



LOCAL GOVERNMENT
ENGINEERING DEPARTMENT

VOLUME I

SURVEY REPORTS (DRAFT 2)

REVIEW & UPDATE OF NAWABGANJ UPAZILA
DEVELOPMENT PLAN (MASTER PLAN) UNDER
UTMIDP, LGED

VOL I: ENGINEERING AND LAND USE SURVEYS,
GEOTECHNICAL AND SEISMOLOGICAL
SURVEYS, HYDROGRAPHIC SURVEY
(GROUP A, B AND C)

OCTOBER
2024

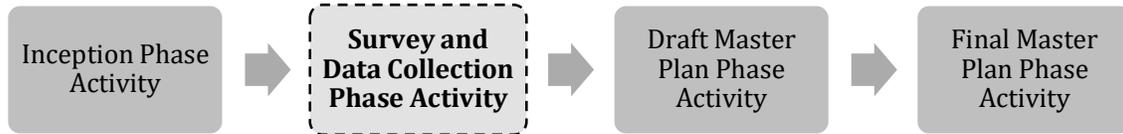


EXECUTIVE SUMMARY

Engineering and Land/Space Use Survey, Geotechnical and Seismological Survey And Hydrographic Survey

CONTEXT OF THE PROJECT

The main objective of this master plan project is to review and update the master plan of Nawabganj upazila under UTMIDP/UMPR-2. Nawabganj Upazila that had been prepared by Urban Development Directorate (UDD) earlier Upazila administration has been recognized as the most important administration level according to the government's recent administrative restructuring policy. The main objective of preparation of the master plan is to assess and improve the quality of all social, economic, administrative and infrastructure services of the upazila. Review and update of Nawabganj Upazila Master Plan is a recent initiative of Local Government Engineering Department (LGED) which is being prepared by Sheltech (Pvt.) Ltd. and Sheltech Consultants (Pvt.) Ltd. The current Survey Report (Draft 2) has been prepared, in persuasion of the Part B (Survey Studies) of the Terms of Reference of Review & Update of Nawabganj Upazila Development Plan (Master Plan). The second draft report, submitted following the first draft in March and a data-sharing workshop on April 2024 at Nawabganj Upazila Complex with local stakeholders, incorporates revised data obtained through field checks, as directed by the ToR and inception report.



Major Phases of the Project

REPORT STRUCTURE AND CONTENT

Survey Reports	
Volume I	Report on Engineering and Land/ Space Use Survey, Geotechnical and Seismological Survey, and Hydrographic Survey
Volume II	Report on Socio-Economic Survey, Economic Activity Survey, and Traffic and Transportation Surveys
Volume III	Working Paper on Population, Heritage, Recreation and Open Space, Health Facility, Education Facility, Agriculture including fisheries, livestock and forestry, Bio-diversity Including flora and fauna, Hazard and disaster, Public health, disease control and wellbeing, Environment, Legal and Institutional Framework for implementation of the project output
Volume IV	Community Engagement (PRA and KII related) Report

SCOPE OF WORK

The scope of Survey Report is as follows:

- To collect all the information as indicated in the ToR for the Project Area.
- Preparation of detailed survey inventory, processing and analyzing survey data, presenting them through mapping and reporting are also a part of this report. These data include physical feature, topographic, land use, hydrographic, geotechnical and seismologic, environment, socio-economic, economic, transportation situation of the project area. Stereo (3D) Satellite Image based advance technology has been used for topographic, physical features and land use survey for the project area.
- Collection of different utility networks like drainage line (storm water), sewerage network, gas supply network, water supply network, and electricity networks form respective agencies;
- Conducting stakeholder's consultation meeting with Local People/Local Leaders/Representatives/Communities to involve them in the process of plan preparation through Participatory Rapid Appraisal (PRA) to incorporate the knowledge and opinions of local/community people in formulating planning proposals.

Table: Administrative Units of Nawabganj Upazila

Local Government Area Type	Units
District	Dhaka
Upazila	Nawabganj
Union	Agla, Bakshanagar, Bandura, Barra, Baruakhali, Churain, Galimpur, Jantrail, Joykrishnapur, Kailail, Kolakopa, Nayansree, Shikari Para, Sholla

POPULATION

Bangladesh has seen rapid urbanization, with the urban population rising from 5% in 1974 to 35% in 2016, straining urban infrastructure and quality of life. Over 500 cities face poor housing, inadequate utilities, and rising slum populations. Conversely, rural areas have developed haphazardly, with increased rural-urban migration due to a lack of facilities and employment. The government's "My Village My Town" initiative aims to improve rural infrastructure and amenities, like transport, healthcare, education, and internet access, to balance development and protect agricultural land. The Prime Minister has directed creating master plans for every Upazila, with LGED leading the planning for twelve Upazilas to ensure sustainable development and better urban-rural balance. Traditionally, Upazila Parishad prepares short-term development schemes, lacking long-term plans. To optimize livelihoods, an interdisciplinary approach is needed. Objectives of the Upazila Master Plan (UMP) include improving quality of life, providing development guidelines, ensuring sustainable urban-rural linkages, protecting agricultural land, and facilitating public and private sector development through participatory planning.

Union Name	Population			
	Male	Female	Total	Density
Agla	9042	10143	19185	1285
Bakshangar	10675	12214	22889	2668
Bandura	14337	16662	30999	2097
Barrah	13393	14762	28155	1644
Baruakhali	8338	9972	18310	1522
Churain	11969	13973	25942	1222
Galimpur	6943	7910	14528	1578
Jantrail	11532	13495	25027	1285
Joykrishnapur	8814	10060	18874	1161
Kailail	13420	15438	28858	828
Kolakopa	11621	12556	24177	3638
Nayanshree	13390	16440	29582	1332
Shikaripara	8658	10316	18974	1673
Sholla	20100	22613	42713	1111

Topographic Survey

Topographic surveying involves precise recording of coordinates and elevation data of natural and artificial features within the designated area, crucial for effective land planning and decision-making processes. The survey encompasses detailed descriptions of land levels, contours, digital elevation models, roads, embankments, natural drainage systems, and water bodies within Nawabganj Upazila. With a total area of 61061.91 acres, water bodies cover 5433.61 acres, constituting 8.90% of the entire Upazila. The survey identifies numerous rivers, canals, ponds, ditches, borrow pits, and swamps, with ponds dominating the water body landscape. Utilizing state-of-the-art equipment such as Total Stations and drones, the survey achieves high accuracy in capturing spot levels and creating detailed contour maps.

Matrice 300 RTK (Real Time Kinematics) Drone, DJI Zenmuse P1 camera, Topcon GR-5 GNSS (Global Navigation Satellite System) Receivers, and Topcon GM101 Total Station have been used for conducting topographic surveys in the Nawabganj Upazila area. Here, the height is determined concerning the Mean Sea Level (MSL), and the height measurement unit is the Meter. The horizontal and vertical distance between each point of the spot level is 5m.

Table: Statistical Summary of Spot-Levels

Types	Values
Minimum	-1.323418
Maximum	10.461782
Mean	5.005971
Standard Deviation	1.50105

Analysis indicates a mean elevation of approximately 5.01 meters, with a standard deviation of 1.50 meters, reflecting uniform terrain characteristics. The contour map, comprising 79899 lines, visually represents elevation differences, aiding in land use planning and infrastructure development. Additionally, the Digital Elevation Model (DEM) offers valuable insights into elevation distribution. Furthermore, the survey examines flow directions of rivers, canals, and drainage channels, enhancing understanding of water flow patterns. Detailed categorization and distribution of water bodies contribute to ecosystem assessment and resource management

efforts. In conclusion, the Topographic Survey chapter serves as a foundational resource for the Upazila Masterplan, providing critical insights into Nawaganj Upazila's geographical features and enabling informed decision-making for sustainable development and resource utilization.

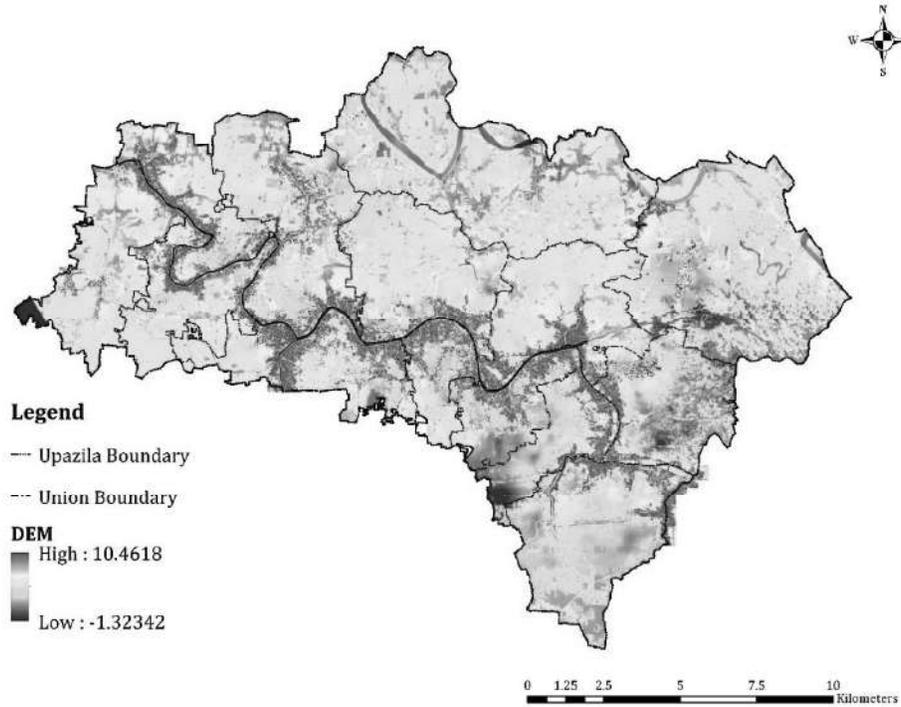


Figure: Digital Elevation Model of Nawabganj Upazila

Physical Features

During the physical feature survey, various details were gathered through the field investigation.

Table: Attribute Collection for Survey

Feature (Structure)	Type	Attributes Collected	Feature Type (Road)	Attributes Collected
Structure Type		1. Pucca (RCC)	Road Name	
		2. Pucca (Masonry)	Road Surface type	1. BC
		3. Semi Pucca		2. RCC
		4. Kutcha		3. HBD
		5. Under Construction		4. WBM
5. Earthen				
Tenure Type		1. Owner Occupied	Road surface condition	6. Other
		2. Tenant Public		1. Good
		3. Tenant Private		2. Fair
		4. Squatting		3. Poor
Construction Year		4. Critical		
Number of floors				
Structure name			Road Width	
Holding No			Footpath (If any)	

Survey Report (Draft 2)Review and Update of Master Plan for
Nawabganj Upazila

v

Dwelling Unit		Surface Type	1. BC
Ownership	1. Government		2. RCC
	2. non-Government		3. HBD
	3. Private		4. WBM
	4. Religious		5. Earthen
Use of different Floors			6. Other
Locality Name			

Feature (Drain)	Type	Attributes Collected	Feature (Waterbody)	Type	Attributes Collected
Material Type		1. Concrete	Type		1. River
		2. Brick			2. Natural Canal
		3. Pipe			3. Irrigation Canal
		4. Earthen			4. Pond
Drainage Condition		1. Good			5. Ditch
		2. Fair			6. Borrow Pit
		3. Poor			7. Marsh
		4. Critical		Depth	
Width of the Drain			Ownership		1. Public
Depth of the Drain					2. Private
Flowline of Drain					

Feature Type (Bridge/Culvert)	Attributes Collected	Feature Type (Electricity, Gas)	Attributes Collected
Name		Substation	If there is any point out the area
Type	1. Iron Bridge		
	2. RCC Bridge	Power Station	
	3. Bailey Bridge		
	4. Pipe Culvert	Transformer	
	5. Sluice Gate		
	6. Railway Bridge		
Length			
Width			
Construction Year			
Condition	1. Good		
	2. Fair		
	3. Poor		
	4. Critical		

A. Structure

A substantial amount of information about various types of buildings has been collected through the comprehensive survey of the area. This information on structure has been categorized into

three primary groups: pucca, semi-pucca, and kutcha/tin shed. This classification aids in comprehending the assortment of buildings within the surveyed region.

Pucca Structures: Buildings falling under this category have brick walls and a concrete roof. These types of structures are well-built and durable, with walls made of bricks and a strong roof made of concrete. The number of pucca structures stands of 23517 and the percentage is 11.15%.

2. Semi-Pucca Structures: The second category includes surfaces with brick, concrete, or strong materials but roofs and walls made of materials other than concrete. This means the surface is sturdy and made of bricks, but the roof and partitions might be made of different materials instead of concrete. The number of semi-pucca structures is 118194 and it is almost 56.02% of total structures.

3. Kutcha Structures: The last category involves structures constructed using materials like earth, thatch, or tin for the walls. These materials may not be as strong as bricks. The roofs of these structures can also be made of materials like tin or thatch. This category has the second highest number with 66460 and the percentage is 31.50%.

Additionally, buildings that are in the process of being constructed, regardless of whether they are intended to be made of tin, brick, or concrete, are categorized as under-construction structures. This category serves as a catch-all for buildings that are not yet completed.

LGED Survey, 2023

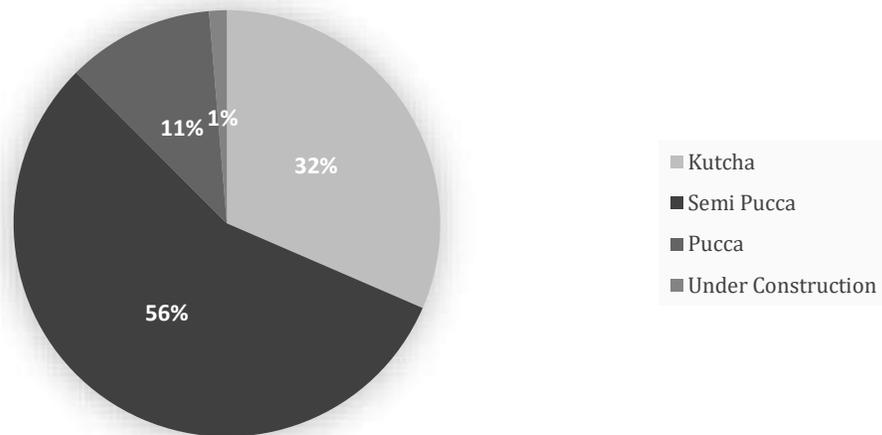


Figure: Share of Structure Type

The comparison between the UDD Survey of 2016 and the LGED Survey of 2023 reveals a notable increase in the number of structures across all categories. Kutcha structures saw a rise from 50000 to 66460, Pucca structures more than doubled from 9496 to 23517, and Semi Pucca structures experienced a substantial surge from 13867 to 118194. Additionally, 2823 structures were reported as under construction in the LGED Survey of 2023, indicating ongoing development activities.

UDD Survey

LGED Survey



Figure: Comparison of Structure share between 2016 to 2023

The data provides an overview of dwelling units across different unions in Nawabganj Upazila. Sholla Union has the highest number of dwelling units, accounting for 14.44% of the total, followed by Bandura with 9.20% and Nayansree with 8.79%. Galimpur has the lowest number of dwelling units, comprising just 3.63%. The total number of dwelling units across all unions is 131,402, reflecting a diverse housing distribution across the region.

Table: Union-wise Dwelling Unit Share

Union	Dwelling Unit	Percentage (%)
Agla	6036	4.59
Bakshanagar	7147	5.44
Bandura	12083	9.20
Barrah	9937	7.56
Baruakhali	6627	5.04
Churain	9530	7.25
Galimpur	4773	3.63
Jantrail	9890	7.53
Joykrishnapur	8402	6.39
Kailail	10759	8.19
Kolakopa	8195	6.24
Nayansree	11549	8.79
Shikaripara	7498	5.71
Sholla	18976	14.44
Grand Total	131402	100.00

B. Community Facilities

Education Facilities

Nawabganj Upazila’s educational facilities, showcasing the distribution of schools, colleges, coaching centers, and madrasas in the region. In the Nawabganj upazila, there are 139 primary schools, 45 high schools, 6 colleges and 76 Madrasas. Moreover, there are 43 kindergarten school and madrasas and 11 coaching centers contributing significantly to the education sector.

Healthcare Facilities

Within the government sector, there is one hospital, 13 Union Health & Family Welfare Center (UHFWC) and 58 community clinics, indicating the provision of public healthcare services at both levels. In the non-government sector, there are 9 hospital or diagnostic centers.

Religious Establishments

With a total of 1154 religious' facilities, Nawabganj appears to be a place where multiple faiths are practiced and accommodated, fostering an environment of religious diversity and cultural richness. 614 mosques, indicating a significant presence of Islamic places of worship. Additionally, there are 533 temples and 7 churches, demonstrating the coexistence of diverse religious traditions within the community.

Open spaces

In total, the area boasts of 227.04 acres of open space (eidgah, park and playground), signifying its commitment to preserving natural areas and providing recreational opportunities for its residents. Nayansree stands out as having the largest expanse of open space, covering 31.85 acres, indicating its potential as a oasis within the urban landscape.

Infrastructure and Service

Nawabganj Upazila is served by a road network of 990.90 km. From construction point these roads are divided in to eight categories including Brick Chips, Cement Concrete, Reinforced Cement Concrete, Hollow Block Bricks, Water Bound Macadam, Other construction materials use, Unique type of blocks and lastly Earthen materials used for construction. Nawabganj-Majhirkanda-Dohar, Dhaka-Keraniganj-Tikorpur-Joypara, Nawabganj-Sholla-Hemayetpur, and Nawabganj-Majhirkanda-Bandura-Baruakhali-Beribadh roads are the main roads of the Upazila area

. Table: Union-wise Transportation Infrastructure Facilities

Union Name	BC	CC	Earthen	HBB	WBM	RCC	Uni-Block	Others	Grand Total
Agla	12.57	3.71	13.76	10.58	0.18	1.54	4.73		47.07
Bakshanagar	18.94	0.91	11.10	6.74		6.77	0.23		44.69
Bandura	24.20	1.21	21.05	15.57		3.96	6.23		72.23
Barrah	26.74	4.18	25.05	13.20		5.65	1.66	0.04	76.54
Baruakhali	36.33	0.04	19.88	5.53		0.12	1.60	0.57	64.06
Churain	30.60	2.47	21.22	4.07		4.26	4.46		67.08
Galimpur	17.95	0.74	8.21	9.26		2.73	0.04		38.93
Jantrail	26.03	0.24	32.02	9.56	0.02	1.28	0.61	1.95	71.71
Joykrishnapur	12.92		29.05	7.44		4.16	1.51		55.07
Kailail	35.02	0.10	33.30	9.96	0.80	1.79	7.24		88.20
Kolakopa	22.46	0.58	10.94	5.64	2.25	5.55	2.39		49.81
Nayansree	26.45		50.05	17.76	5.82	0.21	5.11		105.41
Shikaripara	11.83	0.81	34.68	13.08	0.22	0.91	1.94		63.46
Sholla	41.44	0.51	66.98	26.14	0.07	1.80	9.67		146.62
Grand Total	343.47	15.51	377.30	154.54	9.37	40.74	47.42	2.56	990.90

In Sholla, there are a total of 146.62 kilometers of roads, with the majority, accounting for 45.68%, being earthen roads. Galimpur presents a different scenario with a total of 38.93 kilometers of roads. Here, a significant 46.10% of roads are constructed with bituminous concrete (BC), while there are smaller segments with reinforced cement concrete (RCC) and HBB (high-quality bituminous concrete) roads.

In total, there are 460 bridges and culverts across the upazila, with 223 bridges and 237 culverts distributed among the unions. Sholla Union has the highest number of both bridges and culverts, totaling 82, followed by Churain with 48 and Kailail with 46. Barrah also has a notable number with 36. Conversely, Joykrishnapur has the fewest.

Within Nawabganj there isn't any drainage system at all without some small drain located at some union's bazar in Nawabganj. These drains are too small and the outfall of the drains is in the Ichamati River. A small number of drainage systems are found only in Kolakopa, Bakshanagar, Bandura, and Nayansree unions.

Nawabganj Upazila houses key power grid substations that are central to its electrical infrastructure. There are two 132/33 KV substations located in Bandura and Agla, and a 33/11 KV sub-center in Kolakopa Union. These facilities distribute electricity across the upazila, supporting industrial, commercial, and residential activities. Additionally, six Palli Bidyut Samiti Complaint Centers handle electricity-related issues for residents. In total, there are 47 high voltage towers and 14,259 electric poles across the upazila, highlighting the extensive electricity distribution infrastructure in the region.

There is only one formal dustbin located in the Kolakopa union of the upazila and no door-to-door solid waste collection system. Maximum people through waste here and there, in the river, khal, and pond. There is a dumping ground beside the Ichamati River.

Groundwater, primarily sourced from tube wells, serves as the main supply of drinking water for residents in the region. However, the contamination of several tube wells with iron and arsenic poses a severe health risk to those who depend on them for their daily water needs. Consequently, many locals have turned to deep tube wells as their primary water source, despite the associated financial and logistical challenges. Additionally, the availability of safe water is further constrained by the presence of only five overhead tanks in the area.

Land Use

Nawabganj Upazila, covering a total area of 61,061.91 acres, is primarily an agriculture-based region, with agricultural land constituting 57.96% of the area. The per capita agricultural land is 0.10 acres, reflecting the strong agricultural focus of the local economy, where most residents are engaged in farming activities. Residential settlements dominate the landscape, accounting for 29.65% of the area, while water bodies, including rivers like Ichamati, Dhaleswari, and Kaliganga, cover approximately 8.90%. Road infrastructure is minimal, comprising only 1.11% of the area.

In comparison, the Urban Development Directorate (UDD) reports agricultural land comprises 63.3% of the area, with water bodies covering 9.64%. Urban residential areas account for just 0.48%, while transport facilities and commercial zones make up 0.82% and 0.36%, respectively. Other facilities, such as mixed zones, government services, recreational, health, and community facilities, also occupy a small percentage of the total area.

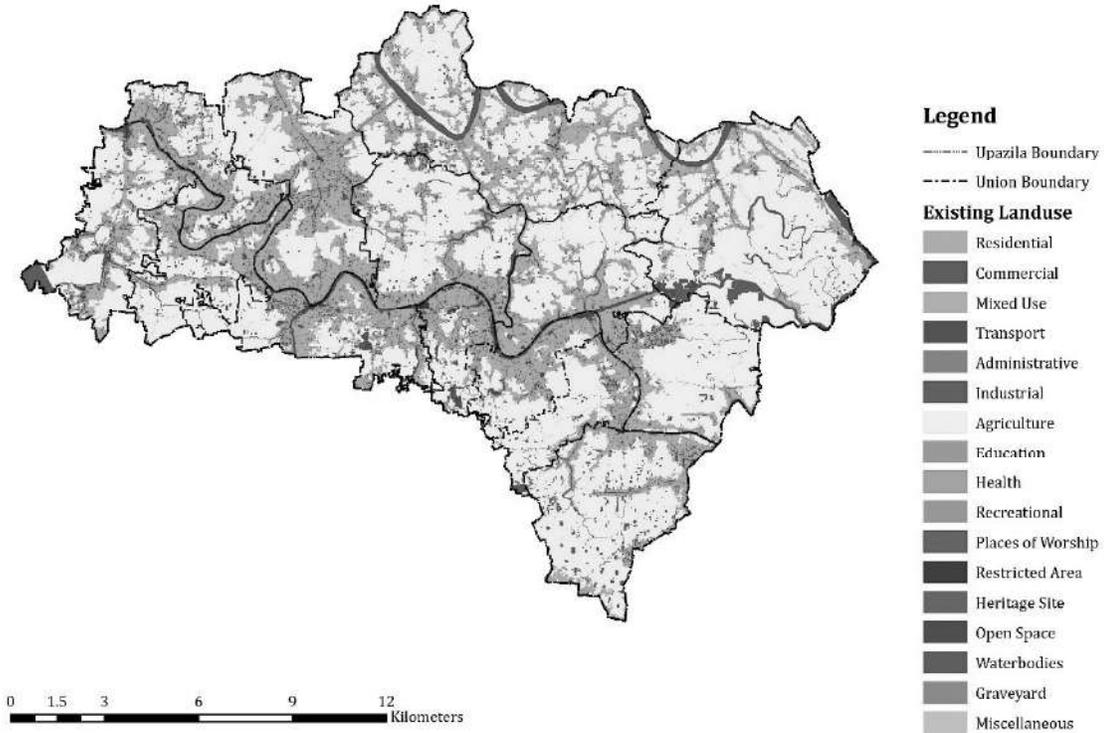


Figure: Land use of Nawabganj Upazila

Environment, Climate Change and Disaster

Water Pollution: The results indicate that all parameters meet Bangladesh's standards except for Iron (Fe) and Manganese. 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.

Noise Pollution: There is around 64 dB of minimum, 88 dB of maximum, and 73 dB of average noise in a mixed-use area in Nawabganj Upazila. The noise level is much higher in mixed-use areas as defined by the Bangladesh Standard (Noise Pollution Control Rules, 2006).

Air Pollution: The research discovered that a mixed land use area's total air quality parameters are higher than the Bangladesh standard.

Waste: 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.

Temperature: 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.

Precipitation: The average maximum rainfall in the study area peaked at 241.00 mm in 2017, while the average minimum rainfall hit 108.42 mm in 2022. In contrast, the average precipitation dropped from 182.75 mm in 2000 to 108.2 mm in 2022, indicating a decline of 74.55 mm over the two-decade span, translating to an annual reduction of 3.72 mm

Humidity: 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% in the Upazila.

Land Surface Temperature: 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.

Hazard and Disaster:

Earthquake: Analyzing the recent earthquake (2014 to 2023) originated within the Bangladesh boundary, the Nawabganj Upazila is lies in moderate to high earthquake sensitive regions. Nawabganj Upazila of Dhaka district is located in zone II. the majority of earthquakes have taken place in seismic zones I and II.

Flood: For Nawabganj Upazila, the majority of Nawabganj is not notably impacted by floods

Riverbank Erosion: 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.

Wetland Loss: 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.

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CHAPTER ONE: INTRODUCTION

1.1 Background of the Project

Like most of the developing countries, development in Bangladesh takes place in and around a few major cities. Hence, the benefits of development are enjoyed by a limited number of urban populations. This leads to national imbalance and disparity in levels of living conditions and development in different parts of the country. Lack of accessibility to important services can be identified as one of the major reasons of underdevelopment of rural areas of Bangladesh. The development of small towns would be given utmost importance in future urbanization of Bangladesh. These are towns at the urban-rural interface having some form of urban infrastructure and the rural populations have the most access to these towns. Therefore, development of the towns/urban centers in terms of the improvement and expansion of ranges of the services will directly benefit the population of their hinterlands and at the same time will be more economically feasible. In these circumstances, a comprehensive development plan is required to address the services needs and required land use transformation which will not only allow any unauthorized and unplanned development, either in urban area or in rural area. Due to lack of such plan, it is generally found that most of the Upazilas in Bangladesh have developed with least coordinated manner possessing very little development control. Measures for the adequate provision of infrastructure, service, utility and modern amenities for maintaining a minimum standard of life, considering environment and sustainability has to be taken. Moreover, in preparing such plan, development constraints and local development potentials are to be identified clearly, and plans would be formulated addressing such development constraints and potentials of the area to make the plan practicable.

In the government's recent policy of overall administrative re-organization, the Upazila has been recognized as the most significant tiers of the administration. It will be planned and developed to accommodate all social, economic, administrative and infrastructure services for the region. This also reflects the national policy of bringing development, administrative and services facilities to the doorstep of the rural masses and to ensure better delivery of government services to the people. In the above background, Urban Development Directorate (UDD) initiated the preparation of the Upazila Development Plan in 2011. They prepared the plan for 16 Upazilas under two projects from 2011 to 2015, and Nawabganj Upazila was one of them. The Upazilas are representing various geographical location and characteristic of Bangladesh.

The reason for revising the plan is based on the various principles of planning practice, as well as the current situation's need. It is recommended to revise the local-level plan every five years to update policy-level plans, such as structure plans. Assessment of social, physical, environmental, transportation sectors depend on the sustainability of the master plan. The world is becoming more complex due to rapid technological advancements, globalization, environmental challenges caused by poverty and population growth, climate change and the need for resilience, the swift spread of pandemics like COVID-19, the necessity for disaster response and recovery coordination, and increased efficiency and DRR. All of these challenges are intertwined with the land's spatial distribution and functions. Additionally, we are transitioning into a middle-income country with increased purchasing power, making it crucial to provide basic civic services and amenities to villages in a planned and efficient manner. Importance of reviewing master plan in upazila play a vital role in connecting rural urban network. Bangladesh's current emphasis on

rural development, as embodied in the "My Village My Town" initiative, is supported by LGED through the UTMIDP framework, which fosters urbanization and ensures that rural areas benefit from infrastructure development comparable to that of towns and cities. This includes modern transportation infrastructure, healthcare and education opportunities, safe drinking water and sanitation, increased access to electricity and fuel, and access to information technology and high-speed internet. These brings attention from higher level authority to prepare, review and update of upazila master plan.

The updating and reviewing of Nawabganj upazila master plan ensures organized and planned development of the whole upazila which will curb indiscriminate and haphazard construction to create liveable environment. While doing so, it was kept in mind that for urban penetration into rural settings will need basic services to ameliorate poor standard of living of the village people. So, the project ensures planned provision of basic infrastructure and services to urban and rural people of the upazila, preventing indiscriminate development on agricultural land, ensuring food production. The promotion of infrastructure and services in the upazila will set the ground for small scale investment in trading and manufacturing leading to growth of rural employment. The project considered the incorporation of risk sensitive development which will make resilient towards different disaster especially flood and promote agro production including pisciculture. The aspects were considered to prepare a guide to coordinated development among the GoB line agencies and other development actors or partners, empowering local government and upazila administration.

1.2 The Upazila

Nawabganj Upazila is situated in Dhaka district with an area of 247 sq. km (nawabganj.dhaka.gov.bd/). It is surrounded by Singair Upazila on the North; Dohar Upazila on the South; Keraniganj, Sirajdikhan and Sreenagar Upazilas on the East; Harirampur and Manikganj Sadar Upazilas on the West. There is no written history about the naming of Nawabganj. There is a popular legend that during the Nawab period, the Nawabs and their subordinates and soldiers used to travel to Dhaka by boat from Murshidabad through the Ichamati river in Nawabganj. They used to pitch their tents and rest in this area along the banks of the Ichamati. At one point the servants of the Nawab started living in this area to collect rent. In this way, the population gradually increased in this area and gradually urban culture was developed. As a result, this area became known as Nawabganj. The Nawabganj Upazila Master Plan stands as the inaugural initiative of LGED for planned development of the upazila. SHELTECH takes immense pride in being an integral part of this undertaking.

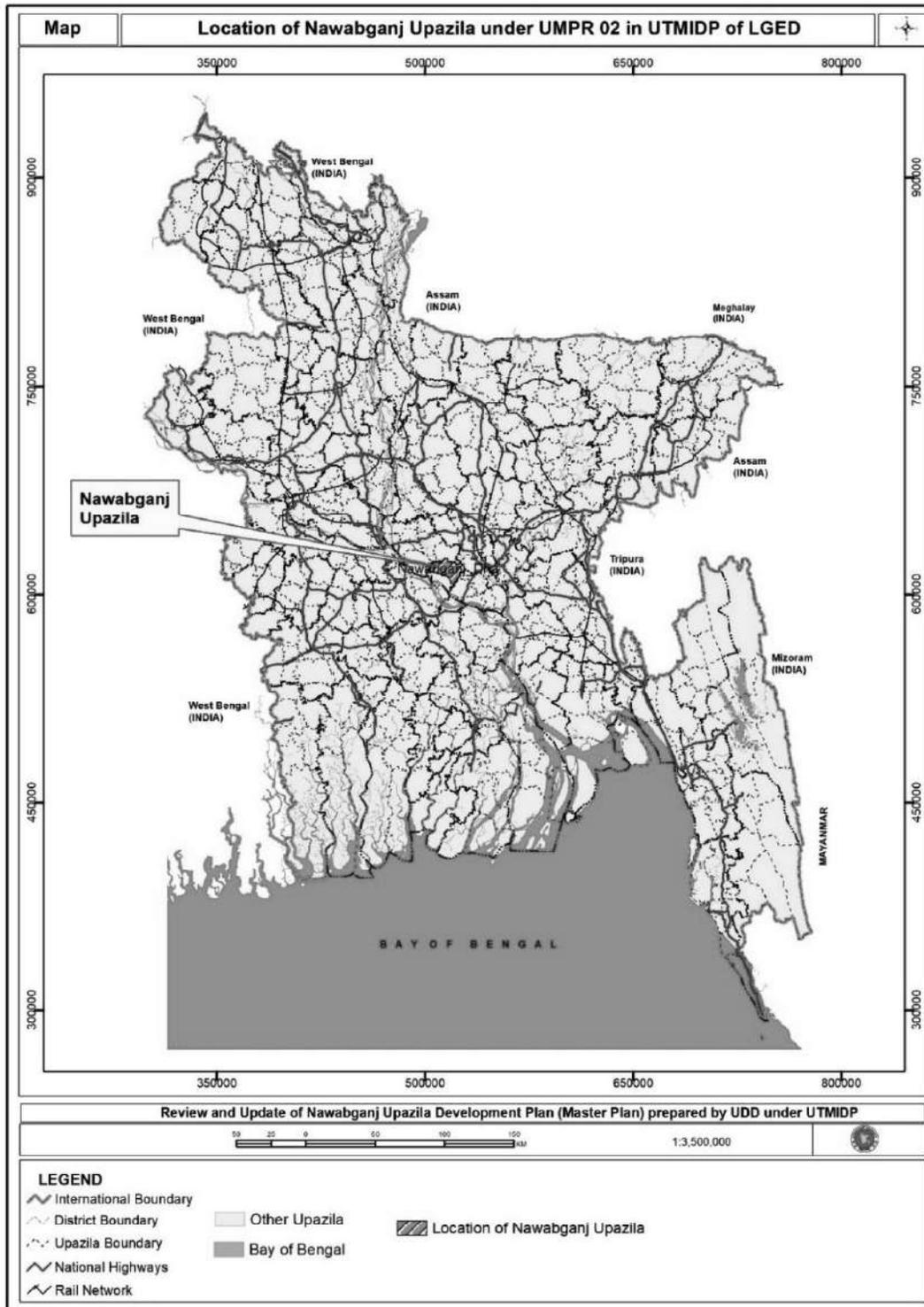


Figure 1-1: Location of Nawabganj Upazila with respect to Bangladesh.

1.3 Objectives of the Project

The upazila needs to be integrated with the mainstream development process of the country. Therefore, an interdisciplinary development planning approach is urgently needed to optimize the livelihood of these areas. Attention needs to be given to the physical development planning problems. The objectives of the Upazila Master Plan (UMP) are set as follows in order to achieve this philosophy.

- a) To bring about significant improvement in the quality of life of upazila people through provisioning of government services and facilities both in urban and rural areas.
- b) To provide guideline for development considering the opportunities and constraints of future development in the upazila.
- c) To ensure planned development both in urban and rural areas maintaining their linkages in order to ensure sustainable environment.
- d) To ensure healthy living and promote wellbeing for all.
- e) To protect agricultural land for ensuring food security.
- f) To ensure increased and fruitful public participation throughout the plan making process.
- g) To facilitate public and private sector's development in the Upazila.
- h) To prepare a multi-sector investment plan through participatory process for better living standards by identifying area-based priorities.
- i) To provide controls for private sector development, and to ensure clarity and security with regard to future development.
- j) The Development Plan (Master Plan) should be prepared with the integration of the local people and well cooperation from other development agencies. It will be a guiding document for implementation development projects by all concerned.

1.4 Scope of Services

The scope of services and data collection surveys in a master plan project typically involves a comprehensive assessment and documentation of the project area's existing physical characteristics and features and infrastructure. The surveys provide critical data that serve as a foundation for urban and regional planning, land development, and infrastructure design. The survey assignment conducted in the review and update of Nawabganj Upazila has the following scope of activities:

Physical features, especially structure information, waterbodies, drainage networks, road connectivity, utility services, urban land use, tenancy types, community facilities, urban infrastructure, and municipal services, are covered in the physical feature survey. The topography survey includes spot levels, contour, flow directions, and water drainage channels.

Physical feature survey is a major component that provides information about building structures, which is highly important for master plan preparation. During the survey, every structure, pre-identified through Drone and latest satellite imagery, is mapped. Structure name, floor uses, tenancy type, age, and holding numbers are documented through field-level data collection and verification. Surveyors generally draw other features in the field that are not

captured and identified in the Drone and latest satellite images. Such features including playground boundaries, gas distribution lines, open spaces, or special areas.

The scope of the physical feature survey is as follows:

- a) Inventory and condition assessment of existing infrastructure such as roads, bridges, utilities (water, sewer, electricity), and public transportation systems.
- b) Establishment of Benchmark (BM) Pillars.
- c) Preparation of digital mouza database.
- d) Conducting Topographic, Physical Feature, and Land use Surveys using Photogrammetric method.
- e) Mapping of existing utility networks (water supply, wastewater, electricity, gas, telecommunications). Assessment of the capacity and efficiency of utility services
- f) Conducting Hydrographic Survey
- g) Identification of property boundaries and ownership information
- h) Assessment of ecological significance and the potential for conservation areas
- i) Assessment of existing parks, community, and open space systems comprised of both natural and manmade features, infrastructures, structures, and systems.

The information gathered in this report is valuable as it will support in the planning phase of the masterplan project.

1.5 Citizen Participation in Survey and Data Collection Work

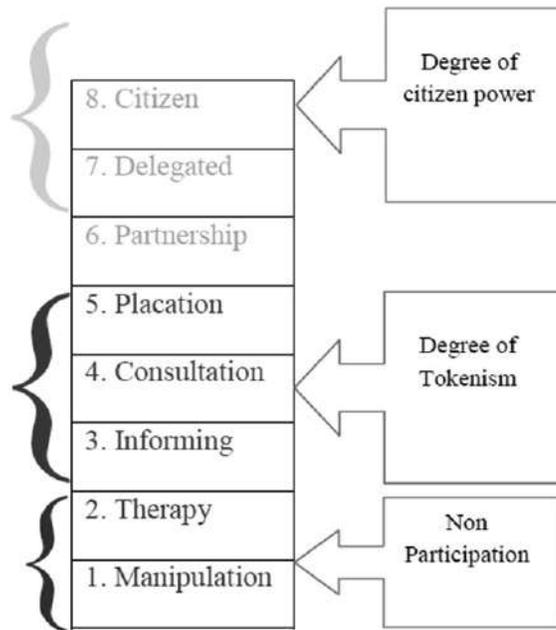


Figure 1-2 : Sherry Arnstein's Eight Steps on a Ladder of Citizen Participation

Source: (Arnstein, 1969)



Figure 1-3: Site Visit

The planning and management approach sees people as the main resource for development rather than as an object of the development effort or as a mere recipient of benefits. Participation means the involvement in the planning and development process of all the individual, interest groups, organizations and communities who might be affected by its outcome. Regular meetings between planners, local authorities and residents were held to discuss the issues as they developed. Residents and local authority collaborated on data collection with ideas coming from both. Their ideas and participation in surveys later be involved in the preparation of the plan.

On 25 June 2023 a team of the Consultant embarked on an initial visit to Nawabganj with the purpose of meeting with the key upazila officials and inform them about the project and introduce themselves with different places of the upazila. The consultant team was accompanied by Dr. Akhter Husain Chaudhury, Dr. Adil Mohammad Khan, Planner Muhammad Ariful Islam, Planner Abu Musa Abdullah and Planner Abdullah Al Masud and other officials of the consulting firm. At the outset team met Mr. Md. Julfikar Haque Chowdhary, the Upazila Engineer. The team also had conversation with Advocate Shafiuddin Mia, Chairman, Barrah Union. The upazila Engineer was informed about the Upazila Planning project, its importance in the regional and national perspective, and its impact in transforming the undeveloped rural areas with urban infrastructure and services.

The Engineer team sealed some important information about the developments in the upazila to the project team. It was conveyed that an economic zone is being developed in the upazila by BEZA in Kailail area, covering an area of 874 acres proposed. Moreover, the Engineer shared plans regarding the excavation of the Ichamati river at various points to facilitate irrigation purposes. This initiative aims to ensure a sufficient water supply for agricultural activities in the region. While meeting the Chairman, it was informed that many Zamindars built a number of beautiful palaces in Kolakopa area. The zamindars, after partition of India in 1947, had left this country and settled down in Kolkata leaving their properties behind. The buildings were lying idle for years.

Gradually, some people took over the buildings illegally. Nobody took any initiative to preserve these as heritage sites. Brojo Niketan has been lately recovered by the administration.



Figure 1-4: Discussion with Upazila Engineer

After the visit to Nawabganj Upazila on July 13, 2023, as part of the project, the consultant, comprising eight members, actively participated in the monthly coordination meeting held on 13 July 2023. At the upazila auditorium the consultant team was accompanied by the team leader Md. Mohirul Islam Mohir, Dr. Akhter Husain Chaudhury, Dr. Adil Mohammed Khan, Planner Abu Musa Abdullah and Planner Abdullah Al Masud and other officials of the consulting firm. The meeting was presided over by honorable Upazila chairman Nasir Uddin Ahmed Jhilu. Diverse range of stakeholders, including the government officials and community representatives like Vice-chairman of Upazila Parisad, Upazila engineer, Chairman of unions were present. The consultant team made substantive contributions by sharing valuable insights and presenting, thereby actively engaging in constructive dialogue aimed at ensuring a comprehensive and inclusive review and update of the development plan. This meeting proved instrumental in fostering effective coordination and cooperation among all participants, collectively working towards the shared objective of enhancing the development outcomes in Nawabganj Upazila.



Figure 1-5: Monthly Coordination Meeting

An initiation workshop on the project was held on August 10, 2023, in Nawabganj Upazila, Parishad presided over by Md Matiur Rahman, the Upazila Nirbahi Officer, and attended by various officials, experts, and local residents. Mr. Julfikar Hossain Choudhury, the Upazila Engineer hosted the workshop. In this workshop, members of the UPDC were also present. This workshop aimed to address matters related to the "Upazila Town (Non-Municipal) Master Plan Formulation and Basic Infrastructure Development Project (1st Revised)," emphasizing the importance of the ongoing process to improve the master plan for Nawabganj Upazila and outlining the key objectives and tasks for successful execution.



Figure 1-6: Initiation Workshop

1.6 Survey and Data Collection Activities

Specified primary and secondary information has been collected for review and analysis to synchronize and develop an overall understanding on the project area. Primary database is helping to explore existing socio-economic conditions, community facilities and land use characteristics, which is of paramount of importance to conduct intensive investigation to prepare a plan. Primary survey includes, Topographic Survey, Physical Feature Survey, Land Use Survey, Hydrological Survey, Socio-economic Survey, Traffic & Transportation Survey, Formal and Informal Economic Activity Survey, Agricultural Land Demarcation Survey, Environmental Survey, Ecological Survey and Agriculture, Fisheries, Livestock Survey, Water and Sanitation Survey, Solid Waste Management Survey, Energy Survey and ICT Survey. Study includes, Population Projection, Hazard and Disaster, Archaeological Study, Study of Social Infrastructure and Legal and Institutional Framework for the comprehension project output.

Modern technologies such as drone-based survey technology, real time kinematic, KoboToolbox, AI tools etc. have been used as survey tools to gather valuable insights and shaping strategic decision. Drones capture high-resolution imagery for detailed mapping crucial in planning. Land use surveys benefit from efficient coverage and data acquisition, aiding in informed decision-making. Topographic surveys leverage drones' ability to navigate challenging terrains, offering precise elevation and contour mapping. In physical feature surveys, drones rapidly assess natural landscapes, supporting environmental conservation efforts. The resolution of drone images will be less than 5 cm. RTK technology utilizes drone navigation systems and a fixed base station to provide real-time, centimeter-level accuracy in positioning. KoboToolbox is instrumental in conducting socioeconomic surveys, streamlining data collection and analysis. Its user-friendly interface enables surveyors to collect diverse socioeconomic data efficiently in the field. With offline capabilities, it's particularly valuable in remote areas. Kobo Toolbox enhances the accuracy and speed of socioeconomic research, facilitating informed decision-making. AI tools revolutionize transportation surveys by automating data collection and analysis. AI tools help to capture video data of different periods for traffic volume count, congestion, and for assessing traffic movement in different periods. These tools enhance efficiency, accuracy, and scalability in monitoring and improving transportation systems.

Modern Technologies for Conducting Surveys



Figure 1-7: Modern Technologies for conducting surveys

Multiple survey techniques have been applied to collect information. These methods facilitate the exchange of information on problem and prospects, need and demand between planning team and local people. Interview technique in conjunction of face-to-face conversation or if face-to-face conversation is not possible, telephone interview has been conducted with the help of structured, semi-structured and unstructured questionnaire or checklist, which facilitated to comprehend deeper insights and context of socio-economics aspects. To collect physical feature information, vector information has been extracted from Drone image. After that required attribute which has been finalized in consultation with relevant experts and PCO, field survey and physical survey map has been prepared. In addition to drone image, archive image has been analyzed to get trend information.

The survey activities of this project have been carried out mainly based on updating of existing database of Master Plan prepared by UDD through Stereo Satellite Imagery, RTK-GPS based Total Station, by orthophoto and drone image etc. The output of the physical survey data has been overlaid on mouza maps to prepare Base Map in the GIS platform.



Figure 1-8: Drone Survey Inspection by Upazila Engineer and LGED Officials



Figure 1-9: BM Installation inspection by PCO



Figure 1-10: Physical Feature Survey Inspection by Assistant Engineer, Nawabganj Upazila

Data on socio-economic condition was collected from both secondary and primary sources. General information on Demography, Family size, Age, Religion, Education, Employment and Occupation Pattern, Land Ownership Pattern, Land Value, Land Utilization, Income Level, Health, and Recreation Facilities, etc. were collected from the primary sources through a specially designed socio-economic survey questionnaire.

Traffic and Transport surveys were carried out including inventory of Road, and Waterway network. Regional network system and its linkage with project area, information on Pedestrian Facilities, Bus/Waterway Routes and parking was collected. It is to be noted that there is no Railway and Air connection in this area.

Environmental study has assessed existing environmental condition, geo-morphology, geology, soil, climate, temperature, humidity, rainfall, wind data from secondary source collected from relevant offices or departments. Questionnaire survey, FGD and secondary data identified the causes of air, water, and noise pollution; contamination list on different components involved with air and water; and existing controlling measures to mitigate environmental pollution.



Figure 1-11: Socio-economic Survey Inspection by PCO



Figure 1-12: Transportation survey inspection by PCO, Nawabganj Upazila.

To ensure public engagement and project monitoring, Upazila Planning and Development Committee (UPDC) has been proposed. The primary aim of forming UPDC is to guarantee local people's active and continuous involvement. Besides, number of workshops, Participatory Rapid/Rural Appraisal (PRA) and Key Informant Interview (KII) has been conducted. The committee is consisting of a total of twenty-nine members or more, chaired by the Upazila Parishad Chairman and co-chaired by UNO. Initiation workshop has already been completed. Soon data sharing workshop will be arranged. In plan preparation stage in total forty-seven PRA sessions will be conducted with different group including youth groups, disadvantage groups, women and children, elected representatives, and representatives associated with economic activities/Hat Bazar/ special areas, labour unions, and transport labours.



Figure 1-13: Upazila Union's Active Participation in PRA Session (Baruakhali)



Figure 1-14: Upazila Union's Active Participation in PRA Session (Bakshanagar)

1.7 Context of the Survey Report

The Survey Report is the second report of the project that conveys the findings of the different surveys and data collection done so far. This report reflects findings of various surveys, such as topography, physical features, hydrography, socio-economic, geotechnical, and seismology, data collected on the environment, climate change, and disaster. The report also includes findings from Participatory Rapid Appraisal (PRA) sessions, key informant interviews, and findings from the data-sharing workshop. The report data will provide extensive support in the preparation of the master plan.

It goes without saying that gathering information from primary and secondary sources is necessary to prepare the master plan. The ToR offers thorough instructions on the data needs and related collection techniques. Relevant data has been gathered in accordance with the ToR's mandate. The first draft report was submitted in the month of March. A preliminary presentation of the data has been made utilizing the descriptive statistical method, including tables, charts, and graphs. Appropriate maps and photos have been inserted to convey distinct viewpoints. A data-sharing workshop with local people on that report was held on 04 April 2024 at Nawabganj Upazila Complex following the thorough instructions offered by the ToR's Part B: 10. workshop is attended by elected officials of the Upazila, members of Upazila Planning and Development Committee (UPDC), woman groups, and members from civil society. The invaluable exchange views encouraged the review of the survey data. Numerous field checks were conducted in a methodological manner at key locations to enhance the accuracy of the data. This systematic approach involved carefully planned visits to strategically selected sites, ensuring that the data collection process was thorough and reliable. The reviewed primary and secondary data are presented in this second draft report. The consulting firm has prepared this report to submit to the client as a deliverable, as per the ToR's directive and in compliance with the inception report.



Figure 1-15: Survey/study result sharing workshop at Nawabganj Upazila Complex



Figure 1-16: Photo Session after Survey/study result sharing workshop



Figure 1-17: Field Checking at Nawabganj Upazila



Figure 1-18: Field Checking at Nawabganj Upazila

Volume-I of the survey report comprises multiple chapters that include the topographic, physical feature, hydrographic, geotechnical, environmental, and land use conditions of the survey area.

1.8 Organization of the Survey Report

According to the Terms of Reference (ToR) for the project, the Survey Report has been prepared in four different volumes. Every survey has adopted specific methods for capturing primary data for the Upazila master plan. Also, various technologies have been integrated into the surveys to expedite the data collection. Chapter 04 to Chapter 09 under Volume-I describe the findings from the field survey conducted based on the Terms of Reference (ToR) of the Local Government Engineering Department (LGED) for the review and update of Nawabganj Upazila Masterplan Preparation Project. The report also uses secondary data as a reference to describe the primary data acquired from the field survey. Secondary data has been collected from multiple sources, such as Nawabganj Upazila, Population and Housing Census-2022 by the Bangladesh Bureau of Statistics, Nawabganj Upazila Statistics Office, Dhaka Deputy Commissioner's Office, Newspaper reports, Research Articles, LGED Reports, Bangladesh Meteorological Department (BMD), Soil Resource Development Institute (SRDI), Prime Minister's Office Digital Library, National Drinking Water Quality Survey (NDWQS) in 2009, etc. Volume-II comprises of socio-economic analysis, economic activity service and traffic and transportation survey. Volume-III and IV deal with sector wise working paper and community engagement report.

CHAPTER TWO: NAWABGANJ UPAZILA PROFILE

2.1 Introduction

Nawabganj Upazila (UZP) is an important administrative tier of local government where both government officials and elected representatives collaborate to deliver public services within a designated jurisdiction. It plays a vital role in facilitating local governance and development for the residents of the area.

Nawabganj Upazila, located in the Dhaka District, came into existence as part of the historical Bengal region. The upazila is situated on the banks of the Ichhamati River, which runs through its landscape, and is known for its blend of cultural heritage and natural beauty. Nawabganj was established as a thana during the British colonial period. Initially, it functioned as part of a thana (police precinct) under the British Raj. After the independence of Bangladesh, it was upgraded to an Upazila (sub-district) in the 1980s, as part of the government's decentralization efforts to bring governance closer to the people. The area has a long-standing history dating back to the Mughal period, during which it was a key administrative and trading center.

Moreover, the upazila is known for its strong community values, which are reflected in the vibrant social life and festivals celebrated throughout the year. The proximity to Dhaka city also gives Nawabganj strategic importance as a growing hub for peri-urban development, balancing rural life with the influence of nearby urban expansion.

2.2 National and Regional Context

The Dhaka District, unlike some other regions of Bangladesh, has been at the forefront of national development. As the economic and political heart of the country, Dhaka's growth has significantly outpaced most other areas. However, despite its rapid urbanization and infrastructure improvements, development across the district is uneven. The government has implemented several strategies, including national and regional policies, to foster balanced growth across the entire district, not just within the metropolitan area of Dhaka city. Key to the nation's overall economic growth is the integration of peripheral areas like Nawabganj, Keraniganj, and Dohar into the broader development framework. These areas are still relatively rural compared to central Dhaka and require improvements in infrastructure, transportation, and public services to ensure they contribute effectively to the national economy.

Nawabganj Upazila Parishad plays a vital role in upholding governance in the Dhaka District by ensuring that governance is decentralized and accessible to its rural communities. The decentralization of decision-making ensures participation in national-level governance through the local councils, contributing to a more inclusive political process and addressing local concerns. In a district where urban development is rapidly advancing, Nawabganj's role becomes even more critical for maintaining a balance between rural and urban governance. Local government bodies like the Upazila Parishad ensure that public services, such as healthcare, education, infrastructure, and agricultural support, are tailored to the needs of rural populations, aligning national policies with local challenges. This integration of local perspectives into national governance helps bridge the gap between the rapidly urbanizing capital and its surrounding rural areas.

Nawabganj Upazila, despite its proximity to Dhaka, faces accessibility challenges in reaching major divisions and economic hubs. Travel between Nawabganj and Dhaka city, though relatively shorter compared to other regions, can still be time-consuming due to poorly maintained roads and infrastructure gaps. The condition of roads within the upazila, similar to other rural areas, suffers from wear and tear, with potholes and damaged bridges, affecting the smooth flow of traffic.

The road network connecting Nawabganj to Dhaka remains underdeveloped, with frequent maintenance issues, poor conditions of bridges, and a lack of modern transportation facilities. The Zinjira-Keraniganj-Dohar road network, crucial for connecting Nawabganj Upazila to Dhaka, faces significant challenges. Heavy congestion during peak hours often leads to delays, impacting daily commutes and local trade. This limits not only the internal movement of goods and people but also hampers connectivity to other divisions, which are vital for trade in agricultural products and resources. Accessibility to other major divisions, such as Chattogram, Sylhet, Khulna, and Rajshahi, is significantly hindered for Nawabganj Upazila. The absence of direct transport links forces travelers to pass through Dhaka, which adds considerable time to their journeys. For instance, reaching Chattogram can take upwards of 10 hours due to this detour. Limited public transport options and inadequate bridge infrastructure exacerbate the issue, slowing communication and economic.



Figure 2-1: Distance of Nawabganj Upazila from major Divisional Cities.

Historically, this region has been part of an extensive water transport network, which was the primary means of travel and trade for many years. Rivers like the Padma and Buriganga played a key role in connecting Nawabganj with other parts of the country, including Rajshahi and Khulna. However, the gradual decline of water-based transport and the increased reliance on road networks have exposed the infrastructural deficiencies of the region.

Nawabganj Upazila in Dhaka District plays a crucial role in contributing to Bangladesh's economy through its agricultural outputs. The region is notable for unique fruits such as Ashphol, which are significant for both local consumption and national markets. Nawabganj is known for its historical sites and local crafts, contributing to the preservation of Bangladeshi heritage and identity.

2.3 Local Context: Area and Boundary

Covering an area of 247.11 square kilometers, Nawabganj upazila is positioned between 23°34' and 23°45' north latitudes and 90°01' and 90°17' east longitudes (nawabganj.dhaka.gov.bd). There are 14 unions in this upazila. They are: Shikaripara, Sholla, Nayansree, Kailail, Joykirshnapur, Baruakhali, Jantrail, Barrah, Agla, Galimpur, Churain, Bakshanagar, kolakopa, Bandura. Nawabganj Upazila is bounded by Singair Upazila to the north, Dohar Upazila to the south, and Keraniganj, Serajdikhan, and Sreenagar Upazilas to the east and west, respectively. This strategic location contributes to its connectivity and interaction with surrounding regions, influencing both its socio-economic activities and cultural exchanges. The region experiences a tropical monsoon climate, with maximum temperatures reaching up to 33.2°C and minimum temperatures dropping to around 13.6°C. The area receives an average annual rainfall of approximately 2,158 mm.

The upazila is characterized by a low-lying topography with significant water bodies. In Nawabganj Upazila, the Ichamoti River is the longest river, flowing centrally through the region. To the north lies the Kaliganga River, while the Dhaleshwari River flows to the east, and the Padma River is situated to the west. The area surrounding the beel in Nawabganj Upazila is part of the larger Arial Beel system, which serves as a crucial economic resource for many local residents. This wetland supports various livelihoods, particularly through fishing and agriculture, making it an essential component of the local economy. The beel's rich biodiversity contributes to the ecological balance and sustains the livelihoods of communities that depend on its resources for food and income.

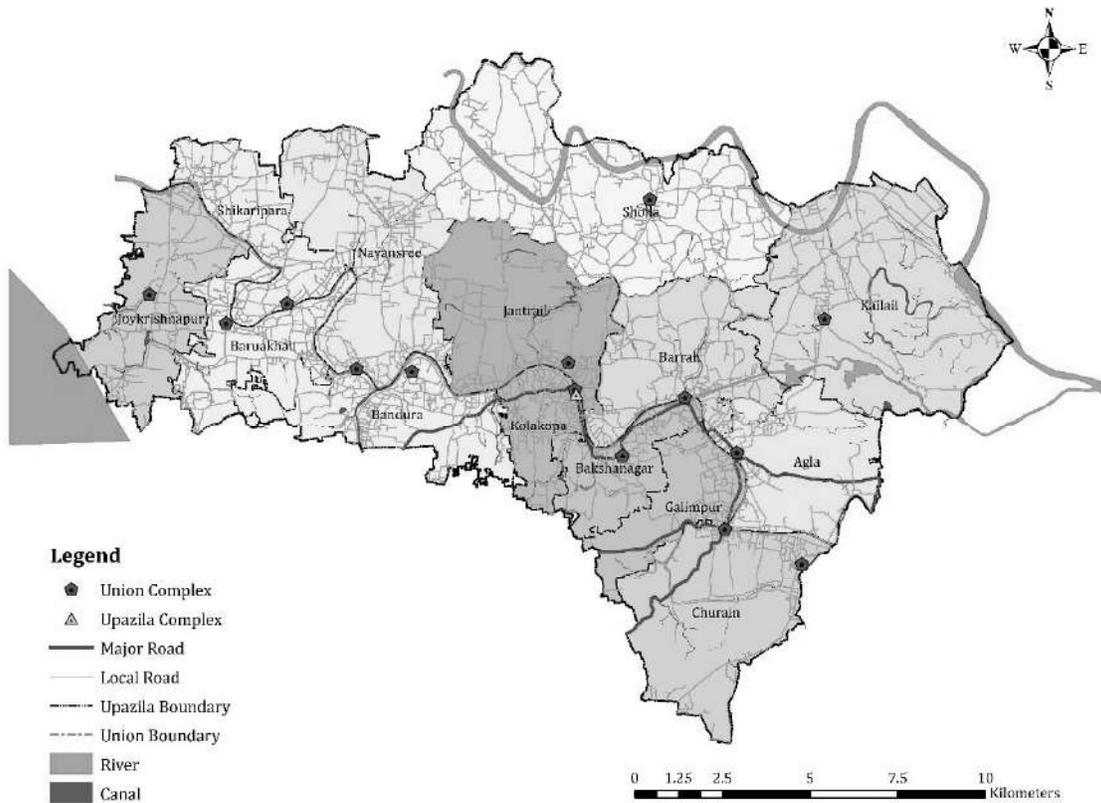


Figure 2-2: Administrative boundary of Nawabganj Upazila

2.4 Existing Institutional Capacity of the Upazila

2.4.1 Legal Mandate

The Upazila has legal mandate to prepare development plan. Section 42(1) of the Upazila Parishad Act 1998 empowers Upazila Parishad to undertake and execute development plans of different terms including Five Year Plan.

During preparation of development plan, the Parishad can consider opinions of the Union Parishad within the upazila, any organization actively engaged in the development of the upazila or any particular person.

The area of planning must be within its jurisdiction and according to the available fund. However, before undertaking any such plan prior approval is needed from the government. The Parishad may take advice from City Corporation, Upazila Parishad, Pourashava Union Parishad or any person during preparation of any such plan.

(2) The plan will consider the following issues:

- a. How the planning project will be funded, who will supervise and implement the project.

- b. Who will execute the plan.
- c. Other necessary issues related to the project.

(3) After preparation of every development plan, the Upazila Parishad after taking opinion of the concerned Parliament Member) will submit one of its copies to the government. It can publish the plan for seeking public opinion and, in cases, consider their opinion for appropriate action.

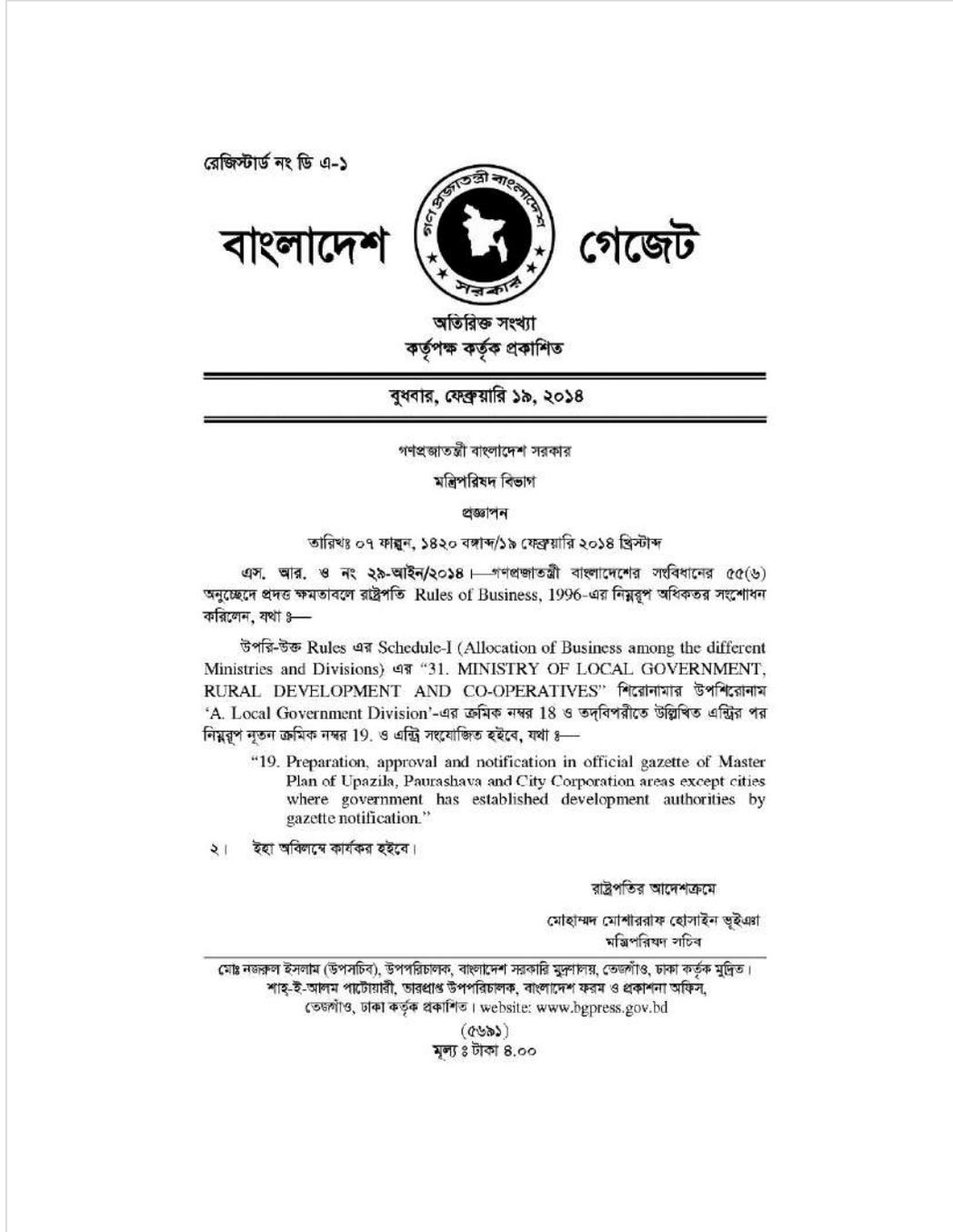


Figure 2-3: Legal Mandate for Upazila Masterplan

2.4.2 Organization Structure and Manpower

The districts were divided into sub-districts to create a mid-level administrative unit called 'upazila'. Bangladesh has 495 upazilas (as of 31 August 2021). The upazilas are the second lowest tiers of the administration in Bangladesh.

Upazilas were formerly known as thanas which literally means police station-controlled area. Despite the meaning, thanas functioned much as an administrative and geographic region, such as today's upazilas. In 1982 thanas were re-termed to as upazilas with provisions for semi-autonomous local governance. This system was reverted to the thana system in 1992. Later, in 1999 geographic regions under administrations of thanas were converted into upazilas again.

Organization Structure

According to the latest version of the Upazila Parishad Act 1998 (Amended in 2009 and 2011) following is the structure of Upazila Parishad.

1. A Chairman
2. Two Vice Chairpersons (One woman)
3. Members(ex-officio)
4. Chairmen of all Union Parishads under the Upazila
5. Mayors of all Pourashavas, if there are any.
6. Three women members
7. Women members of the reserved seats.
8. Official members,
9. Chairman of the Upazila Central Co-operative Association within the Upzila and
10. One nominated member.

The local Parliament member serves as the adviser of the parishad.

Chairman and two Vice Chairpersons, including one female, are directly elected by the local people.

One-third of the total women members from reserved seats of Union Parishad, under an Upazila, are the Upazila Parishad members. The women members of the reserved seats of the Union Parishad elect them. The Upazila Parishad Chairman and Vice-chairpersons will have to resign from their party positions if they hold any. The Vice-Chairpersons will elect a two-member Chairman panel who will serve as the Chairman if the elected Chairman fails to carry out his/her duty for absence, illness or any other reason. Upon suggestion of the Local Government Commission, the government can suspend any Chairmen, Vice-Chairperson and women members temporarily if their work goes against the parishad's interest or seems "unexpected" from administrative point of view.

Standing Committee

Standing committees are formed to perform the activities of the Upazila Parishad smoothly, covering the following themes:

1. Law and order;
2. Health and family planning; 3) Agriculture, fisheries, livestock, irrigation, and environment;
3. Education;

4. Social welfare, women, and child development;
5. Sports, culture, and youth development;
6. Communication and development of infrastructure;
7. Establishment, finance, and accounts; and;
8. Audit and evaluation.

Apart from the above standing committees of the Upazila Parishad can form additional standing committees in accordance with the Upazila Parishad Act. All decisions of the standing committees are to be discussed in the general meeting of the Parishad.

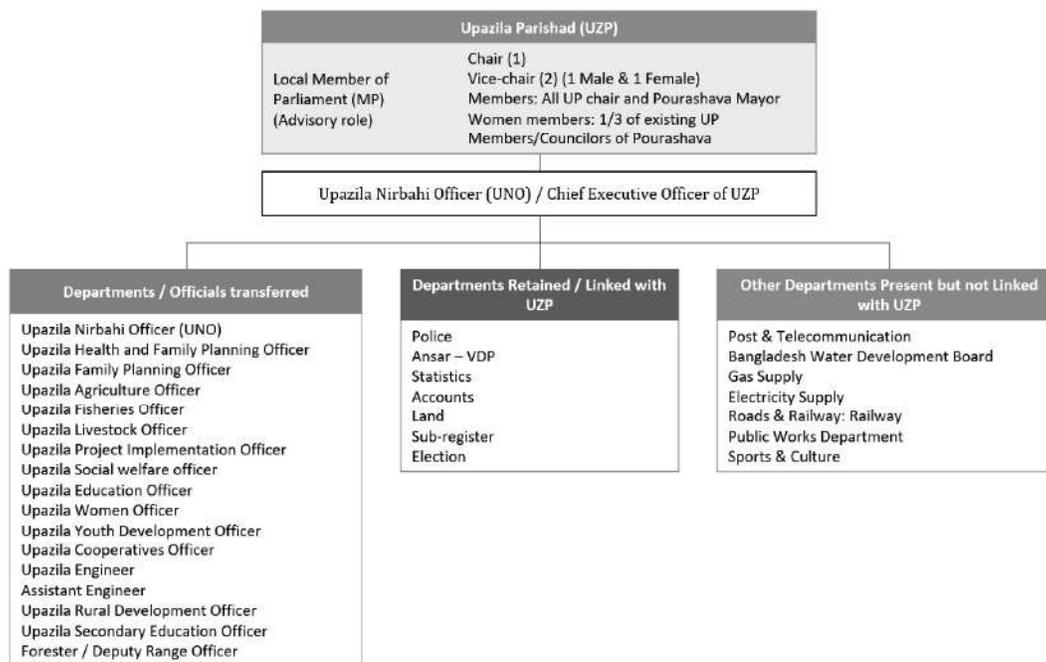


Figure 2-4: Upazila Parishad Organogram

2.4.3 Functions

There are 20 functions for the Upazila Parishad as determined by the Act.

Table 2-1: Functions of Upazila Parishad

Sector	Function
Administration and Finance	<ol style="list-style-type: none"> 1. <u>Preparation of the development plan for 5 years and also for different durations.</u> 2. Coordination and supervision of Officers from NBDs 3. Coordinate, support and monitor Union Parishad development activities, Extend cooperation with other organizations 4. Promotion of e-governance 5. Other tasks directed by the government
Law and Order	<ol style="list-style-type: none"> 6. Discussions with police department and submission of reports on law and order in Upazila 7. Raise awareness and take preventive actions against terrorism, crime, drug abuse

Sector	Function
	8. Coordination of disaster management activities
Infrastructure Development	9. Construction and maintenance of inter-Union roads 10. Implementation of small-scale water resources project
Rural Development	11. Support and coordination of the activities of cooperative societies and NGOs
Agriculture	12. Undertake activities to improve agriculture, livestock, fisheries and forestry
Education	13. (a) Raise awareness of the importance of education (b) Supervision of activities and institutions with a view to improve secondary level education system
Health	14. Provision of public health, nutrition and family planning services
Water Supply and Sanitation	15. Improvement of sanitation and sewerage system, supply of safe drinking water
Culture, Youth and Sports	16. Implement the activities for women, children, social welfare and youth, sports and culture
Social Welfare	17. Creation of self-employment to reduce poverty 18. Raise awareness against offences over woman and child abuse
Environment and Forestry	19. Undertake social forestry programs for environment conservation and improvement
Commerce and Trade	20. Implementation of activities to establish and promote small and cottage industries

Source: Local Government (Upazila) Act 1998.

2.5 Demographic Information

Demographic is crucial for understanding the composition and diversity of a population, helping in areas such as public policy, urban planning, marketing, and social services. By analyzing demographic trends, organizations and governments can make informed decisions regarding resource allocation, infrastructure development, and social programs to meet the needs of different population groups.

2.5.1 Union wise Population Distribution

Sholla Union has the highest total population, with 42,713 people. Galimpur Union has the lowest population, with 14,528 people. Most unions show a higher female population compared to males, with exceptions like Galimpur and Joykrishnapur, where the gender gap is smaller. The gender disparity is particularly noticeable in unions like Nayanshree and Sholla, where females significantly outnumber males.

Table 2-2: Population and Spatial Distribution

Union Name	Population		
	Male	Female	Total
Agla	9042	10143	19185
Bakshangar	10675	12214	22889
Bandura	14337	16662	30999
Barrah	13393	14762	28155
Baruakhali	8338	9972	18310

Churain	11969	13973	25942
Galimpur	6943	7910	14528
Jantrail	11532	13495	25027
Joykrishnapur	8814	10060	18874
Kailail	13420	15438	28858
Kolakopa	11621	12556	24177
Nayanshree	13390	16440	29582
Shikaripara	8658	10316	18974
Sholla	20100	22613	42713

Source: BBS, 2022.

2.5.2 Union wise Population Density

Kolakopa Union has the highest population density, with 3,638 people per square kilometer, making it the most densely populated area. Kailail Union has the lowest population density at 828 people per square kilometer, indicating a more sparsely populated area compared to others. Bakshangar Union and Bandura Union also have high population densities at 2,668 and 2,097 people per square kilometer, respectively, reflecting crowded conditions.

Table 2-3: Population and Density Distribution

Union Name	Total	Density (Sq. Km)
Agla	19185	1285
Bakshangar	22889	2668
Bandura	30999	2097
Barrah	28155	1644
Baruakhali	18310	1522
Churain	25942	1222
Galimpur	14528	1578
Jantrail	25027	1285
Joykrishnapur	18874	1161
Kailail	28858	828
Kolakopa	24177	3638
Nayanshree	29582	1332
Shikaripara	18974	1673
Sholla	42713	1111

Source: BBS, 2022.

2.5.3 Literacy

According to BBS 2022, literary rate (15+ yrs.) of Nawabganj Upazila is 75.75%. From the data, it has been found that literacy rate among the male population is more than that of the female population. The literacy rate (15+ yrs) by sex is shown below.

Table 2-4: Literacy Rate by Sex, 1991-2022

Sex	1991	2001	2011	2022
Both Sex	34.5	54.4	57.8	79.27
Male	38.5	56.4	57.7	80.65
Female	30.6	52.6	57.9	78.09

Source: BBS, 2011 and 2022

Table 2-5: Literacy rate and Spatial Distribution

Union Name	Literacy		
	Male	Female	Total
Agla	76.54	75.35	75.88
Bakshangar	78.91	76.39	77.56
Bandura	80.86	78.84	79.75
Barrah	82.09	78.5	80.08
Baruakhali	75.83	74.11	74.86
Churain	79.4	77.69	78.44
Galimpur	83.94	81.82	82.78
Jantrail	74.38	71.25	72.63
Joykrishnapur	70.78	69.41	70.03
Kailail	72	69.88	70.81
Kolakopa	85.45	82.87	84.09
Nayanshree	77.29	75.59	76.32
Shikaripara	71.09	70.75	70.9
Sholla	72.5	68.2	70.16

Source: BBS, 2022

2.5.4 Poverty

According to the 2016 poverty mapping data for Bangladesh, Nawabganj Upazila exhibited a notably low poverty rate. The Headcount Ratio (HCR) at the upper poverty line was estimated at 0.7%, with a standard error of 0.2%. This metric represents the percentage of the population living below the upper poverty line, which is a threshold set higher than the extreme poverty line to encompass a broader range of economic deprivation. In contrast, the district-level HCR upper limit was reported at 10%. Nawabganj stands out as having a significantly lower poverty rate compared to the district average. This suggests that the upazila has relatively better economic conditions and a smaller proportion of its population living in poverty.

2.5.5 Migration

Almost all Upazila level towns in Bangladesh have rural based urban settings. Absence of enough economic activities in these towns fails to create enough employment for the poor job seekers. As a result, rural people looking for jobs mostly migrate to bigger cities. Migration is mostly caused by poverty and unemployment. Migration information is not available in population census by BBS. It only considers the natural growth rate. But actual population projection requires both natural growth rate and migration rate. For this unavailability of migration rate, population projection also became very difficult. Basically, the women are engaged in 'domestic house workers' as a livelihood means and commute to bigger cities. Ultimately, migration occurs.

Most youth nurture to go abroad to earn better. The family remaining in the native land receives remittance from their kith and kin earning abroad. This lifestyle has become a livelihood pattern for many families in Nawabganj Upazila. People in Nawabganj Upazila generally travel to European countries to get engaged in low paid jobs.

2.6 Economy

Nawabganj Upazila is primarily an agriculture-based economy. Farming, fishery, and livestock play a vital role in the economy and livelihoods of communities. With a population of over 348786, Nawabganj Upazila is a bustling hub of economic activity, with agriculture, fishery, and

livestock being major contributors. The fertile land and water resources of the Upazila have long been plying important role for agricultural prosperity., Crops such as, paddy, wheat, jute, vegetables, and fruits are abundantly grown here. The region is also well-known for its fisheries industry, which is mainly focused on freshwater fish. Additionally, livestock farming is a crucial component of the local economy, with dairy and poultry farming being the main types of livestock reared in the area.

2.6.1 Agriculture/Farming

Nawabganj Upazila falls in agro-ecological zone 8 of Bangladesh, which is in the Young Brahmaputra and Jamuna Floodplain. The Young Brahmaputra and Jamuna floodplain is a region located in the northern part of Bangladesh and India. It is formed by the deposition of sediments carried by the Brahmaputra and Jamuna rivers, which flow through the region of active Brahmaputra-Jamuna Floodplain (3,190 sq km). This region comprises the belt of unstable alluvial land along the Brahmaputra-Jamuna rivers where land is constantly being formed and eroded by shifting river channels. The floodplain soil in this region is mainly composed of alluvial deposits of sand, silt, and clay. These soils are typically fertile and well-drained, making them suitable for agriculture. However, the high levels of flooding in the region can cause erosion and nutrient loss, which can negatively impact soil fertility and crop productivity.

The majority of the population in Nawabganj Upazila relies on agriculture as their primary source of income, which is primarily focused on the production of rice, jute, vegetables, and fruits. Rice is the most important crop, and it is cultivated on a large scale in this area. Of the total upazila land area the cultivated land is around 17827 hectares. Farmers in Nawabganj Upazila use traditional farming techniques, and there is a growing trend towards the use of modern farming practices such as high-yielding varieties of crops, irrigation facilities, and improved farming equipment.

Table 2-6: Agricultural situation

Agricultural Situation	Metric Ton
Total food crop production	49580
Yearly demand of food	48180
Food waste, livestock feed	0
Food surplus	1400

Source: Nawabganj Agriculture Office, 2023

Paddy, jute, potato, mug, lentil, khesari, chili, mustard, coriander seed, groundnut, betel leaf, sugarcane, watermelon, vegetables are other major agricultural products in Nawabganj. There are also various types of seasonal fruits produced like mango, jackfruit, banana, papaya, guava, plum, lemon, coconut, betel nut, palm, wood nut, and kaiju nut.

Table 2-7: Agricultural Information

.	Demographic Description (Population Census 2011)	
1	Total population	316425
2	Population density Person/ Sq. Km	1293
3	Number of Villages	329
4	Number of Unions	14
5	Number of Pourashava	-
6	Number of Agriculture Block	42
7	Land Under Irrigation (Hectares)	12000
Serial No	Area Description	Area (Hector/Number)
1	Forest Land	425
2	River and Waterbodies	1062
3	Orchard	288
4	Cultivated Land	17511
5	Urban Area/dwelling/street	4679
6	Permanent Settlement	516
Serial No	Use of Cultivable Land	
1	Single-crop Land	6993
2	Double-crop Land	8628
3	Triple-crop Land	2181
4	Land with more than three Crop	25
5	Total Cropped Area	30892
6	Net Cropped Area	17827
7	Crop Intensity (%)	174.385
8	Land use density (%)	100.24%
9	Temporary Fallow	245
10	Kharif Season 1	9000
11	Kharif Season 2	6500
12	Rabi Season	17784
Serial No	Farming Family	60340
1	Landless	6634
2	Remote	12012
3	Small	6014
4	Medium	750
5	Large	102
6	Total Farming Families	25512
Serial No	Institution Related to Agricultural Development	
1	Number of Banks	31
2	Number of Poultry Farms	135
Serial No	Number of Nursery	
1	Government	01
2	Private	12
3	Number of seed dealers	05
4	Number of fertilizer dealers	14
5	Union-level fertilizer seller	64

6	Pesticide seller	77
Serial No	Food Situation (Metric Tons)	
1	Food Demand	48180
2	Food Production (Cereal)	49580
3	Surplus	+1400
4	Net	0

Source: Nawabganj Agriculture Office, 2023

2.6.2 Fishery

Inland water fisheries of Bangladesh are divided into two types. One is Inland open-water fishery (river & estuary, Sundarban, Beel, Kaptai Lake, flood land), and the other is Inland closed-water fishery (pond & ditch, Baor, shrimp (freshwater shrimp) & fish farm).

In the rainy season, large number of young and old including women in rural areas catch fish in the floodplain, public canal, river etc. In addition, pond and ditches are also used for closed water fishery. Freshwater fish is an important source of animal protein accounting for around 60% of the total animal protein intake (Rifat et al., 2023). Moreover, freshwater fish, both caught in public water and cultured, is also an important source of cash income.

Table 2-8: Inland fish available in Nawabganj Upazila

Local Name	English name	Local Name	English name
Bhetki/Koral	Barramundi/Seabass	Koi	Climbing Perch
Tengra	Striped dwarf catfish	Illish	Hilsha
Rui	Indian major carp	Taki	Spotted snakehead
Catla	Catla	Cheng	Asiatic snakehead
Mrigal	Mrigal	Aor	Long-whiskered catfish
Bele	Tank Goby	Shol	Banded snakehead
Magur	Air breathing Ctfish	Foli	Grey featherback
Rup Chanda	Chinese pomfret	Mola	Indian carplet
Bata	Bata labeo	Dhela	Cotio
Kachki	Ganga river sprat	Kalibaus	Black rohu
Potka	Gangaetic puffer fish	Pangus	River pungus

Source: Nawabganj Fisheries Office, 2023

This set of data, in table presents key figures related to aquatic resources and fish production. The information includes the number of ponds (1824), presence of non-government seed production farms (5), existence of a fish sanctuary (1), annual fish demand (4887), and annual fish production (3817). These statistics signify a substantial reliance on ponds and non-government seed production for fish cultivation. The single fish sanctuary contributes to conservation efforts. Notably, there is a shortfall in meeting the annual fish demand, indicating potential opportunities for enhancing fish production to meet local needs.

Table 2-9 Fishery scenario

No of Pond	1824
Non-Govt. Seed Production Farm	5
Fish Sanctuary	1
Annual Fish Demand	4887
Annual Fish Production	3817

Source: Nawabganj Fisheries Office, 2023

In Nawabganj Upazila, prawn, shrimp, and crab are also produced. Prawn is known as Golda chingri, Chatka chingri and Gura chingri by their different sizes. Shrimps are different types mostly known as Bagda chingri, Chaka chingri, Chapra chingri, Horina chingri, Chali chingri. Crabs are locally named Shela kakra, Zaji kakra, Sataru kakra, and Sagor kakra.

2.6.3 Livestock and Poultry

The livestock and poultry subsector of agriculture has proven to be a promising and dynamic sector with enormous poverty-reduction potential. It is a highly viable sector for creating jobs and income for landless, unemployed youth, and destitute women. The following table presents the inventory of total livestock of Nawabganj Upazila according to the Nawabganj Upazila at a glance.

Table 2-10: Overall Scenario of Livestock Department of Nawabganj Upazila

Department of livestock and veterinary hospital	1
Artificial reproduction center	1

Source: Upazila Livestock Office, 2023

Table 2-11: Statistical data of livestock and poultry

Name	Number
Cow	57852
Goat	10485
Ship	1286
Hen	56527
Duck	35225
Turkey	715
Pigeon	33222
Buffalo	37
Quail	1252

Source: Upazila Livestock Office, 2023

Table 2-12: Statistical data on farm

Type of farm	Number of livestock
Cow	10256
Goat	1875
Ship	257
Poultry/Layer	533
Pigeon	664
Duck	29
Buffalo	3
Turkey	15

Source: Upazila Livestock Office, 2023

Climatic and topographic conditions, especially the high temperature and high humidity and frequent flooding, are not suitable for domestic animals. Pasture lands are not abundantly available for raising cattle and goat. Recently water shortage and development of agricultural machinery have caused unfavorable conditions to water buffalos. Due to the low feed efficiency, it has been difficult to enhance livestock farming in Bangladesh under the low food self-sufficiency. For these reasons, livestock farming has not been a priority sector in the past.

However, it is necessary to develop livestock in the future as an important income source of farmers. Livestock is a demand-driven product. As the national economy develops, consumption of livestock will increase.

2.7 Historical Background of the Upazila

2.7.1 History of the Upazila

As already stated during the Nawab period, the Nawabs and their subordinates and soldiers used to travel to Dhaka by boat from Murshidabad through the Ichamati river in Nawabganj. They used to pitch their tents and rest in this area along the banks of the Ichamati. Nawab staff at one stage decided to live in the area to collect rent. This led to growth of population and gradually a ganj or marketplace developed with the growth of human settlement. During Nababi reign the place was named as Nababganj. Nawab Alivardi Khan admired his journey from Murshidabad to Dhaka through Nawabganj's Ichamati river. Emperor Sher Shah Suri extended Grand Trunk Road from Sonargaon to Nawabganj's Kolakopa region connecting Jessore. During that time, postal service was introduced, where horse was used as the carrier. The-then Kolakopa-Bandura was focal point of trade and business for around 200 years. The house engaged with oil business was locally known as Teli Bari, and betel-leaf business known as Painna Bari. The legend Hazrat Shah Sufi Qari Muhammad Ismail (R.A.H.) was born in Sonahazra, Nawabganj who initiated present Jail dress up following Islamic tradition with Tupi (cap), full pant. Previously, British style was followed with half-pant culture.

2.7.2 Arrival of Christian community

The arrival of Christian community started during the arrival of Vasco da Gama in the Indian sub-continent by preaching of chris Christian sermons of the-then Portuguese Kings. It is assumed that during the year 1576 to 1676, the Christian community developed in Nawabganj Upazila with the help of missionaries. The famous Hasnabad church (Holy Rosary Church), locality known as 'Pobitro Rani Jopmala Girza' was established in 1777 and the Christian community extended towards present Hasnabad, Golla,Tuital, Bakhshanagar having the focal towards Hasnabad. Portuguese traders, subordinate Portuguese officers of the Mughal empire and their marriage to local women, many local people converted to Christianity that helped to build Indo-Portuguese culture and the evolution of Christian community.

2.7.3 Anti-British Movement

Nawabganj region played a crucial role in anti-British movement started from 1905. Nawabganj took part in that movement by boycotting foreign clothing and encouraging indigenous products. Notable persons from Nawabganj were Hasmot Ali Chowdhury of Galimpur, Rajendro Chondro Ray and Pitthinaddar Digindro Shingho of Govindopur. Bengal participation was restricted in 1911. The Khilafat movement was established in 1920 and also took part in anti-British movement. The women's organization from Nawabganj also took part in the movement. Komolarani of Kashimpur gave her life (beaten to death) as she was accused of hosting flag of independence in gate of the-then Nawabganj thana. Mahatma Gandhi came to Nawabganj through Komola Launch and landed at Moinot Ghat in the year June 1925. He gave a speech in Kolakopa village of Radhanath Saha addressing woman community. He was given a welcome letter and a bouquet costing the-then six thousand five hundred ten taka and six ana/pence. Netaji Subhas

Chandra Bose also came to Nawabganj on March 1929 to encourage the youths of Govindapur and Nawabganj.

2.7.4 Liberation war

In the Great War of Liberation, the freedom-mad people of Nawabganj have an immortal success story. On April 1, 1971, the flag of Bangladesh was hoisted on the grounds of Nawabganj Pilot High School under the leadership of the then member of the People's Council, Abu Mohammad Subid Ali Tipu. At that time, the-then liberation war commander Badiuzzaman Badi, Shaikat Hossain Angur, Baten Mia, Mumtaz Uddin Ahmed, and many other freedom fighters were present. The name 'Azizur Razman Faku' comes first while describing in the history of Nawabganj's liberation war. In 1971, the biggest and most talked about liberation war was occurred in Agla, Galimpur, Churain. On September 23, 1971, at around 4.00 p.m., a large number of Pak Army arrived at Galimpur on the way to Nawabganj from Dhaka on the river route (Ichamati) with a launch named ML Pointer. They were ambushed by Mukti Bahini and after three days of fighting, all the 45 Pak soldiers in the launch were killed. The group leader of Pak Army Captain Zafar Ullah Khan was killed in that battle. In November 1971, the camp of Nawabganj Pilot School was attacked by Pak Army. After Tarabi prayers in the month of fasting, the freedom fighters attacked from three sides and destroyed the camp and killed 17/18 Pak soldiers. The survivors were taken from Dhaka by the Pak Army.

2.8 Language, Culture and Places of Interest

Nawabganj Upazila has an ancient township. The language here is fluent and clean Bengali. Asamiya effect is observed in some words. Persian language is still used in ancient Muslim zamindar families here. Nawabganj is the birthplace of the famous "The Lion Circus of Bangladesh". The victory of Nawabganj in the cultural arena is remarkable. Kabigan, Bichargan, Zarigan, Yatra (Jatrapala), Sarigan, Snake-charmer performances, Boat race, Bull race, Natak (drama) entertain people throughout the year. Nawabganj is a traditional upazila near Dhaka. Muslims, Hindus, Christians have been living in brotherhood here for ages. Here the ancient religious institutions of different religions bear witness to it. Vanga Masjid at New Bandura, Ancient church founded in 1776 at Hasnabad village, Khelaram Datar's house at Kalakopa village, ancient mosque of Nawabi age at Kashimpur, Shiv Mandir/Math at Jantrail Union. Moreover, the birthplace of Mahakobi (The Great Poet) Kaikobad is in the Agla Union of this upazila.

In antiquity, Nawabganj likely occupied a strategic position within the Indian subcontinent, potentially witnessing the ebb and flow of various local empires and dynasties. During the medieval era, the region might have been part of the influential Sultanate of Bengal, contributing to trade and administrative networks that crisscrossed the subcontinent. With the advent of the Mughal Empire, Nawabganj could have continued to thrive as an economic and administrative center, potentially seeing the construction of architectural marvels that characterized Mughal urban planning. The notable site seeing spots attracting tourists are Afaz Uddin Shah Majar, Braja Niketan, Khelaram Datar Kotha, Vanga Masjid, Hasnabad church and many more.

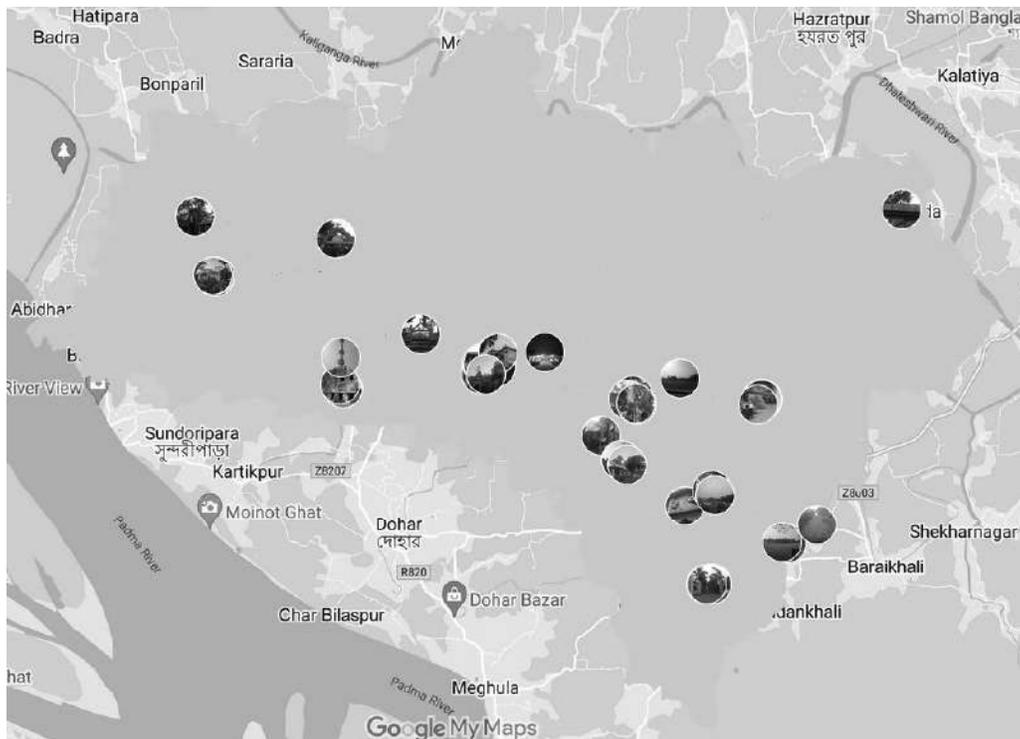


Figure 2-5: Notable Tourist Sites in Nawabganj Upazila



Figure 2-6: Heritage site inventory interview with Director, 17 Ansar Batallion, Kalakopa

2.8.1 Sports and Recreation

Nawabganj upazila has a glorious past in sports. East Bengal and Mohon Bagan teams used to come from Kolkata to play football at the field of Yunus Sareng in Komarganj. The playground of Nawabganj Pilot High School is located in the center of the upazila. Every year, Deputy Commissioner Gold Cup football competition, Deputy Commissioner Gold Cup cricket competition and various school sports games are arranged here. Kabigan-Bichargan still keeps the village people of this area entertained throughout the winter. Kalakopa, Bandura, Chandrakhola, Dighirpar, Bhanga Vita boats attract crowds during monsoons. Various fairs are held in Battala, Hattala, temple premises of the area. Kalakopa Harihar Ghosh fair, Galimpur fair, Gobindpur fair, Dohar-Nawabganj college ground fairs still keep the environment vibrant.

2.8.2 Famous Personalities

Nawabganj's famous personalities include the great poet Kaykobad, Shah Qari Mohammad Ismail, Sufi Pir Afaz Uddin Shah, local folk singer Abdur Rahman Boyati, Unique group's Chairman Md. Noor Ali, Jamuna group's Chairman Nurul Islam Babul and many more.

CHAPTER THREE: Physical Survey: Approach and Methodology for GIS Database Preparation

3.1 Introduction

Chapter 03 of the Survey Report provides details of the various survey methodologies used to conduct physical surveys of the Nawabganj Upazila Master Plan area. Preparation of comprehensive GIS data includes three major activities including conducting topographic survey, physical features and landuse survey of the project area. This chapter also covers the updating process of the digital mouza database and the construction of BM Pillars in the upazila.

3.2 Approach and Methodology of Updating the UDD Database

Data collection is a crucial step in the preparation of a Master Plan. It helps in making informed decisions and shaping the plan's strategies. A comprehensive approach to data collection involves defining the goals and objectives of the master plan and identifying the aspects of the community or region that the plan will address. Usually, data collection is expensive, time consuming and not always straightforward, so special care is needed in the planning, design and conduct of surveys. High quality with accuracy and relevant data are essential for analysis and serve to support policy formulation and decision-making.

Urban Development Directorate (UDD) initiated the preparation of the Upazila Development Plan in 2011. They prepared the plan for 16 Upazilas under two projects from 2011 to 2015, and Nawabganj Upazila was one of them. Before starting the data collection efforts, it was important to review the existing GIS database of UDD. This helped in understanding the context and identifying any data gaps that needed to be filled. All the GIS databases, including mouzas, were collected from the PCO of UTMIDP, LGED.

Ortho-rectified satellite images were utilized to update survey activities. Both drone-based and the latest archive satellite image-based survey methods were used to update the GIS database for the entire Upazila. Drones captured high-resolution imagery for detailed mapping, which is crucial for the plan preparation process and was used in the selected built-up areas of the Upazila.

Before deploying the full survey team, a preliminary survey team led by the Senior Consultant (Survey) conducted a thorough reconnaissance of the project site. During the field investigation, they visited some key areas of the upazila, interacted with local residents through discussions, and familiarized themselves with the local conditions. The team also met with officials from the Upazila Parishad, Union Parishad, and UNO of the Upazila to secure their cooperation and support for the survey activities. Once a separate Project Office with accommodations for the survey personnel was established at the upazila level, the full survey teams were deployed.

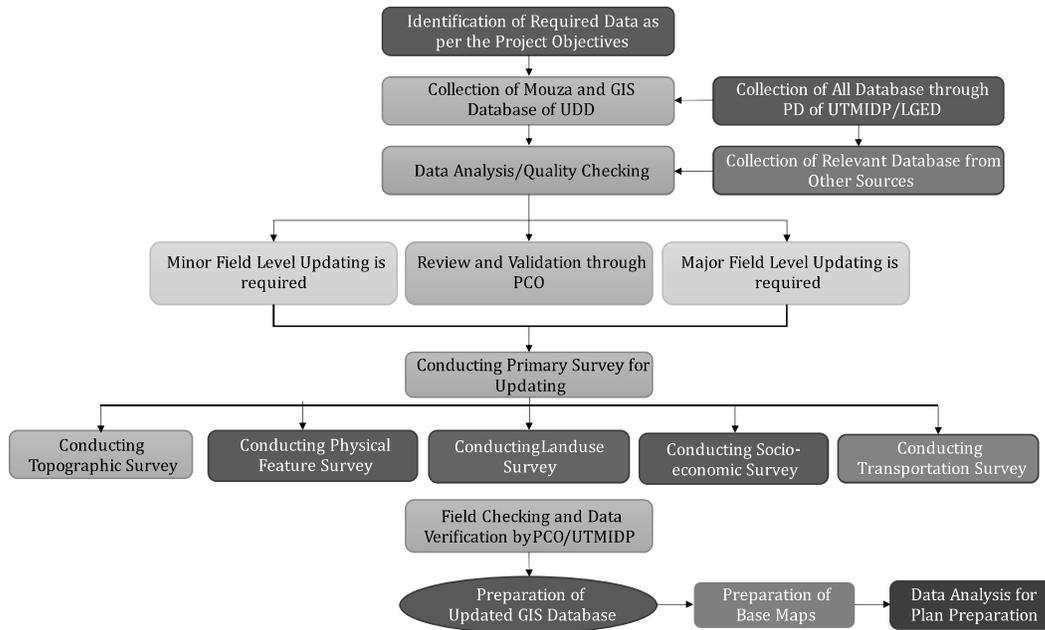


Figure 3-1: Flow Diagram of Updating GIS Database and Map Layout Preparation using RS/BS Mouza Map

3.3 Preparation of Updated Digital Mouza Database

As mentioned earlier, all scanned, digitized and geo referenced mouza maps prepared by UDD, were collected from the PCO of UTMIDP, LGED. Nawabganj Upazila is comprised of 238 RS Mouza Maps. The consultant identified many errors including geo referencing in the mouza maps, which were then corrected by the consultants. After collecting the maps, the consultants made updates to rectify the mouza database.

3.3.1 Mouza Map Verification/Edit Plot Checking of the Digitized Mouza Maps

In total two different methods have been applied to check accuracy collected digitized mouza maps including i) light table checking and ii) on-screen checking. The digitized mouza maps were checked and verified by superimposing on the original mouza maps using the light table (**Figure-3-2**). During the process of mouza maps, a thorough checking was carried out in consultation with the PCO, UTMIDP, and GIS experts of the consulting teams. This involves an edit plot check, which helps to identify and solve any possible errors such as missing arcs, dislocated arcs, wrong or missing polygon labels, tic location and ID, etc. Besides, spelling mistakes, improper spacing, uniformity and accuracy of data entry, blank fields, missing annotations, etc. issues have checked (**Figure-3-3**) during the in this checking process. Once all the errors are resolved, the updated digitized mouza maps were prepared.

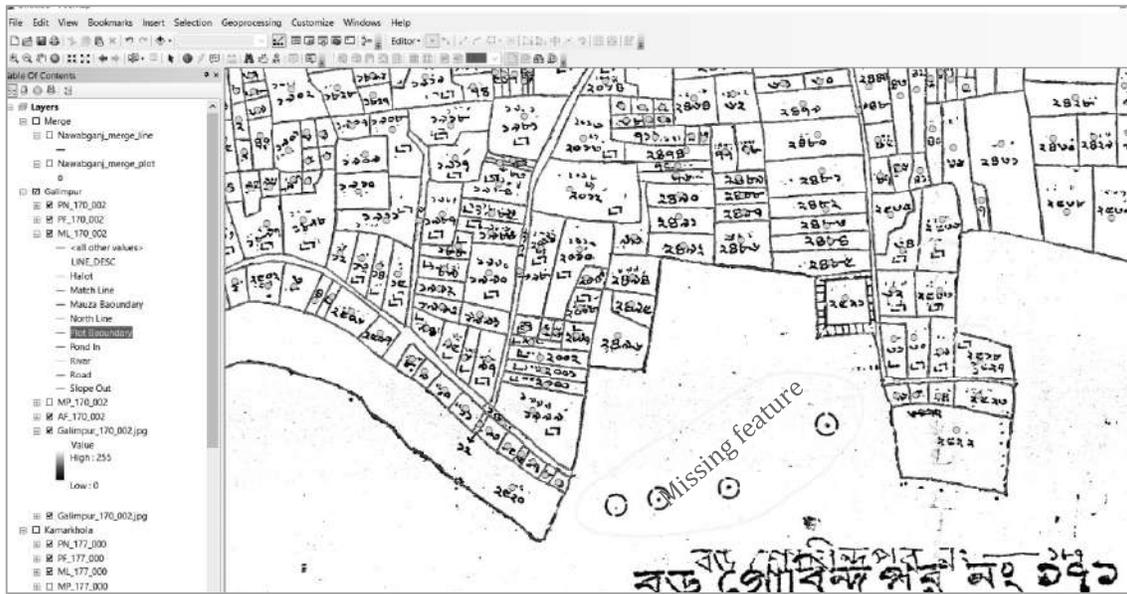


Figure 3-2: Sample of error checking on light table

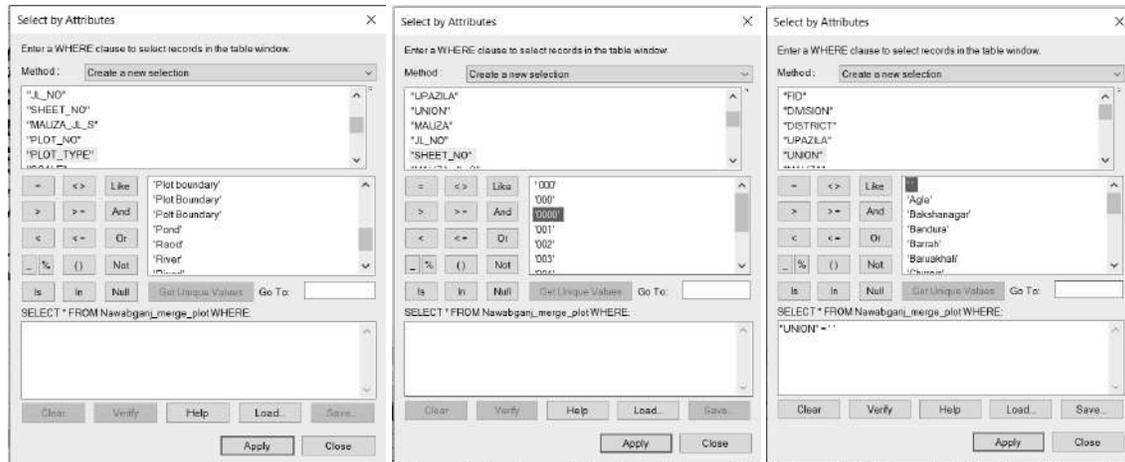


Figure 3-3: On screen error checking sample

3.3.2 Correction of the Digitized Mouza Maps

Once the edit plot checking was completed, necessary corrections were made based on the comments provided by PCO. The Mouza maps/sheets were then printed out again and checked thoroughly to ensure that all the corrections have been made as required. After the finalization of the digitization process of mouza maps, both soft and hard copies of all the data (in ArcGIS compatible form) have been submitted to the PCO/UTMIDP.

3.3.3 Preparation of Geo Database

Three file geodatabases have been created using BUTM projection criteria. File geodatabase is preferred due to its portability and its ability to contain up to 01 (one) TB of data. Scanned images have been processed in three stages, with different geodatabases created for each stage. To

ensure uniqueness of the geodatabases, a GIS Database Specification (Annex-1) has been prepared with input from experts during several meetings with PCO.

As per the Terms of Reference (ToR), it has been specified that the projection system of all databases will be in BUTM2010. The BUTM projection system is defined during the creation of the geodatabase, and while importing these rectified maps, the projection is automatically defined. The advantage of using a geodatabase is that feature classes can be exported to the widely used Shapefile format. As a requirement of the ToR, the mouza maps are submitted in the prescribed scale, sheet-by-sheet, so that they can be checked and verified by superimposing them on the original mouza maps using a light table after completing all the above-stated processes.

3.3.4 Converting Digitized Maps to Geo Database Format

Polygon, line, point, and annotation features from digitized mouza sheets are stored in geodatabase (ArcGIS) format. These features are used to create a polygon database of mouza maps in ArcGIS.

3.3.5 Projection System

A projection system is a mathematical method used to represent the Earth's three-dimensional surface on a two-dimensional map. Projection systems are essential for accurately representing the Earth's curved surface on flat maps. It has been mentioned earlier that the projection system of all databases will be in BUTM2010 as per the Terms of Reference (ToR).

All maps are projected to the BUTM2010 projection system with the following parameters:

Projection: Transverse Mercator

False Easting: 500000.0

False Northing: 0.0

Central Meridian: 90.0

Scale Factor: 0.9996

Latitude of Origin: 0.0

Linear Unit: Meter (1.0)

3.3.6 Geo-referencing of Mouza Map

For geo-referencing of mouza maps, ortho-rectified latest satellite images of the project area have been used as a control layer. This satellite image version contains a rich source of real-world coordinates/GCPs since it is created from the raw images by applying two processes sequentially: aerial triangulation and ortho-rectification. The resultant ortho-rectified image is a planimetrically correct image. It has a constant scale wherein features are represented in their 'true' positions. This allows for accurately measuring distances, angles, and areas.

The aerial Triangulation process establishes precise and accurate relationships between image coordinate systems and a defined coordinate system (datum and projection) to accurately orient the image so that vector mapping is done by digital photogrammetry. The required number of GCP of sub-centimeter accuracy is acquired and used in the aerial triangulation process using the

DGPS method. Match-AT module of the INPHO photogrammetry suite is used in performing aerial triangulation.

3.3.7 Joining of Mouza Maps and Demarcation of the Study Area/Master Plan Area

The process of joining Mouza maps and demarcating the project area/boundary have been carried out through the use of GIS platform. To create a composite Mouza map, the digitized and projected Mouza sheets were appended. Once all the Mouza maps of the study area are geo-referenced, the Master Plan area is demarcated by the consultants of the project. All kind of survey works and study under the project have been conducted using this boundary.

3.3.8 Preparation of Layout of Project Area Map

The final map with standard layout (mosaic mouza of the project area) have been prepared with consultation by a team comprised of a GIS expert, a senior urban planner of a consulting firm, and PCO using ArcGIS. All the features of Mouza maps, including plot number, sheet, Mouza, and project boundary etc., have been identified and shown in the project area maps in a separate layer. This map layout has been submitted to the project director in both hard copy and soft copy formats.

A standard plan map layout, scale, legend, paper size, grid, and other relevant issues have been developed with consultation by a team comprised of a GIS expert, a senior urban planner of the consulting firm, and PCO of UTMIDP for the preparation of the map layout

3.4 Establishment of BM Pillars and GCP

14 BM Pillars were constructed under the UDD Project. Most of the existing BMs were found in bad condition through the field investigation by the consultant and 01 was found missing. Considering the importance and need of the project, all new Bench Mark (BM) pillars have been constructed within the project area. The location of each BM has been finalized in consultation with the Client and Upazila Parishad. In addition to BM pillars, necessary number of Ground Control Points (GCP) have also been established in order to support drone survey and topographic survey using Total Station.

3.4.1 Establishment of Ground Control Point (GCP)

Unlike traditional geo-rectification techniques, GCPs in digital photogrammetric have three coordinates: X, Y, and Z. These GCPs have also been used here for geo-referencing each of the images and to establish the relationship between the images. This relationship is established using the bundle block adjustment approach.

To conduct GPS and Total Station Survey, establishment of adequate and uniformly distributed Ground Control Points is very crucial. Since all the subsequent survey operations are dependent on and related to the Ground Control Point, any error simply multiplies and compounds to a huge total deviation. As such accuracy of Ground Control Point coordinate values both along horizontal and vertical axes is of utmost importance. Establishment of GCPs comprises the following (**Figure 3-4**) item of works:



Figure 3-4: Methodology of GCP Establishment

Ground Control Points (GCP) have been selected by photo identification of existing ground features. Considerable number of GCP is selected as required for the whole study area. Value of all GCPs is collected by conducting field survey using RTK GPS method. After surveying all GCPs coordinates post processing is done as a whole. Consultant estimated the distribution and quantity of GCPs based on area size and shape of the project area is collected for the purpose of aerial triangulation of the drone images. Both horizontal and vertical accuracy tolerance of the GCP within 10cm range.

Establishing adequate and uniformly distributed Ground Control Points is crucial for GPS and Total Station Surveys. Since all subsequent survey operations depend on and relate to the Ground Control Point, any error simply multiplies and compounds to a huge total deviation. As such, the accuracy of Ground Control Point coordinate values along horizontal and vertical axes is paramount which has been ensured under this project.

Table 3-1: Location of GCPs in Nawabganj Upazila

Name	X	Y	Name	X	Y
GCP 1	90° 2'25.92"E	23°40'44.73"N	GCP 17	90°10'24.02"E	23°38'22.68"N
GCP 2	90° 3'51.43"E	23°42'29.22"N	GCP 18	90°11'15.80"E	23°39'28.29"N
GCP 3	90° 4'41.53"E	23°41'10.43"N	GCP 19	90°11'48.22"E	23°40'6.47"N
GCP 4	90° 4'8.95"E	23°40'54.35"N	GCP 20	90°11'26.96"E	23°38'44.21"N
GCP 5	90° 5'22.84"E	23°40'47.65"N	GCP 21	90°12'22.73"E	23°37'58.95"N
GCP 6	90° 6'8.70"E	23°41'22.07"N	GCP 22	90°12'44.85"E	23°39'0.66"N
GCP 7	90° 6'44.50"E	23°42'5.73"N	GCP 23	90°11'44.80"E	23°37'26.68"N
GCP 8	90° 7'16.29"E	23°41'34.33"N	GCP 24	90°13'24.46"E	23°37'21.09"N
GCP 9	90° 6'41.65"E	23°40'4.87"N	GCP 25	90°13'28.65"E	23°36'40.15"N
GCP 10	90° 5'54.06"E	23°39'30.50"N	GCP 26	90° 8'25.70"E	23°42'11.79"N
GCP 11	90° 6'45.83"E	23°39'27.07"N	GCP 27	90° 9'59.29"E	23°41'59.65"N
GCP 12	90° 7'45.42"E	23°39'11.73"N	GCP 28	90°11'9.27"E	23°42'34.30"N
GCP 13	90° 8'27.47"E	23°39'44.56"N	GCP 29	90° 9'55.92"E	23°41'13.31"N
GCP 14	90° 8'47.39"E	23°39'26.66"N	GCP 30	90°10'31.92"E	23°40'33.17"N
GCP 15	90° 9'23.75"E	23°39'4.89"N	GCP 31	90°13'7.71"E	23°42'2.08"N
GCP 16	90°10'7.40"E	23°39'30.96"N	GCP 32	90°14'1.86"E	23°40'46.28"N

3.4.2 Collection and Identification of Reference BM

Coordinates of reference control points, which are within or near the project area have been collected from Survey of Bangladesh. The selection of existing reference BM inside or around the project area is essential for establishing a new GCP network for the project area. As per ToR, the consultant has identified the existing BMs of SoB as reference BM. Reference BM provides geo-

reference (x, y) and elevation (z) with respect to a datum, i.e., the coordinates of the GCPs. Horizontal coordinates (x, y) of control points are established, connecting at least two (2) national reference BMs. Accuracy tolerance is maintained at a maximum of 5cm in both planimetry and height. For establishing new GCP coordinates, the available SoB BMs in and around the project area are collected from the Survey of Bangladesh (SoB).

Coordinates and the Elevation of Reference Benchmarks were collected from the Survey of Bangladesh. The location of Reference BMs, which are close to the project area, is shown below.

The list of control points along with type has been provided in Table 3-2 below:

Table 3-2: Reference Control Points

SL	ID No.	Serial No.	Height above MSL (m)	DATUM	Location & Description		
					Easting	Northing	Description
1	SOB BM-3344A	470 of 834	6.363	WGS84/UTM ZONE 46N	201781.517	2621060.113	The pillar is situated at south-west corner of Kumar Barilla Govt. Primary School's compound and East side of brick soling road. Vill: Kumar Barilla, Upazila: Nababganj, District: Dhaka.



Figure 3-5: Photograph of SoB Control Point at Nawabganj Upazila

3.4.3 Construction of Bench Mark Pillar (BM)

With the guidance and consultation provided by the Project Coordination Office (PCO), the establishment of BM pillars in each union within the upazila has been initiated. According to ToR, BM Pillars covering the entire project area are needed to establish each union. Dimension of the pillar is 10"x10", base 3'x3', height 5' over the land, where the RCC pillar has been constructed on-site and nailed at the top center. A three-dimensional coordinate has been established on the nail position.

Benchmark Pillars (BM's) has been started following the approved specification and design (**Figure-3-6**) by the PCO of UTMIDP. Location and coordinates of the BM Pillars have presented in **Map 3-8** and **Table 3-3** below.

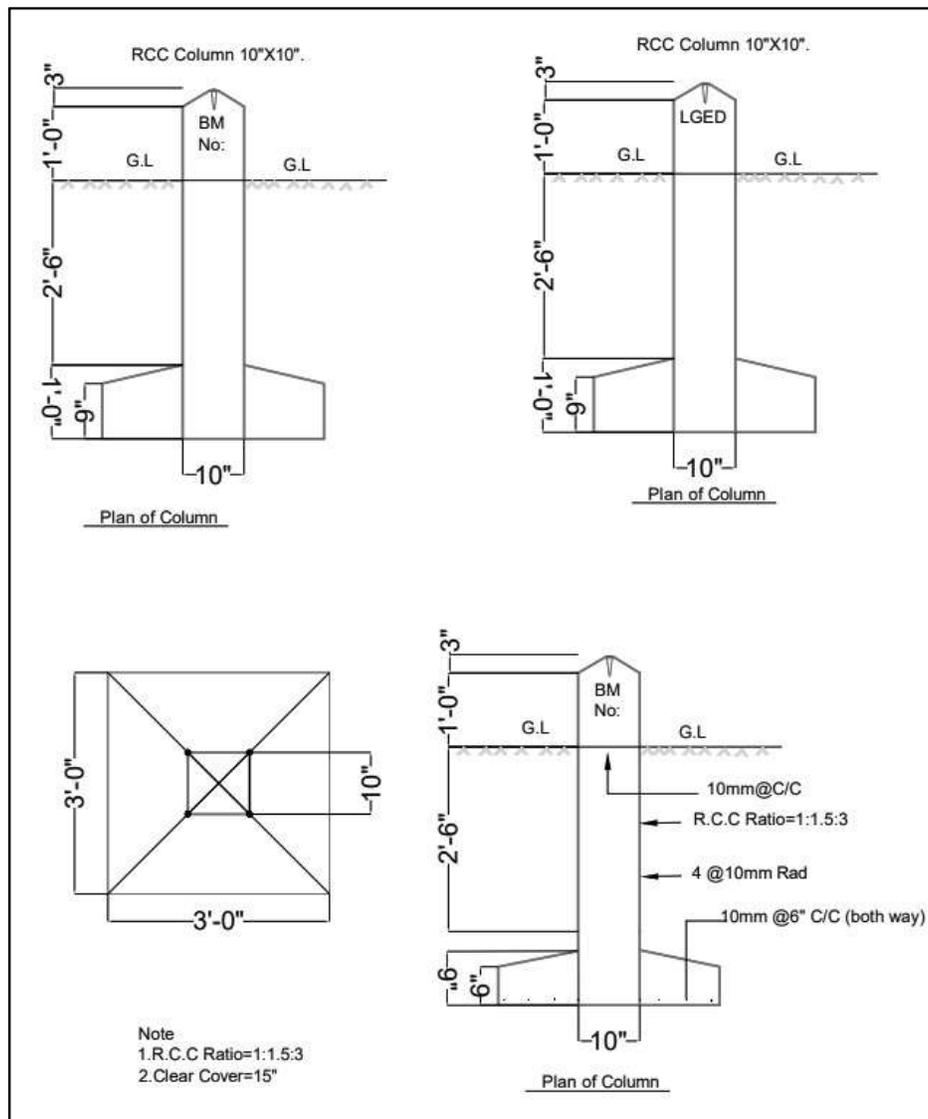


Figure 3-6: Details of BM Pillar approved by PCO



Figure 3-7: Sample of BM installation

Table 3-3: Location of the Benchmark Pillar (BM) established in Nawabganj Upazila

Sl. No.	BM Number	Union Name	Latitude	Longitude	Location
01	BM 01	1 no Shikaripara	23.68249°	90.08313°	Shikaripara Union Parishad Complex
02	BM 02	2 no Joykrishnapur	23.68491°	90.04508°	Joykrishnapur Union Parishad Complex
03	BM 03	3 no Baruakhali	23.67745°	90.06584°	Baruakhali Union Parishad Complex
04	BM 04	4 no Nayansree	23.66593°	90.10222°	Nayansree Union Parishad Complex
05	BM 05	5 no Sholla Union	23.70932°	90.18416°	Sholla Union Parishad Complex
06	BM 06	6 no Jantrial	23.66786°	90.16138°	Jantrial Union Parishad Complex
07	BM 07	7 no Bandura	23.66538°	90.11742°	Bandura Union Parishad Complex
08	BM 08	8 no Kolakopa	23.65932°	90.16359°	Kolakopa Union Parishad Complex
09	BM 09	9 no Bakshanagar	23.6432°	90.17645°	Bakshanagar Union Parishad Complex

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Sl. No.	BM Number	Union Name	Latitude	Longitude	Location
10	BM 10	10 no Barrah	23.65854°	90.19401°	Barrah Union Parishad Complex
11	BM 11	11 no Kailail	23.67844°	90.23304°	Kailail Union Parishad Complex
12	BM 12	12 no Agla Union	23.64413°	90.20866°	Agla Union Parishad Complex
13	BM 13	13 no Galimpur	23.62439°	90.20503°	Galimpur Union Parishad Complex
14	BM 14	14 no Churain	23.6154°	90.22631°	Churain Union Parishad Complex

3.5 Extraction of Features from Satellite Image or Orthophoto

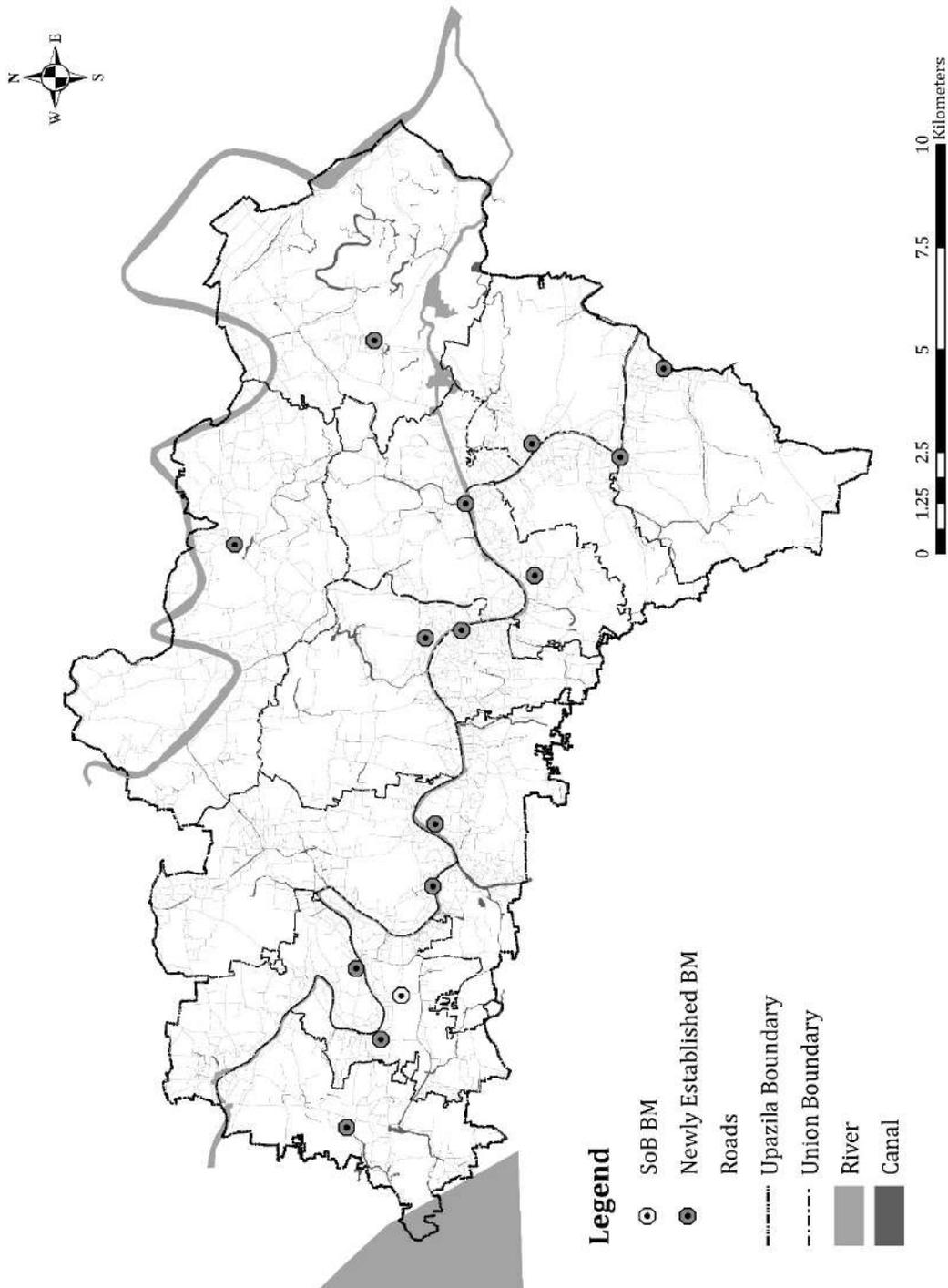


Figure 3-8: Location of Newly Established BM

3.5.1 Acquisition of Orthophoto

In the ToR, it has been mentioned that Satellite image and/or drone image will be used for urban area and selected other built-up areas including growth centers, selected hat/bazaar, and transport nodes. The stereo image resolution for urban areas will be 10 cm (3/4 bands), while for rural areas, it will be 30 cm (3/4 bands). According to the given instructions, consultants gathered satellite images of the entire Nawabganj Upazila, dividing between the built-up and rural areas. A physical survey of the 61 square kilometers of Nawabganj Upazila identified as built-up area was conducted using drones. In the remaining areas, the latest satellite images from the Survey of Bangladesh (SoB) and the database prepared in the UDD master plan were used to conduct the survey on the ground. Resolution of the drone based was less than 5 cm.

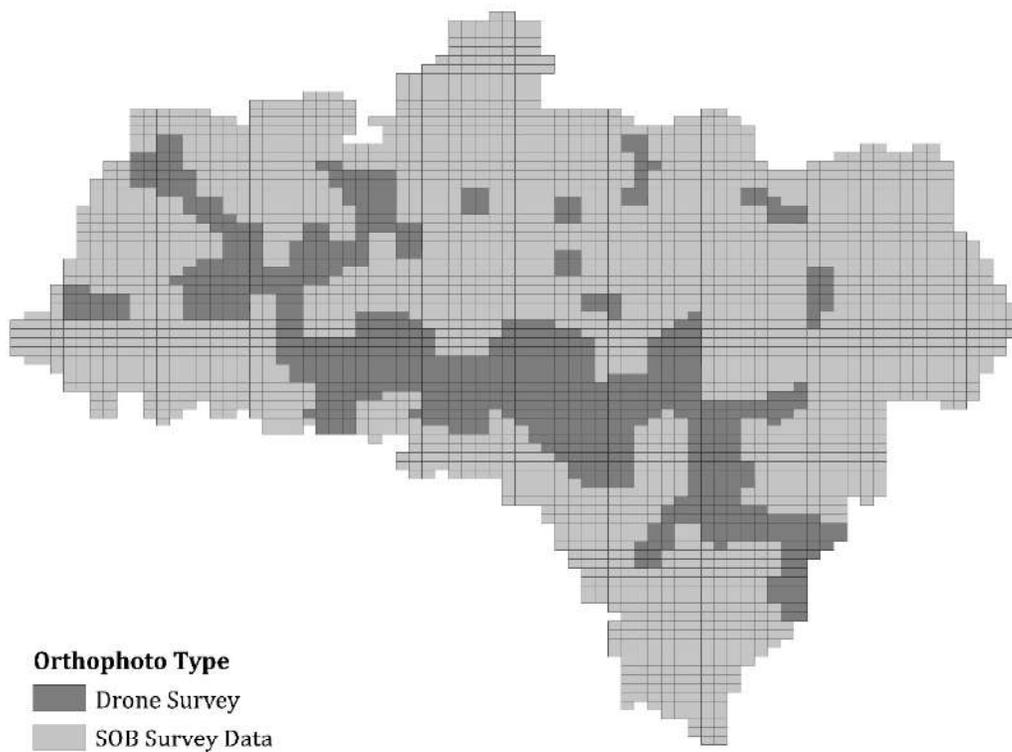


Figure 3-9: Selected Area for Drone Survey in Nawabganj

3.5.2 Capturing Aerial Photographs and Aerial Photos Using Drone

Aerial photographs have been captured covering the land area at an altitude of 280-300ft. Photos were captured in such a style that a descent orthophoto and DSM is generated. With the presence of the Upazila Engineer, Union Chairman, Senior Consultant (Planning) of UTMIDP, local people, and relevant experts of the consulting firm, the drone survey of the upazila was inaugurated. In the inauguration ceremony, the experts provided a concise explanation of the project's background, objectives, required surveys, and intended purposes, including the outcomes of the upazila master plan project. Additionally, the Photogrammetry expert explained the processes of obtaining high-quality images collection using drone with its accuracy and resolution etc.



Figure 3-10: Drone used for capturing aerial photographs

Specification of aircraft and sensor for capturing aerial photographs will be as follows:

Specification of Aircraft:

Dimensions:	810×670×430 mm [Unfolded, propellers excluded]		
	430×420×430 mm [Folded, propellers included]		
Diagonal Wheelbase:	895 mm	Max Take-off Weight:	9 kg
Max Payload:	2.7 kg	Weight:	without batteries ± 3.6 kg
			with 2x TB60 batteries ± 6.3 kg
Operating Frequency:	2.400 GHz - 2.483 GHz (Europe, Japan, Korea)	Transmission Power (EIRP):	
	5.725 GHz - 5.850 GHz (United States, China)	2.4000 - 2.4835 GHz	29.5 dBm FCC
			18.5 dBm CE/SRRC/MIC
		5.725 - 5.850 GHz	28.5 dBm FCC/SRRC
			12.5 dBm CE
Hovering Accuracy: (P-mode with GPS)		RTK Positioning Accuracy:	(When RTK enabled and fixed)
Vertical:	±0.1 m (Vision System enabled)		1cm + 1ppm Horizontal
	±0.5 m (GPS enabled)		1.5cm + 1ppm Vertical
	±0.1 m (RTK enabled)		
Horizontal:	±0.3 m (Vision System enabled)	Max Angular Velocity:	Pitch: 300°/s Yaw: 100°/s
	±1.5 m (GPS enabled)	Max Pitch Angle:	30° P-mode
	±0.1 m (RTK enabled)		25° Forward Vision System enabled
Max Ascent Speed:	S mode: 6 m/s	Max Decent Speed:	Vertical S mode: 5 m/s
	P mode: 5 m/s		P mode: 3 m/s
			Tilt S mode: 7 m/s
Max Speed:	S mode: 23 m/s	Max Wind Resistance:	15 m/s
	P mode: 17 m/s	Max Flight Time:	55 min
Max Service Ceiling:	Above Sea Level	Supported DJI Gimbals:	
	5 000 m [with 2110 propellers, take-off weight ≤ 7 kg]		Zenmuse XT2/XTS/Z30/H20/H20T
	7 000 m [with 2195 propellers, take-off weight ≤ 7 kg]		
Supported Gimbal Configurations:	Single Downward Gimbal, Dual Downward Gimbals,	Environmental Rating:	IP43
	Single Upward Gimbal, Upward & Downward Gimbals,	GNSS:	GPS+GLONASS+BeiDou+Galileo
	Triple Gimbals	Operating Temperature:	-20° to 50°C



Figure 3-11: Drone Survey Image

DRTK-2 Mobile Station, which is a necessary and integrated part of Matrice 300 RTK aircraft, has been used as base station. In RTK mode, it normally corrects the image position and orientation. After preparation of the draft survey alignment, flight plans have been prepared and uploaded into the aircraft controller. During preparing flight plans, following overlap was maintained:

Front Overlap $\geq 70\%$

Side Overlap $\geq 60\%$

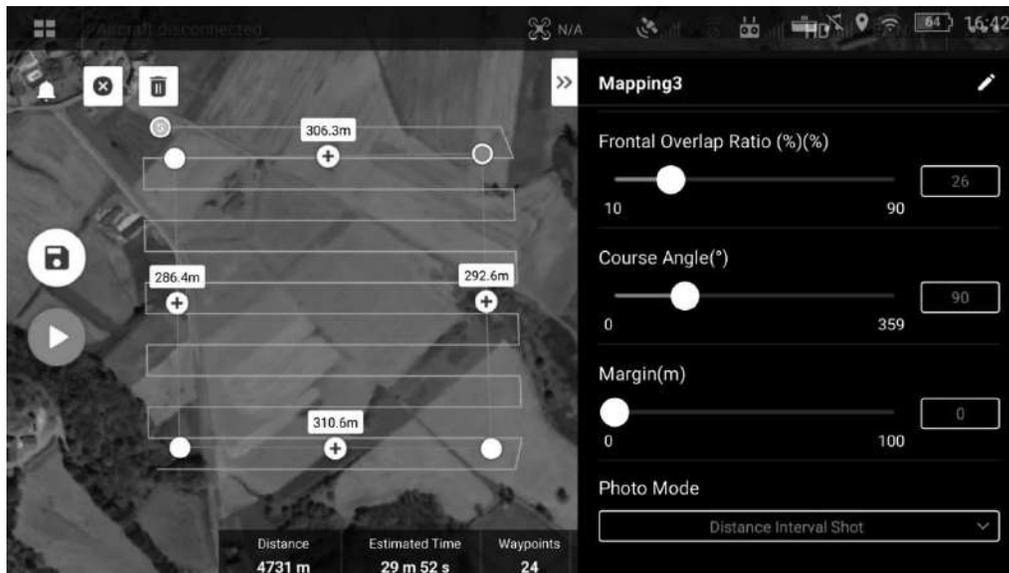


Figure 3-12: Preparation of flight plan and overlap

3.5.3 Processing of Orthophoto/Satellite Image

Orthophotos that are intended for delivery as end products require additional processing steps and input information. This involves having a precise ground model, accurately positioning the raw images, performing color corrections, selecting shapes, and creating 3D vector models of objects on the surface or depth maps in order to produce true-orthophotos etc. Processing of Orthophoto/Satellite Image has been presented in the **Figure-3-12** below.

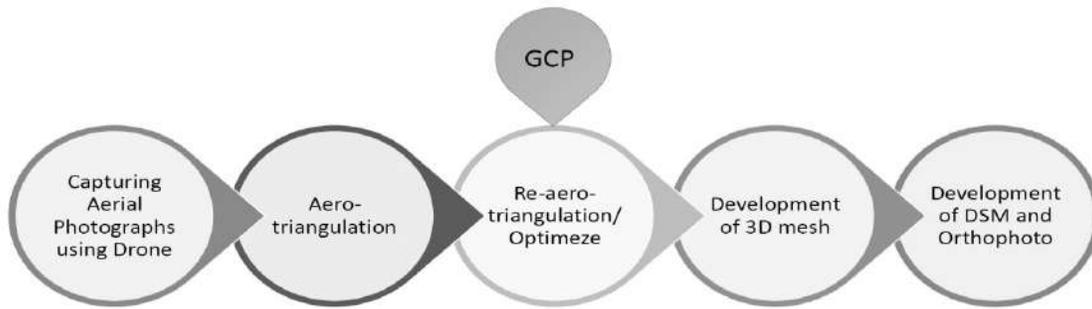


Figure 3-13: Preparation of DSM or DEM Aerial Photos

Output of aerial photos are as following:

1. Orthophoto (<0.05m)
2. Point Cloud (3D Mesh)
3. Digital Surface Model (DSM)
4. Digital Elevation Model (DEM)

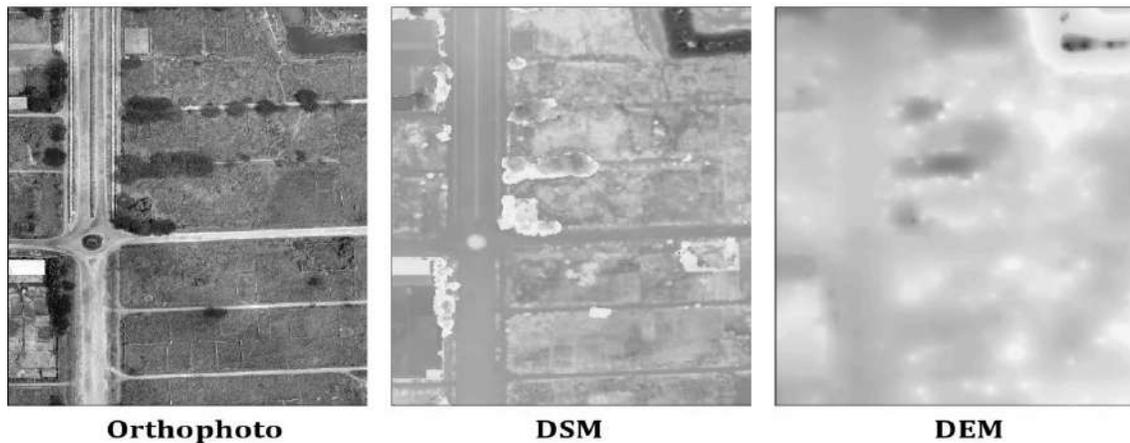


Figure 3-14: Outputs of aerial photos

3.5.4 Preparation of DSM or DEM from Aerial Photos

DSM and DEM have been prepared both from aerial photos. Pix4DMapper or Context Capture software has been used as processing software. GCP points are used properly in order to build the 3D mesh first. DSM and orthophoto has been generated at second step. The point cloud and the DSM has been processed to produce the DTM points, which excludes the points that do not

represent the elevations of the ground. Only the spot elevation points of the ground have been used in order to develop the DEM. While generating the contours, necessary break lines have been added as per the instructions given by the PCO. Contour lines have been created at 0.3m interval or as per direction of the client.

Methodology for DTM production:

1. At the very first stage, the BM pillar values that are comprised by the survey area are collected from the Survey of Bangladesh (SOB) database and then using dual frequency advanced GNSS receivers. The data Comparison between them led us to find the height above “Mean Sea Level (MSL)” values for each Ground Control Points (GCP) and Check Points (CP) which were generated later.
2. Two “Temporary Bench Marks (TBM)” were generated as well.
3. A total of 47 nos. “Check Points (CP)” and 34 nos. “Ground Control Points (GCP)” were generated.
4. Considering the GCPs as base stations, the built-up areas of the upazila were surveyed by Martice 300 RTK drone equipped with “DJI Zenmuse P1 Camera.”
5. Using photogrammetric analysis, dense point clouds were generated and then they were classified to eliminate the non-ground points to get a “Digital Terrain Model (DTM).”
6. Each flight data was classified separately to get the precise data and then they were merged together.
7. The merged point cloud data was then interpolated into raster using “Inverse Distance Weighted (IDW)” technique.
8. Another secondary raster dataset was merged with the primary data by mosaicking them together. The secondary dataset had been matched to the primary dataset by resampling method.
9. Since an interpolation manipulates the original data, the manipulation was solved by finding the differences between GNSS data post processing values and Raster (DTM) value.

3.5.5 Digital Mapping (Feature Extraction) from Ortho-rectified Orthophoto

The objective of feature extraction is to digitize as many features as possible from images from the ortho-rectified orthophoto. Spatial resolution of satellite images that have been collected using Drone for Nawabganj Upazila is less than 5 cm. As the resolution is very high, it was easy to extract features at a satisfactory accuracy level. A team of photogrammetrists digitized to extract the following physical and landuse features in 3-dimension (X, Y, Z) by using ArcGIS 10.8 software for the entire Nawabganj Upazila.



Figure 3-15: Digital Photogrammetric Workstations

- a) **All Structure (Building)**
- b) **All Roads**
- c) **Waterbodies**
- d) **Bridge and Culvert**
- e) **All Drains**
- f) **All Electric Point**
- g) **Railway Tracks**
- h) **All Others Poly** (Auto Rickshaw Stand, Bazar, Botanical Garden, Bus Stand, Bus Terminal, Cemetery, Chatal, CNG Station, Crematorium, Dairy Farm, Dustbin, Eidgah, Electric Substation, Factory, Filling Station, Forest Land, Garbage Disposal Site, Garden, Gas Transmission Station, Graveyard, Helipad, Heritage Site, Hospital, Land Fill, Market, Open Space, Park, Playground, Poultry Farm, Railway Station, Restricted Area, Shahid Minar, Slum, Stadium, Waste Treatment Plant, Truck Terminal, Single Crop Land, Double Crop Land, Triple Crop Land, Brickfield, Zebra Crossing, Road Island, Aquaculture, Sand Filling Area, Super Shop, Fire Service, Others)
- i) **All Others Point** (ATM Booth, Amusement Park, Roundabout, Place of encroachment of drain/canal, Spring, Cyclone Shelter, Water fall, Telephone Exchange, Monument, Police box, Traffic signal, Auditorium, Auto Rickshaw Stand, Boat Ghat, Bollard, Brickfield, Bus Depot, Bus Stand, Bus Terminal, Cemetery, Church, Cinema Hall, Clinic, Club, mobile tower, electric pole, Electric Tower, High Voltage tower etc.)
- j) **All Others Line** (Boundary walls, Abutment walls, Guide Walls, Guard Rails, Embankments, etc.)

Digital photogrammetry is enough to acquire 3D points and other terrain features from stereo models.

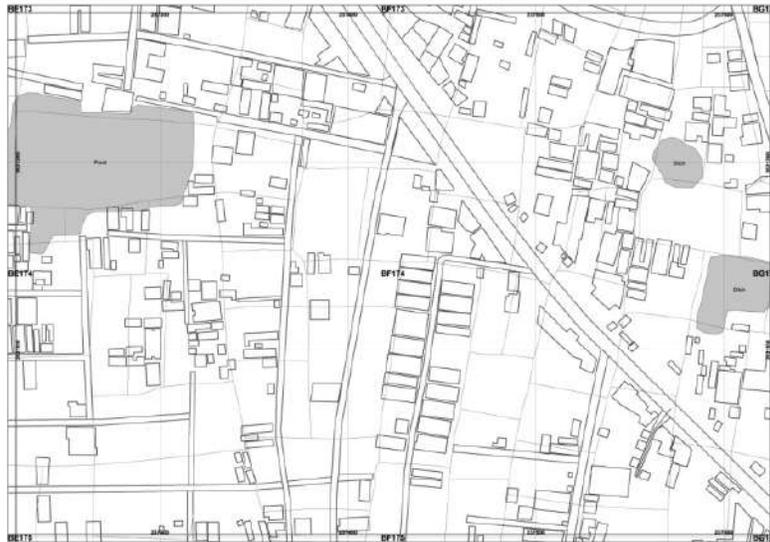


Figure 3-14: Feature digitization from true orthophoto

3.6 Preparation of Base Map and Attribute Data Collection

Base map and attribute data collection are essential steps in urban planning project. Effective base map and attribute data collection are critical for informed decision-making, spatial analysis, and planning in various sectors, contributing to more efficient resource allocation, infrastructure development, and environmental management.

3.6.1 Preparation of Log Book for Attribute Data Collection

The logbook contains the structure's information to be collected from the field survey. Structure ID, structure type, tenure type, age, number of floors, structure name, holding number, dwelling unit, floor usage, and locality name are common attributes in the log sheets.

Str. ID	Str. Type (1) Plaster (ECR) (2) Plaster (Masonry) (3) Semi-Plaster (4) Kachha (5) Under Construction	No. of Floor	Str. Name	Construction Year	Dwelling Unit	Use_Floor 0	Use_Floor 1	Use_Floor 2	Use_Floor 3	Use_Floor 4	Use_Floor 5	Tenure Type (1) Owner (2) Tenant (Public) (3) Tenant (Private) (4) Squating	Ownership (1) Govt. (2) Non-Public (non-departmental unit) (3) Non-Government (NGO) (4) Corporate/Industry (5) Private (6) Subsidized	Locality Name
DE344	4	1	সংস্কৃত বাড়ি		1	R						1	3	জিলাপাড়া
BE354	4	1				BR						1	3	4
1358	4	1	সংস্কৃত বাড়ি		1	R						1	3	6
BE378	4	1				K						1	3	6
1366	4	1	সংস্কৃত বাড়ি		1	R						1	3	6
BE384	4	1	সংস্কৃত বাড়ি		1	R						1	3	6
1374	4	1	সংস্কৃত বাড়ি		1	R						1	3	4
1375	4	1				R						1	3	4
BE388	4	1				K						1	3	4
1388	4	1	সংস্কৃত বাড়ি		1	R						1	3	4
BE390	4	1				STR+H						1	3	4
BE392	4	1				BR						1	3	4
1393	4	1	সংস্কৃত বাড়ি		1	R						1	3	4
BE394	4	1				STR						1	3	4
1397	4	1				K						1	3	4
BE398	4	1				BR						1	3	4
1400	4	1	সংস্কৃত বাড়ি		1	R						1	3	4
1400	4	1				K						1	3	4

Figure 3-16: Sample Log Sheet for Collection of Structure Attribute

3.6.2 Overlaying of Digitized Data and Printing Maps

Physical features, topographic and land use map data, and DTM points are digitized in photogrammetry from a stereo pair model. All feature measurements are in 3D and stored in ArcGIS-supported file format. The base map (A3 Size) is prepared from the data extracted in photogrammetry at a 1:1000 map scale but finalized by a team consisting of Sr. Consultant (GIS & RS), Consultant (GIS & RS) GIS Analyst, Sr. Urban Planners of the consultants, and technical experts of PCO/LGED.

Physical features have been digitized from orthophotos. The features visible in the drone images were identified and inserted into a geodatabase. Different physical feature layers were used to print a digital map based on the geodatabase features. On the map, features such as roads, bridge, culverts, building structures, electric poles, waterbodies, drains, railway line etc. were marked. A geodatabase having A3 size grids was prepared covering the entire Upazila. Based on each grid (360mx240m), A3 Size field survey maps, having a scale of 1:1000, were produced.

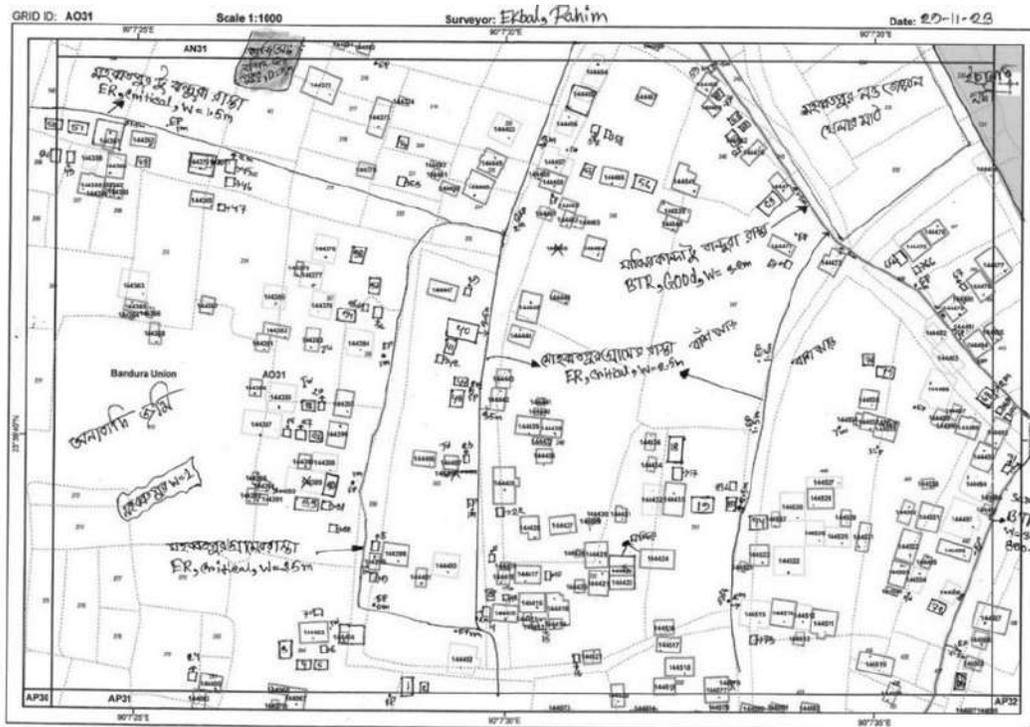


Figure 3-17: Map used for Physical Feature Survey Data Collection

In Nawabganj Upazila, there are a total of 3083 A3-sized survey base maps. Each of the grids on these maps has a unique ID that has been automatically generated using ArcGIS software. The generated grids have been depicted by following figure (Figure 3-18).

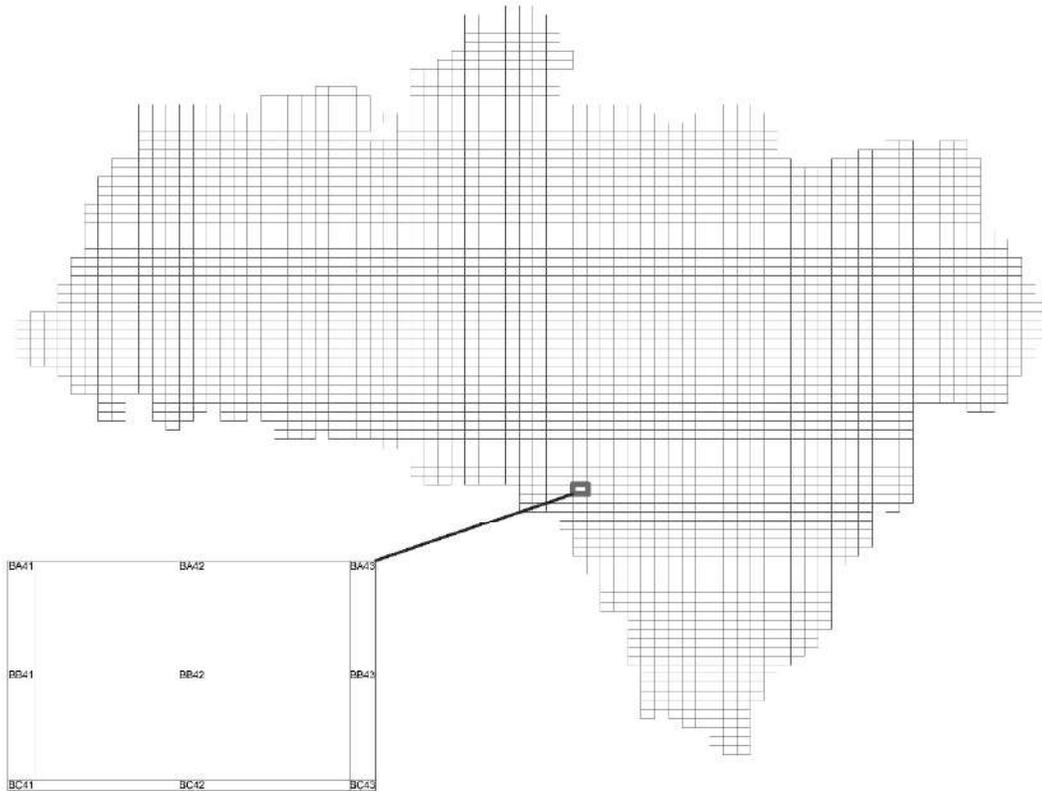


Figure 3-18 : A3 Sized survey grids for Nawabganj Upazila Mobilization of Survey Team

A dynamic and qualified survey team experienced with GPS and satellite advanced technology was deployed to conduct physical feature, land, and topographic surveys from the project office at Upazila level. The composition of the survey team with their designation is given below:

Table 3-4: Composition of Survey Team

SL	Field of Expertise	No. of Expert/
01	Sr. Consultant (Survey)	1
02	Sr. Consultant (GIS & RS)	1
03	Sr. Consultant (Photogrammetry)	1
06	Survey Coordinator	6
08	Surveyors	20

For physical survey, survey team were divided in ten groups to collect the plot level information from the field. Each team collected all features i.e., structures, water bodies, roads, etc. with their attributes. Survey team was supervised by the Survey Expert.

3.6.3 Topographic Survey and Ground Truthing

The topographic database is obtained from geo-referenced 3D (Four bands) images and further cross-checked and ground truthing by using RTK-GPS and Total Station to obtain and verify 3D

data (X, Y, Z value) on location and alignment of all data obtained from physical feature survey including roads, flood embankments and drainage divides. Location and alignment of all drainage and irrigation channels/canals showing depth and direction of flow. Closed boundary/outline of the homestead, water bodies, swamps, forest, etc. junctions, spot heights or land levels at 5m (five meter) interval in the upazila and break line where required such as dyke, embankment, roads, rail-rails, river bank, rail line etc. Distribution of spot height checking have been distributed evenly across the boundary of the project area

In the densely vegetated area and cloud covered area, RTK-GPS and Total Stations are used to obtain 3-D data (X, Y, Z value) for enriching the photogrammetric data of roads, flood embankments and other drainage divides, drainage, and irrigation channels. The Survey team conducted the survey to collect topographic features as much as possible using survey equipment and satellite image-based map sheets. The surveyors have collected the following features from the field:

- Closed boundary/outline of the homestead, alignment of rivers, lake, canal, and drainage channels, etc., showing the depth and direction of the flow
- Alignment of roads, railways, embankments, dykes, and other drainage divides.
- Outline of bazaars, waterbodies, swamps, barren land, low land, borrow pits, forest, open space, restricted area, Groups of trees, Sand/Sand Dunes, etc.



Figure 3-19 : Data Collection and Inspection

3.6.4 Physical Feature Survey

Physical feature survey has been conducted for the planning area. Location and dimension (X, Y, Z value) of all existing structures and features and their attributes are collected. A list of physical features and their attributes are given below:

- Type, width, length, and name of road, road level above datum, slopes, borrow pit
- Identification of bridge or culvert on the road their length, width and span, condition of abutments, condition of the deck, wing walls abutments
- Type, size, depth, inlet and outlet location of drain along with flow direction width and depth of the canal and irrigation channel, place of encroachment
- Type of drainage system, size, and location of drainage line, location of bins, location of solid waste dumping ground, identification of any other garbage collection system
- Identification of the water supply system, location of water tanks, tube-wells or any other water supply source point, and capacity
- Identification, location and capacity of electric substation, telephone exchange, ICT facility, gas substation etc. Treatment plant, waste disposal facilities.
- Identification, location and capacity of electricity telephone, gas post, and line

A physical feature survey has been conducted for the whole project area using survey base maps with Log Book. Survey teams equipped with smartphones, tape, color pens, map sheets, log books, etc., went to the field to collect attribute data of the features digitized from stereo images in the prescribed log book. Any missing features, like structure, road, channel, etc., were drawn in the field. A sample page of a log book with collected information is shown in Figure 3-19 and a sample surveyed map sheet is shown in Figure 3-20.

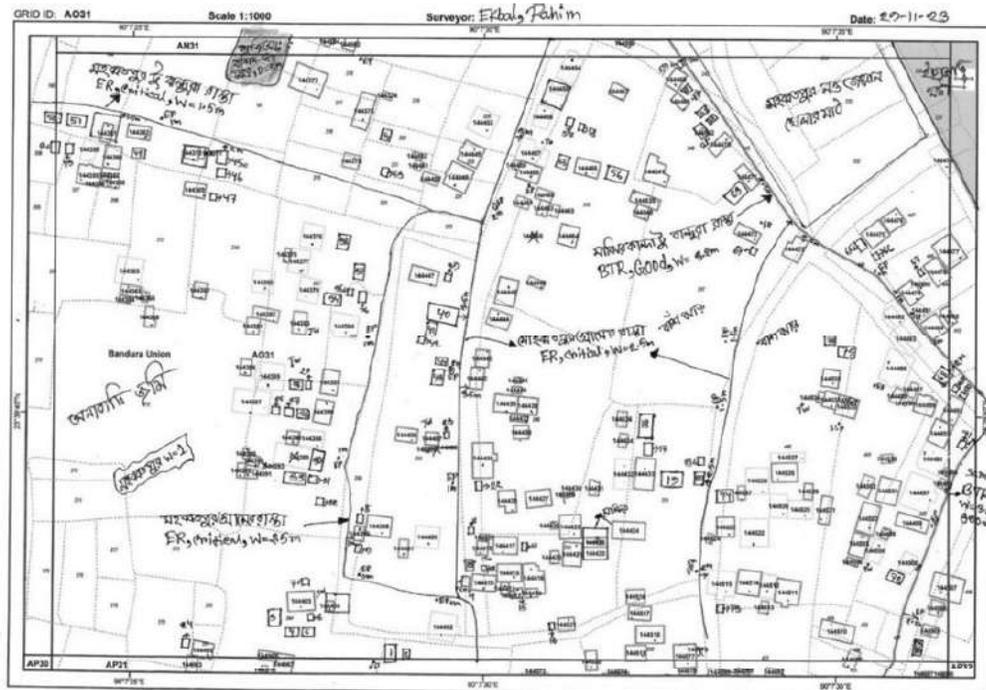


Figure 3-20: Sample Surveyed Base Map of Physical Feature Survey

Str. ID	Str. Type (1) Pucca (RCC) (2) Pucca (Masonry) (3) Semi Pucca (4) Kuchha (5) Under Construction	No. of Floor	Str. Name	Construction Year	Dwelling Unit	Use_Floor G	Use_Floor 1	Use_Floor 2	Use_Floor 3	Use_Floor 4	Use_Floor 5	Tenure Type (1) Owner (2) Tenant (Public) (3) Tenant (Private) (4) Squatting	Ownership (1) Government (Govt./Bd./Public/semi-governmental use) (2) Non-Government (NGO/ Corporate/Industry) (3) Private (4) Religious	Locality Name
DE-314	4	1	বাংলা বাড়ার		1	R						1	3	নবাবগঞ্জ
BE-315	4	1				BR						1	3	4
1358	4	1	বাংলা বাড়ার		1	R						1	3	6
BE-318	4	1				K						1	3	6
1366	4	1	বাংলা বাড়ার		1	R						1	3	6
BE-320	4	1	বাংলা বাড়ার		1	R						1	3	6
1344	4	1	বাংলা বাড়ার		1	R						1	3	6
1345	4	1				R						1	3	6
BE-322	4	1				K						1	3	6
1348	4	1	বাংলা বাড়ার		1	R						1	3	6
1365	4	1				STR						1	3	6
BE-324	4	1				BR						1	3	6
1359	4	1	বাংলা বাড়ার		1	R						1	3	6
BE-326	4	1				STR						1	3	6
BE-328	4	1				K						1	3	6
BE-330	4	1				BR						1	3	6
1349	4	1	বাংলা বাড়ার		1	R						1	3	6
1400	4	1				K						1	3	6

Figure 3-21: Sample Logbook Page with Information Recorded in Field

3.6.5 Land use Survey

The land use survey was carried out by recording the current use of the land in the project area. The existing use of land was classified according to the provisions given in the TOR of the UTMIDP Project. Land use surveys, basically, records the use of land by its functional activity such as residential, industrial, commercial etc. The land use survey (both attribute and spatial) indicates the use of each plot of land covering the whole area. The base maps prepared for physical survey was used as base maps for land use survey.

The surveyors visited each and every site with hard copy of printed image-based maps to record existing uses with specified notation and colors. Structural use related data were available from physical feature map. Usually, structural use defines the use of land parcel. Land use information of Mouza plots without structure was collected through direct field survey or processing of satellite images. Through Field survey, land use information was collected as categorized below:

Table 3-5: Existing Generalized Land Use Categories

Sl. No.	Land Uses	Illustrated
1	Residential	Planned Residential Area, Govt. Quarters, Housing/Shelter Project, Private Housing, Rest/Guest/Circuit House, Banglow, Mess, Orphanage/Old Home, Rural Homestead, Slum, Squatters
2	Commercial	Residential Hotel/ Hotel & Restaurant, Wholesale Rice Market, Wholesale Vegetables Market, Wholesale Fish Market, Wholesale Paper Market, Wholesale Grocery Goods Market, Wholesale Fruit Market, Book Stall, Cloths Shop, Paper & Magazine, Stationery Shop, Shoe Shop, Bag & Leather Goods, Cosmetics, Spectacles, Electronic Goods, Audio Video Cassette, Utensils/crockeries, Sports Goods, Computer Goods, Motor Car Parts,

Sl. No.	Land Uses	Illustrated
		Jewelry shops, Show Room, Furniture Shop, Department Store, Mobile Sales Center, Hardware Goods, Sweet Shop, Bakery Shop, Gift Shop, Press & Printing, Grocery Shop, Gun Shop, Iron & Steel Shops, Shopping Center/Mall, Shopping Mall, Super Market, Rubber Stamps, Phone-Fax-Photocopy, Cycle Store, Studio/Color Lab, Drug/Pharmacy, Pottery shop, Electronics, Sports and Athletics, Kitchen Market, Katcha Bazar, Beauty Parlor/Hair dresser, Govt. Food Godown, Cold Storage, Others Godown.
3	Mixed Use	Commercial – Residential, Office/service – Residential, Commercial – green category Industrial, Two or more use.
4	Transport	R & H Road/LGED Road, Primary Road/ Major Through fare, Secondary Road (Pucca), Secondary Road (Kutchra), Local Road (Pucca), Local Road (Kutchra), Access Road (Pucca), Access Road (Kutchra), Footpath (Paved), Footpath (Unpaved), Walkway, Embankment cum Road, Airport / Bus terminal / Truck terminal / BRTC bus Depot / Tempo stand / Rickshaw stand / Railway station / BIWTA Terminal/ Launch Terminal etc. Broad gauge, Meter gauge, River.
5	Administrative	Deputy Commissioner's Office, Zilla Parishad Office, SP Office/Police Headquarter, Civil Surgeon Office, LGED Office, Upazila Headquarter, Upazila Parishad Office, Union Parishad Office, Settlement Office, Post office, Bank, Public Works Department Office, R&H Office, DPHE Office, Statistical Bureau Office, PDB Office, BWDB Office, DoE Office, All types of Government Office, Private Bank/ Insurance Company, Mercantile & Cooperatives, Money Exchange Center, Private company/Different types of NGO/CBO/Club, Construction Office, Commercial Group Office, Trading Corporation Office, Security Service Office, Law Chamber, Doctors Chamber, Political Party Office, Professional's Association, Labor Union.
6	Industrial	Dairy Products, Fish & Sea Food, Salt Crushing Mill, Soft Drink, Bakery Product, Cotton Textile, Jute Textile, Silk & Artificial Textile, Dyeing Industry, Coconut Fiber Industry, Knitting Industry, Hosiery Products, Readymade Garments, Tannery & Finishing, Leather Buying House, Leather Footwear, Compressed Natural Gas, Fertilizers, Insecticides Industry, Soap & Detergent, Paints & Varnishes, Medicine and Drugs Company, Paper Product (all kind), Newspaper, Rubber Footwear, Cycle & Tyre Tube, PVC Product, Glass Product, Bricks Kiln/Fields, Cement, Iron & Steel, Re rolling mills, Hand & Edge tools, Bland &, Knives, Heating & Lighting, Plumbing, Equipment, Machinery Equipment, Wire & Cables, Electric Lamps, Electrical, Apparatus, Fruits & Vegetables, Oil Products, Edible Salt, Molasses, Atta, Maida & Suji (Flour Mill), Spice Industry, Rice Mill, Boiler (Rice), Handicrafts, Pottery, Carpets, Fabrics, Sewing/Hand loom Products, Wooden Furniture, Cane Furniture, Steel Furniture, Ship Building, Lime Stone, Sports & Athletics.
7	Agricultural	Single crop land, Double crop land, Triple crop land, Barren land, Orchard, Different types of flower garden, Hatchery/Gher, Livestock / Poultry Farm / Diary Farm, Agricultural Research Area
8	Education	Kindergarten and Nursery, Primary School, High School, College, Public University, Private University, Public Medical College, Private Medical College, Homeopathic Medical College, Engineering College/University, Law College, Social Research, Health Research, Economic Research,

Sl. No.	Land Uses	Illustrated
		Vocational Training Institute, Physical Training Institute, Nursing Training Institute, Ters Training College, Computer Training Institute, Dakhil Madrasa, Alim Madrasa, Fazil Madrasa, Kamil Madrasa, Hafezia Madrasa, Tutorial/ Coaching Center, Government Training Institute, Library, Museum, Social Welfare Institution
9	Health	Govt. Hospital / Pvt Hospital / Mental Hospital/ Maternity/ Children Hospital / Clinic/ Diagnostic Center, Veterinary Hospital, Drug, Rehab Center
10	Recreational and Open Space	Cinema Hall, Theater Hall, Museum & Art gallery, Auditorium /Community Center/Town Hall, Park/Playground/Amusement Park/Theme Park, Stadium/ Gymnasium/Swimming Pool, Tennis Complex, Golf Course, Public Gathering Space like National Park/Botanical Garden, Zoological Park, Forest Land/Urban Green, Ecological Park/sites, Riverbank
11	Community Facilities	Mosque, Eidgah / Mazar/ Dargha, Temple, Church, Pagoda, Graveyard, Cemetery, Cremation and other place of worship
12	Restricted Area	Cantonment/BDR/Navy, Police Station, Ansar Camp, Jail, TV Station, Radio Station, T&T Board, Power Supply Station, Solid Waste Dumping Ground, Slaughterhouse, Water Pump House, Hazardous Area, Monument, Shahid Minar
13	Heritage Site	Archeological site, Old zamindar bari, palace, other Historic Sites
14	Water bodies	Pond, Dighi, Ditch, Marshy Lands, Beels, Lakes, Khals, Streams, River

3.7 Processing of Survey Data

Processing of survey data is a crucial step in preparing a master plan, as it provides valuable insights into various aspects of the project. The process for handling survey data in this project is given below:

3.7.1 Data Cleaning and Validation

Cleaning process of the collected data has been carried out to remove any inconsistencies, errors, or missing values. Validate the data to ensure its accuracy and reliability. Validation of the data for accuracy and reliability by cross-checking responses with other sources or conducting follow-up surveys have also been done.

3.7.2 Iterative Process

Iterative review and refinement of survey data was done based on feedback from Upazila Parishad, PCO, LGED, and project team. Updating of Draft GIS Database submitted to the PCO has been made as per their feedbacks and comments. During the data sharing workshop of the survey report held on April 4, 2024, in Nawabganj Upazila, several observations were received from the union chairman which was updated by the consultants. Furthermore, a team visited the upazila with printed maps for the quality checking of the database.

3.8 Field Verification of Maps

After compilation of the updated database, feature maps have been prepared following prescribed database specification and feature typology in different layers. Physical feature, land

use survey maps and other maps as per the ToR have been printed in 30-inch x 40-inch paper and were sent to the field for checking by the field surveyors first. After making necessary corrections, these maps will again be sent to the PCO, UTMIDP for further verification. PCO team will also verify the survey maps both in hard and soft copy.

3.9 Updating of Maps and Database

Once the required corrections and feedback have been received from the PCO, the database and maps will be further updated and finalized. A set of thematic maps has been prepared based on the database, and the Draft Survey Report-2 has also been produced.

CHAPTER FOUR: TOPOGRAPHIC SURVEY

4.1 Introduction

Topographical survey refers to recording the coordinates and elevation (height) data of natural and artificial features within a designated survey area. It includes: The surveyed points are mapped in three dimensions related to the national grid system and datum information.

The main benefit of a topographic survey is helping in planning and decision-making by providing land surface level. Topographic surveys may use various techniques to measure lands level. This chapter covers detailed about the topographic survey method and detailed description of the land levels, contour, digital elevation models, roads and embankments/dykes, natural drainage systems, and waterbody, etc.

4.2 Equipment and Format Used

Matrice 300 RTK Drone, DJI Zenmuse P1 camera, Topcon GR-5 GNSS (Global Navigation Satellite System) Receivers, and Topcon GM101 Total Station have been used for conducting topographic surveys in the Nawabganj Upazila area.

GNSS Receiver Maintained the Following Specifications:

Satellites: GPS, GLONASS, Galileo, BeiDou, SBAS, QZSS

Number of Channels: 226 Channel Vanguard Technology TM with Universal Tracking Channels

Accuracy: H: 3.0mm + 0.1ppm; V: 3.5mm +0.4ppm in Static Mode FC-500 Data Controller

Table 4-1: DJI Zenmuse P1 Camera Specification

Attribute	Value
Type	JPG File
Tags	single
Dimensions	8192 x 5460
Comments	0.9.142
Camera maker	DJI
Camera model	Zenmuse P1
Subject	default
F-stop	f/5.6
Exposure time	1/1000 sec.
ISO speed	ISO-710
Exposure bias	0 step
Focal length	35 mm
Max aperture	2.97
Flash mode	No flash
Metering mode	Average
35mm focal length	35

Table 4-2: Coordinate System Used for Topographic Survey

Projected Coordinate System	WGS_1984_UTM_Zone_45N
Projection	Transverse_Mercator
False_Easting	500000
False_Northing	0
Central_Meridian	87
Scale_Factor	0.9996
Latitude_Of_Origin	0
Linear Unit	Meter (1.0)

The Total Station used for the Topographic Survey maintained the Following Specifications:

Accuracy (ISO 17123-3:2001): $1'' \pm (2 + 2\text{ppm} \times D)$ mm

Measuring range (under average conditions)

Reflectorless: 0.3 to 500m

Mini Prism: 1.3 to 500m

One Prism: 1.3 to 4000m



Figure 4-1: Topographic Field Survey

4.3 Land Level Findings

4.3.1 Spot Levels of Nawabganj Upazila Area

Spot levels of the total area of Nawabganj Upazila have been identified through post-processing from the camera -installed drone. For this purpose, DJI Zenmuse P1 camera installed on the DJI Matrice 300 RTK (Real Time Kinematics) has been used to detect the height levels of Nawabganj Upazila.

The following statistics (Table 4-3) collectively provide a comprehensive overview of the spot-level distribution, central tendency, and variability. It is essential to consider these values together to understand the characteristics of the spot levels in the Nawabganj. Here, the height is

determined concerning the Mean Sea Level (MSL), and the height measurement unit is the Meter. The horizontal and vertical distance between each point of the spot level is 5m (Figure 4-2).

Table 4-3: Statistical Summary of Spot-Levels

Types	Values
Minimum	-1.323418
Maximum	10.461782
Mean	5.005971
Standard Deviation	1.50105

A total of 61786979 data points has been collected in Nawabganj Upazila. From the dataset, it has been found that the minimum and maximum heights of the Nawabganj Upazila are -1.32 m and 10.46 m, respectively. The mean/average height of the Upazila is approximately 5.00 m. The standard deviation of heights is about 1.50 m. A lower standard deviation generally indicates that the data points are close to the mean, while a higher standard deviation suggests greater variability. A standard deviation of 1.50 m means that the data points in the dataset are relatively close to the mean of 5.00 m, but they have some spread around that average. Most values are likely within about 1.50 m of the mean.

4.3.2 Union-Wise Spot Levels

Spot levels of each union in the Nawabganj Upazila have been calculated using geoprocessing tools in ArcGIS. The analysis provides the number of points, minimum and maximum heights, average heights, standard deviation, and variance of spot heights for each union. Note that all types of heights have been calculated in meter units.

Table 4-4: Statistical Summary of Union-wise Spot-Levels

Union	Minimum	Maximum	Range	Mean	Standard Deviation
Agla	0.852556	8.963742	8.111187	4.266522	1.651219
Bakshanagar	0.654279	8.910748	8.256469	5.016715	2.025185
Bandura	0.57591	8.998728	8.422818	5.479884	1.689837
Barrah	0.833848	8.959618	8.12577	5.392281	1.304902
Baruakhali	0.875739	8.891415	8.015676	5.36419	1.458101
Churain	0.976871	9.424004	8.447133	4.397781	1.476746
Galimpur	0.525578	8.995004	8.469426	4.42233	1.859737
Jantrail	0.555492	8.917973	8.362481	5.009416	1.217573
Joykrishnapur	0.741528	9.891362	9.149834	5.225542	1.31158
Kailail	0.201885	9.386473	9.184588	4.34412	1.175887
Kolakopa	0.806355	8.917097	8.110742	5.666839	1.607749
Nayansree	0.927756	9.939878	9.012123	5.477591	1.370784
Shikaripara	0.940829	10.45868	9.517851	5.903403	1.452897
Sholla	-1.323418	10.461782	11.785201	5.157025	1.223156

Both maximum and minimum heights have been recorded in Sholla. The average height for the unions varies from 4.27 m to 5.90 m. The highest and lowest average heights have been found in Shikaripara and Galimpur Agla, respectively. Bakshanagr, Bandura, Barrah, Baruakhali, Jantrial, Joykrishnapur, Kolakopa, Nayansree, Sholla and Shikaripara have average heights that are more than 5m, and the rest of the unions have average heights between 4m to 5m. The standard deviation ranges from 1.18 m to 2.03 m. The highest and lowest standard deviation was found in Bakshanagar and Kailail, meaning that the variation of heights is the highest in Bakshanaga and the lowest in Kailail.

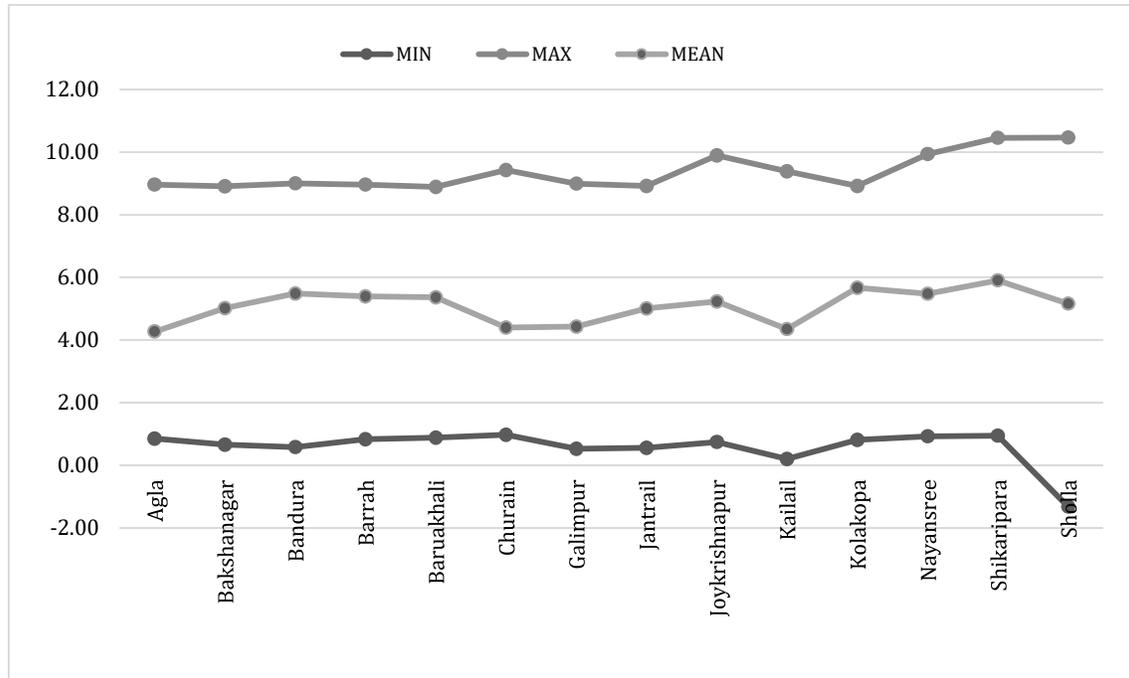


Figure 4-2: Union-wise Spot-Levels

Figure 4-2 demonstrates that the average height for the unions in Nawabganj upazila varies from 4 to 6 m.

4.3.3 Land Use-wise Spot Levels of Nawabganj Upazila

The entire land use of Nawabganj Upazila has been categorized into 17 types, such as residential, commercial, mixed-use, transport, administrative, industrial, agricultural, health, open space and recreational, community facilities, restricted area, heritage site, education, waterbodies. The administrative and heritage sit have the highest mean elevations, such as 7.34m, and 7.22 m, respectively. The mean heights of commercial, residential, educational, and industrial uses are 7.04 m, 6.37 m, 6.46 m, and 4.85 m, respectively. In addition, transport has a mean height of 6.24m in Nawabganj Upazila. Table 4-5 demonstrates detailed mean heights for each category of land use.

Table 4-5: Mean Spot Height of Nawabganj Upazila by Land Use

Types	Mean Height (m)	Land use	Mean Height (m)
Administrative	7.34	Mixed Use	6.84
Agriculture	4.43	Open Space	4.96
Commercial	7.04	Places of Worship	6.66
Education	6.46	Recreational	5.60
Graveyard	6.08	Residential	6.37
Health	6.89	Restricted Area	6.56
Heritage Site	7.22	Transport	6.24
Industrial	4.85	Waterbodies	3.74
Miscellaneous	6.32		

Source: Field Survey, 2023

4.4 Contour Description

A total of 79899 lines have been identified in the contour map. Figure 4-5 is a graphical representation of contour lines that showcases the distribution of values within a specific range or set of intervals. The histogram shows that maximum contour lines have fallen in between -1m to 10m. The contour map has been prepared with the help of DJI Terra and ArcGIS 10.8 with a line interval of 0.50 m.

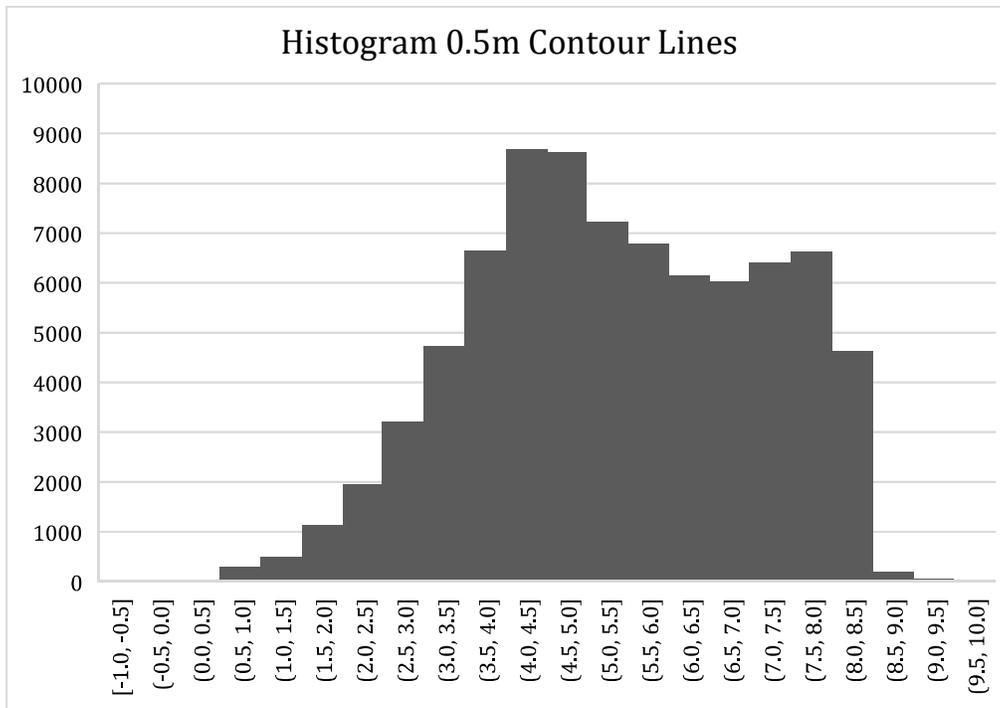


Figure 4-3: Histogram of Contour Lines

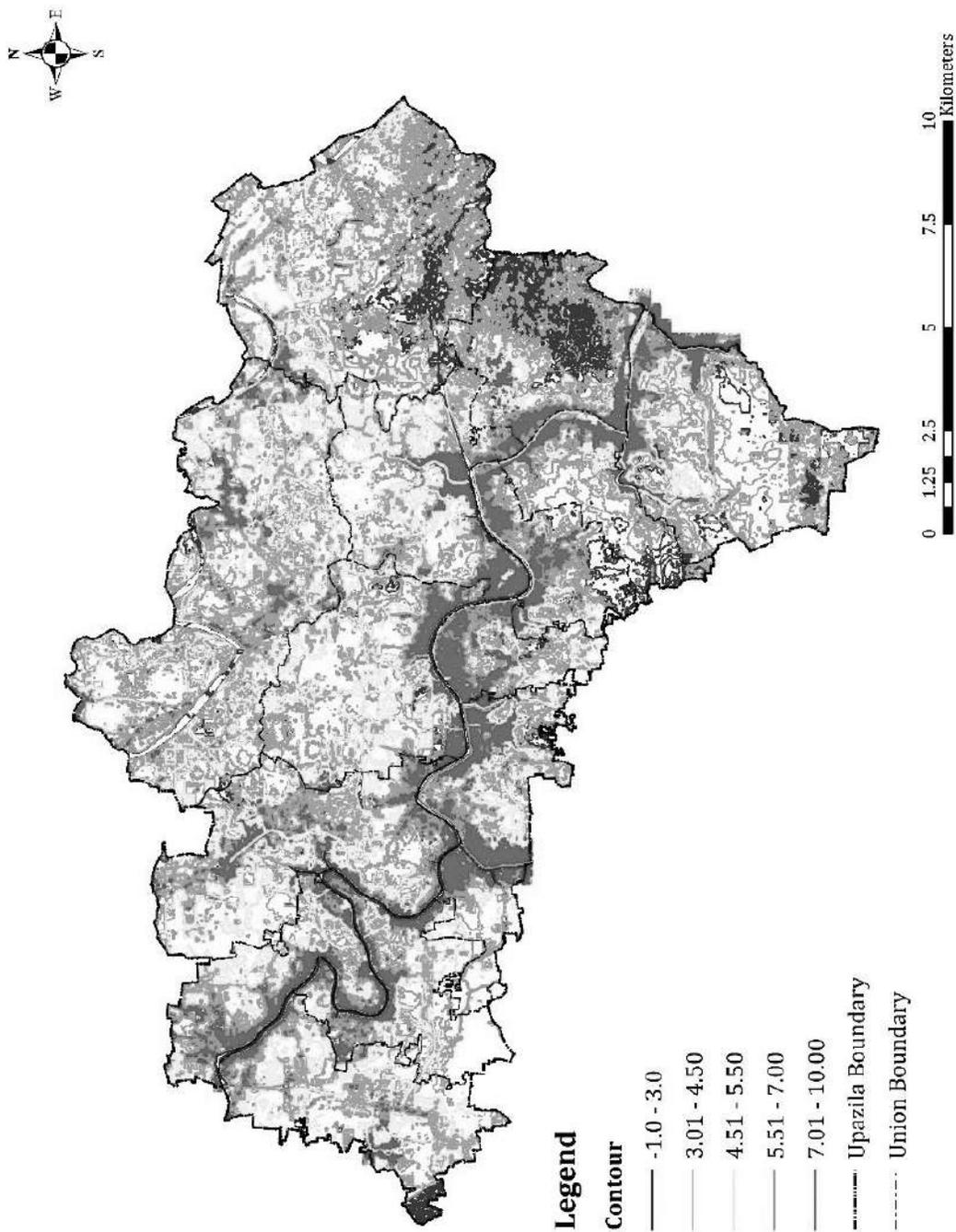


Figure 4-4: Contour Map of Nawabganj Upazila

4.4.1 Contour Map

The following map (Figure 4-4) shows the distribution of contour lines in Nawabganj Upazila. Although the contour lines have been prepared in 0.5m intervals, the following map has categorized the lines into five categories based on natural breaks ranging from -1m to 10 m for a better understanding of the elevation differences in the area.

4.5 DEM (Digital Elevation Model)

A single-band Digital Elevation Model (DEM) of Nawabganj upazila has been developed from the data acquired from the drone. The model is a raster image having elevation values in each pixel. The Image is in georeferenced TIFF format with 32-bit pixel depth, having 13686 and 9911 columns and rows, respectively. Additionally, the width and length of each pixel is 2m. The elevation values have been shown by a color ramp (Figure 4-5). The maximum and minimum values found in the elevation are 10.46 m and -1.32 m, respectively. The average elevation is 5.01 m with a standard deviation of 1.50 m.

4.6 Drainage Flow Direction

Flow Direction has been calculated from DEM using the PCRaster Tool in QGIS. PCRaster finds sinks, then fills those sinks and creates a flow direction raster. The Iddcreate creates a local drain direction map using the 8-point pour algorithm with flow directions from each cell to its steepest downslope neighbor. Figure 4-6 shows flow directions: south, southwest, southeast, west, flat, east, northeast, north, and northeast.

4.7 Waterbody

Waterbodies are essential features of any area and play critical roles in ecosystems, transportation, recreation, and the availability of freshwater resources for human use. The survey demarcated waterbodies from satellite and high-resolution drone images and verified information through field-level physical feature surveys conducted between August to December 2023. Figure 4-7 demonstrates category-wise waterbody distribution in the Nawabganj area.

The survey finds the following number of waterbodies, including canals, ditches, marshes, borrow pits, ponds, and rivers:

Table 4-6: Category-wise Number of Waterbodies with Area

Waterbody Type	Area in Acre
River	1812.19
Canal	1036.22
Pond	1999.76
Ditch	277.95
Swamp	314.46
Total	5440.58

The total area of Nawabganj Upazila is 61061.91 acres whereas the waterbody occupies 5440.58 acres of this area, encompassing 8.90% of the entire upazila. Rivers and canals share 33.31% and 19.05% of the area of water bodies. The pond shares 36.76% of the waterbody.

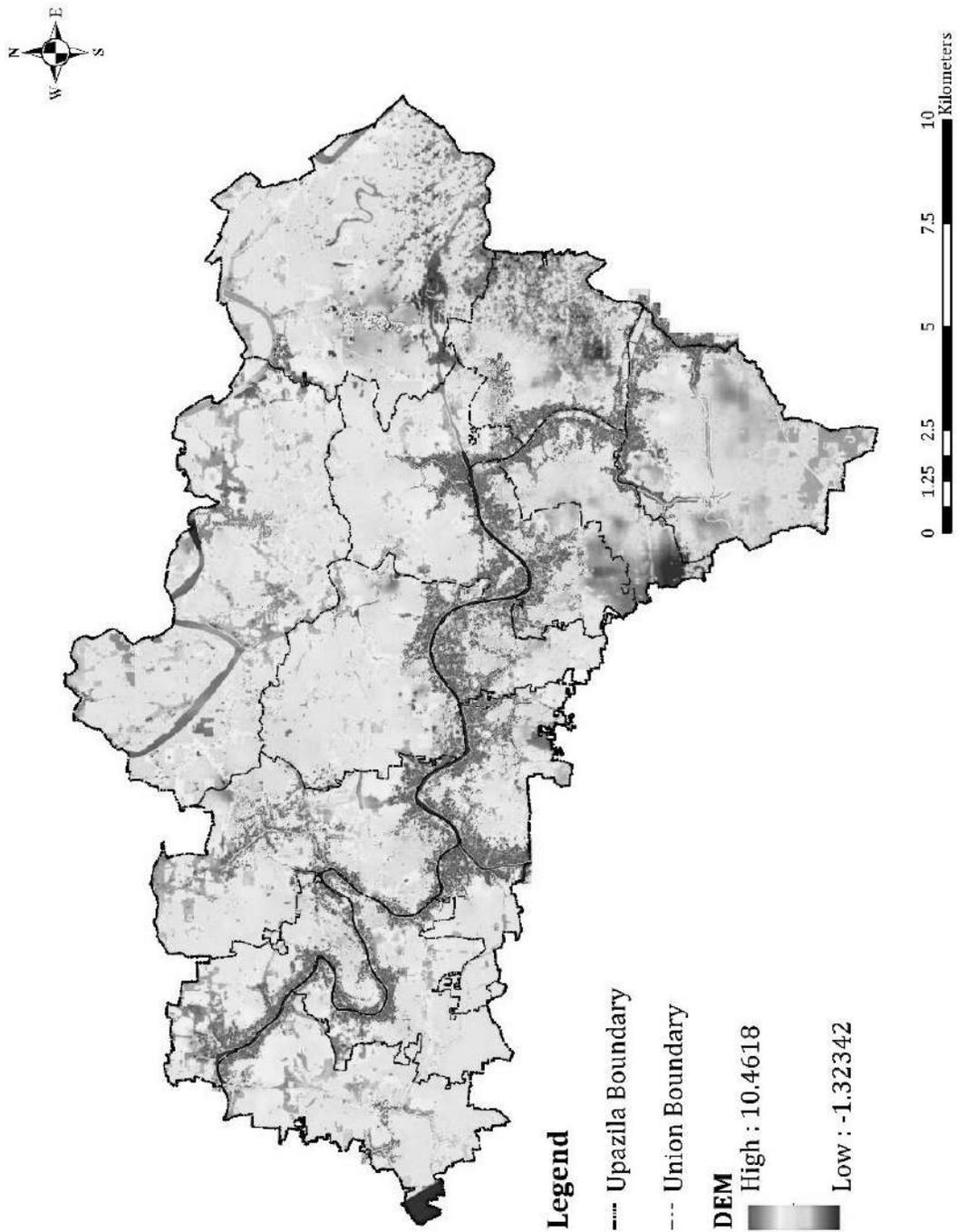


Figure 4-5: Digital Elevation Model of Nawabganj Upazila

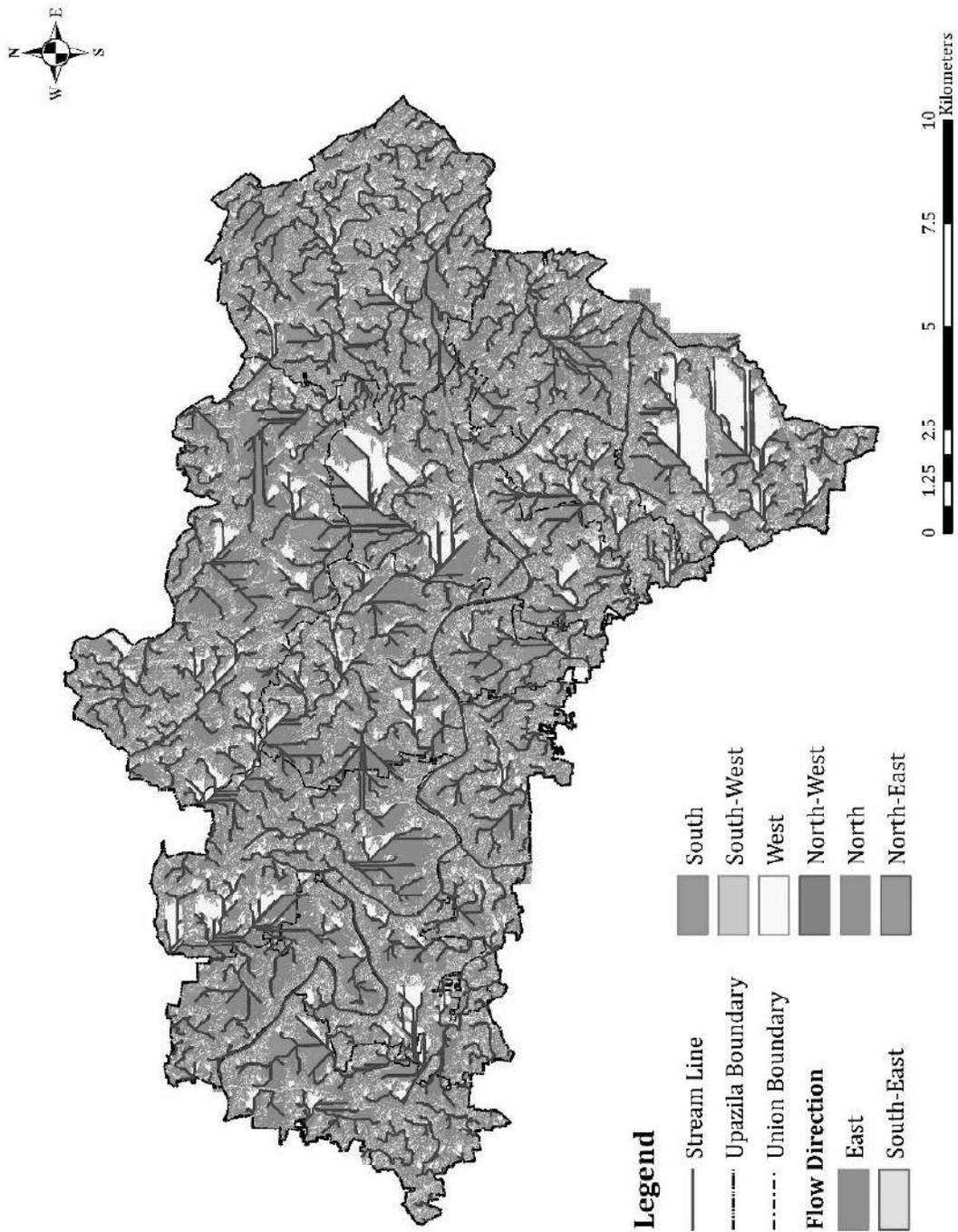


Figure 4-6: Flow Direction Map of Nawabganj Upazila

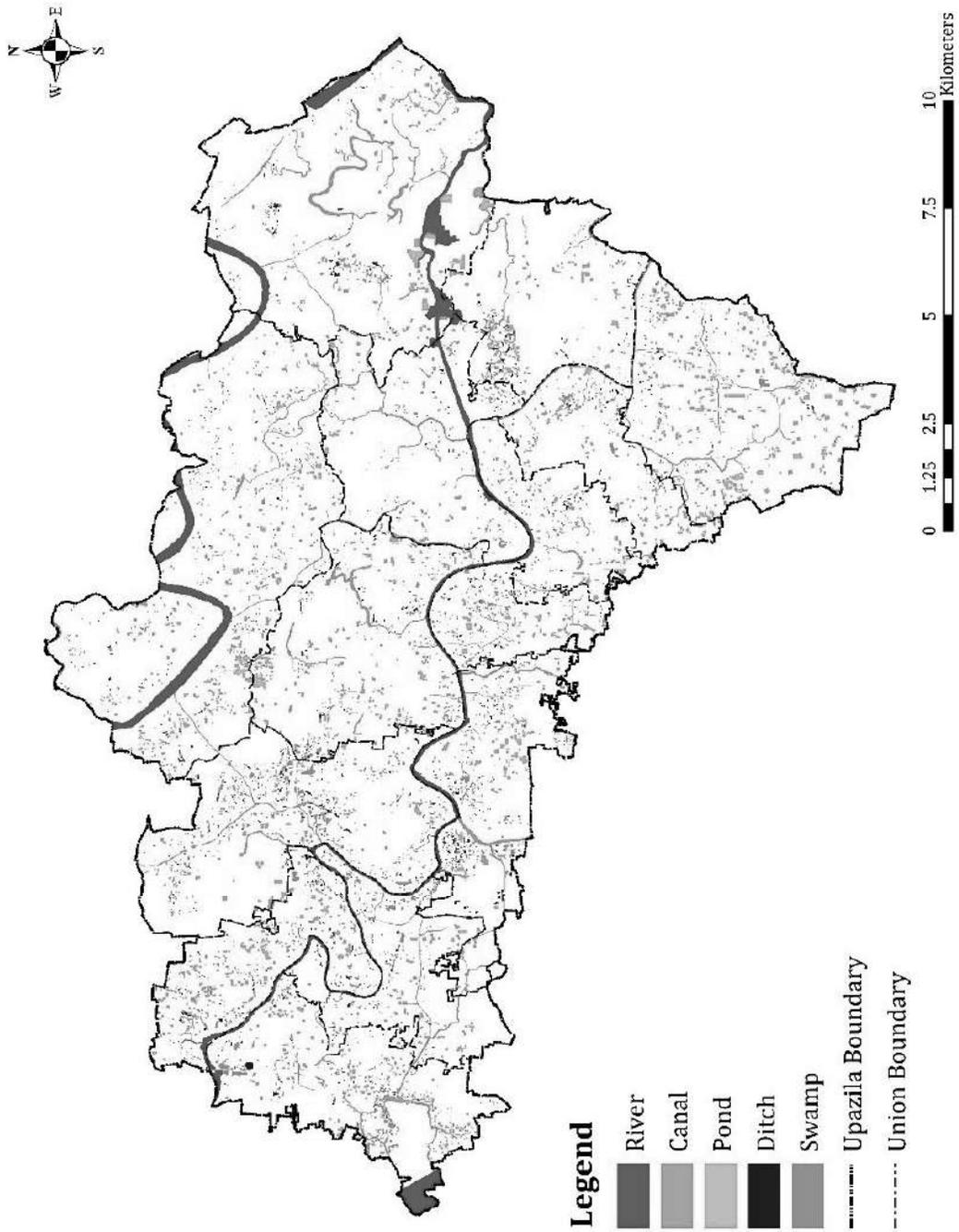


Figure 4-7: Waterbodies of Nawabganj Upazila

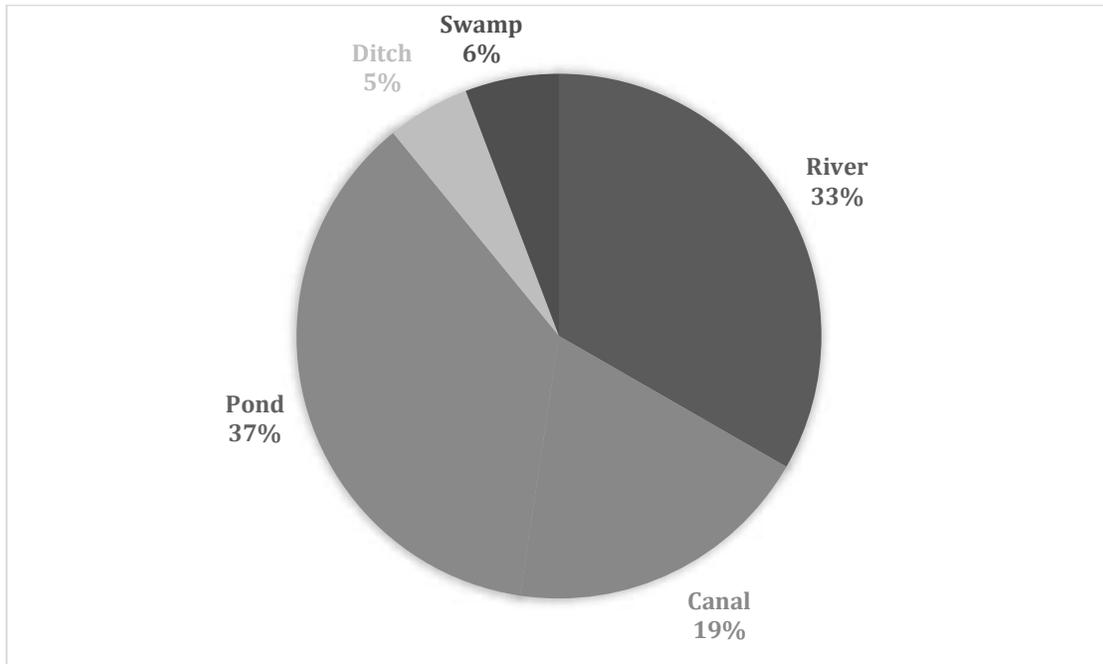


Figure 4-8: Share of Waterbodies by Type

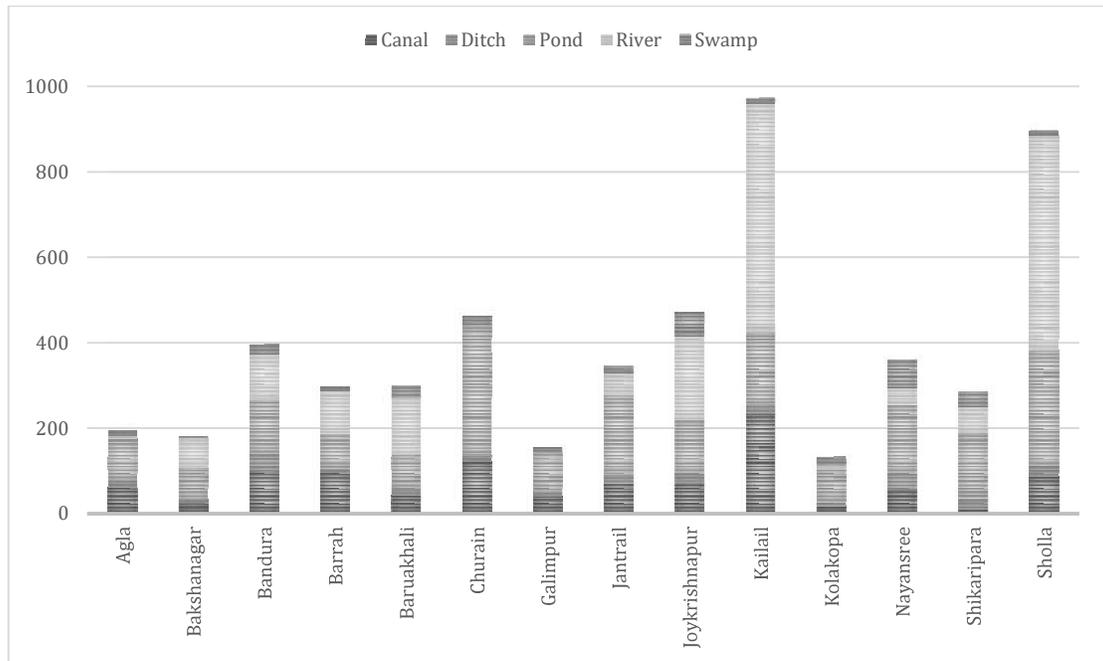


Figure 4-9: Union-wise Distribution of Waterbodies

Table 4-7 depicts the union-wise area of waterbodies. Kailail union has the highest area of rivers and canals which is 535.48 and 234.58 acres respectively. Also, Churain has a total area of 307.07acres comprising ponds. Nayansree and Joykrishnapur covers almost one-third of the swamp area in Nawabganj Upazila.

Table 4-7: Union-wise Area (in Acre) of Waterbodies

Union Name	Canal	Ditch	Pond	River	Swamp	Total
Agla	61.26	16.86	96.47	8.25	11.10	193.94
Bakshanagar	23.19	10.03	73.52	70.05	2.91	179.70
Bandura	101.78	38.92	125.03	108.93	21.11	395.76
Barrah	95.81	8.99	83.33	99.71	8.29	296.12
Baruakhali	42.21	14.82	81.12	132.31	27.31	297.77
Churain	121.94	13.77	307.07		19.42	462.20
Galimpur	40.80	10.13	91.64		12.05	154.61
Jantrail	70.96	21.01	186.22	51.57	14.43	344.19
Joykrishnapur	72.39	21.51	125.97	196.75	54.12	470.74
Kailail	234.58	21.69	168.49	535.48	12.74	972.97
Kolakopa	18.28	9.93	76.15	9.53	19.18	133.07
Nayansree	55.10	39.24	161.37	37.59	66.65	359.95
Shikaripara	11.17	25.00	153.84	59.01	35.13	284.16
Sholla	86.77	26.08	269.55	503.01	10.01	895.42
Grand Total	1036.22	277.95	1999.76	1812.19	314.46	5440.58

Source: Field Survey, 2023

Table 4-8 demonstrates information on the water bodies within Nawabganj Upazila. It highlights several significant rivers, including the Kaliganga (17.04 km), Ichamati (38.73 km), Padma (1.2 km), and Dhaleshwari (2.6 km) rivers. Additionally, it lists numerous canals such as Hatuira Canal (8.15 km) and Paiksha Canal (8.44 km), with lengths varying from 0.36 km (Nalgora Canal) to 8.44 km. These rivers and canals are crucial for Nawabganj's water management, irrigation, transportation, and local ecosystems, supporting both agricultural and daily life activities in the region.

Table 4-8: Length of Major River and Canal

Name	Length (km)
River	
Kaliganga River	17.04
Ichamati River	38.73
Padma River	1.2
Dhaleshwari River	2.6
Canal	
Hatuira Canal	8.15
Tashulya Canal	4.87
Paiksha Canal	8.44
Balengar Canal	3.14
Katakhali Canal	5.1
Dighogram Boro Canal	7.28
Hayatkanda Canal	3.68
Haichora Canal	1.95
Shapkhali Canal	1.55
Balur Char Canal	1.27
Madhabpur Canal	2.14
Bahra Ulman Canal	4.63
Dorikanda Canal	1.48

Name	Length (km)
Kiranchi Canal	2.28
Krishnakhali Canal	1.12
Amai Canal, Raipur	1.95
Nalgora Canal	0.36
Chandrakhola Canal	3.93
Rani Canal	4.44
Morgashi Canal	1.88
Rani Khali Canal	4.55
South Balukhanda Canal	1.67
Shyampur Canal	1.99
Hazratpur Canal	2.72
Kamarkhola Canal	3.84

Source: Field Survey, 2023

Table 4-9 provides an overview of pond sizes in Nawabganj Upazila, categorized into three groups based on their area. Ponds smaller than 0.5 acres make up the majority, with 804.61 ponds covering a total area of 3763 acres, accounting for 76.16% of the total pond area. Ponds between 0.5 and 1.0 acres comprise 527.91 ponds, covering 773 acres and contributing to 15.64% of the total area. Meanwhile, ponds larger than 1.0 acre total 667.24 ponds, with a combined area of 405 acres, making up 8.20% of the overall pond area. This distribution highlights that smaller ponds (<0.5 acres) dominate the landscape of Nawabganj Upazila, while larger ponds represent a smaller portion of the total pond area.

Table 4-9: Pond Size by Number and Area

Area of Pond (Acre)	Number	Total Area (Acre)	Percentage (%)
< 0.5	804.61	3763.00	76.16%
0.5 - 1.0	527.91	773.00	15.64%
>1.0	667.24	405.00	8.20%

CHAPTER FIVE: PHYSICAL FEATURES

5.1 Introduction

For preparation of any urban development plan, it is essential to have a comprehensive understanding of all the features on land surface of the entire project area. This helps to identify opportunities to provide new infrastructure and assess the level and number of properties going to be affected due to development. The "Physical Feature Survey" is a thorough examination of the entire area of its physical features that documented the findings on specialized maps and in soft copies. Nawabganj Upazila is a place with significant potential waiting to be uncovered. However, before any changes, such as constructing new structures, it is crucial to have a clear understanding of what already exists. This study followed a set of guidelines known as the "Terms of Reference," which facilitated a systematic and organized survey. It involved a comprehensive assessment of natural elements like land and water, as well as man-made structures such as buildings and roads. The survey collected two types of data-attributes and non-attribute.

5.2 Attribute Data Collected

During the physical feature survey, various details were gathered through the field investigation. Different aspects like buildings, roads, waterways, and more were observed. Information about the type of buildings, their age, names, number of floors, no of dwelling units, ownership, and use was recorded. Additionally, details about drainage systems, roads, bridges, water bodies, and locations where people access electricity were also noted. Even smaller features, such as special places, farmland with various crops, areas for leisure, historical sites, places of worship, and open spaces, were documented.

In simple terms, everything that could be seen with our own eyes was carefully documented during the survey and then transferred onto maps.

Various elements' locations, characteristics, and attributes were collected from every part of Nawabganj Upazila by carefully surveying the physical features. The main goal was to understand how things are right now in the Upazila. This helps making plan for the future and make smart decisions. The survey work sets the ground for sensible and considerate development that matches what's already here.

Table 5-1: Attribute Collection Table

Feature Type (Structure)	Attributes Collected	Feature Type (Road)	Attributes Collected
Structure Type	1. Pucca (RCC) 2. Pucca (Masonry) 3. Semi Pucca 4. Kutcha 5. Under Construction	Road Name	
Tenure Type	1. Owner Occupied 2. Tenant Public 3. Tenant Private 4. Squatting	Road Surface type	1. BC 2. RCC 3. HBD 4. WBM 5. Earthen 6. Other
Construction Year		Road surface condition	1. Good 2. Fair 3. Poor 4. Critical
Number of floors		Road Width	
Structure name		Footpath (If any)	
Holding No		Surface Type	1. BC 2. RCC 3. HBD 4. WBM 5. Earthen 6. Other
Dwelling Unit			
Ownership	1. Government 2. non-Government 3. Private 4. Religious		
Use of different Floors			
Locality Name			

Feature Type (Drain)	Attributes Collected	Feature Type (Waterbody)	Attributes Collected
Material Type	1. Concrete 2. Brick 3. Pipe 4. Earthen	Type	1. River 2. Natural Canal 3. Irrigation Canal 4. Pond 5. Ditch 6. Borrow Pit 7. Marsh
Drainage Condition	1. Good 2. Fair 3. Poor 4. Critical	Depth	
Width of the Drain		Ownership	1. Public 2. Private
Depth of the Drain			
Flowline of Drain			

Feature Type (Bridge/Culvert)	Attributes Collected
Name	
Type	1. Iron Bridge 2. RCC Bridge 3. Bailey Bridge 4. Pipe Culvert 5. Sluice Gate 6. Railway Bridge
Length	
Width	
Construction Year	
Condition	1. Good 2. Fair 3. Poor 4. Critical

Feature Type (Electricity, Gas)	Attributes Collected
Substation	If there is any point out the area
Power Station	
Transformer	

Agriculture	Single Crop Land, Double cropland, Triple cropland, Barren land, Orchard, Different types of flower garden, Hatchery/Gher/Livestock/Dairy Farm/Agricultural Research Area
Recreational	Cinema Hall, Theater Hall, Museum & Art gallery, Auditorium /Community Center/Town Hall, Park/Playground/Amusement Park/Theme Park, Stadium/Gymnasium/Swimming Pool, Tennis Complex
Places of Worship	Mosque, Eidgah / Mazar/ Dargha, Temple, Church, Pagoda and other place of worship
Restricted Area	Cantonment/SOR/Navy, Police Station, Ansar Camp, Jail, TV Station, Radio Station, T&T Board, Power Supply Station
Heritage Site	Archeological site, Old zamidar bari, palace, other Historic Sites,
Open space	National Park/Botanical Garden, Zoological Park, Forest Land/Urban Green, Ecological Park/sites, River Bank, Shore line in case of coastal pourashavas
Water bodies	Pond, Tank, Beels, Lakes, Rivers, Khals, Streams, Drain
Graveyard	Graveyard, Cemetery, Cremation place
Miscellaneous	Solid Waste Dumping Ground, Slaughter House, Water Pump House, Hazardous Area, Monument, Shahid Minar

5.3 Growth and Distribution of Buildings (LGED vs UDD)

There was a noticeable increase in residential, commercial, and industrial building projects in Nawabganj Upazila between 2016 and 2023. New homes, apartment buildings, and gated communities were built as a result of the population growth and the ensuing increase in housing demand. In addition, the growth of economic activity prompted the construction of marketplaces, office buildings, and shopping centers to meet the expanding demands of both customers and businesses.

Table 5-2: Union-wise Growth Distribution of Structures

Union	UDD Survey, 2016	LGED Survey, 2023	Increase	% of increase
Agla	4443	8763	4320	97.23
Bakshanagar	4453	10762	6309	141.68
Bandura	6497	20345	13848	213.14
Barrah	5206	15364	10158	195.12
Baruakhali	3686	11097	7411	201.06
Churain	4404	13284	8880	201.63
Galimpur	2528	6710	4182	165.43
Jantrail	5005	15843	10838	216.54
Joykrishnapur	4723	13298	8575	181.56
Kailail	5406	18702	13296	245.95
Kolakopa	6389	11274	4885	76.46
Nayansree	6871	20619	13748	200.09
Shikaripara	4670	12675	8005	171.41
Sholla	9082	32258	23176	255.19
Grand Total	73363	210994	137631	187.60

Source: Field Survey, 2023

Over the period from 2016 to 2023, Nawabganj Upazila witnessed significant urbanization and development across its various unions. The data reflects a remarkable increase in the number of buildings in each union, with growth ranging from 76.46% in Kolakopa to an impressive 255.19% in Sholla. On average, there was a notable surge of 187.60% in building numbers across all unions during this period. This surge underscores the rapid pace of socio-economic changes and infrastructure development within the region, indicating substantial urban expansion and population growth.

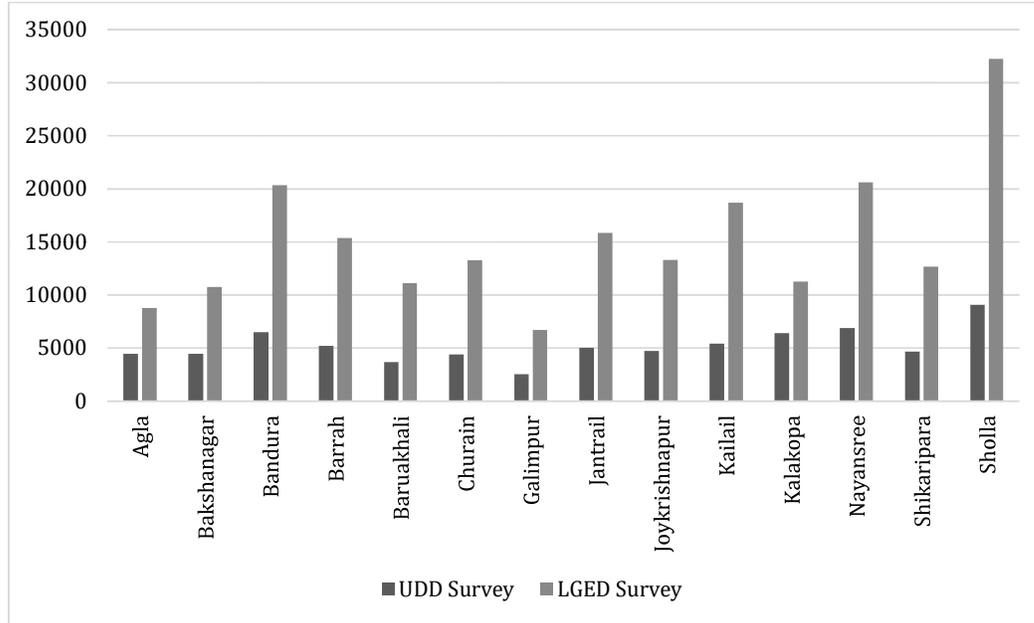


Figure 5-1: Union-wise Growth and Distribution of Buildings

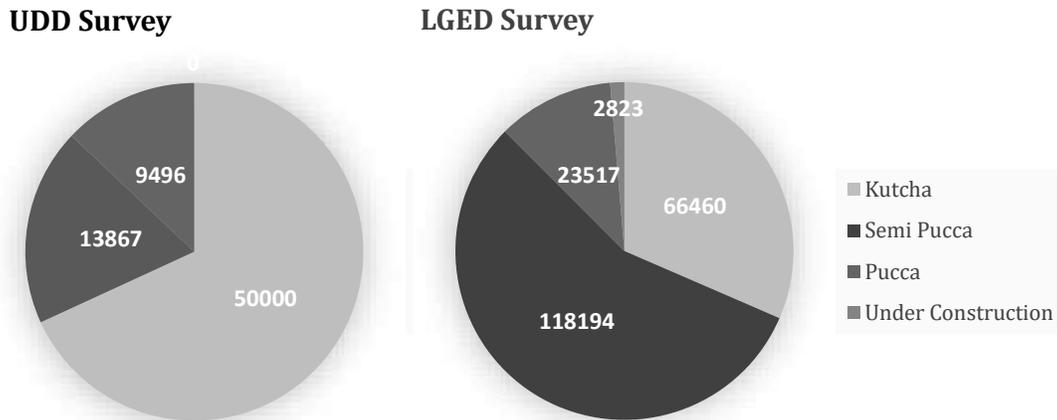


Figure 5-2: Comparison of Structures between UDD Survey and LGED Survey

The comparison between the UDD Survey of 2016 and the LGED Survey of 2023 reveals a notable increase in the number of structures across all categories. Kutcha structures saw a rise from 50000 to 66460, Pucca structures more than doubled from 9496 to 23517, and Semi Pucca structures experienced a substantial surge from 13867 to 118194. Additionally, 2823 structures were reported as under construction in the LGED Survey of 2023, indicating ongoing development activities. This data underscores significant urbanization and development trends, with a notable shift towards the construction of more permanent and durable structures, alongside continued investment in infrastructure.

5.4 Structure

As a recently set up upazila, changes have happened in the main part of the upazila. This includes extension of businesses and the human settlement. It is to be noted that most buildings in Nawabganj are "kutcha" buildings. These buildings are made by bamboo, mud, thatch, or tin. In more recent times, there have been new buildings constructed that have a modern appearance. They come with various designs that match the way the people live today. These buildings indicate the growth and changes taking place in the area.

In Nawabganj, there are several places of worship where people go to pray, like mosques and temples. Each of these places has its unique design that reflects its beliefs. Additionally, there are structures serving as shops, schools, and offices that keep the place functioning.

5.4.1 Construction Type

A substantial amount of information about various types of buildings has been collected through the comprehensive survey of the area. This information on structure has been categorized into three primary groups: pucca, semi-pucca, and kutcha/tin shed. This classification aids in comprehending the assortment of buildings within the surveyed region.

1. Pucca Structures: Buildings falling under this category have brick walls and a concrete roof. These types of structures are well-built and durable, with walls made of bricks and a strong roof made of concrete. The number of pucca structures stands of 23517 and the percentage is 11.15%.

2. Semi-Pucca Structures: The second category includes surfaces with brick, concrete, or strong materials but roofs and walls made of materials other than concrete. This means the surface is sturdy and made of bricks, but the roof and partitions might be made of different materials instead of concrete. The number of semi-pucca structures is 118194 and it is almost 56.02% of total structures.

3. Kutcha Structures: The last category involves structures constructed using materials like earth, thatch, or tin for the walls. These materials may not be as strong as bricks. The roofs of these structures can also be made of materials like tin or thatch. This category has the second highest number with 66460 and the percentage is 31.50%.

Additionally, structures that have both walls and roofs made from materials other than tin, brick, or concrete are also categorized as kutcha structures. This category is a catch-all for structures that don't fit into the pucca or semi-pucca classifications due to the materials used in their construction.

LGED Survey, 2023

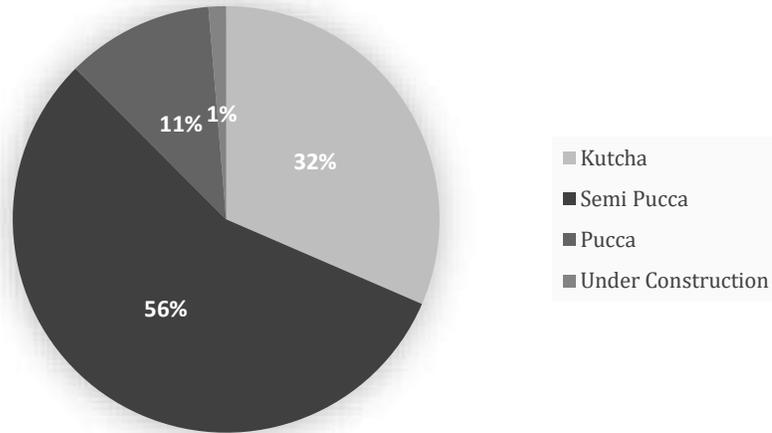


Figure 5-3: Share of Structure Type

The data on structure types in Nawabganj Upazila shows a distribution where 31.50% are "Kutcha" structures, 10.97% are "Pucca (RCC)" buildings, 0.18% are "Pucca (Masonry)" and 56.02% fall into the "Semi Pucca" category. A small fraction, about 1.34%, is currently "Under Construction." This data highlights the prevalence of temporary and less permanent structures in the area, with ongoing development efforts. The provided data offers a comprehensive overview of the structural composition of Nawabganj Upazila, organized under each union. Each union is characterized by different types of dwellings, including kutcha, pucca, semi-pucca, and those currently under construction. Agla, for example, comprises a total of 8763 structures, with kutcha, pucca (RCC & Masonry), semi-pucca, and under-construction units accounting for 32.48%, 17.15%, 48.16%, and 2.21% of the total, respectively. The data illustrates a varying distribution of these housing types across different unions, with Joykrishnapur and Kolakopa standing out for having a high percentage of kutcha and pucca structures, respectively. This information provides valuable insights into the upazila's housing infrastructure and highlights differences in construction types among its various union.

Type Unions	Kutcha		Pucca (Masonry)		Pucca (RCC)		Semi Pucca		Under Construction		Grand Total	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
Agla	2846	32.48	67	0.76	1436	16.39	4220	48.16	194	2.21	8763	100.00
Bakshanagar	1895	17.61	68	0.63	1623	15.08	6876	63.89	300	2.79	10762	100.00
Bandura	5140	25.26	4	0.02	2954	14.52	12018	59.07	229	1.13	20345	100.00
Barrah	4129	26.87	38	0.25	1923	12.52	9044	58.86	230	1.50	15364	100.00
Baruakhali	3550	31.99	2	0.02	923	8.32	6527	58.82	95	0.86	11097	100.00
Churain	3961	29.82	24	0.18	2023	15.23	6999	52.69	277	2.09	13284	100.00
Galimpur	1481	22.07	36	0.54	1086	16.18	3929	58.55	178	2.65	6710	100.00
Jantrail	6123	38.65	12	0.08	1581	9.98	7994	50.46	133	0.84	15843	100.00
Joykrishnapur	5663	42.59	6	0.05	699	5.26	6872	51.68	58	0.44	13298	100.00
Kailail	6314	33.76	43	0.23	1625	8.69	10590	56.62	130	0.70	18702	100.00
Kolakopa	1977	17.54	26	0.23	1969	17.46	6873	60.96	429	3.81	11274	100.00
Nayansree	6010	29.15	8	0.04	2009	9.74	12367	59.98	225	1.09	20619	100.00
Shikaripara	4210	33.21	8	0.06	1083	8.54	7224	56.99	150	1.18	12675	100.00
Sholla	13161	40.80	35	0.11	2206	6.84	16661	51.65	195	0.60	32258	100.00
Grand Total	66460	31.50	377	0.18	23140	10.97	118194	56.02	2823	1.34	210994	100.00

Table 5-3: Union-wise Structure Type

5.4.2 Dwelling Unit

Under physical feature survey, surveyors determined the count of dwelling units within each house across the upazila. The data on the number of dwelling units has been organized in the table below to provide a union-wise breakdown of dwelling unit information.

Table 5-4: Union-wise Dwelling Unit Share

Union	Dwelling Unit	Percentage (%)
Agla	6036	4.59
Bakshanagar	7147	5.44
Bandura	12083	9.20
Barrah	9937	7.56
Baruakhali	6627	5.04
Churain	9530	7.25
Galimpur	4773	3.63
Jantrail	9890	7.53
Joykrishnapur	8402	6.39
Kailail	10759	8.19
Kolakopa	8195	6.24
Nayansree	11549	8.79
Shikaripara	7498	5.71
Sholla	18976	14.44
Grand Total	131402	100.00

Source: Field Survey, 2023

The dwelling unit data for Nawabganj Upazila, categorized by union, offers a glimpse into the distribution of residential housing within Upazila. Sholla emerges as having the highest concentration of dwelling units, with 14.44% of the total, indicating a relatively dense residential presence in this union. Bandura closely follows, contributing 9.20%, and reflecting a comparable amount of residential accommodations. Conversely, Galimpur has the lowest proportion at 3.63%, signifying a lower number of dwelling units within this union. The remaining unions exhibit varying percentages, ranging from 4.59% to 8.79%, highlighting their distinct residential landscapes. In total, there are 131402 dwelling units in Nawabganj Upazila, and this data provides essential information for urban planning and housing development strategies, aiding in resource allocation and infrastructure decisions.

Table 5-5: Status of Per Capita Living Space in Nawabganj Area

Floor Space	Square Feet	Per Capita Living Space (sft/person)
Total Floor Space	100296689.03	287.56
Total Residential Floor Space	73857013.76	211.75

5.4.3 Floor Height

The data on floor height in Nawabganj Upazila reveals that the majority of structures, at 95.23%, consist of just one floor, indicating a predominance of single-story buildings in the area. Multi-

story structures are relatively rare, with two-story buildings at 3.62%, three-story buildings with 0.77%, four-story buildings at 0.25%, five-story buildings at 0.09%, six-story buildings at 0.02% and even two seven-story building at 0.01%. This data highlights the dominance of single-story structures in Nawabganj Upazila's building landscape.

Table 5-6: Floor Height Percentage

Floor Number	Structures	Percentage (%)
1	206326	95.23%
2	3925	3.62%
3	559	0.77%
4	133	0.25%
5	40	0.09%
6	9	0.02%
7	2	0.01%
Grand Total	210994	100.00%

Source: Field Survey, 2023

Table 5-7: Union-wise Floor Height

Union	Floor 1	Floor 2	Floor 3	Floor 4	Floor 5	Floor 6	Floor 7	Grand Total
Agla	8503	224	31	3	1		1	8763
Bakshanagar	10341	353	54	13		1		10762
Bandura	19719	522	78	18	6	2		20345
Barrah	15041	284	34	3	2			15364
Baruakhali	10937	148	11	1				11097
Churain	12798	419	53	12	1	1		13284
Galimpur	6451	215	35	9				6710
Jantrail	15574	231	32	4	2			15843
Joykrishnapur	13215	81	2					13298
Kailail	18385	278	32	7				18702
Kolakopa	10562	495	135	49	27	5	1	11274
Nayansree	20330	273	12	4				20619
Shikaripara	12482	168	23	2				12675
Sholla	31988	234	27	8	1			32258
Grand Total	206325	3925	559	133	40	9	2	210994

Source: Field Survey, 2023

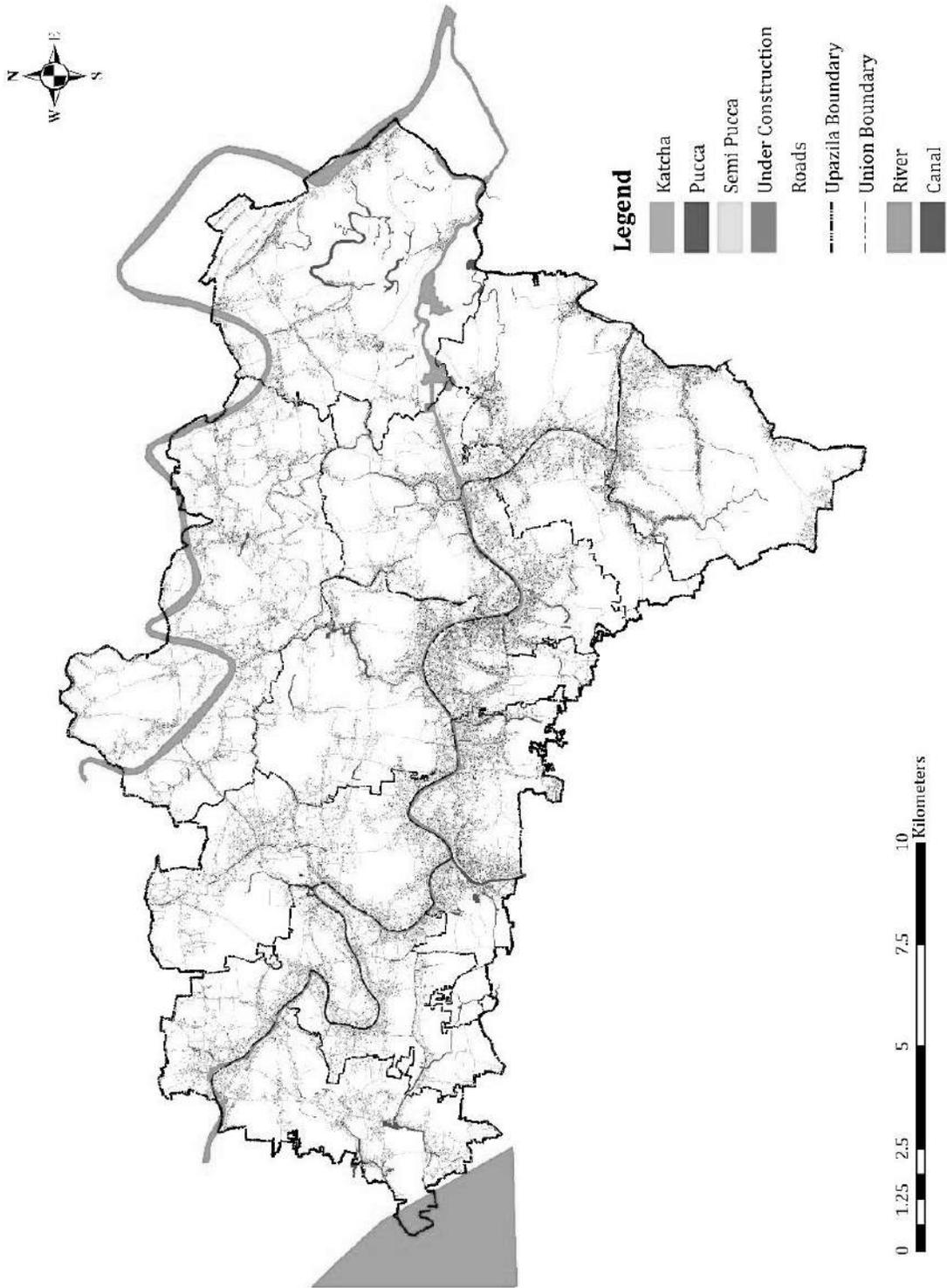


Figure 5-4: Structure Type Map

The union-wise data on floor heights is presented as a percentage distribution. It offers a comprehensive view of the built-up landscape within each union. Kolakopa emerges as the union with the most diverse range of floor heights, where approximately 93.68% of structures have one floor, 4.39% have two floors, 1.20% have three floors, 0.43% have four floors, 0.24% have five floors, 0.04% have six floors and a minor 0.01% are seven-story buildings, collectively summing up to 100% of the structures within the union. Similarly, Sholla displays the least variety in floor heights, with approximately 99.16% consisting of one-floor buildings, 0.73% being two-floor structures, 0.08% comprising three-floor buildings, and 0.02% representing four-floor buildings.

Table 5-8: Union-wise Floor Height Share

Union	Floor 1	Floor 2	Floor 3	Floor 4	Floor 5	Floor 6	Floor 7	Grand Total
Agla	97.03	2.56	0.35	0.03	0.01	0.00	0.01	100.00
Bakshanagar	96.09	3.28	0.50	0.12	0.00	0.01	0.00	100.00
Bandura	96.92	2.57	0.38	0.09	0.03	0.01	0.00	100.00
Barrah	97.90	1.85	0.22	0.02	0.01	0.00	0.00	100.00
Baruakhali	98.56	1.33	0.10	0.01	0.00	0.00	0.00	100.00
Churain	96.34	3.15	0.40	0.09	0.01	0.01	0.00	100.00
Galimpur	96.14	3.20	0.52	0.13	0.00	0.00	0.00	100.00
Jantrail	98.30	1.46	0.20	0.03	0.01	0.00	0.00	100.00
Joykrishnapur	99.38	0.61	0.02	0.00	0.00	0.00	0.00	100.00
Kailail	98.30	1.49	0.17	0.04	0.00	0.00	0.00	100.00
Kolakopa	93.68	4.39	1.20	0.43	0.24	0.04	0.01	100.00
Nayansree	98.60	1.32	0.06	0.02	0.00	0.00	0.00	100.00
Shikaripara	98.48	1.33	0.18	0.02	0.00	0.00	0.00	100.00
Sholla	99.16	0.73	0.08	0.02	0.00	0.00	0.00	100.00
Grand Total	97.79	1.86	0.26	0.06	0.02	0.00	0.00	100.00

Source: Field Survey, 2023

On the other hand, almost every union predominantly consist of single-story structures, with approximately 93.68% to 99.16% respectively having only one floor. This data depicts a diverse architectural composition across different unions in Nawabganj Upazila, reflecting variations in building heights and providing crucial insights for urban planning, infrastructure development, and resource allocation strategies within the upazila.

Table 5-9: Union-wise Floor Area of Residential Structures

Union Name	Katcha	Semi Pucca	Pucca	Grand Total
Agla		351.63	546.31	1315.56
Bakshnagar		387.78	606.31	1343.96
Bandura		292.80	566.76	1531.36
Barrah		352.63	509.00	1302.45
Baruakhali		359.07	510.29	1300.57
Churain		330.20	495.66	1377.82
Galimpur		331.98	531.76	1285.65
Jantrail		310.54	542.72	1301.35
Joykrishnapur		309.85	449.23	1272.01
Kailail		309.66	417.76	1279.38

Kolakopa	259.98	568.56	1344.84	733.89
Nayansree	375.96	555.87	1440.70	640.28
Shikaripara	317.74	561.46	1361.99	593.20
Sholla	345.60	491.46	1338.99	521.19
Grand Total	329.34	519.58	1359.88	606.09

The table provide insights into the housing distribution across different unions of Nawabganj Upazila based on three categories: Katcha (non-permanent), Semi Pucca (semi-permanent), and Pucca (permanent) houses. The grand total reflects the combined averages for each union, with 606.09 as the overall average. Kolakopa and Bakshnagar unions have relatively higher grand total averages, indicating greater housing development in these areas. Pucca housing has the highest average at 1359.88 units, indicating a significant portion of permanent homes across the unions. The average number of Semi Pucca houses is 519.58 units across the unions. The average Katcha housing across all unions is 329.34 units.

5.4.4 Structure Use

The structures of Nawabganj Upazila are used for different purposes, such as residential, mixed-use, health, educational, government, commercial, community facilities, agriculture, and restricted. The different unions in the upazila have different mixes of these uses.

The data provided in Figure 5-5 represents the structural composition, highlighting the distribution of usage within the upazila. Nawabganj Upazila is primarily characterized by residential use, accounting for a significant majority at 91.72% of the total structures followed by agriculture with 4.26%. This suggests a predominance of housing and dwelling land use within the locality, indicating a substantial population residing in the area. All other uses together make up a minor portion of the building use structure, collectively representing just 4.02% of the total area.

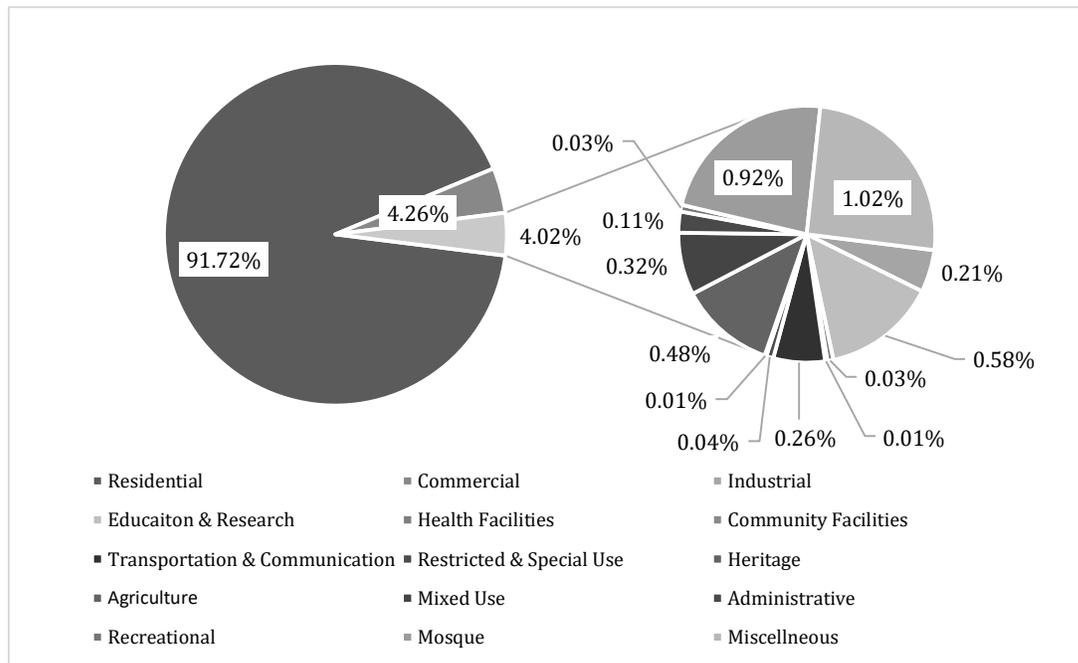


Figure 5-5: Share of Structure

Structure Use	Agla		Bakshaganagar		Bandura		Barrah		Baruakhali		Churain		Galimpur	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
Residential	8138	92.87	9487	88.15	18459	90.62	14479	94.29	10146	91.54	12265	92.54	6069	90.72
Commercial	183	2.09	743	6.93	1064	5.35	362	2.37	516	4.69	467	3.42	311	4.50
Industrial	5	0.06	37	0.34	59	0.29	6	0.04	33	0.29	15	0.11	13	0.18
Educaiton & Research	58	0.66	54	0.50	126	0.62	66	0.43	86	0.77	71	0.52	57	0.87
Health Facilities	2	0.02	5	0.05	5	0.02	4	0.02	4	0.03	3	0.02	4	0.06
Community Facilities	1	0.01	3	0.03	3	0.01		0.00	1	0.01	1	0.01	1	0.03
Transportation & Communication	32	0.36	46	0.42	74	0.36	45	0.29	33	0.28	36	0.26	21	0.29
Restricted & Special Use		0.00		0.00		0.00		0.00		0.00		0.00		0.00
Heritage	1	0.01		0.00	3	0.01	4	0.03		0.00		0.00		0.00
Agriculture	81	0.92	72	0.67	85	0.42	68	0.43	21	0.18	73	0.53	69	1.02
Mixed Use	33	0.37	76	0.70	77	0.37	36	0.23	24	0.19	54	0.39	20	0.28
Administrative	13	0.15	14	0.13	22	0.11	9	0.06	10	0.09	11	0.08	3	0.04
Recreational		0.00	3	0.03		0.00	2	0.01		0.00	14	0.10	1	0.01
Mosque	106	1.20	139	1.28	190	0.94	136	0.87	101	0.88	86	0.64	68	0.98
Miscellaneous	110	1.27	83	0.78	178	0.87	147	0.94	122	1.05	188	1.38	73	1.03
Grand Total	8763	100.00	10762	100.00	20345	100.00	15364	100.00	11097	100.00	13284	100.00	6710	100.00

Table 5-10: Union-wise Structure Use

Structure Use	Jantrail		Joykrishnapur		Kailail		Kolakopa		Nayansree		Shikaripara		Sholla	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
Residential	14662	92.89	12213	92.56	17173	92.60	9569	83.35	19149	92.04	11858	94.30	30020	94.41
Commercial	560	3.56	648	4.61	593	3.07	894	9.80	632	4.39	406	2.98	917	2.67
Industrial	24	0.14	25	0.18	49	0.23	125	0.95	53	0.21	8	0.05	64	0.11
Educaiton & Research	67	0.42	51	0.35	113	0.54	118	1.27	100	0.46	73	0.55	171	0.54
Health Facilities	5	0.03	3	0.02	7	0.03	12	0.08	5	0.02	3	0.02	11	0.02
Community Facilities	1	0.01	1	0.01	2	0.02	3	0.04		0.00		0.00	4	0.01
Transportation & Communication	32	0.18	26	0.16	34	0.15	30	0.22	42	0.17	25	0.15	50	0.07
Restricted & Special Use		0.00		0.00	7	0.03	90	0.82		0.00		0.00	1	0.00
Heritage		0.00		0.00		0.00	8	0.06		0.00	5	0.05		0.00
Agriculture	79	0.45	70	0.47	114	0.50	28	0.22	106	0.42	55	0.33	153	0.24
Mixed Use	61	0.34	7	0.04	56	0.25	103	0.73	21	0.08	22	0.17	65	0.12
Administrative	11	0.06	13	0.09	20	0.09	55	0.47	25	0.10	9	0.11	35	0.06
Recreational	1	0.01		0.00	9	0.04	51	0.45	1	0.00	2	0.01	1	0.00
Mosque	172	0.95	134	0.84	223	1.05	98	0.74	229	1.02	107	0.67	272	0.49
Miscellaneous	168	0.99	107	0.68	302	1.40	90	0.80	256	1.08	102	0.60	494	1.27
Grand Total	15843	100.00	13298	100.00	18702	100.00	11274	100.00	20619	100.00	12675	100.00	32258	100.00

Table 5-11: Union-wise Structure Use

Sholla is characterized by a predominant presence of residential structures, comprising a significant 94.41% of its total structures, highlighting it as a primarily residential area. Conversely, Galimpur stands out for its substantial percentage of agricultural structures, accounting for 1.02% of its total. This data underscores the diverse land usage patterns across different unions, from the predominantly residential nature of Barrah to the agricultural focus of Galimpur.

When it comes to educational facilities, Galimpur and Baruakhali are the frontrunners, contributing 0.87% and 0.77% to the overall composition, respectively. Kolakopa stands out as having a noteworthy administrative structure usage at 0.32%, implying the presence of significant administrative and governmental institutions.

Both commercial and industrial structures find their primary locations in Kolakopa with contributions of 9.80% and 0.95%, respectively. Followed by Bakshanagar with contributions of 6.93% and 0.34%, respectively.

Open space and recreational areas are somewhat scarce across most unions, underscoring the potential for further development in this aspect.

In summary, this data paints a vivid picture of the diverse and dynamic landscape of Nawabganj Upazila, revealing the pivotal roles played by residential, agricultural, commercial, educational, administrative, and industrial sectors in shaping the character of each union. These statistics provide valuable information for urban planning and development within the upazila.

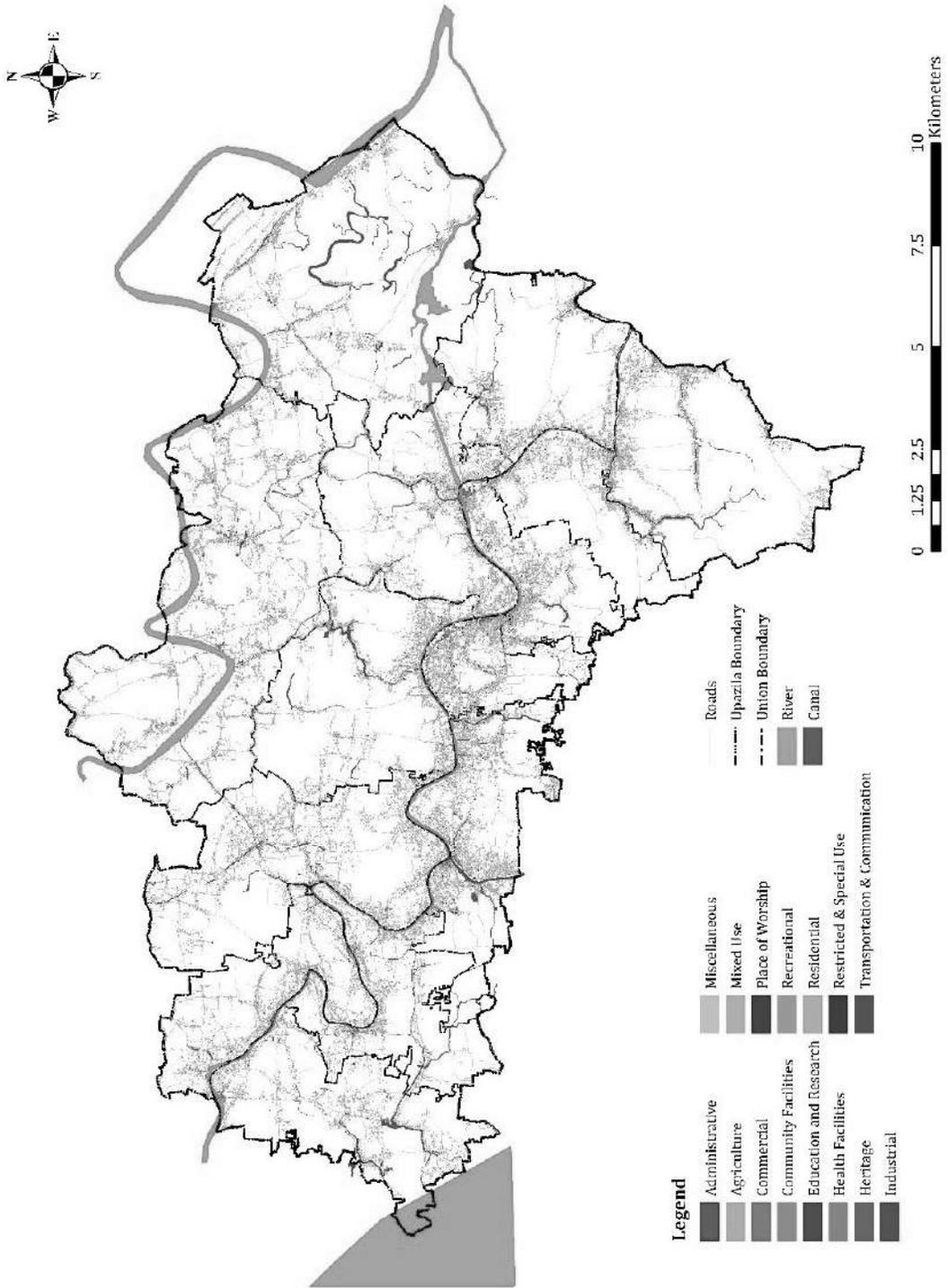


Figure 5-6: Distribution of Structure in Nawabganj Upazila

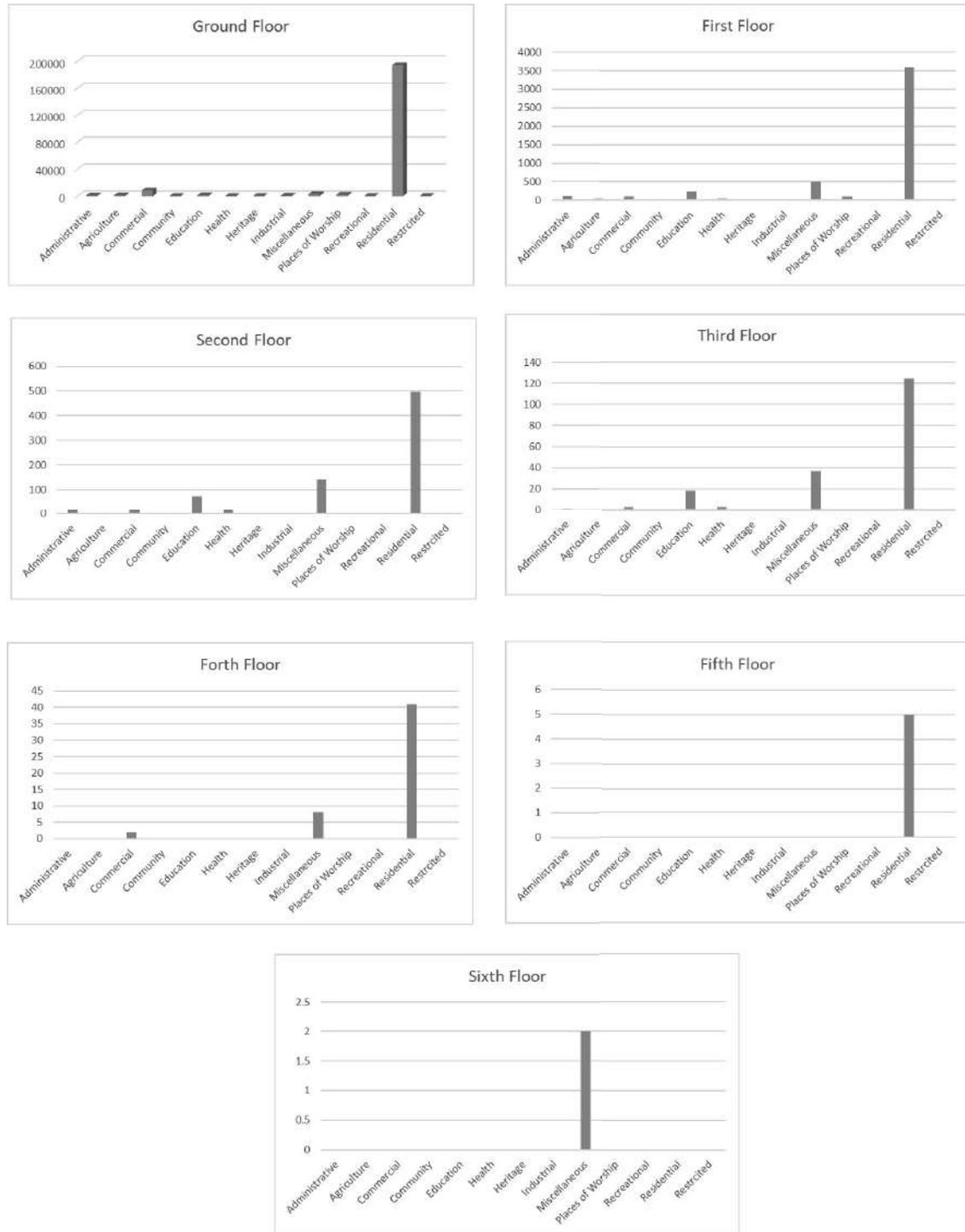


Figure 5-7: Floor wise structure use

5.4.5 Community Facilities

Community facilities are vital to any area as they provide everyday living services. These places, including libraries, parks, health centers, and recreational spaces, are considered the heart of the

community. This report will explore the importance of these special places within the project area, which include facilities like, education, leisure, healthcare, and cultural enrichment. The significance of these municipal assets will be examined, with their crucial role in improving the quality of life, promoting unity, and propelling our community to union a brighter future being highlighted by us.

5.4.5.1 Educational Facilities

The provided data shows a comprehensive overview of Nawabganj Upazila's educational facilities, showcasing the distribution of schools, colleges, coaching centers, and madrasas in the region. In the Nawabganj upazila, there are 139 primary schools, 45 high schools, 6 colleges and 76 Madrasas. Moreover, there are 43 kindergarten school and madrasas and 11 couching centers contributing significantly to the education sector. A significant number of madrasas reflect the cultural and religious diversity within the upazila. Altogether, this data illustrates a multifaceted educational environment in Nawabganj Upazila, catering to various educational needs and preferences of its residents.

Table 5-12: Educational Facilities

Union	Primary School	High School	College	Madrasa	Grand Total
Agla	7	1		5	13
Bakshanagar	8	2	1	2	13
Bandura	10	5		10	25
Barrah	10	2		6	18
Baruakhali	9	1		5	15
Churain	8	3	1	5	17
Galimpur	4	2	1	9	16
Jantrail	13	2		3	18
Joykrishnapur	8	2		2	12
Kailail	13	6		6	25
Kolakopa	5	6	1	9	21
Nayansree	14	5		4	23
Shikaripara	9	2	1	2	14
Sholla	21	6	1	8	36
Grand Total	139	45	6	76	266

Source: Field Survey, 2023

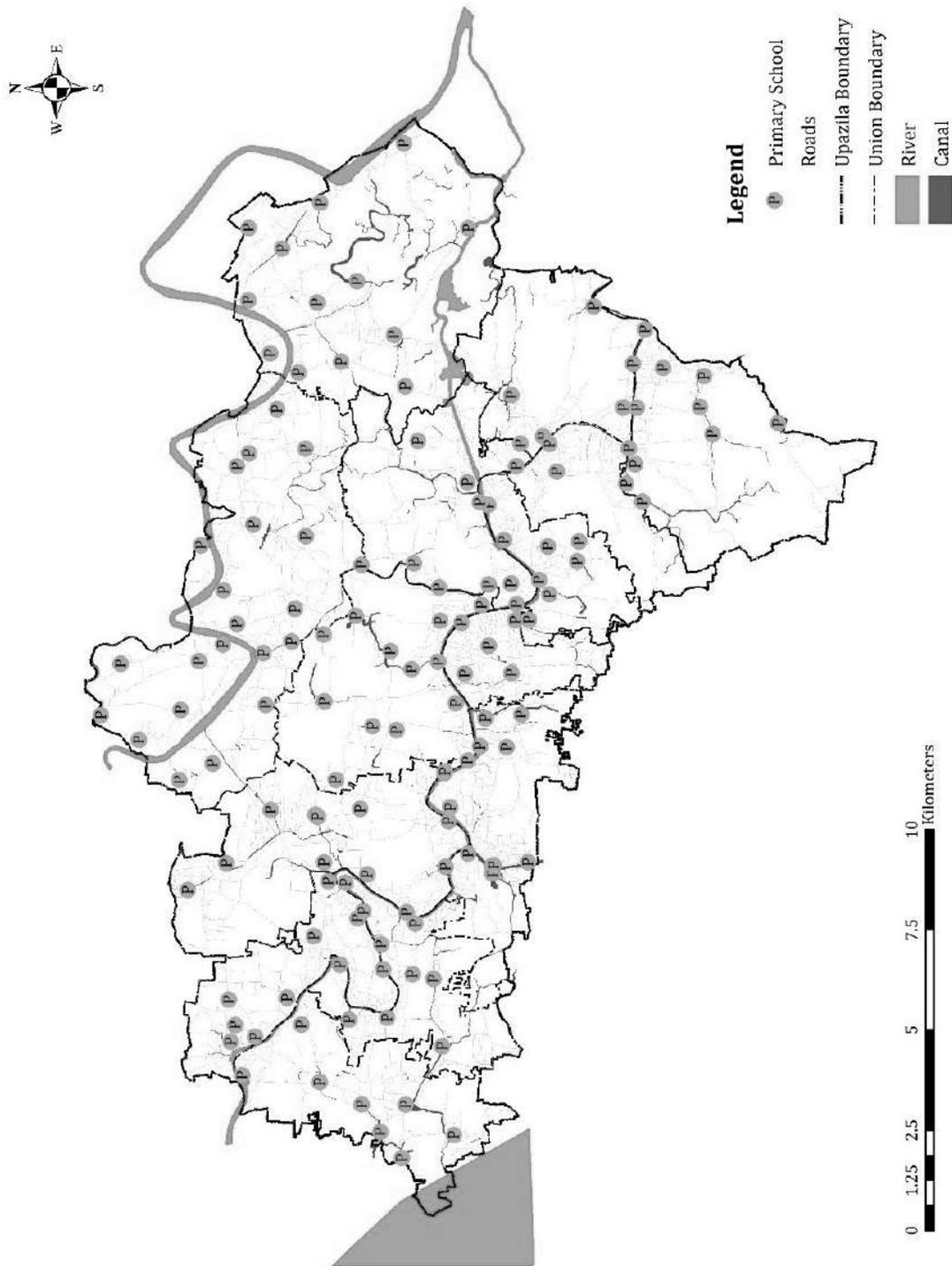


Figure 5-8: Primary School Location Map

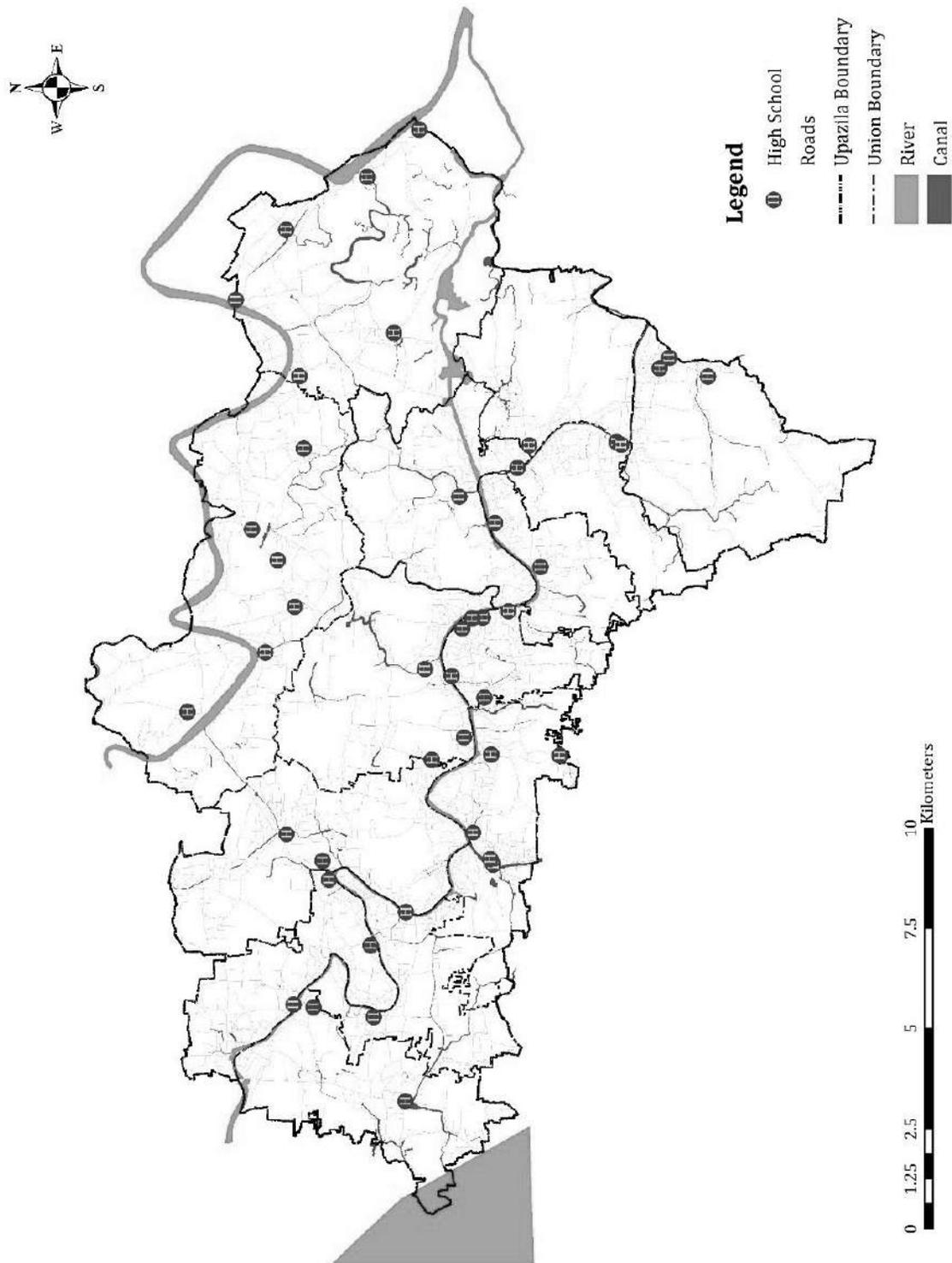


Figure 5-9: High School Location Map

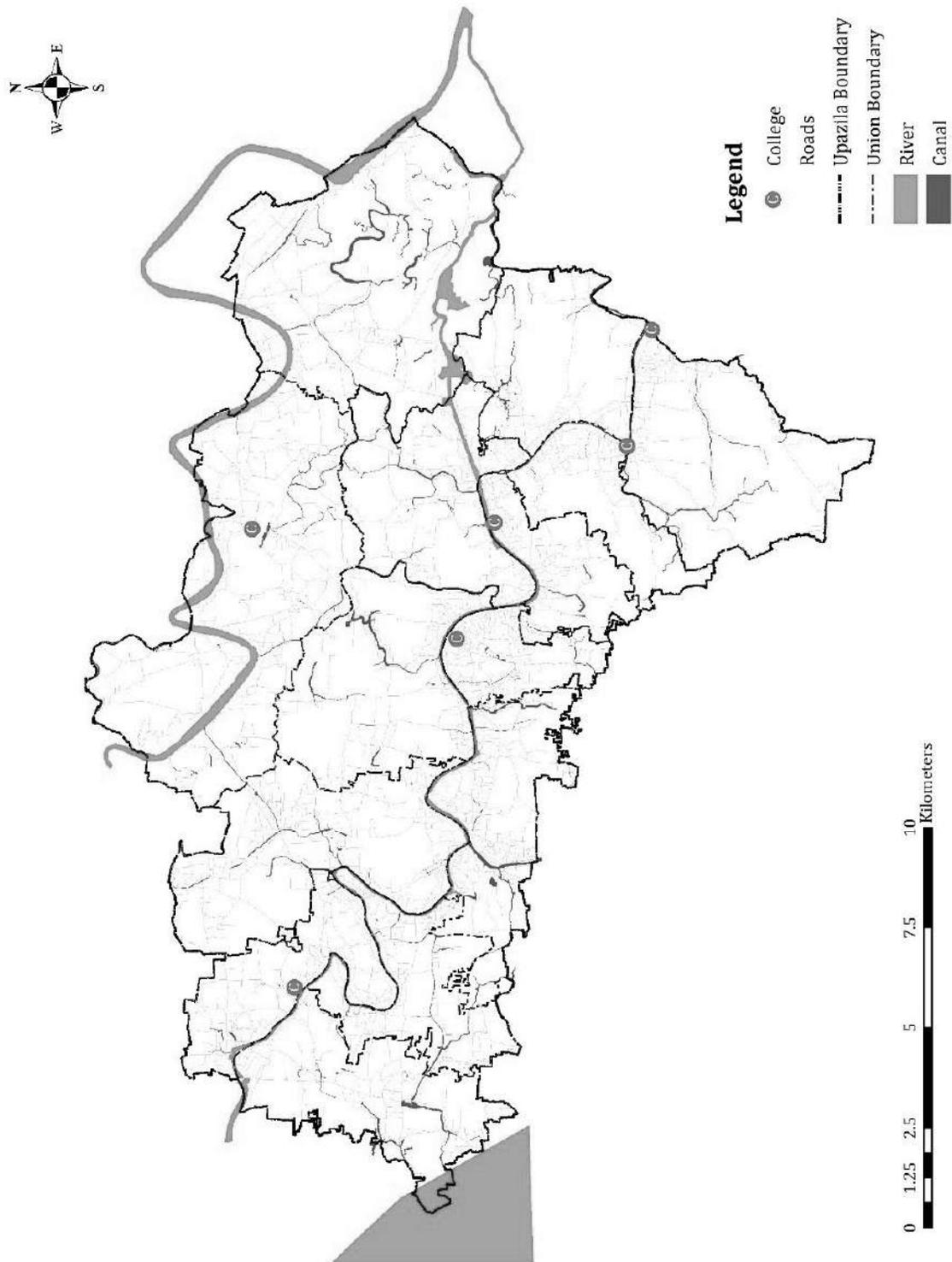


Figure 5-10: College Location Map

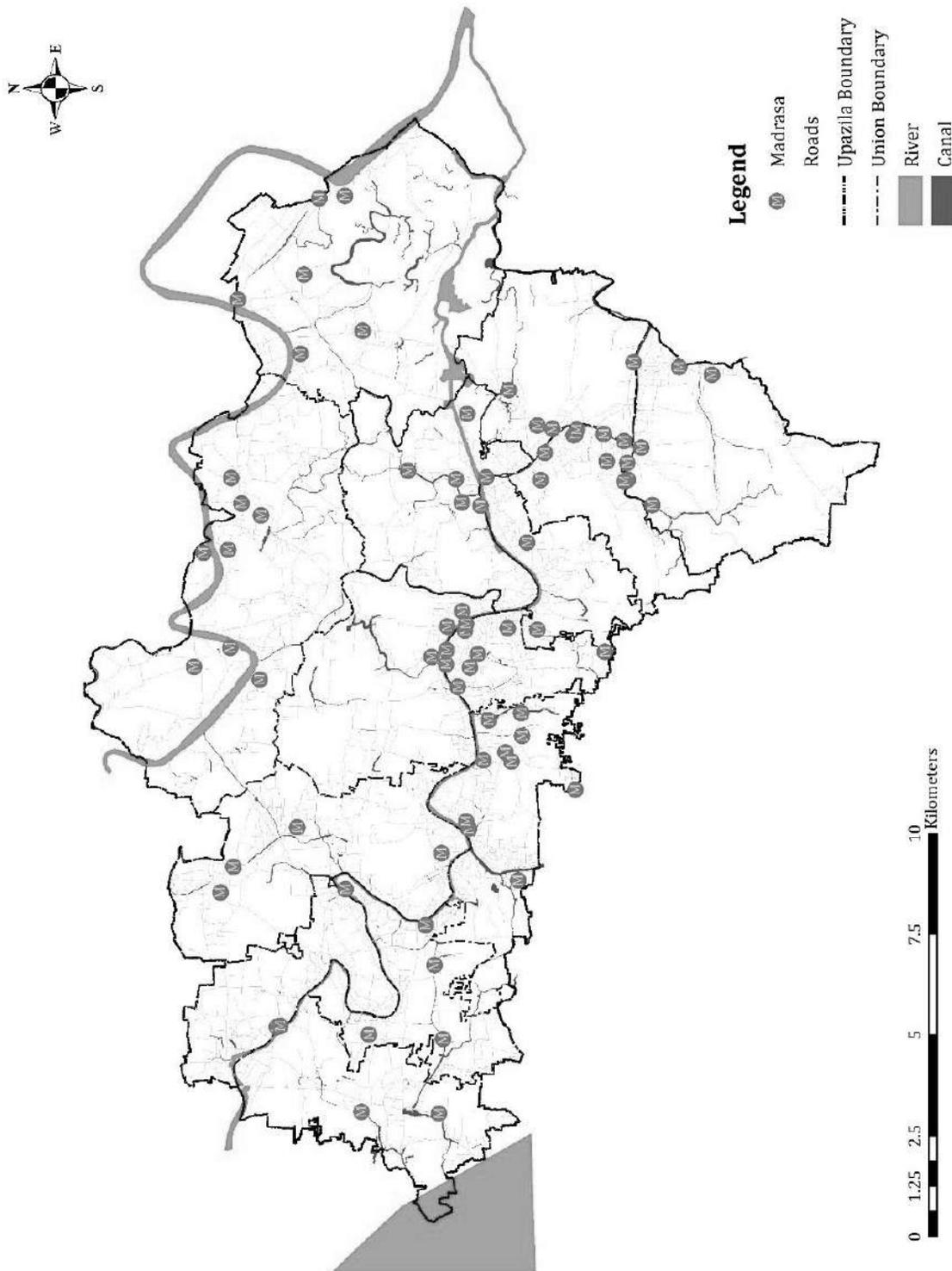


Figure 5-11: Madrasa Location Map

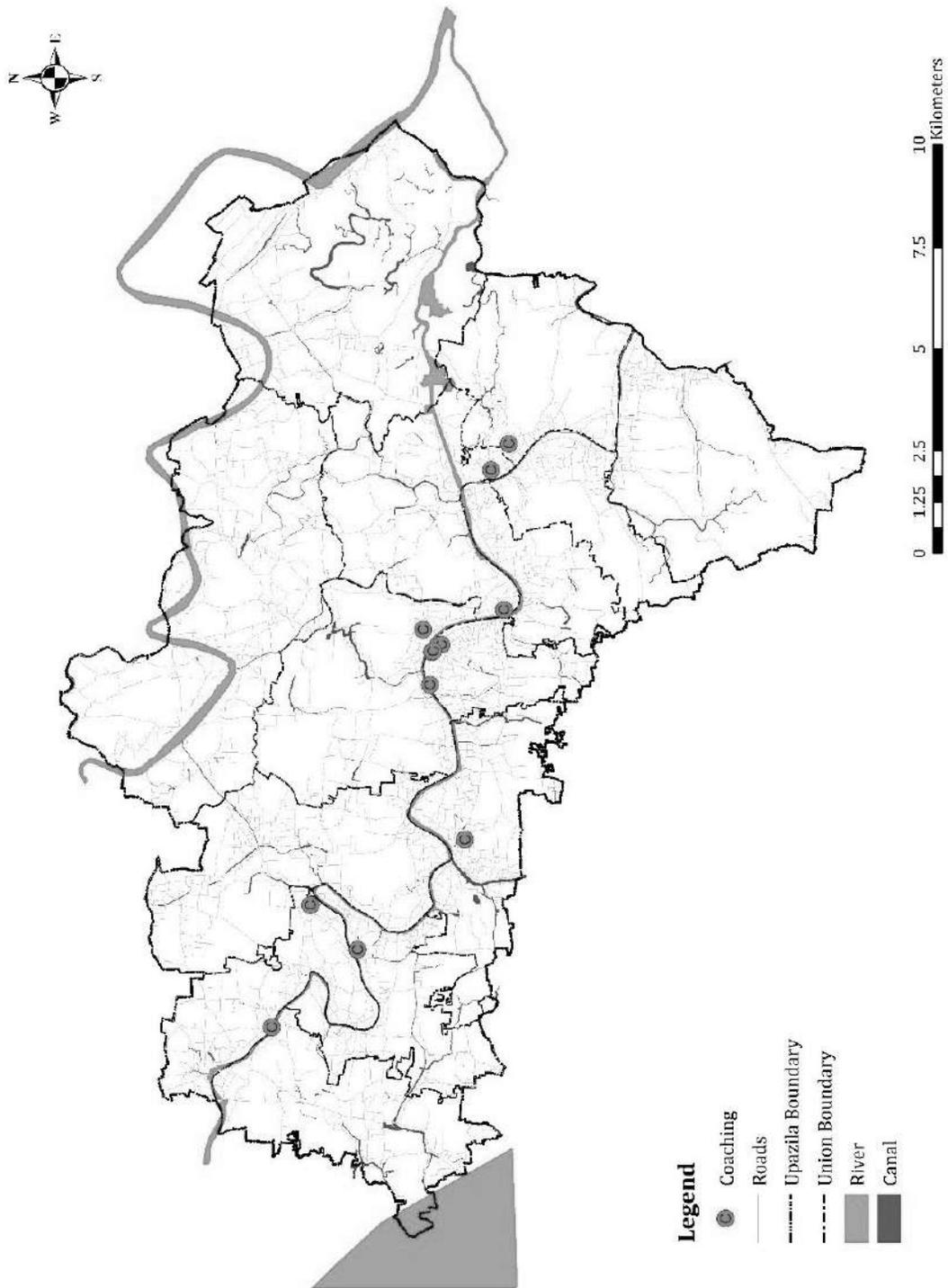


Figure 5-12: Coaching Centre Location Map

5.4.5.2 Healthcare Facilities

Table 5-12 shows the healthcare infrastructure of Nawabganj Upazila, outlining the distribution of hospitals and clinics in the area. Within the government sector, there is one hospital, 13 Union Health & Family Welfare Center (UHFWC) and 58 community clinics, indicating the provision of public healthcare services at both levels. In the non-government sector, there are 9 hospital or diagnostic centers, reflecting the active participation of private healthcare providers in meeting the healthcare needs of the community. Beside these, there are few private clinic and pharmacy which are also contributing to the health care facilities. Overall, this data underscores the upazila's commitment to ensuring access to healthcare services by maintaining government-run medical facilities while also accommodating the presence of private clinics to cater to the diverse healthcare requirements of the upazila's residents.

Table 5-13: Healthcare Facilities

Union Name	Community Clinic	Hospital	UHFWC	Grand Total
Agla	3		1	4
Bakshanagar	4		1	5
Bandura	7	1	1	9
Barrah	4		1	5
Baruakhali	2	1	1	4
Churain	2		1	3
Galimpur	2		1	3
Jantrail	5		1	6
Joykrishnapur	3		1	4
Kailail	5	1	1	7
Kolakopa	8	7		15
Nayansree	4		1	5
Shikaripara	2		1	3
Sholla	7		1	8
Grand Total	58	10	13	81

Source: Field Survey, 2023

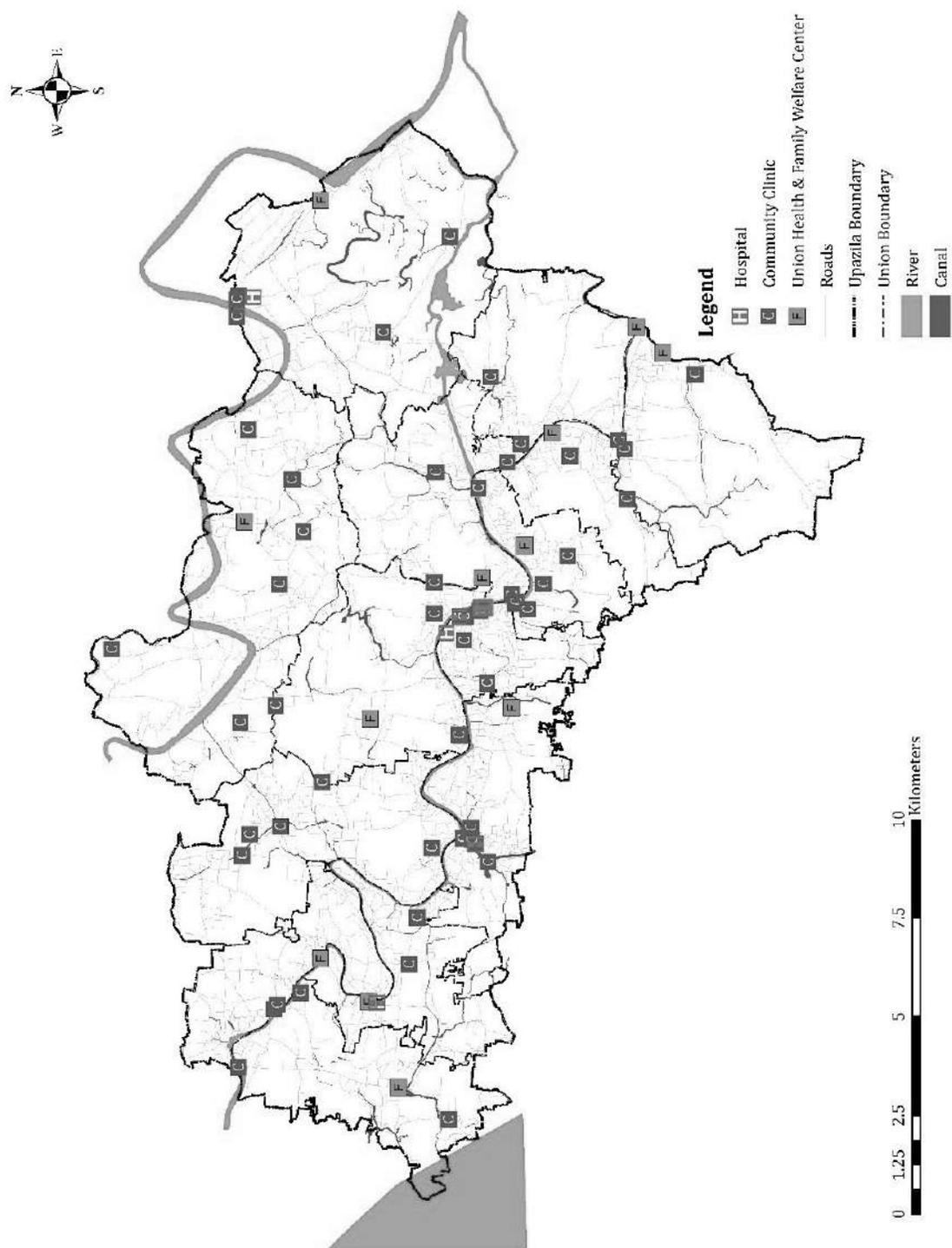


Figure 5-13: Location of Hospitals/Clinics

5.4.5.3 Administrative Facilities

The Administrative Structure Category includes both government and non-government structures used for administrative purposes. This category includes government buildings such as the Union Parishad building and the structures of other government departments and ministries. This category also includes offices run by banks, non-governmental organizations (NGOs), clubs, and private or corporate businesses. There are 250 constructions of this class in the Upazila or 0.11% of all structures.

5.4.5.4 Religious Facilities

The following data provides a succinct overview of the religious facilities within Nawabganj Upazila, outlining the number of mosques, temples, and churches in the upazila. The figures reveal a total of 614 mosques, indicating a significant presence of Islamic places of worship. Additionally, there are 533 temples and 7 churches, demonstrating the coexistence of diverse religious traditions within the community. With a total of 1154 religious' facilities, Nawabganj appears to be a place where multiple faiths are practiced and accommodated, fostering an environment of religious diversity and cultural richness. This data underscores the upazila's commitment to providing spaces for religious observance and reflects the harmonious cohabitation of various religious communities within the area.

Table 5-14: Religious Facilities

Union Name	Church	Mosque	Temple	Grand Total
Agla		28	27	55
Bakshanagar	2	47	38	87
Bandura	2	53	61	116
Barrah		48	21	69
Baruakhali		35	19	54
Churain		49	6	55
Galimpur		31	6	37
Jantrail		25	100	125
Joykrishnapur	1	40	35	76
Kailail		60	53	113
Kolakopa		37	23	60
Nayansree	2	53	49	104
Shikaripara		38	23	61
Sholla		70	72	142
Grand Total	7	614	533	1154

Source: Field Survey, 2023

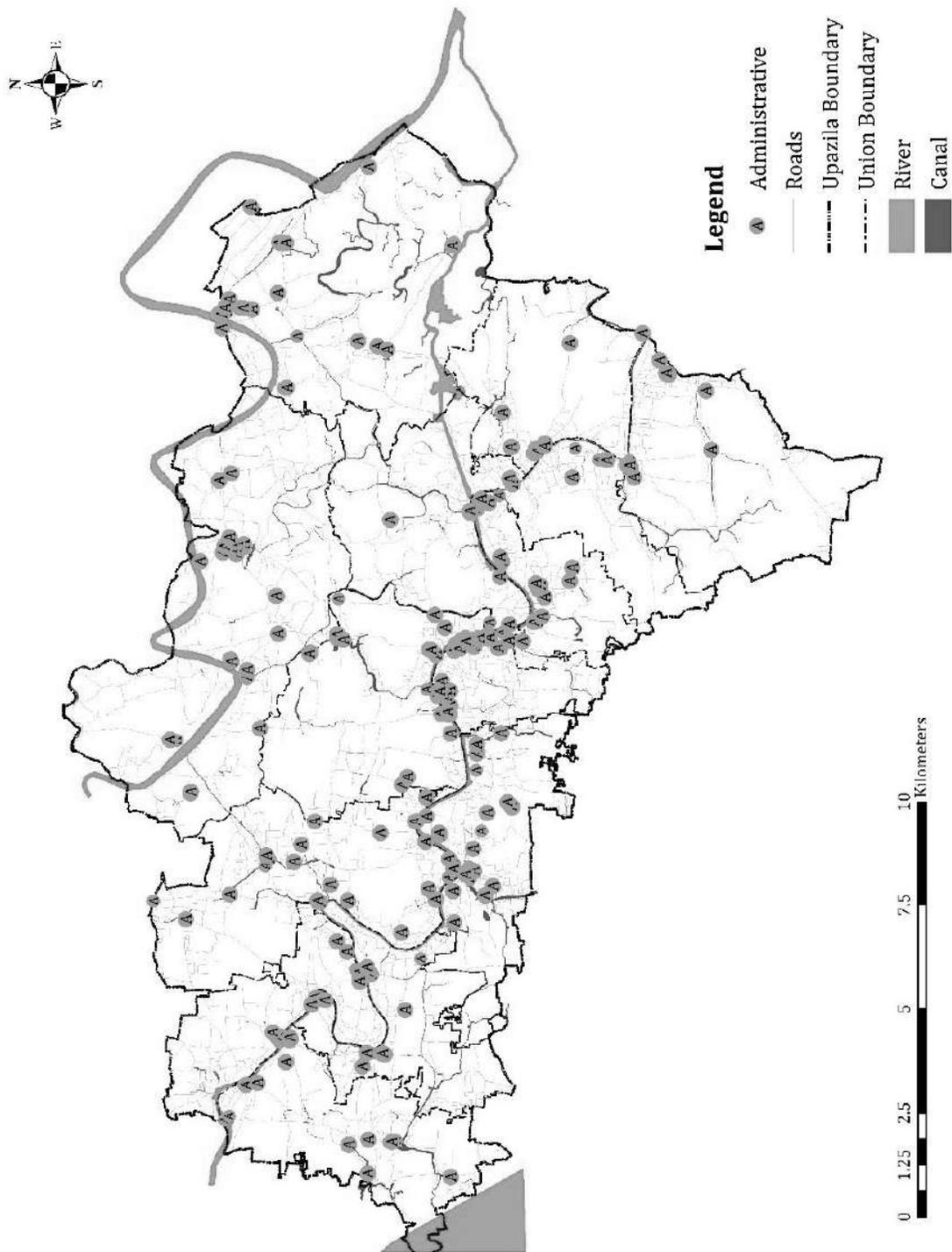


Figure 5-14: Location of Administrative Facilities

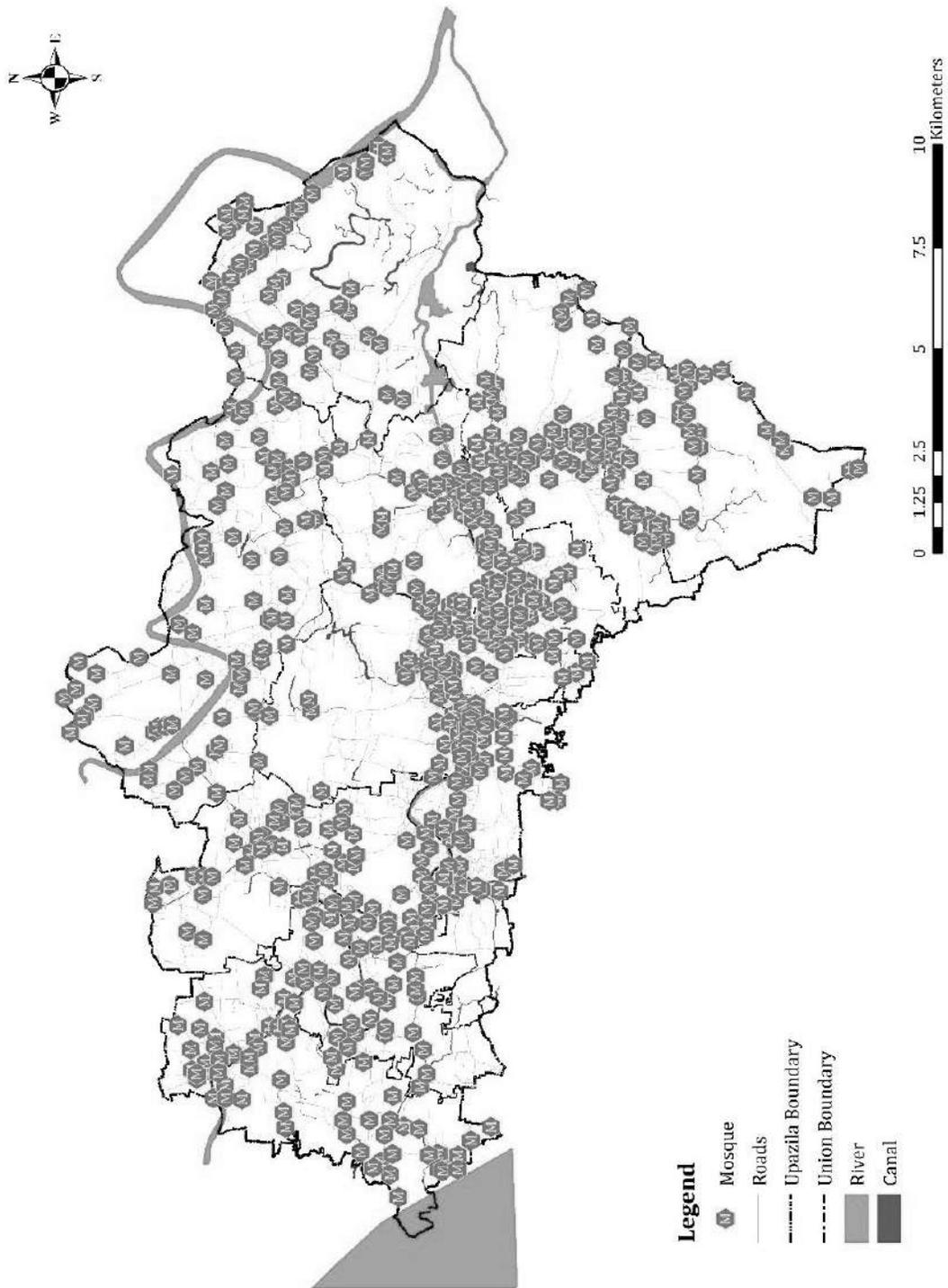


Figure 5-15: Location of Mosque

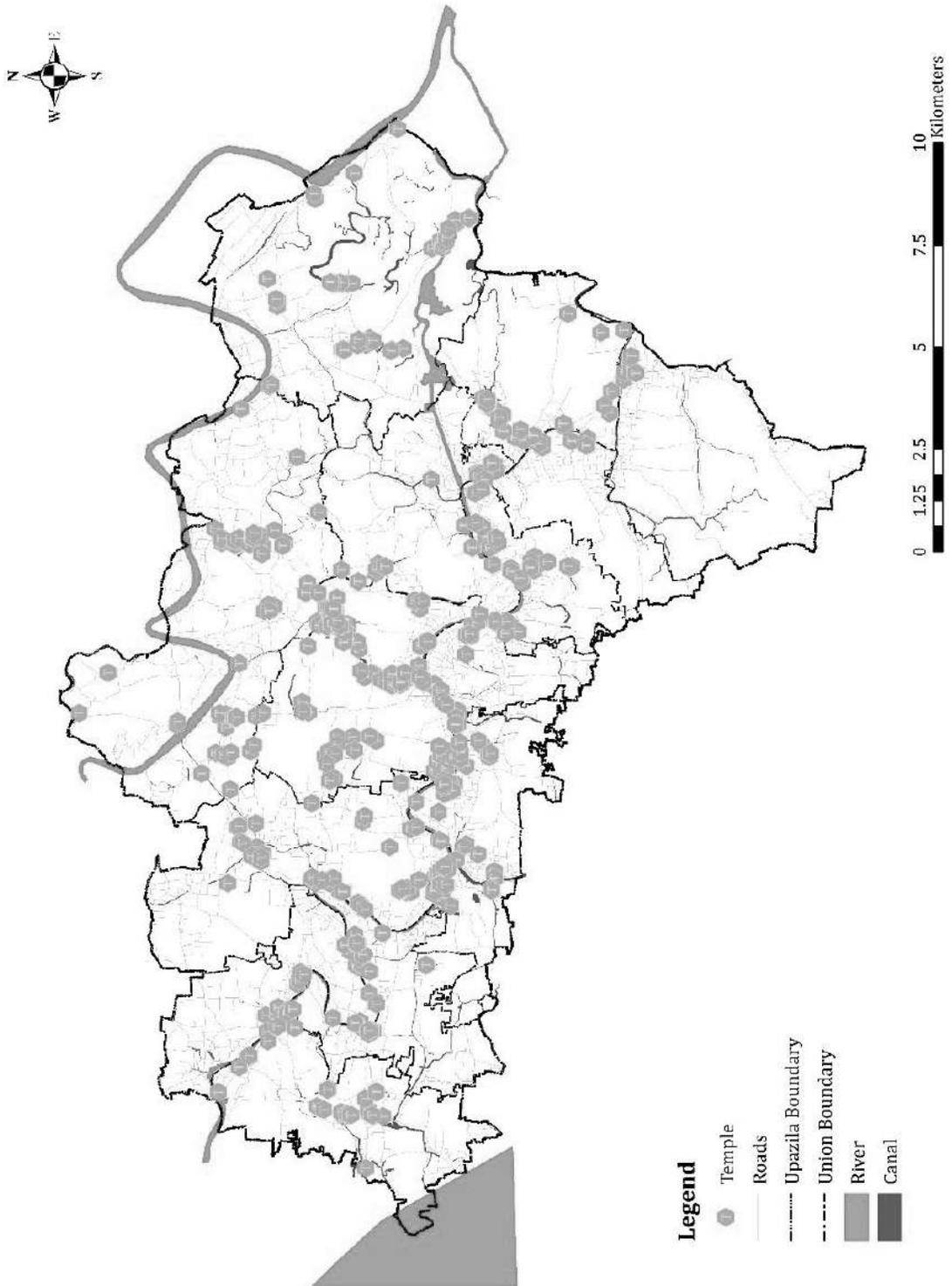


Figure 5-16: Location of Temple

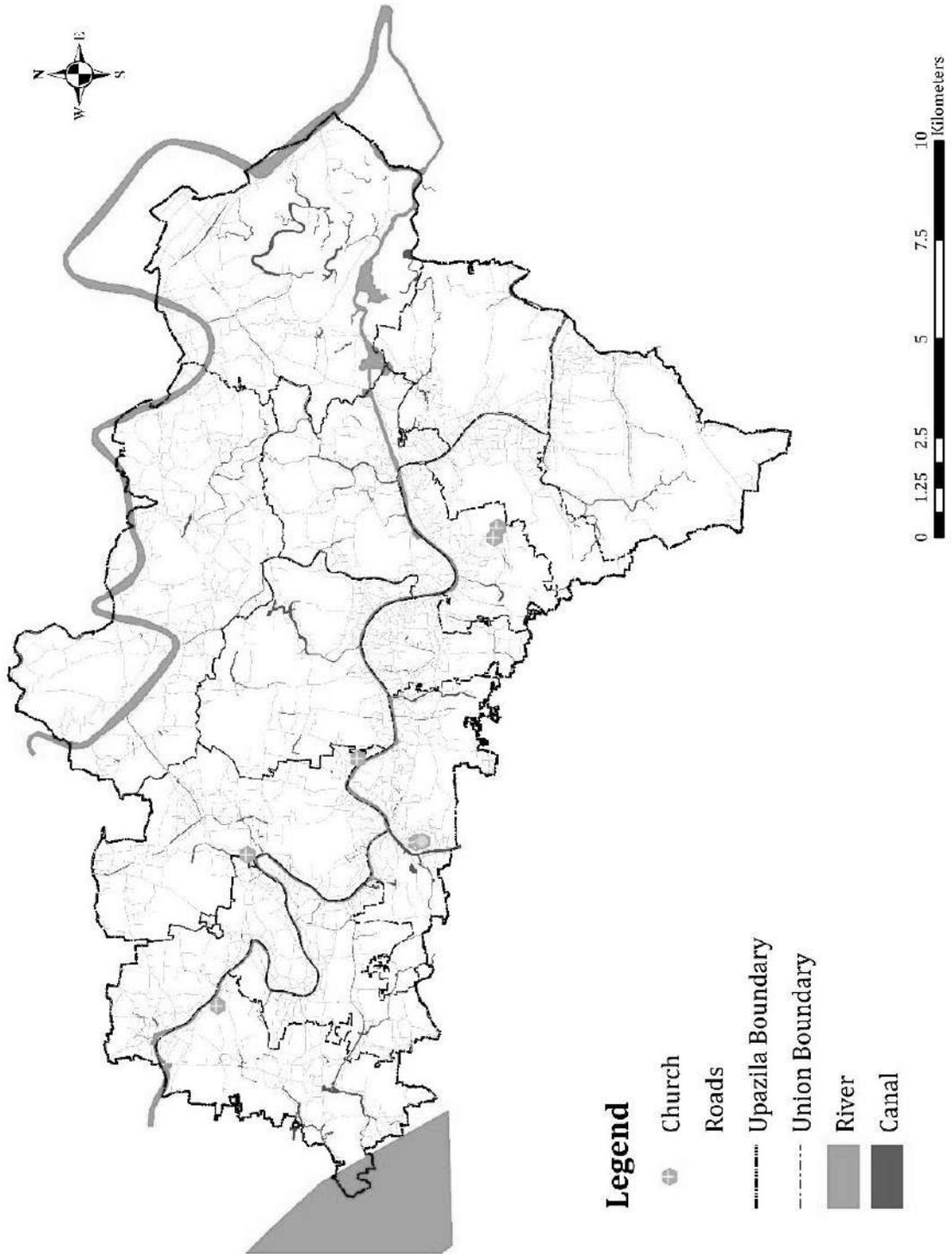


Figure 5-17: Location of Church

5.4.5.5 Open Space and Recreational Facilities

The open space in Nawabganj Upazila reveals an interesting distribution across its various unions. In total, the area boasts of 227.04 acres of open space (eidgah, park and playground), signifying its commitment to preserving natural areas and providing recreational opportunities for its residents. Nayansree stands out as having the largest expanse of open space, covering 31.85 acres, indicating its potential as a oasis within the urban landscape. Sholla and Kolakopa also contribute significantly to this green initiative with 28.04 and 21.98 acres, respectively. On the other hand, Agla, Galimpur, Joykrishnapur, and Bakshanagar have smaller or unspecified open space areas, suggesting potential areas for future development or enhancement of public spaces.

Table 5-15: Union-wise Open Space

Union Name	Area in acre
Agla	7.83
Bakshanagar	9.50
Bandura	21.18
Barrah	7.68
Baruakhali	14.91
Churain	15.77
Galimpur	8.57
Jantrail	16.71
Joykrishnapur	10.64
Kailail	17.02
Kolakopa	21.98
Nayansree	31.85
Shikaripara	15.37
Sholla	28.04
Grand Total	227.04

Source: Field Survey, 2023

Table 5-16: Union-wise Recreational Facilities

Union Name	Eidgah	Park	Playground	Grand Total
Agla	1		12	13
Bakshanagar	3		13	16
Bandura	5		27	32
Barrah	1		17	18
Baruakhali	2		19	21
Churain	7		15	22
Galimpur	2		12	14
Jantrail	2		22	24
Joykrishnapur	4		18	22
Kailail	6	1	23	30
Kolakopa	1	3	19	23
Nayansree	5		36	41
Shikaripara	1		22	23
Sholla	6		33	39
Grand Total	46	4	288	338

Source: Field Survey, 2023

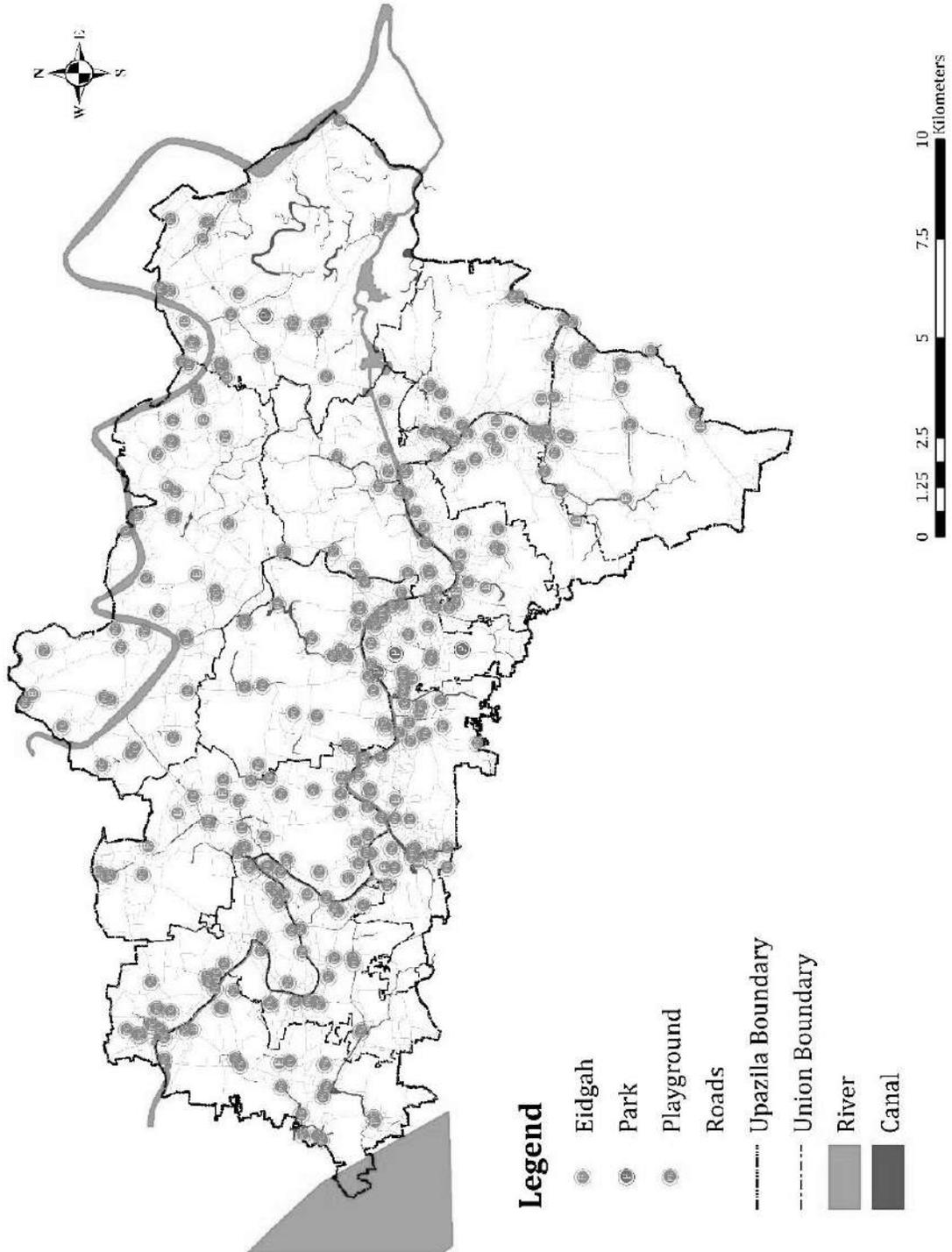


Figure 5-18: Open Space and Recreational Facilities Map

Nawabganj Upazila offers a total of 338 of open spaces spread across its unions which serves as both religious and recreational facilities. Nayansree leads with 39 of open spaces, followed by Sholla, Bandura, and Kailail with 39, 32 and 30 spaces, respectively. This data reflects the area's commitment to leisure and sports but also suggests room for potential improvement and expansion to enhance residents' quality of life.

5.4.5.6 Graveyard/Crematorium

In Nawabganj Upazila, there are 217 facilities dedicated to the solemn purpose of providing final resting places for its residents. Among these, 182 locations are classified as graveyards, offering individuals a place for burial in line with their cultural and religious practices. Additionally, 4 cemeteries are available in the area, offering an alternative burial option to christian people. In addition, there are 31 crematoriums available to support the Hindu community in performing their cultural and religious burial rituals. These burial sites collectively serve as crucial community assets, ensuring that the people of Nawabganj Upazila have access to appropriate and respectful locations to commemorate and honor their departed loved ones. The thoughtful management of these graveyards and the presence of a cemetery underscore the upazila's commitment to delivering essential services for its residents, even in matters of deep significance and reverence.

Table 5-17: Graveyard/Crematorium

Union Name	Cemetery	Crematorium	Graveyard	Grand Total
Agla			8	8
Bakshanagar	1	2	12	15
Bandura	1	3	10	14
Barrah		1	12	13
Baruakhali		1	16	17
Churain		2	10	12
Galimpur		1	10	11
Jantrail		4	8	12
Joykrishnapur		3	16	19
Kailail		2	12	14
Kolakopa		2	12	14
Nayansree	2	7	13	22
Shikaripara		1	18	19
Sholla		2	25	27
Grand Total	4	31	182	217

Source: Field Survey, 2023

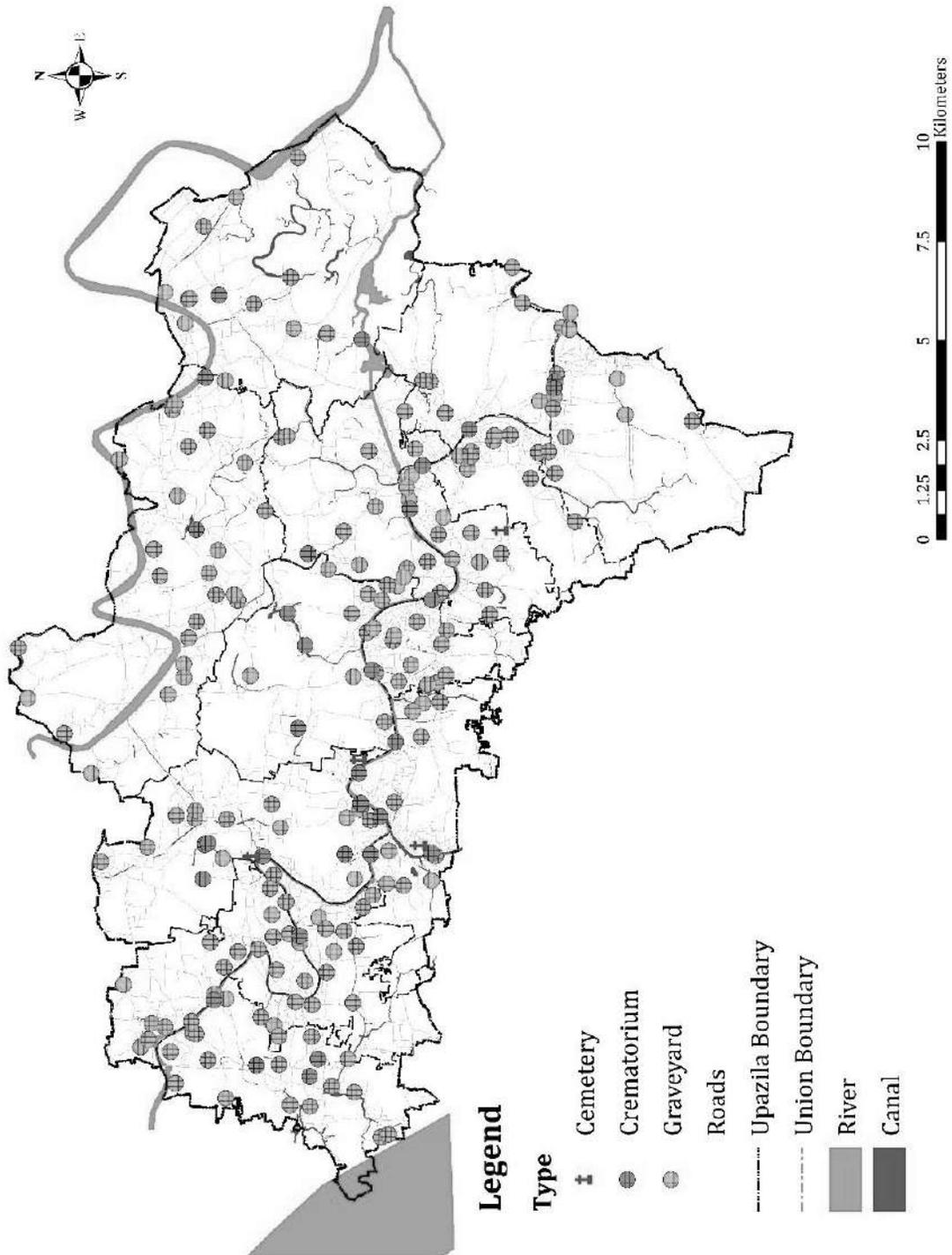


Figure 5-19: Graveyard/Crematorium Map

5.4.5.7 Heritage Site

Nawabganj could have continued to thrive as an economic and administrative center, potentially seeing the construction of architectural marvels that characterized Mughal urban planning. Nawabganj is one of the prominent regions in Dhaka containing a large number of old buildings and Zamindari Bari, Amongst the archaeologically or historically famous buildings the most well-known ones are Hasnabad Church, Braja Niketon, the Baghmara Moth, the Bakshanagar Church and the residence of Khelaram. The notable site seeing spots attracting tourists are Afaz Uddin Shah Majar, Braja Niketan, Khelaram Datar Kotha, Vanga Masjid, Hasnabad church and many more. Nawabganj's famous personalities include the great poet Kaykobad, Shah Qari Mohammad Ismail, Sufi Pir Afaz Uddin Shah, local folk singer Abdur Rahman Boyati, Unique group's Chairman Md. Noor Ali, Jamuna group's Chairman Nurul Islam Babul and many more.

Table 5-18: List of Heritage Site of the Upazila

Union Name/Location	Name of potential heritages
Aglā	Mahakabi Kaykobad's Residence
	Hozrat Shah Sufi Mokkaam Ali Mazar
Bakshanagar	Bakshanagar Old Church
	Bokshanagar Church/ St. Anthony of Padua's Church
	Late Actor Jasim's House
	Hormohon Shah Zamidar Bari
	Hormohon Shah Temple
	Row Saraj Gosai Akhra
	Lion Circus Owner's Residence
Bandura	Hasnabad Church/ Our Lady of Holy Rosary Church
	Braza Niketan
	Shahi Vanga Mosque
Churain	Muskil Kosha/Shonahazra Masjid
Galimpur	Afaz Uddin Shah Majar
Joykrishnapur	Zomidar Bari and Shibmondir
Kailail	Binod Shah Majar
Kolakopa	Kokil Peari Palace

Union Name/Location	Name of potential heritages
	Khelaram Datar Kotha
	Ansar Camp (Painna Bari & Teli Bari & Podder Bari & Moth Bari)
	Adnan Palace
	Sri Shoshi Mohon Zamidar Bari
Nayansree	Boro Golla Church/ St.Francis Xavier's Church
	Tuital Church/ Holy Spirit Church
Shikaripara	Boktarnagar Zamidar Bari
	Boktarnagar Zamidar Bari Mosque

5.4.5.8 Existing Key Point Installation (KPI)

Nawabganj Upazila, with its rich historical backdrop and cultural prominence, has become a focal point for strategic developments, including Key Point Installations (KPI). KPIs are essential locations or structures that require heightened protection due to their significant roles in the region's socioeconomic or cultural frameworks. KPI of Nawabganj include one electric power generation unit in Kailail, two electric substations in Bandura and Agla, and one electric subcenter in Kolakopa. These KPIs are crucial for the area's energy infrastructure, ensuring a stable and uninterrupted supply of electricity to the region. Given their importance in powering essential services such as healthcare, commerce, and residential needs, maintaining their security and operational integrity is paramount.

5.5 Connectivity and Infrastructure

Nestled in the heart of the region, Nawabganj Upazila is a vibrant hub of activity and community life, sustained by a network of essential urban infrastructure services. The physical feature survey explores the urban infrastructure that forms the lifelines of this upazila, with a particular focus on the main artery that connects it to the main Dhaka-Nawabganj Highway which is Nawabganj-Keraniganj-Dhaka Road. Also, Nawabganj-Majhirkanda-Dohar, Dhaka-Keraniganj-Tikorpur-Joypara, Nawabganj-Sholla-Hemayetpur, and Nawabganj-Majirkanda-Bandura-Baruakhali-Beribadh roads are the five main roads of the Upazila area. More than mere ribbons of asphalt, these roads are the conduits of commerce, pathways of progress, and threads that interweave Nawabganj Upazila into the tapestry of the nation. They represent how the community is linked to distant cities, the facilitators of the movement of goods and people, and a critical component of the economic landscape of the region. As this chapter is further explored, the significance of these vital highways has been examined, along with a broader consideration of the urban infrastructure services that form the foundation of the quality of life in Nawabganj Upazila. From the provision of clean water and the efficient management of waste to the maintenance of public spaces, the essence of the community is defined by these services.

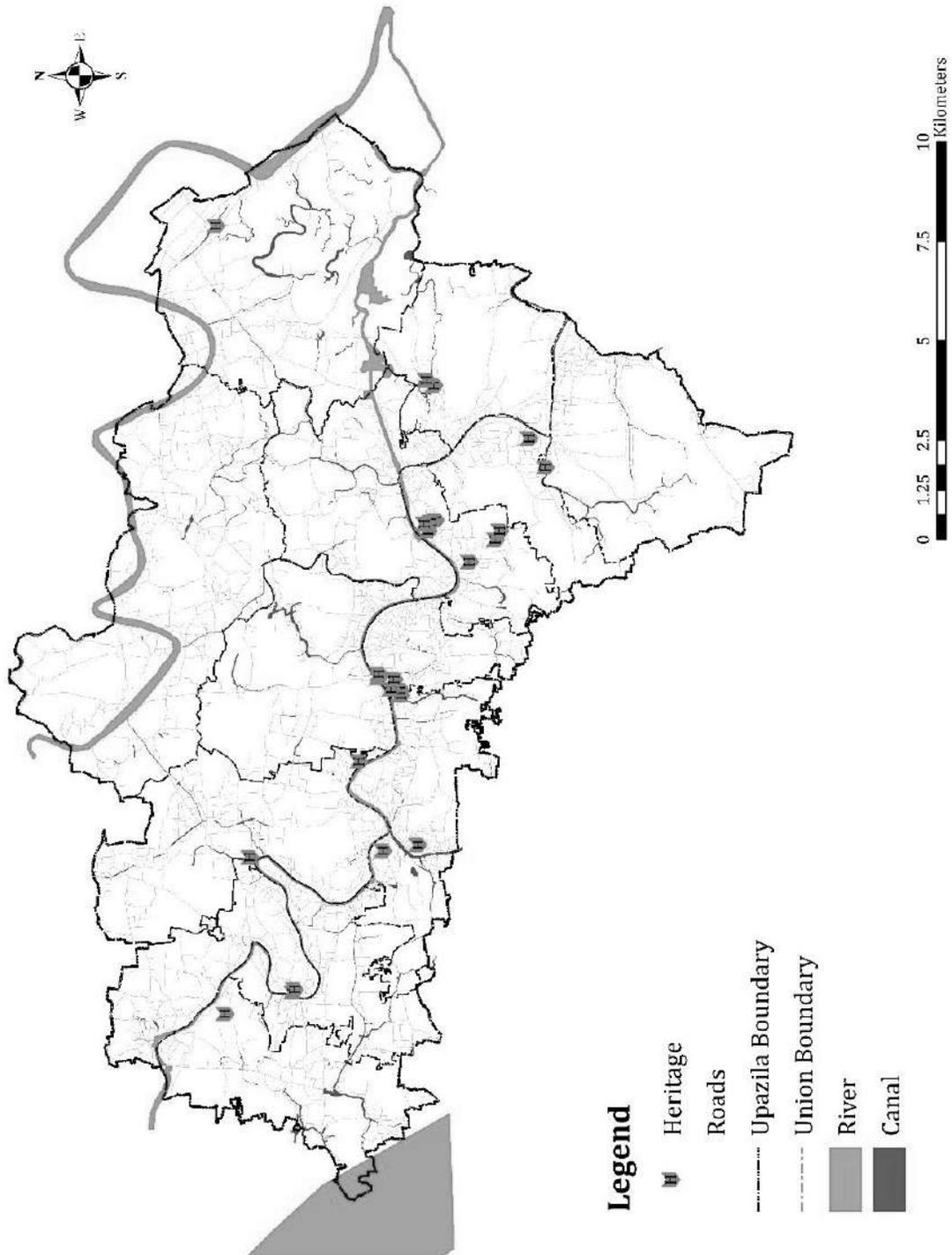


Figure 5-20: Heritage Site Map

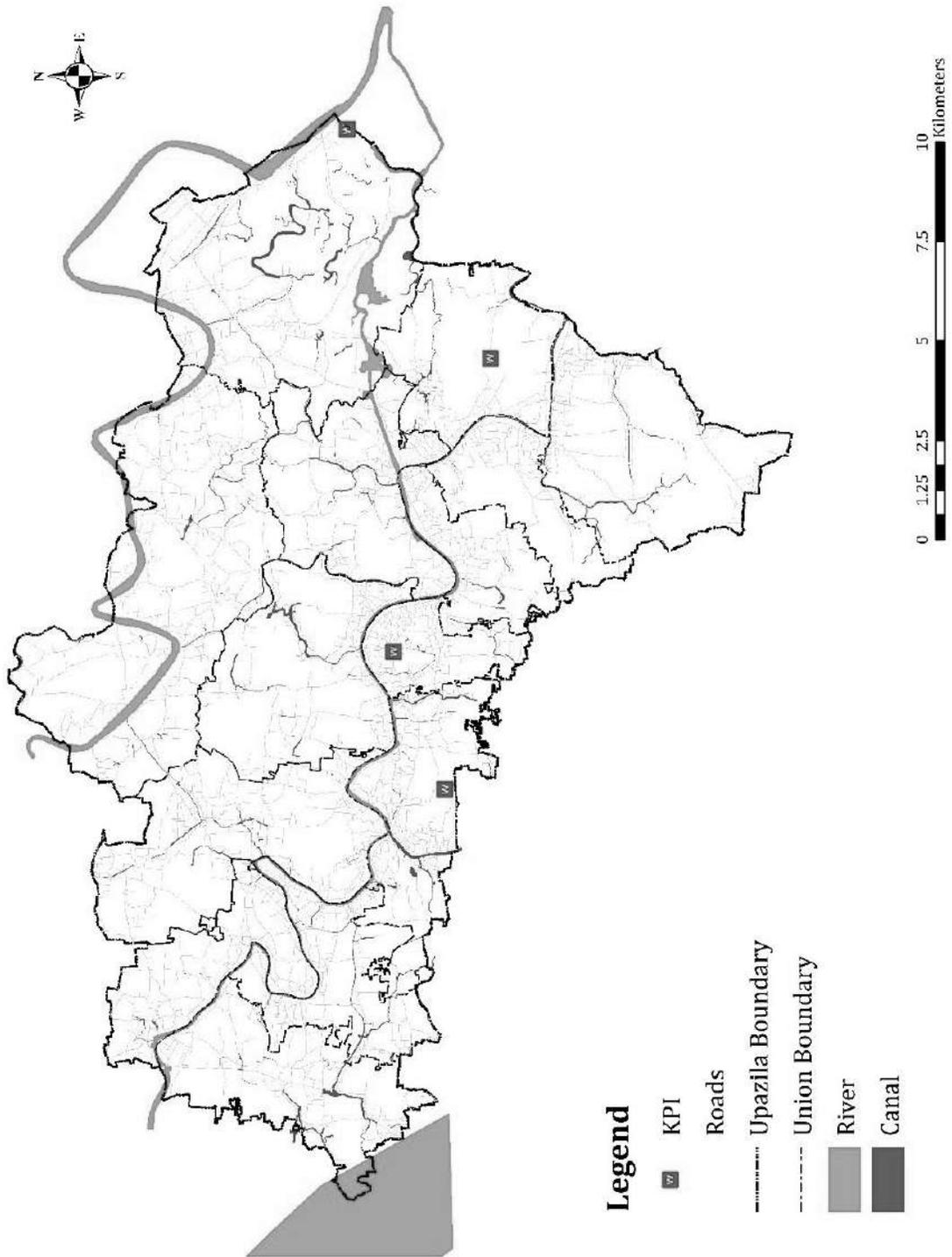


Figure 5-21: Key Point Installation Map of Nawabganj

5.5.1 Road Network System

Nawabganj Upazila is served by a road network of 990.90 km. From construction point these roads are divided in to eight categories including Brick Chips, Cement Concrete, Reinforced Cement Concrete, Hollow Block Bricks, Water Bound Macadam, Other construction materials use, Unique type of blocks and lastly Earthen materials used for construction.

5.5.2 Transport Infrastructure Facilities

Table 5-19: Union-wise Transportation Infrastructure Facilities

Row Labels	BC	CC	Earthen	HBB	WBM	RCC	Uni-Block	Others	Grand Total
Agla	12.57	3.71	13.76	10.58	0.18	1.54	4.73		47.07
Bakshanagar	18.94	0.91	11.10	6.74		6.77	0.23		44.69
Bandura	24.20	1.21	21.05	15.57		3.96	6.23		72.23
Barrah	26.74	4.18	25.05	13.20		5.65	1.66	0.04	76.54
Baruakhali	36.33	0.04	19.88	5.53		0.12	1.60	0.57	64.06
Churain	30.60	2.47	21.22	4.07		4.26	4.46		67.08
Galimpur	17.95	0.74	8.21	9.26		2.73	0.04		38.93
Jantrail	26.03	0.24	32.02	9.56	0.02	1.28	0.61	1.95	71.71
Joykrishnapur	12.92		29.05	7.44		4.16	1.51		55.07
Kailail	35.02	0.10	33.30	9.96	0.80	1.79	7.24		88.20
Kolakopa	22.46	0.58	10.94	5.64	2.25	5.55	2.39		49.81
Nayansree	26.45		50.05	17.76	5.82	0.21	5.11		105.41
Shikaripara	11.83	0.81	34.68	13.08	0.22	0.91	1.94		63.46
Sholla	41.44	0.51	66.98	26.14	0.07	1.80	9.67		146.62
Grand Total	343.47	15.51	377.30	154.54	9.37	40.74	47.42	2.56	990.90

Source: Field Survey, 2023

Table 5-20: Union-wise Road Type Percentage

Union Name	Percentage (%)								Grand Total
	BC	CC	Earthen	HBB	WBM	RCC	Uni-Block	Others	
Agla	26.71	7.89	29.24	22.47	0.39	3.26	10.04	0.00	100.00
Bakshanagar	42.38	2.03	24.84	15.08	0.00	15.15	0.52	0.00	100.00
Bandura	33.51	1.68	29.14	21.56	0.00	5.49	8.62	0.00	100.00
Barrah	34.94	5.46	32.73	17.25	0.00	7.39	2.17	0.06	100.00
Baruakhali	56.71	0.06	31.03	8.64	0.00	0.18	2.50	0.88	100.00
Churain	45.62	3.69	31.63	6.06	0.00	6.35	6.64	0.00	100.00
Galimpur	46.10	1.90	21.08	23.79	0.00	7.02	0.10	0.00	100.00
Jantrail	36.30	0.34	44.65	13.33	0.03	1.78	0.85	2.72	100.00
Joykrishnapur	23.45	0.00	52.75	13.50	0.00	7.56	2.74	0.00	100.00
Kailail	39.70	0.11	37.76	11.29	0.90	2.02	8.21	0.00	100.00
Kolakopa	45.09	1.16	21.97	11.32	4.52	11.14	4.80	0.00	100.00
Nayansree	25.09	0.00	47.48	16.85	5.52	0.20	4.85	0.00	100.00
Shikaripara	18.63	1.28	54.64	20.61	0.35	1.43	3.06	0.00	100.00
Sholla	28.26	0.35	45.68	17.83	0.05	1.23	6.60	0.00	100.00

Grand Total	34.66	1.56	38.08	15.60	0.95	4.11	4.79	0.26	100.00
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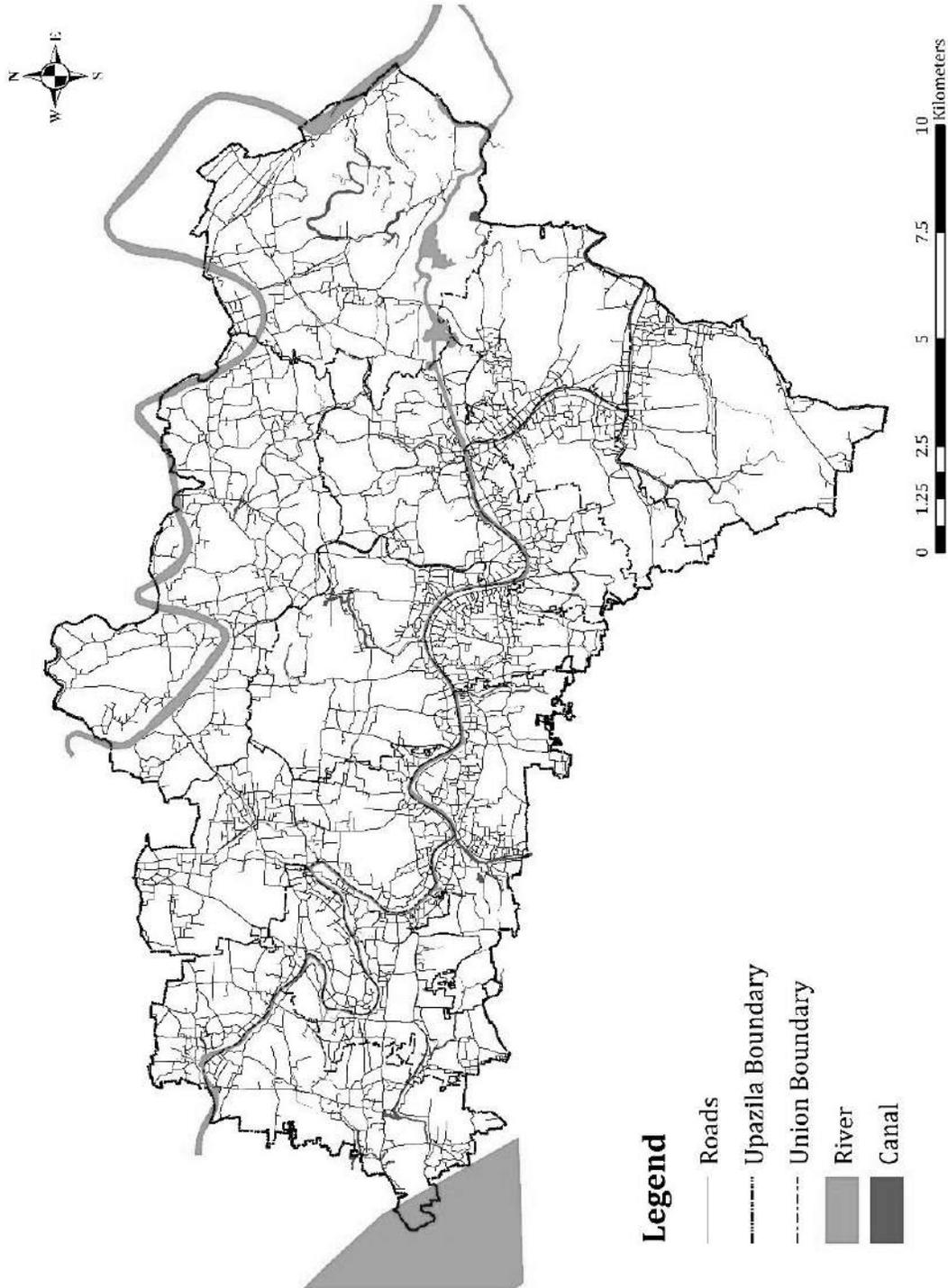


Figure 5-22: Road Centerline Map

The data provided offers a comprehensive breakdown of road types within Nawabganj Upazila, categorizing them based on the construction materials used. In Sholla, there are a total of 146.62 kilometers of roads, with the majority, accounting for 45.68%, being earthen roads. Galimpur presents a different scenario with a total of 38.93 kilometers of roads. Here, a significant 46.10% of roads are constructed with bituminous concrete (BC), while there are smaller segments with reinforced cement concrete (RCC) and HBB (high-quality bituminous concrete) roads.

Jantrail features 44.69 kilometers of roads, showcasing a more diverse mix. Bituminous concrete (BC) roads account for 26.03%, while reinforced cement concrete (RCC) and HBB roads make up smaller percentages. Nayansree has 105.41 kilometers of roads, primarily consisting of earthen roads at 47.48%. Joykrishnapur, with a total of 55.07 kilometers of roads, is notable for having a large number of earthen roads and no CC and WBM types. In Kolakopa, there are 49.81 kilometers of roads, with bituminous concrete (BC) roads constituting 45.09% of the total. Galimpur exhibits 38.93 kilometers of roads, primarily divided between bituminous concrete (BC) and high-quality bituminous concrete (HBB) roads. Shikaripara has 63.46 kilometers of roads, with earthen roads comprising the largest portion. Lastly, Agla boasts 47.07 kilometers of roads, with a relatively large amount of Uni-Block Road distribution among various road types.

In the total for Nawabganj Upazila, the data reveals that earthen roads make up the majority at 38.08%, followed by bituminous concrete (BC) roads at 34.66%. Reinforced cement concrete (RCC) and high-quality bituminous concrete (HBB) roads contribute to a smaller percentage of the overall road network. This information is vital for infrastructure planning, as it provides a clear picture of the types of roads in the region and can guide future road maintenance and development initiatives to enhance transportation infrastructure in Nawabganj Upazila.

Table 5-21: Road Width Percentage

Union Name	10 Feet or less	11-20 Feet	20 Feet or more	Grand Total
Agla	75.26%	13.45%	11.29%	100.00%
Bakshanagar	76.43%	13.05%	10.53%	100.00%
Bandura	83.37%	11.80%	4.84%	100.00%
Barrah	83.18%	14.58%	2.24%	100.00%
Baruakhali	86.92%	12.86%	0.22%	100.00%
Churain	83.64%	16.33%	0.03%	100.00%
Galimpur	68.50%	30.01%	1.49%	100.00%
Jantrail	89.49%	10.51%	0.00%	100.00%
Joykrishnapur	76.37%	23.63%	0.00%	100.00%
Kailail	70.58%	29.42%	0.00%	100.00%
Kolakopa	82.09%	10.39%	7.53%	100.00%
Nayansree	90.26%	9.74%	0.00%	100.00%
Shikaripara	91.99%	8.01%	0.00%	100.00%
Sholla	86.47%	13.00%	0.53%	100.00%
Grand Total	82.92%	15.02%	2.07%	100.00%

Source: Field Survey, 2023

The data about road width in Nawabganj Upazila offers a comprehensive view of the distribution of road widths categorized by their respective measurements in feet. Within the Upazila Area, the

road network spans a total length of 990.90 kilometers, representing a crucial aspect of the local infrastructure. Among these roads, 82.92% of the total road length consists of roadways are 10 feet wide or less, amounting to 821.61 kilometers. Furthermore, there are 148.80 kilometers of roads falling within the 11 to 20 feet width category, constituting 15.02% of the entire road network.

The least amount of the road infrastructure in Nawabganj Upazila are 20 feet wide or more category, accounting for 20.49 kilometers or 2.07% of the total road length. This suggests a significant emphasis on moderately sized roads, catering to a range of transportation needs within the Upazila Area.

The data on road width distribution serves as a valuable resource for urban planning and infrastructure development endeavors. It offers insights into the diverse range of road sizes present in Nawabganj, enabling authorities to make informed decisions about road maintenance, expansion, and the overall enhancement of transportation infrastructure to better accommodate the needs of the local community and facilitate efficient mobility throughout the upazila area

Table 5-22: Union-wise Road Condition Percentage

Unions	Good	Fair	Poor	Critical	Grand Total
Agla	28.43%	8.44%	58.87%	4.25%	100.00%
Bakshanagar	35.78%	27.46%	35.89%	0.87%	100.00%
Bandura	23.05%	22.15%	41.39%	13.42%	100.00%
Barrah	35.99%	10.46%	36.38%	17.17%	100.00%
Baruakhali	18.40%	30.65%	43.68%	7.27%	100.00%
Churain	30.00%	21.46%	42.76%	5.78%	100.00%
Galimpur	50.98%	6.94%	33.84%	8.25%	100.00%
Jantrail	32.78%	4.15%	53.45%	9.61%	100.00%
Joykrishnapur	22.86%	9.45%	48.04%	19.64%	100.00%
Kailail	29.96%	17.01%	40.49%	12.54%	100.00%
Kolakopa	36.07%	17.87%	36.32%	9.74%	100.00%
Nayansree	16.84%	17.39%	50.01%	15.76%	100.00%
Shikaripara	5.45%	13.17%	68.96%	12.41%	100.00%
Sholla	25.35%	11.71%	48.67%	14.27%	100.00%
Grand Total	29.14%	14.81%	45.16%	10.88%	100.00%

Source: Field Survey, 2023

The provided data offers a comprehensive overview of the road conditions in Nawabganj Upazila, categorized into four distinct conditions: Good, Fair, Poor, and Critical. Agla shows 58.87% of its roads as Poor, a substantial 35.99% as Good, 8.44% as Fair, and, 4.25% as Critical. Bakshanagar reveals the highest number 35.89% of its roads are classified as poor, 0.87% are Critical, 27.46% are Fair, while a significant 35.78% of roads are classified as Good. In Galimpur, the majority of roads are reported to be in good condition at 50.98%, with 6.94% classified as Fair, 33.84% as Poor, and a minimal 8.25% in Critical condition. Sholla has 25.35% of its roads rated as Good, a small number like 11.71% as Fair, and a significant 48.67% in the Poor category, with a low number in Critical condition. Shikaripara predominantly falls in the Poor category at 68.96%, with 12.41% rated as Critical and a small portion as Good or Fair categories. Joykrishnapur stands out with 19.64% of its roads in Critical condition, while 48.04% are Poor, 9.45% are in Fair and 22.86% are in good condition. Kailail has 40.49% of its roads classified as Poor and 17.01% as Fair, with a small number of roads in Good or Critical condition. In Kolakopa, 36.07% of roads are

Good, 17.87% are Fair, 36.32% are Poor, and 9.74% are Critical. Churain displays 30.00% of roads in good condition, 21.46% in Fair, 42.76% in Poor, and 5.78% in Critical.

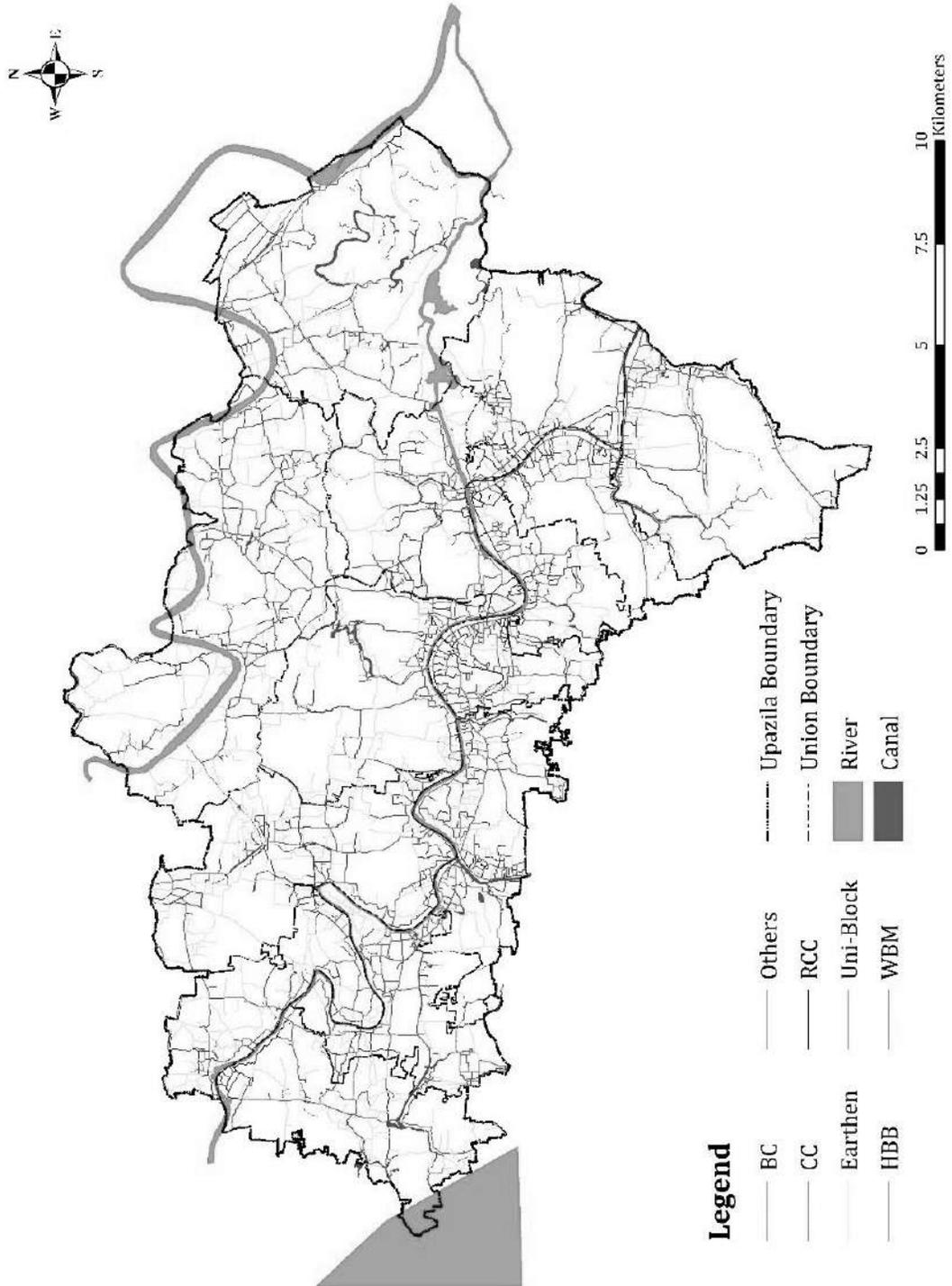


Figure 5-23: Road Surface Type Map

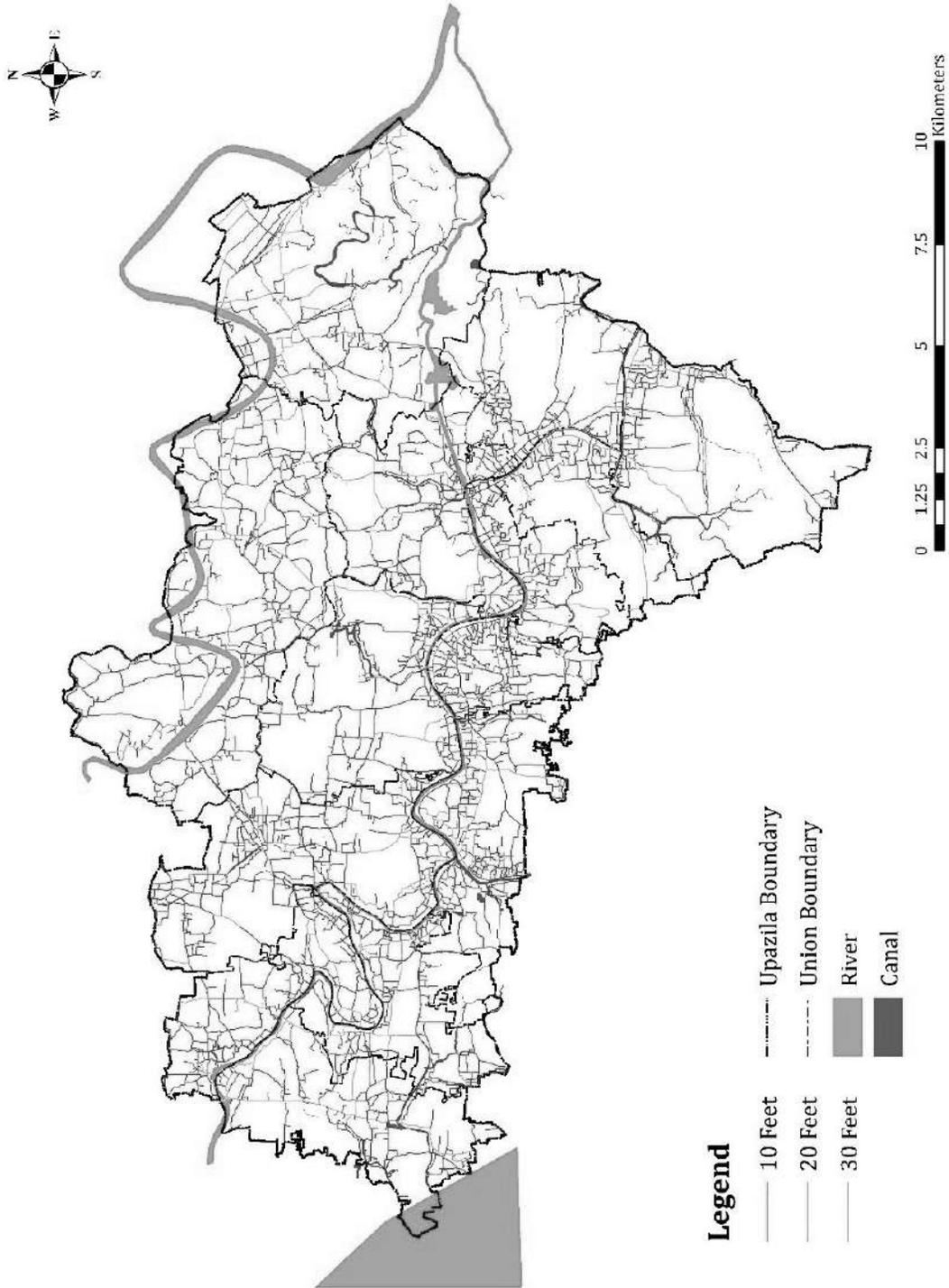


Figure 5-24: Road Width Map

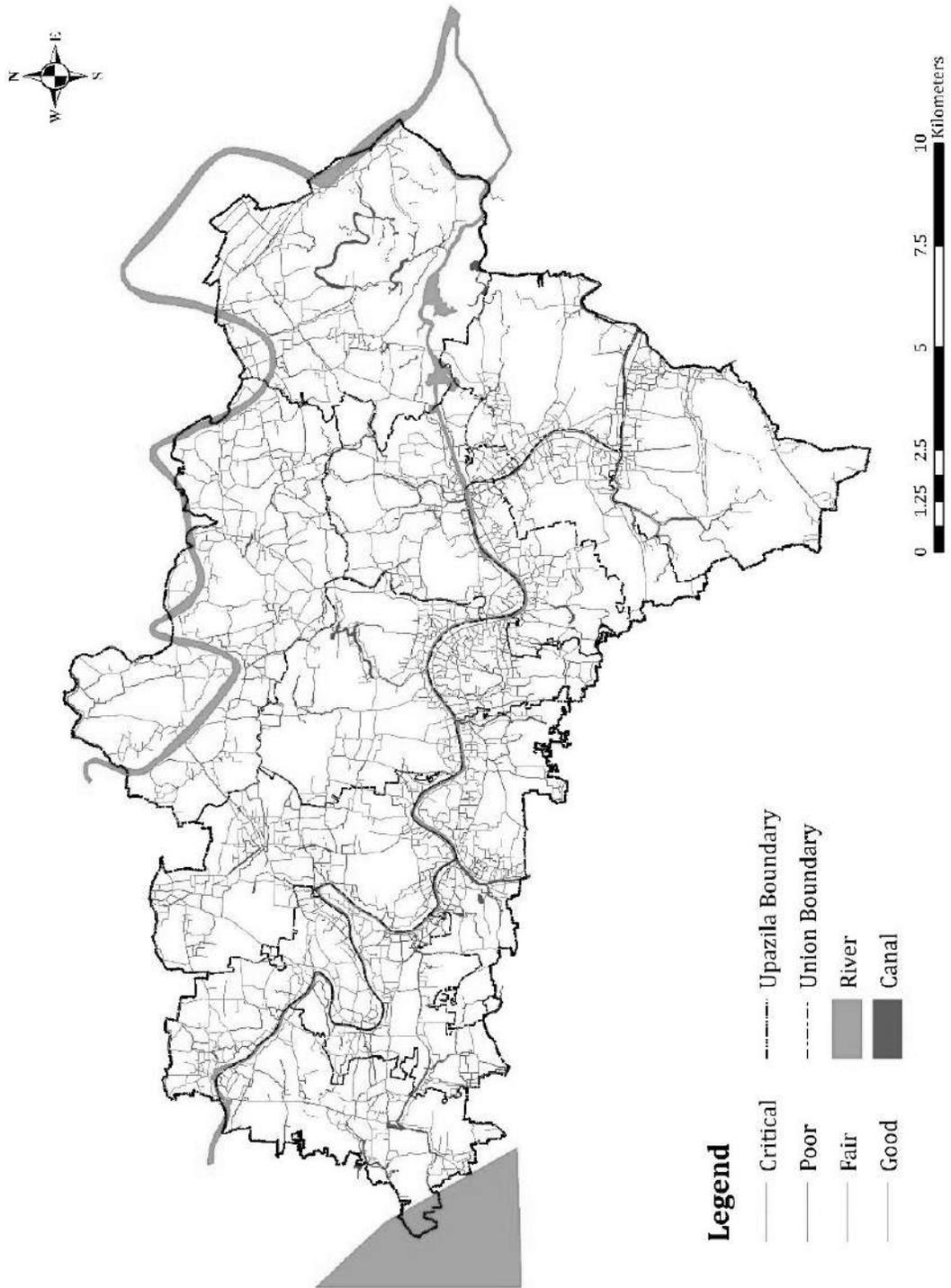


Figure 5-25: Road Condition Map

In conclusion, the data on road conditions in Nawabganj Upazila paints a comprehensive picture of the state of its road infrastructure across different unions. There is a significant variation in road conditions, with some unions boasting a majority of their roads in Good or Fair condition, while others face more challenging circumstances, with a substantial proportion of their roads categorized as Poor or even Critical. Galimpur stands out as a positive example, with a majority of its roads in good condition, indicating a focus on maintenance and quality. On the other hand, Shikaripara faces considerable challenges, with the majority of its roads falling into the Poor category.

Overall, the data highlights the need for targeted infrastructure investments and maintenance efforts in Nawabganj Upazila to ensure safe and reliable road networks. It also underscores the importance of addressing critical road conditions promptly to prevent further deterioration. By addressing these disparities and prioritizing road infrastructure improvements, Nawabganj Upazila can enhance transportation safety and accessibility for its residents and visitors.

5.5.2 Bridge and Culverts

The data has been collected about provided offers a comprehensive overview of the bridge and culvert infrastructure within Nawabganj Upazila, categorized across its various unions. Agla features a total of 10 bridges and 10 culverts. Bakshanagar has 14 bridges and 8 culverts, Bandura has 11 bridges and 21 culverts. Churain stands out with 40 bridges and 8 culverts, indicating a relatively higher concentration of bridge structures. On the other hand, in Sholla, there are 33 bridges and 49 culverts, showcasing a higher number of culvert infrastructure. Joykrishnapur has 8 bridges and 1 culverts, emphasizing the lack of culverts within its area. Shikaripara features 7 bridges and 15 culverts, presenting a small number of bridge infrastructure types. Similarly, in Kolakopa, there are 6 bridges and 25 culverts, highlighting the importance of culverts for efficient water management. Nayansree boasts 9 bridges and 15 culverts, Jantrail has 21 bridges and 11 culverts. In total, Nawabganj Upazila has 223 bridges and 237 culverts, showcasing a notable investment in essential infrastructure for transportation and water management, vital for the community's connectivity and overall well-being.

Table 5-23: Union-wise Number of Bridge and Culvert

Row Labels	Bridge	Culvert	Grand Total
Agla	10	10	20
Bakshanagar	14	8	22
Bandura	11	21	32
Barrah	27	9	36
Baruakhali	9	21	30
Churain	40	8	48
Galimpur	11	15	26
Jantrail	21	11	32
Joykrishnapur	8	1	9
Kailail	17	29	46
Kolakopa	6	25	31
Nayansree	9	15	24
Shikaripara	7	15	22
Sholla	33	49	82

Row Labels	Bridge	Culvert	Grand Total
Grand Total	223	237	460

Source: Field Survey, 2023

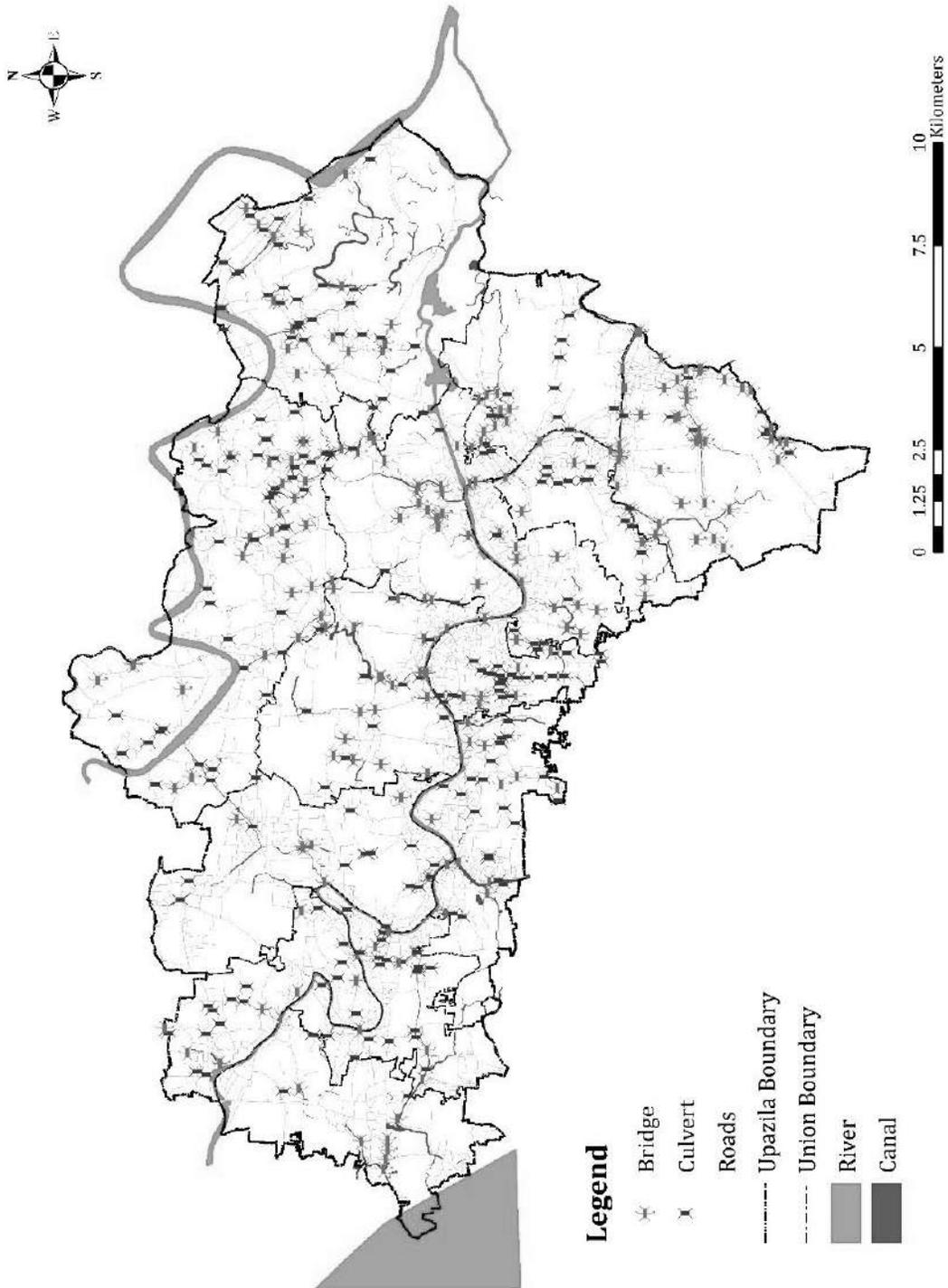


Figure 5-26: Bridge Culvert Map

5.5.3 Drainage Facilities

Within Nawabganj there isn't any drainage system at all without some small drain located at some union's bazar in Nawabganj. These drains are too small and the outfall of the drains is in the Ichamati River. A small number of drainage systems are found only in Kolakopa, Bakshanagar, Bandura, and Nayansree unions. The rest of the unions are deprived of these facilities.

5.6 Utility Services

The most crucial elements within every thriving community are the utility services. These essential services create the backbone of urban life, covering various functions like managing water, sewage, public transportation, and street lighting. This chapter explores the intricacies of municipal utility services, highlighting their crucial role in shaping the livability, sustainability, and growth of towns and cities. Examining the unique challenges and innovative solutions in this field reveals how upazila's daily work to provide its residents with efficient, reliable, and eco-friendly services, thereby paving the way for vibrant and harmonious urban living.

5.6.1 Power Supply Network- Voltage-based Network

The provided data offers insights into the distribution of electric infrastructure in Nawabganj Upazila, specifically focusing on electric poles and high voltage electric towers across its various unions. Agla has 609 electric poles and 14 high voltage electric towers, indicating a relatively lower reliance on taller structures for electricity distribution. In Sholla, there is a higher presence of electric poles with 3141 poles, reflecting the increasing demand for electricity infrastructure. Kolakopa follows a similar trend with 1012 electric poles and 4 towers, suggesting a balanced approach to electricity distribution. Agla, Bakshanagar, Bandura, Galimpur, Kailail and Kolakopa have presence of both electric poles and high voltage electric tower.

Table 5-24: Union-wise Electric Pole & Electric Tower

Row Labels	High Voltage Tower	Electric Pole	Grand Total
Agla	14	609	623
Bakshanagar	8	731	739
Bandura	8	1106	1114
Barrah		887	887
Baruakhali		595	595
Churain		1008	1008
Galimpur	10	597	607
Jantrail		766	766
Joykrishnapur		710	710
Kailail	3	1085	1088
Kolakopa	4	1012	1016
Nayansree		1282	1282
Shikaripara		730	730
Sholla		3141	3141
Grand Total	47	14259	14306

Source: Field Survey, 2023

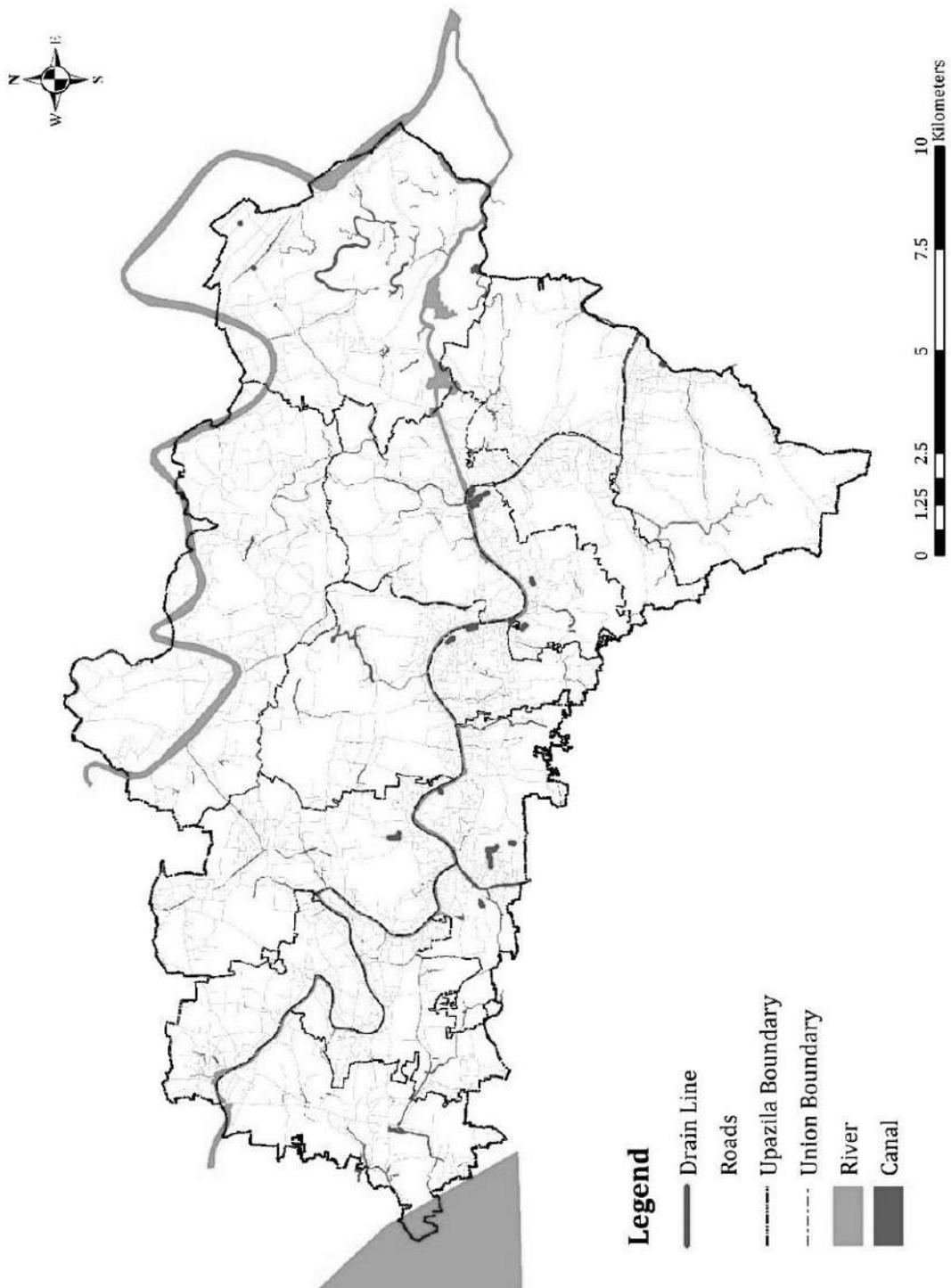


Figure 5-27: Existing Drainage System

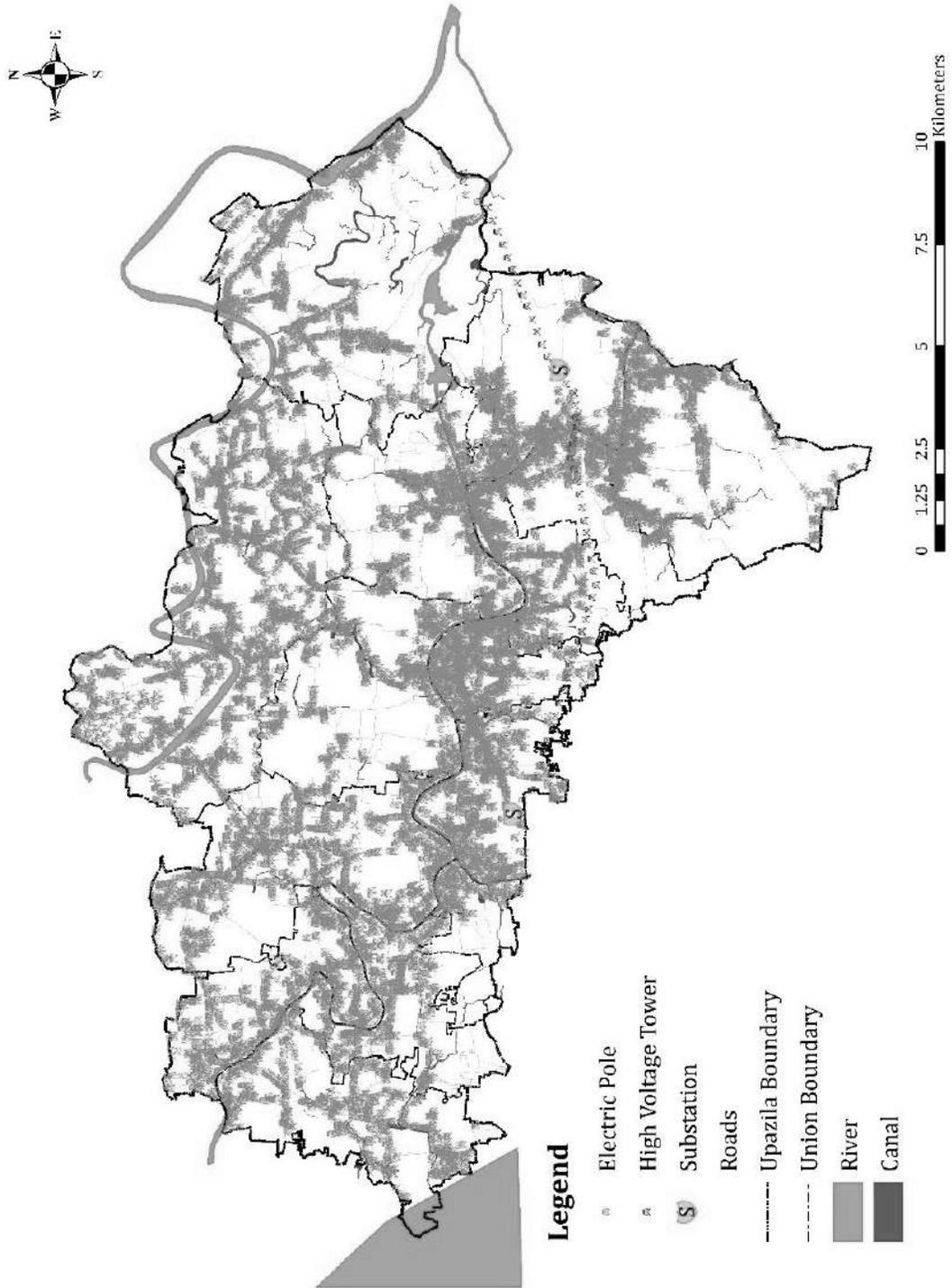


Figure 5-28: Existing Electric Pole and Tower

On the other hand, Barrah, Baruakhali, Churain, Nayansree, Shikaripara, Sholla, Jantrail, and Joykrishnapur have numbers of electric poles but no high voltage electric towers. In total, Nawabganj Upazila boasts 14306 electric poles and 47 high voltage electric towers, indicating a substantial investment in electrical infrastructure to cater to the needs of its residents and businesses.

5.6.2 Location of Power Sub Station

Nawabganj Upazila accommodates a vital power grid substation, serving as a cornerstone of the region's electrical infrastructure. Situated strategically to cater to the energy demands of the area, this substation stands as a testament to the modernization and development efforts within the locality. Nawabganj Upazila accommodates several vital power grid substations, serving as key components of the region's electrical infrastructure. Nawabganj Upazila's power grid substation efficiently distributes electricity across its various unions, ensuring seamless access to power for its inhabitants. With reliability, it supplies energy to key locations within the upazila, supporting industrial, commercial, and residential activities. In total there are two substations of 132/33 KV located in Bandura and Agla Union. The one sub center of 33/11 KV located in Kolakopa Union. These distribution network extends its reach to the unions of Nawabganj Upazila, and through these unions, the power grid substation empowers communities, facilitating economic growth, and enhancing the quality of life for residents. Moreover, there are six Palli Bidyut Samiti Complain Centers, which are local offices established to address and resolve electricity-related issues for residents. These centers are strategically located throughout Nawabganj Upazila, allowing citizens to report any disruptions or concerns regarding their electricity supply. On the other hand, Dhaka Southern Power Generation facility, a oil based thermal power plant, located in Kailail union. Its presence underscores the significance of efficient energy management in driving progress and prosperity within Nawabganj Upazila and the broader Dhaka region.

5.7 Upazila Urban Basic Services

The crucial role of supporting the community is played by upazila services. They are the behind-the-scenes operators ensuring that their daily lives run seamlessly from morning to night. In this chapter, an exploration will be conducted to delve into the vital services provided by the upazila, and their significance in daily routines will be examined.

5.7.1 Solid Waste Management Facilities- STS, Dumping site location

In Nawabganj Upazila, the solid waste management system is very weak. There is only one formal dustbin located in the Kolakopa union of the upazila and no door-to-door solid waste collection system. Maximum people through waste here and there, in the river, khal, and pond. There is a dumping ground beside the Ichamati River. Upazila solid waste collection van dumps the waste here. Except for this, there isn't any solid waste management system at all.

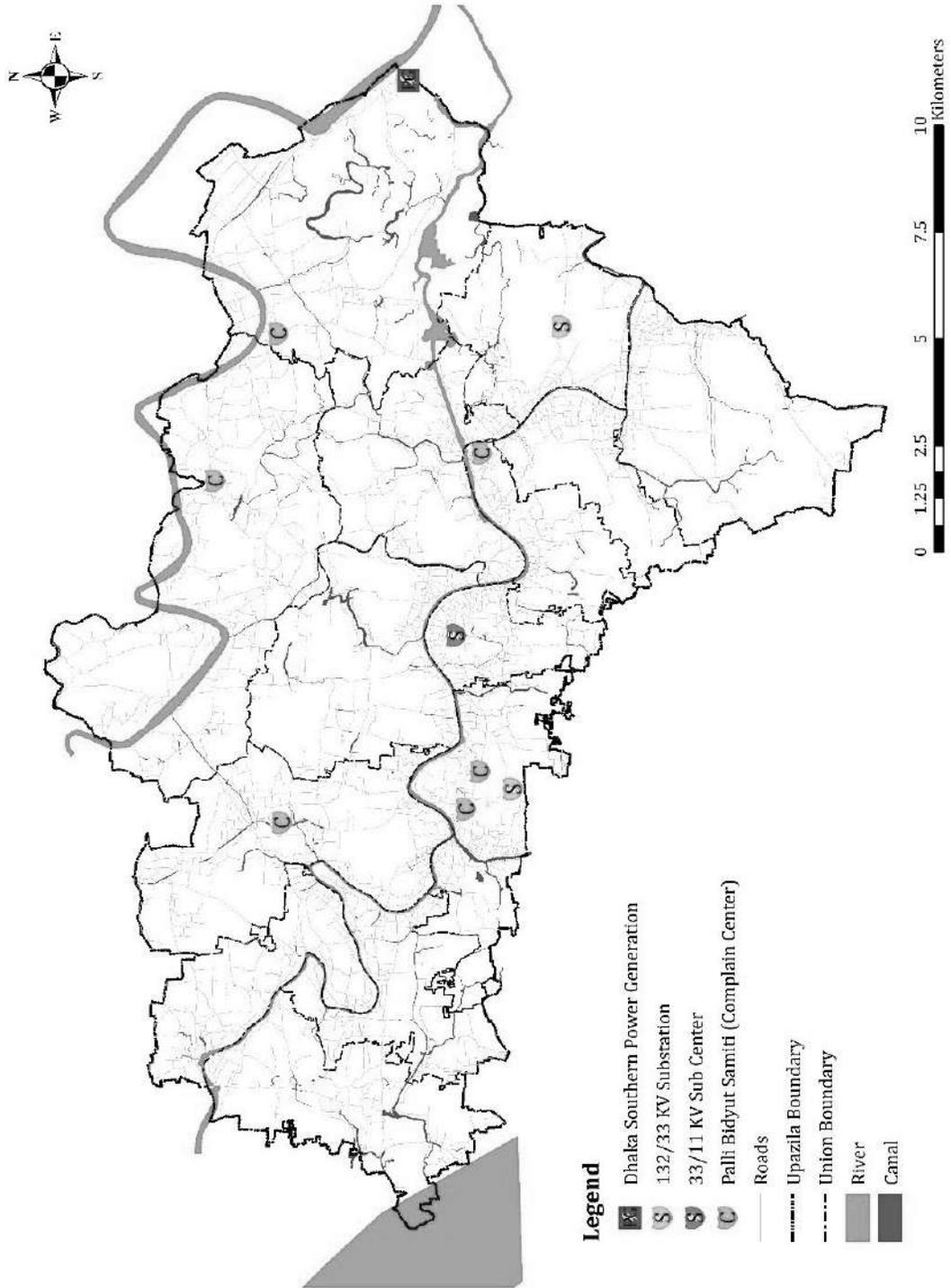


Figure 5-29: Power Substation Map

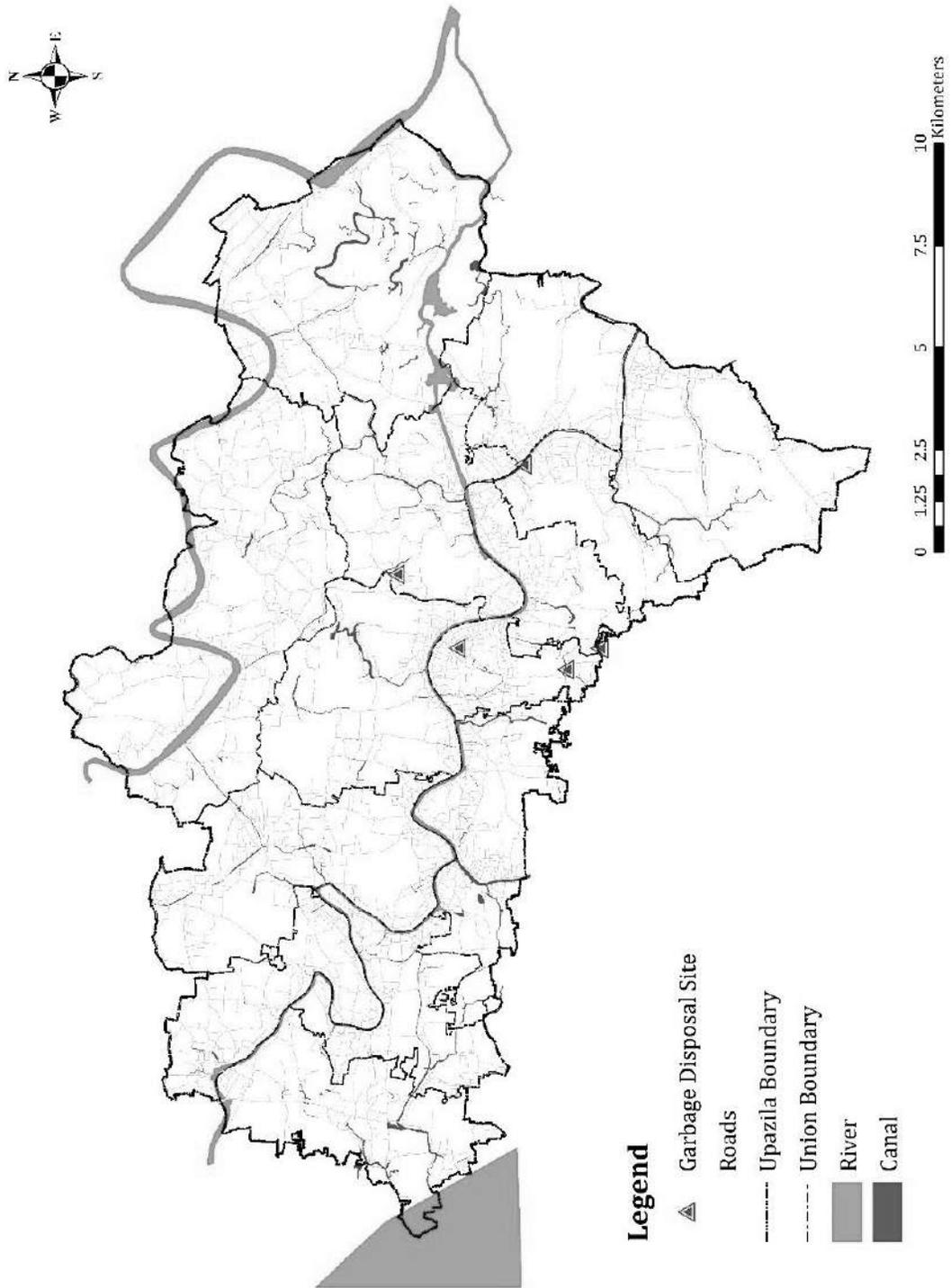


Figure 5-30: Solid Waste Management Map

5.7.2 Water Supply System- supply network, location of tube well

The Water Supply System in Nawabganj Upazila, plays a crucial role in ensuring access to clean and safe water for the local residents. This well-designed system incorporates various components such as water sources, treatment plants, distribution networks, and storage facilities to provide a reliable and sustainable water supply. With a focus on improving public health and promoting hygiene, the system employs modern technologies for water purification, ensuring that the water meets quality standards. Though a large percentage of the unions need to be developed in terms of infrastructure, and there are notably few water tanks to meet the demands of the entire community. The problem is made worse by the iron and arsenic found in several tube wells, which seriously endangers the health of people who depend on them for their daily water needs. A lot of locals have turned to deep tube wells as their main water supply despite the expenses and practical difficulties involved. This grave situation must be addressed immediately to guarantee that every resident in Nawabganj Upazila has access to sustainable and clean water resources.

5.7.3 Public Toilet

There are only fourteen public toilets carefully placed around Nawabganj. These facilities are essential commodities for residents and tourists to maintain comfort and cleanliness in public areas. However, despite the presence of these public toilets, there remains a significant lack of adequate facilities to meet the growing population's demands. Long queues and overcrowding are common issues faced by users, particularly during peak hours.

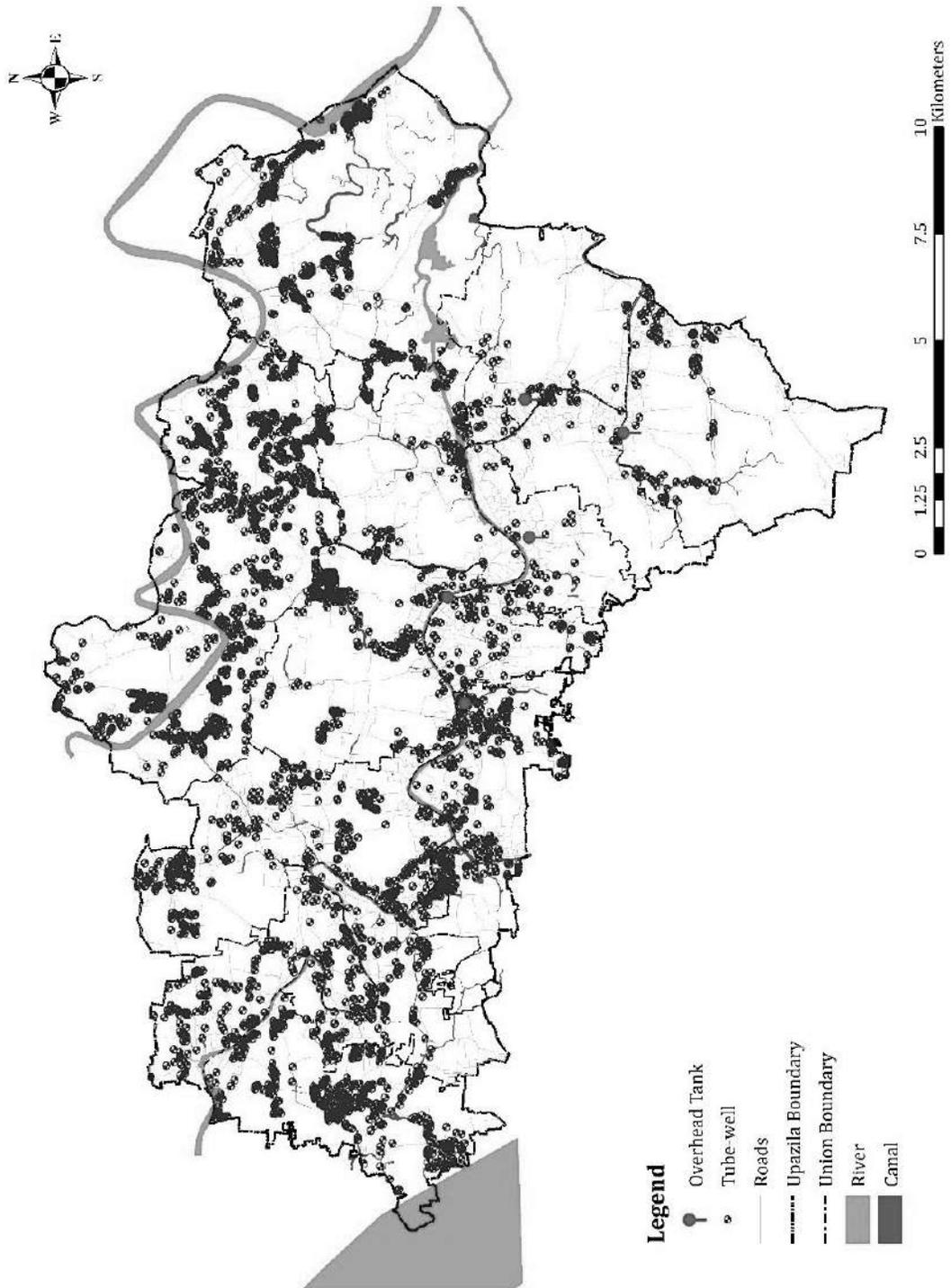


Figure 5-31: Water Supply System Map

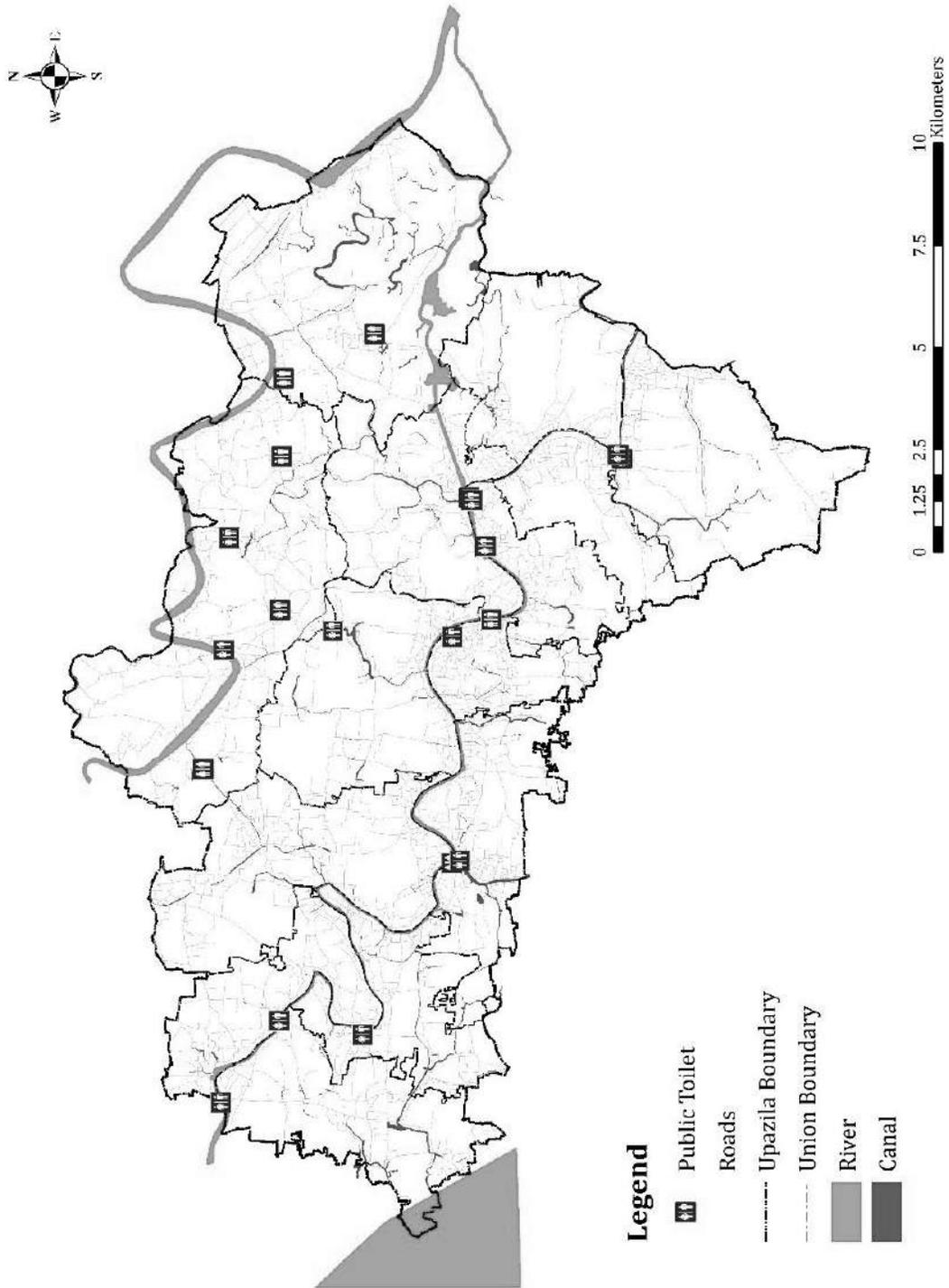


Figure 5-32: Public Toilet Location Map

5.7.4 Street Light

The data provided represents the distribution of street lamps in Nawabganj Upazila, showcasing both traditional lamp posts and more sustainable solar lamp posts across various unions. In Bandura, there are 64 conventional lamp posts and 1 solar lamp post, indicating a growing emphasis on eco-friendly lighting solutions. Kolakopa boasts a total of 75 lamp posts, with 72 being traditional and 3 solar-powered, reflecting a balanced approach to street lighting. In Sholla, a considerable 65 lamp posts illuminate the streets, of which 2 are conventional and 63 are solar-powered, emphasizing a substantial adoption of solar energy. Agla has no traditional lamp posts but 14 solar ones, offering a more limited but still appreciable lighting presence. Churain has 33 traditional lamp posts, while solar lighting has not yet been introduced. Bakshanagar has no lamp posts but still has 45 solar lamp posts. In Shikaripara, there are 11 conventional and 24 solar lamp posts, highlighting an increasing shift to unions renewable energy source. Kailail boasts 38 street lamps in total, with 35 being traditional and 3 solar, illustrating a promising trend to unions sustainability. Jantrail follows a similar pattern to Agla and Bakshanagar with no traditional and 24 solar lamp posts.

Table 5-25: Union-wise Lamp Post and Solar Lamp Post

Union	Lamp Post	Solar Lamp Post	Grand Total
Agla		14	14
Bakshanagar		45	45
Bandura	64	1	65
Barrah	39	1	40
Baruakhali	29	7	36
Churain	33		33
Galimpur	5	19	24
Jantrail		24	24
Joykrishnapur	5	22	27
Kailail	35	3	38
Kolakopa	72	3	75
Nayansree	2	38	40
Shikaripara	11	24	35
Sholla	2	63	65
Grand Total	297	264	561

Source: Field Survey, 2023

The grand total for Nawabganj Upazila reveals a significant investment in street lighting, with 297 conventional lamp posts and 264 solar lamp posts, indicating a commendable commitment to both safety and environmental conservation in the community.

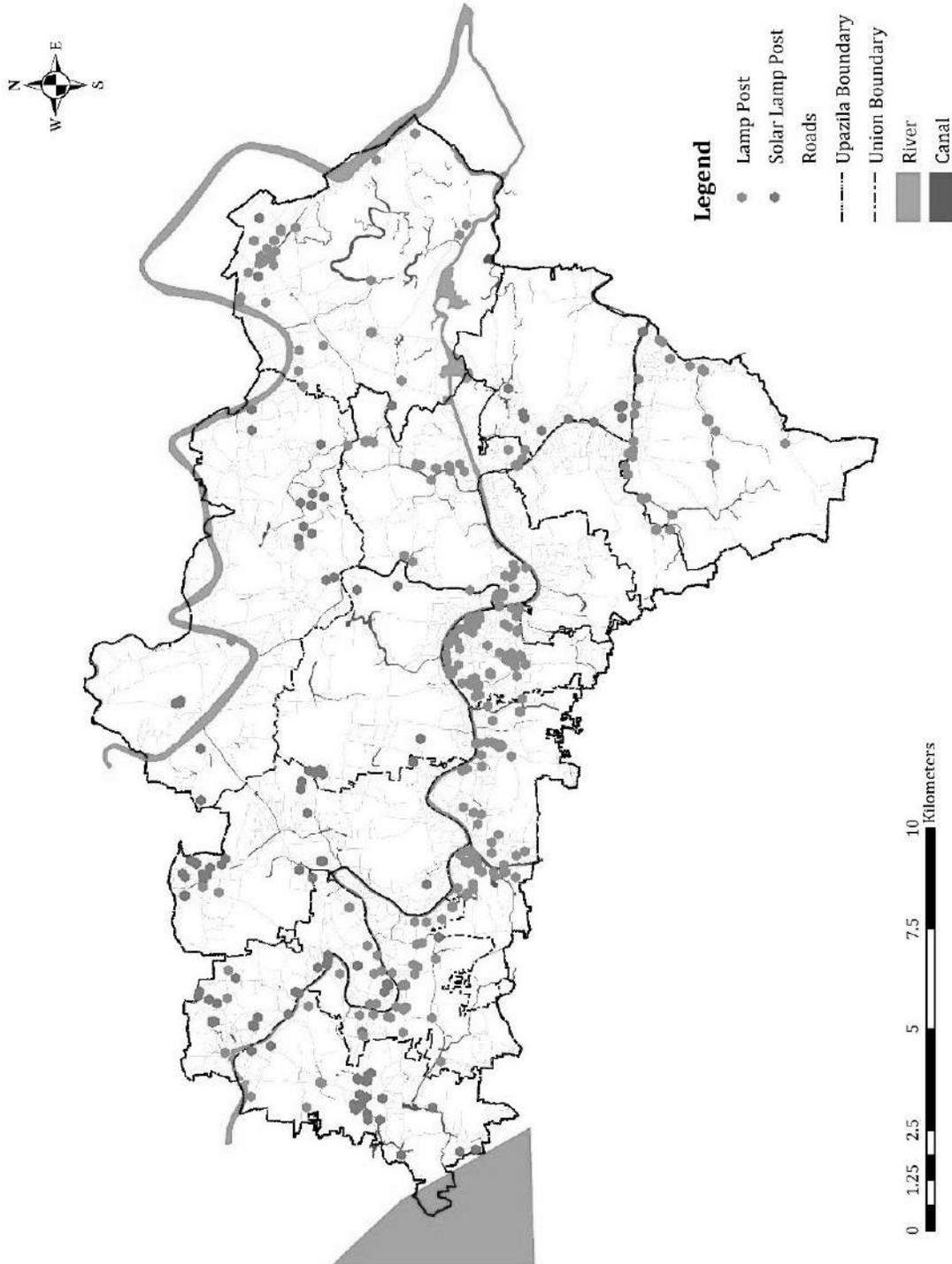


Figure 5-33: Street Light Location Map

5.8 Other Services

In Nawabganj, other services like sanitation, ICT network connectivity, CNG stations, growth centers, and bustling hat/bazars contribute to the community's well-being and development. Sanitation efforts ensure cleanliness through waste management initiatives, while the ICT network facilitates connectivity and access to information. The presence of CNG stations offers convenient and eco-friendly fuel options, supporting sustainable practices. Growth centers stimulate economic activity, fostering entrepreneurship and job opportunities. Meanwhile, vibrant hat/bazars serve as bustling marketplaces, promoting local commerce and community interaction. Together, these services enhance Nawabganj's infrastructure and quality of life, fostering prosperity and social cohesion within the community.

5.8.1 Sanitation

The figure 5-32 provides insight into the variety of sanitation facilities available in the surveyed area, with modern latrines being the most common type, followed by latrines with a slab. However, it also highlights that there are households with no sanitary latrine facilities or less hygienic options like hanging latrines or latrines without a slab. According to the survey, the findings show that the sanitation condition of Nawabganj is not satisfactory. In Nawabganj, 15% of households do not have sanitary latrine facilities, 5.83% of households use hanging latrines, and 18.33% of households use latrines without a slab. Well-functioning latrines are available in well-structured buildings in Nawabganj. In moderately urban areas, the sanitation status is good but not up to the mark. Most of the people of Nawabganj Upazila live in rural areas. Therefore sanitation condition is worse in rural areas of Nawabganj.

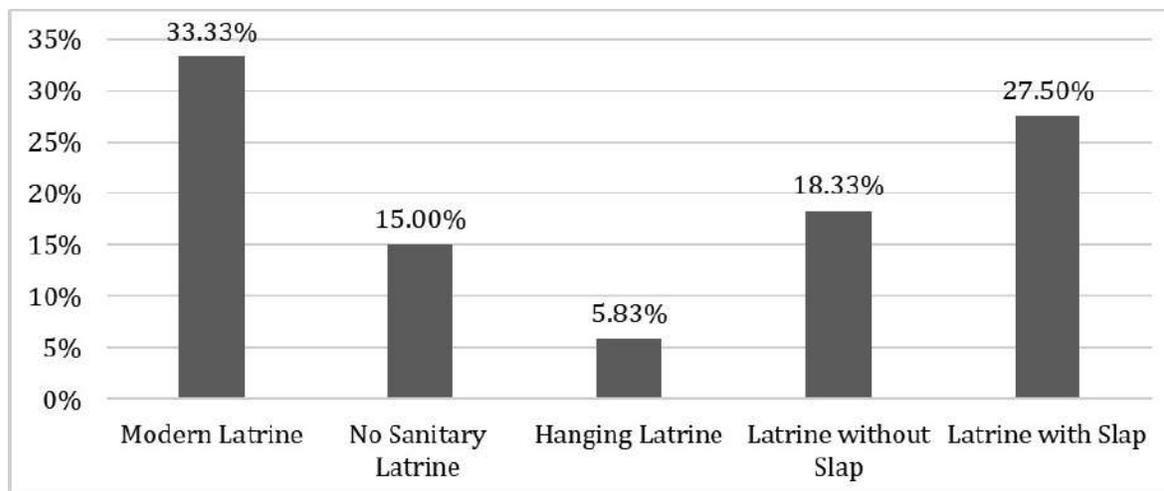


Figure 5-34: Types of Sanitary Latrine in Nawabganj Upazila

The figure in figure 5-33 provides insights into the diverse range of materials used in latrine construction in Nawabganj. It reflects the varied socioeconomic conditions of the upazila, with

different materials being chosen based on factors such as availability, cost, and local building practices.

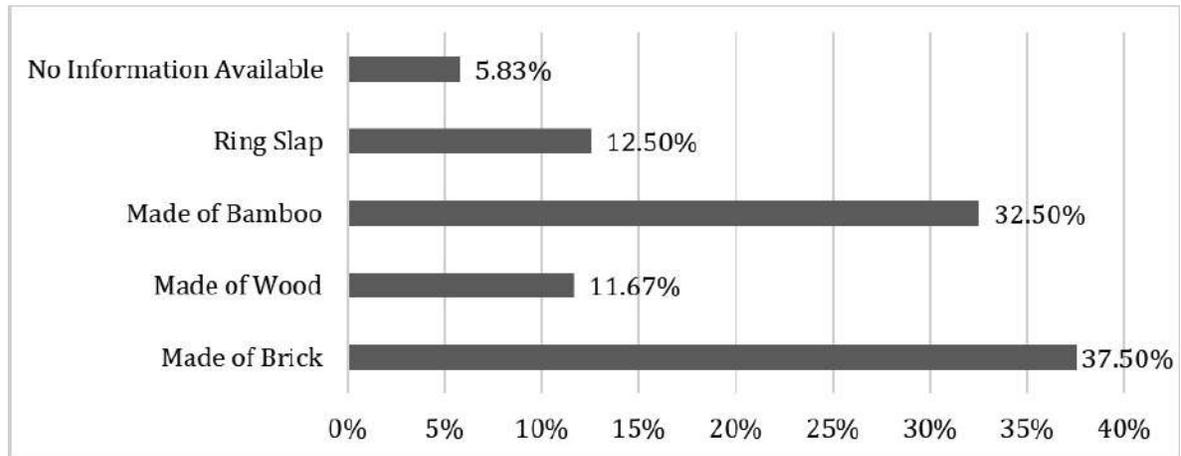


Figure 5-35: Material used to build structure of the latrine

Additionally, it underscores the importance of understanding local contexts and preferences in implementing effective sanitation strategies and infrastructure development initiatives. The findings of the survey show that in Nawabganj, 32.50% of latrines are made of bamboo, 11.67% are made of wood, and 12.50% of latrines consist of only a ring slab.

5.8.2 ICT Network

Nawabganj benefits from the presence of four ICT (Information and Communication Technology) centers, serving as vital hubs for digital literacy, skill development, and access to technology. These centers offer training programs, internet access, and support for innovation, contributing to the advancement of digital literacy and the local economy. However, despite these efforts, it's worth noting that there is still a lack of sufficient ICT centers to fully meet the growing demand for digital resources and training opportunities in Nawabganj. Addressing this gap by establishing additional ICT centers could further enhance digital inclusion and foster socio-economic development within the Upazila.

5.8.3 CNG Station

Nawabganj Upazila is served by four CNG (Compressed Natural Gas) stations, which play a critical role in providing clean and affordable fuel options to residents and commuters. These stations offer a convenient refueling infrastructure for vehicles running on CNG, promoting environmental sustainability by reducing emissions and dependence on traditional fossil fuels. However, the limited number of CNG stations in Nawabganj may pose challenges in meeting the growing demand for alternative fuel sources, especially as the population and number of vehicles continue to rise. Expanding the network of CNG stations could enhance accessibility and contribute to the broader goal of transitioning towards greener transportation solutions within the Upazila.

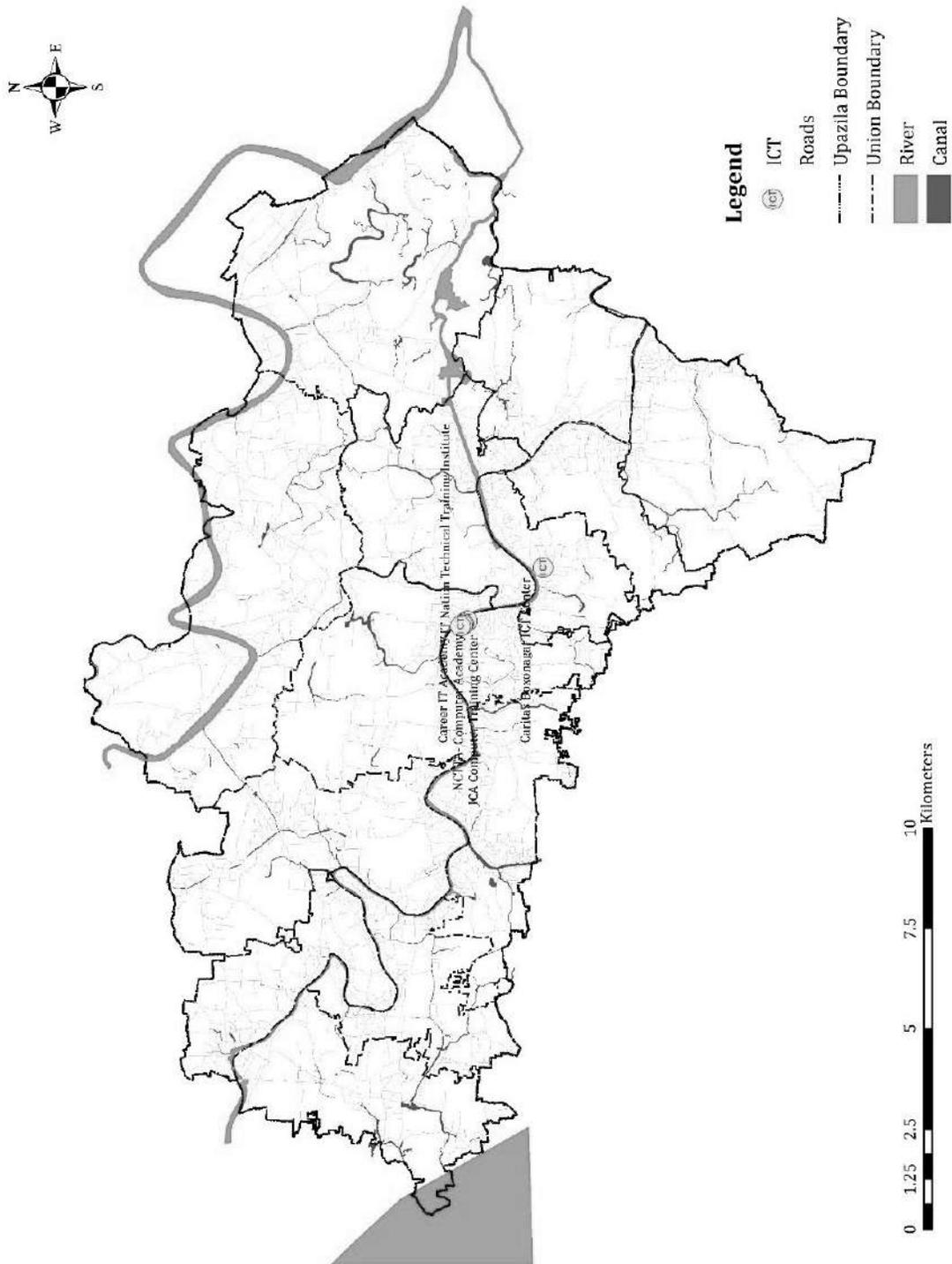


Figure 5-36: ICT Network Location Map

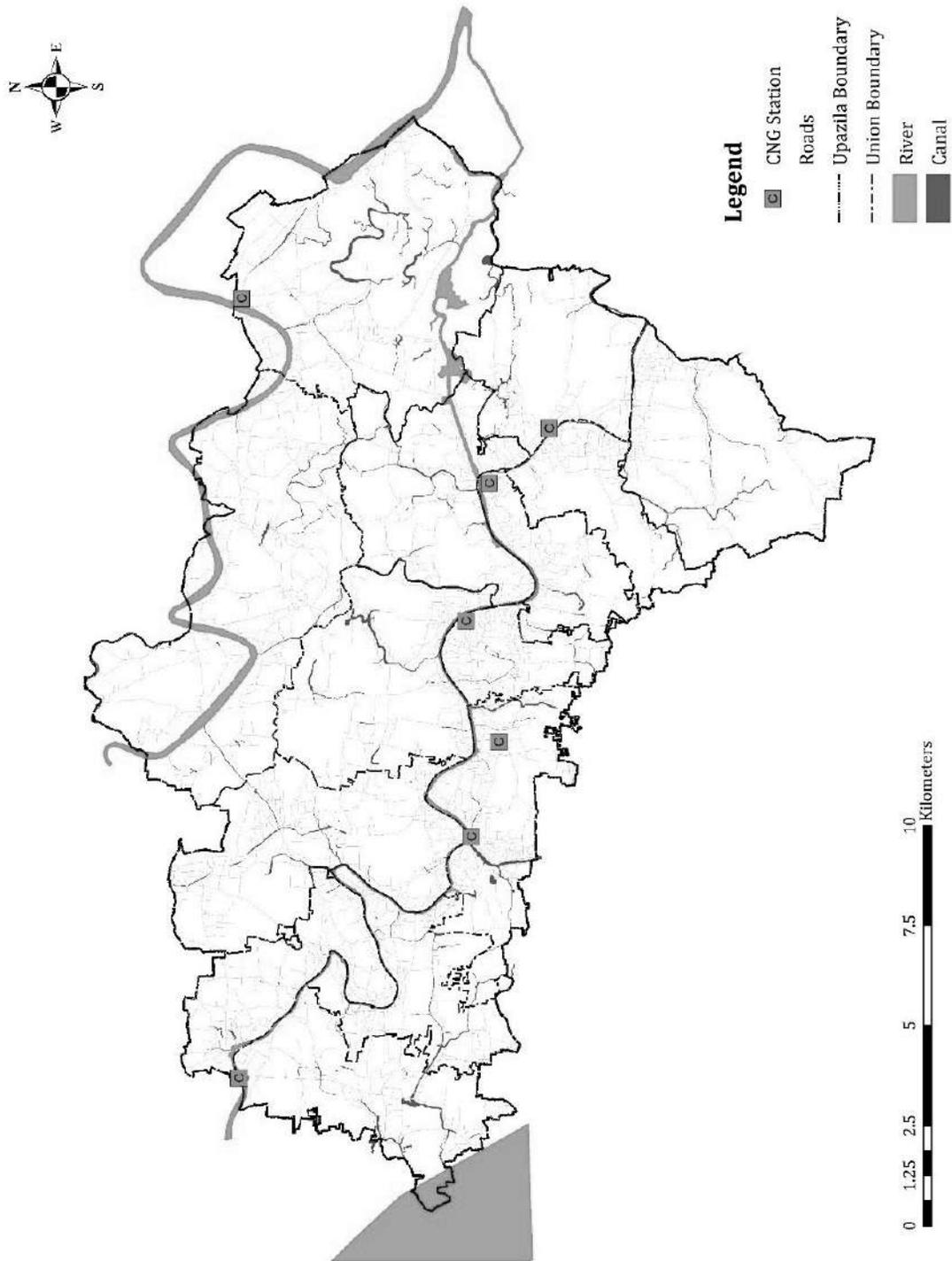


Figure 5-37: CNG Station Map

5.8.4 Growth Center

In Nawabganj Upazila, five growth centers serve as vital catalysts for economic and social activities. Located strategically, they foster innovation, entrepreneurship, and inclusive development by addressing key areas such as skill development, technology adoption, market access, and infrastructure enhancement. These centers provide support to startups and small businesses, offering resources, mentorship, and networking opportunities to empower aspiring entrepreneurs. Through skill development programs, they equip individuals with the necessary competencies for success in the modern economy. Additionally, they promote the adoption of innovative technologies, facilitate market access, and spearhead infrastructure development initiatives.

Table 5-26: Union-wise Growth Center List

Union Name	Growth Center Name
Bakshanagar	Komorganj Bazar
Baruakhali	Baruakhali Bazar
Churain	Gobindopur Bazar
Kolakopa	Nawabganj Bazar
Kailail	Paragram Bazar

5.8.5 Hat/Bazar

The bustling hats (markets) and bazars of Nawabganj Upazila, serve as vibrant hubs of commerce and social interaction, deeply ingrained in the fabric of the local community. Among these, the 60 hat-bazars scattered across the upazila hold particular significance, symbolizing the economic vitality and cultural richness of the region. Each bazaar carries its unique charm and caters to the specific needs and preferences of the surrounding population.

Table 5-27: Union-wise Bazar List

Union	Name of Bazar	Union	Name of Bazar	
Agla	Tikorpur Bazar	Sholla	Awana Bazar	
Bakshanagar	Bakshanagar Bazar		Singhora Bazar	
	Bardhan Para Bazar		Bashnol Bazar	
	Barrah Bazar		Sholla Bazar	
Bandura	Sadapur Bazar		Patiljhap Bazar	
	Dhapari Bazar		Shinghora Bazar	
	Bandura Bazar		Balukhanda Bazar	
	Noton Bandura Hat		Nilamborpotti Bazar	
Barrah	Agla Bazar		Dattakhanda Bazar	
	Kandamatra Bazar		Uttar Balukhanda Bazar	
Baruakhali	Alalpur Bazar		Ruparchar Bazar	
	Kumarbarilla Bazar		Chandrokhola Bazar	
Jantrail	Jantrail Possim Para Bazar		Nayansree	Gobindopur Bazar
	Jantrail Notun Bazar			Choto Golla Bow Bazar
	Horishkul Bazar	Khanepur Bazar		
	Harishkul Nodir Parer Bazar	Tuital Bazar		

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Union	Name of Bazar	Union	Name of Bazar
	Hariahkul Hasiba School Bazar		Charkholshi Probbhati Bazar
	Bhawali Bazar		Tasholla Bangla Bazar
	Nolgora Bazar		South Jamsha Bazar
	Chandrokhola Market Bazar	Kolakopa	Shurganj Bazar
	Chandrokhola Kalibari Bazar		Bagmara Bazar
Joykrishnapur	Bhalenga Bazar	Kailail	Poddar Bazar
	Ghoshail Bazar		Kailail Bazar
	Kathuri Bazar		Malikanda Bazar
	Sona Baju Beribad Bazar		Katakhali Bazar
Shikaripara	Daudpur Bazar	Churain	Nayakanda Bazar
	Hagradi Bazar		Meleng Bazar
	Shikaripara Bazar		Churain bazar
	Moheshpur Bazar		Durgapur Bazar
Galimpur	Galimpur Bazar		

Source: Field Survey (2023)

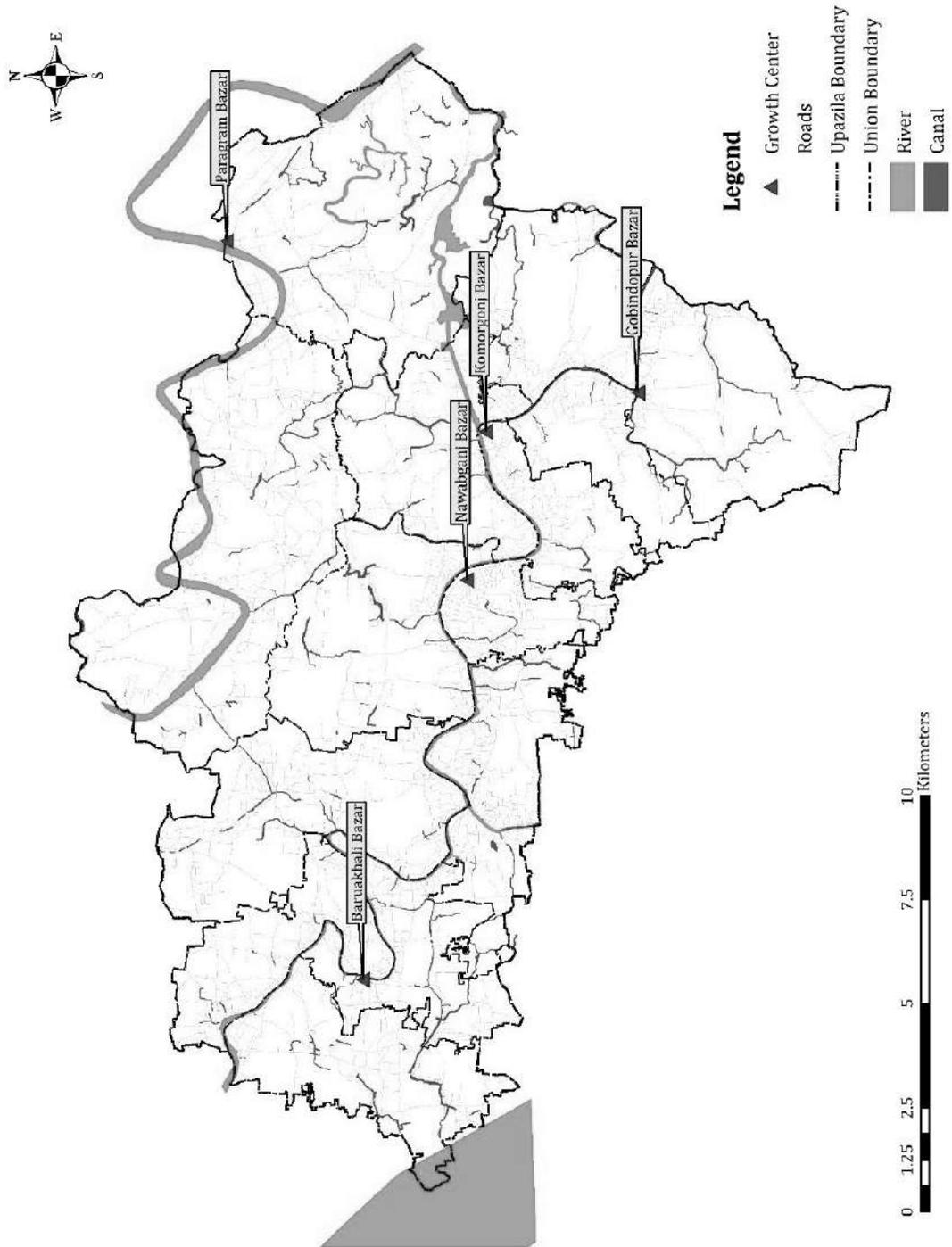


Figure 5-38: Growth Center Location Map

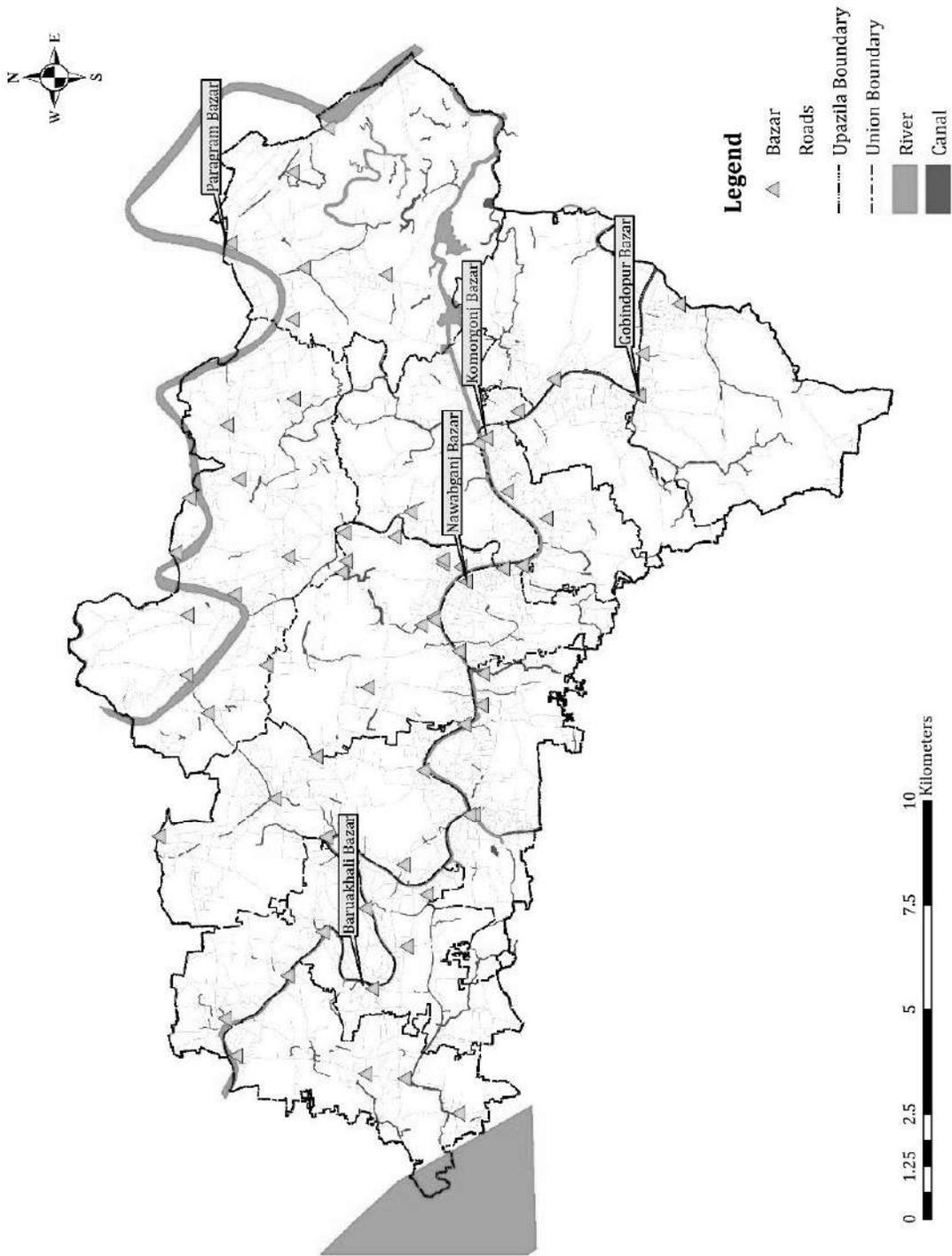


Figure 5-39: Hat/Bazar Location Map

CHAPTER SIX: EXISTING LAND USE SURVEY

6.1 Introduction

Nawabganj Upazila, situated within the diverse tapestry of Dhaka District, stands at a crucial crossroads of progress and advancement. As the upazila embarks on the ambitious journey of crafting a master plan to steer the future of its dynamic community, a thorough land use survey becomes an undeniable necessity. In the realm of master plan formulation, land use plays a pivotal role. It signifies the allocation and utilization of land within a defined geographical area for various purposes and social activities. These purposes can encompass Residential, Commercial endeavors, Administrative, Education, Health, Industrial, Places of Worship, Recreational spaces, and crucial conservation areas like Historical importance, Topology, Roads, Waterbodies, & Agricultural ventures; categorizing land use provides the essential framework for shaping Nawabganj Upazila's physical and functional landscape. It influences everything from the strategic development of infrastructure to establishing effective zoning regulations.

Land use information is gleaned from an extensive process known as a land use survey. This methodical and comprehensive undertaking aims to capture and analyze data pertaining to the current utilization of land within Nawabganj Upazila, Dhaka. The survey extends its scope to examine the spatial distribution, density, and unique characteristics of various land use categories within the designated area.

Land use surveys employ various data collection methods to paint a comprehensive picture:

Field observations: Trained personnel visited the upazila to directly observe and document land use patterns on-site.

Geographic Information Systems (GIS) technology: This advanced technology allows for the creation of digital maps that depict land use patterns visually.

Aerial photography: Images captured from drones are analyzed to identify and categorize land use types.

Stakeholder interviews: Engaging with residents, community leaders, and other stakeholders provided valuable insights into the present land use scenario and future extensions. Nawabganj Upazila paves the way for well-informed area planning by conducting a thorough land use survey. This information ensures that future developments align with the existing land use dynamics, fostering sustainable growth and ensuring the upazila's continued prosperity.

Land use is based on the functional dimension of land for different human purposes or economic activities. Specifically, it records the functional activity of the stakeholders. The survey operation was conducted to record the land use features by individual codes, which are later processed to get the category land use area.

Nawabganj Upazila area is about 247 sq km. and the whole area has been surveyed. Nawabganj Upazila has been sub-divided into 14 unions of different sizes. Among them, the Sholla Union has the largest area (38.3 sq k.m.), and the smallest area (6.7 sq k.m.) is known by Kolakopa Union. The largest Union covers 15.63% of the total area, and the smallest covers about 2.77% of the grand total area.

6.2 Land Use Classifications

Land use is classified as zones, and areas within Nawabganj Upazila are categorised based on their primary function. These classifications serve as a valuable tool for urban planners, providing a structured framework to analyze, manage, and ultimately guide the allocation and development of land resources. Each class signifies a distinct category of land use, encompassing everything from bustling residential zones to sprawling agricultural fields. Understanding these classifications is crucial for crafting effective land use policies, zoning regulations, and a comprehensive master plan that fosters organized and sustainable growth for Nawabganj Upazila.

For this specific analysis, whole land use within Nawabganj Upazila has classified land use into the following categories:

6.2.1 Residential

Areas primarily dedicated to housing, ranging from single-family homes to skyscrapers. The residential land use class encompasses areas primarily designated for housing and accommodation. These zones accommodate single-family homes, skyscrapers, condominiums, and other residential structures. Residential areas are the backbone of communities, providing residents with safe and comfortable living environments. Effective residential planning considers housing density, building types, and neighborhood amenities to create diverse and inclusive communities.

6.2.2 Commercial

Areas dedicated to commerce and business activities include shops, markets, and restaurants. Commercial land use zones are dedicated to facilitating business and commercial activities. They host various enterprises, including grocery stores, offices, restaurants, and entertainment venues. These areas are vital economic hubs, promoting commerce, employment, and revenue generation. Careful planning within commercial zones balances commercial activity with factors like traffic management and accessibility.

6.2.3 Mixed-Use

Areas combine residential and commercial functions with industrial uses, offering a dynamic blend of living and working spaces. Mixed-use areas blend various land use classes within a single zone, creating vibrant, walkable, and multifunctional neighborhoods. These zones combine residential, commercial, and sometimes industrial or recreational elements, fostering a sense of community and reducing the need for long commutes. Mixed-use developments prioritize convenience and sustainability, encouraging residents to live, work, shop, and play within their immediate vicinity.

6.2.4 Transport

Areas dedicated to transportation infrastructure, including roads and public transport facilities. Transport land use encompasses infrastructure related to transportation, including roads, regional connectivity, and transit hubs. These areas facilitate the movement of people and goods, connecting communities and supporting economic activity. Efficient transport planning is crucial to alleviate congestion, enhance connectivity, and reduce environmental impacts. In this report,

the following classes are treated as transport land use: Primary Road, Secondary Road, Local Road, Access Road, Footpath, Walkway, Embankment cum road, Bus terminal, Truck terminal, BRTC bus depot, Tempo stand, Auto/Rickshaw stand, BIWTA terminal (Boat Ghat).

6.2.5 Administrative

Area refers to areas allocated for public administrative and institutional purposes. This includes Government Offices, Civic centers, public libraries, and other facilities essential for local, regional, or national government functioning. These areas provide crucial public services and social wellbeing activities and symbolize the seat of governance within a jurisdiction.

6.2.6 Industrial

Areas dedicated to industrial activities, including manufacturing and processing facilities. Industrial land use zones accommodate manufacturing, warehousing, and distribution activities. They serve as centers of production, supporting economic growth and job creation. Industrial planning ensures compatibility with neighboring land uses while minimizing environmental and health impacts.

6.2.7 Agricultural

Areas primarily used for agricultural purposes include crop cultivation and animal rearing. Agricultural land use designates areas primarily dedicated to farming and food production. These zones include crop cultivation, livestock farming, and agri-business operations. Sustainable agricultural planning aims to preserve fertile soil, protect water resources, and promote food security.

6.2.8 Education

Areas dedicated to educational institutions, including schools, colleges, and universities. Education land use class encompasses areas devoted to educational institutions, such as schools, colleges, and universities. These institutions are pivotal in nurturing knowledge, skills, and human capital, contributing to communities' intellectual and social development.

6.2.9 Health

Areas dedicated to healthcare facilities, such as hospitals, clinics, and medical centers. Healthcare land use focuses on medical facilities, hospitals, clinics, and other infrastructure that ensure health services. Accessible and well-planned healthcare services are essential for community well-being and emergency response.

6.2.10 Recreational

Areas dedicated to leisure and recreational activities include parks, playgrounds, and sports facilities. This type of land use offers the scope for escaping the hustle and bustle of daily life. These pockets of leisure cater to a range of interests, from enjoying the serenity of nature to engaging in active pursuits.

6.2.11 Restricted Area

Areas with restricted access due to environmental, cultural, or security reasons. Restricted areas include military bases, airports, or zones with safety or security concerns. Access to these areas is controlled and regulated due to specific risks or sensitivities.

6.2.12 Water bodies

Areas covered by water bodies, such as rivers, lakes, and ponds. It is essential for environmental preservation, water supply, and recreational opportunities.

6.2.13 Graveyard

Areas dedicated to where people are buried after their death, which is a part of community services and amenities, such as Graveyard, Cemetery, and Cremation place

6.2.14 Heritage Site

This class includes different archaeological sites, such as Old Zamindar Bari and other places of interest (Historical sites).

6.2.15 Open Space

Open Space includes Different types of Gardens, Forest land, Urban green space, Riverbank, Shorelines, parks, playgrounds, etc.

By analyzing these land use classes, we gain valuable insights into the current composition of Nawabganj Upazila. This information serves as a foundation for informed decision-making, enabling us to craft a future-oriented master plan that caters to the community's needs while ensuring sustainable development and optimal utilization of land resources.

The prime paradox of urban land involves managing vital economic activities within limited urban space accommodating a large population. Land use classification aims to preserve land for effective public regulation and ensures proper utilization of land use. Classification systems vary globally and are driven by regional land use goals. Ambiguity arises between land cover and land use, with the distinction being that land cover pertains to surface features, while land use considers multifaceted activities. Automated systems aid land cover classification, while land use classification requires on-site investigation.

Table 6-1: Land Use Category

SL. No	Land uses	Illustrated
1	Residential	Planned Residential area, Govt. Quarters, Private Housing,
		Rest/Guest/Circuit House, Bungalow, Mess, Orphanage/Old Home, Rural Homestead, Slum, Squatters

SL. No	Land uses	Illustrated
2	Commercial	Residential Hotel/ Hotel & Restaurant, Wholesale Rice Market, Wholesale Vegetables Market, Wholesale Fish Market, Wholesale Paper Market, Wholesale Grocery Goods Market, Wholesale Fruit Market, Book Stall, Cloths Shop, Paper & Magazine, Stationery Shop, Shoe Shop, Bag & Leather Goods, Cosmetics, Spectacles, Electronic Goods, Audio Video Cassette, Utensils/crockeries, Sports Goods, Computer Goods, Motor Car Parts, Jewelry shops, Show Room, Furniture Shop, Department Store, Mobile Sales Center, Hardware Goods, Sweet Shop, Bakery Shop, Gift Shop, Press & Printing, Grocery Shop, Gun Shop, Iron & Steel Shops, Shopping Center/Mall, Super Market, Rubber Stamps, Phone-Fax- Photocopy, Cycle Store, Studio/Color Lab, Drug/Pharmacy, Pottery shop, Electronics, Sports and Athletics, Kitchen Market, Katcha Bazar, Beauty Parlor/Hair dresser, Govt. Food Godown, Cold Storage, Others Godown
3	Mixed Use	Commercial-Residential, Office/service-Residential, Commercial- green category Industrial, Two or more use
4	Transport	R & H Road/LGED Road, Primary Road/ Major Through fare, Secondary Road (Pucca), Secondary Road (Kutchra), Local Road (Pucca), Local Road (Kutchra), Access Road (Pucca), Access Road (Kutchra), Footpath (Paved), Footpath (Unpaved), Walkway, Embankment cum Road, Airport / Bus terminal / Truck terminal / BRTC bus Depot / Tempo stand / Rickshaw stand / Railway station / BIWTA Terminal/ Launch Terminal etc. Broad gauge, Meter gauge, River.
5	Administrative	Deputy Commissioner's Office, Zilla Parishad Office, SP Office/Police Headquarter, Civil Surgeon Office, LGED Office, Upazila Headquarter, Pourashava Office, Union Parishad Office, Settlement Office, Post office, Bank, Public Works Department Office, R&H Office, DPHE Office, Statistical Bureau Office, PDB Office, BWDB Office, DoE Office, All types of Government Office, Private Bank/ Insurance Company, Mercantile & Cooperatives, Money Exchange Center, Private company/Different types of NGO/CBO/Club, Construction Office, Commercial Group Office, Trading Corporation Office, Security Service Office, Law Chamber, Doctors Chamber, Political Party Office, Professional's Association, Labor Union
6	Industrial	Dairy Products, Fish & Sea Food, Salt Crushing Mill, Soft Drink, Bakery Product, Cotton Textile, Jute Textile, Silk & Artificial Textile, Dyeing Industry, Coconut Fiber Industry, Knitting Industry, Hosiery Products, Readymade Garments, Tannery & Finishing, Leather Buying House, Leather Footwear, Compressed Natural Gas, Fertilizers, Insecticides Industry, Soap & Detergent, Paints & Varnishes, Medicine and Drugs Company, Paper Product (all kind), Newspaper, Rubber Footwear, Cycle & Tire Tube, PVC Product, Glass Product, Bricks Kiln/Fields, Cement, Iron & Steel, Re rolling mills, Hand & Edge tools, Bland &, Knives, Heating & Lighting, Plumbing, Equipment, Machinery Equipment, Wire & Cables, Electric Lamps, Electrical, Apparatus, Fruits & Vegetables, Oil Products, Edible Salt, Molasses, Atta, Maida & Suji (Flour Mill), Spice Industry, Rice Mill, Boiler (Rice), Handicrafts, Pottery, Carpets, Fabrics, Sewing/Hand loom Products, Wooden Furniture, Cane Furniture, Steel Furniture, Ship Building, Lime Stone, Sports & Athletics.

SL. No	Land uses	Illustrated
7	Agricultural	Single crop land, Double crop land, Triple crop land, Barren land, Orchard, Different types of flower garden, Hatchery/Gher, Livestock/ Poultry Farm / Dairy Farm, Agricultural Research Area
8	Education	Kindergarten and Nursery, Primary School, High School, College, Public University, Private University, Public Medical College, Private Medical College, Homeopathic Medical College, Engineering College/University, Law College, Social Research, Health Research, Economic Research, Vocational Training Institute, Physical Training Institute, Nursing Training Institute, Teachers Training College, Computer Training Institute, Dakhil Madrasa, Alim Madrasa, Fazil Madrasa, Kamil Madrasa, Hafezia Madrasa, Tutorial/ Coaching Center, Government Training Institute, Library, Museum, Social Welfare Institution
9	Health	Govt. Hospital / Pvt Hospital / Mental Hospital/ Maternity/ Children Hospital / Clinic/ Diagnostic Center, Veterinary Hospital
10	Recreational	Cinema Hall, Theater Hall, Museum & Art gallery, Auditorium/Community Centre/Town Hall, Park/Playground/Amusement Park/Theme Park, Stadium/Gymnasium/Swimming Pool, Tennis Complex
11	Restricted Area	Cantonment/BDR/Navy, Police Station, Ansar Camp, Jail, TV Station, Radio Station, T&T Board, Power Supply Station
12	Water bodies	Pond, Tank, Beels, Lakes, River, Khal's, Streams, Drain
13	Graveyard	Graveyard, Cemetery, Cremation place
14	Heritage Site	Archeological site, Old zamindar bari, palace, other Historic Sites
15	Open Space	National Park/Botanical Garden, Zoological Park, Forest Land/Urban Green, Ecological Park/sites, River Bank, Shore line in case of coastal upazilas.

6.3 Present Land Use Scenario in Nawabganj Upazila

Nawabganj Upazila land use is classified into different classes, including Residential, Agriculture, Commercial, Educational, Administrative, Health, Heritage Site, Industrial, Mixed Use, Open Space, Restricted Area, Transport, Water bodies, etc. Following Figure 6.2 illustrates the land use occupied by different classes. Table 6.2 provides a comprehensive overview of land use within the Nawabganj Upazila area. It presents data on different land use categories, including their respective areas in square kilometers (sq. km), areas in acres, and the percentage of each land use type in relation to the total area of the following Upazila.

Table 6-2: Nawabganj Upazila Land use statistics

Land use	Area (Acre)	Area (Hector)	Area (Sq. k.m.)	Percentage (%)
Residential	18102.09	7325.66	73.26	29.65
Commercial	234.12	94.75	0.95	0.38
Mixed Use	303.81	122.95	1.23	0.50
Transport	677.37	274.12	2.74	1.11
Administrative	16.96	6.86	0.07	0.03
Industrial	137.59	55.68	0.56	0.23
Agriculture	35393.88	14323.39	143.23	57.96

Land use	Area (Acre)	Area (Hector)	Area (Sq. k.m.)	Percentage (%)
Education	183.04	74.08	0.74	0.30
Health	9.84	3.98	0.04	0.02
Recreational	178.77	72.35	0.72	0.29
Places of Worship	139.17	56.32	0.56	0.23
Restricted Area	25.17	10.19	0.10	0.04
Heritage Site	6.21	2.51	0.03	0.01
Open Space	126.41	51.16	0.51	0.21
Waterbodies	5433.61	2198.90	21.99	8.90
Graveyard	92.90	37.60	0.38	0.15
Miscellaneous	0.95	0.38	0.00	0.00
Total	61061.91	24710.88	247.11	100.00

Source: Field Survey, 2023

The total area of Nawabganj Upazila is 61061.91 acres. The agricultural zone consists of 57.96% area in Nawabganj Upazila. The per capital Agri land is 0.10 acre. From these above-mentioned statistics, it can be said that Nawabganj is basically an agriculture-based upazila. The economy of Nawabganj Upazila is primarily based on agriculture, as most number of people are engaged in Agricultural activities. Residential settlements are also dominant in this upazila, making up 29.65% of the total area. About 8.90% of the water body is covered by rivers, khals, beel ponds, etc. The upazila has three main rivers: the Ichamati, the Dhaleswari, and the Kaliganga. Only 1.11% of the area is used for roads. Mixed zones, administrative facilities, Recreational facilities, Health facilities, Industrial facilities, and Places of worship are also available in this upazila. Their percentage of area is comparatively low among the whole area of Nawabganj upazila.

According to UDD's findings, the total area of Nawabganj Upazila is 61434.9 acres. The agricultural zone consists of 63.3% area in Nawabganj Upazila. Nawabganj is basically an agriculture-based upazila. The economy of Nawabganj Upazila is primarily based on agriculture, which is the main source of income. Vegetation zones and rural settlements are also dominant in this upazila. 9.64% of the area is covered with waterbody, including rivers, khal, beel, etc. The upazila has three main rivers: the Ichamati, the Dhaleswari, and the Kaliganga. Only 0.48% of the area is considered an urban residential area. Transport facilities and commercial zones consist of 0.82% and 0.36% of the area, respectively. Mixed zones, government services, recreational facilities, health facilities, and community facilities are also present in this upazila. Their percentage of area among the total Nawabganj upazila is comparatively low.

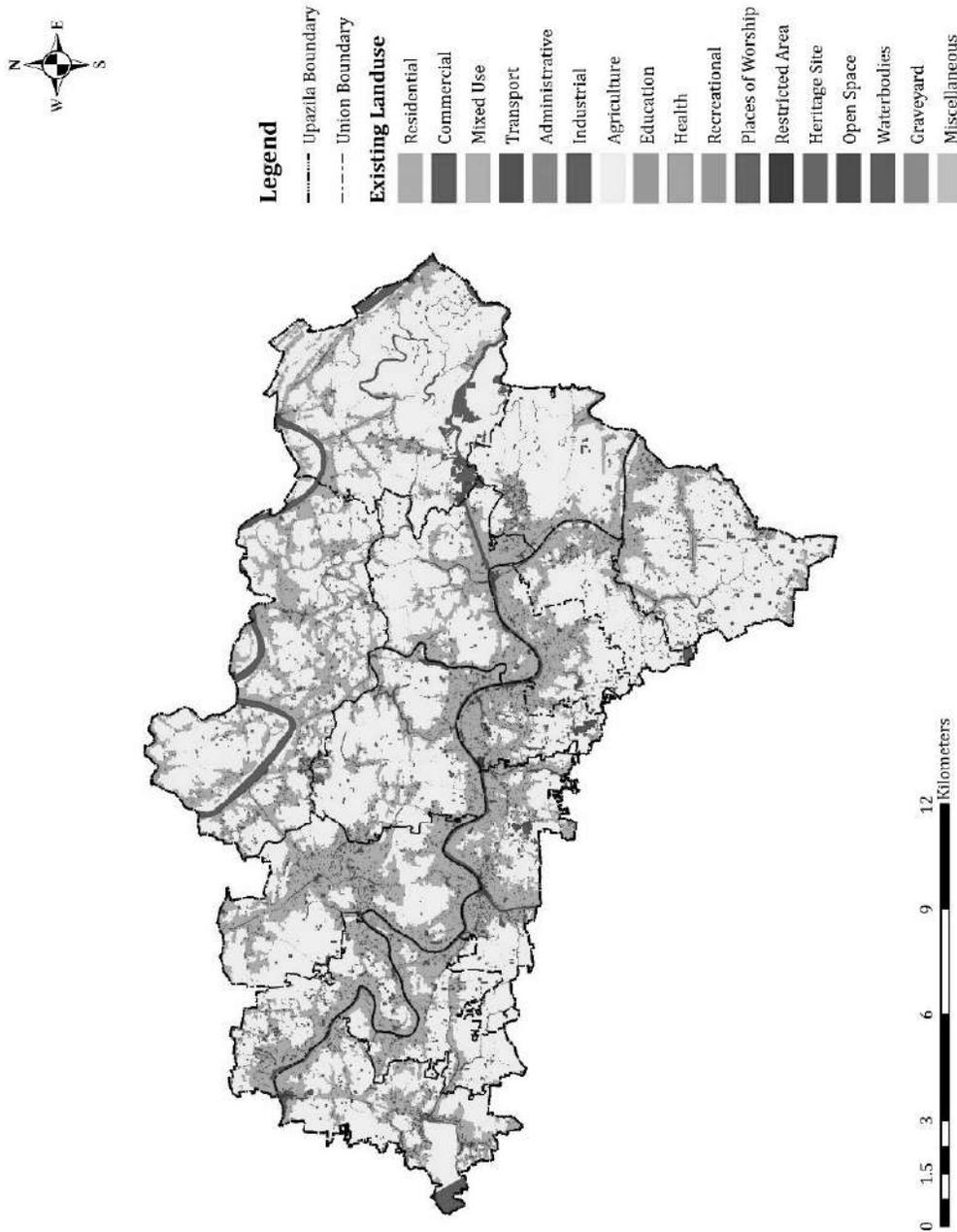


Figure 6-1: Existing Land use pattern of Nawabganj Upazila

6.4 Union-wise Land use Status

6.4.1 Agla Union

Nearly 73.25% of Agla 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 nearly about 1.01% of total Agla Union Land. Besides, Waterbody contributes about 5.20% of the total land area of Agla Union, including Pond, Khal, and Rivers.

Agriculture: Agla Union's land use profile reveals a distinct agricultural character, with nearly 73.25% 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 19.59%, suggesting a well-established community presence. Residential areas are established primarily around the bank of the Ichamati River and Dhaka to Nawabganj Sadar Road connectivity.

Water bodies: Water bodies comprise around 5.20%, encompassing Ponds, Khal, and rivers, adding valuable ecological diversity to the landscape. The Ichamati River crosses the Agla Union.

Table 6-3: Existing Land use category of Agla Union in Nawabganj Upazila

Land use	Area (Acre)	Area (Hector)	Area (Sq. k.m.)	Percentage (%)
Residential	721.72	292.07	2.92	19.59%
Commercial	4.81	1.95	0.02	0.13%
Mixed Use	3.54	1.43	0.01	0.10%
Transport	37.04	14.99	0.15	1.01%
Administrative	0.84	0.34	0.00	0.02%
Industrial	0.00	0.00	0.00	0.00%
Agriculture	2698.38	1092.00	10.92	73.25%
Education	7.27	2.94	0.03	0.20%
Health	0.77	0.31	0.00	0.02%
Recreational	5.66	2.29	0.02	0.15%
Places of Worship	5.81	2.35	0.02	0.16%
Restricted Area	0.00	0.00	0.00	0.00%
Heritage Site	0.44	0.18	0.00	0.01%
Open Space	0.00	0.00	0.00	0.00%
Waterbodies	191.71	77.58	0.78	5.20%
Graveyard	5.61	2.27	0.02	0.15%
Miscellaneous	0.03	0.01	0.00	0.00%
Total	3683.63	1490.71	14.91	100.00%

Source: Field Survey, 2023

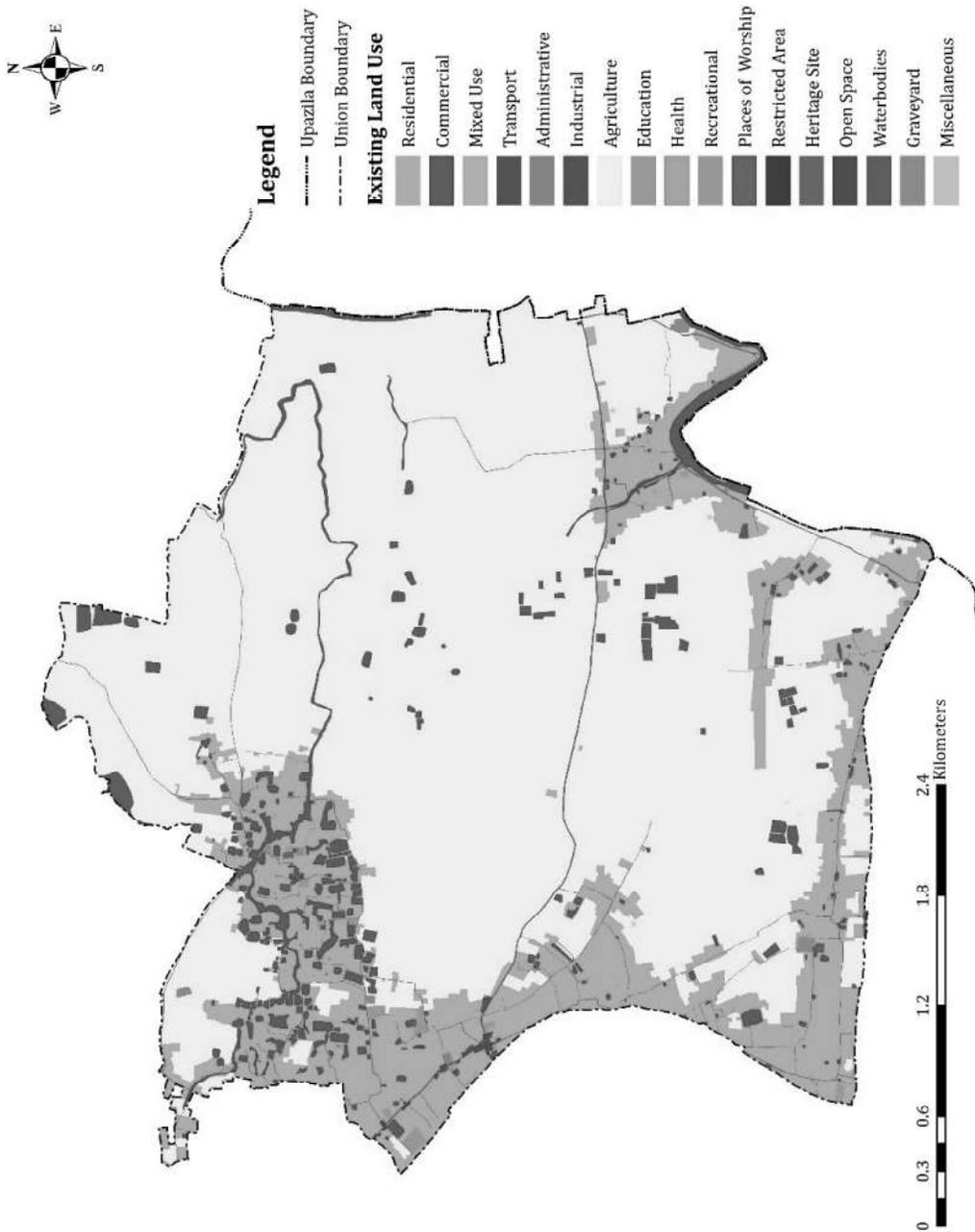


Figure 6-2: Existing Land use pattern of Agla Union

Road: Transportation infrastructure plays a moderate role, with roads encompassing nearly about 1.01% of the land. The road that passes through Tikorpur to Nawabganj Upazila Complex is the most vibrant in 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.

6.4.2 Bakshanagar Union

Nearly 44.37% of Bakshanagar 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. Roads contribute nearly about 1.65% of the total Bakshanagar Union Land. Besides, Waterbody contributes about 8.47% of the total land area of Bakshanagar Union, in which Pond, Khal, and Rivers are included.

Table 6-4: Existing Land use category of Bakshanagar Union in Nawabganj Upazila

Land use	Area (Acre)	Area (Hector)	Area (Sq. k.m.)	Percentage (%)
Residential	892.06	361.00	3.61	42.08%
Commercial	22.86	9.25	0.09	1.08%
Mixed Use	9.14	3.70	0.04	0.43%
Transport	35.08	14.20	0.14	1.65%
Administrative	1.03	0.42	0.00	0.05%
Industrial	2.80	1.13	0.01	0.13%
Agriculture	940.54	380.62	3.81	44.37%
Education	8.68	3.51	0.04	0.41%
Health	0.37	0.15	0.00	0.02%
Recreational	4.86	1.97	0.02	0.23%
Places of Worship	9.31	3.77	0.04	0.44%
Restricted Area	0.00	0.00	0.00	0.00%
Heritage Site	0.57	0.23	0.00	0.03%
Open Space	6.80	2.75	0.03	0.32%
Waterbodies	179.50	72.64	0.73	8.47%
Graveyard	6.14	2.49	0.02	0.29%
Miscellaneous	0.00	0.00	0.00	0.00%
Total	2119.74	857.83	8.58	100.00%

Source: Field Survey, 2023

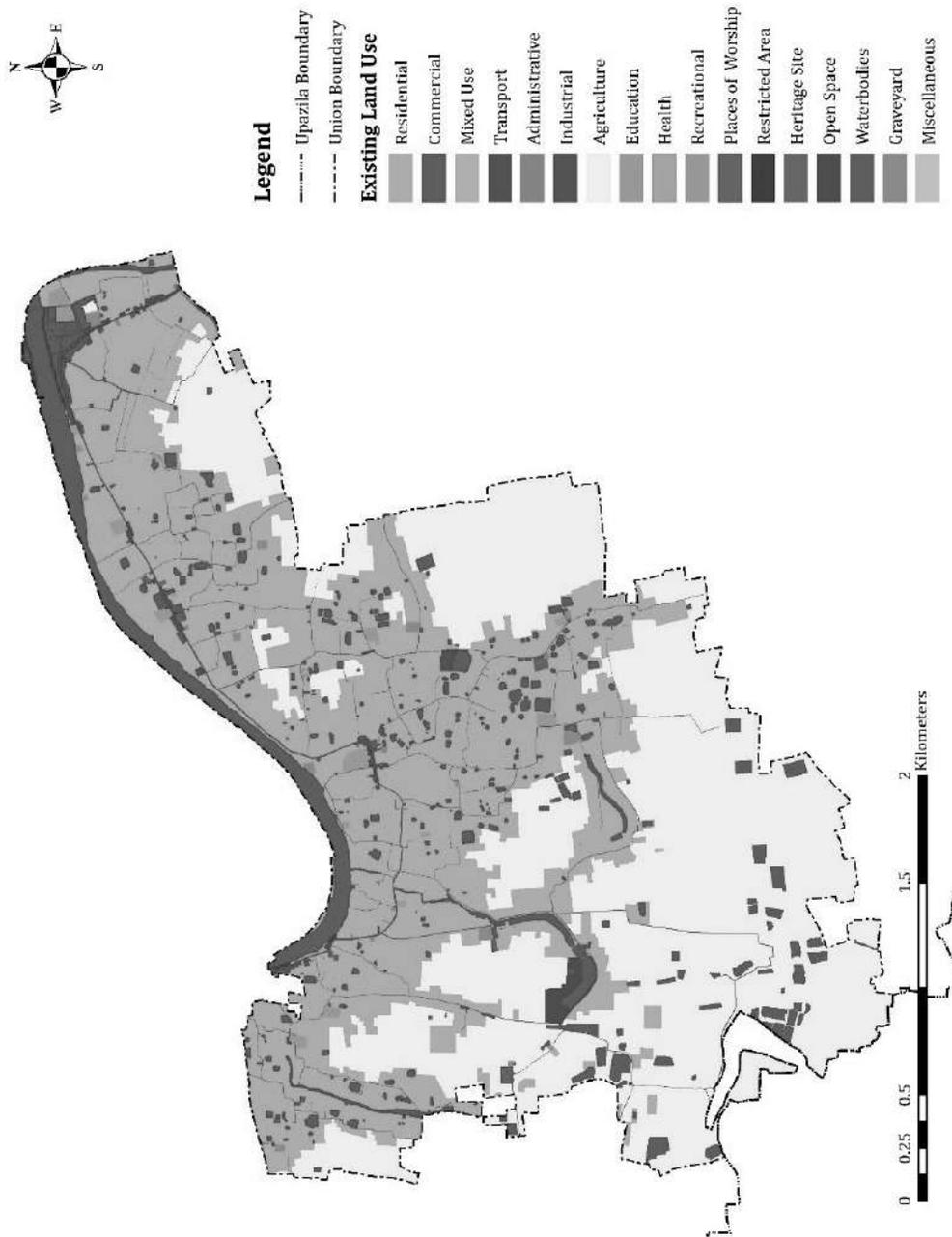


Figure 6-3: Existing Land use pattern of Bakshanagar Union

Agriculture: Bakshanagar Union's land use profile reveals a distinct agricultural character, with nearly 44.37% 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 42.08%, suggesting a well-established community presence. Residential areas are established primarily around the bank of the Ichamoti River and have connectivity from Dhaka to Nawabganj Sadar Road.

Water bodies: Water bodies comprise around 8.47%, encompassing Ponds, Khal, and rivers, adding valuable ecological diversity to the landscape. Ichamoti River crosses the Bakshanagar Union. Balurchor Khal and Dighirpar Khal are the two prevailing waterbodies in this union.

Road: Transportation infrastructure plays a moderate role, with roads encompassing nearly about 1.65% of the land. The road that passes through Komorganj Bazar to Nawabganj Upazila Complex via Dighirpar is the most vibrant road in the union.

Around 1.08% of the land within the union is commercial. While several land use categories exist, including 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.

6.4.3 Bandura Union

Nearly 46.27% of Bandura 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 nearly about 1.42% of the total Bandura Union Land. Besides, Waterbody contributes about 10.74% of the total land area of Bandura Union, in which Pond, Khal, and Rivers are included.

Agriculture: Bandura Union's land use profile reveals a distinct agricultural character, with nearly 46.27% 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 37.42%, suggesting a well-established community presence. Residential areas are established primarily around the bank of the Ichamoti River and its associate khal. Besides, Nawabganj Sadar to Bandura Bus Terminal via Majhir Kanda Road is the main road connectivity by which settlement areas are established at this union.

Water bodies: Water bodies comprise around 10.74%, encompassing Ponds, Khal, and rivers, adding valuable ecological diversity to the landscape. Ichamoti river crosses the Bandura Union. Shadapur Khal and Hazratpur Khal are the two prevailing waterbodies in this union.

Road: Transportation infrastructure plays a moderate role, with roads encompassing nearly about 1.42% of the land. The road that passes through Bandura Bus Terminal to Nawabganj Upazila Complex via Majhirkanda is the most vibrant road in 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 6-5: Existing Land use category of Bandura Union in Nawabganj Upazila

Land use	Area (Acre)	Area (Hector)	Area (Sq. k.m.)	Percentage (%)
Residential	1366.93	553.18	5.53	37.42%
Commercial	34.04	13.77	0.14	0.93%
Mixed Use	19.43	7.86	0.08	0.53%
Transport	52.01	21.05	0.21	1.42%
Administrative	0.99	0.40	0.00	0.03%
Industrial	23.16	9.37	0.09	0.63%
Agriculture	1690.19	684.00	6.84	46.27%
Education	14.12	5.72	0.06	0.39%
Health	0.43	0.18	0.00	0.01%
Recreational	16.37	6.63	0.07	0.45%
Places of Worship	12.42	5.02	0.05	0.34%
Restricted Area	0.05	0.02	0.00	0.00%
Heritage Site	0.99	0.40	0.00	0.03%
Open Space	23.23	9.40	0.09	0.64%
Waterbodies	392.40	158.80	1.59	10.74%
Graveyard	5.85	2.37	0.02	0.16%
Miscellaneous	0.01	0.00	0.00	0.00%
Total	3652.63	1478.17	14.78	100.00%

Source: Field Survey, 2023

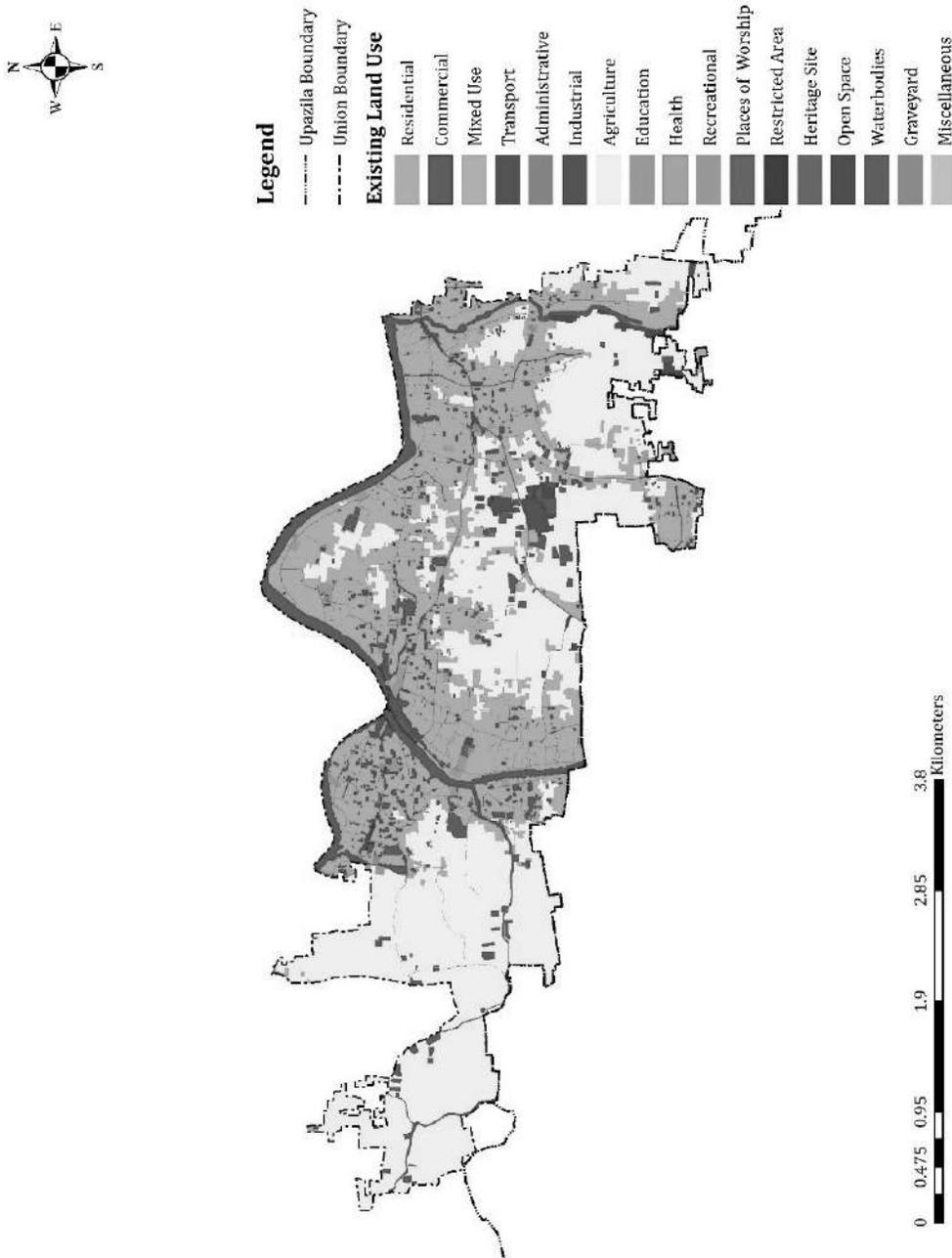


Figure 6-4: Existing Land use pattern of Bandura Union

6.4.4 Barrah Union

Nearly 57.38% of Barrah 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 nearly about 1.24% of total Barrah Union Land. Besides, Waterbody contributes about 7.02% of the total land area of Barrah Union, including Pond, Khal, and Rivers.

Agriculture: Barrah Union's land use profile reveals a distinct agricultural character, with nearly 57.38% 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 32.65%, suggesting a well-established community presence. The residential area is established primarily around the bank of the Ichamoti River and its associate khal. Besides Nawabganj Sadar to Barrah Union Health Complex via Bagmara bridge and Komorganj Bazar to Aona Bazar via Komorganj-Barrah bridge, the main road connectivity by which settlement areas are established at this union.

Table 6-6: Existing Land use category of Baruakhali Union in Nawabganj Upazila

Land use	Area (Acre)	Area (Hector)	Area (Sq. k.m.)	Percentage (%)
Residential	1381.78	559.19	5.59	32.65%
Commercial	11.09	4.49	0.04	0.26%
Mixed Use	8.81	3.57	0.04	0.21%
Transport	52.60	21.28	0.21	1.24%
Administrative	0.76	0.31	0.00	0.02%
Industrial	0.69	0.28	0.00	0.02%
Agriculture	2428.57	982.81	9.83	57.38%
Education	8.66	3.51	0.04	0.20%
Health	0.31	0.12	0.00	0.01%
Recreational	15.12	6.12	0.06	0.36%
Places of Worship	9.69	3.92	0.04	0.23%
Restricted Area	0.00	0.00	0.00	0.00%
Heritage Site	0.00	0.00	0.00	0.00%
Open Space	9.78	3.96	0.04	0.23%
Waterbodies	296.90	120.15	1.20	7.02%
Graveyard	7.41	3.00	0.03	0.18%
Miscellaneous	0.12	0.05	0.00	0.00%
Total	4232.29	1712.75	17.13	100.00%

Source: Field Survey, 2023

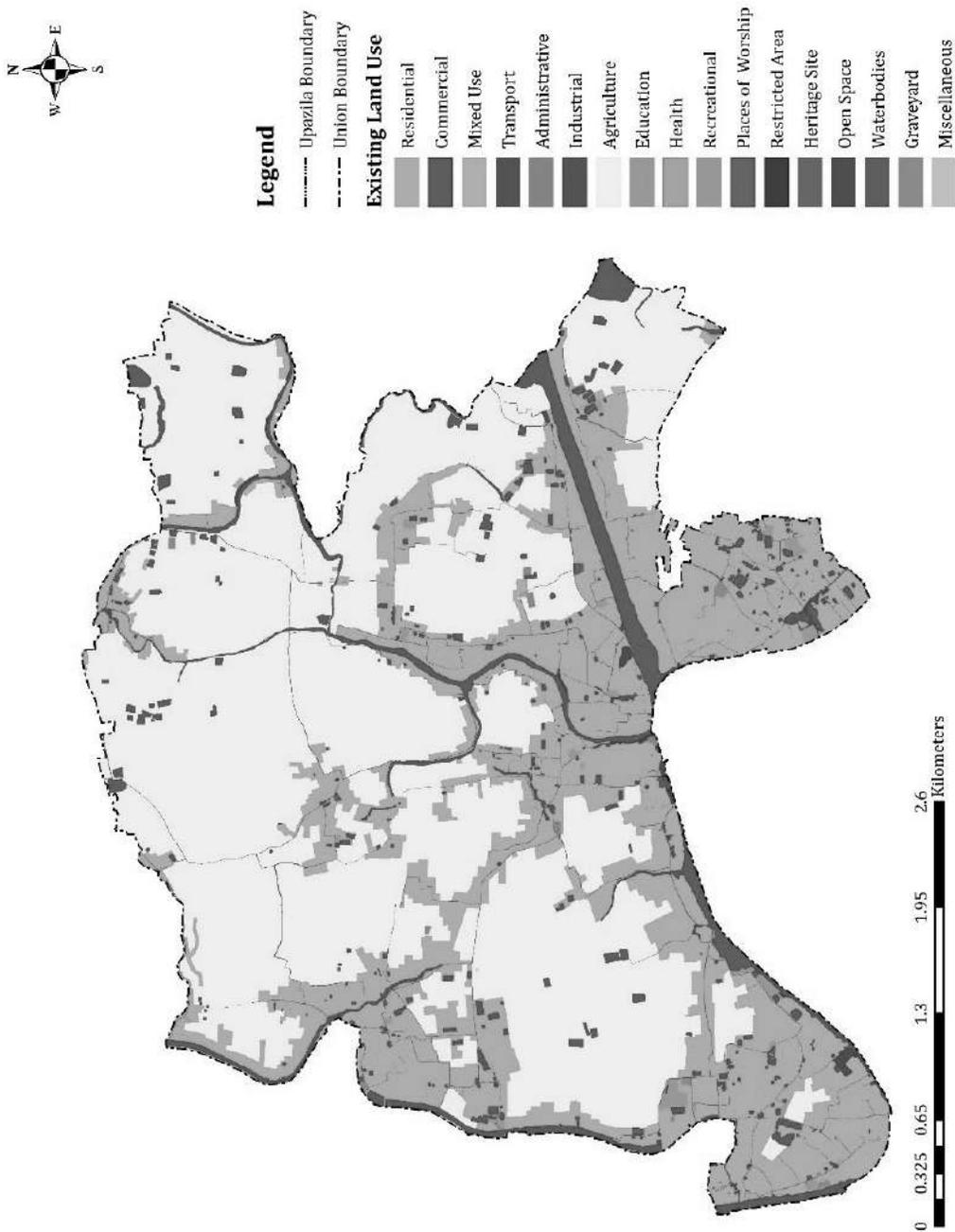


Figure 6-5: Existing Land use pattern of Barrah Union

Water bodies: Water bodies comprise around 7.02% of the landscape, encompassing ponds, Khal, and rivers, adding valuable ecological diversity. The Ichamoti River crosses the Bandura Union. Barrah Khal and Norbori Khal are the two prevailing water bodies in this union.

Road: Transportation infrastructure plays a moderate role, with roads encompassing nearly about 1.24% of the land. The road that passes through Barrah bazaar to Jantrail Union via Algirchar 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.

6.4.5 Baruakhali Union

Nearly 53.02% of Baruakhali 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 nearly about 1.32% of the total Baruakhali Union Land. Besides, Waterbody contributes about 10.17% of the total land area of Baruakhali Union, in which Pond, Khal, and Rivers are included.

Table 6-7: Existing Land use category of Baruakhali Union in Nawabganj Upazila

Land use	Area (Acre)	Area (Hector)	Area (Sq. k.m.)	Percentage (%)
Residential	991.24	401.14	4.01	33.35%
Commercial	5.51	2.23	0.02	0.19%
Mixed Use	19.20	7.77	0.08	0.65%
Transport	39.19	15.86	0.16	1.32%
Administrative	0.93	0.38	0.00	0.03%
Industrial	0.55	0.22	0.00	0.02%
Agriculture	1576.15	637.85	6.38	53.02%
Education	11.70	4.73	0.05	0.39%
Health	0.45	0.18	0.00	0.02%
Recreational	11.60	4.69	0.05	0.39%
Places of Worship	9.09	3.68	0.04	0.31%
Restricted Area	0.00	0.00	0.00	0.00%
Heritage Site	0.00	0.00	0.00	0.00%
Open Space	0.00	0.00	0.00	0.00%
Waterbodies	302.27	122.32	1.22	10.17%
Graveyard	4.63	1.87	0.02	0.16%
Miscellaneous	0.07	0.03	0.00	0.00%
Total	2972.56	1202.95	12.03	100.00%

Source: Field Survey, 2023

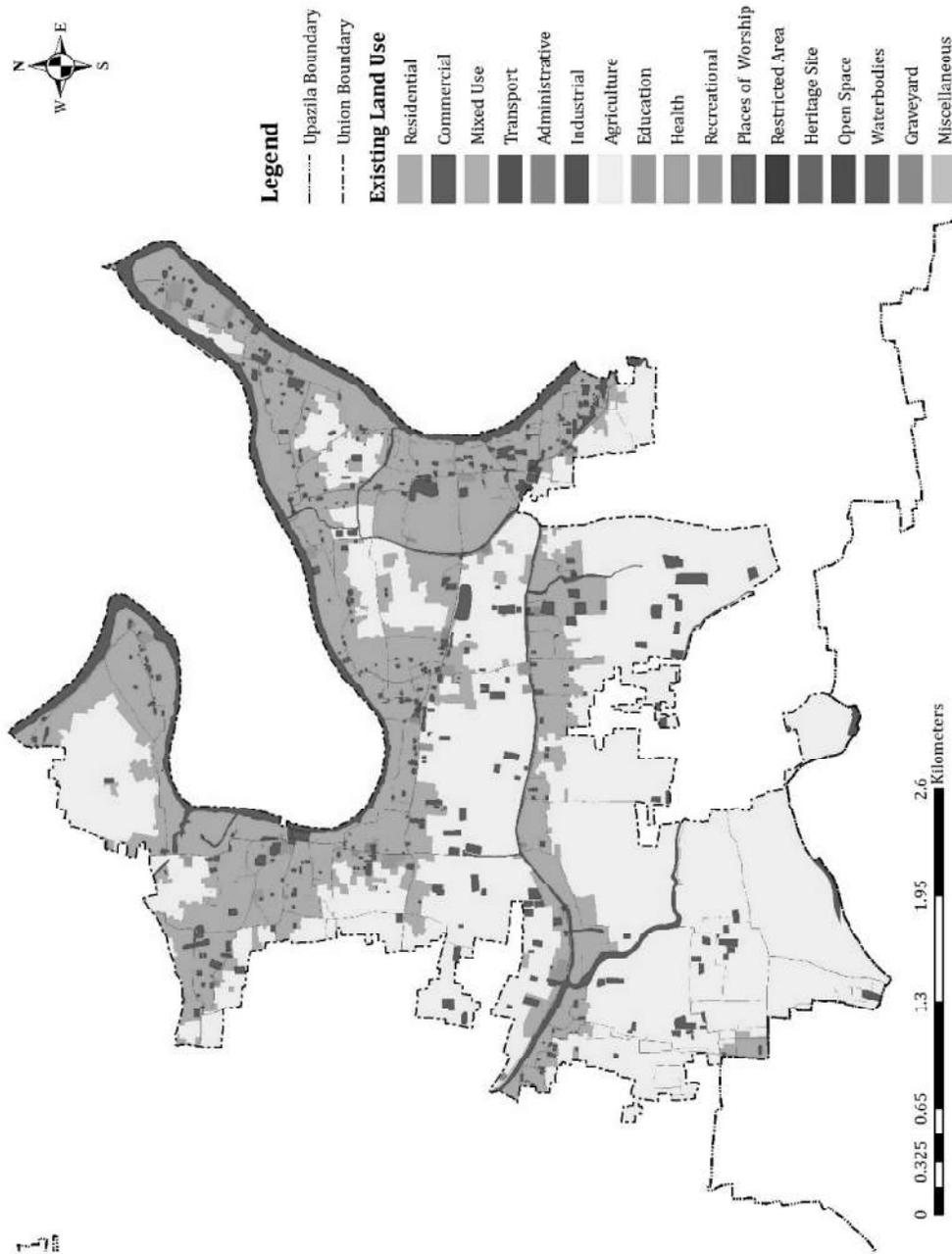


Figure 6-6: Existing Land use pattern of Baruakhali Union

Agriculture: Baruakhali Union's land use profile reveals a distinct agricultural character, with nearly 53.02% 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 33.35%, suggesting a well-established community presence. Residential areas are established primarily around the bank of the Ichamoti River and its associate khal. Bandura Bazar to Baruakhali Bazar via Kumarbarilla Bazar is the main road connectivity by which settlement areas are established at this union.

Water bodies: Water bodies comprise around 10.17%, encompassing Ponds, Khal, and rivers, adding valuable ecological diversity to the landscape. Ichamoti River crosses the Baruakhali Union. Korpara Khal and Dhiringogram Khal are the two prevailing waterbodies in this union.

Road: Transportation infrastructure plays a minimal role, with roads encompassing 1.32% of the land. The road that passes through Alalpur bazaar to Baruakhali bazaar via Kumarbarilla bazaar is the most vibrant in 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.

6.4.6 Churain Union

Nearly 69.79% of Churain 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 nearly around 0.83% of total Churain Union Land. Besides, Waterbody contributes about 8.78% of the total land area of Churain Union, including Pond, Khal, and Rivers.

Agriculture: Churain Union's land use profile reveals a distinct agricultural character, with nearly 69.79% 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 about 19.48%, suggesting a well-established community presence. Residential areas are established primarily around the bank of the Ichamoti River and its associate khal. Besides Churain Bazar to Galimpur Bazar via Durgapur Bazar is the main road connectivity by which settlement areas are established at this union.

Water bodies: Water bodies comprise around 8.78%, encompassing Ponds, Khal, and rivers, adding valuable ecological diversity to the landscape. Ichamoti River crosses the Churain Union. Muslimhati Khal and Kamarkhola Khal are the two prevailing waterbodies in this union.

Road: Transportation infrastructure plays a moderate role, with roads encompassing about 0.83% of the land. The roads that pass through Galimpur Bazar to Churain Bazar via Durgapur Bazar and Churain Bazar to Kamarkhola Bazar are the most vibrant roads 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: Land use category of Churain Union in Nawabganj Upazila

Land use	Area (Acre)	Area (Hector)	Area (Sq. k.m.)	Percentage (%)
Residential	1022.24	413.69	4.14	19.48%
Commercial	14.59	5.91	0.06	0.28%
Mixed Use	5.69	2.30	0.02	0.11%
Transport	43.70	17.69	0.18	0.83%
Administrative	0.57	0.23	0.00	0.01%
Industrial	0.54	0.22	0.00	0.01%
Agriculture	3661.50	1481.76	14.82	69.79%
Education	11.72	4.74	0.05	0.22%
Health	0.42	0.17	0.00	0.01%
Recreational	8.74	3.54	0.04	0.17%
Places of Worship	5.88	2.38	0.02	0.11%
Restricted Area	0.00	0.00	0.00	0.00%
Heritage Site	0.04	0.02	0.00	0.00%
Open Space	4.13	1.67	0.02	0.08%
Waterbodies	460.89	186.51	1.87	8.78%
Graveyard	5.94	2.40	0.02	0.11%
Miscellaneous	0.00	0.00	0.00	0.00%
Total	5246.58	2123.22	21.23	100.00%

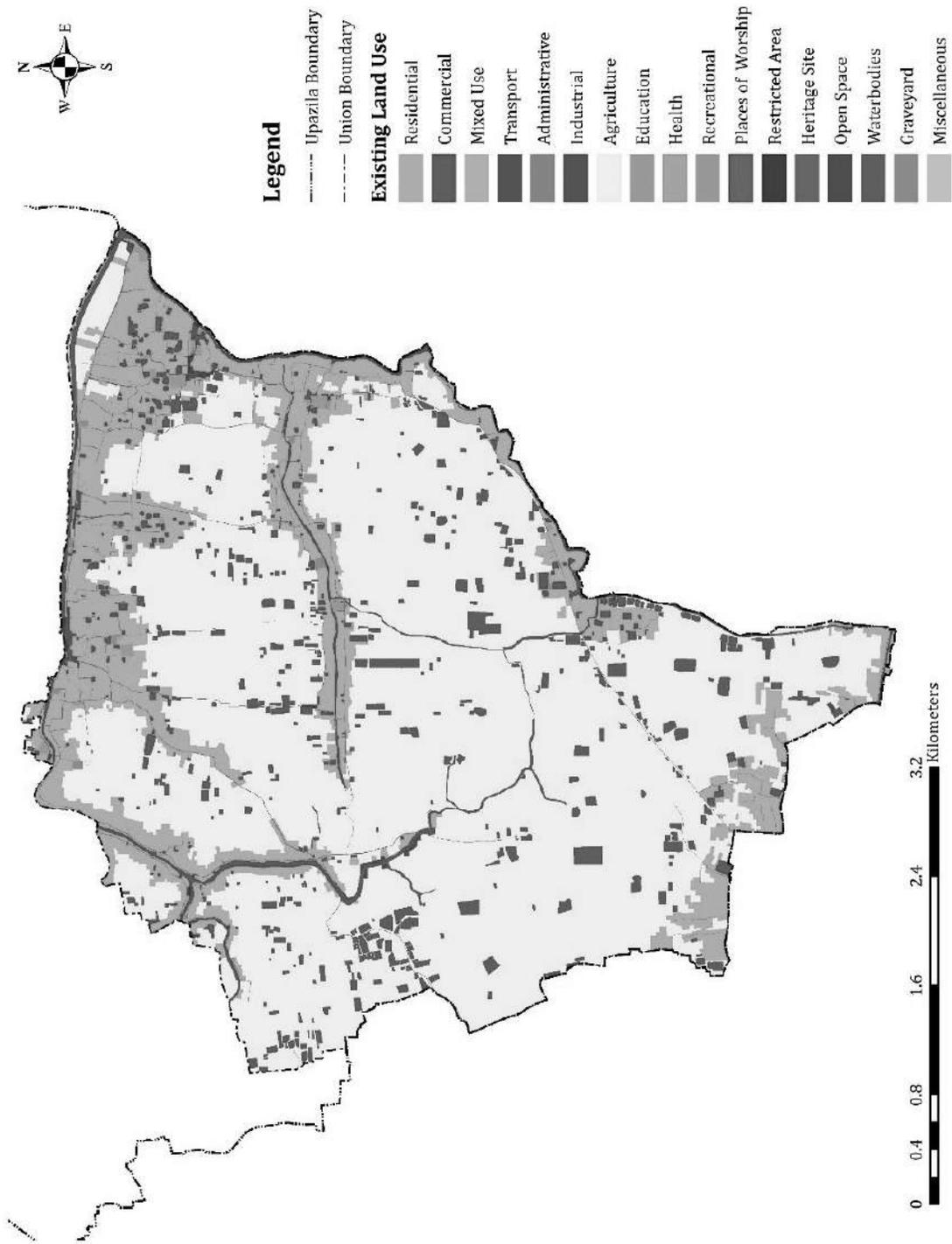


Figure 6-7: Existing Land use pattern of Churain Union

6.4.7 Galimpur Union

Nearly 65.02% of Galimpur 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 nearly around 1.31% of total Galimpur Union Land. Besides, Waterbody contributes more than 6.76% of total land area of Galimpur Union in which Pond, Khal, Rivers are included.

Agriculture: Galimpur Union's land use profile reveals a distinct agricultural character, with nearly 65.02% 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 with various types of livestock farms.

Residential: Residential areas, primarily rural homesteads, occupy the second largest land share, around 23.96%, suggesting a well-established community presence. Residential areas are established primarily around the bank of the Ichamoti river and its associate khal. Galimpur Bazar to Agla Bridge via Noadda is the main road connectivity by which settlement areas are established at this union.

Table 6-8: Existing Land Use Pattern of Galimpur Union

Land use	Area (Acre)	Area (Hector)	Area (Sq. k.m.)	Percentage (%)
Residential	545.27	220.66	2.21	23.96%
Commercial	13.49	5.46	0.05	0.59%
Mixed Use	4.67	1.89	0.02	0.21%
Transport	29.82	12.07	0.12	1.31%
Administrative	0.12	0.05	0.00	0.01%
Industrial	26.32	10.65	0.11	1.16%
Agriculture	1479.61	598.78	5.99	65.02%
Education	5.56	2.25	0.02	0.24%
Health	0.42	0.17	0.00	0.02%
Recreational	5.86	2.37	0.02	0.26%
Places of Worship	4.27	1.73	0.02	0.19%
Restricted Area	0.00	0.00	0.00	0.00%
Heritage Site	0.00	0.00	0.00	0.00%
Open Space	0.00	0.00	0.00	0.00%
Waterbodies	153.93	62.29	0.62	6.76%
Graveyard	6.19	2.50	0.03	0.27%
Miscellaneous	0.00	0.00	0.00	0.00%
Total	2275.53	920.88	9.21	100.00%

Source: Field Survey, 2023

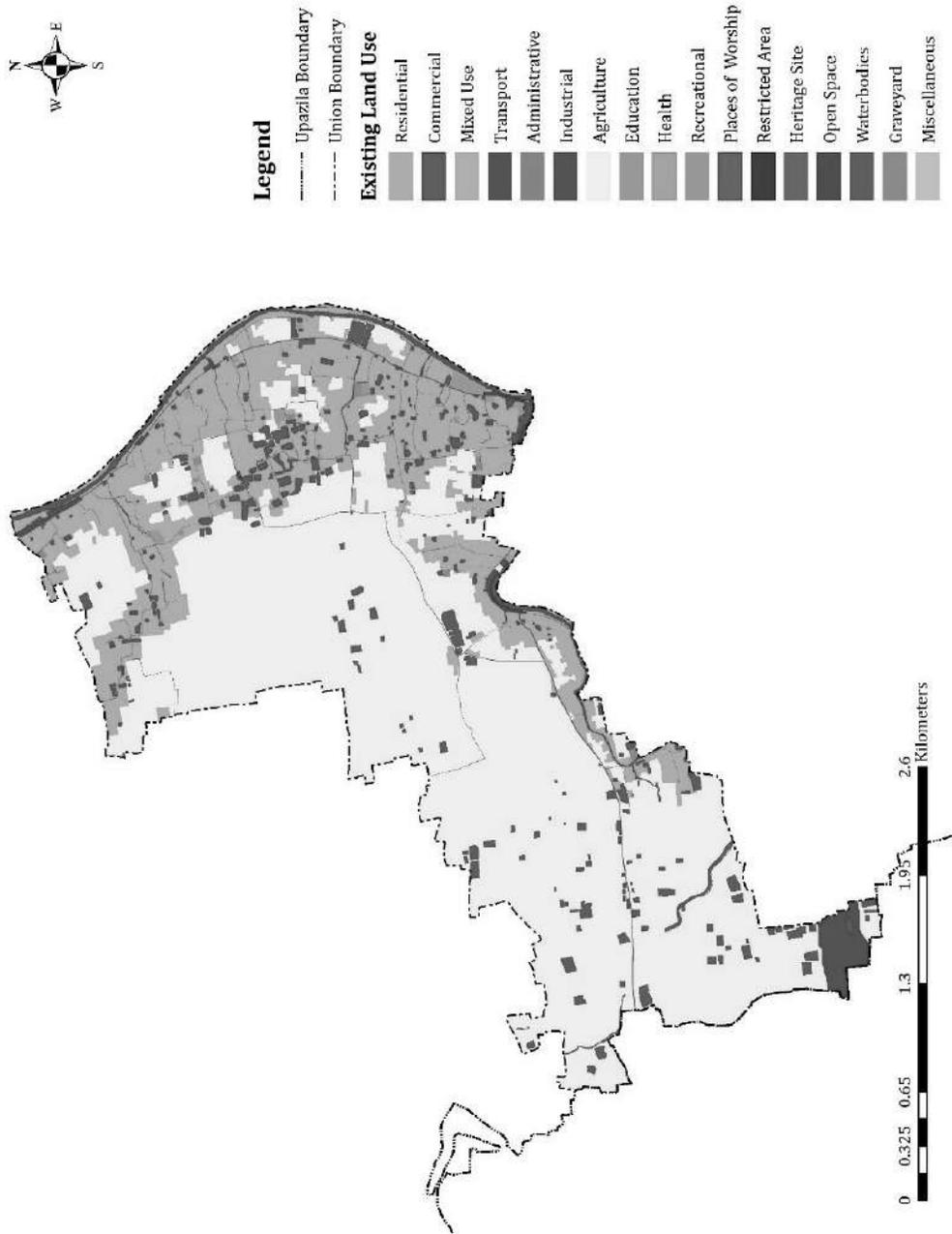


Figure 6-8: Existing Land Use Pattern of Galimpur Union

Water bodies: Water bodies comprise around 6.76%, encompassing Ponds, Khal, and rivers, adding valuable ecological diversity to the landscape. The Ichamoti River crosses the Galimpur Union.

Road: Transportation infrastructure plays a moderate role, with roads encompassing about 1.31% of the land. The roads that pass through Galimpur Bazar to Agla bridge via Noadda and Galimpur Bazar to Tikorpur via Surjokhali are the most vibrant roads of the union.

Around 1.16% of the land within the union is industrial. While several land use categories exist, including commercial, mixed-use, administrative, 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.

6.4.8 Jantrail Union

Nearly 61.46% of Jantrail 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 less than 1% of total Jantrail Union Land. Besides, water bodies, including ponds, Khal, and rivers, contribute about 9.30% of the total land area of Jantrail Union.

Table 6-9: Existing Land Use Pattern of Jantrail Union

Land use	Area (Acre)	Area (Hector)	Area (Sq. k.m.)	Percentage (%)
Residential	1326.91	536.98	5.37	27.57%
Commercial	10.69	4.33	0.04	0.22%
Mixed Use	60.28	24.40	0.24	1.25%
Transport	44.65	18.07	0.18	0.93%
Administrative	0.82	0.33	0.00	0.02%
Industrial	0.45	0.18	0.00	0.01%
Agriculture	2958.19	1197.14	11.97	61.46%
Education	17.72	7.17	0.07	0.37%
Health	0.33	0.13	0.00	0.01%
Recreational	10.44	4.22	0.04	0.22%
Places of Worship	9.38	3.79	0.04	0.19%
Restricted Area	0.00	0.00	0.00	0.00%
Heritage Site	0.00	0.00	0.00	0.00%
Open Space	25.38	10.27	0.10	0.53%
Waterbodies	344.60	139.46	1.39	7.16%
Graveyard	3.00	1.21	0.01	0.06%
Miscellaneous	0.01	0.00	0.00	0.00%
Total	4812.86	1947.69	19.48	100.00%

Source: Field Survey, 2023

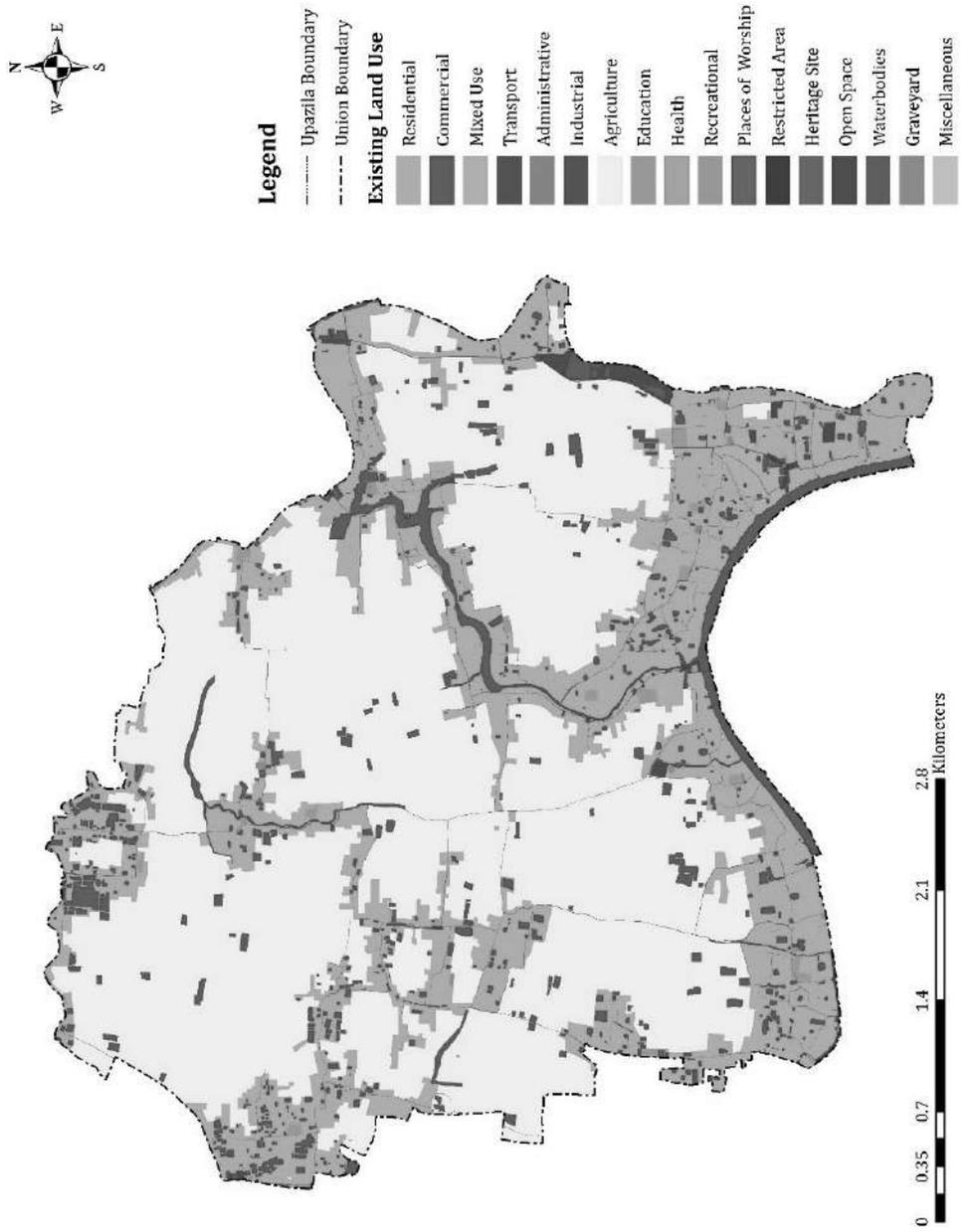


Figure 6-9: Existing Land Use Pattern of Jantrail Union

Agriculture: Jantrail Union's land use profile reveals a distinct agricultural character, with nearly 61.46% of its total area dedicated to agricultural land use. This underscores the significance of

agriculture as the community's primary economic driver and livelihood source. 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 27.57%, suggesting a well-established community presence. Residential areas are established primarily around the bank of the Ichamati River.

Waterbodies: Waterbodies comprise around 7.16%, encompassing ponds, khals, and rivers, adding valuable ecological diversity to the landscape. The Ichamoti River flows by the south side of the Jantrail Union.

Road: Transportation infrastructure plays a minimum role, with roads encompassing only 0.93% of the land. The road that passes through Jantrail Bridge to Chandro-khola Bazar is the most vibrant in the union.

Around 1.25% of the land within the union is mixed-use zones. While several land use categories exist, including commercial, 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.

6.4.9 Joykrishnapur Union

Nearly 57.14% of Joykrishnapur 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 only 0.91% of the total Joykrishnapur Union Land. Besides, Waterbody contributes about 11.59% of the total land area of Joykrishnapur Union, including Pond, Khal, and Rivers.

Agriculture: Joykrishnapur Union's land use profile reveals a distinct agricultural character, with nearly 57.14% 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 about 28.96%, suggesting a well-established community presence. Residential areas are established primarily around the bank of the Ichamoti River and Sonabaju Beribadh to Barha road connectivity.

Waterbodies: Waterbodies comprise around 11.59%, encompassing ponds, khals, and rivers, adding valuable ecological diversity to the landscape. Ichamoti and Padma Rivers flow by the north and south sides of the Joykrishnapur union, respectively.

Road: Transportation infrastructure plays a moderate share, with roads encompassing 0.91% of the land. The road that passes through Sonabaju Beribadh to Shikaripara is the most vibrant road in 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 6-10: Existing Land Use Pattern of Joykrishnapur Union

Land use	Area (Acre)	Area (Hector)	Area (Sq. k.m.)	Percentage (%)
Residential	1163.84	470.99	4.71	28.96%
Commercial	15.28	6.18	0.06	0.38%
Mixed Use	6.63	2.68	0.03	0.16%
Transport	36.54	14.79	0.15	0.91%
Administrative	0.60	0.24	0.00	0.01%
Industrial	1.92	0.78	0.01	0.05%
Agriculture	2296.56	929.38	9.29	57.14%
Education	6.06	2.45	0.02	0.15%
Health	0.43	0.17	0.00	0.01%
Recreational	7.33	2.97	0.03	0.18%
Places of Worship	10.60	4.29	0.04	0.26%
Restricted Area	0.00	0.00	0.00	0.00%
Heritage Site	0.00	0.00	0.00	0.00%
Open Space	3.80	1.54	0.02	0.09%
Waterbodies	465.69	188.46	1.88	11.59%
Graveyard	4.12	1.67	0.02	0.10%
Miscellaneous	0.06	0.02	0.00	0.00%
Total	4019.46	1626.62	16.27	100.00%

Source: Field Survey, 2023

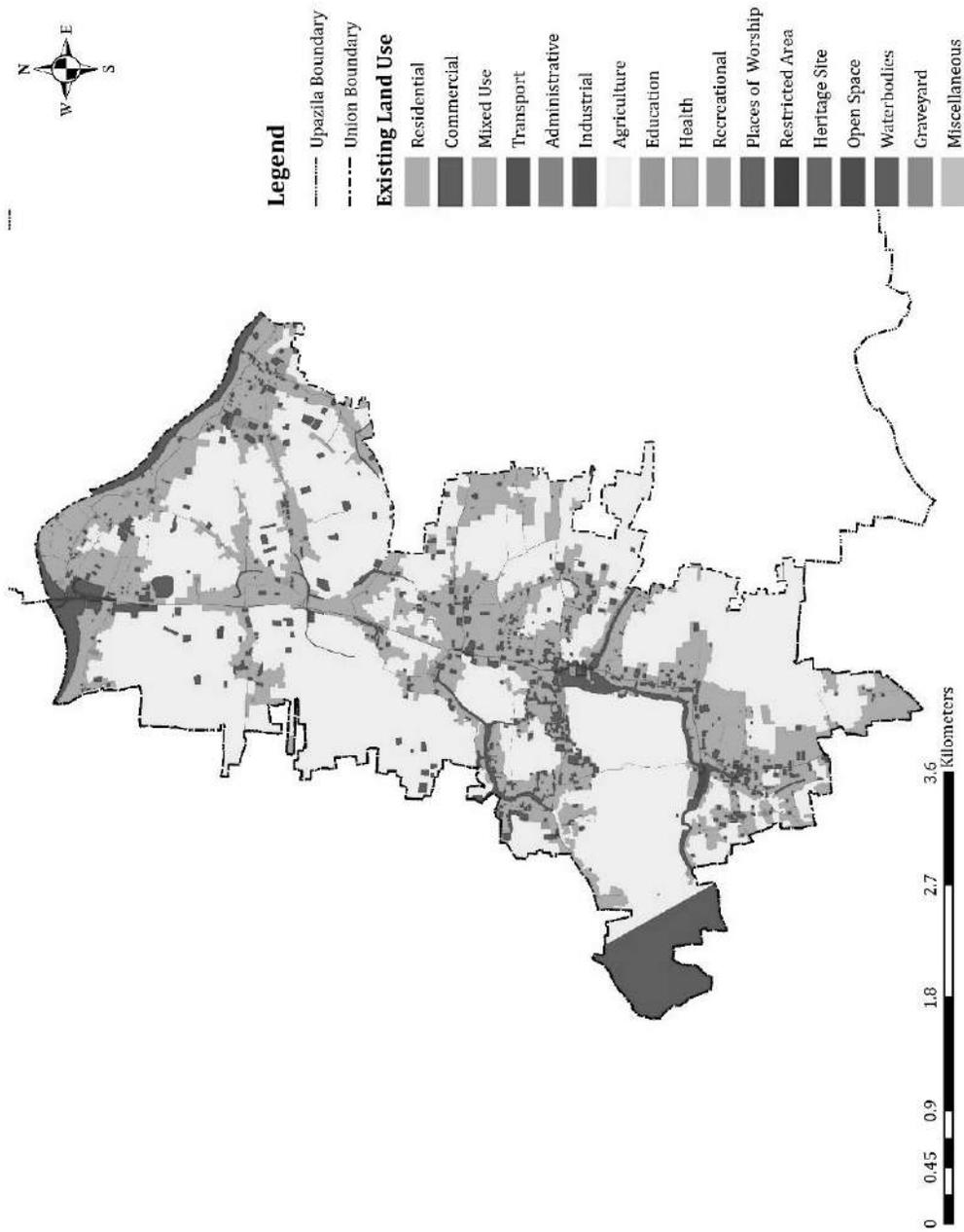


Figure 6-10: Existing Land Use Pattern of Joykrishnapur Union

6.4.10 Kailail Union

Nearly 71.22% of Kailail 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 only 0.77% of total Kailail Union Land. Besides, Waterbody contributes about 11.30% of the total land area of Kailail Union, including Pond, Khal, and Rivers.

Agriculture: Kailail Union's land use profile reveals a distinct agricultural character, with nearly 71.22% 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 15.13%, suggesting a well-established community presence. Residential areas are established primarily around the banks of the Kaliganga and Dhaleshwari rivers and the Sonabaju Beribadh to Barha road.

Waterbodies: Waterbodies comprise around 11.30%, encompassing ponds, khals, and rivers, adding valuable ecological diversity to the landscape. Ichamoti, Kaliganga, and Dhaleshwari rivers flow from the south, north, and east sides of the Kailail union, respectively.

Table 6-11: Existing Land Use Pattern of Kailail Union

Land use	Area (Acre)	Area (Hector)	Area (Sq. k.m.)	Percentage (%)
Residential	1303.02	527.31	5.27	15.13%
Commercial	17.41	7.04	0.07	0.20%
Mixed Use	3.49	1.41	0.01	0.04%
Transport	65.92	26.68	0.27	0.77%
Administrative	0.87	0.35	0.00	0.01%
Industrial	43.22	17.49	0.17	0.50%
Agriculture	6135.63	2483.00	24.83	71.22%
Education	12.92	5.23	0.05	0.15%
Health	0.51	0.21	0.00	0.01%
Recreational	13.54	5.48	0.05	0.16%
Places of Worship	10.47	4.24	0.04	0.12%
Restricted Area	6.02	2.44	0.02	0.07%
Heritage Site	0.00	0.00	0.00	0.00%
Open Space	20.43	8.27	0.08	0.24%
Waterbodies	973.29	393.88	3.94	11.30%
Graveyard	8.13	3.29	0.03	0.09%
Miscellaneous	0.00	0.00	0.00	0.00%
Total	8614.86	3486.31	34.86	100.00%

Source: Field Survey, 2023

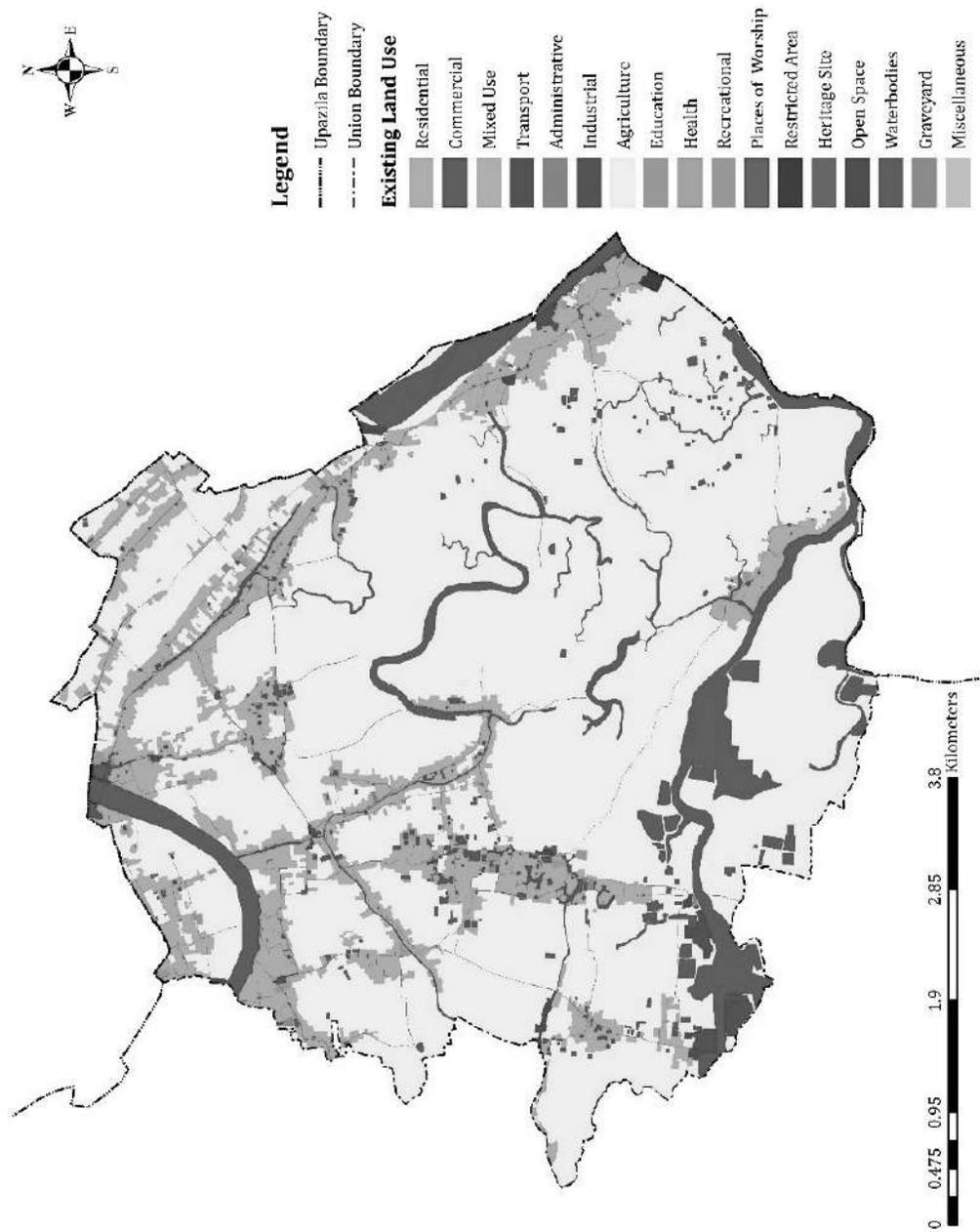


Figure 6-11: Existing Land Use Pattern of Kailail Union

Road: Transportation infrastructure plays a moderate role, with roads encompassing 0.77% of the land. The road that passes through Maliail to Paragram is the most vibrant in 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.

6.4.11 Kolakopa Union

Residential areas, primarily rural homesteads, are the most prominent land use, occupying a significant portion and reflecting the established community presence. Nearly 36.74% of Kolakopa Union's area is dedicated to agriculture, forming the bedrock of its economy and livelihoods. Roads contribute 2.62% of the total Kolakopa Union Land. Besides, water bodies contribute about 8.10% of the total land area of Kolakopa Union, including Pond, Khal, and Rivers.

Residential: Residential areas, primarily rural homesteads, occupy the largest land share, nearly 41.68%, suggesting a well-established community presence. Residential areas are established primarily around the bank of the Ichamoti River and Nawabganj Upazila Road connectivity

Table 6-12: Existing Land Use Pattern of Kolakopa Union

Land use	Area (Acre)	Area (Hector)	Area (Sq. k.m.)	Percentage (%)
Residential	684.55	277.03	2.77	41.68%
Commercial	38.96	15.77	0.16	2.37%
Mixed Use	13.92	5.63	0.06	0.85%
Transport	37.06	15.00	0.15	2.26%
Administrative	6.79	2.75	0.03	0.41%
Industrial	28.29	11.45	0.11	1.72%
Agriculture	603.51	244.23	2.44	36.74%
Education	18.41	7.45	0.07	1.12%
Health	3.72	1.51	0.02	0.23%
Recreational	21.98	8.89	0.09	1.34%
Places of Worship	3.94	1.59	0.02	0.24%
Restricted Area	19.10	7.73	0.08	1.16%
Heritage Site	1.77	0.72	0.01	0.11%
Open Space	20.87	8.45	0.08	1.27%
Waterbodies	132.98	53.81	0.54	8.10%
Graveyard	6.14	2.48	0.02	0.37%
Miscellaneous	0.53	0.22	0.00	0.03%
Total	1642.52	664.70	6.65	100.00%

Source: Field Survey, 2023



Figure 6-12: Existing Land Use Pattern of Kolakopa Union

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