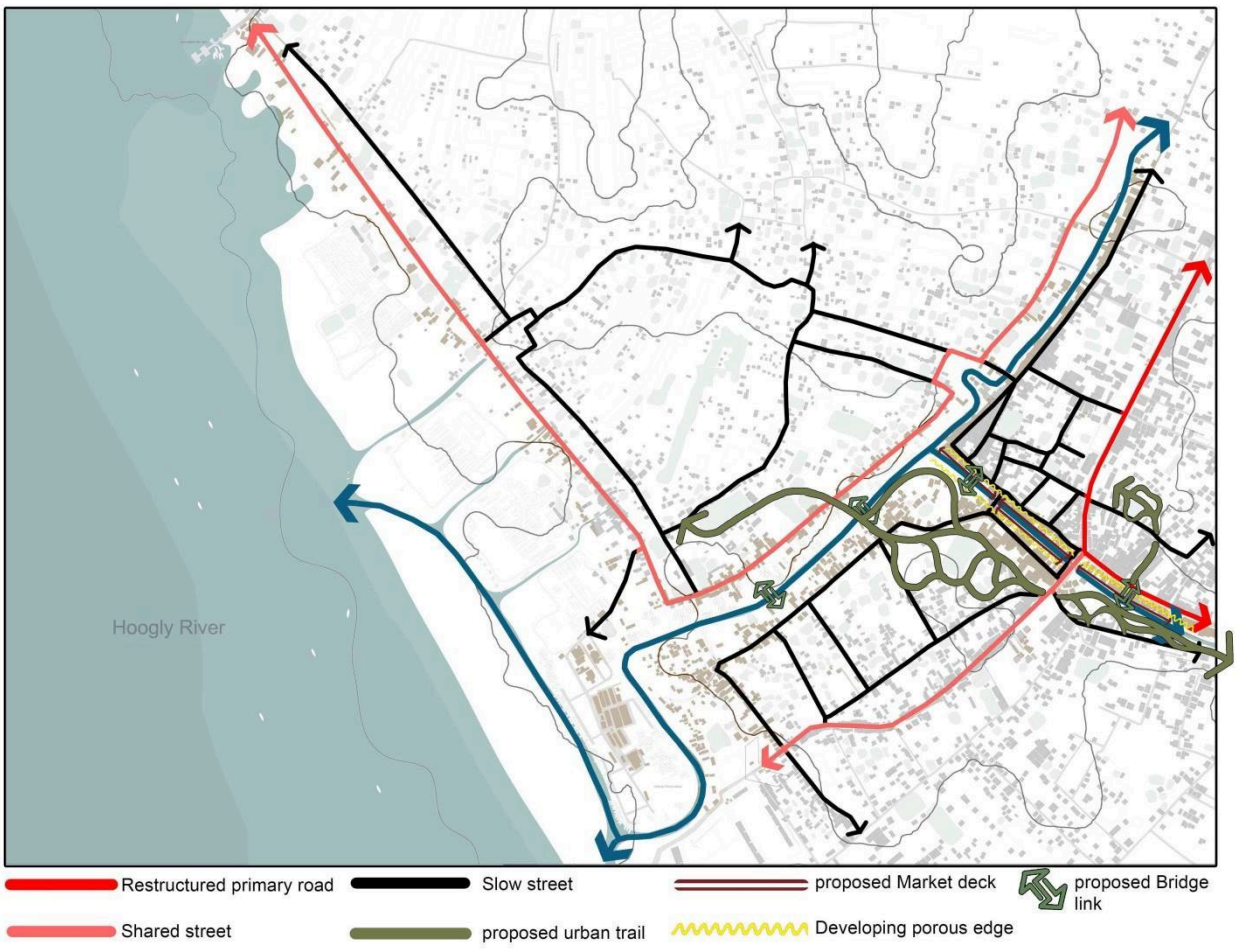


Figure 153: Objective 03 [Source - Author]

11.2.3.1 Strategy 01 - Develop a canal integrated mobility system to enhance the functionality of the canal and establish a variable and meaningful canal front.

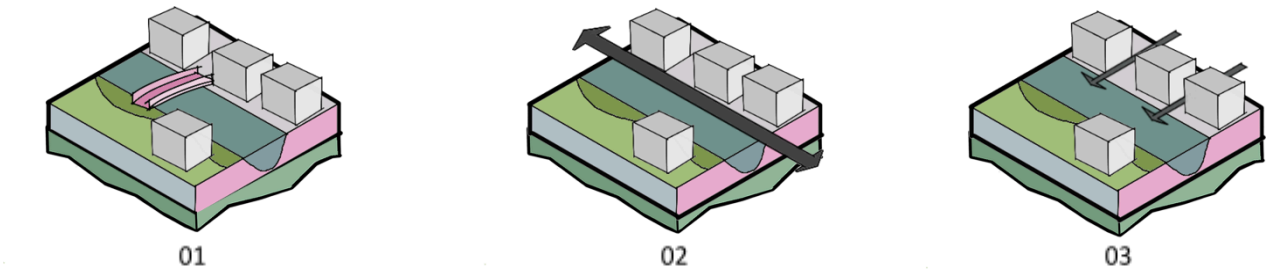


Figure 153.1: Strategy 01 [Source - Author]

(01) Establishment of linkages at old and new market area. (02) Dedicated continuous stretch of deck space on canal edge at market area. (03) development of a Permeable market stretch.

11.2.3.2 Strategy 02 - Develop an integrated mobility corridor through the implementation of a green urban link with dedicated pedestrian and cycle facility.

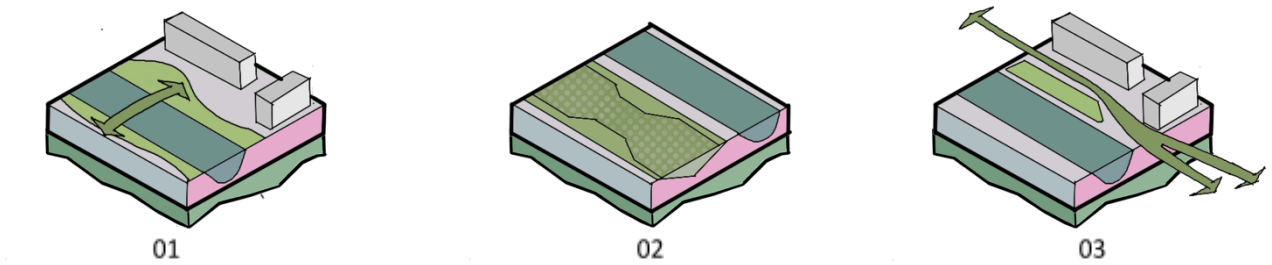
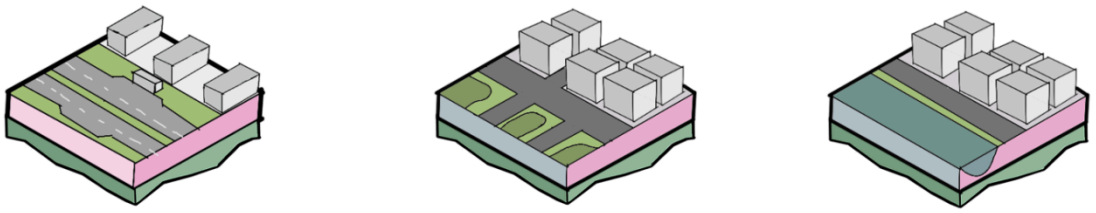


Figure 153.2: Strategy 02 [Source - Author]

(01) Urban green link development. Permeable recreational surface. (02) Dedicated pedestrian and (03) cycle green corridor.

11.2.3.3 Strategy 03 - Develop a diverse set of integrated streetscapes with pedestrian, cycle and NMV facilities based on the existing city fabric.



(01) Restructuring primary Road. (02) Development of Slow Development of shared Street. (03) street.

Figure 153.3: Strategy 03 [Source - Author]

11.2.4 Objective 04: Economy

Developing the gateway to the city by legible space planning.

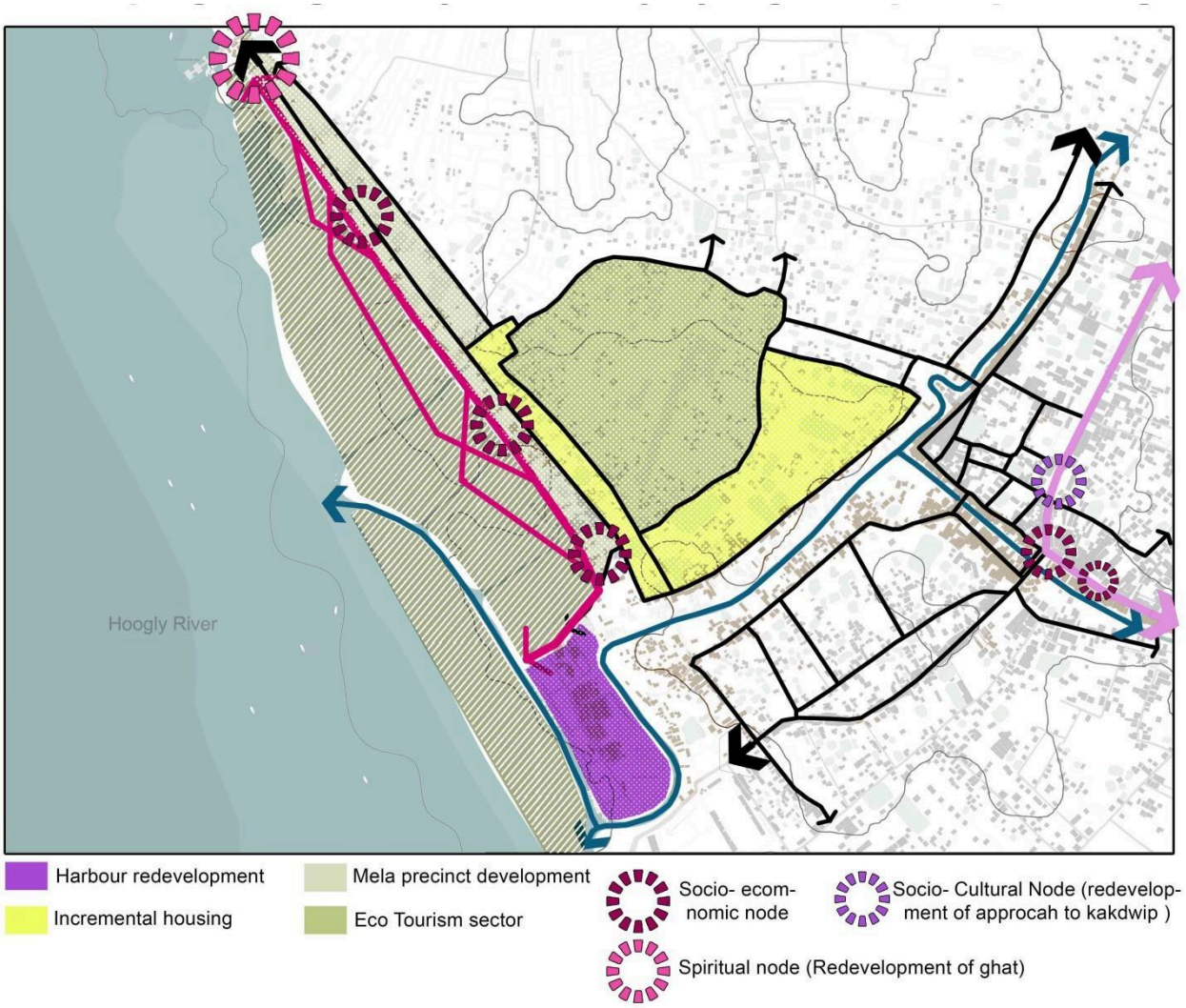


Figure 154: Objective 04 [Source - Author]

11.2.4.1 Strategy 01 - Redevelop the city Centre with city level gathering place or public plaza to strengthen the idea of arrival to the gateway city.

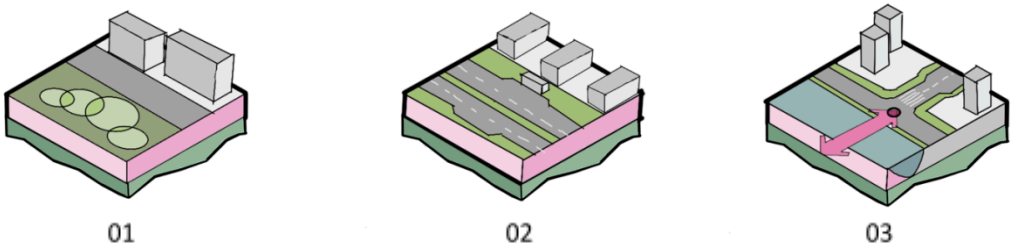


Figure 154.1: Strategy 01[Source - Author]

(01) Relocating the Bus depot and rejuvenating the space as a public plaza. (02) Development of the approach road to enhance the city image. (03) Redevelopment of the Kakdwip Chowrastha with the bridge.

11.2.4.2 Strategy 02 - Development Ferry ghat, Fishing harbor and river promenade with Cycle and pedestrian facilities integrated with pause points for active community participation.

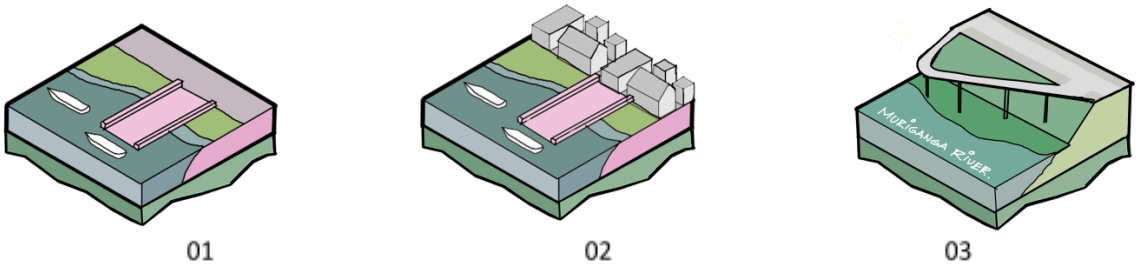


Figure 154.2: Strategy 02 [Source - Author]

(01) Redevelopment of Ferry Ghat. (02) Redevelopment of Fishing Harbor. (03) River Promenade

11.2.4.3 Strategy 03 - Development of the ephemeral urban framework and eco resorts along the muri Ganga River front.

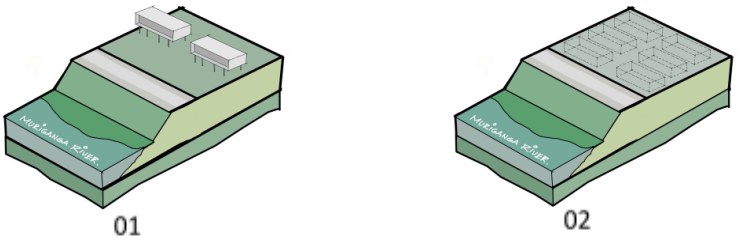


Figure 154.3: Strategy 03 [Source - Author]

(01) Eco Resorts development & generation of local economy. (02) Ephemeral urban framework for Ganga sagar mela & multipurpose use space with rental revenue generation

11.3 CITY LEVEL STRUCTURE PLAN

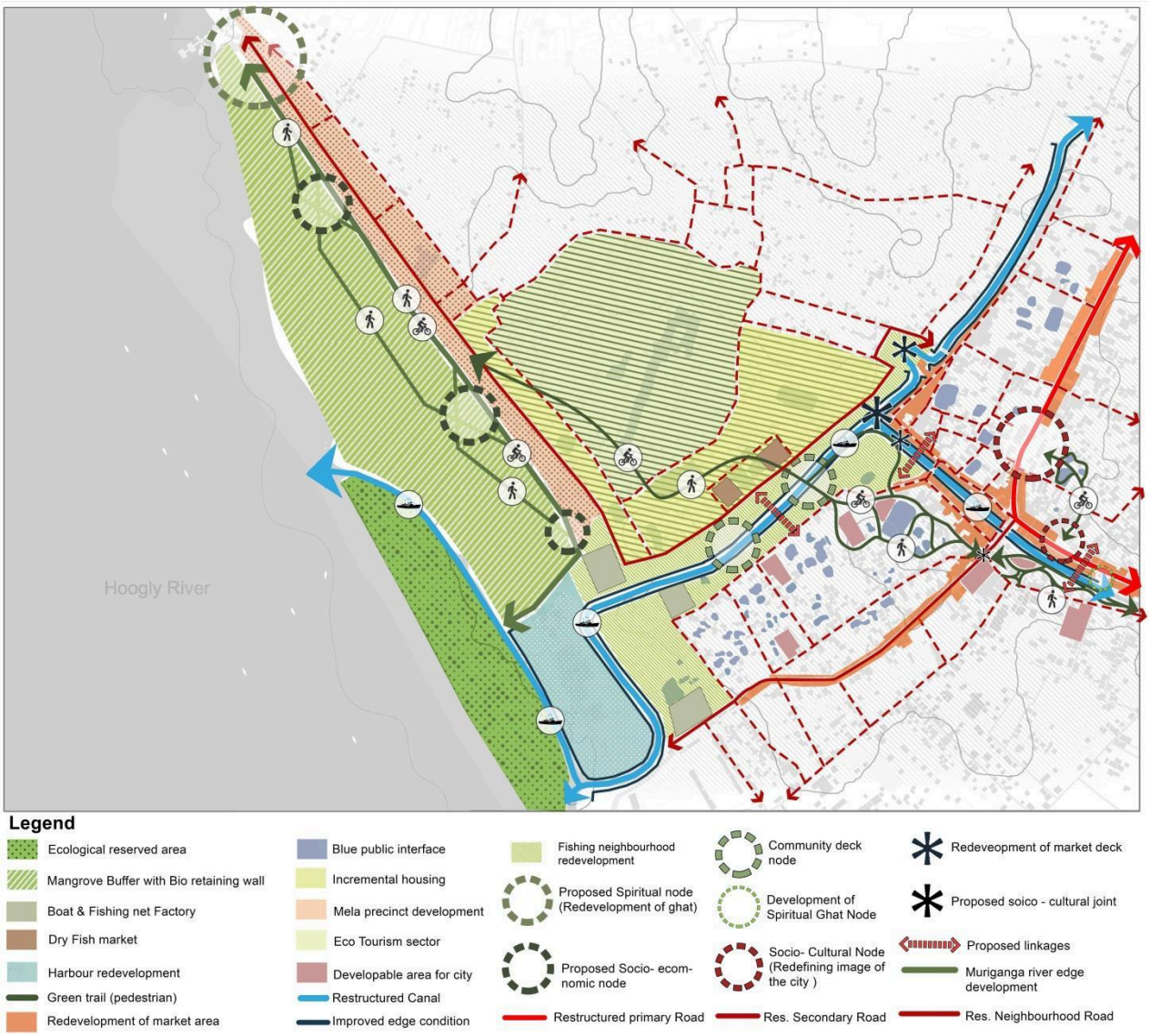


Figure 155: Structure plan [Source - Author]

11.3.1 Financial strategy

The first phase of your development plan aims to revitalize the canal front and create social spaces along it. This can be achieved through various strategies such as landscaping, adding amenities such as benches and seating areas, and creating recreational spaces such as parks and playgrounds.

Creating a tourist destination is also important for generating revenue. In the second and third phase, by developing the canal front into an attractive and interesting place to visit, city authority can encourage tourists to come to the area and spend money on local businesses such as restaurants, shops, and hotels. This can provide a boost to the local economy and create jobs for residents.

Figure 156: Development Impact map [Source - Author]

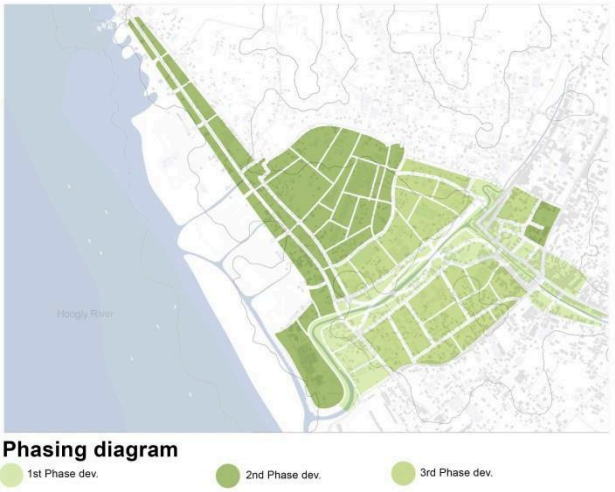
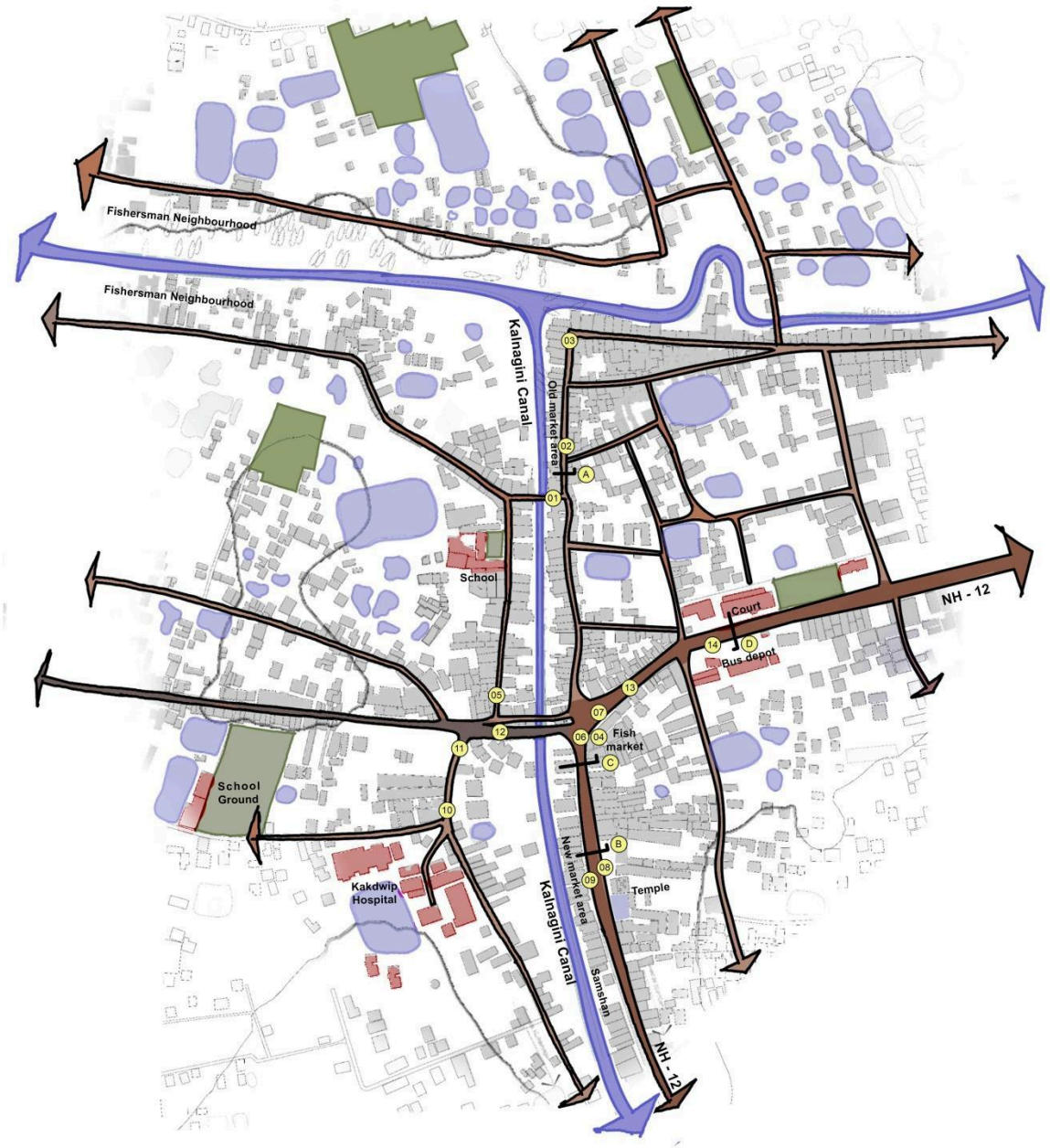


Figure 157: Phasing diagram [Source - Author]

11.4 SITE DELINEATION

11.4.1 Existing site structure (core city)

The site for the intervention has been chosen near the city core with market area where the Kalnagini canal goes through the city. The city core is having national highway and other important built structure which has been used as a magnet for the site level interventions.



11.4.1.1 Existing structure of the old market area

No separate pedestrian and vehicular existing structure exist. Narrow roads occupied by parking of two wheelers and other vehicles. No suitable streetscape is existed in a form to enhance the activity of the market. linkages are broken. no seamless linkages between canals and road. Few & Congested entry to the Canal side of the old market area with improper infrastructure for the existing activities. Decapitated condition of the fish and vegetable market with unplanned Solid

and liquid waste disposal leads to spoil the experience of shopping. the old market area is very congested and road width are not sufficient to hold the huge traffic at the time of peak business hour.

Figure 158.1: Existing old market area condition [Source - Author]

11.4.1.2 Existing structure of the new market area

Open space near new market area surrounded by temple shops and street food shops with toto parking having no characters and functionality. Street sides and shop fronts are encroached with parking and street with no dedicated footpath and natural or building shadings. Minimum available foot paths and shop fronts are occupied by the street vendors. Road width reduced by the street side parking. City main roads are occupied by unauthorized retailers and vendors. no dedicated space for street vendors,parkings,pedestrian facilities. Unorganized road structures with unplanned road turnings leads to congestions and accidents.

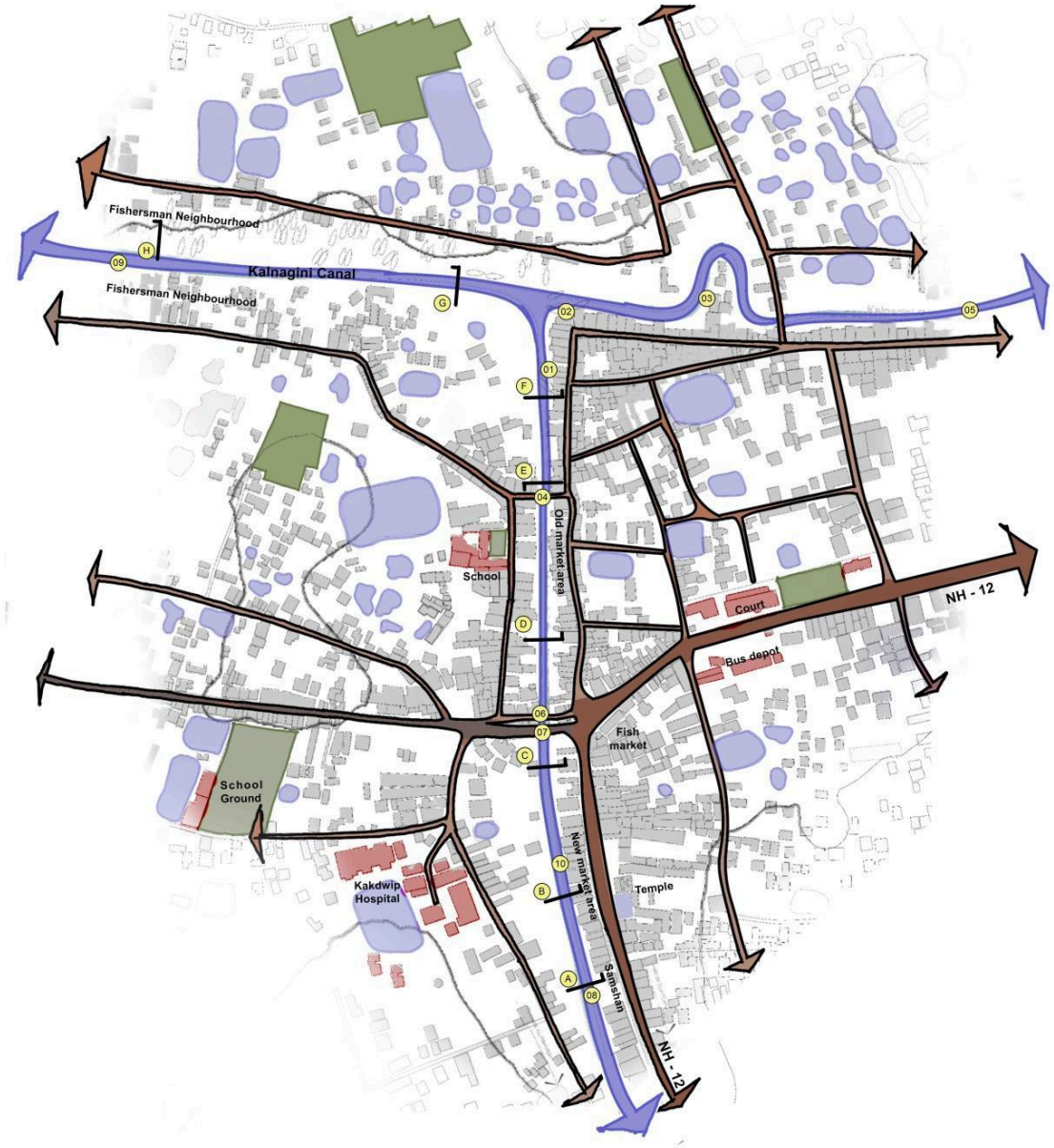
Figure 158.2: Existing new market area condition [Source - Author]

11.4.1.3 Existing structure of the city approach

Unplanned road junction is so unsafe for the city people to cross the road. The edge of the main road is encroached by the fruit and vegetable vendors. The core of the city is lacking the imageability. The famous chow rastha of the central node of two market is always congested. The road leading towards the city core is also very poorly designed with almost no green spaces inaccessible and encroached footpath. The approach to the city is through a bus depot. hence the imageability of the city arrival & the sense of community space at the heart of the city are missing.

Figure 158.3: Existing City approach [Source - Author]

11.4.2 Existing site structure (Canal Edge)



11.4.2.1 Edge Condition of Kalnagini Canal (Old market area)

The old market area is partially porous along the canal side. which is now also accessible for business purpose. but no ghats are there. Available space for the drop-off and pickup decks are not available. and minimum space available for market to connect to the water edge. Functionality of the market area is affected due to the encroached Canal front and improper infrastructure to support the existing activity. Unplanned bridge's locations and structures leads to inaccessible to the continuous stretch of the canal. Unstructured canal edge and entry. the old market area is very congested and road width are not sufficient to hold the huge traffic at the time of peak business hour.

Figure 159.1: Old market area canal front [Source - Author]

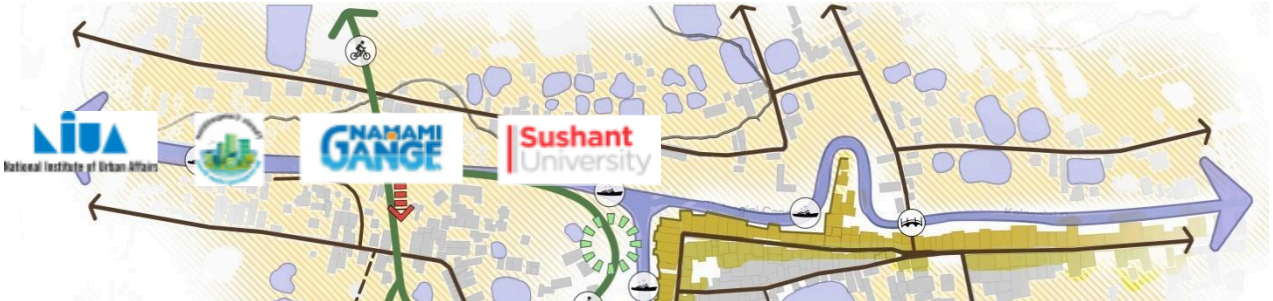
11.4.2.2 Edge Condition of Kalnagini Canal (new market area)

Detoriating connecting links or bridges, located at the heart of the city. the canal is polluted and encroached by the buildings. City waste dumping from the major bridge to the canal without having any treatment. The canal is reducing its water holding capacity day by day. Canal edge along the Kakdwip Maha Samsan is unmaintained and polluted. Ghat space is not structured for the purposeful usage. The linkages between Kakdwip and Kalinagar are not there. Only the area can be accessible through the ferry boat hence social infrastructure of kakdwip area are not easily accessible by kalinagar people. The new market area is more encroached than old market area. River front is not accessible and used as dumping zone.

Figure 159.2: New market area canal front [Source - Author]

11.5 SITE LEVEL STRUCTURE PLAN

The Structure plan for the site has been proposed with the consideration of the existing magnet spaces of the site. To enhance the canal front functionality market deck and green trails has been added. With the evolution of the design many relevant pause spaces for the community and the tourist has been located and designed with the essence of sunderban.



11.6 MASTER PLAN

Proposed Master plan of the intervention site

01.Redevelopment of commercial stretch	10.Redevelopment of kakdwip Crematorium	19. Bengal Misti Plaza	28.Redevelopment of fish & vegi market-
02.City Arrival Plaza -	11.Proposed Green link 01	20. Bird Tower	29. River deck 01
03.Fish Pond -	12.Art Cafe	21. Community Fishing Pond	30. Bird Gazing towert
04.Community pond with tarpan ghat -	13.Cafe	22. Lagoon & Biodiversity zone	31. River deck 02
05.Community room & Swimming club -	14.Readers Cafe	23. Fishing club & training centre	32. Green Link 02
06.Community garden & flower nursery -	15.Yoga & meditation green	24. Cultural club , library & tution centre	33. Old market Deck
		25. Food vending zone & craft shop	34. Deck Link
	Badm	& craft Workshop & museum	35. Depth increased & edge defined Kalnagini Canal
	ical m	und gazing tower	36. Green tail 37. City gathering OAT

Figure 161: Mater Plan [Source - Author]

11.6.1 Market area detail

The part plan has been extracted from the master plan and shown the entry level plans of the buildings planned for the area. All the retail buildings has been planned within the natural setup to give the essence of biodiversity of sunderban . The idea of Secondary city arrival has been defined by the Food Plaza. All the other small pond will act like a water retention area and sewage neutralized water space with fishes to maintain the permissible BOD level of the water.

Figure 162: Market area entry level plan [Source - Author]

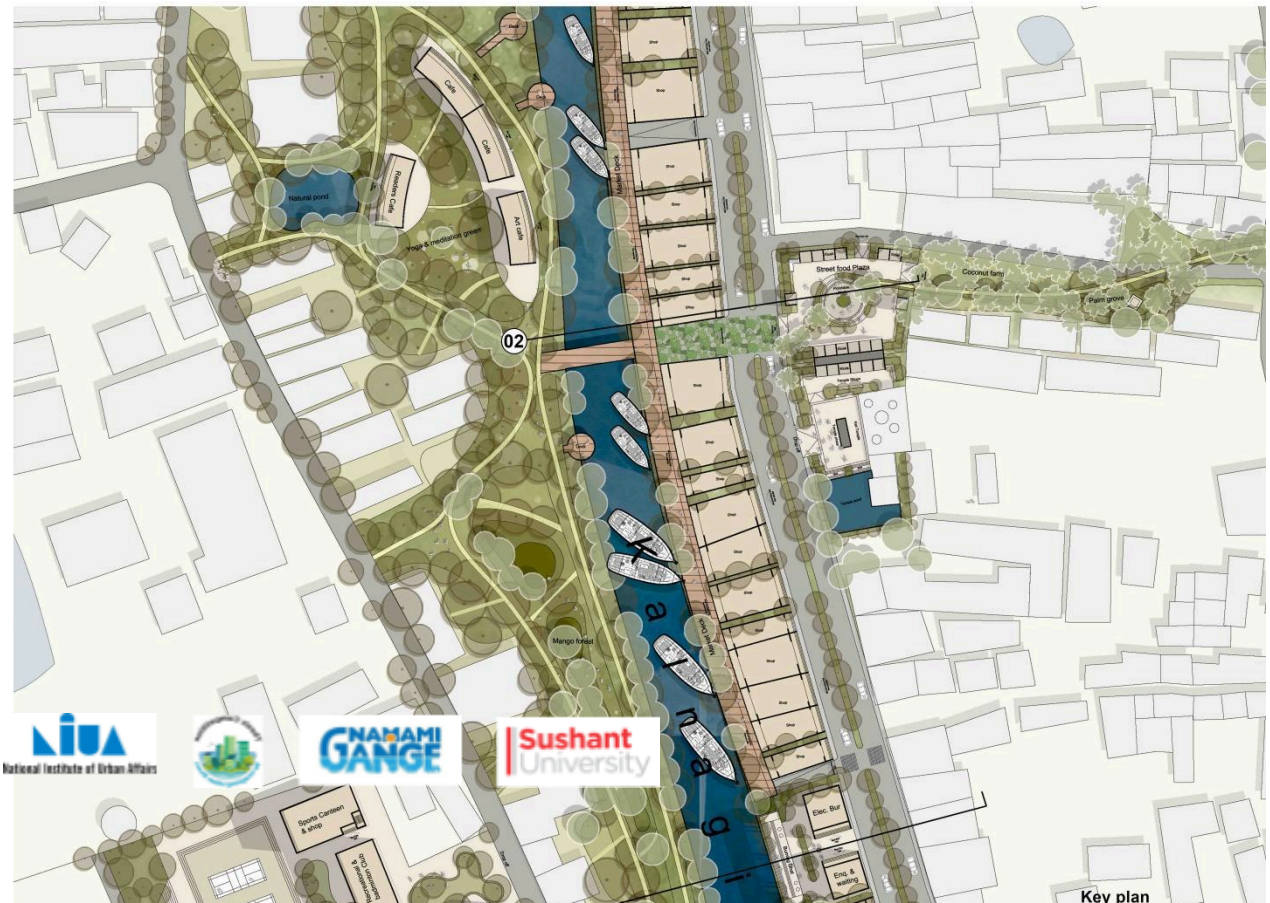


Figure 163: Objectives overlay [Source - Author]

The intervention area has been shown in the aerial view is the City Market Area which is reimagined at the edge of Kalnagini Canal.

Figure 164: Aerial view of the development [Source - Author]

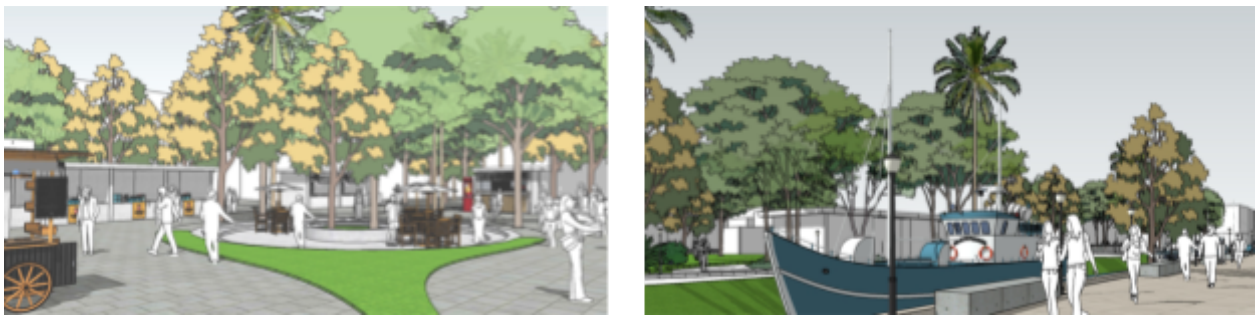


Figure 165: Visuals [Source - Author]

11.6.1.1 DEVELOPMENT GUIDELINES & TYPOLOGY

11.6.1.1.1 Built space system

11.6.1.1.1.1 Building edge guidelines

The edge of the built form is what makes the envelope of the street. This is called Street Edge.
further we have categorized the edges
Permeable edge - These edges allow maximum possibility of participation as they permit both visual and physical access.
Expanded edge - when two different domain spills over together at another zone.
Interactive edge - when ground floor has a functional aspect then the edges become interactive.

Figure 167: Edge [Source - Author]

Transparent edge --When the two domains are defined loosely, leaving an undefined area in between, the edge has no strong definition and appears
1. mixed use development encourages clear pedestrian environment which creates a variety of edges and knits the area.
2. landscaping will be provided along the setback to soften the edge.
3. setbacks to be utilized in active and transparent manner to create more utility.
4.buildings are located at the street edge, directly adjacent to the sidewalk. They create a continuous street wall, with the exception of public spaces and laneway access points.

11.6.1.1.1.2 Typology

Residential Typology
01. Stilt residential building typology for the upcoming new buildings inside the neighborhood, this typology will help the city people to withstand with flood conditions. total building heights not more than 15m with 3m of stilt. Indoor and outdoor amenity spaces for resident use must be provided.
Commercial Typology
01. Discrete Kiosk cluster Typology.
02. Mixed used Canal edge Market Typology.
03. Alfresco Cafe / Informal Cafe Typology.

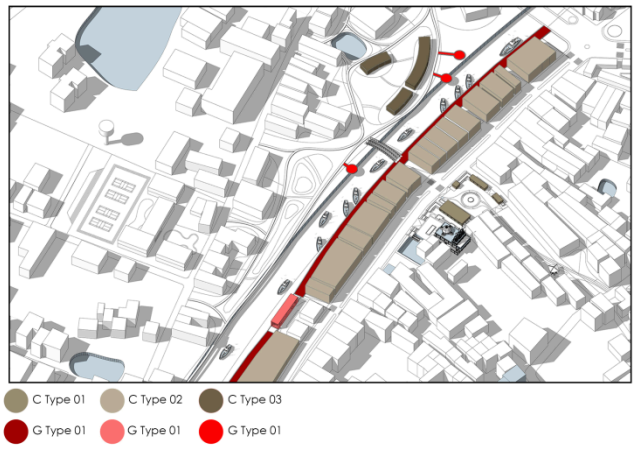


Figure 168: Typology [Source - Author]

Ghat Typology

01. Market Deck as Business Ghat Typology
02. Samshan Ghat as Spiritual Ghat Typology
03. Observation Deck as Recreational Ghat typology

11.6.1.1.2 Open space system

11.6.1.1.2.1 Mobility guidelines

Cycling Network Design Guidelines

1. Cycling will be supported and encouraged by providing safe, accessible and convenient cycling facilities within the neighborhood.
2. Urban green trail has 3-meter bicycle friendly shared curb lanes and marked with sharrows or be designed as signed bicycle routes.

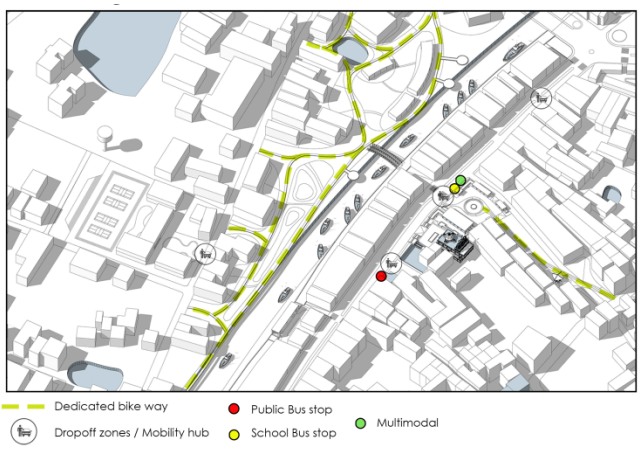


Figure 169: Mobility [Source - Author]

Pedestrian Network Design Guidelines:

1. Sidewalks and pedestrian street crossings will be continuous, universally accessible, barrier free and clearly designated
3 Sidewalks widths will have a minimum dimension of 1.2 meters but be more generous whenever possible.
4. The design of pedestrian street crossings will have differentiated paving materials and/or colors that identify their function.
5. Streetscape design will include long trees for shading, pedestrian scaled lighting and other people-oriented amenities such as benches and landscaping.

11.6.1.1.2.2 Street guidelines

1. the streetscape of 15m national highways should be revised with the proper pedestrian green stretch, bioswales, rain garden and permeable paving.
2. 7 to 8 m city collector going towards the Muriganga river should have its frontages with mixed used buildings, streets should be incorporated with street lights, trees and seating places.
3.5 to 6 m roads have been designed as the principles of woonerf street.

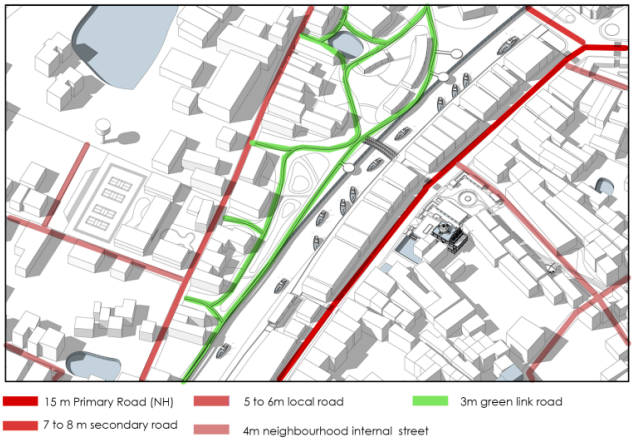


Figure 170: Street [Source - Author]

4. 4m internal road should be designed with mostly pedestrian facilities and notification should be circulated into the neighborhood for widening the street to incorporate the drainage system.

No on road parking is permitted throughout the residential clusters.
5. dedicated drop off zones are provided all over the sector to cater the needs.

6. Dedicated school bus stops are aligned at every 450 m of residential area.
7. The streets and neighborhood is designed in such a way that it is pedestrian friendly.

11.6.1.1.2.3 Blue and green Guidelines

1 A range of active and passive open spaces will be incorporated throughout the Site.
2. Landscaping and grading treatments will provide a smooth transition between indoor and outdoor spaces, and eliminate barriers accessibility.
3. Stalls will be provided in open spaces to enhance the edge condition.
4.Avoid privacy fencing at the front of the house; if considered, privacy fencing should not extend beyond the main front wall of the dwelling.

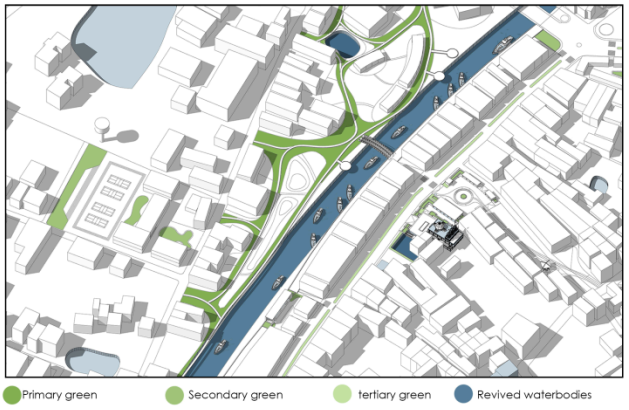


Figure 171: Blue & Green [Source - Author]

05. Roof tops should be used as gardening space and water holding space, for rain water harvesting.

06. all roads should be shared with deciduous trees with large foliage to shade the pathways.
07. sewage systems should be de centralized and local ponds and be used as a discharge area for the treated water.

08. Bio sweals should be added at the edge of the road and the pavement before the water enters to the drainage system it should go through the purification.

11.7 USER EXPERIENCE WITH THE BLUE AND GREEN NETWORK

The intervention zones have been detailed out to depict the activities of the locations dedicated to various functions. Following the revival of dedicated zones with unique strategies, a user experience maze has been set up to explain the experience of the city by visitors and locals. Water has been celebrated in almost every part of the city. And every significant part of the city has been stitched with the cultural, recreational, spiritual, and ecological essence that had previously been lost.

11.7.1 Samabesh Mancha - At the arrival of the Kakdwip City one can see a place for the city People Gathering place for different events. The local community gathered at the samabesh Mancha for public speaking.

Figure 172 : Samabesh mancha [Source - Author]

11.7.2 Dalan Bari - Then the experience goes to the Dalan Bari with a forest court to celebrate the Sundarban and Bengal. Ganesh puja has been celebrated with in the forest court at the Dalan.

Figure 173: Dalan bari [Source - Author]

11.7.3 Tarpan Ghat - A community with tarpan ghat and swimming pool for the locals to enjoy the serenity of the nature. Tarpan ghat has been used by the locals for swimming and other leisure activities.

Figure 174: Tarpan ghat [Source - Author]

11.7.4 Kunja Chaya – The next part goes through a need full flower nursery with coconut farm for the community. Coconut farm has been used and nurtured by the local community

Figure 175: Kunja Chaya [Source - Author]

11.7.5 Bhojon Samabesh – Bhojan samabesh is used as a secondary place for the city arrival and place for market community food joint. Bhojan Samabesh has been used by the market people for fooding activity.

Figure 176: Bhojan samabesh [Source - Author]

11.7.6 Kakdwip Krira Bhaban – A most important function has been added for the local young community to encourage the sports activity. A sunken badminton and tennis court for the young people to play and hold water in monsoon.

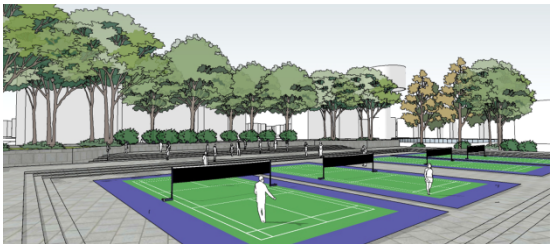


Figure 177 : Kakdwip Krira Bhaban [Source - Author]

11.7.7 Kakdwip Hat – A new approach has been initiated at market area with backyard with deck space and connected canal front. New market deck has been now used by the market community and city people purposefully.

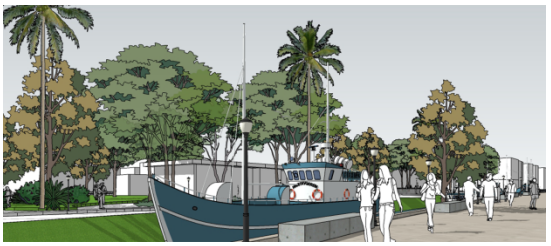


Figure 178: Kakdwip Hat [Source - Author]

11.7.8 Heritage more – A place to celebrate the Cultural and archaeological heritage of Bengal and kakdwip. Bengal Misti Plaza is busy with the day time activity and has been occupied by visitors.

Figure 179 : Heritage more [Source - Author]

11.7.9 Kristi Jheel – At this place the visitors and the local people will celebrate the rich culture of the kakdwip with fishing. Kristi jheel and its peripheral development has been repurposed for fishing activity.

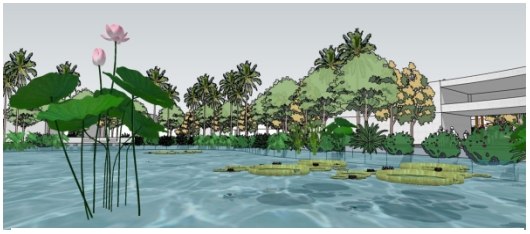


Figure 180 : Kristi jheel [Source - Author]

11.7.10 Kakdwip Pakhiraloy - Here one can celebrate the rich biodiversity of sunderban and will continue experience to the Muriganga riverfront. The bird watching deck to enjoy the various migrated bird and lush green forest.

Figure 181: Kakdwip pakhiraloy [Source - Author]

11.8 INTEGRATED DEVELOPMENT OF THE PRECINCT:

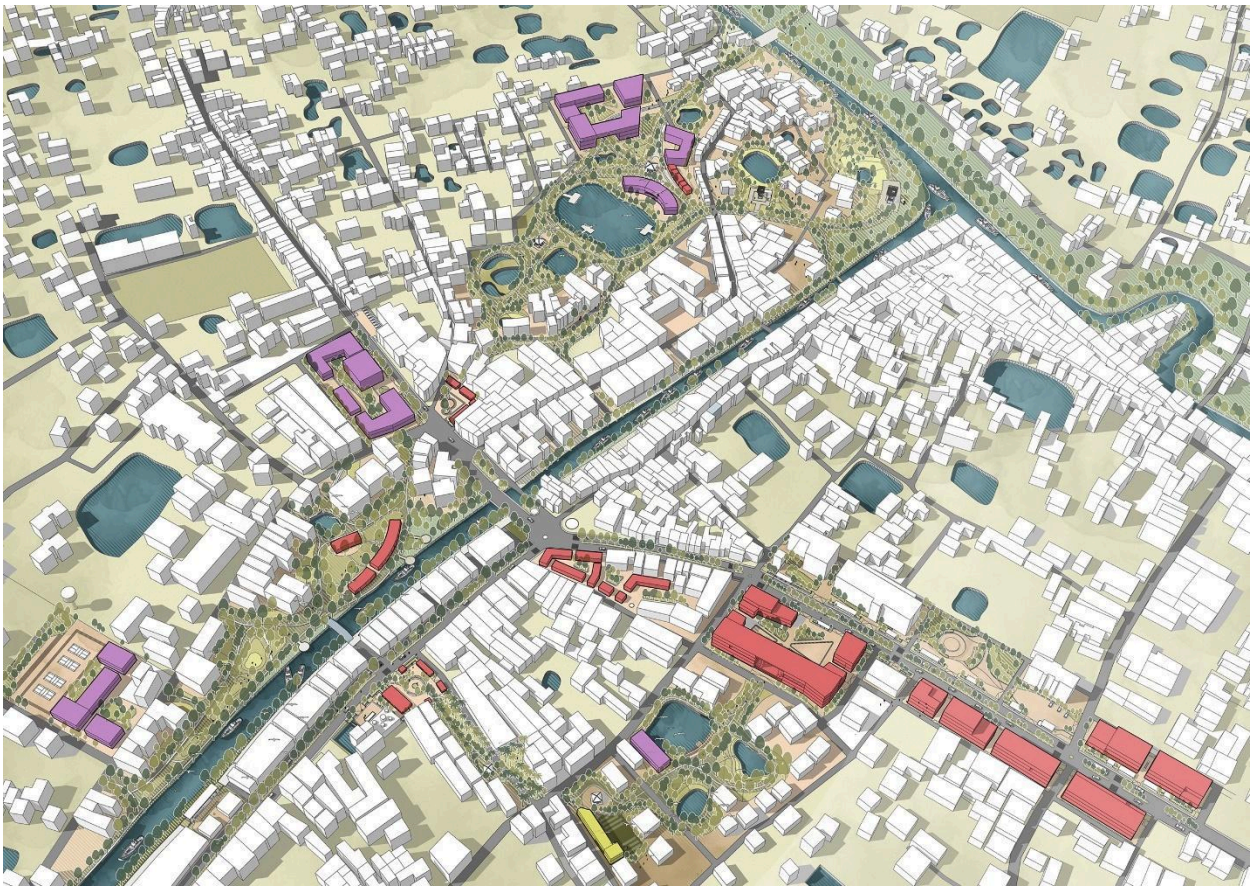


Figure 182: Visualization of the Integrated Development with the Canal [Source - Author]

GLOSSARY OF TERMS:

01. **Socio-Economic** – The social science that studies how economic activity affects and is shaped by social processes.
02. **Biodiversity -** The variety of life on Earth at all its levels, from genes to ecosystems.
03. **Resilient -** Able to withstand or recover quickly from difficult conditions.
04. **Riverine Culture -** The river culture concept sets out to restore harmony between humans and nature in those places where humanity first developed and expanded.
05. **Aquifers-** A body of rock and/or sediment that holds groundwater.
06. **Hydrologically-** In a way that relates to the study of water on the earth**.**
07. **Flash floods -** A flood caused by heavy or excessive rainfall in a short period of time.
08. **Urban Morphology -** The study of urban forms and of the agents and processes responsible for their transformation over time. Urban form refers to the main physical elements that structure and shape the city including streets, squares (the public space), street blocks, plots, and buildings, to name the most important.
09. **Alliance -** A group of countries or political parties that are formally united and working together because they have similar aims.
10. **Chronological -** Following the order in which they occurred.
11. **Geological -** Relating to the study of the earth's physical structure and substance.
12. **Flora and fauna -** Flora refers to all plant life and fauna refers to all animal life
13. **Typology -** A system used for putting things into groups according to how they are similar.
14. **Ephemeral -** Lasting for a very short time.
15. **Demography -** The statistical study of human populations.
16. **Human geography -** The branch of geography that studies spatial relationships between human communities, cultures, economies, and their interactions with the environment
17. **Structure plan -** A planning document which guides future land use and development for an area.
18. **Edge -** The outside limit of an object, area, or surface.
19. **Master plan -** A comprehensive plan of action.
20. **Landuse -** The term used to describe the human use of land.
21. **Landcover -** The surface cover on the ground, whether vegetation, urban infrastructure, water, bare soil or other.
22. **Urban fabric -** The physical characteristics of urban areas.
23. **Subdivision -** An administrative division of an Indian state below the level of a district.
24. **Samabesh mancha –** Amalgamation area of a city.
25. **Dalan bari –** Typology of Building Belongs to West Bengal usually having central courtyard with balconies at the periphery.
26. **Tarpan ghat –** A Deck space along waterbodies used for cultural and spiritual purpose.
27. **Kunja Chaya –** Forest Shaded area.
28. **Bhojan samabesh –** Collective Food Joints.
29. **Krira Bhaban –** Sports Club.

30. Hat – Market Place.
31. More – Junction.
32. Jheel – Large Waterbody**.**

33. Kristi – Cultural
34. **Pakhiraloy -** Bird sanctuary
35. City Image - How individuals perceive and recall features in urban spaces.
36. Circular resources - A model of production and consumption, which involves sharing, leasing, reusing, repairing, refurbishing and recycling existing materials and products as long as possible.
37. Squatter settlements - A residential area which has developed without legal claims to the land and/or permission from the concerned authorities to build.
38. Break waters - An offshore structure (as a wall) to protect a harbor or beach from the force of waves.
39. **Bio retaining wall -** Adaptive retaining wall by having particular components for wastewater separation, water filtration, and plant cultivation.
40. **Bio swale -** A long, channeled depression or trench that receives rainwater runoff.
41. Sponge street – Road design intended to absorb rain and prevent flooding.
42. Detention tank - An artificial flow-control structure that is used to contain stormwater and wastewater for a limited period of a time.
43. **Green roof -** Ballasted roofs consisting of a waterproofing membrane, growing medium (soil) and vegetation (plants) overlying a traditional roof.
44. Community garden - A piece of land gardened or cultivated by a group of people individually or collectively**.**
45. Urban farming - Growing plants or raising animals within a city.
46. Plaza - A public square, marketplace, or similar open space in a built-up area.
47. Eyes on Canal - An exercise in participatory planning to make the canal a livable place for the residents.
48. Slow street - Corridors designated as shared spaces for pedestrian, bike, scooter, wheelchair, and car traffic.
49. Shared street - A roadway designed for slow travel speeds where pedestrians, cyclists, and motorists all share the right of way.
50. **Rainwater harvesting -** The collection and storage of rainwater that would otherwise flow down gutters into the drain.

ACRONYMS/ ABBREVIATIONS:

01. ABC - Active, Beautiful, Clean
02. FARU – Faculty of Architecture Research Unit
03. GAP – Ganga Action Plan
04. STP – Sewage treatment Plant
05. BOD – Biological Oxygen Demand
06. NMCG - National Mission for Clean Ganga
07. NIUA – National Institute of Urban Affairs
08. NGRBA - National Ganga River Basin Authority
09. RTF - Rethinking The Future
10. RCA – River City Alliance
11. TOI – Times of India
12. CD – Community Development
13. BC – Before Christ
14. LU- Land Use
15. LC –Land Cover
16. PHED – Public Health Engineering Department
17. PJAEE - Palarch's Journal of Archaeology of Egypt/ Egyptology
18. HFL - High Flood Level
19. MoHUA – Ministry of Housing and Urban Affairs
20. SWOT – Strength Weakness Opportunity Threat
21. NH- National Highway
22. CBD – Central Business District
23. RCC – Reinforced Cement Concrete

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CERTIFICATE OF COMPLETION

This is to certify that this thesis project titled "Reimagining the river front as a socio-economic interface – a case of Kakdwip" was carried out by Sh./Smt. Debjyoti Saha, a student of Urban Design (M.Arch), at the Sushant School of Art and Architecture. The research for this project was undertaken under the guidance of the afore-mentioned institute and completed during the period of 02.01.2023 to 23.05.2023.

his p wa nde d *Thesis Project Competition on RE- INI RIV n- 3)* hosted by the National Institute of Urban Affairs (NIUA) and the National Mission for Clean Ganga (NMCG).

This report has been submitted by the student as a final deliverable under the