

Agriculture: Kolakopa Union's land use profile reveals a distinct agricultural character, with nearly 36.74% of its total area dedicated to agricultural land use. This underscores the significance of agriculture as the primary economic driver and livelihood source for the community. This area includes single—and double-cropping land and various types of livestock farms.

Waterbodies: Waterbodies comprise around 8.10%, encompassing ponds, khals, and rivers, adding valuable ecological diversity to the landscape. The Ichamoti River flows by the north side of the Kolakopa Union.

Road: Transportation infrastructure plays a moderate role, with roads encompassing 2.62% of the land. The road that passes through Shurganj to Sadapur is the most vibrant in the union.

While several land use categories exist, including mixed-use, administrative, health, religious facilities, and heritage sites, their collective footprint remains comparatively minimal, hovering at less than 1%. This indicates a potentially limited range of these services and amenities within the union. However, open spaces and commercial, industrial, educational, and recreational land uses are more than 1% in this union. Besides, around 1.16% of the total land area is also restricted.

6.4.12 Nayansree Union

Nearly 45.55% of Nayansree Union's area is dedicated to agriculture, which forms the bedrock of its economy and livelihoods. Residential areas, primarily rural homesteads, are the second most prominent land use, occupying a significant portion and reflecting the established community presence. Road contributes to 1.18% of the total Nayansree Union Land. Besides, Waterbody contributes about 6.54% of the total land area of Nayansree Union, including Pond, Khal, and Rivers.

Agriculture: Nayansree Union's land use profile reveals a distinct agricultural character, with nearly 45.55% of its total area dedicated to agricultural land use. This underscores the significance of agriculture as the primary economic driver and livelihood source for the community. This area includes single—and double-cropping land and various types of livestock farms.

Residential: Residential areas, primarily rural homesteads, occupy the second largest land share, nearly 44.33%, suggesting a well-established community presence. Residential area is established majorly around the bank of the Ichamoti river and Bokchor road connectivity.

Waterbodies: Waterbodies comprise around 6.54%, encompassing ponds, khals, and rivers, adding valuable ecological diversity to the landscape. Ichamoti River flows by the south and southwest sides of the Nayansree union.

Road: Transportation infrastructure plays a moderate share, with roads encompassing 1.18% of the land. Road that passes through Maliail to Paragram road is the most vibrant road of the union.

While several land use categories exist, including commercial, mixed-use, administrative, industrial, educational, health, recreational, religious facilities, heritage sites, and open spaces, their collective footprint remains comparatively minimal, hovering at less than 1%. This indicates a potentially limited range of services and amenities within the union.

Table 6-13: Existing Land Use Pattern of Nayansree Union

Survey Report (Draft 2)**Review and Update of Master Plan for
Nawabganj Upazila****6-35**

Land use	Area (Acre)	Area (Hector)	Area (Sq. k.m.)	Percentage (%)
Residential	2433.11	984.65	9.85	44.33%
Commercial	19.98	8.08	0.08	0.36%
Mixed Use	31.33	12.68	0.13	0.57%
Transport	64.58	26.14	0.26	1.18%
Administrative	1.40	0.57	0.01	0.03%
Industrial	2.89	1.17	0.01	0.05%
Agriculture	2499.97	1011.70	10.12	45.55%
Education	17.98	7.27	0.07	0.33%
Health	0.49	0.20	0.00	0.01%
Recreational	27.99	11.33	0.11	0.51%
Places of Worship	20.34	8.23	0.08	0.37%
Restricted Area	0.00	0.00	0.00	0.00%
Heritage Site	0.00	0.00	0.00	0.00%
Open Space	2.84	1.15	0.01	0.05%
Waterbodies	358.92	145.25	1.45	6.54%
Graveyard	6.56	2.65	0.03	0.12%
Miscellaneous	0.01	0.00	0.00	0.00%
Total	5488.38	2221.07	22.21	100.00%

Source: Field Survey, 2023

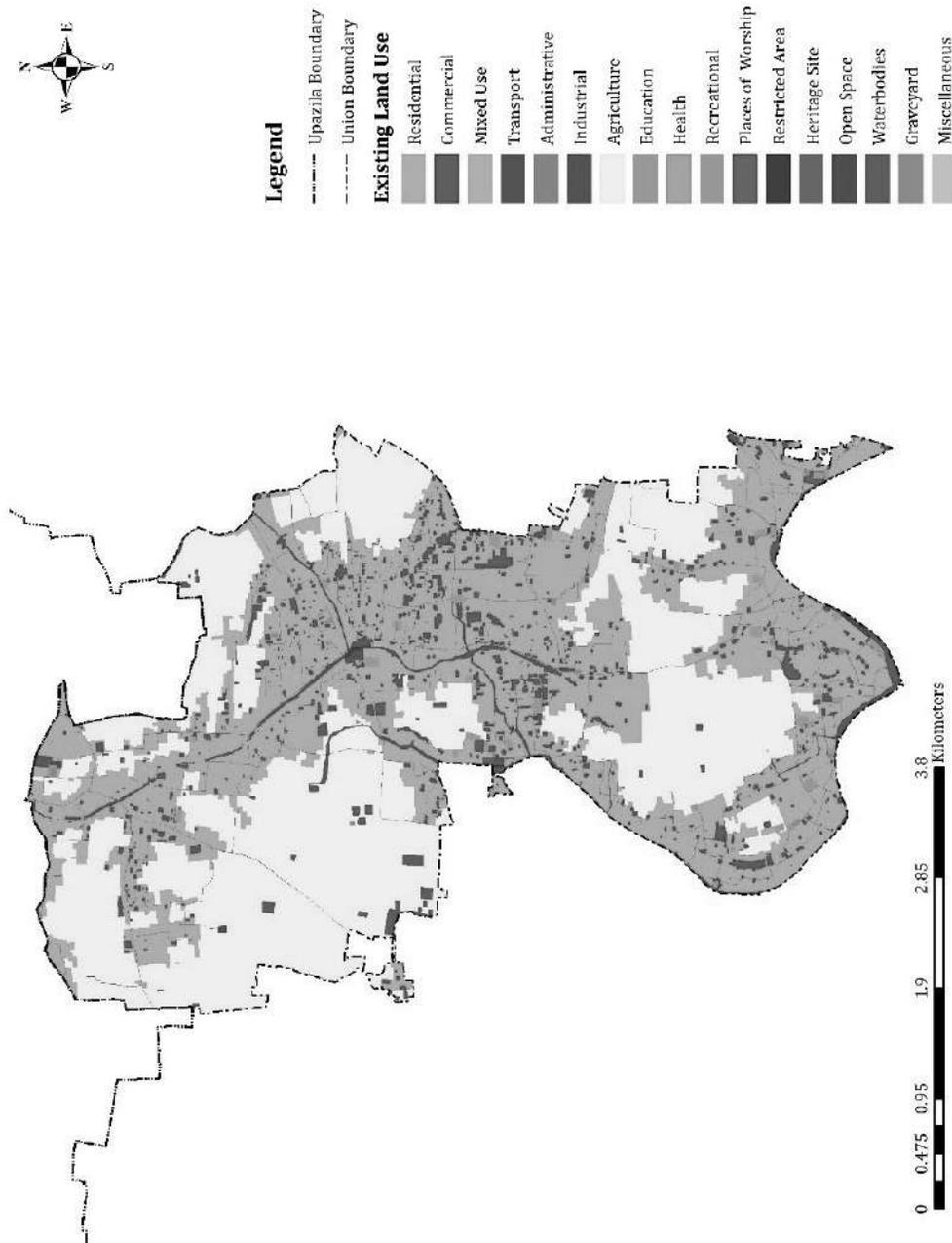


Figure 6-13: Existing Land Use Pattern of Nayansree Union

6.4.13 Shikari Para Union

Nearly 43.14% of Shikaripara Union's area is dedicated to agriculture, forming the bedrock of its economy and livelihoods. Residential areas, primarily rural homesteads, are the second most

prominent land use, occupying a significant portion and reflecting the established community presence. Road contributes to the 1.38% of total Shikaripara Union Land. Besides, Waterbody contributes about 10.13% of the total land area of Shikaripara Union, in which Pond, Khal, and Rivers are included.

Agriculture: Shikaripara Union's land use profile reveals a distinct agricultural character, with nearly 43.14% of its total area dedicated to agricultural land use. This underscores the significance of agriculture as the primary economic driver and livelihood source for the community. This area includes single—and double-cropping land and various types of livestock farms.

Residential: Residential areas, primarily rural homesteads, occupy the second largest land share, nearly 42.76%, suggesting a well-established community presence. The residential area is established primarily around the bank of the Ichamoti River.

Waterbodies: Waterbodies comprise around 10.13%, encompassing ponds, khals, and rivers, adding valuable ecological diversity to the landscape. Ichamoti flows by the west and south sides of the Shikaripara Union.

Road: Transportation infrastructure plays a moderate share, with roads encompassing 1.38% of the land. The road that passes from Monikanda to Hagradi road is the most vibrant road in the union.

While several land use categories exist, including administrative, commercial, educational, health, industrial, and religious facilities, their collective footprint remains comparatively minimal, hovering less than 1%. This indicates a potentially limited range of services and amenities within the union.

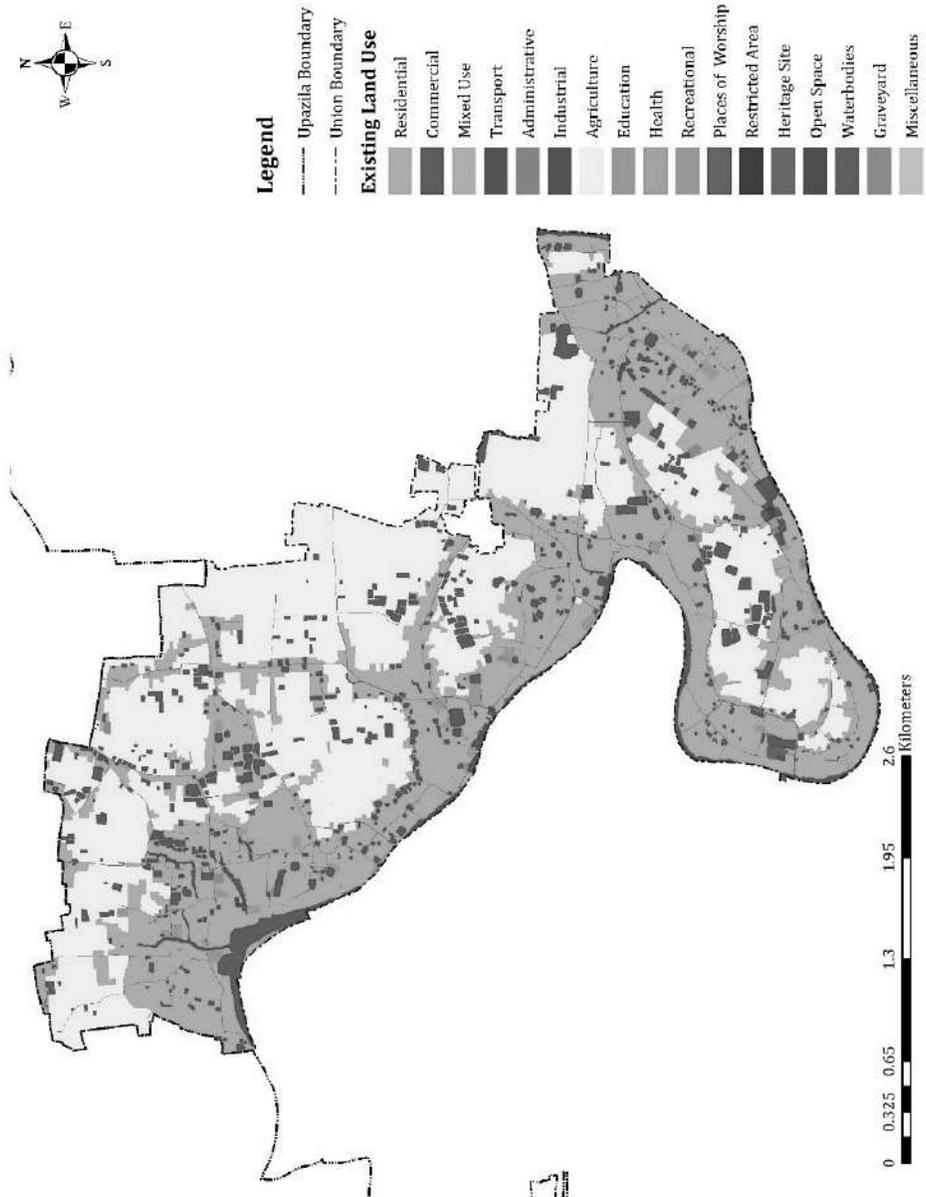


Figure 6-14: Existing Land Use pattern of Shikari Para Union

Table 6-14: Land Use Pattern of Shikari Para Union

Land use	Area (Acre)	Area (Hector)	Area (Sq. k.m.)	Percentage (%)
Residential	1198.20	484.89	4.85	42.76%
Commercial	12.42	5.02	0.05	0.44%
Mixed Use	13.11	5.31	0.05	0.47%
Transport	38.74	15.68	0.16	1.38%
Administrative	0.75	0.30	0.00	0.03%
Industrial	0.10	0.04	0.00	0.00%
Agriculture	1208.78	489.18	4.89	43.14%
Education	11.88	4.81	0.05	0.42%
Health	0.56	0.23	0.00	0.02%
Recreational	13.86	5.61	0.06	0.49%
Places of Worship	9.65	3.91	0.04	0.34%
Restricted Area	0.00	0.00	0.00	0.00%
Heritage Site	2.40	0.97	0.01	0.09%
Open Space	0.30	0.12	0.00	0.01%
Waterbodies	283.85	114.87	1.15	10.13%
Graveyard	7.31	2.96	0.03	0.26%
Miscellaneous	0.11	0.04	0.00	0.00%
Total	2802.01	1133.93	11.34	100.00%

Source: Field Survey, 2023

6.4.14 Sholla Union

Nearly 60% of Sholla Union's area is dedicated to agriculture, forming the bedrock of its economy and livelihoods. Residential areas, primarily rural homesteads, are the second most prominent land use, occupying a significant portion and reflecting the established community presence. Road contributes to the 2.09% of total Sholla Union Land. Besides, Waterbody contributes about 8% of total land area of Sholla Union in which Pond, Khal, Rivers are included.

Agriculture: Sholla Union's land use profile reveals a distinct agricultural character, with nearly 60% of its total area dedicated to Agricultural Land use which underscores the significance of agriculture as the primary economic driver and livelihood source for the community. This area includes single and double cropping land various types of livestock farm.

Residential: Residential areas, primarily rural homesteads, occupy the second largest land share, which is nearly about 30% suggesting a well-established community presence. Residential area is established majorly around the bank of the Kaliganga river and Nawabganj Sadar to Hemayetpur road connectivity.

Water bodies: Water bodies comprise around 8%, encompassing ponds, khals, and rivers, adding valuable ecological diversity to the landscape. Kaliganga River crossing across the Sholla Union.

Road: Transportation infrastructure plays a moderate share, with roads encompassing 2.09% of the land. Road that passes through Sholla Bazar to Hemayetpur is the most vibrant road of the union.

While several land use categories exist, including administrative, commercial, educational, health, industrial, and religious facilities, their collective footprint remains comparatively minimal, hovering less than 1%. This indicates a potentially limited range of services and amenities within the union.

Table 6-15: Existing Land Use Pattern of Sholla Union

Land use	Area (Acre)	Area (Hector)	Area (Sq. k.m.)	Percentage (%)
Residential	3071.22	1242.88	12.43	32.33%
Commercial	13.00	5.26	0.05	0.14%
Mixed Use	104.56	42.31	0.42	1.10%
Transport	100.46	40.66	0.41	1.06%
Administrative	0.50	0.20	0.00	0.01%
Industrial	6.64	2.69	0.03	0.07%
Agriculture	5216.29	2110.96	21.11	54.91%
Education	30.34	12.28	0.12	0.32%
Health	0.64	0.26	0.00	0.01%
Recreational	15.41	6.24	0.06	0.16%
Places of Worship	18.34	7.42	0.07	0.19%
Restricted Area	0.00	0.00	0.00	0.00%
Heritage Site	0.00	0.00	0.00	0.00%
Open Space	8.85	3.58	0.04	0.09%
Waterbodies	896.69	362.88	3.63	9.44%
Graveyard	15.88	6.43	0.06	0.17%
Miscellaneous	0.01	0.00	0.00	0.00%
Total	9498.84	3844.04	38.44	100.00%

Source: Field Survey, 2023

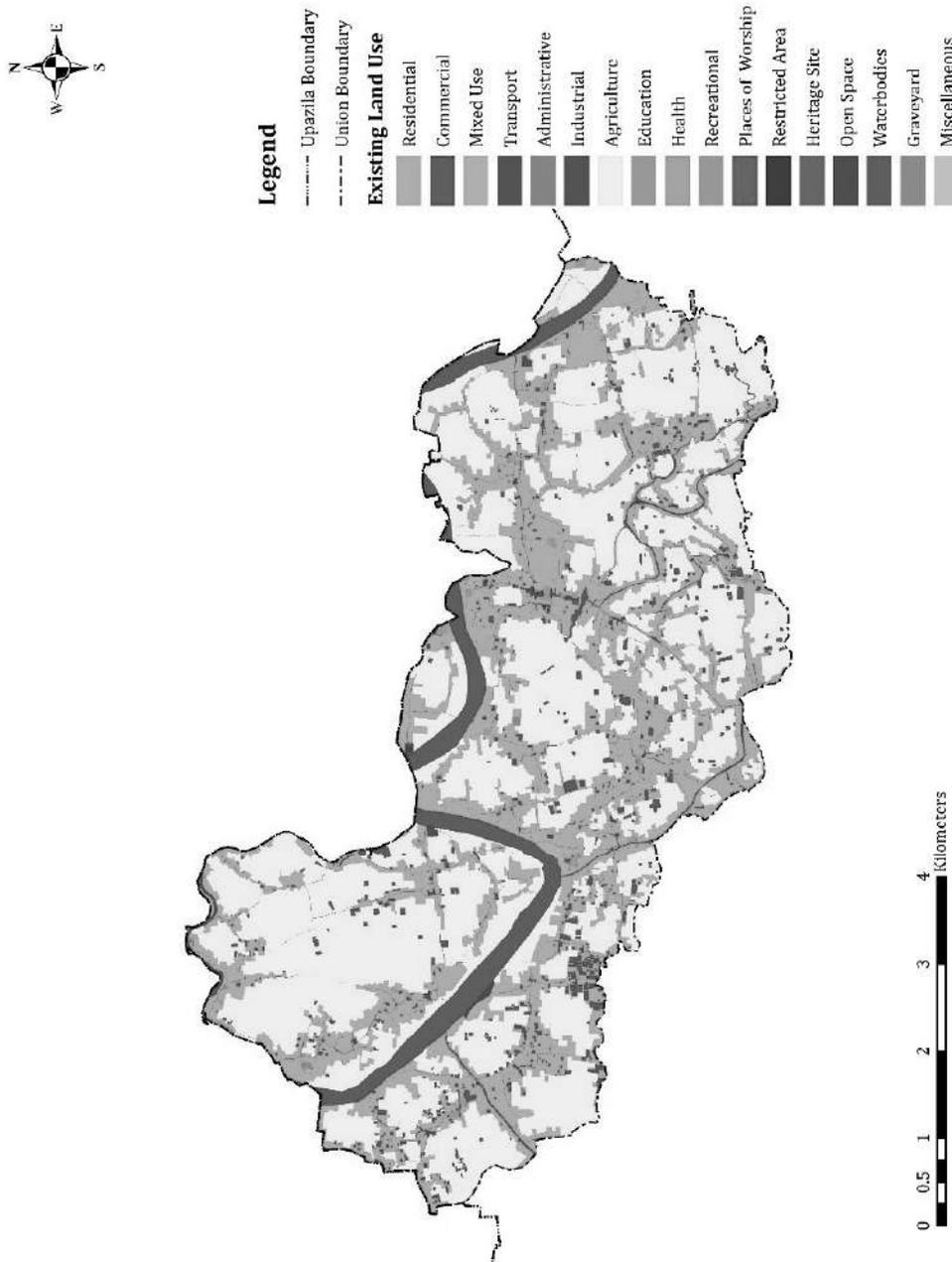


Figure 6-15: Existing Land Use Pattern of Sholla Union

6.5 Changes of Major Land Uses in UDD Master Plan

6.5.1 Major Changes in Land Use

There have been noticeable land use changes in Nawabganj Upazila between 2013 and 2023. As seen from Figure 6.17 below, the land under agriculture has been reduced from 63.30% in 2013 to 57.96% in 2023. About 5.34% of agricultural land was converted to other uses in 10 years. The

rate of conversion each year was approximately 0.53%. During the same period, residential land use increased from 10.28% in 2013 to 29.65% in 2023, about a 19.37% increase in 10 years. About a 1.94% increase each year. The waterbody figure decreased from 9.64% in 2013 to 8.90% in 2023. Land devoted to road and transport facilities, primarily including roads, increased from 0.82% in 2013 to 1.11% in 2023, an increase of 0.29% during the period. Land devoted to mixed-use, which mostly includes the mixed function of commercial-residential land, increased from 0.04% in 2013 to 0.50% in 2023, a rise of 0.46% during the period.

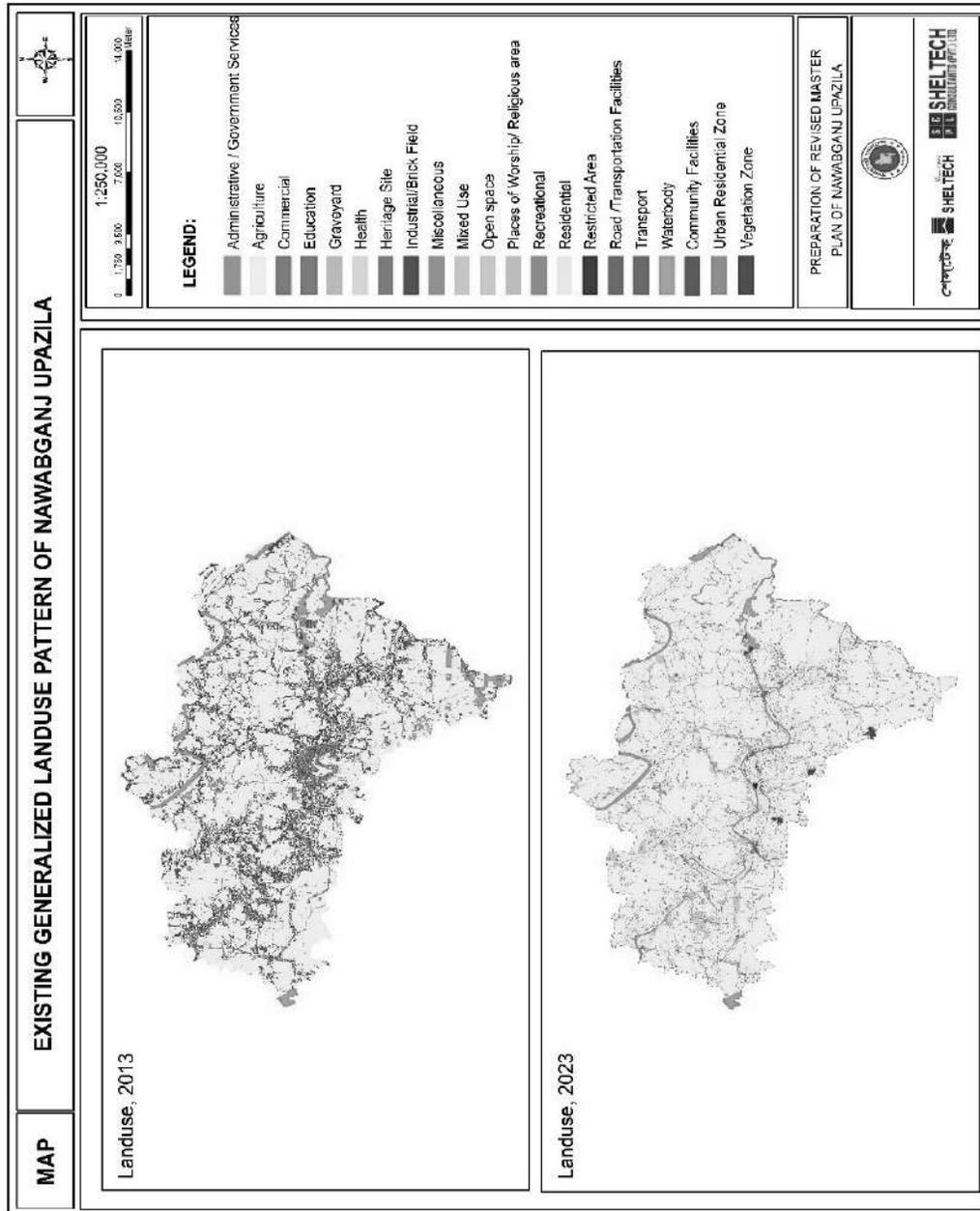


Figure 6-16 : Comparative Picture of Major Land Use Change from UDD Master Plan

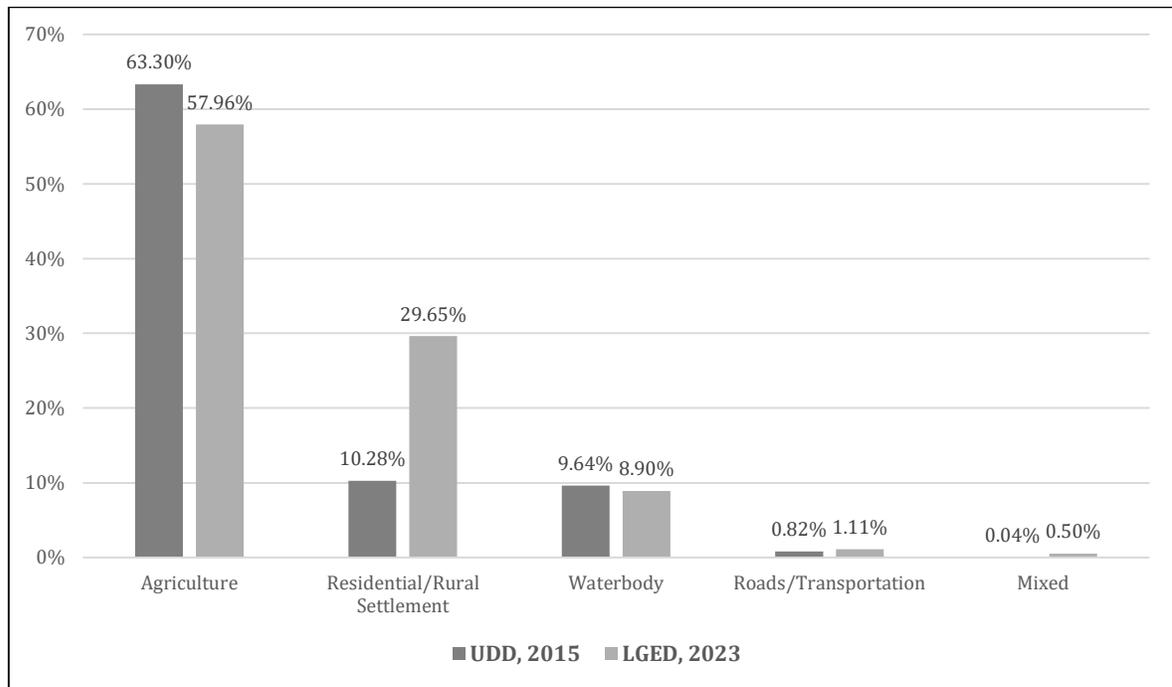


Figure 6-17 : Comparative Picture of Major Land Use Change from UDD Master Plan

6.5.2 Changes in Agricultural Land Use

The comparison between the UDD Survey of 2015 and the LGED Survey of 2023 reveals increases in agricultural areas in Agla, Churain, and Kailail while decreases in Bakshanagar, Bandura, Barrah, Baruakhali, Galimpur, Jantrail, Joykrishnapur, Kolakopa, Nayansree, Shikaripara, and Sholla. Churain experiences the most substantial surge, from 65.55% to 69.79%, while Baruakhali experiences the most decline, from 66.90% to 53.02%.

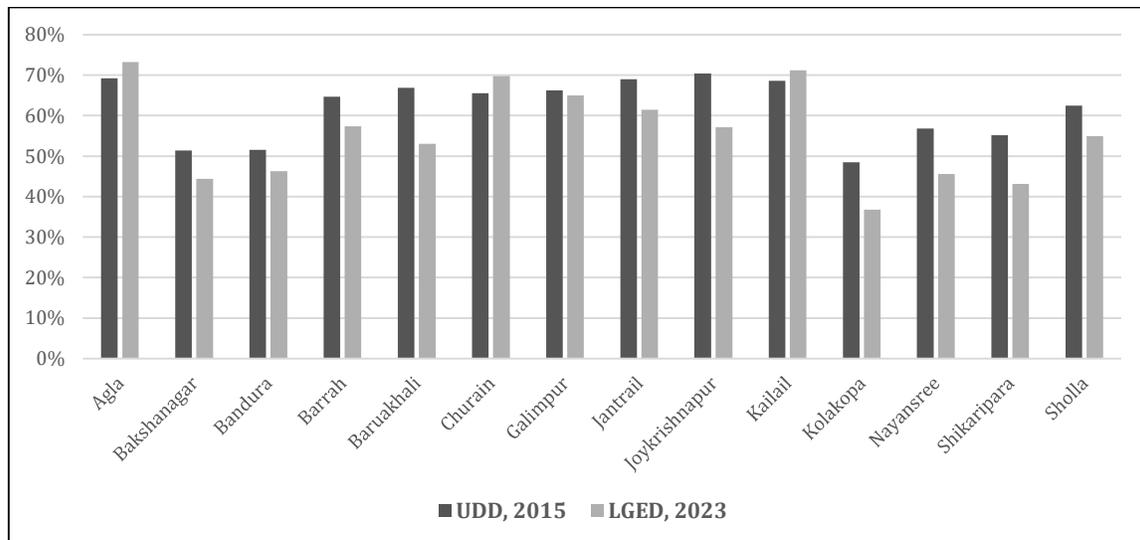


Figure 6-18: Comparative Picture of Union-wise Agricultural Land Use (Percent)

6.5.3 Changes in Commercial Land Use

The comparison between the UDD Survey of 2015 and the LGED Survey of 2023 reveals increases in commercial area in Agla, Bakshanagar, Bandura, Barrah, Galimpur, Jantrail, Joykrishnapur, Kailail, Kolakopa, and Nayanshree while decreases in Baruakhali, Churain, Shikari para, and Sholla. The most substantial surge from 1.85% to 2.37% is observed in Kolakopa, while the most decline from 0.53% to 0.19% is observed in Baruakhali.

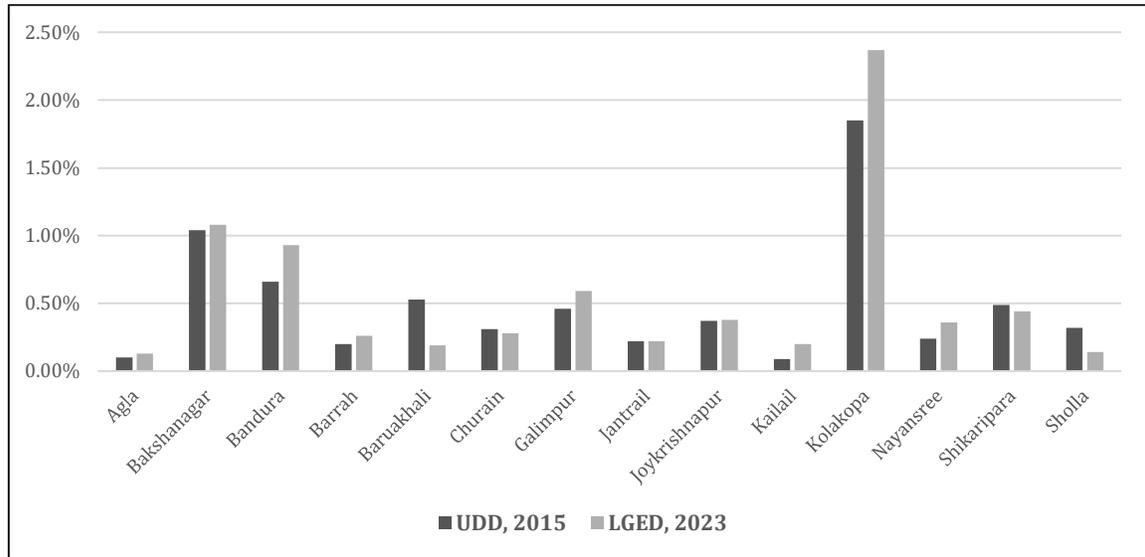


Figure 6-19: Union-wise percentage of Commercial land use

6.5.4 Changes in Educational Land Use

The comparison between the UDD Survey of 2015 and the LGED Survey of 2023 reveals increases in educational areas across all unions. The most substantial surge from 0.36% to 1.12% is observed in Kolakopa.

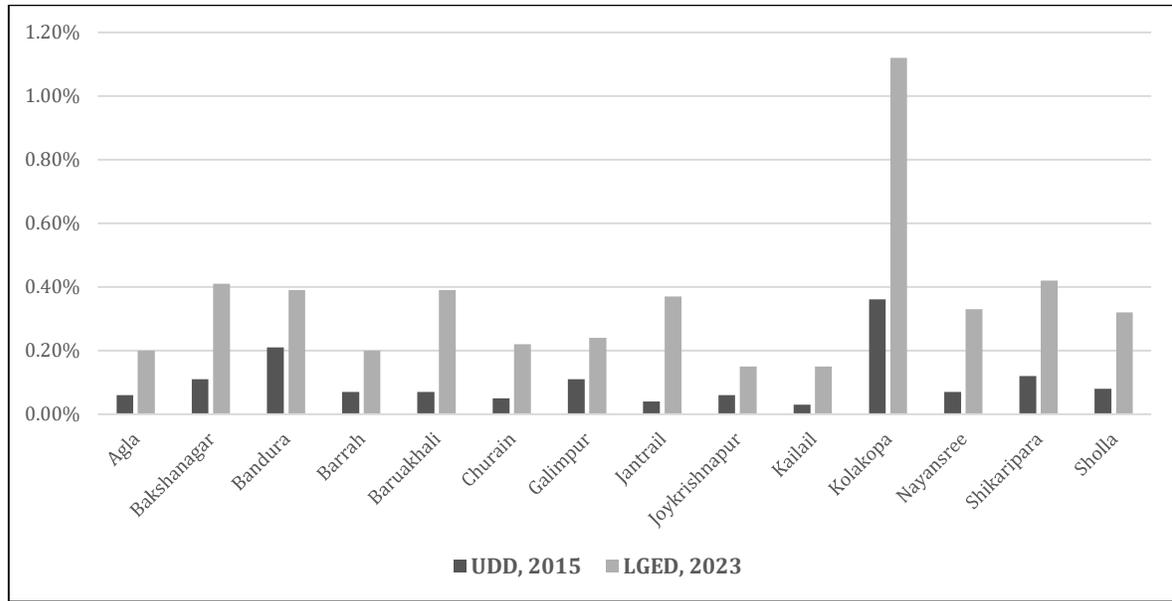


Figure 6-20: Union-wise percentage of educational land use

6.5.5 Changes in Mixed Land Use

The comparison between the UDD Survey of 2015 and the LGED Survey of 2023 reveals increases in mixed areas across all the unions. The most substantial surge, from 0.01% to 1.25%, is observed in Jantrail.

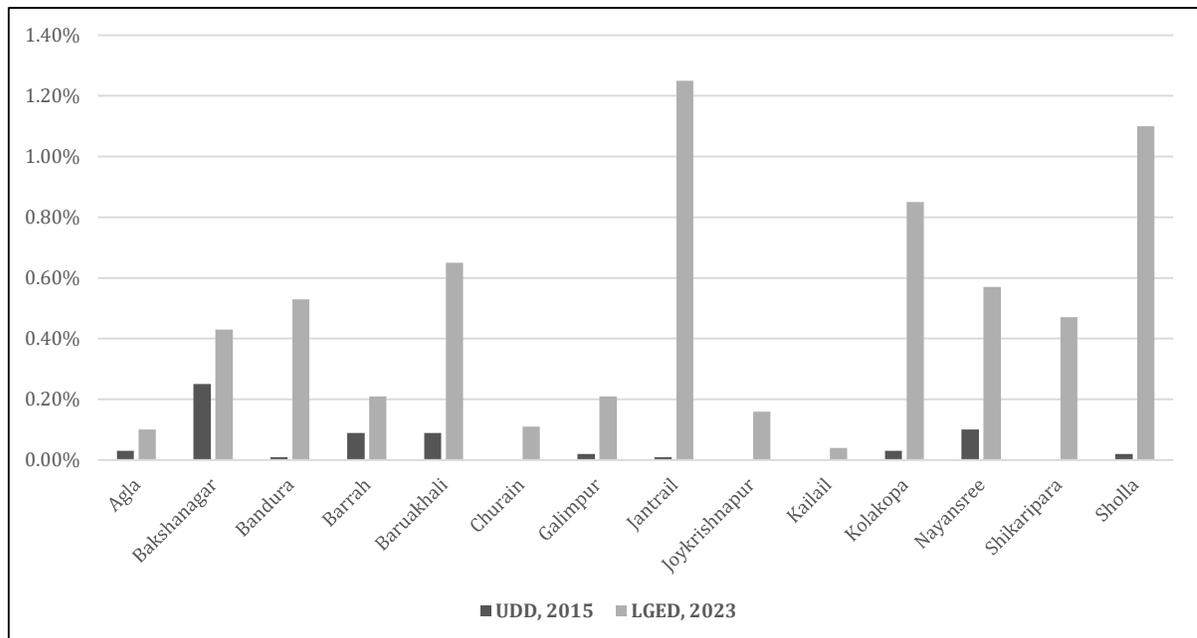


Figure 6-21: Union-Wise Percentage of Mixed Land Use Change

6.5.6 Changes in Residential Land Use

The comparison between the UDD Survey 2015 and the LGED Survey 2023 reveals increases in residential areas across all unions. Kolakopa experienced the most substantial surge, a 41.68% expansion of rural settlements in 2023, whereas in 2015, there were no rural settlements in this union.

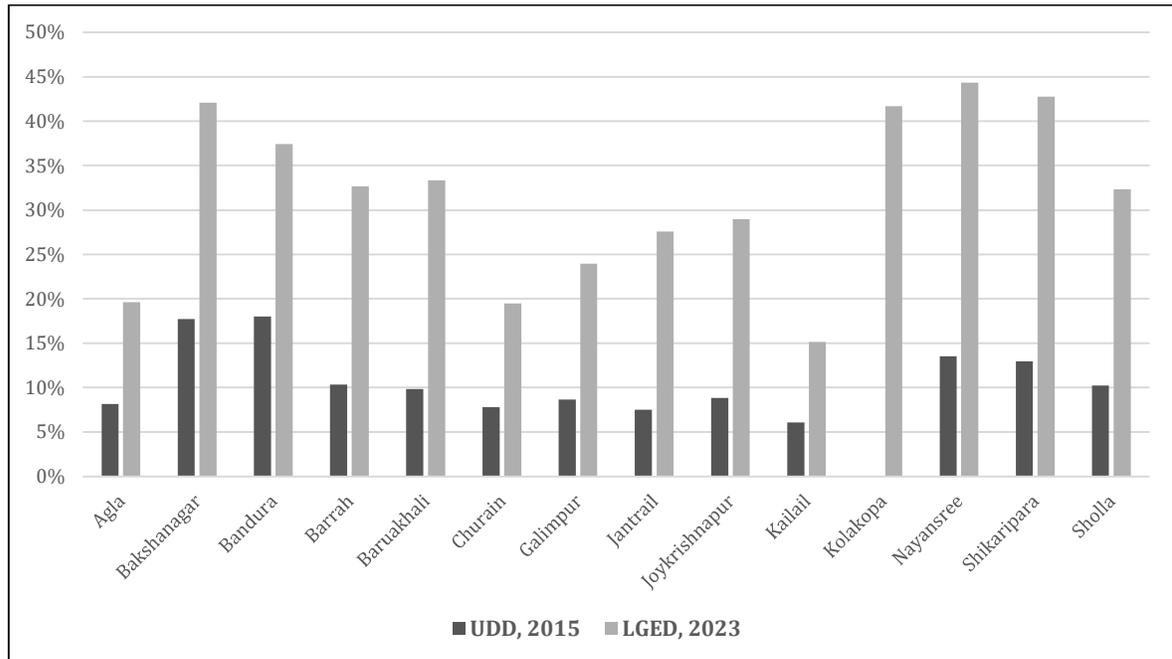


Figure 6-22: Union-wise Residential Land Use Change

6.5.7 Changes in Waterbody Land Use

The comparison between the UDD Survey of 2015 and the LGED Survey of 2023 reveals increases in waterbody areas in Bakshanagar, Bandura, Barrah, Baruakhali, Joykrishnapur, Nayanshree, and Shikaripara while decreases in Agla, Bakshanagar, Churain, Galimpur, Jantrail, Kailail, Kolakopa, and Sholla. The most substantial surge from 6.22% to 10.17% is observed in Baruakhali, while the most decline from 15.74% to 8.78% is observed in Churain.

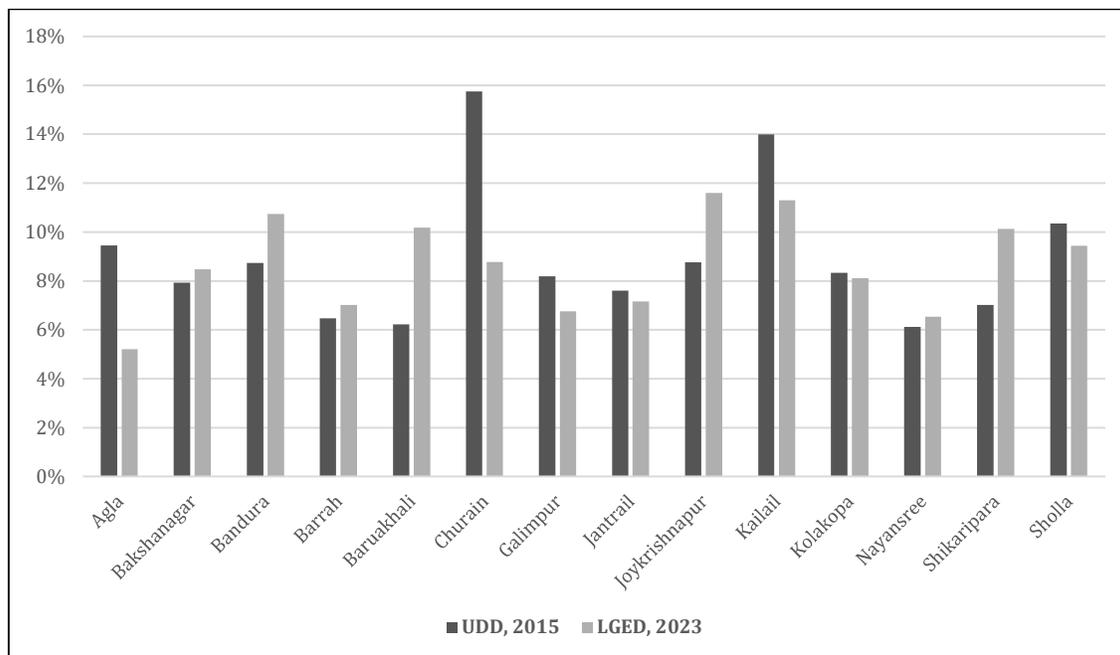


Figure 6-23: Union-Wise Waterbody Land Use Change

6.6 Upazila Land Use Trend Analysis (Last 25 Years)

The table presents a comprehensive overview of satellite image acquisitions spanning four significant milestones in 1993, 2003, 2013, and 2023. Each entry encapsulates vital details crucial for understanding the evolution of remote sensing technology and its applications over time. In 1993, the acquisition date was December 13th, marking a pivotal moment in satellite imaging history. Landsat 5, equipped with the Thematic Mapper (TM) sensor, was crucial in capturing high-resolution imagery of the Earth's surface. Notably, the data obtained on this date boasted a remarkably low cloud coverage of less than 10%, ensuring the clarity and accuracy of the images. A decade later, in 2003, the satellite imagery landscape continued to evolve with advancements in technology and data acquisition methods. Landsat 5 remained at the forefront, once again demonstrating its reliability and versatility in capturing detailed land observations. On December 21st, Landsat 5, armed with the TM sensor, delivered imagery with minimal cloud coverage, offering researchers and analysts pristine views of the Earth's surface. By 2013, a new era dawned with the debut of Landsat 8, signifying a leap forward in satellite imaging capabilities. Equipped with the state-of-the-art Operational Land Imager (OLI) sensor, Landsat 8 revolutionized the field of remote sensing with its enhanced spectral resolution and data quality. On December 18th, Landsat 8 showcased its prowess by acquiring imagery with less than 10% cloud coverage, setting a new standard for clarity and precision in land observations. Fast forward to 2023, and Landsat 8 continued to dominate the satellite imaging landscape, solidifying its position as a cornerstone of Earth observation missions. On December 3rd, Landsat 8, equipped with the OLI sensor, delivered yet another round of high-quality imagery with minimal cloud interference, reaffirming its status as a reliable and indispensable tool for monitoring environmental changes, land use dynamics, and natural disasters.

Table 6-16: LULC Classes and Corresponding Land Use Types

Classes	Description
Waterbody	Wetlands, gully, marshy land, low-lying lands and gully.
Built-up	Residential, industrial, commercial areas, settlements, roads, mixed urban areas, impervious covers.
Bare land	Open space, landfill sites, brickfields, barren soil, construction sites, abandoned land, uncultivated land.
Agriculture land	Crop fields, fruits and other cultivated lands, fallow lands.
Vegetation	Forest and trees, vegetative lands, mixed forest land, gardens.

Table 6-17: Details of the utilized Landsat images

Years	Acquisition date	Satellite	Sensor	Cloud coverage
1993	1993-12-13	Landsat 5	TM	<10%
2003	2003-13-21	Landsat 5	TM	<10%
2013	2013-12-18	Landsat 8	OLI	<10%
2023	2023-12-03	Landsat 8	OLI	<10%

Source: (<https://earthexplorer.usgs.gov/>)

6.6.1 Land Cover of 1993

In 1993, the land use distribution in the specified area reflected a diverse array of human and natural activities. With a total area of 246.25 square kilometers, the landscape showcased a variety of land utilization patterns, each contributing uniquely to the region's character and functionality. The dominant land use category in 1993 was agricultural land, comprising 176.46 square kilometers, which accounted for a substantial 71.66% of the total area. This vast expanse of land was dedicated to farming activities, including crop cultivation, livestock rearing, and other agricultural practices vital for sustaining the local economy and food production. Contrasting with the expansive agricultural zones, built-up areas occupied a relatively small portion of the landscape, encompassing 1.38 square kilometers or merely 0.56% of the total area. These developed regions were characterized by urban infrastructure, including buildings, roads, and other human-made structures, indicative of urbanization and settlement expansion. Similarly modest in extent were vacant lands, totaling 1.07 square kilometers, constituting a mere 0.44% of the entire area. These undeveloped spaces, though limited, likely served as potential sites for future development or remained in their natural state, contributing to biodiversity and ecosystem health within the region. Vegetation, encompassing 53.03 square kilometers or 21.53% of the landscape, represented a vital component of the area's ecological fabric. This category included lush forests, verdant grasslands, and other natural habitats, providing essential ecosystem services, such as carbon sequestration, soil retention, and wildlife habitat. Lastly, water bodies

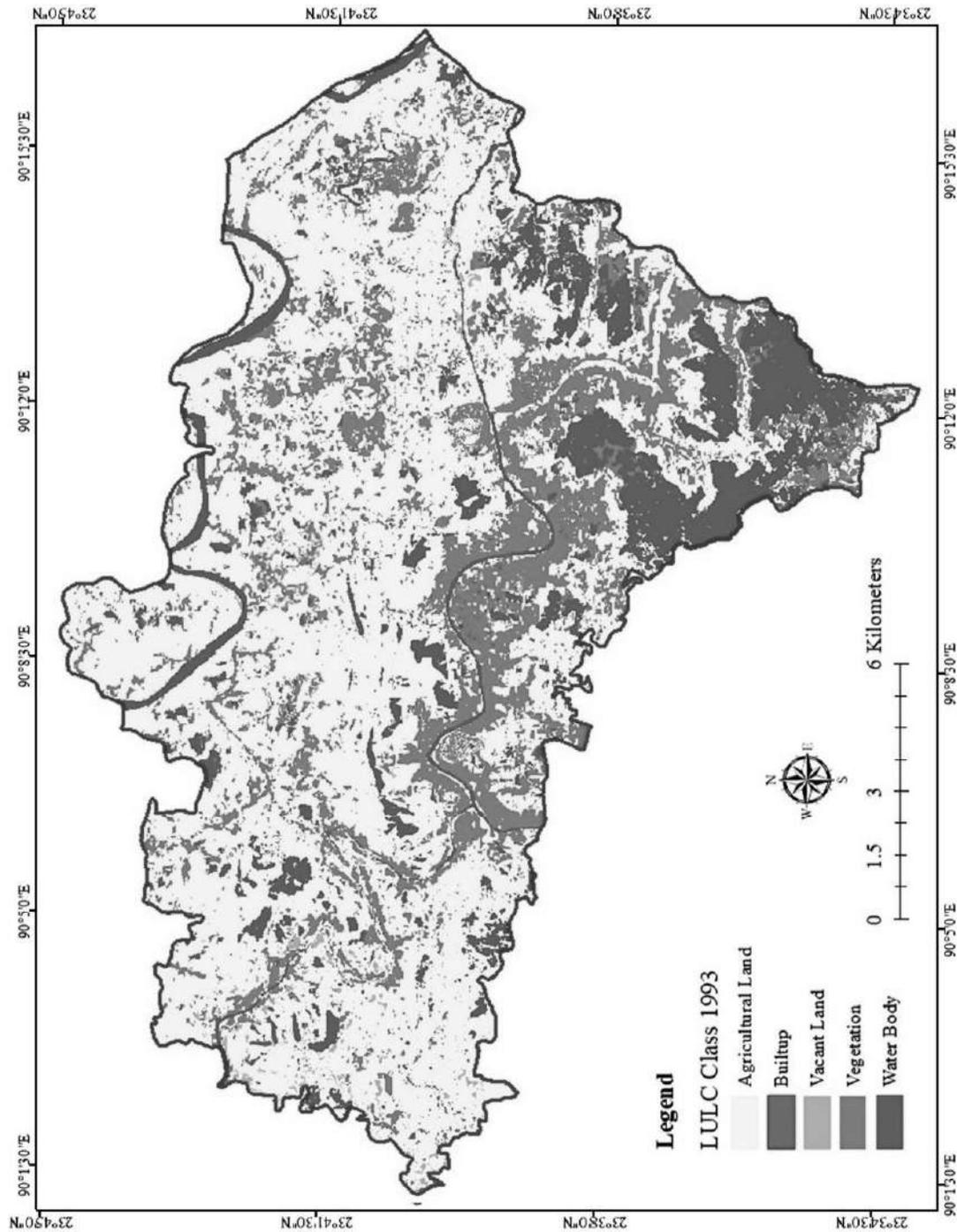


Figure 6-24: Land Cover of 1993

covered 14.31 square kilometers, representing 5.81% of the total area. These aquatic ecosystems, comprising lakes, rivers, and ponds, played a crucial role in regulating local climate, supporting biodiversity, and providing recreational opportunities for residents and visitors alike.

6.6.2 Land Cover of 2003

In 2003, land use patterns revealed a story of evolving human interaction with the environment. With a total area of 246.25 square kilometers, every hectare bore the marks of human endeavor, natural processes, and the delicate balance between the two. At the heart of the tableau lay the sprawling expanse of agricultural land, stretching across 175.86 square kilometers. This vast domain, comprising verdant fields and productive farms, stood as a testament to the region's agrarian heritage and its vital role in sustaining local livelihoods and food security. However, subtle shifts hinted at changing agricultural practices or perhaps encroachment by other land uses. In stark contrast, the built-up areas, totaling 2.74 square kilometers, punctuated the landscape with the concrete and steel of human habitation. 52.43 square kilometers of vegetation that adorned the landscape. From dense forests to open meadows, these green oases provided vital ecosystem services, including carbon sequestration, air purification, and habitat for diverse flora and fauna. Water bodies, spanning 13.51 square kilometers. Water bodies comprising lakes, rivers, and ponds, played a vital role in regulating the local climate, supporting aquatic ecosystems, and providing essential resources for human consumption and industry.

6.6.3 Land Cover of 2013

In 2013, the land use distribution within the specified area painted a vivid picture of the region's socio-economic and environmental landscape. Across the expanse of 246.25 square kilometers, each parcel of land told a story of human endeavor, natural bounty, and the delicate balance between the two. At the forefront stood the sprawling fields of agricultural land, stretching over 175.73 square kilometers. This expansive domain, representing 71.36% of the total area, bore witness to the region's agricultural heritage and its pivotal role in sustaining communities, fostering economic growth, and ensuring food security. Against the backdrop of advancing urbanization, these fertile fields remained a steadfast symbol of the region's agrarian identity. The built-up areas cover 3.91 square kilometers. While still relatively modest in extent, these burgeoning urban centers, comprising residential neighborhoods, commercial districts, and industrial zones, signaled the march of progress and the growing footprint of human settlement on the landscape. On the other hand, vacant land covers 1.53 square kilometers. The vegetation cover contains a total of 52.33 square kilometers, and water bodies cover 12.76 square kilometers.

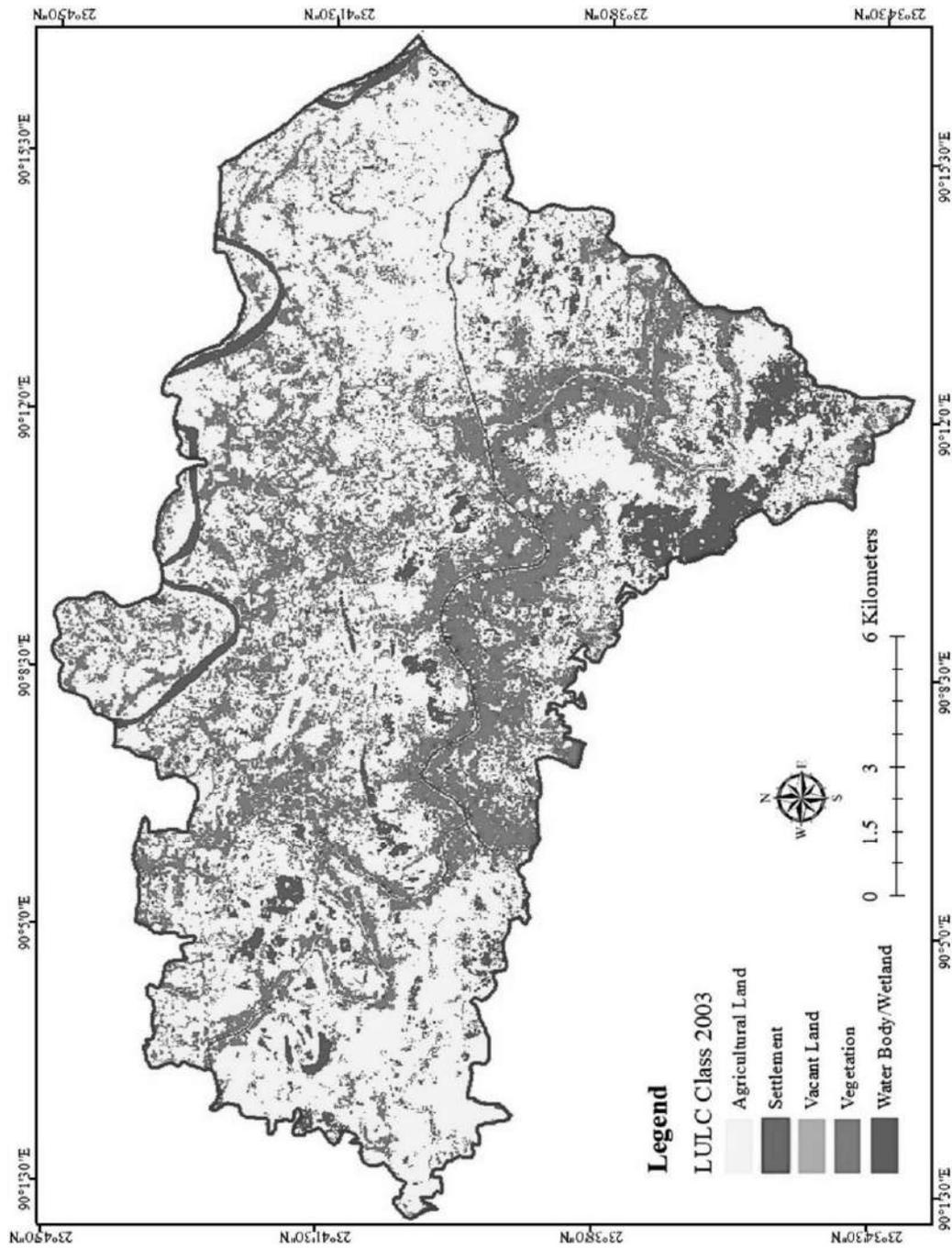


Figure 6-24: Land Cover of 2003

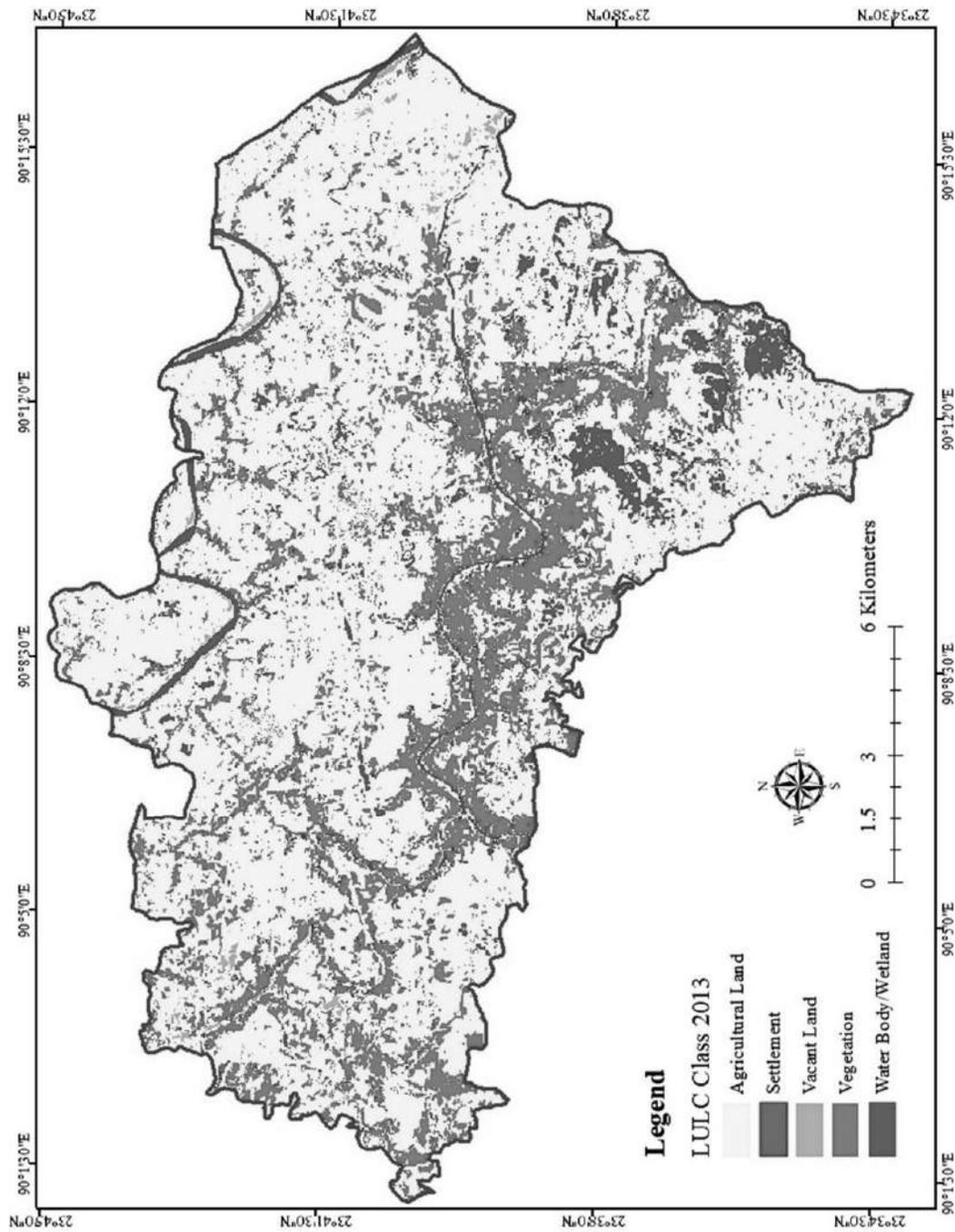


Figure 6-25: Land Cover of 2013

6.6.4 Land Cover of 2023

In the landscape of 2023, the intricate tapestry of land use painted a vivid picture of the region's dynamic evolution, reflecting the interplay of human activities and natural processes. Across the expanse of 246.25 square kilometers, each hectare bore the marks of human endeavor, environmental stewardship, and the delicate balance between development and conservation. At the forefront stood the enduring presence of agricultural land, spanning 172.73 square kilometers. This vast expanse, representing 70.14% of the total area, underscored the region's agricultural heritage and critical role in sustaining communities, driving economic growth and ensuring food security. Despite pressures from urbanization and changing land use patterns, agriculture remained a resilient cornerstone of the local economy.

In juxtaposition, the expanding footprint of built-up areas emerged as a defining feature, covering 9.55 square kilometers. This growth, accounting for 3.88% of the landscape, bore witness to the relentless march of urbanization, characterized by the development of residential neighborhoods, commercial centers, and industrial zones. The urban landscape pulsed with vitality, serving as hubs of innovation, culture, and economic activity. Amidst the hustle and bustle of human activity, pockets of vacant land dotted the landscape, totaling 1.05 square kilometers. Though modest in size, these undeveloped spaces held the promise of future growth, conservation, or recreational opportunities, serving as buffers against urban sprawl and sanctuaries for biodiversity amidst urbanization.

Nature's embrace was evident in the verdant expanses of vegetation, covering 50.61 square kilometers, and water bodies, covering 12.31 square kilometers. From the analysis, it is clear that agricultural, vacant, vegetation and water bodies decreased, and built-up areas increased over the past 30 years.

Table 6-18: Land use Change over the past 30 Years

Year	1993		2003		2013		2023	
	Area Sqkm	Percentage						
Agricultural Land	176.46	71.66	175.86	71.42	175.73	71.36	172.73	70.14
Built-up	1.38	0.56	2.74	1.11	3.91	1.59	9.55	3.88
Vacant Land	1.07	0.44	1.71	0.70	1.53	0.62	1.05	0.43
Vegetation	53.03	21.53	52.43	21.29	52.33	21.25	50.61	20.55
Water Body	14.31	5.81	13.51	5.49	12.76	5.18	12.31	5.00
Total	246.25	100.00	246.25	100.00	246.25	100.00	246.25	100.00

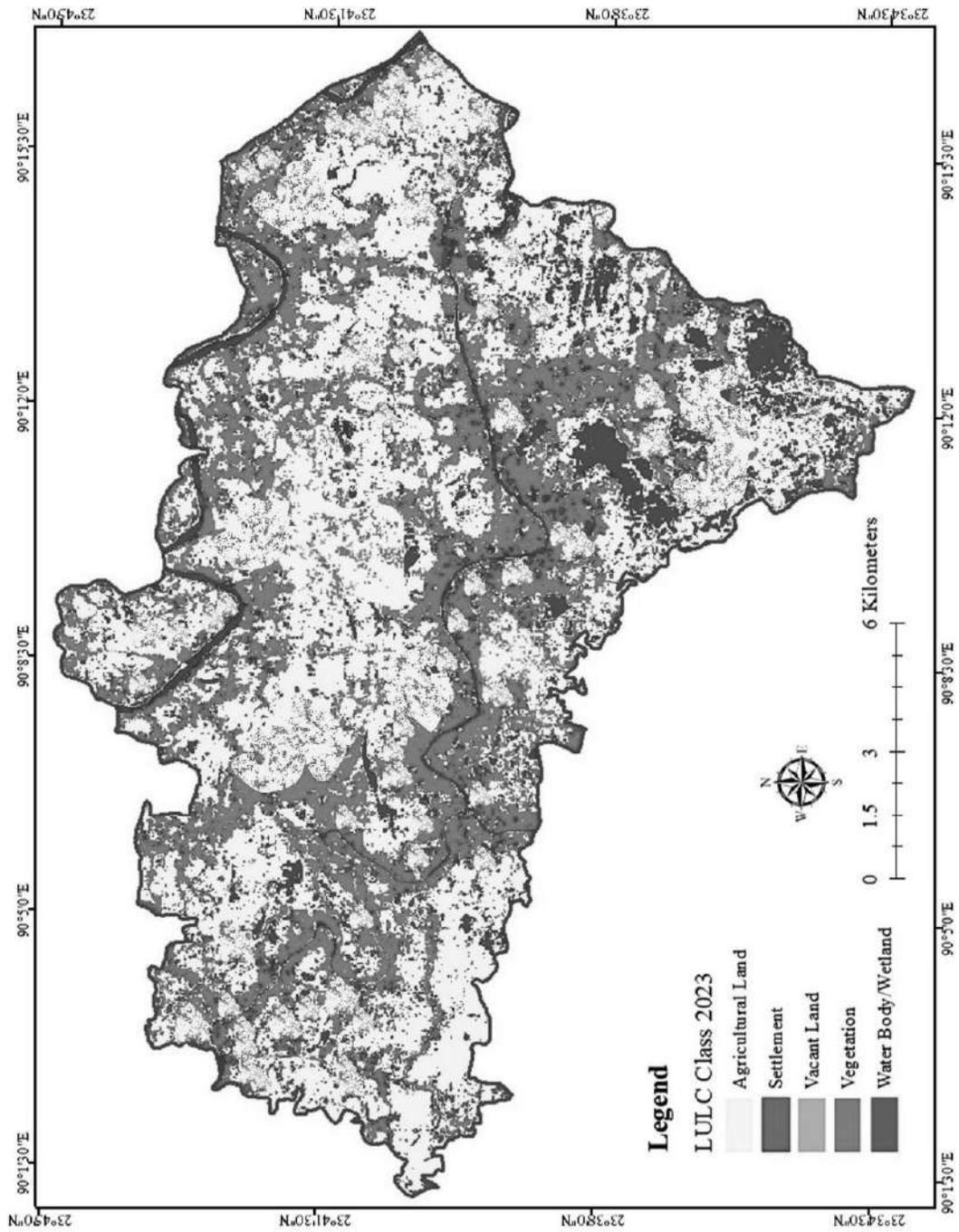


Figure 6-26: Land Cover of 2023

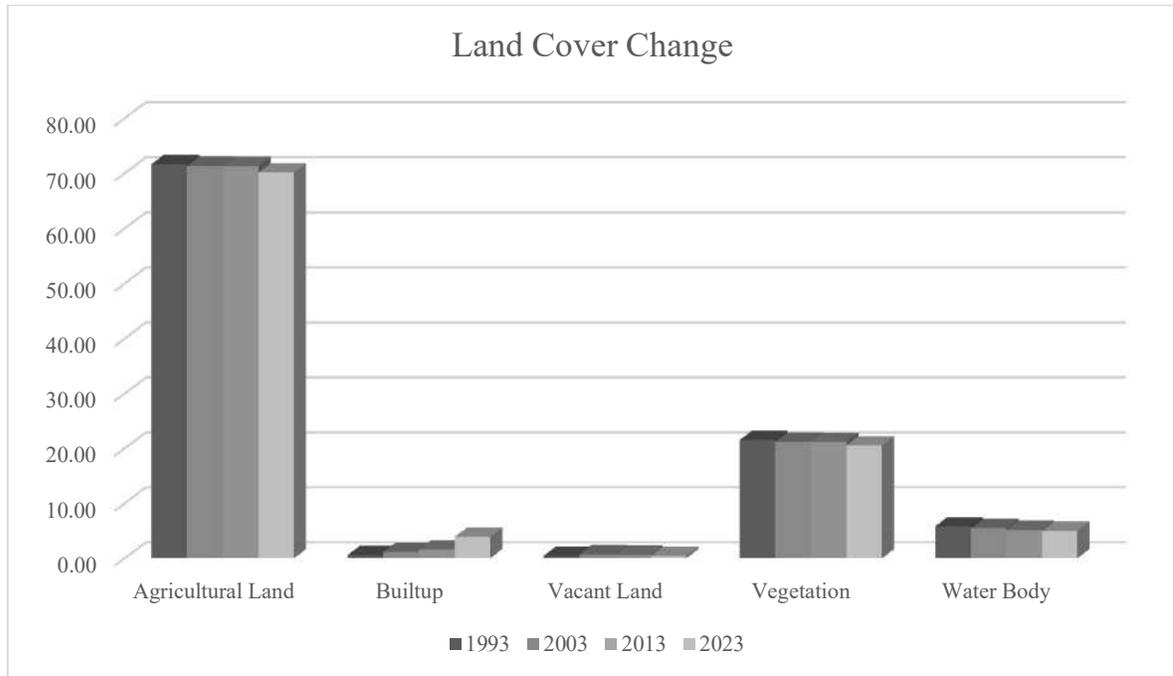


Figure 6-27: Land Cover Change throughout the past 30 years

CHAPTER SEVEN: HYDROGRAPHIC SURVEY

7.1 Introduction

The hydrographic survey is vital for gathering comprehensive information regarding water bodies, including depths, seasonal water levels, and widths. It serves as a crucial tool for assessing flood risks and understanding water flow directions. For instance, Engineers and urban planners can assess flood risks, evaluate mitigation solutions, and create resilient infrastructure that can resist future flood events by incorporating survey data into flood modeling.

This chapter presents a summary of the results and observations derived from an extensive hydrographic survey carried out in Nawabganj Upazila. The primary objective of the survey was to evaluate the hydrographic attributes of the upazila and collect relevant data on rivers, canals, water bodies, channels, and associated features. The survey was conducted by the consulting firm in 2023.

7.2 Water bodies and their flow/tidal characteristics Survey Methodology

Water bodies have been delineated using the RS Mouza maps collected from DC office and orthophoto acquired from drone image and latest satellite image which was purchased from the SOB as the base map. Delineated water bodies then verified through field survey and determined their categories and attributes. Flow direction and tidal characteristics of the rivers and canals have been identified during the collection of cross section by dedicated Hydrographic Survey Team.

The two rivers Ichamati and Kaliganga pass the upazila and the Padma River that located at the south-southwest of the upazila each have the tidal effect. Canals connected with these rivers also experience tidal effects. But many canals were either silted up or lost the flow due to construction of the embankment. Such canals were found either encroached or full of water hyacinth.

7.3 Delineation of Encroachment

The encroachment of water body has been identified from digitized Mouza maps (Past condition) and the orthophoto acquired from drone image (Present condition). This area of the rivers and canals have been lost due to several reasons like siltation, loss of flow, accretion at river and canal banks, illegal occupiers and others. Delineated location of encroachment is shown in Figure 7-1.

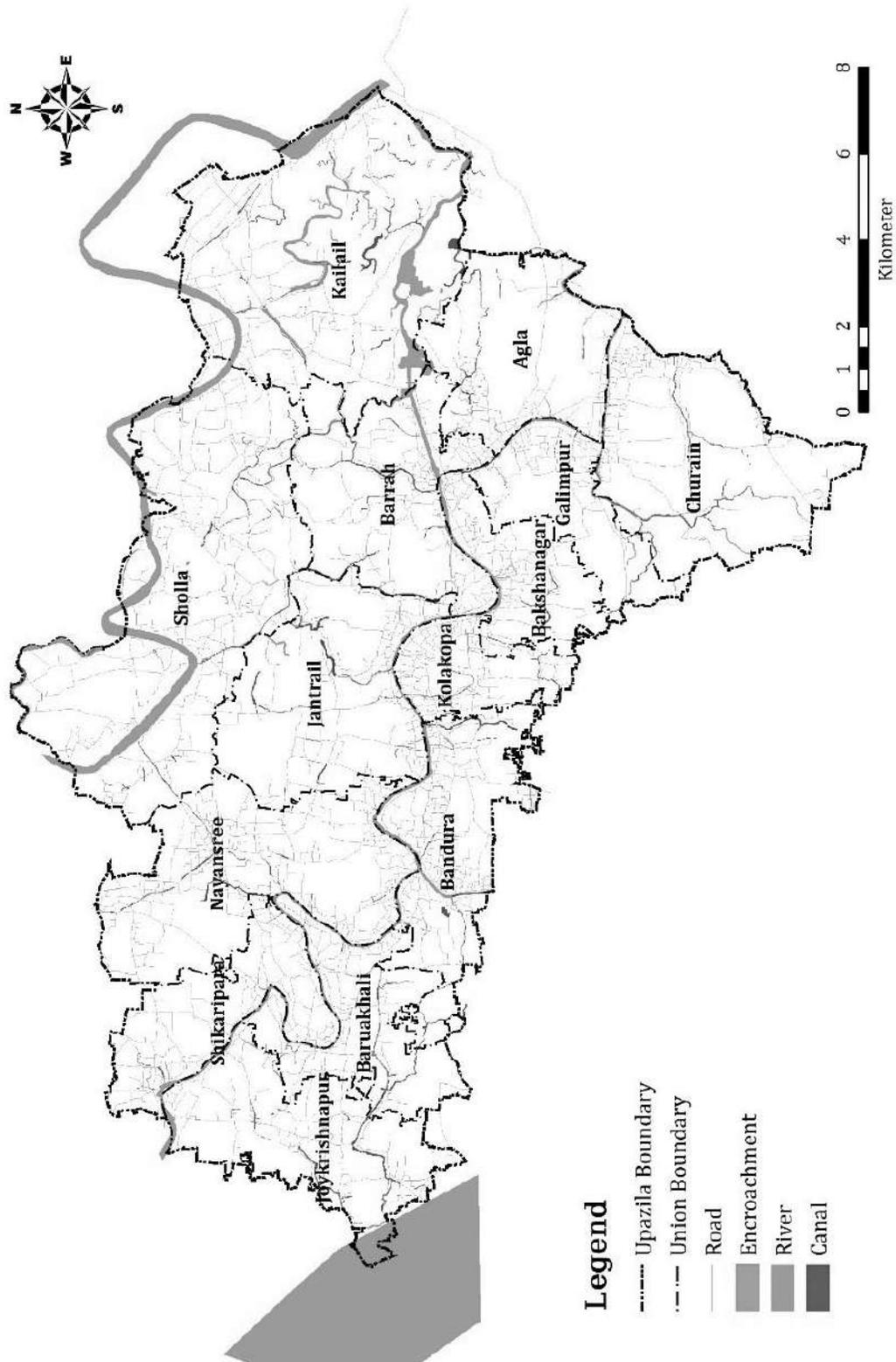


Figure 7-1: Location of Encroachment

7.4 Water control structure analysis

Location and condition of water control structures have been identified during physical feature survey. Four sluice gate locations are shown in **Error! Reference source not found.** Sluice gate at Titpaldiya, Joykrishnapur on the Beribadh to Joypara Road (Figure 7-2) was found operational but poor in timely management of flow through the gate. Local people said farmers living within the embankment do not get water timely through the sluice gate. The Beribadh to Joypara Road is the embankment which was built to protect the area from flood caused by the increased water level in the Padma River. This road cum embankment is blocking the flow of many canals and the Ichamati River which is shown in Figure 7-2. Area within the embankment does not get water for agricultural use in dry season. As the Ichamati River is blocked, it is not navigable between the Padma River and the Ichamati River.



Figure 7-2: Sluice gate at Titpaldiya, Joykrishnapur

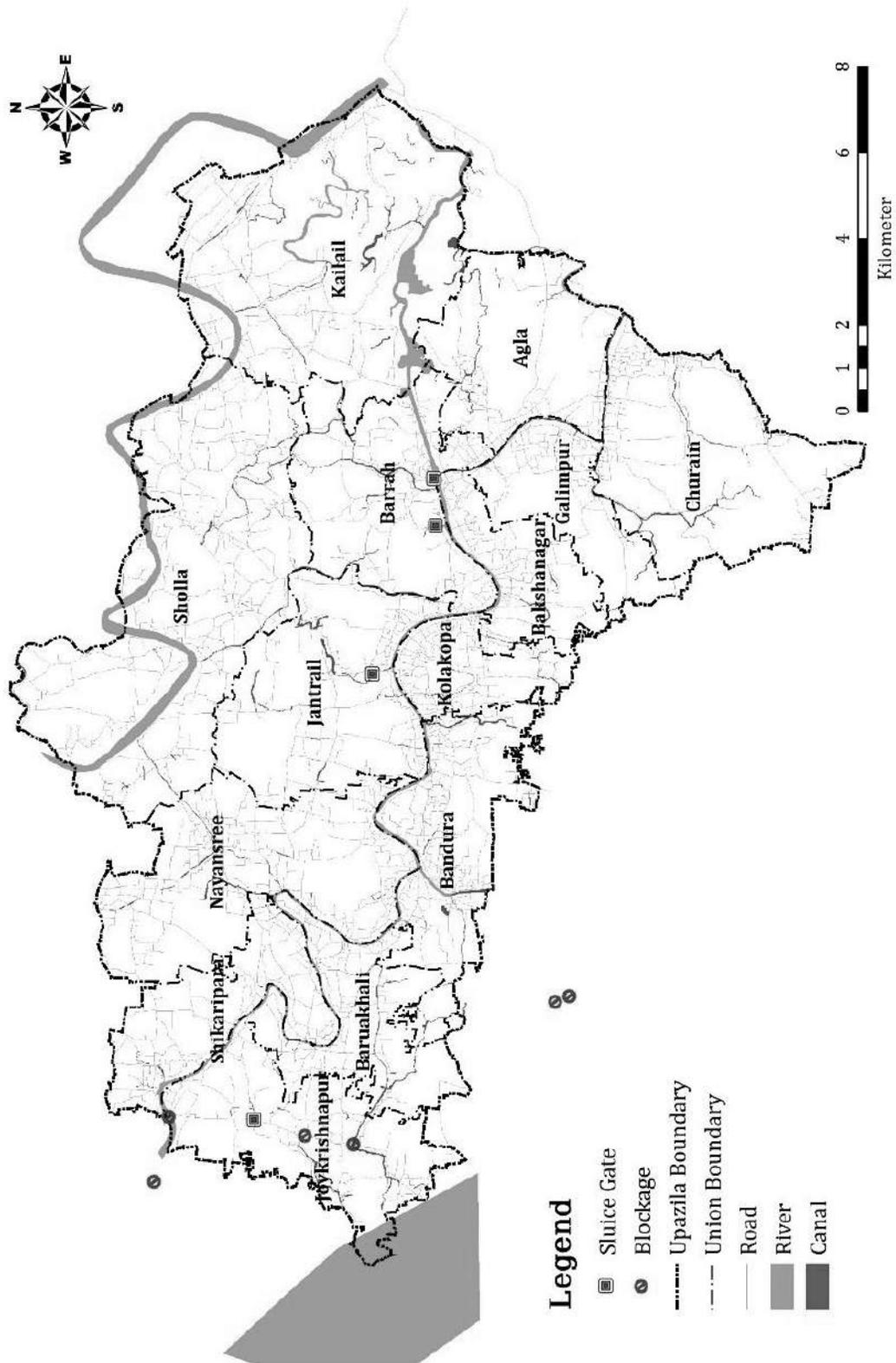


Figure 7-3: Location of water control structure

7.5 Cross Section of the Rivers

River cross section is collected from secondary source for the Ichamati river, Kaliganga river and Dhaleswari river. These rivers flow through different locations of Nawabganj Upazila. There are mainly two rivers that flow through Nawabganj Upazila by two sides. They are Kaliganga river and Ichamati river. The river Ichamati flows through the center of Nawabganj Upazila, while the river Kaliganga surrounds the northern part of the area. The Kaliganga River passes through Patiljhaj, Khatia, Melang, and Balukhanda before entering Nawabganj Upazila and leaving at Paragram. It converges with the Dhaleshwari river at Hazratpur, located outside of Nawabganj upazila. Conversely, the Ichamati river passes through Baruakhai and Khanepur before entering Nawabganj at Sonabaju. The cross-sectional data are collected from Bangladesh Water Development Board (<http://hims.bwdb.gov.bd/hydrology/>). Locations of the river cross sections are shown in Figure 7-4. Detail cross-sectional data are attached to this report at ANNEXURE 7-1.

7.6 Cross Section of the Canals

Cross Section of the Canals are collected from primary survey is conducted into three phases. First, the emphasis is on identifying survey locations. The expert team examines critical points specially the starting, turning, and ending point of water bodies. Then a KML file is created and provided to the survey team, showing these locations that have been marked for further examination. The next step involves gathering data on cross sections, water depth, seasonal water level, current drainage networks, and other information. When conducting surveys, surveyors use Total Station or Level Machine and Global Positioning System (GPS) navigation techniques, carefully taking into account variables including the survey's scope, goals, and particular features that need to be mapped. They use Levelling Staff in order to measure the depth of the water and calculate the Reduced Levels of the banks of a river or canal, referencing Bench Mark values for accuracy. They also measure the physical turbidity of the river or canal.

Surveyors acquire Reduced Levels for dry rivers and canals by placing the Levelling Staff at different locations along the river or canal, since there is no water during the dry season. Moreover, they record water levels in the monsoon and dry seasons. They communicate with locals to find the maximum water level during monsoon compared to a river bank, which they then use to calculate the Reduced Level.

There are almost 50 canals that pass-through Nawabganj through fourteen unions. The survey team collected cross sectional data between 500m intervals. Locations of the river cross sections are shown in Figure 7-4. Detailed information regarding the length of canals, their links with the river, condition, cross sections etc. are included in this report at ANNEXURE 7-2.

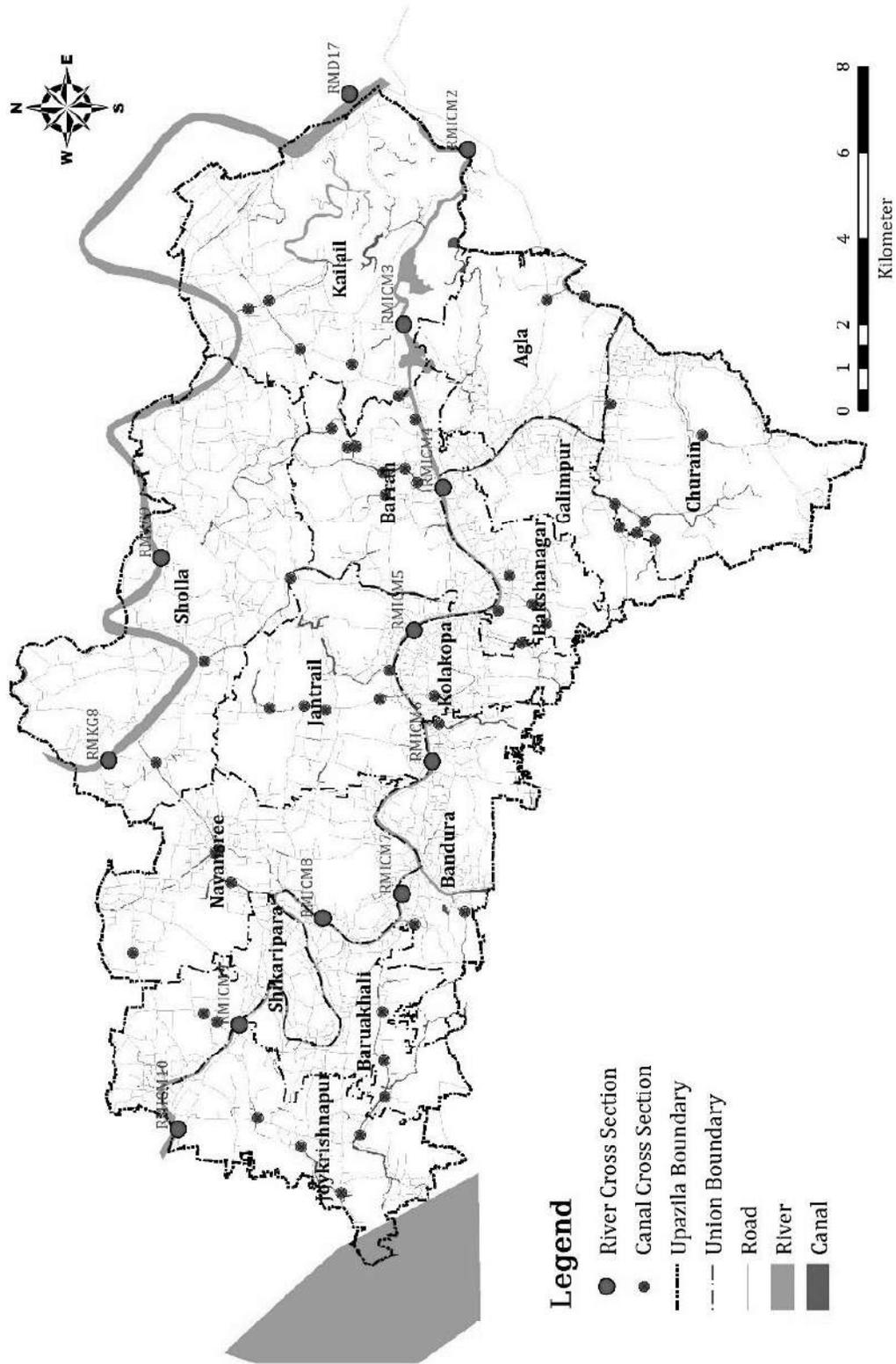


Figure 7-4: Cross section location of rivers and canals

7.7 Water Level Data

To assess the surface water characteristics of the study area, water level (WL) data were collected from two non-tidal gauge stations of BWDB: Baruria Transit (ID: SW91.9L) at the Padma River, Taraghat (ID: SW137A) at Kaliganga River and five tidal gauge stations of BWDB: Bhagyakul (ID: SW93.4L) and Mawa (ID: SW93.5L) at the Padma River, Savar (ID: SW69), Kalatia_Outfall (ID: SW70) and Rekabi Bazar (ID: SW71A) at Dhaleswari River on the outside the study boundary as there is no station within the study area. These data are used for hydrological analysis, flood modeling to determine the hydrological characteristics of the upazila. The station named Kalatia_Outfall (ID: SW70) at Dhaleswari River is located adjacent to the study area and closest among the other studied stations. Figure 7-5 shows the monthly average water level recorded at Kalatia_Outfall (ID: SW70) station at Dhaleswari River.

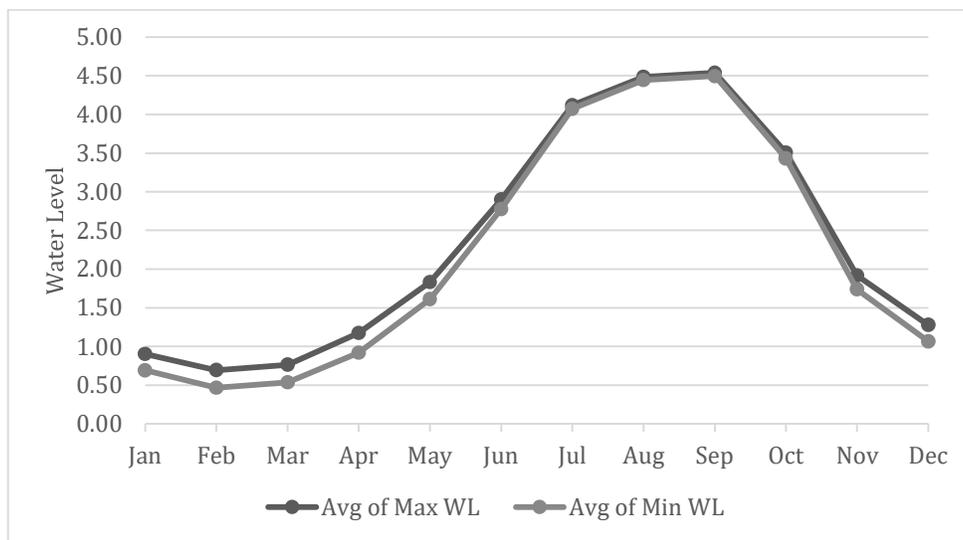


Figure 7-5: Monthly Average of Maximum and Average of Minimum Water Level of the Kalatia_Outfall (ID: SW70) station at Dhaleswari River

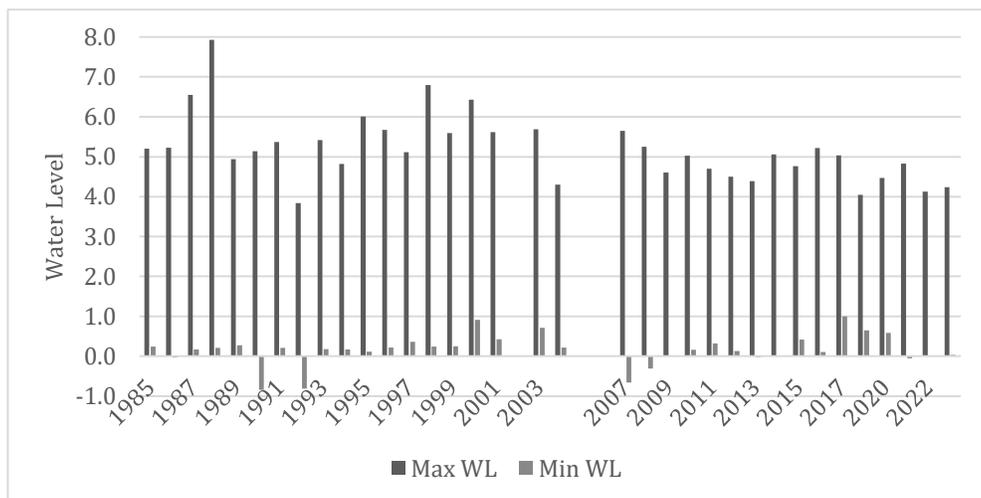


Figure 7-6: Maximum flood level and minimum WL recorded at Kalatia_Outfall (ID: SW70) station at Dhaleswari River

7.8 Highest flood level data

Water level of nearby stations is collected for the years 1985 to 2023. Figure 7-6 shows the maximum flood level and minimum water level recorded at Kalatia_Outfall (ID: SW70) station at Dhaleswari River.

7.9 Daily/Hourly Rainfall Data

Bangladesh Meteorological Department (BMD) is the main source of rainfall data. Daily rainfall was collected from the meteorological station of Dhaka with station ID- 11111 for the years 1987 to 2023 and 3-Hourly rainfall were collected for the years 2003 to 2023.

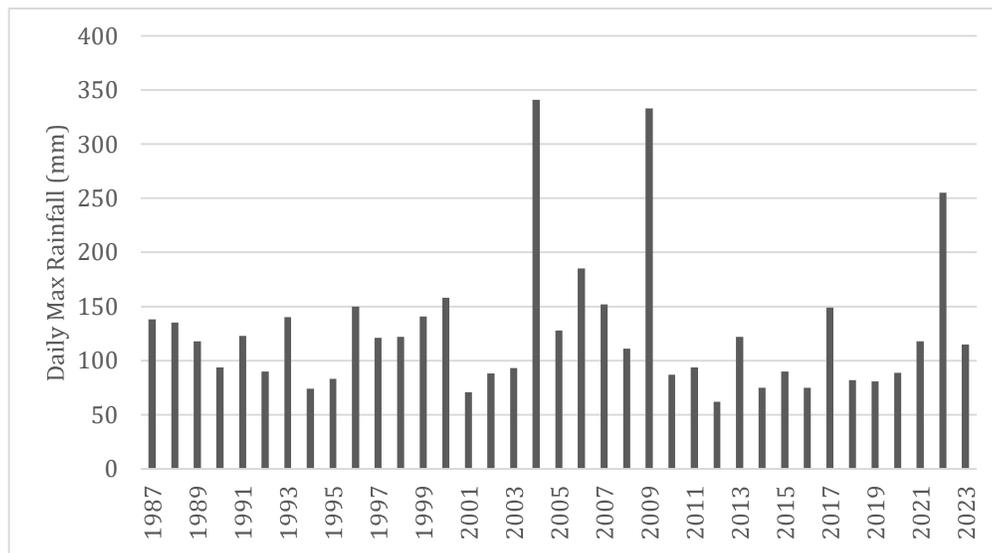


Figure 7-7: Daily maximum rainfall of Dhaka Station

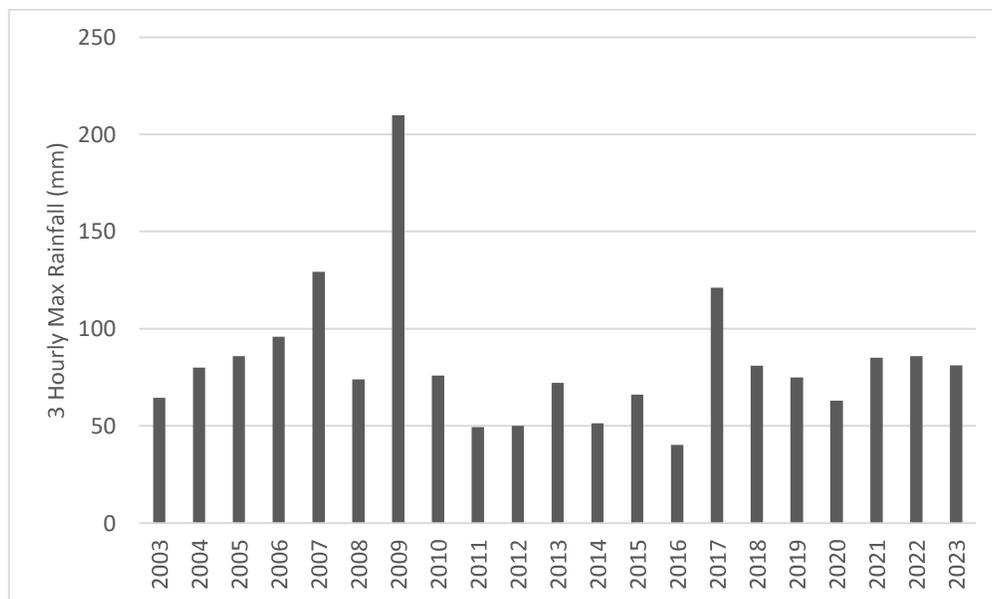


Figure 7-8: 3 Hourly maximum rainfall of Dhaka Station

CHAPTER EIGHT: GEOTECHNICAL AND SEISMOLOGICAL AND HYDROGRAPHIC SURVEY

8.1 Introduction

The main objectives of these investigation to estimate local site effects against earthquakes and the task has been segregated by three-fold: 1) To determine shear wave velocity profile at various sites, 2) To classify soil conditions according to seismic design specifications and 3) To analyze soil amplifications in the area. Field measurements of shear wave velocities were conducted in Nawabganj Upazila and described below.

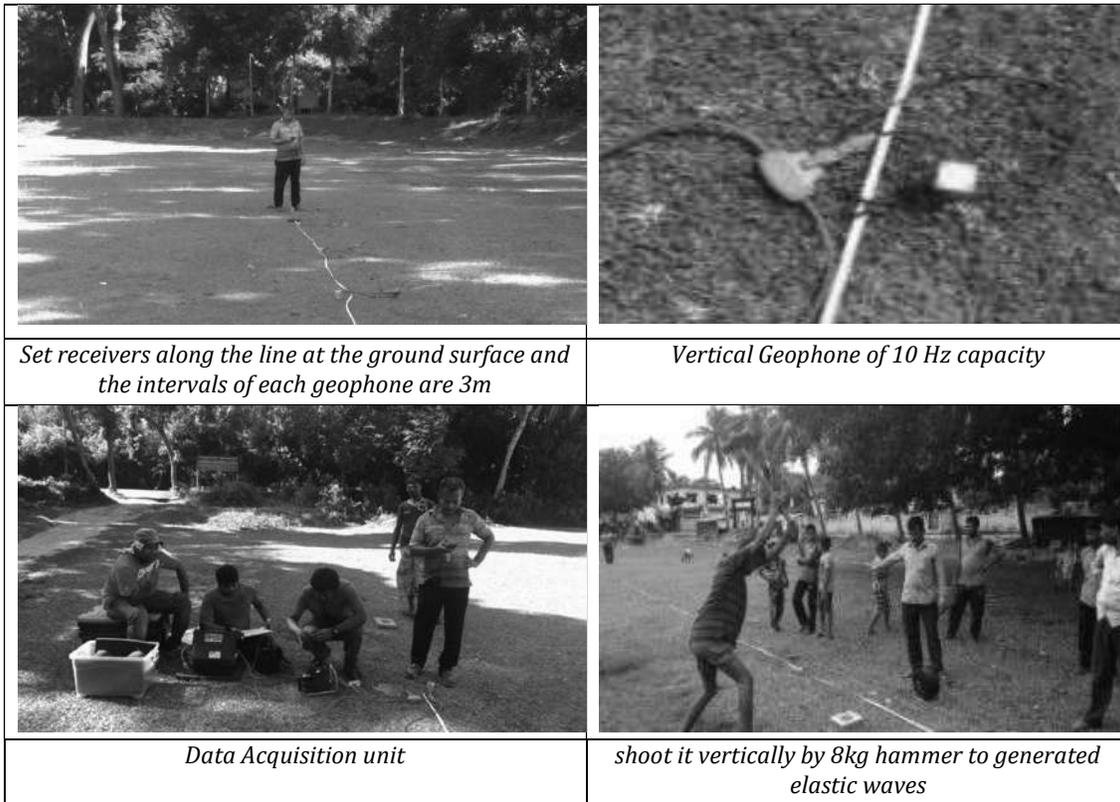
Shear wave velocity profile (V_s profile) in the field were carried out by two geophysical exploration methods namely 1) seismic downhole test and 2) Multichannel Analysis of Surface Wave (MASW).

Seismic downhole test is a direct measurement method for obtaining the shear wave velocity profile of soil stratum. However, the test requires borehole which is not time and cost effective for the project. Multichannel analysis of surface waves (MASW) is a non-invasive technique which can be used to determine the V_s profile at sites. In this project, the seismic downhole and MASW tests were performed at 3 and 5 locations respectively. Locations of seismic downhole test and MASW tests are shown in Map 2. The GPS coordinate of the test locations is showing in Table 2.

Table 8-1: Down-hold Seismic Test (PS Logging) and MASW test locations

Upazila Name	Test/ Survey Name	ID	Location Name	Coordinate	
				Latitude	Longitude
Nawabganj	Downhole Seismic Test (PS Logging)	BH-31	Galimpur Sanban girls high school field, Galimpur	23.62696	90.20647
		BH-40	Shikaripara T.K.M high school field, Shikari para	23.69993	90.06897
		BH-36	Nawabganj Press Club, Nawabganj sadar upazila	23.66061	90.11801
	Multichannel Analysis of Surface Waves (MASW)	MASW N 01	Near Bandura Union Office, Nawabganj	23.66543	90.11801
		MASW N 02	Bardhanpara Govt. Primary School, Boynagar Union, Nawabganj	23.65251	90.18288
		MASW N 03	Banokhali, Last boundary of Agla union, Nawabganj	23.63617	90.24857

Upazila Name	Test/ Survey Name	ID	Location Name	Coordinate	
		MASW N 04	Sholla High School field, Sholla Union, Nawabganj	23.70975	90.18594
		MASW N 05	Kailail Hanif Dakhil Madrasha, Kailali Union, Nawabganj	23.68668	90.23368



Set receivers along the line at the ground surface and the intervals of each geophone are 3m

Vertical Geophone of 10 Hz capacity

Data Acquisition unit

shoot it vertically by 8kg hammer to generated elastic waves

Figure 8-1: MASW N 01- Near Bandura Union Office, Nawabganj (Plate 1)

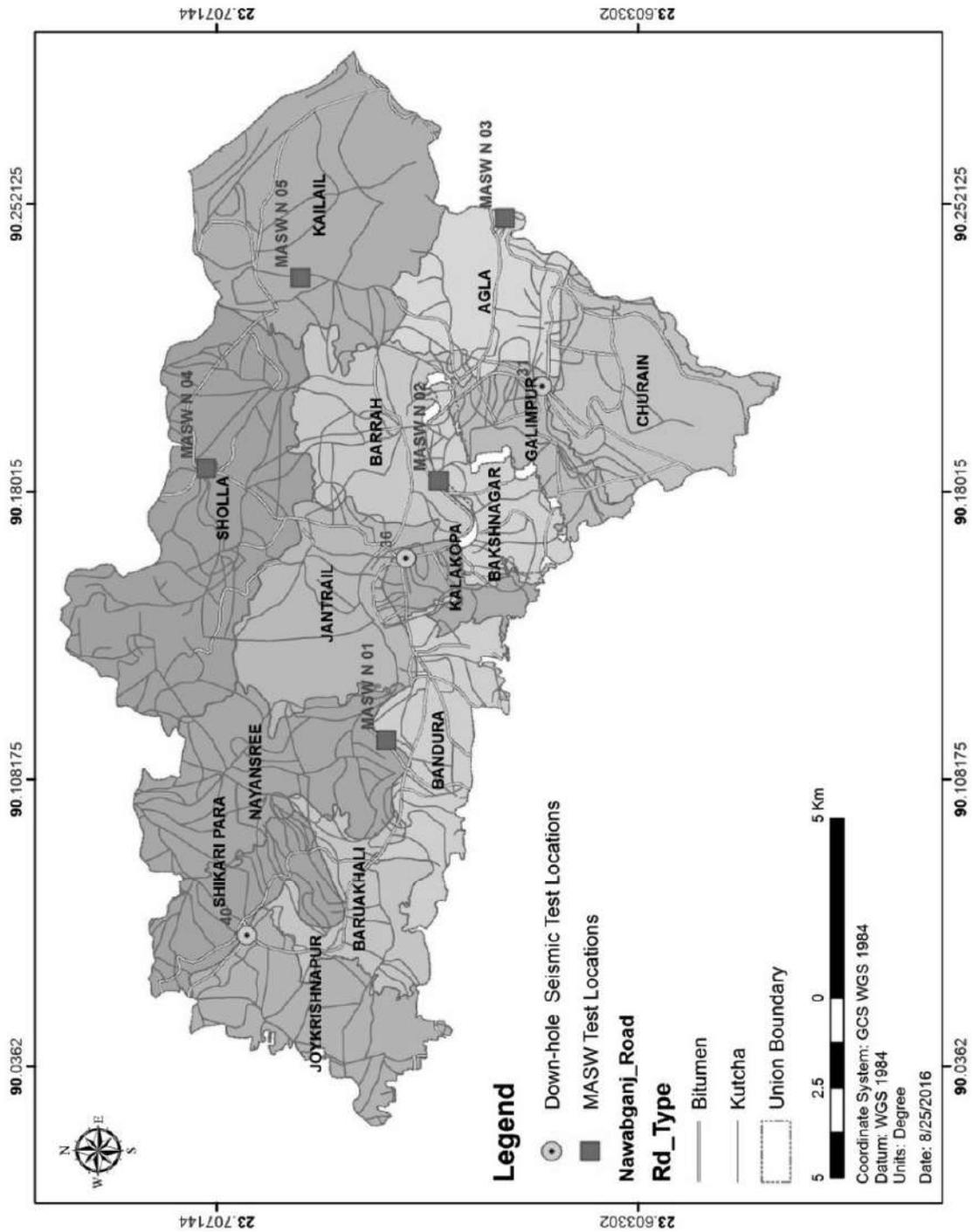


Figure 8-2: Locations Map of the Geophysical tests at Nawabganj Upazila



Preparing PVC Casing for PS Logging Test



Test hole



Data Acquisition Unit



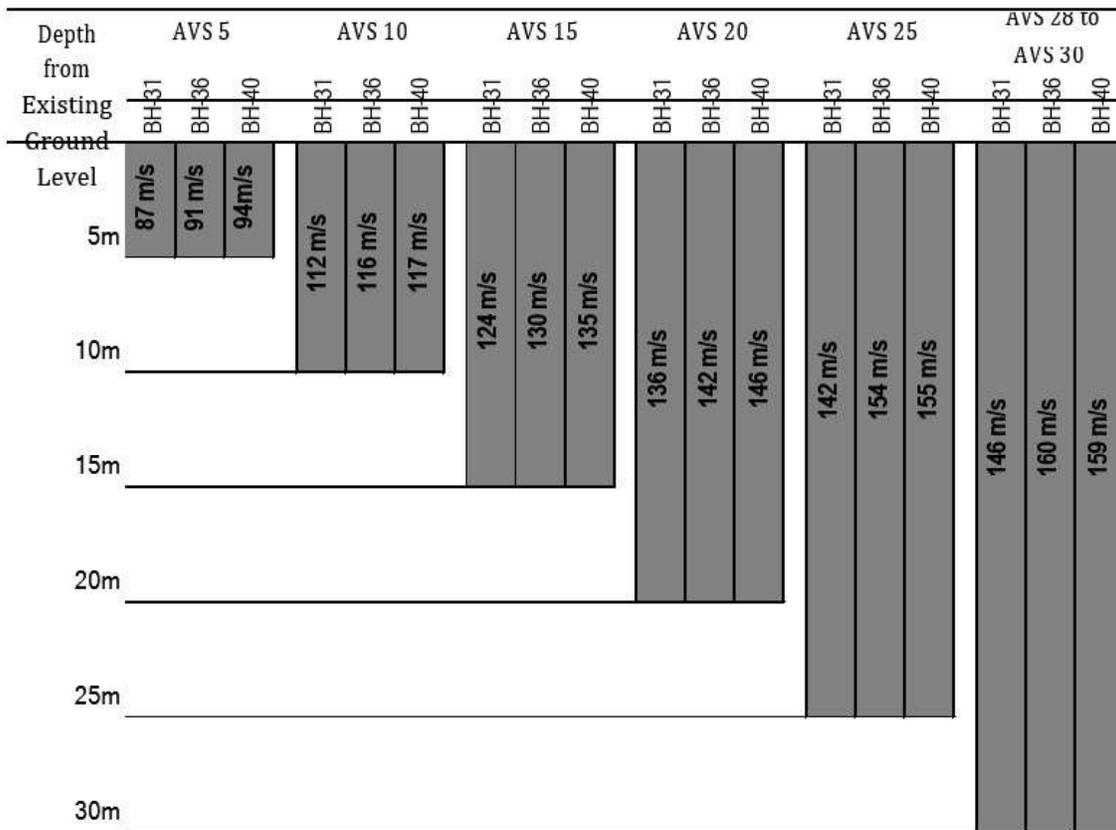
Geophone Installation into the Borehole

Figure 8-3: PS logging Data Acquisitions at Nawabganj Upazila (Plate 2)

8.1.1 Down-Hole Seismic (PS Logging) Test Results

As a fundamental parameter, shear wave velocity is required to define the dynamic properties of soils. If the soil velocity is less than 180m/s, it can be said as loose or soft soil. Estimation of shear wave velocity (V_s) / average shear wave velocity (AVS) and mapping is a way to characterize varying site conditions, and it can also be used to model earthquake-related ground shaking. Estimation of AVS aims to generate a map of estimated shear wave velocities for the upper 30m of the subsurface. Further this map can be used for seismic site response analysis i.e., to determine peak ground acceleration (PGA) and spectral acceleration (SA) values of both bedrock and ground surface. In this context, Downhole seismic test data acquisition has been completed at Nawabganj Upazila in three different locations on date 28th June 2016.

The average shear wave velocity (AVS) of each PS logging test is tabulated in Table 3. Work plan of the test depth was 30m, however, in some locations did not reach the geophone to the 30 m in depth due to adverse conditions of PVC.



Source: Field survey, 2016

Figure 8-4: Summary of PS Logging Test Result

According to down hole seismic test results, the average shear wave velocities up to depth 30 are 146 m/s to 160 m/s. if considering 30-meter depth position, the average shear wave velocity of all borehole locations are showing soft or loose soil condition as foundation soil on the other hand if considering below 20 meters to 30-meter depth position, the average velocity of shear wave is showing moderate soil condition. But actual soil condition (soil type, engineering properties and seismic behavior of soil) will be known when all the field data (SPT and soil laboratory test result, down hole seismic test result and MASW test result) has been integrated in a module to produces different type of maps including micro-zonation map of the project area.

The shear wave velocities at every 1m interval of each site are given in Appendix A in tabular and also graphical format.

8.1.2 MASW Survey Result

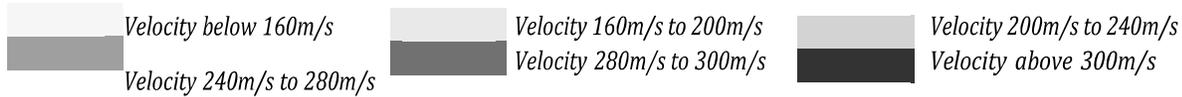
To predict subsurface shear-wave interval velocities, multi-spectral analyses of surface waves (MASW) are popularly used. Shear wave velocities can also extract additional velocity-related information such as mechanical properties of soils and rocks. In general, MASW data compare favorably to other geophysical methods for predicting interval velocities. Furthermore, comparisons to vertical seismic profiles correlate well with MASW predicted shear wave interval velocities. In this perspective, MASW test has been completed at five different locations at

Nawabganj Upazila by 27th June and field raw data has been processed and also interpreted. The results of the MASW test are enclosed in Appendix B in the tabular and also graphical format.

According to MASW test result, shear wave velocity of the project area is showing soft to moderate soil condition for foundation. MASW-01, MASW-02 and MASW -04 test results show more than 180 m/s but others two locations the average velocity is bellow 180m/s. The detailed MASW survey results are shown in Table 4.

Table 8-2: Summary of MASW Test Results

MASW N 1		MASW N 2		MASW N 3		MASW N 4		MASW N 5	
Depth (m)	Velocity (m/s)	Depth (m)	Velocity (m/s)	Depth (m)	Velocity (m/s)	Depth (m)	Velocity (m/s)	Depth (m)	Velocity (m/s)
0.0	143	0.0	118	0.0	99	0.0	100	0.0	102
1.7	143	1.7	122	1.7	104	1.1	98	1.1	101
3.8	154	3.8	147	3.8	124	2.3	106	2.3	102
6.3	182	6.3	192	6.3	161	3.7	133	3.7	113
9.2	226	9.2	215	9.2	199	5.3	169	5.3	136
12.5	266	12.5	217	12.5	201	7.0	205	7.0	163
16.2	272	16.2	215	16.2	201	8.9	239	8.9	193
20.4	273	20.4	212	20.4	199	11.0	270	11.0	204
25.0	273	25.0	209	25.0	197	13.2	302	13.2	206
40.0	293	40.0	217	40.0	204	15.6	302	15.6	205
						18.1	301	18.1	203
						20.9	299	20.9	201
						23.7	298	23.7	199
						26.8	297	26.8	198
						36.4	302	36.4	206
AVS 30- 217.8 m/s		AVS 30- 186.2 m/s		AVS 30- 167 m/s		AVS 30- 213 m/s		AVS 30- 167 m/s	



8.2 Geotechnical Investigations

To ensure safety of human beings and materials, geotechnical investigations have become an essential component of every construction, it includes a detailed investigation of soil strength, composition, water content, and other important soil characteristics. Investigation borings with standard penetration test were conducted to know vertical geological conditions. The borings with SPT were carried out at 21 points at Nawabganj Upazila.

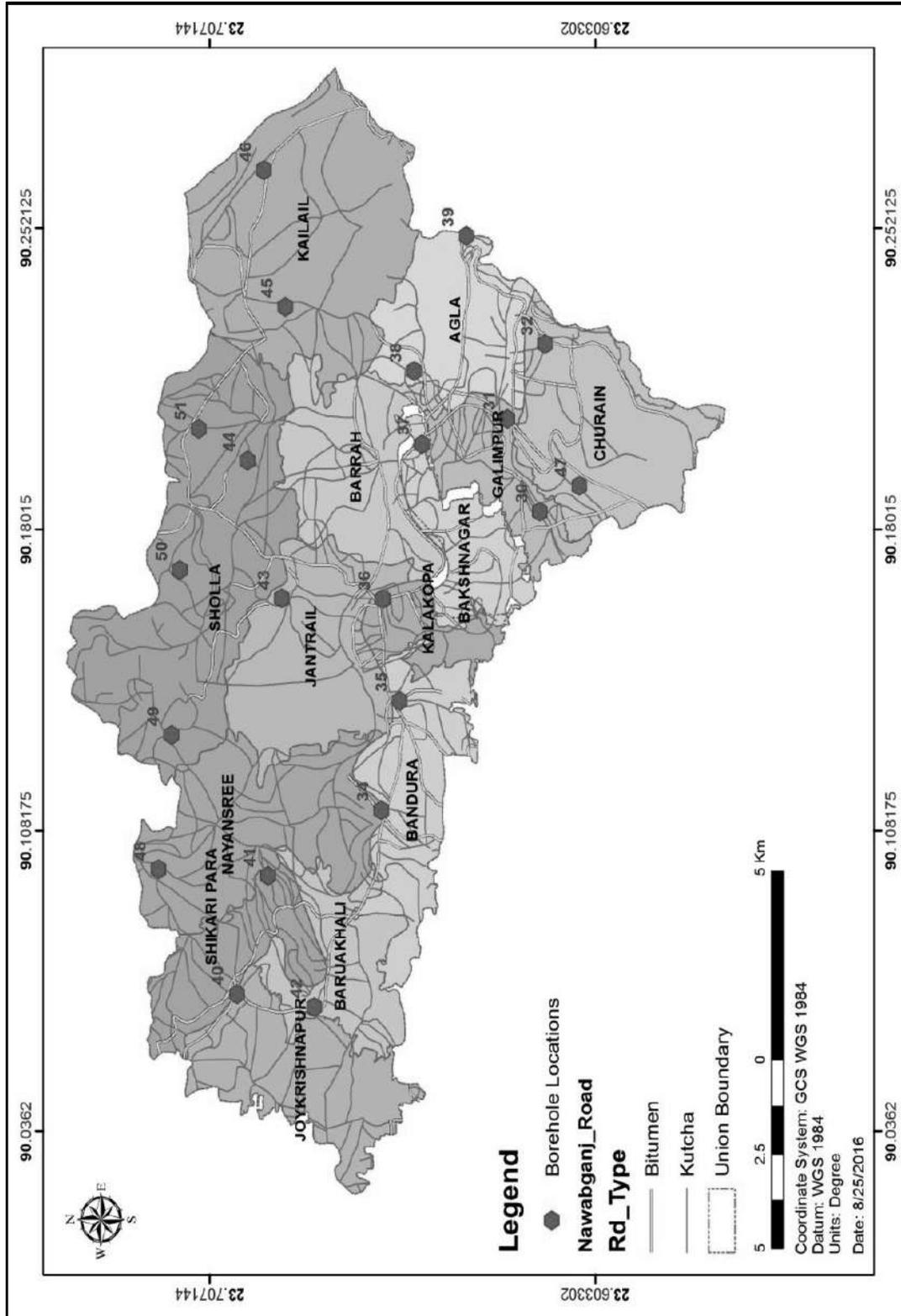


Figure 8-5: Locations Map of the Standard Penetration tests (SPT) at Nawabganj Upazila

8.2.1 Standard Penetration Test (SPT) Log Analysis and Interpretation

SPT is a common in-situ testing method used to determine the geotechnical engineering properties of subsurface soils. It was developed in the late 1920s and has been used extremely in North and South America, the United Kingdom, Japan, and elsewhere. Because of this long record of experience, the SPT is well-established in engineering practice. It is performed inside exploratory boring using inexpensive and readily available equipment, and thus adds little cost to a site characterization program. Although the SPT also is plagued by many problems that affect its accuracy and reproducibility, it probably will continue to be used for the foreseeable future, primarily because of its low cost. However, it is partially being replaced by other test methods, especially on larger and more critical projects.

All the borings have to be conducted and preparation of field bore log by visual classification has to be done in the presence of experienced technical personnel. The borehole records have to be taken that include soil type, nature of sample, soil moisture content and consistency, SPT blow counts (N Value), ground water observation and apparent origin (fill, alluvium, recent sediments, etc.) and daily field logs have been prepared. The bore locations are given in following table 5 and the geotechnical borehole log are enclosed in the below section.

Table 8-3: Bore Hole Information Summary at Nawabganj Upazila

BH ID	Location	Co-ordinate		Union	Minimum	Maximum
		Lat	Long		N value	SPT
30	Payeksha Kaborestan Mosque, Galimpur	23.61821	90.18433	Galimpur	3	47
31	Galimpur sanaban girls high school field, Galimpur	23.62696	90.20647	Galimpur	6	30
32	88 no. churain govt. primary school, churain	23.6168	90.22437	Churain	4	37
34	Bandura Al-amin 34 Madrasha, Bandura Union	23.66103	90.11303	Bandura	2	38
35	Sadapur progoti govt. primary school, Bandura	23.65603	90.13924	Bandura	2	50
36	Nawabganj press club, Nawabganj Sadar upazila	23.66061	90.16345	Kalakopa	2	50
37	Chowkighata govt. primary school, Agla	23.65007	90.20043	Agla	2	43
38	Mazpara govt. primary school field, Agla	23.65214	90.21791	Agla	7	38
39	Kharsur high school, Agla	23.63808	90.25023	Agla	5	29

BH ID	Location	Co-ordinate		Union	Minimum	Maximum
		Lat	Long		N value	SPT
40	Shikaripara T. K. M. high school field, Shikari Para	23.69993	90.06897	Shikari para	3	48
41	Bokchar govt. primary school, Daudpur, Nayanshree	23.69151	90.09744	Nayanshree	5	43
42	Barruakhali govt. primary school, Po Hat Baruakhali	23.67906	90.06593	Baruakhali	3	44
43	Chondrokola Kali Mondir, Jantrail union	23.68779	90.16364	Jantrail	2	60
44	Hayat kanda Mosque, Sholla Union	23.69704	90.19654	Sholla	2	42
45	Kailail Mosque, Kailail gram	23.68686	90.23328	Kailail	5	50
46	Malikanda govt. hospital, Bottola, Kailail	23.69273	90.26591	Kailail	5	50
47	Khan Para (Mushim Hati), Churain	23.60762	90.19053	Churain	2	48
48	Uttar Barra, Nayanshree Union	23.72091	90.0989	Nayanshree	2	45
49	Sholla Union	23.71735	90.13104	Sholla	3	42
50	Chokuriya Chokbari govt. primary school, Sholla	23.7151451	90.1704712	Sholla	2	50
51	Sultanpur govt. primary school, Modhon Mohonpur, Sholla Union	23.70997	90.20408	Sholla	7	50

While boring and SPT testing, soil samples are being visually classified in the following way:

Table 8-4: Soil Classification Based on Sieve Sizes and Grain Size Distribution

Sieve	Soils	Designations
+No 4 (4.76mm)	Gravel	
No.4 to No 10(2.00mm)	Coarse	Sand
No. 10 to No 40 (0.42mm)	Medium	Sand

Sieve +No 4 (4.76mm)	Soils Gravel	Designations
No. 40 to No 200 (0.07mm)	Fine	Sand
No.200	Silt or Clay	

Some soil has one dominant lithology with minuscule amount of other soil type. In such cases, minor soil samples are written in the following manner along with dominant soil type.

Trace 1 to 10%

Little 10 to 25%

With 25 to 35%

SPT- N value is also noted down while SPT Testing. Then the collected soil samples are being cross checked with SPT-N values to ensure quality data collection.

Based on N-values, other very useful soil parameters may be obtained from the co-relation charts given by different research workers. Two such useful co-relations for cohesive and non-cohesive soils after K. Terzaghi are given below:

Table 8-5: Values of Relative Density (Dr.), Friction Angle and Unit Weight of Non- cohesive soil based on N- values.

N-values	Condition	Relative Density	Angle of Internal friction (Degree)	Moist Unit Weight (Pcf)
0-4	Very Loose	0-15%	28 ⁰	70-100
4-10	Loose	15-35%	28 ⁰ -30 ⁰	95-125
10-30	Medium dense	35-65%	30 ⁰ -36 ⁰	110-130
30-50	Dense	65-85%	36 ⁰ -41 ⁰	110-140
Over 50	Very dense	85-100%	Over 41 ⁰	> 130

Table 8-6: Values of Unconfined Compressive Strength based on N-values for Cohesive Soil (Approximate):

N-values	Condition	Unconfined Compressive Strength (Tsf)
Below 2	Very soft	Below 0.25
2-4	Soft	0.25-0.50
4-8	Medium stiff	0.50-1.00
8-16	Stiff	1.00-2.00
16-32	very stiff	2.00-4.00
Over 32	Hard	over 4.00

In the above table the shear strength of cohesive soil is equal to ½ of unconfined compressive strength and the angle of shearing resistance is equal to zero. It should be remembered that the co-relation for cohesive soil is not always very reliable.

8.3 Conclusion:

Nawabganj Upazila and its adjoining areas is mostly comprised of monotonous flood plain area except few depressions. Soil quality of the project area varies according to morphological difference, that's why geological, geotechnical, and geophysical investigations has been carried out such a pattern to cover all morphological unit. In this consequences, 21 boreholes with SPT, 3 downhole seismic tests and 5 MASW program has been completed in the field as a part of this survey investigation. During this survey, soil samples (disturbed and undisturbed) are also collected for further laboratory tests which will give idea about the soil engineering properties. This investigation data will be analyzed and integrated in a module from which it can be possible to generate geomorphologic map, sub-surface litho-logical 3D model of different layers, engineering geological mapping based on AVS30, Seismic Hazard Assessment Map (risk sensitive micro-zonation maps), soil type map, seismic intensity map, Peak Ground Acceleration (PGA) and recommended building height maps for both high rise building and low rise building etc.

Above investigation and outcomes would give a clear idea about the geo-hazard status of landscape where newly urban developing activities or any other mega infrastructure project is going on and this mentioned investigation also gives idea about the vulnerability of existing build up infrastructure of a particular area Based on these results, proper management techniques as well as other necessary adaptation process could be addressed before or after the development activities in the studied area. It is to be mentioned that the long-term maintenance cost will be reduced, and the developed structure will withstand against the potential natural hazards if the infrastructures are built following the risk informed physical land-use plan.

CHAPTER NINE: ENVIRONMENT, CLIMATE CHANGE AND DISASTER

9.1 Introduction

The environmental research evaluates the current living conditions in urban areas and examines the effects of future urbanization. Generally, speaking, the urban environment comprises resources, human activities, and other processes that transform these resources into different usable products and services. It also includes the consequences of these processes, which can be either detrimental or beneficial. The available resources encompass human resources, solar energy, land, water, air, minerals, electricity, fuels, and recyclable minerals

Table 9-1: Topic covered by the UDD and LGED

Topic	UDD	LGED
Sanitation	Covered Only Ownership	Details Survey Conducted
Solid Waste Management	Covered Dumping Site, WM Problem	Details Survey Conducted
Drinking Water	Covered Only Source of Water	Details Survey Conducted
Soil Condition	Basic Type and Characteristics	Covered
Brick Field	Impact on Agriculture	Impact on Agriculture, Human Health and Environment
Water Logging	Covered	Covered
Wetland Ecosystem	Covered	Covered With Proper Mapping
Loss of Biodiversity	Covered	Covered
Disaster And Hazard	Partially Covered (Flood, Cyclone, River Bank Erosion, Drought)	Covered With Proper Mapping Including Earthquake
Environment	Partially Covered	Covered With Statistical Analysis
Climatic Factor	Not Covered	Covered Including Temperature, Rainfall, Humidity, Wind Speed, LST
Environmental Pollution Survey	Not Covered	Covered - Air, Noise, Water, River Bed Toxicity
Carbon Footprint	Not Covered	Carbon Emission from Residential, Transportation, Brick Field
Ecosystem Service Valuation	Not Covered	Provisioning, Cultural, Regulating, Supporting Services
Medical Waste	Not Covered	Details Survey Conducted

The processes involved include manufacturing, transportation, construction, mitigation, population growth, community services, residential activities, and daily living. These processes can have both negative effects, such as air, water, and noise pollution, waste generation, and sewage congestion, as well as positive effects, such as the production of goods, value addition, improved knowledge-based education, and access to superior services. The topics covered in this chapter include the environment, climate change, and the disasters that Bangladesh is predominantly afflicted by.

In comparing the environmental and developmental initiatives undertaken by the Urban Development Directorate (UDD) and the Local Government Engineering Department (LGED), it

becomes evident that LGED offers a more detailed and comprehensive approach across a variety of issues. While UDD addresses key areas such as sanitation, solid waste management, and drinking water primarily at a surface level, focusing on aspects like ownership and basic characteristics, LGED delves deeper with detailed surveys and analyses. This includes extensive work on soil conditions, the impact of brick fields not only on agriculture but also on human health and the environment, and thorough assessments of water logging, wetland ecosystems, and biodiversity loss. Notably, LGED extends its coverage to include climatic factors, environmental pollution, carbon footprint, and ecosystem service valuation, areas that UDD has either partially covered or omitted entirely. Additionally, LGED's efforts to map out disasters and hazards, including earthquakes, and to conduct surveys on medical waste management, signify a holistic approach to environmental and urban planning challenges, emphasizing the importance of detailed research and mapping in informing sustainable development strategies.

9.2 Environmental Condition

9.2.1 Natural Environment

Fossil life, vegetation, minerals, air, water, and land are all essential components of natural environment. Their interactions sustain life and preserve ecological equilibrium via processes such as photosynthesis, nutrient cycling, and water filtration. These resources are susceptible to substantial alterations caused by human activities, including deforestation, pollution, and climate change; these consequences have a cascading impact on air purity, biodiversity, water quality, and soil health. It is critical to implement sustainable management and conservation strategies in order to prevent adverse effects and guarantee the continued availability and well-being of these vital resources for future generations.

9.2.2 Built Environment

Built Environment refers to the infrastructure such as buildings, housing, and transportation networks like, roads and railways, along with utilities like electricity, water supply, and gas, essential for urban development and quality of life. These elements involve complex planning, construction, and maintenance processes. Their development can have significant environmental impacts, including habitat disruption and resource depletion. However, sustainable practices and technologies can mitigate these effects, enhancing efficiency and reducing harm to the environment. For comprehensive insights, there is need to explore resources on urban planning and sustainable development.

9.2.3 Socio-economic Environment

Urban lifestyles in general encompass resources, processes, and effects associated with human activities, education, health, arts and culture, economic and business activities, and heritage. The urban environment is defined as the point where these three dimensions intersect and overlap. Human-induced environmental concerns include but are not limited to contamination of potable water, air, land, and noise, sewage, sanitation, and solid refuse management. Slum settlements and clusters located on the outskirts of urban areas represent a deteriorated human living environment devoid of nearly all fundamental necessities, including but not limited to secure housing, employment opportunities, access to healthcare, potable water, sanitation, communication, and education. These areas warrant particular consideration. Moreover, in order

to implement water resource management objectives and safeguard the remaining natural and ecologically sensitive areas from degradation, the purpose of this survey is to impose control on development.

9.2.4 Existing Ecological Resources

The study area is rich in ecological resources, featuring diverse landscapes like, vegetative lands, wetlands (including rivers, canals, ponds), and agricultural areas. These environments provide habitats for a wide range of aquatic and terrestrial flora and fauna, contributing to the region's biodiversity and ecological balance.

9.2.5 Designation of Environmental Sensitive Areas

An environmentally sensitive area is a region that is environmentally protected, where various human activities can lead to complex changes that compromise the integrity of the environment and ecosystem. Due to its natural features, Nawabganj and various regions of Bangladesh are rich in biodiversity and natural resources. However, due to some unsustainable activities, various regions of the country face different types of damage to the environment and biodiversity. In order to protect the country's environment, biodiversity, and natural resources, the government has declared and listed 13 areas as environmentally vulnerable areas under the Bangladesh Environmental Conservation Act, 1995 (amended 2010) at various times. It should be noted, however, that there are no environmentally vulnerable or protected areas listed in the project areas. Therefore, in the proposed master plan, ponds, canals, rivers, parks, forest areas, etc., have been considered as environmentally sensitive areas. Special management is needed to preserve environmentally sensitive areas so that they are not jeopardized by urbanization.

9.2.6 Environmental Pollution

The research performed laboratory tests to address the challenges of environmental monitoring and contamination, since there was little information available from secondary sources. A study of air, noise, surface water, and groundwater pollution has been carried out to determine and evaluate the environmental health of Nawabganj Upazila. This portion of the research presents the test findings.

9.2.6.1 Water Pollution

Table 9-2: Ground Water Quality of Nawabganj Upazila

SL.#	Water Quality Parameters	Bangladesh Standard	Concentration Present	Unit	Analysis Method	LOQ
1	Alkalinity	-	35	mg/L	Titrimetric	-
2	Arsenic (As)	0.05	0.001	mg/L	AAS	0.001
3	Chloride	150-600	30	mg/L	Titrimetric	-
4	Dissolved Oxygen	6.0	6.05	mg/L	Multimeter	-
5	Hardness	200-500	185	mg/L	Titrimetric	-
6	Iron (Fe)	0.3-1	3.04	mg/L	AAS	0.05
7	Manganese (Mn)	0.1	0.91	mg/L	AAS	-

SL.#	Water Quality Parameters	Bangladesh Standard	Concentration Present	Unit	Analysis Method	LOQ
8	Salinity	-	0.26	%	Multimeter	-
9	Total Coliform	0	0	CFU/100 ml	Membrane Filtration Method	-
10	Fecal Coliform	0	0	CFU/100 ml	Membrane Filtration Method	-

Source: Field Survey 2024

To assess groundwater quality in Nawabganj Upazila, specific parameters were analyzed, as shown in Table 9-2. The results indicate that all parameters meet Bangladesh's standards except for Iron (Fe) and Manganese, with Manganese levels at 0.91 mg/L significantly above the national standard of 0.1 mg/L, marking the water as hazardous without treatment. Iron levels were also high at 3.04 mg/L, surpassing the standard range of 0.3-1 mg/L, necessitating an iron treatment system for the water source, though it may be safe for those accustomed to it.

Table 9-3: Surface Water Quality (Ichamati River) of Nawabganj

SL.#	Water Quality Parameters	Bangladesh Standard	Concentration Present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	0.011	mg/L	AAS	0.001
2	Chemical Oxygen Demand (COD)	4.0	12	mg/L	CRM	4.0
3	Dissolved Oxygen (BO)	6.0	5.60	mg/L	Multimeter	-
4	pH	6.5-8.5	7.6	mg/L	pH Meter	-
5	Salinity	-	0.34	%	Multimeter	-
6	Total Dissolved Solid (TDS)	1000	342	mg/L	Multimeter	-
7	Total Suspended Solid (TSS)	10	4	mg/L	Gravimetric Method	-
8	Turbidity	10	32.8	NTU	Turbidity Meter	-
9	Vibrio Cholerae	-	Present	-	Culture	-
10	BOD5	0.2	3.5	mg/L	Standard BOD5 Test	-
11	Total Coliform	0	0	CFU/100 ml	Membrane Filtration Method	-
12	Fecal Coliform	0	0	CFU/100 ml	Membrane Filtration Method	-

Source: Field Survey 2024

As shown in Table 9-3, a number of factors were examined in order to evaluate the surface water quality of the Ichamati River. With the exception of COD, turbidity, and vibrio cholerae, the findings show that all criteria satisfy Bangladesh's standard. The turbidity measurement of 32.8 NTU is much more than the normal limit of 10 NTU. There is Vibrio cholerae in this river. It is thus forbidden to consume or utilize this water for any other purpose. Without protection, humans shouldn't be exposed to it. The overall quality of the water is moderate for aquatic life.



Figure 9-1: Sample Collection (Left: Ichamati River and Right: Kaliganga River, Field Survey 2024)

Table 9-4: Surface Water Quality (Kaliganga River) of Nawabganj

SL.#	Water Quality Parameters	Bangladesh Standard	Concentration Present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	0.01	mg/L	AAS	0.001
2	Chemical Oxygen Demand (COD)	4.0	8	mg/L	CRM	4.0
3	Dissolved Oxygen (BO)	6.0	8.92	mg/L	Multimeter	-
4	pH	6.5-8.5	7.8	mg/L	pH Meter	-
5	Salinity	-	0.31	%	Multimeter	-
6	Total Dissolved Solid (TDS)	1000	308	mg/L	Multimeter	-
7	Total Suspended Solid (TSS)	10	13	mg/L	Gravimetric Method	-
8	Turbidity	10	19	NTU	Turbidity Meter	-
9	Vibrio Cholerae	0	Absent	-	Culture	-
10	BOD5	0.2	2.1	mg/L	Standard BOD5 Test	-

SL.#	Water Quality Parameters	Bangladesh Standard	Concentration Present	Unit	Analysis Method	LOQ
11	Total Coliform	0	110000	CFU/100ml	Membrane Filtration Method	-
12	Fecal Coliform	0	8000	CFU/100ml	Membrane Filtration Method	-

Source: Field Survey 2024

9.2.6.2 River Bed Toxicity of Ichamati River)

After conducting a reconnaissance survey, it became apparent that the primary rivers of Nawabganj Upazila are interconnected with the Dhaleshwari River. Situated close to ternary industries in Hemayadpur, Savar, the Dhaleshwari River receives discharge from these industries, potentially leading to contamination by heavy metals in the connecting rivers. Consequently, a survey was carried out to assess the presence of heavy metals in the rivers of Nawabganj Upazila. The findings reveal contamination by various heavy metals, notably Zinc (Zn), Copper (Cu), Cadmium (Cd), Lead (Pb), Nickel (Ni), and Chromium (Cr).

Table 9-5: Result of River Bed Toxicity

Elements	Results	Unit	EPA, 1993
Zinc (Zn)	64.49	ppm	7500
Copper (Cu)	41.30	ppm	4300
Cadmium (Cd)	0.02	ppm	85
Lead (Pb)	14.49	ppm	420
Nickel (Ni)	39.75	ppm	75
Chromium (Cr)	39.92	ppm	3000

Source: Field Survey 2024

9.2.6.3 Noise Pollution

Table 9-6: Result of Tested Noise Level (NL) of Nawabganj Upazila

SI No	Sample	Locations	GPS Coordinates	Conc. Present (dB)			Standard, (Day time)	Category
				L _{eq}	L _{max}	L _{min}		
1	1	In front of Zila Parishad Market near Nawabganj Bus Stand	23°39'39.7"N, 90°9'43.6"E	73	88	64	60	Mixed Area

Source: Field Survey 2024

*BD Standard= Bangladesh Standard (ECR, 1997 = Environmental Conservation Rules, 1997) (Field test result 2024)

To evaluate the degree of noise in Nawabganj Upazila, a noise pollution survey was carried out. According to the results, there is around 64 dB of minimum, 88 dB of maximum, and 73 dB of average noise in a mixed-use area. The noise level is much higher in mixed-use area as defined by the Bangladesh Standard (Noise Pollution Control Rules, 2006). The research discovered that a mixed land use area's total air quality parameters are higher than the Bangladesh standard, as shown in **Table 9- 6**.

9.2.6.4 Air Pollution

The quality of air in an area is vital for ensuring the good health of the local people, as well as for the health of the environment, which depends on it. Nawabganj Upazila is dominated by rural activities, but this upazila is directly connected and located beside Dhaka city, which is one of the highly air-polluted cities in Bangladesh. The Regional Connectivity Road named Zinzira-Karaniganj-Nawabganj-Srinagar passes through Nawabganj Upazila, which increases the possibility of air pollution in the area. Therefore, an air pollution survey has been conducted to identify the potential sources and pollutants in Nawabganj Upazila. The outcomes of the survey show that PM₁₀ and PM_{2.5} are the primary pollutants in this area. The findings also reveal that the main sources of pollution in the area are emissions from vehicular movement, commercial activities, and mixed land use.

Table 9-7: Result of Tested Air Quality of Nawabganj Upazila

Sample	Ambient Air Pollutants' Conc. in µg/m ³						CO (ppm)
	PM _{2.5}	PM ₁₀	CO ₂	NO ₂	SO ₂	O ₃	
AAQ-I	108	222	51	23	132	98	0.0
Method of Analysis	Real Time Monitoring by Particulates Sensor based analysis			Real Time Monitoring by High Sensitivity Electrochemical Sensor			
	Instrument: Eyesky AQM-09 Air Quality Monitoring System						
ECR,1997	65 (24 H)	150 (24 H)	200 (24 H)	100 (Annual)	365 (24 H)	157 (24 H)	10 (8 H)

Source: Field Survey 2024

*ECR, 1997 = Environmental Conservation Rules, 1997 amended on 2005 (Schedule-2 *)

Legend: PM_{2.5} Particulate Matter of a diameter of 2.5 micron or less, PM₁₀- Particulate Matter of a diameter of 10 micron or less, NO₂- Nitrogen Di-Oxide, SO₂- Sulphur Di-Oxide, O₃- Ozone, CO- Carbon Monoxide, H - Hour



Source: Field Survey 2024

Figure 9-2: Air and Noise Pollution testing Instrument and Survey Records

9.2.6.5 Solid Waste Survey Point

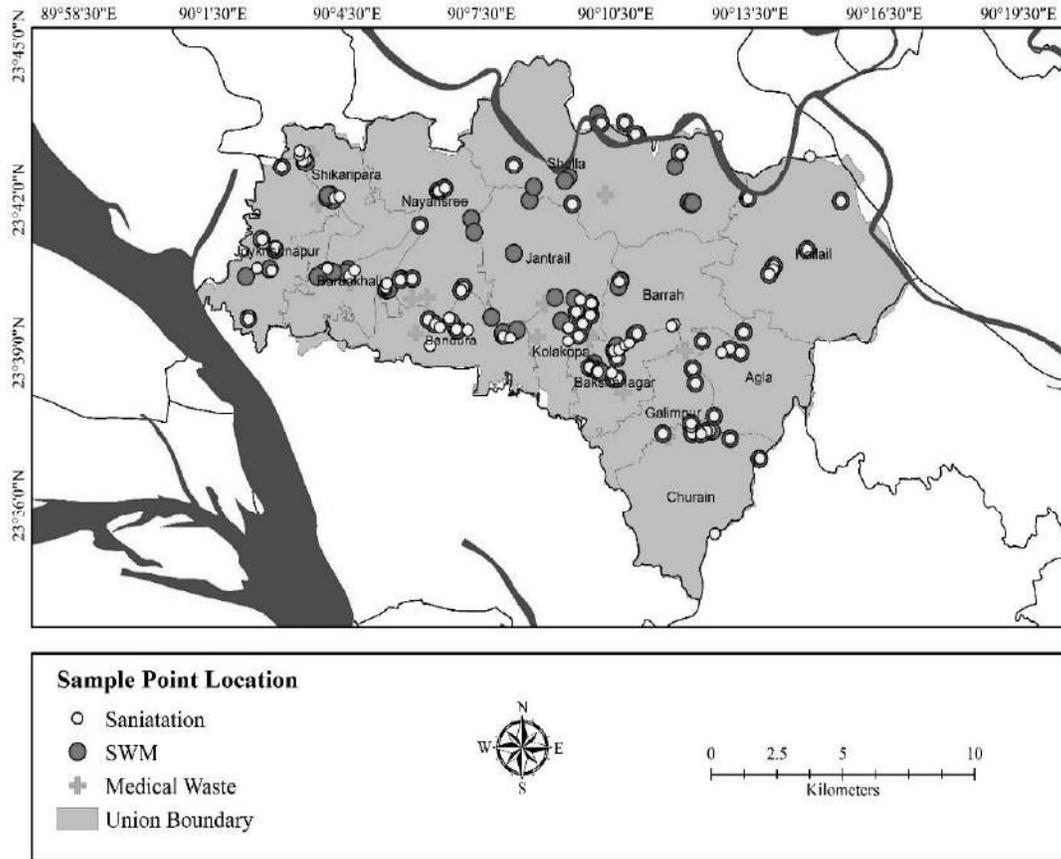


Figure 9-3: Survey Point Location for Sanitation, SWM and Medical

A questionnaire survey was used to gather data on medical waste, solid waste management (SWM), and sanitation. A total of 288 sample were selected and gathered data in Nawabganj Upazila from various garbage sources. In order to cover all 14 unions in Nawabganj cluster random sampling method was applied to select household. Among them 140 samples were obtained from SWM, 120 from Sanitation, and 28 from Hospital, Clinic, and Diagnostic Center. Figure 9-3 shows the location of the survey. The household of Nawabganj provided the sanitation and SWM data, while the hospital, clinic, and diagnostic center provided the data pertaining to medical waste.

9.2.7 Solid Waste Management in Nawabganj

9.2.7.1 Source of Waste in Nawabganj

According to data analysis from surveys, the primary source of garbage generation in Nawabganj Upazila is domestic, with commercial waste contributing in second. According to the statistics, families are responsible for a noteworthy 89.70% of garbage, which amounts to around 25.30 tons each month.

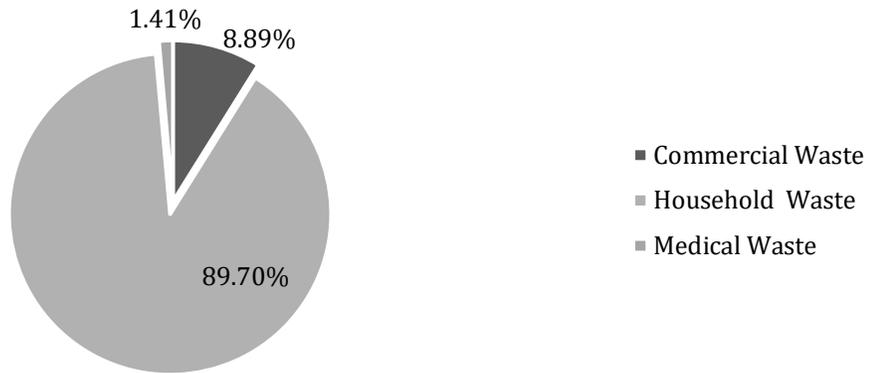
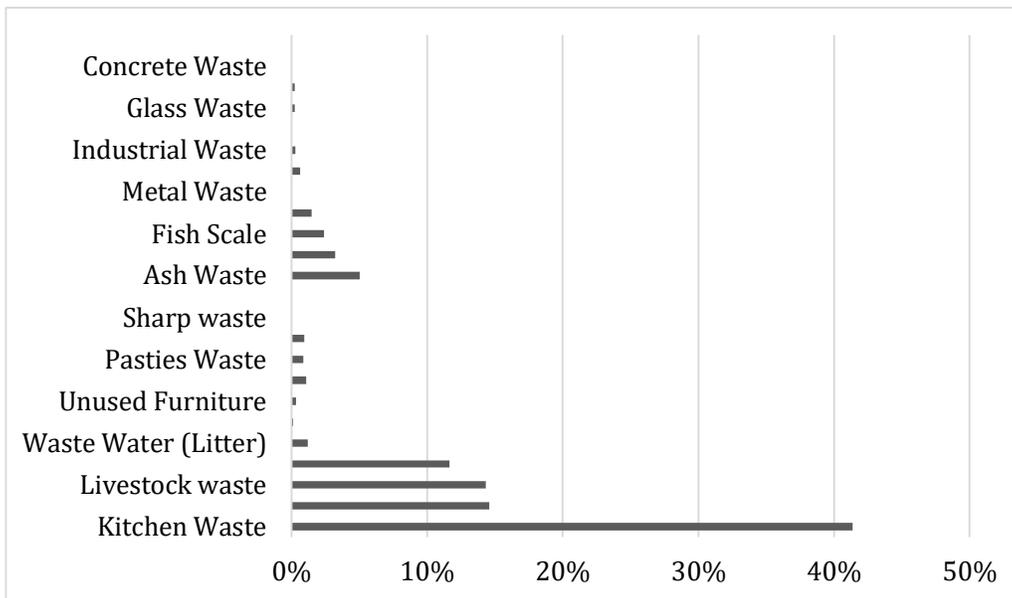


Figure 9-4: Source of Waste in Nawabganj Upazila (Field Survey 2024)

9.2.7.2 Household Waste



Source: Field Survey 2024

Figure 9-5: Source of Household Solid Waste in Nawabganj Upazila

The solid waste of Nawabganj Upazila has been divided into 21 different categories, which are included in Figure 9- 5. The analysis indicates that the main sources of waste in Nawabganj are kitchen waste, livestock by-products, sanitary waste, and ash waste, contributing 49.20%, 17.02%, 13.84%, and 5.96% to the waste stream, respectively.

9.2.7.3 Union wise Solid Waste Scenario

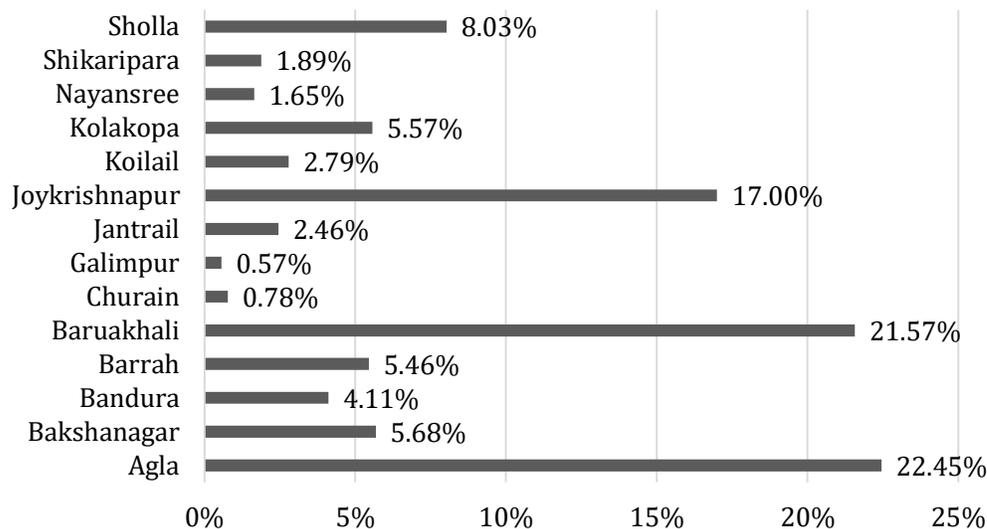


Figure 9-6: Union wise Solid Waste Scenario

The goal of this study is to evaluate the distribution of solid waste across different unions in Nawabganj Upazila, as depicted in Figure 9-6. The findings reveal that Agla, Baruakhali, Joykrishnapur, and Sholla Union contribute 22.45%, 21.57%, 17%, and 8.03% to the overall waste production, respectively.

9.2.7.4 Per Capita Waste Generation

Table 9-8: Per Capita Solid waste Generation in Nawabganj Upazila

Union	Waste/Day	Population (2022)	kg/person/Day
Agla	1148	18372	0.06
Bakshanagar	1394	22733	0.06
Bandura	1492	30357	0.05
Barrah	1413	27996	0.05
Baruakhali	1124	17731	0.06
Churain	431	25096	0.02
Galimpur	103	14528	0.01
Jantrail	652	24908	0.03
Joykrishnapur	1050	18611	0.06
Koilail	863	28400	0.03
Kolakopa	1479	23505	0.06
Nayansree	523	29583	0.02

Union	Waste/Day	Population (2022)	kg/person/Day
Shikaripara	389	18752	0.02
Sholla	2573	42391	0.06
Total	199019	342963	0.58

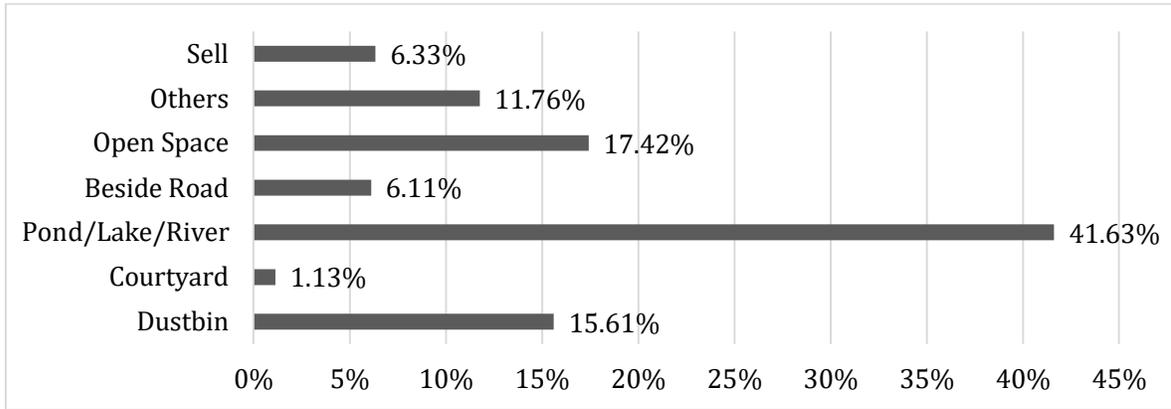


Figure 9-7: Common Waste Disposal sites of Nawabganj Upazila

The survey findings revealed that most of the waste generated in Nawabganj is being dumped in the nearest ponds, canals, and rivers due to the lack of a waste management system and waste disposal site. These activities are the primary sources of surface water pollution and environmental degradation. Figure 9-7 shows the most common sites for dumping waste in Nawabganj Upazila.

9.2.7.5 Solid Waste Dropping Site

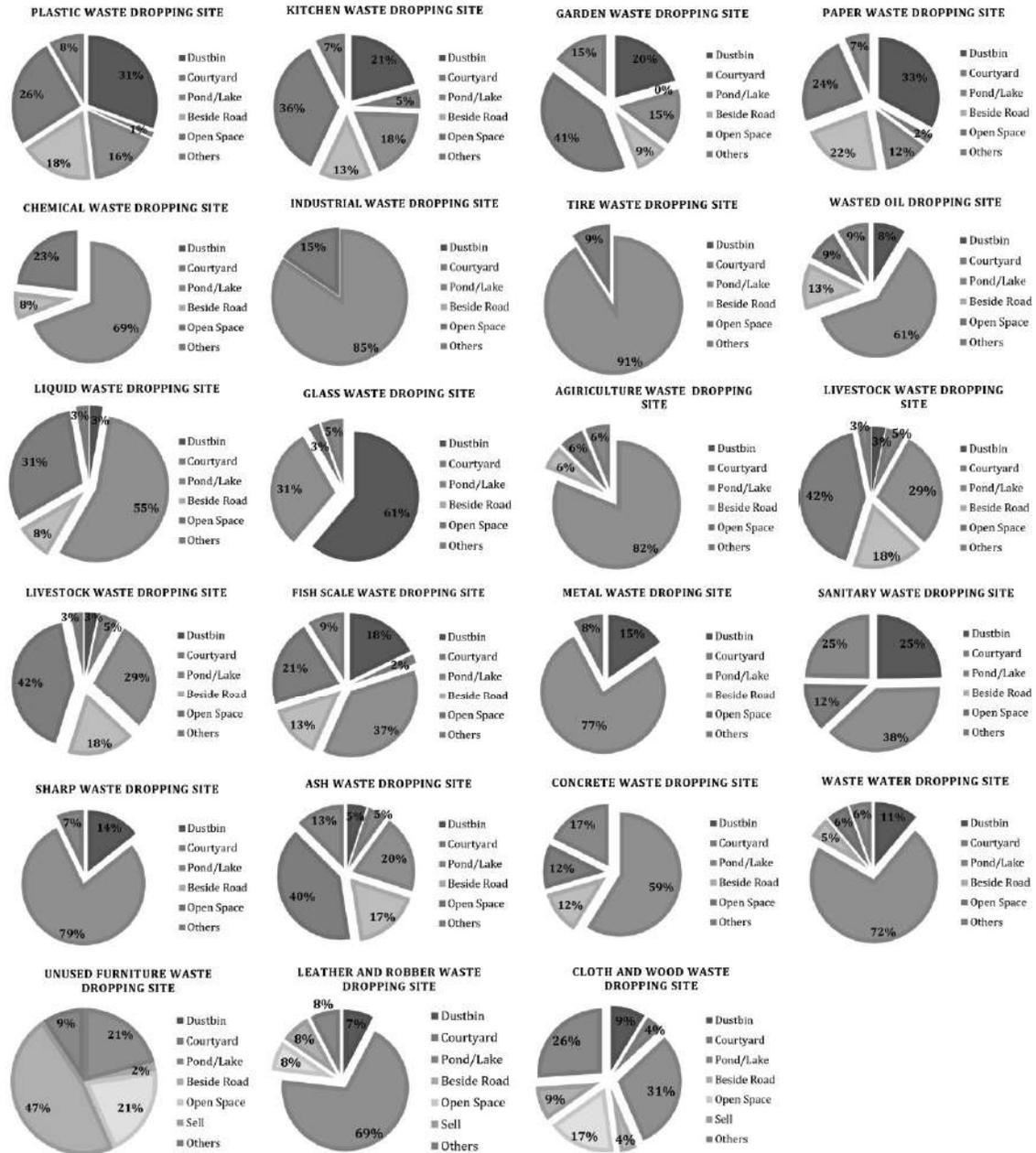


Figure 9-8: Scenario of Solid Waste Disposal according to waste type in Nawabganj Upazila

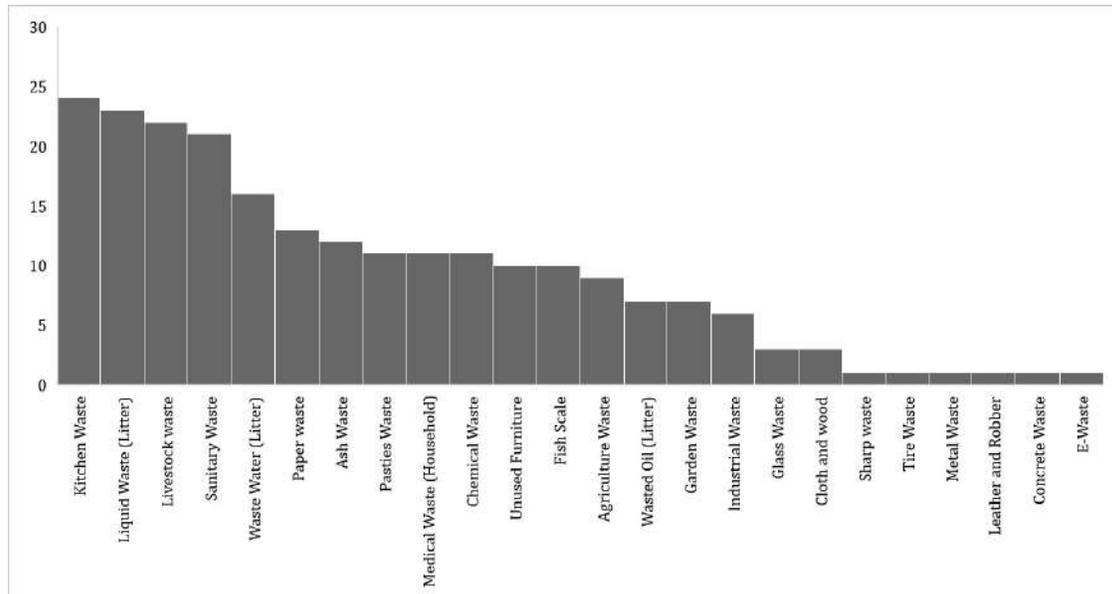


Figure 9-9: Rank of the waste categories of Nawabganj Upazila

The Figure 9- 9 depicts the prevalent waste categories typically encountered in Nawabganj. The primary sources of waste in Nawabganj Upazila include kitchen activities, liquid consumption, wastewater, livestock byproducts, ash resulting from wood fuel combustion, fish remnants, agricultural residue, paper, and plastic.

9.2.7.6 Solid Waste Separation and Re-use

The waste segregation scenario and the percentage of biodegradable waste currently being reused in Nawabganj are depicted in Figure 9-10. Based on the questionnaire survey, the majority of Nawabganj Upazila residents do not separate their waste according to its biodegradability. The results show that while 18% of households used to store waste separately, 49% of households do not, and 33% of households take no action to address these issues. Only 8% of them are citizens who recycle biodegradable garbage to make compost fertilizer and vermicompost, as shown in Figure 9- 10 (B).

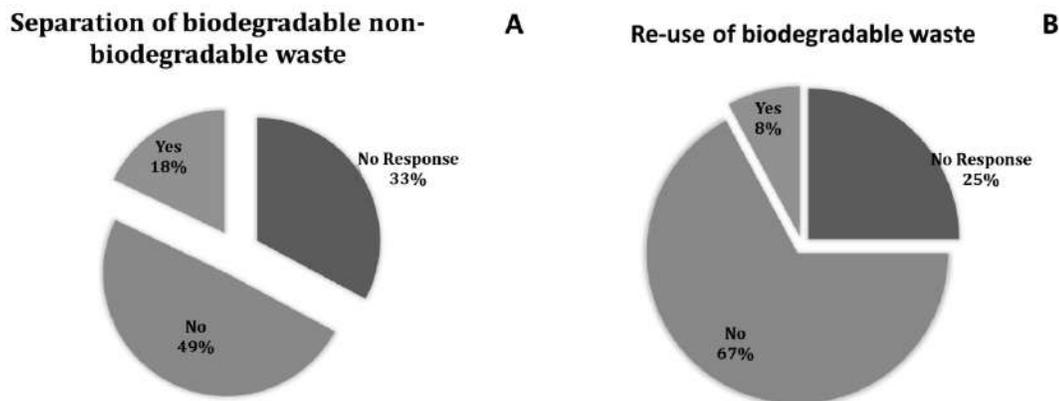


Figure 9-10: Status of Waste segregation and re-use in Nawabganj

Figure 9- 11 represents the percentage of biodegradable waste reused in the form of compost and vermicompost fertilizer in Nawabganj.

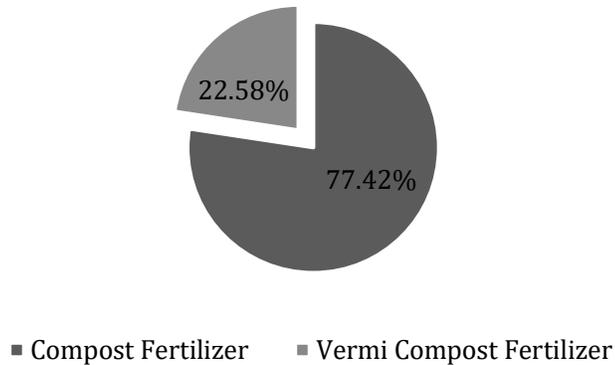


Figure 9-11: Way of Re-using the biodegradable Waste

The findings show that 77.42% of biodegradable waste is being used as compost fertilizer, while 22.58% of it is used as vermicompost fertilizer. Compost and vermicompost fertilizers are used in agricultural land (35.63%), vegetable gardening (21.84%), fruit gardening (16.09%), and 9.20% of them are sold at local markets. The use of these fertilizers enhances soil fertility, structure, moisture retention, nutrient content, and microbial activity, promoting healthy plant growth and disease resistance.

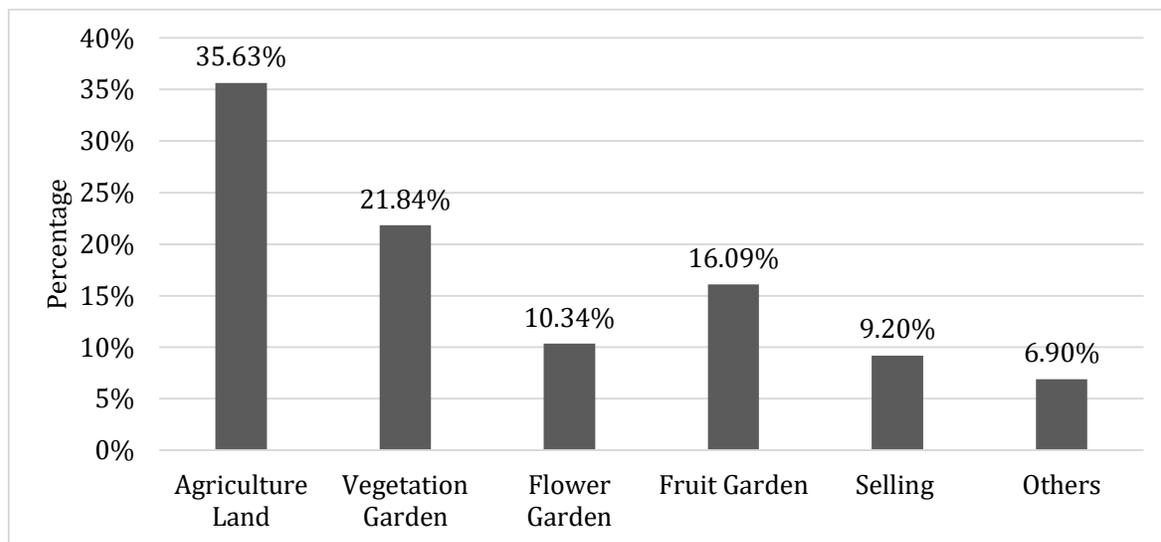


Figure 9-12: Use of Compost and Vermi Compost Fertilizer

A smaller fraction of compost and vermicompost is sold in local markets, indicating a commercial aspect to composting. The produced fertilizer is not only used by the producers themselves but also sold to other gardeners, farmers, or consumers looking for organic soil amendments.

9.2.7.7 Effect of poor unsafe, non-environment friendly solid waste management

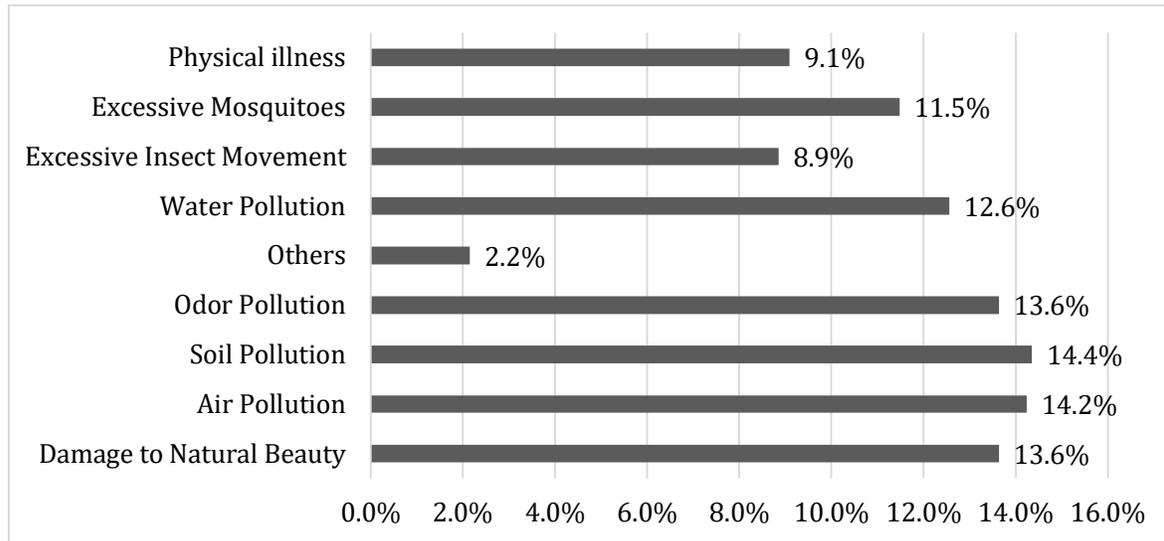
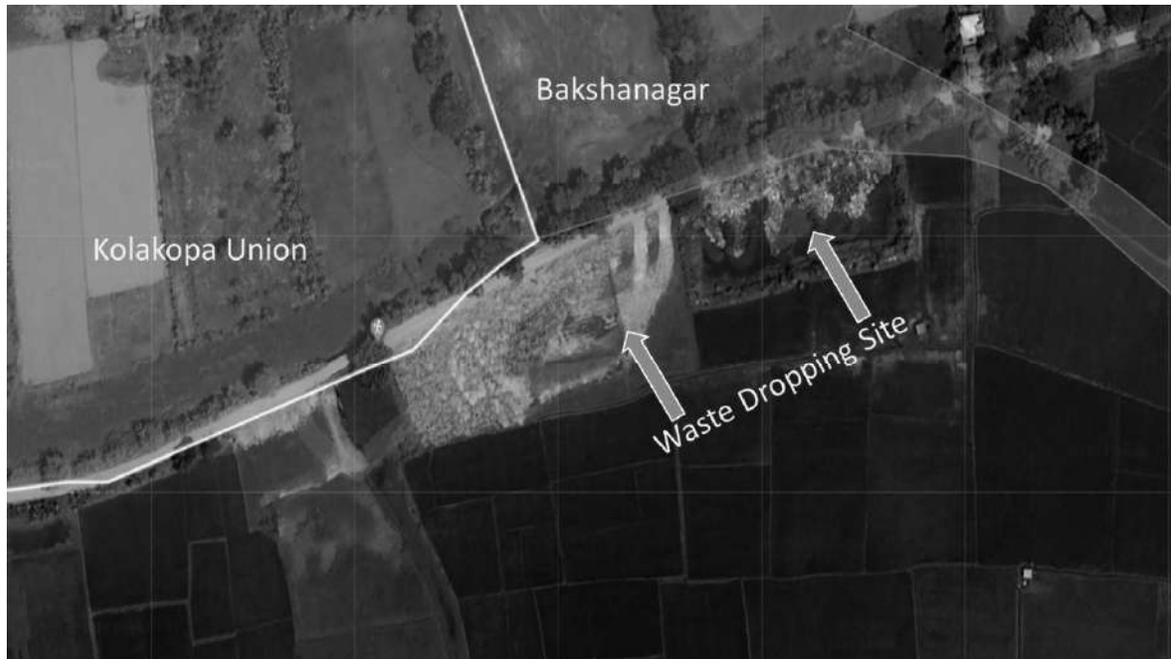


Figure 9-13: Status of problem faced by the citizens due to unplanned solid waste management

Figure 9- 13 illustrates the problems faced by citizens due to unplanned solid waste management, along with the corresponding percentages of the total reported issues. A significant percentage of citizens (13.6%) are concerned about the impact of waste on the aesthetics of their environment. Additionally, concerns about air pollution, odor pollution, and soil pollution are reported by 14.2%, 13.6%, and 14.4% of citizens, respectively. The unpleasant smells arising from waste can affect the quality of life and may also indicate decomposing organic matter. Furthermore, waste is adversely affecting soil quality water quality, which could potentially harm plant life, human health and infiltrate the food chain.

9.2.7.8 Land Fill Site in Nawabganj

Nawabganj Upazila is predominantly a rural area. The people in this region primarily sustain themselves through farming, small-scale commerce, and remittances. Almost 40% of the population in this upazila remains uneducated. Consequently, the residents are largely unaware of the benefits of waste management. A survey report reveals that the waste management system in Nawabganj Upazila is inadequate.



Source: Field Survey 2024

Figure 9-14: Location of Unofficial Land Fill site of Nawabganj Upazila

There is no household waste collection system and waste dropping site (landfill) implemented by the government authorities. Moreover, no private organizations or volunteer groups are involved in waste management in Nawabganj Upazila. Locals often choice to disposing of waste beside their courtyards, on roads, and nearest ponds and rivers. Littering can have significant negative impacts on the environment, public health, aesthetics, wildlife, soil degradation, water contamination, and the blockage of drainage systems. The study discovered an unauthorized landfill near the Kolapoka and Bakshanagar unions in Nawabganj, depicted in Figure 9- 14. Locals from these areas often use this site for waste disposal. The landfill spans approximately 0.62 acres, with waste covering around 0.32 acres.

9.2.7.9 Qurbani's Waste Management

Qurban is an important religious event for the Islamic community all over the world which is also known as Eid-ul-Adha. In almost all developing countries of the world the whole procedure of Qurbani is much easier and environment-friendly. To perform the rituals, one must take the purchased livestock to a specific location for slaughter. Then the meat and bone that is edible are given to people and the carcass is sent to the dumping area or for reuse. This aids in keeping the environment safe and the meat disease-free. The Qurbani waste includes blood, bones, horn, heads, and the blood-soaked mats.

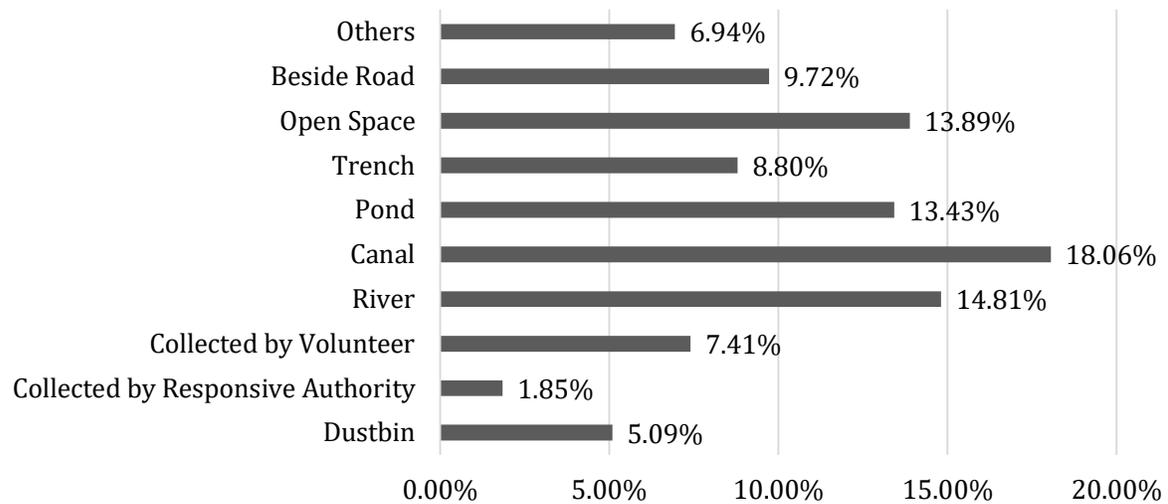


Figure 9-15: Scenario of Qurbani's Waste Disposal

The situation is horrifying regarding the unhygienic handling of meat and waste, as well as the improper management of animal skins and remaining feed in our country, especially in Nawabganj Upazila. In Nawabganj Upazila, there is no specific location designated for slaughter. The citizens of the locality used to slaughter beside the road, near the river, canal, and open space, among other places.



Source: Field Survey 2024

Figure 9-16: Same photos of Nawabganj Waste Disposal Systems

The union people dispose of their generated slaughter waste in canals (18.06%), rivers (14.81%), ponds (13.43%), open spaces (13.89%), and beside roads (9.72%), as presented in Figure 9- 15. In Nawabganj, there is no slaughter waste management community, but some self-motivated individuals form groups during the festival to manage and collect Qurbani waste from the union. These volunteer groups are not available in all the unions of Nawabganj Upazila. They are temporary groups of people used to do social work during the festival, especially in Nayansree, Sholla, and Kailail Union. The skin of the cows is being collected by representatives of the tannery industries, while some of them are collected by the Madrasah Community in Nawabganj.

9.2.7.10 Awareness Assessment on SWM

It is important to justify the Knowledge, Attitude, and Practice (KAP) of the community people. The KAP Model provides access to qualitative and quantitative information. In this study, the questions related to awareness assessment include knowledge and attitude of the citizens about household waste management. The awareness section consisted of 13 items, and each question has a possible response of “Yes,” “No,” “Others or Don’t know.” The findings show that 26.92%±0.164 of citizens are not aware of household waste management, and 33.63%±0.139 of citizens have no knowledge about waste management. The survey results reveal that 39.45%±0.242 of people are aware and have knowledge about waste management, but the amount is quite smaller than expected presented in Table 9- 9. From analyzing the data, it can be said that the community people are not sufficiently aware and knowledgeable about proper household waste management. Therefore, it is necessary to take steps to enhance the awareness and knowledge of citizens on SWM.

Table 9-9: Distribution of awareness level on household Solid Waste Management

Awareness Level Assessment	Not Aware	Aware	Don't Know
Household solid waste management committee are needed in the community	17.14%	42.86%	40.00%
Every people have to know about household solid waste management	9.29%	52.14%	38.57%
Local authorities have no role to play in the house hold solid waste management	35.71%	22.86%	41.43%
Respiratory distress, diarrhea and many other diseases arise due to improper waste Management	17.14%	42.14%	40.71%
Household solid waste can't reuse or recycle	52.86%	10.00%	37.14%
Waste disposal on open places will be harmful for human health	9.29%	59.29%	31.43%
All streets, River, Canal, Pond should be clean and free of waste	9.29%	61.43%	29.29%
I am always concern about collect and dispose of household solid waste management	18.57%	68.57%	12.86%
I am aware about door-to-door waste collection system	30.71%	41.43%	27.86%
I am aware of Secondary Waste Management System	33.57%	2.86%	63.57%
Do you want Ward based Waste Management Approach?	15.71%	77.86%	6.43%
I used to store liquid and solid waste into separate bins	50.71%	13.57%	35.71%
I used to store biodegradable and non-biodegradable waste into separate bins	50.00%	17.86%	32.14%
Mean	26.92%	39.45%	33.63%
Standard Deviation (SD)	0.164	0.242	0.139

Source: Field Survey 2024

9.2.7.11 Practice Level Assessment on SWM

The section concerning practice comprised 12 items, with each question allowing for responses of “Yes,” “No,” or “Sometimes.” According to the findings, 67.86%±0.143 of citizens do not engage in household waste management practices, while 17.74%±0.074 sometimes do. The survey results indicate that only 14.40%±0.102 of people actively practice and possess knowledge about waste management, the value considerably lower than anticipated as shown in Table 9- 10. Upon analyzing the data, it becomes evident that the community lacks adequate willingness to engage in proper household waste management practices. Consequently, there is a pressing need to undertake measures aimed at enhancing the awareness, knowledge, and practice of citizens regarding SWM.

Table 9-10: Distribution of Practice level on household Solid Waste Management

Practice Level Assessment	No	Yes	Sometimes
I use different bins for waste disposal	69.29%	5.00%	25.71%
I throw waste to river, pond, canal	45.00%	30.00%	25.00%
I throw waste to drain	73.57%	7.86%	18.57%
use our kitchen waste as compost to me for Gardening	95.00%	2.86%	2.14%
I reuse grocery bags	70.71%	18.57%	10.71%
reuse our old materials than buying a new one	77.86%	3.57%	18.57%
I throw waste to open field.	43.57%	32.14%	24.29%
collect the waste in a household container without cover	61.43%	24.29%	14.29%
collect the waste in plastic bag	61.43%	11.43%	27.14%
I segregate bio-degradable and non-biodegradable wastes at home	77.86%	10.71%	11.43%
I keep all the garbage in one garbage container	75.71%	7.86%	16.43%
I dispose the solid waste regularly	62.86%	18.57%	18.57%
Mean	67.86%	14.40%	17.74%
Standard Deviation	0.143	0.102	0.074

Source: Field Survey 2024

9.2.8 Medical Waste Management

Medical activities safeguard the health of the community of Nawabganj but their functioning results in the production of wide varieties of wastes. Medical services are a lifesaving tools but improper management of the medical waste may cause adversely impact on environment, food chain as well as public health directly and indirectly. Medical waste constitutes a public health hazard, if not managed properly. Although majority of the medical waste is no more dangerous than household/municipal waste, the hazardous waste, if exposed to the people or environment in an untreated form, pose various kinds of danger. Therefore, a survey has been conducted to get the detailed baseline scenario and status of medical waste management of existing hospitals, clinics, diagnostic center in Nawabganj Upazila.

9.2.8.1 Bin Placement

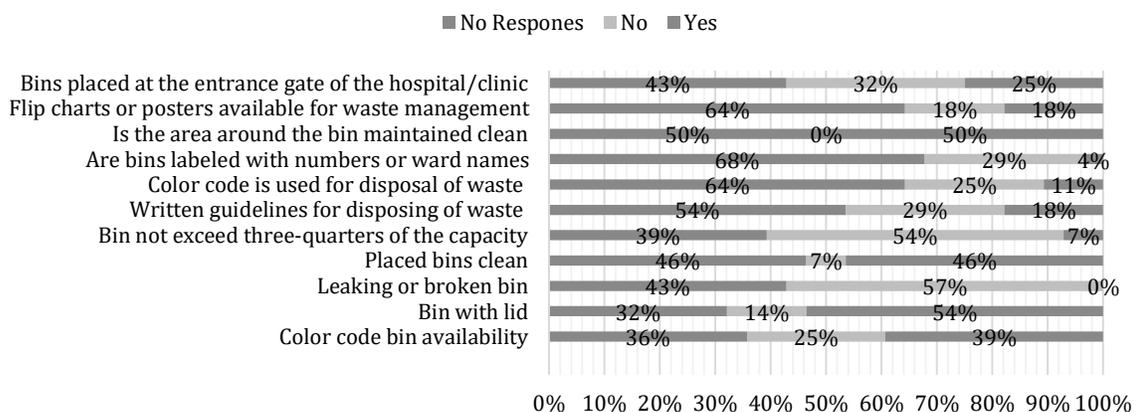


Figure 9-17: Bin Placement and condition of the placed bin in health care facilities

According to the investigation results on the placement of bins in various hospitals, clinics, and diagnostic centers, it has been found that, on average, 25% of medical service providers use dustbins to store medical waste. Among them, 39% of medical service providers label their bins according to color (Red, Yellow, Green, Black) to store different types of waste.



Source: Field Survey 2024

Figure 9-18: Placement of bin in private hospital, clinic, diagnostic center

Figure 9-17 shows that 54% of bins have lids, and 18% of bins have written guidelines for disposing of waste. The Figure 9-18 and Figure 9-19 show the placement of bins in private and public hospitals and clinics in Nawabganj. The visuals indicate that the private sector is more organized than the public sector in the study area. Public clinics use safety boxes and plastic bins without lids, while private clinics use color-coded plastic bins with lids to store medical waste.



Source: Field Survey 2024

Figure 9-19: Bin Placement of Govt. clinic of Nawabganj

9.2.8.2 Waste Classification and Storage According Color Code

The segregation of medical waste ensures the ability to manage, handle, treat, and dispose of medical waste while considering the safety of human and environmental health. Medical waste consists of infectious waste, sharp objects, and pathogens that pose risks to human health and the environment if not managed appropriately.

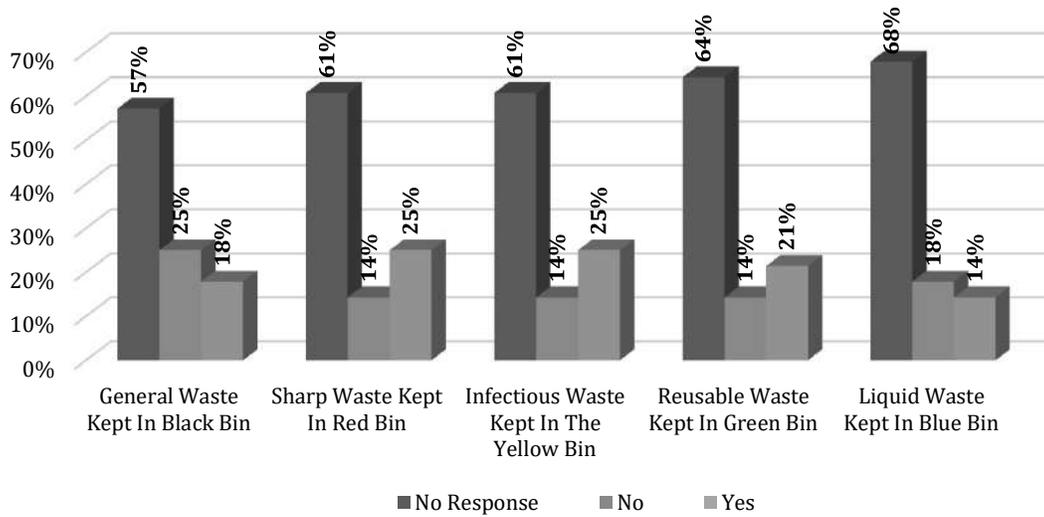


Figure 9-20: Status of storing waste according to the waste classification (Color coded)

A study was conducted to assess medical waste segregation in Nawabganj by utilizing a questionnaire survey in different healthcare facilities. The investigation found that, on average, 62% of hospitals, clinics, and diagnostic centers failed to provide information related to medical waste segregation, while the rest were able to provide this information. Among them, an average of 17% of hospitals declared that they do not segregate medical waste according to color code; instead, they store all kinds of waste in a common bin, mixing it with general waste. Only 21% of medical service providers store medical waste according to the color code stipulated by the environmental management framework of the Ministry of Health and Family Welfare. The survey covered the Upazila Health Complex of Nawabganj Upazila. The condition of this public hospital is represented in Figure 9- 20. The Upazila Complex has several color-coded bins to store waste in a classified manner, but the bins are not cleaned or maintained properly. The number of bins present in this hospital is not sufficient to serve the huge number of patients within its complex.



Source: Field Survey 2024

Figure 9-21: Medical Waste Management Scenario of Nawabganj Upazila Health Complex

9.2.8.3 Waste Collection and Transport

To assess the medical waste collection and transport system, some questions were asked based on the criteria mentioned in Table 9- 11.

Figure 9-22: Condition assessment of waste collection, transport and management

Criteria	No Response	No	Yes
Available Trolleys for Carrying Waste	39.29%	32.14%	28.57%
Waste Covered with a Lid During Transport	46.43%	17.86%	35.71%
Selected Route Used for Carrying the Waste	64.29%	10.71%	25.00%
Available Water Supply for Cleaning the Floor	35.71%	0.00%	64.29%
Available Cleaning Tools, Sand, Fire Extinguisher and Reagents	53.57%	14.29%	32.14%
Having Unauthorized Animals and Insects	75.00%	21.43%	3.57%
Having Proper Lighting and Passive Ventilation	35.71%	0.00%	64.29%
Storage Room in Proximity to Food Preparation Area	78.57%	21.43%	0.00%
Easy Access for Vans to Pick up Waste	60.71%	14.29%	25.00%
Waste Stored for More than 24 Hours	64.29%	25.00%	10.71%

Source: Field Survey 2024

The assessment results found that the waste collection and transport system of Nawabganj Upazila is not significantly good. The results show that, on average, only 29% of public health centers are able to meet the assessment criteria. There is a noteworthy opportunity for improvement if they follow national environmental and health policies.

9.2.8.4 Types of Equipment Wear During Collection of Waste

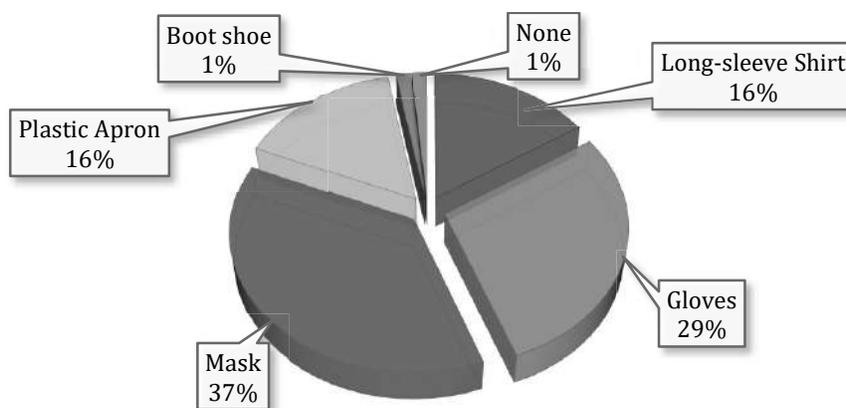


Figure 9-23: Percentage of equipment wear during collection of medical waste

The survey was conducted to find out which types of equipment are being wear by waste collector during collecting, transporting waste in Nawabganj. The equipment was classified into various type such as boot shoe, plastic apron, long-sleeve shirt, gloves, mask which is presented in Figure 9- 22. The shows that most of the waste collector used mask and gloves when they collect medical

waste which are 37% and 29% respectively. 16% of the waste collector used to wear plastic apron and long sleeve shirt.

9.2.8.5 Medical Waste Disposal Site

The disposal or destruction of medical waste is an important practice to reduce the effects of hazardous, sharp, infectious waste on humans and the environment. A survey was conducted to identify the methods of destroying medical waste and the common places for disposing of waste from hospitals, clinics, and diagnostic centers in Nawabganj.

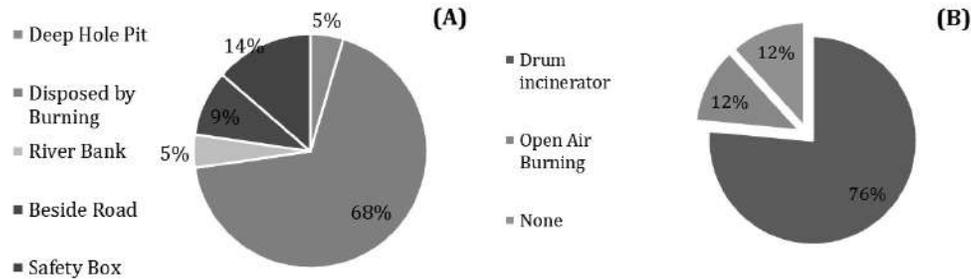


Figure 9-24: Way of Disposing Medical Waste in Nawabganj

The investigation found that most medical waste is being stored in government-provided safety boxes in the majority of public clinics, while very few private clinics follow this practice, accounting for around 68%.

Figure 9-24: Way of Disposing Medical Waste in Nawabganj(A) and

Figure 9-24: Way of Disposing Medical Waste in Nawabganj(B) depict the medical waste disposal sites and the methods of destroying sharp, infectious waste in Nawabganj, respectively. The investigation reveals that medical waste is being disposed of in safety boxes (68%), beside roads (9%), riverbanks (5%), by burning (14%), and in deep pit holes (5%). The majority of medical waste is being destroyed by drum incinerators, accounting for nearly 76%, while around 12% is disposed of through open burning.

9.2.9 Sanitation

The sanitation condition in Bangladesh presents significant challenges and improvement during the last decades. Bangladesh has made remarkable progress on Millennium Development Goals by significantly reducing the population without access to improved water supply and sanitation facilities. The United Nations has set Sustainable Development Goal 6 (SDG 6) to ensure availability and sustainable management of water and sanitation for all by 2030. This goal includes targets for achieving universal and equitable access to safe and affordable drinking water, adequate and equitable sanitation and hygiene, ending open defecation, improving water quality, increasing water-use efficiency, implementing integrated water resources management, and expanding international cooperation on water- and sanitation-related activities. A study has conducted a survey to assess the condition of sanitation in Nawabganj Upazila of Bangladesh.

9.2.9.1 Sanitary Latrine Availability

The sanitation assessment reveals that in Nawabganj Upazila, 41% of households do not have their own sanitary latrines, indicating a common reliance on communal or external facilities. It is

observed that the less durable 'Kaccha' houses in this area are particularly underserved in terms of having access to proper sanitation facilities.

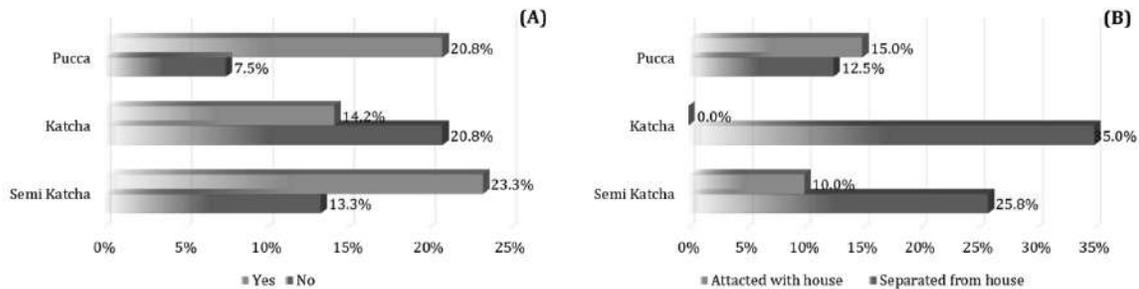


Figure 9-25: Status of Sanitary Latrine Availability in Nawabganj

Furthermore, a majority of the latrines, approximately 71.7%, are not attached to the houses. Visual representations of this data are provided in Figure 9- 24 (A) and Figure 9- 24(B), which detail the types of latrine structures available and their respective locations in relation to the housing structures.

9.2.9.2 Ownership of the Sanitary Latrine

The Figure 9- 26 illustrates the percentages of households in Nawabganj Upazila that have access to private and shared latrines, categorized by the type of house structure—Pucca, Katcha, and Semi Katcha. For Pucca, or permanent homes, 18.8% have private latrines and 7.7% use shared latrines.

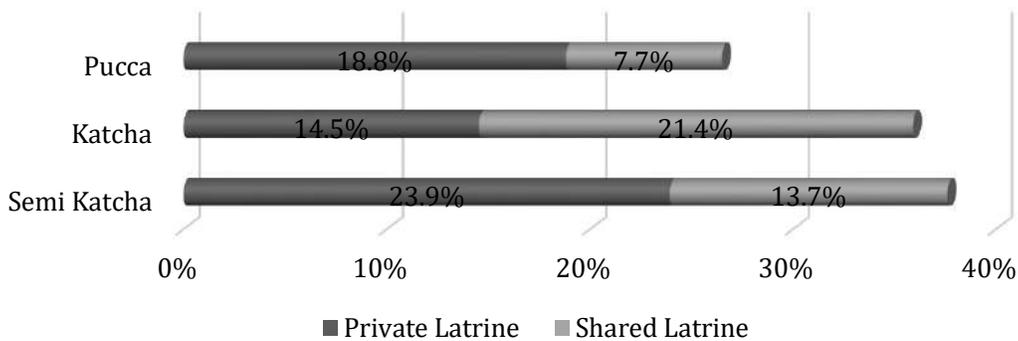


Figure 9-26: Status of Sanitary Latrine Ownership in Nawabganj

Katcha house have 14.5% with private latrines and a higher percentage of 21.4% using shared latrines. Semi Katcha homes, have the highest percentage of private latrines at 23.9% and 13.7% for shared latrines. The data suggests that semi-permanent structures have better access to private latrines compared to the other types, whereas temporary homes have a higher reliance on shared latrines.

9.2.9.3 Assessment of Latrine Condition

The Figure 9- 26 presents the types of latrines used by the households of Nawabganj Upazila. The results show that 33.33% of households in the study area have Hygiene latrines, which are likely to be well constructed and designated to promote cleanliness and minimize health risks. 27.50% of households have pit latrines with a slab, 18.33% have pit latrines without a slab, 15% have

shared latrines, and 5.83% have hanging latrines, which are typically built over water bodies and have no pit.

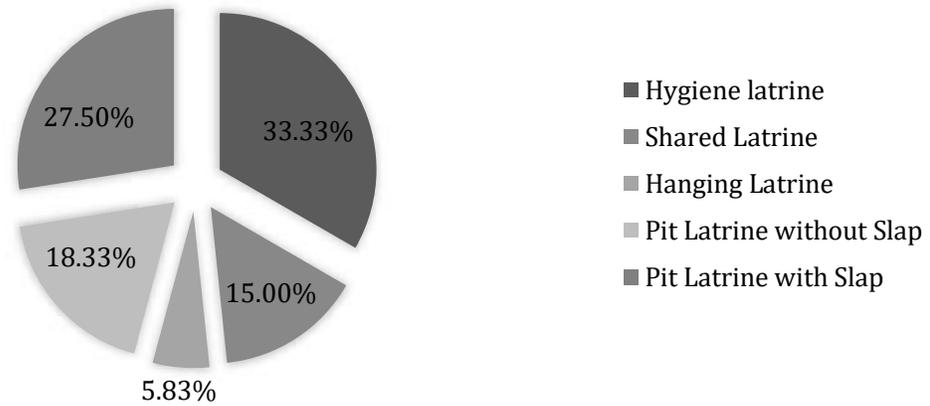


Figure 9-27: Types of Sanitation Latrines

Figure 9- 27 displays the materials utilized for constructing latrines in Nawabganj Upazila. The results of the survey indicate that 37% of latrines are constructed with brick structures, 32% are made of bamboo, 13% incorporate ring slabs, and 12% are crafted from locally available wood in the study area. The **Error! Reference source not found.** shows the visual condition of the latrines in Nawabganj.

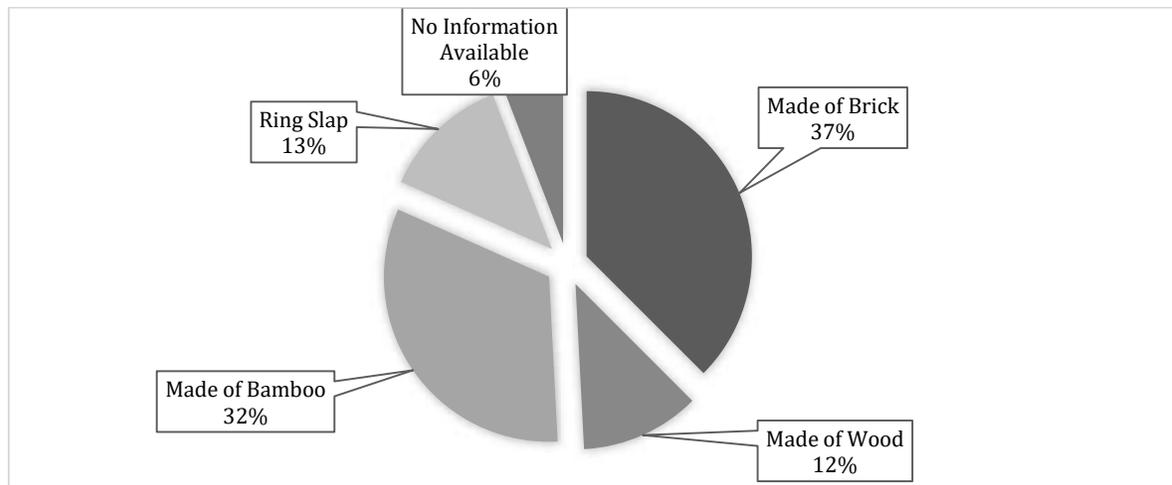


Figure 9- 1 Material used to construct latrine's super structures

The households in Nawabganj were asked to report the frequency with which they clean their latrines to assess hygiene practices in the use of sanitary latrines.

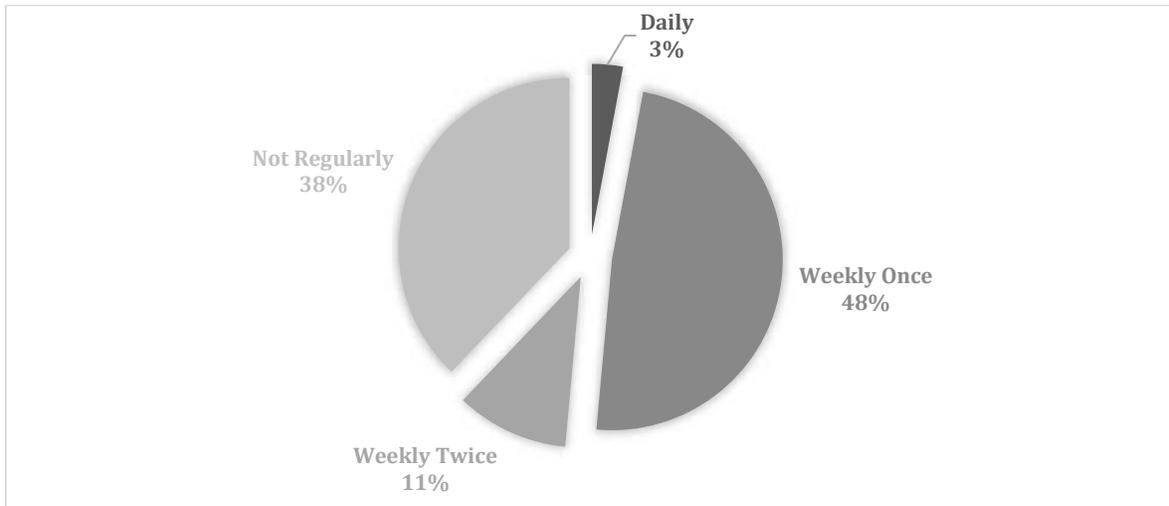


Figure 9-28: Latrine Cleaning Status

The findings show that only 3% of households clean their latrines daily, 48% clean once a week, 11% clean twice a week, and 38% do not clean their latrines regularly, as presented in Figure 9-28.



Figure 9-29: Same photos of Nawabganj Upazila's Sanitary Latrine

9.2.9.4 Source of Water for Latrine

The findings of the survey regarding the sources of water being used in latrines show that there are various sources available. The most common sources of water in Nawabganj are tubewell groundwater, adjacent canals, and ponds, as presented in Figure 9-30.

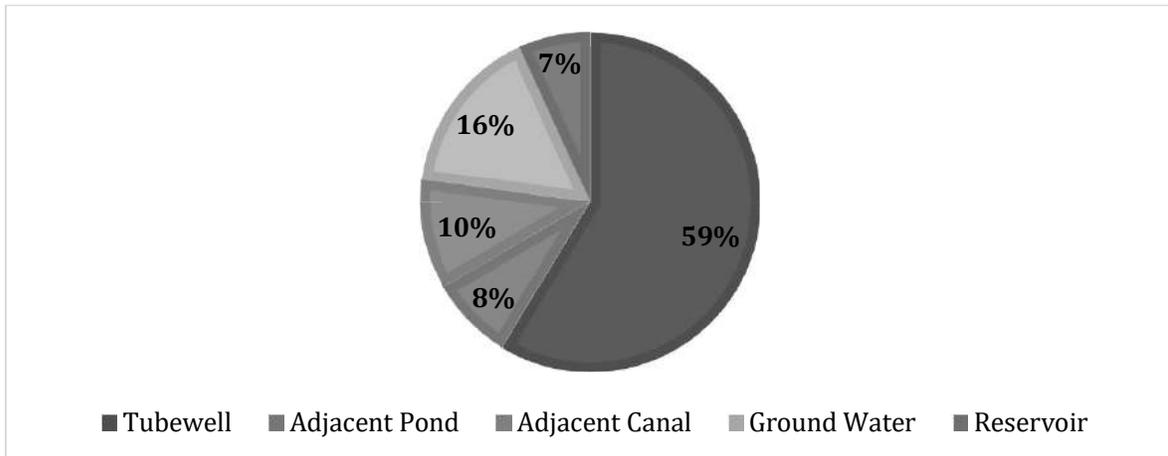


Figure 9-30: Source of water used in Latrine

Some people in Nawabganj collect water from nearby rivers, canals, and ponds, storing it in reservoirs for later use. Among these sources, 59% of people rely on water extracted by tubewells, 16% use groundwater, 10% collect water from adjacent canals, and 8% from adjacent ponds

9.2.9.5 Fecal Sludge Management

In this part of the study, citizens were asked to respond regarding where they dispose of fecal sludge in Nawabganj. The most common findings were lowland areas, adjacent ponds, adjacent rivers, canals, and open pits.

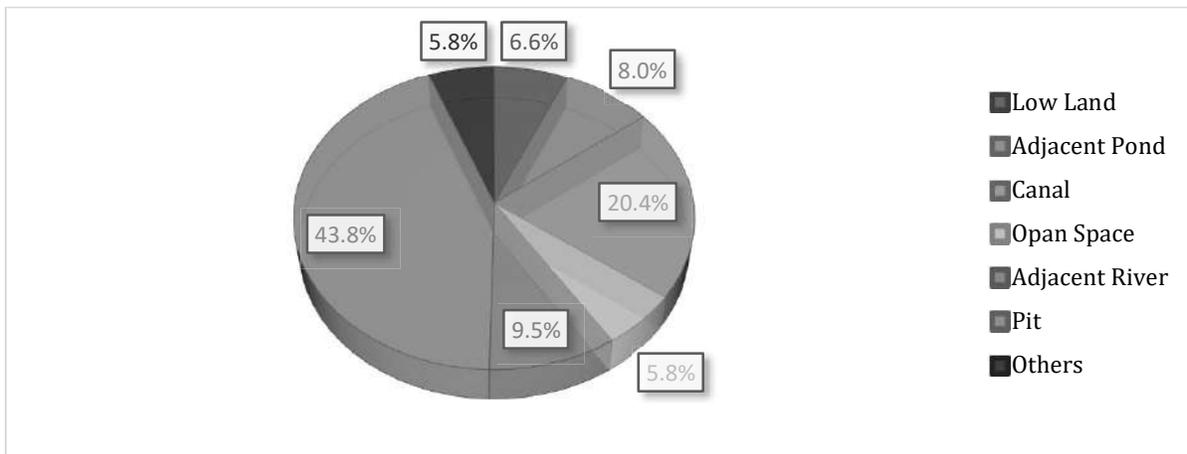


Figure 9-31: Disposal site of fecal Sludge in Nawabganj

Although there is no specific site or authority to manage fecal sludge, people generally manage it themselves. The results show that 43.8% of citizens usually dump fecal waste into small or deep pits, 20.4% dispose of it into nearby canals, 8% into ponds, and 9.5% into rivers as presented in Figure 9- 31. The improper management of fecal sludge has significant negative impacts on both public health and the environment. Contamination of water by fecal matter can result in waterborne diseases, causing illness and even death, especially among children and vulnerable populations. Exposure to untreated fecal sludge can lead to the spread of diseases such as diarrhea and cholera. Mismanagement of fecal waste can also pollute the environment by

disrupting natural ecosystems, depleting oxygen levels, and harming aquatic life. Pathogens present in fecal sludge can negatively impact biodiversity by affecting aquatic organisms and wildlife.

9.2.9.6 Impact of Improper Sanitation Practice in Nawabganj

The impact of improper sanitation practices is complex and can have severe consequences for public health, the environment, and socioeconomic development. Throughout the survey, the study was able to identify several issues faced by the local people in Nawabganj. These include damage to natural beauty, air pollution, soil pollution, odor pollution, excessive insect movement, excessive mosquitoes, physical illness, water pollution, and the response rates are represented in **Error! Reference source not found..** The results have found that 16.6% of people have faced air pollution problems, 16.4% have faced soil pollution, and 12.6% of people believe that it may damage natural beauty and increase mosquitoes in Nawabganj Upazila.

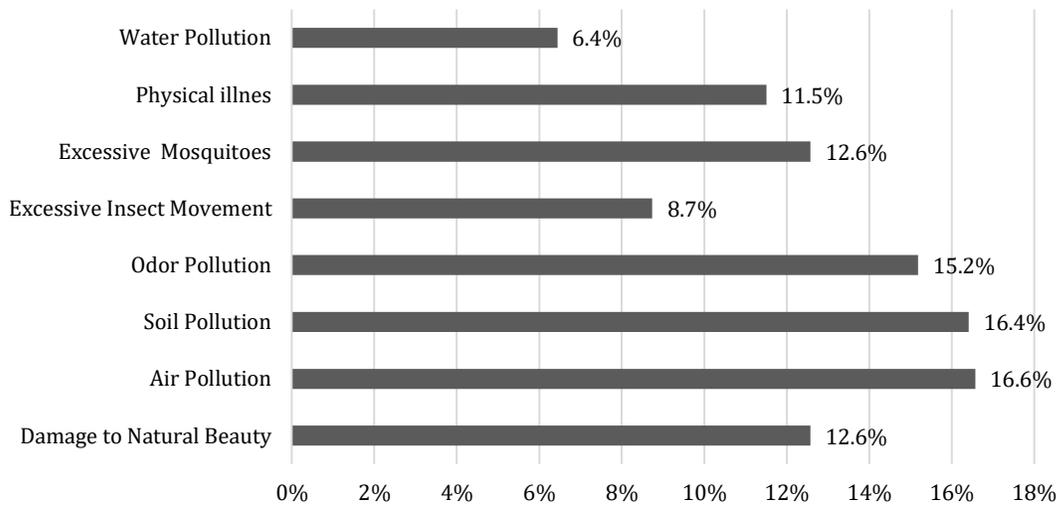


Figure 9-32: Impact of improper sanitation practice in Nawabganj

9.2.10 Water Supply

9.2.10.1 Source of Water in Nawabganj

Water supply is a crucial need for citizens, playing a key role in human health, economic progress, and environmental sustainability. Access to clean and safe water is essential for disease prevention, sanitation, and overall well-being. A survey conducted to assess the water supply conditions in Nawabganj identifies seven sources of water, as listed in **Error! Reference source not found..** Residents of Nawabganj primarily use clean water for drinking, feeding livestock, and kitchen activities. The survey results indicate that the majority of people in Nawabganj rely on tube wells to meet their daily water needs, with 68.18% using tube well water for drinking and 25% depending on pumped groundwater. For kitchen tasks and feeding livestock, they mainly use tube well water, pumped groundwater, rainwater, and water from ponds and rivers.

Table 9-11: Water Source of Nawabganj Upazila

Water Source	Drinking Water	Kitchen Work	Livestock
River	1.14%	2.15%	6.25%
Canal	0.00%	0.00%	0.00%
Pond	2.27%	3.23%	10.42%
Rain Water	0.00%	6.45%	0.00%
Public Tab Water	2.27%	2.15%	0.00%
Tube-well	68.18%	62.37%	62.50%
Pumped Ground Water	25.00%	22.58%	18.75%
Others	1.14%	1.08%	2.08%
Total	100.00%	100.00%	100.00%

Source: Field Survey 2024

9.2.10.2 Drinking Water Quality Assessment from Citizens Perspective

A survey was conducted to determine a qualitative assessment of drinking water quality in Nawabganj, which is presented in Figure 9-33: Water Quality Assessment from Citizens Perspective. In this way, local people were asked about the quality of water from where they collect water regularly.

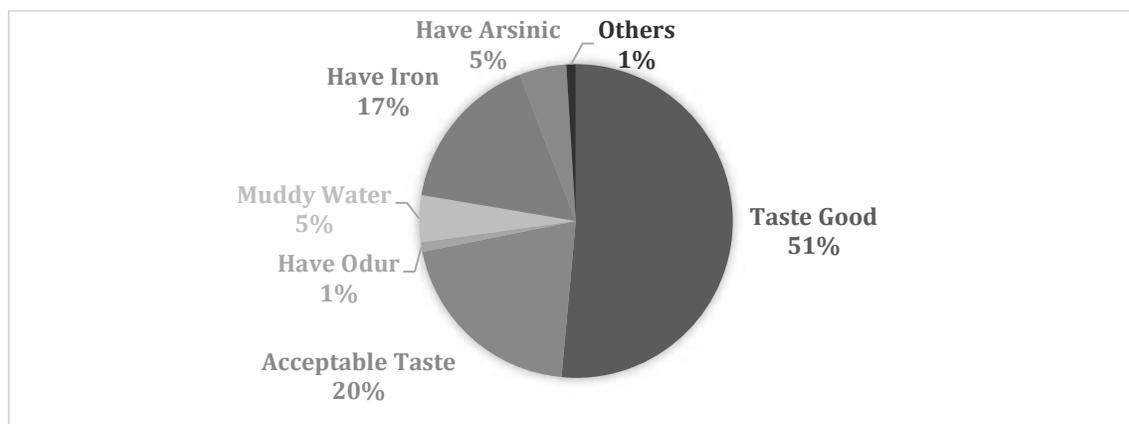


Figure 9-33: Water Quality Assessment from Citizens Perspective

According to the respondent, it shows that half of the people observe that the water has a good taste, 20% respond that the water has an acceptable taste, 17% are experienced with water containing iron, and 5% of people say the water is muddy in color and has arsenic contamination.

9.2.10.3 Distance between house and Water Source

To get the information regarding the distance between the source of water and the house, a survey was conducted through a questionnaire. The findings of these survey are presented in Figure 9- 34. The results indicate that most of water source are situated within walking distance which required 1-3 mins said by 86% of respondents in Nawabganj.

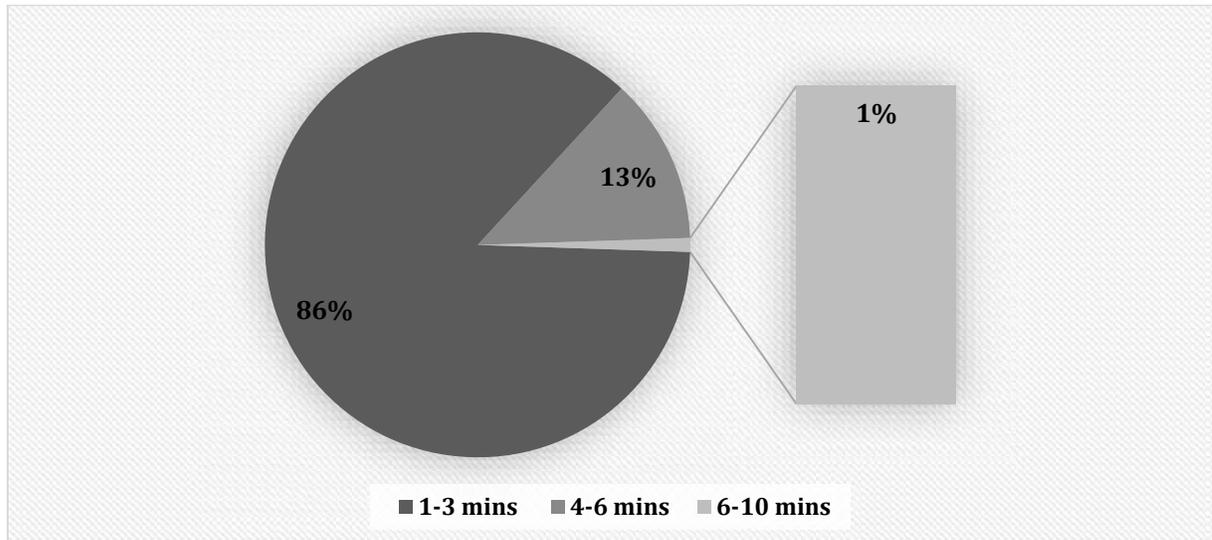


Figure 9-34: Walking Distance from house to drinking water sources

9.2.11 Existing Ecology (Terrestrial Fauna, Flora, Aquatic Fauna and Flora)

9.2.11.1 Terrestrial Fauna

Various studies have documented a decreasing trend in the population of diverse faunal species in Bangladesh. Approximately 23% of vertebrates in Bangladesh are encountering varying degrees of threats (Feeroz, 2014). According to the IUCN (2000), 57% of reptiles and 36% of mammals are facing threats. The same report identified 388 bird species, with 19 classified as Critically Endangered, 18 as Threatened Endangered, and 4 as Vulnerable. Among the birds that have become extinct in Bangladesh, only one species (the Pink-headed Duck) has reached global extinction. The gradual depletion of habitat is contributing to the decline in both population and diversity of invertebrates in the country.

The Nawabganj Upazila, located in the Dhaka District, have a high level of biological and ecological diversity, hosting a wide array of terrestrial fauna that is locally abundant. The harmonious coexistence of both plant and animal life is crucial for safeguarding the area's biodiversity. Predominantly rural, this region serves as a habitat for a diverse range of birds, animals, and insects. Among them, the following species are commonly found in Nawabganj Upazila - *Apis indica* (Indian honeybee), Chiroptera (Bats), *Acridotheres tristis* (Common Myna), *Pycnonotus cafer* (Red-Vented Bulbul), *Copsychus saularis* (Magpie-Robin), *Psittacula kramera* (Rose-Ringed Parakeet), *Latrodectus katipo* (katipo spider), *Canis aureus* (golden jackal), Monitor lizards, and *Macaca arctoides* (stump-tailed macaque).

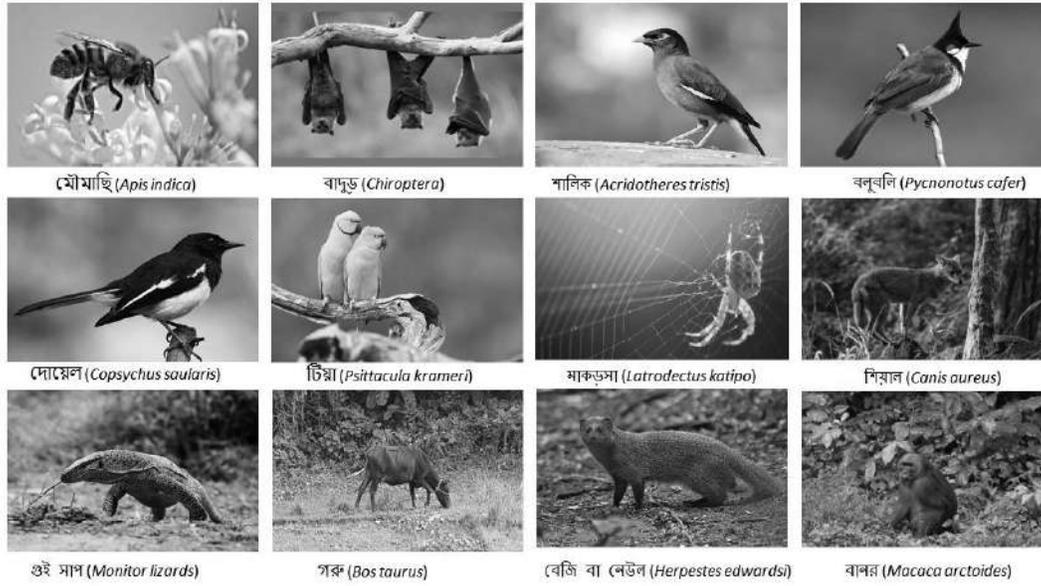


Figure 9-35: Scenario of terrestrial fauna (Photo courtesy: Internet and Field Survey)

These diverse species contribute to the ecological richness of the area. Terrestrial birds in the study area are divided into two groups: those in floodplains and wetlands, and those in dry land habitats. Birds of prey, including the Brahminy Kite, herons, and Common Kingfisher, thrive in the region. Other common species like, the Bronzed Drongo, Common Mynah, Barn Owl, and Blue Rock Pigeon are also present. Notably, the Brahminy Kite is classified as a threatened species by the IUCN-Bangladesh (2015).

9.2.11.2 Aquatic Fauna

The study area encompasses various wetland types, including rivers, khals/canals, beels, ditches, and ponds. Two distinct categories of wetlands have been identified: (i) Perennial wetlands, such as beels, khals, and homestead ponds, which retain water throughout the entire year.

Table 9-12: List of Aquatic Faunal Species of Nawabganj Upazila

English Name	Scientific name	Family name	IUCN Status	Local Status
Birds				
White breasted Kingfisher	Halcyon smyrnensis	Alcedinidae	NO	Common
Common Kingfisher	Alcedo atthis	Alcedinidae	NO	Common
Brahminy Kite	Haliastur indus	Accipitridae	LC	Common
Little egret	Egretta garzetta	Ardeidae	LC	Common
Great egret	Casmerodius albus	Ardeidae	LC	Common
pond heron	Ardeola grayii	Ardeidae	LC	Common
Grey heron	Ardea cinerea	Ardeidae	LC	Common
Little cormorant	Phalacrocorax niger	Phalacrocoracidae	LC	Common
Black Kite	Milvus migrans	Accipitridae	NO	Common
Reptiles				
Bengal Monitor	Varanus bengalensis	Varanidar	NT	Common
Stripes Keelback	Amphiesma stolata	Natricidae	NO	Common
Olive Keelback	Atretium schistosum	Natricidae	NO	Common

English Name	Scientific name	Family name	IUCN Status	Local Status
Rat Snake	Ptyas mucosus	Colubridae	LC	Common
Garden Lizard	Calotes versicolor	Agamidae	LC	Common
Checkered Keel back	Xenocrophis piscator	Colubridae	NO	Common
Smooth water snake	Enhydris enhydris	Homalopsidae	NO	Common
Amphibians				
Common Toad	Bufo melanosticus	Ranidae	NO	Common
Skipper Frog	Euphlyctis cyanophlyctis	Ranidae	NO	Common
Cricket frog	Rana limnocharis	Ranidae	NO	Common
Bull frog	Hoplobatrachus tigerinus	Ranidae	NO	Common
Mammals				
Ganges River Dolphin	Platanista gangetica	Platanistidae	EN	Common

*Note: NO= Not Threatened; NT= Nearest Vulnerable, LC=Least Concern, EN= Endangered

Source: Red list of Threatened Animals of Bangladesh (IUCN) 2015, EIA of Nawabganj 2021 and Field Survey 2024

The water from these sources is commonly utilized for domestic needs and fish cultivation, making them favorable for aquatic fauna. The second type is (ii) Seasonal wetlands, characterized by water presence only during the rainy season, drying up in the dry season. The existence of these diverse wetland types provides a varied habitat for aquatic fauna. Below are listed the aquatic flora species found in the study area.

9.2.11.3 Terrestrial Flora

In the terrestrial ecosystem of the Study area, floral distribution can be divided into four categories which are crop-field, homestead, roadside and river/canal side vegetations. In the study area, maximum of agricultural land was found as medium high land which are inundated during monsoon. Major crops found in this field are; Auas, B. Aman and Boro paddy. Besides these, some vegetables and economically valued crops are also cultivated in the dry season. During the month November to February, Onion, Garlic, Coriander, Black Cumin are commonly found in this region.

In the homestead vegetation of the region, commonly planted tree species include Jackfruit (*Artocarpus heterophyllus*), American mahogany (*Swietenia mahagoni*), Banana (*Musa sp*), Gogon Shirish tree (*Albizia lebbek*), Indian nut palm (*Areca catechu*), Pomelo (*Citrus maxima*), Mallotus (*Trewia nudiflora*), Black Berry (*Rubus argutus*), Silk tree (*Albizia richardiana*), Jujube (*Ziziphus mauritiana*), and others. This vegetation serves as essential shelter for local wildlife. The area is also utilized for cultivating various vegetables and economically valuable crops. In addition to the cultivated varieties, different plant species, primarily weeds, thrive in the area, including *Echinochloa colonum*, *Centipeda orbicularis*, *Cheratopteris sp*, *Panicum repens*, *Amaranthus spinosus*, *Cyperus sp.*, *Ethulia conyzoides*, *Chenopodium ambrosoides*, and more. This type of vegetation creates a feeding habitat for numerous wildlife.

The vegetation alongside roads is primarily deliberate plantings, creating a well-established ecosystem. Commonly found in this region are introduced species such as West Indian mahogany (*Swietenia mahagoni*), Silk tree (*Albizia richardiana*), and Date palm (*Phoenix sylvestris*).

Additionally, there is a presence of small-sized herbs and shrubs, including black nightshade (*Solanum nigrum*), Ivy gourd (*Coccinia grandis*), Taro (*Colocasia esculenta*), Makra (*Dactyloctenium aegyptium*), Fig tree (*Ficus hispida*), and Pink Morning Glory (*Ipomoea fistulosa*), frequently observed in the study area. In the area of Shikaripara Union and Bakshanagar Union of the Upazila, the Eucalyptus (*Eucalyptus obliqua*) tree is also noticeable.

The vegetation along the sides of rivers, canals, and khals is characterized by the presence of local plant species such as Beachwood (*Gmelina arborea*), Bamboo (*Bamboosa sp*), Banana (*Musa sp*), and others. Some herbs and shrubs, including Wild Senna (*Senna hebecarpa*), Croton plant (*Codiaeum variegatum*), Mexican poppy (*Argemone Mexicana*), Chinese Spinach (*Amaranthus dubius*), are also observed in the vegetation along rivers, canals, and khals. These plant communities serve as crucial habitats for a diverse range of insects, reptiles, birds, and small mammals

9.2.11.4 Aquatic Fauna

The wetlands within the project area play a crucial role in supporting the aquatic ecosystem by supplying essential nutrients. Both seasonal and perennial wetlands contribute to the flourishing of aquatic plant communities. Various types of aquatic flora were observed throughout the project area, including common submerged species like Tape grass (*Vallisneria spiralis*), Isotes, and Nitella. In this area, free-floating plants such as Water hyacinth (*Eichhornia crassipes*), Water cabbage (*Pistia stratiotes*), and Azola (*Azolla pinnata*) were identified. Rooted floating plant communities dominate both perennial and seasonal wetlands within the project area, with Water lily (*Nymphae nouchali*) being the most prevalent species. Sedges and meadow plants are abundant in seasonal wetlands, and notable plants in the project area include Knotweed (*Polygonum Sp*), Pink morning glory (*Ipomoea fistulosa*), *Salvinia auriculata*, and *Azolla pinnata*.

9.3 Climate Change and Environment

The environment is the surroundings or state in which abiotic, biotic, and anthropogenic components interact with one another. It comprises both the physical and natural surroundings that collectively provide the context in which life takes place. The environment consists of elements such as air, water, soil, climate, flora, and fauna, and their interactions. The abiotic component includes the atmosphere, hydrosphere, lithosphere, climate, and solar energy, among other things. The built environment serves as an example of anthropogenic environmental component. The long-term patterns of temperature, humidity, wind, precipitation, and other atmospheric characteristics in a certain location are referred to as the climate. Changes or disruptions to these characteristics have a substantial impact on different parts of the natural environment, including ecosystems, biodiversity, and human societies. (Abbass, Qasim, Song, Murshed, & Mahmood, 2022)

Indeed, due to its geographical location, Bangladesh is considered one of the most at-risk countries when it comes to climate change. The nation faces annual challenges such as tropical cyclone, storm surge, coastal erosion, and the backwater effect due to the extreme climatic conditions prevalent in the region. Climate change include the low-lying topography, frequent tropical cyclones with associated heavy rainfall, and the extensive coastline susceptible to erosion and rising sea levels (Ali, 1999). The interplay of climate change issues poses significant threats to the population, agriculture, and infrastructure, necessitating a combination of adaptation and

mitigation measures, such as early warning system, sustainable land-use practice, and international collaboration to address the impacts of climate change and enhance resilience in the face of environmental challenges.

9.3.1 Climatic Condition

9.3.1.1 Temperature

The data has been collected from only one weather station in Nawabganj Upazila, which is located in Dhaka, the data will be the same for all places in Nawabganj Upazila. The data shows that the average maximum temperature in the study area was recorded as 31°C in July 2022, and the average minimum temperature was 20.25°C in January 2022.

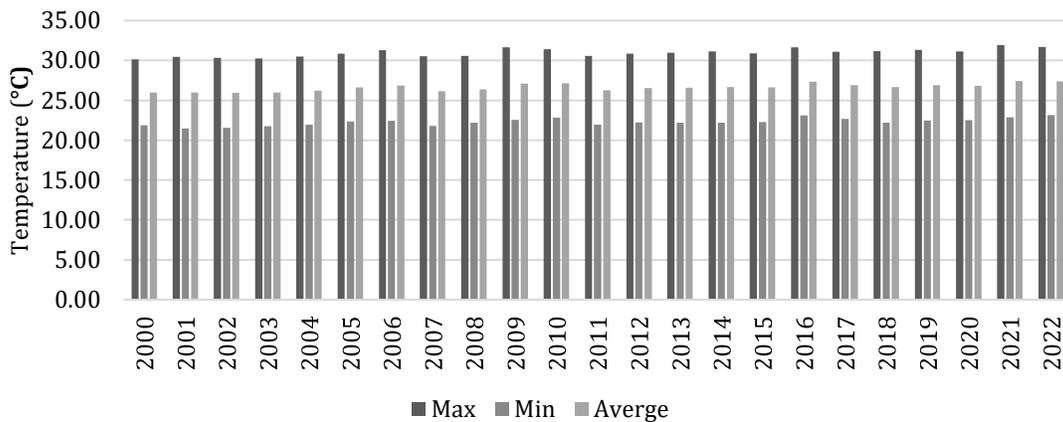


Figure 9-36: Trend of Temperature over the last 20 years (Source: Bangladesh Agricultural Research Council (BARC))

According to temperature patterns documented over a 20-year period, it is clear that the average temperature in the research area is gradually rising (Error! Reference source not found.). The average temperature in 2000 was 26°C, and by 2022, it had risen to 27.40°C. During this two-decade period, the average temperature increased by 1.40°C, showing a yearly increase of 0.07°C in the studied region.

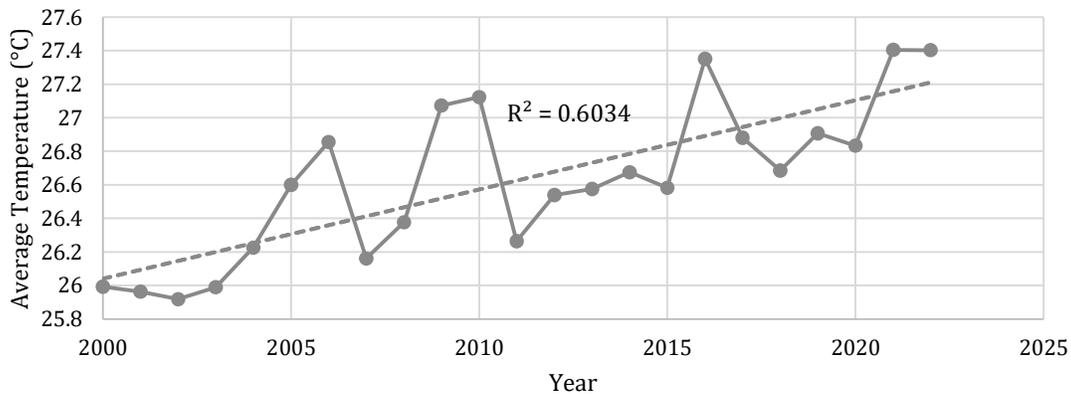


Figure 9-37: Average annual temperature trend at the study area from 2000 to 2022

9.3.1.2 Precipitation

With only one weather station situated in Nawabganj Upazila, specifically in Dhaka, the recorded data remains uniform across all locations in Nawabganj Upazila. The figures indicate that the average maximum rainfall in the study area reached 241.00 mm in 2017, while the average minimum rainfall stood at 108.42 mm in 2022, as illustrated in Figure 9- 38.

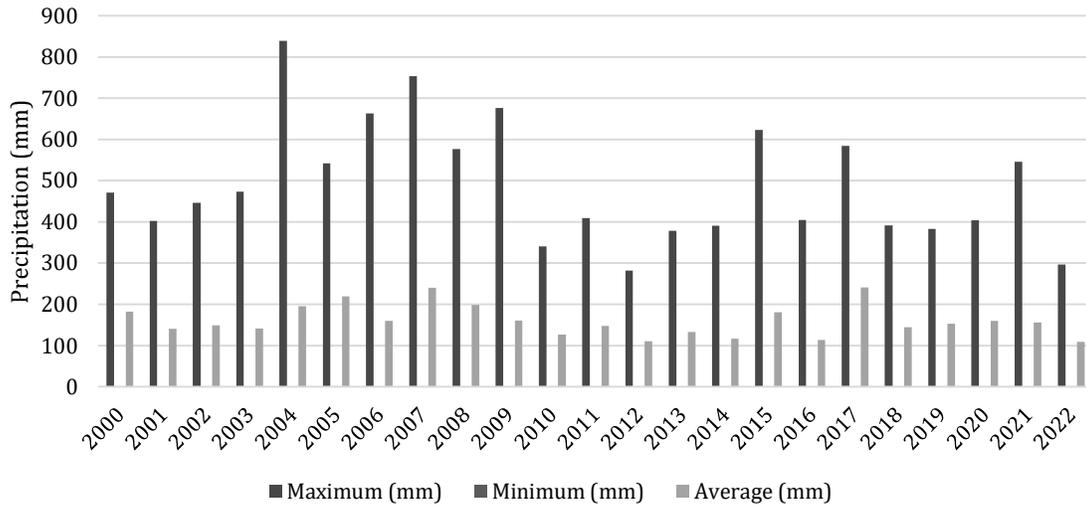


Figure 9-38: Trend of precipitation over the last 20 years (Source: Bangladesh Agricultural Research Council (BARC))

The average annual precipitation in the study area reveals a decreasing trend during the 2000 to 2022 period, as illustrated in Figure 9- 39.

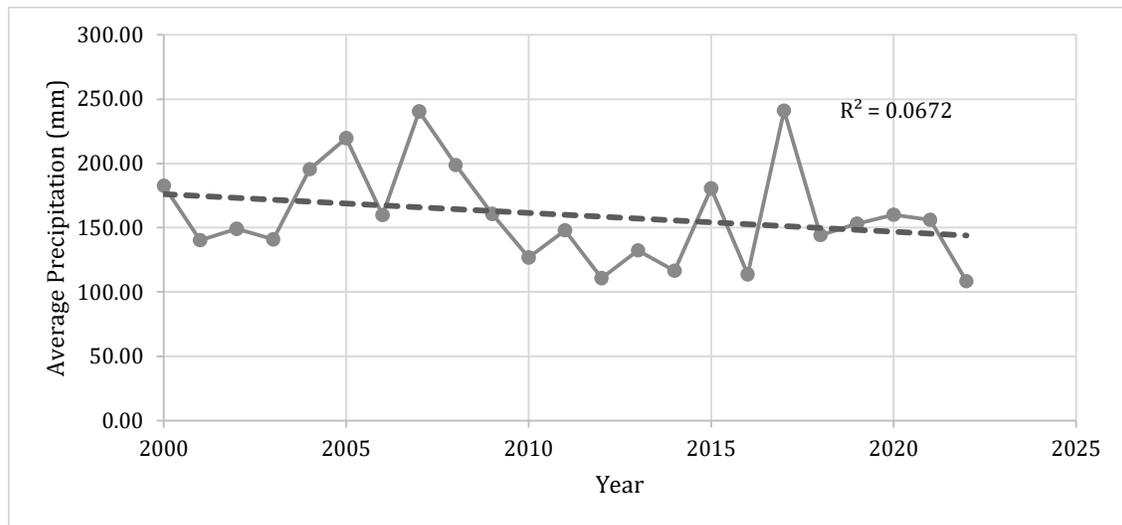


Figure 9-39: Average annual Precipitation trend at the study area from 2000 to 2022

In 2000, the average precipitation measured 182.75 mm, and by 2022, it had dropped to 108.2 mm. Over this two-decade timeframe, the average precipitation witnessed a decline of 74.55 mm, indicating an annual reduction of 3.72 mm in the study region.

9.3.1.3 Humidity

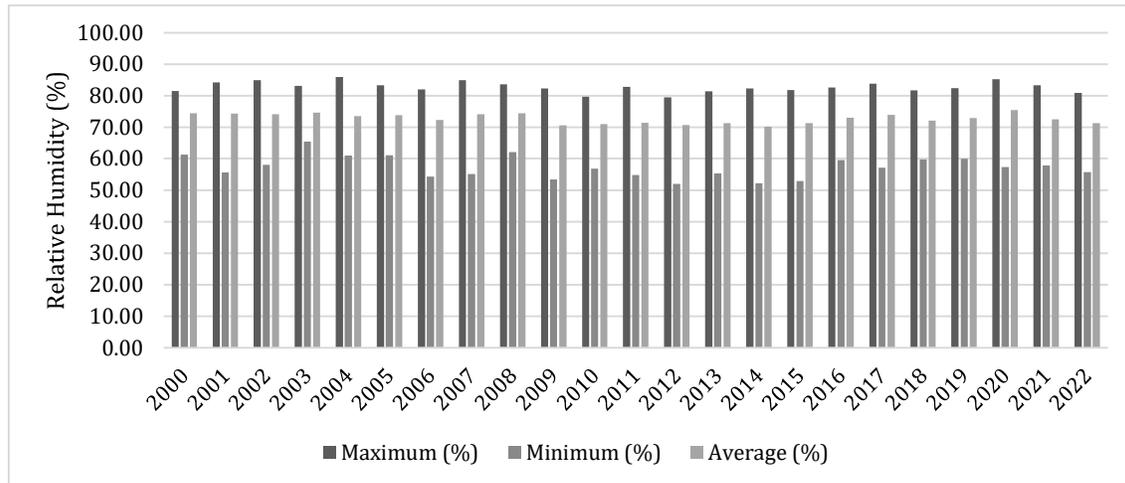


Figure 9- 2 Trend of Humidity over the last 20 years (Source: Bangladesh Agricultural Research Council (BARC))

The average annual humidity in the study area reveals a decreasing trend during the 2000 to 2022 period, as illustrated in Figure 9- 41. In 2000, the average humidity measured 74.45%, and by 2022, it had dropped to 71.24%. Over this two-decade timeframe, the average humidity witnessed a decline of 3.21%.

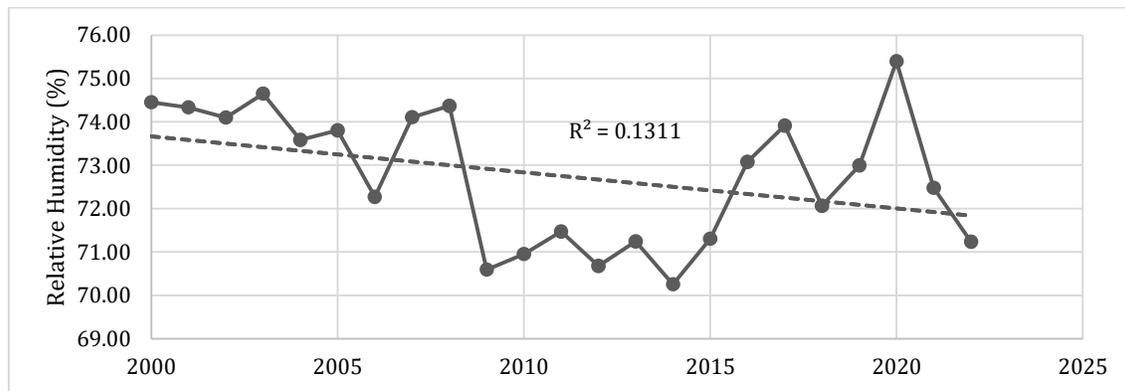


Figure 9-40: Average annual humidity trend at the study area from 2000 to 2022

In Nawabganj Upazila, there has been an observed upward trend in average temperature over the past two decades, accompanied by decreasing average rainfall and relative humidity. This pattern, especially notable in Nawabganj Upazila areas, can contribute to a higher incidence of heat-related illnesses and stress among the population. The reduced humidity, coupled with drier conditions, may elevate airborne dust and particulate matter, subsequently diminishing air quality and potentially impacting respiratory health and agriculture production.

9.3.1.4 Wind Speed and Direction

With just one weather station located in Nawabganj Upazila, the recorded data remains uniform across all areas in Nawabganj Upazila. Upon analyzing the wind speed in Nawabganj Upazila over a

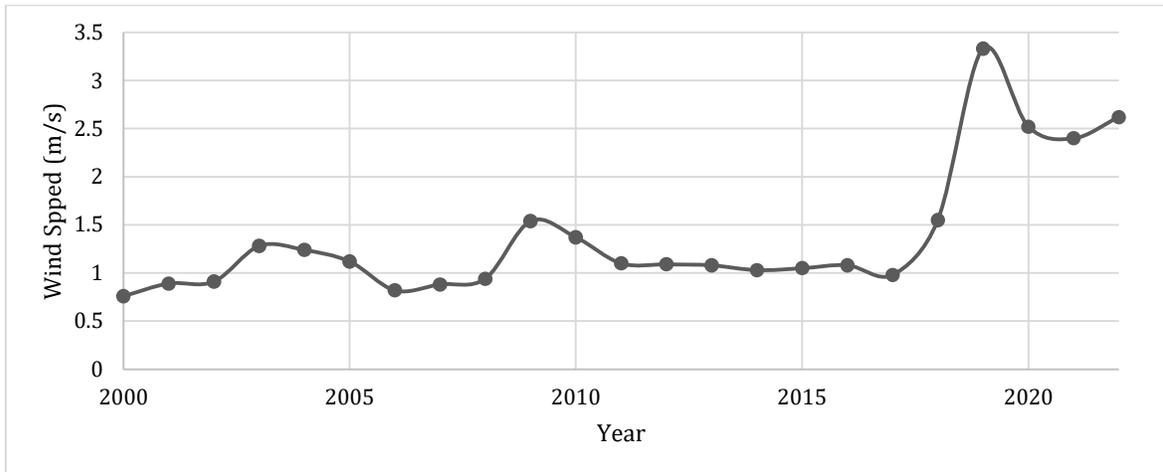


Figure 9-41: Wind Speed Pattern of Nawabganj Upazila (Source: Bangladesh Agriculture Research Council)

span of 20 years, it was observed that the minimum wind speed recorded was 0.76 m/s in 2000, while the maximum wind speed reached 3.33 m/s in 2019. The average wind speed in that locality is approximately 1.3 m/s. The usual wind speed in the study area is being disturbed due to several cyclones such as Sidr, Fani, Bulbul, Amphan, Yaas, and Sitrang.

9.3.1.5 Land Surface Temperture (LST)

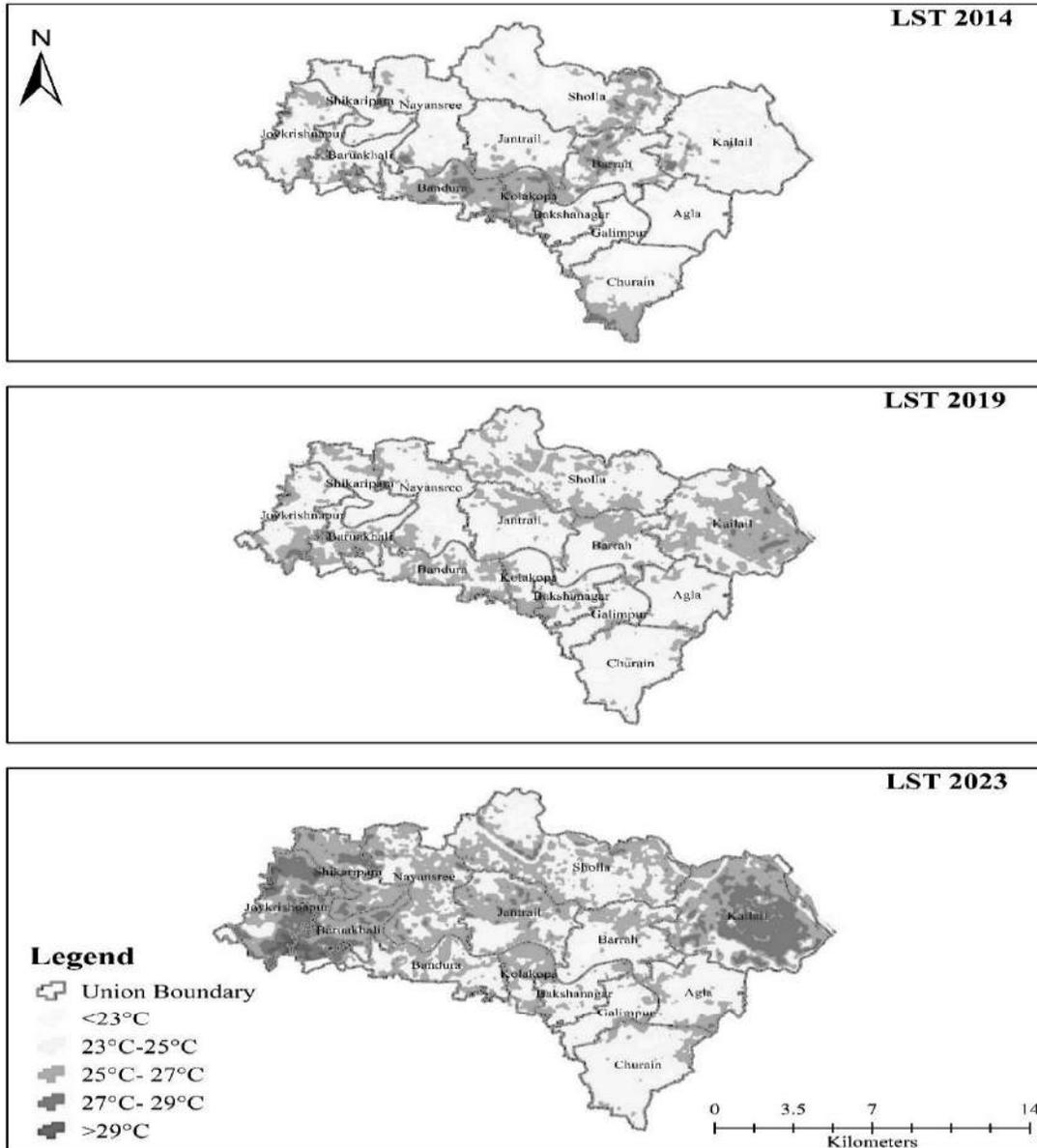


Figure 9-42: Land Surface Temperature of Nawabganj Upazila

The Land Surface Temperature (LST) in Nawabganj Upazila was analyzed using Landsat's thermal imagery in ArcGIS for 2014, 2019, and 2023. The findings reveal an increase in the minimum LST from 19.7°C in 2014 to 21.7°C in 2023, marking a 2°C rise. Additionally, the average LST experienced a growth of 1.75°C, moving from 23.45°C in 2014 to 25.17°C in 2023, indicating a warming trend over the period.

9.3.2 Disaster

9.3.2.1 Earthquake

An earthquake is a natural event that takes place when there is an abrupt release of energy from the earth's crust. This energy is conveyed through seismic waves, leading to ground vibrations that may result in structural and infrastructural harm, as well as potential loss of life. The intensity, duration, and occurrence of earthquakes vary based on factors like, location, depth, and the specific fault type. Additionally, earthquakes have the potential to instigate other natural disasters like, tsunamis and landslides. Bangladesh is a country located in a seismically active zone and is prone to earthquakes. Over the years, Bangladesh has experienced several significant earthquakes, with varying degrees of damage, loss of life, loss of liquefaction properties. Liquefaction occurs when an earthquake's tremors increase underground water pressure in certain soils, causing them to temporarily lose strength. This can lead to considerable damage to structures, land, and infrastructure, alongside economic and social impacts.

The Figure 9- 44 shows the seismic zones of Bangladesh. It explains that Nawabganj Upazila of Dhaka district located in zone II. Understanding the causes and effects of earthquakes is essential for developing strategies to minimize their impact and improve earthquake preparedness and response. Seismologists use various tools and techniques to monitor and study earthquakes, including seismic sensors, GPS, and computer modeling. Earthquake continue to be a significant threat to communities around the world, highlighting the need for ongoing research and investment in earthquake mitigation and disaster management. The Bangladesh government has taken steps to increase earthquake preparedness and response, including the development of building codes and the establishment of an earthquake early warning system. However, there is still much work to be done to ensure that Bangladesh is fully prepared for the next major earthquake.

The latest earthquake data was obtained from the BMD website. Bangladesh underwent numerous moderate to low-intensity earthquakes between 2014 and 2023, with most originating within the country. On average, these earthquakes measured about 4.3 on the Richter Scale. In 2023, the strongest earthquake on record occurred, measuring 5.50 in magnitude. Analysis of Bangladesh's seismic zone map, shown in **Error! Reference source not found.** and **Error! Reference source not found.**, indicates that the majority of earthquakes have taken place in seismic zones I and II. Over the past 10 years, Bangladesh experienced 27 earthquakes, with 6 occurring in 2023 and 5 in 2020. The Figure 9- 45 shows the earthquake intensity and its spatial distribution. According to the geographical position of Nawabganj upazila, is situated in seismic zone II, which has been experiencing several land shakings over the last 10 years. According to the earthquake intensity map Nawabganj Upazila lies within a region of high to moderate intensity.

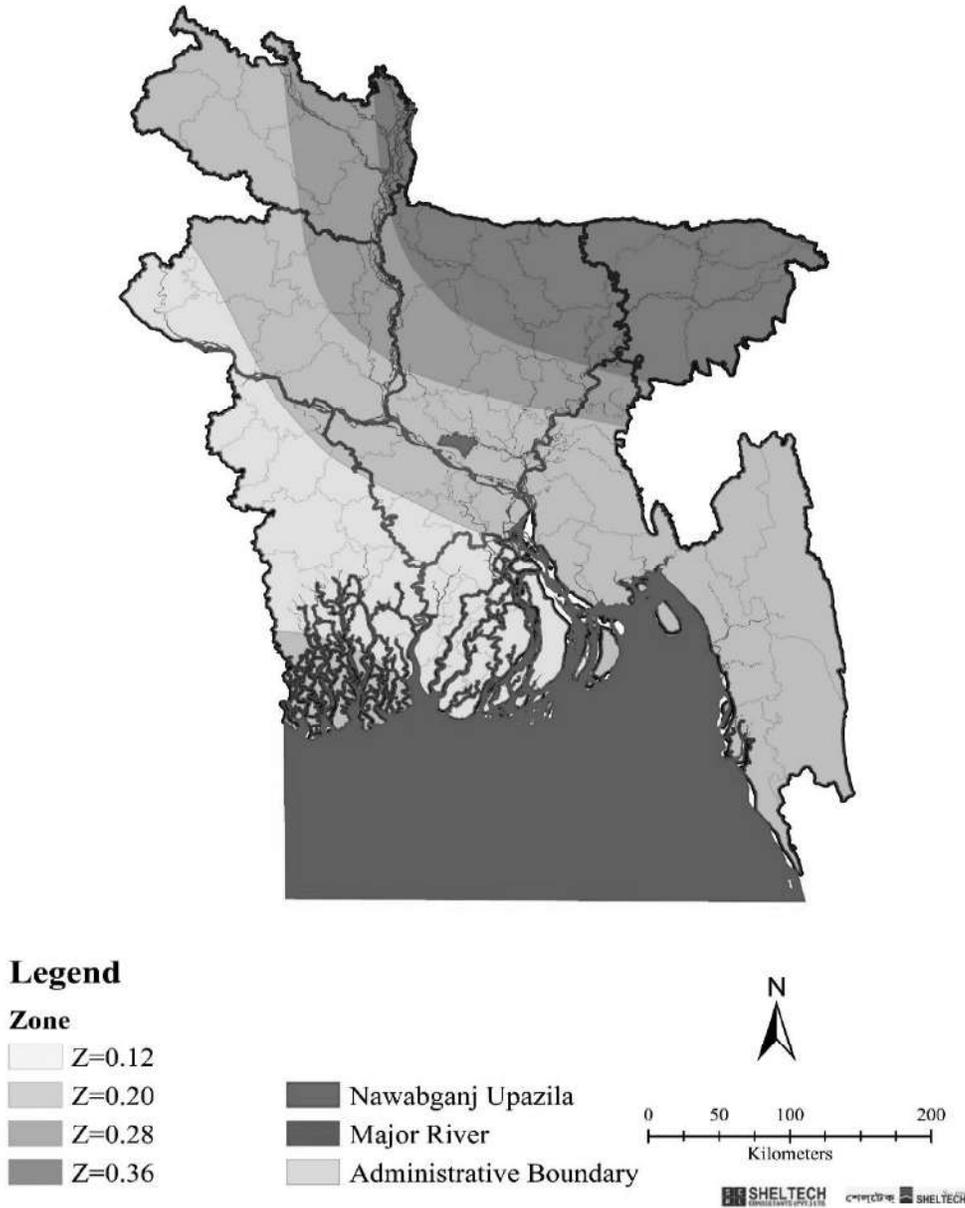


Figure 9-43: Bangladesh Seismic Zone

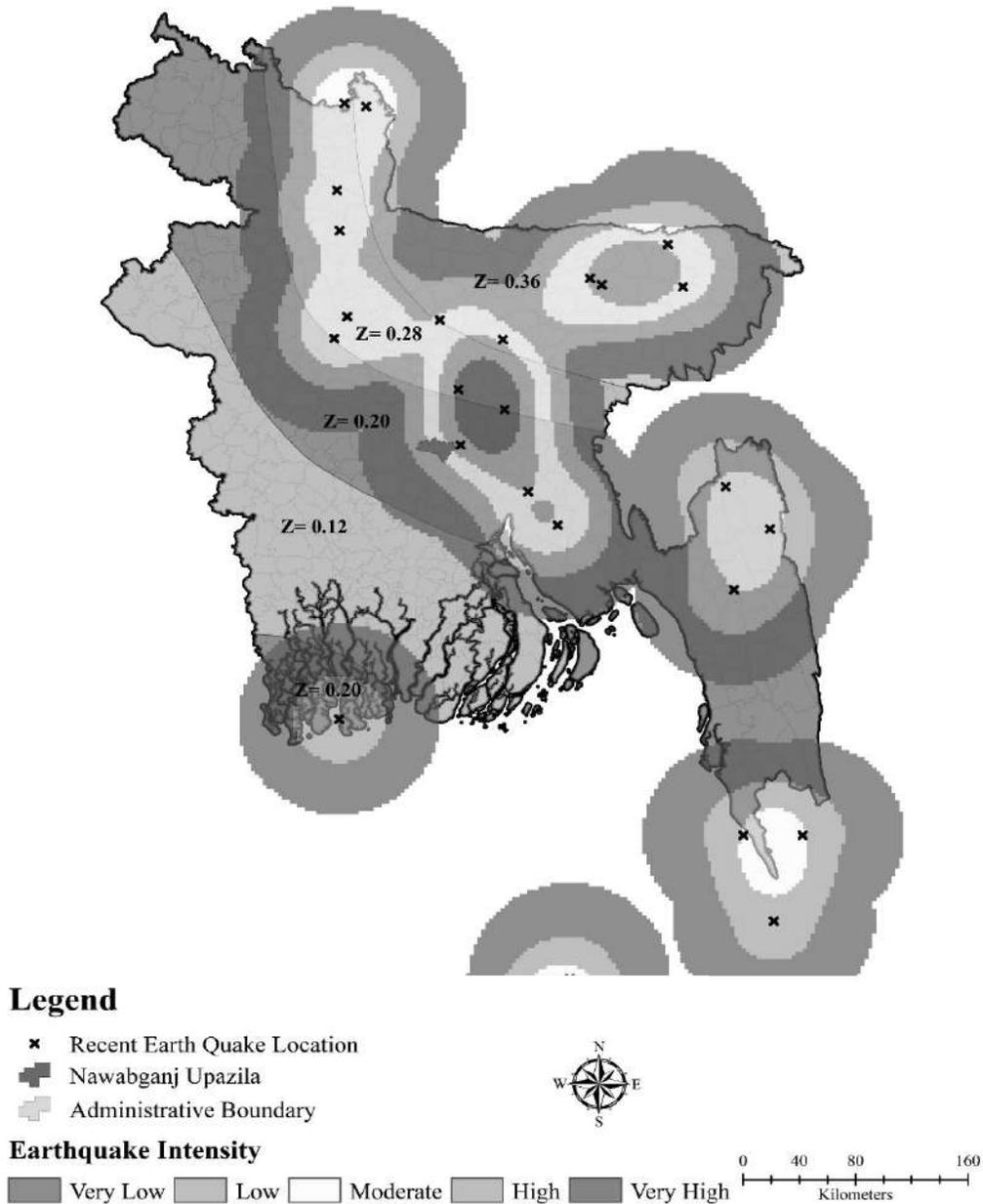


Figure 9-44: Recent Earth Quake intensity and its spatial distribution (2014-2023)

9.3.2.2 Flood

Flood-prone areas are locations with an elevated risk of flooding, influenced by factors like, precipitation, terrain, drainage patterns, and proximity to water bodies. Understanding these zones are crucial as they can impact safety and pose a threat to properties within those areas. Community flood maps serve as valuable tools, illustrating the probability and intensity of flooding across various regions. As per the Flood Prone Zone Map for Nawabganj Upazila, the

majority of Nawabganj is not notably impacted by floods. Figure 9- 46 delineates the flood-prone zones within a specific region, using various colors to denote the extent of river flooding. Areas in green are susceptible to low river flooding, purple designates moderate river flooding, and red indicates locations with severe river flooding.

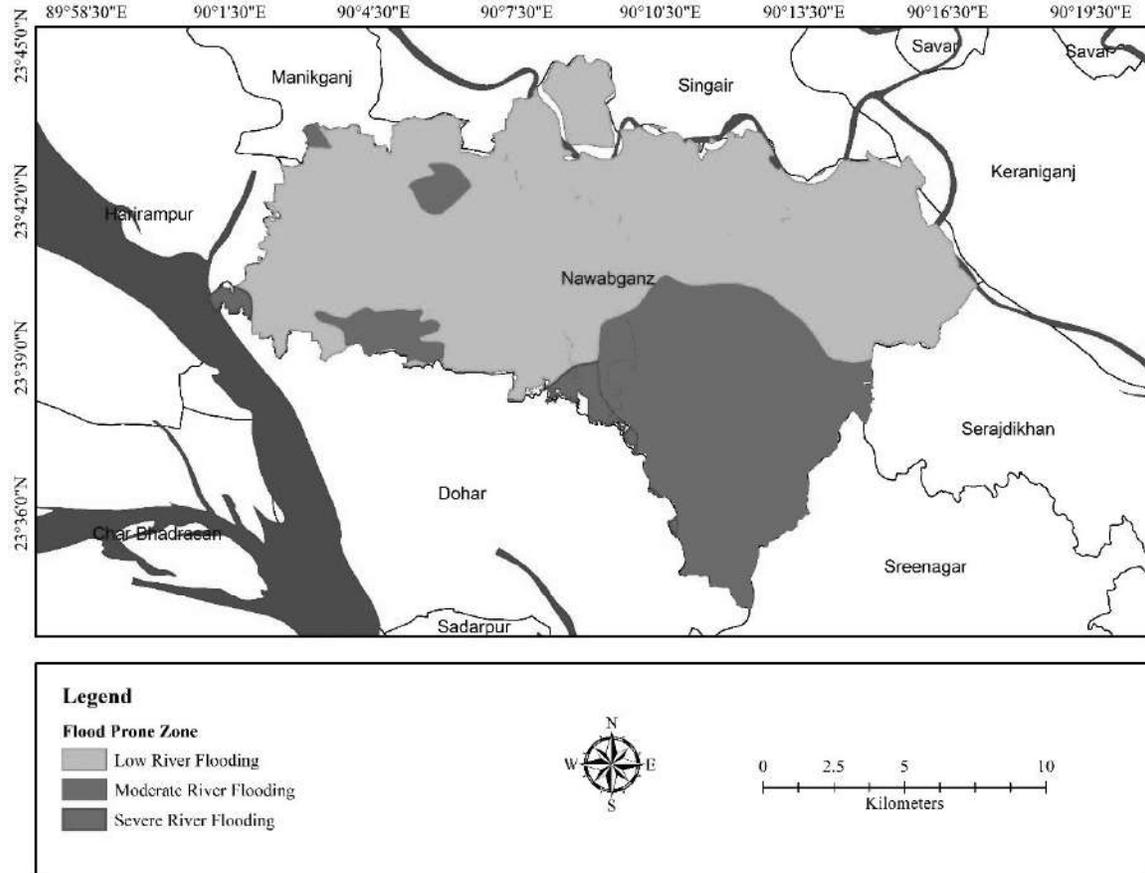


Figure 9-45: Flood Prone Area in Nawabganj Upazila

9.3.2.3 River Erosion

River bank erosion is the process where water flow removes soil and rock from a riverbank, leading to changes in river shape and course. Accretion, on the other hand, is the buildup of sediment in certain areas, leading to land formation along the riverbanks or within the river channel itself. Both processes are natural parts of a river's lifecycle but can be influenced by human activities such as deforestation, construction, and water management practice. River accretion and erosion are significant geographical processes affecting Bangladesh, a country characterized by its vast riverine system. The Ganges, Brahmaputra, and Meghna rivers, along with their numerous tributaries and distributaries, dominate the landscape of Bangladesh, making it highly susceptible to the impacts of river accretion and erosion.

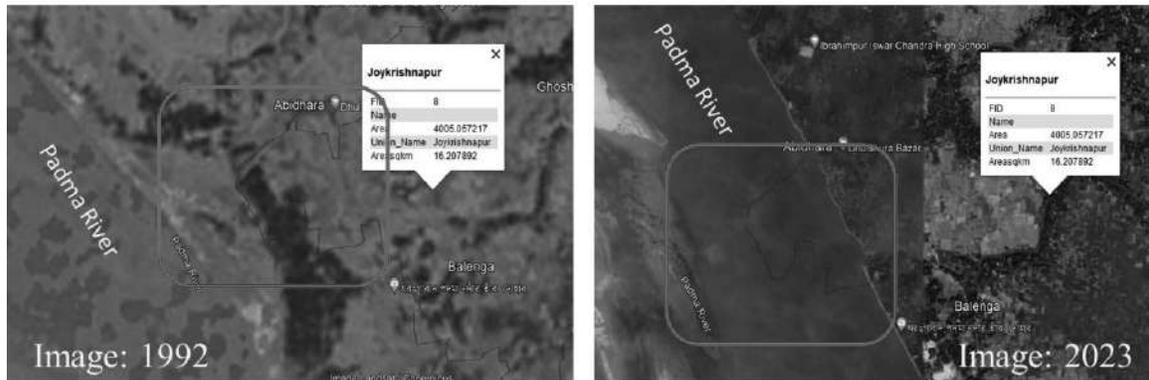


Figure 9-46: River Bank Erosion (1992 -2023) (Padma River near Shikaripara Union Nawabganj)

Nawabganj Upazila, positioned within Dhaka District, is adjacent to the rivers Padma, Kaliganga, and Ichamati, the latter winding through the upazila itself. Due to climate change, there is a noticeable transformation in the morphology of the riverbanks within this upazila. Figure 9- 47 illustrate the river erosion scenarios of the Padma and Ichamati Rivers, respectively, in the study area.



Figure 9-47: Ichamati River Erosion from 1992 to 2023

The analysis of river morphological changes was conducted using remote sensing technologies, utilizing change detection tools in ENVI 5.3, which is specialized for analyzing remotely sensed data. To identify the morphological changes in the riverbank, Landsat 5 TM and Landsat 8 OLI imagery were used for the years 1992 and 2023, respectively.

shows that over the past 25 years, the river in Nawabganj Upazila has experienced accretion of 2.15 square kilometers and erosion of 2.77 square kilometers.

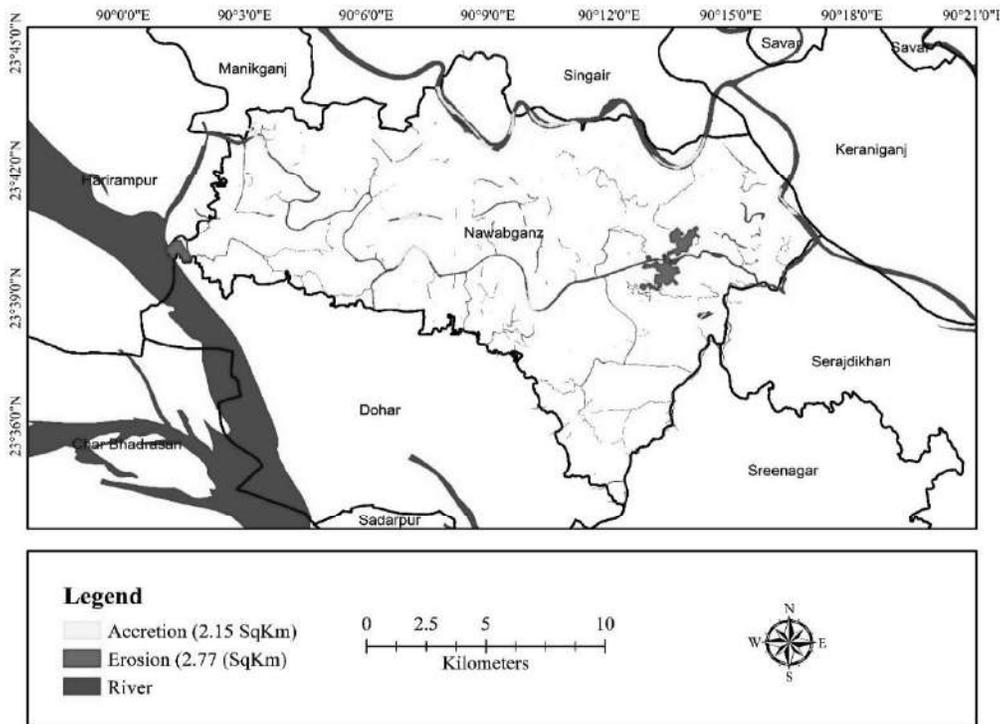


Figure 9-48: River Bank Accretion and Erosion Scenario of river in Nawabganj Upazila (1992-2023)

9.3.2.4 Fire Hazard

Fire safety in Bangladesh has been a significant concern, with numerous incidents highlighting the inadequacy of safety measures in place. Despite the presence of some indirect fire safety measures in commercial and industrial buildings, the lack of trained personnel to operate manual extinguishing equipment poses risks. The need for direct and automatic extinguishing systems is evident, yet their adoption is hindered by high costs. Moreover, non-compliance and mismanagement exacerbate the situation, with many buildings lacking proper emergency exits and fire extinguishers often being expired or merely for show. Electrical short circuits are a major cause of fire in urban area. There's a pressing need for better fire service and water access for firefighting. The overall scenario calls for stringent compliance, regular inspections, and mandatory fire drills to enhance fire safety standards.

In 2017, a total of 18,105 fires caused a loss of Tk 257 crore as Fire Department data shows. The fires injured 269 people and killed 45 others. According to information from the Fire Service and Civil Defense, there were approximately 21,601 fire occurrences in the nation in the year 2021. Additionally, the nation suffered an estimated financial loss of Tk218 crore as a result of these fire occurrences according to the report of "The Business Standard" published on June 2022. In five years, the number of fires increased by 4,117, or 22 percent. In the five years from 2016 to 2021, a total of 3,093 people were killed and 13,863 injured due to fire. According to the fire service, a total of 1,17,060 fires have been reported across the country in the last six years, of which 6,081 were in industries.

9.3.3 Lightning

Thunderstorm in Bangladesh is a significant natural hazard, leading to a considerable number of fatalities and injuries each year. The country experiences an increase in thunderstorm activity during the pre-monsoon and monsoon seasons, with May seeing the highest frequency of these events. The combination of rising global temperature and local climatic conditions, including higher sea surface temperature, contribute to the increased formation of cumulonimbus cloud, which are responsible for lightning and thunder during these storms. Recent reports highlight the devastating impact of thunderstorms in Bangladesh. For instance, a single day saw 17 fatalities occurred due to lightning strikes in various districts, underscoring the lethal nature of these storms according to the report published by bdnews24 on 7 June 2021. The Bangladesh Meteorological Department has issued warnings for more thunderstorms, indicating that the conditions are ripe for further severe weather events, which could lead to heavy rains and potentially more casualties.

The death toll from thunderstorms in Bangladesh is alarmingly high, with over 1,400 deaths recorded between 2010 and 2016. The rate of fatalities due to thunderstorms in the country is estimated to be as high as 0.9 per million population per year, which is significant when compared to the global range of 0.2 to 1.7 deaths per million. The increase in temperature and change in rainfall patterns, partly due to climate change, have led to more frequent and severe thunderstorms (DM Watch, May 2023)

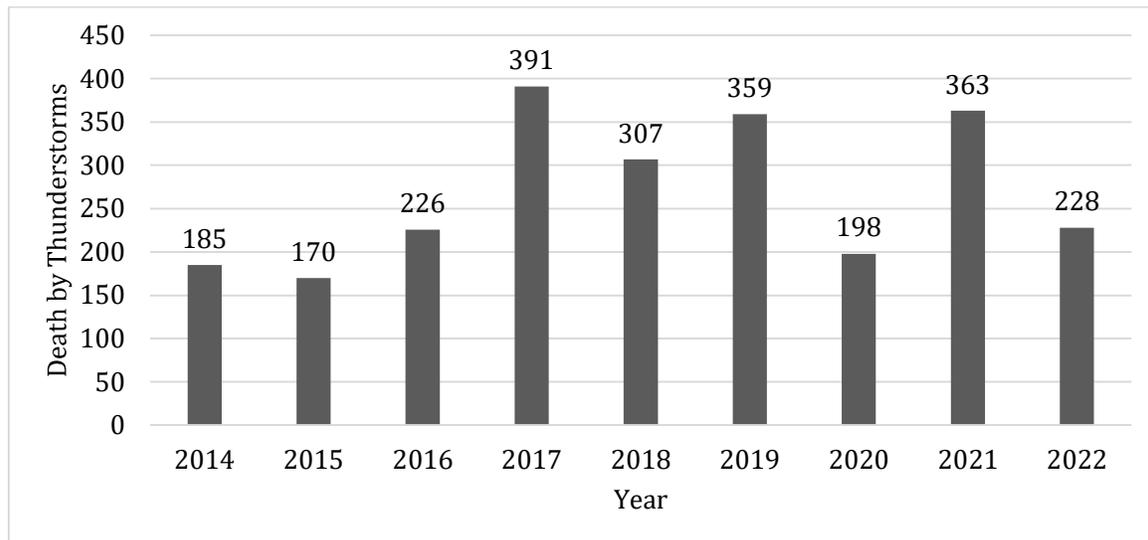


Figure 9-49: Frequency of Death by Lighting effect in Bangladesh (Source: Department of Disaster Management, Bangladesh)

Bangladesh has seen a near-record number of deaths this year from a phenomenon that appears to be worsening with climate change: lightning strikes. So far this year, 261 people have died from lightning in the country, putting the South Asian nation on track to beat last year's 265 deaths. Most lightning deaths usually occur during the warm months of March to July (Financial Express, 2021). The problem has prompted Bangladesh's government to add lightning strikes to the country's list of official types of disasters, which includes floods, cyclones and storm surges, earthquakes, drought and riverbank erosion, among others (NDTV World, 2016). The government of Bangladesh has taken steps to address the risks posed by thunderstorms,

including declaring them a natural disaster in 2016 and implementing various measures such as planting palm trees and installing lightning rods. However, the challenge remains substantial, with the need for increased public education, improved meteorological warnings, and more effective lightning protection strategies to mitigate the impact of these deadly storms

9.3.4 Infrastructure Collapse

In Nawabganj, a predominantly rural area characterized by its low-rise buildings, the risk of infrastructure collapse is relatively low due to the generally sturdy construction of one or two-story structures. However, infrastructure issues are more pronounced in regions near riverbanks, where river erosion has caused significant displacement and damage. In these areas, the natural processes of erosion undermine the stability of infrastructure, leading to increased vulnerability and collapse. The contrast between the robust nature of rural infrastructure and the erosion-affected areas highlights the need for targeted interventions to address and mitigate the impact of riverbank erosion on local infrastructure.

9.3.5 Wet Land Loss

A region of land that is saturated or completely submerged in water is called a wetland. Wetlands are places where water either covers the soil or is present at or near the soil's surface year-round or for different parts of the year, including the growing season. Wetlands are ecologically varied and extremely productive part of ecosystem that sustain stream flows, improve water quality, manage erosion, store carbon, and serve as a habitat for at least one-third of all threatened and endangered species.

Wetlands filter sediment and absorb a variety of pollutants from surface waters, acting as natural water purifiers. This purifying action also improves groundwater supplies' quality in certain wetland settings. Along rivers and streams, wetlands absorb energy and retain water during storms, lowering the risk of flash floods and minimizing downstream flood damage. During dry spells, the gradual release of this stored water can help maintain stream flow.

Numerous species of amphibians, reptiles, birds, and mammals with special adaptations to aquatic conditions find home in wetlands. Wetlands are a common source of food and shelter for upland animals including deer, elk, and bears. Particularly, important to many migratory bird species. Certain kinds of wetlands are some of the planet's most productive ecosystems. With the exception of farmed sugar cane, no other agricultural crop can yield more plant material or store more energy per acre than a stand of cordgrass in a salt marsh. Plants, fish, and wildlife in estuaries and other downstream habitats depend on nutrients and plant debris flushed from some wetland systems during storms.

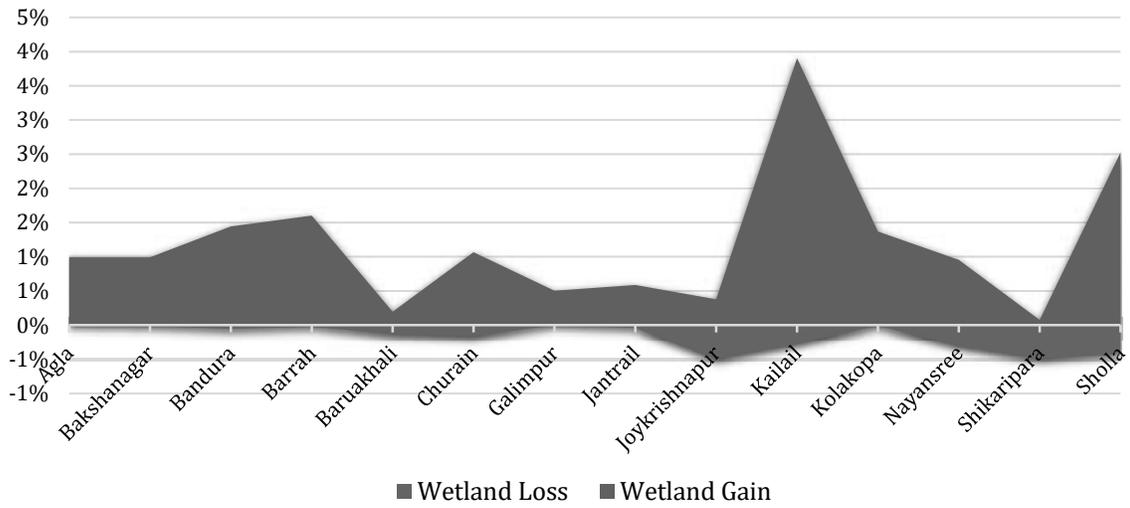


Figure 9-50: Graphical representation of wetland loss and gain in difference union of Nawabganj from 1992 to 2023

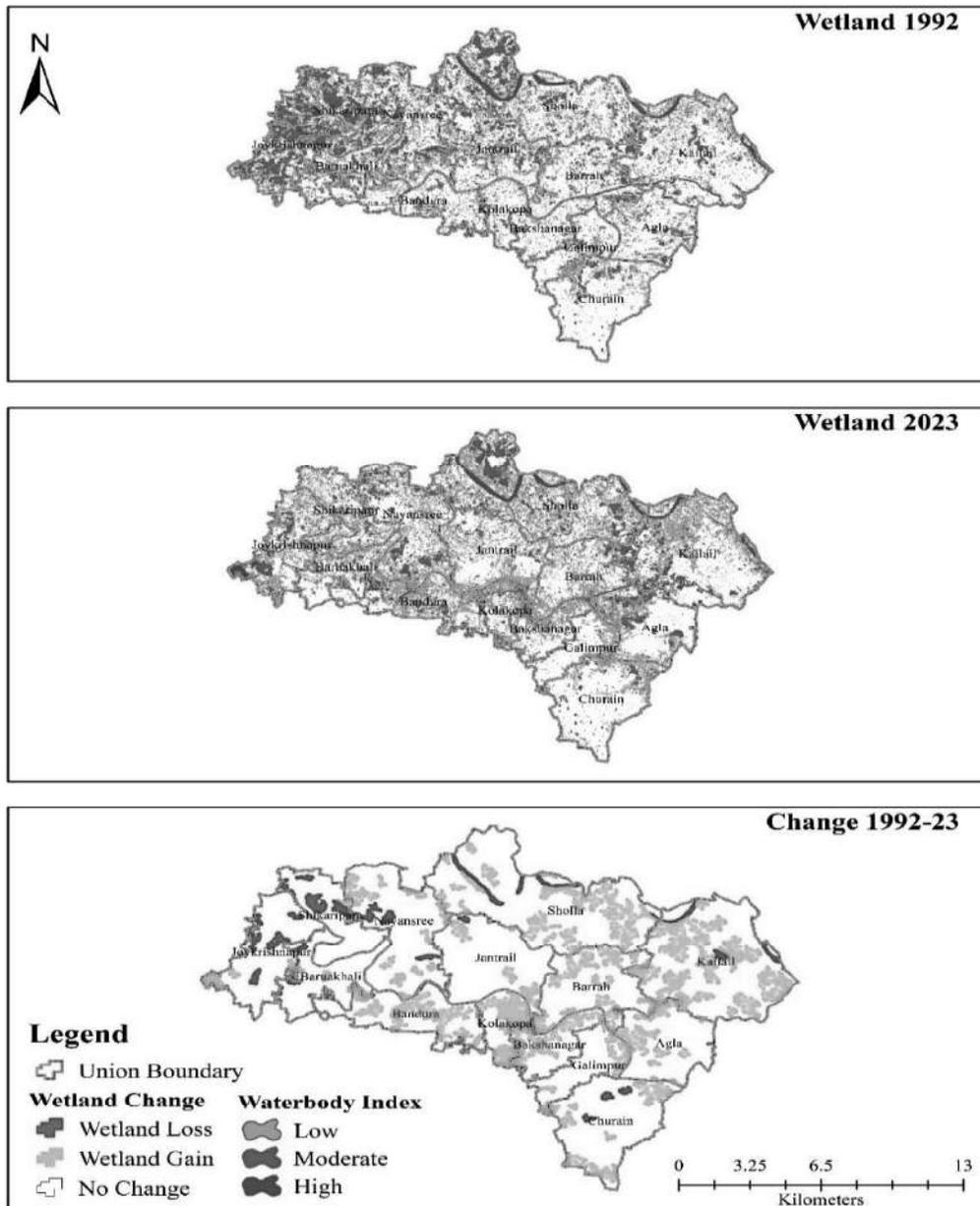


Figure 9-51: Wetland Change Scenario of Nawabganj Upazila from 1992-2023

The wetland change detection analysis was conducted by computing the NDWI (Normalized Difference Water Index) for the years 1992 and 2023. The NDWI algorithm makes use of the green and near-infrared (NIR) bands of Landsat imagery. The photos from Landsat 5 (TM) for the year 1992 and Landsat 8 (OLI) for the year 2023 were obtained from the USGS (United States Geological Survey). Both images were collected in the month of March to minimize the impact of seasonal variations.

For the last thirty years, the wetland in Nawabganj Upazila has been consistently expanding. Over this specific timeframe, the wetland has undergone a growth of 16.16%, which is approximately equal to an expansion of nearly 41 square kilometers. The union areas of Kailail, Sholla, Barrah,

Bandura, and Kolakopa in Nawabganj Upazila play a prominent role in the spread of wetlands in the region. The Joykrishnapur, Shikaripara, and Nayansree union have the most significant decline in wetland area. The expansion of wetlands in Nawabganj could be attributed to soil excavation for construction purposes, where the extracted soil is used to elevate land in adjacent areas. This elevation modification might disrupt natural water flow, leading to increased water accumulation in these excavated areas, consequently enlarging the wetland regions. Furthermore, the practice of creating ponds through excavation also contributes to this expansion, as the removed soil is utilized to raise ground levels for residential development.

Figure 9-52: Wetland loss and gain Scenario 1992 to 2023

Union Name	Wetland Loss		Wetland Gain		Unchanged	
	Area (SqKM)	%	Area (SqKM)	%	Area (SqKM)	%
Agla	0.00	0.00%	2.45	0.99%	12.50	5.06%
Bakshanagar	0.03	0.01%	2.45	0.99%	6.06	2.45%
Bandura	0.14	0.05%	3.57	1.44%	11.00	4.45%
Barrah	0.06	0.02%	3.95	1.60%	13.17	5.33%
Baruakhali	0.32	0.13%	0.48	0.20%	11.10	4.50%
Churain	0.40	0.16%	2.64	1.07%	18.16	7.36%
Galimpur	0.00	0.00%	1.24	0.50%	7.95	3.22%
Jantrail	0.10	0.04%	1.45	0.59%	17.96	7.28%
Joykrishnapur	1.22	0.49%	0.94	0.38%	14.06	5.69%
Kailail	0.67	0.27%	9.64	3.90%	24.52	9.93%
Kolakopa	0.02	0.01%	3.38	1.37%	3.20	1.30%
Nayansree	0.76	0.31%	2.36	0.96%	19.05	7.72%
Shikaripara	1.20	0.49%	0.19	0.08%	10.03	4.06%
Sholla	0.99	0.40%	6.24	2.53%	31.22	12.65%
Total	5.91	2.39%	40.96	16.60%	199.97	81.01%

9.3.6 Nighttime Light scenario at Nawabganj

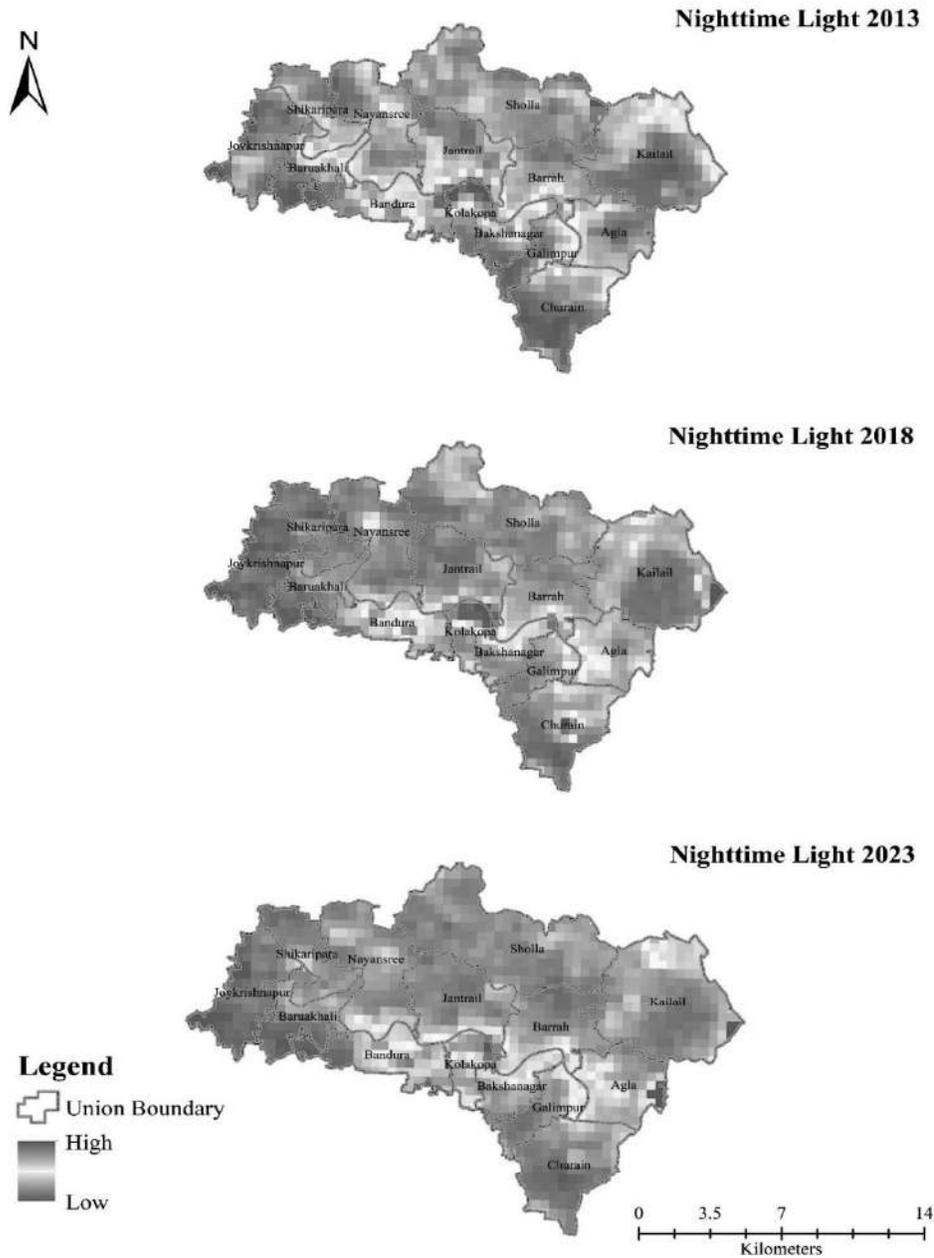


Figure 9-53: Nighttime Light of Nawabganj Upazila inducing light pollution due to economic activities

The nighttime light map of Nawabganj illustrates an increase in economic activities over time. While this map is a valuable tool for assessing economic growth, it also highlights concerns about light pollution and its disruptive effects on local ecosystems, particularly nocturnal birds such as bats and owls. Light pollution can disorient these creatures, impairing their hunting abilities, increasing their vulnerability to predators, and disrupting their migratory paths. Furthermore, artificial lighting interferes with the natural light cycles crucial for plant processes like

photoperiodism, which governs phases of growth and flowering. This disruption can affect the health of plants and the pollinators, like bees, that depend on them. Additionally, many insects are drawn to artificial lights, often resulting in their premature death or disrupted movement and mating patterns. Such disturbances can have a domino effect on food chains, particularly impacting species that feed on these insects.

9.4 Carbon Footprint Assessment

The information associated with the assessment of the carbon emission status of Nawabganj Upazila has been collected through a questionnaire survey, asking the community's households about their daily, weekly, monthly, or yearly expenditure on consuming food, goods, services, transportation, fuel, and agricultural activities. The study also includes the carbon emissions from brick fields located within the project area. The aim of this study is to assess how individual consumption patterns are contributing to the increase in the national carbon footprint.

9.4.1 Food Consumption Footprint

According to the findings it was discovered that 12.50% of a citizen's footprint was formed as a result of the food consumption decisions that they made. Food Consumption is responsible for emitting 99487.21 tons of CO₂ and able to create 82056.94 Gha footprint which is 0.216 per capita Gha in a year. The origin of the ecological footprint left by human consumption of food was broken down into seven distinct categories, including fruits and vegetables, meat, cereal, drinks, dairy products, confectionary goods, and others.

Table 9-13: Carbon footprint associated with food consumption

Emission Source	Tons of CO ₂	Annual Footprint (Gha)	CO ₂ Contribution (%)
Cereal	35303.61	29118.38	4.44%
Confectionary	4571.26	3770.37	0.57%
Dairy	4055.82	3345.24	0.51%
Drinks	2031.45	1675.53	0.26%
Fish	12349.23	10185.63	1.55%
Fruits &Vegetables	12994.26	10717.65	1.63%
Meat	14187.40	11701.75	1.78%
Others	13994.18	11542.38	1.76%
Total	99487.21	82056.94	12.50%

Source: Field Survey 2024

According to the findings it was stated that a significant portion of the carbon footprint was attributed to cereal consumption, accounting for 4.44% of the total food consumption footprint. This percentage corresponds to a value of 29118.38 Gha footprint and responsible for emitting 35303.61 tons of CO₂ in the atmosphere. Similarly, the consumption of meat, fruits and vegetables, and dairy products contributed 1.78%, 1.63%, and 0.51% accordingly to the overall carbon footprint in Nawabganj Upazila. The exponential growth of the population in Nawabganj Upazila has had a significant impact on the overall consumption of food, resulting in a subsequent increase in food production and carbon footprint.

9.4.2 Goods Consumption Footprint

The carbon footprint resulting from the consumption of commodities were classified into three categories: furnishing and equipment, housekeeping, and other factors. Throughout the duration of the study, participants were requested to provide per unit cost regarding their weekly, monthly, or daily use of various commodities.

Table 9-14: Carbon footprint associated with goods consumption

Emission Source	Tons of CO2	Annual Footprint (Gha)	CO2 Contribution (%)
Furnishing and Equipment	4905.33	4045.91	0.62%
Housekeeping	1112.22	917.36	0.14%
Others	7557.88	6233.73	0.95%
Total	13575.44	11197.00	1.71%

Source: Field Survey 2024

According to the findings, it was observed 1.71% of carbon footprint generated from the consumption of goods in a year in Nawabganj which is able to create 11197 Gha footprint and responsible for emitting 13575.44 tons of carbon in a year. Among them 0.62%, 0.14%, portion of carbon footprint were formed as result of furnishing and equipment use, housekeeping activities.

9.4.3 Energy Consumption Footprint (Household)

The source of footprint from energy consumption at household level has been categories into four classes such as using of charcoal, electricity, LPG and Wood. The result of the study reveals that 18.81% of footprint are associated with energy consumption at household level which is able to create 94308.83 Gha footprint in a year that is 0.248 Gha per capita. Its responsible for emitting 149700.66 tons CO2 in a year.

Table 9- 1 Carbon footprint associated with energy consumption at household level

Emission Source	Tons of CO2	Annual Footprint (Gha)	CO2 Contribution (%)
Charcoal	58.87	71.40	0.01%
Electricity	97206.85	30644.77	12.21%
LPG	52077.04	63158.61	6.54%
Wood	357.90	434.06	0.04%
Total	149700.66	94308.83	18.81%

Source: Field Survey 2024

9.4.4 Transportation Footprint

Transportation activities are one of the major sources of CO2 emissions worldwide today. A study was conducted to estimate the amount of carbon being emitted in Nawabganj Upazila due to the excessive use of different modes of transportation. It has estimated that 20.47% of carbon footprint are coming from the transportation activities which is releasing 162925.86 tons of carbon in the air. The results reveal that the use of electricity is the prime source of CO2 emissions because of the abundant use of auto-rickshaws or electric vehicles in Nawabganj. From the volume count survey in Nawabganj Upazila on a random day, it was found that 42% of vehicles are electric (auto-rickshaws). Due to excessive and uncontrol use of use electric vehicles,

contributing 11.13% of carbon footprint in local level which is emitting 88601.34 tons carbon in the atmosphere. There also has some fuel engine vehicles creating 2.97% of carbon footprint.

Table 9- 2 Carbon footprint associated with transportation activities

Emission Source	Tons of CO2	Annual Footprint (Gha)	CO2 Contribution (%)
Asphalt Use	50715.44	15988.20	6.37%
Electricity	88601.34	27931.85	11.13%
Fuel Consumption	23609.08	7442.84	2.97%
Total	162925.86	51362.89	20.47%

Source: Field Survey 2024

9.4.5 Services Consumption Footprint

The source of service-related carbon footprint has been categorized into five different classes in this study: administrative, education, entertainment, health, and technical activities. The results show that service-related activities are responsible for adding 0.78% of the carbon footprint in a year. Among the sub-categories of services, 0.28% of the footprint is produced from the educational sector, and 0.21% of the footprint is associated with entertainment activities in Nawabganj Upazila

Table 9-15: Carbon footprint associated with services

Emission Source	Tons of CO2	Annual Footprint (Gha)	CO2 Contribution (%)
Administrative	236.43	195.00	0.03%
Education	2261.74	1865.48	0.28%
Entertainment	1641.64	1354.03	0.21%
Heath	1203.70	992.81	0.15%
Technical	870.95	718.36	0.11%
Total	6214.46	5125.68	0.78%

Source: Field Survey 2024

9.4.6 Agriculture Carbon Footprint

The result presents a detailed breakdown of CO2 emissions from various sources associated with agricultural activities in Nawabganj Upazila, quantifying the emissions in tons of CO2, their corresponding ecological footprint in global hectares (Gha), and their percentage contributions to the total emissions. Electricity is the predominant source, contributing 18.79% of the emissions with 149,579.16 tons of CO2. Fuel consumption and LPG are also significant contributors, with 7.53% and 7.24% respectively. Wood usage is detailed in four sub-categories (Wood, Wood Briquettes, Wood Leaf/Timber, and Wood Straw), each contributing less than 0.5% individually. The total emissions from all sources amount to 276,739.18 tons of CO2, impacting 201,373.93 Gha and making up 34.77% of the overall emissions. This data underscores the critical areas for targeted emissions reduction strategies.

Table 9-16: Carbon footprint associated with agricultural activities

Emission Source	Tons of CO2	Annual Footprint (Gha)	CO2 Contribution (%)
Electricity	149579.16	47155.31	18.79%
Fuel Consumption	59965.70	72725.91	7.53%
LPG	57639.77	69905.04	7.24%
Wood	3900.96	4731.05	0.49%
Wood (Briquettes)	530.05	642.83	0.07%
Wood (Leaf, Timber)	2677.69	3247.48	0.34%
Wood (Straw)	2445.85	2966.31	0.31%
Total	276739.18	201373.93	34.77%

Source: Field Survey 2024

9.4.7 Brick Field Carbon Footprint

This result provides a summary of brick field CO₂ emissions from coal and diesel along with their annual ecological footprint in global hectares (Gha) and their respective contributions to total emissions in percentages. Coal emissions amount to 355.82 tons, impacting 112.17 Gha and contributing just 0.04% to the total emissions.

Table 9-17: Carbon footprint associated with brick production

Emission Source	Tons of CO2	Annual Footprint (Gha)	CO2 Contribution (%)
Coal	355.82	112.17	0.04%
Diesel	8841.50	2787.31	1.11%
Total	9197.32	2899.48	1.16%

Source: Field Survey 2024

Diesel, on the other hand, accounts for 8,841.50 tons of CO₂, affecting 2,787.31 Gha, and making up 1.11% of the total emissions. Combined, these two sources emit a total of 9,197.32 tons of CO₂, with an overall ecological footprint of 2,899.48 Gha, which contributes to 1.16% of the total emissions. The findings highlight the relatively smaller scale of these emissions compared to other sources.

9.4.8 Waste Generation Footprint

In order to examine the carbon footprint generated from local community, the study estimated the total amount of waste are generating in Nawabganj Upazila through a comprehensive survey. The findings of the study area illustrate that waste generation is contributing 9.81% of carbon footprint in a year which is responsible for creating 94734.14 Gha footprint annually.

Table 9-18: Carbon footprint associated with waste generation

Emission Source	Tons of CO2	Annual Footprint (Gha)	CO2 (%)	Contribution
Waste	78112.46	94734.14	9.81%	

Source: Field Survey 2024

9.4.9 Carbon Footprint Agglomeration

The probable source of carbon emission in Nawabganj Upazila has been categorized into eight (8) classes include emission from – agricultural activities, brick production, energy from household

Table 9-19: Overall Carbon footprint in Nawabganj Upazila

Emission Source	Tons of CO2	Annual Footprint (Gha)	Per Capita/year	CO2 Contribution (%)
Agriculture	276739.184	201373.927	0.530	34.77%
Brick Field	9197.319	2899.484	0.008	1.16%
Energy (Household)	149700.662	94308.831	0.248	18.81%
Food	99487.213	82056.937	0.216	12.50%
Goods	13575.436	11197.004	0.029	1.71%
Service	6214.460	5125.680	0.013	0.78%
Transportation	162925.857	51362.892	0.135	20.47%
Waste Generation	78112.456	94734.142	0.249	9.81%
Total	795952.589	543058.898	1.430	100.00%

Source: Field Survey 2024

consumption, food consumption, goods consumption, service consumption, transportation activities and waste generation. According to the findings in Nawabganj Upazila the primary sources of carbon emission are agriculture (34.77%), Transportation (20.47%) and household energy (18.81%), generating 0.53, 0.135, and 0.248 Gha per capita annual footprint respectively. Other notable contributors include food production (12.50%), waste generation (9.81%), goods manufacturing (1.71%), brick fields (1.16%), and services (0.78%). The total CO2 emissions amount to 795,952.589 tons annually, with a per capita emission of 1.430 tons per year and an overall annual footprint of 543,058.898 global hectares (Gha).

9.5 Biocapacity Assessment

The table has provided below shows the biological capacity of Nawabganj Upazila for year 2003, 2013 and 2023. The findings of the study reveal biocapacity of agriculture land, vacant land is showing decreasing trend over the last 20 years, with a decreasing rate of 0.37% and 1.90% per

year respectively whereas Built-up and vegetation covers biocapacity shows increasing trend with a rate of growing of 4.45%, 0.24% and 1.85% per year respectively. The result of the study also is delivered information regarding overall biocapacity reduction in Nawabganj Upazila. The per capita biocapacity of Nawabganj in 2003 was estimated around 0.244 Gha but in 2023 it was observed 0.238 Gha. Over the 20 years timespan the biological capacity has been declined with a rate of 0.13 per year.

Table 9-20: Biological Capacity of Nawabganj Upazila

Bio-productive land	Biocapacity in Gha			Change rate (%)
	2003	2013	2023	
Agricultural Land	88443.46	87339.24	82355.09	-0.37%
Built-up	418.74	3481.12	3773.73	4.45%
Vacant Land	148.33	23.90	107.56	-1.90%
Vegetation	2922.11	2637.21	3070.65	0.24%
Water Body	568.20	1093.75	901.84	1.85%
Total in Gha	92500.84	94575.23	90208.87	-0.13%
Gha/ Per Capita	0.244	0.249	0.238	-0.13%

Source: Field Survey 2024

9.6 Ecological Deficit Assessment

The figure below represents a comparative ecological footprint status among global, national, and local levels. According to the findings, the footprint in Nawabganj Upazila is 1.43 Gha per capita, while the biocapacity is 0.238 Gha per capita. In contrast, the footprint in Bangladesh is 0.72 Gha per capita, with a biocapacity of 0.38 Gha per capita.

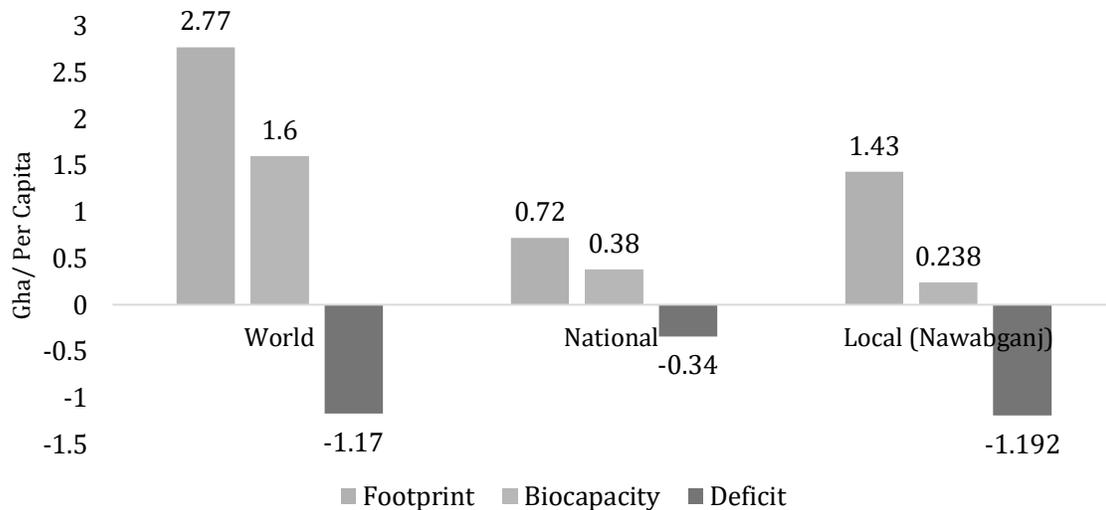


Figure 9-54: Comparative Ecological Deficit Scenario of Nawabganj Upazila

The result shows that Nawabganj Upazila is in an overshoot condition considering its biological capacity, which is about 1.192 Gha per capita. This conveys a message that the existing natural resources are not sufficient to sequester the footprint generated by its citizens

9.7 Ecosystem Service Value (ESV) Assessment

The terms ecosystem service value refers to the benefits and supports that people obtain from an ecosystem. In this study the ecosystem service value has been classified into four border classes including some sub-categories present in table below. Ecosystem Service Valuation quantifies the monetary value of various ecosystem services across different land types (vegetation, barren land, and waterbody) in Nawabganj Upazila, totaling 3,063.30 million Bangladeshi Taka (BDT).

Table 9-21: Ecosystem Service Valuation in Nawabganj Upazila

Ecosystem Services	Sub-types	Ecosystem Service Value in Million BDT				
		Crop	VL	BL	WB	Total ESV
Provisioning	Climate Regulation	136.51	252.00	0.13	9.50	398.14
	Food Production	140.72	20.43	0.02	2.44	163.62
	Gas Regulation	101.33	267.48	0.06	2.35	371.22
	Raw materials	54.89	184.51	0.04	1.61	241.05
Regulating	Hydrological Regulation	108.37	253.24	0.07	86.53	448.20
	Waste Treatment	195.61	106.50	0.25	68.46	370.81
Supporting	Biodiversity Production	143.54	279.25	0.39	15.81	438.99
	Soil Conservation	206.87	248.91	0.17	1.89	457.84
Cultural	Recreation and Culture	23.92	128.79	0.24	20.47	173.42
Total		1111.76	1741.12	1.36	209.05	3063.30

Where VL = Vegetation, BL = Barren Land, WB = Waterbody, BA = Built-up Area

It categorizes services into provisioning (e.g., climate regulation, food production), regulating (e.g., hydrological regulation, waste treatment), supporting (e.g., biodiversity production, soil conservation), and cultural (e.g., recreation and culture), with significant contributions from vegetation and barren land. This valuation highlights the essential role of different land types in maintaining ecological balance and supporting human well-being in the region.

9.8 Brick Field Impact on Human

One of the main causes of air pollution in Bangladeshi cities is brick kilns. Brick kilns cause major harm to agricultural land in addition to raising the danger of pollution and health problems. There are more than fifteen operational brick kilns in Nawabganj Upazila. They primarily begin operations during the dry season. People who live within three kilometers of the brick field as well as those who are directly employed by bricklayers have been surveyed to determine the effects of brick kilns.

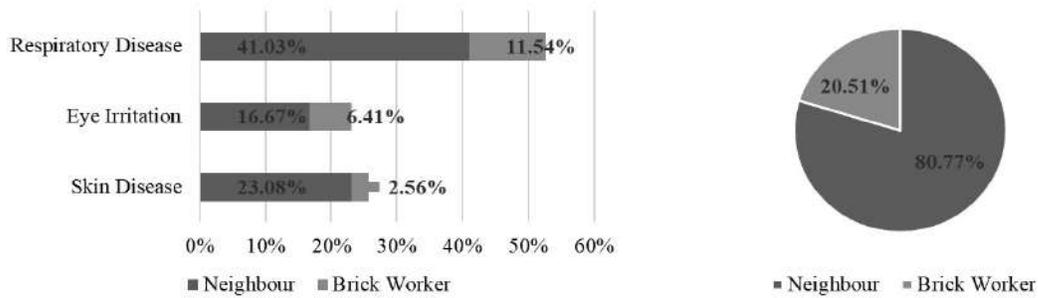


Figure 9-55: Comparative Ecological Deficit Scenario of Nawabganj Upazila

A total of 79 individuals shared their observations about the effects of kilns; of them, 20.51% worked there, and 80.77% resided three kilometers away from the brick field. The findings showed that, among the employees, approximately 11.54% had respiratory illness, 6.41% had ocular discomfort, and 2.56% had skin illness. The results also show that lung disease affects 41.03% of those who live far from brick kilns, while skin disease affects 16.67% and eye irritation affects 23.08% of those who live distant from brick kilns. In summary, respiratory diseases afflict the majority of individuals in Nawabganj Upazila.

9.9 Brick Field Impact on Cropland

The expansion of brickfields can have significant negative impacts on agricultural land. The extraction of clay and other materials for brick production often leads to soil degradation, including the loss of fertile topsoil crucial for crop growth, and alterations in soil structure and fertility. Additionally, the conversion of fertile agricultural land to brickfields reduces the availability of land for farming, which can decrease local agricultural output. Water sources near brickfields can become polluted with contaminants from brick-making processes, affecting soil quality and irrigation. The burning of fuel in brick production releases pollutants into the air, which can harm plant health and growth. The removal of vegetation and topsoil can also increase soil erosion, further degrading the land's agricultural potential. Moreover, the presence of brickfields can alter local microclimates, impacting temperature and humidity levels that are vital for crop production. While brickfields can offer economic benefits and employment opportunities, they often come at the cost of diminishing the economic viability of agriculture by reducing the amount of usable arable land. Addressing these issues requires careful planning and management to minimize land conversion, mitigate pollution, and restore degraded lands.

Reference

Abbass, K., Qasim, M. Z., Song, H., Murshed, M., & Mahmood, H. (2022). A review of the global climate change impacts, adaptation, and sustainable mitigation measures. *Environmental Science and Pollution Research*. doi:<https://doi.org/10.1007/s11356-022-19718-6>

Ali, A. (1999). Climate change impacts and adaptation assessment in Bangladesh. Inter-Research Science Publisher. doi:[doi:10.3354/cr012109](https://doi.org/10.3354/cr012109)

Feeroz, D. M. (2014). Wildlife diversity in Bangladesh: 40 Years of Research and Conservation. The Festschrift on the 50th Anniversary of The IUCN Red List of Threatened Species.

Rifat MA, Wahab MA, Rahman MA, Nahiduzzaman M, Mamun AA. Nutritional value of the marine fish in Bangladesh and their potential to address malnutrition: A review. *Heliyon*. 2023 Feb 8;9(2):e13385. doi: [10.1016/j.heliyon.2023.e13385](https://doi.org/10.1016/j.heliyon.2023.e13385). PMID: 36873138; PMCID: PMC9975239

Arnstein, S. (1969). A ladder of citizen participation. *Journal of the American Planning Association*, 35(4), 216-224.

CHAPTER TEN: Electricity and Energy Related Survey

10.1 Introduction

Nawabganj is an upazila in Dhaka District in the middle of Bangladesh, located in the Dhaka Division. Its area is 244.81 square km and comprises of 14 numbers of union, 178 numbers of mouzas and 305 numbers of villages. This upazila has no Pourasabha. Geographically Nawabganj upazila is located between 23°34' and 23°45' north latitudes and in between 90°01' and 90°17' east longitudes.

Electricity and energy related survey is aimed at collecting energy consumption of samples for five categories like (a) households, (b) business and industrial enterprises, (c) individuals and organizations engaged in agricultural activities (Mechanized cultivation, irrigation, molasses making, mechanical threshing, etc.), (d) biomass fuel dealer/ petrol pump/ CNG filling station/ LPG supplier/ diesel, petrol, kerosene dealer/ natural gas supplier/ distribution entities, etc., and (e) electricity supply/ distribution/ generation entities in the planned area. To conduct the survey a compact and extensive pre-coded structured questionnaire has been prepared. The questionnaire has been pre-tested through piloting. After the piloting is done, the questionnaire has been incorporated corresponding corrections and taken approval of the PCO. The approved questionnaire has been used for comprehensive energy data collection process. In most of the cases, the survey has been done by using Kobo Toolbox, which is a real time online data management system with image and geo-coordinates. Where internet is not available manual data recording is done by filling the questionnaire sheets. Surveys for all the five categories have been conducted between April 25, 2024 to May 1, 2024.

10.2 Methodology

10.2.1 Sample Size Selection

To facilitate the data collection process, a stratified sample survey has been conducted. The strata are reflected the prevalent socio-economic strata of the upazila. The number and character have been determined in consultation with the PCO. The selected sample size is such that all kind of statistical analysis can be performed at least with 95% confidence level. There are sufficient number of samples from all unions and of the upazila so that statistical analysis can be conducted both at union levels.

Total 156 numbers of samples have been taken from all of the 14 numbers of unions. Samples from the unions covered are Agla, Bakshangar, Bandura, Barrah, Baruakhali, Churain, Galimpur, Jantrail, Joykrishnapur, Kailail, Kolakopa, Nayanshree, Shikaripara and Sholla.

For category 'a' total 48 numbers of samples have been surveyed. For category 'b' total 39 numbers of samples have been surveyed. For category 'c' total 37 numbers of samples have been surveyed. For category 'd' total 31 numbers of samples have been surveyed. For category 'e' yet to be surveyed with the representatives from the electricity distribution company, PBS.

10.2.2 Selection and Training of Enumerator

The surveyors and enumerators are selected from the university graduates who are trained in survey and enumeration of various types of social and economic survey. They are also trained by the experienced people from the relevant discipline. Moreover, each survey and enumerator team has been trained by the Consultant (Energy) for each of the categories.

10.2.3 Survey Procedure

This study comprised an electricity and energy survey to identify the energy consumption pattern in the Nawabganj upazila of the Dhaka district of the northern part of Bangladesh. To identify the energy consumption pattern survey of the categories selected are 'a' - households, 'b' - business and industrial enterprises, 'c' - individuals and organizations engaged in agricultural activities (Mechanized cultivation, irrigation, molasses making, mechanical threshing, etc.), 'd' - biomass fuel dealer/ petrol pump/ CNG filling station/ LPG supplier/ diesel, petrol, kerosene dealer/ natural gas supplier/ distribution entities, etc., and 'e' - electricity supply/ distribution/ generation entities.

Prior to the final survey, a piloting survey was conducted to pre-test the questionnaire. Finally, the study was conducted through a semi-structured questionnaire between April 25, 2024 to May 1, 2024. The sequence of sampling was from upazila to union council (smallest rural administrative unit under upazila), and from union to households.

Table 10-1 Profile of the study area

Union Name	Area (km ²)	Population	Population density (person/km ²)	Number of villages	Number of households
Agla	14.93	19187	1285	12	4971
Bakshangar	8.58	22892	2669	17	5962
Bandura	14.78	31000	2097	21	7868
Barrah	17.13	28155	1644	20	7124
Baruakhali	12.03	18310	1522	35	5033
Churain	21.23	25942	1222	16	6573
Galimpur	9.21	14853	1613	17	3811
Jantrail	19.48	25028	1285	17	6443
Joykrishnapur	16.26	18874	1161	29	5259
Kailail	34.86	28863	828	11	7494
Kolakopa	6.65	24178	3638	28	6495
Nayanshree	22.21	29832	1343	35	7698
Shikaripara	11.34	18974	1673	25	5068
Sholla	38.44	42179	1097	30	10895

For the household survey the respondent was asked to provide information on monthly income, to know their social status. Subsequently, they were requested to provide information on types and sources of energy use, monthly consumption of different energy fuels, types and sources of

biomass fuels, monthly consumption of various biomass fuels, types of use of biomass fuels used for cooking, etc. Also, use of solar panels for using electric bulb for lighting and fans was surveyed.

Thus, in this study, a total of 48 households' samples were taken from total 14 numbers of unions. From each union households were selected randomly. The list of selected unions for the study is given in Table 1. The surveyed households who seem to provide their information on energy consumption were representatives from different socio-economic status in the society. The questionnaire is available at the Annexure 10-1 of the report.

In this study, a total of 39 numbers of business and industrial units were selected randomly. Surveys for individuals and business enterprises engaged in agricultural activities the samples were randomly selected. In this study, a total of 37 samples were taken and the selection of agricultural activities were done randomly.

Surveys in the section 'd' included sellers of biomass fuel, petrol pump, CNG filling station, LPG distributor, diesel, petrol, kerosine seller, and natural gas distribution company. Total survey taken for the source of energy seller/ distributor for 31 samples.

10.3 Data Analysis

The physical quantities and units of data from biomass and other sources of energy were provided directly from survey. In this study, biomass sources are considered in four categories such as (i) firewood, (ii) tree leaves and crop residue, straw, (iii) rice husk, (iv) dried cow dung, (v) bamboo, twigs and leaves of bamboo, (vi) briquette and (vii) saw dust, saw mill residue, etc. A standard energy unit was considered to measure physical quantities of fuel consumption. Biomass quantity is calculated in kilogram (kg), whose energy equivalent is converted to Mega Joule. For other types of fuels, such as kerosene, diesel, petrol, octane counted in liter (l), natural gas for domestic use is in numbers of burners and in industrial use in cubic meters, LPG in kg and electricity in kWh. For solar PV panels the energy consumption is calculated in kWh. For consumption of biogas, although not found to use in the survey area, is considered in consumption hours. To perform data analysis; firstly, obtained raw data counted in general physical unit (e.g. kg, liter, kWh) were inputted into excel sheet. In Table 10-2 total and average consumption of different types of biomass fuel for the households for cooking for different unions is summarized from the surveyed data.

Table 10-2: Consumption of biomass fuel for the households for cooking for different unions

Name of the unions	Sample (Nos)	Firewood (kg)	Leaves, twigs and crop residue, straw (kg)	Rice husk (kg)	Dried cow dung (kg)	Bamboo, twigs of bamboo, leaves of bamboo (kg)	Briquette (kg)	Saw dust, saw mill residue (kg)
Agla	4	90	14	0	0	28	0	0
Bakshanagar	3	500	100	0	0	0	0	0
Bandura	3	0	0	0	0	0	0	0
Barrah	3	230	90	0	100	80	0	0
Baruakhali	3	1000	180	0	0	0	0	0
Churain	4	56	72	0	0	60	0	0
Galimpur	3	75	40	12	0	12	0	12
Jantrail	4	455	100	0	0	0	0	0

Name of the unions	Sample (Nos)	Firewood (kg)	Leaves, twigs and crop residue, straw (kg)	Rice husk (kg)	Dried cow dung (kg)	Bamboo, twigs of bamboo, leaves of bamboo (kg)	Briquette (kg)	Saw dust, saw mill residue (kg)
Joykrishnapur	3	185	102	0	0	0	0	0
Kailail	4	520	280	0	70	0	0	0
Kaleidoscope	4	270	320	0	0	180	0	0
Nayonshree	3	300	345	0	0	45	0	0
Shikaripara	4	85	10	0	0	0	0	0
Sholla	3	40	88	0	15	0	0	0
Total	48	3806	1741	12	185	405	0	12
Average per household		79.29	36.27	0.25	3.85	8.44	0.00	0.25

Table 10-3: Energy Equivalence of biomass fuel consumed for the households for cooking for different unions

Name of the unions	Sample (Nos)	Firewood (MJ)	Leaves, twigs and crop residue, straw (MJ)	Rice husk (MJ)	Dried cow dung (MJ)	Bamboo, twigs of bamboo, leaves of bamboo (MJ)	Briquette (MJ)	Saw dust, saw mill residue (MJ)	Energy Equivalence of Total Consumption of Biomass (MJ)	Energy Equivalence of Average Consumption per Household of Biomass (MJ)
Agla	4	1,440	189	-	-	504	-	-	2,133.00	533.25
Bakshona gar	3	8,000	1,350	-	-	-	-	-	9,350.00	3,116.67
Bandura	3	-	-	-	-	-	-	-	-	-
Barrah	3	3,680	1,215	-	1,450	1,440	-	-	7,785.00	2,595.00
Baruakhal i	3	16,000	2,430	-	-	-	-	-	18,430.00	6,143.33
Churain	4	896	972	-	-	1,080	-	-	2,948.00	737.00
Galimpur	3	1,200	540	150	-	216	-	162	2,268.00	756.00
Jantrail	4	7,280	1,350	-	-	-	-	-	8,630.00	2,157.50
Joykrishna pur	3	2,960	1,377	-	-	-	-	-	4,337.00	1,445.67
Kailail	4	8,320	3,780	-	1,015	-	-	-	13,115.00	3,278.75
Kaleidoscope	4	4,320	4,320	-	-	3,240	-	-	11,880.00	2,970.00
Nayonshree	3	4,800	4,658	-	-	810	-	-	10,267.50	3,422.50
Shikaripara	4	1,360	135	-	-	-	-	-	1,495.00	373.75
Sholla	3	640	1,188	-	218	-	-	-	2,045.50	681.83
Total	48	60,896	23,504	150	2,683	7,290	-	162	80,876.00	1,684.92

Energy contents of different types of biomass fuels were converted into a uniform physical unit MJ (Mega Joule). Energy contents of biomass fuel were carried out from following energy conversion factors. Firewood constitutes 16 MJ/kg, agricultural waste (e.g., crop residue, saw dust, etc.) 13.5 MJ/kg, dried cow dung 14.5 MJ/kg, branches 16 MJ/kg. Heating value of rice husk is considered 12.5 MJ/kg. and bamboo is 18 MJ/kg. Heating value of briquette is considered 18.5 MJ/kg.¹ Based on these conversion factors total and average consumption in Mega Joule of different biomass fuel is shown in Table 10-3.

Table 10-4: Consumption of fuels other than biomass for the households for cooking and other purposes for different unions

Name of unions	Sample (Nos)	Biogas, (consumption hrs.)	Natural gas (No. of Burners)	LPG (kg)	Kerosine (liter)	Diesel (liter)	Electricity consumption by induction heater, rice cooker, etc. (kWh)	Electricity consumption, (kWh)*
Agla	4	0	0	72	0	0	36	-
Bakshonagar	3	0	0	12	0	0	0	-
Bandura	3	0	0	72	0	0	0	-
Barrah	3	0	0	72	0	0	31.5	-
Baruakhali	3	0	0	36	0	0	0	-
Churain	4	0	0	12	0	0	0	-
Galimpur	3	0	0	24	0	0	24	-
Jantrail	4	0	0	60	0	0	0	-
Joykrishnapur	3	0	0	12	0	0	0	-
Kailail	4	0	0	12	0	0	0	-
Kaleidoscope	4	0	0	72	0	0	0	-
Nayonshree	3	0	0	36	0	0	0	-
Shikaripara	4	0	0	84	0	0	0	-
Sholla	3	0	0	24	0	0	126	-
Total	48	0	0	600	0	0	217.5	-
Average per household		0.00	0.00	12.50	0.00	0.00	4.53	-

* Electricity consumption will be calculated after receiving data from respective PBS.

Table 10-5: Consumption of energy by transport, diesel generator and with solar PV system for households for different unions

Name of unions	Sample (Nos)	Fuel for transport			Fuel for diesel generator	Solar PV system
		Petrol/Octane (liter)	Diesel (liter)	Others	Diesel (liter)	(kWh)
Agla	4	0	0	0	0	0
Bakshonagar	3	0	0	0	0	0
Bandura	3	15	0	0	0	0
Barrah	3	0	0	0	0	0
Baruakhali	3	0	0	0	0	0
Churain	4	0	0	0	0	0
Galimpur	3	20	0	0	0	0
Jantrail	4	0	0	0	0	0
Joykrishnapur	3	10	0	0	0	0
Kailail	4	0	0	0	0	0
Kaleidoscope	4	0	0	0	0	0
Nayonshree	3	0	0	0	0	0
Shikaripara	4	0	0	0	0	0
Sholla	3	15	0	0	0	0
Total	34	60	0	0	0	0
Average per household		1.76	0.00	0.00	0.00	0.00

Table 10-6: Average consumption of biomass fuel and other energy sources by households for different income groups

Income group, per month	No. of Households	Average consumption per month									
		Energy types									
		Biomass (kg)	Energy Equivalence of Total Biomass (MJ)	Electricity consumption (kWh)*	LPG (kg)	Kerosene (liter)	Diesel (liter)	Petrol/Octane (liter)	Natural gas (m3)	Biogas (m3)	Solar PV (kWh)
G1 = ≤ 15,000 BDT	18	177.28	2736.64	-	12.67	0	0	0	0	0	0
G2 = 15,001-30,000 BDT	27	102.59	1574.98	-	12	0	0	1.67	0	0	0
G3 = ≥ 30,001 BDT	3	66.67	966.67	-	16	0	0	5	0	0	0

* Electricity consumption will be calculated after receiving data from respective PBS.

Table 10-7: Average consumption of different biomass fuels by households for different income groups

Income groups	No. of Households	Firewood (kg)	Leaves, twigs and crop residue (kg)	Rice husk (kg)	Dried cow dung (kg)	Bamboo, twigs of bamboo, leaves of bamboo (kg)	Briquette (kg)	Saw dust, saw mill residue (kg)
G ₁ = ≤ 15,000 BDT	18	112.06	51.17	0	0	14.06	0	0
G ₂ = 15,001-30,000 BDT	27	63.3	25.93	0.44	6.85	5.63	0	0.44
G ₃ = ≥ 30,001 BDT	3	26.67	40	0	0	0	0	0

Based on the energy content in Mega Joule mentioned earlier, Table 8 shows the energy consumption of different biomass fuels by households for different income groups under G₁, G₂ and G₃, which are G₁ = ≤ 15,000 BDT, G₂ = 15,001-30,000 BDT and G₃ = ≥ 30,001 BDT.

Table 10-8: Average energy consumption of different biomass fuels by households for different income groups

Income groups	No. of Households	Firewood (MJ)	Leaves, twigs and crop residue (MJ)	Rice husk (MJ)	Dried cow dung (MJ)	Bamboo, twigs of bamboo, leaves of bamboo (MJ)	Briquette (MJ)	Saw dust, saw mill residue (MJ)
G ₁ = ≤ 15,000 BDT	18	1792.89	690.75	0	0	253	0	0
G ₂ = 15,001-30,000 BDT	27	1012.74	350	5.56	99.35	101.33	0	6
G ₃ = ≥ 30,001 BDT	3	426.67	540	0	0	0	0	0

Table 10-9: Biomass fuel consumption for business and industrial enterprises for different unions

Name of the unions	Sample (Nos)	Firewood, twigs (kg)	Leaves, twigs and crop residue, straw (kg)	Rice husk (kg)	Dried cow dung (kg)	Bamboo, twigs of bamboo, leaves of bamboo (kg)	Brickette (kg)	Saw dust, saw mill residue (kg)
Agla	3	0	0	0	0	0	0	0
Bakshanagar	4	0	0	0	0	0	0	0
Bandura	4	0	0	0	0	0	0	0
Barrah	4	0	0	0	0	0	0	0
Baruakhaly	4	0	0	0	0	0	0	0

Name of the unions	Sample (Nos)	Firewood, twigs (kg)	Leaves, twigs and crop residue, straw (kg)	Rice husk (kg)	Dried cow dung (kg)	Bamboo, twigs of bamboo, leaves of bamboo (kg)	Brickette (kg)	Saw dust, saw mill residue (kg)
Churaine	3	600	0	0	0	0	0	0
Galimpur	2	0	0	0	0	0	0	0
Jantrail	4	0	0	0	0	0	0	0
Jaykrishnapur	3	1200	0	0	0	0	0	0
Kailail	3	0	0	0	0	0	0	0
Kalakopa	6	0	0	0	0	0	0	0
Noyonshree	3	0	0	0	0	0	0	0
Shikaripara	3	0	0	0	0	0	0	0
Sholla	3	0	0	0	0	0	0	0
Total	49	1,800	0	0	0	0	0	0
Average per unit		36.73	0.00	0.00	0.00	0.00	0.00	0.00

Table 10-10: Energy consumption other than biomass fuel for business and industrial enterprises for different unions

Name of unions	Sample (Nos)	Biogas, (consumption hrs.)	Natural gas (No. of burners)	LPG (kg)	Kerosine (liter)	Diesel (liter)	Coal (kg)	Electricity consumption (kWh)
Agla	3	0	0	272	0	0	0	-
Bakshanagar	4	0	0	160	0	0	0	-
Bandura	4	0	0	0	0	0	0	-
Barrah	4	0	0	336	0	0	0	-
Baruakhaly	4	0	0	0	0	0	0	-
Churaine	3	0	0	456	360	0	0	-
Galimpur	2	0	0	240	0	0	0	-
Jantrail	4	0	0	264	0	0	0	-
Jaykrishnapur	3	0	0	24	0	0	0	-
Kailail	3	0	0	530	0	0	0	-
Kalakopa	6	0	0	36	0	0	0	-
Noyonshree	3	0	0	0	0	0	0	-
Shikaripara	3	0	0	0	0	0	0	-
Sholla	3	0	0	516	0	0	0	-
Total	49	0	0	2,834	360	0	0	-
Average consumption per unit		0.00	0.00	57.84	7.35	0.00	0.00	-

* Data to be received from PBS.

Table 10-11: Consumption of energy by transport and diesel generator for business and industrial enterprises for different unions

Name of unions	Sample (Nos)	Fuel for transport	Fuel for diesel generator
----------------	--------------	--------------------	---------------------------

		Petrol/ Octane (liter)	Diesel (liter)	Others (unit)	Diesel (liter)
Agla	3	0	0	0	0
Bakshanagar	4	0	0	0	0
Bandura	4	0	0	0	0
Barrah	4	0	0	0	0
Baruakhaly	4	0	0	0	0
Churaine	3	0	0	0	0
Galimpur	2	0	0	0	0
Jantrail	4	0	0	0	0
Jaykrishnapur	3	16	0	0	0
Kailail	3	0	0	0	0
Kalakopa	6	0	0	0	0
Noyonshree	3	0	0	0	0
Shikaripara	3	0	0	0	0
Sholla	3	0	0	0	0
Total	49	16	0	0	0
Average consumption per unit		0.33	0.00	0.00	0.00

Table 10-12: Consumption of biomass fuel for agricultural purposes for different unions

Name of the unions	Sample (Nos)	Firewood, twigs (kg)	Leaves, twigs and crop residue, straw (kg)	Rice husk (kg)	Dried cow dung (kg)	Bamboo, twigs of bamboo, leaves of bamboo (kg)	Briquette (kg)	Saw dust, saw mill residue (kg)
Agla	3	3.92	4.50	2	1.17	4	0	0
Bakshanagar	3	201.67	0	0	16.67	0	0	0
Bandura	4	15.00	13.33	0.00	0	2.08	0	0
Barrah	3	9.58	10.58	9	0	2.33	0	0
Baruakhali	2	250.00	16.67	0.00	8.33	0.00	0	0
Churain	2	1.83	1.17	0.00	0.00	1.50	0	0
Galimpur	3	3.67	2.75	1	1	3	0	0
Jantrail	2	12.50	10.00	0	0	0	0	0
Joykrishnapur	1	1.83	2.50	0	0	0	0	0
Kailail	3	125.00	16.67	0	0	0	0	0
Kaleidoscope	2	6.67	7.92	0	0	0.00	0	0
Nayonshree	3	11.67	30.00	8.33	16.67	5.00	0	0
Shikaripara	2	23.33	0	0	0	0	0	0
Sholla	4	32.50	26.25	10.17	0.00	5.00	0	0
Total	37	699.17	142.33	30.58	43.67	22.50	0	0
Average consumption per unit		18.90	3.85	0.83	1.18	0.61	0	0

Table 10-13: Consumption of fuel by transport, thresher and diesel generator for agricultural purposes for different unions

Name of unions	Sample (Nos)	Fuel for transport			Fuel for diesel generator
		Petrol/ Octane (liter)	Diesel (liter)	Others	Diesel (liter)
Agla	3	0	1720	0	0
Bakshanagar	3	0	4725	0	0
Bandura	4	30	320	0	0
Barrah	3	0	1175	0	0
Baruakhali	2	0	1710	0	0
Churain	2	0	912	0	0
Galimpur	3	0	605	0	0
Jantrail	2	0	800	0	0
Joykrishnapur	1	0	2000	0	0
Kailail	3	70	2340	0	0
Kaleidoscope	2	0	300	0	0
Nayonshree	3	0	890	0	0
Shikaripara	2	0	2710	0	300
Sholla	4	0	1935	0	0
Total	37	70	2340	0	300
Average consumption per unit		1.89	63.24	0.00	8.11

Table 10-14: Amount of diesel, kerosine, petrol, octane sales and sale of CNG from petrol pump and CNG filling station for each union

Name of unions	Natural Gas (m3)	LPG (kg)	Kerosine (liter)	Petrol/ Octane (liter)	Diesel (liter)	Coal (kg)
Agla	0	8450	0	25000	60000	0
Bakshanagar	0	375	0	18600	18000	0
Bandura	0	1440	0	5500	3400	0
Barrah	0	1465	0	300	300	0
Baruakhaly	0	0	0	1000	200	0
Churaine	0	570	0	0	0	0
Galimpur	0	270	0	0	200	0
Jantrail	0	1440	0	2100	1900	0
Jaykrishnapur	0	720	0	2200	0	0
Kailail	0	1710	0	400	0	0
Kalakopa	0	360	0	0	0	0
Noyonshree	0	1260	15	1110	1000	0
Shikaripara	0	192	0	0	0	0
Sholla	0	600	0	800	3000	0
Total	0	18,852	15	57,010	88000	0
Sample size	0	26	1	15	12	0
Average Selling per unit	0	725.08	15	3800.67	7333.33	0

10.4 Data Quality

The field survey activities were monitored by the members of the consultant team in some places to oversee the study activities to ensure quality. Team members have visited field to verify and confirm the study findings with the existing situation. In addition, quality of data collection of the enumerators was monitored by the supervisors through mobile phone.

Majority of the data from the questionnaire were collected by Kobo Toolbox and some of the remaining data were taken in hard copy. The survey data were plotted in Excel sheet based on the questionnaire. From the Excel sheet data were processed and transformed into tabulated form for each section. So, the data quality was ensured for each level from survey to data processing and data formulation.

10.5 Survey Results

10.5.1 Section A: Households

The respondent had the option to respond with multiple answers in the survey. It has been found that the household owners have used different sources of energy for cooking for domestic purpose. It is observed that biomass fuel used per month for each household on average are firewood is 79.29 kg, leaves, twigs, crop residue is 36.27 kg, rice husk is 0.25 kg, dried cow dung is 3.85 kg, bamboo, twigs of bamboo, leaves of bamboo is 8.44 kg, and saw dust, saw mill residue is 0.25 kg. No briquette is found in the survey to be used for cooking by households. Total average energy equivalent of biomass fuel used per month for each household is 1,684.92 MJ.

Other than biomass fuel the household usage for cooking is LPG. LPG consumed for average household is 12.50 kg per month. Electricity is used for lighting, fan and other electrical appliances. Moreover, electricity is used for cooking by induction heater and rice cooker. Average electricity consumption by induction heater, rice cooker, etc. for average household is 4.53 kWh. Average domestic level consumption of petrol/ octane for transport such as for motorcycle, is 1.76 liters (Table 5). No diesel for transport and diesel generator is used in this Upazila. No solar PV system found in the survey in this Upazila.

Income groups of the respondent

When all types of biomass fuels are considered in weight, average consumption of biomass fuels for household per month was found to be highest (177.28 kg) in the low-income group (income below BDT 15,000 per month) and lowest (66.67 kg) in the high-income group (above BDT 30,001 per month). Considering energy equivalent of all the biomass fuels, average consumption of biomass fuels among low income (below BDT 15,000 per month), middle (between BDT 15,001 to BDT 30,000 per month) and high income (above BDT 30,001 per month) groups of households are about 2736.64MJ per month, 1574.98 MJ per month and 966.67 MJ per month respectively.

However, average consumption of LPG for all the three income groups shows close, which are 12.67 kg for low, 12 kg for middle and 16 kg for high income groups. Consumption of petrol/ octane is the highest for high income group, which is 5 liter per household. For low-income group no record of consumption of petrol was found. For middle-income group average consumption of petrol/ octane is 1.676 liter per household per month.

Considering different types of biomass fuels used for different income groups, firewood shows highest in the low-income group (112.06 kg) and lowest in the high-income group (26.67 kg). For the low-income group use of leaves, twigs and crop residue (51.17 kg), bamboo, twigs of bamboo (14.06 kg) are found highest. In the high-income group rice husk, dried cow dung, bamboo, twigs, briquette and saw dust are not found to use in the survey. In the low-income group, there is no use of rice husk, dried cow dung, briquette and saw dust. Use of dried cow dung (6.85 kg) is found only in the middle-income group.

10.5.2 Section B: Business /Industrial Enterprises

Grocery shop, restaurant, cosmetics shop, tea stall, sweat seller, poultry shop, sanitary product seller, paint shop, telecom shop, garments and cloth store, etc. are included in the survey of business and industrial enterprises. For business and industrial enterprises, only firewood is used. For each unit average amount per month of firewood used is 36.73 kg. Leaves, twigs and crop residue, straw, rice husk, dried cow dung, bamboo, twigs of bamboo, leaves of bamboo, briquette and saw dust, saw mill residue are not used for business and industrial enterprises. For average business and industrial unit total energy equivalent of firewood is 587.76 MJ.

For business and industrial enterprises average consumption of LPG is 57.84 kg and kerosine is 7.35 liter per unit. There is no consumption of biogas, natural gas, diesel or coal found in the survey. Average petrol/octane consumption for use of transport for business and industrial unit is 0.33 liters. No use of diesel for transport and for diesel generator was found in the survey.

10.5.3 Section C: Individuals and Enterprises engaged in agricultural activities (Mechanized cultivation, Irrigation, Molasses making, Mechanical threshing, etc.)

For agricultural activities per month average use of biomass fuel of firewood is 18.90 kg, leaves, twigs and crop residue, straw is 3.85 kg, rice husk is 0.83 kg, dried cow dung is 1.18 kg and bamboo, twigs of bamboo, leaves of bamboo is 0.61 kg. There is no use of briquette and saw dust, saw mill residue for agricultural purpose. For agricultural purpose only diesel and LPG are used, whose average amount is 0.56 liters and 0.03 kg respectively. No biogas, natural gas, kerosine, electricity and solar pump is used. For transport, power tiller, thresher, irrigation pump, tractor, etc. average petrol/ octane used is 1.89 liters and diesel fuel used is 63.24 liters. Diesel used in diesel generator for agricultural purpose is 8.11 liters.

10.5.4 Section D: Biomass fuel Seller/ Petrol Pump/ CNG Filling Station/ LPG Supplier/ Diesel, Petrol, Kerosene Dealer/ Natural Gas Supplier, etc.

For different types of biomass fuels there is no record of sales of firewood, rice husk, dried cow dung, briquette and saw dust residue are in the survey. There is no natural gas supply in Nawabganj Upazila. Survey from petrol pump, LPG supplier, diesel, petrol and kerosine dealer found that monthly average LPG sold is 725.08 kg, kerosine 15 liters, petrol/octane 1077.69 liters and diesel 1000 liters respectively.

10.6 Energy Practices and Energy Characteristics

To know the energy practices, it is basically required to understand the types and availability of energy sources in the Upazila. Natural gas is not available in the Upazila. So, it is found that there is no use of natural gas for households, business, industrial or agricultural purposes. It is found that the households use different types of biomass fuels for cooking purposes. Biomass usage constitutes of fire wood, leaves, twigs and crop residue, bamboo, twigs of bamboo, leaves of bamboo for cooking. It is seen that there is small amount of rice husk, dried cow dung and saw dust, saw mill residue used for cooking purpose. No briquette is found to use for cooking in the survey.

In the survey there is no use of biogas for cooking. Biogas plant hasn't developed yet to the Upazila due to lack of technical involvement and knowledge.

Average use of LPG per household is 12.50 kg, which indicates that the households rely on LPG for cooking. However, electricity used for cooking with the appliances of induction heater and rice cooker is very low. Its average consumption per month is 4.53 kWh.

For business and industrial purposes average use of LPG is also considerable amount (57.84 kg).

10.7 Findings and Critical Issues

Following findings and issues need to be considered:

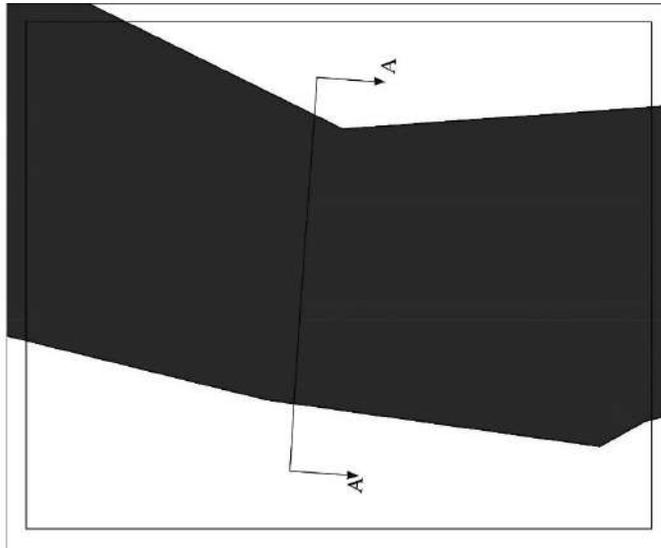
- (i) Most households are still dependent on different types of biomass fuels for cooking purpose. The use of biomass fuel is responsible for environmental pollution and reduction of forest reserve.
- (ii) Use of LPG is also found, which indicates that households are sharing the energy source of firewood and LPG for cooking.
- (iii) The smart and clean energy like electricity have limited use by the households for cooking is due to high price.
- (iv) Solar PV system for households is not found. This is due to the lack of consciousness and difficult to reach the solar PV system to the rural people.
- (v) Large amount of firewood consumption is seen for business and industrial enterprises in this Upazila. Where no diesel or coal is consumed for this purpose.
- (vi) There is no solar pump used in this Upazila. Using a limited space the solar pumps can be installed and can save energy. It is also environmentally friendly. So, solar pumps can be encouraged to use here

ANNEXURE 7-1

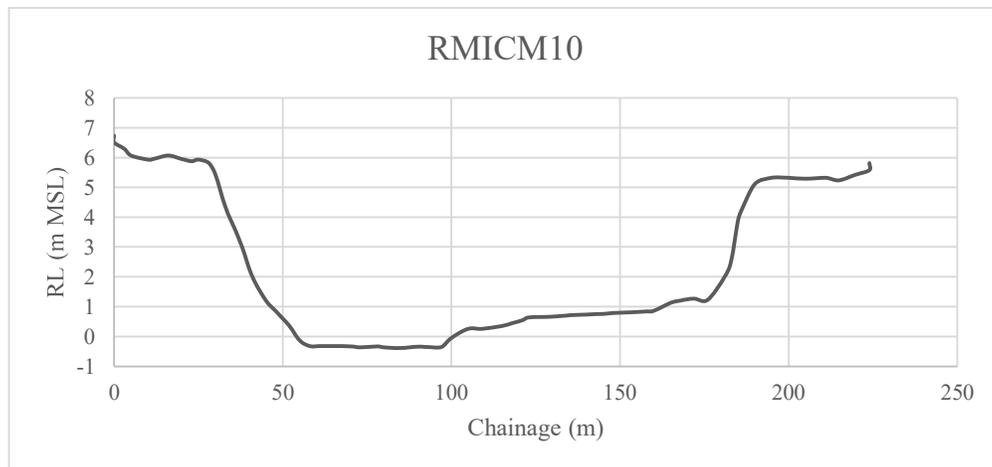
Cross Section of the Rivers

River name: Ichamati

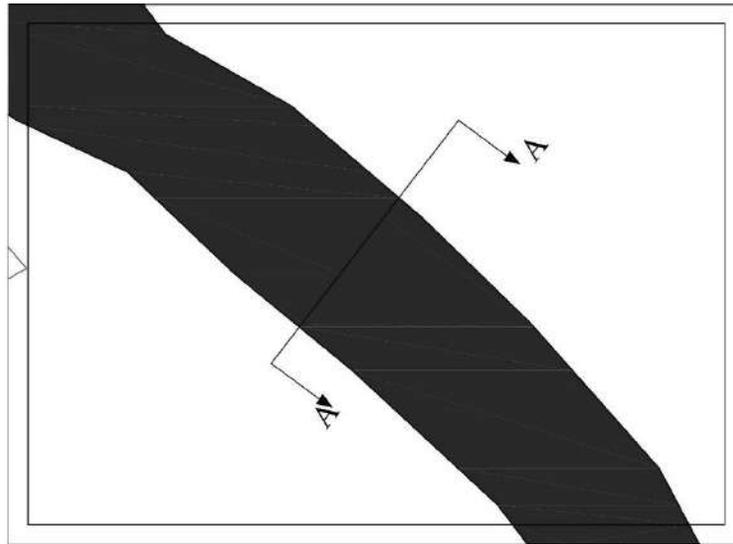
Plan view of ID: RMICM10



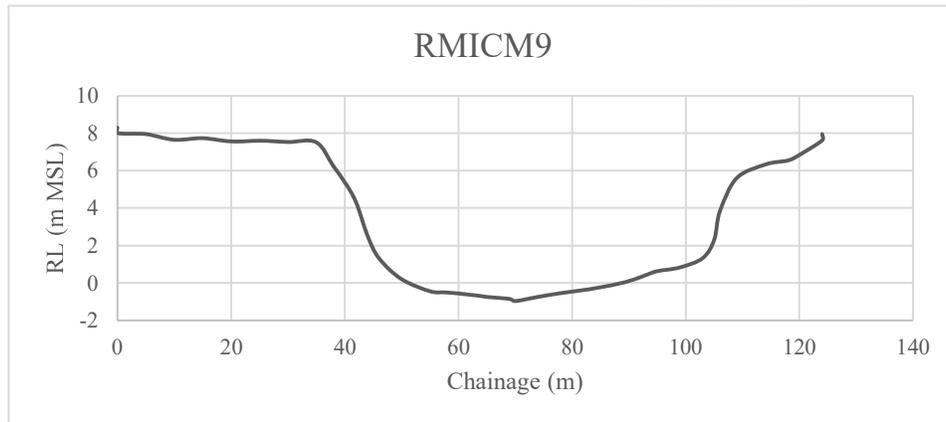
Cross section:



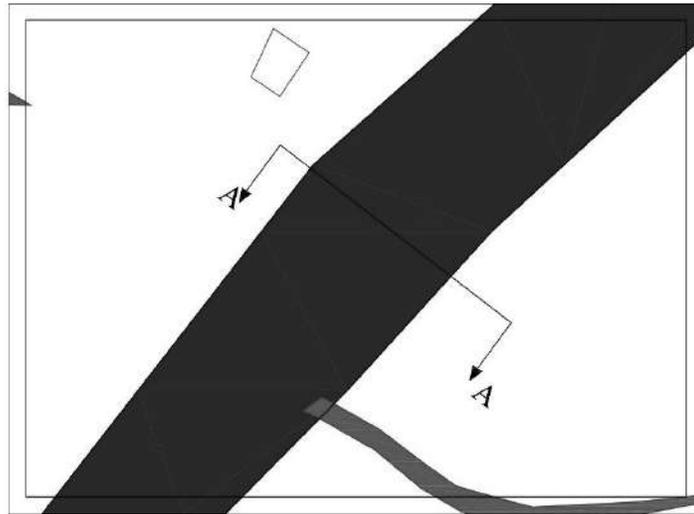
Plan view of ID: RMICM9



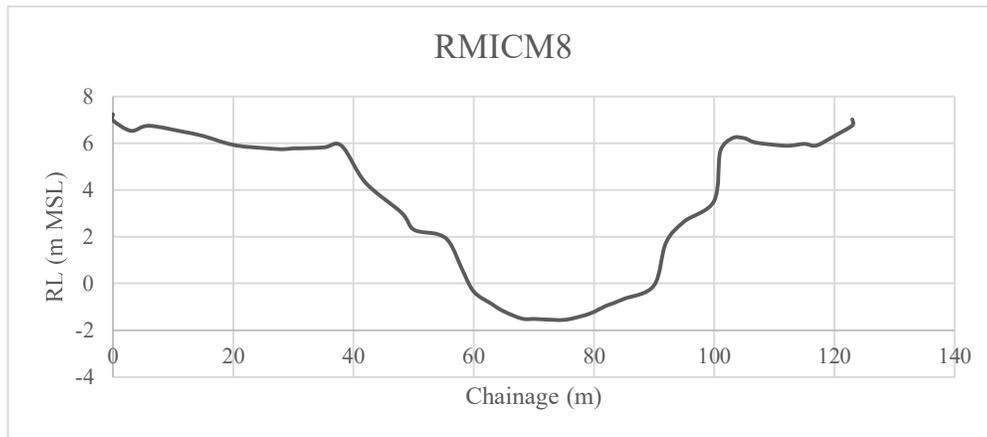
Cross section:



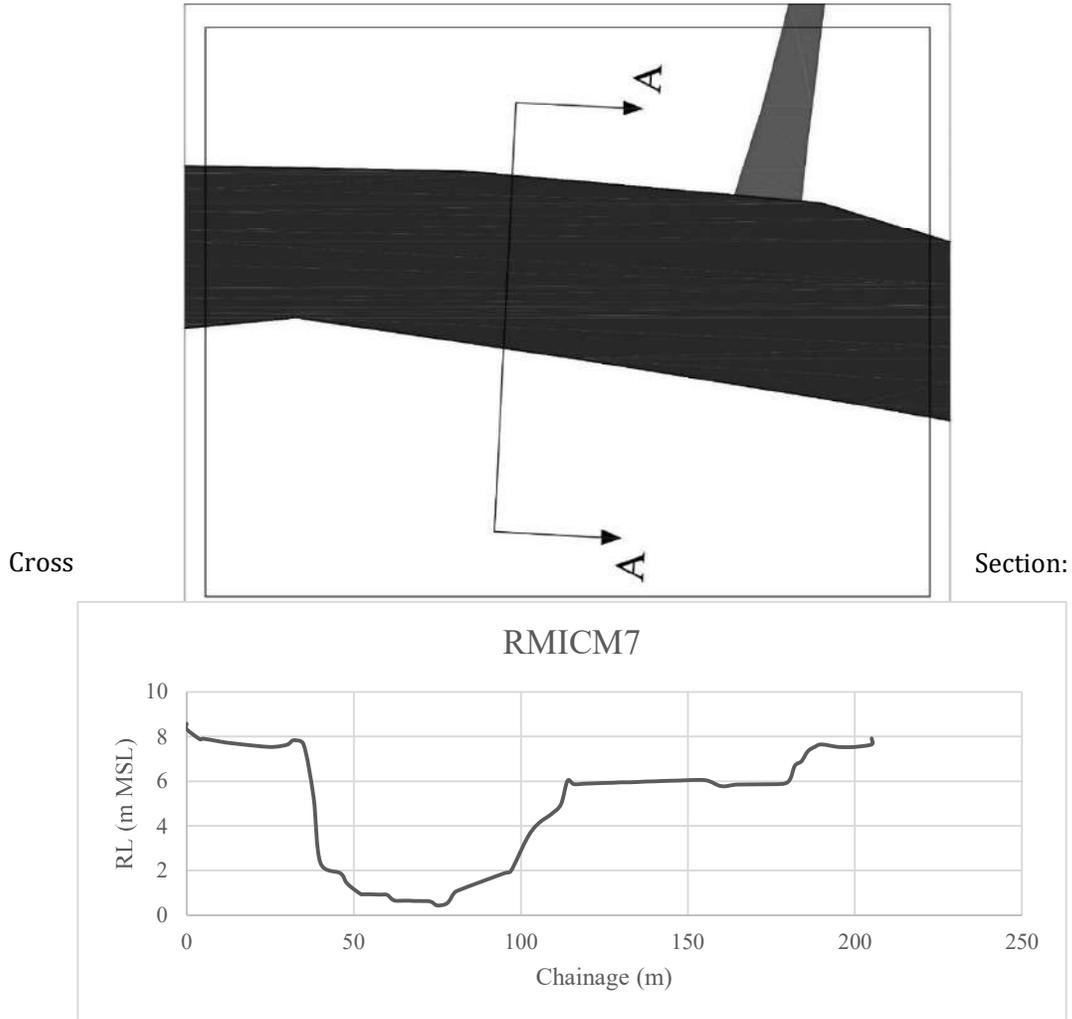
Plan view of ID: RMICM8



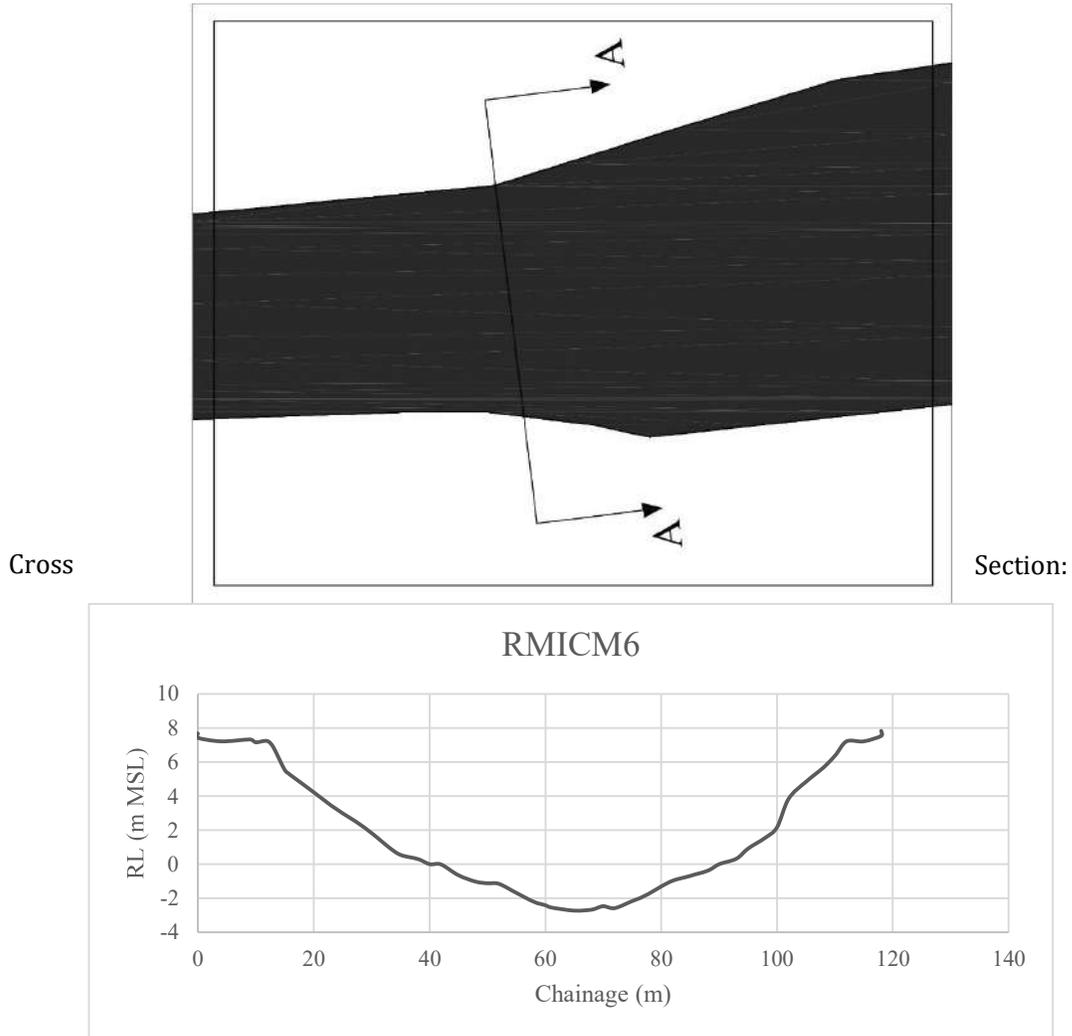
Cross Section:



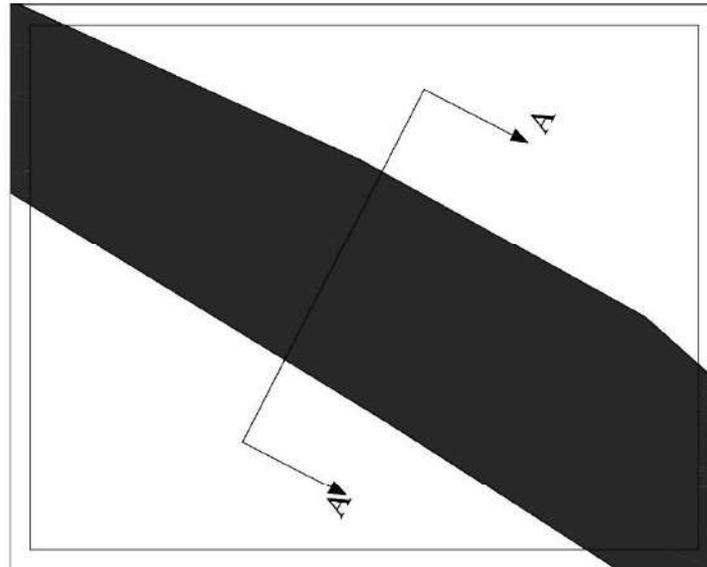
Plan view of ID: RMICM7



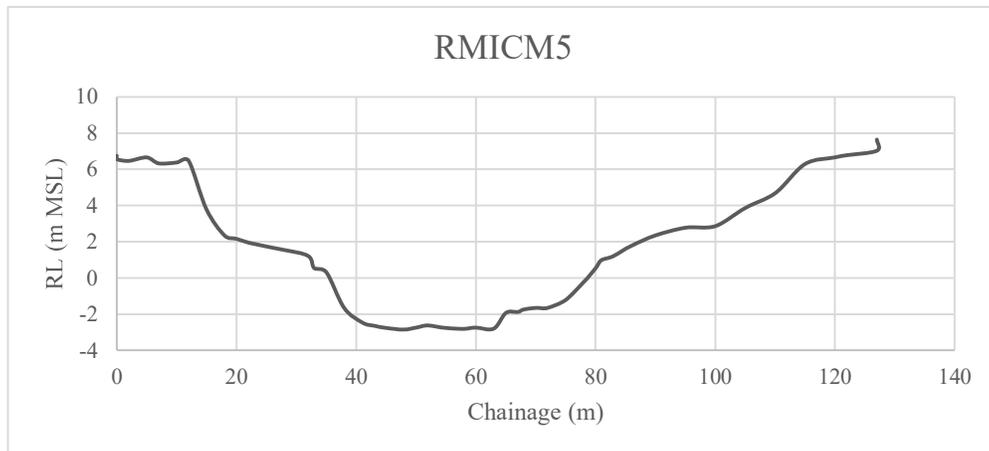
Plan view of ID: RMICM6



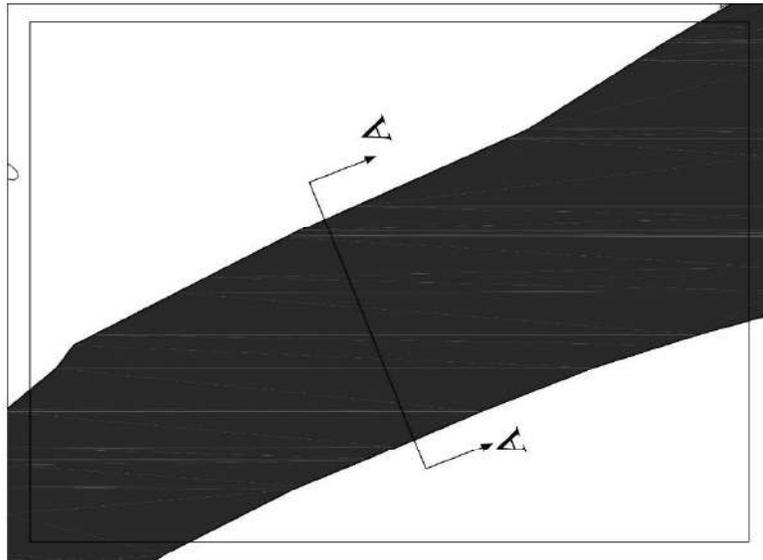
Plan view of ID: RMICM5



Cross Section:

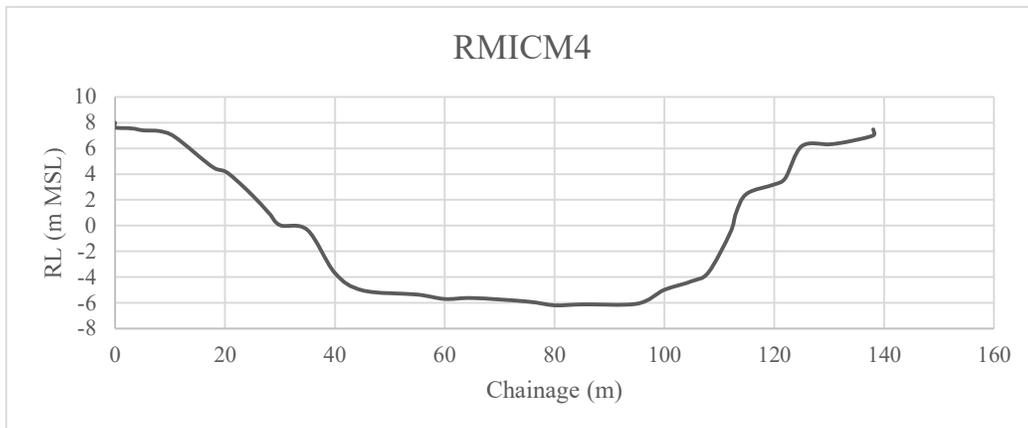


Plan view of ID: RMICM4

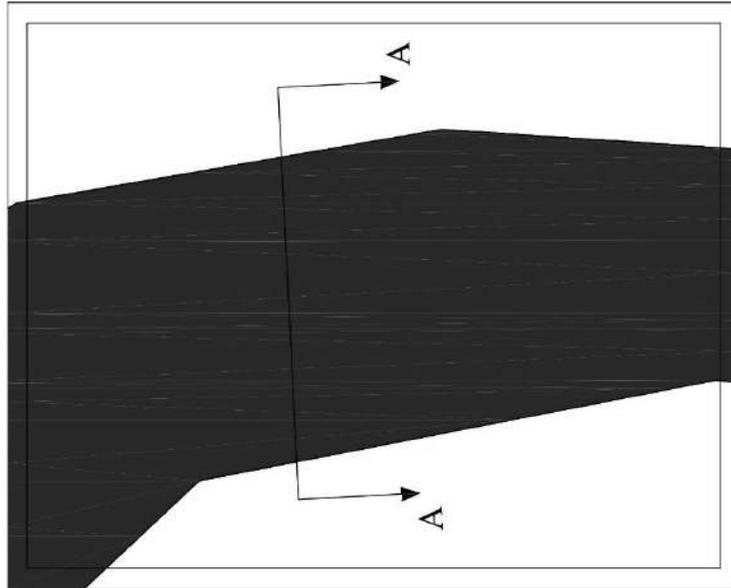


Cross

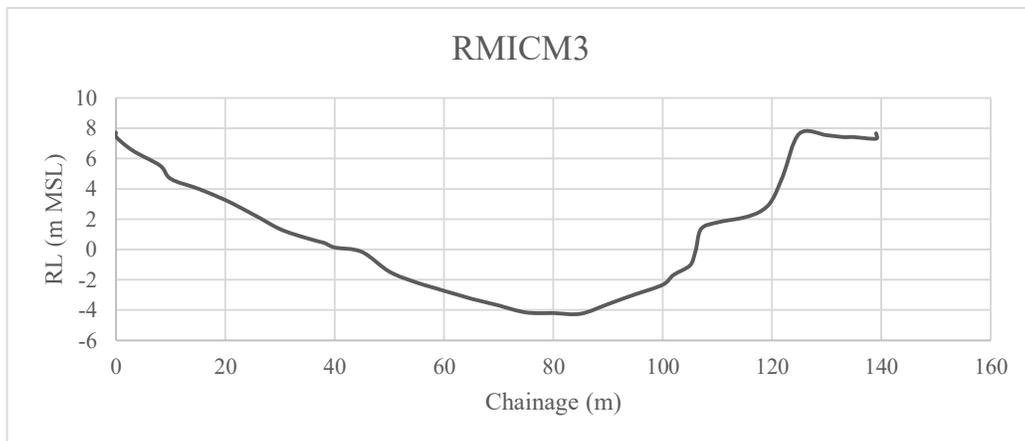
Section:



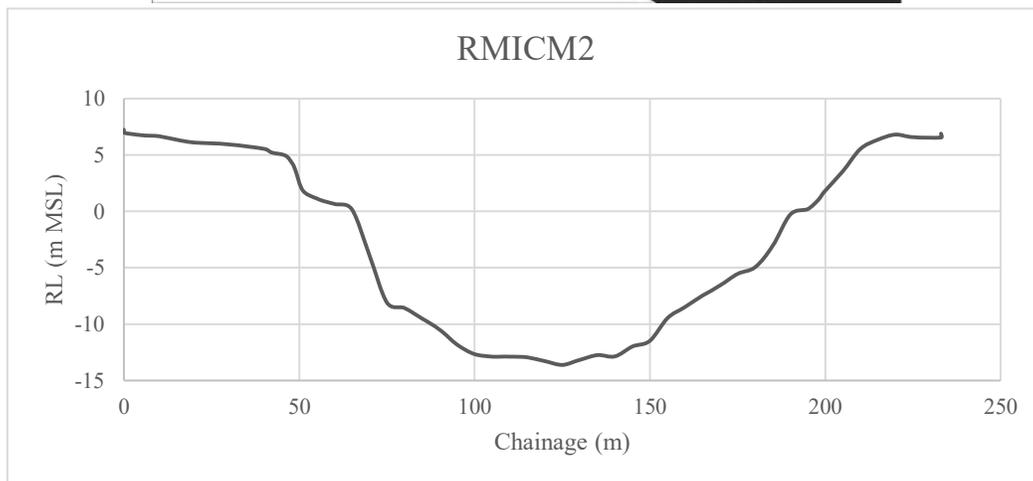
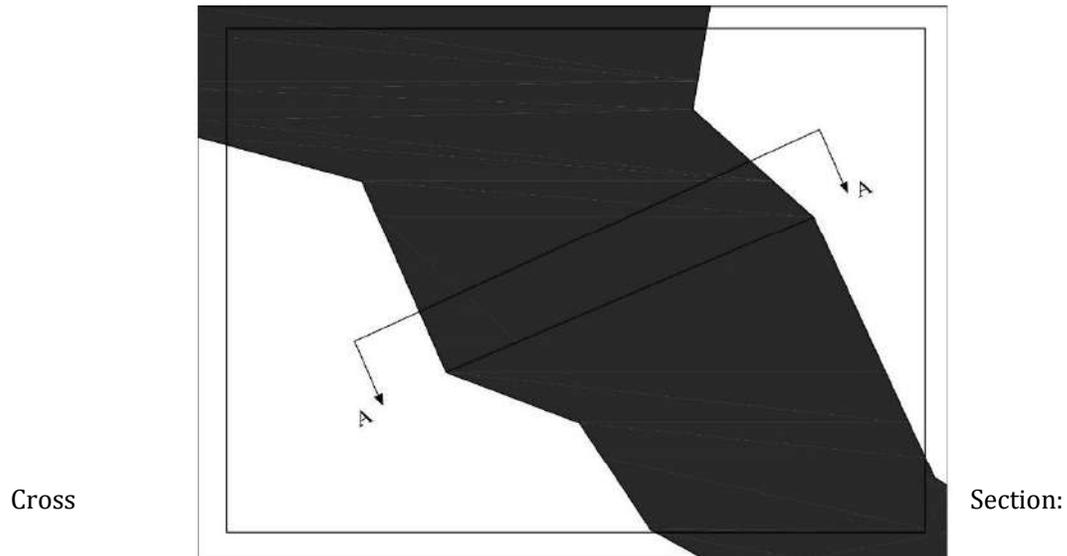
Plan view of ID: RMICM3



Cross Section:

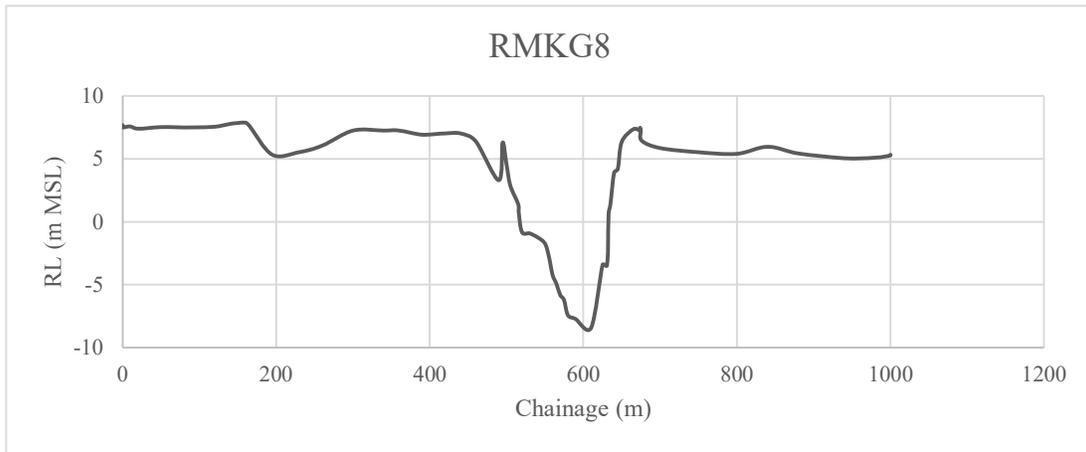
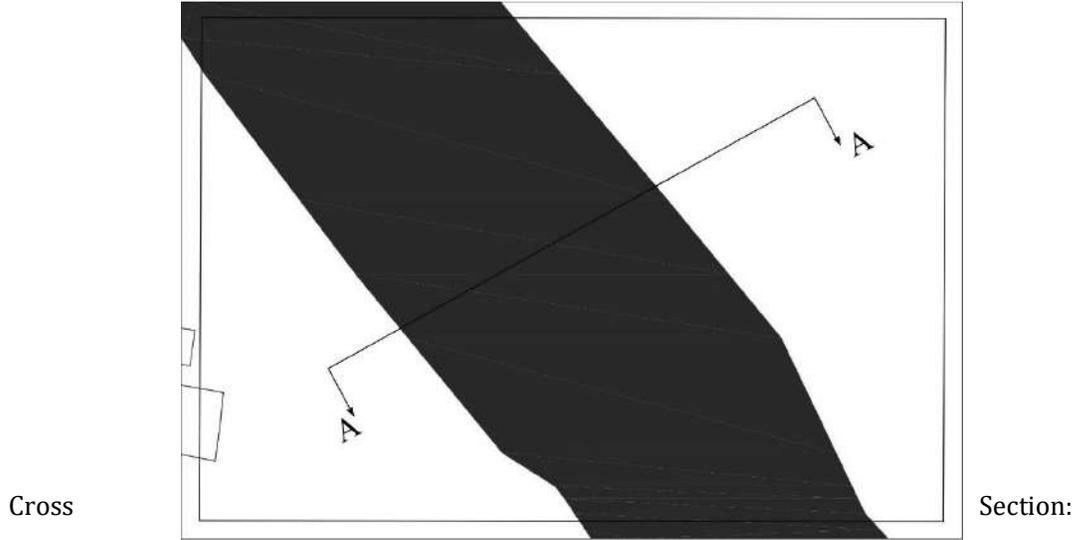


Plan view of ID: RMICM2

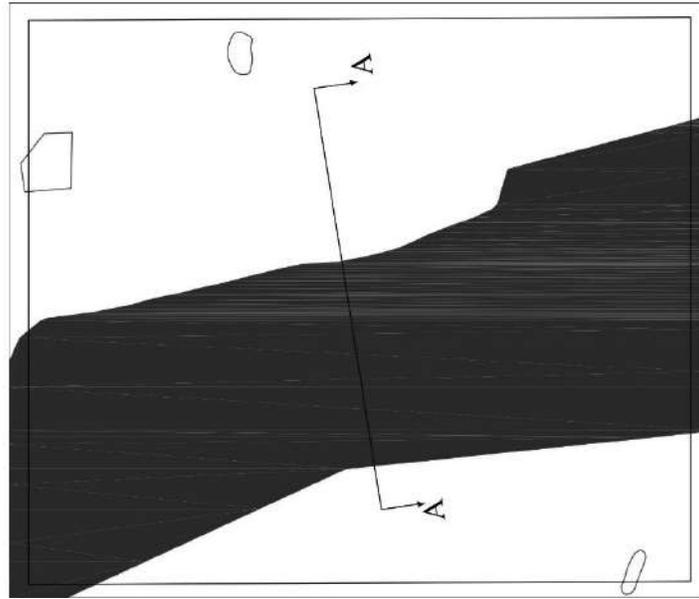


River Name: Kaliganga

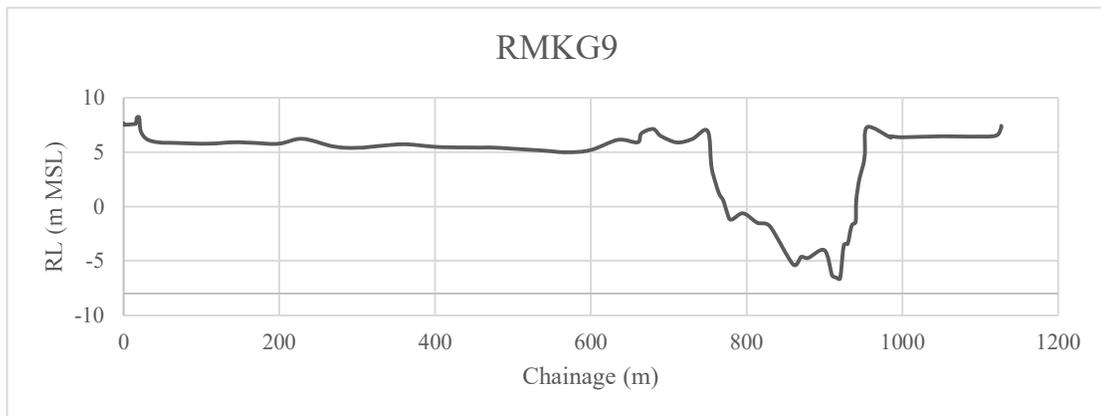
Plan view of ID: RMKG8



Plan view of ID: RMKG9

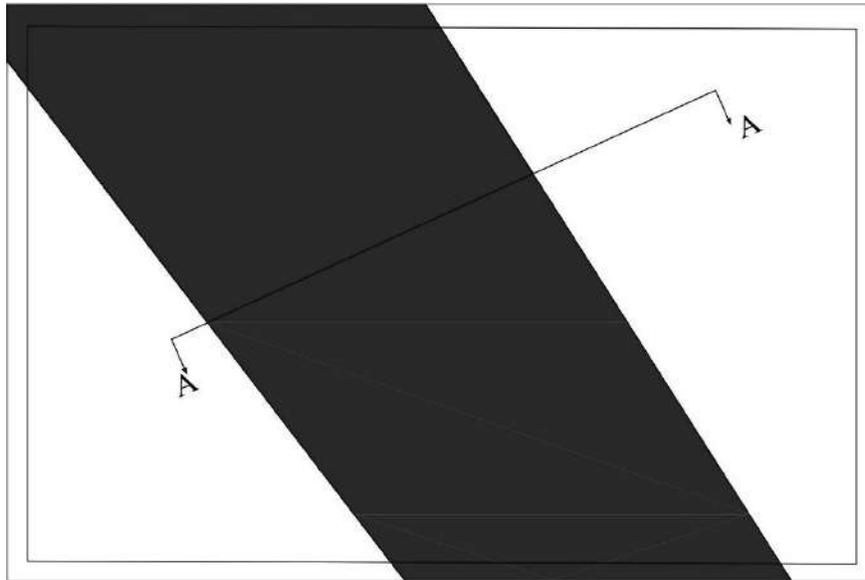


Cross Section:

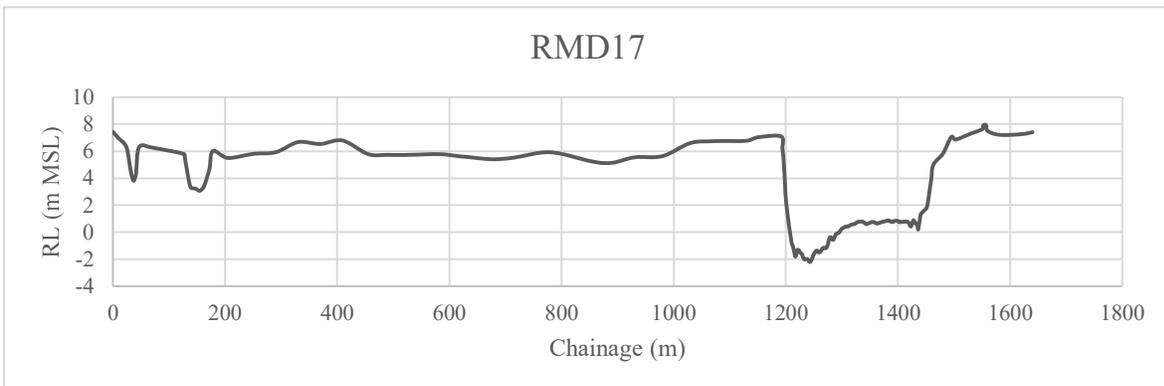


River Name: Dhaleswari

Plan view of ID: RMD17



Cross Section:



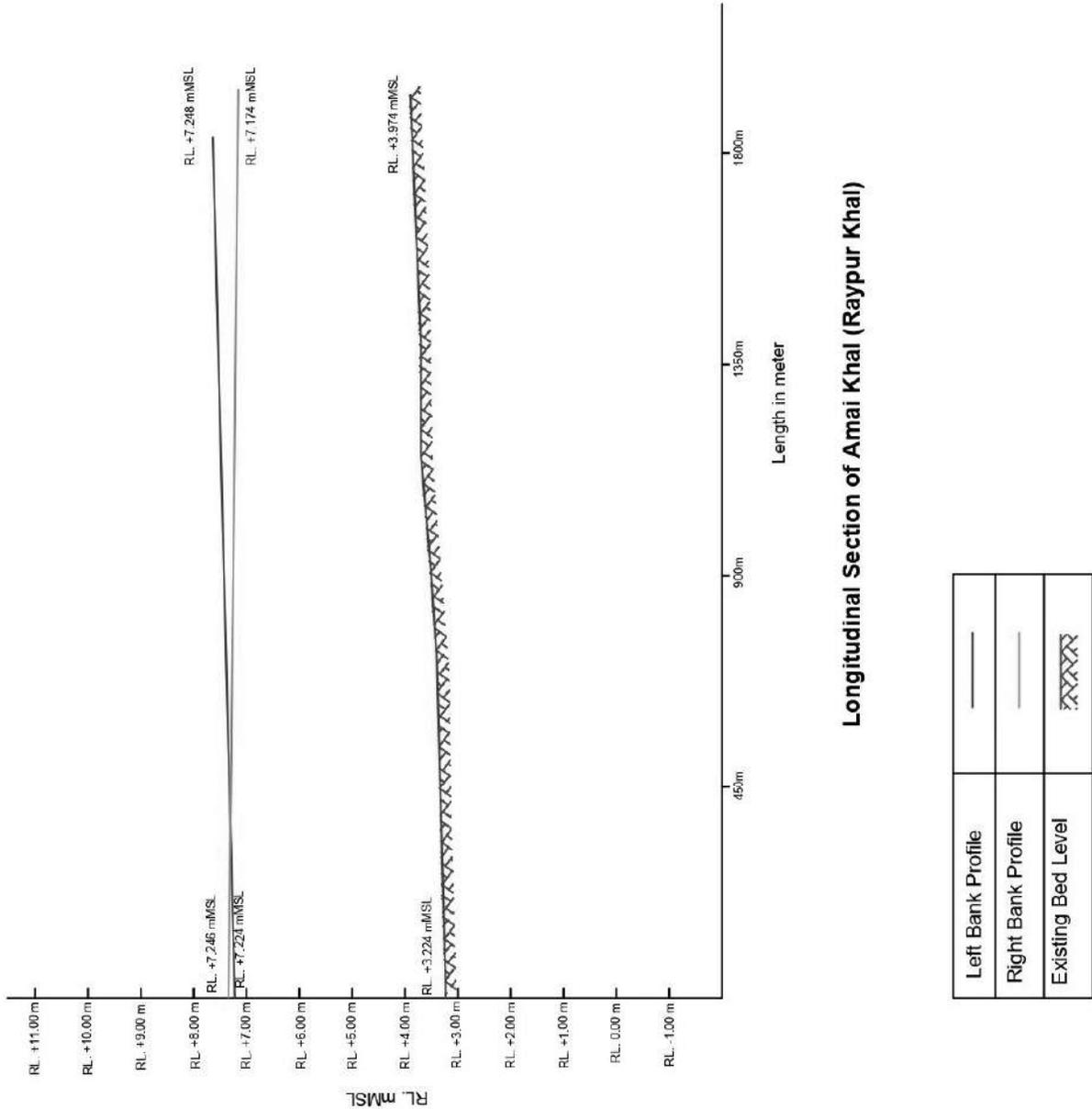
ANNEXURE 7-2

Cross Section of the Cannels

Long Profile and Cross Section of the Canals

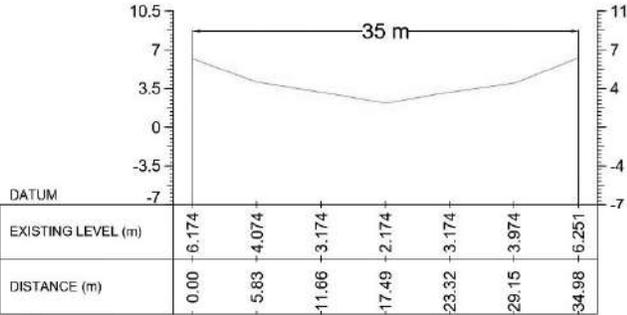
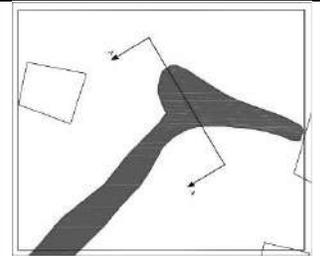
Canal: Amai Khal (Raypur Khal) (Total Length 3000 m).

Long Profile of the Canal:



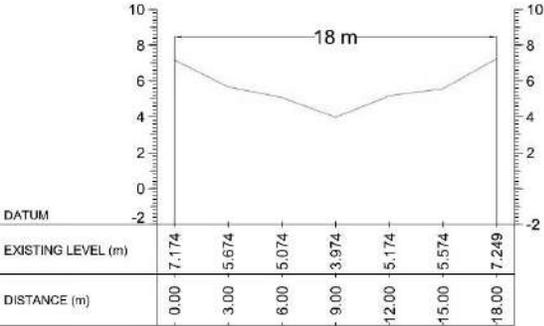
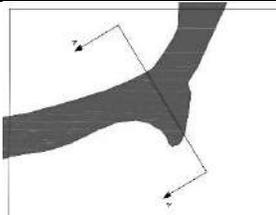
Cross Sections:

Point: 1. Depths are taken between 5.83 m interval.

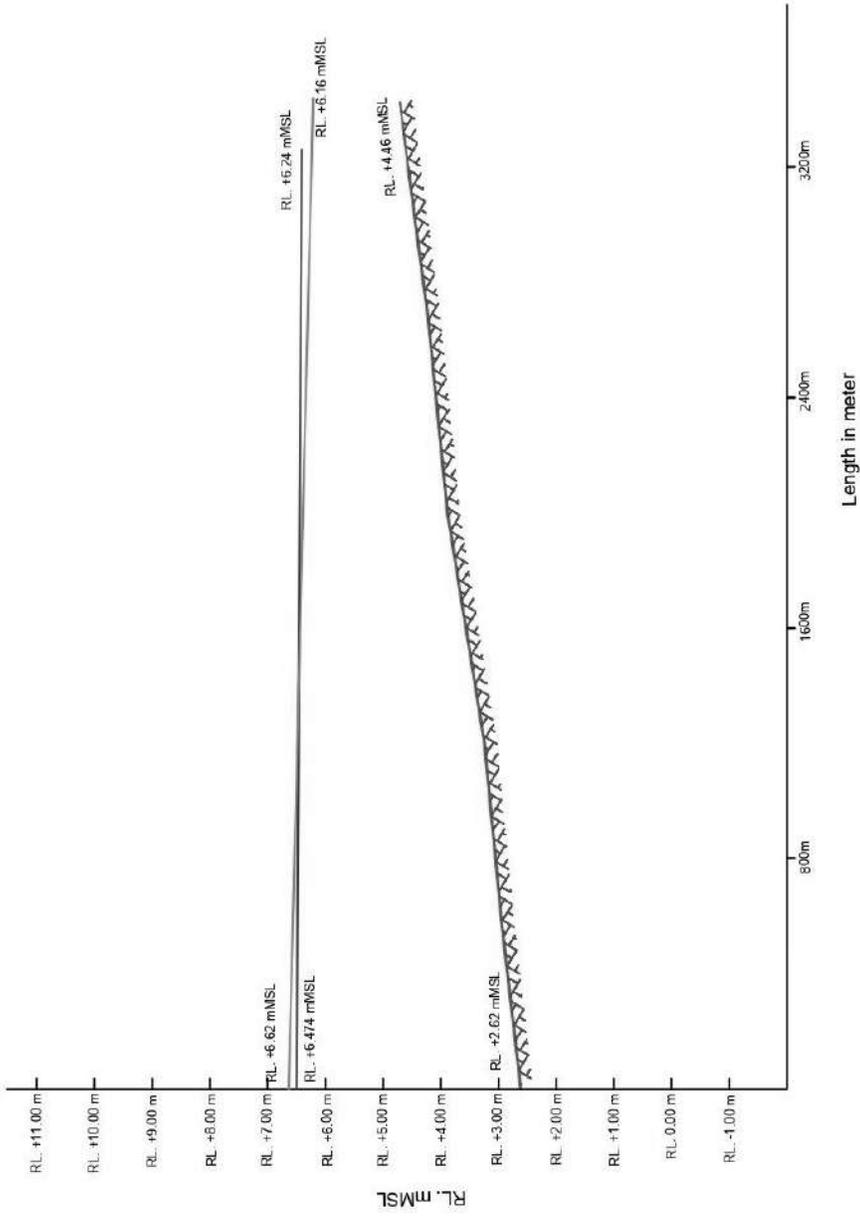
Location:	N:23.684700 E:90.043995 Asaipur, Joykrisnapur khal																									
Width:	35 (m)																									
Depth:	Point 1 (m):	2.1																								
	Point 2 (m):	3.0																								
	Point 3 (m):	4.0																								
	Point 4 (m):	3.0																								
	Point 5 (m):	2.2																								
Direction of flow:	Flow from west direction to south and connected with the Padma River																									
Remarks:	N/A																									
Photograph:		 <table border="1"> <tr> <td>DATUM</td> <td>-7</td> <td>-7</td> <td>-7</td> <td>-7</td> <td>-7</td> <td>-7</td> <td>-7</td> </tr> <tr> <td>EXISTING LEVEL (m)</td> <td>6.174</td> <td>4.074</td> <td>3.174</td> <td>2.174</td> <td>3.174</td> <td>3.974</td> <td>6.251</td> </tr> <tr> <td>DISTANCE (m)</td> <td>0.00</td> <td>5.83</td> <td>11.66</td> <td>17.49</td> <td>23.32</td> <td>29.15</td> <td>34.98</td> </tr> </table> <p>0+000.00</p>	DATUM	-7	-7	-7	-7	-7	-7	-7	EXISTING LEVEL (m)	6.174	4.074	3.174	2.174	3.174	3.974	6.251	DISTANCE (m)	0.00	5.83	11.66	17.49	23.32	29.15	34.98
	DATUM		-7	-7	-7	-7	-7	-7	-7																	
EXISTING LEVEL (m)	6.174	4.074	3.174	2.174	3.174	3.974	6.251																			
DISTANCE (m)	0.00	5.83	11.66	17.49	23.32	29.15	34.98																			
																										

Point: 2. Depths are taken between 3 m interval.

Canal: Dirghoram Khal (Boro Khal)

Location:	N:23.676151 E:90.033704 Raypur, Joykrisnapur																									
Width:	18 (m)																									
Depth:	Point 1 (m):	1.5																								
	Point 2 (m):	2.1																								
	Point 3 (m):	3.2																								
	Point 4 (m):	2.0																								
	Point 5 (m):	1.6																								
Direction of flow:	Flow from south direction to west direction and connected with the Padma River.																									
Remarks:	N/A																									
Photograph:		 <table border="1"> <thead> <tr> <th>DATUM</th> <th>0.00</th> <th>3.00</th> <th>6.00</th> <th>9.00</th> <th>12.00</th> <th>15.00</th> <th>18.00</th> </tr> </thead> <tbody> <tr> <td>EXISTING LEVEL (m)</td> <td>7.174</td> <td>5.674</td> <td>5.074</td> <td>3.974</td> <td>5.174</td> <td>5.574</td> <td>7.249</td> </tr> <tr> <td>DISTANCE (m)</td> <td>0.00</td> <td>3.00</td> <td>6.00</td> <td>9.00</td> <td>12.00</td> <td>15.00</td> <td>18.00</td> </tr> </tbody> </table> <p>1+633.00</p>	DATUM	0.00	3.00	6.00	9.00	12.00	15.00	18.00	EXISTING LEVEL (m)	7.174	5.674	5.074	3.974	5.174	5.574	7.249	DISTANCE (m)	0.00	3.00	6.00	9.00	12.00	15.00	18.00
	DATUM		0.00	3.00	6.00	9.00	12.00	15.00	18.00																	
EXISTING LEVEL (m)	7.174	5.674	5.074	3.974	5.174	5.574	7.249																			
DISTANCE (m)	0.00	3.00	6.00	9.00	12.00	15.00	18.00																			
																										

Long Profile of the Canal:

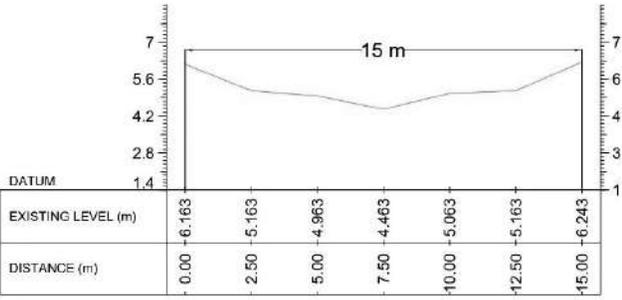
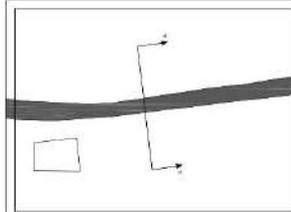


Longitudinal Section of Dirghoram Khal (Boro Khal)

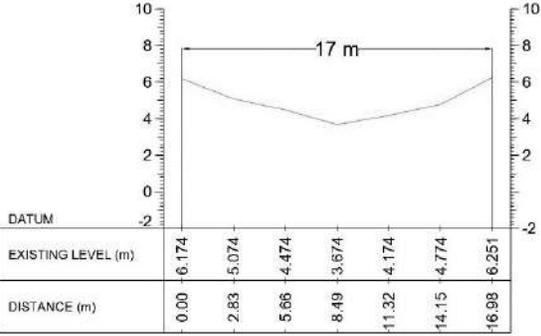
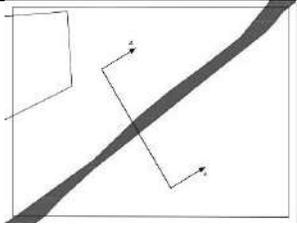
Left Bank Profile	
Right Bank Profile	
Existing Bed Level	

Cross Sections:

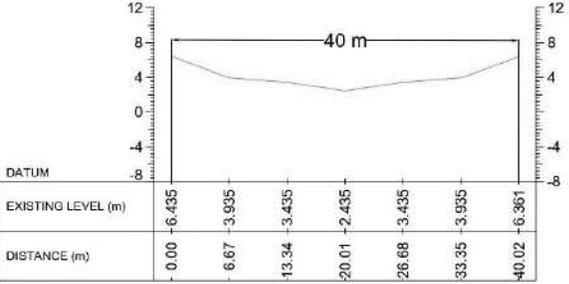
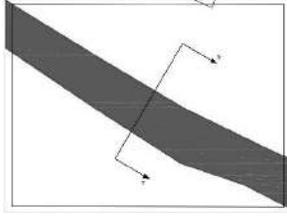
Point: 1. Depths are taken between 2.5 m interval.

Location:	N:23.668377 E:90.075045 Korpara, Baruakhali																												
Width:	15 (m)																												
Depth:	Point 1 (m): 1.0																												
	Point 2 (m): 1.2																												
	Point 3 (m): 1.7																												
	Point 4 (m): 1.1																												
	Point 5 (m): 1.0																												
Direction of flow:	Flow from west direction to east direction																												
Remarks:	Very poor condition, occupied by local people.																												
Photograph:		 <table border="1"> <thead> <tr> <th>DATUM</th> <th colspan="8">1.4</th> </tr> </thead> <tbody> <tr> <td>EXISTING LEVEL (m)</td> <td>6.163</td> <td>5.163</td> <td>4.963</td> <td>4.463</td> <td>5.063</td> <td>5.163</td> <td>6.243</td> <td></td> </tr> <tr> <td>DISTANCE (m)</td> <td>0.00</td> <td>2.50</td> <td>5.00</td> <td>7.50</td> <td>10.00</td> <td>12.50</td> <td>15.00</td> <td></td> </tr> </tbody> </table> <p>2+851.00</p>	DATUM	1.4								EXISTING LEVEL (m)	6.163	5.163	4.963	4.463	5.063	5.163	6.243		DISTANCE (m)	0.00	2.50	5.00	7.50	10.00	12.50	15.00	
	DATUM		1.4																										
EXISTING LEVEL (m)	6.163	5.163	4.963	4.463	5.063	5.163	6.243																						
DISTANCE (m)	0.00	2.50	5.00	7.50	10.00	12.50	15.00																						
																													

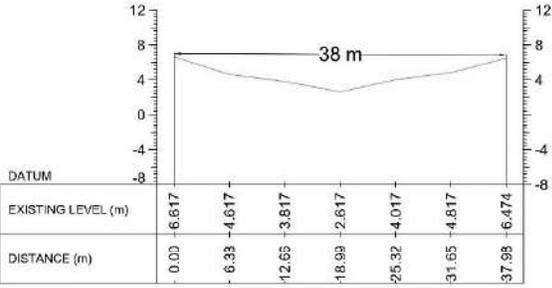
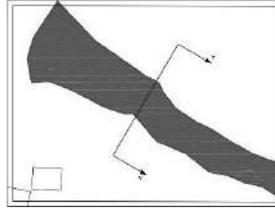
Point: 2. Depths are taken between 2.83 m interval.

Location:	N:23.667797 E:90.063834 Zoainatpur, Baruakhali																															
Width:	17 (m)																															
Depth:	Point 1 (m):	1.1																														
	Point 2 (m):	1.7																														
	Point 3 (m):	2.5																														
	Point 4 (m):	2.0																														
	Point 5 (m):	1.4																														
Direction of flow:	Flow from west direction to east direction																															
Remarks:	This canal is blocked.																															
Photograph:		 <table border="1"> <thead> <tr> <th colspan="2">DATUM</th> </tr> </thead> <tbody> <tr> <td>EXISTING LEVEL (m)</td> <td>+6.174</td> </tr> <tr> <td></td> <td>-5.074</td> </tr> <tr> <td></td> <td>-4.474</td> </tr> <tr> <td></td> <td>-3.674</td> </tr> <tr> <td></td> <td>-4.174</td> </tr> <tr> <td></td> <td>-4.774</td> </tr> <tr> <td></td> <td>-6.251</td> </tr> <tr> <td>DISTANCE (m)</td> <td>0.00</td> </tr> <tr> <td></td> <td>2.83</td> </tr> <tr> <td></td> <td>5.66</td> </tr> <tr> <td></td> <td>8.49</td> </tr> <tr> <td></td> <td>11.32</td> </tr> <tr> <td></td> <td>14.15</td> </tr> <tr> <td></td> <td>16.98</td> </tr> </tbody> </table> <p>4+068.00</p>	DATUM		EXISTING LEVEL (m)	+6.174		-5.074		-4.474		-3.674		-4.174		-4.774		-6.251	DISTANCE (m)	0.00		2.83		5.66		8.49		11.32		14.15		16.98
	DATUM																															
EXISTING LEVEL (m)	+6.174																															
	-5.074																															
	-4.474																															
	-3.674																															
	-4.174																															
	-4.774																															
	-6.251																															
DISTANCE (m)	0.00																															
	2.83																															
	5.66																															
	8.49																															
	11.32																															
	14.15																															
	16.98																															
																																

Point: 3. Depths are taken between 6.67 m interval.

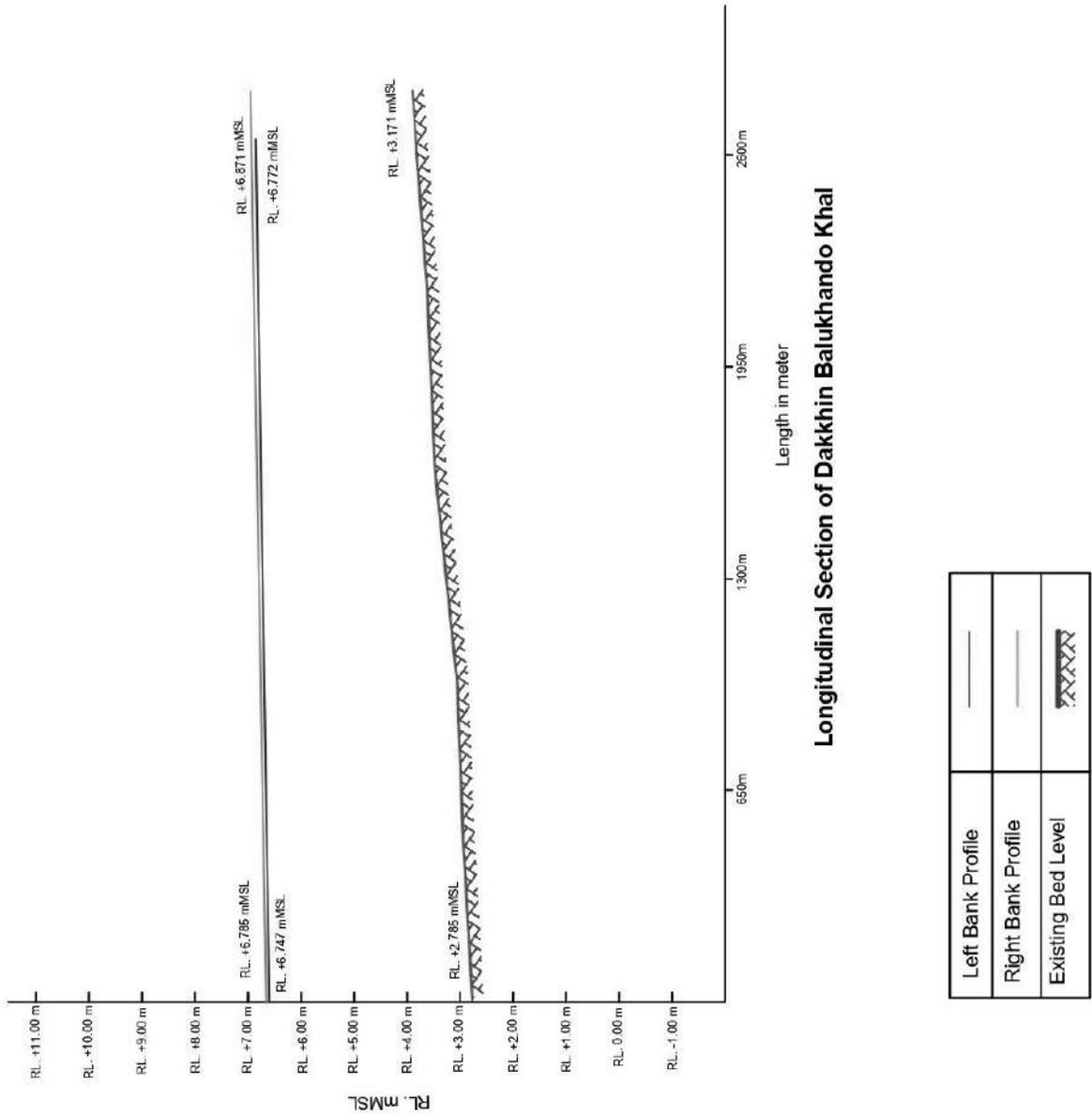
Location:	N:23.667506 E:90.055743 Dirghogram, Baruakhali																															
Width:	40 (m)																															
Depth:	Point 1 (m):	2.5																														
	Point 2 (m):	3.0																														
	Point 3 (m):	4.0																														
	Point 4 (m):	3.0																														
	Point 5 (m):	2.5																														
Direction of flow:	Flow from west direction to east direction and connected with the Ichamati River.																															
Remarks:	N/A																															
Photograph:		 <table border="1"> <thead> <tr> <th colspan="2">DATUM</th> </tr> </thead> <tbody> <tr> <td>EXISTING LEVEL (m)</td> <td>-6.435</td> </tr> <tr> <td></td> <td>-3.935</td> </tr> <tr> <td></td> <td>-3.435</td> </tr> <tr> <td></td> <td>-2.435</td> </tr> <tr> <td></td> <td>-3.435</td> </tr> <tr> <td></td> <td>-3.935</td> </tr> <tr> <td></td> <td>-6.361</td> </tr> <tr> <td>DISTANCE (m)</td> <td>0.00</td> </tr> <tr> <td></td> <td>6.67</td> </tr> <tr> <td></td> <td>13.34</td> </tr> <tr> <td></td> <td>20.01</td> </tr> <tr> <td></td> <td>26.68</td> </tr> <tr> <td></td> <td>33.35</td> </tr> <tr> <td></td> <td>40.02</td> </tr> </tbody> </table> <p>4+973.00</p>	DATUM		EXISTING LEVEL (m)	-6.435		-3.935		-3.435		-2.435		-3.435		-3.935		-6.361	DISTANCE (m)	0.00		6.67		13.34		20.01		26.68		33.35		40.02
	DATUM																															
EXISTING LEVEL (m)	-6.435																															
	-3.935																															
	-3.435																															
	-2.435																															
	-3.435																															
	-3.935																															
	-6.361																															
DISTANCE (m)	0.00																															
	6.67																															
	13.34																															
	20.01																															
	26.68																															
	33.35																															
	40.02																															
																																

Point: 4. Depths are taken between 6.33 m interval.

Location:	N: 23.672410 E:90.046954 Ghosail, Joykrisnapur khal																					
Width:	38 (m)																					
Depth:	Point 1 (m): 2.0																					
	Point 2 (m): 2.8																					
	Point 3 (m): 4.0																					
	Point 4 (m): 2.6																					
	Point 5 (m): 1.8																					
Direction of flow:	Flow from west direction to east direction and connected with the Padma River.																					
Remarks:	N/A																					
Photograph:		 <table border="1"> <thead> <tr> <th colspan="2">DATUM</th> </tr> </thead> <tbody> <tr> <td>EXISTING LEVEL (m)</td> <td>6.617</td> </tr> <tr> <td>DISTANCE (m)</td> <td>0.00</td> </tr> <tr> <td></td> <td>6.33</td> </tr> <tr> <td></td> <td>12.65</td> </tr> <tr> <td></td> <td>18.98</td> </tr> <tr> <td></td> <td>25.32</td> </tr> <tr> <td></td> <td>31.65</td> </tr> <tr> <td></td> <td>37.98</td> </tr> <tr> <td></td> <td>6.474</td> </tr> </tbody> </table> <p>6+024.00</p>	DATUM		EXISTING LEVEL (m)	6.617	DISTANCE (m)	0.00		6.33		12.65		18.98		25.32		31.65		37.98		6.474
	DATUM																					
EXISTING LEVEL (m)	6.617																					
DISTANCE (m)	0.00																					
	6.33																					
	12.65																					
	18.98																					
	25.32																					
	31.65																					
	37.98																					
	6.474																					
																						

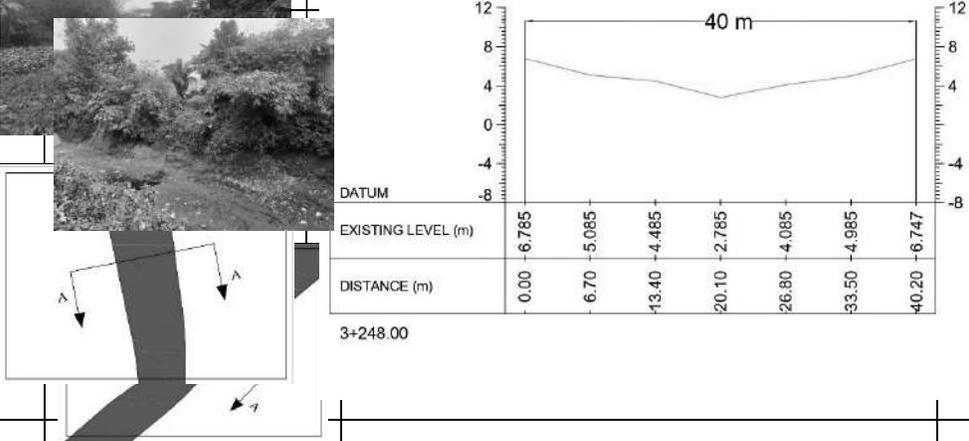
Canal: Dakkhin Balukhando Khal

Long Profile of the Canal:



Cross Sections:

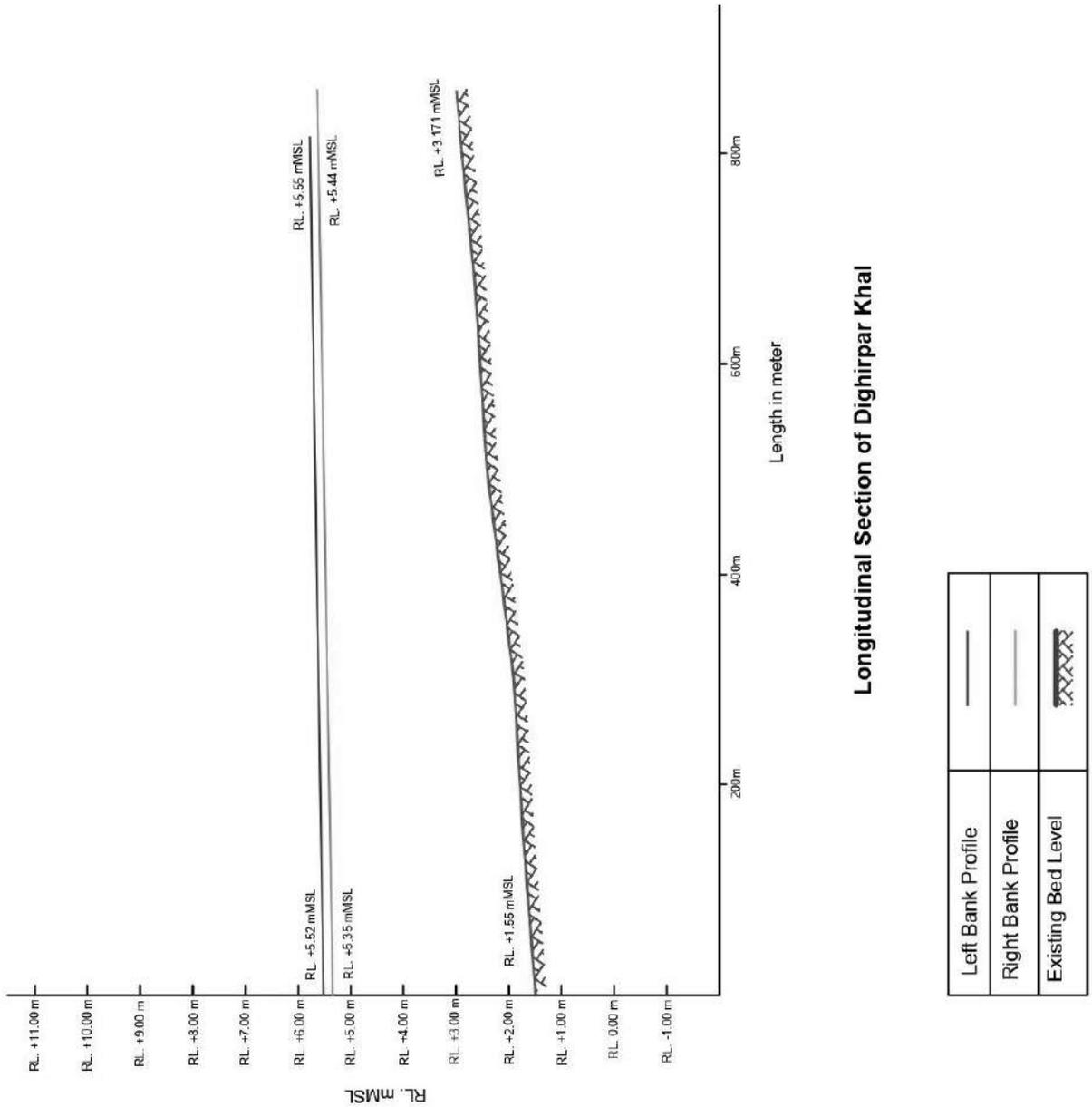
Point: 1. Depths are taken between 3 m interval.

Location:	N:23.703224 E:90.111273 Bangla Bazar, Nayansree
Location:	N:23.716816 E:90.130967
Width:	40 (m)
Depth:	Point South Balukhando, Sholla
Width:	Point 2 (m): 2.3 Point 3 (m): 4.0
Depth:	Point 1 (m): 1.8 Point 4 (m): 2.5 Point 5 (m): 1.8 Point 3 (m): 3.7
Direction of flow:	Flow from east direction to south direction and connected with the Kalganga River. Point 4 (m): 2.6 Point 5 (m): 1.7
Remarks:	Very flow condition as excavation is required in east direction and connected with the Kalganga River.
Photograph:	
Remarks:	
Photograph:	

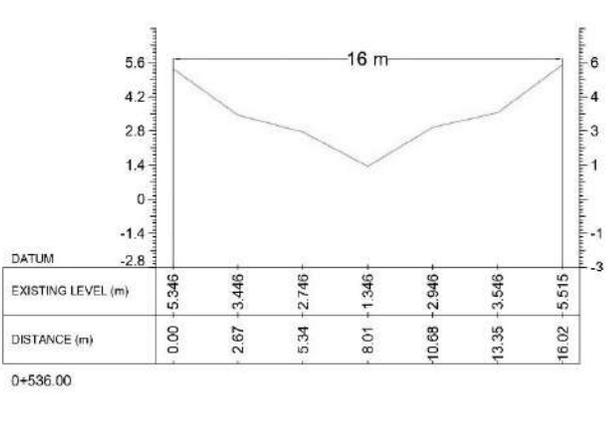
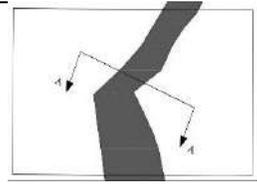
Point: 2. Depths are taken between 6.67 m.

Canal: Dighirpar Khal

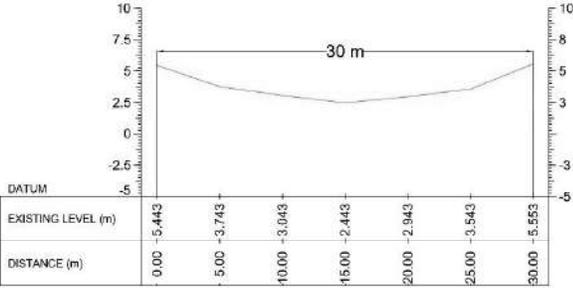
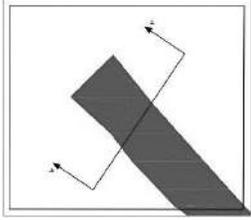
Long Profile of the Canal:



Point: 1. Depths are taken between 2.67 m interval.

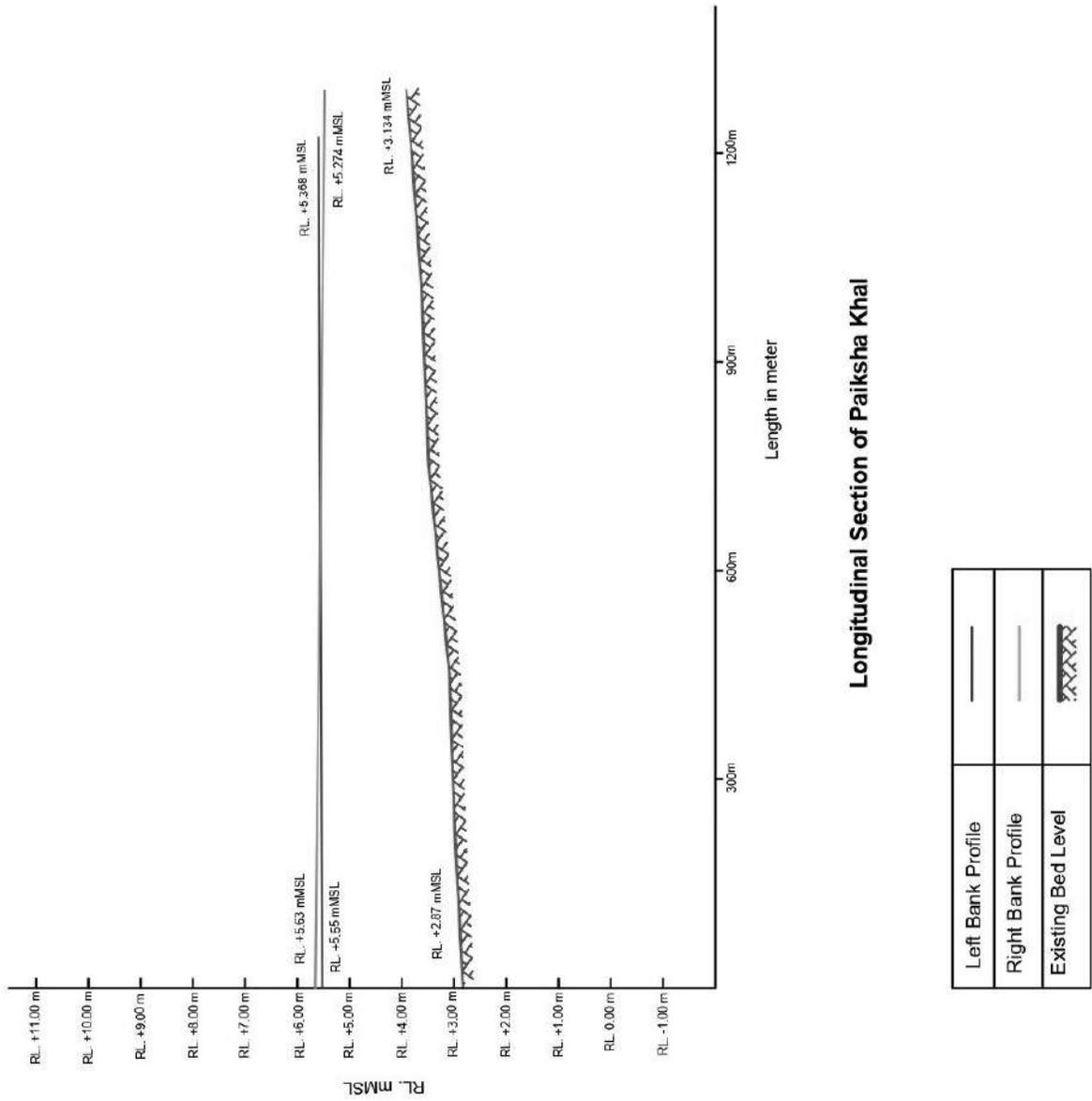
Location:	N:23.638585 E:90.168495 Dighirpar, Bakshanagar																															
Width:	16 (m)																															
Depth:	Point 1 (m):	1.9																														
	Point 2 (m):	2.6																														
	Point 3 (m):	4.0																														
	Point 4 (m):	2.4																														
	Point 5 (m):	1.8																														
Direction of flow:	Flow from east direction to south direction																															
Remarks:	This canal is blocked.																															
Photograph:		 <table border="1"> <thead> <tr> <th colspan="2">DATUM</th> </tr> </thead> <tbody> <tr> <td>EXISTING LEVEL (m)</td> <td>-5.346</td> </tr> <tr> <td>DISTANCE (m)</td> <td>0.00</td> </tr> <tr> <td>EXISTING LEVEL (m)</td> <td>-3.446</td> </tr> <tr> <td>DISTANCE (m)</td> <td>2.67</td> </tr> <tr> <td>EXISTING LEVEL (m)</td> <td>-2.746</td> </tr> <tr> <td>DISTANCE (m)</td> <td>5.34</td> </tr> <tr> <td>EXISTING LEVEL (m)</td> <td>-1.346</td> </tr> <tr> <td>DISTANCE (m)</td> <td>8.01</td> </tr> <tr> <td>EXISTING LEVEL (m)</td> <td>-2.946</td> </tr> <tr> <td>DISTANCE (m)</td> <td>10.68</td> </tr> <tr> <td>EXISTING LEVEL (m)</td> <td>-3.546</td> </tr> <tr> <td>DISTANCE (m)</td> <td>13.35</td> </tr> <tr> <td>EXISTING LEVEL (m)</td> <td>-5.515</td> </tr> <tr> <td>DISTANCE (m)</td> <td>16.02</td> </tr> </tbody> </table> <p>0+536.00</p>	DATUM		EXISTING LEVEL (m)	-5.346	DISTANCE (m)	0.00	EXISTING LEVEL (m)	-3.446	DISTANCE (m)	2.67	EXISTING LEVEL (m)	-2.746	DISTANCE (m)	5.34	EXISTING LEVEL (m)	-1.346	DISTANCE (m)	8.01	EXISTING LEVEL (m)	-2.946	DISTANCE (m)	10.68	EXISTING LEVEL (m)	-3.546	DISTANCE (m)	13.35	EXISTING LEVEL (m)	-5.515	DISTANCE (m)	16.02
	DATUM																															
EXISTING LEVEL (m)	-5.346																															
DISTANCE (m)	0.00																															
EXISTING LEVEL (m)	-3.446																															
DISTANCE (m)	2.67																															
EXISTING LEVEL (m)	-2.746																															
DISTANCE (m)	5.34																															
EXISTING LEVEL (m)	-1.346																															
DISTANCE (m)	8.01																															
EXISTING LEVEL (m)	-2.946																															
DISTANCE (m)	10.68																															
EXISTING LEVEL (m)	-3.546																															
DISTANCE (m)	13.35																															
EXISTING LEVEL (m)	-5.515																															
DISTANCE (m)	16.02																															
																																

Point: 2. Depths are taken between 5 m interval.

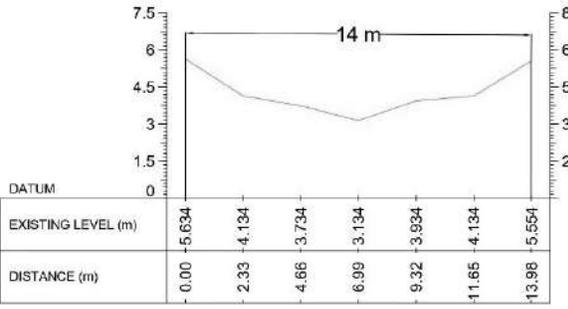
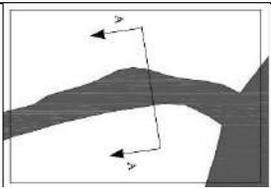
Location:	N:23.635684 E:90.164102 Chak Dighirpar																															
Width:	30 (m)																															
Depth:	Point 1 (m):	1.7																														
	Point 2 (m):	2.4																														
	Point 3 (m):	3.0																														
	Point 4 (m):	2.5																														
	Point 5 (m):	1.9																														
Direction of flow:	Flow from east direction to south direction																															
Remarks:	Occupied by the local people.																															
Photograph:		 <table border="1"> <thead> <tr> <th colspan="2">DATUM</th> </tr> </thead> <tbody> <tr> <td>EXISTING LEVEL (m)</td> <td>-5.443</td> </tr> <tr> <td>DISTANCE (m)</td> <td>0.00</td> </tr> <tr> <td>EXISTING LEVEL (m)</td> <td>-3.743</td> </tr> <tr> <td>DISTANCE (m)</td> <td>5.00</td> </tr> <tr> <td>EXISTING LEVEL (m)</td> <td>-3.043</td> </tr> <tr> <td>DISTANCE (m)</td> <td>10.00</td> </tr> <tr> <td>EXISTING LEVEL (m)</td> <td>-2.443</td> </tr> <tr> <td>DISTANCE (m)</td> <td>15.00</td> </tr> <tr> <td>EXISTING LEVEL (m)</td> <td>-2.943</td> </tr> <tr> <td>DISTANCE (m)</td> <td>20.00</td> </tr> <tr> <td>EXISTING LEVEL (m)</td> <td>-3.543</td> </tr> <tr> <td>DISTANCE (m)</td> <td>25.00</td> </tr> <tr> <td>EXISTING LEVEL (m)</td> <td>-5.553</td> </tr> <tr> <td>DISTANCE (m)</td> <td>30.00</td> </tr> </tbody> </table> <p>1+364.00</p>	DATUM		EXISTING LEVEL (m)	-5.443	DISTANCE (m)	0.00	EXISTING LEVEL (m)	-3.743	DISTANCE (m)	5.00	EXISTING LEVEL (m)	-3.043	DISTANCE (m)	10.00	EXISTING LEVEL (m)	-2.443	DISTANCE (m)	15.00	EXISTING LEVEL (m)	-2.943	DISTANCE (m)	20.00	EXISTING LEVEL (m)	-3.543	DISTANCE (m)	25.00	EXISTING LEVEL (m)	-5.553	DISTANCE (m)	30.00
	DATUM																															
EXISTING LEVEL (m)	-5.443																															
DISTANCE (m)	0.00																															
EXISTING LEVEL (m)	-3.743																															
DISTANCE (m)	5.00																															
EXISTING LEVEL (m)	-3.043																															
DISTANCE (m)	10.00																															
EXISTING LEVEL (m)	-2.443																															
DISTANCE (m)	15.00																															
EXISTING LEVEL (m)	-2.943																															
DISTANCE (m)	20.00																															
EXISTING LEVEL (m)	-3.543																															
DISTANCE (m)	25.00																															
EXISTING LEVEL (m)	-5.553																															
DISTANCE (m)	30.00																															
																																

Canal: Paiksha Khal

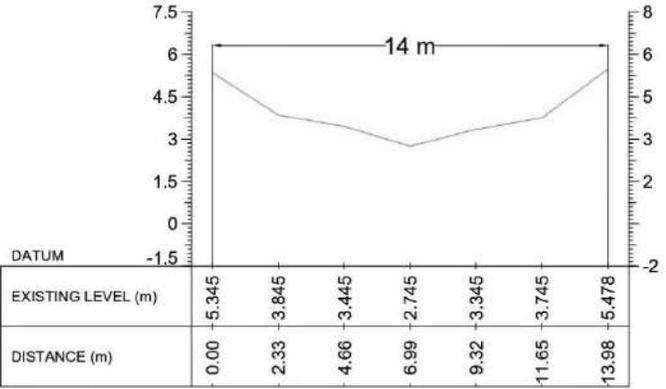
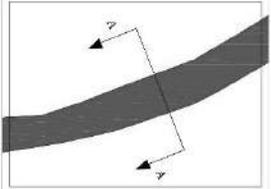
Long Profile of the Canal:



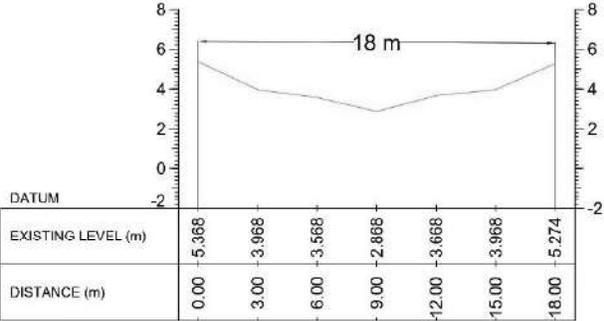
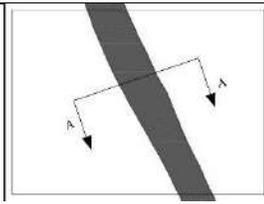
Point: 1. Depths are taken between 2.33 m interval.

Location:	N:23.621739 E:90.191795 Sankarkhali Primary School, Churain							
Width:	14 (m)							
Depth:	Point 1 (m): 1.5							
	Point 2 (m): 1.9							
	Point 3 (m): 2.5							
	Point 4 (m): 1.7							
	Point 5 (m): 1.5							
Direction of flow:	Flow from north direction to south direction and connected with Munshinagar Canal.							
Remarks:	N/A							
Photograph:		 <table border="1"> <thead> <tr> <th colspan="2">DATUM</th> </tr> </thead> <tbody> <tr> <td>EXISTING LEVEL (m)</td> <td>+5.634 4.134 3.734 3.134 3.934 4.134 5.554</td> </tr> <tr> <td>DISTANCE (m)</td> <td>0.00 2.33 4.66 6.99 9.32 11.65 13.98</td> </tr> </tbody> </table> <p>1+874.00</p>	DATUM		EXISTING LEVEL (m)	+5.634 4.134 3.734 3.134 3.934 4.134 5.554	DISTANCE (m)	0.00 2.33 4.66 6.99 9.32 11.65 13.98
	DATUM							
EXISTING LEVEL (m)	+5.634 4.134 3.734 3.134 3.934 4.134 5.554							
DISTANCE (m)	0.00 2.33 4.66 6.99 9.32 11.65 13.98							
								

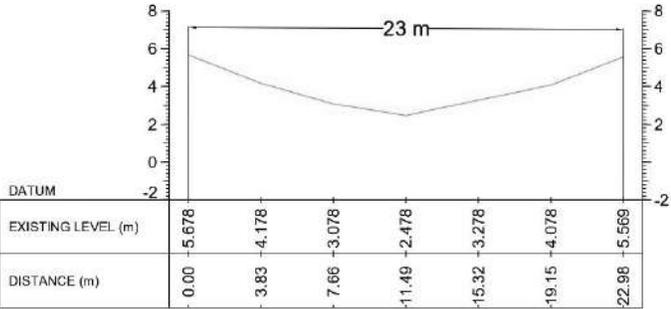
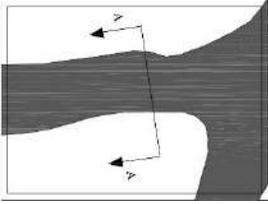
Point: 2. Depths are taken between 2.33 m interval.

Location:	N:23.620772 E:90.186288 Sankarkhali, Galimpur							
Width:	14 (m)							
Depth:	Point 1 (m): 1.5							
	Point 2 (m): 1.9							
	Point 3 (m): 2.6							
	Point 4 (m): 2.0							
	Point 5 (m): 1.6							
Direction of flow:	Flow from west direction to east direction							
Remarks:	N/A							
Photograph:		 <table border="1"> <thead> <tr> <th colspan="2">DATUM</th> </tr> </thead> <tbody> <tr> <td>EXISTING LEVEL (m)</td> <td>5.345, 3.845, 3.445, 2.745, 3.345, 3.745, 5.478</td> </tr> <tr> <td>DISTANCE (m)</td> <td>0.00, 2.33, 4.66, 6.99, 9.32, 11.65, 13.98</td> </tr> </tbody> </table> <p>2+493.00.00</p>	DATUM		EXISTING LEVEL (m)	5.345, 3.845, 3.445, 2.745, 3.345, 3.745, 5.478	DISTANCE (m)	0.00, 2.33, 4.66, 6.99, 9.32, 11.65, 13.98
	DATUM							
EXISTING LEVEL (m)	5.345, 3.845, 3.445, 2.745, 3.345, 3.745, 5.478							
DISTANCE (m)	0.00, 2.33, 4.66, 6.99, 9.32, 11.65, 13.98							
								

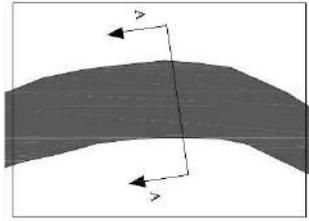
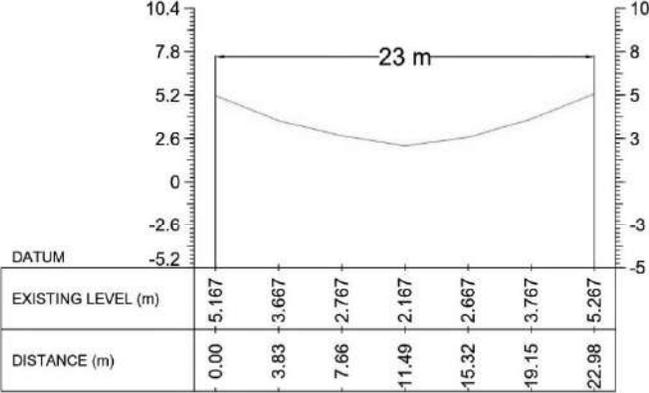
Point: 3. Depths are taken between 3 m interval.

Location:	N:23.617085 E:90.185239 Paiksha, Galimpur							
Width:	18 (m)							
Depth:	Point 1 (m): 1.4							
	Point 2 (m): 1.8							
	Point 3 (m): 2.5							
	Point 4 (m): 1.7							
	Point 5 (m): 1.4							
Direction of flow:	Flow from south direction to north direction							
Remarks:	Very poor condition, occupied by the local people							
Photograph:		 <table border="1" data-bbox="808 997 1383 1129"> <thead> <tr> <th colspan="2">DATUM</th> </tr> </thead> <tbody> <tr> <td>EXISTING LEVEL (m)</td> <td>5.368 3.968 3.568 2.868 3.668 3.968 5.274</td> </tr> <tr> <td>DISTANCE (m)</td> <td>0.00 3.00 6.00 9.00 12.00 15.00 18.00</td> </tr> </tbody> </table> <p>3+050.00</p>	DATUM		EXISTING LEVEL (m)	5.368 3.968 3.568 2.868 3.668 3.968 5.274	DISTANCE (m)	0.00 3.00 6.00 9.00 12.00 15.00 18.00
	DATUM							
EXISTING LEVEL (m)	5.368 3.968 3.568 2.868 3.668 3.968 5.274							
DISTANCE (m)	0.00 3.00 6.00 9.00 12.00 15.00 18.00							
								

Point: 4. Depths are taken between 3.83 m interval.

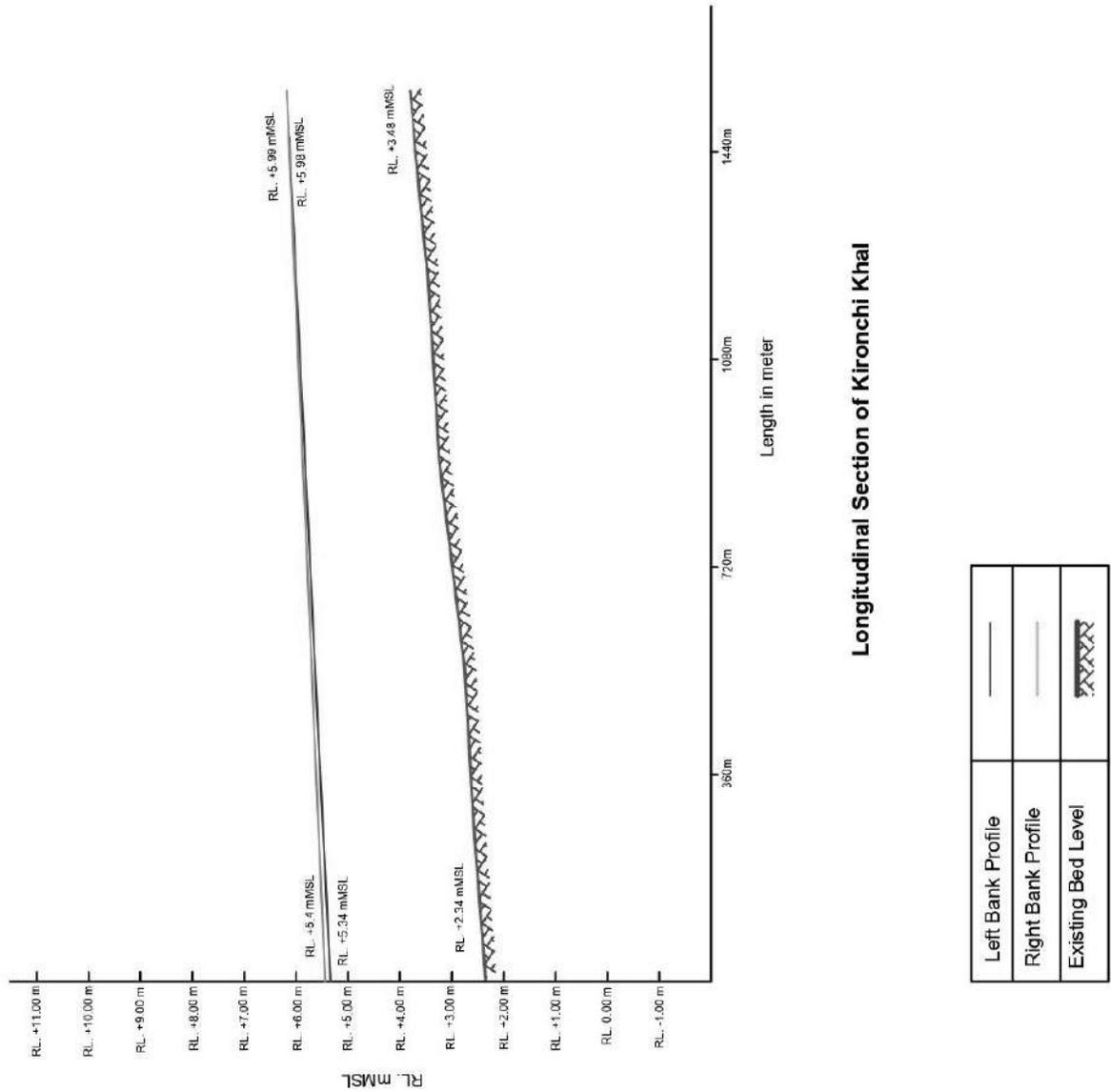
Location:	N:23.615436 E:90.187736 Santir Bazar, Churain							
Width:	23 (m)							
Depth:	Point 1 (m): 1.5							
	Point 2 (m): 2.6							
	Point 3 (m): 3.2							
	Point 4 (m): 2.4							
	Point 5 (m): 1.6							
Direction of flow:	Flow from west direction to east direction and connected with the Ichamati River.							
Remarks:	N/A							
Photograph:		 <table border="1"> <thead> <tr> <th colspan="2">DATUM</th> </tr> </thead> <tbody> <tr> <td>EXISTING LEVEL (m)</td> <td>5.678 4.178 3.078 2.478 3.278 4.078 5.569</td> </tr> <tr> <td>DISTANCE (m)</td> <td>0.00 3.83 7.66 11.49 15.32 19.15 22.96</td> </tr> </tbody> </table> <p>2+762.00</p>	DATUM		EXISTING LEVEL (m)	5.678 4.178 3.078 2.478 3.278 4.078 5.569	DISTANCE (m)	0.00 3.83 7.66 11.49 15.32 19.15 22.96
	DATUM							
EXISTING LEVEL (m)	5.678 4.178 3.078 2.478 3.278 4.078 5.569							
DISTANCE (m)	0.00 3.83 7.66 11.49 15.32 19.15 22.96							
								

Point: 5. Depths are taken between 3.83 m interval.

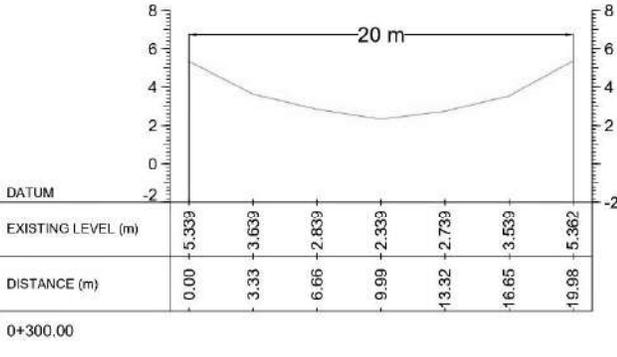
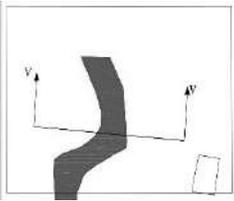
Location:	N:23.613291 E:90.183596 Sonatola, Churain																								
Width:	23 (m)																								
Depth:	Point 1 (m): 1.5																								
	Point 2 (m): 2.4																								
	Point 3 (m): 3.0																								
	Point 4 (m): 2.5																								
	Point 5 (m): 1.4																								
Direction of flow:	Flow from south direction to north direction and connected with the Ichamati River.																								
Remarks:	N/A																								
Photograph:																									
		 <table border="1"> <thead> <tr> <th>DATUM</th> <th>0.00</th> <th>3.83</th> <th>7.66</th> <th>11.49</th> <th>15.32</th> <th>19.15</th> <th>22.98</th> </tr> </thead> <tbody> <tr> <td>EXISTING LEVEL (m)</td> <td>+5.167</td> <td>+3.667</td> <td>+2.767</td> <td>+2.167</td> <td>+2.667</td> <td>+3.767</td> <td>+5.267</td> </tr> <tr> <td>DISTANCE (m)</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table> <p>3+545.00</p>	DATUM	0.00	3.83	7.66	11.49	15.32	19.15	22.98	EXISTING LEVEL (m)	+5.167	+3.667	+2.767	+2.167	+2.667	+3.767	+5.267	DISTANCE (m)						
DATUM	0.00	3.83	7.66	11.49	15.32	19.15	22.98																		
EXISTING LEVEL (m)	+5.167	+3.667	+2.767	+2.167	+2.667	+3.767	+5.267																		
DISTANCE (m)																									

Canal: Kironchi Khal.

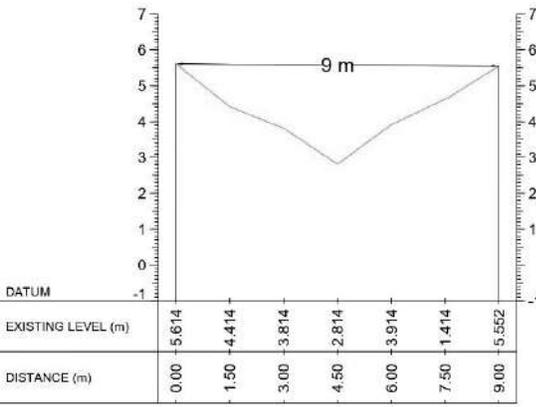
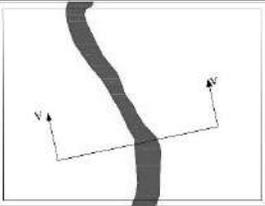
Long Profile of the Canal:



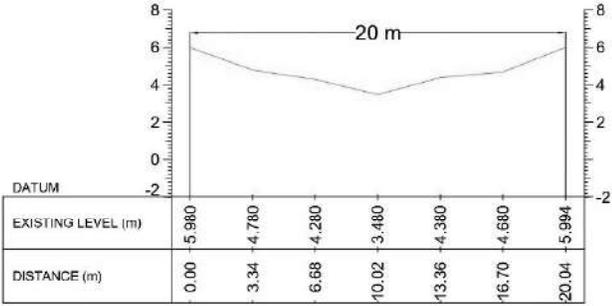
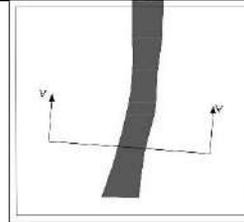
Point: 1. Depths are taken between 3.33 m interval

Location:	N:23.693276 E:90.143833 South Kironchi							
Width:	20 (m)							
Depth:	Point 1 (m): 1.7							
	Point 2 (m): 2.5							
	Point 3 (m): 3.0							
	Point 4 (m): 2.6							
	Point 5 (m): 1.8							
Direction of flow:	Flow from north direction to south direction							
Remarks:	N/A							
Photograph:		 <table border="1"> <thead> <tr> <th colspan="2">DATUM</th> </tr> </thead> <tbody> <tr> <td>EXISTING LEVEL (m)</td> <td>0.00 5.333 3.33 3.633 6.66 2.833 9.99 2.333 13.32 2.733 16.65 3.533 19.98 5.362</td> </tr> <tr> <td>DISTANCE (m)</td> <td></td> </tr> </tbody> </table> <p>0+300.00</p>	DATUM		EXISTING LEVEL (m)	0.00 5.333 3.33 3.633 6.66 2.833 9.99 2.333 13.32 2.733 16.65 3.533 19.98 5.362	DISTANCE (m)	
	DATUM							
EXISTING LEVEL (m)	0.00 5.333 3.33 3.633 6.66 2.833 9.99 2.333 13.32 2.733 16.65 3.533 19.98 5.362							
DISTANCE (m)								
								

Point: 2. Depths are taken between 1.5 m interval.

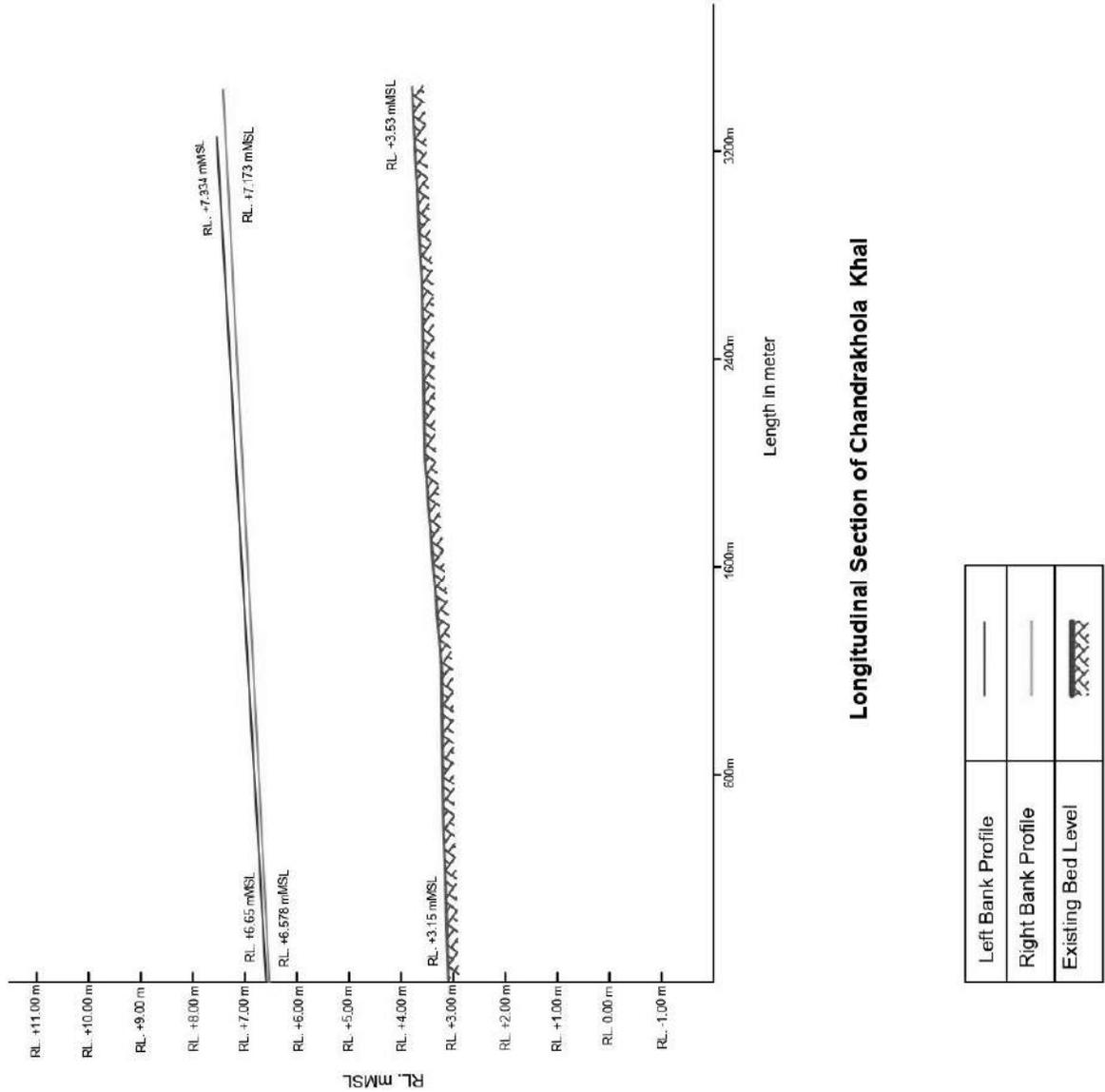
Location:	N:23.685992 E:90.144469 Kironchi, Jantrail																															
Width:	9 (m)																															
Depth:	Point 1 (m):	1.2																														
	Point 2 (m):	1.8																														
	Point 3 (m):	2.8																														
	Point 4 (m):	1.7																														
	Point 5 (m):	1.2																														
Direction of flow:	Flow from north direction to south direction																															
Remarks:	N/A																															
Photograph:		 <table border="1" data-bbox="787 1060 1307 1186"> <thead> <tr> <th colspan="2">DATUM</th> </tr> </thead> <tbody> <tr> <td>EXISTING LEVEL (m)</td> <td>5.614</td> </tr> <tr> <td></td> <td>4.414</td> </tr> <tr> <td></td> <td>3.814</td> </tr> <tr> <td></td> <td>2.814</td> </tr> <tr> <td></td> <td>3.914</td> </tr> <tr> <td></td> <td>1.414</td> </tr> <tr> <td></td> <td>5.552</td> </tr> <tr> <td>DISTANCE (m)</td> <td>0.00</td> </tr> <tr> <td></td> <td>1.50</td> </tr> <tr> <td></td> <td>3.00</td> </tr> <tr> <td></td> <td>4.50</td> </tr> <tr> <td></td> <td>6.00</td> </tr> <tr> <td></td> <td>7.50</td> </tr> <tr> <td></td> <td>9.00</td> </tr> </tbody> </table> <p>1+218.00</p>	DATUM		EXISTING LEVEL (m)	5.614		4.414		3.814		2.814		3.914		1.414		5.552	DISTANCE (m)	0.00		1.50		3.00		4.50		6.00		7.50		9.00
	DATUM																															
EXISTING LEVEL (m)	5.614																															
	4.414																															
	3.814																															
	2.814																															
	3.914																															
	1.414																															
	5.552																															
DISTANCE (m)	0.00																															
	1.50																															
	3.00																															
	4.50																															
	6.00																															
	7.50																															
	9.00																															
																																

Point: 3. Depths are taken between 3.33 m interval.

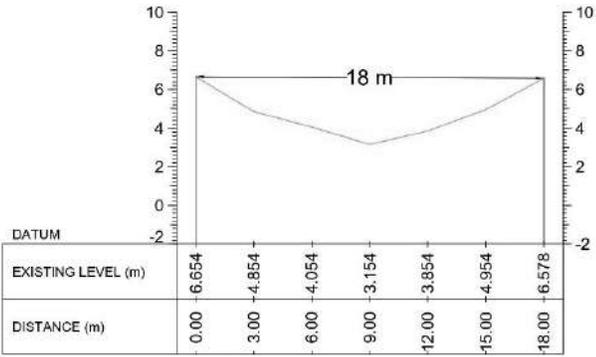
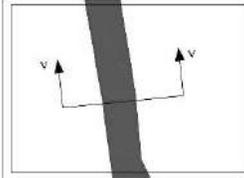
Location:	N:23.681548 E:90.143542 Gasibari, Jantrail																									
Width:	20 (m)																									
Depth:	Point 1 (m): 1.2																									
	Point 2 (m): 1.7																									
	Point 3 (m): 2.5																									
	Point 4 (m): 1.6																									
	Point 5 (m): 1.3																									
Direction of flow:	Flow from east direction to south direction.																									
Remarks:	Very poor condition, excavation is needed																									
Photograph:		 <table border="1" data-bbox="760 1003 1344 1129"> <thead> <tr> <th>DATUM</th> <th>EXISTING LEVEL (m)</th> <th>DISTANCE (m)</th> </tr> </thead> <tbody> <tr> <td></td> <td>5.980</td> <td>0.00</td> </tr> <tr> <td></td> <td>4.780</td> <td>3.34</td> </tr> <tr> <td></td> <td>4.280</td> <td>6.68</td> </tr> <tr> <td></td> <td>3.480</td> <td>10.02</td> </tr> <tr> <td></td> <td>4.380</td> <td>13.36</td> </tr> <tr> <td></td> <td>4.680</td> <td>16.70</td> </tr> <tr> <td></td> <td>5.994</td> <td>20.04</td> </tr> </tbody> </table> <p>1+730.00</p>	DATUM	EXISTING LEVEL (m)	DISTANCE (m)		5.980	0.00		4.780	3.34		4.280	6.68		3.480	10.02		4.380	13.36		4.680	16.70		5.994	20.04
	DATUM		EXISTING LEVEL (m)	DISTANCE (m)																						
	5.980	0.00																								
	4.780	3.34																								
	4.280	6.68																								
	3.480	10.02																								
	4.380	13.36																								
	4.680	16.70																								
	5.994	20.04																								
																										

Canal: Chandrakhola Khal

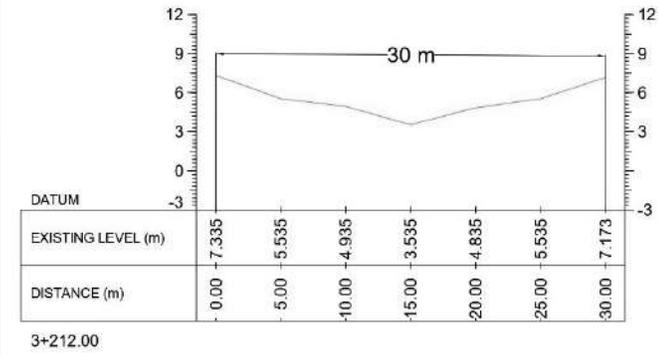
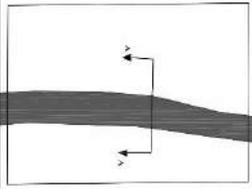
Long Profile of the Canal:



Point: 1. Depths are taken between 3 m interval.

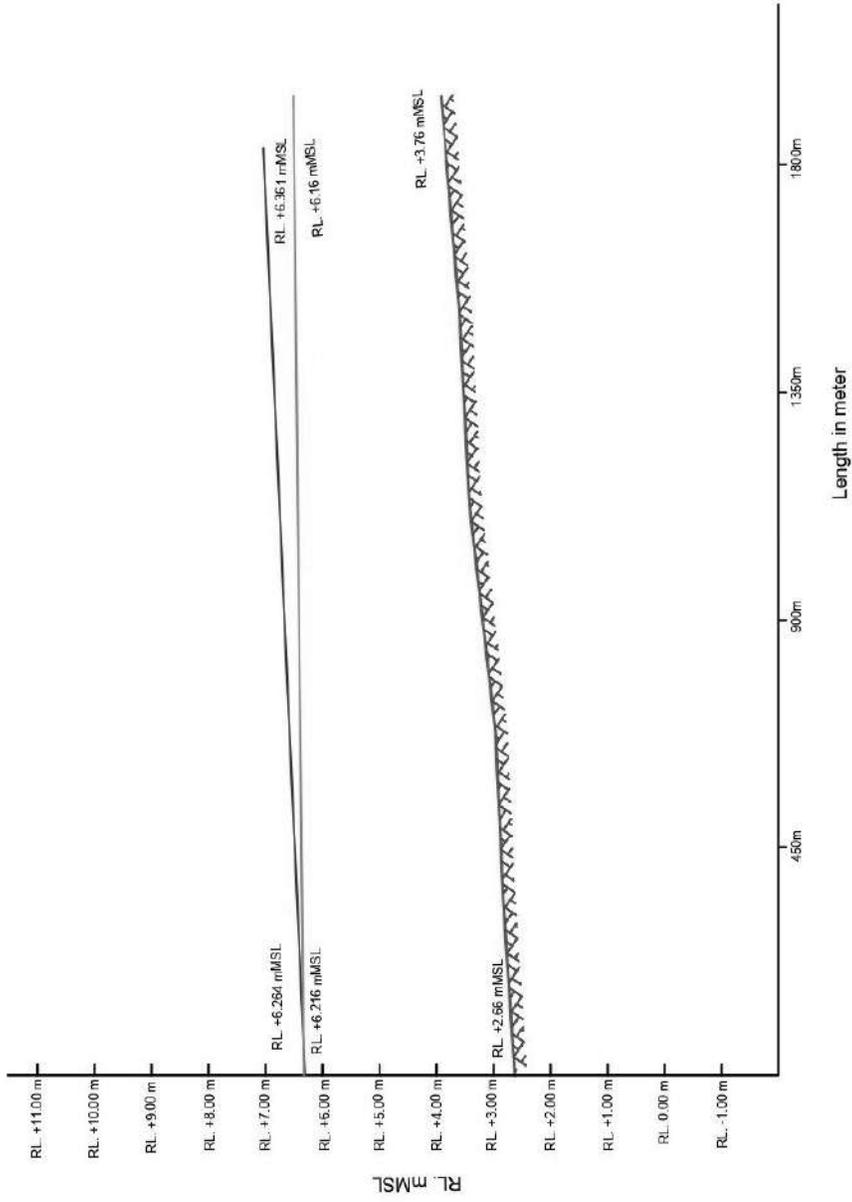
Location:	N:23.707143 E:90.154134 East Patiljhap, Sholla							
Width:	18 (m)							
Depth:	Point 1 (m):	1.8						
	Point 2 (m):	2.6						
	Point 3 (m):	3.5						
	Point 4 (m):	2.8						
	Point 5 (m):	1.7						
Direction of flow:	Flow from south direction to north direction and connected with the Kaliganga River.							
Remarks:	N/A							
Photograph:		 <table border="1"> <thead> <tr> <th colspan="2">DATUM</th> </tr> </thead> <tbody> <tr> <td>EXISTING LEVEL (m)</td> <td>0.00 +6.654 3.00 +4.854 6.00 +4.054 9.00 +3.154 12.00 +3.854 15.00 +4.954 18.00 +6.578</td> </tr> <tr> <td>DISTANCE (m)</td> <td></td> </tr> </tbody> </table> <p>0+096.00</p>	DATUM		EXISTING LEVEL (m)	0.00 +6.654 3.00 +4.854 6.00 +4.054 9.00 +3.154 12.00 +3.854 15.00 +4.954 18.00 +6.578	DISTANCE (m)	
	DATUM							
EXISTING LEVEL (m)	0.00 +6.654 3.00 +4.854 6.00 +4.054 9.00 +3.154 12.00 +3.854 15.00 +4.954 18.00 +6.578							
DISTANCE (m)								
								

Point: 2. Depths are taken between 5 m interval.

Location:	N:23.689375 E:90.173350 Chandrakhola Sholla																									
Width:	30 (m)																									
Depth:	Point 1 (m):	1.8																								
	Point 2 (m):	2.4																								
	Point 3 (m):	3.8																								
	Point 4 (m):	2.5																								
	Point 5 (m):	1.8																								
Direction of flow:	Flow from east direction to west direction and connected with the Kaliganga River.																									
Remarks:	N/A																									
Photograph:		 <table border="1" style="margin-top: 10px;"> <thead> <tr> <th>DATUM</th> <th>0.00</th> <th>5.00</th> <th>10.00</th> <th>15.00</th> <th>20.00</th> <th>25.00</th> <th>30.00</th> </tr> </thead> <tbody> <tr> <td>EXISTING LEVEL (m)</td> <td>+7.335</td> <td>+5.535</td> <td>+4.935</td> <td>+3.535</td> <td>+4.835</td> <td>+5.535</td> <td>+7.173</td> </tr> <tr> <td>DISTANCE (m)</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table> <p>3+212.00</p>	DATUM	0.00	5.00	10.00	15.00	20.00	25.00	30.00	EXISTING LEVEL (m)	+7.335	+5.535	+4.935	+3.535	+4.835	+5.535	+7.173	DISTANCE (m)							
	DATUM		0.00	5.00	10.00	15.00	20.00	25.00	30.00																	
EXISTING LEVEL (m)	+7.335	+5.535	+4.935	+3.535	+4.835	+5.535	+7.173																			
DISTANCE (m)																										
																										

Canal: Katakhal Khal

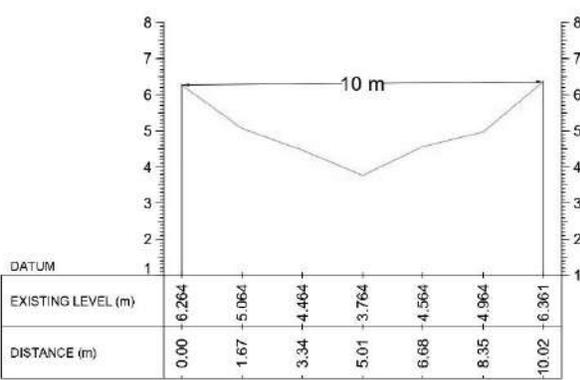
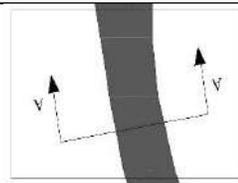
Long Profile of the Canal:



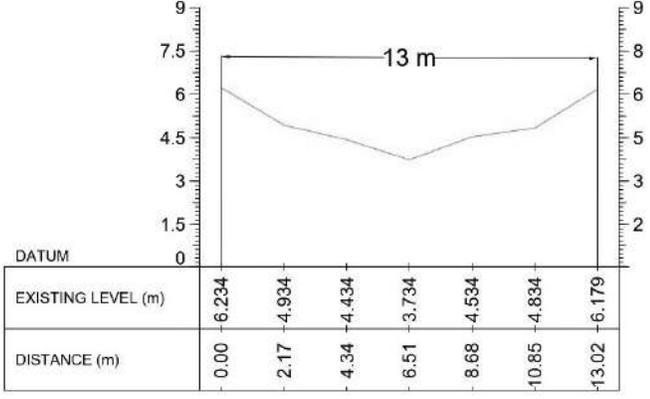
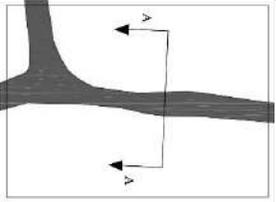
Longitudinal Section of Katakhal Khal

Left Bank Profile	———
Right Bank Profile	-----
Existing Bed Level	XXXXX

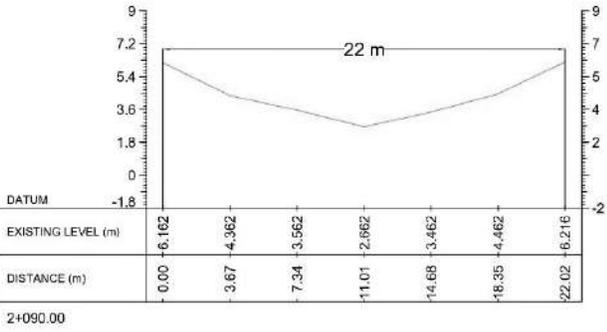
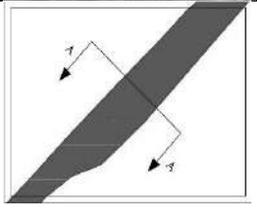
Point: 1. Depths are taken between 1.67 m interval.

Location:	N:23.699348 E:90.234338 Katakhal, Kailail							
Width:	10 (m)							
Depth:	Point 1 (m): 1.2							
	Point 2 (m): 1.8							
	Point 3 (m): 2.5							
	Point 4 (m): 1.7							
	Point 5 (m): 1.3							
Direction of flow:	Flow from north direction to south direction and connected with the Ichamati River.							
Remarks:	N/A							
Photograph:		 <table border="1"> <thead> <tr> <th colspan="2">DATUM</th> </tr> </thead> <tbody> <tr> <td>EXISTING LEVEL (m)</td> <td>0.00 -6.204 1.67 -5.064 3.34 -4.464 5.01 -3.764 6.68 -4.564 8.35 -4.964 10.02 -6.361</td> </tr> <tr> <td>DISTANCE (m)</td> <td></td> </tr> </tbody> </table> <p>0+291.00</p>	DATUM		EXISTING LEVEL (m)	0.00 -6.204 1.67 -5.064 3.34 -4.464 5.01 -3.764 6.68 -4.564 8.35 -4.964 10.02 -6.361	DISTANCE (m)	
	DATUM							
EXISTING LEVEL (m)	0.00 -6.204 1.67 -5.064 3.34 -4.464 5.01 -3.764 6.68 -4.564 8.35 -4.964 10.02 -6.361							
DISTANCE (m)								
								

Point: 2. Depths are taken between 2.17 m interval.

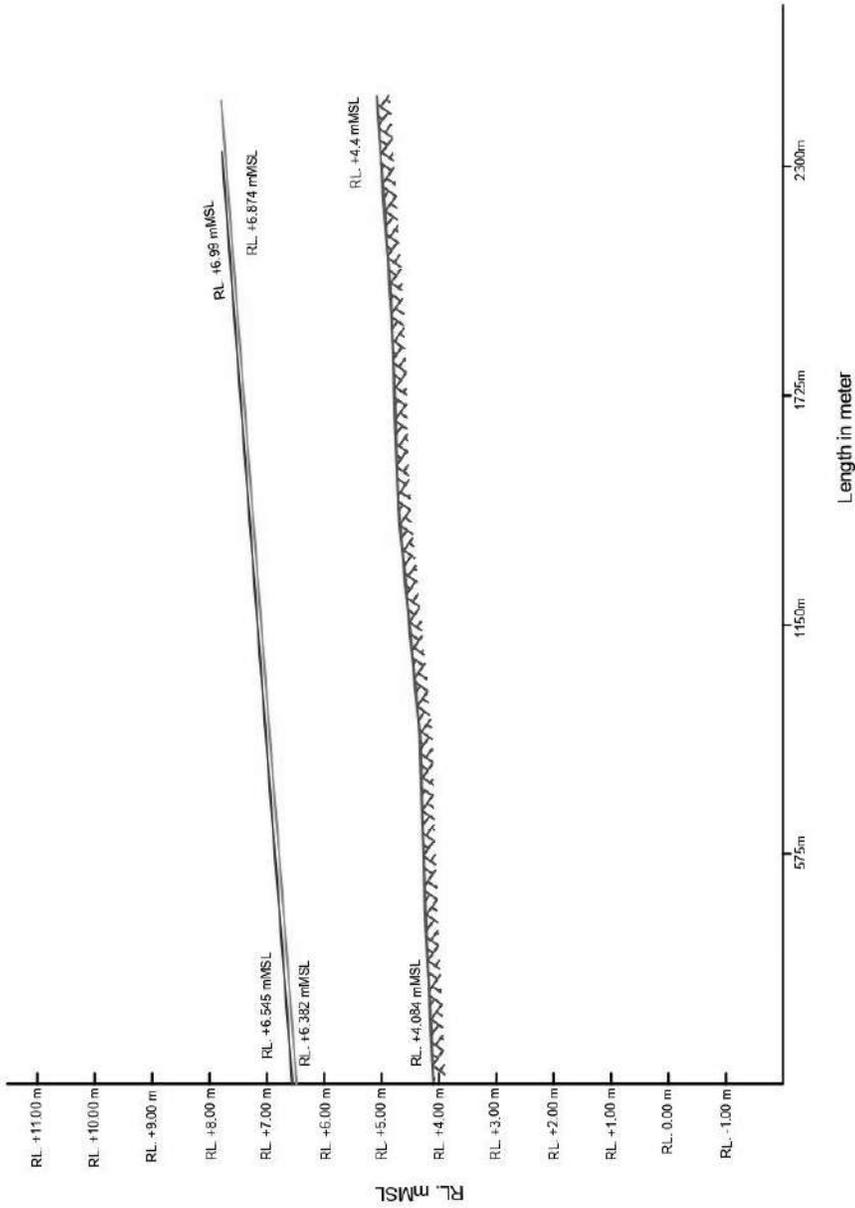
Location:	N:23.695073 E:90.236316 Raypur, Kailail																															
Width:	13 (m)																															
Depth:	Point 1 (m): 1.3																															
	Point 2 (m): 1.8																															
	Point 3 (m): 2.5																															
	Point 4 (m): 1.7																															
	Point 5 (m): 1.4																															
Direction of flow:	Flow from north direction to east direction																															
Remarks:	N/A																															
Photograph:		 <table border="1"> <thead> <tr> <th colspan="2">DATUM</th> </tr> </thead> <tbody> <tr> <td>EXISTING LEVEL (m)</td> <td>6.234</td> </tr> <tr> <td></td> <td>4.934</td> </tr> <tr> <td></td> <td>4.434</td> </tr> <tr> <td></td> <td>3.734</td> </tr> <tr> <td></td> <td>4.534</td> </tr> <tr> <td></td> <td>4.834</td> </tr> <tr> <td></td> <td>6.179</td> </tr> <tr> <td>DISTANCE (m)</td> <td>0.00</td> </tr> <tr> <td></td> <td>2.17</td> </tr> <tr> <td></td> <td>4.34</td> </tr> <tr> <td></td> <td>6.51</td> </tr> <tr> <td></td> <td>8.68</td> </tr> <tr> <td></td> <td>10.85</td> </tr> <tr> <td></td> <td>13.02</td> </tr> </tbody> </table> <p>0+861.00</p>	DATUM		EXISTING LEVEL (m)	6.234		4.934		4.434		3.734		4.534		4.834		6.179	DISTANCE (m)	0.00		2.17		4.34		6.51		8.68		10.85		13.02
	DATUM																															
EXISTING LEVEL (m)	6.234																															
	4.934																															
	4.434																															
	3.734																															
	4.534																															
	4.834																															
	6.179																															
DISTANCE (m)	0.00																															
	2.17																															
	4.34																															
	6.51																															
	8.68																															
	10.85																															
	13.02																															
																																

Point: 3. Depths are taken between 3.67 m interval.

Location:	N:23.688328 E:90.225379 Meleng, Kalail							
Width:	22 (m)							
Depth:	Point 1 (m): 1.8							
	Point 2 (m): 2.6							
	Point 3 (m): 3.5							
	Point 4 (m): 2.7							
	Point 5 (m): 1.7							
Direction of flow:	Flow from west direction to east direction and connected with the Kaliganga River.							
Remarks:	N/A							
Photograph:		 <table border="1"> <thead> <tr> <th colspan="2">DATUM</th> </tr> </thead> <tbody> <tr> <td>EXISTING LEVEL (m)</td> <td>-6.162 -4.362 -3.562 -2.662 -3.462 -4.462 -6.216</td> </tr> <tr> <td>DISTANCE (m)</td> <td>0.00 3.67 7.34 11.01 14.68 18.35 22.02</td> </tr> </tbody> </table> <p>2+090.00</p>	DATUM		EXISTING LEVEL (m)	-6.162 -4.362 -3.562 -2.662 -3.462 -4.462 -6.216	DISTANCE (m)	0.00 3.67 7.34 11.01 14.68 18.35 22.02
	DATUM							
EXISTING LEVEL (m)	-6.162 -4.362 -3.562 -2.662 -3.462 -4.462 -6.216							
DISTANCE (m)	0.00 3.67 7.34 11.01 14.68 18.35 22.02							
								

Canal: Barrah Ulman Chandra Khal

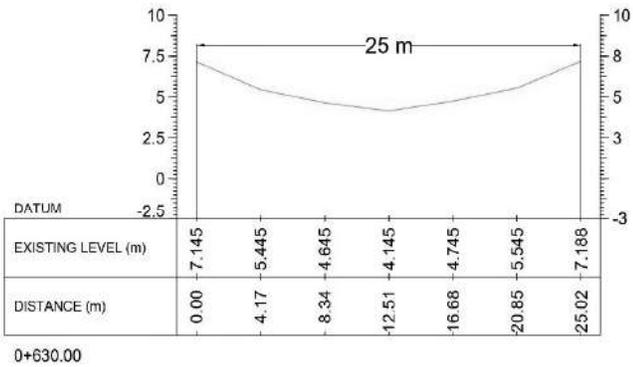
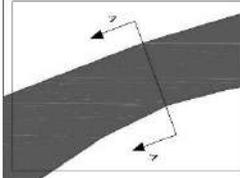
Long Profile of the Canal:



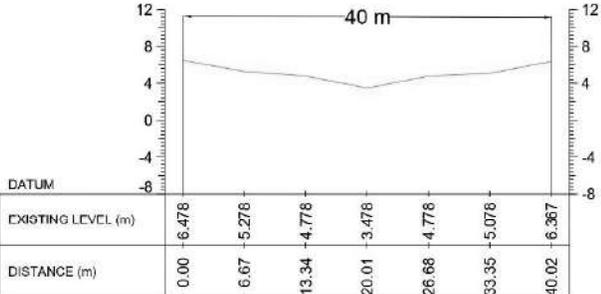
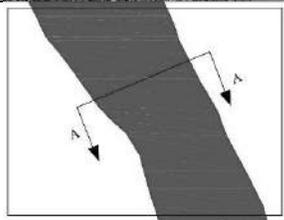
Longitudinal Section of Barrah Ulman Chandra Khal

Left Bank Profile	———
Right Bank Profile	———
Existing Bed Level	XXXXX

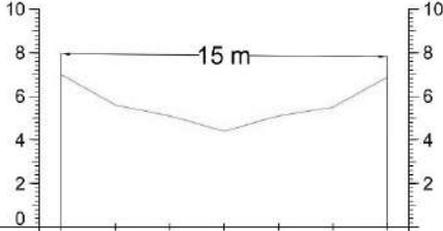
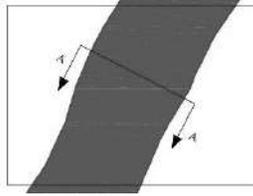
Point: 1. Depths are taken between 4.17 m interval.

Location:	N:23.663241 E:90.195696 Boro Barrah																												
Width:	25 (m)																												
Depth:	Point 1 (m):	1.7																											
	Point 2 (m):	2.5																											
	Point 3 (m):	3.0																											
	Point 4 (m):	2.4																											
	Point 5 (m):	1.6																											
Direction of flow:	Flow from west direction to east direction.																												
Remarks:	N/A																												
Photograph:		 <table border="1"> <tr> <td>DATUM</td> <td>-2.5</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>EXISTING LEVEL (m)</td> <td>7.145</td> <td>5.445</td> <td>4.645</td> <td>4.145</td> <td>4.745</td> <td>5.545</td> <td>7.186</td> <td></td> </tr> <tr> <td>DISTANCE (m)</td> <td>0.00</td> <td>4.17</td> <td>8.34</td> <td>12.51</td> <td>16.68</td> <td>20.85</td> <td>25.02</td> <td></td> </tr> </table> <p>0+630.00</p>	DATUM	-2.5								EXISTING LEVEL (m)	7.145	5.445	4.645	4.145	4.745	5.545	7.186		DISTANCE (m)	0.00	4.17	8.34	12.51	16.68	20.85	25.02	
	DATUM		-2.5																										
EXISTING LEVEL (m)	7.145	5.445	4.645	4.145	4.745	5.545	7.186																						
DISTANCE (m)	0.00	4.17	8.34	12.51	16.68	20.85	25.02																						
																													

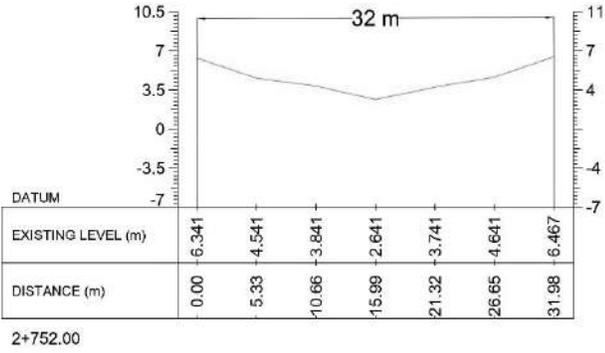
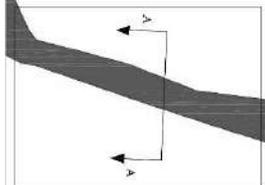
Point: 2. Depths are taken between 6.67 m interval.

Location:	N:23.665876 E:90.198855 West Barrah, Barrah																									
Width:	40 (m)																									
Depth:	Point 1 (m): 1.2																									
	Point 2 (m): 1.7																									
	Point 3 (m): 3.0																									
	Point 4 (m): 1.7																									
	Point 5 (m): 1.4																									
Direction of flow:	Flow from south direction to north direction																									
Remarks:	N/A																									
Photograph:		 <table border="1" data-bbox="771 997 1372 1123"> <thead> <tr> <th>DATUM</th> <th colspan="7"></th> </tr> </thead> <tbody> <tr> <td>EXISTING LEVEL (m)</td> <td>6.478</td> <td>5.276</td> <td>4.778</td> <td>3.478</td> <td>4.778</td> <td>5.078</td> <td>6.367</td> </tr> <tr> <td>DISTANCE (m)</td> <td>0.00</td> <td>6.67</td> <td>13.34</td> <td>20.01</td> <td>26.68</td> <td>33.35</td> <td>40.02</td> </tr> </tbody> </table> <p>1+102.00</p>	DATUM								EXISTING LEVEL (m)	6.478	5.276	4.778	3.478	4.778	5.078	6.367	DISTANCE (m)	0.00	6.67	13.34	20.01	26.68	33.35	40.02
	DATUM																									
EXISTING LEVEL (m)	6.478	5.276	4.778	3.478	4.778	5.078	6.367																			
DISTANCE (m)	0.00	6.67	13.34	20.01	26.68	33.35	40.02																			
																										

Point: 3. Depths are taken between 2.5 m interval

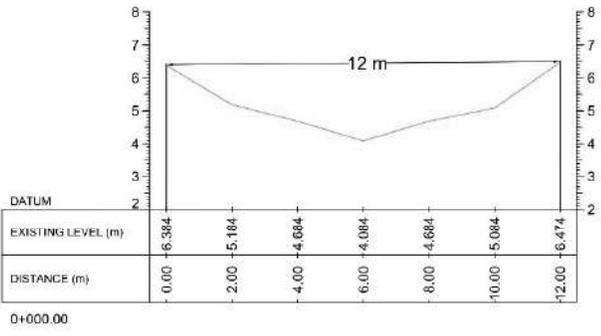
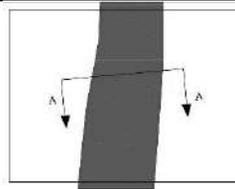
Location:	N:23.670464 E:90.197848 Rasulpur, Barrah							
Width:	15 (m)							
Depth:	Point 1 (m): 1.4							
	Point 2 (m): 1.9							
	Point 3 (m): 2.6							
	Point 4 (m): 1.9							
	Point 5 (m): 1.5							
Direction of flow:	Flow from west direction to north direction							
Remarks:	N/A							
Photograph:		 <table border="1"> <thead> <tr> <th colspan="2">DATUM</th> </tr> </thead> <tbody> <tr> <td>EXISTING LEVEL (m)</td> <td>6.998 5.598 5.098 4.398 5.098 5.498 6.874</td> </tr> <tr> <td>DISTANCE (m)</td> <td>0.00 2.50 5.00 7.50 10.00 12.50 15.00</td> </tr> </tbody> </table> <p>1+677.00</p>	DATUM		EXISTING LEVEL (m)	6.998 5.598 5.098 4.398 5.098 5.498 6.874	DISTANCE (m)	0.00 2.50 5.00 7.50 10.00 12.50 15.00
	DATUM							
EXISTING LEVEL (m)	6.998 5.598 5.098 4.398 5.098 5.498 6.874							
DISTANCE (m)	0.00 2.50 5.00 7.50 10.00 12.50 15.00							
								

Point: 4. Depths are taken between 5.33 m interval.

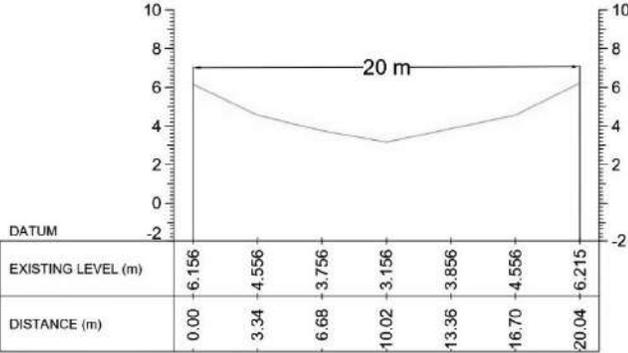
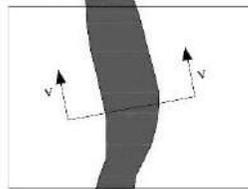
Location:	N:23.676092 E:90.203639 Sonarga, Barrah																															
Width:	32 (m)																															
Depth:	Point 1 (m): 1.8																															
	Point 2 (m): 2.5																															
	Point 3 (m): 3.7																															
	Point 4 (m): 2.6																															
	Point 5 (m): 1.7																															
Direction of flow:	Flow from west direction to east direction and connected with the Ichamati River.																															
Remarks:	Newly dug canal.																															
Photograph:		 <table border="1" data-bbox="760 1035 1333 1167"> <thead> <tr> <th colspan="2">DATUM</th> </tr> </thead> <tbody> <tr> <td>EXISTING LEVEL (m)</td> <td>6.341</td> </tr> <tr> <td></td> <td>4.541</td> </tr> <tr> <td></td> <td>3.841</td> </tr> <tr> <td></td> <td>2.641</td> </tr> <tr> <td></td> <td>3.741</td> </tr> <tr> <td></td> <td>4.641</td> </tr> <tr> <td></td> <td>6.467</td> </tr> <tr> <td>DISTANCE (m)</td> <td>0.00</td> </tr> <tr> <td></td> <td>5.33</td> </tr> <tr> <td></td> <td>10.66</td> </tr> <tr> <td></td> <td>15.99</td> </tr> <tr> <td></td> <td>21.32</td> </tr> <tr> <td></td> <td>26.65</td> </tr> <tr> <td></td> <td>31.98</td> </tr> </tbody> </table> <p>2+752.00</p>	DATUM		EXISTING LEVEL (m)	6.341		4.541		3.841		2.641		3.741		4.641		6.467	DISTANCE (m)	0.00		5.33		10.66		15.99		21.32		26.65		31.98
	DATUM																															
EXISTING LEVEL (m)	6.341																															
	4.541																															
	3.841																															
	2.641																															
	3.741																															
	4.641																															
	6.467																															
DISTANCE (m)	0.00																															
	5.33																															
	10.66																															
	15.99																															
	21.32																															
	26.65																															
	31.98																															
																																

Branches of Barrah Ulman Chandra Khal:

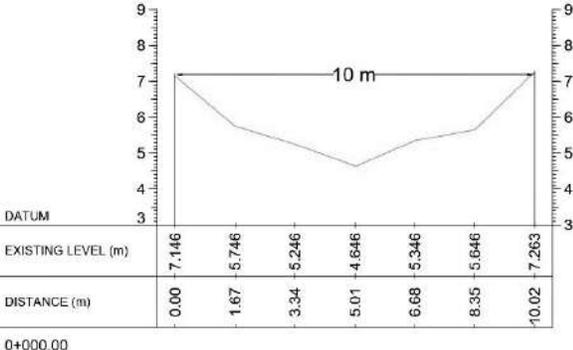
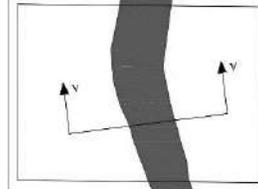
Point: 1. Depths are taken between 2 m interval.

Location:	N:23.669875 E:90.192767 Chak Barrah, Barrah																															
Width:	12 (m)																															
Depth:	Point 1 (m): 1.2																															
	Point 2 (m): 1.7																															
	Point 3 (m): 2.3																															
	Point 4 (m): 1.7																															
	Point 5 (m): 1.3																															
Direction of flow:	Flow from west direction to north direction																															
Remarks:	This canal is blocked.																															
Photograph:		 <table border="1"> <thead> <tr> <th colspan="2">DATUM</th> </tr> </thead> <tbody> <tr> <td>EXISTING LEVEL (m)</td> <td>-6.384</td> </tr> <tr> <td>DISTANCE (m)</td> <td>0.00</td> </tr> <tr> <td>EXISTING LEVEL (m)</td> <td>-5.184</td> </tr> <tr> <td>DISTANCE (m)</td> <td>2.00</td> </tr> <tr> <td>EXISTING LEVEL (m)</td> <td>-4.084</td> </tr> <tr> <td>DISTANCE (m)</td> <td>4.00</td> </tr> <tr> <td>EXISTING LEVEL (m)</td> <td>-4.084</td> </tr> <tr> <td>DISTANCE (m)</td> <td>6.00</td> </tr> <tr> <td>EXISTING LEVEL (m)</td> <td>-4.684</td> </tr> <tr> <td>DISTANCE (m)</td> <td>8.00</td> </tr> <tr> <td>EXISTING LEVEL (m)</td> <td>-5.084</td> </tr> <tr> <td>DISTANCE (m)</td> <td>10.00</td> </tr> <tr> <td>EXISTING LEVEL (m)</td> <td>-6.474</td> </tr> <tr> <td>DISTANCE (m)</td> <td>12.00</td> </tr> </tbody> </table> <p>0+000.00</p>	DATUM		EXISTING LEVEL (m)	-6.384	DISTANCE (m)	0.00	EXISTING LEVEL (m)	-5.184	DISTANCE (m)	2.00	EXISTING LEVEL (m)	-4.084	DISTANCE (m)	4.00	EXISTING LEVEL (m)	-4.084	DISTANCE (m)	6.00	EXISTING LEVEL (m)	-4.684	DISTANCE (m)	8.00	EXISTING LEVEL (m)	-5.084	DISTANCE (m)	10.00	EXISTING LEVEL (m)	-6.474	DISTANCE (m)	12.00
	DATUM																															
EXISTING LEVEL (m)	-6.384																															
DISTANCE (m)	0.00																															
EXISTING LEVEL (m)	-5.184																															
DISTANCE (m)	2.00																															
EXISTING LEVEL (m)	-4.084																															
DISTANCE (m)	4.00																															
EXISTING LEVEL (m)	-4.084																															
DISTANCE (m)	6.00																															
EXISTING LEVEL (m)	-4.684																															
DISTANCE (m)	8.00																															
EXISTING LEVEL (m)	-5.084																															
DISTANCE (m)	10.00																															
EXISTING LEVEL (m)	-6.474																															
DISTANCE (m)	12.00																															
																																

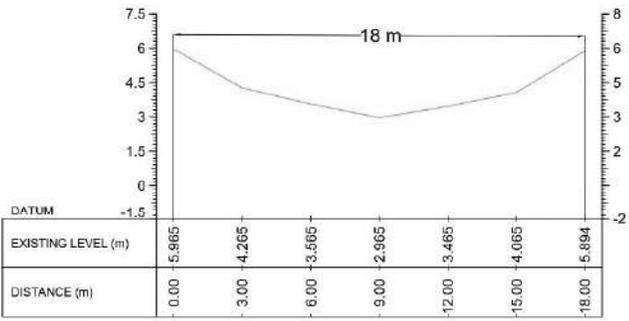
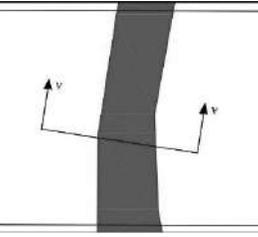
Point: 2. Depths are taken between 3.33 m interval.

Location:	N:23.677973 E:90.203443 Chandura, Barrah							
Width:	20 (m)							
Depth:	Point 1 (m): 1.6							
	Point 2 (m): 2.4							
	Point 3 (m): 3.00							
	Point 4 (m): 2.3							
	Point 5 (m): 1.6							
Direction of flow:	Flow from west direction to east direction and connected with the Ichamati River.							
Remarks:	Very poor condition, excavation is required							
Photograph:		 <table border="1" data-bbox="737 1050 1338 1178"> <thead> <tr> <th colspan="2">DATUM</th> </tr> </thead> <tbody> <tr> <td>EXISTING LEVEL (m)</td> <td>6.156 4.556 3.756 3.156 3.856 4.556 6.215</td> </tr> <tr> <td>DISTANCE (m)</td> <td>0.00 3.34 6.68 10.02 13.36 16.70 20.04</td> </tr> </tbody> </table> <p>0+000.00</p>	DATUM		EXISTING LEVEL (m)	6.156 4.556 3.756 3.156 3.856 4.556 6.215	DISTANCE (m)	0.00 3.34 6.68 10.02 13.36 16.70 20.04
	DATUM							
EXISTING LEVEL (m)	6.156 4.556 3.756 3.156 3.856 4.556 6.215							
DISTANCE (m)	0.00 3.34 6.68 10.02 13.36 16.70 20.04							
								

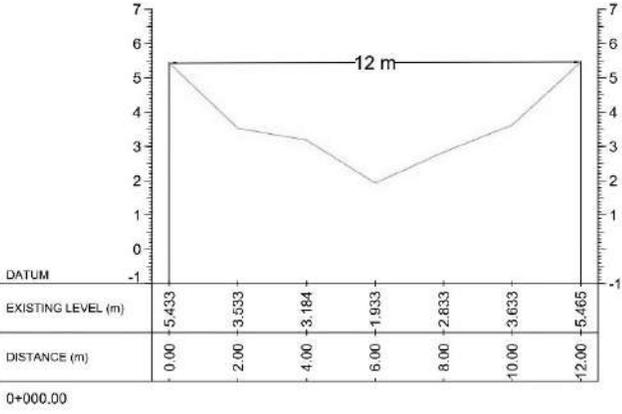
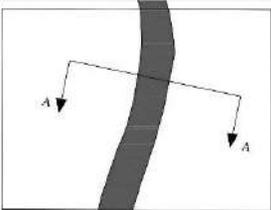
Canal: Madhabpur Khal (Total length 1500 m). Depths are taken between 1.67 m interval.

Location:	N:23.658825 E:90.147256 Harvanga, Kolakopa																									
Width:	10 (m)																									
Depth:	Point 1 (m): 1.4																									
	Point 2 (m): 1.9																									
	Point 3 (m): 2.5																									
	Point 4 (m): 1.8																									
	Point 5 (m): 1.5																									
Direction of flow:	Flow from east direction to north direction and connected with the Ichamati River.																									
Remarks:	Very poor condition																									
Photograph:		 <table border="1"> <tr> <td>DATUM</td> <td colspan="7"></td> </tr> <tr> <td>EXISTING LEVEL (m)</td> <td>7.146</td> <td>5.746</td> <td>5.246</td> <td>4.646</td> <td>5.346</td> <td>5.646</td> <td>7.263</td> </tr> <tr> <td>DISTANCE (m)</td> <td>0.00</td> <td>1.67</td> <td>3.34</td> <td>5.01</td> <td>6.68</td> <td>8.35</td> <td>10.02</td> </tr> </table> <p>0+000.00</p>	DATUM								EXISTING LEVEL (m)	7.146	5.746	5.246	4.646	5.346	5.646	7.263	DISTANCE (m)	0.00	1.67	3.34	5.01	6.68	8.35	10.02
	DATUM																									
EXISTING LEVEL (m)	7.146	5.746	5.246	4.646	5.346	5.646	7.263																			
DISTANCE (m)	0.00	1.67	3.34	5.01	6.68	8.35	10.02																			
																										

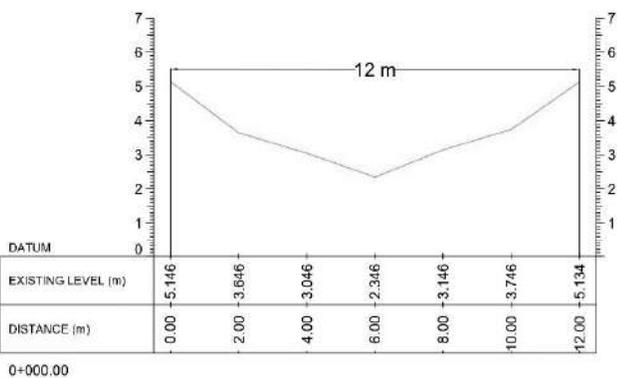
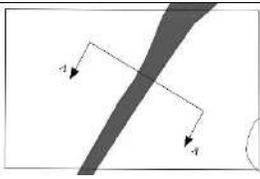
Canal: Balur char Khal (Total length 1200 m). Depths are taken 3 m interval.

Location:	N:23.640789 E:90.159700 Balurchar, Bakshanagar							
Width:	18 (m)							
Depth:	Point 1 (m): 1.7							
	Point 2 (m): 2.4							
	Point 3 (m): 3.0							
	Point 4 (m): 2.5							
	Point 5 (m): 1.9							
Direction of flow:	Flow from east direction to south direction.							
Remarks:	This canal is occupied by the local people							
Photograph:		 <table border="1"> <thead> <tr> <th colspan="2">DATUM</th> </tr> </thead> <tbody> <tr> <td>EXISTING LEVEL (m)</td> <td>5.965, 4.265, 3.565, 2.965, 3.465, 4.065, 5.894</td> </tr> <tr> <td>DISTANCE (m)</td> <td>0.00, 3.00, 6.00, 9.00, 12.00, 15.00, 18.00</td> </tr> </tbody> </table> <p>0+000.00</p>	DATUM		EXISTING LEVEL (m)	5.965, 4.265, 3.565, 2.965, 3.465, 4.065, 5.894	DISTANCE (m)	0.00, 3.00, 6.00, 9.00, 12.00, 15.00, 18.00
	DATUM							
EXISTING LEVEL (m)	5.965, 4.265, 3.565, 2.965, 3.465, 4.065, 5.894							
DISTANCE (m)	0.00, 3.00, 6.00, 9.00, 12.00, 15.00, 18.00							
								

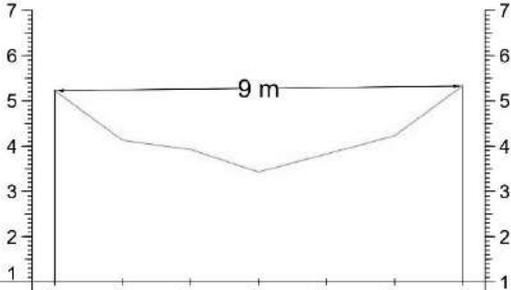
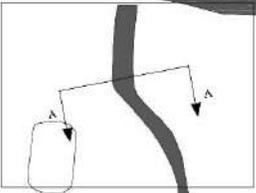
Canal: Bakshanagar Bazar Canal (Total Length). Depths are taken between 2 m interval.

Location:	N:23.643633 E:90.174891 Bakshanagar Bazar Khal							
Width:	12 (m)							
Depth:	Point 1 (m): 1.9							
	Point 2 (m): 2.5							
	Point 3 (m): 3.5							
	Point 4 (m): 2.6							
	Point 5 (m): 1.8							
Direction of flow:	Flow from east direction to south direction and connected with the Ichamati River							
Remarks:	Very poor condition, need to dig a canal.							
Photograph:		 <table border="1"> <thead> <tr> <th colspan="2">DATUM</th> </tr> </thead> <tbody> <tr> <td>EXISTING LEVEL (m)</td> <td>0.00 -5.433 2.00 -3.633 4.00 -3.184 6.00 -1.933 8.00 -2.833 10.00 -3.633 12.00 -5.465</td> </tr> <tr> <td>DISTANCE (m)</td> <td></td> </tr> </tbody> </table> <p>0+000.00</p>	DATUM		EXISTING LEVEL (m)	0.00 -5.433 2.00 -3.633 4.00 -3.184 6.00 -1.933 8.00 -2.833 10.00 -3.633 12.00 -5.465	DISTANCE (m)	
	DATUM							
EXISTING LEVEL (m)	0.00 -5.433 2.00 -3.633 4.00 -3.184 6.00 -1.933 8.00 -2.833 10.00 -3.633 12.00 -5.465							
DISTANCE (m)								
								

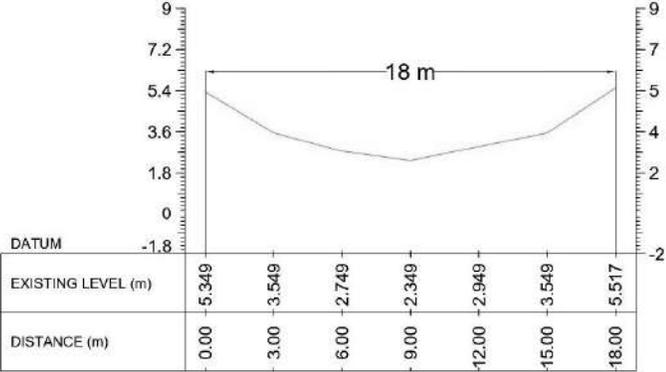
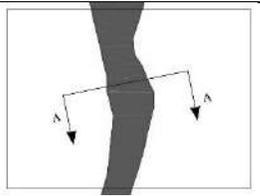
Canal: Dighirpar Khal (Total Length 800 m). Depths are taken between 2 m interval.

Location:	N:23.645876 E:90.166930 Dighirpar choto khal, Bakshanagar							
Width:	12 (m)							
Depth:	Point 1 (m): 1.5							
	Point 2 (m): 2.1							
	Point 3 (m): 2.8							
	Point 4 (m): 2.0							
	Point 5 (m): 1.4							
Direction of flow:	Flow from south direction to north direction and connected with the Ichamati River.							
Remarks:	Very poor condition							
Photograph:		 <table border="1"> <thead> <tr> <th colspan="2">DATUM</th> </tr> </thead> <tbody> <tr> <td>EXISTING LEVEL (m)</td> <td>0.00 -5.146 2.00 -3.646 4.00 -3.046 6.00 -2.346 8.00 -3.146 10.00 -3.746 12.00 -5.134</td> </tr> <tr> <td>DISTANCE (m)</td> <td></td> </tr> </tbody> </table> <p>0+000.00</p>	DATUM		EXISTING LEVEL (m)	0.00 -5.146 2.00 -3.646 4.00 -3.046 6.00 -2.346 8.00 -3.146 10.00 -3.746 12.00 -5.134	DISTANCE (m)	
	DATUM							
EXISTING LEVEL (m)	0.00 -5.146 2.00 -3.646 4.00 -3.046 6.00 -2.346 8.00 -3.146 10.00 -3.746 12.00 -5.134							
DISTANCE (m)								
								

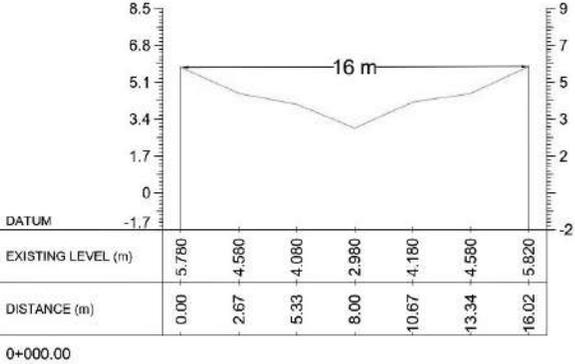
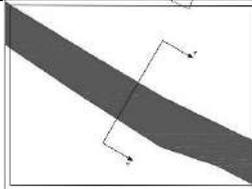
Canal: Durgapur Khal (Total Length 1100 m). Depths are taken between 1.5 m interval.

Location:	N:23.623271 E:90.214417 Durgapur Churain																									
Width:	9 (m)																									
Depth:	Point 1 (m):	1.1																								
	Point 2 (m):	1.3																								
	Point 3 (m):	1.8																								
	Point 4 (m):	1.4																								
	Point 5 (m):	1.0																								
Direction of flow:	Flow from south direction to north direction																									
Remarks:	Very poor Condition. This canal is blocked.																									
Photograph:		 <table border="1" data-bbox="740 1087 1398 1234"> <thead> <tr> <th>DATUM</th> <th>0.00</th> <th>1.50</th> <th>3.00</th> <th>4.50</th> <th>6.00</th> <th>7.50</th> <th>9.00</th> </tr> </thead> <tbody> <tr> <td>EXISTING LEVEL (m)</td> <td>5.227</td> <td>4.127</td> <td>3.927</td> <td>3.427</td> <td>3.827</td> <td>4.227</td> <td>5.324</td> </tr> <tr> <td>DISTANCE (m)</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table> <p>0+000.00</p>	DATUM	0.00	1.50	3.00	4.50	6.00	7.50	9.00	EXISTING LEVEL (m)	5.227	4.127	3.927	3.427	3.827	4.227	5.324	DISTANCE (m)							
	DATUM		0.00	1.50	3.00	4.50	6.00	7.50	9.00																	
EXISTING LEVEL (m)	5.227	4.127	3.927	3.427	3.827	4.227	5.324																			
DISTANCE (m)																										
																										

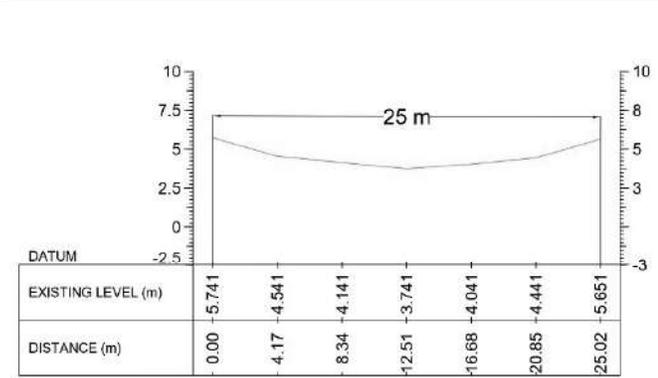
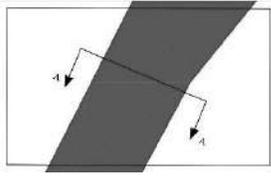
Canal: Kamarkhola Khal (Total Length 2400 m). Depths are taken between 3 m interval.

Location:	N:23.603807 E:90.207700 Kamarkhola Chakpar, Churain							
Width:	18 (m)							
Depth:	Point 1 (m):	1.8						
	Point 2 (m):	2.6						
	Point 3 (m):	3.0						
	Point 4 (m):	2.4						
	Point 5 (m):	1.8						
Direction of flow:	Flow from north direction to south direction and use for irrigation purpose.							
Remarks:	Newly dug canal							
Photograph:		 <table border="1" data-bbox="727 1087 1364 1207"> <thead> <tr> <th colspan="2">DATUM</th> </tr> </thead> <tbody> <tr> <td>EXISTING LEVEL (m)</td> <td>5.349 3.549 2.749 2.349 2.949 3.549 5.517</td> </tr> <tr> <td>DISTANCE (m)</td> <td>0.00 3.00 6.00 9.00 12.00 15.00 18.00</td> </tr> </tbody> </table> <p>0+000.00</p>	DATUM		EXISTING LEVEL (m)	5.349 3.549 2.749 2.349 2.949 3.549 5.517	DISTANCE (m)	0.00 3.00 6.00 9.00 12.00 15.00 18.00
	DATUM							
EXISTING LEVEL (m)	5.349 3.549 2.749 2.349 2.949 3.549 5.517							
DISTANCE (m)	0.00 3.00 6.00 9.00 12.00 15.00 18.00							
								

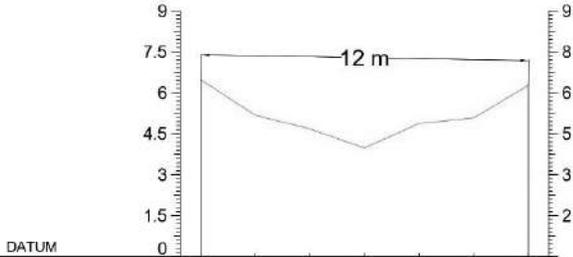
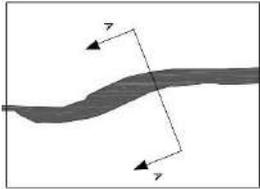
Canal: Gokulnagar Khal (Total length 2700 m). Depths are taken between 2.67 m interval.

Location:	N:23.636870 E:90.237745 Gokulnagar, Agla							
Width:	16 (m)							
Depth:	Point 1 (m): 1.2							
	Point 2 (m): 1.7							
	Point 3 (m): 2.8							
	Point 4 (m): 1.6							
	Point 5 (m): 1.2							
Direction of flow:	Flow from south direction to north direction and connected with the Ichamati River.							
Remarks:	N/A							
Photograph:		 <table border="1" data-bbox="769 1050 1344 1199"> <thead> <tr> <th colspan="2">DATUM</th> </tr> </thead> <tbody> <tr> <td>EXISTING LEVEL (m)</td> <td>5.780 4.560 4.080 2.960 4.180 4.580 5.820</td> </tr> <tr> <td>DISTANCE (m)</td> <td>0.00 2.67 5.33 8.00 10.67 13.34 16.02</td> </tr> </tbody> </table> <p>0+000.00</p>	DATUM		EXISTING LEVEL (m)	5.780 4.560 4.080 2.960 4.180 4.580 5.820	DISTANCE (m)	0.00 2.67 5.33 8.00 10.67 13.34 16.02
	DATUM							
EXISTING LEVEL (m)	5.780 4.560 4.080 2.960 4.180 4.580 5.820							
DISTANCE (m)	0.00 2.67 5.33 8.00 10.67 13.34 16.02							
								

Canal: Agla Khal (Total Length 3200 m). Depths are taken between 4.17 m interval.

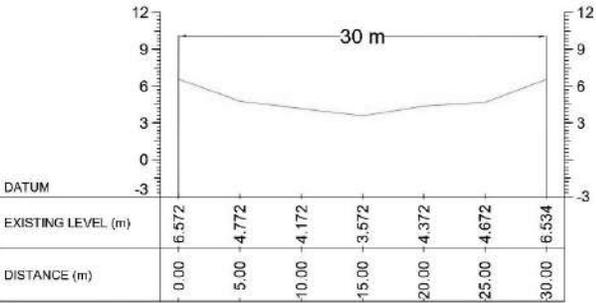
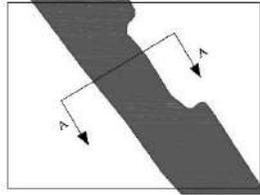
Location:	N:23.628928 E:90.238786 Chocoria, Agla																												
Width:	25 (m)																												
Depth:	Point 1 (m):	1.2																											
	Point 2 (m):	1.6																											
	Point 3 (m):	2.0																											
	Point 4 (m):	1.7																											
	Point 5 (m):	1.3																											
Direction of flow:	Flow from south direction to north direction and connected with the Ichamati River.																												
Remarks:	Excavation is required for this canal.																												
Photograph:		 <table border="1" data-bbox="743 1039 1356 1165"> <thead> <tr> <th colspan="2">DATUM</th> <th>0.00</th> <th>4.17</th> <th>8.34</th> <th>12.51</th> <th>16.68</th> <th>20.85</th> <th>25.02</th> </tr> </thead> <tbody> <tr> <td>EXISTING LEVEL (m)</td> <td></td> <td>-5.741</td> <td>-4.541</td> <td>-4.141</td> <td>-3.741</td> <td>-4.041</td> <td>-4.441</td> <td>-5.651</td> </tr> <tr> <td>DISTANCE (m)</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table> <p>0+000.00</p>	DATUM		0.00	4.17	8.34	12.51	16.68	20.85	25.02	EXISTING LEVEL (m)		-5.741	-4.541	-4.141	-3.741	-4.041	-4.441	-5.651	DISTANCE (m)								
	DATUM		0.00	4.17	8.34	12.51	16.68	20.85	25.02																				
EXISTING LEVEL (m)		-5.741	-4.541	-4.141	-3.741	-4.041	-4.441	-5.651																					
DISTANCE (m)																													
																													

Canal: Shikaripara Khal (Total Length 800 m). Depths are taken between 2 m interval.

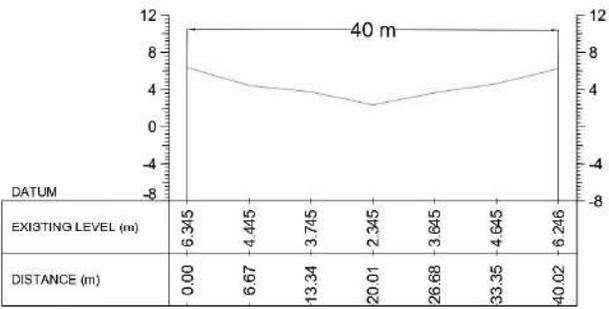
Location:	N:23.702912 E:90.072083 Shikaripara khal																															
Width:	12 (m)																															
Depth:	Point 1 (m): 1.3																															
	Point 2 (m): 1.8																															
	Point 3 (m): 2.5																															
	Point 4 (m): 1.6																															
	Point 5 (m): 1.4																															
Direction of flow:	Flow from west direction to east direction																															
Remarks:	Occupied by the local people																															
Photograph:		 <table border="1" data-bbox="787 1081 1339 1186"> <thead> <tr> <th colspan="2">DATUM</th> </tr> </thead> <tbody> <tr> <td>EXISTING LEVEL (m)</td> <td>6.477</td> </tr> <tr> <td></td> <td>5.177</td> </tr> <tr> <td></td> <td>4.677</td> </tr> <tr> <td></td> <td>3.977</td> </tr> <tr> <td></td> <td>4.877</td> </tr> <tr> <td></td> <td>5.077</td> </tr> <tr> <td></td> <td>6.267</td> </tr> <tr> <td>DISTANCE (m)</td> <td>0.00</td> </tr> <tr> <td></td> <td>2.00</td> </tr> <tr> <td></td> <td>4.00</td> </tr> <tr> <td></td> <td>6.00</td> </tr> <tr> <td></td> <td>8.00</td> </tr> <tr> <td></td> <td>10.00</td> </tr> <tr> <td></td> <td>12.00</td> </tr> </tbody> </table> <p>0+000.00</p>	DATUM		EXISTING LEVEL (m)	6.477		5.177		4.677		3.977		4.877		5.077		6.267	DISTANCE (m)	0.00		2.00		4.00		6.00		8.00		10.00		12.00
	DATUM																															
EXISTING LEVEL (m)	6.477																															
	5.177																															
	4.677																															
	3.977																															
	4.877																															
	5.077																															
	6.267																															
DISTANCE (m)	0.00																															
	2.00																															
	4.00																															
	6.00																															
	8.00																															
	10.00																															
	12.00																															
																																

Canal: Tashulla Khal (Total Length 1500 m).

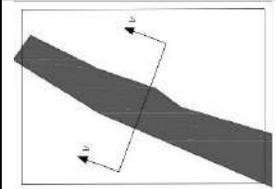
Point: 1. Depths are taken between 5 m interval.

Location:	N:23.704034 E:90.110284 Tashulla, Nayansree							
Width:	30 (m)							
Depth:	Point 1 (m): 1.8							
	Point 2 (m): 2.4							
	Point 3 (m): 3.0							
	Point 4 (m): 2.2							
	Point 5 (m): 1.9							
Direction of flow:	Flow from east direction to north direction and connected with the Tashulla Khal.							
Remarks:	N/A							
Photograph:		 <table border="1"> <thead> <tr> <th colspan="2">DATUM</th> </tr> </thead> <tbody> <tr> <td>EXISTING LEVEL (m)</td> <td>0.00 -6.572 5.00 -4.772 10.00 -4.172 15.00 -3.572 20.00 -4.372 25.00 -4.672 30.00 -6.534</td> </tr> <tr> <td>DISTANCE (m)</td> <td></td> </tr> </tbody> </table> <p>0+000.00</p>	DATUM		EXISTING LEVEL (m)	0.00 -6.572 5.00 -4.772 10.00 -4.172 15.00 -3.572 20.00 -4.372 25.00 -4.672 30.00 -6.534	DISTANCE (m)	
	DATUM							
EXISTING LEVEL (m)	0.00 -6.572 5.00 -4.772 10.00 -4.172 15.00 -3.572 20.00 -4.372 25.00 -4.672 30.00 -6.534							
DISTANCE (m)								
								

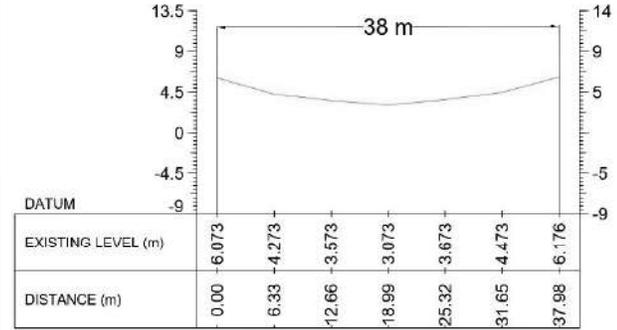
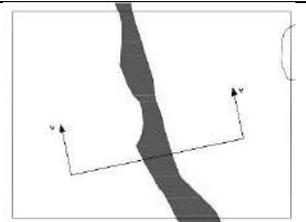
Point: 2. Depths are taken between 6.67 m interval.

Location:	N:23.700580 E:90.103721 Tuital, Nayansree																												
Width:	40 (m)																												
Depth:	Point 1 (m): 1.9																												
	Point 2 (m): 2.6																												
	Point 3 (m): 4.0																												
	Point 4 (m): 2.7																												
	Point 5 (m): 1.7																												
Direction of flow:	Flow from east direction to south direction and connected with the Ichamati River.																												
Remarks:	N/A																												
Photograph:		 <table border="1" data-bbox="738 1018 1315 1144"> <thead> <tr> <th colspan="2">DATUM</th> <th>0.00</th> <th>6.67</th> <th>13.34</th> <th>20.01</th> <th>26.68</th> <th>33.35</th> <th>40.02</th> </tr> </thead> <tbody> <tr> <td>EXISTING LEVEL (m)</td> <td></td> <td>6.345</td> <td>4.445</td> <td>3.745</td> <td>2.345</td> <td>3.645</td> <td>4.645</td> <td>6.246</td> </tr> <tr> <td>DISTANCE (m)</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table> <p>0+000.00</p>	DATUM		0.00	6.67	13.34	20.01	26.68	33.35	40.02	EXISTING LEVEL (m)		6.345	4.445	3.745	2.345	3.645	4.645	6.246	DISTANCE (m)								
	DATUM		0.00	6.67	13.34	20.01	26.68	33.35	40.02																				
EXISTING LEVEL (m)		6.345	4.445	3.745	2.345	3.645	4.645	6.246																					
DISTANCE (m)																													

Canal: Jalachar Khal (Total Length 2200 m). Depths are taken between 2.17 m interval.

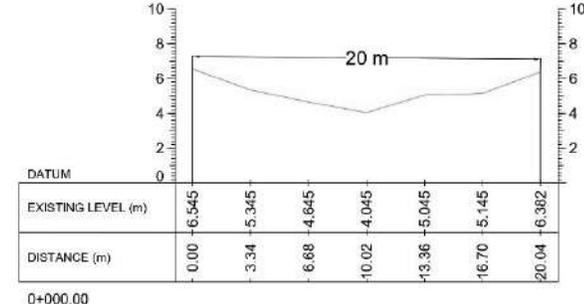
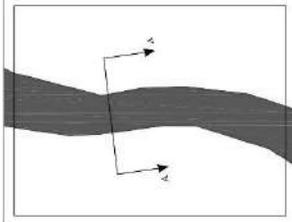
Location:	N:23.670175 E:90.146439 Jalalchar, Jantrail																												
Width:	13 (m)																												
Depth:	Point 1 (m):	1.2																											
	Point 2 (m):	1.6																											
	Point 3 (m):	2.1																											
	Point 4 (m):	1.7																											
	Point 5 (m):	1.4																											
Direction of flow:	Flow from north direction to south direction and connected with the Ichamati River.																												
Remarks:	N/A																												
Photograph:		 <table border="1" data-bbox="743 1073 1336 1203"> <thead> <tr> <th colspan="2">DATUM</th> <th>0.00</th> <th>2.17</th> <th>4.34</th> <th>6.51</th> <th>8.68</th> <th>10.85</th> <th>13.02</th> </tr> </thead> <tbody> <tr> <td>EXISTING LEVEL (m)</td> <td></td> <td>5.362</td> <td>4.162</td> <td>3.762</td> <td>3.262</td> <td>3.662</td> <td>3.962</td> <td>5.563</td> </tr> <tr> <td>DISTANCE (m)</td> <td></td> <td>0.00</td> <td>2.17</td> <td>4.34</td> <td>6.51</td> <td>8.68</td> <td>10.85</td> <td>13.02</td> </tr> </tbody> </table> <p>0+000.00</p>	DATUM		0.00	2.17	4.34	6.51	8.68	10.85	13.02	EXISTING LEVEL (m)		5.362	4.162	3.762	3.262	3.662	3.962	5.563	DISTANCE (m)		0.00	2.17	4.34	6.51	8.68	10.85	13.02
	DATUM		0.00	2.17	4.34	6.51	8.68	10.85	13.02																				
EXISTING LEVEL (m)		5.362	4.162	3.762	3.262	3.662	3.962	5.563																					
DISTANCE (m)		0.00	2.17	4.34	6.51	8.68	10.85	13.02																					

Canal: Harishkul Khal (Total Length 2200 m). Depths are taken between 6.33 m interval.

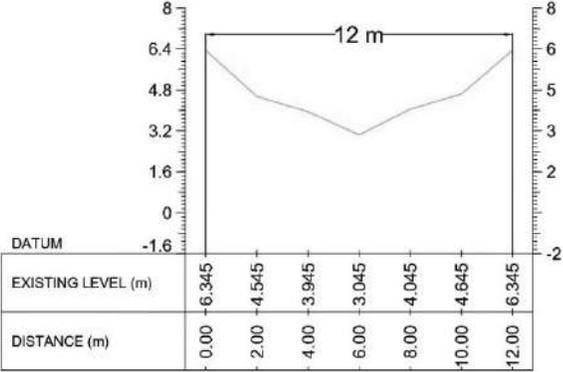
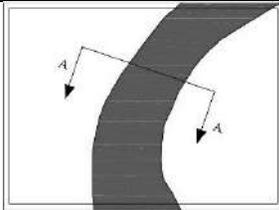
Location:	N:23.668276 E:90.152931 Harishkul, Jantrail							
Width:	38 (m)							
Depth:	Point 1 (m): 1.8							
	Point 2 (m): 2.5							
	Point 3 (m): 3.0							
	Point 4 (m): 2.4							
	Point 5 (m): 1.6							
Direction of flow:	Flow from north direction to south direction and connected with the Ichamati River.							
Remarks:	N/A							
Photograph :		 <table border="1"> <thead> <tr> <th colspan="2">DATUM</th> </tr> </thead> <tbody> <tr> <td>EXISTING LEVEL (m)</td> <td>0.00 +6.073 6.33 +4.273 12.66 +3.573 18.99 +3.073 25.32 +3.673 31.65 +4.473 37.98 +6.176</td> </tr> <tr> <td>DISTANCE (m)</td> <td>0.00 6.33 12.66 18.99 25.32 31.65 37.98</td> </tr> </tbody> </table> <p>0+000.00</p>	DATUM		EXISTING LEVEL (m)	0.00 +6.073 6.33 +4.273 12.66 +3.573 18.99 +3.073 25.32 +3.673 31.65 +4.473 37.98 +6.176	DISTANCE (m)	0.00 6.33 12.66 18.99 25.32 31.65 37.98
	DATUM							
EXISTING LEVEL (m)	0.00 +6.073 6.33 +4.273 12.66 +3.573 18.99 +3.073 25.32 +3.673 31.65 +4.473 37.98 +6.176							
DISTANCE (m)	0.00 6.33 12.66 18.99 25.32 31.65 37.98							
								

Canal: Rani Khal (Total Length 2500 m).

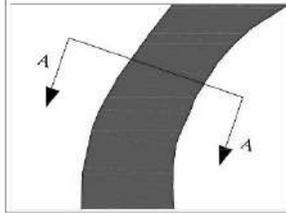
Point: 1. Depths are taken between 3.33 m interval.

Location:	N:23.681357 E:90.207606 East chak barrah, Barrah																									
Width:	20 (m)																									
Depth:	Point 1 (m): 1.2																									
	Point 2 (m): 1.9																									
	Point 3 (m): 2.5																									
	Point 4 (m): 1.5																									
	Point 5 (m): 1.4																									
Direction of flow:	Flow from south direction to north direction																									
Remarks:	N/A																									
Photograph:		 <table border="1"> <tr> <td>DATUM</td> <td>0.00</td> <td>3.34</td> <td>6.68</td> <td>10.02</td> <td>13.36</td> <td>16.70</td> <td>20.04</td> </tr> <tr> <td>EXISTING LEVEL (m)</td> <td>6.545</td> <td>5.345</td> <td>4.545</td> <td>4.045</td> <td>5.045</td> <td>5.145</td> <td>6.382</td> </tr> <tr> <td>DISTANCE (m)</td> <td>0.00</td> <td>3.34</td> <td>6.68</td> <td>10.02</td> <td>13.36</td> <td>16.70</td> <td>20.04</td> </tr> </table> <p>0+000.00</p>	DATUM	0.00	3.34	6.68	10.02	13.36	16.70	20.04	EXISTING LEVEL (m)	6.545	5.345	4.545	4.045	5.045	5.145	6.382	DISTANCE (m)	0.00	3.34	6.68	10.02	13.36	16.70	20.04
	DATUM		0.00	3.34	6.68	10.02	13.36	16.70	20.04																	
EXISTING LEVEL (m)	6.545	5.345	4.545	4.045	5.045	5.145	6.382																			
DISTANCE (m)	0.00	3.34	6.68	10.02	13.36	16.70	20.04																			
																										

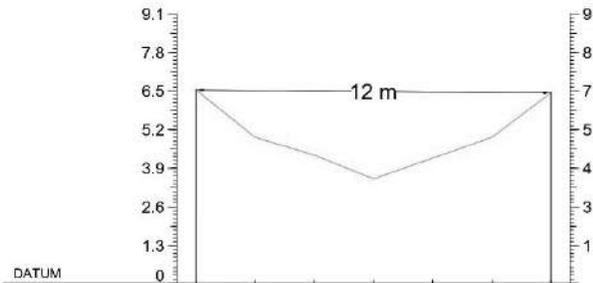
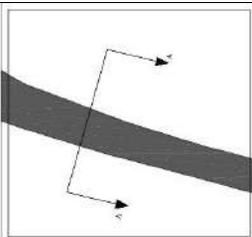
Point: 2. Depths are taken between 2 m interval.

Location:	N:23.667455 E:90.215294 Telenga, Kailail																			
Width:	12 (m)																			
Depth:	Point 1 (m):	1.8																		
	Point 2 (m):	2.4																		
	Point 3 (m):	3.3																		
	Point 4 (m):	2.3																		
	Point 5 (m):	1.7																		
Direction of flow:	Flow from south direction to west direction and connected with the Kaliganga River.																			
Remarks:	N/A																			
Photograph:		 <table border="1" data-bbox="773 1081 1307 1203"> <thead> <tr> <th colspan="2">DATUM</th> </tr> </thead> <tbody> <tr> <td>EXISTING LEVEL (m)</td> <td>+6.345</td> </tr> <tr> <td>DISTANCE (m)</td> <td>0.00</td> </tr> <tr> <td></td> <td>2.00</td> </tr> <tr> <td></td> <td>4.00</td> </tr> <tr> <td></td> <td>6.00</td> </tr> <tr> <td></td> <td>8.00</td> </tr> <tr> <td></td> <td>10.00</td> </tr> <tr> <td></td> <td>12.00</td> </tr> </tbody> </table> <p>0+000.00</p>	DATUM		EXISTING LEVEL (m)	+6.345	DISTANCE (m)	0.00		2.00		4.00		6.00		8.00		10.00		12.00
	DATUM																			
EXISTING LEVEL (m)	+6.345																			
DISTANCE (m)	0.00																			
	2.00																			
	4.00																			
	6.00																			
	8.00																			
	10.00																			
	12.00																			
																				

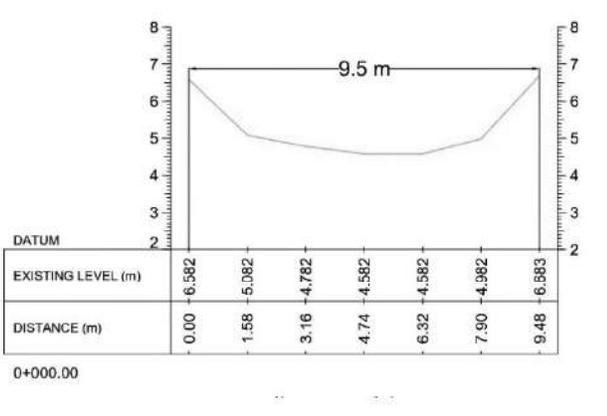
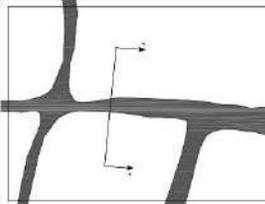
Canal: Branch of Ichamoti River (Total Length 1800 m). Depths are taken between 3.33 m interval.

Location:	N:23.663927 E:90.210099 Mailail, Barrah							
Width:	20 (m)							
Depth:	Point 1 (m):	1.2						
	Point 2 (m):	1.7						
	Point 3 (m):	2.4						
	Point 4 (m):	1.6						
	Point 5 (m):	1.2						
Direction of flow:	Flow from south direction to north direction and connected with the Ichamati River.							
Remarks:	N/A							
Photograph:		 <table border="1"> <thead> <tr> <th colspan="2">DATUM</th> </tr> </thead> <tbody> <tr> <td>EXISTING LEVEL (m)</td> <td>0.00 -6.617 3.34 -5.417 6.68 -4.917 10.02 -4.217 13.36 -5.017 16.70 -5.417 20.04 -6.624</td> </tr> <tr> <td>DISTANCE (m)</td> <td></td> </tr> </tbody> </table> <p>0+000.00</p>	DATUM		EXISTING LEVEL (m)	0.00 -6.617 3.34 -5.417 6.68 -4.917 10.02 -4.217 13.36 -5.017 16.70 -5.417 20.04 -6.624	DISTANCE (m)	
	DATUM							
EXISTING LEVEL (m)	0.00 -6.617 3.34 -5.417 6.68 -4.917 10.02 -4.217 13.36 -5.017 16.70 -5.417 20.04 -6.624							
DISTANCE (m)								

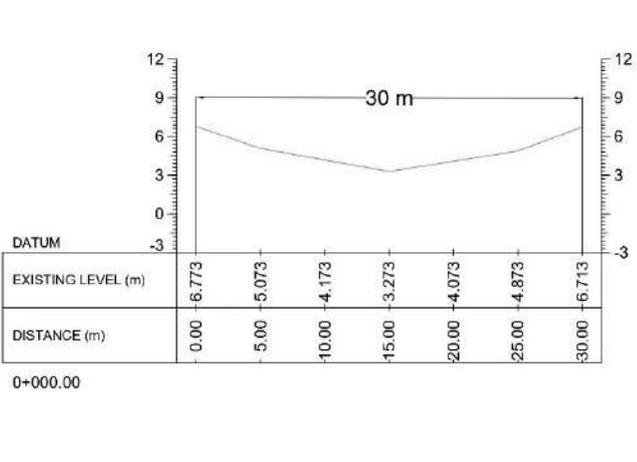
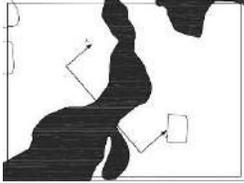
Canal: North Telenga (Total Length 1800 m). Depths are taken between 2 m interval.

Location:	N:23.677396 E:90.222287 North Telenga, Kailail							
Width:	12 (m)							
Depth:	Point 1 (m):	1.6						
	Point 2 (m):	2.2						
	Point 3 (m):	3.0						
	Point 4 (m):	2.3						
	Point 5 (m):	1.6						
Direction of flow:	Flow from east direction to west direction and connected with the Kaliganga River.							
Remarks:	N/A							
Photograph:		 <table border="1" data-bbox="787 1123 1380 1239"> <thead> <tr> <th colspan="2">DATUM</th> </tr> </thead> <tbody> <tr> <td>EXISTING LEVEL (m)</td> <td>6.542 4.942 4.342 3.542 4.242 4.942 6.445</td> </tr> <tr> <td>DISTANCE (m)</td> <td>0.00 2.00 4.00 6.00 8.00 10.00 12.00</td> </tr> </tbody> </table> <p>0+000.00</p>	DATUM		EXISTING LEVEL (m)	6.542 4.942 4.342 3.542 4.242 4.942 6.445	DISTANCE (m)	0.00 2.00 4.00 6.00 8.00 10.00 12.00
	DATUM							
EXISTING LEVEL (m)	6.542 4.942 4.342 3.542 4.242 4.942 6.445							
DISTANCE (m)	0.00 2.00 4.00 6.00 8.00 10.00 12.00							
								

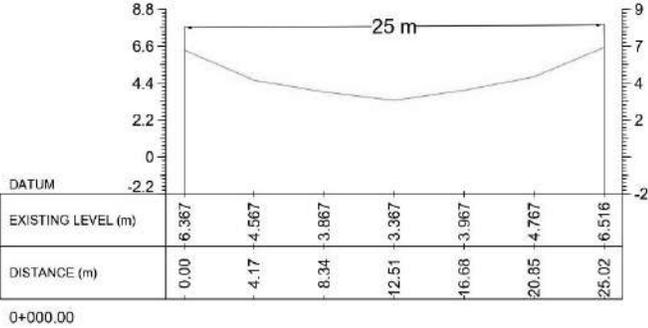
Canal: Krishna Khali Khal (Total Length 2000 m). Depths are taken between 1.58 m interval.

Location:	N:23.693969 E:90.050237 Kollyansree Joykrisnapur Khal																									
Width:	9.5 m																									
Depth:	Point 1 (m):	1.5																								
	Point 2 (m):	1.8																								
	Point 3 (m):	2.0																								
	Point 4 (m):	2.0																								
	Point 5 (m):	1.6																								
Direction of flow:	Flow from east direction to west direction and connected with the Padma River.																									
Remarks:	N/A																									
Photograph:		 <table border="1"> <thead> <tr> <th>DATUM</th> <th>0.00</th> <th>1.58</th> <th>3.16</th> <th>4.74</th> <th>6.32</th> <th>7.90</th> <th>9.48</th> </tr> </thead> <tbody> <tr> <td>EXISTING LEVEL (m)</td> <td>6.582</td> <td>5.082</td> <td>4.782</td> <td>4.582</td> <td>4.582</td> <td>4.982</td> <td>6.583</td> </tr> <tr> <td>DISTANCE (m)</td> <td>0.00</td> <td>1.58</td> <td>3.16</td> <td>4.74</td> <td>6.32</td> <td>7.90</td> <td>9.48</td> </tr> </tbody> </table>	DATUM	0.00	1.58	3.16	4.74	6.32	7.90	9.48	EXISTING LEVEL (m)	6.582	5.082	4.782	4.582	4.582	4.982	6.583	DISTANCE (m)	0.00	1.58	3.16	4.74	6.32	7.90	9.48
	DATUM		0.00	1.58	3.16	4.74	6.32	7.90	9.48																	
EXISTING LEVEL (m)	6.582	5.082	4.782	4.582	4.582	4.982	6.583																			
DISTANCE (m)	0.00	1.58	3.16	4.74	6.32	7.90	9.48																			
																										

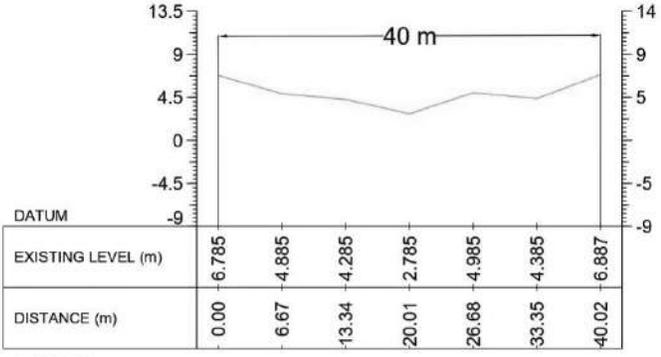
Canal: Branch of Ichamati River (Total Length 2800 m). Depths are taken between 5 m interval.

Location:	N:23.661861 E:90.095157 Nurnagar, Bandura							
Width:	30 (m)							
Depth:	Point 1 (m): 1.7							
	Point 2 (m): 2.6							
	Point 3 (m): 3.5							
	Point 4 (m): 2.7							
	Point 5 (m): 1.9							
Direction of flow:	Flow from north direction to south direction and connected with the Ichamati River.							
Remarks:	N/A							
Photograph:		 <table border="1"> <thead> <tr> <th colspan="2">DATUM</th> </tr> </thead> <tbody> <tr> <td>EXISTING LEVEL (m)</td> <td>6.773 5.073 4.173 3.273 4.073 4.873 6.713</td> </tr> <tr> <td>DISTANCE (m)</td> <td>0.00 5.00 10.00 15.00 20.00 25.00 30.00</td> </tr> </tbody> </table> <p>0+000.00</p>	DATUM		EXISTING LEVEL (m)	6.773 5.073 4.173 3.273 4.073 4.873 6.713	DISTANCE (m)	0.00 5.00 10.00 15.00 20.00 25.00 30.00
	DATUM							
EXISTING LEVEL (m)	6.773 5.073 4.173 3.273 4.073 4.873 6.713							
DISTANCE (m)	0.00 5.00 10.00 15.00 20.00 25.00 30.00							
								

Canal: Branch of Ichamati River (Total Length 3000 m). Depths are taken between 4.17 m interval.

Location:	N:23.651506 E:90.098152 Nayanagar, Bandura.							
Width:	25 (m)							
Depth:	Point 1 (m): 1.8							
	Point 2 (m): 2.5							
	Point 3 (m): 3.0							
	Point 4 (m): 2.4							
	Point 5 (m): 1.6							
Direction of flow:	Flow from east direction to south direction and connected with the Ichamati River.							
Remarks:	N/A							
Photograph:		 <table border="1"> <thead> <tr> <th colspan="2">DATUM</th> </tr> </thead> <tbody> <tr> <td>EXISTING LEVEL (m)</td> <td>6.367 4.567 3.867 3.367 3.967 4.767 6.516</td> </tr> <tr> <td>DISTANCE (m)</td> <td>0.00 4.17 8.34 12.51 16.68 20.85 25.02</td> </tr> </tbody> </table> <p>0+000.00</p>	DATUM		EXISTING LEVEL (m)	6.367 4.567 3.867 3.367 3.967 4.767 6.516	DISTANCE (m)	0.00 4.17 8.34 12.51 16.68 20.85 25.02
	DATUM							
EXISTING LEVEL (m)	6.367 4.567 3.867 3.367 3.967 4.767 6.516							
DISTANCE (m)	0.00 4.17 8.34 12.51 16.68 20.85 25.02							

Canal: Hazratpur Khal (Total length 3500 m). Depths are taken between 6.67 m interval.

Location:	N:23.657808 E:90.141058 Hazratpur, Bandura																												
Width:	40 (m)																												
Depth:	Point 1 (m): 1.9																												
	Point 2 (m): 2.5																												
	Point 3 (m): 4.0																												
	Point 4 (m): 1.8																												
	Point 5 (m): 2.4																												
Direction of flow:	Flow from east direction to north direction and connected with the Ichamati River.																												
Remarks:	N/A																												
Photograph:		 <table border="1"> <thead> <tr> <th colspan="2">DATUM</th> <th>0.00</th> <th>6.67</th> <th>13.34</th> <th>20.01</th> <th>26.68</th> <th>33.35</th> <th>40.02</th> </tr> </thead> <tbody> <tr> <td>EXISTING LEVEL (m)</td> <td></td> <td>-6.785</td> <td>-4.885</td> <td>-4.285</td> <td>-2.785</td> <td>-4.985</td> <td>-4.385</td> <td>-6.887</td> </tr> <tr> <td>DISTANCE (m)</td> <td></td> <td>0.00</td> <td>6.67</td> <td>13.34</td> <td>20.01</td> <td>26.68</td> <td>33.35</td> <td>40.02</td> </tr> </tbody> </table> <p>0+000.00</p>	DATUM		0.00	6.67	13.34	20.01	26.68	33.35	40.02	EXISTING LEVEL (m)		-6.785	-4.885	-4.285	-2.785	-4.985	-4.385	-6.887	DISTANCE (m)		0.00	6.67	13.34	20.01	26.68	33.35	40.02
	DATUM		0.00	6.67	13.34	20.01	26.68	33.35	40.02																				
EXISTING LEVEL (m)		-6.785	-4.885	-4.285	-2.785	-4.985	-4.385	-6.887																					
DISTANCE (m)		0.00	6.67	13.34	20.01	26.68	33.35	40.02																					
	