



Bangladesh Agricultural Development Corporation (BADDC)

Draft Final Report

**Environmental Impact Assessment (EIA)
of Ashuganj-Palash Sabuj Project
by Bangladesh Agricultural Development Corporation**



April 2025

C₃GIS

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Unit Conversion

1 Acre = 100 Decimal

1 Hectare = 247 Decimal

1 Hectare = 10,000 m²

1 Hectare = 2.47 Acre

1 Kg = 1000 gm

1 Ton = 1000 kg

1 Kani = 30 Decimal

Abbreviations and Acronyms

3R	Reduce, Reuse and Recycle
$\mu\text{S}/\text{cm}$	MicroSiemens per Centimeter
$\mu\text{g}/\text{m}^3$	Micrograms per Cubic Meter
$^{\circ}\text{C}$	Degrees Celsius
ABS	Access and Benefit-Sharing
ADB	Asian Development Bank
AEZs	Agro-Ecological Zones
AGW	Ground Water Quality (Ashuganj)
AI	Aridity Index
AICA	Ashuganj Irrigation Command Area
APAIP	Ashuganj-Palash Agro-Irrigation Project
APS	Ashuganj Power Station
As	Arsenic
ASQ	Soil Quality (Ashuganj)
ASW	Surface Water Quality (Ashuganj)
AWD	Alternate Wetting and Drying
BADC	Bangladesh Agricultural Development Corporation
BARC	Bangladesh Agriculture Research Council
BBS	Bangladesh Bureau of Statistics
BCCSAP	Bangladesh Climate Change Strategy and Action Plan
BCSIR	Bangladesh Council of Scientific and Industrial Research
BDT	Bangladeshi Taka
BINA	Bangladesh Institute of Nuclear Agriculture
BIWTA	Bangladesh Inland Water Transport Authority
BMD	Bangladesh Meteorological Department
BNBC	Bangladesh National Building Code
BOD	Biological Oxygen Demand
BRRRI	Bangladesh Rice Research Institute
BSCIC	Bangladesh Small and Cottage Industries Corporation
BTM	Bangladesh Transverse Mercator
BUET	Bangladesh University of Engineering and Technology
BWDB	Bangladesh Water Development Board
CAD	Command Area Development
CAAQMMS	Continuous Ambient Air Quality Micro-Monitoring Station
CCL	Cash Compensation under Law

Cd	Cadmium
CDA	Chittagong Development Authority
CEGIS	Center for Environmental and Geographic Information Services
CEGIS	Center for Environmental and Geographic Information Services
CITES	Convention on International Trade in Endangered Species
CO	Carbon Monoxide
COD	Chemical Oxygen Demand
DAE	Department of Agriculture Extension
dB	Decibel
DC	District Commissioner
DCA	Double Cropped Area
DEM	Digital Elevation Model
DG	Director General
DLS	Department of Livestock
DO	Dissolved Oxygen
DoE	Department of Environment
DoF	Department of Fisheries
DTW	Deep Tube Well
EC	Electrical Conductivity
ECA	Environment Conservation Act
ECAs	Ecologically Critical Areas
ECC	Environmental Clearance Certificate
ECR	Environmental Conservation Rules
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EN	Endangered
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
ESMP	Environmental and Social Management Plan
FGD	Focus Group Discussion
FPCO	Flood Plan Coordination Organization
FWIP	Future-With-Project
FWOP	Future-Without-Project
FY	Fiscal Year
GAP	Good Agricultural Practices
GHG	Green House Gas
GI	Galvanized Iron
GIS	Geographic Information System

GO	Governmental Organizations
GoB	Government of Bangladesh
GPS	Ghorashal Power Station
GRP	Glass Fibre Reinforced Plastic
GSB	Geological Survey of Bangladesh
GW	Groundwater
ha	Hectare
HYV	High Yielding Variety
ICM	Integrated Crop Management
IECs	Important Ecological Components
IEEs	Initial Environmental Examinations
IESCs	Important Environmental and Social Components
IFC	International Finance Corporation
ISC	Important Social Component
IUCN	International Union for Conservation of Nature
IWQI	Irrigation Water Quality Index
K	Potassium
KDA	Khulna Development Authority
Kg	Kilogram
KII	Key Informant Interview
KII	Key Information Interview
LC	Least Concern
LGD	Local Government Division
LLP	Low Lift Pump
MCA	Multi-Criteria Analysis
MEAs	Multilateral Environmental Agreements
mg/L	Milligrams per Liter
mg/m ³	Milligrams per Cubic Meter
ml	Milliliter
MoEFCC	Ministry of Environment, Forest and Climate Change
WMOs	Water Management Organizations
MT	Metric Tons
N	Total Nitrogen
N/A	Not Applicable
NAP	National Agriculture Policy
NBSAP	National Biodiversity Strategy and Action Plan of Bangladesh
NCA	Net Cultivated Area
NCS	National Conservation Strategy

NEMAP	National Environmental Management Action Plan
NEMAP	National Environment Management Action Plan
NEP	National Environment Policy
NGOs	Non-governmental Organization
NO ₂	Nitrogen Dioxide
NOC	No Objection Certificate
NT	Near Threatened
NWMP	National Water Management Plan
NWRD	National Water Resources Database
O ₃	Ozone
ODS	Ozone Depletion Substance
OM	Organic Matter
O&M	Operation and Maintenance
P	Phosphorus
Pb	Lead
PCM	Public Consultation Meeting
PDB	Power Development Board
PFA	Private Forest Act
PGW	Ground Water Quality (Palash)
PICA	Palash Irrigation Command Area
PIM	Participatory Irrigation Management
PM	Particulate Matters
PMSC	Project Management Supervision Consultant
PMU	Project Management Unit
PPE	Personal Protective Equipment
PPPs	Policies, Plans, and Programs
PPR	Paste des petits Ruminants
PSQ	Soil Quality (Palash)
PSW	Surface Water Quality (Palash)
PWD	Public Works Department
RAJUK	Rajdhani Unnayan Kartripakkha
RAWES	Rapid Assessment of Wetland Ecosystem Services
RCC	Reinforced Concrete
RDA	Rural Development Academy
ROW	Right of Way
RRA	Rapid Rural Appraisal
RRI	River Research Institute
RS	Remote Sensing

SAAO	Sub-Assistant Agriculture Officer
SCA	Single Cropped Area
SCC	Site Clearance Certificate
SIA	Social Impact Assessment
SIS	Small Indigenous Species
SMV	Slow Moving Vehicle
SO ₂	Sulfur Dioxide
Sq.km	Square Kilometer
SRDI	Soil Resource Development Institute
SRDI	Soil Resource Development Institute
STW	Shallow Tube Well
SW	Surface Water
TCA	Triple Cropped Area
TDS	Total Dissolved Solids
TL	Team leader
ToC	Table of Contents
ToR	Terms of Reference
TSP	Triple Superphosphate
UAEO	Upazila Agriculture Extension Offices
UAO	Upazila Agriculture Officer
ULO	Upazila Livestock Officer
UNFCCC	United Nations Framework Convention on Climate Change
USGS	U.S. Geological Survey
VS	Veterinary Surgeon
VU	Vulnerable
WARPO	Water Resources Planning Organization
WB	World Bank

Glossary

- Aus:* Group of rice varieties which are sown during the month March-April and harvested in July-August every year is considered to be Aus paddy. From time immemorial Aus paddy which is grown in our country is called local Aus.
- Aman:* Group of rice varieties grown in the monsoon season and harvested in the post-monsoon season. This is generally transplanted at the beginning of monsoon from July-August and harvested in November-Dec. Mostly rain-fed, supplemental irrigation is needed in places during the dry spell.
- Boro:* A group of rice varieties sown and transplanted in winter and harvested at the end of the pre-monsoon season. These are mostly HYV and fully irrigated, planted in December-January, and harvested before the onset of monsoon in April- May.
- Kharif:* Pre-monsoon and monsoon growing season. Cropping season is linked to the monsoon between March-October, often divided into Kharif-I (March-June) and Kharif-II (July-October).
- Rabi:* Dry agricultural crop growing season; mainly used for the cool winter season between November and February.

Medium High land (F₁): Seasonally flooded from 30-90 cm deep and Aman can be transplanted

Medium Low Land (F₂): Seasonally flooded from 90-180cm deep.

Low land (F₃): Seasonally flooded from 180-275 cm deep where B. Aman can be grown

Executive Summary

The Ashuganj-Palash Green Project (proposed), would be implemented by the Bangladesh Agricultural Development Corporation (BADC), which is a sustainable irrigation initiative designed to enhance agricultural productivity by utilizing treated cooling water from nearby thermal power plants. Operational since 1992 across the Ashuganj and Palash regions, the project aims to boost food security, reduce reliance on groundwater, and promote climate-resilient farming practices. This Environmental and Social Impact Assessment (ESIA) evaluates the project's potential impacts, aligning with Bangladesh's Environmental Conservation Rules (ECR'2023) and international best practices. The study outlines the project's scope, objectives, and methodology; incorporating baseline environmental and socio-economic conditions, stakeholder consultations, and multidisciplinary expert analysis to ensure sustainable implementation. Key focus areas include water resources management, ecological conservation, and socio-economic benefits, with the ultimate goal of delivering a cost-effective, environmentally compliant, and socially inclusive irrigation solution. By transitioning from groundwater to surface water-based irrigation, the project seeks to optimize agricultural yields, mitigate environmental risks, and support Bangladesh's long-term food security and rural development goals.

The proposed irrigation project in Bangladesh, classified under the Red category as per the Environmental Conservation Rules (ECR) 2023, must comply with a comprehensive set of legal, policy, and administrative frameworks. Nationally, key legislation includes the Environmental Conservation Act (ECA) 1995 and its amendments, which mandate obtaining an Environmental Clearance Certificate (ECC) upon conducting Environmental Impact Assessments (EIA), and preparing an Environmental Management Plan (EMP). Additional relevant laws include the Bangladesh Biodiversity Act (2017), Noise Pollution Control Rules (2006), Wildlife Conservation and Security Act (2012), Bangladesh Water Act (2013), and the Land Acquisition and Requisition Act (2017), which collectively govern ecosystem protection, pollution control, water resource management, wildlife conservation, and fair land acquisition. Labour and safety standards are enforced through the Bangladesh Labour Act (2006, amended 2013) and the Fire Prevention Act (2003), ensuring worker welfare and operational safety. The Department of Environment (DoE) oversees compliance and issues required approvals, including the Site Clearance Certificate (SCC) and ECC, through a structured process involving project approval, local authority consent, EIA submission with public hearings, and final clearance. Internationally, Bangladesh is committed to the Convention on Biological Diversity (1992), the UN Framework Convention on Climate Change (UNFCCC), CITES (1973), and the Rio Declaration (1992), aligning national development with global environmental standards. Where national regulations fall short, the project must adhere to the International Finance Corporation (IFC) Performance Standards and World Bank Environmental, Health, and Safety Guidelines to ensure best practices in environmental and social risk management. Therefore, successful implementation requires strict adherence to national and international laws, robust environmental planning, and meaningful stakeholder engagement to ensure legal compliance and long-term sustainability.

The Environmental and Social Impact Assessment (ESIA) follows a systematic approach to evaluate potential environmental and social impacts of the proposed project, ensuring compliance with national policies and international standards such as the World Bank Environmental and Social Framework, ADB guidelines, and WARPO's 2005 EIA guidelines. The methodology includes baseline data collection on physical, biological, and socio-economic conditions through field surveys, stakeholder consultations, and secondary sources like government reports and satellite imagery. Key steps involve scoping to identify critical impact areas, assessing both quantitative (e.g., water quality, crop yields) and qualitative (e.g., ecological and social effects) impacts, and comparing Future-Without-Project (FWOP) and Future-With-Project (FWIP) scenarios. Public participation is integral, with stakeholder feedback gathered through Focus Group Discussions (FGDs), Key Informant

Interviews (KIIs), and Public Consultation Meetings (PCMs). The study also develops an Environmental Management Plan (EMP) incorporating mitigation measures to offset adverse effects, prioritizing avoidance, minimization, and compensation where necessary as well as enhancement measures in the case of positive impacts. The final ESIA report adheres to DoE and ECR'2023 regulations, ensuring transparency and sustainability in project implementation while addressing environmental and social risks through structured mitigation and monitoring strategies.

The Ashuganj-Palash Green Project, has been utilizing the cooling water from the Ashuganj and Ghorashal thermal power plants for irrigation since 1992, drawing from the Meghna and Shitalakshya rivers to support agriculture in Brahmanbaria and Narsingdi districts. The project, now in its fifth phase completed in June 2020, aims to boost food production by replacing groundwater use with surface water from power plant cooling systems, thus reducing irrigation costs and enhancing sustainability. However, both sub-projects face significant challenges: in Ashuganj, the construction of a six-lane highway threatens the primary irrigation canal (borrow pit), rice mill waste clogs canals, and aging infrastructure hampers water flow; in Palash, the absence of a cooling reservoir, municipal waste dumping, and damaged underground pipelines reducing irrigation efficiency. Multi-criteria analysis (MCA) guided intervention planning was considered. In Ashuganj, an RCC-lined canal along the highway was selected for its low cost and minimal land acquisition needs, while an alternative railway-owned water body is considered for reservoir replacement. In Palash, the chosen solution is to cover the canal with RCC slabs to prevent waste dumping, along with identifying a potential reservoir site near a cooperative mill. Proposed interventions include constructing 8.18 km of RCC-lined canals, installing siphons, silt traps, and smart-card-based pipelines in Ashuganj, and slab covering, canal re-excavation, and buried pipelines in Palash. These actions are expected to provide year-round irrigation, particularly for Boro rice, reducing dependence on groundwater, improving soil fertility, and enhancing biodiversity and socio-economic conditions. The project is structured into pre-construction, construction, and post-construction phases, emphasizing stakeholder involvement, sustainability, and efficient water management. Overall, the Ashuganj-Palash Green Project seeks to modernize irrigation infrastructure while addressing urbanization and environmental challenges through cost-effective and sustainable solutions.

The environmental baseline for the Ashuganj-Palash irrigation project (1991–2022) outlines critical climatic, geological, hydrological, and land resource factors influencing sustainable infrastructure design. Meteorologically, Sylhet experiences the highest rainfall (up to 1,350 mm in June–July), while Dhaka and Mymensingh show a declining rainfall trend and experience minimal precipitation in the dry season (Nov–Feb). Temperatures peak between April and June (up to 36°C) and drop to 8–12°C during December–January, with an overall warming trend. Relative humidity reaches 85–87% during the monsoon, and evaporation is highest in March–April (~8.9 mm/day). Sylhet records the most sunshine (9.77 hrs/day in December), while wind speeds peak in May (23–36 km/h). Topographically, Ashuganj is low-lying (50% at 3–4 mPWD), prone to shallow monsoon flooding, while Palash, slightly elevated by the Madhupur Tract, sits mainly at 4–6 mPWD. Geologically, Ashuganj comprises Holocene alluvial silt (62.5%) and marsh clay/peat (31.7%), placing it in seismic Zone III (moderate-high risk). Palash, dominated by alluvial silt (83.6%) and Madhupur Clay (6.7%), falls in Zone II (moderate risk). The Meghna River has stabilized after historical narrowing due to the Brahmaputra's avulsion, while the Titas (Ashuganj) and Sitalakshya (Palash) rivers show seasonal variability and erosion tendencies, respectively. Land resource analysis shows that Ashuganj and Palash fall within fertile agro-ecological zones—Old Meghna Estuarine and Old Brahmaputra Floodplains- with 54% of land as net cultivable area and dominant soil textures of clay loam, loam, and sandy loam. Palash soils have higher moisture retention (55% in high category), while Ashuganj has 73% in the medium category. These conditions offer both opportunities and constraints: while fertile soils and abundant surface water support irrigation, challenges include seismic vulnerability, erratic weather patterns, and flood risks.

The water resources system in Ashuganj and Palash relies on both surface water sourced from rivers (Meghna, Shitalakshya, Titas) and canals (e.g., Boalia Khal, Jafor Khal), and groundwater for irrigation,

agriculture, and domestic use. Ashuganj depends mainly on the Upper Meghna River, which experiences peak monsoon flows of 19,800 m³/s, while Palash draws water from the Shitalakshya River, affected by tidal influences and sedimentation. Canals suffer from siltation, reducing water conveyance capacity. Groundwater levels fluctuate seasonally, with the lowest depths in April–May (dry season) and recharge during monsoons. Over-extraction for irrigation is a growing concern. Key hydrological challenges include siltation, waterlogging in low-lying areas, droughts (notably in 1994–95 and 2014–16), and flooding (severe events in 1988, 1998, 2004). Surface water quality remains generally suitable for irrigation with pH: 7.2–8.6 and TDS <1000 mg/l, though pollution hotspots exist near industrial zones (e.g., high orthophosphate in the Ashuganj power plant canal). Groundwater is safe for drinking (pH: 6.9–7.9, TDS <1000 mg/l). Noise levels exceed residential limits in industrial areas (e.g., Ashuganj Power Plant: 79 dBA), while rural areas remain within permissible levels. Air quality is generally acceptable—PM10 and PM2.5 within limits, and SO₂, NO₂, CO, O₃ well below regulatory thresholds. Major concerns include dry-season water scarcity, industrial/agricultural pollution, dilapidated infrastructure, and climate change impacts. Recommended actions include canal re-excavation, industrial discharge monitoring, sustainable groundwater management, and flood/drought resilience building— all pointing to the need for integrated water resources management for long-term sustainability.

The Ashuganj-Palash region has a productive agricultural base with two major cropping seasons: Kharif (March–October) and Rabi (November–February). During Kharif-I (March–June), high temperatures and low rainfall support crops like HYV Aus rice, jute, and summer vegetables, while Kharif-II (July–October), dominated by monsoon rains, favors HYV Aman rice. The Rabi season sees the cultivation of HYV Boro rice, pulses, mustard, and winter vegetables. Cropping intensity in Ashuganj part is 208 percent, with cultivation primarily rice-based (75.85% of 38,534 ha). Palash portion has a higher cropping intensity of 222 percent and more diversified agriculture, including fruits like banana and papaya, with non-rice crops dominating (54.08% of 25,070 ha). Crop production totals are 159,626 MT in Ashuganj (99,834 MT rice, 59,792 MT non-rice) and 196,504 MT in Palash (41,897 MT rice, 154,607 MT non-rice), with losses of 3,552 MT and 4,486 MT respectively. Irrigation covers 17,145 ha area of Ashuganj and 10,565 ha of Palash lands, though challenges like high irrigation costs, silted canals, and iron contamination in groundwater. Key agricultural issues include waterlogging during Kharif-II, irregular Rabi irrigation, pre-harvest rains damaging HYV Boro, and pest attacks (e.g., brown planthopper, fruit weevil).

In livestock and poultry, Ashuganj has 162,702 cattle, 1.9 million chickens, and 249,593 ducks; Palash has 254,984 cattle, 2.3 million chickens, and 141,627 ducks. Major diseases include foot-and-mouth disease (FMD) in cattle and Newcastle disease/PPR in poultry/goats, especially during May–October. Feed shortages during the monsoon force reliance on rice straw and commercial feed.

Fisheries are supported by rivers and wetlands like the Meghna (Ashuganj), Shitalakshya (Palash), and beels, such as Chinadi Beel and Galania Haor, with a total fish production of 9,941 MT (Ashuganj: 2,832 MT, Palash: 7,109 MT). Aquaculture is semi-intensive (Major Carp, Tilapia), but threats include pollution, overfishing with fine-mesh nets, invasive species (e.g., Sucker Mouth Catfish), and habitat loss due to siltation and encroachment.

Ecologically, the region hosts diverse flora, such as mango, banana, mahogany, Hijol, Karoch and fauna including Asian Openbill, Baya Weaver, Kingfishers, Golden Jackal, mongooses, and snakes like Monocellate Cobra. Key wetlands like Chinadi Beel (Palash) and Galania Haor (Ashuganj) support biodiversity and provide vital ecosystem services—freshwater, food, flood control, and cultural values. However, habitat destruction, pollution, and climate change pose significant threats.

The Ashuganj-Palash region spans Brahmanbaria and Narsingdi districts, with populations of 827,499 and 666,359 respectively. Brahmanbaria has a sex ratio of 106.7 and an average household size of 4.0, while Narsingdi shows a more balanced sex ratio of 100.4 and household size of 3.3. Indigenous communities include 372 ethnic people in Brahmanbaria (Chakma, Tripura, Garo) and 852 in

Narsingdi, engaging in agriculture, handicrafts, and seasonal fishing, with cultural observances like Boishabi, Durga Puja, and Christmas. Literacy rates are 72.06% in Brahmanbaria and 77.56% in Narsingdi, with higher female literacy in the former district (73.10%) and higher male literacy in the latter district (79.0%). Economic livelihoods are agriculture-based (34.5% Brahmanbaria, 23.94% Narsingdi), complemented by a strong industrial base in Narsingdi (35.22% in industry). Common occupations include farming (rice, jute, vegetables), fishing, day labor, and rickshaw/van pulling. Water access is high, with 99% using tube wells, but sanitation varies: 60.12% in Narsingdi and 45.26% in Brahmanbaria with respect to use of safe latrines, while 22.06% of the Brahmanbaria still rely on unsafe disposal. Electricity access is nearly universal (99.8%). However, healthcare remains weak—45% depend on informal care, and only 10% access to trained doctors. Average household income ranges from BDT 10,301 to 26,163, with 50% of households are just break even, 30% in deficit, and only 20% with a surplus. Labor wages vary: BDT 400–900/day in farming (lower for females) and BDT 500–1,000/day in non-farm work. Migration patterns include seasonal labor movement for harvesting and construction, and permanent migration to Dhaka and Gazipur for industrial work. Gender dynamics remain male-dominated in decision-making, though female education is improving and contributing to rising participation in households. The region's cultural richness is evident in Brahmanbaria's folk music (Baul, Bhatiali) and heritage sites like Isa Khan's Capital and Arunodaya Kali Temple, while Narsingdi hosts book fairs, traditional music, and Shitalakshya River tourism. Infrastructure is supported by the Dhaka–Sylhet Highway, Ashuganj River Port, and Ashuganj Power Station, though issues like canal disruptions from road expansion and flooding during monsoons persist. Key economic activities—agriculture, industry (textiles, brick kilns), and commerce: face constraints from water scarcity and yield volatility. The study emphasizes addressing water and sanitation gaps, healthcare access, livelihood diversification through skill training, gender equity, and resilient infrastructure development to strengthen the region's socio-economic fabric and climate resilience.

Stakeholder consultations for the Ashuganj–Palash Irrigation Project, involving 17 sessions with 358 participants across Brahmanbaria and Narsingdi, highlighted widespread support for the initiative, particularly its potential to improve irrigation efficiency and reduce costs. Farmers, fishermen, and local leaders raised major concerns about silted canals (e.g., Talla Khal, Jafar Khal), delayed water supply from power plants, groundwater over-extraction, and leaky RCC canals that damage adjacent crops. Environmental issues, such as industrial and medical waste pollution, arsenic-contaminated groundwater, and loss of biodiversity (e.g., fish and migratory birds), were also noted, along with health risks like skin diseases. Stakeholders reported significant agricultural impacts, including 20–50% yield reductions, waterlogging damage to Aman rice, and increased rodent infestations due to predator loss. Community suggestions included urgent re-excavation of canals, repairing infrastructure like sluice gates, ensuring timely water release, improving drainage, forming local water-user committees, and banning industrial waste discharge. Participants also called for fair compensation, local job opportunities, and training in eco-friendly farming and fish culture. Notably, 85% of participants welcomed the project for its economic and livelihood benefits, such as lowering irrigation costs from BDT 3,000 to 1,500 per kani (30 dcml) and enabling canal-based aquaculture. The consultations concluded with strong recommendations for immediate canal restoration, strict pollution control, community involvement in water management, and enhanced climate resilience to ensure sustainable agricultural and ecological outcomes.

The Ashuganj Palash Green Project, aims to modernize irrigation systems by transitioning from groundwater dependency to surface water-based infrastructure. The initiative includes the construction and rehabilitation of regulators, excavation and re-excavation of canals, and installation of hydraulic structures. Its core objective is to enhance water resource management, improve agricultural productivity, and promote socio-economic development in the Ashuganj and Palash regions. This Environmental and Social Impact Assessment (ESIA) evaluates the potential

environmental and social impacts of the project and outlines mitigation measures for the negative impact and enhancement measures for the positive impact to ensure sustainability.

Key Environmental and Social Components (IESCs):

- **Water Resources:** Risks include contamination from construction waste and temporary drainage disruptions. However, long-term benefits include improved surface water availability, enhanced conveyance capacity, and reduced groundwater depletion. The IESCs considered in this section are: Drainage, Groundwater, Surface Water Availability and Water level of Chinadi Beel.
- **Environmental Quality:** Construction activities may lead to sedimentation, dust, and noise pollution. These impacts are short-term and can be mitigated. The IESCs considered in this section are: Surface Water Quality, Noise Level and Air quality.
- **Land and Agriculture:** Temporary land use changes are expected during construction. The project is expected to expand irrigated areas, improve cropping patterns, and boost crop yields. The IESCs considered in this section are: Land Use, Changes in Land Quality and environmental pollution, Irrigated Area, Cropping pattern and intensity, Crop damage and Crop production.
- **Fisheries and Ecology:** While construction may temporarily disrupt aquatic habitats and vegetation, long-term benefits include improved fish habitats and ecological restoration through planned reforestation and waterbody conservation. The IESCs considered in this section are: Fish Production, Vegetation and Aquatic Habitat.
- **Socio-Economic Conditions:** The project will strengthen rural livelihoods, increase food security, generate employment, and contribute to poverty reduction through agricultural growth. The IESCs considered in this section are: Improved Livelihoods, Increase food security, Employment Generation, Poverty Reduction, Occupational health and safety and Community health and safety.

Impact Assessment:

- **Pre-Construction Phase:** Impacts are minimal and localized, including minor vegetation clearance, noise, and dust.
- **Construction Phase:** Short-term negative impacts include pollution and habitat disruption. However, job opportunity will be created during various construction activities.
- **Post-Construction Phase:** Long-term positive impacts include reliable water supply, increased agricultural productivity, improved ecological health, and socio-economic upliftment.

Environmental Management Plan (EMP):

- **Mitigation Measures:** Emphasize proper waste disposal, water quality protection, noise and dust suppression, and biodiversity conservation.
- **Enhancement Measures:** Include community-based employment, training programs, and ecological restoration (e.g., wetland conservation, tree plantations).
- **Monitoring Plan:** Ongoing monitoring of water quality, noise, biodiversity, and compliance to ensure environmental and social standards are met.

The Ashuganj Palash Green Project is projected to deliver wide-ranging benefits through sustainable water use, increased agricultural outputs, and community empowerment. Although construction-phase impacts are inevitable, they are short-lived and manageable with the outlined EMP. The project

aligns with Bangladesh's development priorities and demonstrates a strong commitment to environmental stewardship and social equity. Successful implementation will depend on coordinated efforts by BADC, contractors, and local authorities, supported by a dedicated EMP budget covering waste management, monitoring, and community programs. This ESIA offers a robust framework for balancing development with environmental and social responsibility.

1. Introduction

1.1 Project Background

In Bangladesh, a nation that depends heavily on agriculture, efficient agricultural water usage is essential for managing water resources and ensuring food security. About 388 lakh metric tons (MT) of food grains were produced in FY 2016–17, with an additional 58 lakh MT coming from imports. Approximately 51% of Bangladesh's land is irrigated, and 71% of the country's land is used for agriculture. On the other hand, excessive groundwater use has resulted in salt intrusion, decreased river flows, diminishing water tables, and groundwater pollution.

National policies prioritize the combined use of surface and groundwater, with a stronger emphasis on surface water-based irrigation, in order to support sustainable irrigation. One noteworthy project is the Bangladesh Agricultural Development Corporation's (BADC), Ashuganj-Palash Agro-Irrigation Project (APAIP), which uses cooling water from the Ashuganj and Ghorashal Thermal Power Stations for irrigation. The project, which began in 1992 and has since been completed in four phases, has increased food output by 96,250 MT and expanded irrigation facilities to 6,073 hectares. Canals, siphons, regulators, sluice gates, and other hydraulic structures are examples of infrastructure.

This initiative addresses important issues including aquifer depletion and promotes sustainable agriculture practices by reducing reliance on groundwater by using water from the Meghna and Shitalakshya Rivers. In order to help thousands of farmers and greatly increase food production, the project's proposed 5th Phase aims to enlarge the current irrigation command area by 5,102 hectares (2,688 hectares in Ashuganj and 2,414 hectares in Palash).

After taking into account all the stages, the Ashuganj-Palash Green Project (proposed) of BADC was created with the goal of improving irrigation with sustainable cooling water use while guaranteeing environmentally friendly agricultural growth. A thorough feasibility assessment that was finished in June 2020 assessed the appropriateness of the green project's suggested measures.

Adherence to national regulations is crucial when executing a large-scale irrigation project such as this one. A comprehensive Environmental and Social Impact Assessment (ESIA), in accordance with ECR'2023 guidelines, is necessary to effectively protect the environment, socioeconomic status, and ecosystem services while also making the irrigation project more environmentally friendly and boosting the project's acceptance by the line agencies and beneficiaries.

Therefore, the purpose of this study is to conduct a comprehensive ESIA analysis in compliance with the ECR 2023.

1.2 Objectives of this Study

This study's primary goals are to assess the environmental and social impacts of the proposed interventions of the Ashuganj-Palash Green Project of BADC and prepare an integrated environmental management plan.

The specific objectives are listed below:

- To evaluate the environmental and social impacts of the proposed interventions in accordance with national protocols, guidelines, rules, and regulations.
- To assess the project's alignment with environmental sustainability, climate resilience, and disaster risk reduction, and propose measures to mitigate any negative impacts.
- To develop an environmental and social impact management plan based on the assessment results.

- To ensure public participation in the impact evaluation process and the preparation of the management plan.
- To create an environmental and social monitoring plan.
- To prepare the ESIA Study Report in compliance with the prescribed format of the Department of Environment (DoE), as outlined in the ECR'2023, SCHEDULE 11: Guidelines for Preparation of Environmental Impact Assessment Reports of Industrial Plants or Projects, and present the report to the DoE to obtain the requisite clearance certificate.

1.3 Scope of Works

The scope of works of the assignment is listed below:

- a) Collection of secondary information on the existing natural resources, their issues and the management approaches/practices by the line agencies and relevant stakeholders;
- b) Review of existing data, maps, information and past relevant studies relevant to the proposed interventions and/or the proposed development;
- c) Establishment of physical, environmental and social baseline conditions:
 - Evaluation of the surface, groundwater, air, noise, soil and sediment quality of the project and the study areas to establish the status of the environmental quality;
 - Assessment of the climate and disaster profile (rainfall, temperature, humidity and others) and their future scenarios;
 - Assessment of the disaster profiles (earthquake and seismicity, flooding and storms) of the study area;
 - Assessment of the water resources (hydrology) status including the issues and problems related to the conservation and the management;
 - Evaluation of the land resources including their qualities and characteristics;
 - Evaluation of agricultural resources in details including farming practices, cropping patterns, crop production, cropping intensity and agricultural input use;
 - Assessment of fisheries resources including fishing practices, fish production, fish habitats, and the existing management practices;
 - Biodiversity profiling (flora and fauna) along with the habitat condition of the major species or ecologically sensitive species;
 - Socio-economic condition assessment in terms of demography, livelihoods, health and sanitation, culture, occupational health and safety including community and gender issues;
- d) Ensuring of stakeholder's participation in all the necessary phases of the study through the Public Consultation Meeting (PCM), Focus Group Discussion (FGD), Key Information Interview (KII), and the information observations and discussions;
- e) Selection of valued environmental components or important environmental components for impact assessment and the management of the resources;
- f) Assessment of environmental and social impacts (ESIA) following the standard impact assessment methods and matrices;
- g) Identification of suitable cost-effective mitigation measures for each of the impacts that can reduce the magnitudes at a significant level;
- h) Preparation of environmental and social management plan (ESMP) setting high conservation priority;

- i) Preparation of environmental and social monitoring plan to protect the existing natural resources;
- j) Preparation of dredged material management plan as per the guidance of the BWDB dredged material management plan (if needed);
- k) The Department of Environment's (DoE) approval of the Environmental Clearance Certificate (ECC);

1.4 Study Area

The Ashuganj-Palash Sabuj Project (proposed) of BADC is centered around two power plants: Ashuganj Power Station (APS) in Brahmanbaria District and Ghorashal Power Station (GPS) in Narsingdi District. The project is divided into two areas (**Figure 1.1**):

- a) Ashuganj Irrigation Area: Covers 25 unions across four Upazilas (Brahmanbaria Sadar, Sarail, Ashuganj, and Nabinagar), bordered by the Upper Meghna and Titas Rivers.
- b) Palash Irrigation Area: Covers 17 unions across three Upazilas (Palash, Narsingdi Sadar and Shibpur), bordered by the Shitalakshya and Haridao Rivers.

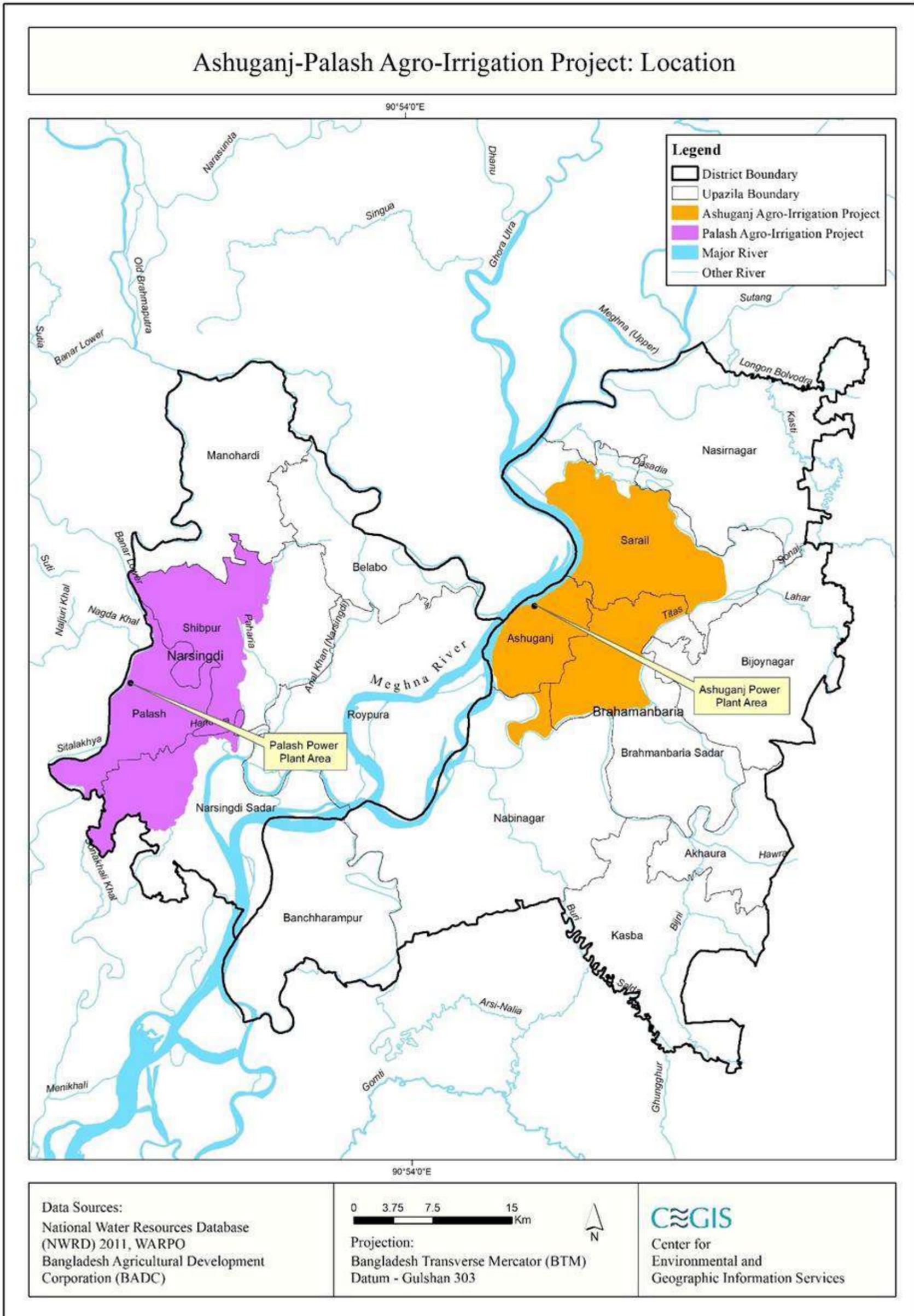


Figure 1.1: Location Map of Asuganj-Palash Green Project (Proposed) of BADC



Figure 1.2: Ashuganj Study Area

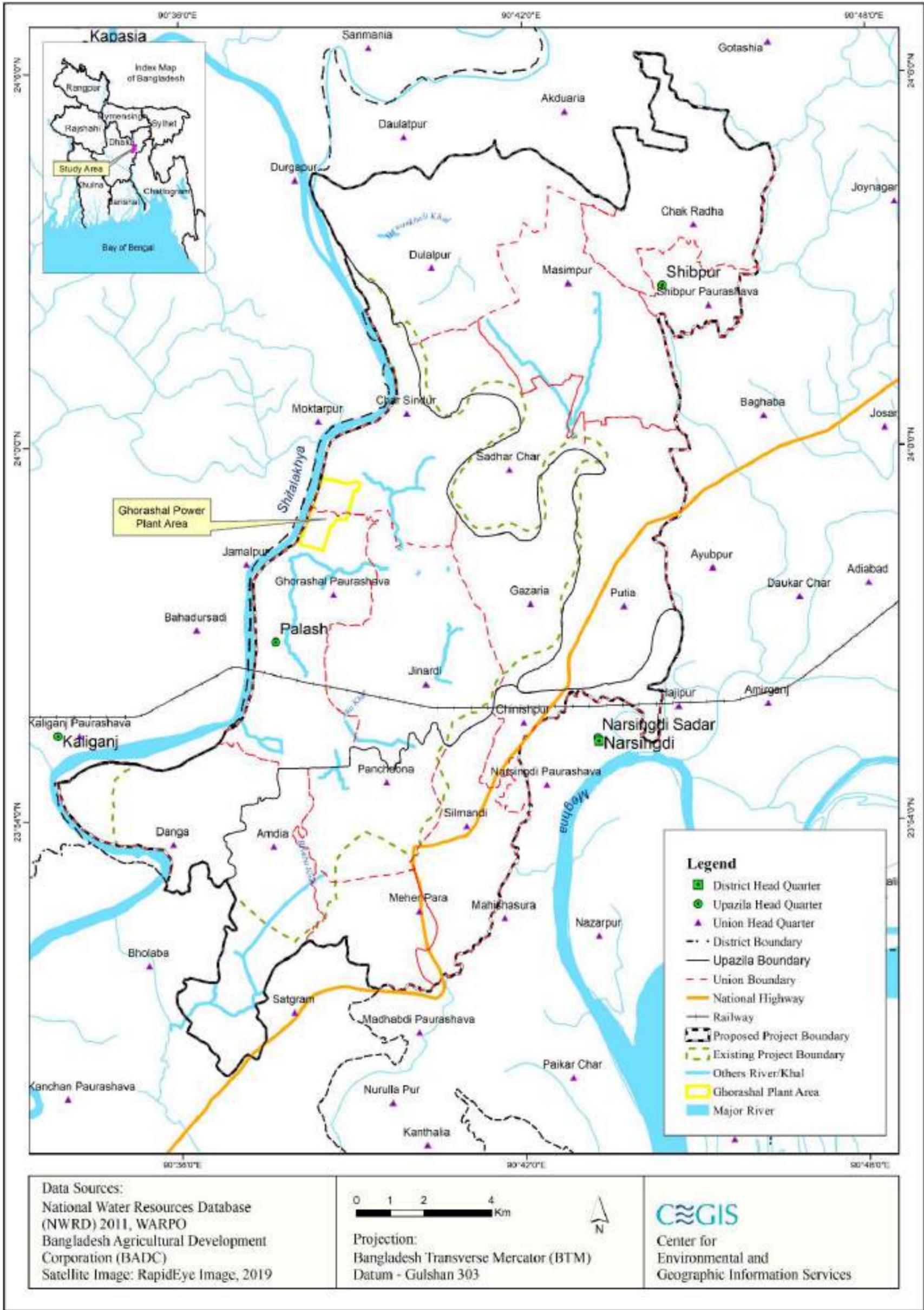


Figure 1.3: Palash Study Area

1.5 Expected Outcomes

The outputs of the study are as follows:

- Environmental and Social baseline condition of the project and ESIA of proposed interventions;
- Environmental Management Plan (EMP) including:
 - Mitigation Plan;
 - Enhancement Plan;
 - Compensation Plan;
 - Environmental Monitoring Plan;
- Environmental enhancement and conservation plan;
- ToR of ESIA duly approved from DoE;
- Risk analysis for environmental sustainability, climate resilience and disaster;
- Legal requirements during implementation of the proposed project interventions;

1.6 Contract Awarding

Center for Environmental and Geographic Information Services (CEGIS) has been entrusted by Bangladesh Agricultural Development Corporation (BADC) to conduct the Environmental and Social Impact Assessment (ESIA) study for “Ashuganj-Palash Green Project (Proposed) of BADC”. In this regard, a contract agreement was signed between BADC and CEGIS on 23 February 2025.

1.7 ESIA Study Team

The study team comprises the following professionals as per the proposal in **Table 1.1**.

Table 1.1: List of Key Professionals

Sl. No.	Name of Professional	Assigned Position
01	Kazi Kamrull Hassan	Team Leader/ESIA Expert
02	H M Nurul Islam	Environmental Specialist
03	Dr. Md. Zahidul Haque	Agriculturist/Agronomist
04	Md. Ashis Mawla	Sociologist
05	Roland Nathan Mondal	Fisheries Expert
06	Tanvir Ahmed	Water Resources Engineer
07	Uzzal Kumar Saha	Ecologist
08	Hasan Tawfique Imam	GIS/RS Expert
09	Sharif Tanver Ahammad	Research Assistant (Ecology)
10	Md. Bariul Musabbir	Research Assistant (Environment)

A team of interdisciplinary experts, including a water resources engineer, environmental specialist, sociologist, fisheries expert, climate change and disaster management expert, soil and agricultural specialist, ecologist, GIS, and RS specialist, worked closely with stakeholders to conduct the ESIA study.

In addition to the above professionals, the additional experts and professionals listed in **Table 1.2** below have also been engaged for the completion of the study successfully on time and with quality.

Table 1.2: List of Additional Professionals

Sl. No.	Name of Professional	Expertise
01	Dr. Ashraful Alam	Fisheries Specialist
02	Masuda Parvin	Junior Ecologist
03	Selina Parveen	Junior Botanist
04	Md. Atikul Islam	Junior Fisheries Specialist
05	Chayon Biswas	Junior Environmental Specialist
06	Satyendro Nath Barman	Junior Environmental Specialist
07	Umme Habiba Ilma	Junior Wildlife Specialist
08	Md. Taifulr Rahman	Junior Agriculturist
09	Md. Hasan Sabit	Junior Agriculturist
10	Md. Tazbiul Islam	Junior Agriculturist
11	Muhammad Shahidur Rahman	Junior Sociologist
12	Sudip Kumar Halder	Junior GIS Specialist
13	Ishtiak Mahmud	Junior Water Resources Engineer

1.8 Structure of the Report

There are ten (10) chapters in the ESIA report. Each chapter has a brief introduction provided below.

Chapter 1	Introduction: This chapter includes the study's history, justification, goals, study area, and scope of effort. A tabular presentation of the core study team and a list of other professionals involved in this study is provided.
Chapter 2	Policy, Legal and Administration Framework: This chapter includes a list and a synopsis of the legal, administrative, and regulatory framework, with a focus on the steps to be taken to secure environmental approval for project implementation.
Chapter 3	Approach and Methodology: This portion of the paper presents the ESIA study's detailed methodology. Examining pertinent policies, plans, and programs (PPPs), scoping and boundarying, data collection methods for documenting the natural environment and its components (environment, water resources, agriculture, fisheries, ecology and ecosystems, and socioeconomic status), assessing the impact of suggested interventions, creating environmental management plans, and creating a monitoring plan are all part of this methodology. However, in order to evaluate the impacts and determine how best to remediate them, local residents and pertinent line agencies are guaranteed to be involved in every step of the ESIA process.
Chapter 4	Project Description: The planned project activities, facilities, and project interventions are succinctly described. Here, only the Ashuganj project's options for the suggested interventions have been assessed. In the Palash case, no other options were evaluated during the feasibility phase. The Palash green project's best possibilities have been put forth.
Chapter 5	Environmental and Social Baseline: In terms of the physical environment, the baseline conditions for the dry season (March–May) of 2025 have been established after assessments of the ambient water, air, noise, and soil quality. As a baseline setting for the biological environment, the current state of the water resources, agricultural and livestock resources, fisheries resources, ecology, and biodiversity (flora and fauna) were all taken into consideration. However, in order to see how

	the project directly affects the beneficiaries, the people, their livelihoods, earnings, and educational backgrounds are also assessed.
Chapter 6	Public Consultation: This section demonstrates how individuals can participate, ensure, and provide feedback when evaluating the impacts of the proposed project and its corrective actions. The outcomes of a number of key informant interviews (KIIs), group meetings, and approximately thirteen public consultation meetings (PCMs) are detailed.
Chapter 7	Important Environmental and Social Components: This section identifies the important environmental elements that must be protected and that the suggested project interventions are likely to affect. Additionally, a reasonable argument is presented to comprehend the limitations of improvement and how they are adversely affected.
Chapter 8	Impact Assessment: The evaluated effects of the suggested treatments are often shown in the impact assessment chapter. Here, all effects—whether favorable or unfavorable—are assessed in relation to the pre-, during, and after construction stages. The residual impact status is also included in this section.
Chapter 9	Environmental Management and Monitoring Plan: An Environmental Management Plan is presented in this chapter with the goal of reducing the project's adverse environmental effects. This chapter has also outlined the environmental monitoring criteria for the successful deployment of mitigating measures during development.
Chapter 10	Waste Disposal Plan;
Chapter 11	Conclusions and Recommendations: is the concluding chapter of this report with conclusion and recommendations.

2. Policy, Legal and Administration Framework

2.1 Introduction

As per Tafshil 1 of the Environmental Conservation Rules (ECR) 2023, this irrigation project falls under the RED category. Accordingly, the implementation of the project-related infrastructural works and other project activities will be guided by the environmental laws, policies, and regulations of the Government of Bangladesh and also International Treaties and commitments that are ratified by the Government of Bangladesh and are summarized in this Chapter.

In this context, the Project Proponent will ensure compliance with all applicable regulations and standards for the environmentally and socially acceptable implementation of this Project.

2.2 Legislation Framework

The DoE is the key technical agency under the Ministry of Environment, Forest and Climate Change (MoEFCC) mandated with statutory responsibility for the implementation of the *Environment Conservation Act, 1995*. The principal activities of the DOE are:

- Defining EIA procedures and issuing environmental clearance certificates - the latter being the legal requirement before the proposed Project can be implemented;
- Providing advice or taking direct action to prevent degradation of the environment;
- Pollution control, including the monitoring of effluent sources and ensuring mitigation of environmental pollution;
- Setting the Quality Standards for environmental parameters;
- Declaring Ecologically Critical Areas (ECAs), where the ecosystem has been degraded to a critical state; and
- Review and evaluation of Initial Environmental Examinations (IEEs) and EIAs prepared for projects in Bangladesh.

2.2.1 Overview of Bangladesh Approval Process

According to the national environmental legislation of Bangladesh (ECA, 1995), all development projects are governed by some legal and institutional requirements. Section 12 of the Environmental Conservation Act (1995) stipulates "No industrial unit or project shall be established or undertaken without obtaining environmental clearance from The Director General of the DoE in the manner prescribed by the Environmental Conservation Rules (ECR) 2023". Therefore, the assessment of relevant legal provisions, policies, strategies, and institutional issues is very important for any project proponent or developer before the execution of a program or plan. The proponent has to be well aware of these requirements and comply with the provisions as applicable and necessary. Before initiating any development project, it is hence required to obtain Environmental Clearances or approval from the Department of Environment (DoE).

In accordance with the ECR, 2023 the proposed project involving re-excavation of canals/channels (more than 5km), construction/rehabilitation of water control structures, etc., falls under the 'Red' category and as such requires conducting EIA to obtain Environmental Clearance Certificate (ECC). The ECC will be issued upon approval of the EIA report (including associated EMP). The proponent is also required to pay an equivalent application fee as prescribed in ECR, 2023. The outlines of the above-noted process are described briefly below:

Stage 1: Project Approval letter, Stage 2: NOC to be obtained from local authority/DC, approval of TOR for EIA, Stage 3: EIA report, EIA submission, presentation on EIA to DoE, and receipt of the ECC. However, this may be noted that DoE requires that project proponents obtain NOCs from concerned agencies or local/regional administrations, which essentially sign off on the project. It is only after these NOCs are secured that DoE issues the ECC to proceed with construction.

2.3 Relevant Bangladesh Legislation

The Bangladesh Legislations that were relevant to this proposed project were categorized by sectors and listed below in **Table 2.1**:

Table 2.1: Sector-wise Relevant Bangladesh Legislations/Policies

Issue	Bangladeshi Legislation or Regulation	Remarks
Prevention of Pollution and Protection of Environment	Article 18(A) of our Constitution,	“The State shall endeavor to protect and improve the environment and to preserve and safeguard the natural resources, bio-diversity, wetlands, forests and wildlife for the present and future citizens.
	Bangladesh Biodiversity Act 2017	Applicable-The Act has provision for protection of biodiversity for sustainable management of ecosystem of the nation in line with the constitution of Bangladesh. In addition, as a dualist country, Bangladesh requires implementing domestic legislation to give legal effect to the provisions of international treaties.
	ECA Rules 2016	May be Applicable-As the proposed project has the provision of re-excavation of khals and construction/rehabilitation of irrigation control structures etc. which may have impacts on the adjacent riverine, and wetland areas within the study area.
	The Forests Act-1927 (including all amendments in 1982, 1989, and Amendment Act in 2000)	Applicable- The proposed interventions may have impact on the adjacent social forest located within project area.
	Private Forest Act (PFA), 1959, The Private Forests Ordinance (1959)	Applicable- The project area may have impact on the adjacent social forestry
	Wildlife (Conservation and Security) Act- 2012-	Applicable- The project may use agricultural land, part of the low land having agroforestry-based trees for storage of excavated materials and other related construction activities which may have impact on the wildlife species in aquatic environment.
	Environment Conservation Act- 1995 (and amended in 2010)	Applicable-The project proposes for re-excavation of rivers, , and construction/rehabilitation of irrigation control structures which fall within jurisdiction of this Act. The provisions of the act apply to obtain ECC and implementation of EMP at all of the project intervention phases during the project life cycle. In addition, the act provides the scope of the court having provision of penalty for violation of act during project implementation activities.
	Environment Conservation Rules-2023	Applicable- As the Rules categorize the subject project as “Red” category and require clearance from DoE, it is stipulated that environmental quality standards and other

Issue	Bangladeshi Legislation or Regulation	Remarks
		relevant requirements shall be complied during the project life cycle. In addition, during the project implementation period the proponent shall comply all rules and standards as specified in the ECR, 2023.
	Protected Area Rule (2017)	May be applicable-provided there is any protected area within close vicinity of project activities.
	The Environment Court Act-2010	Applicable-The court has jurisdiction, in accordance with the act's provisions, over trial for an offense or for compensation under an environmental law, imposing penalties for violation, etc.
	The Ground Water Management Ordinance 1985	Applicable-As the proposed development has provision of using ground water for drinking and sanitation purpose during the project implementation period. Management of groundwater resources; Tube well shall not be installed in any place without the license granted by Upazila Parishad or local authority having this legal jurisdiction.
	Natural Water Bodies Protection Act 2000	May be Applicable-According to this Act, the character of water bodies i.e., rivers, canals, tanks, or floodplains identified as water bodies in designated municipal areas. This includes, divisional towns, and district towns, but it does not cover rural areas. The Act prohibits filling or encroachment of water bodies, and it also outlines penalties for violations, including imprisonment and fines. It prohibits filling, encroaching, or any act that could harm natural water bodies within these municipal areas.
	The Embankment and Drainage Act, 1952	Applicable - This Act consolidates the laws relating to Embankments and drainage. It provides provision for the construction, maintenance, management, removal, and control of embankments and water courses for the better drainage of lands and for their protection from floods, erosion, or other damage by water.
	Vehicle Act 1927, the Motor Vehicles Ordinance 1983	Applicable- As the proposed project has provision to use transportation to perform project activities.
	Noise Pollution Control Rules- 2006	Applicable-As the project will create noise.
	Bangladesh Water Act- 2013	Applicable-As the project proposes to utilize waters and also sharing water resources with other consumers (farmers, fisherman and navigation).
	National River conservation commission Act-2013	Applicable-As the proposed project has likeliness of pollution impact in the river due to project activities and labour camps near construction sites.
	The Canal Act, 1927.	Applicable-as the proposed project has provision of rehabilitation of canals.
	Water Resources Planning Act, 1992	Applicable- As the Act made to ensure the development and balanced use of water resources and the proposed project may have influence on many Khals and rivers in the Ashuganj and Palash Project areas.

Issue	Bangladeshi Legislation or Regulation	Remarks
	Bangladesh Climate Change Trust Act 2010	Applicable-The act stated the relevant authority to redress the adverse impact of climate change on Bangladesh and to take measures on other matters relating thereto.
	Water-course Act, 2000, the Sand Quarry and Earth Management Act, 2010	Applicable-as the regulations are related to water resource management and the proposed project may have influence on many khals within the study area of the project.
	The Balumahal and Soil Management Rules, 2011	Applicable-As the proposed project involves reexcavation activities in the khal(s) under study area. The Balumahal and Soil Management Rules, 2011 stipulates the process how the re-excavation will be given and how the whole process will be conducted. The BIWTA is responsible under rule 3(10) to regularly observe the dredging operation and effects of such dredging operation on the river's environment and eco-balance.
	Jalmahal Management Policy, 2009	May be applicable-As the proposed project has provision for reexcavation activities in khal(s) under study area and may have impact on the fishing activities in those areas. The Policy, 2009 emphasizes the public interest with a view to giving priority to the provision of settlements in favor of real fishermen and conservation of biodiversity.
	National Water management plan-2001 and approved in 2004	Applicable-NWMP is a rolling plan to be periodically updated to include new priorities and challenges in the water sector.
	National Conservation Strategy- 1992	Applicable-As related to conservation of environment.
	National Environmental Management Action Plan NEMAP- 1995)	Applicable-As related to the conservation of habitat and biodiversity etc.
	Bangladesh Climate Change Strategy and Action Plan (2008) and 2009.	BCCSAP (2009) focuses to • Ensure existing assets (e.g., coastal and river embankments) are well maintained and fit for purpose and that urgently needed infrastructure is put in place to deal with the likely impacts of climate change. • Enhance the capacity government ministries, civil society and private sector to meet the challenge of climate change (Relevance-Considered in project design components)
	Environmental Policy- 1992, National Environmental policy updated in 2018	Applicable-As the proposed project has likeliness of having impact on the surrounding environment.
	National Forest Policy-1994	Applicable-As the policy focuses on the management of forest and development of social forest area.
	National Water Policy- 1999	Applicable-The policy aims for sustainable management of water. Also added to ensure efficient and equitable management of water resources for different purposes, proper harnessing and development of surface and groundwater, availability of water to all concerned and institutional capacity building for water resource management.
Fisheries	The Protection and Conservation of Fish Act- 1950 and The Protection	Applicable- The project requires compliance with any rules related to inland waters of Bangladesh.

Issue	Bangladeshi Legislation or Regulation	Remarks
	and Conservation of Fish Rules- 1985	
	National Fisheries policy- 1998	Applicable-as the policy provided guidelines for protection of fish in the water bodies and proposed project have plan to utilize natural water bodies and other irrigation structures implementation activities.
Land use and cultural heritage.	National Land Use Policy- 2001	Applicable- As the proposed project will be involved in the construction of irrigation related structures/interventions and also utilize adjacent land for storage of materials.
	The National Agriculture Policy 2018	Applicable- Applicable, as the proposed project will provide surface water irrigation facilities in agriculture land.
	Irrigation Act, 1876 (Act No. III of 1876)	Applicable-as the proposed project will enhance water resources and reduce inundation of adjacent cropland.
	Bangladesh Irrigation Water Rate Ordinance, 1983 (Ordinance No. XXXI of 1983)	Applicable-as the proposed project will enhance water resources of river and may provide support in the irrigation of adjacent crop land.
	Antiquities Act 1968	May be applicable, provided any antiques are affected/recovered/protected by the proposed project interventions e.g. re-excavation of rivers and khals, construction/rehabilitation of water control structures for irrigation, etc.
	Acquisition and Requisition of Immovable Property Act, 2017	Applicable: As the proposed project would have provision of Acquisition or requisition of land area.
Power generation, energy and industries	Electricity Act, 2018	Applicable-As the proposed project has provision of utilizing power sources for operation water control structures in the Asuganj and Palash Power plant areas and also labour camps in the adjacent project area.
Procurement in Bangladesh and port	The Public Procurement Regulations- 2003 (including all amendments)	Applicable-As government procurement process will be adopted for development of this proposed project.
Health and Safety and labor management	The Penal Code- 1860	Applicable-as the proposed project has provision of pollution impact on the surrounding environment.
	Fire prevention and Extinguish Act- 2003	Indirectly Applicable-as the proposed project has provision of accidental event and may create fire.
	The Explosive Act, 1884	Applicable-as the proposed project has provision of certain quantity of fuel storage. To prevent any accident due to explosive storage for use in transportation or other project activities and also due to careless handling/management.
	Bangladesh Labour Act 2006 and Bangladesh Labour (Amendment) Act, 2013, Bangladesh Labour Rules- 2015 enacted.	Applicable -As this law provided guidelines for employment of workers and their safety.

2.3.1 Brief Outlines of Relevant Environmental Regulations

The Environment Court Act, 2010

The Environment Court Act, 2010 provides for the establishment of environment courts and matters incidental thereto. This act also provides the jurisdictions of the environment court, penalty for violating the court's order, trial procedure in special magistrate's court, power of entry and search, procedure for investigation, procedure, and power of environment court, authority of environment court to inspect, appeal procedure and formation of the environment appeal court.

Environmental Conservation Act (1995)

The Bangladesh Environment Conservation Act of 1995 (ECA, 1995) is the key legislation in relation to environmental protection in Bangladesh. This Act is promulgated for environment conservation, standards, development, pollution control, and abatement. The Act was amended in 2000, 2002, 2007, and 2010.

The main objectives of the Act are:

- Conservation and improvement of the environment; and
- Control and mitigation of pollution of the environment;

The main strategies of the Act can be summarized as:

- Declaration of ecologically critical areas and restriction on the operations and processes, which can or cannot be carried/initiated in the ecologically critical areas;
- Regulations in respect of vehicles emitting smoke harmful for the environment;
- Environmental clearance;
- Regulation of the industries and other development activities' discharge permits;
- Promulgation of standards for quality of air, water, noise and soil for different areas for different purposes;
- Promulgation of a standard limit for discharging and emitting waste; and
- Formulation and declaration of environmental guidelines;

The ECA, 1995 specified that no industrial unit or project shall be established or undertaken without obtaining Environmental Clearance from Director General in a manner prescribed by the Rules. The project proponent must obtain Environmental Clearance from the Director General (DG) of Department of Environment (DoE). An appeal procedure does exist for those proponents who fail to obtain clearance. Failure to comply with any part of this Act may result in punishment of imprisonment or fine or both. The DoE executes the Act under the leadership of the DG.

Bangladesh Environmental Conservation Act (ECA), Amendments in 2010

The Bangladesh Environment Conservation Act (Amendment), 2010 introduces new rules & restriction on: a) Ensure proper management of hazardous wastes to prevent environmental pollution and Health Risk, b) No remarked water body cannot be filled up/changed; in case of national interest; it can be done after getting clearance from the respective department; and c) Emitter of any activities/incident will be bound to control emission of environmental pollutants that exceeds the existing emission standards (d) Government may declare any ecosystem as "Ecologically critical area" if it appears to be degraded or expected to be degraded and take all precaution measures to protect that ecosystem. In addition, the government shall stop any ongoing activities and will not allow any new developments in the ecosystem after the declaration of "Ecologically Critical Area".

The Bangladesh Environment Conservation Rules, 2023

In accordance with section 20 of The Bangladesh Environment Conservation of Act No. 1 of 1995, the Government in March, 2023 passed the Bangladesh Environment Conservation Rules, 2023. The various important provisions of the Regulation are as follows:

Rule-3 Application and Remedies for Environmental Pollution or Degradation Damages Remedies

Sub-section (1) of Section 8 of the Act requires the Director-General to dispose of an application within 30 working days by means of the public hearing. The Director General may extend the application period by 15 working days, if necessary, by stating the reason.

Rule-4 Notice for Collection of Samples

According to the provisions of Section 11 of the Act, if an officer authorized by the Director General wants to take samples of air, water, soil, or other substances for the purpose of analysis, the owner, occupier, or agent of the factory, premises or place concerned shall give a notice in accordance with Form-2.

Rule 5 Classification of Industrial Institutions and Projects for the purpose of issuing environmental and location clearance certificate

Industry/ projects and units must be classified based on their activities, pollution, and potential harm to the environment and health. The categories are: a. Green; b. Yellow; c. Orange; and d. Red.

Details Explanation are as follows: green categories are Units or projects that have a low impact on the environment and human health. Yellow Category industrial units or projects have a moderate impact on the environment and human health. Orange Categories are institutions or projects that have a significant impact on the environment and human health. Red category has a strong impact on the environment and human health and must reduce environmental impact by protecting environment also by taking pollution control measures.

Rule-6. Obligation to obtain Location Clearance and Environmental Clearance Certificate

Before instituting new yellow, orange and red industries mentioned in rule 5 and taking up the project, first the location clearance and then the Environmental Clearance Certificate should be obtained from the Director.

- For green categories industrial unit Environmental Clearance Certificate must be obtained from the director.
- In the case of all categories of industrial unit or projects set up in government or private export processing zones, economic zones or industrial cities of Bangladesh Small and Cottage Industries Corporation, it is not necessary to take location clearance certificate, only Environmental Clearance Certificate should be taken from the Director.
- Without taking a Location Clearance Certificate, no development of land or construction of any infrastructure for this purpose shall be allowed for the establishment of an industrial unit of the yellow, orange and red categories.
- Gas, electricity, water, or other essential services cannot be provided to new industries, institutions or projects of yellow, orange and red categories without obtaining Location Clearance Certificate.
- New industrial Units of green, yellow and red categories will not be allowed to conduct trial production or launch projects without obtaining Environmental Clearance Certificate.

Rule-7 describes application procedure for Location clearance and Environmental Clearance Certificate

The application should be submitted to the District office, if there is no District office the application should be submitted to the office or departmental office without jurisdiction. In metropolitan area an application should be submitted to metropolitan office. The application must be submitted to District office if there is no separate office for metropolitan area. Application should be submitted to regional office or divisional office if multiple Districts under the same division. If the same category is widespread, the application should be submitted to the head office of the department.

Rule-9 specifies the procedure for issuance of Environmental Clearance and Location Clearance Certificate

The project proponent shall apply for environmental clearance certificate by filling up the form-3 and shall follow specified schedule based on different project categories and fees will be as specified in the rules.

The Rule has specified time period for lodging application for issuance for Environmental clearance for different categories of projects. However, red category project related environmental clearance procedures is described below: Within 20 (twenty-one) working days of the application's submission, the applicant should receive the Environmental Clearance Certificate. Provided that if the application is rejected, the concerned applicant shall be notified in writing and the reasons for it within 5 (five) working days of the decision. Rule14 Procedure for granting location clearance certificate to red category industrial units and projects should fill the Form 3 schedule 6 and guideline of schedule-9 shall be followed. Provided, however, that any additional information or documents required may be provided to the applicant for submission within a maximum of 7 (seven) working days. Also provided that, if the application is rejected, the concerned applicant shall be notified in writing and the reasons for it within maximum 7 (seven) working days of the decision.

Rule-27 specifies the appeal procedures

It describes that within 30 days of the day the notice, order, or direction was given, anyone who is dissatisfied they have been aggrieved by one of these issues has the right to file an appeal with the government-established Appellate Authority. Provided that no such appeal can be filed by any industrial unit or project entrepreneur who has not applied for Environmental Clearance Certificate.

Rule 36 specifies the environmental damage remedy and compensation

Under clause-7 of the Act, activities of responsible persons, industrial unit or projects may be suspended till the pollution is not controlled. In case of failure to pay compensation, the Location Clearance Certificate issued in favor of the concerned individual industrial unit or project shall not be suspended or renewed.

Bangladesh Biodiversity Act 2017

As a dualist country, Bangladesh requires implementing domestic legislation to give legal effect to the provisions of international treaties. After 25 years of the adoption of the CBD, the Bangladesh Biological Diversity Act 2017 was enacted to fulfil the State's international obligations. The law introduces Access and Benefit-Sharing (ABS) mechanism and also promotes research related to biotechnological and also documentation of traditional knowledge.

Noise Pollution (Control) Rules, 2006

This Rule gives the authority to all the Union Councils, Paurasabhas, City Corporations, City Development Authority (i.e. RAJUK, CDA, KDA, RDA etc.) to mark off the areas under their jurisdiction

as silent, residential, mixed, commercial or industrial. They should also put signs to mark those areas. The act also describes the approved standard limit of sound in the added schedule 1 and 2. In the schedule 1, silent area means area up-to a radius of 100 meters around hospitals or educational institutions or special institutions/ establishments identified/to be identified by the government. In the silent area it is prohibited to use any kind of horns of vehicles, audio signals and loudspeakers. According to this act, daytime is counted from 6am to 9pm whereas nighttime is counted from 9pm to 6am. As the proposed project has provision of creating noise pollution in the surface, hence this act is applicable.

The Motor Vehicle Ordinance, 1983

This regulation stated to impose a penalty of maximum two hundred taka for those vehicles that are emitting smokes that poses health hazard in the public places. It also restricts the passenger from smoking in public service vehicles and in any other vehicles with notice of not smoking. This ordinance is enforced occasionally but a regular enforcement would be helpful to reduce air pollution in big cities including Dhaka. However, it is to be noted that amount of the penalty is very low which may be revised as well.

Wildlife (Conservation and Security) Act 2012

The Wildlife (Conservation and Security) Act 2012, passed in Parliament on 8th July, 2012. Under this act, the hunting, trapping, killing of wildlife are strictly prohibited. There are certain provisions kept in this Act, e.g., entrance, management, rules and regulation of the protected area etc. If any person without license performs any kind of trade, he will be imprisoned for at least a year. The project site is expected to use land areas adjacent to agroforestry for storage of materials which may be utilized by visiting wildlife. In addition, this proposed project will carry out different bank protection and erosion control activities which will have potential impact on the aquatic life of the rivers.

The Protection and Conservation of Fish Rules, 1985

These are a set of rules in line with the overall objectives of the Fish Act. Section 5 of the Rules requires that “No person shall destroy or make any attempt to destroy any fish by explosives, gun, bow and arrow in inland waters or within coastal waters”. Section 6 of the Rules states: - “No person shall destroy or make any attempt to destroy any fish by poisoning of water or the depletion of fisheries by pollution, by trade effluents or otherwise in inland waters”. Therefore, these rules are relevant for this proposed project and subsequently the proposed intervention needs to be conducted in such a manner that the activities do not cause damage to the inland waters’ fisheries.

The Bangladesh Water Act 2013

The Bangladesh Water Act 2013 was passed by the Government on 6 November 2013 to ensure “integrated development, management, abstraction, distribution, use, protection and conservation of water resources”. By virtue of this Act all rights over surface water, ground water, sea water rain water and water in the atmosphere is vested on the State. Notwithstanding the above, “rights over the surface water on any private land shall remain with the owners of such land”, and such right to use the water shall be subject to the provision of the Act. Including the legal basis for ensuring equitable water rights that take account of all uses of water. Furthermore, under the provisions of this Act, “right to potable water, and to water for hygiene and sanitation shall be treated as the highest priority right”.

The Act makes a provision for constituting a National Water Resources Council headed by the Prime Minister. The Council is the highest decision-making body and is empowered to make policies, give instructions to develop National Water Resources Plan for integrated development and safe abstraction of water and its proper use to ensure protection and conservation of water resources. The

Council is also mandated to approve the National Water Resources Plan and ensure its implementation, as well as give advice to the Government to enter into agreement through signing memorandum of understanding and/or signing conventions and treaty with any Government and international or regional organization to undertake joint survey, exchange data/information with respect to common water resources and its abstraction and development and undertaking joint measures to prevent pollution of common water resources.

The Act also makes a provision for approving national water resources plan prepared in accordance with the water resources planning Act, 1992 containing among others the following matters namely:

- Analysis of economic, natural, social, political, environmental, and ecological and institutional elements, characteristics and impact of water resources;
- Integrated use of surface and ground water emphasizing the highest possible use of rain water;
- Determination of water quality standard;
- Fixation of priority of water use.
- The Act also makes further provision for:
 - declaration of water stress area and management thereof;
 - preferential use of water in the water stress area and exemption thereof;
 - fixing the lowest safe yield level of aquifer and restrictions on abstracting groundwater; and
 - Protection of flood control embankment, which states “to ensure the sustainability of the flood control embankment, no person shall, without the permission of the appropriate authority, be allowed to construct any house, establishment or any other structure on, or on the slope of such embankment;”

Finally, if anybody deliberately violates or ignore the responsibility or protection under this Act, in that case, under the provisions of sub-section (2), she/he will get maximum of 5 years’ imprisonment or maximum Tk. 10,000 as financial punishment or both the punishments. As the proposed project has provision of management of water and may create potential impact in the water ways, hence this act is applicable.

The BWDB Act (2000)

The act covers power and responsibility of the Board, function of the Board, Board general Administration, composition of the Board of Directors, power and responsibility of the Directors and Director General, implementation and management of future projects, transfer of the ownership and management of the existing projects, budget etc.

The act requires BWDB to perform the following structural and non-structural functions. Structural functions include; (i) river & river basin management; (ii) development and construction or erection of reservoir, barrage, embankment, regulator and other infrastructure for flood control; (iii) drainage improvement, irrigation and drought prevention;(iv) augmenting water flows for irrigation, pisciculture, navigation, wildlife conservation, reforestation and overall environmental enhancement, re-excavation of river ways, canal/khal/Beels etc. for optimum changes of water ways; (v) estuary control for land reclamation, accretion and conservation; (vi) river bank erosion control for protection of towns, growth centers, places of historical & national importance; (v) construction and protection of coastal embankment; (vi) prevention of salinity intrusion and mitigation of desertification; and (vii) rain water harvesting for irrigation, environment and water supply.

Non-structural and supportive functions: (i) flood and drought forecasting and warning; (ii) hydrological investigation data collection, compilation and dissemination; (iii) reforestation and fisheries program in BWDB projects, in cooperation with relevant government agencies; (iv) road

construction on embankment; (v) research and application; and (vi) organize and ensure local stakeholders' participation for sustainable management of BWDB projects.

Irrigation Act, 1876 (Act No. III of 1876)

This Act provides for the management, conservation and use of all irrigation works in Bangladesh, being those canals, channels, reservoirs or other such as rivers. The Government shall be responsible for the construction and maintenance of all the irrigation works in order to supply water through the country and, in this capacity, shall fine whoever attempt to obstruct, damage, divert water or pollute it. The Act provides also for the construction of waterworks that supply water from a channel directly to the irrigation fields (village-channel): individuals may be appointed by authorities to build a village channel, pending the consent of the owners and tenants of the land the channel belongs to.

Bangladesh Irrigation Water Rate Ordinance, 1983 (Ordinance No. XXXI of 1983)

The Ordinance provides for water charges applied to tenants or owners of land benefiting from water supplies on behalf of the Government, and the law also ratifies diversion of normal water flow as an offence subjected to a fine up to ten times the water charge for that financial year. A fine will also be solicited for wasting water or using it with no authorization.

Partial or total tax remission shall be granted by the Authorities in case of poor harvest or none at all. The passage of water throughout the land and any work undertaken in order to construct and maintain water works will be free of charge for their owners and tenants. Article 9 ratifies diversion of normal water flow as an offence subjected to a fine up to ten times the water charge for that financial year. A fine will also be solicited for wasting water or using it with no authorization.

2.4 Administrative and Land Acquisition Sector (Brief Outlines of Some Laws)

Acquisition and Requisition of Immovable Property Act, 2017

Land acquisition in Bangladesh is governed by the Acquisition and Requisition of Immovable Property Act, 2017 (henceforth, the 2017 Act) which repealed the Acquisition and Requisition of Immovable Property Ordinance 1982 (with subsequent amendments of the latter up to 1994) and b) the East Bengal State Acquisition and Tenancy Act (1950) revised in 1994. The 2017 Act provides certain safeguards for the owners and has provision for payment of "fair value" for the property acquired.

The Deputy Commissioner (DC) in all cases, determine "market value" of acquired assets on the date of notice of acquisition (notice under Section 9 of the 2017 Act). The assessment of this market value is done considering the average price of immovable properties of the same class, with similar facilities and within the vicinity of the "to be" permanently acquired land and assets. The DC then adds 200% and 300% premium of the assessed value for cash compensation under law (CCL) of the land and assets including house for government and non-governmental acquisitions respectively.

For any other losses as specified above, i.e., from (b) to (e)¹, the DC adds 100% premium of the assessed value to pay as compensation.

If land acquired has standing crops cultivated by tenant (bargadar) under a legally constituted written agreement, the law requires that part of the compensation money be paid in cash to the tenants as per the agreement. If there is a dispute regarding the amount of compensation, there is an option for arbitration and the procedures for such is in place.

¹ (b) loss of crops or trees; (c) loss of affected immovable property separated from existing immovable property; (d) loss of other immovable property or movable property or income; (e) transfer cost of affected residential and commercial properties.

This Project has the plan for requisition of some of the adjacent private property for disposal of materials which will be dealt under the provisions of this law. In case of any acquisition of private land for construction of embankment, proposed bank protection works or any other purposes, the project authority shall abide by the 2017 Act.

The Penal Code, 1860

The Penal Code of 1860 has some valid provisions related to pollution management, environment protection and protection of health and safety. Chapter XIV of the Penal Code provides offences affective public health, safety, convenience, decency and morals: Section 277: Falling Water or Public Spring or Reservoir; Section 278: Making Atmosphere Noxious to Health; Section 284: Negligent Conduct with Respect to Poisonous Substance; Section 285: Negligent Conduct with Respect to Fire or Combustible Matter; and Section 286: Negligent Conduct with respect to Explosive Substance.

According to the Section 277, whoever voluntarily corrupts or fouls the water of any public spring or reservoir, to render it less fit for the purpose for which it is ordinarily used will be punished under the law.

According to the Section 278 whoever voluntarily vitiates the atmosphere in any place so as to make it noxious to the health of persons in general dwelling or carrying on business in the neighborhood or passing along a public way will get punishment.

The proposed project is expected to have impact on the surrounding environment and water ways due to storage of materials and bank protection activities and hence, this law is applicable.

2.5 Health and Safety including Labor Sector (Brief Outlines of Some Laws)

Fire prevention and extinguish Act-2003

The act states to obtain a license from Director General of Fire Services in case of any ware house/storage during pre-construction and construction period. The proposed project activities expected to encounter accidental fire particularly in the labour camp; hence this regulation will be applicable.

The Fire Services Ordinance 1959

The Fire Services Ordinance 1959 states that the owner needs to obtain a license under the Ordinance before using premises as a warehouse of construction storages including fuels and petroleum products.

2.6 Brief Outline of Environmental and Other Related Policy Guidance and Plans

Under the study, a number of sectoral national policies have been reviewed to identify the guiding principles which are relevant to the proposed project installation, operation and maintenance activities. The sectoral policies will include environment, water, forest, transport, import; fisheries etc.

National Environment Policy, 2018

The National Environment Policy (NEP) is one of the key policy documents of the Government. The policy addresses 24 sectors in all, in addition to providing directives on the legal framework and institutional arrangements. Communication and Transportation is one of the key sectors covered in this policy. The major declarations in different sectors under the policy are listed below:

- conduct environmental impact assessment before undertaking any project for communication and transportation development and management.

- keep the rivers, canals, and all other water bodies and water resources free from pollution;
- ensure sustainable, long-term, environmentally sound, and scientific exploitation and management of the underground and surface water resources; and
- roadside tree plantation program should be ensured during the development of new road;

The EIA study of the proposed project activities is required to address the potential impacts and propose mitigation measures.

National Environment Management Action Plan 1995

The National Environment Management Action Plan (NEMAP) is a wide-ranging and multi-faceted plan, which builds on and extends the statements set out in the National Environment Policy (NEP). NEMAP was developed to address issues and management requirements for a period between 1995 to 2005 and set out the framework within which the recommendations of the National Conservation Strategy (NCS) are to be implemented.

NEMAP has the following broad objectives:

- Identification of key environmental issues affecting Bangladesh;
- Identification of actions necessary to halt or reduce the rate of environmental degradation;
- Improvement of the natural and built environment;
- Conservation of habitats and biodiversity;
- Promotion of sustainable development; and
- Improvement in the quality of life of the people.

One of the key issues in NEMAP regarding the energy sector is “energy conservation awareness is generally low throughout the country”. However, the policy focuses on the precaution for control of environmental degradation and conservation of biodiversity.

The National Forest Policy (1994)

This is the revised version of the National Forest Policy of 1977 in light of the National Forestry Master Plan. The major targets of the Policy are to conserve the existing forest areas; management of protected areas, bring about 20% of the country’s land area under the afforestation program, and increase the reserve forestland by 10% by the year 2015 through coordinated efforts of GO-NGOs and active participation of the people.

The priority protection areas are the habitats that encompass representative flora and fauna in the core area of national parks, wildlife sanctuaries, and game reserves.

The need for amendments of the existing forestry sector-related laws and the adoption of new laws for sectoral activities have been recognized as important conditions for achieving the policy goals and objectives. The Forest Policy also recognizes the importance of fulfilling the responsibilities and commitments under international multilateral environmental agreements.

The National Water Policy (1999)

The National Water Policy of 1999 was adopted to ensure efficient and equitable management of water resources, proper harnessing, and development of surface and groundwater, availability of water to all concerned, and institutional capacity building for water resource management. It has also addressed issues like river basin management, water rights and allocation, public and private investment, water supply and sanitation, and water needs for agriculture, industry, fisheries, wildlife, navigation, recreation, environment, preservation of wetlands, etc.

It provides the framework for the management of water resources of the country in a comprehensive, integrated, and equitable manner. The policy recognizes that water is essential for human survival, the socio-economic development of the country, and the preservation of its natural environment. It is vital that the continued development and management of the nation's water resources should include the protection, restoration, and preservation of the environment and its bio-diversity.

The Policy states that excessive water salinity in the southwest region is a major deterrent to industrial growth. In addition, pollution of both surface and groundwater around various industrial centers of the country due to untreated effluent discharge into water bodies is a critical water management issue. The Policy suggests that the following matters should be considered:

- Zoning regulations will be established for the location of new industries in consideration of fresh and safe water availability and effluent discharge possibilities;
- Effluent disposal will be monitored by relevant Government agencies to prevent water pollution;
- Standards of effluent disposal into common watercourses will be set by WARPO in consultation with DOE;
- Industrial polluters will be required under law to pay for the cleanup of water-bodies polluted by them;

The policy aims to guide the major players in the water sector to ensure optimal development and management of water. The policy emphasizes efficient and equitable management of water resources, proper harnessing, and development of surface and groundwater, availability of water to all concerned, and institutional capacity building for water resource management. It also addresses issues like river basin management, water rights and allocation, public and private investment, water supply and sanitation, and water needs for agriculture, industry, fisheries, wildlife, navigation, recreation, environment, preservation of wetlands, etc. The policy has several clauses related to the project for ensuring environmental protection and are described below:

Clause 4.6b of this policy states that natural depressions and water bodies in major urban areas must be preserved in order to recharge underground aquifers and rainwater management. Moreover, measures must be taken to minimize disruption to the natural aquatic environment in streams and water channels. In addition, (Clause 4.9b) emphasized that each water resources development project or rehabilitation program to consider environmental protection, restoration, and enhancement measures consistent with the National Environmental Management Action Plan.

National Fisheries Policy, 1998

The National Fisheries Policy provides the framework for the conservation and management of fisheries resources to ensure supply and enhance production. All the water bodies suitable for fisheries production and their fisheries resources conservation, development and management are addressed under this policy. These include rivers and canals, haor and baor, floodplains, open and coastal water systems.

Wetland Policy, 1998

The Policy is relevant to the Project because the proposed project has the provision of use of groundwater and may have run of discharges from agricultural field which may pose pollution impact in the adjacent surface water sources. In addition, the policy seeks to conserve wetlands to sustain their ecological and socio-economic functions and further sustainable development; establish key principles for wetland sustainability and unsustainable practices; maintain existing levels of biodiversity; maintain wetland functions and values; and actively promote the integration of wetland functions in resources management and economic development decision making.

National 3R Strategy for Waste Management

The 3R Strategy (means Reduce, Reuse and Recycle, is the principle of reducing, reusing and recycling resources and products) has been formulated in line with the National Goal of eliminating of waste disposal on open dumps, rivers and flood plain by 2015 and promoting recycling of waste through mandatory segregation of waste at source as well as creating a market for recycled products and providing incentives for recycling of waste. The priority sectors for 3R are identified as municipal solid waste, industrial waste, biomedical waste, institutional and commercial waste, project related waste and agricultural waste.

The first core principle of the National 3R Strategies distinguishes waste as a resource. Realizing the importance of the source separation of waste, it is regarded as the second core principle of the strategies. Third and fourth principles state that technologies should be environment friendly, appropriate and affordable. Cleaner production is another core principle which is the continual effort to prevent pollution, reduce the use of energy, water and material resources and to minimize waste in the production process.

Product life extension, industrial symbiosis and by-product exchange, polluters pay principle and take back provisions, green purchasing, establishing environmental management system, public-private partnership to secure improvements in the services, collaboration with scientific research bodies to promote 3R. Additionally another core principle of the strategies suggests undertaking separate laws for specific products, setting recycling target, including 'design for environment considerations' concepts for reducing environmental impacts at all phases of product life cycle.

Bangladesh Climate Change Strategy and Action Plan (BCCSAP 2008 and 2009)

The Bangladesh climate change strategy and action plan is built on six pillars namely i) food security, social protection and health; ii) Comprehensive Disaster Management; iii) infrastructure; iv) research and knowledge management; v) Mitigation and low carbon development; and vi) capacity building and institutional. The strategy and action plan emphasize on ensuring existing assets (e.g., coastal and river embankments) are well maintained and fit for purpose and that urgently needed infrastructure is put in place to deal with the likely impacts of climate change. -enhance the capacity of government ministries, civil society, and the private sector to meet the challenge of climate change.

National Conservation Strategy, 1992

Bangladesh National Conservation Strategy was drafted in late 1991 and submitted to the Government in early 1992. This was approved in principle; however, the Cabinet is yet to give its final approval of the document. For sustainable development in the energy sector, the strategy document offered various recommendations but only those recommendations that are relevant for this project are:

- To use minimum possible area of land in exploration sites;
- Rehabilitate site when abandoned;
- To take precautionary measures against Environmental Pollution from liquid effluents, condensate recovery and dehydration Plants; and
- Technology assessment for selection of appropriate technologies;

National Biodiversity Strategy and Action Plan for Bangladesh - 2004

The National Biodiversity Strategy and Action Plan of Bangladesh (NBSAP) "provides a framework for conservation, sustainable use and sharing the benefits of biodiversity of the country" (GoB 2004: v). The core focus of NBSAP has been ensuring cross-sectoral linkages and provides a framework for securing the necessary environmental settings to reduce poverty and ensure sustainable

development. Sixteen strategies have been developed to shape and direct the actions towards achieving the goals and objectives of the NBSAP. The NBSAP emphasizes on integration of biodiversity conservation into the national development planning and processes.

From this perspective, the proposed project needs to recognize the value and importance of biodiversity and adopt measure to ensure that the integrity of the ecosystems is not adversely impacted by project activities in any stages of project implementation and operations.

National Agricultural Policy 2018

The National Agriculture Policy was formulated in 1999 to make the nation self-sufficient in food through increasing production of all crops including cereals and ensure a dependable food security system for all. This was amended in 2013 aiming to tackle other challenges including the adverse impact of climate change in the farm sector. The new agriculture policy (2018) has given emphasis on investment for irrigation management, agriculture cooperatives, and marketing, safe and nutritious food production, use of information and communication technology, etc. Natural disasters like extreme temperatures, cyclones, high and low tides, drought, thunderbolts, submergence, and salinity have also been addressed for taking appropriate steps both from research and farmers' level to avoid productivity loss under the situation.

It gives the following directives to attain the objective of this policy:

- Based on assessing water availability and ensuring optimum utilization of limited water resources for irrigation, the pipeline can be used instead of the irrigation canal.
- Attention should be given to the balanced use of both surface and groundwater and encourage less water-required crops in drought-prone areas.
- Conservation of rainwater to increase surface water availability for irrigation.
- Increase Aus, Aman, vegetable cultivation, and introduction of water-saving crops through increasing Supplementary irrigation.
- Utilize used water of the industry sector for irrigation.
- Excavation of canal, pond, and wetland for preservation and best utilization of surface water.
- On a priority basis irrigation structure should get electricity at a reasonable price.
- Use of solar energy for irrigation.
- Developing irrigation management zoning plan considering assessment of surface water availability, geographic characteristic of different areas and sector wise future water demand.
- Use water balance model to determine the quantity of surface and ground water and future water demand for different sectors including agriculture considering future extension of irrigable area.
- Develop Water Management Organization (WMO) to ensure participation of local beneficiaries.

2.7 Relevant International Legal Obligation

It has been noted that Bangladesh has already had accessed to, ratified or signed a number of important multilateral environmental agreements (MEAs) related to environment protection and conservation of natural resources which shall have to be complied with during implementation of the project. The pertinent ones of these are highlighted in **Table 2.2** below:

Table 2.2: Relevant Environment Related International Convention and Treaties

Sector	International Convention and Treaties	Status and remarks
Environment and biodiversity	Convention on the Conservation of Migratory species of wild Animals (Bonn 1979)	1-12-2005 (ratified)-Applicable as the proposed project will have impact adjacent to river bank and also dredged materials storage areas near to low flood plain and bill areas hence it may have likeliness of potential impact on biodiversity as well
	Vienna Convention for the Protection of the Ozone Layer (Vienna, 1985) and Montreal Protocol on Substances that Deplete the Ozone Layer (Montreal, 1997)	02.08.90 (ratified). Not directly applicable. However, use of any Ozone Depletion Substance (ODS) could have impact on ozone layer depletion of which ultimately affect plankton and food chain
	United Nations framework convention on climate change-1992	Applicable-as the proposed project has likeliness of emission of Green House Gas (GHG) from dredging activities, vehicle and construction equipment and requires compliance of this convention.
	Convention on International Trade in Endangered Species of Wild Fauna and Flora (Washington, 1973.) ("CITES Convention")	20-11-1981 (ratified)- Applicable as the subject project's interventions would have impact on both terrestrial and aquatic ecosystems and likeliness to have impact on the wild flora and fauna, hence required to comply with this convention.
	Convention on Persistent Organic Pollutants, Stockholm	23.5.2001 (signed) 3-5-1994 (ratified)-Applicable- as the proposed project has likeliness of potential impact on the biodiversity of both terrestrial and aquatic ecosystems 20 March, 1994 (ratified). Not directly applicable. However, the presence of any of the listed materials/chemicals will be prohibited during the project life cycle based on the guidelines.
	United Nations Framework Convention on Climate Change (UNFCCC)	1997 Ratified. Parties to take precautionary measures to anticipate, prevent or minimize the causes of climate change and mitigate its adverse effects. (Relevance- The project is subject to the impact of climate change. Engineering designs of the subproject consider climate change impacts, such as flooding and river water level rise).
	Paris Convention on Protection of the World Cultural and Natural Heritage, 1972	1983 Ratified. Parties to ensure the protection and conservation of the cultural and natural heritage situated on the territory of, and primarily belonging to, the State
	At the universal level, the UN Declaration on the Rights of Indigenous Peoples (2007) is the latest human rights instrument addressing the basic rights of world indigenous people.	Ratified-The proposed project activities shall avoid tribal and indigenous areas.
	Convention on Occupational Health Services (Geneva, 1985)	Applicable- To promote a safe and healthy working environment.

2.7.1 Outline of the Provisions of Major International Legal Obligation

Bangladesh is a signatory to a number of Multilateral Environmental Agreements (MEAs) and also some bilateral instruments. Some of them are very important in the context of environmental protection and the pertinent are described below:

Rio Declaration on Environment and Development 1992

Rio Declaration on Environment and Development adopted the global action program for sustainable development called 'Rio Declaration' and 'Agenda 21'.

Principle 4 of the Rio Declaration, 1992, to which Bangladesh is a signatory along with a total of 178 countries, states, "In order to achieve sustainable development, environmental protection should constitute an integral part of the development process and cannot be considered in isolation from it". The proposed development project is expected to pose a threat to the habitat to threaten aquatic species of the river within the jurisdiction of the project; hence Principal -4 of the Rio declaration is applicable for this project and therefore, special caution shall be taken care of during implementation of this project activity.

Convention on International Trade in Endangered Species of Wild Fauna and Flora (1973)

Entered into force on 01 July 1975, this frame work addresses the overharvesting and exploitation patterns that threatened species of flora and fauna. Bangladesh ratified in 20 November 1981. Under this Convention, the governments agree to restrict or regulate trade in species that are threatened by unsustainable patterns and to protect certain endangered species from overexploitation by means of a system of import/export permits.

Project components such as bank protection and dredging activities will ensure that it will not cause any harvesting and exploitation of wild flora and fauna during pre-construction, construction, operation, and decommissioning. In addition, storage of construction and disposal materials in the land will not have impact on the adjacent aquatic species.

Vienna Convention for the Protection of the Ozone Layer (1985)

A framework for efforts to protect the globe's ozone layer by means of systematic observations, research, and information exchange on the effects of human activities on the ozone layer and to adopt legislative or administrative measures against activities likely to have adverse effects on the ozone layer. Bangladesh ratified on 2nd August 1990.

Project components will not use chemicals that can affect the ozone layer such as methyl chloroform, a solvent.

Convention on Biological Diversity (1992)

The Convention on Biological Diversity, Rio de Janeiro, 1992 was adopted on 5 June 1992 and entered into force on 29 December 1993. Bangladesh ratified the Convention on 20 March 1994.

The Contracting Parties of the Convention have committed to:

- Introducing appropriate procedures requiring environmental impact assessments of its proposed projects that are likely to have significant adverse effects on biodiversity, with a view to avoiding or minimizing such effects, and where appropriate allow for public participation in such procedures; and
- Introducing appropriate arrangements to ensure that environmental consequences of its programs and policies, that are likely to have significant adverse impacts on biodiversity, are duly considered;

Obligation has been placed on State parties to provide for environmental impact assessments of projects that are likely to have significant adverse effects on biological diversity (art. 14).

United Nations Framework Convention on Climate Change (1992)

The ultimate objective of this Convention and any related legal instruments that the Conference of the Parties may adopt is to achieve, in accordance with the relevant provisions of the Convention, stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. The Parties should protect the climate system for the benefit of present and future generations of humankind, on the basis of equity and in accordance with their common but differentiated responsibilities and respective capabilities.

Bangladesh is a signatory to the Protocol and thus the Project is being undertaken in line with the Bangladesh Government's strategies for greenhouse gas planning for the country. As the proposed project has the provision of greenhouse gas emission (fugitive as well), hence this convention is applicable.

2.8 IFC HES Guidelines and Environmental Standards Relevant to the Project

The International Finance Corporation (IFC) developed its Sustainability Framework in 2006 and further revised it in 2012 which articulates its strategic commitment to sustainable development. The IFC's Environmental and Social Performance Standards, part of the overall Sustainability Framework, have been adopted by many as an international benchmark for identifying and managing environmental and social risks within the private sector. However, if necessary for accessing funds under this institution for this project, the IFC safeguard policies shall be followed. In addition, IFC guidelines are also applied where GOB does not have appropriate guidelines.

Besides that, during the project implementation period, the proponent will follow GOB and applicable WB/IFC guidelines/performance standards as required on the basis of whichever is stringent. This may be noted that critical habitat assessment of any endangered species under WB-ESS6 and IFC-PS-6 is not included in the present project study contract.

However, the present study will follow all available standards from Bangladesh (including ECA, 1995 and ECR, 2023, Noise Pollution Control Rules, 2006) and also IFC guidelines (IFC Health and Safety General Guidelines, 2008) as applicable.

3. Approach and Methodology

3.1 Overall Approach

Environmental and Social Impact Assessment (ESIA) is a systematic process that identifies and evaluates the potential impacts (positive and negative) that a project has on the biophysical and socio-economic environment and identifies mitigation measures that need to be implemented to avoid, minimize, or reduce and offset the negative impacts and also identifies measures to enhance positive impacts. During the conduct of the study, different national policies, legal and regulatory frameworks relevant to the environmental and social aspects of the project were reviewed during the impact assessment, which would assist in preparing the Environmental and Social Management Plan (ESMP). The World Bank Environmental and Social Framework, the environmental policy of the Asian Development Bank (ADB), and the EA guideline of the Water Resources Planning Organization (WARPO) are also reviewed.

According to the Terms of Reference (ToR), the study is intended to prepare an Environmental and Social Impact Assessment (ESIA) report containing an Environmental Management Plan (EMP) and an Environmental Monitoring Plan for the conservation of wetlands, aquatic resources, fisheries resources, bird sanctuaries, etc., following the approved format of the DoE.

3.2 ESIA Methodology

This ESIA study has been carried out following the 'Guidelines for Environmental Assessment of Water Development Projects (Flood Control, Drainage and Irrigation)' prepared by the Flood Plan Coordination Organization (FPCO) in 1992. These guidelines were updated by the Water Resources Planning Organization (WARPO), which was approved by the Government of Bangladesh in 2003 and published in 2005. This study followed the updated guidelines.

Social Impact Assessment (SIA) has also been integrated into the EIA Guidelines, considering society and human beings as an integral part of the environment. SIA started with the baseline, where existing socio-economic conditions were recorded by collecting data from both secondary and primary sources. The baseline was followed by Project and study area boundary delineation, where communities and social issues were considered. In the scoping process, important social components likely to be impacted were selected along with the important environmental components. Public consultations, an integral part of the EIA process, considered the views and perceptions of local people and communities. Their suggestions were recorded in the chapter on public consultation. At the impact assessment stage, impacts on the important social components were assessed at the pre-construction, construction, and post-construction phases. Finally, the environmental and social management plan has been prepared suggesting mitigation, compensation, and enhancement measures for the important social components.

The ESIA is not fully a linear process. Still, one where several stages are carried out in parallel, and the assumptions and conclusions are revisited and modified as the study progresses. All steps of the ESIA process were intended to include full and effective people's participation. The activities undertaken at each of the steps of the ESIA process have been described in the following sections. The overall ESIA process followed is shown schematically in **Figure 3.1**.

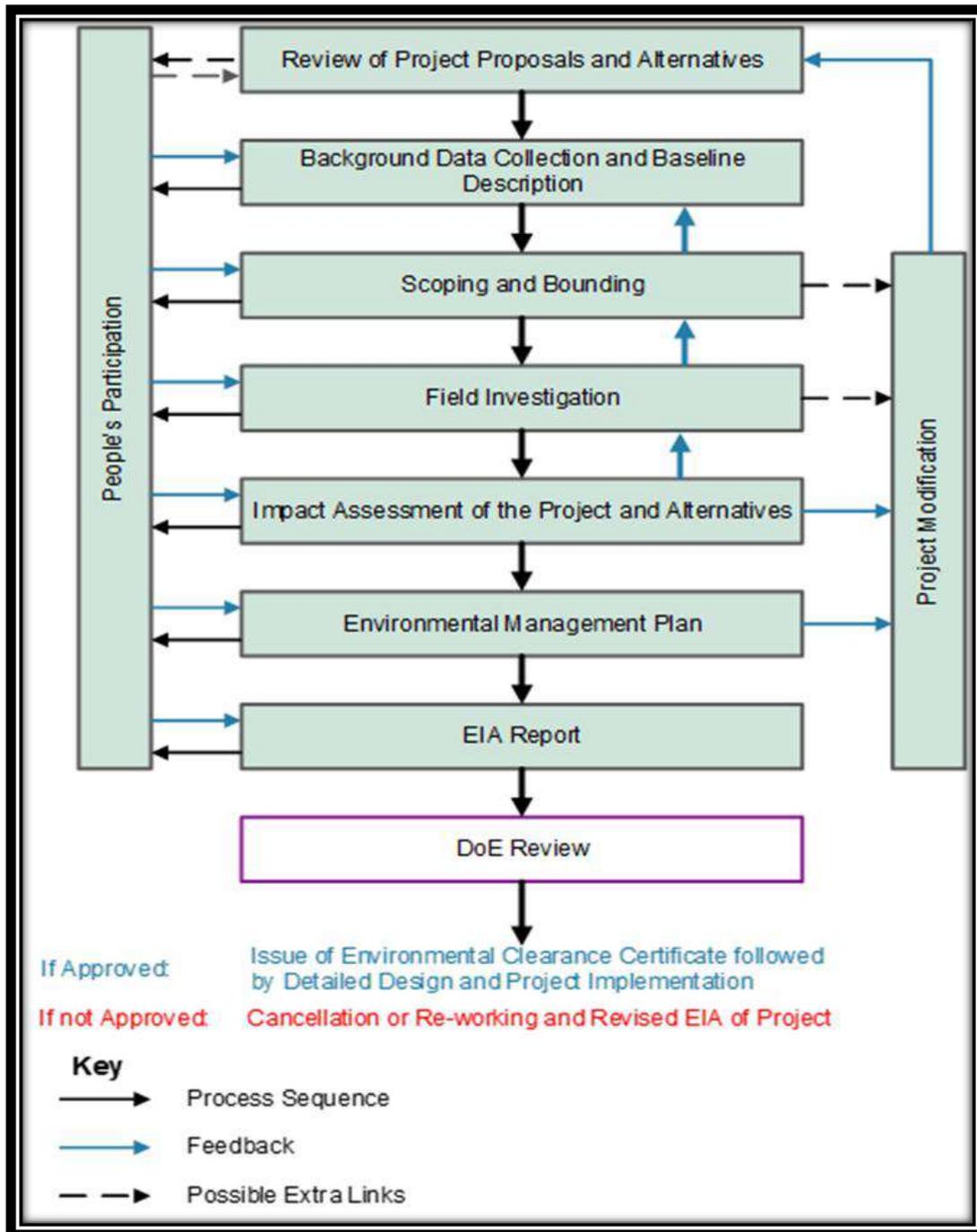


Figure 3.1: Approach of EIA Process

3.2.1 Review of Project Proposal and Alternatives

Detailed interventions (e.g., location and description of the irrigation infrastructures) which are relevant to the project and other related aspects collected from the technical feasibility study. Then the Team leader (TL) under the ESIA study team interpret this information for the multi-disciplinary team members for assessing the environmental and social impacts of the proposed project. During the collection of engineering details of the project and other related aspects, a brief presentation on these projects received from the technical feasibility study team members to understand the project activities under the pre-construction, construction, and post-construction phases. If the technical feasibility consultant considered any types of alternatives in respect of proposed interventions under

the project, then the details of alternative measures also be collected from the technical feasibility consultant. Otherwise, alternative descriptions of project interventions discarded in the ESIA report.

3.2.2 Baseline Data Collection

The precondition for the ESIA study is the collection of baseline data. The baseline condition of the project influence area was determined based on information gathered from technical study reports, field investigations, and consultations with relevant stakeholders. The baseline assessment covers the physical, biological, and socio-economic environment, along with identifying potential issues related to the proposed project site and its surrounding areas. Sectoral information from field visits was collected using questionnaires, which are provided in the inception report. The following figure visually represents the types of sectoral information needed for baseline data collection.

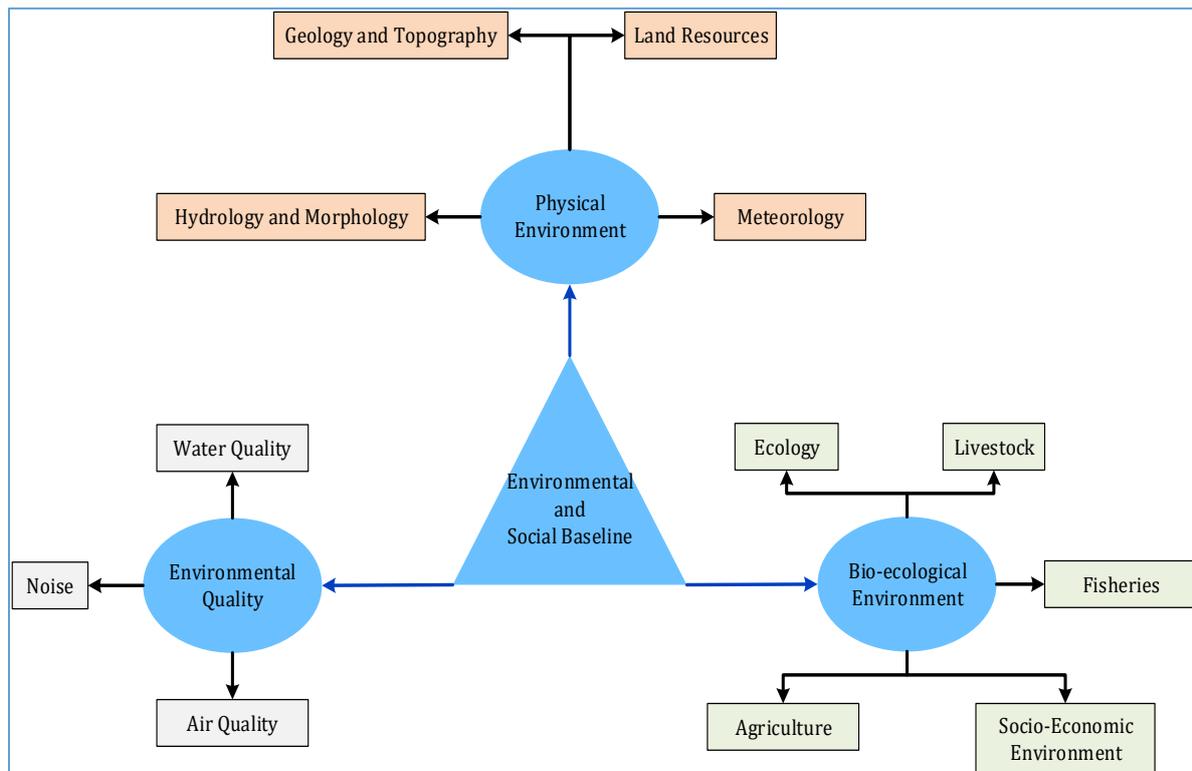


Figure 3.2: Flowchart of the Baseline Data Collection

a) Physical Environment

Geology and Topography

The general geological features and seismicity of the Project area collected from the available secondary literature and the Geological Survey of Bangladesh (GSB). The topographic data (soft and hard copy) collected from the Geological Survey of Bangladesh (GSB), the National Water Resources Database (NWRD) of the Water Resources Planning Organization (WARPO), the CEGIS archive and the feasibility study report. Digital Elevation Model (DEM) used to illustrate the topographical settings of the Project area.

Hydrology and Morphology

Water resources data in terms of connectivity, flooding, morphology, drainage pattern, and water use were collected from secondary sources. The multidisciplinary study team members conduct primary

observation during the field visit. These data and feedback from the local people during field visits were used to prepare the baseline condition for this project.

Hydrological Analysis

Surface water level and discharge of the river(s) and groundwater level were analyzed by collecting data from the nearest stations within/near the project area from BADC, Bangladesh Water Development Board (BWDB)/National Water Resources Database (NWRD). Thereafter, the hydrological analyses were carried out.

Table 3.1: Data Type and Stations for Hydro-meteorological Data

Data Type	Station	Source
Discharge	Stations within the Project Area	BWDB
Surface water Level		BWDB
Ground Water Level		BWDB/BADC
Meteorology	Dhaka	BMD

Meteorology

Meteorological data such as rainfall, temperature, sunshine hours, humidity, wind speed, evaporation, and evapotranspiration of the Dhaka BMD station were collected from the Bangladesh Meteorological Department (BMD) and analyzed for assessing the local climate of the study area.

Land Resources

The land comprises natural resources such as soils, minerals, water, and biota. These components are organized in ecosystems, which provide various services essential for maintaining the integrity of life support systems and productive capacity. High-resolution recent satellite imagery (6-meter resolution SPOT image) of the study area was used for the extraction of the baseline data on land use. Land type, soil texture, available soil moisture, drainage characteristics, etc., data collected using the SOLARIS-SRDI tool (2006). Collected data from secondary sources was verified during the field investigation. Data on AEZs collected from the Fertilizer Recommendation Guide (BARC, 2018) and the NWRD of the Water Resources Planning Organization (WARPO) are archived in CEGIS. Collected data from secondary sources was verified during the field investigation.

Table 3.2: Physical Features Data

Data type	Sources
Land Use	Satellite Image, 2019
AEZ	BARC
BEZ	IUCN,2002
Land Type	SRDI
Soil Texture	SRDI
Drainage	SRDI
Socio-economic Condition	BBS

Soil Quality

Fourteen (14) soil samples were collected from different locations in the study area based on the land use. Soil samples were collected from the agricultural field near the cooling water discharge point,

suburban/industrial area, newly irrigated areas, and existing irrigated areas. A random sampling method was followed to eliminate the tendency of bias. Before sampling, existing plants and vegetation were removed with the help of a spade. Composite subsoil samples collected with the help of an auger at a depth of 15 cm from the same site for analyzing the stated parameters: soil pH, organic matter (OM), electrical conductivity (EC), total nitrogen (N), available phosphorus (P), exchangeable potassium (K), and heavy metals lead (Pb) and cadmium (Cd).

Soil samples were composited from 5 sub-sites within a 10 x 10 m square plot. The number of sub-sites may vary due to sampling plot size and shape. One composite soil sample representative of each strategic point. Samples tested by the Soil Resource Development Institute (SRDI). Results of soil quality collected from the SRDI and appended in the baseline report. Details are presented in **Table 3.3**. The sampling locations are presented in **Figure 3.4** and **Figure 3.5**.

Table 3.3: Soil Quality Parameters

Sl. No.	Ashuganj	Palash	Soil Quality Parameters
	Sample ID		
1	ASQ-3	PSQ-1	pH, Organic matter (OM), Electrical Conductivity (EC), Nitrogen (N), Phosphorus (P), Potassium (K), Lead (Pb), and Cadmium (Cd)
2	ASQ-4	PSQ-4	
3	ASQ-1	PSQ-2	pH, Organic matter (OM), Nitrogen (N), Phosphorus (P) and Potassium (K)
4	ASQ-2	PSQ-3	
5	ASQ-5	PSQ-5	
6	ASQ-6	PSQ-6	
7	ASQ-7	-	
8	ASQ-8	-	

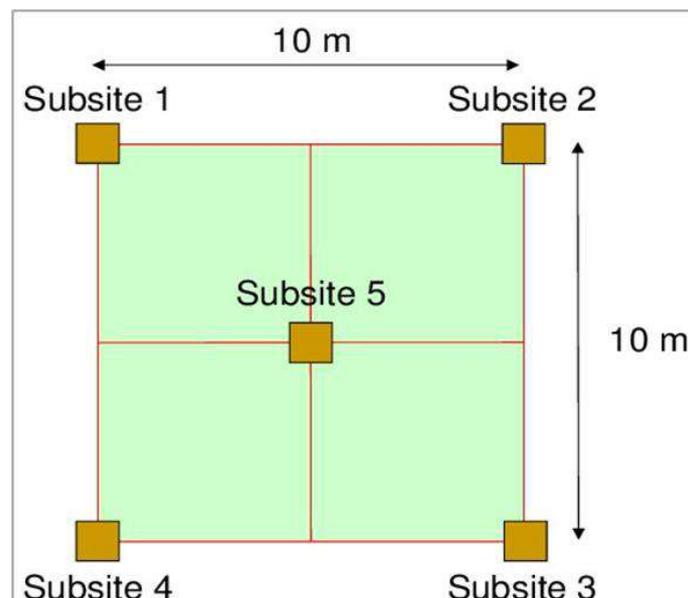


Figure 3.3: Soil Sample Collection Process

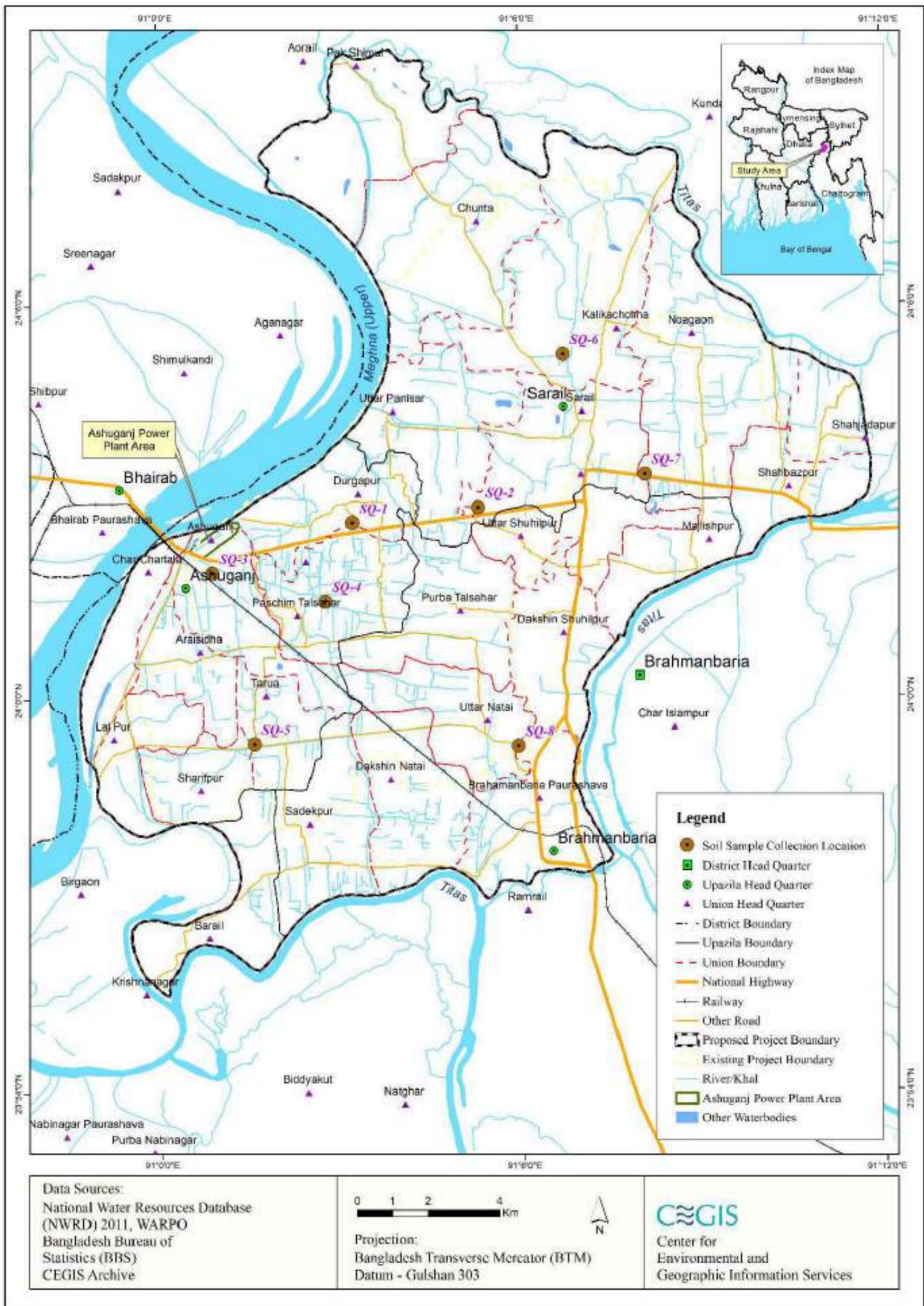


Figure 3.4: Soil Sample Collection Location Map of Ashuganj

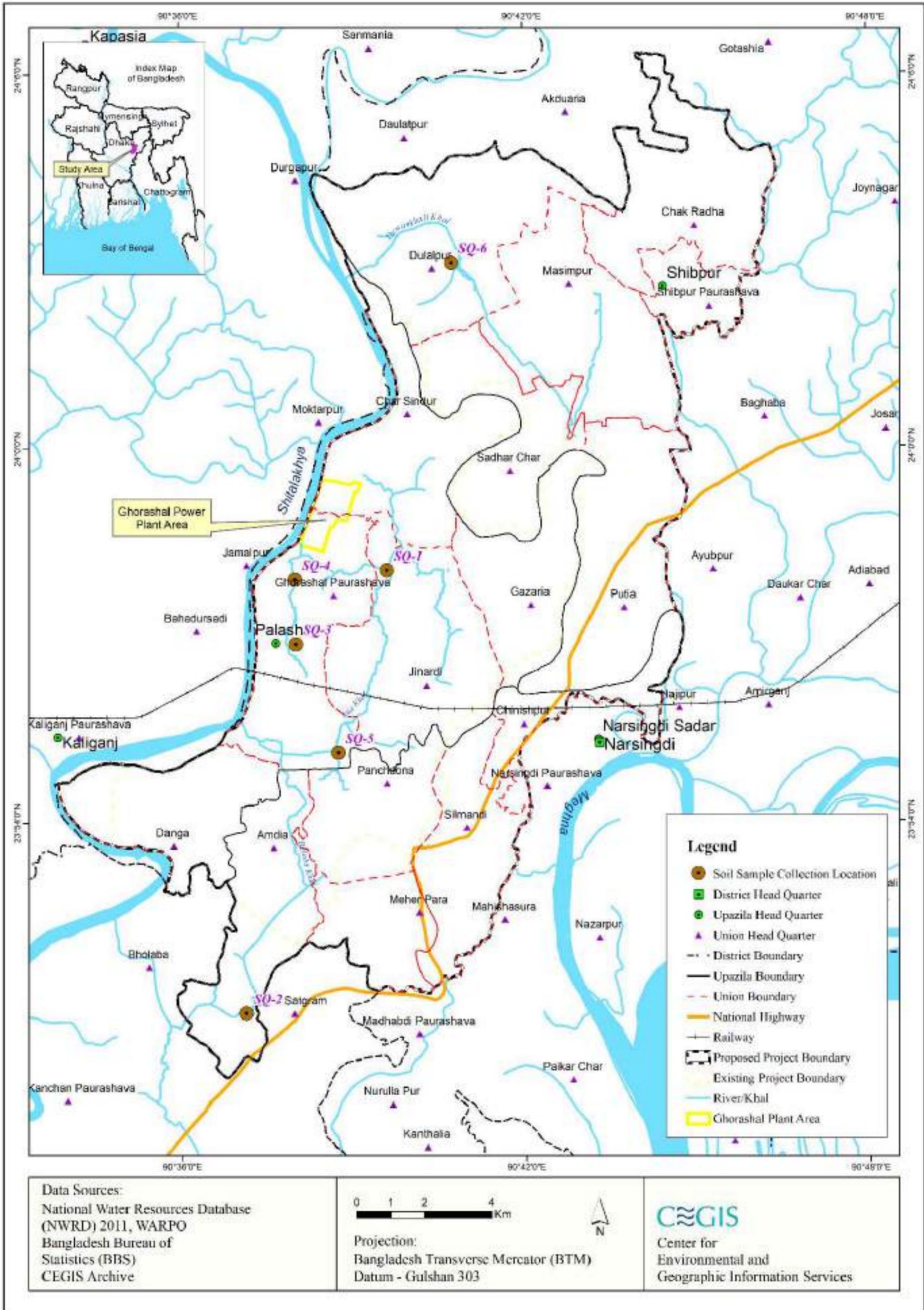


Figure 3.5: Soil Sample Collection Location Map of Palash

Environmental Quality

Water Quality

Testing of both surface and groundwater quality was conducted at key locations of the study area. Water quality of rivers/channels, khals, and ecologically important wetlands examined to determine the quality of the surface water. Concerning groundwater, sampling points, particularly community access points, will be identified and sampled.

The present condition of water quality was assessed by examining prior research and evaluating a variety of physical and chemical water quality parameters. In addition to that, standard practices were followed for sample collection and measurement of water quality parameters strategically. The measurement is a blending of in-situ and ex-situ water quality testing techniques. A handheld water quality monitoring device was used for in-situ testing, while ex-situ parameters were tested at the accessible laboratories in CEGIS laboratory/RRI-Dhaka laboratory/BUET environmental laboratory/BCSIR Central Laboratory. Additionally, secondary literature (if available) was followed to assess previous water quality status within the study area.

The baseline water quality status compared with the national standard (ECR'2023) for various uses, viz., drinking (groundwater), irrigation, and fisheries (surface water).

A 15 number of water samples (surface and ground) are listed as the following in Table 3.4 along with the physical and chemical parameters to be tested. **Figures 3.6** and **3.7** shows the tentative locations for water sampling within Ashuganj and Palash irrigation project boundaries, respectively.

Table 3.4: Water Sample Number, IDs and Selected Parameters

Surface Water		Parameters	Groundwater		Parameters
Ashuganj	Palash		Ashuganj	Palash	
ASW-1	PSW-1	Dissolved Oxygen (DO), pH, Electric Conductivity (EC), Total Dissolved Solids (TDS), Temperature, Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Nitrate-Nitrogen, Orthophosphate	AGW-1	PGW-1	Dissolved Oxygen (DO), pH, Electric Conductivity (EC), Total Dissolved Solids (TDS), Temperature, and Arsenic (As)
ASW-2	PSW-2		AGW-2	PGW-2	
ASW-3	PSW-3		AGW-3	PGW-3	
ASW-4	PSW-4		AGW-4	PGW-4	
ASW-5	PSW-5		AGW-5	PGW-5	
ASW-6	PSW-6		AGW-6	-	
ASW-7	PSW-7		AGW-7	-	
ASW-8	-				

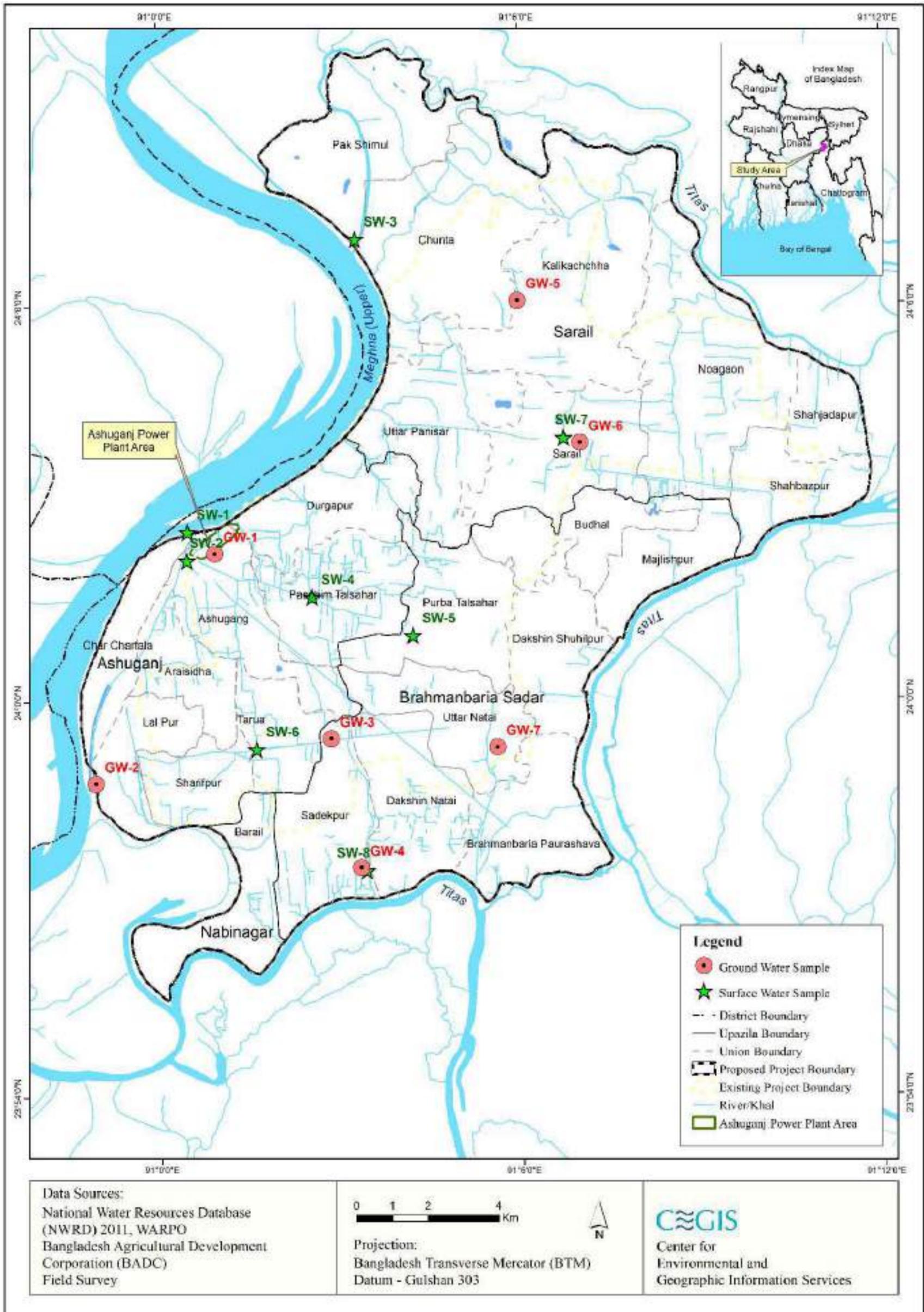


Figure 3.6: Water Sampling Locations in Ashuganj Green Project

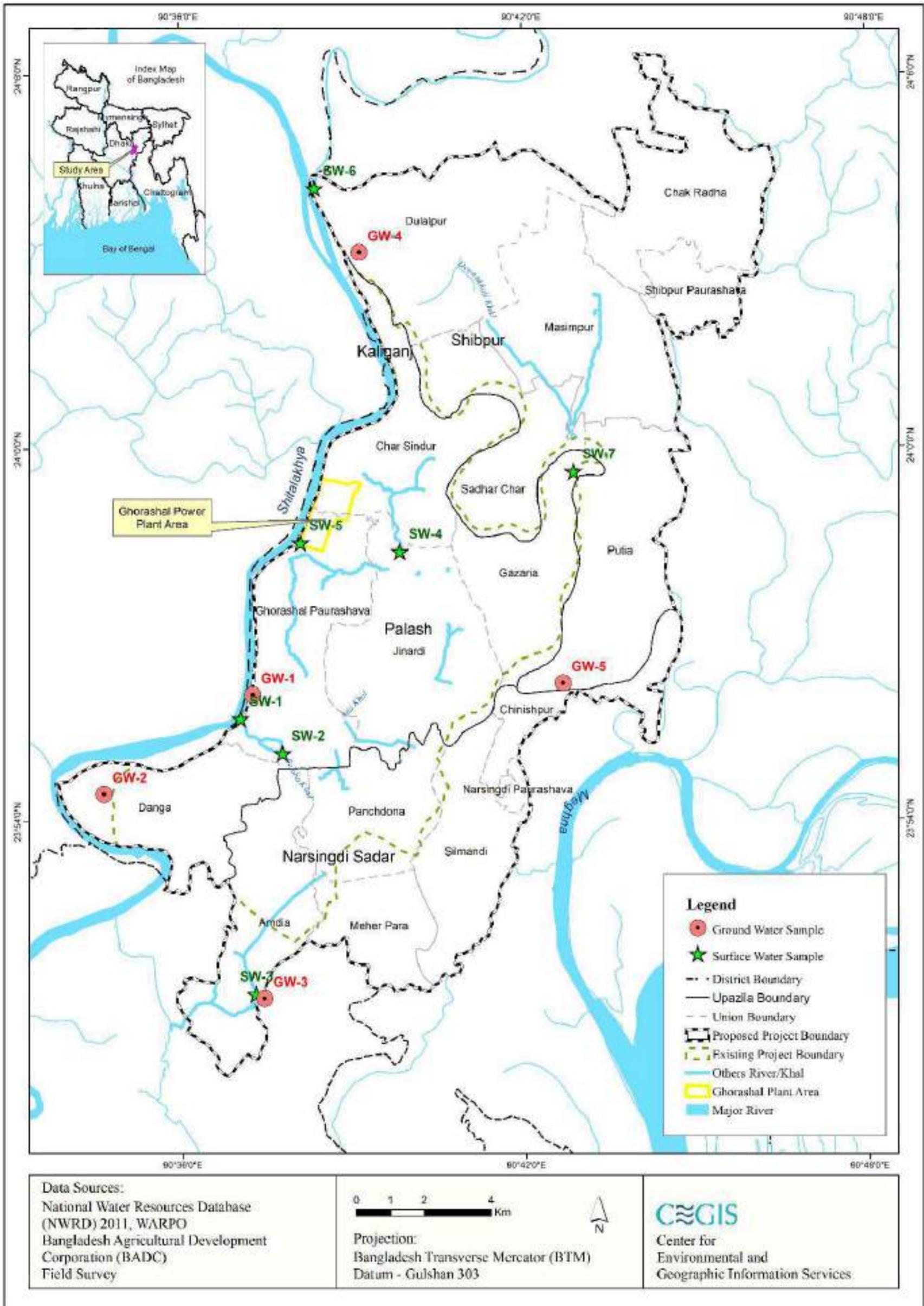


Figure 3.7: Water Sampling Locations in Palash Green Project

Air Quality

Major criteria pollutants in the ambient air are broadly classified into (i) Particulate Matters (PM₁₀ and PM_{2.5}), and (ii) Gaseous Pollutants (NO_x, SO₂, CO, and O₃). The DoE has established national ambient air quality standards for these pollutants under the Air Pollution (Control) Rules, 2022, which used for comparison with the monitoring results.

The ambient air quality monitoring was conducted for a 24-hour average monitoring period at four (02) locations within the study area. The monitoring location was selected based on the wind direction, sensitive receptor points, accessibility, and insights gained during a reconnaissance field visit. These selection criteria might facilitate assessing the maximum contribution of criteria pollutants in the project airshed. The parameters that were monitored are: Particulate Matters i.e., PM₁₀ and PM_{2.5} and Gaseous Pollutants i.e., Nitrogen Dioxide (NO_x), Sulfur Dioxide (SO₂), Carbon Monoxide (CO), and Ozone (O₃). It is to be mentioned here that air quality monitoring was performed using AirSENCE (Model: AS400P-1021C6B440224, CANADA), which is an advanced, accurate, and affordable Continuous Ambient Air Quality Micro-Monitoring Station (CAAQMMS).

Noise Quality

In and around the project site, ambient noise levels were recorded both during the day and at night. The Noise Pollution (Control) Rules, 2006's various zones and the presence of sensitive receptors close to the project site were taken into consideration when choosing monitoring sites. A reconnaissance field tour was used to finalize the monitoring locations at the inception stage. An ANSI Type II noise level meter (KANOMAX) was used for this survey. Before every monitoring session, the noise meter is set up and calibrated, taking into account the acoustic environment and site characteristics. In each location, a five-minute measurement technique with a 30-second interval was used. Every thirty seconds, the average dbA was noted.

b) Biological Environment

Agriculture Resources

Farming methods, crop production limitations, cropping patterns, crop variety, crop yield, crop damage, and agricultural inputs are all examples of data pertaining to agricultural resources. By creating a questionnaire, conducting in-depth field surveys, and consulting with local residents and relevant agricultural officials, these data were gathered from primary sources. Secondary sources of information about agricultural resources were also gathered from Upazila Agriculture Extension Offices (UAEO) within the project area. Data on crop damage and output gathered during the previous three years in the field.

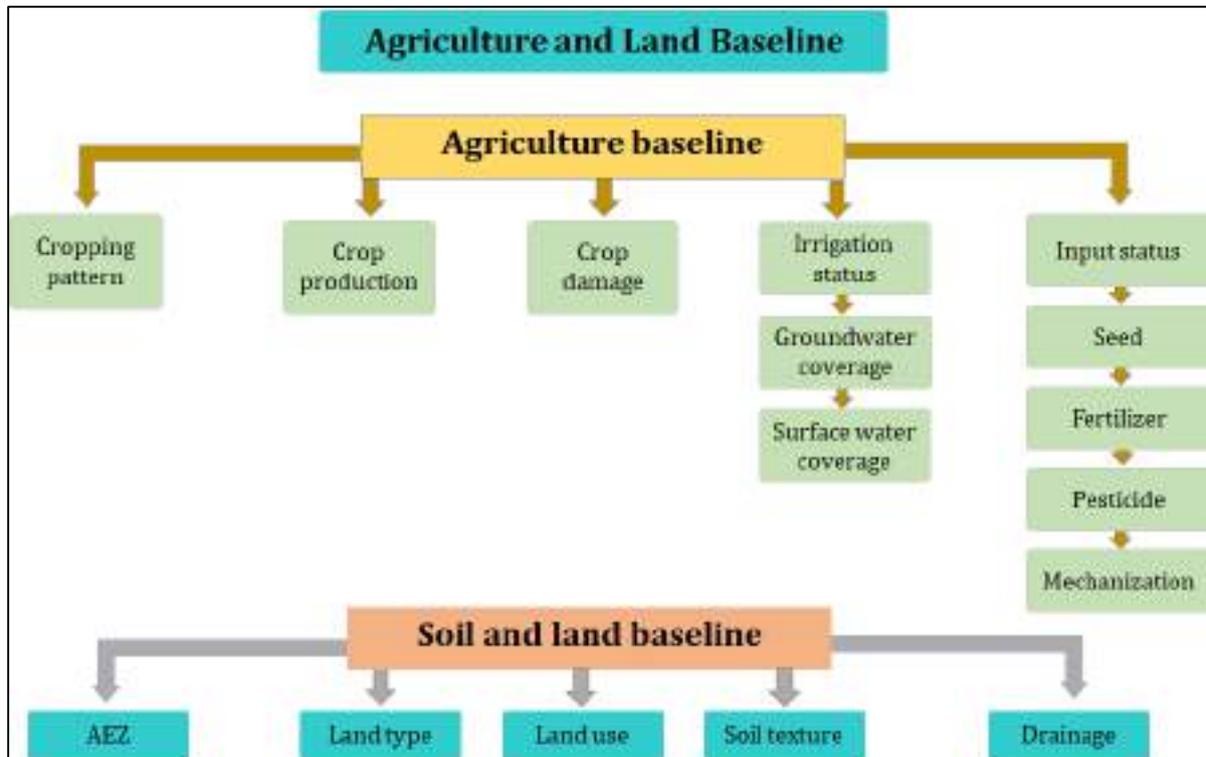


Figure 3.8: Land and Agriculture Data Collection Framework

Crop Production

Crop production has been determined by using the formula:

$$\text{Total crop production} = (\text{Damage Free Area} \times \text{Normal Yield}) + (\text{Damaged Area} \times \text{Damaged Yield})$$

Crop Damage

The crop damage (production loss) has been calculated by using the formula:

The crop damage (production loss) = (Total cropped area × Normal yield) - (Damaged area × Damaged yield + Damage Free Area × Normal Yield). The crop damage data were collected from the field for the last 3 years.

Livestock Resources

At the field level survey and in conjunction with the local population through Key Informant Interviews (KII), the current state of the study affects area's livestock (cattle, goat, and sheep) and poultry (duck and chicken) was assessed. Data on livestock resources was gathered from Upazila Livestock Offices (ULO) in the study area using secondary sources.

Fisheries Resources

By taking into account the seasonal variation of ecosystem-based fish habitat area, habitat condition that respects suitability for major sensitive fish species, fish habitat and productivity in dry and wet seasons, fish diversity, fish migration, and fish production, the Fisheries Biologist gathers primary and secondary data on fisheries resources. The fisheries specialist created a checklist/questionnaire prior to data collection. The checklist had a variety of information that was designed with the project interventions' building activities in mind. Data for the study was gathered using a variety of survey methods, including market surveys and catch assessment surveys. Important biodiversity hot spots in the research area that are biologically, ecologically, and intervention-sensitive were found and

evaluated by examining various types of literature, speaking with local environmentalists, naturalists, and old fisherman, as well as by making direct physical observations.

Indicators selected for fisheries resource assessment are presented in **Figure 3.9**.

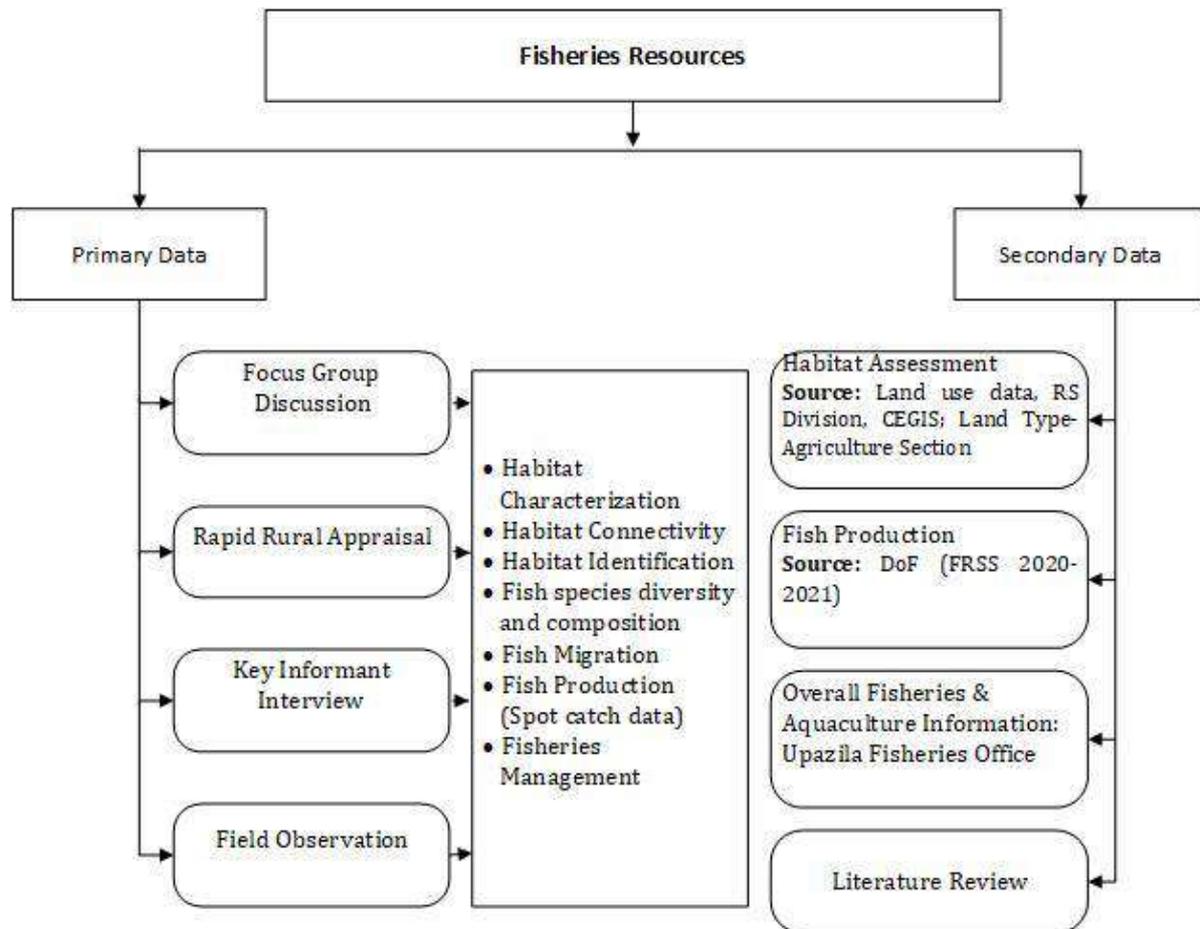


Figure 3.9: Fisheries Resource Indicators and the Source of Data

Ecological Resources

Plants and animals, birds, migrating birds, amphibians, reptiles, mammals, and other aquatic life forms are the main subjects of the ecological survey. Gathering habitat data, locating sensitive habitats, researching ecological shifts, and evaluating possible ecological effects are all part of the fieldwork. To define the ecological baseline condition of the project influence region, the team employed the following field investigation techniques.

- **Bio-Ecological Zone:** Using the data from the CEGIS database, the proposed study creates a map of the Bio-Ecological Zone. Additionally, the research team gathered various data on bio-ecological zones and their attributes from the International Union for Conservation of Nature's (IUCN) publications as well as those of other pertinent organizations.
- **Ecosystem of the Project Location:** The terrestrial and aquatic ecosystems at the project site were gathered, examined, and reported on by the study. The project's closeness to direct, indirect, and cumulative project-related impacts on habitats and ecosystem biodiversity was taken into account in the assessment.
- **Vegetation and Floral Diversity:** The study team's ecologist evaluated the floral diversity and vegetation cover of various ecosystem types, including aquatic and terrestrial environments. The homestead vegetation, roadside vegetation, floral diversity, and significant habitat inside and/or

surrounding project areas are all included in the terrestrial ecosystem. The water ecosystem's floral variety includes floating, merging, and submerged vegetation. Information gathering on ecosystems and habitats, sensitive habitat identification, and ecological change detection are all part of the field activities. Physical observation, a quadrat survey, a transect walk, and local consultation are examples of field investigation techniques.

- **Wildlife Resources:** The study team's ecologists focused on animal resources, such as migratory and native birds, amphibians, reptiles, mammals, etc. Information gathering on ecosystems and habitats, sensitive habitat identification, and ecological change detection are all part of the field activities. Physical observation, habitat surveys, transect walks, and local consultation are examples of field investigation techniques.
- **Selection of biodiversity hotspots:** The project area's biodiversity hotspots were identified via physical observation and a review of the literature. By examining the habitat patterns, floral and faunal mix, population size, and conservation relevance of the terrestrial and aquatic species, biodiversity hotspots were found. The selection of hotspots is influenced by forest patches, dense vegetation, and river confluences, particularly for migratory and aquatic birds, local avifauna, mammals, amphibians, and reptiles.

Socio-Economic Environment

The data collected from different sources to establish a baseline for this ESIA study, which can be grouped into the following two categories:

- **Primary sources:** Data collected from the project area and concerned unions and municipalities in the Project/study area through questionnaire surveys, Rapid Rural Appraisal (RRA), consultation meetings, and informal interviews. The primary data collected by using the following methods:
 - **Informal interview:** Informal interviews conducted in the Project area. This technique refers to an informal discussion about project-related issues, which usually provides much information since respondents feel comfortable in this type of interview. Local people are the key informants of this method. In this regard, the triangulation process may be triggered to verify/ identify the authenticity of the data.
 - **Group Discussion:** Formal and informal group discussions with different groups of people carried out during the field investigation. Data on income, expenditure, social overhead capital and quality of life, migration, communication system, and cultural and heritage features of the project area will be collected.
 - **Focus Group Discussion (FGD):** There several FGDs with different occupational, vulnerable groups and a group of people with homogenous interests to understand their views on the proposed project. The impact likely to be brought out by the project and their suggestion regarding the project planning also collected through the FGDs.
 - **Key Informant Interview (KII):** Some key actors selected from different stakeholder groups to collect information on socio-economic aspects and project -related information for the study. A checklist used in this regard.
- **Secondary sources:** The union specific demographic data extracted from population and housing census 2022. Besides, relevant secondary literature and project documents also reviewed to gather knowledge about the project and project area people.

This study focuses exclusively on the proposed project area to investigate the socio-economic condition. The proposed socio-economic survey carried out within this area. However, this study often goes beyond this geographical boundary if any indicator requires. **Table 3.5** presents a set of indicators for the baseline survey.

Table 3.5: Variables, Indicators, and Mode of Data Collection

Variables	Indicators	Techniques of Data Collection
Demographic profile	Population and household, Density, Age structure, Sex composition, Ethnic identity, etc.;	Literature review, Secondary data (BBS), and field investigation through the informal interview, group discussion and focus group discussion and KII.
Quality of life	Housing, education, literacy, accessibility to services i.e., power, water, sanitation, etc.; Common property resources	Literature review, Secondary data (BBS), and field investigation through the informal interview, group discussion and focus group discussion and KII.
Economy & livelihood	The dependency ratio, distribution of income and expenditure, labor market, employment and livelihoods, Self-assessed	Literature review, Secondary data (BBS), and field investigation through the informal interview, group discussion and focus group discussion and KII.
Infrastructure	Existing infrastructure includes transportation, communication, common property resources, flood shelter, etc;	Field observation, formal and informal discussion with local people
Cultural resources	Cultural and archeological resources in the project area.	Field observation through alignment
Vulnerability, assets and gender issues	Landholding and land tenure ship, Resource control and power structure, social conflicts, socially vulnerable groups, vulnerability context, Gender disparity, health and safety, etc.;	Group discussion and Focus group discussion and Informal interview.

The data collected from Consultation meetings, FGDs, KII, Group Discussion, and informal interviews analyzed using appropriate statistical tools and instruments. The sum and percentage of total values used to specify the percentage of households containing different values on different variables.

3.2.3 Scoping and Bounding

Scoping

The sector-wise Important Environmental and Social Components (IESCs) that are anticipated to be influenced by the suggested solutions were chosen through a scoping exercise. There were two phases to scoping. The ESIA study team's individual experts created an initial list of the elements of respective fields that could be influenced by the project interventions' pre-, during-, and post-construction activities.

Stakeholder opinions about those environmental and social issues were gathered at community scoping sessions in the second stage. The IESCs were chosen using the ESIA team members' professional judgment and the feedback from the stakeholders gathered during the scoping sessions.

Bounding

The bounding of the project influence area identified considering the proposed interventions of the project. Area likely to be impacted by the activities under each intervention delineated in consultation with the BADC office in addition to feedback received from the local people during reconnaissance field visit and baseline data collection. The entire area likely to be affected by the proposed construction activities of project considered as the potential area to be impacted. Two impacted zones (**Figure 3.9**) selected for each interventions considering the communication and hydro-morphology of the project influence area such as:

- a) Direct Impacted area;
- b) Indirect Impacted area;

The project's direct impacted area is determined by the shape and hydrological parameters of the river, which includes the project area. The indirect impacted area includes external river flooding, socioeconomic considerations, surrounding existing natural settings (environment) transportation flow, and the economy of the places that are not included in the direct impacted area.



Figure 3.10: Impacted Area Selection Criteria

The bounding of the study area has been identified considering the following aspects as well:

- Catchment area;
- Biodiversity hotspot;
- Riverine fish habitat;
- Human habitat areas;
- Socio-Economic aspect;

The map of the study area is shown in **Figure 1.1**.

3.2.4 Field Investigations

The ESIA study team members collect detailed data on the possible impact of the construction activities under different interventions after developing the checklist considering physical, biological and socio-economic condition. Detailed data on IESCs collected from the field during the major field investigation stage. Information on the IESCs gathered through a mixed method including FGD and KII using checklists. Intensive consultation with the local (Public Consultation Meeting) people carried out in each case for securing people's participation. The multidisciplinary ESIA study team members also make professional observations and justification during the field visits.

3.2.5 Impact Assessment

The environmental and social impacts of the activities under the proposed project on the IESCs assessed through several sets of activities. Impacts are the results of interaction of specific project activities with the existing environmental settings. The impacts of the interventions under the proposed project estimated on the basis of the differences in the changes between baseline and the Future-Without-Project (FWOP) condition and the baseline and Future-With-Project (FWIP) condition.

The Future-Without-Project (FWOP) conditions generated through trend analysis and consultation with the local people. This reflects the conditions of the IESCs in the absence of the proposed interventions under the project.

Changes expected to be brought about due to the proposed project assessed to generate the Future-With-Project (FWIP) condition. Comparison and projection methods used for predicting the impacts. The environmental impact assessments initiated by predicting changes in the bio-physical and social environment. This includes both positive and negative impacts which considered in the preparation of the environmental management plan. The positive impacts were assigned a plus (+) sign while the negative impacts were assigned a minus (-) sign.

Quantification of impacts on some of the IESCs was possible, but quantification of impacts especially on the ecological and social impacts was not possible, in which cases qualitative impacts were assessed. Qualitative impact was assessed considering the duration of the potential impact; spatial extent of the potential impact; reversibility; likelihood; and legal standards and established professional criteria.

Water Resources

The water Resource Engineer assessed and evaluated the impact of the IECs on water resources by analyzing the consequence of the possible change in different identified important elements under water resources caused due to different activities of the proposed interventions. He assessed the sensitivity and magnitude of the possible impact on water resources.

Water Quality

Individual water quality criteria were evaluated during the dry season. As a result, the activities required for the suggested remedies were connected to the existing problems with water quality. As a result, the current water quality parameters were subject to activities-based influences. Sensitivity to the aquatic environment and its lifeforms as well as water quality parameters will be taken into account.

Air Quality and Noise Level Acquisition

The purpose is to assess the probable positive and negative impacts on the surrounding air quality and noise level for the implementation of the Ashuganj-Palash Green Project (proposed) of BADC. In this study, an interaction matrix method was applied to evaluate the expected environmental impacts. The interaction matrices were widely used in the environmental impact assessments (EIAs) method, where project activity is shown in the row of the matrix and environmental and social components are presented in the column of the matrix. On the other hand, information on the sources of noise from different equipment, machinery, mobilization, and associated activities was provided by the project proponent, and the impact of the associated construction and protection activities on noise level enhancement was assessed by the abovementioned method. Later on, the potential impacts were examined at the impact evaluation stage.

However, the impact evaluation was made following the operational guidelines of the EIA guideline of the DoE. All associated impacts from the project planning to operation were described with detailed information. Every probable consequence will be identified and will be categorized as **major**, **moderate**, **minor**, or **minimal** based on consideration of the parameters such as i) Duration of the impact; ii) Spatial extent of the impact; iii) Reversibility; and iv) Legal standards. The sensitivity of a receptor is then determined based on the review (proximity/numbers/vulnerability) and the presence of the features of the surrounding area. After that, the significance of the impact criteria has been determined to assess the final impact on the air and noise quality of the receiving environment or potential receptor.

Land and Agriculture

The proposed interventions might have negative impacts on soil and agriculture in the study area. Moreover, the proposed interventions might have short-term and long-term impacts on agricultural crop production, irrigation, cropping patterns, etc. The impacts on land and agricultural resources were evaluated considering all criteria followed, such as:

- Cropping pattern and intensity;
- Crop yield; and
- Crop production etc.;

For instance, the research area is currently experiencing a scarcity of irrigation water as a result of inadequate drainage systems and infrastructure associated with irrigation. It would be very beneficial and highly effective for national plans if the cooling water from the Ashuganj Power Plant could be utilized for irrigation. The impact was calculated using these characteristics, which were regarded as IECs.

Crop production in the catchment area will rise if the proposed project interventions develop and establish drainage systems and other irrigation-related infrastructures. Additionally, groundwater pressure will be reduced. One potential result of the project interventions will be this.

For this context, a four-layer analysis was carried out which is presented in **Figure 3.11**.

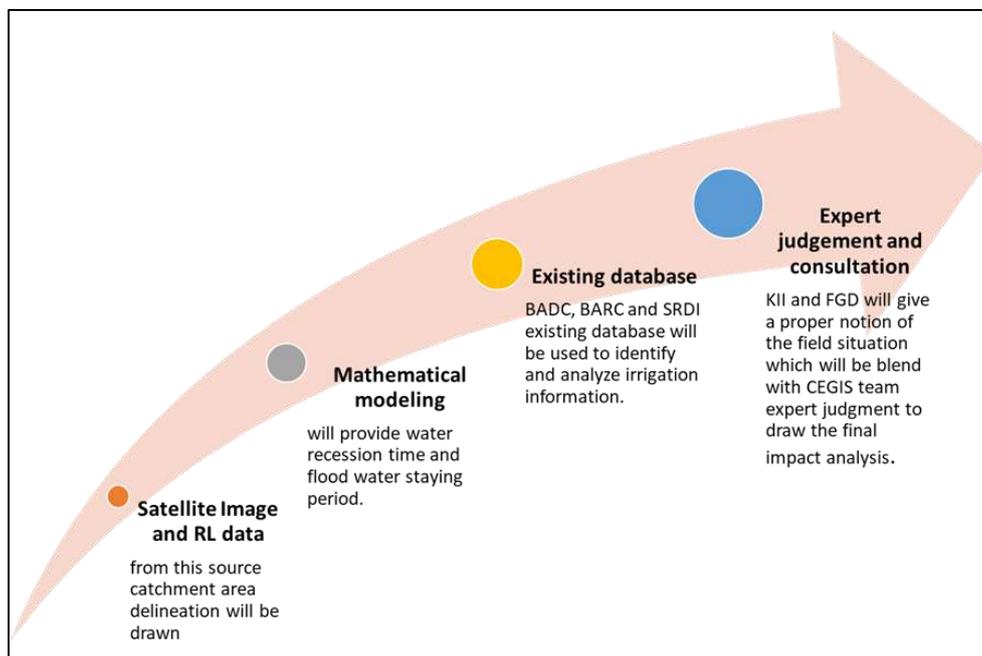


Figure 3.11: Land and Agriculture Resources Impact Analysis Procedure

Fisheries

By examining the potential changes in several identified significant elements under fisheries resources brought about by various activities of the proposed interventions, fisheries biologists examined and assessed the impact of the IECs on fisheries resources. He evaluated the potential impact on fishery resources, including its sensitivity and magnitude.

Ecology

Stakeholder interaction, physical observation, literature review, satellite image analysis, and expert opinions are all part of the overall strategy.

The selection of IECs (Important Ecological Components) was used to evaluate the effects on flora, fauna, and their ecosystems following the completion of the technical report. Changes in plant coverage, vegetation damage from re-excavation, and other infrastructure development associated with the construction of irrigation facilities addressed the effects on flora. Changes in wildlife habitat area, habitat appropriateness, and species conservation significance were the main factors highlighting the effects on faunal species and wildlife. Using the following matrix, the qualitative data regarding the effects on biological components was transformed into quantitative data:

Qualitative impacts were evaluated in those situations, and scores were assigned a (+) sign for positive impacts and a (-) sign for negative ones. On a scale of 1 to 10, the extent of both positive and negative effects was displayed. The total effects and a summary of each score were provided.

An ecosystem conservation plan was put forth based on the impact magnitudes in order to lessen the negative effects and increase the positive effects brought about by project activities.

Socio-economic Conditions

To evaluate the effect of the suggested interventions on the chosen ISCs, the sociologist held FGD, KII, PRA, and consultative meetings. Additionally, when the interventions were put into place with the project's future in mind, the sociologist evaluated the socioeconomic circumstances of the locals and stakeholders going forward and planned for the effects.

Qualitative Impact Assessment

Some of the IESCs, particularly the majority of the social consequences, may not be measurable. For those IESCs, the qualitative impact was evaluated. The size, sensitivity, and importance of the IESCs will be supplied for the qualitative effect assessment.

Identification of Impacts and Mitigations Measures

Members of the ESIA team described the main method for impact detection and mitigation, which was based on stakeholder recommendations and expert assessment. This documents the justification for the impacts and their possible importance, mitigation strategies, residual effects, and risk following mitigation, all of which are connected to pertinent laws, the specifications of the construction contract, and the ESMP's provisions. Based on the socioeconomic baseline, effects were found that had an impact on the impacted individuals' economic activity or community, if any. These were further divided into impacts during construction and those that followed in terms of operations.

3.2.6 Potential Impact Evaluation Methodology

Assessment of the effects and identification of residual impacts take account of any incorporated mitigation measures adopted due to any potential impact of project activities and are largely dependent on the extent and duration of change, the number of people or size of resources affected, and their sensitivity to change. Potential impacts may be either negative or positive (beneficial), and

the methodology defined below was applied in this ESIA study to define both beneficial and adverse potential impacts.

The criteria for determining significance are generally specific for each environmental and social aspect, but generally, the magnitude of each potential impact is defined along with the sensitivity of the receptor. The generic criteria for defining the magnitude and sensitivity used for the study are summarized below:

Magnitude

The assessment of magnitude undertaken in two steps. Firstly, the key issues associated with the study will be categorized as beneficial or adverse. Secondly, potential impacts categorized as major, moderate, minor or negligible based on consideration of the following parameters:

- a) Duration of the potential impact;
- b) Spatial extent of the potential impact;
- c) Reversibility;
- d) Likelihood; and
- e) Legal standards and established professional criteria;

The magnitude of potential impacts of the proposed interventions under the project generally identified according to the categories outlined in **Table 3.6**.

Table 3.6: Parameters for Determining Magnitude

Parameter	Major	Moderate	Minor	Negligible
Duration of potential impact	Long term (More than 15 years)	Medium term lifespan of the project (5 to 15 years)	Less than project lifespan	Temporary with no detectable potential impact
Spatial extent of the potential impact	Widespread far beyond project boundaries	Beyond immediate project components, site boundaries or local area	Within project boundary	Specific location within project component or site boundaries with no detectable potential impact
Reversibility of potential impacts	Potential impact is effectively permanent, requiring considerable intervention to return to baseline	Baseline requires a year or so with some interventions to return to baseline	Baseline returns naturally or with limited intervention within a few months	Baseline remains constant
Legal standards and established professional criteria	Breaches national standards and or international guidelines/obligations	Complies with limits given in the national standards but breaches international lender guidelines in one or more parameters	Meets minimum national standard limits or international guidelines	Not applicable

Parameter	Major	Moderate	Minor	Negligible
Likelihood of potential impacts occurring	Occurs under typical operating or construction conditions (Certain)	Occurs under worst case (negative impact) or best case (positive impact) operating conditions (Likely)	Occurs under abnormal, exceptional or emergency conditions (occasional)	Unlikely to occur

Sensitivity

The sensitivity of a receptor is determined based on a review of the population (including proximity/numbers/vulnerability) and the presence of features at the proposed intervention site under the project or surrounding areas. The criteria for determining receptor sensitivity of the project's potential impacts are outlined in **Table 3.7**.

Table 3.7: Criteria for Determining Sensitivity

Sensitivity Determination	Definition
Very High	Vulnerable receptor with little or no capacity to absorb the proposed changes or minimal opportunities for mitigation.
High	Vulnerable receptor with little or no capacity to absorb the proposed changes or limited opportunities for mitigation.
Medium	Vulnerable receptor with some capacity to absorb the proposed changes or moderate opportunities for mitigation.
Low / Negligible	Vulnerable receptor with good capacity to absorb the proposed changes or/and good opportunities for mitigation.

Assigning Significance

Following the assessment of magnitude, the quality and sensitivity of the receiving environment or potential receptor were determined, and the significance of each potential impact was established using the potential impact significance matrix shown in **Table 3.8** below:

Table 3.8: Assessment of Potential Impact Significance

Magnitude of potential impact	Sensitivity of receptors			
	Very High	High	Medium	Low / Negligible
Major	Critical	Major	Moderate	Negligible
Moderate	Major	Major	Moderate	Negligible
Minor	Moderate	Moderate	Low	Negligible
Negligible	Negligible	Negligible	Negligible	Negligible

Mitigation Measures

Subsequent to the impact assessment discussed above, appropriate mitigation measures were proposed to avoid, mitigate/reduce, or compensate for the identified impacts. Generally, impacts having moderate to critical consequence significance, according to Table 3.8 require avoidance/appropriate mitigation or compensatory measures to reduce the significance. Impacts having low to negligible significance are left out as they are, requiring no mitigation measures.

Generally, preference is given to the avoidance of impact with the help of options available for the nature, siting, timing, method/procedure, or scale of any project activity. If avoidance is not possible, appropriate mitigation and control measures are proposed to reduce the consequence of the significance of the predicted impact. Finally, if reduction of impact is not possible, compensatory measures are proposed.

Assessment of Residual Impacts

The final step in the impact assessment process is to determine the significance of the residual impacts, which essentially are the impacts that might be experienced even after implementing the mitigation/compensatory measures. Ideally, all residual impacts are of negligible to low significance. For any residual impacts having moderate significance, a monitoring mechanism is necessary to ensure that their significance is not further increased. No residual impacts with major or critical significance are generally acceptable.

3.2.7 Environmental Management Plan (EMP)

The prepared Environmental Management Plan (**Figure 3.12**) recommends mitigation strategies to lessen the impact of the negative impacts, enhancement strategies to increase the benefit of the positive impacts, compensation strategies to make up for the unavoidable negative impacts, and an environmental monitoring strategy to keep an eye on changes occurring as the project is being implemented. Incorporation into the project cost estimate was also recommended by the EMP implementation cost estimate.

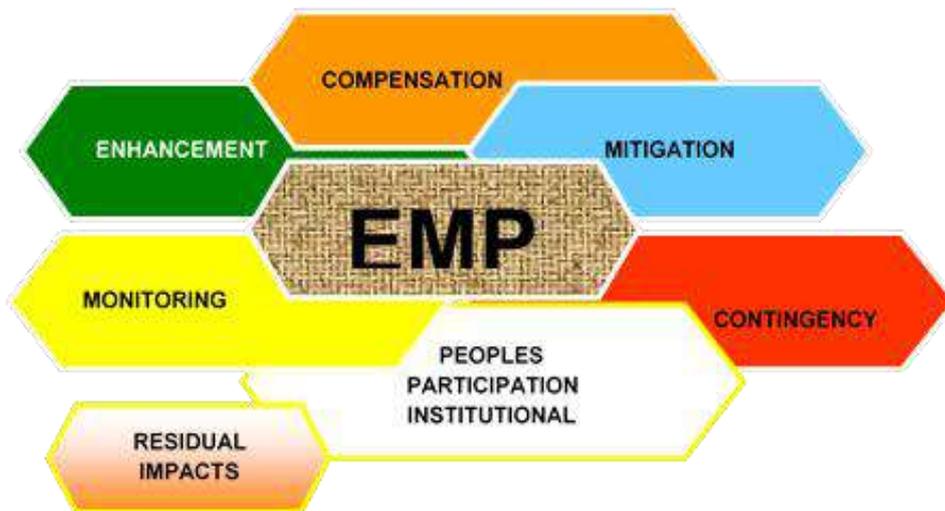


Figure 3.12: Environmental Management Plan (EMP) Preparation Framework

Pre-construction, construction, post-construction/operation, and maintenance phases were separated for each EMP component. The EMP's implementation entails the institutions' responsibilities to guarantee the effective use of all parties.

3.2.8 People's Participations

Public consultation is mandatory for an ESIA study of any development project. It is a part of the ESIA process aimed at involving the project stakeholders in the project development and implementation process. During the consultation process, information on the proposed interventions under the project was discussed, while the results of the impact assessment were shared during the disclosure sessions.

In the consultation process, the stakeholders involved worked with the study consultants in reforming/developing the activities under the interventions, considering the local needs and aspirations in line with the problems and solutions suggested by them. The proposed civil works under the interventions, findings of the environmental impact assessment, and the environmental management plan were shared with the stakeholders for obtaining their perceptions, views, and feedback on the probable changes likely to take place within the project influence area.

Participation is a key component of the study's overall process and will be integrated into each of the aforementioned processes. Participating in Public Consultation Meetings (PCM) at the village, upazila, district, and divisional levels are stakeholders from various sectors of the project influence area, and their input is taken into account while creating the study report. The overall planned project activities for the project area's improvement were discussed in the PCM, FGD, KII, and RRA. **Figure 3.13** provides a description and illustration of the public consultation procedure.

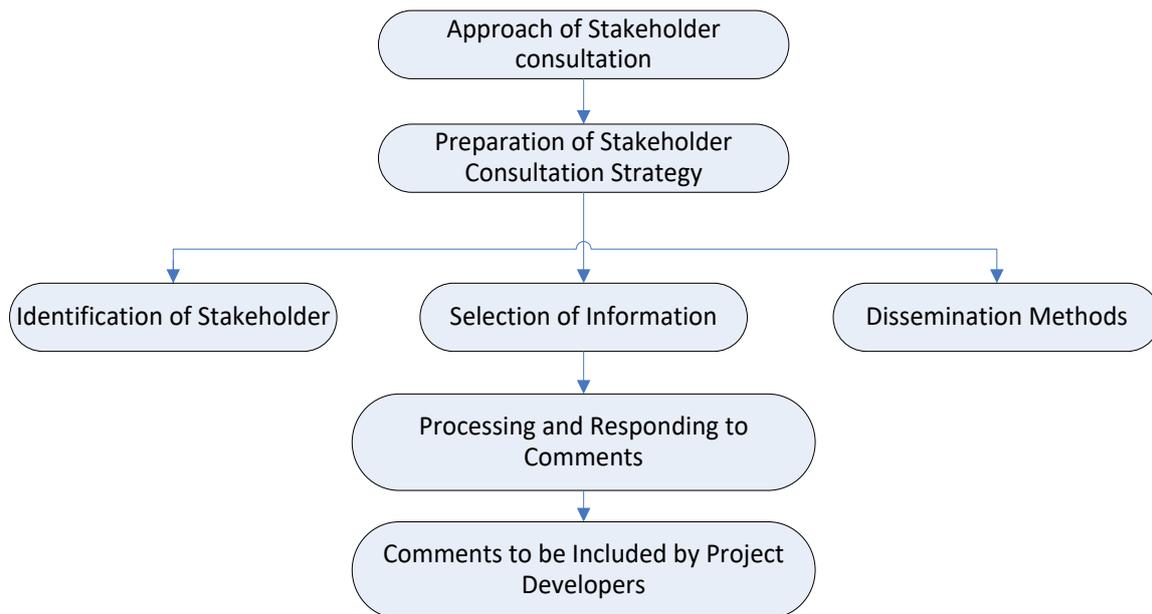


Figure 3.13: Approach of Consultation

3.2.9 ESIA Report

A thorough ESIA report with all required sections and components was prepared in accordance with SCHEDULE 11 and ECR 2023 regulations 15 and 16. Appendix A contains the DoE-approved ToC.

4. Project Description

4.1 Introduction

The Ashuganj-Palash Sabuj Project has been managed by the Bangladesh Agricultural Development Corporation (BADC) since 1992, utilizing water from the cooling systems of power plants. The water used for irrigation in the Ashuganj and Palash areas comes from the cooling systems of the Ashuganj and Ghorashal thermal power stations. The source of this water is the Meghna and Shitalakhya rivers. The project has been implemented in a series of phases from the 1st to the 5th and is recognized as a green project. The 1st phase was started in 1992 and completed in June 1995, while the 5th phase started in July 2015 and was completed in June 2020.

The existing Ashuganj sub-project is bounded by the Upper Meghna and Titas rivers and includes 21 Unions from 04 Upazilas (Brahmanbaria Sadar, Sarail, Ashuganj, and Nabinagar). The existing Palash sub-project spans 15 Unions across 03 Upazilas (Palash, Narsingdi Sadar, and Shibpur) and is bounded by the Shitalakhya and Haridoya rivers. The master plan for the Ashuganj-Palash Agro-Irrigation Project outlines the modernization, expansion, and sustainability of the existing Ashuganj and Palash sub-projects in phases. In the timeline of the Ashuganj-Palash Agro-Irrigation Project, the next phase is referred to as the Ashuganj-Palash Green Project, which will also include the existing command area along with the expanded region.

4.2 Project Objectives

The overall objective of the irrigation project is to increase the country's food production by using surface water of the Upper Meghna and the Shitalakhya in the form of condenser cooling water coming from the Ashuganj Power Station (APS) and the Ghorashal Power Station (GPS) respectively.

4.3 Existing Problems

4.3.1 Problems in Ashuganj Sub-project

The development work for the six-lane highway with a top width of 36.59 meters (120 feet) has already started. The water-cooling reservoir and the main irrigation canal (Borrow pit) for water supply in Sarail Upazila will be completely occupied due to the six-lane highway development work by Roads and Hoghway. The rice mills located beside the Ashuganj-Sarail main irrigation canal are being used as dumping sites for waste, particularly husk from the mills. The physical condition of several water control infrastructures is poor, necessitating immediate repair and rehabilitation to ensure the supply of proper irrigation water. Unplanned and insufficiently wide culvert construction over the main irrigation canal prevents adequate irrigation water supply to the Sarail area. There are some construction defects in the RCC canals of the Ashuganj irrigation project, which obstruct the flow of irrigation water, making it particularly difficult to supply water at the end of the canal. This results in wastage of water through holes made in the RCC walls by local water users, adversely affecting irrigation water supply to agricultural fields.

4.3.2 Problems in Palash Sub-Project

The Palash (Ghorashal) power plant lacks a reservoir for cooling water. Water is supplied to the irrigation canal directly from the outfall channel of the power plant's cooling system through water control infrastructures located within the power plant. The underground RCC pipeline constructed for irrigation in Gazaria Union at Palash site is completely damaged and unsuitable for rehabilitation. Waste is dumped into the irrigation canals in Palash, and even drains have been connected to these canals. Due to dumping waste into the irrigation canals, it is not possible to supply irrigation water

according to farmers' demands in the main canals, especially at the end of these canals where water supply is minimal, resulting in a shortage of irrigation water for farmers.

There are no organizations among the general farmers in the Palash project area, and they are not yet registered by the government. Beneficiary farmers report that they pay irrigation fees to field workers for their respective blocks.

4.4 Project Alternatives

4.4.1 Ashuganj

The Ashuganj irrigation system has been in operation since 1992. The gross area of the project is 28,869 ha and the net cultivated area (NCA) is 19,444 ha. The water from the power plant is diverted from the outfall canal to the power plant by a common water diversion structure to the water-cooling reservoir through a deep RCC line canal located within the power station compound. Water is diverted to the existing reservoir from the intake channel through two bridges constructed across the highway. The reservoir is located in the other side of the intake channel and is adjoining to the highway at Ashuganj. Water from the reservoir is conveyed by the borrow pit canal (main canal-1) of the RHD to irrigate the command area of Sarail Upazila mainly with small area under Ashuganj on both sides of the highway. The main canal-2 is an RCC lined canal which takes water also from the reservoir and deliver water to the command area of Ashuganj and Brahmanbaria Upazila using the drainage canal also. The existing drainage network is being used for dual purpose – irrigation during dry season and drainage during rainy season and post-monsoon period.

From field observation and discussion with different stakeholders including the farmers, it appears that the Ashuganj irrigation system has been performing below their potential. The Dhaka-Sylhet highway has been under development from 2-lane to 6-lane including 2-lane for Slow Moving Vehicle (SMV) road. As a result, the existing borrow pit canal will be affected by the development of 6-lane highway. This has necessitated new interventions to continue delivery of irrigation water to the command area and also for sustainability of the irrigation system. Multi-criteria analysis (MCA) is made because of their inherent ability to judge different alternative scenarios for selection of the best alternative for implementation.

Option Development

Various options have been developed based on the types of existing infrastructure for irrigation and the objectives of the sub-project. These are discussed in the follow sections:

Options for the main canal

The existing borrow pit-cum main canal which was used as the main canal-1, may not be available for delivery of irrigation water in future, if the elevated road is not implemented. Land for the borrow-pit may be required for the development of the existing 2-lane road into 6-lane road. Different alternatives of the borrow pit-cum-Main canal-1 have been identified through field visits and discussion with various stakeholders including BADC and RHD. These are described below:

Option 1

Retaining wall-cum RCC lined canal of about 5.20 m bed width and 11.60 km long in the northern edge of Right of Way (ROW) of Ashuganj-Sarail part of Dhaka-Sylhet highway;

Option 2

Alternative 1: Glass fiber reinforced plastic 4 buried pipelines of 2.20 m dia from the existing reservoir up to the turning point at Sarail having a length of about 11.60 km;

Alternative 2: Reinforced concrete (RCC) 5 buried pipeline of 2.20 m dia from the existing reservoir up to the turning point a Sarail having the same length as mentioned above;

Option 3

Rectangular RCC new canal of about 8.00 m bed width and about 9.0 km long in the proposed new alignment, starting from the existing railway water body as the proposed reservoir for cooling of water up to the Jafar khal at the west of Sarail to make a link with the canal network of Sarail area;

Options for reservoir

The existing reservoir is located adjoining to the highway in the south. Water is delivered to the reservoir from the power plant by an intake channel and ultimately through 2 bridges constructed across the highway. At present, the existing reservoir has been filled up with sand by the power plant authority, leaving some space of the reservoir along the highway. The power station is located in the Ashuganj town. The town has been growing rapidly. There is little scope to find suitable land for the reservoir for cooling purpose of water in the rapidly growing Ashuganj town.

However, there exists water bodies of railway department, adjacent to the existing reservoir. These water bodies of railway department, adjacent to the existing reservoir. These water bodies can be used as reservoir for cooling purpose of the discharged water of the power plant for use in irrigation through the irrigation canal network. It needs to be discussed with the railway department for the availability of these water bodies to use as a water cooling reservoir of the power plant, and dispose of water for irrigation.

The other possible option is to keep the existing reservoir for cooling of water by withdrawal of deposited sand and to deliver water to the proposed intervention to be used as the main supply canal for Ashuganj sub-project. This is due to the fact that the existing main two canals along with water intake regulators have been constructed close to the reservoir to take water directly from the reservoir. Non-availability of the existing reservoir will make the existing main canals, along with the canal network for irrigation, a difficult situation to supply water for irrigation.

Multi-Criteria Analysis and Finalization of Option

Multi-criteria Analysis (MCA) is a fundamental step in the rational decision-making process. The main purpose of MCA is to investigate several alternatives before selecting one option.

Option Selection Criteria

The options are the possible categories of interventions that may suit the existing physical condition and objectives of the system. The criteria used for the options are as follows:

- Physical condition of the area;
- Existing canal network;
- Sustainability of the project;
- Local demand for the project;
- Categories of interventions;
- Advantages and disadvantages of the option;
- Inspection, monitoring of O&M and their advantages and disadvantages of different options.

Identification of problems and repair work in different options

Analysis of option for finalization: Various options for the main canal system as well as the internal canal network have been identified for the continuous delivery of water for irrigation in the project command area. The identified options have been mainly on technical criteria. The analysis applied for identification of probable best option.

Various options for the main canal-1 and their multi-criteria analysis for identification of best option for implementation can be seen in the tables below:

Table 4.1: Options and Their Multi Criteria Analysis for the Main Canal-1

Option	Type of intervention	Advantages	Disadvantages	Remarks
Option-1				
Retaining wall-cum-RCC lined canal	Type-3: RCC retaining wall-cum RCC lined canal of about 5.2m bed width in the northern edge of Right of Way (ROW) of Ashuganj- Sarail part of Dhaka-Sylhet highway	<ul style="list-style-type: none"> • May be accommodated in the land proposed for acquisition by R&H Deptt. Further land acquisition may not be needed. • Percolation and seepage losses are minimum. • Minimum maintenance cost. • No erosion of canal and less siltation in canal bed. • Less expensive than pipeline. • Inspection, monitoring, identification of problems and repair works are relatively easy. 	<ul style="list-style-type: none"> • Need high retaining wall and cost will be more. • Further expansion of road may affect the canal. • The canal may intercept rice Mills. The issue can be resolved by discussion with rice mill owners. This part of the canal can be a conduit. 	
Option 2				
Alternative-1: GRP buried pipeline	Type-1: Buried 2.20 m dia glass fibre reinforced plastic (GRP) pipeline for delivery of water from the existing reservoir up to Sarail turning point (moor) under pressure flow.	<ul style="list-style-type: none"> • May be accommodated in the land for acquisition by RHD, further land acquisition may not be required, but compensation for crop loss may be required if crop exist during installation of pipe. • Water losses in seepage and evaporation is very low. • Maintenance cost is 	<ul style="list-style-type: none"> • The proposed pipeline may intercept rice mills. If so, the issue can be solved by discussion with owners of rice mills. • The number of pipeline may be a bit high as the water surface elevation at the reservoir is not high enough. • Inspection, monitoring, 	<ul style="list-style-type: none"> • If the existing reservoir is not available, then feeding the main canal/ pipeline will be too difficult.

Option	Type of intervention	Advantages	Disadvantages	Remarks
		less.	identification of problems and repair works are relatively difficult.	
Alternative-2: RCC buried pipeline	Type-2: Buried 2.20 m dia RCC [pipeline for delivery of water for irrigation from the existing reservoir up to Sarail turning point (moor) under pressure flow.	<ul style="list-style-type: none"> • May be accommodated in the land proposed for acquisition by RHD. Further land acquisition may not be required. But compensation for crop loss may be required if crop exist during installation of pipeline. • Water losses due to seepage and evaporation is very low. • Maintenance cost is less 	<ul style="list-style-type: none"> • The proposed pipeline may intercept rice mills. If so, the issue can be resolved by discussion with rice mill owners. • The number of pipelines may be a bit high as the water surface elevation at the reservoir is not high enough. • Inspection, monitoring, identification of problems and repair works are relatively difficult. 	
Option-3: RCC Rectangular canal at the edge of the slope of the highway from the existing reservoir	5 Rectangular type RCC lined canal of about 8.0 m width at the edge of the northern slope of the Ashuganj-Sarail part of the Dhaka-Sylhet highway for about 11.69 km.	<ul style="list-style-type: none"> • Percolation and seepage losses are minimum; • Maintenance cost is minimum; • Eliminated the effect of scouring the canal bed; • No erosion of canal; • Less expensive than pipeline; • Inspection, monitoring of O&M, identification of problems and repair works are relatively easy than pipeline. 	<ul style="list-style-type: none"> • May need land acquisition of about 11.50ha to convey large flow (about 8.0m width up to 11.50km length); • The canal may intercept many rice mills. The issue can be resolved by discussion with rice mill owners. A close conduit in such reaches may be considered. 	

Table 4.2: Options and Their Multi Criteria Analysis for Internal Canal Network

Option	Type of intervention	Advantages	Disadvantages	Remarks
Option-1	Using existing canal network including drainage canals for irrigation (drainage canals are used dual purpose-both irrigation and drainage).	<ul style="list-style-type: none"> Land acquisition is not needed; Relatively low cost; Farmers are familiar with the existing system; Using the existing facilities already created for irrigation. 	<ul style="list-style-type: none"> Existing canal networks are not designed for irrigation, not in line with irrigation water delivery; Some of the command area cannot be brought under irrigation through the 	This option cannot provide irrigation to the entire irrigable area.
Option-2: New irrigation network without the use of drainage canal for irrigation (Drainage canal to be used for drainage)	A completely new canal system for irrigation with required water control/ regulating structures.	<ul style="list-style-type: none"> A well-designed canal network with which it will be possible to irrigate the entire irrigable area. System will be modern and water delivery will be smooth; Water can be delivered as per demand. 	<ul style="list-style-type: none"> Need acquisition of considerable amount of land to accommodate the canals; It is expansive; Need much time for implementation; May affect supply of 	The option is good, but involve very high cost and time for implementation.
Option -3	A combination of new and existing canal network for both irrigation and drainage.	<ul style="list-style-type: none"> Less cost than completely new canal system for irrigation; Need minimum land acquisition to minimize the deficiency of the existing canal system; Will not affect the existing water delivery for irrigation; Using the existing facilities already created. 	<ul style="list-style-type: none"> Need land acquisition to make linkage with the existing canal system to deliver water for irrigation; Need more maintenance works of the existing infrastructure. 	This option appears to be reasonable.

Use of Ground water for Irrigation

The small pieces of land which have no link and are far away from the irrigation canal network may be difficult to bring under irrigation facility from project water. Similarly, the lands which are located in isolated pockets in the surroundings of settlements or other features is also difficult to provide

irrigation in these categories of lands from project water. In such cases, ground water may be used to irrigate these types of land as an alternative option for project water.

Description of the Selected Option

Option 1 is finalised after the Ministerial meeting, which was held on 17 June 2020 in the conference room of the Ministry of Agriculture.

4.4.2 Palash

The Palash sub-project has been in operation since 1992. Bangladesh Agricultural Development Corporation is responsible for its operation, maintenance and management. The project has been using water for the cooling system of the Ghorasal Power Plants (GPP) for irrigation diverting the water from the outfall channel of the power plants disposed water. There are seven (7) units for power generation in Ghorasal power station at present. Four (4) units out of seven have already been converted into re-cycling of used water for re-use in cooling system. In future the remaining power plants may be converted into close cycle water cooling system or there may be advanced type of cooling system available in future due to advancement of technology. As a result, water from the cooling system of the power plants may not be available for irrigation in long term perspective.

At present, there is no reservoir in Palash irrigation sub-project for cooling purpose of the discharge water of the cooling system of the Ghorasal power plants. The power station is located in the fast-growing Ghorasal municipality area. The main canal of the Palash Irrigation Sub-Project is an open canal. It passes through the municipality area. The garbage and the household's wastages have been dumping into the main canal by the dwellers living around the main canal route. The irrigation system consists of RCC lined canals and the existing drainage canals. Gravity irrigation is mainly within the Jinary union so long the water surface level in canals permits and the remaining area is being irrigated by LLPs. There are thirty-two (32) structures at present in Palash Sub-Project. Out of which 21 (twenty-one) need repair and upgrading.

Option Development

Various options are identified based on the categories of existing infrastructures for irrigation and the objectives of the sub-project. These are described in the relevant section below:

Option for the Main Canal: The main canal has been originated from the power station compound. Water is diverted from the outfall channel of the disposed water of the power plants by a water diversion structure into the main canal. The main canal is a rectangular type reinforced concrete (RCC) lined canal. The canal has been working well except the problem created in the water flow by the garbage and household wastage which are dumping by the dwellers living around the canal route within the municipality area. The probable options to resolve the issue are provided below:

Option-1

The main canal can be covered by RCC slab having sufficient hole to release heat from the water along with motivational activities to be undertaken by BADC and the representatives of the WMO of the farmers to the dwellers living around the canal to dispose the garbage and the household wastage to somewhere else in a safe place. The WMOs needs to be formed for the purpose of participatory water management and operation and maintenance (O&M) of the irrigation system.

Option-2

Existing situation (No slab on top of the main canal) with motivational activates mentioned below:

- To undertake motivational activities to dispose the garbage and household wastage somewhere else;
- To take help from the local administration to take necessary step to keep the canal free from garbage and household wastage;

Discussion with municipality authority to introduce some mechanism to collect and dispose in a safe place. In future the population will increase considerably and safe disposal of these huge garbage will be highly required to keep the living environment healthy. So, introducing a mechanism as early as possible for collection and disposing to a safe place will be a remarkable step for the municipality.

Option for the Reservoir

At present, there is no reservoir to use for cooling the disposed water of the cooling system of the Ghorasal power plants of Palash Irrigation Sub-Project. The power station is located in the fast-growing Ghorasal municipality area. It is difficult to find land in the municipality area for reservoir to use for cooling the water of the power plant.

However, as an option a plot of land about 0.75 ha around the cooperative mill has been identified. This land may be considered to use as a cooling reservoir. It needs to discuss with the owners of the land about the availability to use as a reservoir.

MCA Analysis and Finalization of Option

The multicriteria analysis is a tool to apply for a rational decision-making process. The main purpose to apply MCA in this study is to investigate a number of alternatives in the light of multicriteria. In this study we apply a methodology for determining priorities in planning and identification of appropriate and the best option using MCA analysis method.

Option Selection Criteria

The development of options for different interventions depends on the type of infrastructure under consideration. The options listed below have been identified by considering the existing situation, future possible scenarios that may likely to occur and the objective of the system. The criteria considered for the options are the followings:

- Physical condition of the area concerned;
- Objectives;
- Sustainability of the system/project;
- Local demand;
- National priority;
- Type of intervention;
- Advantage and disadvantages of the options;
- Inspection, monitoring, identification of problems and repair;
- Better performance of the project;

Analysis of Option for Finalization

Various options for the different types of interventions have been identified and analyzed mainly on technical criteria. The multicriteria (MCA) applied for analysis for the identification of best alternatives can be seen in **Table 4.3** below:

Table 4.3: Analysis of Options by MCA for Different Interventions

Option	Option-01	Option-02	Option-03
Component	Water Resources		
Proposed Intervention	Using water of the power plants.	Pumping water from Sitalakhya River.	Using groundwater by Shallow Tube-well.
Advantages	<ul style="list-style-type: none"> Using power plant disposed water without cost; Using the existing irrigation facilities created in the sub-project. 	The Sitalakhya river may be the main source for water in case of non-availability of water from power plants.	Only the isolated pocket can be irrigated by ground water through STW.
Disadvantages	In long term perspective water may not be available from the power plants and may need to explore some other source.	Involve cost for installation of pump station along with ancillary structure.	<ul style="list-style-type: none"> Ground water is less priority than surface water; Possibility for over extraction and declining groundwater table, if too many STWs are used for pumping ground water; Risk for drinking water as the ground water level may fall beyond suction limit of hand tube well.
Remarks	-	Cultivable area is declining noticeably due to urbanization.	-
Component	Water Cooling Reservoir		
Proposed Intervention	Existing situation (No cooling reservoir)	Cooling reservoir at the identified land of the mill.	-
Advantages	Land acquisition will not require	<ul style="list-style-type: none"> Demand for cooling water can be fulfilled; Water temperature will remain suitable for crop in hot period of growing season. 	-
Disadvantages	<ul style="list-style-type: none"> Acquisition of land for cooling reservoir will be required; Water temperature is slightly above the ambient temperature, may affect crop in hot period, especially from 	<ul style="list-style-type: none"> Need land acquisition; Involve cost. 	-

Option	Option-01	Option-02	Option-03
	middle of March to onward.		
Remarks	-	-	-
Component	Main canal and management of dumping garbage		
Proposed Intervention	Covering the canal by Slab (RCC) having sufficient holes to release heat from water.	Action to be taken by BADC and the WMO of the farmers (No slab over canal).	-
Advantages	<ul style="list-style-type: none"> • Dumping of garbage and household wastages can be avoided; • No obstacle for water flow; • Will be environmentally healthy; • Smooth delivery of water. • No money will be required for cleaning the wastages from canal bed; • Pollution of water can be avoided; • Falling of sewerage water into the canal can be avoided. 	Construction cost for slab will not require.	-
Disadvantages	<ul style="list-style-type: none"> • Incur considerable cost; • Dumping may continue over the slab. 	<ul style="list-style-type: none"> • May take time to form WMOs; • May arise conflict when the representatives of the WMO start working on the issue. 	-
Remarks	-	The water users/farmers to be organized for water management, can also take the responsibility to solve the issue of dumping garbage in the canal.	-
Component	Internal Canal network		
Proposed Intervention	A completely new canal network for irrigation only, no use of any drainage canal for irrigation.	Upgrading the existing irrigation infrastructure with some interventions.	-
Advantages	<ul style="list-style-type: none"> • Can be effective for water delivery; • Project performance is expected to increase; 	<ul style="list-style-type: none"> • Relatively Low cost; • Using the existing facilities created already for the project. 	-

Option	Option-01	Option-02	Option-03
	<ul style="list-style-type: none"> Smooth and reliable irrigation water supply possible. Irrigation and drainage canals separated completely for better performance. 		
Disadvantages	<ul style="list-style-type: none"> Will be very costly; Need acquisition of enough land for the canal network; Water delivery may affect during construction period. 	<ul style="list-style-type: none"> Need sufficient time for construction; May affect to some extent in water delivery during construction. 	-
Remarks	-	-	-
Component	To irrigate Shibpur Area		
Proposed Intervention	To supply project water to irrigate Shibpur area.	Installation of an LLP station at Dewankhali Khal to irrigate command area of Shibpur Upazila.	-
Advantages	<ul style="list-style-type: none"> Installation of pump not required; Area can be expanded by project water; Project performance will be increased. 	<ul style="list-style-type: none"> Source of water is close to the area and smooth delivery possible; Not dependent of power plant water, uncertainty is less. 	-
Disadvantages	<ul style="list-style-type: none"> Need inverted syphon across the Haridoya river to deliver water to Shibpur; Every possibility for siltation as the water head is too low for flushing of silt. Bed level of the Haridoya river is very deep, construction of an inverted syphon is technically less feasible. May have uncertainty to deliver water without interruption. 	<ul style="list-style-type: none"> Involve cost; Dependent on availability of electricity; Need operation and maintenance cost. 	-
Remarks	-	-	-
Component	Improvement of water management at farm level		
Proposed Intervention	Present practice	Buried pipeline for LLPs and introduction of Alternate Wetting and Drying (AWD) method of irrigation and prepaid smart card system.	-

Option	Option-01	Option-02	Option-03
Advantages	<ul style="list-style-type: none"> Familiar by the farmers in the existing practices; Farmers can make farm water course with ancillary farm structure to irrigate each plot of land. 	<ul style="list-style-type: none"> Saving of water and efficient irrigation possible. Production cost can be minimized by use of less water; Saving of water by AWD and more area can be irrigated; About 100% irrigation service charge can be realized by introducing prepaid smart card system; BADC have some experience in prepaid smart card system. 	-
Disadvantages	<ul style="list-style-type: none"> Project performance is relatively low; Use more water than required by crop; Loss - of water is relatively high. Realization of service charge is very low. 	<ul style="list-style-type: none"> Need electric connection to operate the LLPs; Depend on continuous power supply; Need acceptance of the farmers. 	-
Remarks	-	-	-

In principle, irrigation canals and drainage canals must be separated from each other. In Palash irrigation system the existing canal network including the drainage canals are being used for dual purpose- irrigation and drainage.

4.4.3 Ashuganj Ago Irrigation Project

Alternative Options for Water Resources

Ashuganj sub-project has been using disposed water of the Ashuganj power plants for irrigation diverting the water from the outfall channel of disposed water of the power plants. In future the power plants may go for close cycle water cooling system, by re-using the water already used for cooling or there may be different type of cooling system due to advancement of cooling technology. As a result, water from the cooling system of the power plants may not be available for irrigation in long term perspective. In this case the Meghna river water with pumping station in suitable location may be an alternative source for irrigation water for Ashuganj sub-project in future. The Meghna river has large volume of discharge even in winter compared to the water demand for irrigation for Ashuganj sub-project.

Alternative Options for Main Canal-cum-Borrow Pit

The borrow pit of the Ashuganj-Sylhet Highway is being used as the main canal-1 of the Ashuganj sub-project. The Dhaka-Sylhet Highway has been developing into 6-lane road from 2-lane. It was planned to implement canal-1 (Option-1) with estimated cost of BDT 12,510 lac in the slope of the new road at

the end of slope of SMV, constructing GRP and RCC buried pipe (2.2m diameter each) at the same place (option-2 and 3 with implementation BDT 35,600 lac and 44,250 lac respectively) and open channel (Option-4) without interfering cost accepted by the Ministerial Meeting which was held on 17 June 2020. Another option, implementation of elevated highway was also discussed with the officials of BADC but because of high cost it was not accepted.

A team visited the project area and found that a new canal can be developed using the borrow pit of the railway at the far end. The reservoir is also filled up by the PDB. As a result, it needs to find alternative options for water cooling reservoir. The area is located within the Ashuganj town and there is little scope to find alternate options as the town is rapidly developing. However, adjacent to the existing reservoir, there is a water body of railway department which can be used as reservoir for cooling of discharged water of the power plants before delivering into the canal network for irrigation. From the proposed reservoir, a new main canal (4th options) has been proposed as an option for the borrow pit. Implementation cost is the lowest (BDT 9560 lac) only) but because of land acquisition of 10 ha it was not considered. The proposed new canal will originate from the reservoir and will join with the existing RCC second main canal (main canal-2) and then will follow a natural drainage canal and agricultural land and finally will join with the Jafor Khal at the western side of the Sarail Upazila headquarter for distribution of irrigation water in the canal network of the Sarail Upazila.

Different Options for Secondary and Other Canals

The existing RCC secondary canals along with earthen secondary and tertiary canals are being used to deliver irrigation water to the farm land. The agricultural lands are scattered mostly surrounded by the settlements. There is no scope to have options for the secondary and the tertiary canals without land acquisition. However, in exceptional cases where there is no drainage canal or link canal within the existing natural canal network to deliver irrigation water, new canal has been proposed for excavation through agricultural land with minimum land requirement.

For the farm water courses, the best option is the buried pipeline with prepaid smart card system can be considered instead of open canal. The land used for buried pipeline can be cultivated. This will help not only for efficient water use but also have great positive influence in collection of irrigation service charge. It needs only to provide better services in water delivery as per demand. For demonstration purpose, it is proposed to install six (6) buried pipeline irrigation system with pre-paid smart card system @ of two (2) in each of the three Upazila. The location of the schemes is to be decided by BADC officials. It is also recommended to convert the existing buried pipeline irrigation schemes into prepaid smart card system.

Different Options for Command Area Development (CAD)

The Command Area Development is an integrated area development towards the command areas of irrigation projects. The main objectives of CAD in Ashuganj irrigation sub-project are:

- Bridge the gap between the potential created and their utilization and efficient farm water management practices;
- To ensure sufficient, timely and equitable distribution of irrigation water in the command;
- Optimum agricultural production;
- Improvement in socio-economic conditions of farmers;

In principles, irrigation canals and the drainage canals must be separated from each other. The different options for command area development for Ashuganj sub-project are as follows:

Option – A:

- Using the existing natural canal networks as much as possible with the new main canal -1 to replace the borrow pit canal of roads and highway department;
- By improving and upgrading the existing physical structures and facilities required for the system including canal network and construction of new structures where required;
- Minimum number of new structures to minimize the costs and land requirement;
- Correction of system deficiencies of the existing system;
- Modernization of the lifting device of the existing system;

Options – B:

- A completely new canal network and new water regulating structures for the entire area with probable land acquisition. The advantages of the new system is the well planned and well-designed layout plan for efficient water distribution system. The drainage canal will be used only for drainage purpose during irrigation season as well as rainy season. The major disadvantage is that it needs acquisition of considerable agricultural land. In Ashuganj, such option is not recommended due to the large requirement of agricultural land and high costs for the interventions.

The other aspects related with the options for command area development are:

- Making block system on hydrological unit for better operation and water distribution, maintenance and management related activities;
- Improvement of drainage system by proper assessment of the capacity of the natural drainage canals and re-designing where necessary;
- Beneficiary mobilization for strong water management organization with effective training program. The tasks of these organization are to resolve problems at farm level, better collection of irrigation fees and resolution of conflicts arising from inefficient water distribution among the users. These organizations can be expected to serve as a driving force for irrigation water management and agricultural development for raising higher level of production and income;
- Involvement of the local government institutions, especially the union Parishad;
- Use of ground water resource where surface water cannot be supplied due to isolated pocket or far away from the supply system;
- To supply sufficient water to the system to cover the target area;
- On-farm development works with ancillary structures (discharge box for LLP at installation site, division box for farm water course) and uPVC buried pipeline for irrigation water distribution with pre-paid smart card system;
- Introduction of rotational supply of water to ensure equitable and assured distribution to individual farm holdings for higher level of efficiency;

Pumping Station

Option for Shapla Beel: As per original plan, irrigation water of the Ashuhanj sub-project has to be delivered to the Shapla Beel by crossing the Titas river through a syphon. The net agricultural area of the Shapla beel is about 23 ha and the extended area is about 1,130 ha. To deliver water to Shapla Beel through a syphon across the Tias river is not technically feasible. The bed of the syphon will be silted up as there will be insufficient water head to create sufficient velocity in the syphon for flushing the silt out of the syphon. As such installation of a pumping station on other side of the Titas river is recommended to irrigate the Shapla Beel area.

Option for Pakshimul: Command area of Pakshimul is located at the north-west part of the project and is far away from the irrigation canal network having no link canal to deliver irrigation water there. One option to bring the area under irrigation is the excavation of a new canal with acquisition of agricultural land. The other option is to install a pump station at the outfall of a natural drainage canal at Ajabpur. The second option seems more feasible to bring the land under irrigation in Pakshimul and north part of Chunta union. Hence, it is recommended for installation of a pump station to irrigate approximately 1000 ha of agricultural land.

Alternative Options for Cooling Water Reservoir

The existing reservoir is located adjoining to the highway and is in the south side of the power station. The power station is located in the Ashuganj town. The town has been growing rapidly. There is not enough scope to find suitable land for the reservoir. However, there exists water bodies of railway department, adjacent to the existing reservoir. These water bodies can be used as reservoir for cooling purpose of the discharge water of the power plants for use in irrigation though the irrigation canal network. It needs to be discussed with railway department to make the water bodies availability for cooling the power plant disposed water to use for irrigation.

4.4.4 Palash Agro Irrigation Project

Alternative Options for Water Resources

Palash sub-project has been using disposed water of the Ghorasal power plants for irrigation, diverting the water from the outfall channel of the power plants disposed water. Four units have already been converted into re-cycling of used water for re-use in cooling system. In future the remaining power plants may be converted into close cycle water cooling system or there may be advanced type of cooling system due to advancement of technology. As a result, water from the cooling system of the power plants may not be available for irrigation in long term perspective. In this case the Sitalakhya river water with pumping station in suitable location may be an alternative source for irrigation water for Palash sub-project in future.

Alternative Options for Main Canal

The main canal of the Palash irrigation sub-project is an open canal. It passes through the municipality area. The garbage and the household's wastages are being dumped into the main canal by the dwellers living around the main canal route. The main canal has been working well except the problem created in the water flow by the garbage dumping by the dwellers. In this situation, the main canal can be covered by RCC slab with sufficient holes to protect from dumping of garbage and dwelling wastages. The alternative option can be a closed conduit. However, as the closed conduit will be costly, it is not recommended. Rather the canal can be covered with slab to protect from dumping of garbage with awareness raising among the population around the main canal.

Different Options for Secondary and Other Canals

In Palash irrigation sub-project, the existing RCC secondary and tertiary canals as well as the natural drainage canals are being used as secondary and tertiary canal to deliver irrigation water to the command area of the sub-project. The agricultural lands are scattered and mostly surrounded by the settlements. The project area is urbanizing rapidly and the command area is also reducing at the same rate. It requires costly agricultural lands to have options for the secondary and the tertiary canals and is not considered. However, for the farm water courses the best option is the buried pipeline with prepaid smart card system. This will help not only for efficient water use but also will help in collection of irrigation service charge from water users.

Different Options for Command Area Development (CAD)

The Command Area Development (CAD) is an integrated area development towards the command area of irrigation projects. The main objectives of CAD in Palash irrigation sub-project are to: i) bridge the gap between the potential created and their utilization and efficient farm water management practices, ii) ensure sufficient, timely and equitable distribution of irrigation water in the command area, iii) optimize agricultural production, iv) involve the beneficiary farmers at all levels for management of water resources through participatory irrigation management (PIM), and v) improve the socio-economic conditions of farmers.

In principle, irrigation canals and the drainage canals are normally separated from each other. The activities under the different options for command area development for Palash sub-project are as follows:

Option – A:

- Using the existing natural canal networks as much as possible with the new minimum structures to minimize the costs of land acquisition;
- By improving and upgrading the existing physical structures and facilities required for the system including canal network and construction of new structures where required;
- Correction of system deficiencies of the existing system, modernization of the lifting device of the existing system;
- Introduction of rotational supply of water to ensure equitable and assured distribution to individual farm holdings;
- Involvement of the local government institutions, especially the union Parishads;
- Beneficiary mobilization for strong water management organization with effective training program. The tasks of these organization are to resolve problems at farm level, better collection of irrigation fees and resolution of conflicts arising from inefficient water distribution among the users. These organizations can be expected to serve as a driving force for irrigation water management and agricultural development for raising higher level of production and income;
- Improvement of drainage system by proper assessment of the capacity of the natural drainage canals and re-designing where necessary;
- Using ground water resource where surface water can not be supplied due to isolated pocket or far away from the supply system;
- To supply sufficient water to the system to cover the target area;
- Making block system on hydrological unit for better Operation and water distribution, maintenance management related activities;
- On-farm development works with ancillary structures (discharge box for LLP installation site, division box for farm water course) and uPVC buried pipeline for irrigation water distribution with pre-paid smart card system;

Options – B:

- The option-B can be a completely new canal networks with new water regulating structures to command the entire area with required land acquisition. The advantages of the new system are the well planned and well-designed layout plan for efficient water distribution system. The major disadvantage in option-B is that it needs acquisition of considerable agricultural land. The command area of Palash sub-project mainly lies within pockets of the settlements and is likely to be reducing rapidly by the urbanization in near future. In this option, the drainage canals will be used only for drainage purpose during irrigation season as well as rainy season. Irrigation water

will not be delivered through the natural drainage canal which is being done at present. Due to large requirement of agricultural land and high cost of new interventions, Option-B is not recommended.

Option for Shibpur

As per original plan, irrigation water of the Palash sub-project has to be delivered to Shibpur by crossing the Haridoya river through a syphon to be constructed. To deliver water to Shibpur through a syphon across the Haridoya river is not technically feasible. The bed of the syphon will be silted up, as there will be insufficient water head to create sufficient velocity in the syphon for flushing the silt out of the syphon. As such, it is recommended to install a pumping station at the outfall of the Dewankhali Khal to pump water from the Sitalakhya river to irrigate Shibpur, rather than construction of a new syphon across the Haridoya river to convey water to Shibpur.

Suitable Site Selection Options for Cooling Water Reservoir

At present, there is no reservoir in Palash irrigation sub-project for cooling purpose of the discharged water of the cooling system of the Ghorasal power plants. The power station is located in the fast-growing Ghorasal municipality area. It is difficult to find suitable land for reservoir to use for cooling the water of the power plant. However, a plot about 0.75 ha around the cooperative mill has been identified to use as a reservoir. It may be mentioned that in future the urban area will be increased as at present there is no reservoir for cooling, it can be omitted for future as in future flows take more time for cooling. It needs to discussion with the owners of the land to know about the availability of the land by acquisition.

4.5 Proposed Interventions

The following interventions have been proposed considering the best possible combination of interventions by the feasibility study through mentioning of two sub-projects. The location of the interventions illustrated in the following map.

Ashuganj Sub-Project

1. Construction of 5.2 m wide, 2.80 m height and 8.183 km long paved (RCC) irrigation canal (main RCC canal-1) from Ashuganj to Sarail junction, at the end of the Right of Way (ROW) of the Ashuganj-Sarail section of the Dhaka-Sylhet highway. (*The discharge of the canal is 13.60 m³/sec. Paved walls on both sides of the paved canal will act as soil retaining walls*).
2. Construction of a siphon consisting of 2.25 m wide, 2.00 m height and 70 m long with a flow rate of 13.60 m³/sec.
3. Construction of a 15 m long silt trap basin at the mouth of the siphon for silt free water flow into the siphon barrel.
4. Construction of double barrel box type closed conduit (2.25 m wide and 2.80 m height) about 3,500 m long in rice mill area to protect the RCC main canal from dumping garbage.
5. Installation of protection system (GI pipe guardrail and warning sign board) on both sides of open main irrigation canal (16 km) in Ashuganj.
6. 2,500 cubic meters of earthwork to stabilize the bank of the reservoir canal.
7. Construction of 500 m RCC canal (4.00 m wide and 1.80 m high) in initial phase of Sarail-Terokhda canal located at east of Sarail Municipality.

8. Electrification and modernization (operating gate through electric motor) of 02 regulators at water diversion site located in the premises of Ashuganj power plant.
9. Reconstruction of 02 regulators of two main irrigation canals (04-vent regulator of at main RCC Canal- and a 02-vent regulator at Main RCC canal- 1-2).
10. Installation of two (02) water gauges to monitor water level 1 and 2 in water bodies and main canal.
11. Construction of a 04-vent regulator over Sarail-Galania Canal located at Sarail.
12. Construction of a 04-vent regulator over Sarail Terkanda canal located at Sarail.
13. Re-construction of a 04-vent Syedtula regulator.
14. Construction of a 03-vent regulator at the offtake of the Terkanda-Budda canal.
15. Construction of a 03-vent regulator at the offtake of the canal on the north side from Terakanda.
16. Construction of a 03-vent regulator over the Naizur Canal.
17. Re-construction of a 03-vent Bug Mara regulator.
18. Re-construction of a 03-vent Prithai regulator.
19. Construction of a 03-vent water retention structure over Budda canal.
20. Construction of a 04-vent water retention structure over Sonaram Pur (S Seven) Canal.
21. Construction of 12 aqueducts over Main RCC Canal-1 along highway bridges.
22. Re-construction of new 01 aqueducts in Talshahr due to damaged existing aqueduct.
23. Repair of weir (23 m long) at Paneshwar.
24. Upgrading of existing 21 regulators with replacement of damaged gates.
25. Extension of 55 m pipe culvert to supply irrigation water at Kamaura in southern side of the highway.
26. Excavation of 35.33 km of earthen channels in 13 canals for Sarail Upazila to provide irrigation water efficiently.
27. Excavation of 15.59 km earthen channel in 14 canals for Ashuganj and Brahmanbaria Sadar Upazila.
28. Dismantling of damaged, broken and useless 16 regulators.
29. Construction of trash racks at offtake of 04 existing siphons (03 at Talshahar and 01 near railway line) to protect floating waste.
30. Re-excavation of Chunta Canal with 1.5 km length and 1.5 m wide (slope 1.5 and depth 1 m)
31. Re-excavation of intake channel for pumping water for irrigation purposes. (3.00 m wide and 1.00 m depth and about 50 m long (225 cubic meters)).
32. Construction of infrastructure to connect proposed Main RCC Canal-1 with existing branch canals (02 RCC and 03 earthen).
33. Construction of 23.00 km RCC secondary and tertiary canals to ensure uninterrupted water flow.
34. Extension of 6,000 m (400m each) Buried Pipe Line in 15 schemes of existing 01 cusec LLP schemes in 4th & 5th Phase.
35. Extension of 57,600 meters (each 1200 meters) Buried Pipe Line in 48 schemes of 01 cusec LLP for new proposed project.
36. Extension of 18,800 meters (400 meters each) Buried Pipe Line in 47 schemes of existing 02-cusec LLP schemes in 4th and 5th stage.

37. Construction of 10,000 meters (each 1200 meters) Buried Pipe Line in 60 schemes of New Proposed Project 02-cusec LLP schemes.
38. Construction of 33 mediums and 18 small scale hydraulic structures (footbridges, culverts, cattle crossings, water passes etc.) for smooth movement of farmers, agricultural products and public over existing canals/channels.

Palash Sub-Project

01. Construction of slabs over three (3.00) kilometers (municipality area) (covering the main canal through slabs with holes to release heat from warm water).
02. Extension of 1,600m (400m each) Buried Pipe Line in 04 Schemes of existing 01-cusec LLP schemes in 4th & 5th Phase.
03. Construction of 13,200 meters (each 1200 meters) of Buried Pipe Line in 11 schemes of 01 cusec LLP schemes for the new proposed project.
04. Extension of 4,400 m (400 m each) Buried Pipe Line in 11 schemes of existing 2-cusec LLP schemes in 4th and 5th phase.
05. Construction of 34,500 meters (1200 meters each) Buried Pipe Line in 23 schemes of existing 02-cusec LLP schemes for the new proposed project.
06. Construction of 44 mediums and 28 minor hydraulic structures (footbridges, culverts, cattle crossing, water passes etc.) for smooth movement of farmers, agricultural products and public over existing canals/channels.
07. Re-excavation of canals.
 - Re-excavation of approximately 5.00 km canal at Balagram near Khilpara.
 - Re-excavation of 200 m intake channel of Balagram Canal for pumping water for irrigation purpose.
 - Development of canal by re-excavating about 6.50 km at Shibpur.
 - Re-excavation of 400 meters' intake channel of Dewankhali Canal for pumping water for irrigation purposes.
08. Construction of 13.00 km RCC secondary and tertiary canals in order to maintain the usual water flow.
09. Construction of trash rack in front of siphon to prevent floating waste from entering the siphon barrel.

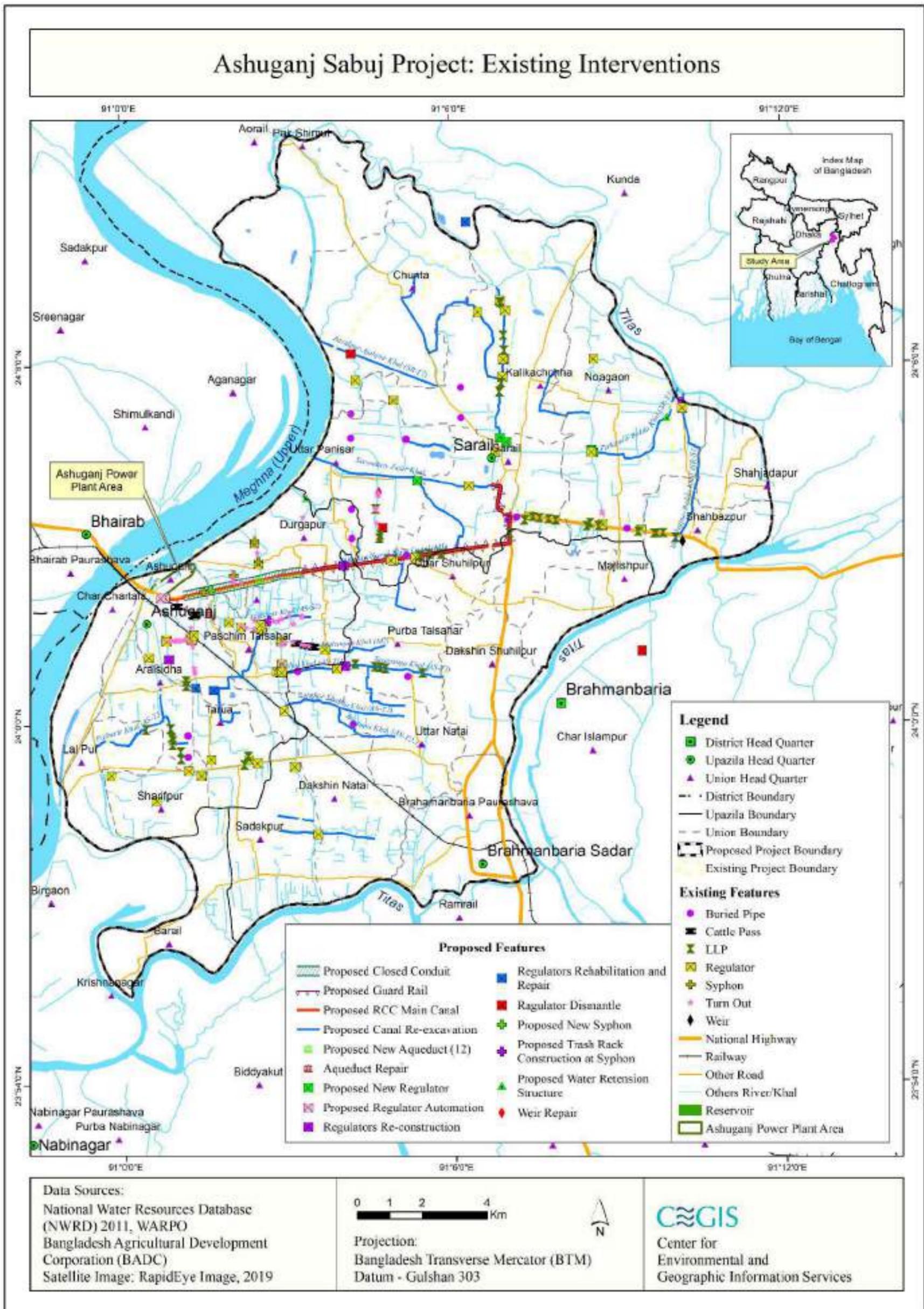


Figure 4.1: Location of the Proposed Project Interventions for Ashuganj Sub-Project

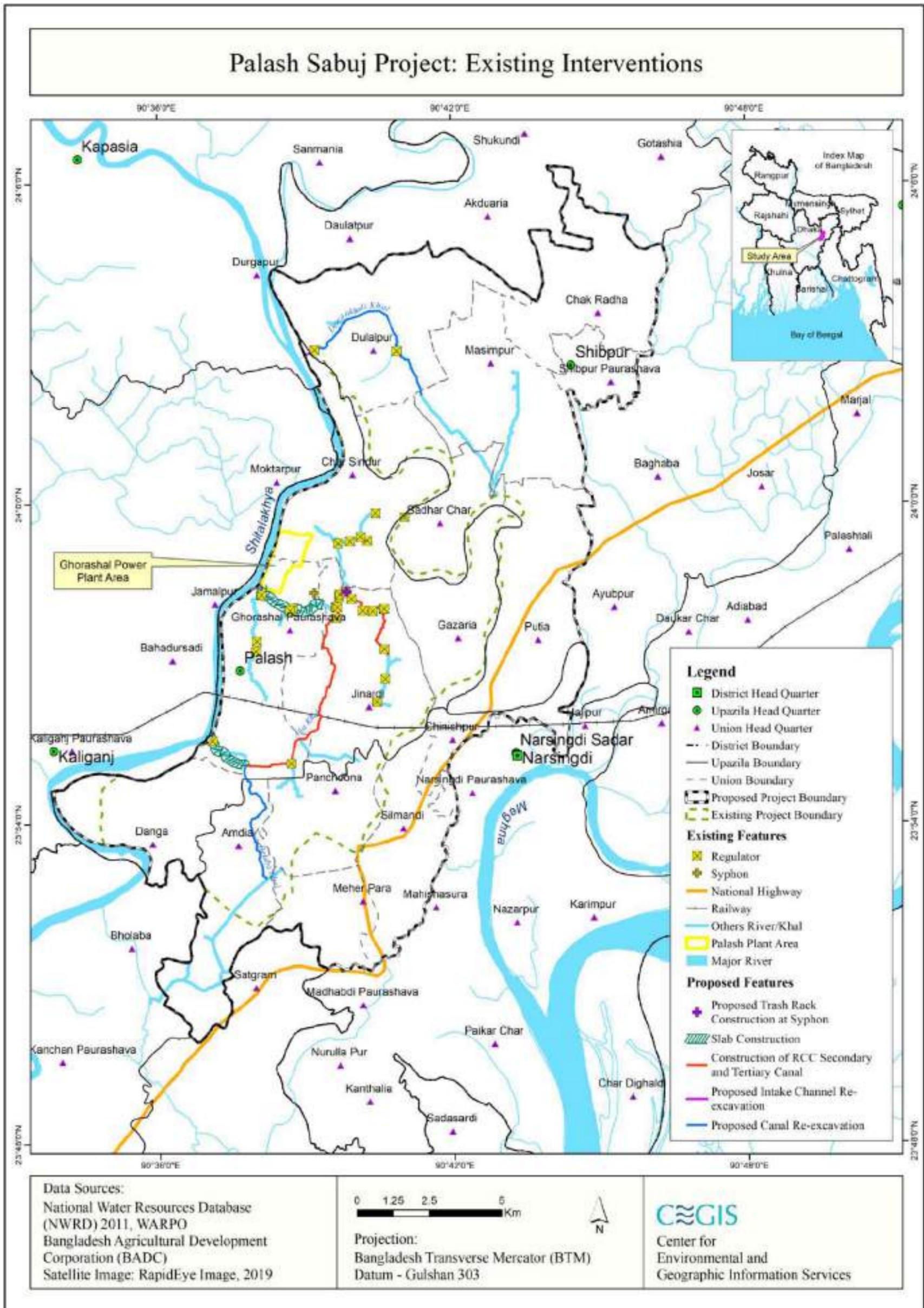


Figure 4.2: Location of the Proposed Project Interventions for Palash Sub-Project

4.6 Expected Benefits

- The irrigation system will be functional throughout the year, especially during the Boro season.
- Surface water availability in the project area will be substantially increased.
- Surface water irrigation costs will be lessened compared to groundwater irrigation.
- Land/soil fertility will be increased by silt being carried with river water for irrigation, consequently, the crop production will also be increased.
- Groundwater abstraction will be less resulting in significant recharge of groundwater in the project area.
- The ecosystem and biodiversity of the area will be enriched and the ambient environment of the project area will also become cooler.
- Overall, the socio-economic condition of the area will be improved significantly.

4.7 Project Activities

A number of activities would be carried out during the pre-construction, construction, and post-construction phases, which include both field and official works. Lists of activities to be performed during these phases are presented in the following:

Ashuganj Sub-Project

Pre-construction Phase	Construction Phase	Post Construction Phase
<ul style="list-style-type: none"> ➤ Geotechnical investigation for the design of different hydraulic structures and regulators. ➤ Construction of site office, labor shed with toilet, installation of batching plant and fabrication yard. ➤ Demarcation of hydraulic structures site; main, secondary and tertiary irrigation canals, buried pipeline alignments. ➤ Clearing of vegetation and debris within the demarcated alignment. ➤ Transportation of construction equipment and materials. ➤ Identification of the earthen materials disposal places. ➤ Display of billboard. 	<ul style="list-style-type: none"> ➤ Construction of paved/RCC irrigation canal. ➤ Construction of siphon and medium & small-scale hydraulic structures. ➤ Construction of silt trap basin, double barrel box type closed conduit and trash rack. ➤ Installation of protection system (GI pipe guardrail) on both sides of open main irrigation canal. ➤ Earthwork for stabilizing the bank of the reservoir canal. ➤ Construction/re-construction of regulators and water retention structures. ➤ Construction of aqueducts. ➤ Repair/upgrading of weir and existing regulators. ➤ Dismantling of damaged, broken and useless regulators. ➤ Excavation/re-excavation of earthen channels, canals and intake channels. ➤ Construction/extension of buried pipe line. ➤ Excavated/re-excavated earth material management. 	<ul style="list-style-type: none"> ➤ Maintenance of irrigation canals, earthen channels and intake channels. ➤ Operation and Maintenance (O&M) of regulator, siphon, aqueduct, water retention structure, silt trap basin, double barrel box type closed conduit, trash rack and medium & small-scale hydraulic structures.

Palash Sub-Project

Pre-construction Phase	Construction Phase	Post Construction Phase
<ul style="list-style-type: none"> ➤ Geotechnical investigation for the design of different hydraulic structures and regulators. ➤ Construction of site office, labor shed with toilet, installation of batching plant and fabrication yard. ➤ Demarcation of hydraulic structures site; secondary and tertiary irrigation canals, buried pipeline alignments. ➤ Clearing of vegetation and debris within the demarcated alignment. ➤ Transportation of construction equipment and materials. ➤ Identification of the earthen materials disposal places. ➤ Display of billboard. 	<ul style="list-style-type: none"> ➤ Construction of RCC secondary and tertiary canals. ➤ Re-excavation of canals/intake channels. ➤ Construction of slabs over canal. ➤ Construction hydraulic structures. ➤ Construction of trash rack. ➤ Construction/extension of buried pipe line. ➤ Re-excavated earth material management. 	<ul style="list-style-type: none"> ➤ Maintenance of secondary & tertiary canals and canals/intake channels. ➤ Operation and Maintenance (O&M) of hydraulic structures, slabs, trash rack.

5. Environmental and Social Baseline

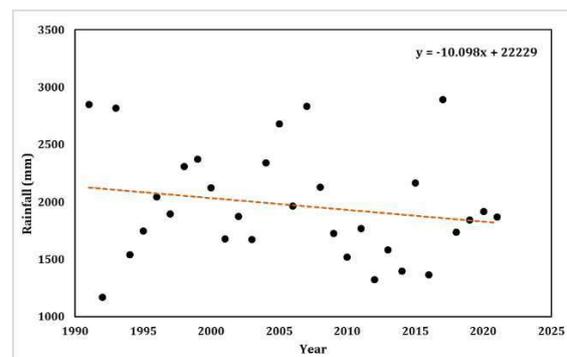
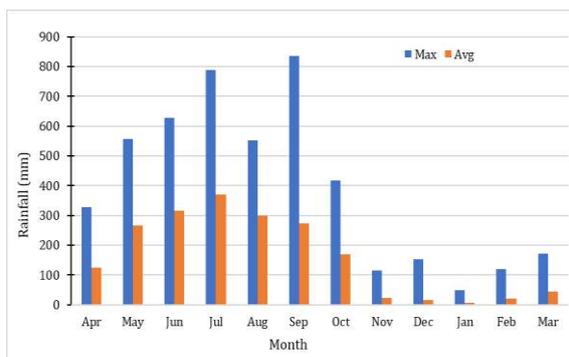
5.1 Physical Environment

5.1.1 Meteorology

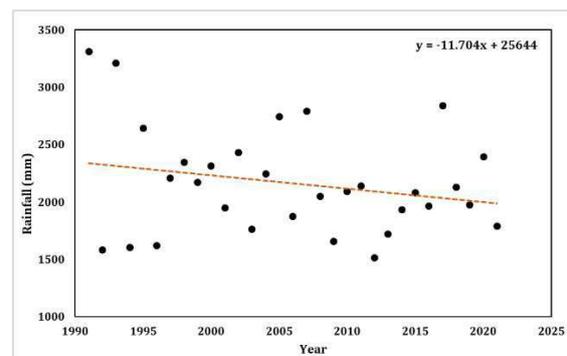
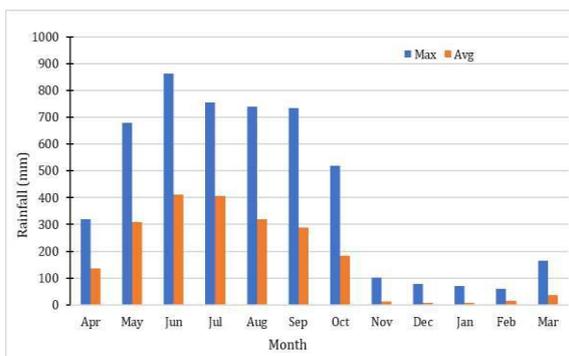
Meteorological data of the study area has been collected from the nearby stations of BMD. Historical records of meteorological parameters i.e., Rainfall, temperature, relative humidity, sunshine hour, evaporation, wind speed etc. has been collected from the respective agencies. Based on the data, trend of recent climate has been analyzed for understanding the pattern of climate in the study area.

Rainfall

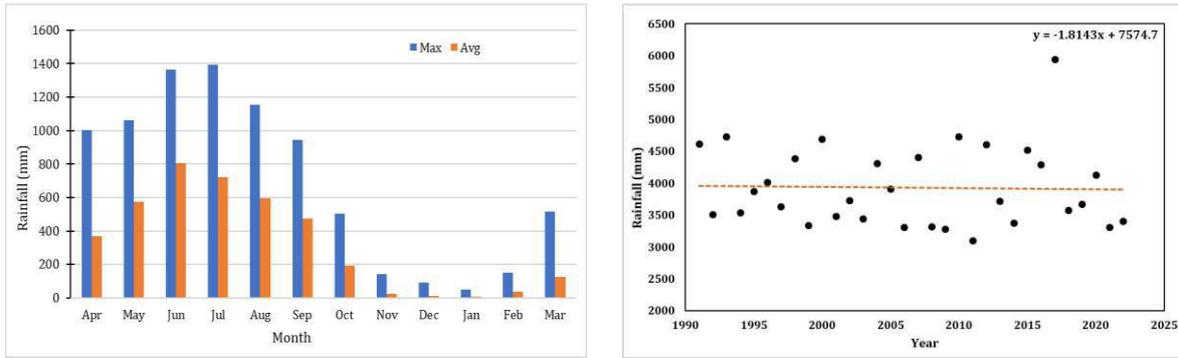
The **Figure 5.1** for Mymensingh, Sylhet, and Dhaka BMD stations illustrate a seasonal pattern (1991-2022) in monthly maximum and average rainfall. In all three locations, rainfall begins to rise significantly in April, with peak levels observed between June and September. Sylhet consistently records the highest rainfall among the three, with maximum values exceeding 1350 mm in June and July, and average rainfall surpassing 800 mm significantly higher than Mymensingh and Dhaka, where peak average rainfall reaches around 370 mm. Mymensingh and Dhaka show similar rainfall trends, though Mymensingh peaks slightly earlier in June, while Dhaka's maximum rainfall is observed in September. The dry season, typically from November to February, is evident across all stations, with minimal rainfall recorded during these months. A decreasing trend in annual total rainfall is noted for all the stations but Sylhet has very less decreasing trend compared to Dhaka and Mymensingh, suggesting potential long-term shifts in regional rainfall patterns of Dhaka and Mymensingh.



a) Dhaka



b) Mymensingh

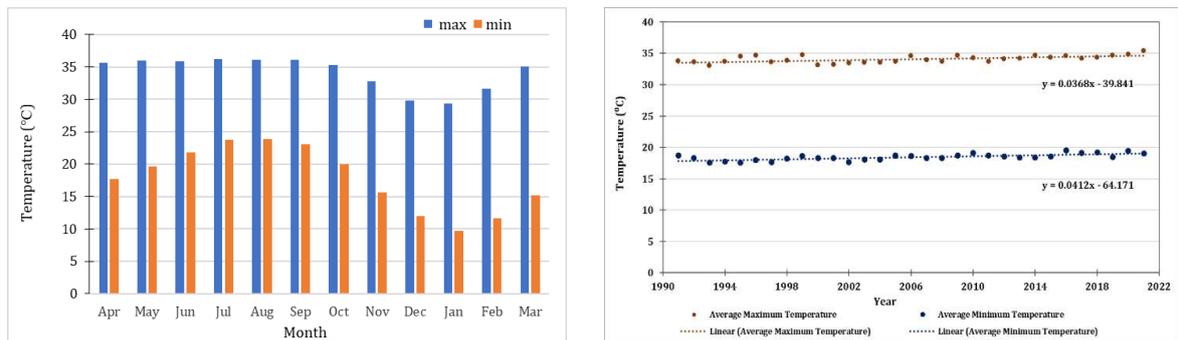


c) Sylhet

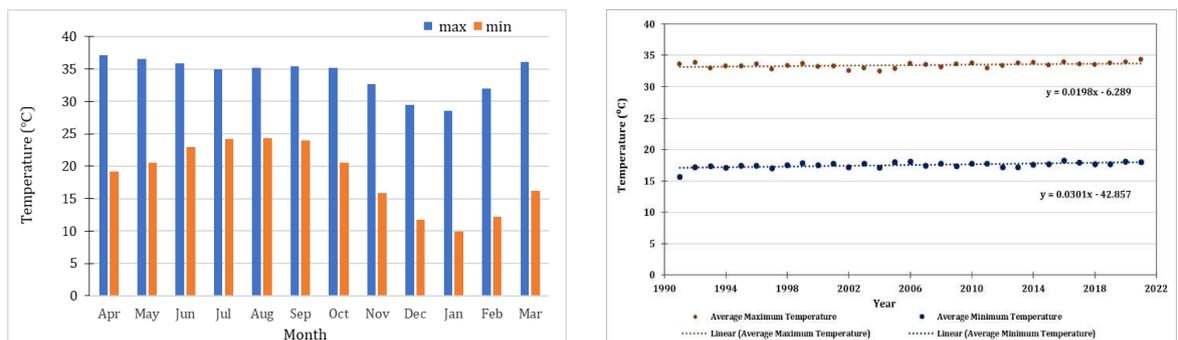
Figure 5.1: Monthly Maximum and Average Rainfall and Annual Rainfall Trend at Mymensingh, Sylhet, Dhaka BMD Station (1991-2022)

Temperature

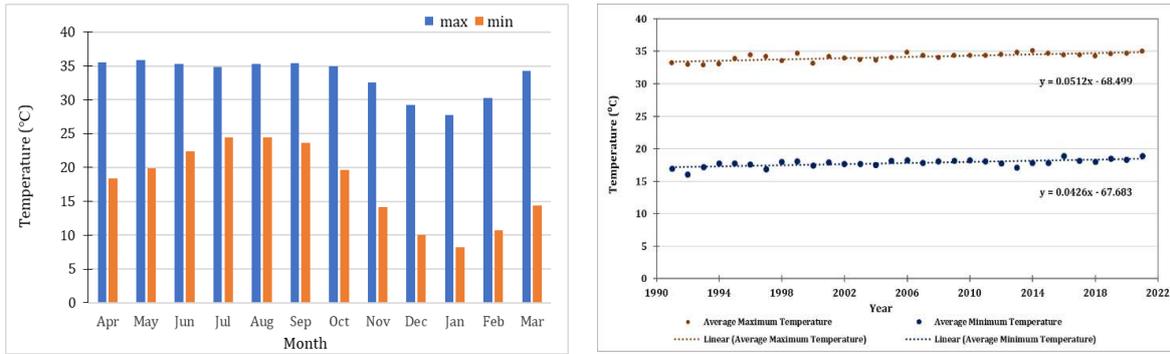
The monthly average maximum and minimum temperature data (Figure 5.2) for Mymensingh, Sylhet, and Dhaka stations all reveal a similar seasonal pattern, with the hottest months occurring between April and June and the coolest months in December and January. In Mymensingh, maximum temperature peak at 36°C in April and May, while Sylhet and Dhaka also experience high temperatures in the same months, with peaks around 35–36°C. During the monsoon season (June to September), temperatures remain high across all three stations but slightly decline compared to the pre-monsoon peak. Minimum temperatures show greater seasonal variation, with months of June to September maintaining temperature around 23–24°C in all locations. In contrast, winter months (December and January) are significantly cooler, with minimum temperatures dropping to around 10°C in Mymensingh, 8–10°C in Sylhet and 10–12°C in Dhaka. Notably, all three stations show an increasing trend in both maximum and minimum temperatures over the study period, indicating a warming climate where summers are becoming hotter and winters milder.



a) Dhaka



b) Mymensingh

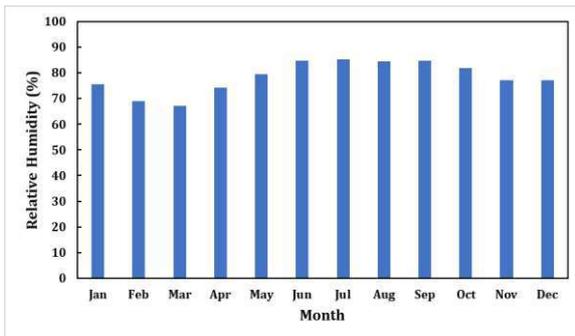


c) Sylhet

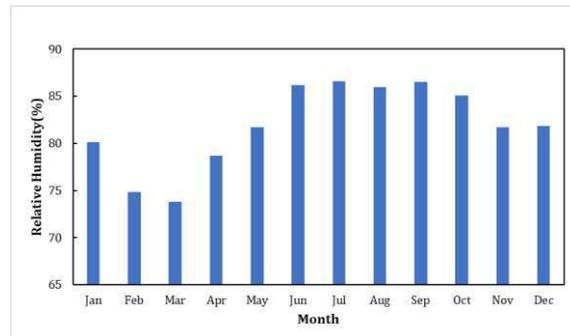
Figure 5.2: Monthly Maximum and Minimum Temperature and Annual Average Temperature Trend at Mymensingh, Sylhet Station (1991-2022)

Relative Humidity

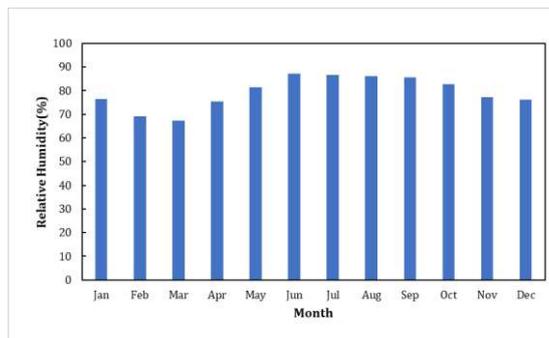
The analysis of average monthly relative humidity data over the last 30 years (1991–2022) from BMD stations at Dhaka, Mymensingh, and Sylhet highlights seasonal and regional variations (**Figure 5.3**). In Dhaka, the average relative humidity ranges from a low of 67.14% in March during the pre-monsoon season to a peak of 85.15% in July during the monsoon. Mymensingh shows slightly higher overall average relative humidity, with values ranging from 73.79% in March to 86.56% in July, indicating a similar seasonal trend but with a generally more humid atmosphere. Sylhet shows a similar pattern, with average relative humidity ranging from 67.21% in March to the highest among the three stations, 87.18% in June. In all three locations, the pre-monsoon season consistently shows the lowest relative humidity, while the monsoon season records the highest, with Sylhet experiencing the most, likely due to its geographical position and higher rainfall.



a) Dhaka



b) Mymensingh



c) Sylhet

Figure 5.3: Monthly Average Relative Humidity at Dhaka, Mymensingh and Sylhet BMD Station (1991-2022)

Evaporation

The analysis of maximum and average monthly evaporation data from BMD stations at Dhaka and Mymensingh over the periods 2001–2011 reveals similar seasonal trends with minor regional differences (**Figure 5.4**). At both stations, the maximum evaporation peaks at 8.9 mm/day in March and drops to 4.7 mm/day in January, indicating that the pre-monsoon season experiences the highest evaporation rates due to increased temperature and solar radiation. The average monthly evaporation at Dhaka ranges from 1.28 mm/day in December to 2.78 mm/day in April, while at Mymensingh it varies slightly from 1.27 mm/day in December to 2.76 mm/day in April. Both regions show the lowest evaporation during the months of November and December. Overall, the evaporation patterns are nearly similar across these regions of Bangladesh.

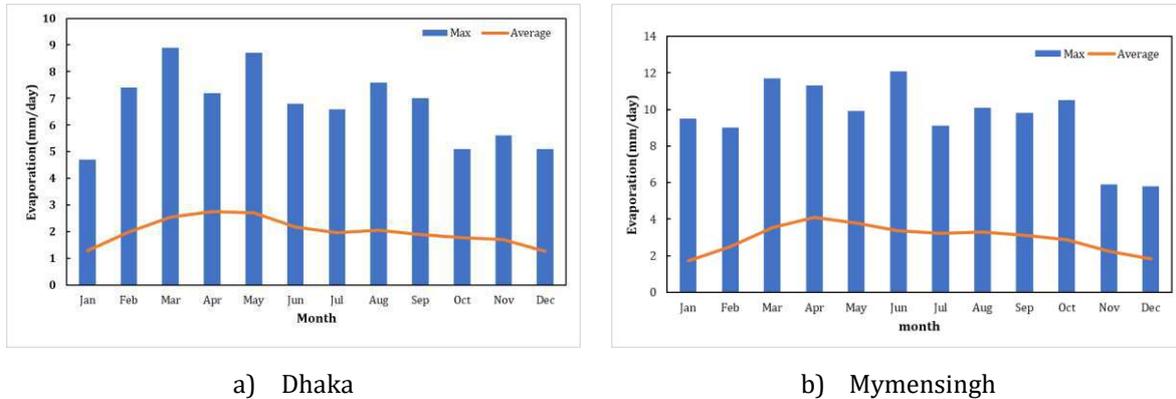
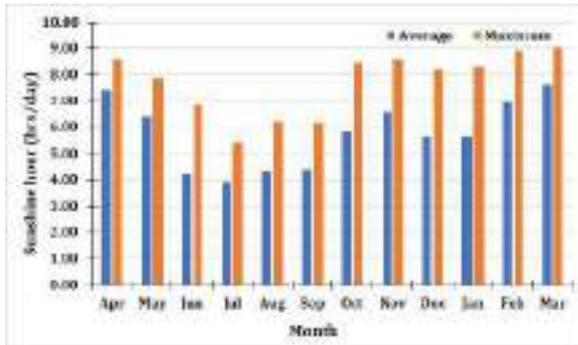


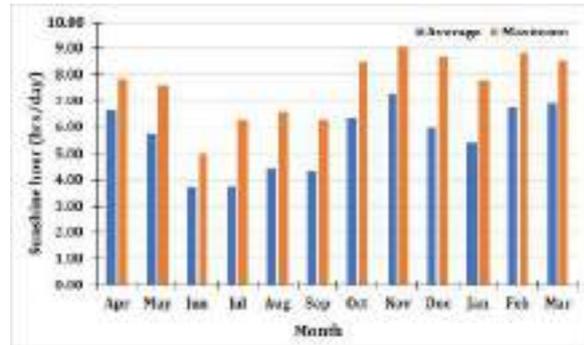
Figure 5.4: Monthly Maximum and Average Evaporation at Dhaka and Mymensingh BMD Station (2001-2011)

Sunshine Hours

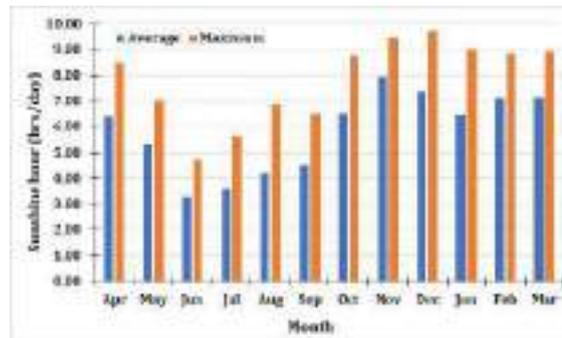
The analysis of maximum and average of monthly average sunshine hour data from BMD stations at Dhaka, Mymensingh, and Sylhet over the last 30 years (1991–2022) shows variations and regional patterns (**Figure 5.5**). Sylhet records the highest maximum sunshine hour among the three, peaking at 9.77 hrs/day in December, while its lowest maximum is 4.73 hrs/day in June. In comparison, Mymensingh's maximum sunshine hour ranges from 5 hrs/day in Jun to 9.05 hrs/day in November, and Dhaka's from 5.4 hrs/day in July to 9.02 hrs/day in March. From analysis of average monthly sunshine hour, Dhaka shows a range of 3.93 hrs/day in July to 7.62 hrs/day in March, Mymensingh varies from 3.72 hrs/day (June) to 7.29 hrs/day (November), and Sylhet varies from 3.25 hrs/day in June to 7.92 hrs/day in November. These variations indicate that Sylhet experiences larger duration of sunshine.



a) Dhaka



b) Mymensingh

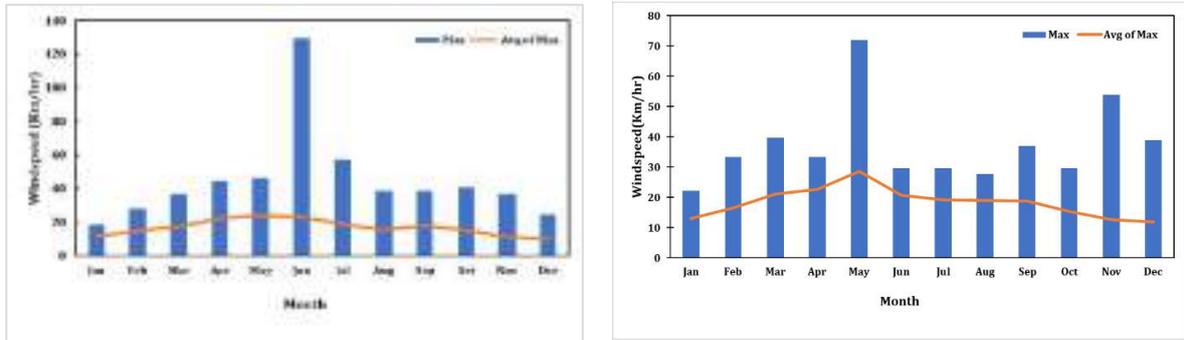


c) Sylhet

Figure 5.5: Monthly Maximum and Average Wind Speed at Dhaka, Mymensingh and Sylhet BMD Station (1991-2022)

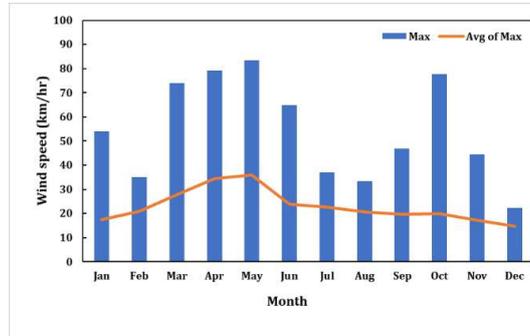
Windspeed

The analysis of maximum and average monthly wind speed data from BMD stations at Dhaka, Mymensingh, and Sylhet over the last 30 years (1991–2022) shows variations and regional patterns (**Figure 5.6**). Dhaka records the highest maximum wind speed among the three, peaking at 129.6 km/h in June, while its lowest maximum is 18.52 km/h in January. In comparison, Mymensingh’s maximum wind speed ranges from 22.22 km/h in January to 72 km/h in May, and Sylhet’s from 22.22 km/h in December to 83.34 km/h in May. From analysis of average monthly wind speed, Dhaka shows a range of 10.34 km/h in December to 23.53 km/h in May, Mymensingh varies from 11.86 km/h to 28.68 km/h, and Sylhet experiences the highest average range, from 14.74 km/h in December to 35.98 km/h in May. These variations indicate that Sylhet experiences stronger average winds during the pre-monsoon season. Dhaka, although experiencing the highest extreme wind speed, has comparatively lower average wind speeds than Sylhet and Mymensingh.



a) Dhaka

b) Mymensingh



c) Sylhet

Figure 5.6: Monthly Maximum and average Wind Speed at Dhaka, Mymensingh and Sylhet BMD Station (1991-2022)

5.1.2 Topography

Ashugani

The geography of the Ashuganj project area is smooth and level, with elevations varying from less than 2 mPWD to more than 6 mPWD. Since ancient times, the floodplain of the nearby river has governed the natural landscape. During the monsoon, this area floods shallowly. The management of water resources from the nearby thermal power plants (Ashuganj Powe plant) is directly related to the drainage system in this area. Nonetheless, the Digital Elevation Model (DEM) map (Figure: 5.7) clearly shows that 50% of the region is within the 3–4 mPWD elevation range, 23% is within the 2-3 mPWD elevation range, and 12% is between the 4-6 mPWD elevation range. While 1% of the land is above 6 mPWD, 14% of the territory is below 2 mPWD.

Palash

Compared to Ashuganj, the Palash region has a slightly greater elevation. This region is higher than Palash because of the Madhupur Tract's terrace area. The Palash project's research area has some higher undulating areas that can be seen. This elevated area is commonly referred to as the Pleistocene Terrace land, and it is frequently encircled by shallow water. During the monsoon season, this area experiences modest flooding. The study area's overall slope is from northeast to southwest. Nevertheless, according to the Digital Elevation Model (DEM) map (Figure: 5.8), 41% of the land is between 4-6 mPWD, 28% is between 3-4 mPWD, and 21% is between 2-3 mPWD. While 1% of the land is above 6 mPWD, 9% of the territory is below 2 mPWD.

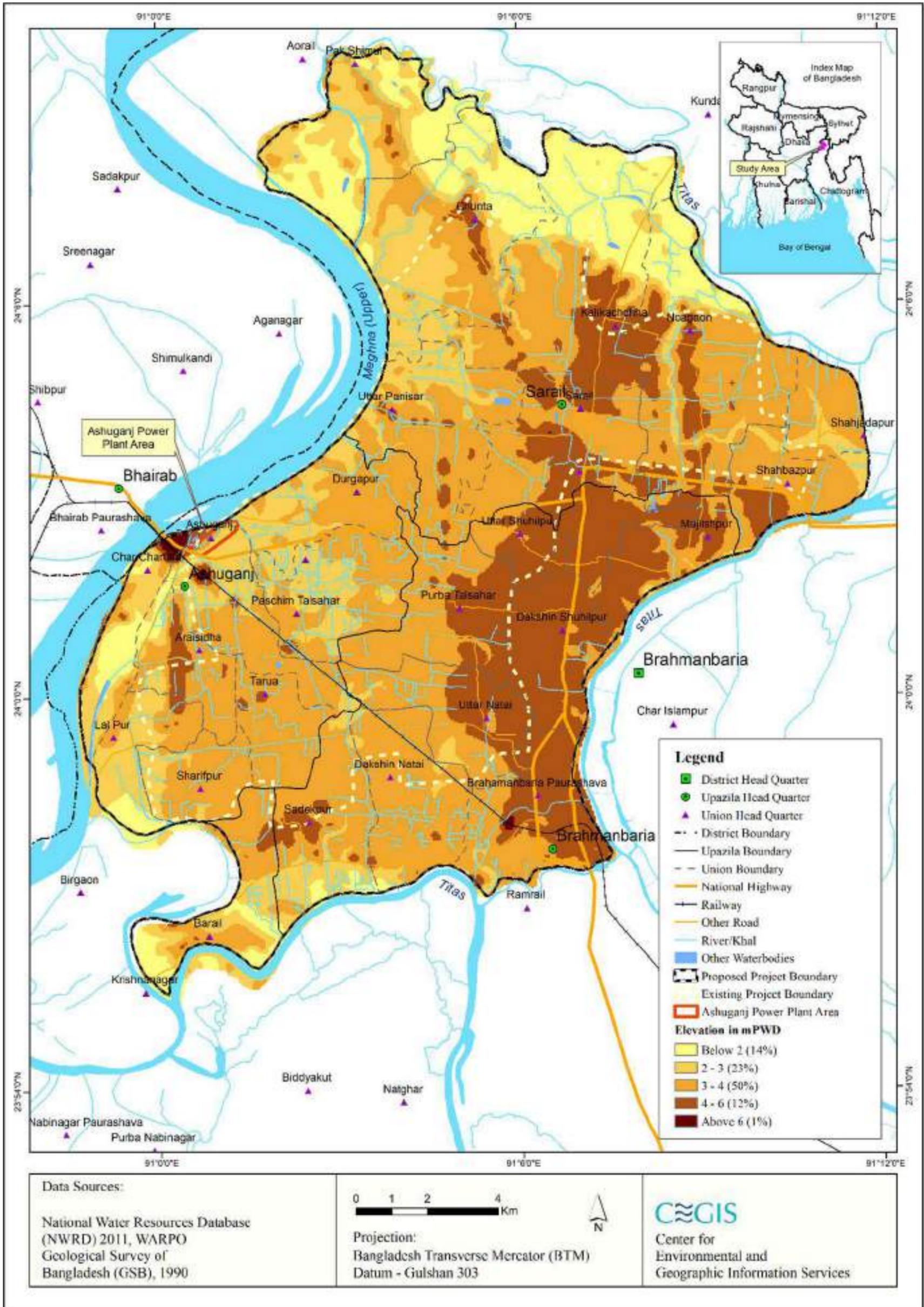


Figure 5.7: Digital Elevation Model (DEM) Map of the Ashuganj Project Area

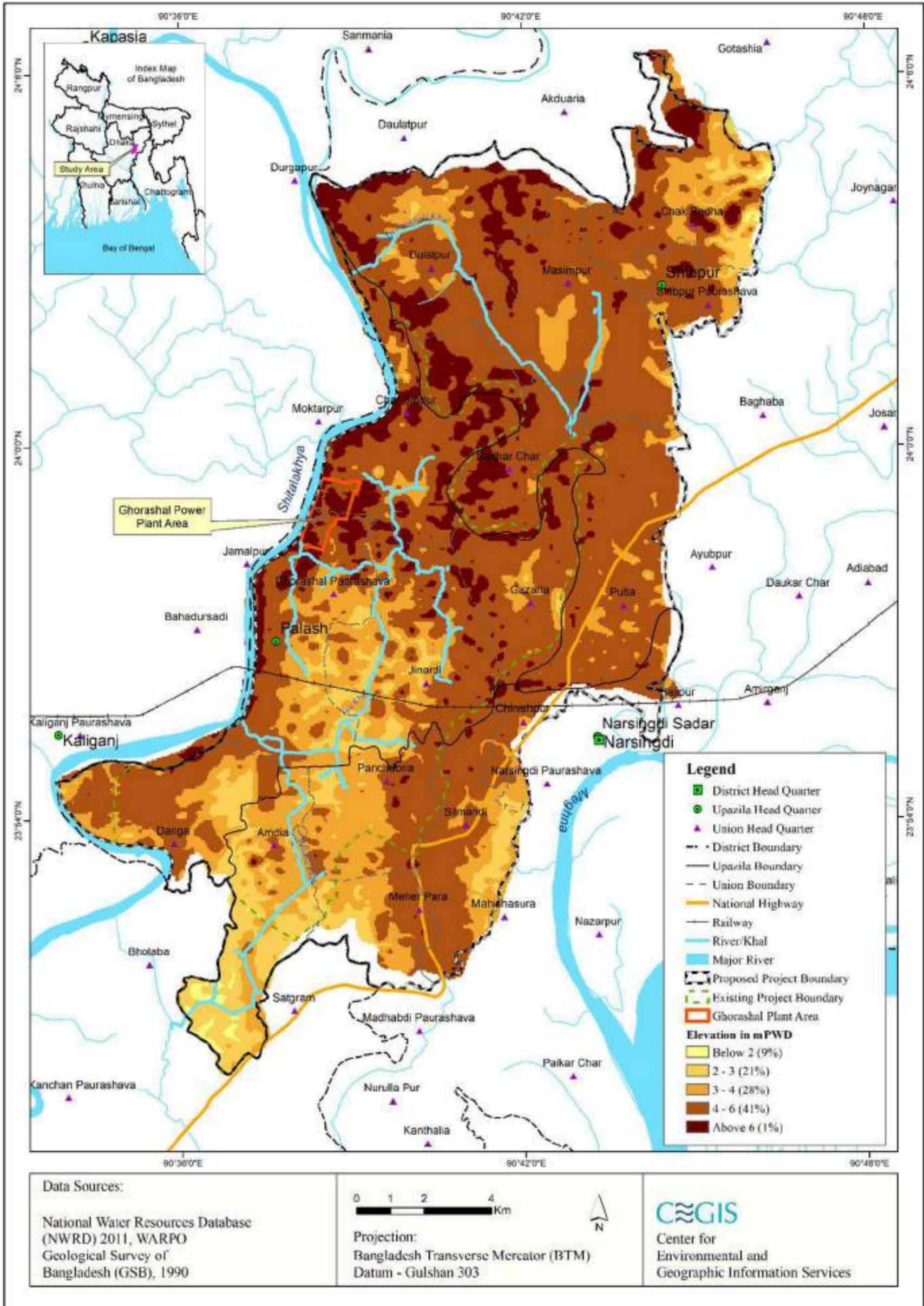


Figure 5.8: Digital Elevation Model (DEM) Map of the Palash Project Area

5.1.3 Geology

Ashuganj

The study region within Ashuganj command area's surface geological exposure is primarily made up of Marshy Peat and Clay, Alluvial Sand, and Alluvial Silt and Clay (**Figure: 5.9**). These sediments come primarily from the Sylhet Basin, the Middle Meghna floodplain, and the Old Meghna Estuarine floodplain. These loose, dark grey sediments date back to the Holocene. Peat is found within the Holocene-aged Alluvium Formation, and the majority of it is subsurface (0.3–2.3 m below the surface). Peat-bearing places are located in low-lying alluvial plains or marshy land.

The majority of peat is found on low-lying agricultural terrain. Since the project region is primarily made up of clay, marshy peat, and alluvial silt, it can hold rainwater and irrigation better than argillaceous soil. **Table 5.1** lists the research area's surface geological formation.

Table 5.1: Surface Geological Formation Coverage and its Percentage in the Ashuganj Command Area

Sl	Geological Formation	Area (ha)	Area (Sq.km)	Covered area %
1	Alluvial sand	1524.30	15.24	5.28
2	Marsh clay and peat	9158.35	91.58	31.72
3	Alluvial silt and clay	140.81	1.41	0.49
4	Alluvial silt	18045.71	180.46	62.51

Source: NWRD Database and CEGIS Archive

To illustrate the detailed geological succession of the study area, **Table 5.2** provides a generalized summary table on the lithological description of surface and subsurface geological formations in and around the project area.

Table 5.2: Stratigraphic Succession of the Sylhet Basin (Northern Part of the Geotectonic Province -2), Central Deeper Part of Foredeep Basin of Bengal Basin

Age (Appx)	Group	Formation	Lithology	Max Thick. (m)	Depositional Ent.	Tectonic Events
Holocene	Dihing	Alluvium		3350	Fluvial	Folding in the eastern Bengal Basin
Pleistocene		Dihing	Poorly consolidated sandstone and clayey sandstone			
Late Pliocene	Dupi Tila	Upper Dupi Tila	Medium to coarse ferruginous sandstone with layers of quartz pebbles and siltstone with lignitic fragments and		Alluvial	Dauki Fault
		Lower Dupi Tila				
Mid Pliocene	Tipam	Girujan Clay	Clay and Siltstone	3500		
		Tipam Sandstone	Coarse-grained, pebbly, cross bedded sandstone.			

Age (Appx)	Group	Formation	Lithology	Max Thick. (m)	Depositional Ent.	Tectonic Events
Early Pliocene Miocene	Surma	Upper Marine Shale	Shale	3900	Fluvial tidal-deltaic	Uplift of the Himalayas.
		Bokabil	Dark grey pyrite bearing shale, sandy shale, siltstone and, Sandstone		estuarine	Orogeny Subduction and folding Indo-Burman Ranges
		Bhuban	Sandstone and sandy shale, siltstone		Shallow marine	
Oligocene	Barail	Unidentified Barail	Pale grey, multi-colored, fine grained sandstone and siltstone, grey carbonaceous siltstone and silty sandstone and shale	7200	Shallow marine to basinal shale	Hard collision, closing of the Eurasian Tethys
Eocene Paleocene	Jainta	Koili Shale	Sandstone, glauconitic shale, carbonaceous and highly fossiliferous limestone; calcareous sandstone, carbonaceous shale and coal seams		Shelf edge Limestone	Soft collision Northward movement of India and sea-floor spreading
		Sylhet Limestone				
		Tura Sandstone	Medium to coarse grained sandstone		Marginal part of the shelf	
Pre-Paleocene	Undifferentiated sedimentary rocks (with some volcanic?)					

Source: Modified after Evans (1964), Holtrop and Keizer (1970), Khan et al. (1988), Hiller and Elahi (1988), Khan (1991a, b), Reimann (1993), Shamsuddin et al. (2001) and Alam et al. (2003)

Palash

A portion of the Palash area is covered by Madhupur Clay Residuum, although the majority of the Palash irrigation project area's surface geological exposures are similar to those of the Ashuganj project area (**Figure: 5.10**). It appears that the Madhupur clay geological formation is early Pleistocene in age. The dark, thick clay at the summit of the Madhupur Clay Residuum seems to have a very consistent composition both laterally and vertically. This clay has a strong capacity to hold irrigation and rainfall water, just like Ashuganj clay's silty clay. **Table 5.3** shows the surface geological formation of the Palash Irrigation Project study region.

Table 5.3: Surface geological Formation Coverage and its Percentage in the Palash Command Area

SI	Geological Formation	Area (ha)	Area (Sq.km)	Covered Area %
1	Alluvial silt	22401.27	224.01	83.55
2	Madhupur Clay residuum	1800.88	18.01	6.71
3	Marsh clay and peat	2608.85	26.09	9.73

Source: NWRD database and CEGIS Archive

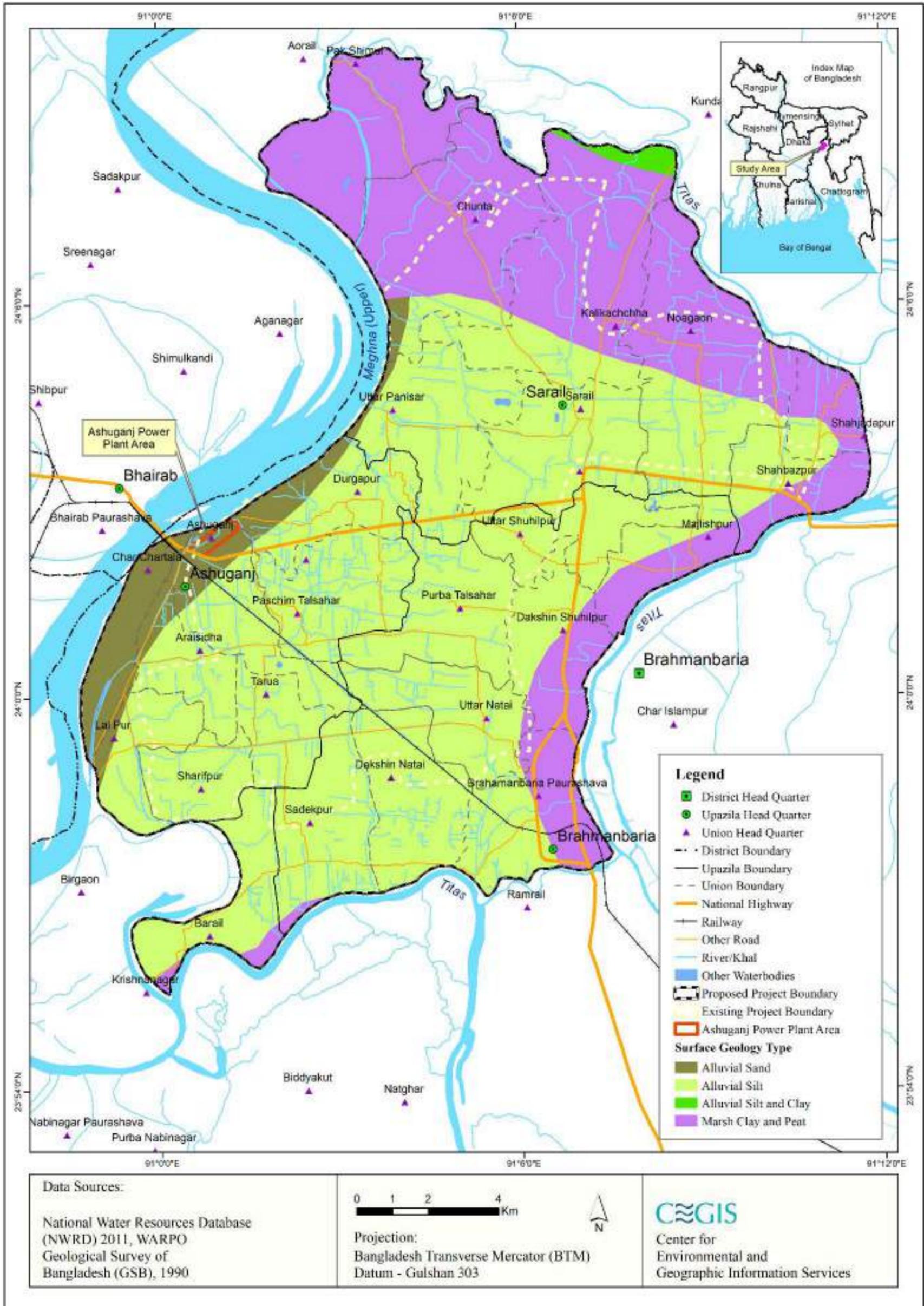


Figure 5.9: Surface Geological Formation of the Ashuganj Project Command Area

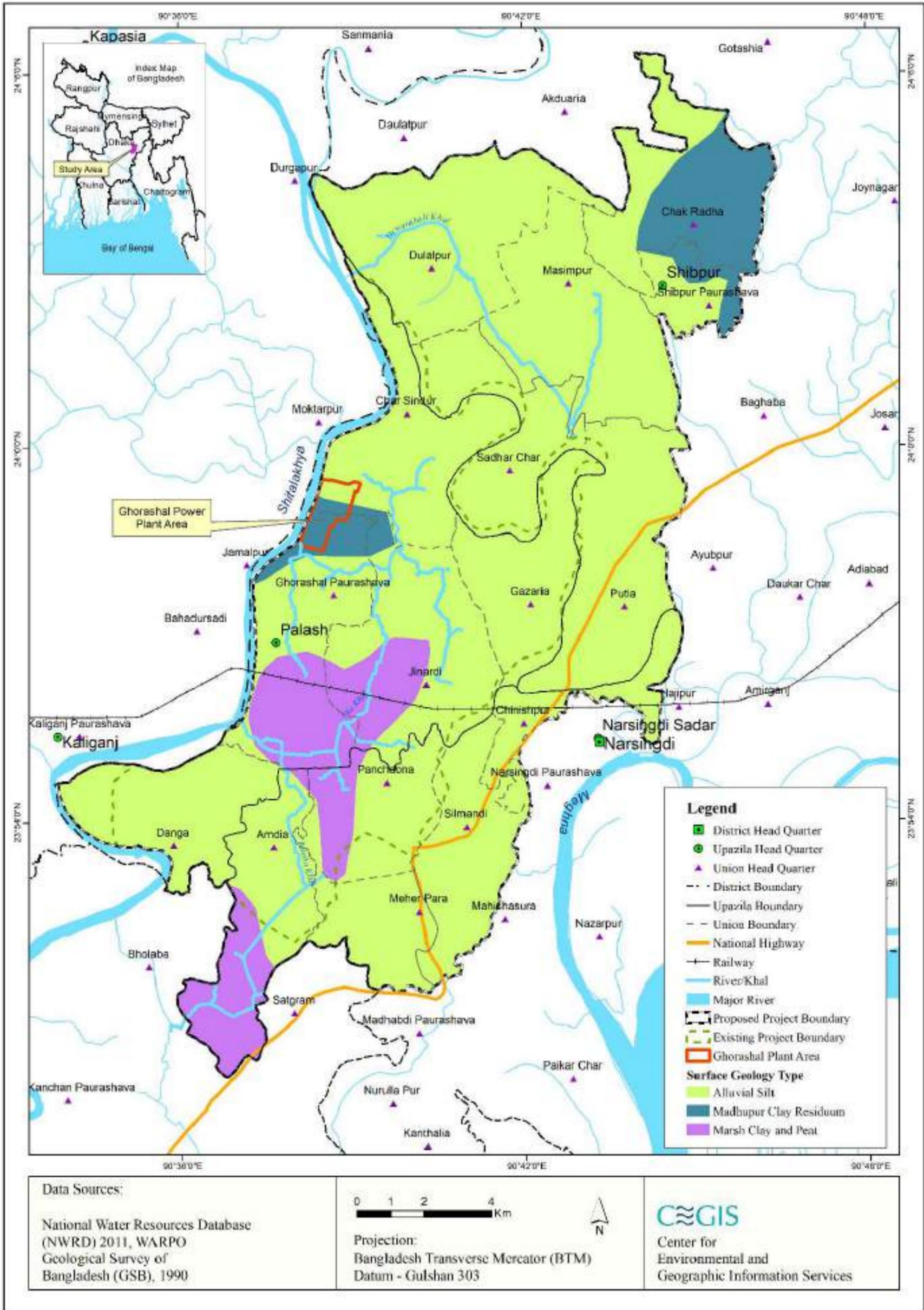


Figure 5.10: Surface Geological Formation of the Palash Project Command Area

5.1.4 Seismicity

Earthquake hazard analysis is more regional in scope than local. For instance, Bangladesh can sustain damage if an earthquake strikes Nepal. Therefore, to forecast any earthquake danger in Bangladesh, regional earthquake analysis is required. The entire land area of Bangladesh has been split into four seismic zones in accordance with the 2020 Bangladesh National Building Code (BNBC) (**Figure 5.11**). $Z = 0.12$ (Zone I), $Z = 0.20$ (Zone II), $Z = 0.28$ (Zone III), and $Z = 0.36$ (Zone IV) are the zone coefficients (Z) for the four zones, respectively. Zones II and III of the seismic classification apply to the research locations (**Figure 5.11**). It is well known that the seismic zone coefficient is thought to give the construction sufficient earthquake protection.

Ashuganj

Zone III encompasses the Ashuganj project area's whole command area. In terms of risk, this location is among Bangladesh's second most susceptible to seismic hazards. According to the relationship between Z values and the Richter Scale, any civil structure created in the study region with a seismic coefficient of Z equal to 0.28 should be built to survive an earthquake of at least 7.0 on the Richter Scale.

Palash

However, **Table 5.4** provides a quick reference for future planning and design reasons for this project by summarizing the major seismic intensity and historical records of earthquakes that have occurred in and around Bangladesh over the last 477 years.

Table 5.4: The Regional Earthquake History of Bangladesh for Last 450 Year

SL	Year	Source Area	Magnitude (Richter Scale)	Depth (Km)
1	1548	Sylhet	-	-
2	1664	Shillong-Plateau	-	-
3	1762	Chittagong-Arakan	≤ 8.8	-
4	1858	Sandway, Myanmar	6.5	-
5	1869	Cachar, India	7.5	48
6	1885	Sirajganj, Bangladesh	7	72
7	1897	Assam, India	8.1	60
8	1906	Calcutta, India	5.5	-
9	1912	Mandalay, Myanmar	7.9	25
10	1918	Srimangal, Bangladesh	7.6	14
11	1930	Dhubri, India	7.1	60
12	1934	Bihar, India-Nepal	8.3	33
13	1943	Numaligarh, Assam, India	7.2	13
14	1938	Mawlaik, Myanmar	7.2	60
15	1950	Assam, Himalaya	8.6	25
16	1950	Chittagong, Bangladesh	6	-
17	1954	Manipur, India	7.4	180
18	1975	Assam, India	6.7	112
19	1981	Sundarbans, Bangladesh	4.9	-
20	1984	Cachar, India	5.7	4

SL	Year	Source Area	Magnitude (Richter Scale)	Depth (Km)
21	1988	Bihar, India-Nepal	6.6	65
22	1988	Phek, Manipur, India	7.3	90
23	1995	Monipur, India	6.4	-
24	1997	Sylhet, Bangladesh	5.6	35
25	1997	Bangladesh-Myanmar	5.3	56
26	1999	Maheshkhali, Bangladesh	4.2	10
27	2003	Rangamati, Bangladesh	5.6	-
28	2011	Sikim, India	6.9	-
29	2015	Gorkha, Nepal	7.8	8.2
30	2016	Imphal, India	6.7	-
31	2016	Baniachang, Sylhet, Bangladesh	4.4	30
32	2023	14 km ESE of Dohar upazila, Dhaka	4.3	10
33	2023	Ramganj Upazila in Lakshmipur	5.5	10
34	2025	Sagaing Fault, Myanmar	7.7	10

Source: U.S. Geological Survey (USGS)

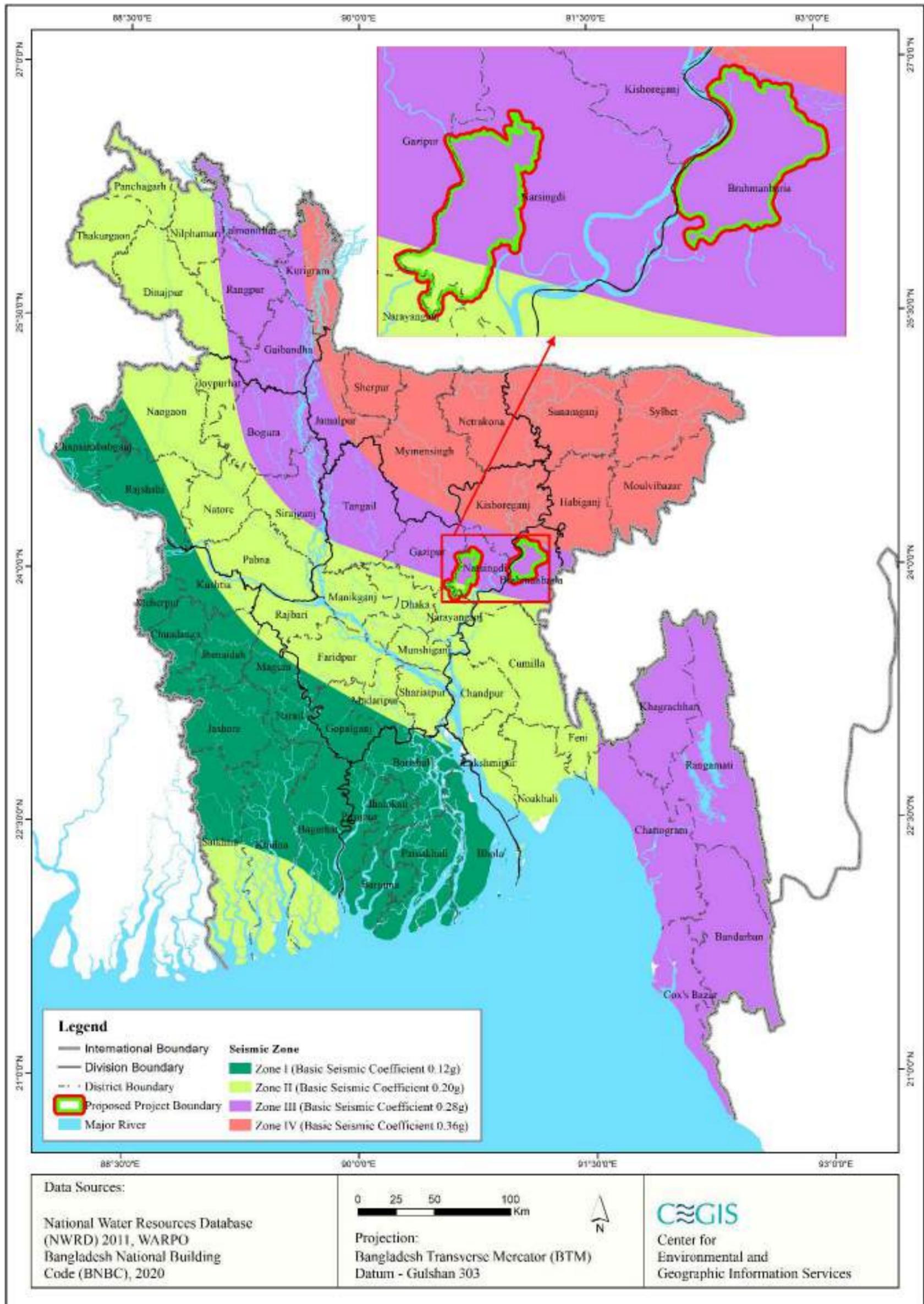


Figure 5.11: Seismic Zoning Map of the Bangladesh Showing the Study Areas

5.1.5 River-Morphology

Meghna (Upper) River

The study areas of Ashuganj and Palash are located on left and right bank of Meghna (upper) river respectively (**Figure 5.12**). Meghna (Upper) is one of the major rivers in Bangladesh and most prominent river of the study region. Its total length is about 156 km from Austagram in Kishoreganj district to Padma-Meghna confluence in Chandpur district.

Figure 5.13 shows changes of Meghna river from 1776 (Rennell's map) to 2021. Rennell's map of 1776 showed a much wider channel than the present Meghna (Upper) River. Historical planform development of the Meghna River in almost 250 years indicates that the river has declined its channel width by reducing the flow. This is because of the avulsion of the Jamuna River where Brahmaputra River has followed its course and the present Brahmaputra River gets minimum amount of flow that entered into the Meghna River system.

At present, the river flows at multiple channels and the mid-channel chars are relatively stable. **Figure 5.14** shows shifting of bankline of Meghna River (only study reach) from 1980 to 2021. The recent development in the last four decades suggest that the river has not changed its course significantly. Maximum shifting in the observed time period is found 370 m.

Other rivers in Palash area: The western side of Palash area is bounded by Sitalakhya River. This river originates from Old Brahmaputra and falls at Dhaleshwari river. Its average width is about 200m. This river is slightly erosion-prone. Haridoya and Brahmaputra (Narsingdi-Narayanganj) flow over the Palash area. These two rivers are morphologically stable and not erosion-prone. Average width of Haridoya and Brahmaputra are 40m and 50m respectively.

Other rivers in Ashuganj area: Titas river surrounds the Ashuganj area in three directions. This river is originated from Meghna and it falls to Meghna again. Length of Titas is about 130 km which acts like a branch of Meghna River. The low laying floodplain of the Titas River in Brahmanbaria district is bounded by elevated old floodplain and thus have formed terraces. Terrace is a step like land formation which consists of a flat or gently sloping geomorphic surface. The river channel becomes narrow in dry season which flows on any lowest pocket of new floodplain (thats why average width of Titas is about 150m only). In monsoon, flow inundates the new floodplain giving an impression of very large water body.

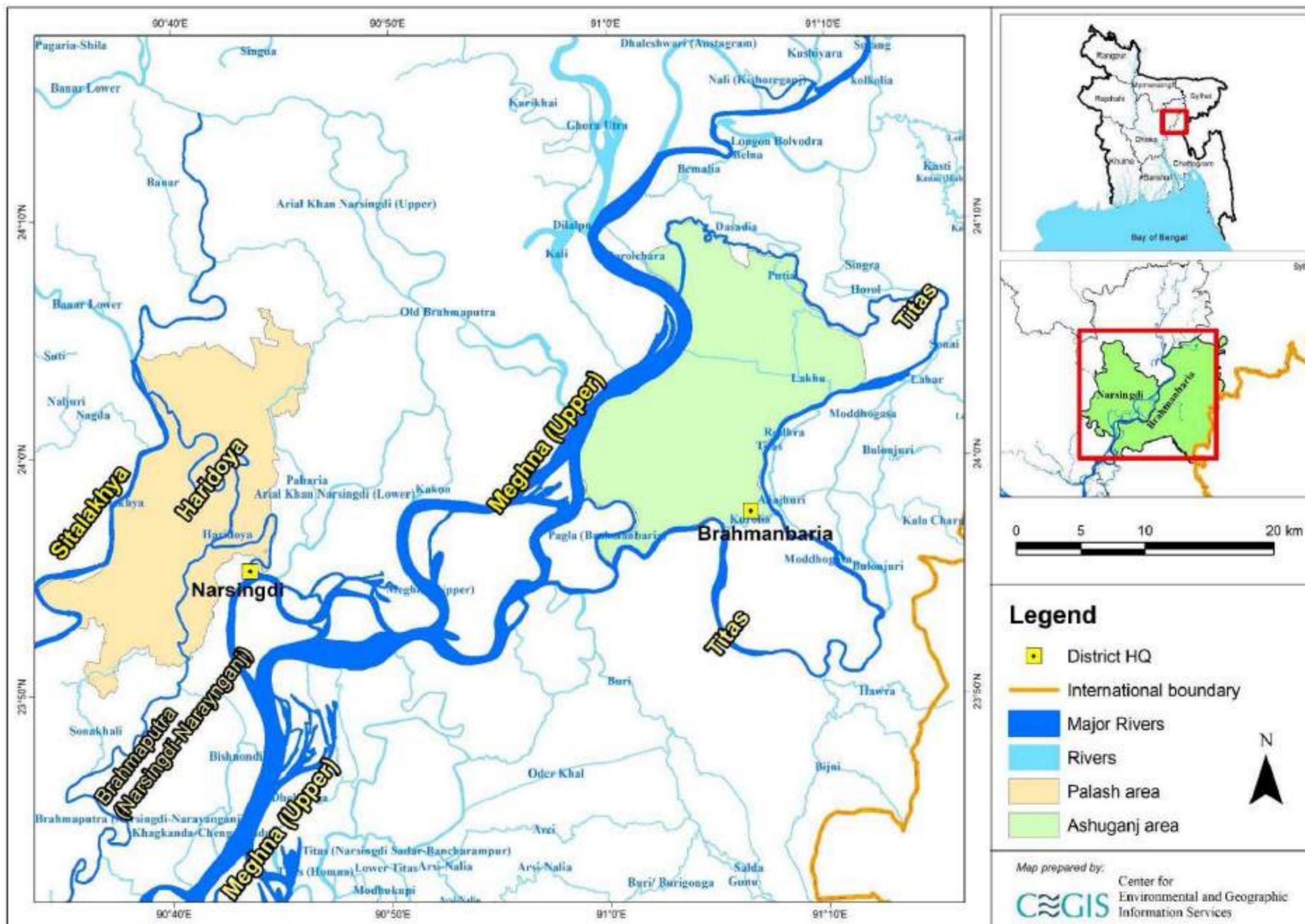
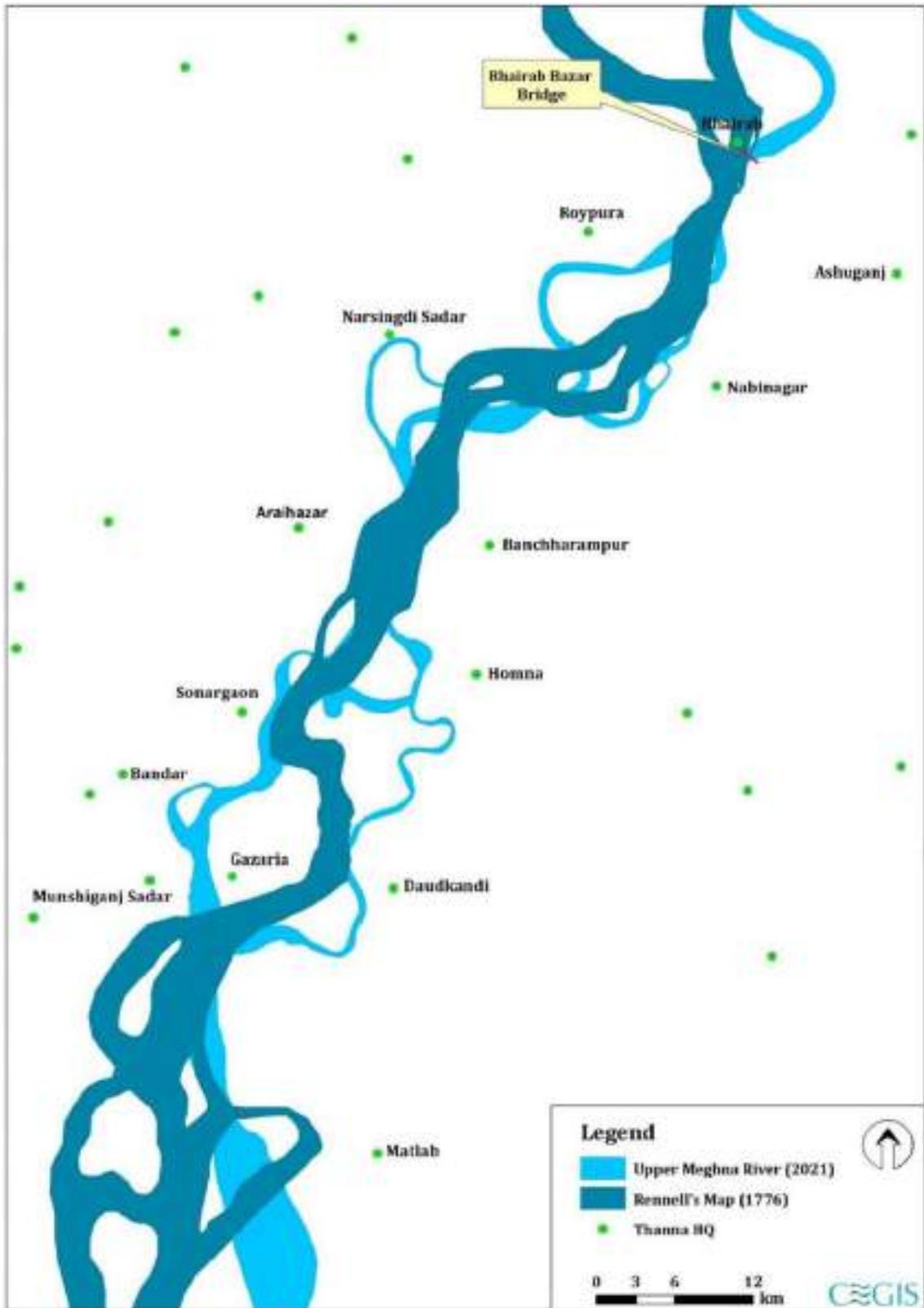
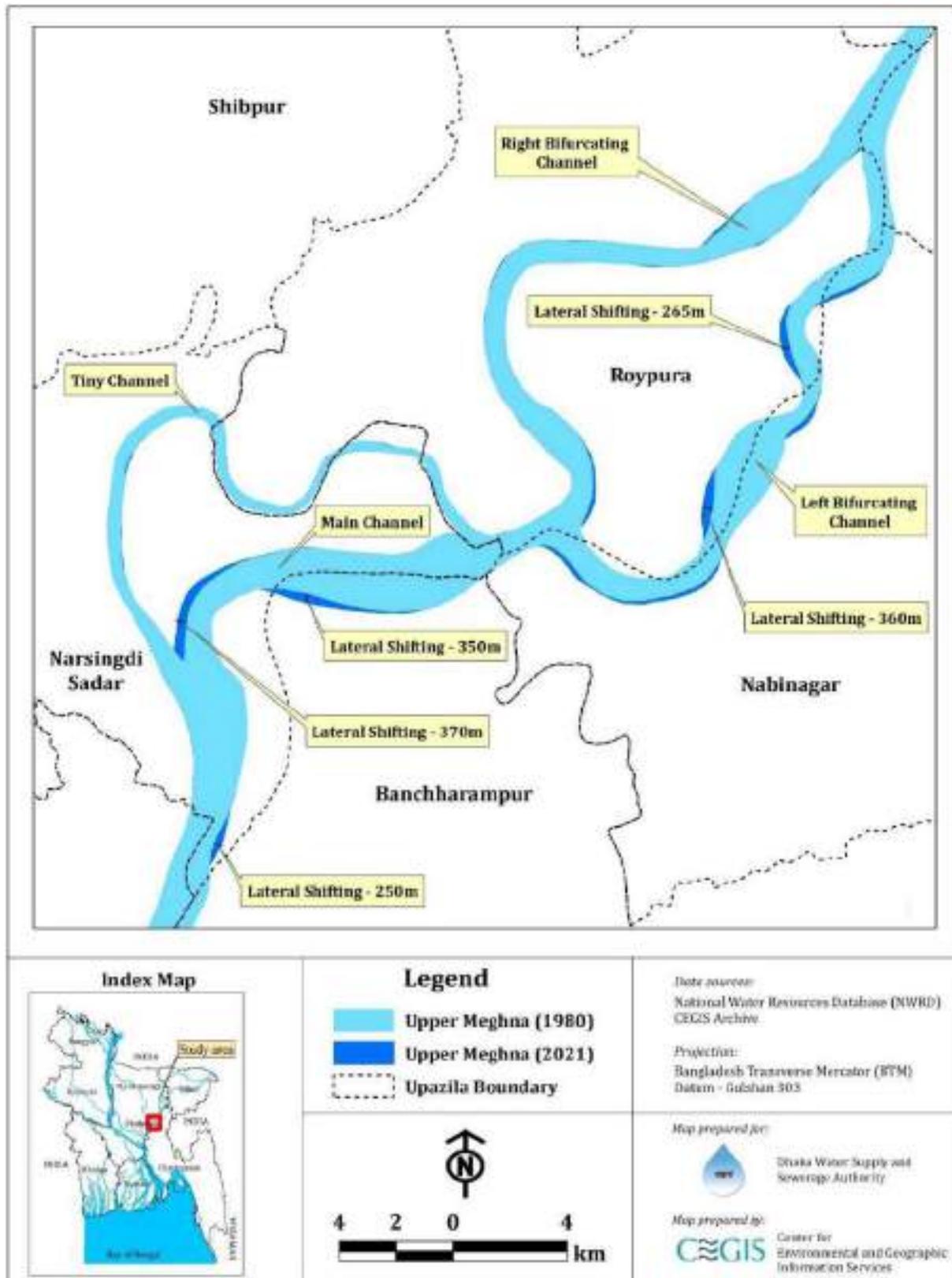


Figure 5.12: River Network in the Study Area



Source: (LGD, 2022)

Figure 5.13: Comparison of Planform Development of Meghna between 1776 and 2021



Source: (LGD, 2022)

Figure 5.14: Shifting of Banklines of Meghna in Study Area during 1980-2021

5.1.6 Land Resources

Natural resources found on the land include water, minerals, soils, and biota. These elements are arranged in ecosystems that offer a range of functions necessary to preserving the integrity of life-supporting systems and their ability to produce. The baseline land use data was collected using high-resolution recent satellite imagery of the research area. The SOLARIS-SRDI tool (2006) has been used to gather data on drainage class, available soil moisture, land type, and soil texture. The Fertilizer Recommendation Guide (BARC, 2018) provided the information on AEZ.

Agro-Ecological Zones (AEZs)

Thirty Agro-Ecological Zones (AEZs), 88 subregions, and 536 units have been identified by adding successive layers of information on the physical environment, which are relevant for land use and assessing agricultural potential in Bangladesh (BARC, 2018). The details are shown in **Table 5.5** and **Figure 5.15**.

Table 5.5: AEZ in the Study Area

Ashuganj Part			Palash Part		
AEZ	Area (ha)	Percent (%) Area	AEZ	Area (ha)	Percent (%) Area
Middle Meghna River Floodplain (AEZ-16)	2,455	8.50	Middle Meghna River Floodplain (AEZ-16)	33	0.12
Old Meghna Estuarine Floodplain (AEZ-19)	23,929	82.89	Madhupur Tract (AEZ-28)	4,265	15.91
Sylhet Basin (AEZ-21)	2,483	8.60	Old Brahmaputra Floodplain (AEZ-9)	22,513	83.97
Total	28,867	100.00		26,811	100.00

Source: BARC, 2018

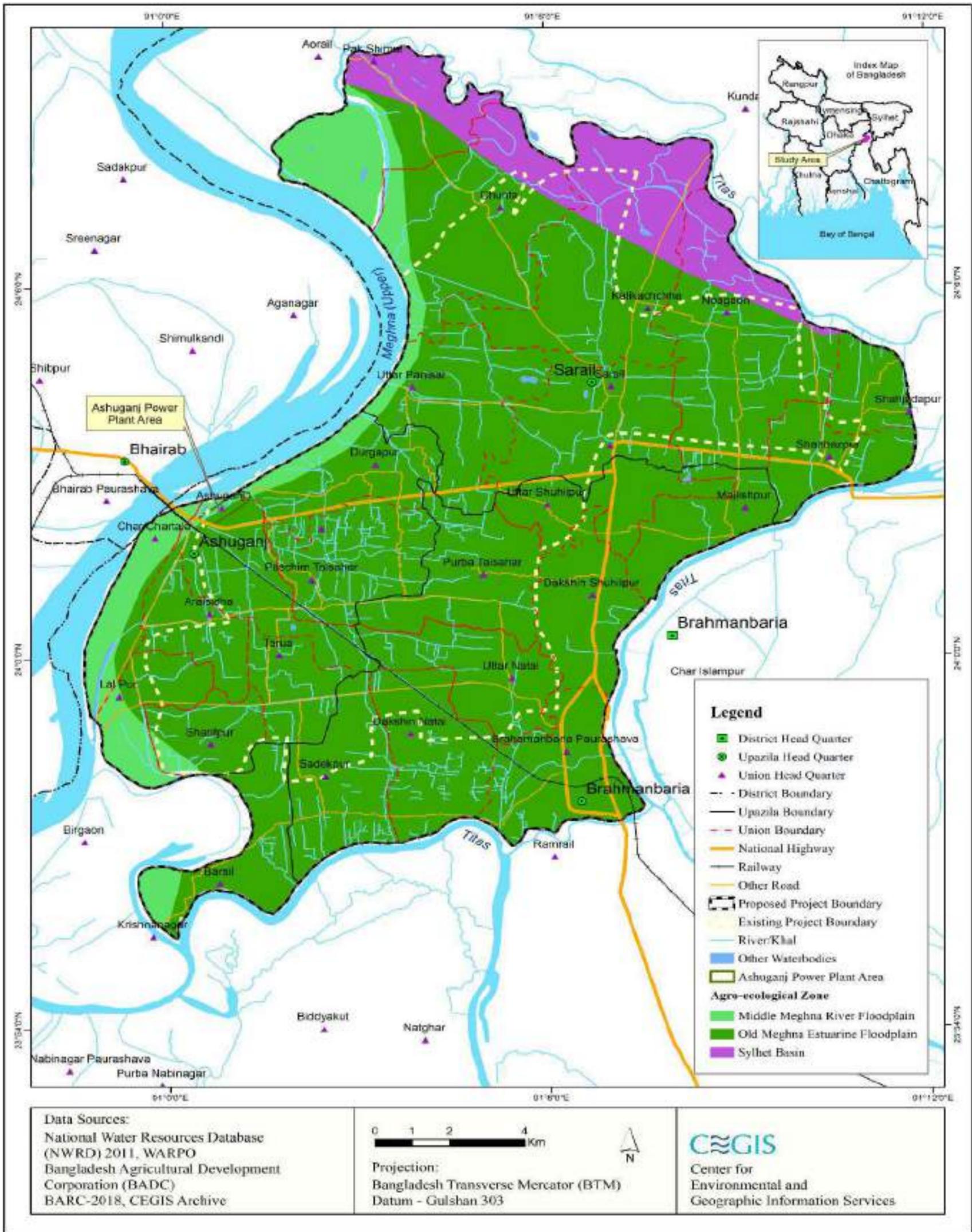


Figure 5.15: AEZ Map of Ashuganj Study Area

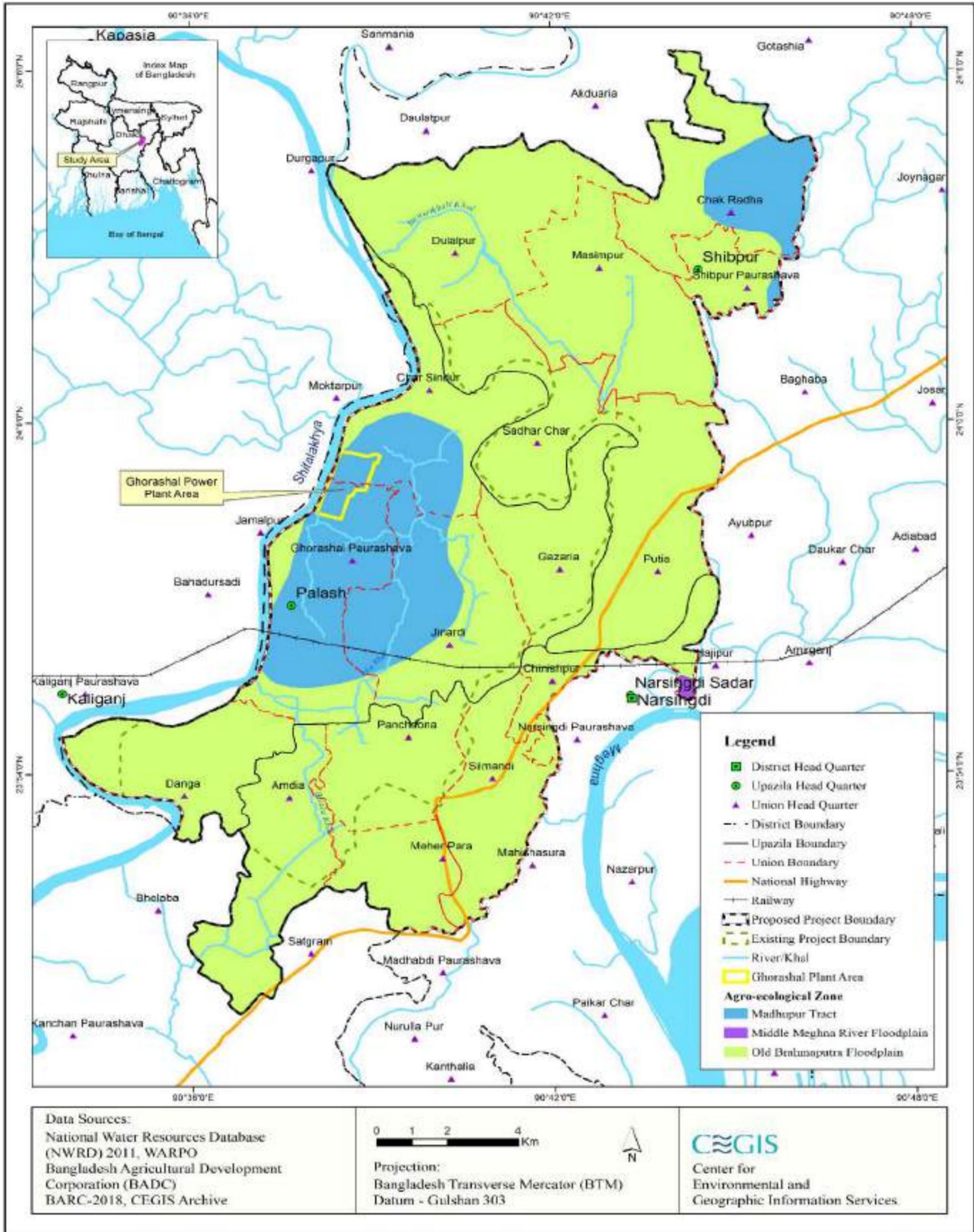


Figure 5.16: AEZ Map of Palash Study Area

AEZ-9: Old Brahmaputra Floodplain

This region covers a large area of Brahmaputra sediments deposited before the river shifted to its current Jamuna channel approximately 200 years ago. The area is characterized by broad ridges and basins. Soils are predominantly silt loams to silty clay loams on ridges and clay in basins, with Dark Grey Floodplain soil being the predominant type. Organic matter content is low on ridges and moderate in basins. Soil reaction ranges from very strongly acidic to neutral in top soils, with neutral subsoils. Highland areas show decreased soil pH. The region has a low general fertility level for N, P, K, S, and B, though CEC status is medium.

AEZ-16: Middle Meghna River Floodplain

This region occupies an abandoned channel of the Brahmaputra River on the border between the greater Dhaka and Cumilla districts. This region includes islands – former Brahmaputra chars, within the Meghna River as well as adjoining parts of the mainland. Soils of the area are grey, loamy on the ridges, and grey to dark grey clays in the basins. Grey sands to loamy sands with compact silty topsoil occupy areas of Old Brahmaputra char. The dominant General Soil type is Non calcareous Grey Floodplain soils. Top soils are strongly acidic to neutral in medium-low and low-land soils and the subsoils are slightly acidic to slightly alkaline. The general fertility level is medium with very low to low in N and low to medium organic matter contents. The P and Zn levels are low to medium and the B level is very low to low.

AEZ-19: Old Meghna Estuarine Floodplain

This region occupies a large area, mainly low-lying between the south of the Surma-Kusiyara Floodplain and the northern edge of the Young Meghna Estuarine Floodplain. It comprises smooth, almost level, floodplain ridges and shallow basins. Silt loam soils predominate in the highlands and silty clay to clay in the lowlands. Non calcareous Dark Grey Floodplain soil is the only General Soil Type of the area. The organic matter content of the soil is low to medium. Moisture holding capacity is medium. Top soils are slightly acidic to slightly alkaline but sub-soils are neutral in reaction. The general fertility level is medium. The Status of K is low to optimum. The level of P is very low to low, S is low to medium and B status ranges from low to optimum.

AEZ-21: Sylhet Basin

The region occupies the lower, western side of the Surma-Kushiyara Floodplain. The area is mainly smooth, broad basins with narrow rims of higher land along rivers. Relief is locally irregular near the rivers. The difference in elevation between river banks and adjoining basin centers is 1-2 meters or more. Soils of the area are grey silty clay loams and clay loams in the higher parts that dry out seasonally and grey clays in the wet basins. Non-calcareous Grey Floodplain soils and Acid Basin Clays are the major components of the General Soil Types. The soils have a medium level of organic matter and soil reaction is mainly slightly acidic in topsoil. Fertility level is medium to high with very low to low N and P contents.

AEZ-28: Madhupur Tract

This region features complex relief with soils developed over Madhupur Clay. The landscape includes level uplands and dissected terraces with shallow to deep valleys. The dominant soil types are Deep Red Brown Terrace, Shallow Red Brown Terrace, and Acid Basin Clays. Terrace soils are better drained, consisting of friable clay loams to clays over a friable clay substratum at varying depths, while valley soils are dark grey heavy clays. Soils are predominantly very strongly acidic, with some areas reaching slightly acidic levels. They have low to medium organic matter content, low moisture holding

capacity, and low fertility. These soils are phosphate fixing with very low to low P and B content, and low to medium K and S content.

Land Use

The gross study area is 55,678 hectares, of which the Net Cultivable Area (NCA) is 29,839 hectares (54% of the study area). The remaining area (46%) comprises rural settlements, orchards and other plantations (trees), freshwater aquaculture, perennial beels/haors/baor, ponds and lake, river and khals and others (brickfield, built-up non-linear, dump sites). The detailed land use of the study area is presented in **Table 5.6**.

Table 5.6: Existing Land Use of the Study Area

Land Use	Ashuganj Part		Palash Part		Total	
	Area (ha)	Percent (%) Area	Area (ha)	Percent (%) Area	Area (ha)	Percent (%) Area
Net Cultivable Area (NCA)	18,533	64	11,306	42	29,839	54
Rural Settlement	7,303	25	11,490	43	18,793	34
Herb Dominated Area, Orchards and Other Plantations (Trees)	9	0	285	1	294	1
Fresh Water Aquaculture	322	1	1,042	4	1,365	2
Perennial Beels, Haors and Baor	10	0	287	1	297	1
Ponds and Lake	137	0	58	0	195	0
Rivers and Khals	686	2	208	1	894	2
Others (Brickfield, Built-Up Non-Linear, Dump Sites)	1,866	6	2,134	8	4,000	7
Total	28,867	100	26,811	100	55,678	100

Source: Satellite Image: SPOT 6

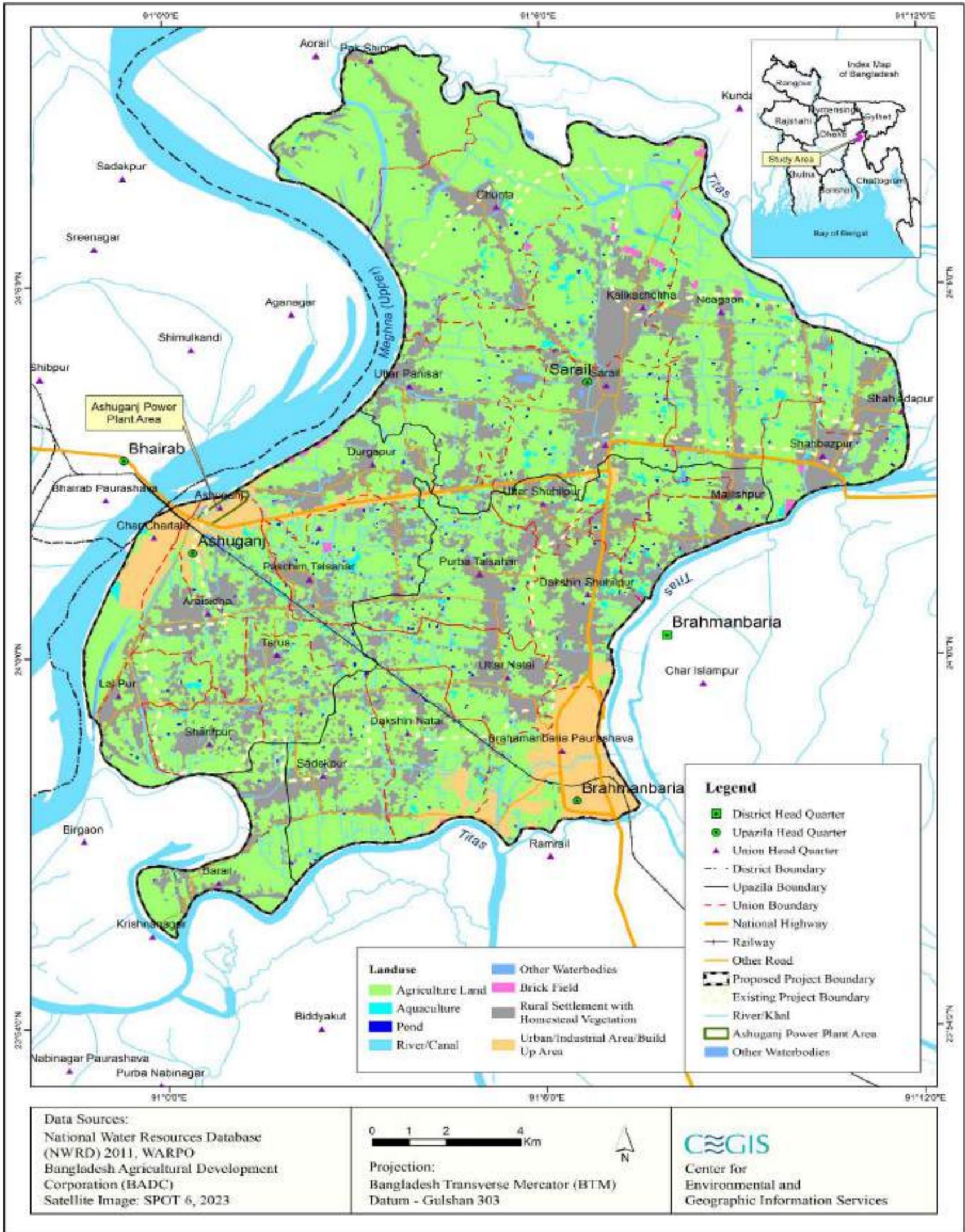


Figure 5.17: Land Use Map of Ashuganj

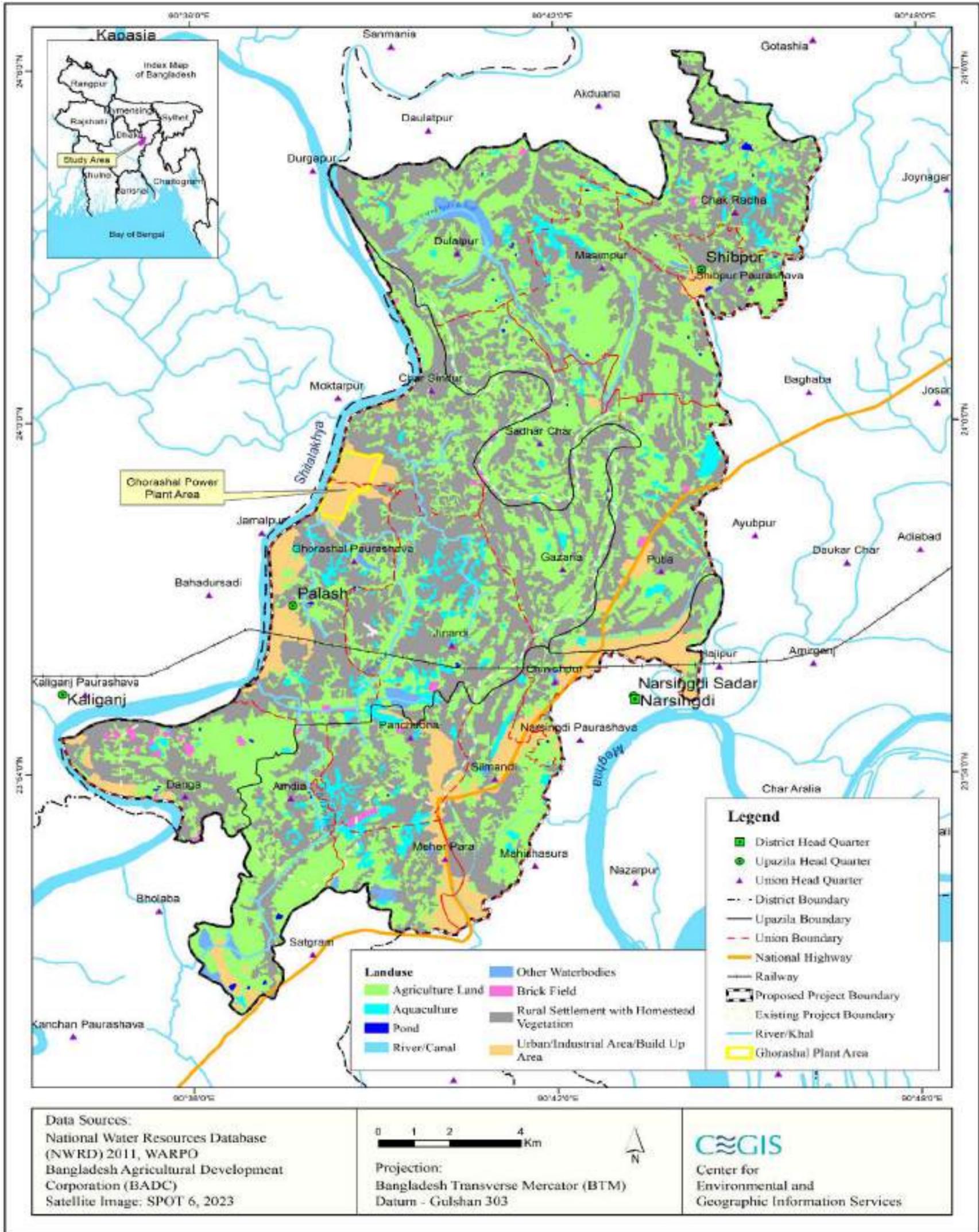


Figure 5.18: Land Use Map of Palash

Land Type

Land type classification is based on the depth of inundation during monsoon season due to normal flooding on agricultural land. In terms of depth of flooding on agricultural land, five classes of land types: Highland (F₀), Medium Highland (F₁), Medium Lowland (F₂), Lowland (F₃), and Very Lowland (F₄) are recognized using SRDI 1995. The dominant land type identified in the study area is medium lowland (F₂), comprising 40% of the total area, followed by medium highland (F₁) at 34%. Detailed land type data of the study area is presented in **Table 5.7** and visually presented in **Figure 5.19 & 5.20**.

Table 5.7: Land Type of the Study Area

Land Type	Ashuganj Part		Palash Part		Total	
	Area (ha)	Percent (%) Area	Area (ha)	Percent (%) Area	Area (ha)	Percent (%) Area
Highland (F ₀)	0	0	1,969	17.42	1,969	7
Medium Highland (F ₁)	6,424	34.66	3,843	33.99	10,268	34
Medium Lowland (F ₂)	9,120	49.21	2,862	25.31	11,981	40
Lowland (F ₃)	927	5.00	2,600	22.99	3,527	12
Very Lowland (F ₄)	2,062	11.13	32	0.29	2,094	7
Total (NCA)	18,533	100.00	11,306	100.00	29,839	100

Source: SRDI, 1995

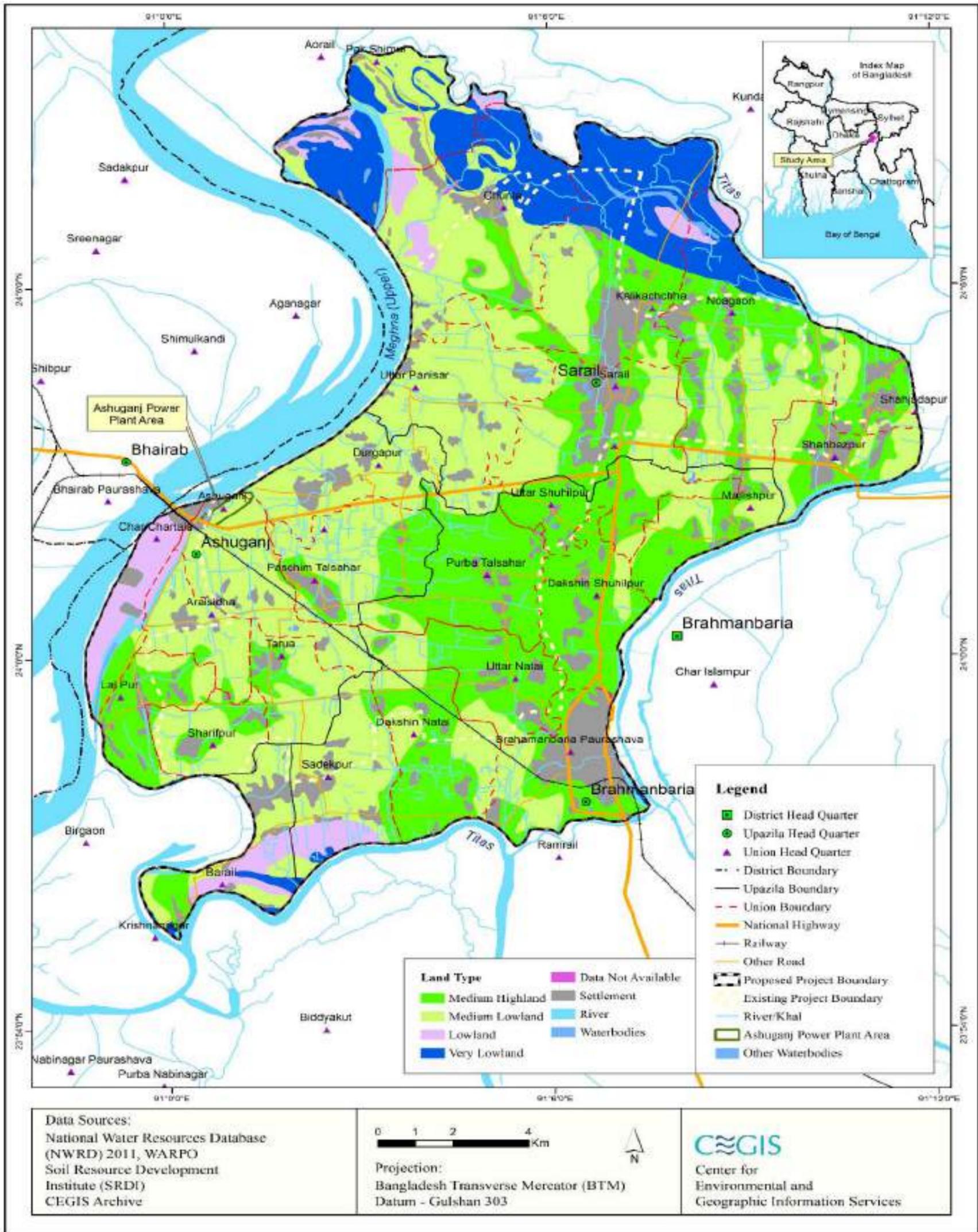


Figure 5.19: Land Type Map of Ashuganj

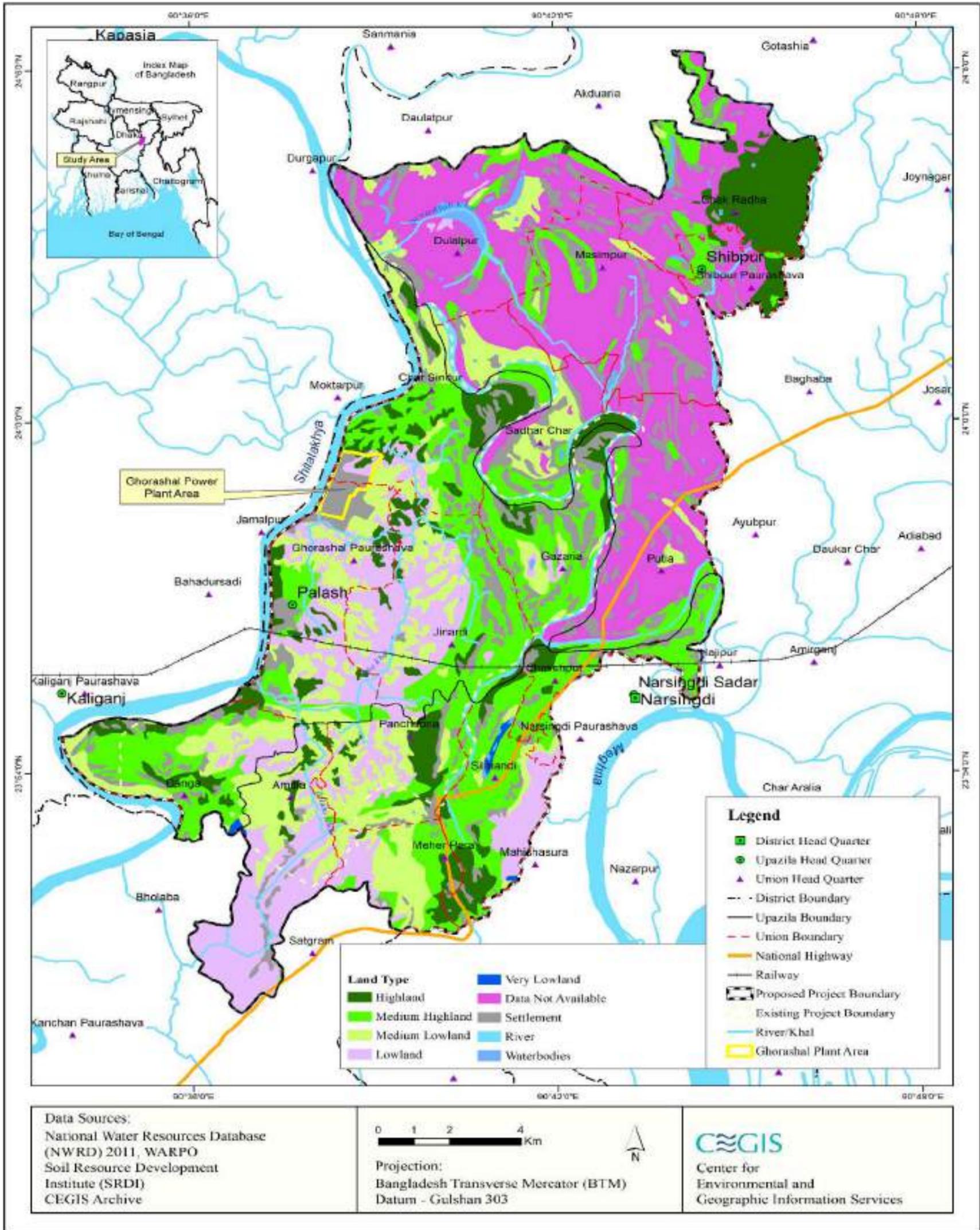


Figure 5.20: Land Type Map of Palash

Soil Texture

Soil texture is the relative proportions of sand, silt and clay, and is an important soil characteristic that determines crop selection, crop production and field management. It influences many other properties of great significance to land use and management. There are 4 (four) types of soil texture in the study area. Clay loam (34.94%) soil is dominant followed by loam (27.64%) and clay (22.53%). Details are presented in **Table 5.8** and visually presented in **Figure 5.21-5.22**.

Table 5.8: Soil Texture of the Study Area

Soil Texture	Ashuganj Part		Palash Part		Total	
	Area (ha)	Percent (%) Area	Area (ha)	Percent (%) Area	Area (ha)	Percent (%) Area
Clay	2,301	12.41	4,421	39.10	6,722	22.53
Clay Loam	7,712	41.61	2,713	23.99	10,425	34.94
Loam	8,207	44.28	40	0.35	8,247	27.64
Sandy Loam	313	1.69	4,132	36.55	4,445	14.90
Total (NCA)	18,533	100.00	11,306	100.00	29,839	100.00

Source: SRDI, 1995

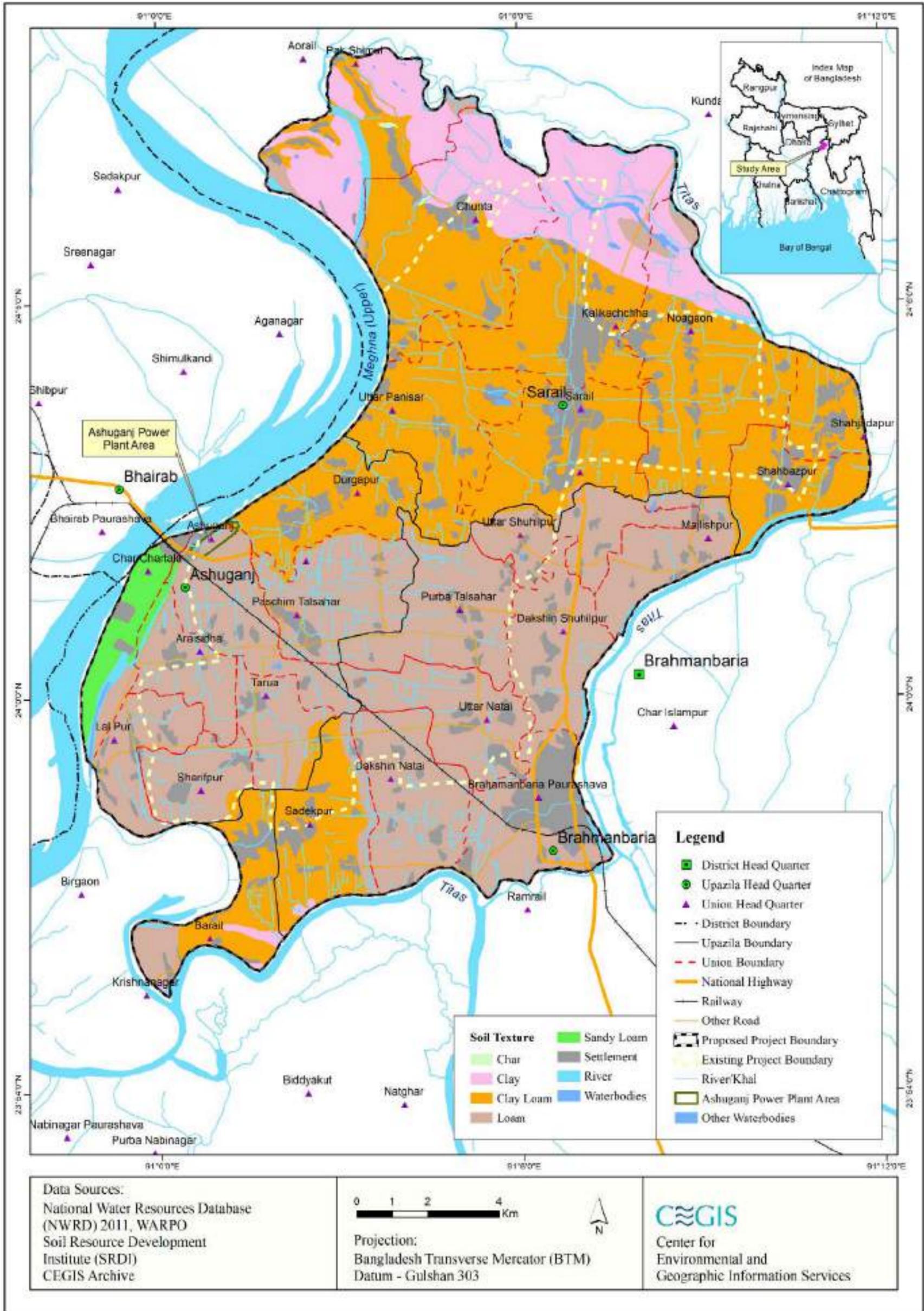


Figure 5.21: Soil Texture Map of Ashuganj

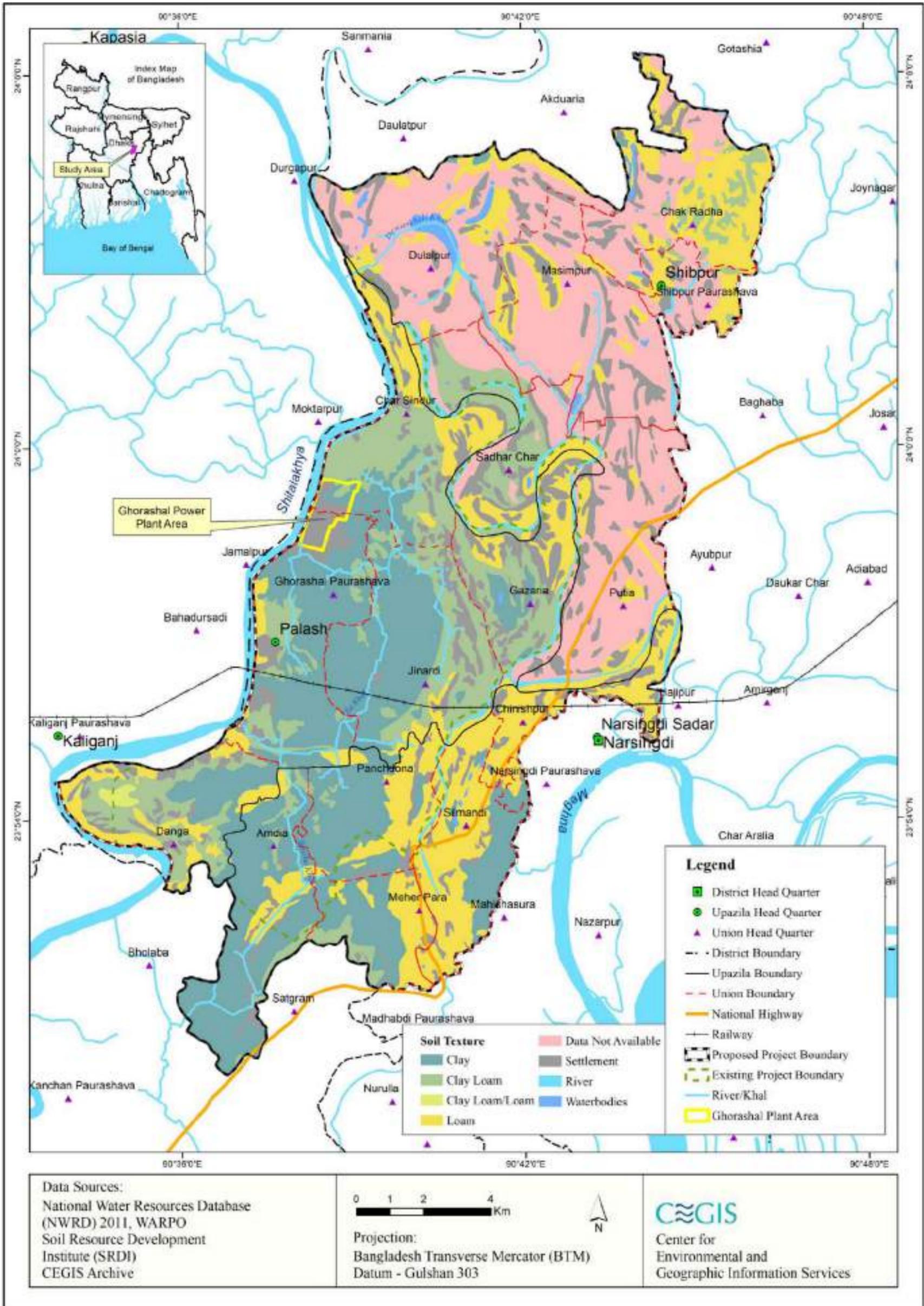


Figure 5.22: Soil Texture Map of Palash

Available Soil Moisture

The available soil moisture is very important for the cultivation of different crops. The soils having capacity of high level of available soil moisture are highly suitable for the cultivation of Rabi crops under rain-fed conditions. According to SRDI 1995; the available soil moisture has been classified into 4 (four) categories, of which 3 (three) categories are available in the study area. The detailed distribution of available soil moisture is presented in **Table 5.9** and visually presented in **Figure 5.23-5.24**.

Table 5.9: Available Soil Moisture of the Study Area

Land Type	Ashuganj Part		Palash Part		Total	
	Area (ha)	Percent (%) Area	Area (ha)	Percent (%) Area	Area (ha)	Percent (%) Area
High	2,293	12.37	6,177	54.64	8,471	28.39
Medium	13,585	73.30	2,106	18.62	15,690	52.58
Low	2,655	14.32	3,023	26.74	5,678	19.03
Total (NCA)	18,533	100.00	11,306	100.00	29,839	100.00

Source: SRDI, 1995

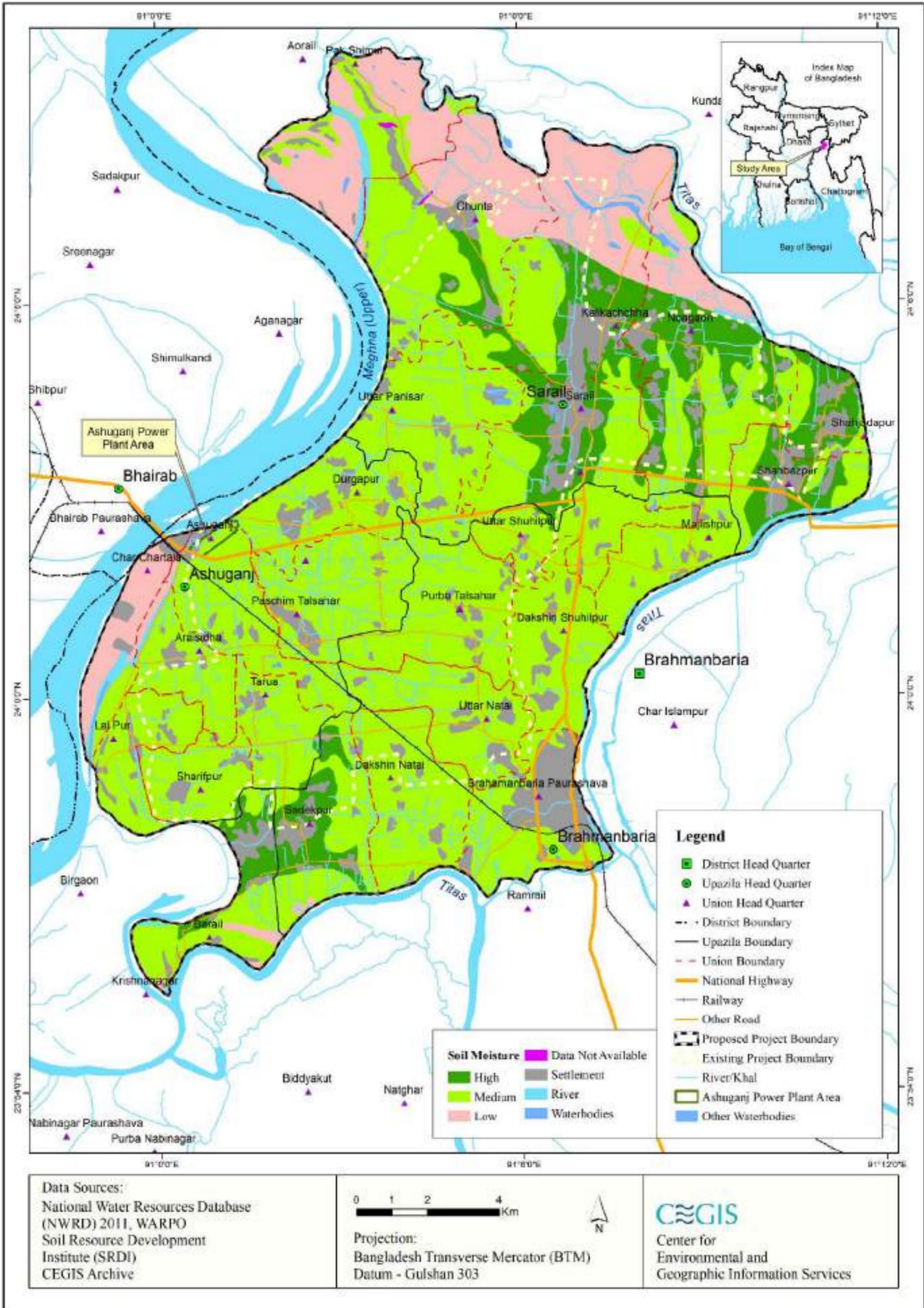


Figure 5.23: Soil Moisture Map of Ashuganj

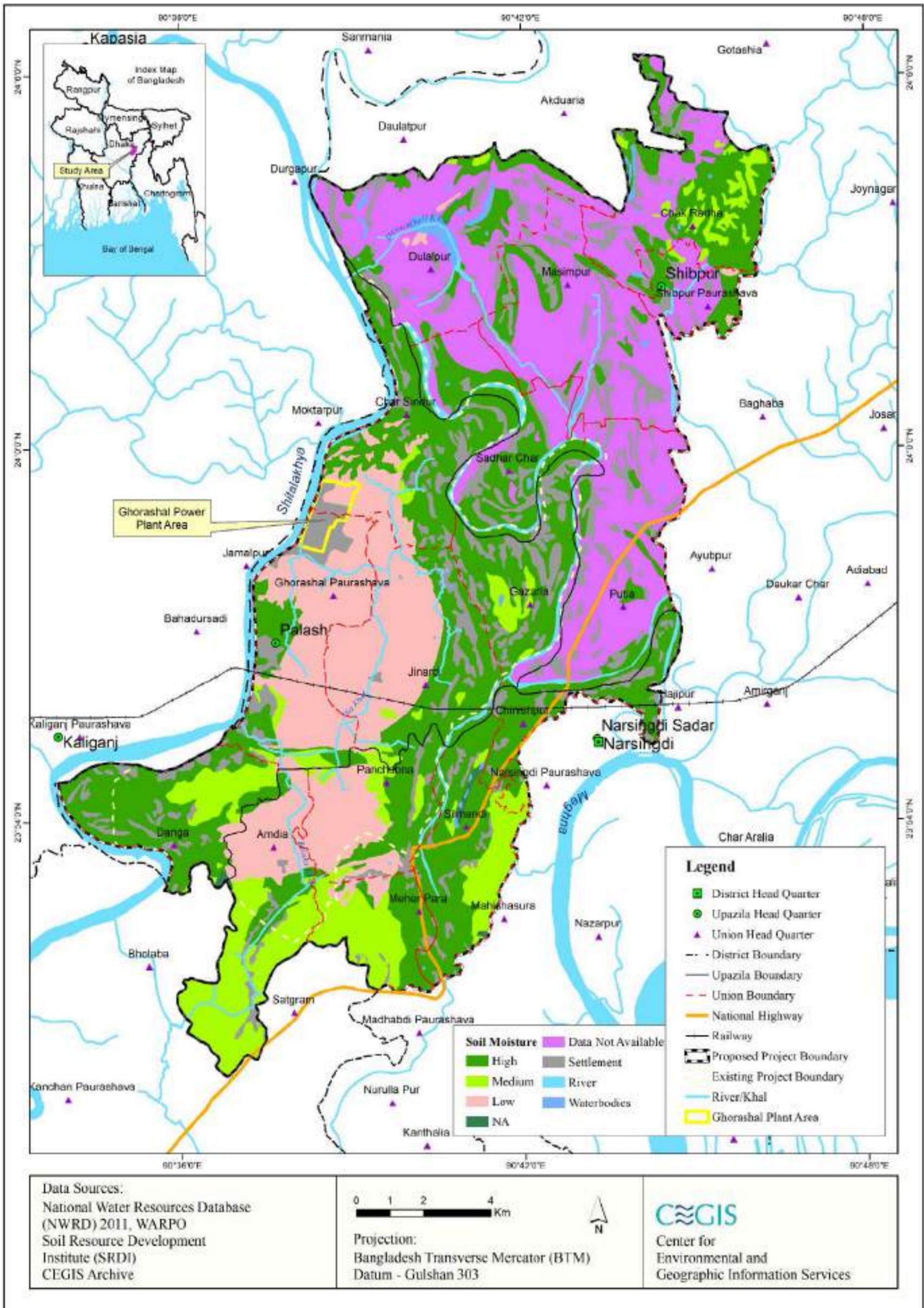


Figure 5.24: Soil Moisture Map of Palash

Drainage Class

Drainage plays a vital role in the management of soil productivity in the study area. As per the SRDI, the drainage characteristics have been divided into six classes from the agricultural point of view. The Ashuganj project area is fully under poorly drained condition. In case of Palash, poorly drained (66.32%) followed by imperfectly drained (31.29%) of the NCA.

Soil Quality Analysis

Soil samples collected from Ashuganj and Palash Project Areas underwent comprehensive analysis of five key soil parameters at the SRDI laboratory. These parameters include pH, organic matter, total nitrogen, available phosphorus, and exchangeable potassium. The analytical results were compared against SRDI standard reference values and critical limits (Ahmmed et al., 2018). The analysis reveals significant variations across sampling locations. Several parameters show deviations from established standard values.

All samples showed acidic conditions. pH values range from 4.7 to 6.0. ASQ-2 had the most acidic conditions (pH 4.7). ASQ-1 had the highest pH (6.0). This acidic condition is likely due to a combination of natural weathering processes and intensive agricultural practices, particularly the use of nitrogen-based fertilizers.

Organic matter content varied considerably. Values range from 1.50% to 3.93%. Most locations exceed the standard reference value of 0.63%. This indicates generally adequate organic content. The highest levels were found at ASQ-6, ASQ-7, and ASQ-8 (3.73-3.93%). PSQ-5 showed the lowest content at 1.50%.

Total nitrogen content ranged from 0.08% to 0.23%. Several locations fall within or below the standard range of 0.27-0.36%. ASQ-2 and PSQ-5 show critically low nitrogen levels of 0.08%. These values fall below the critical threshold of 0.12%. This indicates potential nitrogen deficiency. The low nitrogen levels are likely due to leaching from excessive rainfall and inadequate fertilizer management practices.

Available phosphorus showed extreme variability. Values range from 7.45 to 60.54 ppm. The standard range is 22.51-30.0 ppm. Six locations fall below the critical level of 7.0 ppm. These include ASQ-7, ASQ-8, PSQ-2, PSQ-3, PSQ-5, and PSQ-6. This suggests phosphorus deficiency that could significantly impact crop productivity. The phosphorus deficiency is likely due to soil fixation in acidic conditions and limited application of phosphorus fertilizers.

Exchangeable potassium levels ranged from 0.18 to 0.54 meq/100g soil. Most locations show adequate levels above the critical threshold of 0.12 meq/100g. ASQ-5 showed the lowest value at 0.18 meq/100g. ASQ-1 showed the highest at 0.54 meq/100g. The reference range is 0.27-0.36 meq/100g.

5.1.7 Water Resources

Water Resources System

Water is an indispensable natural resource for the sustenance of human life and other biota of a region. The hydrology of the study area comprises both surface water and groundwater. The sources of surface water are rivers, khals, ponds, and other wetlands. Besides surface water, groundwater is also available in the area.

Water resources play a pivotal role in sustaining irrigation and enhancing agricultural productivity. The project area encompasses a network of significant hydrological features, including the Meghna, Shitalakshya, and Titas rivers, along with an extensive system of canals. The region is reliant on both surface water sources, primarily from the Upper Meghna River and the Shitalakshya River, and groundwater reserves that serve as supplementary sources for irrigation.

Despite these hydrological advantages, the current condition of water resources presents several critical challenges. Many of the canals within the project area have undergone substantial siltation, necessitating urgent re-excavation to restore their conveyance capacity. Furthermore, sediment deposition in sections of the Shitalakshya and Titas rivers has significantly impaired their hydraulic

efficiency. During the dry season, water quality deteriorates in these rivers due to reduced flow, exacerbating concerns over the availability and sustainability of irrigation water. Addressing these challenges through systematic water resource management is imperative for ensuring the long-term viability of the project.

The details of hydrological status of the study area are provided in the subsequent sections.

Surface Water System

The project area's primary surface water sources include the Upper Meghna River, which supplies irrigation water to the Ashuganj command area, and the Shitalakshya River, which serves the Palash command area. Several khals (natural drainage channels), such as Boalia Khal, Jafor Khal, Bodguni Khal, Durgapur Khal, and Budda Khal, play an essential role in the region's water conveyance network, supporting both irrigation and drainage.

In Ashuganj, the Upper Meghna River remains a vital resource, with a peak flow rate of 19,800 m³/s during the monsoon season, ensuring ample water availability. However, during the dry season (January-April), the river experiences a substantial reduction in discharge, necessitating the implementation of water management strategies to optimize utilization. The Ashuganj Power Station significantly influences water distribution by extracting cooling water from the river and subsequently discharging a portion of it back into the irrigation system via a cooling reservoir.

Similarly, in Palash, the Shitalakshya River exhibits tidal influences during the monsoon season, while its flow diminishes markedly between January and April. Prolonged sedimentation has further reduced its effective conveyance capacity, posing challenges for maintaining a stable irrigation supply. The irrigation infrastructure in this region consists of reinforced concrete (RCC)-lined canals and earthen canals, which function as irrigation conduits during the dry season and drainage channels during the monsoon. Sustained re-excavation and systematic maintenance of these canals are imperative to mitigate flow restrictions and enhance overall water distribution efficiency. The surface water system of the study area illustrated in the following maps.

Ashuganj

The Ashuganj Project area is bounded by the river Meghna (upper) on the west and the river Titas flows on the other three sides (**Figure 5.26**). The project area also interlinks with borrow pits and many natural khals such as Boalia khal, Jafor khal, Bodguni khal, Durgapur khal, Budda khal, Sonarampur khal, Majlishpur khal, Hasina khal, Laowi khal etc. which function as drainage outlets to the adjacent Meghna & Titas rivers. There are frequent intersections of irrigation canal network with the existing drainage canals and roads.

The Ashuganj power station is using water from the Meghna (upper) river for cooling the power plants and then discharges back into the river through outfall canal. Some of the water from outfall canal is being diverted to a water-cooling reservoir by an offtake structure for irrigation purpose.

Previously the water from the reservoir is being delivered to the command area through two main canals i.e Ashuganj-Sarail-Shahbajpur borrow pit canal and Ashuganj-Andidil-Jatrapur-Tarua RCC canal. At present the borrow pit canal has filled up due to the expansion of the road, and the irrigation water supply from the power plan to the northern portion of the command area completely shut down.

The description of above-mentioned canal and Meghna (upper) river is provided below as this is the main source of surface water.

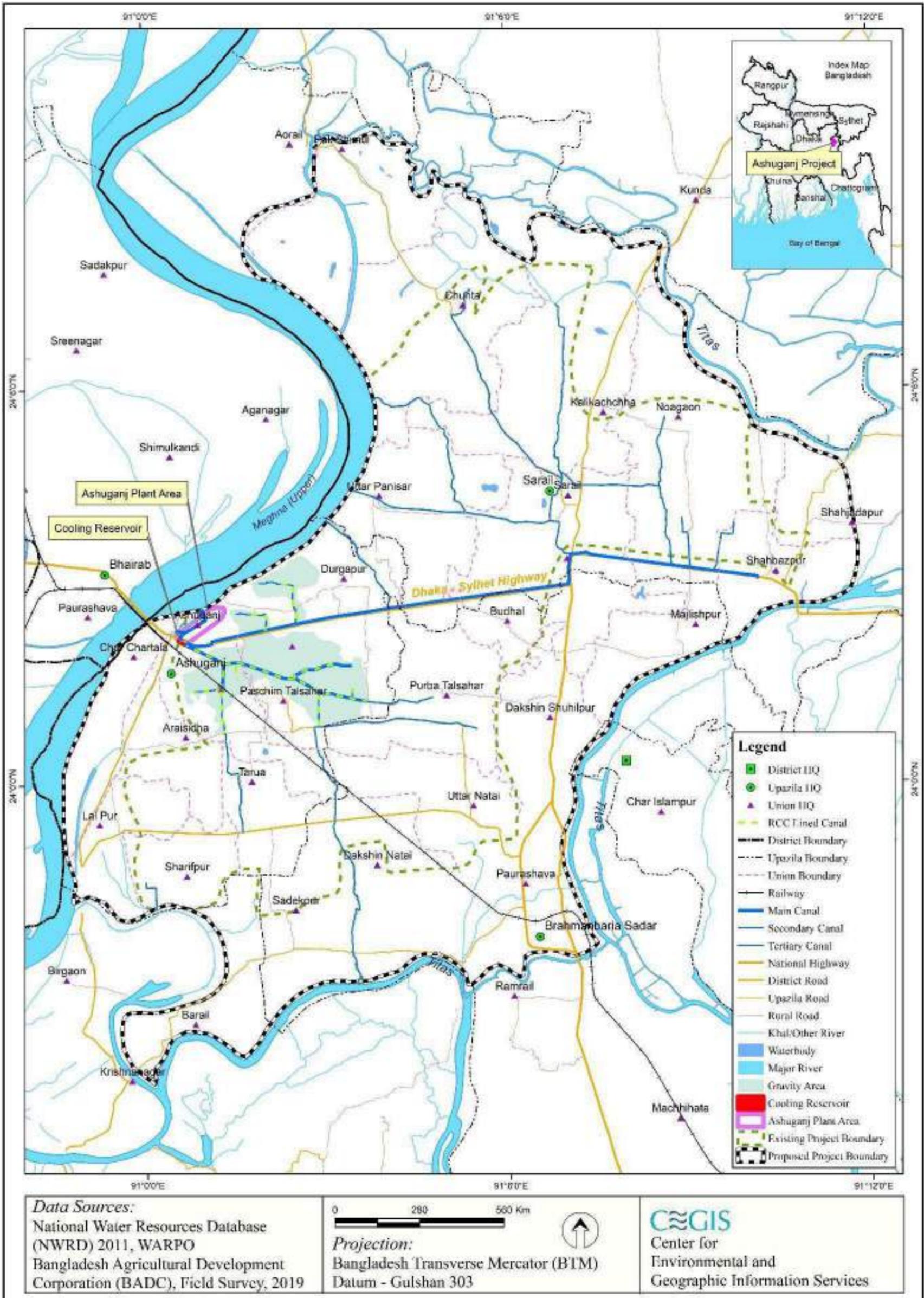


Figure 5.25: Water Resource System of the Ashuganj Area

Meghna (Upper) River: The Upper Meghna River is a major watercourse in Bangladesh, playing a crucial role in the country's hydrology and economy. It is formed by the confluence of several rivers, including the Surma and Kushiya, which originate from India and merge in Bangladesh. The Upper Meghna flows through the northeastern and central regions of the country before continuing southward as the Lower Meghna, eventually emptying into the Bay of Bengal.

The Upper Meghna serves as a key drainage channel for numerous rivers in northeastern Bangladesh. It carries large volumes of water, especially during the monsoon, helping to replenish floodplains and wetlands. The river supports agriculture, fisheries, and navigation, making it an essential lifeline for local communities. Its diverse aquatic ecosystem provides a habitat for various fish species, contributing to Bangladesh's inland fishery industry. Additionally, it plays a crucial role in maintaining the region's groundwater recharge and sediment deposition, which benefits farming activities.

The river faces several challenges, including pollution, bank erosion, and the impact of climate change. Industrial and agricultural waste has led to water quality deterioration, affecting aquatic life and human health. Erosion along the riverbanks threatens settlements and agricultural land, particularly in regions like Brahmanbaria, Kishoreganj, and Narsingdi. Additionally, climate-induced changes, such as irregular rainfall and rising sea levels, have altered the river's flow patterns, leading to unpredictable flooding and water shortages in certain seasons.

Titas River: The Titas River is a significant tributary of the Meghna River, originating in Brahmanbaria, Bangladesh. It flows through the Brahmanbaria and Cumilla districts before rejoining the Meghna. The river plays a crucial role in the region's ecosystem, supporting agriculture, fisheries, and local livelihoods.

The Titas River is vital for irrigation, fisheries, and transportation. It supports extensive rice cultivation, particularly in the floodplains, and provides sustenance to the local Malo fishing community. During the monsoon, the river overflows, replenishing wetlands and floodplain ecosystems. The Titas is also home to diverse fish species, maintaining ecological balance and biodiversity.

Over the years, pollution, siltation, and encroachment have significantly degraded the river. Industrial waste and household garbage have polluted its waters, affecting both human and aquatic life. Additionally, climate change and erratic rainfall have altered the river's flow, leading to water shortages in dry seasons and excessive flooding in monsoons. Encroachment and illegal sand mining further threaten its natural course and navigability.

Palash

The water resource system in the study area is mainly governed by the Sitalakhya, Puraton Brahmaputra, Hariduar river, also there are several small and medium canals contribute to the surface water system of the study area like; Dewankhali canal, Belabo, Nehabo, etc.

The description of major rivers is provided below:

Shitalakhya River: The Shitalakhya River is an important river in central Bangladesh, flowing through the Dhaka, Gazipur, Munshiganj, Narayanganj, and Narsingdi districts. It originates from the Old Brahmaputra River and eventually merges with the Dhaleshwari River, which further connects to the Meghna River. The river plays a significant role in transportation, industry, and agriculture.

The Shitalakhya is crucial for navigation, irrigation, and fisheries. It is one of the key waterways for commercial transport, particularly supporting Narayanganj, a major industrial hub. The river also provides water for irrigation and is home to a variety of fish species, supporting local livelihoods.

Additionally, it serves as an important freshwater source for domestic and industrial use, particularly in Dhaka and Narayanganj.

The Shitalakhya River faces serious environmental threats, including industrial pollution, encroachment, and declining water quality. Industrial effluents from textile, dyeing, and chemical factories have led to severe water pollution. Encroachment along the riverbanks has reduced its natural flow, contributing to erosion and habitat destruction. Additionally, overcrowding of vessels in the river has disrupted its ecosystem and affected navigation.

Haridoya River: The Haridoya River is a tributary of the Shitalakhya River, playing a vital role in the hydrological system of Gazipur and Narsingdi districts. The river originates from the low land of Kapasia, Narsingdi Sadar, Palash, and Shibpur upazilas and eventually merges with the Upper Meghna River. It supports local agriculture, fisheries, and water transportation in the region.

The Haridoya River serves as a key irrigation source for surrounding agricultural lands, contributing to rice and vegetable farming in Narsingdi and Gazipur. It also supports local fisheries and provides livelihoods for many river-dependent communities. The river plays an essential role in replenishing groundwater and maintaining the ecological balance of its basin.

The river faces threats from pollution, siltation, and encroachment. Increased industrial activity, particularly from textile and dyeing factories, has led to water quality deterioration. Encroachment and unregulated sand mining have also contributed to riverbank erosion, affecting both agriculture and settlements. Climate change has further altered the river's flow patterns, leading to seasonal water shortages.

Old Brahmaputra River: The Old Brahmaputra River is a historic and significant river in Bangladesh, originally the main channel of the Brahmaputra River before it shifted westward due to tectonic activity and sedimentation in the 18th century. It now flows through the Mymensingh, Kishoreganj, and Narsingdi districts before merging with the Meghna River.

The Old Brahmaputra plays a crucial role in irrigation, navigation, and fisheries. It serves as a primary water source for agriculture, particularly in Mymensingh and Kishoreganj, where it supports rice and vegetable farming. The river is also an essential fish habitat, contributing to Bangladesh's inland fisheries sector. Additionally, it helps regulate flood control and sediment transport, replenishing wetlands and low-lying areas.

Despite its historical significance, the Old Brahmaputra River is facing serious environmental challenges. Siltation and encroachment have reduced its navigability, impacting river transport and local livelihoods. Pollution from industrial and household waste has led to declining water quality, threatening both human and aquatic life. Additionally, climate change has altered the river's flow, causing seasonal water shortages and excessive flooding during the monsoon.

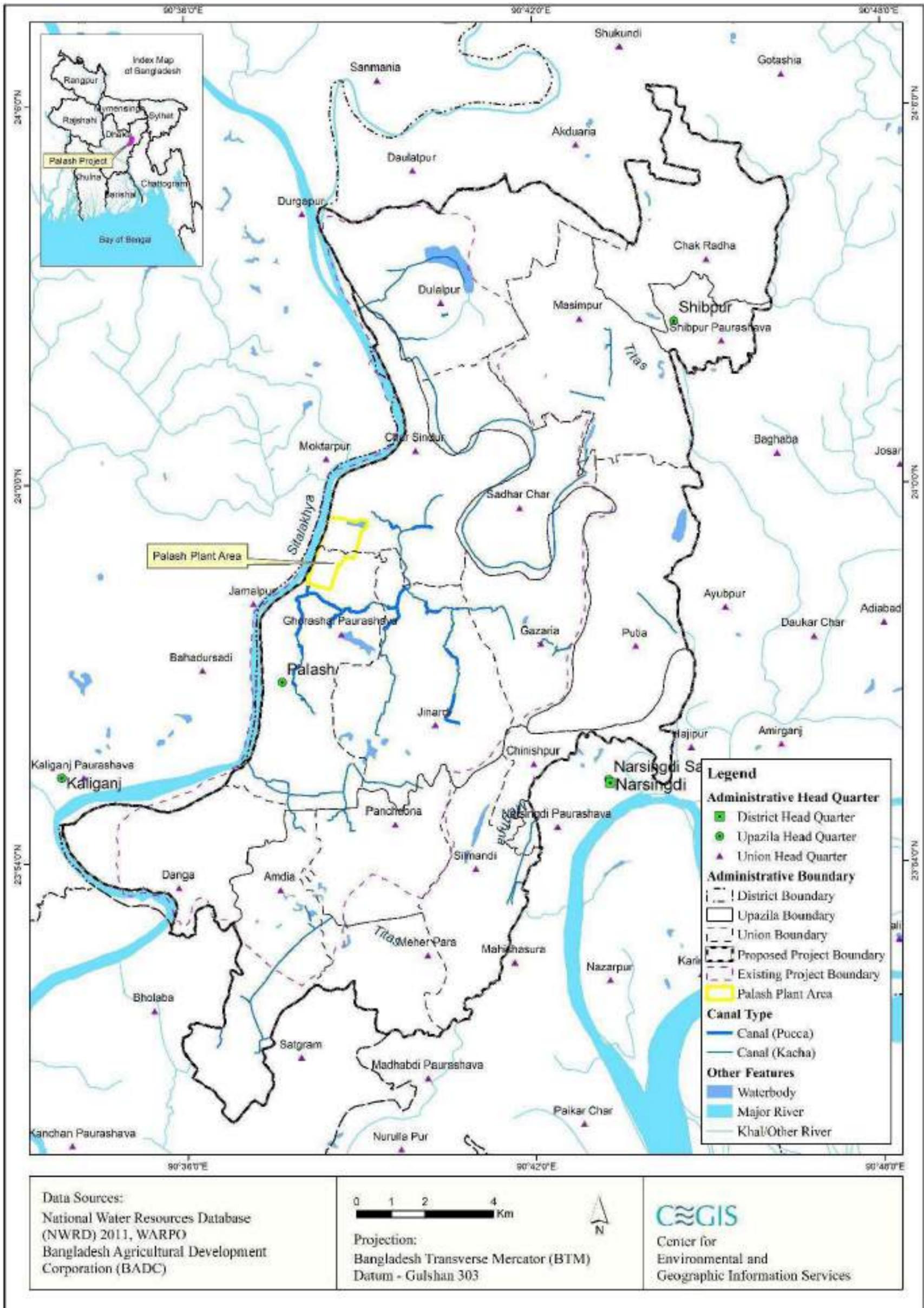


Figure 5.26: Water Resource System of the Palash Area

Hydrological Analysis

Meghna (Upper) at Bhairab Bazar

The Danger Level in this river at BWDB Bhairab Bazar Station is 6.25 m PWD. It is a Class-I Route of the BIWTA. The maximum and minimum water level as well as Discharge at Bhairab station (station id: 273) are shown in **Figure 5.27** and **Figure 5.28** respectively.

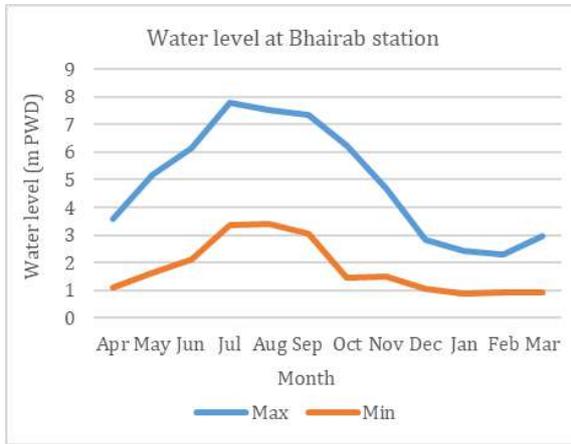


Figure 5.27: Monthly Water Level at Bhairab Station (1989-2018)

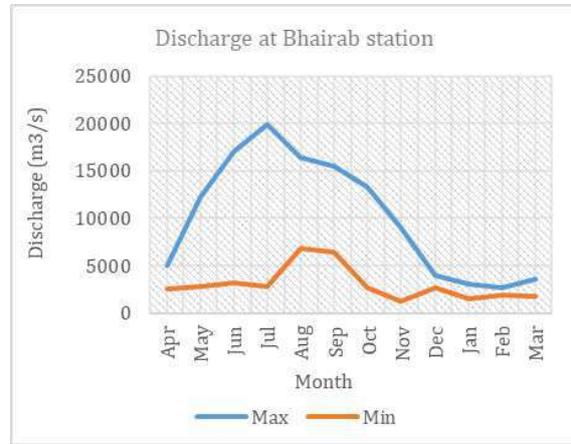


Figure 5.28: Monthly Discharge at Bhairab Station (1989-2018)

Shitalakshya River

The river is under tidal influence and maximum tidal difference is 0.60m. It is a Class-III Route of the BIWTA. The maximum and minimum water level as well as discharge at Demra station (station id: 179) of Shitalakshya River are shown in **Figure 5.29** and **Figure 5.30** respectively. **Figure 5.6** shows that the annual maximum discharge of Shitalakshya River is reducing over the years.

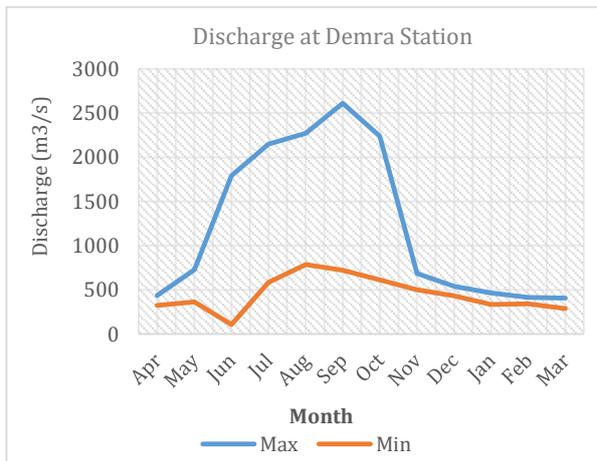


Figure 5.29: Monthly Discharge at Demra Station (1980-2009)

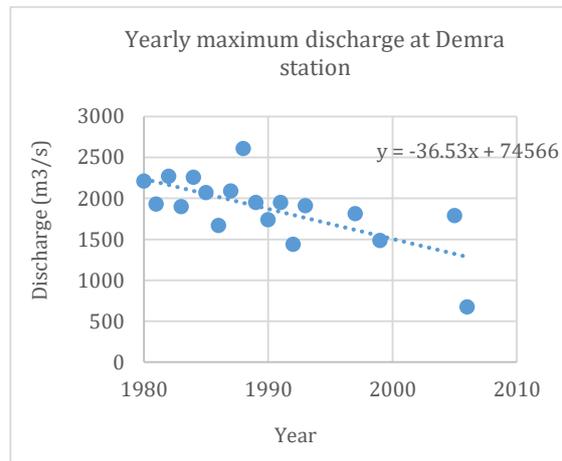


Figure 5.30: Yearly Maximum Discharge at Demra Station (1980-2009)

Drainage Congestion, and Water Logging

The project area encompassing Ashuganj (Brahmanbaria District) and Palash (Narsingdi District) is characterized by a low-lying floodplain landscape interlaced with a network of natural khals (canals), beels (depressions), and man-made drainage channels. While this natural drainage system provides

essential pathways for rainwater and surface runoff, it has been significantly compromised over the years due to siltation, unplanned infrastructure development, encroachments, and inadequate maintenance.

Ashuganj Region

In Ashuganj, several agricultural zones are seasonally affected by poor internal drainage. The natural khals in the region, such as Budhal khal, Budda khal, Naijur khal, Maishar khal, etc, have become heavily silted and narrowed, reducing their carrying capacity. Furthermore, the absence or dysfunction of adequate regulatory structures (e.g., regulators, sluice gates) prevents efficient drainage of excess rainwater during the monsoon. As a result, moderate to severe waterlogging occurs from July to September, affecting cropping intensity, delaying planting schedules, and damaging rural infrastructure.

Palash Region

Palash Upazila is similarly prone to localized waterlogging, particularly in the low-lying areas adjacent to canals such as Saner bari, Jinardi, Dighdia, Nehabo Khal, RCC main canal, etc. These drainage channels have insufficient slope and are often obstructed by aquaculture bunds, culverts, and agricultural encroachments, waste dumping, siltation. The water cannot drain efficiently into the adjacent rivers like the Shitalakhya, resulting in standing water during and after heavy rainfall events.

Groundwater Level Analysis

Groundwater level monitoring was carried out at two key locations within the project influence area: Majlishpur, B. Baria Sadar (ID: BAR006) and Jinardi, Palash (ID: NAR005). The monthly variations of groundwater depths (measured in meters below ground level) reveal distinct seasonal trends reflecting the hydrogeological response to monsoon rainfall and water demand.

The groundwater depth at Majlishpur shows typical monsoonal fluctuation. The shallowest levels occur in **August and September**, with minimum depths reaching **0.68 m and 0.38 m**, respectively—indicating high recharge during peak monsoon. The deepest levels are recorded in **April and May**, with maximum depths of **6.90 m and 6.99 m**, respectively, corresponding to the pre-monsoon dry season and high irrigation withdrawal.

The **monthly average groundwater depth** remains between **2.67 m (August)** and **5.05 m (March)**, suggesting that although groundwater is under seasonal stress, significant recharge occurs during the monsoon.

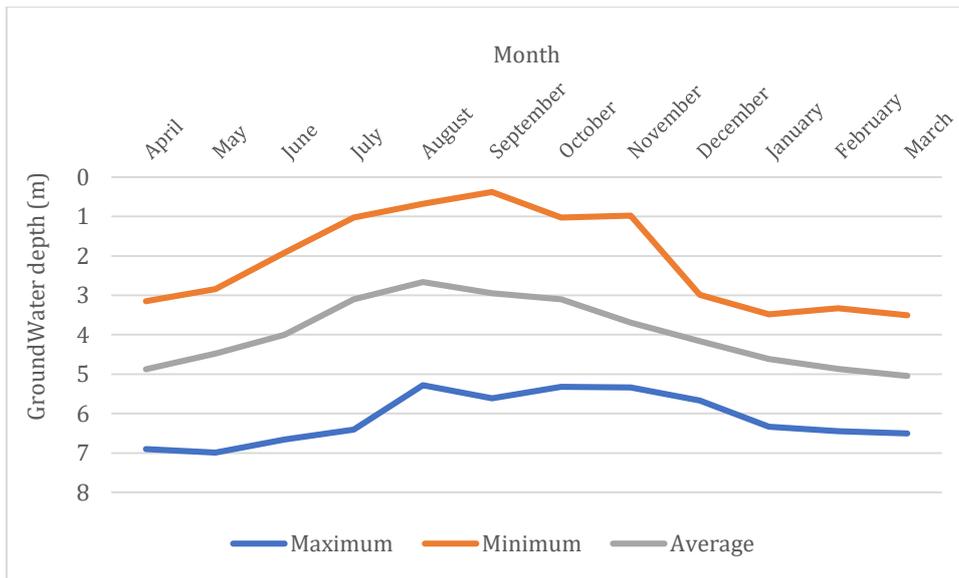


Figure 5.31: Depth of Groundwater Majlishpur, B. Baria Sadar (ID: BAR006)

The Jinardi monitoring station demonstrates a deeper overall groundwater profile compared to Majlishpur. Peak depths are observed during the dry season in **April and May**, with maximum levels of **9.35 m** and **9.37 m**, indicating substantial withdrawal pressures, likely for irrigation and domestic use. Minimum groundwater levels in monsoon months like **July (1.12 m)** and **September (1.52 m)** reflects effective recharge.

The **average monthly** groundwater depths range from **3.16 m (September)** to **5.04 m (February)**, highlighting that Jinardi may experience more prolonged dry periods and delayed recovery compared to Majlishpur.

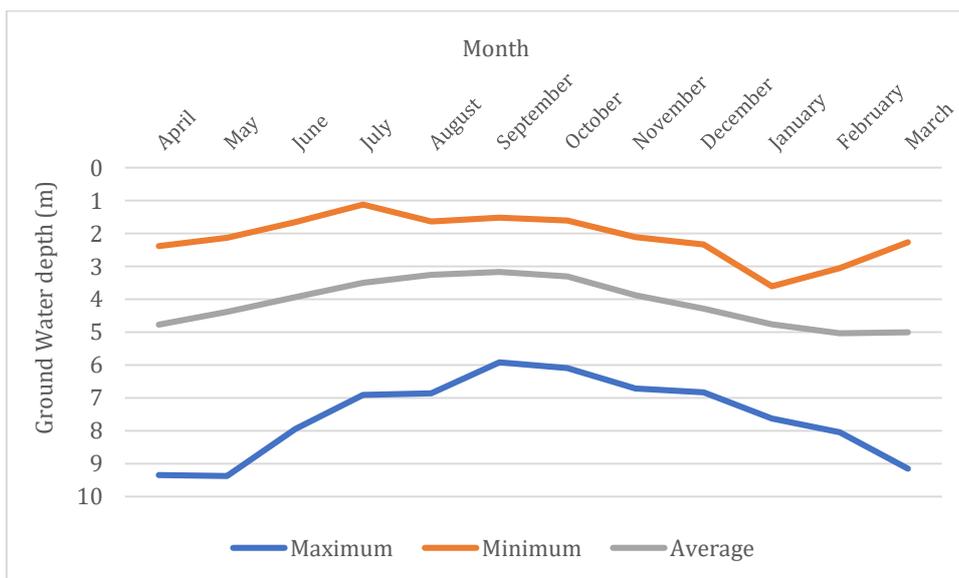


Figure 5.32: Depth of Groundwater Jinardi, Narshingdi (ID: NAR005)

Flooding

As much as 20% of Bangladesh experiences normal annual flooding while more than 50% of the country has been inundated by historical catastrophic flood events (Ali 2007; Chowdhury 2000). Exceptionally, the devastating floods of 1987, 1988, and 1998 inundated more than 60% of the nation, with serious casualties.

Ashuganj and Narshingdi district is located in the North-Central region of Bangladesh, and has an area of 1114 and 1927 km². The Narshingdi and Brahmanbaria district's elevation ranges between 5 to 15 meters (16 to 49 feet), and above sea level.

Narshingdi, located in central Bangladesh along the Meghna River, experiences periodic flooding due to monsoon rainfall and upstream water flow from the Meghna Basin. The annual flood monitoring reports indicate that Narshingdi has been affected by various flood events over the years, with water levels often surpassing danger thresholds. In past floods, Narshingdi has experienced inundation of low-lying areas, disrupted agricultural activities and impacted local infrastructure. The Meghna River plays a significant role in causing floods, particularly when excessive rainfall coincides with high tides.

Ashuganj, situated along the eastern bank of the Meghna River in Brahmanbaria District, faces severe flood risks due to its proximity to one of the major river systems in Bangladesh. Flooding in Ashuganj is primarily driven by:

- Overflow from the Meghna River due to upstream water flow from India and heavy monsoon rains.
- Storm surges and tidal effects, which exacerbate flooding conditions.
- Embankment failures and erosion, contributing to long-term flood vulnerability.
- Previous flood reports indicate that Ashuganj, like many parts of Brahmanbaria, has experienced severe floods.

Flooding situation is quite nominal in the study area. According to the opinion of the local people, the most devastating flood occurred in 1988, 1998 and 2004. During these periods of flooding, almost the entire study area was severely affected and significant amount of damage occurred. At present, only the low agricultural land goes under water about 2-3 feet during heavy rainfall and flood water does not enter into the existing households. Local people further reported that no significant flood occurred within the last ten years.

Drought

Narsingdi and Brahmanbaria are agriculturally significant districts in Bangladesh, heavily reliant on seasonal monsoons and river systems. Recent climatic shifts and anthropogenic pressures have heightened vulnerability to droughts, impacting livelihoods, ecosystems, and water security.

The study area has historically faced recurrent droughts, shaped by Bangladesh's monsoon-dependent climate and geographical vulnerabilities. These events have caused significant agricultural losses, water crises, and socio-economic disruptions.

Table 5.10: Mazor Historical Drought Event in Narshingdi and Brahmanbaria

Year	Remarks
1973-1974	The rainfall was extremely low. (FAO, 1975; Islam, 1982)
1981-1982	The Old Brahmaputra River nearly dried up 50-60% yield losses in Narshingdi, The Titas River's flow reduced drastically
1994-1995	A prolonged dry spell linked to El Niño, affecting pre-monsoon rainfall. (Ahmed, 2000) Delayed monsoon caused seedling failures in jute and vegetables Shallow tube-wells ran dry in Brahmanbaria.
1997-1999	Groundwater depletion
2006	Record-low pre-monsoon rainfall
2014-2016	El Niño-Driven Drought (Hossain et al., 2017).

In this study, De Martonne aridity index was used to identify drought scenarios. The classification of drought based on the AI is shown in the table below.

Table 5.11: Drought Types Based on Aridity Index

Aridity Index	Vegetation
<5	Desert
5-10	Dry-steppe
10-20	Prairie
20-30	Transition between grassland, and forest
30-60	less vegetation
60-100	Moderate vegetation
100<	More vegetation

The assessment of drought conditions in the Narsingdi and Brahmanbaria regions was conducted using the Aridity Index (AI), which is calculated based on annual rainfall and average temperature. The AI values were analyzed and classified according to the standard Drought Types Based on Aridity Index to determine the prevailing drought characteristics in these areas.

The dataset includes AI values over a period of 30 years, providing an extensive overview of climatic variations. The statistical analysis of AI values shows:

- Mean AI: 47.37
- Minimum AI: 28.74
- Maximum AI: 70.35
- Standard Deviation: 11.35

These values indicate variability in drought severity over time, with fluctuations in AI influencing the vegetation and water availability in the study area.

The AI values were categorized based on the established Drought Types and then estimated the frequency:

- Less Vegetation (AI: 30-60) - 25 occurrences
- Moderate Vegetation (AI: 60-100) - 4 occurrences
- Transition between Grassland and Forest (AI: 20-30) - 1 occurrence

The data suggests that the majority of years fall under the Less Vegetation category (30-60 AI), indicating moderate drought conditions where water availability and vegetation density are lower than optimal levels. Additionally, Moderate Vegetation conditions (60-100 AI) were observed in four years, suggesting periods of relatively higher rainfall and favorable growing conditions. One year recorded an AI in the Transition between Grassland and Forest (20-30 AI) range, indicating a period of more severe drought stress. **Figure 5. 33** shows the changes in Aridity Index over the period of 1992 to 2021 in the Dhaka district.

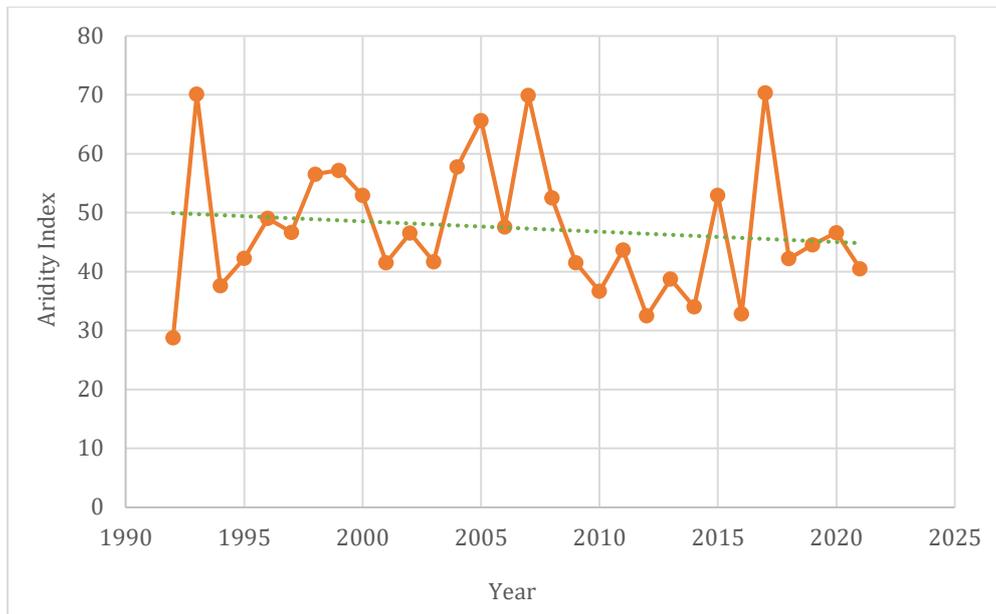


Figure 5.33: Annual Aridity Index (1993-2022) at Dhaka Station

The drought analysis for Narsingdi and Brahmanbaria highlights significant fluctuations in aridity conditions, with most years classified under Less Vegetation. This necessitates proactive measures in water resource management, agricultural adaptation, and infrastructure development to ensure resilience against climate variability and potential drought impacts.

Problem and Issues in Water Resource

Water resource management in the study area faces significant challenges due to both natural and anthropogenic factors. The availability, quality, and sustainability of water resources are increasingly under stress, affecting agricultural productivity, ecosystem health, and overall socio-economic stability. Understanding these challenges is crucial for developing effective mitigation and adaptation strategies.

Water Scarcity and Seasonal Variability: One of the primary issues in water resource management is the seasonal fluctuation in water availability. The region experiences substantial variations in rainfall, with excessive water availability during the monsoon season and acute shortages in the dry season. This imbalance leads to water stress in critical periods, affecting irrigation, drinking water supply, and industrial use. Again, the agriculture of the study area largely depends on the irrigation water from Ashuganj and Ghorashal Power plant. In recent time the Northern main canal closed due to the expansion of Ashuganj-Sarai highway. Which leads the farmers to depend on the ground water for irrigation. The over-reliance on groundwater exacerbates this issue, as groundwater levels continue to decline due to excessive abstraction during dry months.

Siltation and Reduced Conveyance Capacity: Several rivers and canals in the region, including the Meghna, Shitalakshya, and Titas, have been affected by siltation. The deposition of sediments reduces the conveyance capacity of these water bodies, leading to inefficient irrigation water distribution and an increased risk of flooding. Many of the earthen and RCC canals are partially or fully silted up, requiring frequent maintenance and re-excavation to restore their functionality.

Water Quality Deterioration: Water pollution is a growing concern in the study area, particularly during the dry season when the flow of rivers and canals is minimal. Industrial effluents, agricultural runoff, and domestic waste discharge contribute to poor water quality. The Shitalakshya and Titas Rivers are particularly affected, with high levels of pollutants detected during the low-flow months.

The contamination of surface and groundwater sources further exacerbates the water crisis by limiting safe and sustainable water availability.

Groundwater Depletion: Excessive groundwater extraction for irrigation has led to a decline in groundwater tables, making it increasingly difficult for farmers to access water. Observations from BWDB monitoring wells in Ashuganj and Palash indicate a long-term downward trend in groundwater levels. Over-extraction, combined with insufficient recharge, threatens the long-term sustainability of groundwater resources. This issue is further complicated by saline intrusion in certain areas, rendering groundwater unsuitable for agricultural use.

Encroachment and Unauthorized Water Use: The unauthorized occupation and encroachment of water channels and reservoirs have disrupted the natural flow of water, reducing the effectiveness of irrigation infrastructure. Illegal dumping of solid waste, unregulated construction along water bodies, and unauthorized water withdrawal for commercial use have further stressed the system.

Infrastructure Deficiencies: The existing water management infrastructure, including regulators, sluice gates, and embankments, is aging and in need of rehabilitation. Several regulators and sluice gates are non-functional, limiting the ability to control water flow efficiently. Additionally, the lack of modernized irrigation systems results in high conveyance losses, further reducing the efficiency of available water resources.

Climate Change Impacts: The increasing unpredictability of climate patterns, including erratic rainfall, prolonged droughts, and extreme flooding, poses additional risks to water resource management. Climate change is expected to exacerbate existing problems, leading to greater variability in river flows, reduced groundwater recharge, and heightened risks of water-related disasters.

Addressing the water resource challenges in the study area requires an integrated approach that combines infrastructure improvements, sustainable water management practices, pollution control measures, and regulatory enforcement. Ensuring long-term water security will necessitate enhanced monitoring, increased public awareness, and investment in climate-resilient water infrastructure. Without proactive intervention, these issues will continue to threaten the sustainability of water resources in the region.

5.2 Environmental Quality

5.2.1 Water Quality

The study area comprises a complex water network of rivers, canals, beels, ditches, and ponds, which collectively contribute to the hydrological, ecological, and socio-economic fabric of the region. As such, understanding the baseline situation of both surface water and groundwater quality is essential, particularly in the context of the implementation of any interventions in this area. The baseline report on water quality provides critical data about the current state of the water quality in the area and serves as a reference for future monitoring and assessment of changes in water quality. This information is crucial for conducting an accurate and comprehensive Environmental Impact Assessment (EIA) before any development activities.

Water Sampling Location: A total of fifteen (15) surface water (SW) samples were collected from several locations in Ashuganj (8) and Palash (7). Besides surface water, twelve (12) groundwater (GW) samples were collected from tube wells that are being used for community purposes at various locations in Ashuganj (7) and Palash (5). The wells range in depth from approximately 65 to 400 feet, and their purpose is to assess the physicochemical properties of the water. The sampling locations are shown in **Figure 5.34** and **Figure 5.35**. **Table 5.12** and **Table 5.13** display the details of the sampling locations.



Figure 5.34: Sampling Locations of Surface Water and Ground Water within the Ashuganj Project Area

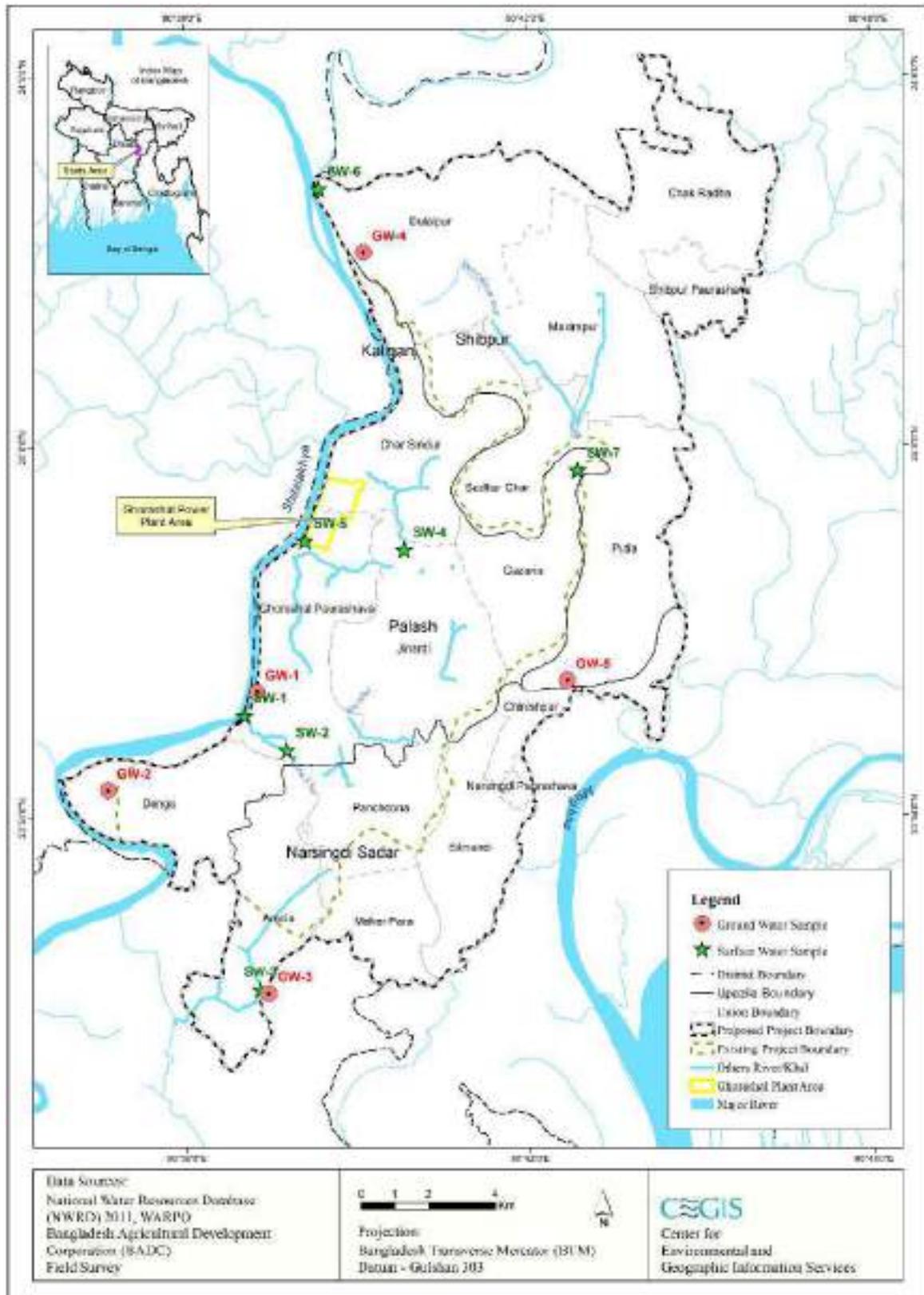


Figure 5.35: Sampling Locations of Surface Water and Ground Water within the Palash Project Area

Table 5.12: Surface Water Sampling Locations

Sample No	Sampling Location	Latitude	Longitude
Ashuganj Project Area			
ASW-1	Ashuganj industrial water discharge canal to Meghna River, Ashuganj, Brahmanbaria	24° 2'36.87"N	91° 0'18.33"E
ASW-2	Main RCC canal, Ashuganj, Brahmanbaria	24° 2'10.83"N	91° 0'17.67"E
ASW-3	River Connected Canal, Nishchintopur, Sharail, Brahmanbaria	24° 7'2.45"N	91° 3'6.64"E
ASW-4	Secondary Canal, Ashuganj, Brahmanbaria	24° 1'37.10"N	91° 2'21.97"E
ASW-5	Tertiary Canal, Ashuganj, Brahmanbaria	24° 1'1.72"N	91° 4'2.04"E
ASW-6	Primary Canal Downstream, Ashuganj, Brahmanbaria	23°59'18.89"N	91° 1'26.01"E
ASW-7	Secondary Canal, Sarail, Brahmanbaria	24°02'33.6"N	91°00'21.8"E
ASW-8	Secondary Canal, Sadar, Brahmanbaria	23°57'28.06"N	91° 3'14.86"E
Palash Project Area			
PSW-1	Shitalakshya River, Ghorashal, Narshingdi	23°55'41.35"N	90°36'51.80"E
PSW-2	Secondary and Tertiary Canal Line, Ghorashal, Narshingdi	23°55'7.80"N	90°37'35.74"E
PSW-3	Secondary Canal downstream, Sadar, Narshingdi	23°51'15.62"N	90°37'7.12"E
PSW-4	Main Canal Downstream, Palash, Narshingdi	23°58'5.20"N	90°39'25.59"E
PSW-5	Main Canal Upstream, Shitalakshya River	23°58'32.22"N	90°37'49.20"E
PSW-6	Brahmaputra- Shitalakshya River Confluence.lakhpur Ghat, Palash, Narshigdi	24° 4'9.92"N	90°38'8.45"E
PSW-7	Chinadi Beel, Dulalpur, Palash, Narshingdi	24° 3'41.74"N	90°40'24.10"E

Table 5.13: Ground Water Sampling Locations

Sample No	Sampling Location	Latitude	Longitude
Ashuganj Project Area			
AGW-1	Ashuganj industrial Area, Ashuganj, Brahmanbaria	24° 2'17.15"N	91° 0'45.20"E
AGW-2	Lalpur bazar, Ashuganj, Brahmanbaria	23°58'48.32"N	90°58'45.94"E
AGW-3	Khaqkchail, Ashuganj, Brahmanbaria	23°59'28.25"N	91° 2'40.09"E
AGW-4	Birampur Chakbazar, Sadar, Barhmanbaria	23°57'30.72"N	91° 3'9.26"E
AGW-5	Asutagram Bazar, Ashuganj, Brahmanbaria	24° 6'6.14"N	91° 5'47.90"E
AGW-6	Kalikaccha, Sarail, Brahmanbaria	24° 3'56.61"N	91° 6'56.42"E
AGW-7	Natai, Sadar, Barhmanbaria	23°59'19.83"N	91° 5'25.40"E
Palash Project Area			
PGW-1	Ghorashal bazar, Narshingdi	23°56'4.68"N	90°37'4.71"E
PGW-2	Islampara Primary School , Palash, Narshigdi	23°54'29.11"N	90°34'28.57"E
PGW-3	Purinda Bazar, Sadar, Narshigdi	23°50'53.11"N	90°37'47.86"E
PGW-4	Lakhpur Bazar, Palash, Narshigdi	24° 4'10.87"N	90°38'23.51"E
PGW-5	Velanagar bazar, Palash, Narshigdi	23°56'14.77"N	90°42'30.17"E

Surface Water Quality

The following **Table 5.14** contains the surface water quality data for both the Ashuganj and Palash project areas in comparison to the Bangladesh standard for irrigation use as per ECR'23.

Table 5.14: Surface Water Quality Status

Parameters	Unit	SW-1	SW-2	SW-3	SW-4	SW-5	SW-6	SW-7	SW-8	Bangladesh Standard (ECR'23) for irrigation
Ashuganj Project Area										
pH	-	7.5	7.8	8.0	7.8	7.3	7.5	7.5	8.0	6.5-8.5
Temp	°C	26.2	26.3	31.0	28.9	28.0	32.6	27.2	30.6	-
DO	mg/l	3.6	5.9	6.8	5.5	5.6	4.5	5.2	6.5	-
EC	µS/cm	417	131	126	128	161	240	105.1	387	2250
TDS	mg/l	208	65.5	62	64	80.1	121	75.2	194	≤1000
BOD	mg/l	8.8	3.5	4.0	4.5	5.2	4.0	4.8	6.0	≤12
COD	mg/l	48	17	21	21	70	46	24	51	100
Nitrate-Nitrogen	mg/l	3.4	1.3	1.0	0.8	2.0	1.0	5.2	1.0	5
Orthophosphate	mg/l	5.68	0.12	0.14	0.15	0.19	1.08	0.53	1.12	2
Palash Project Area										
pH	-	7.5	7.8	8.0	7.2	8.1	8.1	8.5	-	6.5-8.5
Temp	°C	27.2	26.3	26.3	24.0	26.7	26.7	31.6	-	-
DO	mg/l	5.2	5.9	5.5	4.2	6.5	6.5	8.5	-	-
EC	µS/cm	150.1	131	67.5	346	360	360	489	-	2250
TDS	mg/l	75.2	65.5	33.7	173	181	181	245	-	≤1000
BOD	mg/l	1.9	2.8	3.0	3.2	1.6	1.7	6.0	-	≤12
COD	mg/l	20	37	19	28	22	20	45	-	100
Nitrate-Nitrogen	mg/l	1.1	0.2	0.9	3.0	1.6	0.8	3.0	-	5
Orthophosphate	mg/l	0.59	0.37	0.47	0.84	0.49	0.40	0.39	-	2

Based on the water quality data, here's a discussion of each parameter:

pH: The pH values in Ashuganj project area range from 7.3 to 8.0, while in Palash project area they range from 7.2 to 8.6. Both areas show slightly alkaline conditions, with Palash having a slightly higher maximum pH (8.6 at SW-7). All sampling points in both areas fall within the Bangladesh Standard (ECR'23) range of 6.5-8.5 for irrigation. High alkalinity can adversely affect nutrient uptake in crops, potentially causing nutrient deficiencies and imbalances of calcium and magnesium².

Temperature: Temperature readings in Ashuganj range from 26.2°C to 32.6°C, with SW-6 recording the highest temperature. In Palash, temperatures range from 24.0°C to 31.6°C, with SW-7 showing the highest value. Temperature variations can affect dissolved oxygen levels and microbial activity in

² <https://ag.umass.edu/greenhouse-floriculture/greenhouse-best-management-practices-bmp-manual/water-quality-for-crop-production>

water bodies³. Higher temperatures typically accelerate microbial metabolism, potentially increasing oxygen demand and biochemical processes in the water.

Dissolved Oxygen (DO): DO levels in Ashuganj range from 3.6 to 6.8 mg/l, while Palash shows slightly higher values ranging from 4.2 to 8.5 mg/l. The lowest DO value (3.6 mg/l) was recorded at SW-1 (Industrial water discharge canal to Meghna River) in Ashuganj, which could be concerning for aquatic life. Low DO levels can result from excessive algae growth, decomposition of organic matter, and high temperatures. Agricultural runoff containing fertilizers can fuel algal blooms, leading to oxygen depletion as these organisms decompose⁴.

Electrical Conductivity (EC): EC values in Ashuganj vary widely from 105.1 to 417 $\mu\text{S}/\text{cm}$, while Palash shows a range from 67.5 to 489 $\mu\text{S}/\text{cm}$. Both areas have EC values well below the Bangladesh Standard of 2250 $\mu\text{S}/\text{cm}$ for irrigation.

Total Dissolved Solids (TDS): TDS in Ashuganj ranges from 62 to 208 mg/l, and in Palash from 33.7 to 245 mg/l. All values are significantly below the Bangladesh Standard of ≤ 1000 mg/l for irrigation. Elevated TDS can result from biological contaminants, agricultural runoff containing pesticides and fertilizers, and industrial discharges of salts and heavy metals.

Biochemical Oxygen Demand (BOD): BOD values in Ashuganj range from 3.5 to 8.8 mg/l, while Palash shows lower values ranging from 1.6 to 6.0 mg/l. All sampling points in both areas comply with the Bangladesh Standard of ≤ 12 mg/l. High BOD indicates excessive organic matter in water, typically from human and animal waste, agricultural runoff, and industrial processes.

Chemical Oxygen Demand (COD): COD in Ashuganj ranges from 17 to 70 mg/l, with SW-5 showing the highest value. In Palash, COD ranges from 19 to 45 mg/l. All values are below the Bangladesh Standard of 100 mg/l. COD measures everything that can be broken down using oxygen through aerobic digestion, including chemical pollutants from industrial processes.

Nitrate-Nitrogen: Nitrate-Nitrogen concentrations in Ashuganj range from 0.8 to 5.2 mg/l, with SW-7 (Secondary Canal, Sarail, Brahmanbaria) showing the highest value (Table 5.14). In Palash, values range from 0.2 to 3.0 mg/l. All sampling points in both areas are within the Bangladesh Standard of 5 mg/l for irrigation. Elevated nitrate levels primarily come from synthetic nitrogen fertilizers and intensive agriculture, with dairy farming being a significant contributor in many regions.

Orthophosphate: Orthophosphate levels in Ashuganj range from 0.12 to 5.68 mg/l, with SW-1 (Water discharge canal to Meghna River) showing an unusually high value. In Palash, values range from 0.37 to 0.84 mg/l. Most sampling points in both areas are below the Bangladesh Standard of 2 mg/l, except for SW-1 in Ashuganj which exceeds the standard, potentially indicating localized phosphate pollution from agricultural or industrial sources.

Concluding Remarks: Based on the analyzed parameters, the surface water quality in both Ashuganj and Palash project areas is suitable for irrigation purposes, with most parameters falling within the Bangladesh Standards (ECR'23) for irrigation water. However, the high orthophosphate concentration at SW-1 (Industrial water discharge canal to Meghna River) in Ashuganj, and low DO at that point has been observed open dumping of organic and other types of solid waste into the canal which causes degradation of the overall water quality (Table 5.14).

³ <https://www.fondriest.com/environmental-measurements/parameters/water-quality/water-temperature/>

⁴ <https://atlas-scientific.com/blog/causes-of-low-dissolved-oxygen-in-water/>



Figure 5.36: SW-1 of Ashuganj: Industrial Water Discharge Canal to Meghna River, Ashuganj



Figure 5.37: SW-7 of Ashuganj: Secondary Canal, Sarail



Figure 5.38: SW-2 for Ashuganj: Main RCC Canal, Ashuganj



Figure 5.39: SW-6 for Palash: Brahmaputra-Shitalakshya River Confluence, Lakhpur Ghat, Palash

Secondary Literatures Relevant to the Study: Tuli *et al.* (2024) conducted a study titled "Characterization of Power Plant Disposal Water from Two Distinct Regions in Bangladesh: A Comparative Assessment of Irrigation Feasibility." The literature mentioned the use of power plant disposal water for irrigation in Ashuganj and Palash under the Ashuganj-Palash Agro-Irrigation Project, highlighting several critical aspects related to water quality and agricultural sustainability. The following points summarize the findings relevant to water quality:

- **pH Levels:** The pH levels at Ghorashal ranged from 6.1 to 7.7, indicating near-neutral to slightly basic conditions, while Ashuganj exhibited pH values between 5.2 and 7.1, suggesting slight acidity
- **Electrical Conductivity (EC):** Ghorashal's water showed EC values ranging from 289.3 to 356.9 $\mu\text{S}/\text{cm}$, compared to Ashuganj's lower salinity levels of 123.4 to 179 $\mu\text{S}/\text{cm}$.
- **TDS Levels:** Ghorashal's water showed TDS values ranging from 157 to 201 mg/L, compared to Ashuganj's lower TDS levels of 60.98 to 97.12 $\mu\text{S}/\text{cm}$.
- **Irrigation Water Quality Index (IWQI):** The IWQI scores for Ghorashal and Ashuganj were 33.48 and 44.24, respectively, both categorizing the water as "excellent" for irrigation purposes. This indicates that the water from both sites is suitable for agricultural use, with minimal industrial or environmental impact.

Razzak *et al.* (2017) conducted a study titled “Assessment of irrigation quality of disposal water of Ashuganj-Polash agro-irrigation project, Brahmanbaria, Bangladesh” which focuses on evaluating the quality of irrigation water sourced from the disposal of a power plant of Ashuganj. The parameters assessed in the study indicate that the irrigation water from the Ashuganj-Polash Agro-Irrigation Project is suitable for agricultural use, with pH and EC values supporting its appropriateness for crop production where the pH of the power plant disposal water samples varied from 5.78 to 6.54 and the electrical conductivity of the water samples ranged from 133.60 to 171.70 $\mu\text{S}/\text{cm}$.

Groundwater Quality

The following **Table 5.15** contains the ground water quality data for both the Ashuganj and Palash project areas in comparison to the Bangladesh standard for drinking purpose as per ECR'23.

Table 5.15: Groundwater Quality Status

Parameters	Unit	GW-1	GW-2	GW-3	GW-4	GW-5	GW-6	GW-7	Bangladesh Standard (ECR'23) for Drinking
Ashuganj Project Area									
pH	-	7.9	7.7	7.2	7.6	7.5	7.1	6.9	6.5-8.5
Temp	$^{\circ}\text{C}$	23.9	24.3	25.0	24.2	24.3	24.8	24.0	20-30
DO	mg/l	2.1	2.8	3.7	2.7	2.4	2.5	2.2	-
EC	$\mu\text{S}/\text{cm}$	1172	750	221	720	810	652	760	-
TDS	mg/l	586	377	110	360	405	326	382	1000
Palash Project Area									
pH	-	7.3	7.1	7.7	7.1	7.5	-	-	6.5-8.5
Temp	$^{\circ}\text{C}$	24.1	24.5	25.0	24.3	24.9	-	-	20-30
DO	mg/l	2.7	3.5	2.2	2.1	2.0	-	-	-
EC	$\mu\text{S}/\text{cm}$	670	426	825	690	860	-	-	-
TDS	mg/l	336	211	410	345	435	-	-	1000

Based on the water quality data, here's a discussion of each parameter:

pH: In Ashuganj, pH values range from 6.9 to 7.9, while in Palash they range from 7.1 to 7.7. All sampling points in both areas fall within the Bangladesh Standard (ECR'23) range of 6.5-8.5 for drinking water. The groundwater in both project areas is slightly alkaline, with Ashuganj showing a wider range of pH values.

Temperature: Temperatures in Ashuganj range from 23.9 $^{\circ}\text{C}$ to 25.0 $^{\circ}\text{C}$, and in Palash from 24.1 $^{\circ}\text{C}$ to 25.0 $^{\circ}\text{C}$. All readings are within the Bangladesh Standard of 20-30 $^{\circ}\text{C}$ for drinking water. The temperature variations between the two project areas are minimal, indicating stable thermal conditions in the groundwater.

Dissolved Oxygen (DO): DO levels in Ashuganj range from 2.1 to 3.7 mg/l, while Palash shows slightly lower values ranging from 2.0 to 3.5 mg/l. There is no specific Bangladesh Standard for DO in drinking water. The relatively low DO levels are typical for groundwater, which is not in direct contact with the atmosphere.

Electrical Conductivity (EC): EC values in Ashuganj vary widely from 221 to 1172 $\mu\text{S}/\text{cm}$, while Palash shows a range from 426 to 860 $\mu\text{S}/\text{cm}$. There is no specific Bangladesh Standard for EC in

drinking water. The higher EC values, especially in Ashuganj, suggest a greater concentration of dissolved ions in the groundwater.

Total Dissolved Solids (TDS): TDS in Ashuganj ranges from 110 to 586 mg/l, and in Palash from 211 to 435 mg/l. All values are below the Bangladesh Standard of 1000 mg/l for drinking water, indicating acceptable levels of dissolved solids in both project areas

Concluding Remarks: Overall, the groundwater quality in both Ashuganj and Palash project areas appears to be suitable for drinking purposes based on the available parameters. All measured values fall within the Bangladesh Standards (ECR'23) for drinking water where standards are provided.

5.2.2 Noise Levels

Major noise-generating activities include the construction of long paved RCC irrigation canals, excavation and re-excavation of earthen and intake channels, installation and reconstruction of regulators, construction of syphons, aqueducts, culverts, and hydraulic structures, as well as the extensive use of heavy machinery for earthwork, concrete pouring, and material transportation. Additionally, the movement of construction vehicles, use of demolition equipment, and erection of steel and concrete structures are significant sources of elevated noise in both areas. These activities have been identified in environmental assessments as key contributors to temporary noise pollution, requiring mitigation measures to minimize impacts on workers and nearby communities.

The Department of Environment (DoE), Bangladesh, has defined standard noise levels through the Noise Pollution (control) Rules, 2006 for different areas during day and night time, which is shown in **Table 5.16**.

Table 5.16: Noise Level Standard in Bangladesh

Sl. No.	Zone Categorization	Standard Leq. dB(A)	
		Day (6:00 am – 9:00 pm)	Night (9:00 pm – 6:00 am)
1	Silent Zone	50	40
2	Residential Zone	55	45
3	Mixed Zone	60	50
4	Commercial Zone	70	60
5	Industrial Zone	75	70

Source: Bangladesh Noise Pollution (control) Rules, 2006.

- a) Silent Area, which covers hospital, medical clinic, educational institution, place of public worship, library, office, and court of law, etc., and 100 m radial area around them.
- b) Residential Area, which covers human habitations.
- c) Commercial Area, which covers commercial facilities, shops, hat-bazaar, etc.
- d) Mixed Area, which covers the residential, commercial, or industrial area.
- e) Industrial Area, which covers industries and factories.

Study areas in both Ashuganj and Palash are predominantly rural with notable industrial and residential zones, creating a mixed acoustic environment. The noise levels were measured during the daytime. No noise was measured during nighttime, as no noise-generating activities should take place during the night. **Table 5.17** presents the noise levels recorded in the Ashuganj study area, while **Table 5.18** presents the noise levels recorded in the Palash study area.

Table 5.17: Noise Level of the Ashuganj Study Area

Date and Time	Location	Source of noise	GPS Coordinate	Noise Level (dBA)
03/03/2025 09:45 am	Near Ashuganj Power plant, Ashuganj, Brahmanbaria	Industrial sound, Light to heavy vehicle movement, human movement	24°2'12.12"N 91°0'33.07"E	79
03/03/2025 11:40 am	Shohagpur Bazar, Ashuganj, Brahmanbaria	Natural noise, local market, Human Movement	24°2'38.89"N 91°2'10.05"E	59
03/03/2025 05:30 pm	Talshahar, Ashuganj, Brahmanbaria	Natural noise, local market, Human Movement, Light vehicle movement	24°1'24.05"N 91°1'52.37"E	61
04/03/2025 10:15 am	Panishwar, Sarail, Brahmanbaria	Agricultural land, Natural noise	24°4'16.71"N 91°3'36.01"E	40
04/03/2025 01:20 pm	Kalikaccha, Sarail, Brahmanbaria	Natural noise, local market, Human Movement	24°5'48.48"N 91°6'47.32"E	51
04/03/2025 04:15 pm	Natai, Brahmanbaria Sadar, Barhmanbaria	Natural noise, local market, Human Movement, Light to medium vehicle movement	23°59'20.96"N 91°5'25.80"E	58

Source: CEGIS field survey (March 2025).

Table 5.18: Noise Level of the Palash Study Area

Date and Time	Location	Source of noise	GPS Coordinate	Noise Level (dBA)
05/03/2025 11:21 am	Majlishpur, Shibpur, Narshingdi	Light to heavy vehicle movement, Natural noise, human movement	24°3'16.08"N 90°44'12.76"E	60
05/03/2025 03:40 am	Chinadi Beel, Shibpur, Narshingdi	Natural noise, Agricultural land, Wetland area	24°3'39.96"N 90°40'33.81"E	39
06/03/2025 09:30 pm	Palash bus stand, Palash, Narshingdi	Industrial sound, Light to heavy vehicle movement, human movement, Local market	23°58'47.88"N 90°38'49.19"E	72
06/03/2025 02:15 pm	Ghoorashal Bazar, Palash, Narshingdi	local bazar, Human Movement, Light to heavy vehicle movement	23°56'4.26"N 90°37'8.26"E	68
06/03/2025 05:15 pm	Nalua, Narshingdi Upazila, Narshingdi	Light to heavy vehicle movement, Natural noise, Agricultural land	23°53'36.07"N 90°39'36.81"E	55

Source: CEGIS Field Survey (March 2025).

5.2.3 Ambient Air Quality

Major activities in the project area include the construction of long paved RCC irrigation canals, excavation and re-excavation of earthen and intake channels, installation and reconstruction of regulators, construction of syphons, aqueducts, culverts, and hydraulic structures. All these activities as well as the extensive use of heavy machinery for earthwork, concrete pouring, and material transportation may alter the quality of ambient air in both the project areas. Additionally, the movement of construction vehicles and equipment, and erection of steel and concrete structures are

significant sources of air pollution in both Ashuganj and Palash area. These activities have been identified in environmental assessments as key contributors to temporary air pollution, requiring mitigation measures to minimize impacts on workers, nearby communities and the ecosystem.

The Department of Environment (DoE), Bangladesh, has defined standards of ambient air quality through the Air Pollution (control) Rules, 2022. The baseline ambient air quality of both the project area (Ashuganj and Palash) has been assessed in four specific monitoring locations. The details of monitoring locations and rationale for selecting these monitoring locations is given in **Table 5.19**. The ambient air quality monitoring results is shown in **Table 5.20**.

Table 5.19: Ambient Air Quality Monitoring Location Details

SL No.	Sample ID	Monitoring Locations	GPS Coordinate		Rationale for Locations
			Latitude	Longitude	
01	AQ-01	Poschim Talshohor Union Parishad Complex, Ashuganj, Brahmanbaria	24° 1'8.77"N	91° 2'12.40"E	<ul style="list-style-type: none"> ○ Near construction site. ○ Human settlements with bazar
02	AQ-02	Kalikaccha Union Parishad Complex, Sarail, Brahmanbaria	24° 5'38.82"N	91° 7'14.55"E	<ul style="list-style-type: none"> ○ Near construction site. ○ Human settlements with bazar
03	AQ-03	Dulalpur Bazar, Dulalpur, Shibpur, Narsingdi	24° 3'3.46"N	90°41'16.75"E	<ul style="list-style-type: none"> ○ Near construction site. ○ Human settlements.
04	AQ-04	Jinardi Union Parishad Complex, Palash, Narsingdi	23°55'53.93"N	90°40'30.16"E	<ul style="list-style-type: none"> ○ Near construction site.

Table 5.20: Ambient Air Quality Monitoring Results

Sl. No.	Criteria Pollutants	Monitoring Results				Value Exposures	Air Pollution (Control) Rules, 2022
		AQ-01	AQ-02	AQ-03	AQ-04		
1	PM ₁₀	63.96	60.76	50.46	47.86	24 hrs avg.	150 (µg/m ³)
2	PM _{2.5}	58.08	55.51	44.08	40.51	24 hrs avg.	65 (µg/m ³)
3	SO ₂	11.83	9.42	10.34	8.42	24 hrs avg.	80 (µg/m ³)
4	NO ₂	2.74	2.20	1.74	1.2	24 hrs avg.	80 (µg/m ³)
5	CO	0.354	0.314	0.254	0.244	08 hrs avg.	05 (mg/m ³)
6	O ₃	15.2	14.56	13.2	14.56	01 hr avg.	180 (µg/m ³)

Source: CEGIS Field Survey, March 2025

The monitoring result revealed that the ambient air quality both in the study area (Ashuganj and Palash) is within the permissible limit in Bangladesh. So the baseline air quality is not of much concern in both the project areas.

The result also revealed that the ambient air quality in the Palash area is comparatively good than in the Ashuganj area. This kind of ambient air quality in the Ashuganj area may result from the indirect impact of currently running Dhaka (Katchpur)-Sylhet 4-lane highway project.

5.3 Biological Environment

5.3.1 Agriculture Resources

The baseline condition of agricultural resources within the Ashuganj and Palash project area has been comprehensively documented through a systematic collection of both primary and secondary data. The assessment covered sixteen (16) irrigation blocks across seven (7) Upazilas within the project boundary, with 11 blocks located in the Ashuganj area and 5 in the Palash area. Data on agricultural resources, including cropping seasons, farming practices, cropping patterns, crop damage and production and agricultural inputs, were collected from local stakeholders and agricultural officials. Information was gathered through multiple sources: detailed field surveys, consultations with local farmers, interviews with Sub-Assistant Agriculture Officers (SAAOs), and discussions with Upazila Agricultural Officers (UAOs) from the Department of Agriculture Extension (DAE).

Farming Practices

Farming practices in the study area are largely controlled by physical, biological, climatologically and socio-economic factors. There are two distinct cropping seasons in a year. They are the Kharif and Rabi seasons. The Kharif season starts in March and ends in October, while the Rabi season starts in November and ends in February. Based on crop adaptability and crop culture, the Kharif season has been further sub-divided into the Kharif-I (March-June) and the Kharif-II (July-October) seasons.

The Kharif-I season is characterized by high temperature, low humidity, high evaporation, high solar radiation, and uncertainty of rainfall due to low alternating dry and wet spells. In this season, the study area mainly cultivates HYV Aus, Jute, and summer vegetables.

The Kharif-II season is characterized by high rainfalls, lower temperatures, high humidity, low solar radiation, and high floods that recede towards the end of the season. Due to the soil's submergence, rice is the predominant crop grown during this season. Excessive soil moisture also restricts other crops suitable for a high-temperature regime. Local and high-yielding varieties of transplanted Aman rice and summer vegetables are grown in the Kharif-II season.

In Rabi season, a wide range of crops such as HYV Boro, Pulses, Mustard and vegetables are grown in the study area. However, there are occasional overlaps such that the Kharif-I season crops HYV Aus are harvest in Kharif-II season and HYV Aman rice and some summer vegetables are harvested in Rabi season. The Rabi season crops like HYV Boro and some winter vegetables) are harvested in the Kharif-I season. The detailed list of crop varieties of the project area are depicted in the **Table 5.21**.

Table 5.21: Different Crop Varieties of Ashuganj and Palash Project Area

Crop	Varieties
Rice (Boro)	BRR1 dhan29, BRR1 dhan88, BRR1 dhan89, BRR1 dhan96, BRR1 dhan100, Binadhan-7, Binadhan-17, Binadhan-25, SL8H
Rice (T. Aman)	BRR1 dhan49, BRR1 dhan75, BRR1 dhan87, BRR1 dhan90, BRR1 dhan95, Chinigura, Kalojira, Najirshail
Rice (HYV Aus)	BRR1 dhan48, BRR1 dhan98
Mustard	BARI Sarisha-14, BINA Sarisha-9
Banana	Amrit Sagar, Champa, Shobri

Source: CEGIS field data collection, 2025

Cropping Patterns and Intensity

Cropping pattern refers to the distribution and proportion of land allocated to different crops within an agricultural system at a specific point in time. Traditionally, farmers develop their cropping pattern by their own experiences, which is largely governed by various factors mainly land topography, irrigation availability and rainfall. Sometimes farmers also discuss with the local Sub-Asstt. Agriculture Officers (SAAOs) of the Department of Agriculture Extension (DAE) for their suggestions. According to local farmers, cropping patterns and crop varieties changed by about 50% compared to the past ten years.

Crop intensity refers to the frequency of cropping on a given piece of land within a specific time frame, typically expressed as the number of crops grown per year. In the study area, crop intensity is influenced by factors such as irrigation availability, soil fertility and climatic conditions.

Ashuganj: The Ashuganj area is characterized by predominant rice-based cropping systems, with HYV Boro being the most common crop in the Rabi season, HYV Aman in Kharif-II and HYV Aus in selected areas during Kharif-I. The most prevalent cropping patterns include Fallow-HYV Aman-HYV Boro and Fallow-Fallow-HYV Boro, with triple cropping patterns like HYV Aus-HYV Aman-HYV Boro being practiced in the project area. The main blocks generally show higher cropping intensities compared to the extended areas. Detailed cropping patterns of different blocks are presented in **Table 5.22**.

Cropping intensity varies significantly across blocks, ranging from 171% in Block F to 246% in Block D, reflecting differences in land types, soil conditions, and water availability. Vegetable cultivation is prominent in Blocks B and G, while pulses and mustard serve as important secondary crops in several blocks. The agricultural land consists of 4,467 ha under single cropping, 16,264 ha under double cropping and 17,803 ha under triple cropping. The overall cropping intensity of this area is 208%.

Table 5.22: Block-wise Cropping Pattern and Intensity in Ashuganj Project Area

Land Type	Present Cropping Patterns			Area (ha)	Percent of NCA	Crop Intensity (%)
	Kharif-I	Kharif-II	Rabi			
Block-A						
F1	Fallow	HYV Aman	Mustard+ HYV Boro	9	0.9	239
F2	Fallow	HYV Aman	Mustard+ HYV Boro	484	44.9	
F2	Fallow	HYV Aman	HYV Boro	515	47.8	
F2	Fallow	Fallow	HYV Boro	69	6.4	
Total				1,077	100	
Block-B						
F1	HYV Aus	HYV Aman	HYV Boro	7	1.0	237
F1	Fallow	HYV Aman	Mustard+ HYV Boro	159	23.0	
F1	S. Vegetables	S. Vegetables	W. Vegetables	103	14.9	
F2	Fallow	HYV Aman	Pulses	7	1.0	
F2	S. Vegetables	S. Vegetables	W. Vegetables	200	28.9	
F2	Fallow	Fallow	HYV Boro	216	31.3	
Total				691	100	
Block-C						
F1	HYV Aus	HYV Aman	HYV Boro	76	6.8	215
F1	Fallow	HYV Aman	Mustard+ HYV Boro	68	6.0	
F1	S. Vegetables	S. Vegetables	W. Vegetables	23	2.0	
F1	Fallow	HYV Aman	W. Vegetables	132	11.7	

Land Type	Present Cropping Patterns			Area (ha)	Percent of NCA	Crop Intensity (%)
	Kharif-I	Kharif-II	Rabi			
F2	Fallow	HYV Aman	W. Vegetables	334	29.6	
F2	Fallow	HYV Aman	Pulses	495	43.9	
Total				1,127	100	
Block-D						
F1	HYV Aus	HYV Aman	HYV Boro	338	32.1	246
F1	Fallow	HYV Aman	HYV Boro	354	33.7	
F1	Fallow	HYV Aman	Mustard+ HYV Boro	144	13.7	
F1	S. Vegetables	Fallow	Mustard	88	8.4	
F2	S. Vegetables	Fallow	Mustard	66	6.2	
F2	S. Vegetables	Fallow	W. Vegetables	62	5.9	
Total				1,052	100	
Block-E						
F1	HYV Aus	HYV Aman	HYV Boro	167	12.4	203
F1	Fallow	HYV Aman	HYV Boro	414	30.7	
F1	S. Vegetables	Fallow	W. Vegetables	28	2.1	
F1	Fallow	HYV Aman	Mustard+ HYV Boro	117	8.7	
F2	Fallow	HYV Aman	Mustard+ HYV Boro	187	13.9	
F2	Fallow	Fallow	Pulses	433	32.2	
Total				1346	100	
Block-F						
F2	Fallow	HYV Aman	Mustard+ HYV Boro	141	15.32	171
F3	HYV Aus	Fallow	HYV Boro	369	40.00	
F4	Fallow	Fallow	HYV Boro	181	19.57	
F5	Fallow	Fallow	HYV Boro	232	25.11	
Total				923	100	
Block-G						
F1	HYV Aus	HYV Aman	HYV Boro	246	13.0	229
F1	S. Vegetables	S. Vegetables	W. Vegetables	617	32.5	
F2	S. Vegetables	S. Vegetables	W. Vegetables	14	0.7	
F2	Fallow	HYV Aman	Mustard+ HYV Boro	29	1.5	
F2	Fallow	HYV Aman	HYV Boro	627	33.0	
F2	Fallow	Fallow	HYV Boro	364	19.2	
Total				1,897	100	
Block-H						
F1	HYV Aus	HYV Aman	HYV Boro	429	22.1	229
F2	HYV Aus	HYV Aman	HYV Boro	344	17.7	
F2	Fallow	HYV Aman	HYV Boro	441	22.8	
F2	Fallow	HYV Aman	Mustard+ HYV Boro	106	5.5	
F2	Jute	HYV Aman	Fallow	97	5.0	
F2	S. Vegetables	S. Vegetables	W. Vegetables	102	5.3	
F3	Fallow	Fallow	HYV Boro	14	0.7	
F4	Fallow	Fallow	HYV Boro	406	21.0	

Land Type	Present Cropping Patterns			Area (ha)	Percent of NCA	Crop Intensity (%)
	Kharif-I	Kharif-II	Rabi			
Total				1,939	100	
Extended-1						
F1	Fallow	HYV Aman	HYV Boro	772	27.8	192
F1	Jute	HYV Aman	W. Vegetables	150	5.4	
F2	Fallow	HYV Aman	HYV Boro	103	3.7	
F2	HYV Aus	Fallow	HYV Boro	848	30.5	
F2	Fallow	Fallow	Mustard+ HYV Boro	249	9.0	
F3	Fallow	Fallow	Mustard+ HYV Boro	295	10.6	
F3	Fallow	Fallow	HYV Boro	297	10.7	
F4	Fallow	Fallow	HYV Boro	65	2.3	
Total				2778	100	
Extended-2						
F1	HYV Aus	HYV Aman	HYV Boro	271	16.4	214
F1	Fallow	HYV Aman	HYV Boro	719	43.6	
F1	Fallow	HYV Aman	Mustard+ HYV Boro	125	7.6	
F2	Fallow	HYV Aman	Mustard+ HYV Boro	73	4.4	
F2	S. Vegetables	Fallow	W. Vegetables	222	13.5	
F2	Fallow	Fallow	HYV Boro	240	14.5	
Total				1649	100	
Extended-3						
F1	HYV Aus	HYV Aman	HYV Boro	599	14.8	182
F2	Fallow	HYV Aman	Mustard+ HYV Boro	608	15.0	
F2	Fallow	HYV Aman	HYV Boro	121	3.0	
F2	Jute	Fallow	HYV Boro	405	10.0	
F3	HYV Aus	Fallow	HYV Boro	368	9.1	
F4	Fallow	Fallow	HYV Boro	1,748	43.1	
F4	Fallow	Fallow	Pulses	203	5.0	
Total				4,053	100	
Grand Total				18,533	-	-
Single Cropped Area (SCA)				4,467		
Double Cropped Area (DCA)				16,264		
Triple Cropped Area (TCA)				17,803		
Total Cropped Area				38,534		
Cropping Intensity (%)				208		

Source: Estimation based on field visit, March 2025, supported by UAO, SAAO of DAE and local farmers.

Palash: The Palash area is characterized by diverse cropping systems, with HYV Boro being the predominant crop in the Rabi season, followed by HYV Aman in Kharif-II and HYV Aus in selected areas during Kharif-I. The most prevalent cropping patterns include Fallow-HYV Aman-HYV Boro and Fallow-Fallow-HYV Boro, with triple cropping patterns such as HYV Aus-HYV Aman-HYV Boro also being practiced in the project area. The main blocks generally exhibit higher cropping intensities compared to the extended areas. Detailed cropping patterns of different blocks are presented in **Table 5.23**.

Cropping intensity varies significantly across blocks, ranging from 197% in Extension 2 Block to 255% in Block A. Vegetable cultivation is particularly prominent in Blocks C and Extension 1, while mustard serves as an important secondary crop in several blocks. The agricultural land consists of 2,520 ha under single cropping, 7,617 ha under double cropping, and 14,933 ha under triple cropping. The overall cropping intensity of this area is 222%.

Table 5.23: Block-wise Cropping Pattern and Intensity in Palash Project Area

Land Type	Present Cropping Patterns			Area (ha)	Percent of NCA	Crop Intensity (%)
	Kharif-I	Kharif-II	Rabi			
Block-A						
F0	Banana	Banana	Banana	106	7.80	255
F0	Papaya	Papaya	Papaya	34	2.51	
F1	S. Vegetables	S. Vegetables	W. Vegetables	273	20.07	
F2	HYV Aus	HYV Aman	HYV Boro	101	7.42	
F2	Fallow	HYV Aman	HYV Boro	335	24.65	
F2	Jute	Fallow	Mustard+ HYV Boro	121	8.89	
F3	Fallow	HYV Aman	Mustard+ HYV Boro	390	28.68	
Total				1359	100	
Block-B						
F0	Banana	Banana	Banana	42	2.07	205
F0	Papaya	Papaya	Papaya	36	1.78	
F0	S. Vegetables	S. Vegetables	W. Vegetables	185	9.05	
F1	HYV Aus	Fallow	HYV Boro	187	9.17	
F1	Fallow	HYV Aman	Mustard+ HYV Boro	286	14.00	
F2	Fallow	HYV Aman	HYV Boro	725	35.50	
F3	Fallow	HYV Aman	W. Vegetables	300	14.72	
F3	Fallow	Fallow	HYV Boro	280	13.72	
Total				2,041	100	
Block-C						
F0	Banana	Banana	Banana	145	5.81	218
F0	S. Vegetables	S. Vegetables	W. Vegetables	345	13.78	
F1	S. Vegetables	S. Vegetables	W. Vegetables	382	15.26	
F1	Jute	Fallow	HYV Boro	260	10.40	
F1	Fallow	HYV Aman	Mustard+ HYV Boro	247	9.85	
F2	Fallow	HYV Aman	HYV Boro	752	30.06	
F2	Fallow	Fallow	HYV Boro	138	5.50	
F3	Fallow	Fallow	HYV Boro	234	9.34	
Total				2,503	100	
Extension 1						
F0	Papaya	Papaya	Papaya	143	4.48	238
F0	S. Vegetables	S. Vegetables	W. Vegetables	1498	47.04	
F1	S. Vegetables	Fallow	HYV Boro	915	28.72	
F1	Fallow	HYV Aman	Mustard+ HYV Boro	238	7.47	
F2	Fallow	Fallow	HYV Boro	392	12.30	
Total				3,185	100	

Land Type	Present Cropping Patterns			Area (ha)	Percent of NCA	Crop Intensity (%)
	Kharif-I	Kharif-II	Rabi			
Extension 2						
F0	Banana	Banana	Banana	234	10.56	197
F1	S. Vegetables	S. Vegetables	W. Vegetables	490	22.09	
F1	Fallow	HYV Aman	Mustard+ HYV Boro	424	19.11	
F2	Fallow	HYV Aman	HYV Boro	334	15.05	
F3	Fallow	Fallow	HYV Boro	719	32.40	
F4	Fallow	Fallow	HYV Boro	17	0.78	
Total				2,218	100	
Grand Total				11,306		
Single Cropped Area (SCA)				2,520		
Double Cropped Area (DCA)				7,617		
Triple Cropped Area (TCA)				14,933		
Total Cropped Area				25,070		
Cropping Intensity (%)				222		

Source: Estimation based on field visit, March 2025, supported by UAO, SAAO of DAE and local farmer

Cropped Area

Ashuganj: The total cropped area in the Ashuganj project area is 38,534 hectares of which the rice cropped area is 29,229 hectares (75.85%) and the non-rice cropped area is 86,522 hectares (24.15%). The details are presented in **Table 5.24**.

Table 5.24: Block-wise Cropped Area in the Ashuganj Project

Location	Area (ha)										Grand Total
	HYV Aus	HYV Aman	HYV Boro	Total Rice Crop	Jute	S. Vegetables	W. Vegetables	Mustard	Pulses	Total Non-rice	
Block A	0	1,009	1,077	2,086	-	-	-	493	-	493	2,579
Block B	7	173	382	562	-	605	302	159	7	1,073	1,635
Block C	76	1,105	144	1,325	-	45	489	68	495	1,096	2,421
Block D	338	836	836	2,010	-	216	62	298	-	576	2,586
Block E	167	885	885	1,937	-	28	28	305	433	793	2,730
Block F	369	141	923	1,433	-	-	-	141	-	141	1,575
Block G	246	902	1,266	2,414	-	1,261	631	29	-	1,921	4,335
Block H	772	1,416	1,740	3,928	97	204	102	106	-	509	4,438
Extended 1	848	1,025	2,629	4,502	150	-	150	544	-	843	5,345
Extended 2	271	1,188	1,427	2,886	-	222	222	198	-	642	3,528
Extended 3	967	1,329	3,850	6,145	405	-	-	608	203	1,216	7,361
Total Area	4,062	10,008	15,159	29,229	652	2,582	1,986	2,949	1,137	9,305	38,534

Source: CEGIS field estimation, March 2025, UAO, SAAO of DAE and local farmers.

Palash: The total cropped area in the Palash project area is 25,070 hectares of which the rice cropped area is 11,511 hectares (45.92%) and the non-rice cropped area is 13,559 hectares (54.08%). The details are presented in **Table 5.25**.

Table 5.25: Block-wise Cropped Area in the Palash Project

Location	Area (ha)											Grand Total
	HYV Aus	HYV Aman	HYV Boro	Total Rice Crop	Jute	S. Vegetables	W. Vegetables	Mustard	Banana	Papaya	Total Non-rice	
Block A	101	826	946	1,873	121	545	273	511	106	34	1,590	3,462
Block B	187	1,311	1,478	2,975	-	370	485	286	42	36	1,219	4,195
Block C	-	999	1,631	2,630	260	1,454	727	247	145	-	2,833	5,463
Extended 1	-	238	1,544	1,782	-	3,911	1,498	238	-	143	5,790	7,572
Extended 2	-	758	1,494	2,251	-	980	490	424	234	-	2,128	4,379
Total Area	288	4,131	7,092	11,511	381	7,260	3,473	1,705	528	213	13,559	25,070

Source: CEGIS field estimation, March 2025, UAO, SAAO of DAE and local farmers.

Crop Production and Damage

The total crop production was estimated using the formula: Total crop production = damage-free area × normal yield + damaged area × damaged yield. The main agricultural production comes from non-rice crops.

Ashuganj: In Ashuganj project area, total crop production is 159,626 metric tons, of which total annual rice (clean) production is 99,834 metric tons and non-rice crops are 59,792 metric tons. Total crop production loss is 3,552 metric tons, of which rice (clean) is 2,909 metric tons and non-rice 643 metric tons. Details are presented in **Table 5.26**.

Table 5.26: Damage Free Area, Damaged Area, Yield, Production and Production Lost in the Ashuganj Project

Location	Area (ha)										Grand Total
	HYV Aus	HYV Aman	HYV Boro	Total Rice Crop	Jute	S. Vegetables	W. Vegetables	Mustard	Pulses	Total Non-rice	
Damage free Area	4,062	9,527	14,644	28,233	642	2,520	1,986	2,855	1,115	9,117	37,350
Avg. Damage free Yield (ton/ha)	2.4	3.0	4.2		2.2	10.0	14.0	1.3	1.5		
Damaged Area	0	480	515	996	10	62	0	94	22	188	1,183
Avg. Damaged	0	2.3	3.5		1.8	8	0	1.1	1.2		

Location	Area (ha)										Grand Total
	HYV Aus	HYV Aman	HYV Boro	Total Rice Crop	Jute	S. Vegetables	W. Vegetables	Mustard	Pulses	Total Non-rice	
Yield (ton/ha)											
Total Production (ton)	9,748	28,582	61,504	99,834	1,413	25,198	27,798	3,711	1,673	59,792	159,626
Production Lost (ton)	0	1,105	1,804	2,909	18	496	0	104	26	643	3,552

Source: CEGIS field estimation, March 2025, UAO, SAAO of DAE and local farmers.

Palash: In Palash project area, total crop production is 196,504 metric tons, of which total annual rice (clean) production is 41,897 metric tons and non-rice crops are 154,607 metric tons. Total crop production loss is 4,486 metric tons, of which rice (clean) is 2,981 metric tons and non-rice 1,505 metric tons. Details are presented in **Table 5.27**.

Table 5.27: Damage Free Area, Damaged Area, Yield, Production and Production Lost in the Palash Project

Location	Area (ha)											Grand Total
	HYV Aus	HYV Aman	HYV Boro	Total Rice Crop	Jute	S. Vegetables	W. Vegetables	Mustard	Banana	Papaya	Total Non-rice	
Damage free Area	288	3,687	6,528	10,504	363	7,193	3,473	1,583	491	208	13,311	23,815
Avg. Damage free Yield (ton/ha)	2.5	3.2	4.5		2.4	12	15	1.5	20	15		
Damaged Area	0	443	564	1,007	19	66	0	122	36	5	248	1,256
Avg. Damaged Yield (ton/ha)	0	2.4	3.4		1.9	10	0	1.3	16	13		
Total Production (ton)	720	11,800	29,378	41,897	870	86,320	52,095	2,374	9,828	3,121	154,607	196,504
Production Lost (ton)	0	1,064	1,917	2,981	36	664	0	158	582	65	1,505	4,486

Source: CEGIS field estimation, March 2025, UAO, SAAO of DAE and local farmers.



Figure 5.40: View of HYV Boro Rice Field in Kalikaccha, Sarail



Figure 5.41: View of Mustard Field in Tarua, Ashuganj



Figure 5.42: View of Banana Field in Dulalpur, Shibpur



Figure 5.43: View of HYV Boro Rice Field in Danga, Palash

Agricultural Input Use

Seed: The role of seeds is very important for growing crops. The seed rate (kg/ha) varies from crop to crop and from block to block. Usually, the seed rate of Ashuganj and Palash project area is higher than the recommended rate. Seed is available in the local market and about 20-30% of farmers are using their seed. The seed rate used (Kg/ha) in the study area is presented in **Table 5.28**.

Labor: In the study area, more than 50% of the cultural practices for crop production are being done manually. So, agricultural labor is considered one of the essential inputs for crop production. The number of labor requirements varies from crop to crop, season to season and from area to area. The labor requirement of different crops is presented in **Table 5.29**.

Fertilizer and Pesticide

The rate of fertilizer use per hectare varies considerably from farmer to farmer depending on soil fertility, cropping pattern, and financial ability of the farmer. The major fertilizers used in this area are Urea, TSP, MP and Gypsum. According to local farmers of the project area, they usually use less fertilizer in the BADC's irrigated agricultural field. The use of pesticides depends on the degree of pest infestation. Local farmers reported that they are using different types (powder and liquid) of pesticides: Virthako, Sumikron, Setara, Abamectin, Acephate, Acetamipirid, Bifenthrin, Cartap, Carbofuran, Carbosulfan, Cumulus, Thiovit, Karate, Basudin(10G), Diazinon(10G), Bistracin, Furfuran,

Vita furan, Bison, Dimecron, Marshal, Ricord, Melathin(57EC), Diazinon(60L), Bristol, Bavistin, Sumithion, and Enfuran, etc. to prevent pest infestation in rice and non-rice crop fields. In the local market fertilizer and pesticide is available to the dealers. Details of fertilizer and pesticide use are shown below in **Table 5.28 and 5.29**.

Table 5.28: Present Input Use of Ashuganj Project Area

Crop Name	Seed	Labor	Fertilizers (Kg/ha)						Pesticide	
	(Kg/ha)	(Nos./ha)	Urea	TSP	MP	Gypsum	Zn	Compost	No. of application	Liq. (ml/ha) apx.
HYV Boro	40-45	130-140	150	75	100	1	1	-	3	1500
HYV Aman	35-40	120-130	90	70	80	-	1	-	2	1000
HYV Aus	30-32	120-130	70	60	50	-	-	-	1	500
Jute	7.5	80-90	50	30	30	-	-	-	-	-
Vegetables	2-4	80	140	80	90	1	2	1000	5	2000
Mustard	6	90	60	40	30	-	-	-	1	400
Pulses	25-30	70	30	40	10	-	-	-	-	-

Source: Farmers interviewed and SAAO's information and March 2025

Table 5.29: Agricultural Inputs Used in Palash Project Area

Crop Name	Seed	Labor	Fertilizers (Kg/ha)						Pesticide	
	(Kg/ha)	(Nos./ha)	Urea	TSP	MP	Gypsum	Zn	Compost	No. of application	Liq. (ml/ha) apx.
HYV Boro	45	110-120	150	75	100	1	1	-	3	1500
HYV Aman	40	100-110	90	70	80	-	1	-	2	1000
HYV Aus	40	90-100	70	60	50	-	-	-	1	500
Jute	7	80-90	50	30	30	-	-	-	-	-
Vegetables	2-4	80-90	140	80	90	1	2	1000	5	2000
Mustard	5	90-100	60	40	30	-	-	-	1	400
Banana	650 (sucker)	150	160	110	50	3	-	7-10 kg/plant	2	1000
Papaya	700 (sapling)	120	130	60	20	0	-	5	0	0

Source: Farmers interviewed and SAAO's information and Mar 2025



Figure 5.44: Consultation with Local Fertilizer Dealer and Farmers



Figure 5.45: Key Information Interview with Upazila Agriculture Officers (UAOs)

Irrigation

Both groundwater and surface water are utilized for crop cultivation during the dry (Rabi) season. Irrigation is provided via Deep Tube Wells (DTWs), Shallow Tube Wells (STWs), and Low Lift Pumps (LLPs); note that all STWs are privately installed. Re-excavation of khals could potentially irrigate an additional 7,000–8,000 hectares. LLPs are particularly used for surface water irrigation, benefiting HYV Boro and Rabi crops. Some crops are rain-fed during both Kharif seasons. However, irrigation costs are notably high (2,000–3,000 BDT per Kani) (1 Kani= 30 decimal) a reflection of the need to double-lift surface water from rivers and canals.

The irrigation data from the Ashuganj Project shows significant spatial variations in agricultural water management across the region. Overall, 17,154 ha of the total cropped area is irrigated, with HYV Boro rice dominating as the primary irrigated crop, covering 15,159 hectares compared to just 1,986 hectares for winter vegetables. One hundred percent of the HYV Aus and approximately eighty percent of the jute and summer vegetables require supplementary irrigation. Detailed irrigated area of Ashuganj is shown below **Table 5.30**.

Table 5.30: Block-wise Irrigated Area of Ashuganj Project

Block Name	Crop name		Block-wise Irrigated Area (ha)	% of total cropped area
	HYV Boro	Winter Vegetables		
Block A	1,077	-	1,077	6.3
Block B	382	302	684	4.0
Block C	144	489	633	3.7
Block D	836	62	898	5.2
Block E	885	28	913	5.3
Block F	923	-	923	5.4
Block G	1,266	631	1,897	11.1
Block H	1,740	102	1,842	10.7
Extended 1	2,629	150	2,778	16.2
Extended 2	1,427	222	1,649	9.6
Extended 3	3,850	-	3,850	22.5
Total Area (ha)	15,159	1,986	17,145	100.00

Sources: Field information and DAE, March 2025

The Palash Project shows a more diverse farming pattern while irrigating about 10,565 ha of its total agricultural land. Unlike Ashuganj, Palash spreads irrigation across multiple crops. While rice (HYV Boro) remains important with 7,092 hectares, a significant portion is dedicated to winter vegetables (3,473 hectares). Supplementary irrigation is essential for the entire area of HYV Aus and about eighty percent of jute and summer vegetables. Uniquely, Palash also irrigates 528 hectares of banana plantations. Detailed irrigated area of Palash is shown below **Table 5.31**.

Table 5.31: Block-wise Irrigated Area of Palash Project

Block Name	Crop name		Block-wise Irrigated Area (ha)	% of total cropped area
	HYV Boro	Winter Vegetables		
Block A	946	273	1,325	11.9
Block B	1,478	485	2,005	18.1
Block C	1,631	727	2,503	22.6
Extended 1	1,544	1,498	3,042	27.4
Extended 2	1,494	490	2,218	20.0
Total Area (ha)	7,092	3,473	10,565	100.00

Sources: Field information and DAE, March 2025



Figure 5.46: Irrigation through RCC Main Canal in Ashuganj



Figure 5.47: Irrigation through Buried Pipe in Sarail



Figure 5.48: Irrigation through Shallow Tube Well (STW) in Shibpur



Figure 5.49: Irrigation through Double Lifting (LLP) in Palash

Problems and Issues

The cultivation of crops in the study area faces several significant challenges. Waterlogging severely impacts T. Aman rice production during the Kharif II season, disrupting growth and reducing yields. During the Rabi season, farmers struggle with irregular irrigation facilities, making it difficult to maintain consistent water supply for crops. Additionally, heavy rainfall frequently occurs just before the harvesting period of High Yielding Variety (HYV) Boro rice, compromising grain quality and causing substantial harvest losses. These constraints collectively hinder agricultural productivity and economic returns for farmers in the region.

The overall problems and issues of crop production in the Ashuganj and Palash project areas are diseases, pests, and environmental hazards that affect major crops like rice, vegetables, banana and papaya. Details of diseases and hazards of major crops are in **Table 5.32**.

Table 5.32: Diseases and Hazards of Major Crops

Rice			Other crops	General threats
Diseases	Pests	Environmental hazards		Wildlife
<ul style="list-style-type: none"> • Brown spot • Blast • Sheath blight • Yellow stem borer 	<ul style="list-style-type: none"> • Rice bugs • Brown planthoppers • Leaf rollers 	<ul style="list-style-type: none"> • Heavy rainfall • Waterlogging • Flash floods • Sudden storms • Heatwaves 	<ul style="list-style-type: none"> • Fruit weevil • Brinjal fruit and shoot borer <p>Banana:</p> <ul style="list-style-type: none"> • Panama disease <p>Papaya:</p> <ul style="list-style-type: none"> • Various pest infestations 	<ul style="list-style-type: none"> • Rats

A few specific problems and issues related to agriculture are presented below:

- The main source of irrigation water (Talla Khal) in Tarua Union of Ashuganj Upazila has become silted up and filled with water hyacinths.
- In Talshohor Union of Ashuganj Upazila, the RCC canal is heavily silted (up to 3 feet of sediment) that disrupt water flowing during the dry season.
- Farmers in Tarua Union face a growing crisis as irrigation water consistently arrives two months behind schedule (February or March).
- In Talshohor Purba Union, water scarcity due to siltation and poor canal conditions has increased irrigation costs (Tk. 2,500-3,000 per kanal).
- High iron content in groundwater in Tarua Union is reducing paddy yields.
- RCC canals in Tarua Union and Talshohor Union are leaking, causing water loss and damaging nearby mustard fields (up to 50% crop loss).
- RCC canal structures in Talshohor Union are deteriorating, with exposed stones and rods.
- In Talshohor Purba Union, some buried pipes are damaged, leading to water waste.
- Current irrigation costs in Tarua Union and Talshohor Purba Union are high (Tk. 2,000-3,000 per kanal), but access to Green Project water could reduce these costs by half.
- In Talshohor Purba Union, waterlogging persists for 15-20 days, causing 20% damage to Aman paddy.
- In Noagaon Union of Sarail Upazila, irrigation has been halted since 2021 due to the closure of key khals (Jafar Khal, Lauya Khal, Budda Khal, Kumtala Khal), reducing arable land and crop production.
- Farmers face a 20-day delay in receiving water from BADC in Danga Union, Palash, delaying boro rice planting.
- The Gopirai Para canal in Palash has leveled with agricultural land, requiring urgent re-excavation.



Figure 5.50: Fallow Land due to Unavailability of Irrigation Water Near Kuttapara, Sarail



Figure 5.51: Silted Up and Water Hyacinth Clogged Dewankhali Canal at Shibpur

5.3.2 Livestock and Poultry

Livestock and Poultry Population

Livestock and poultry are vital components of an integrated farming system and significantly contribute to the economy of the study area.

Ashuganj: The livestock resources are mainly cattle, buffalo, goats, sheep, chickens and ducks. Household level rearing is common in most of the farm families. The estimated livestock and poultry population in the project area is presented in **Table 5.33**.

Table 5.33: Livestock and Poultry Population in Ashuganj Project area

Upazila	Cattle	Buffalo	Goat	Sheep	Chicken	Ducks
B. Baria Sadar	47,417	630	2,062	545	585,601	125,176
Ashuganj	30,420	65	3,700	300	417,864	28,960
Nabi Nagar	25,776	370	3,702	431	214,904	68,750
Sarail	59,089	656	9,850	1,007	682,859	26,707
Total	162,702	1,721	19,314	2,283	1,901,228	249,593

Sources: DLS and field investigation, March 2025

Table 5.34: Percent of Families Keeping Livestock and Poultry Birds

Name of Livestock and Poultry	% of HH Having Livestock/ Poultry
Cow/Bullock	36
Buffalo	2
Goat	4
Sheep	2
Duck	60
Chicken	55

Sources: DLS and field investigation, March 2025

Palash: The livestock resources in the project areas are mainly cattle, buffalo, goats, sheep, chickens and ducks. Livestock and poultry population in project area (Palash) is given below.

Table 5.35: Livestock Population in Project Area (Palash)

Upazila	Cattle	Buffalo	Goat	Sheep	Chicken	Ducks
Narsinghdi Sadar	179,927	65	32,150	3,510	1,352,000	57,300
Palash	26,221	42	17,654	1,786	432,258	34,569
Shibpur	48,836	38	22,144	879	511,533	49,758
Total	254,984	145	71,948	6,175	2,295,791	141,627

Source: Reflected from the DLS estimation, 2025

Chicken and ducks are the major type of poultry in the project areas. From the **Table 5.36** it is evident that in Palash area, chicken population is many times more than duck population.

Table 5.36: Families Keeping Livestock and Poultry in Project Area (Palash)

Livestock and Poultry species	% of HH having Livestock/ Poultry
Cow	52
Buffalo	1
Goat	16
Sheep	2
Chicken	57
Ducks	31

Source: Reflected from the DLS estimation, 2025

**Figure 5.52: View of Livestock and Poultry in the Study Area**

Feed and Fodder

Feed and fodder information was collected through consultation with local farmers, Upazila Livestock Officer (ULO) and Veterinary Surgeons (VS) of the study area. Livestock owners of the study are facing problems concerning the availability of feed and fodder during the monsoon season due to the non-availability of grazing land. During the monsoon (July-October), most of the area remains underwater and HYV Aman rice remains in the field then the rice straw/rice hay is the only source of fodder. Besides grass, rice polish and oil cakes are also common fodders in the study area. During the dry season, especially from late December to late April, grazing land is available. The poultry and duck population at the family level survive by scavenging and generally, no feed supplements are provided. However, the livestock and poultry farmers used readymade feed from the union/village level market.

Livestock and Poultry Diseases

In the study area, production of livestock and poultry is mainly constrained by diseases and death of the population. According to the Upazila Livestock Officer (ULO) and Veterinary Surgeon (VS), every year livestock population is affected by different diseases. According to VS, the unhygienic condition of the courtyard during this season increases the diseases of poultry birds. May to October months is the period of spreading diseases to livestock and poultry populations on a large scale. However, some diseases are spread around the year. The VS informed that some women/men vaccinators were developed, they are providing vaccination, and presently the percentage of disease is less. Details of the study area are presented in **Table 5.37**.

Table 5.37: Diseases of Livestock and Poultry in the Study Area

Livestock & Poultry Name	Name of Diseases	Disease (Timing)	Causes
Cow/Bullock	FMD	May to July	Viral
	Mastitis	June to September	Indigestion
	Pet Fula	Round the year	Indigestion
Goat	Paste des petits Ruminants (PPR)	June to September	Helminth
	Pneumonia	Round the year	Viral
Sheep	PPR	May to September	Bacterial
Duck	Plague	September to December	Viral
	Cholera	Round the year	Viral
Chicken	New castle (Ranikhet)	Round the year	Viral
	Fowl Pox	March to July	Viral

Sources: DLS and field investigation, March 2025

5.3.3 Fisheries Resources

The study area covers two regions namely the Ashuganj Irrigation Command Area (AICA) and the Palash Irrigation Command Area (PICA). These areas have various water bodies, such as rivers, canals, borrow pits, beels, and aquaculture ponds, which act as fish habitats either seasonal or perennial. These habitats play an important role in fish production, supporting both local and national needs through both capture (natural) and culture (farmed) fisheries. The Ashuganj-Palash Green Project, run by BADC, uses cooling water from the Ghorashal and Ashuganj Power Plants for irrigation in a sustainable way. This project promotes eco-friendly farming while highlighting the importance of fisheries for food security and rural livelihoods in the study area.

Fisheries (Capture Fisheries)

Ashuganj

The fisheries habitats in the area include river, canal/Khal, Borrow pit and floodplain (**Figures 5.53-5.54**). The Meghna River falls within the study area which plays a crucial role in the connectivity of various canals and fish habitats, influencing the distribution and abundance of fish species in the study area. The additional water from the power plant is discharged into the Meghna River through the Poschim Bazar Canal which supports different type of fish species such as Bele, Gaura, Rui, Catla, Boal, Ayre, Kachki, Taki etc.

There are some natural Khals of which important ones are Budda khal, Golanika khal, Jafor khal, Sonarampur Khal, Dharmar khal, Bitghor Khal and Badguni Khal. Among the Khals, the Sonarampur

Khal, Dharmar khal is connected with the Meghna River and the Badguni Khal is connected with the Titas River. Local people reported that these Khals are seasonal and become active in monsoon. During monsoon, the Khals function as fish migration route and breeding ground for some Small Indigenous Species (SIS) and live fishes. The Poschim Sonarampur Khal (Main Canal-1) connects to two important water bodies namely Talshur Kur and Tollar Kur, supporting fish like Taki (*Channa punctata*), Puti (*Puntius sophore*), Shol (*Channa striata*), and Tengra (*Mystus tengara*). On the other hand, Main Canal-2, originally a borrow pit that was once a fish habitat but now become inactive due to sedimentation from highway road construction. Kalikuccho Nondipara Canal, which connects with the Golanha Haor, previously facilitated fish migration during monsoon. However, over the last four to five years, fish abundance has drastically declined due to the construction of a regulator in the canal. Additionally, the canals are covered with water hyacinth and polluted by household waste, infrastructure development, and hydrological changes have led to habitat degradation, reducing fish populations and threatening the overall aquatic ecosystem. The study area comprises some low-lying areas that become inundated by riverine flooding in the monsoon. The low-lying area is identified as floodplain habitat which functions as fish breeding, feeding and nursing ground for SIS of fish.



Figure 5.53: Partial View of the Upper Meghna River in the AICA



Figure 5.54: Partial View of Bitghor Khal in the AICA

Palash

The fisheries habitats in the study area include rivers, canals (Khal), Beels and floodplains (**Figures 5.55-5.57**). A section of the Shitalakshya River falls within this area. This river is perennial and freshwater nature. The river faces some challenges like siltation, pollution from fertilizer and coil factories has severely degraded water quality, leading to frequent fish mortality. Additionally, the presence of Sucker Mouth Catfish (*Pterygoplichthys pardalis*), an invasive species, poses a significant threat to native fish biodiversity. Despite these challenges, fishermen reported that Jhatka Ilish (juvenile Hilsa) still appears in the river during the monsoon. The peak fishing season in the river extends from Boishakh to Karthik (April to November).

Another important fish habitat is the Chinadi Beel, which is located in Shibpur Upazila and covering about 183 acres. This beel serves as a breeding, nursing, and feeding ground for small indigenous fish species (SIS). The beel is connected to the Shitalakshya River, which helps fish migration and supports aquatic life. The Department of Fisheries (DoF) runs beel nursery program twice a year for maintain fish populations. Additionally, the local community stocks fish fry worth 50,000–60,000 BDT annually to improve fish availability. Now the beel faces serious problems harming fish and other aquatic species due to discharging of pollutants from nearby a chemical factory. The beel is connected with 22 canals but many of them are now blocked due to siltation and decomposition of water hyacinths. This

has caused obstruction of fish migration, reducing fish populations over time. The common and available catch v fish species are Puti (*Puntius sophore*), Chingri (*Macrobrachium rosenbergii* / various shrimp species), Chela (*Chela cachius*), Tengra (*Mystus tengara*), Rui (*Labeo rohita*), Catla (*Catla catla*), Chital (*Notopterus chitala*), Shing (*Heteropneustes fossilis*), Koi (*Anabas testudineus*), Boal (*Wallago attu*), Bheda (*Amblypharyngodon mola*), Tilapia (*Oreochromis niloticus*), and Baim (*Mastacembelus armatus*). Local people reported that harmful fishing practices like the use of Chaina Jal and Current Jal are depleting fish stocks and damaging the ecosystem. Fish migration from khal to beel vise-versa is blocked by Bana (bamboo poles) during the monsoon. However, the primary irrigation khals, other natural khals (Dewankhali Khal, Bagdi Khal) and Beels (Lebukata Beel, Gahangir Beel, MamaBagna Beel, Silmandi Beel, etc.) function as fish habitat seasonally in the study area.



Figure 5.55: Partial View of the Shitalakshya River



Figure 5.56: Partial View of Dewankhali Khal



Figure 5.57: Partial View of Chinadi Beel

Aquaculture

Ashuganj

In the study area, freshwater aquaculture is predominantly practiced using two methods such as semi-intensive and intensive farming. Local fish farmers in the study area has widely adopted these methods for fish cultivation. According to fish farmers, some ponds require irrigation water during the dry season to maintain a suitable water level, especially for culturing Major Carp, Exotic Carp, live fish, and other fast-growing species. Most of the ponds in the area hold water at an average depth of around one meter for almost round the year. To promote rapid fish growth, supplementary feed is commonly provided in the fish pond.



Figure 5.58: Aquaculture Ponds in AICA

Palash

The culture fishery habitats in the study area are predominantly consist of freshwater aquaculture ponds and household ponds (**Figure 5.59**). These freshwater aquaculture ponds are typically perennial and large in size, providing a stable environment for fish cultivation throughout the year. The aquaculture practices in these ponds range from extensive to semi-intensive culture methods. Major carp, exotic carp, cat fish, live fish and other fast-growing fish species are cultured in these ponds. The supplementary feed is a common used in most of these ponds, ensuring rapid growth and higher yields.



Figure 5.59: Aquaculture Ponds in the PICA

Fish Habitat Assessment

The estimated area of total fish habitats in the study area is about 2,751 ha. In AICA and PICA the habitat area is about 1,155 ha and 1,595 ha respectively. The fish habitat area is detailed in the following **Table 5.38**.

Table 5.38: Fish Habitat Area in the Study Area

Habitat Category	Fish Habitat Area (Ha)		
	Habitat Type	Ashuganj	Palash
Fisheries (Capture)	River and Canal	686	208
	Beel	10	281
	Sub-Total	696	489
Aquaculture	Extensive	9	33
	Semi-intensive	285	594
	Intensive	165	473
	Baor	-	6
	Sub-Total	459	1,106
Total		1,155	1,595
Grand Total		2,751	

Source: Landuse data extracted from satellite image 2023 and CEGIS field findings, 2025

Fish Production

The estimated total fish production in the study area is about 9,941 metric ton (MT). In AICA and PICA the habitat area is about 2,832 MT and 7,109 MT respectively. The breakdown of fish production in the study area is shown in **Table 5.39**.

Table 5.39: Fish Production in the Study Area

Habitat Category	Fish Production (MT)		
	Habitat Type	Ashuganj	Palash
Fisheries (Capture)	River and Canal	313	95
	Beel	13	327
	Sub-Total	325	422
Aquaculture	Extensive	14	49
	Semi-intensive	1128	2307
	Intensive	1365	4320
	Baor	-	13
	Sub-Total	2,506	6,687
Total		2,832	7,109
Grand Total		9,941	

Source: Production estimation based on DoF 2023 and CEGIS field findings 2025

Pond Watering system

Surface water pond irrigation is very limited in the study area. According to local residents, the duration of water availability in a pond is between 35 and 40 weeks a year. The minimum suitable water depth for aquaculture ranges from 1 to 1.5 meters. Farmers near Kalikuccho Khal reported that they previously used surface water irrigation for aquaculture. Due to reduced water availability, they now rely on groundwater to maintain pond levels, especially during the dry season (January–March) for commercial fish culture. The shortage of water has led to various fish diseases, and in some cases, farmers struggle to maintain their production systems properly. Generally, if a pond is not irrigated, farmers can produce only one cycle of fish. Ponds located near irrigated crop fields can receive water

through seepage or base flow of the Ashuganj Power Station uses Upper Meghna River water, while the Ghorashal Power Station relies on the Shitalakshya River condenser cooling and other plant operations, allowing farmers to achieve two fish cycles with moderate production. Water quality is often recognized as an important issue but is not properly managed. The condenser cooling water used for irrigation is generally uncontaminated, except for the presence of chlorine. While using this water for pond irrigation, it does not harm cultured fish.

Fish Species Diversity

The study area supports diverse fish biodiversity, particularly Small Indigenous Species (SIS), due to the presence of various flowing and static water bodies, including rivers, beels, khals, and floodplains. According to field findings, a total of 32 fish species have been identified as representative samples, though local fishers estimate that total fish diversity could range from 60 to 100 species in the last decade. Local fishers reported that the populations of key fish species such as Chital, Boal, Bagh Ayre, and Kacki have declined sharply over the last 10 years. In the study area, Puti is particularly abundant between the Bhadro and Aashwin months, although local residents reported that fish populations were significantly higher 15 to 20 years ago. However, multiple threats have led to a decline in fish populations, including habitat loss from siltation and wetland encroachment, pollution from agricultural runoff and industrial waste, and overfishing with fine-mesh nets. Climate change, characterized by erratic rainfall and rising temperatures, further exacerbates the issue, while invasive species like tilapia outcompete native fish. Weak enforcement of fishing regulations has also contributed to declining fish abundance and diversity. Hilsa (*Tenualosa ilisha*) is seasonally present, particularly during monsoon migrations along the Meghna and Titas rivers. The following **Table 5.40** lists fish species likely found in the study area, with their IUCN status based on the 2015 Red List of Threatened Species for Bangladesh by IUCN Bangladesh.

Table 5.40: Lists of Fish Species in the Study Area

Local Name	Common Name	Scientific Name	Habitat	IUCN Status in BD
Rui	Rohu	<i>Labeo rohita</i>	River, Beel	Least Concern (LC)
Katol	Catla	<i>Catla catla</i>	River, Beel	Least Concern (LC)
Mrigel	Mrigal	<i>Cirrhinus cirrhosus</i>	River, Beel	Least Concern (LC)
Kalbaush	Kalbaush	<i>Labeo calbasu</i>	River, Beel	Least Concern (LC)
Sarpunti	Olive Barb	<i>Puntius sarana</i>	River, Canal	Vulnerable (VU)
Puti	Spotfin Swamp Barb	<i>Puntius sophore</i>	River, Canal	Least Concern (LC)
Mola	Mola Carplet	<i>Amblypharyngodon mola</i>	Canal	Least Concern (LC)
Tengra	Tengra Catfish	<i>Mystus tengara</i>	River, Canal	Least Concern (LC)
Bujuri Tengra	Striped Dwarf Catfish	<i>Mystus vittatus</i>	River	Least Concern (LC)
Gulsha	Day's Mystus	<i>Mystus bleekeri</i>	River, Beel	Least Concern (LC)
Boal	Freshwater Shark	<i>Wallago attu</i>	River	Near Threatened (NT)
Pabda	Pabdah Catfish	<i>Ompok pabda</i>	River	Near Threatened (NT)
Magur	Walking Catfish	<i>Clarias batrachus</i>	Beel, Canal	Least Concern (LC)
Shing	Stinging Catfish	<i>Heteropneustes fossilis</i>	Beel, Canal	Least Concern (LC)
Taki	Spotted Snakehead	<i>Channa punctata</i>	Beel, Canal	Least Concern (LC)

Local Name	Common Name	Scientific Name	Habitat	IUCN Status in BD
Shol	Striped Snakehead	<i>Channa striata</i>	River, Beel, Canal	Least Concern (LC)
Gojar	Great Snakehead	<i>Channa marulius</i>	River, Beel, Canal	Least Concern (LC)
Koi	Climbing Perch	<i>Anabas testudineus</i>	Beel, Canal	Least Concern (LC)
Kholisha	Banded Gourami	<i>Trichogaster fasciata</i>	Beel, Canal	Least Concern (LC)
Lal Kholisha	Dwarf Gourami	<i>Colisa lalia</i>	Beel, Canal	Least Concern (LC)
Baim	Barred Spiny Eel	<i>Macrogynathus pancalus</i>	River, Beel, Canal	Least Concern (LC)
Sal Baim	Zig-zag Eel	<i>Mastacembelus armatus</i>	River, Beel	Least Concern (LC)
Foli	Bronze Featherback	<i>Notopterus notopterus</i>	River, Beel	Least Concern (LC)
Chital	Clown Knifefish	<i>Chitala chitala</i>	River, Beel	Endangered (EN)
Ilish	Hilsa Shad	<i>Tenualosa ilisha</i>	River	Least Concern (LC)
Chapila	Indian River Shad	<i>Gudusia chapra</i>	River	Least Concern (LC)
Kajuli	Gangetic Ailia	<i>Ailia coila</i>	River	Near Threatened (NT)
Gharua	Garua Bachcha	<i>Clupisoma garua</i>	River	Endangered (EN)
Kakila	Freshwater Garfish	<i>Xenentodon cancila</i>	River, Beel	Least Concern (LC)
Chela	Phulo Chela	<i>Salmostoma phulo</i>	River, Beel	Least Concern (LC)
Darkina	Flying Barb	<i>Esomus danricus</i>	Beel, Canal	Least Concern (LC)
Gutum	Guntea Loach	<i>Lepidocephalichthys guntea</i>	Beel, Canal	Least Concern (LC)

Source: CEGIS field visit, 2025

Fisheries Management

The study area has no river or Beel fish sanctuary reported by local fishers. Therefore, fisheries management organization or co-operative is absent in the study area.

5.3.4 Ecological Resources

This section describes two key aspects: (1) the overall baseline conditions of the irrigated area, including homesteads near the canals, croplands, and aquatic habitats, and (2) Project area's ecosystems that may be impacted by the proposed intervention. Additionally, it covers important habitat areas, ecosystem services, and existing threats to biodiversity.

Data for this assessment were collected from both primary and secondary sources. A biodiversity expert used the transect and quadrat methods to determine the biodiversity index, floral composition, faunal habitats, and key habitat areas. Information on biodiversity threats and ecosystem services was gathered through Focus Group Discussions (FGDs) and Key Informant Interviews (KIIs). These findings were further validated using expert judgment, the IUCN Red List, and bio-ecological zone classifications.

Type of the Ecosystem

The proposed Project has been fallen Brahmanbaria and Narsingdi districts and its surrounding area comprise different landforms like homesteads, agricultural land, ponds, canals, floodplain, haor, beel, rivers, orchards etc. and having various vegetation patterns which create diverse habitats for wildlife. The Meghna, Titas, Haridoha and Sitalakha Rivers are contributed as main source of flow regime to all

ecological components, both **Terrestrial** and **Aquatic**. In physiographic and biodiversity points of view the area has already demarcated under certain bio-ecological zones described as below.

Bio Ecological Zones: IUCN-The World Conservation Union has divided the whole country into 25 bio-ecological zones (2002). The aspects on which these zones are primarily centered are physiography, climate, soil type, flooding depth and biodiversity's. The proposed area has fallen under three Bio-ecological Zones namely; Brahmaputra-Jamuna floodplain, Meghna floodplain and The Haor basin in which, major portion of the study area are fall over the zone namely Brahmaputra-Jamuna (48%) and lest of the part falls over The Haor basin (14%). **Table 5.41** represents area and location of Bio-ecological zones with ecological features and present condition within the different areas. **Figure 5.60 and Figure 5.61** show the Bio-ecological zones which are present inside and in the surroundings of the study area.

Table 5.41: Major Ecological Features and Present Condition according to BEZ Zones

BEZ Zone with ID	Area (ha.)	Percentage	Major Ecological Features ¹	Present Condition According to BEZ	District
Brahmaputra-Jamuna floodplain (4c)	26521	48	It possesses a unique variety of plants, medicinal herbs, fruit bearing trees, jungle shrubs, creepers and climbers, trees etc. Bushes of reeds, canes, orchids are also found. Among the bird species, small game birds and several varieties of pheasants were commonly found.	Especially Supari, Sirish, Bamboo, Mahogany, Coconut etc. are major cultivated plants Migratory birds are observed during the winter. Biodiversity points of view, Chinadi beel exist in major important wetlands.	Brahmanbaria and Narsingdi
Meghna floodplain (4e)	20741	38	Palm and betel nut are the dominant species of this zone. Several varieties of cane, a good deal of bamboo and thatching grass. Several species of raptorial birds are found.	Commercial fruit orchards of Mango, Guava, Banana, Jackfruit and Litchi are common. Migratory birds are observed during the winter.	
The Haor basin (5a)	9718	14	Haor and beel provide habitats for various types of aquatic species of plants and animals. Aquatic vegetation provides ideal grazing for domestic livestock and a source of fuel and fertilizers for the local inhabitant	Galania Haor is present in this area. Numerous local and migratory birds are observed during the winter and dry season. This wetland is characterized by mixed vegetation.	

Source: 1 = IUCN, 2002, 2= CEGIS EIA Field visit, March, 2025

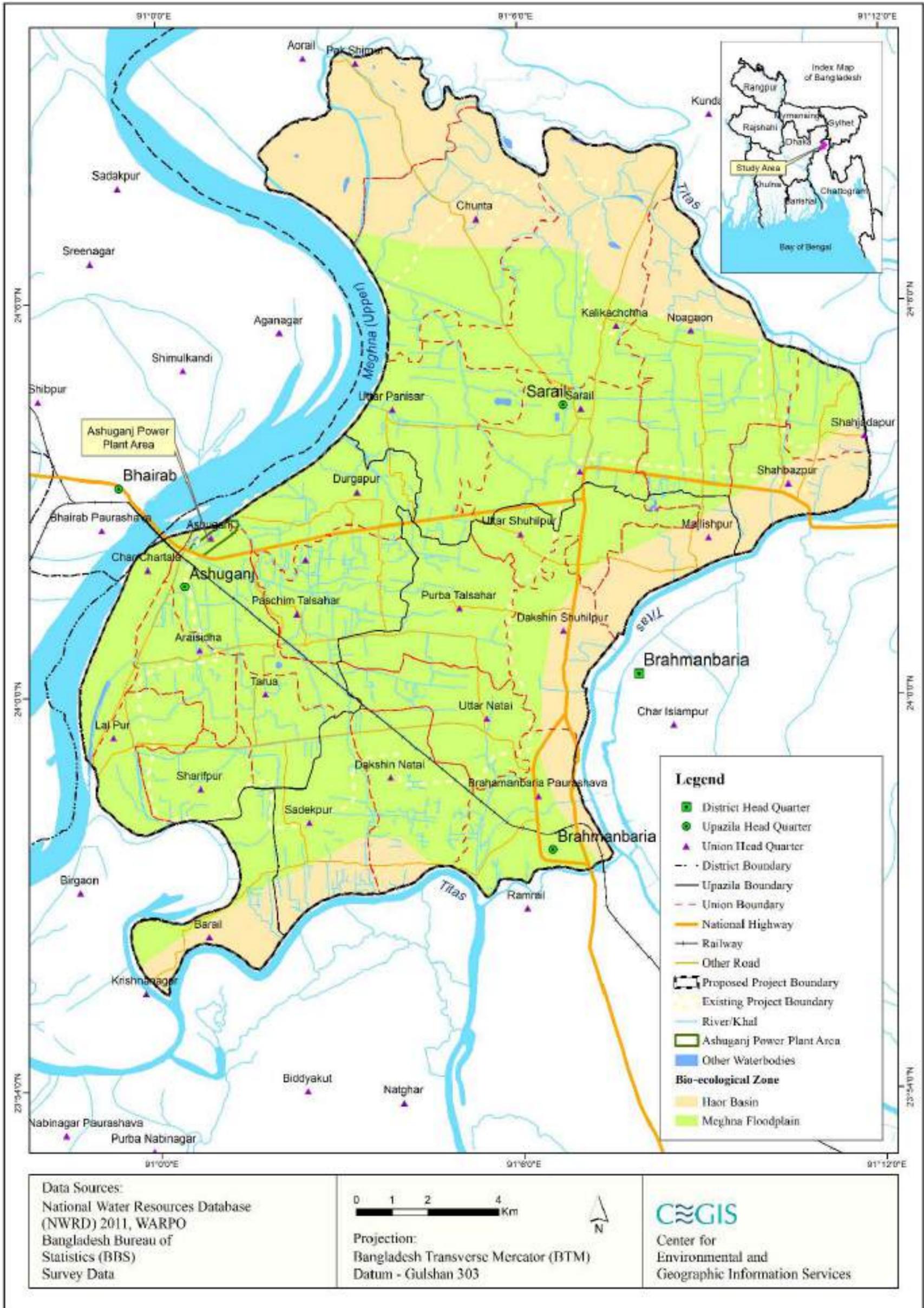


Figure 5.60: Bio-ecological Zones within the Ashuganj Area

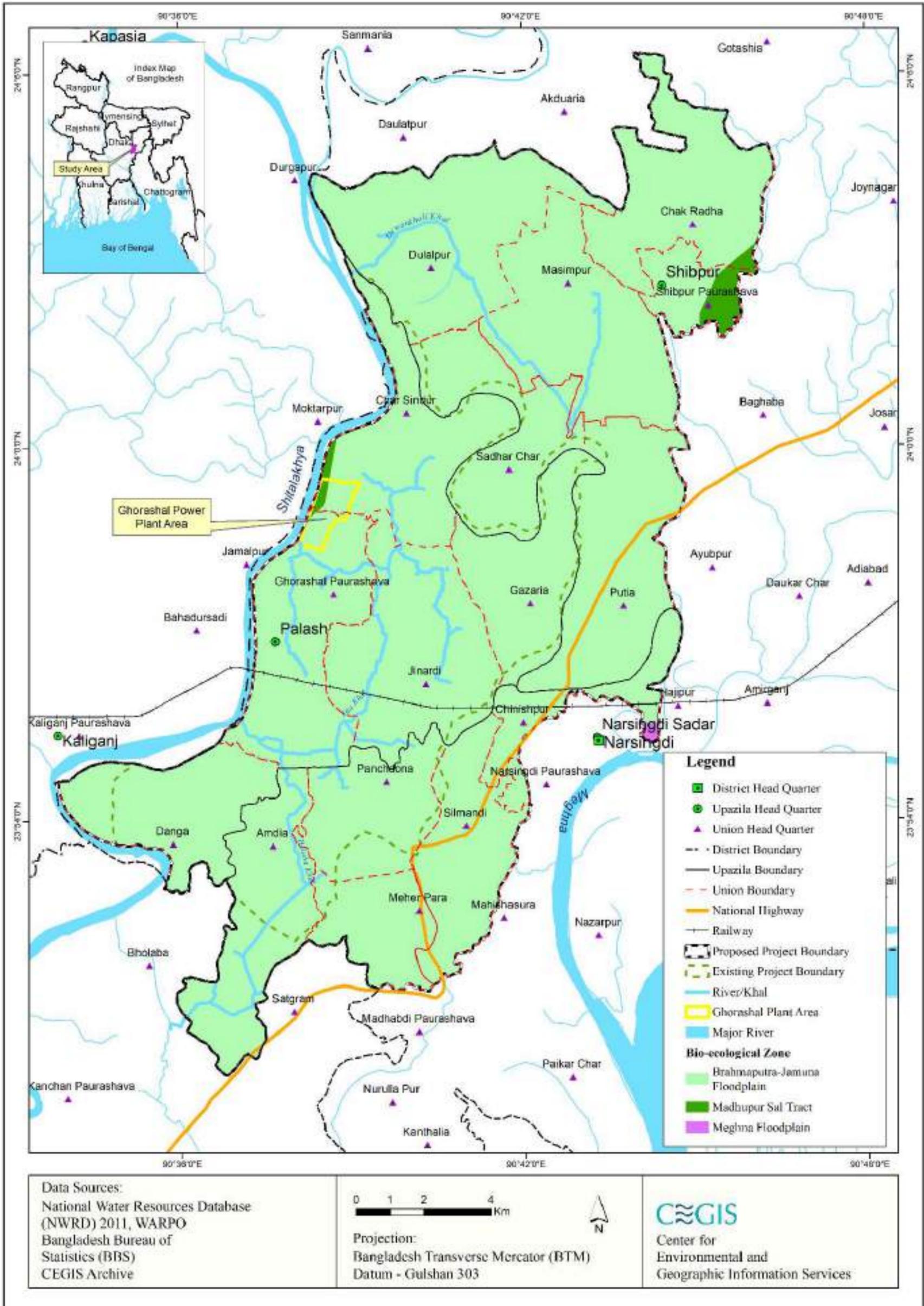


Figure 5.61: Bio-ecological Zones within the Palash Area

Diversity and Composition of Flora

The proposed areas of Ashuganj and Palash exhibit rich floral diversity due to the presence of various ecosystems. Terrestrial floral diversity has been observed in upland areas, homesteads, ridges, institutional grounds, roadsides, and agricultural fields, where vegetation plays a crucial role in the plant community of the project area. Most households are covered with cultivated plant species, while a smaller portion is occupied by wild shrubs and herbs.

The most common cultivated tree species in the project area include Silkoroi (*Albizia procera*), Kathal (*Artocarpus heterophyllus*), Aam (*Mangifera indica*), Narikel (*Cocos nucifera*), Mahogany (*Swietenia mahagoni*), Raintree (*Samanea saman*), Baroi (*Ziziphus mauritiana*), Shimul (*Bombax ceiba*), and Jam (*Syzygium cumini*). The upper canopy is primarily dominated by Raintree, Narikel, and Silkoroi, while the lower canopy layers consist of shrubs and herbs such as Patipata, Dolkolmi, Makhna, Jagotmadan, and Bonjal. Additionally, commonly cultivated trees are also found near canals and settlement margins within the Ashuganj-Palash Green Project area.

A significant number of bamboo orchards are present across the project area. Among commercial plantations, Mango, Mahogany, and Bamboo dominate homesteads, village roadsides, and croplands. Furthermore, fruit trees such as Banana, Guava, Litchi, and Citrus are commonly planted in homesteads to meet local demand. Roadside vegetation, primarily consisting of hardwood exotic species, forms an ecosystem where Sissoo, Mahogany, and Akashmoni occupy the canopy at heights of 50–70 feet. Orchard vegetation, including Mango, Banana, and Betelnut, is widespread, providing shelter and food for birds, small mammals, and reptiles. Local communities cultivate these plantations for their commercial value.

Crop fields exhibit the least floral diversity but serve as important grazing and feeding habitats for various indigenous insects, birds, and small mammals. Homestead platforms primarily feature commercial plantations dominated by timber and fruit-bearing trees. These monoculture woodlands provide timber for furniture-making and domestic fuel needs. In addition to cultivated species, various weed species coexist with crops, including *Euphorbia hirta*, *Rorippa indica*, *Cynodon dactylon*, *Marsilea quadrifolia*, *Heliotropium indicum*, *Cyperus* sp., *Croton bonplandianum*, and *Chenopodium* sp.

Marginal tree species such as Panimorich, Biiskatali, Nol, and Khagra dominate the inner portions of canals, whereas Bermuda grass, Cyperus, Cogon grass, Justicia, and various other grasses grow on the upper sections of canal dykes. Roadside vegetation in the project area is primarily composed of Sirish (*Albizia lebeck*), Sisso (*Dalbergia sissoo*), Pitali (*Trewia nudiflora*), Jarul (*Lagerstroemia speciosa*), Mahogany (*Swietenia mahagoni*), and Silkoroi (*Albizia procera*).

Wetland tree species such as Karoch (*Pongamia pinnata*), Pitali (*Trewia nudiflora*), Baroon (*Crataeva nurvala*), and Hizol (*Pongamia pinnata*) are commonly found near water bodies and at the margins of settlements, particularly in villages like Galania, Noagaon, and Chunta, located in the northeastern portion of Galania Haor under Sarail Upazila.

The composition of aquatic floral species varies based on wetland depth and duration of inundation, categorized into submerged, free-floating, and rooted-floating types. Seasonal inundation enriches aquatic floral diversity and populations, converting these areas into croplands during the dry season. Numerous canals, ditches, and ponds are abundant with free-floating and rooted-floating hydrophytes. Submerged plants thrive in both perennial and seasonal wetlands, growing as water levels rise and persisting as long as water is present. Free-floating plants such as Salvinia, Azolla, Pistia, and Lemna are widespread across the study area. Rooted-floating plants are one of the most dominant plant types in wetland areas, with species like *Nymphaea nouchali* and *Nymphaea stellata* being the most common.

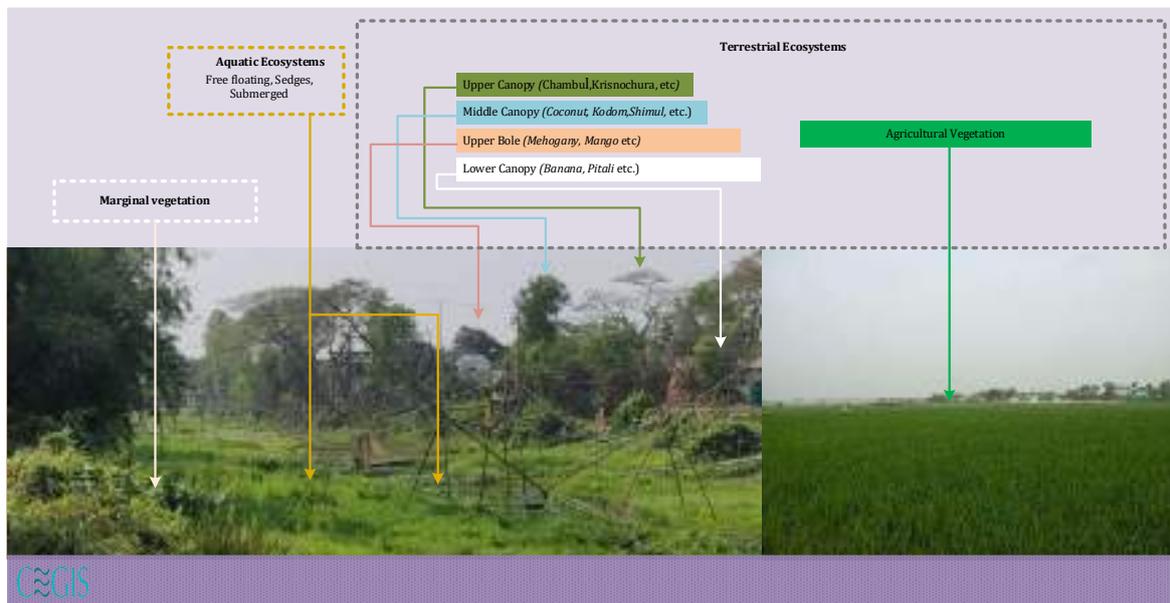


Figure 5.62: Vegetation Pattern of the Proposed Project Area

A vegetation survey was conducted to assess the plant species diversity in the Ashuganj-Palash Sabuj Green Project area using a random quadrat survey approach. The survey included homestead vegetation and canal-side plant species.

- A total of 26 plant species (excluding undergrowth) were recorded from eight surveyed quadrats (10m × 10m) in homestead areas (**Annexure B: Flora and Fauna-Table 1**).
- A total of 33 undergrowth plant species (Herbs & shrubs) were recorded from eight surveyed quadrats (1m × 1m) in canal-side areas (**Annexure B: Flora and Fauna-Table 2**).

The Shannon-Wiener Diversity Index was used to analyze species diversity. The results indicated a medium level of diversity (2.06) for trees and a high level of diversity (3.67) for herbs and shrubs. The

list of major terrestrial floral species, including their local names, average heights, abundances, and uses, is provided in **Annexure B: Flora and Fauna-Table 3**.

Diversity and Composition of Fauna

Terrestrial: During field visit, a total of 52 species, out of 68 species of wildlife were found in the project areas of Ashuganj, Brahmanbaria and Palash, Narshingdi, which were terrestrial (**Annexure B: Flora and Fauna-Table 4**). Among them, 3 (5.77%) was amphibian, 5 (9.62%) were reptiles, 34 (65.38%) were birds and 10 (19.23%) were mammals. In terms of terrestrial amphibians, Common Toad (*Duttaphrynus melanostictus*) and Indian Bull Frog (*Hoplobatrachus tigerinus*) were frequently found in all of the unions of Ashuganj, Sarail, Brahmanbaria Sadar of Brahmanbaria and Palash, Shibpur, Narshingdi Sadar of Narshingdi. Another amphibian species was the Common Tree Frog (*Polypedates leucomystax*). Because of its great adaptability, this frog may live in a variety of settings, such as farmhouse gardens, shrubs, tree holes, primary and secondary woods, and human settlements.

The recorded 5 reptile species were from order Squamata. Among them, Common Skink (*Eutropis carinata*), Common Garden Lizard (*Calotes versicolor*) and House Lizard (*Hemidactylus flaviviridis*) were very common in all of the unions of project areas. The remaining 2 species were snakes, venomous and non-venomous. Indian Rat Snake (*Ptyas mucosa*) was so frequent in human habitations, village groves, crop fields, hay stores and large grain stores, unused ruins, rat holes and termite mounds of the villages of Ashuganj and Palash. In contrast, the venomous Monocellate Cobra (*Naja kaouthia*) was found only in Brahmanbaria Sadar Upazilla. Local respondents ensured its presence near their settlements, cultivated fields and bushy areas. While the cobra has a preference for small rodents such as the lesser bamboo rat, it will also happily feast on reptiles and amphibians, including lizards, frogs, toads and even smaller snakes. Due to their fondness for small mammals, Monocellate cobras are generally found in areas that are attractive to rodents, such as agricultural areas and bushy or patchy areas with plenty of vegetation. Among the project areas of Ashuganj and Palash, this species was recorded from the unions of 'Brahmanbaria Sadar' upazilla, due to its geographic condition. The water flow in the wetlands is so less in the unions of 'Brahmanbaria' upazilla. As a result, the human habitations and cultivated lands have become suitable habitat for the Monocellate Cobra.

Most of the bird species (56%.) were from order Passeriformes. The remaining bird species were from order Columbiformes, Ciconiiformes, Accipitriformes, Piciformes, Coraciiformes, Cuculiformes, Strigiformes and Bucerotiformes. In Sarail Upazilla of Brahmanbaria, the agricultural fields, roadside vegetation and homestead forests of Kalikaccha union, is a good habitat for birds like Black Drongo (*Dicrurus macrocercus*), Jungle Crow (*Corvus leucomystax*), Common Myna (*Acridotheres tristis*), Asian Pied Starling (*Sturnus contra*), Oriental Magpie Robin (*Copsychus saularis*), Brahminy Kite (*Haliastur indus*) etc.

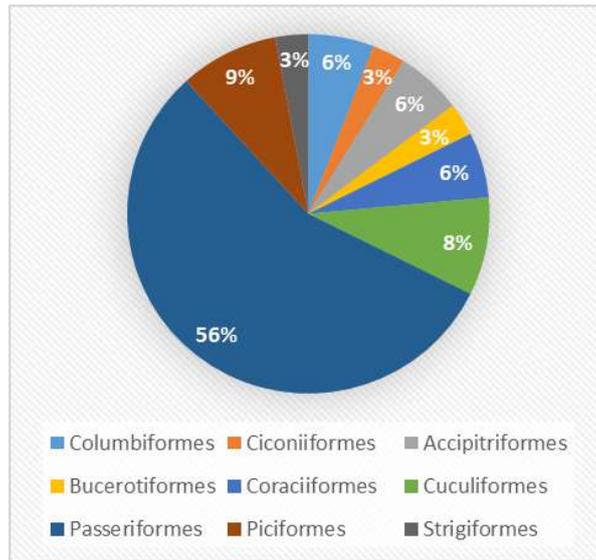


Figure 5.63: Variation in Orders of Observed Bird Species

Asian Openbill (*Anastomus oscitans*) was found both in the agricultural fields of Ashuganj and Palash, due to its food availability. The usual foraging habitats of it are crop fields, irrigation canals, seasonal marshes etc. This long-legged bird feeds mainly on large molluscs, especially Pila species, water snakes, frogs and large insects, and they separate the shell from the body of the snail using the tip of the beak. Two large flying groups were recorded in Ashuganj upazila.



Figure 5.64: Asian Openbill (Left) and Common Hoopoe (Right)

Bitghor, Panisshor union of Sarail Upazila, is home to a variety of birds including Spotted Owlet (*Athene brama*), Black-rumped Flameback (*Dinopium benghalense*), Fulvous-breasted Woodpecker (*Dendrocopos macei*), Asian Koel (*Eudynamys scolopaceus*), Common Hoopoe (*Upupa epops*), Long-tailed Shrike (*Lanius Schach*), Chestnut-tailed Starling (*Sturnus malabaricus*) etc.

The nests of Baya Weaver (*Ploceus philippinus*) were found in a homestead patch at Shantinagar, Panisshor union, which indicates a good ecosystem for birds in those human habitations. These nests are a living illustration of evolutionary adaptations, reflecting their complex social structures and communal living. In addition to the weavers, other tiny birds and insects find refuge in these nests, forming a microhabitat that promotes biodiversity. The roadside vegetation and infrastructures of RCC main canal from Ashuganj to Sarail, provide food and shelter to some birds like Eastern Spotted Dove (*Spilopelia chinensis*), Indian Roller (*Coracias benghalensis*) etc., as there are plenty of rice mills

on both sides of the road. The homestead vegetation of Brahmanbaria Sadar harbor Greater Coucal (*Centropus sinensis*), Asian Green Bee-eater (*Merops orientalis*), Common Iora (*Aegithina tiphia*), Common Tailorbird (*Orthotomus sutorius*) etc.



Figure 5.65: Nest of Baya Weaver (Left) and Baya Weaver (Right)

A total of 10 species of mammals were found in the project areas. Of them, 3 were from order Carnivora, 5 were from Rodentia, 1 was from Eulipotyphla, and 1 was from Chiroptera. 2 species of Rat, out of 3, Lesser Bandicoot Rat (*Bandicota bengalensis*) and Large Bandicoot Rat (*Bandicota indica*) are very common in the swampy areas, fields, rice paddies, and the outskirts of human dwellings such as compounds and gardens of the project areas. According to local farmers, Large Bandicoot Rat destroys harvested paddy and cause a great financial loss of rice production. Golden Jackal (*Canis aureus*), locally known as Pati Shial, was found in Brahmanbaria Sadar upazila. Because they are opportunistic, golden jackals enter human settlements at night to consume trash. Their diversified food includes rodents, ground birds and their eggs, fish, insects, frogs, frogs, and fruits. Mongooses were frequently found in and around countryside houses, bushes, hedges and crop fields.

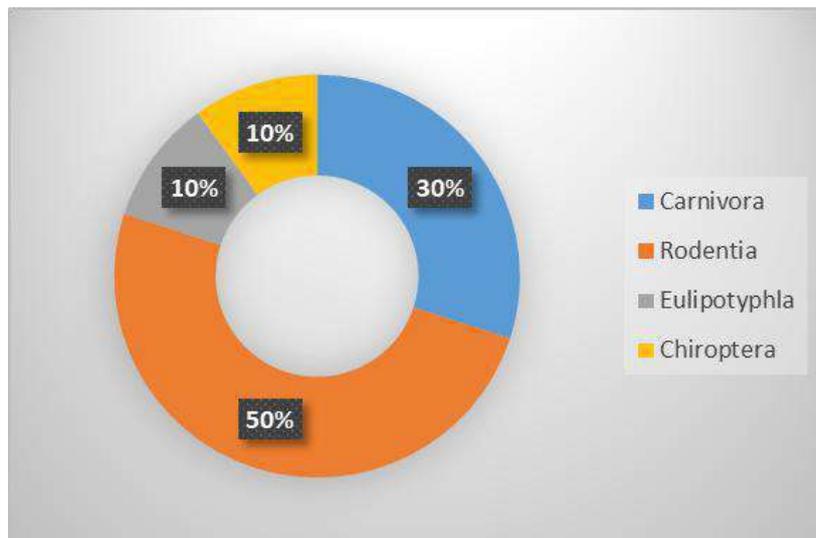


Figure 5.66: Variation in Orders of Observed Mammals

Aquatic Fauna: During field visit, out of 68 species, 16 species of wildlife were found in the aquatic ecosystem. Among them, 1 (6.67%) was amphibian, 1 (6.67%) was reptile and 14 (87.5%) were birds. The only amphibian was the Skipper Frog (*Euphlyctis cyanophlyctis*) from Dicroglossidae family. It is insectivorous in habit and feed on aquatic floating insects, insect larvae and other insects from the floating vegetations. It remains active all year round, even when the temperature dips down to 10°C in winter. It prefers roadside ditches, canals, fish ponds and other wetlands as its habitat and breeding.

The Checkered Keelback (*Xenochrophis piscator*) was widespread in the canals of the unions of Sarail and Ashuganj Upazilas of Brahmanbaria and Palash Upazila of Narshingdi. This snake is nocturnal as well as diurnal. Adults of this species eat fish, frogs, lizards, rodents, and birds, while young consume frog eggs, tadpoles, small frogs, and insects. It consumes large number of nymphs of grasshoppers in the rice field and thus acts as one of the natural controlling agents of rice grasshoppers and it preys during day and night.



Figure 5.67: Checkered Keelback (Left) and Cattle Egret (Right)

A total of 14 species of birds belonging to 6 orders (Gruiformes, Pelecaniformes, Suliformes, Charadriiformes, Coraciiformes and Anseriformes), were recorded from the project areas. The avian diversity suggests that the wetlands of the project area support diverse range of habitats making suitable for aquatic birds.

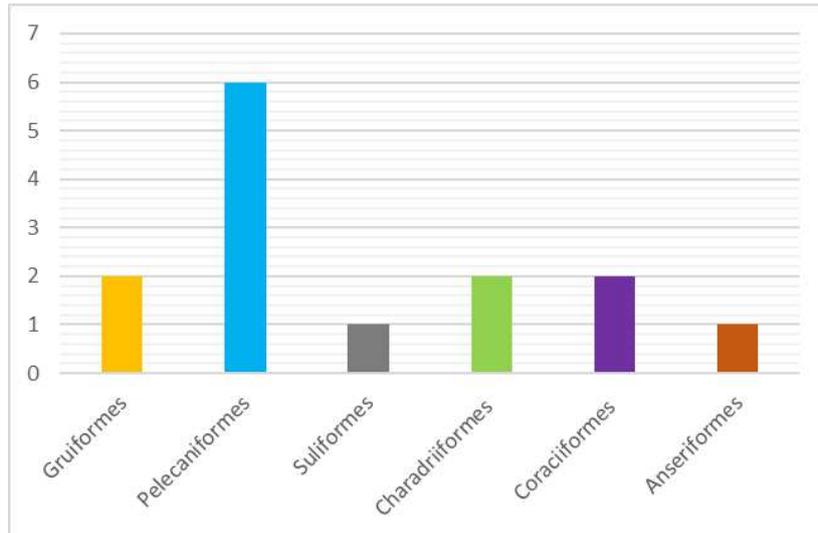


Figure 5.68: Variation in Orders of Observed Aquatic Bird Species

Identification of nearby biodiversity hotspots, protected areas, wetlands, and critical habitats

An important wetland, Galania haor, located in Sarail, Brahmanbaria, supports a wide range of birds like Cattle Egret (*Bubulcus ibis*), Little Egret (*Egretta garzetta*), Little Cormorant (*Microcarbo niger*), Indian Pond Heron (*Ardeola grayii*) etc. This wetland provides a great habitat for these birds which indicates a healthy aquatic ecosystem in Sarail. Common Kingfisher (*Alcedo atthis*), White-throated Kingfisher (*Halcyon smyrnensis*) and Indian Pond Heron were found in almost all wetlands like canals, beel, ponds etc. of the project areas.

Chinadi beel, located in Shibpur, Narshingdi, is a valuable hotspot for both resident and winter visiting birds. Some species, including White-breasted Waterhen (*Amaurornis phoenicurus*), Purple Swamphen (*Porphyrio porphyrio*), Great White Egret (*Ardea alba*), Bronze-winged Jacana (*Metopidius indicus*), Red-wattled Lapwing (*Vanellus indicus*) and Lesser Whistling Duck (*Dendrocygna javanica*) were found in large quantities in Chinadi beel. This wetland is enriched with numerous aquatic vegetation like water hyacinth, water velvet, water lily, duck weed etc., phytoplankton and zooplankton, dragonflies and damselflies, which are essential food for these aquatic birds. Two large flocks of Little Cormorant were also recorded from this beel.



Figure 5.69: Aerial Drone View of Chinadi Beel

Ecosystem Services Provided by the Project Area

In the wetland evaluation processes, the rivers, canals and beels were considered as wetlands and the different unique site characteristics have been assessed at first. Wetlands and its major features have been assessed through field visit and consultation with local people in different methods (KII, IS and FGD) and following the existing features of the wetlands. In total ten sites have been selected while 7 were for canals and 3 were for the Meghna, Shitalakhya and Haridoya River. In **Figures 5.67-5.68** the wetland evaluation sites are portrayed while **Table 5.42** shows the regarding site characteristics with unique names and Geo-coordinates of the sites.

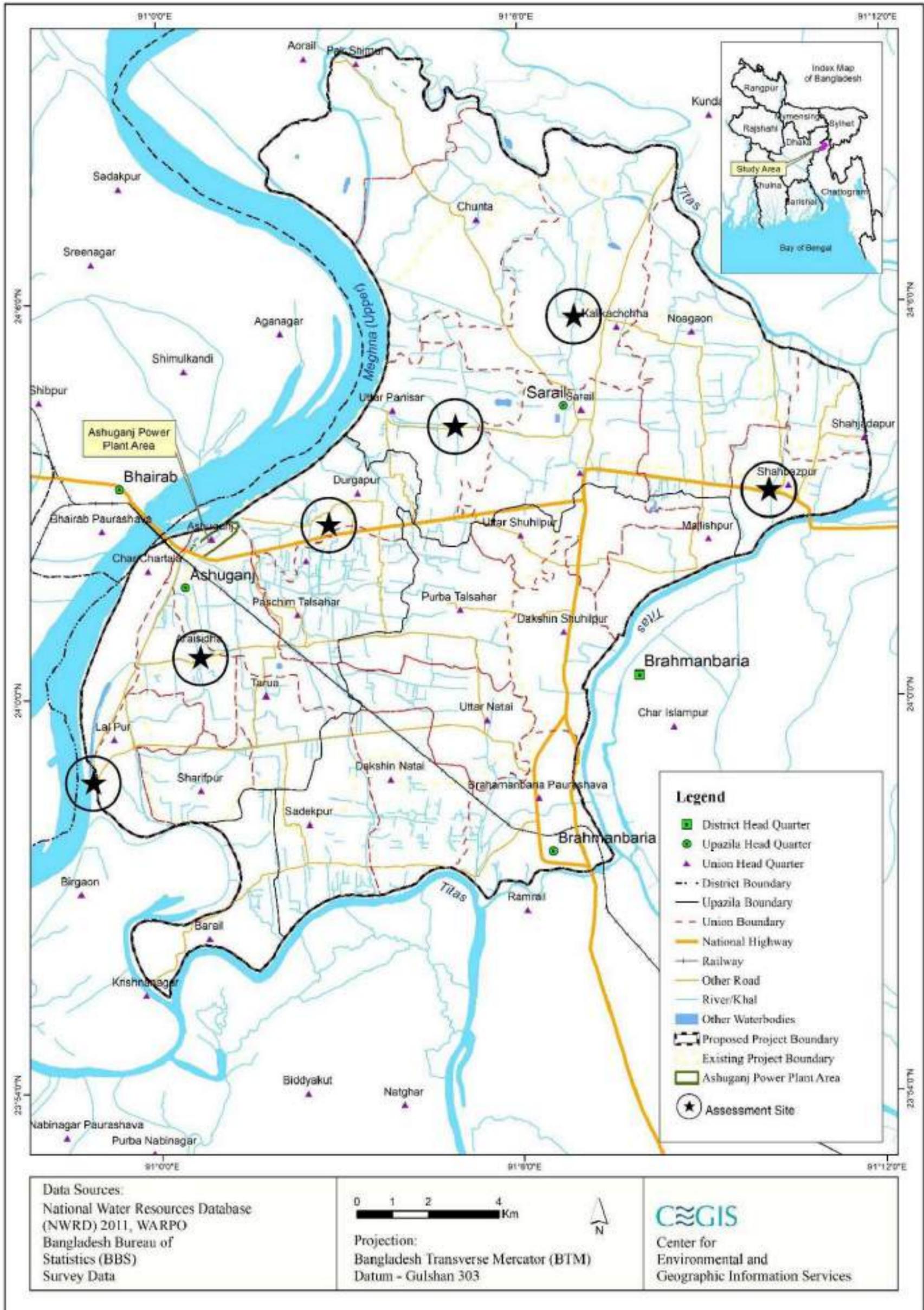


Figure 5.70: Locations of Field Assessments of Ecosystem Services within the Ashuganj Area

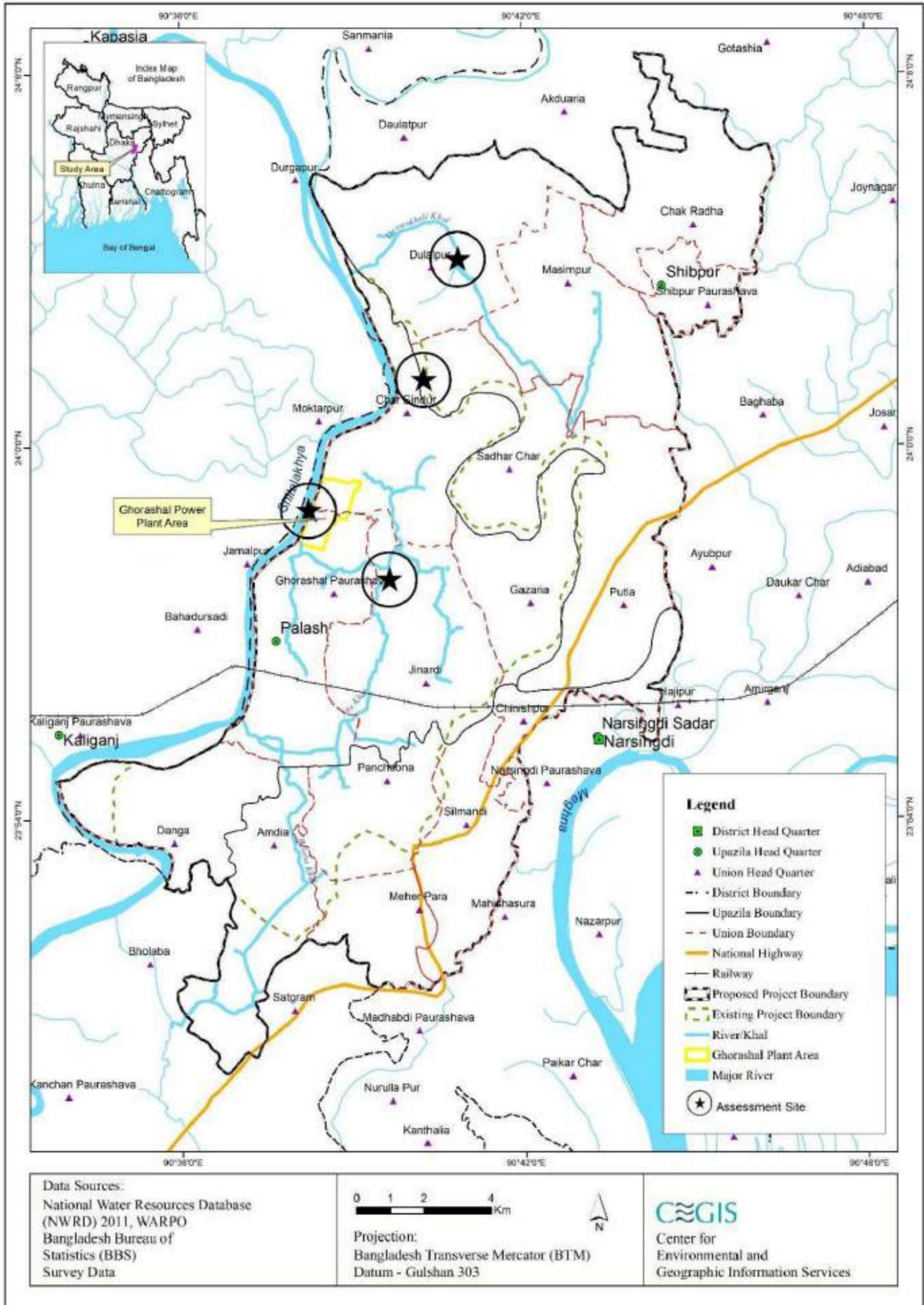


Figure 5.71: Locations of Field Assessments of Ecosystem Services within the Palash Area

Table 5.42: Site Name and Its Characteristics

SL.	Site code	Location, Geo-coordinates with associated wetlands	Assessed indicators	Site Characteristics
Ashuganj Sabuj Irrigation Project				
1	Site 1	Village: Lalpur Launch Ghat, Union: Lalpur, UPZ: Ashuganj, Dist.: Brahmanbaria 23°58'46.48"N 90°58'42.99"E Meghna River	Perennial water body, Floating aquatic vegetation, River bed siltation, Dolphin's migration, Fish production	<ul style="list-style-type: none"> - Perennial water body - Good riparian vegetation - Adjacent crop field on both banks - Marshy characteristics with aquatic vegetation inside the canals area
2	Site 2	Village: Bahadurpur, Union: Panisar, UPZ: Ashuganj, Dist.: Brahmanbaria 24° 2'40.88"N 91° 2'38.87"E Main Canal-1	Perennial water body, Crop cultivation, Floating aquatic vegetation, Homestead vegetation	<ul style="list-style-type: none"> - Moderate crop land vegetation - Connectivity loss due to Highway Road construction activities - Structure (Syphon, Regulator) is present - Water pollution due to urban runoff - Moderate herbs and shrubs are observed - Adjacent proposed construction of RCC canal, close conduits, Syphon, Gurd Rail, Regulator etc.
3	Site 3	Village: Kalikachohha Nandi Para, Union: Kalikachohha UPZ: Sarail, Dist.: Brahmanbaria 24° 5'49.53"N 91° 6'44.40"E Kalikachohha Khal	Seasonal water body, Fish production, Wetland tree species are present,	<ul style="list-style-type: none"> - Wetland tree species along the canal side - Connecting secondary and tertiary canals are present - Structure (Culvert, Regulator) is present - Low fish production - Adjacent proposed construction & re-construction of Regulator. Re-excavation of connecting secondary & tertiary canals
4	Site 4	Location: Bitghar Bazar Union: Panisar, UPZ: Sarail, Dist.: Brahmanbaria 24° 4'9.72"N 91° 4'45.33"E Jafar Khal	Seasonal water body, Crop cultivation, Fish production, Water hyacinth is present, Water pollution	<ul style="list-style-type: none"> - Fish production (Capture fish culture fish) - Tertiary canal is present - Exotic tree species along the river side - Good riparian vegetation - Structure (Regulator) is present - Adjacent proposed construction & re-construction of Regulator. Re-excavation of connecting secondary & tertiary canals,
5	Site 5	Village: Shabajpur, Union: Shabajpur, UPZ: Sarail, Dist.: Brahmanbaria 24° 3'9.90"N	Perennial shallow water body, Crop cultivation, Fish production, Siltation, Land	<ul style="list-style-type: none"> - Perennial shallow water body - Low fish production (Capture fish) - Structure (culvert) is present - Canal bed siltation is high - Land Encroachment is present

SL.	Site code	Location, Geo-coordinates with associated wetlands	Assessed indicators	Site Characteristics
		91° 9'57.19"E Budda Khal	Encroachment, Water pollution	<ul style="list-style-type: none"> - Water pollution due to urban runoff - Connection with Titas River - Adjacent proposed construction & re-construction of Regulator. Re-excavation of connecting secondary & tertiary canals
6	Site 6	Village: Bhavanipur, Union: Araishida UPZ: Ashuganj, Dist.: Brahmanbaria 24 91° 0'30.57"E 91° 0'30.57"E Bhavanipur Khal	Perennial shallow water body, Fish production, Siltation, Land Encroachment, Water pollution, Aquatic floating vegetation	<ul style="list-style-type: none"> - Perennial shallow water body - Low fish production (Capture fish) - Canal bed siltation is high - Water pollution due to urban runoff - Water hyacinth is present - Adjacent proposed Re-excavation of connecting secondary & tertiary canals
Palash Sabuj Irrigation Project				
7	Site 7	Location: Boat Ghat, Ghorashal Power station, Paurashava, Dist.: Narsingdi 23°59'0.18"N 90°38'4.15"E Shitalakhya River	Perennial water body, Enrich riverside vegetation, Fish production	<ul style="list-style-type: none"> - Perennial water body - Fish production (Capture fish) - Jetty of Ghorashal Power station - Water pollution is present due to industrial and urban runoff - Moderate crop land vegetation
8	Site 8	Village: Beel Chinadi, Union: Dulalpur, UPZ: Shibpur, Dist.: Narsingdi 24° 3'2.81"N 90°40'41.68"E Dawankhali Khal with connecting Chinadi beel	Perennial water body, Crop field, Homestead vegetation, Fish production, Aquatic vegetation, Recreation site	<ul style="list-style-type: none"> - High fish production (Capture fish) - Enrich floral and faunal diversity - Migratory birds are present - Popular Recreation site - Marshy characteristics with aquatic vegetation inside the beel area - Perennial beel is present (Chinadi Beel) - Adjacent proposed Re-excavation of canal
9	Site 9	Location: Charsindur, Union: Palash, Dist.: Narsingdi 24° 1'6.49"N 90°40'5.54"E Haridoya River	Aquatic vegetation seasonal water body, Homestead vegetation,	<ul style="list-style-type: none"> - Crop cultivation is present - Marshy characteristics with aquatic vegetation inside the beel area - Water control structure is present - Adjacent crop field on both banks
10	Site 10	Village: Senebari, Union: Jinardi, UPZ: Palash, Dist.: Narsingdi 23°57'53.45"N 90°39'28.53"E Jinardi Khal	Seasonal water body, Crop field, Homestead vegetation, Fish production, Aquatic vegetation,	<ul style="list-style-type: none"> - Crop cultivation (Amon crop) - Marshy characteristics with aquatic vegetation inside the canal area - Siphon is present - Adjacent proposed Re-excavation of canal, Construction of Trash Rack

Note: The site characteristics have been assessed through the field observation and consultation with local people

Ecosystem services recorded: Ecosystem services have been recorded and fitted into the Defra scale (2007)⁵ of likely significance of ecosystem services. For the purpose of data manipulation, analysis and statistical presentation, the relative scale has been converted into a normal non-linear numerical scale where 1 to 10 values were assigned to the various categories. A frequency table of ecosystem services has generated and presented in Table 5:43. Rapid Assessment of Wetland Ecosystem Services (RAWES)² was applied for evaluate the Meghna, Shitalakhya and Haridoya River and connecting canals and beels.

Table 5.43: Count Data for the Frequency of the Ecosystem Service Scores

Ecosystem Service Type	Ecosystem Services	n	++	+	0	-	-
Provisioning	Freshwater	10	5	3	2	0	0
	Food	10	6	2	2	0	0
	Fuel	10	0	2	8	0	0
	Fiber	10	0	0	10	0	0
	Genetic resources	10	0	3	7	0	0
	Natural medicines/pharmaceuticals	10	0	0	10	0	0
	Ornamental resources	10	0	0	10	0	0
	Clay, mineral, aggregate harvesting	10	3	2	5	0	0
Regulating	Energy harvesting from natural air and water flows	10	0	0	10	0	0
	Air quality regulation	10	0	0	10	0	0
	Local climate regulation	10	0	0	10	0	0
	Global climate regulation	10	0	0	10	0	0
	Water regulation	10	5	3	2	0	0
	Flood hazard regulation	10	0	3	4	3	0
	Storm hazard regulation	10	0	3	4	3	0
	Pest regulation	10	0	0	7	3	0
	Disease regulation human	10	0	0	4	6	0
	Disease regulation livestock	10	0	0	6	4	0
	Erosion regulation	10	0	1	4	5	0
	Water purification	10	0	3	4	3	0
	Pollination	10	0	3	7	0	0
	Salinity regulation	10	0	0	10	0	0
Fire regulation	10	0	1	9	0	0	
Noise and visual buffering	10	0	0	10	0	0	
Cultural	Cultural heritage	10	0	2	6	2	0
	Recreation and tourism	10	0	4	3	3	0
	Aesthetic value	10	0	3	3	4	0
	Spiritual and religious value	10	0	0	7	3	0
	Inspirational value	10	0	2	6	2	0

⁵ Department for Environment, Food and Rural Affairs; *Securing a healthy natural environment: An action plan for embedding an ecosystems approach*; <http://www.defra.gov.uk>

Ecosystem Service Type	Ecosystem Services	n	++	+	0	-	-
	Social value	10	0	6	4	0	0
	Educational and research	10	0	0	10	0	0
	Soil formation	10	0	4	5	1	0
Supporting	Primary production	10	2	3	2	2	1
	Nutrient cycling	10	0	4	3	3	0
	Water recycling	10	0	4	4	1	1
	Provision of habitat	10	5	2	2	1	0

Note: n=Total Survey Site; ++=Potential Significant Positive Contribution, += Potential Positive Contribution; 0=Negligible Contribution; -= Potential Negative Contribution; --= Potential Significant Negative Contribution

Evaluation of ecosystem services: All the sites of Meghna, Shitalakhya and Haridoya River and connecting canals and beels are giving some sort of ecosystem services like either positive or negative to the human wellbeing with a different magnitude. Ecosystem services making significant positive contribution and recorded less frequently than those making a positive contribution (**Table 5:43**). The highest significant positive contribution of any ecosystem service found food provision (++=6) followed by the Fresh water (++= 5), Water regulation (++=5), provision for habitat (++=5), Clay, mineral, aggregate harvesting (++=3), and primary production in aquatic corner (++=2) also made a significant positive contribution. Social values (+=6) and Nutrient cycling, water recycling, soil formation, recreation and tourism (+=4) are the most frequently occurring ecosystem service making a positive contribution.

In addition, freshwater (+=3), food (+=2), fuel (+=2), genetic resources (+=3), water regulation (+=3), Flood hazard regulation (+=3), storm hazard regulation (+=3), pollination (+=3), soil formation (+=5), nutrient cycling (+=3), water recycling (+=4) and provision for habitat (+= 2) all made positive contribution at more than two-thirds of all the field sites (**Table 5:42**). Water recycling and primary production (- -=1) made the most significant negative contribution due to the dry crop field and vegetation coverage by aquatic floating vegetation in canals and beels, especially water hyacinth that hinders the evapotranspiration and kept the water cycle and primary production very local scale.

The Meghna, Shitalakhya and Haridoya River and connecting canals and beels in generally moderately support the freshwater, food, flood regulation and wildlife habitat in both wet and dry seasons.

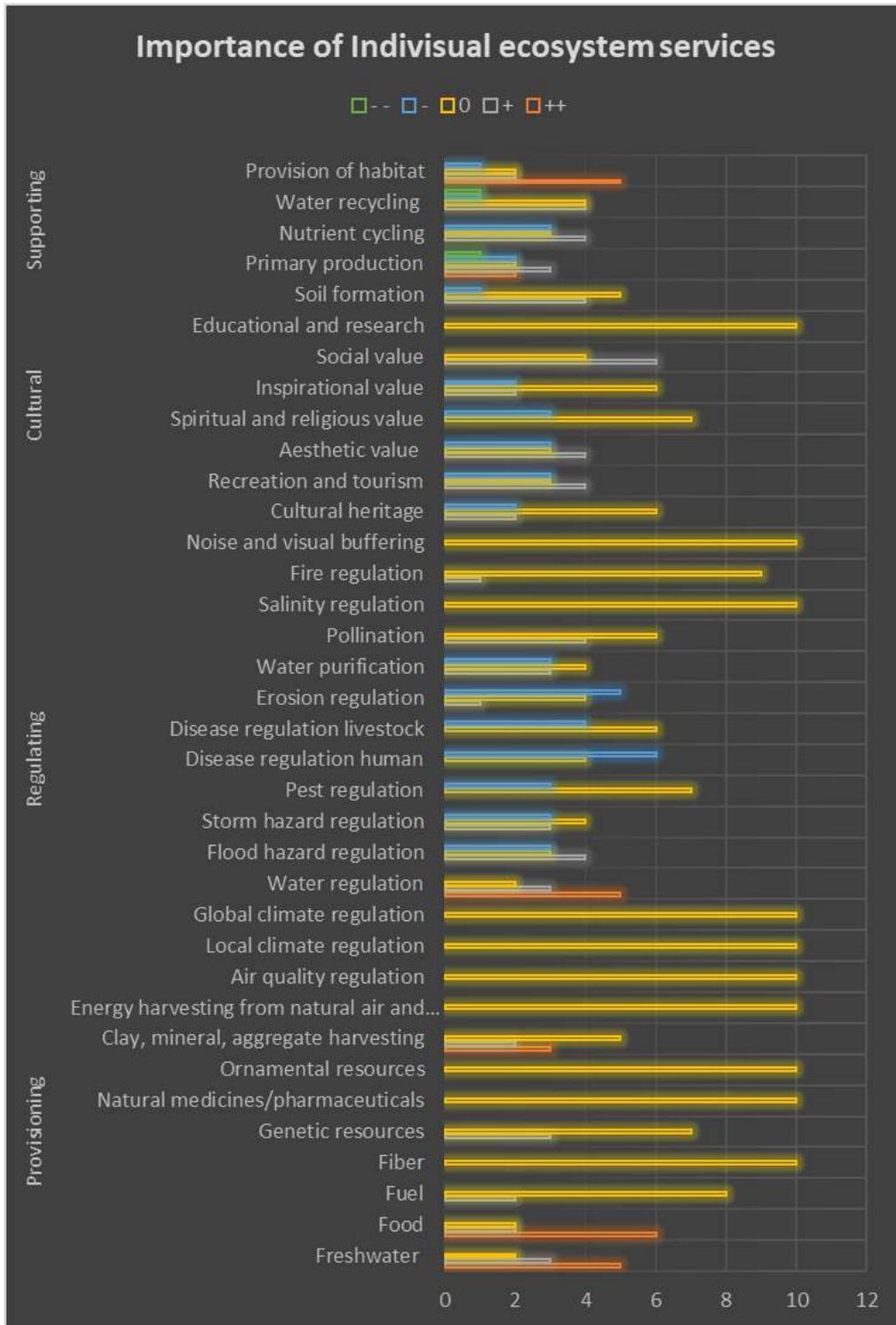


Figure 5.72: Relative Importance of Individual Ecosystem Services from All Field Assessment Sites (n=10) with '0' Score Removed

Potential Risks to Ecosystems

The Ashuganj and Palash Green Project is located in an ecologically diverse region that includes wetlands, forests, agricultural lands, and homesteads. However, several potential risks threaten the ecosystems within the project area. These risks stem from human activities, infrastructure development, and natural environmental changes.

1. Habitat Destruction and Land Conversion

- Expansion of agriculture, settlements, and commercial plantations may lead to loss of natural habitats, particularly wetlands and riparian zones.
- Deforestation for timber, fuelwood, and monoculture plantations (such as Mahogany and Mango) reduces biodiversity and alters ecosystem functions.
- Encroachment of wetlands for agriculture and infrastructure development threatens wetland-dependent flora and fauna.

2. Water Pollution and Degradation of Aquatic Ecosystems

- Discharge of agrochemicals (fertilizers, pesticides, and herbicides) into water bodies can cause eutrophication, leading to the depletion of dissolved oxygen and loss of aquatic life.
- Industrial and household wastewater runoff may introduce pollutants that degrade water quality and harm aquatic organisms.
- Alteration of natural hydrological patterns due to irrigation and drainage projects can negatively impact wetland vegetation and aquatic biodiversity.

3. Invasive Species and Biodiversity Loss

- Introduction and spread of invasive plant species (such as water hyacinth and exotic fast-growing trees) may outcompete native flora, reducing overall biodiversity.
- Replacement of native tree species with commercial plantations disrupts the ecological balance, affecting dependent wildlife species.

4. Climate Change and Extreme Weather Events

- Rising temperatures and changes in rainfall patterns can impact wetland hydrology, affecting seasonal aquatic plant communities and water availability.
- Increased frequency of flooding and drought can lead to habitat degradation, soil erosion, and shifts in plant composition.
- Salinity intrusion in low-lying wetland areas may threaten freshwater ecosystems and species adapted to specific conditions.

5. Overexploitation of Natural Resources

- Unregulated harvesting of wetland plants, timber, and medicinal plants may lead to population decline of key species.
- Overgrazing by domestic livestock in agricultural and wetland areas may degrade vegetation and soil quality, affecting regeneration and habitat stability.

6. Road and Infrastructure Development

- Construction of roads, embankments, and irrigation canals may fragment habitats, disrupting wildlife movement and connectivity between ecosystems.
- Increased human activity in ecologically sensitive zones can disturb breeding and nesting sites of birds and small mammals.

5.3.5 Socio Economic Resources

The current section delineates baseline condition of social and economic resources of the study area. In doing so, a number of socio-economic indicators are analyzed based on the available data of the study area. The study area boundary is demarcated based on the extent of impact of the study and demonstrated through the geographical locations in the Government's administrative units (namely district, upazila and union).

The socio-economic condition of the people living within the boundary of the study area is captured in this section. Primary data were gathered by using a variety of data collection techniques, such as Rapid Rural Appraisal (RRA), Key Informant Interview (KII), informal discussions and observations. Moreover, secondary information is supplemented from the community series of the Population and Housing Census 2022, published by Bangladesh Bureau of Statistics (BBS) in 2022. Further, an estimation of the current population has been done using the national growth rate.

Administrative Area Boundary

The geographical location of the project as well as study area has been defined through the administrative units of union and upazila within the district. For this ESIA, the study area consists of primarily two (2) Districts, Brahmanbaria and Narsingdi. Brahmanbaria district covers Twenty-four (24) unions of four Upazilas (Ashuganj, Brahmanbaria Sadar, Nabinagar, & Sarail).

On the other hand, the Narsingdi district covers sixteen (16) unions of three (03) Upazilas (Narsingdi Sadar, Palash & Shibpur). The administrative boundary of the project and the study area are presented in **Appendix C**.

Demography

Brahmanbaria

According to the Population and Housing Census of 2022, the study area has a total population of 827,499, comprising **223,217** households of which **394,687** (47.7%) are male and **432,812** (52.3%) are female. Among the total population. The average sex ratio of male and female of these unions is 106.7, which is higher than the national figure of 98.07. A closer analysis of the data by Upazila reveals that Nabinagar Upazila has the highest sex ratio of 110.4, while Ashuganj Upazila records the lowest at 104.2. The average household size in Brahmanbaria District is 4.8.

Table 5.44: Demographic Profile

District	Upazila	Household	Population			Sex Ratio	HH Size
			Total	Male	Female		
Brahmanbaria	Ashuganj	43606	189347	91107	98241	104.7	4.4
Brahmanbaria	Brahmanbaria Sadar	107598	372433	179257	193177	105.2	3.9
Brahmanbaria	Nabinagar	4682	19675	8803	10871	110.5	4.2
Brahmanbaria	Sarail	67331	246044	115520	130523	106.5	3.4
Average/Total		223,217	827,499	394,687	432,812	106.7	4.0

Source: Population and Housing Census 2022, (BBS- 2024)

Narshinhdi

On the other hand, according to the Population and Housing Census, 2022 the Narshinhdi District area is comprised of **223,682** households in which **335,383** (50.33%) are male and **330,977** (49.67%) are female. The average male-female sex ratio of the study area is **100.4**. The average household size for

study area is 3.3, which is also lower than the national average of average of 4.4 [BBS, 2022]. The population distribution for study area is presented in **Table 5:45**.

Table 5.45: Demographic Data of the Study Area

District	Upazila	Household	Population			Sex Ratio	HH Size
			Total	Male	Female		
Narsingdi	Narsingdi Sadar	109494	280460	143450	137010	97.7	3.4
Narsingdi	Palash	61291	198690	100374	98316	100.5	3.1
Narsingdi	Shibpur	52897	187210	91559	95651	103	3
Total		223,682	666,359	335,383	330,977	100.4	3.3

Source: Population and Housing Census 2022, (BBS- 2024)

Indigenous People

Brahmanbaria

It is enriched by the presence of various ethnic groups such as the Chakma, Tripura, Garo, Marma, Bom, Barman, Santal, and others. **Table 5:46** indicates the proportion of ethnic people in the study area.

However, immigrant communities have their own cultures. Their festivals are very colorful and full of music and dancing. Boishabi (Biju, Sangrai, Bishu), Buddha Purnima, Kathin Chibar Daan, Ker Puja, Wangala, Christmas, Bawm New Year etc. are the major religious festivals.

Their dress, food habit and celebration styles can be easily distinguished from the Bengalis and other communities. An ethnic community's primary source of revenue is agriculture. The primary agricultural crop in this region is rice. It has been noted that ethnic communities are impoverished. The majority of the ethnic groups are hardworking, using day laborers in agriculture. Both men and women are expected to contribute to the family's needs in the culture of the ethnic group.

Table 5.46: Ethnic Population in the Study Area

District	Upazila	Total	Male	Female
Brahmanbaria	Ashuganj	21	15	6
Brahmanbaria	Brahmanbaria Sadar	307	136	171
Brahmanbaria	Nabinagar	32	21	11
Brahmanbaria	Sarail	12	100	7
Total		372	272	195

Source: Population and Housing Census 2022, (BBS- 2024)

Narshinhdi

On the other hand, the lifestyle of indigenous communities depends on diverse cultural traditions, religious beliefs, and social structures. Their way of life is primarily nature-dependent, agriculture-based, and enriched with unique cultural heritage. However, modernization and urbanization have brought changes to their lifestyles. Their language, religion, and social rituals have preserved their distinct identity, which is an integral part of Bangladesh's diverse culture. Agriculture, daily wage labor, hunting, fishing, and foraging are their primary means of livelihood. Durga Puja, Chhath Puja, Sangrai (Boishabi), Buddha Purnima, Karam Festival, Christmas, Easter, and Karma Puja (Karam Festival) are among the major religious festivals.

Each of these indigenous groups celebrates unique religious festivals based on their spiritual beliefs, whether Buddhist, Hindu, Christian, or animist. Many of their festivals revolve around harvests, nature worship, and religious devotion, preserving their rich cultural heritage.

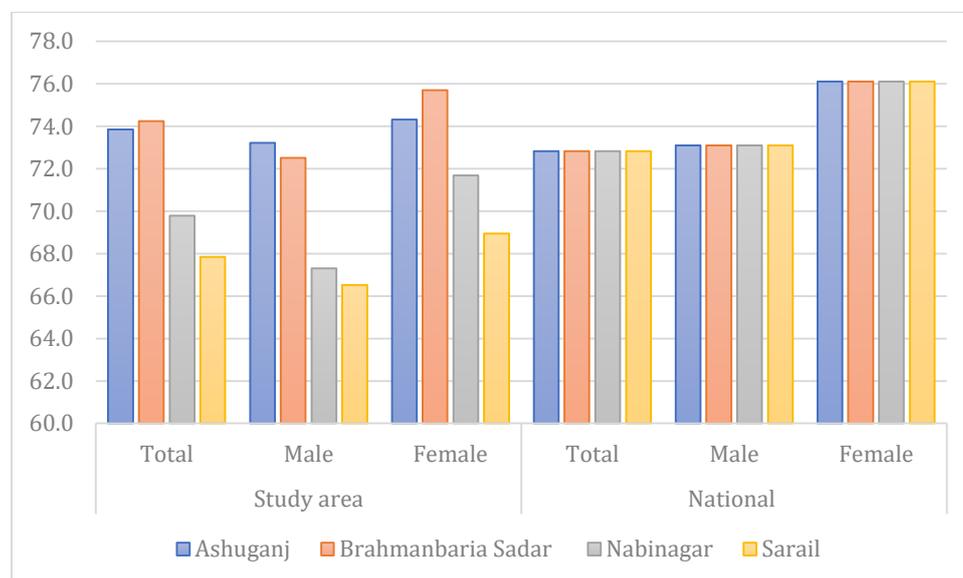
Table 5.47: Ethnic Population in the Study Area

District	Upazila	Total	Male	Female
Narsingdi	Narsingdi Sadar	508	280	228
Narsingdi	Palash	263	142	121
Narsingdi	Shibpur	81	46	35
Total		852	468	384

Source: Population and Housing Census 2022, (BBS- 2024)

Education

The literacy rate (based on the definition of “ability to write a letter in any language”) in the **Brahmanbaria** District is 72.06%, where male accounts for 70.79% and female for 73.10%. On the other hand, the Literacy rate in the **Narsingdi** District is 77.56%, where male accounts for 79.0% and female 76.12%. Data shows that the picture of the study area is not different from the national literacy picture (National is 74.80% which male 76.71 % and female 72.94 %). The male literate populations are ahead of their female counterpart. Moreover, the overall literacy rate of the study area is a little bit higher than that in the national level (**Figure 5.73**).



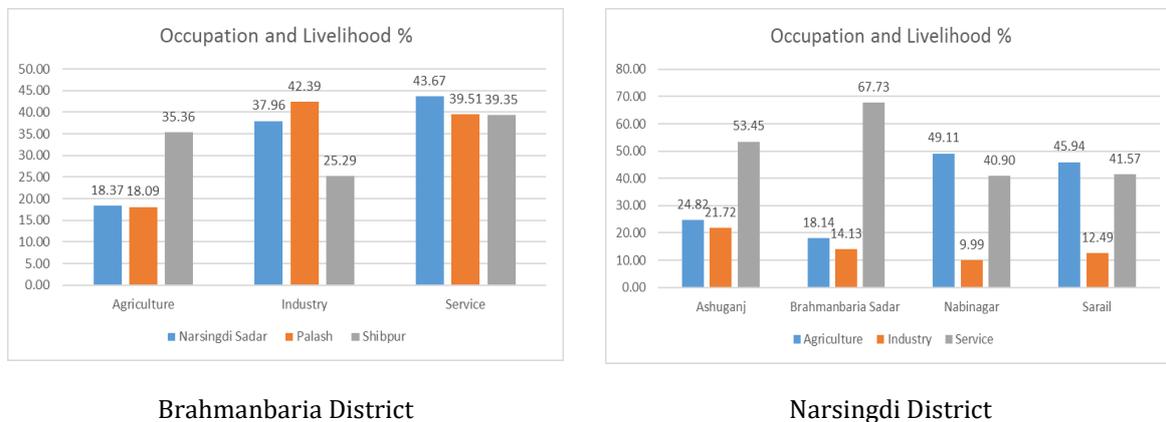
Source: Population and Housing Census 2022, (BBS- 2024)

Figure 5.73: Literacy Rate among the Studied Population

People’s access to education of this area is same like other rural area of Bangladesh. Enrolment in education shows the difference regarding attending and not attending school by age group. In terms of attending school age groups of 6 to 10 years and 11 to 14 years is the highest and second highest respectively while this situation is very awful for higher studies which is over 20 years or more ages. It indicates that education enrolment over 20 years’ age or more is becoming less important due to economic factor. This group of people became bound to engage themselves in income generating activities rather than education.

Occupation and Livelihoods

The employed population has been distributed into three sectors: agriculture, service, and industry. Thus, according to data (BBS, 2022), Service is the dominant mode of livelihood in the Study area both in **Brahmanbaria** (50.9%) and **Narsingdi** (40.84%). This group includes farmers, leaseholders, sharecroppers, fishers of both professional and seasonal, and livestock and poultry farmers. The second-largest employment sector is service which refers to salaried employees working in different sectors.



Source: Population and Housing Census 2022, (BBS- 2024)

Figure 5.74: Employed Population by Sector, 2022

It is evident in the Figure 5.74 that out of the total employed population of the both district, **34.5%** and **23.94** are engaged in agriculture 14.58 and 35.22% in industry sector.

The field study in the project area both Brahmanbaria and Narsingdi found that the people are engaged in a diversity of activities for income sources and to earn their livings. The available BBS data seem to have limited value to understand the variety of economic activities in the project area. This section provides a summary of the field-level findings, further complemented with secondary sources. Overall, the employment and occupational patterns in the project area can be divided into the following broad categories: farmers, laborers, industrial workers, Transport drivers, and businessmen/traders etc.

Farmer: Agriculture is a primary occupation here. Many people earn their livelihood by cultivating rice, wheat, potatoes, vegetables, and fruits. However, due to riverbank erosion and flooding, many farmers have lost their land, making agriculture a significant challenge for them. In this area, two types of sharecropping are generally practiced: Aadha (half share): If the landowner supplies all the inputs for farming, the harvest is divided into two equal parts. Tevaga (one-third share): If the cultivator bears all the expenses, the total produce is divided into three parts, with one-third going to the landowner. Through this system, even landless farmers get an opportunity to earn a livelihood, although their financial security remains uncertain.

Business and Trade: In addition, many people earn their livelihood by running local shops, selling goods in the market, and engaging in the business of fruits and vegetables. In this area, there are some small business establishments and shops where many local people work.

Industry and Labor Work: One of the key sources of employment here is the auto rice mill. In addition, people are engaged in cottage industries, construction labor, boat and net repairs, as well as the maintenance of agricultural machinery. They also earn income through various types of day labor work.

Fishing: Another occupation of the people of the study area is fishing in rivers. Low income farming households reported that seasonal fishing in rivers and wet lands is another source of their income. They use various types of boats to catch fish, and some process the fish (for example, by drying them) for sale.

Day Labor: There are a large number of absolute and functionally landless people, who worked as agricultural and non-agricultural laborers in the study area. However, if there is no available work in this area, they migrate to different districts for work. For non-agricultural day laborers they migrate to cities i.e. Dhaka, Sylhet and Chattagram, whereas for agriculture laboring they migrate to adjacent districts.

Van/Rickshaw Puller: In the past, there were a few people involved in the rickshaw/van pulling profession in the study area. However, after evolving the motorized rickshaw/van and auto bikes, a large number of people including unemployed youth are engaged in this profession, as it is convenient and comparatively low laborious work.

Household Work: Household work, such as cooking, sewing clothes, and managing the household, is carried out. Women, in particular, are engaged in making Nakshi Kantha and various types of handicrafts.

Quality of Life Indicators

Drinking Water

Brahmanbaria: Collecting drinking water from Tube well is predominant (98.96%) throughout the study area and other sources (0.02%) are very few, which are open water bodies as sources i.e. ponds, or other water bodies, which store rainwater etc.

Table 5.48: Source of Drinking Water of Brahmanbaria

Upazila	Tap/pipe (Supply)	Tube-well (Deep/Shallow)	Bottled/Jar Water	Well	Pond/River/Canal/Lake	Spring	Rain Water	Others
Ashuganj	2.63	97.21	0.08	0.01	0.02	-	-	0.04
Brahmanbaria Sadar	0.00	99.81	0.02	0.15	0.03	-	-	0.00
Nabinagar	0.00	99.91	0.02	0.00	0.06	-	-	0.00
Sarail	0.00	99.84	0.13	0.00	0.02	-	-	0.02
Average	0.66	99.19	0.06	0.04	0.03	-	-	0.01

Source: Population and Housing Census 2022, (BBS- 2024)

Narsingdi: Collecting drinking water from Tube well is predominant (99.16%) throughout the study area. Supply of “tap water” (0.80%) (Sourced from Tap) is mainly used in Paurashava areas on a rental basis.

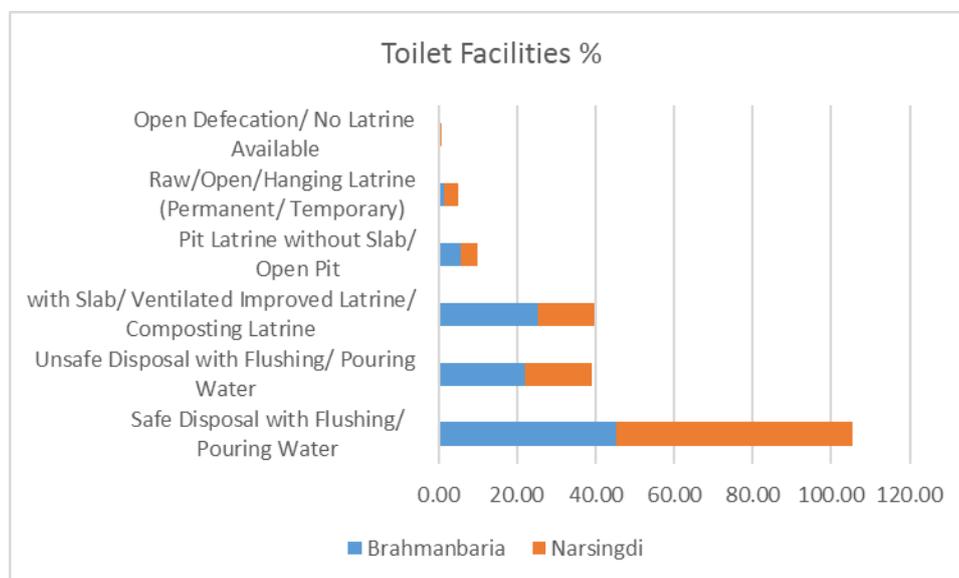
Table 5.49: Source of Drinking Water of Narsingdi

Upazila	Tap/pipe (Supply)	Tube-well (Deep/Shallow)	Bottled/Jar Water	Well	Pond/River/ Canal/Lake	Spring	Rain Water	Others
Narsingdi Sadar	0.03	99.92	0.04	0.01	0.01	-	-	0.00
Palash	2.53	97.39	0.03	0.01	0.01	-	-	0.03
Shibpur	0.00	99.99	0.00	0.00	0.00	-	-	0.00
Average	0.85	99.10	0.02	0.01	0.01	-	-	0.01

Source: Population and Housing Census 2022, (BBS- 2024)

Sanitation

Sanitation⁶ facilities in the study area show that about 22.06% and 16.96% of households from the Brahmanbaria and Narsingdi district respectively use Unsafe Disposal with Flushing/ Pouring Water latrines. The prevalence of Safe Disposal with Flushing/ Pouring Water sanitary latrines is also higher in Brahmanbaria (45.26%) and Narsingdi (60.12%) district. Field findings confirm that Unsafe Disposal with Flushing/ Pouring Water latrines are predominant among kutcha houses. As water-sealed sanitary latrines are used by kutcha, semi-pucka, and pucka households. Water-sealed sanitary latrines are available predominantly in pucka houses.



Source: Population and Housing Census 2022, (BBS- 2024)

Figure 5.75: Sanitation Facility in the Study Area

Electricity

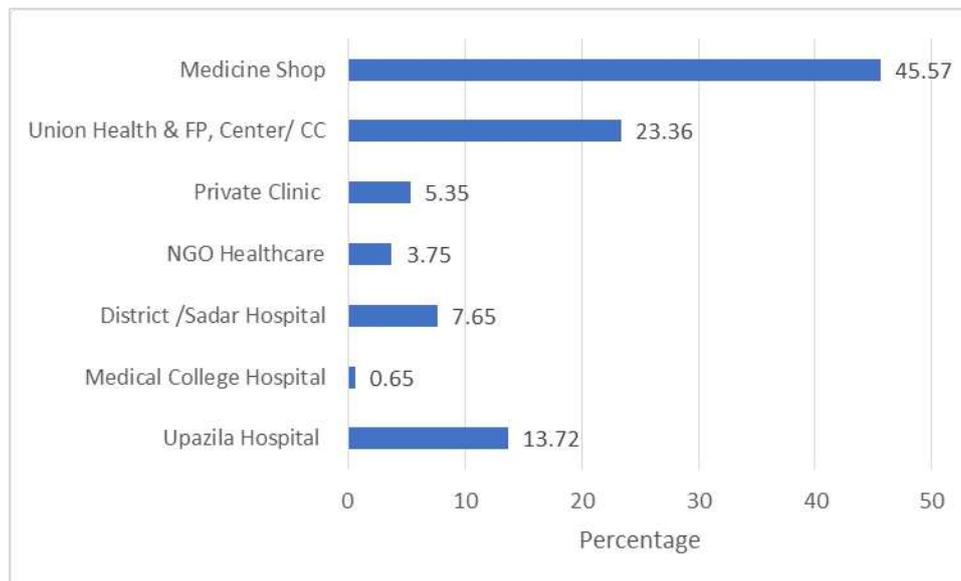
Electricity is the important requirement for the development of an area. It is an important indicator of measuring the advancement of an area. According to BBS, 2022, only 99.8% of households in the

⁶ BBS defined four types sanitation in Bangladesh such as (i) Sanitary (water-sealed): A water sealed latrine is simply a pit latrine that has a water barrier to prevent odors. These latrines are simply pits dug in the ground in which human waste is deposited. (ii) Sanitary (not water-sealed/ring slab), latrine with a slab or other secure cover over the drop hole, or a polyethylene flap preventing in-sects from flying into or coming out of the pit; and (iii) Non-sanitary (Kucha): latrine is a frame or platform extending over earth or water; an "open pit latrine" does not have a squat platform or slab on the pit and (iv) No facilities: Defecation in bushes or fields or other outdoor locations.

study area have electricity coverage but during the field visits, it is observed that at present almost 100% of households have electricity connections in both Brahmanbaria and Narsingdi.

Access to Health Service

Local people prefer to go to the informal healthcare/workers, such as medicine shops or village doctors for common diseases. Besides, people most frequently access to the Union Health and Family Planning Centre and the Community Clinics. However, people access to the Upazila Health Complex and district hospital in the case of more severe health problems. This implies the preference of closer facilities rather than the distant one, since it involves additional expense and troublesome journey (see **Figure 5:76**).



Source: CEGIS Field Survey, 2025

Figure 5.76: Perception on Health Seeking by Service Providers

Access to health services and facilities refers to availability and adequacy of supply, affordability, physical accessibility, and socio-cultural acceptability. Field data shows that there are 72 community clinics and 29 union complexes at the union level. People stated that the existing services are almost inaccessible to rural poor people. Therefore, a substantial pattern tends to receive services from the local chemist and or quack doctors. They stated that most of the community clinics are located at the preferable locations of local political leaders therefore; remote villagers have limited access than that of these adjacent villagers.

Survey also confirmed that nearly 45 of percent people receive health services from quack doctors and 30 percent from paramedic/ diploma physicians and only 10 percent from trained doctor. It is noteworthy that about 5% do not receive treatment facility due to their impoverishment. People reported that the earlier tendency to go to the local healer for treatment has been taken place by registered/trained physicians. It is assumed that economic wellbeing may drive them toward receiving treatment facilities from trained physicians whether it is expensive or cost effective.

Quality of health services and facilities is quite poor as reported by the local people. People are much more aware to receive treatment facilities from registered physicians. Some people obtain treatment from private clinic and upazila health centers. They go to Brahmanbaria, Narsingdi and Dhaka for treatment.

Poverty

Household income and expenditure were assessed following local people's response in different consultations. In the study area, it was found that in most of the cases income and expenditure vary from BDT 10,301 to 26,163 per month. **Figure 5:77** shows that the average income and expenditure ratio in this range is 50% and 55% respectively. The lowest income and expenditure vary from BDT 7,000 to 10,000 per month and the ratio is about 2% and 5%, respectively.

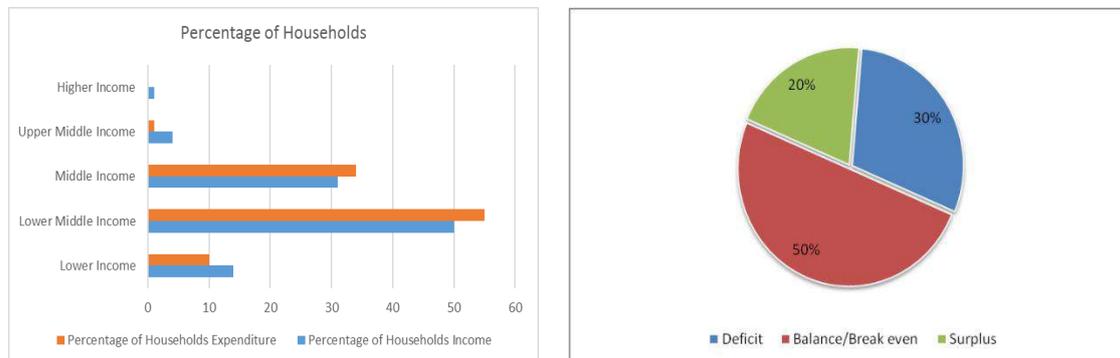


Figure 5.77: Household Income - Expenditure and Poverty Status

The Poverty profile has been prepared through a self-assessment exercise of local community. The assessment was made for three different categories i.e. deficit, balance/breakeven, and surplus. The categorization was based on the year-round income along with the food consumption of the inhabitants. From the analysis, it is observed that around 50% of households in the study area are in balanced/breakeven condition and about 20% are in surplus condition. The rest of the households are in the 'deficit' category.

Labor Availability and Wage Rate

Field findings show that there is a practice of sharecropping in the study area, because a large number of population of that area are landless and marginal farmer. Some of these people also work as a day laborer on others field. In the study area, the maximum male farming labor wage is 600-900 BDT per day and minimum is 400-600 BDT/day. Non-farming labor wage rate is 600-1000 BDT per day and minimum wage rate is 500 BDT per day. Though the agricultural wage rate is lower than the non-agricultural wage rate, most of the laborers are engaged in agriculture sector due to the availability of working opportunity in the study area.

Population Migration

There is a tendency of migration among the people. It is found that few households have permanently migrated from the study area. This group of people specially migrated for better jobs and education. Besides, temporary seasonal labor migration to other districts was reported during the harvesting season, and also for earthwork. Although such migration is for agricultural work, some also work in urban centers as transport workers such as in rickshaw pulling, and construction workers. The destination varies depending on personal contacts and network; however, the following were reported as typical destinations; Dhaka and Gazipur for working in Industries and contributes significantly in family income.

Gender

The area is dominated by the male as per the traditional scenario in rural Bangladesh. Senior male member of the family is the main guardian of the family and take major decisions of the family where

in most of the cases female decisions remain inconsequential. However, in some cases, especially in literate families, both male and female members are jointly participating in major decision making.

In occupational aspect, there found gaps between male and female in respect to wage rate. Male are paid higher wage than female counterparts. The local people stated that, male are mostly engaged in laborious jobs which need higher physical strength whereas such types of work is difficult to do by the female, even if, the female engaged to do such jobs but could not able to reach in expected output in spite of having have full dedication.

On the other hand, literacy rate of female is increasing at higher pace than that of male and dropout rate is drastically decreased with decreasing rate of early marriage in the study area. Some of these women having minimum academic background out-migrated to Dhaka and Gazipur for working in Industries and contributes significantly in family income. Women are significantly engaged in different NGOs which provided medical support, income generating support and other safety nets.

Social and Cultural Amenities

Brahmanbaria

Brahmanbaria is known for its rich cultural heritage, educational institutions, and vibrant community activities.

i. Cultural Heritage

- **Folk Music and Dance:** Brahmanbaria is famous for its traditional folk music, especially Baul and Bhatiali songs. These performances are often accompanied by instruments like the Ektara and Dotara, which are part of the local musical culture.
- **Festivals:** The area celebrates various traditional festivals, such as Pohela Boishakh (Bengali New Year) and other local festivals, with processions, cultural performances, and community gatherings.

ii. Historic Sites

- **Brahmanbaria District Museum:** This museum showcases the rich history and cultural artifacts of the district, including ancient tools, pottery, and other relics that represent its historical importance.
- **Temples and Historical Monuments:** Brahmanbaria is home to several temples and historical monuments, some of which are linked to the region's colonial past and its historical development.

iii. Educational and Cultural Institutions

- **Akhtaruzzaman Chowdhury Tara Hall:** This cultural hall serves as a venue for music, dance, and drama performances. It is one of the key places for cultural events in the district, where both local and national artists perform regularly.
- **Public Libraries and Institutions:** There are libraries and cultural centers that promote reading and creative arts among the locals.

iv. Social Amenities

- **Health Services:** Brahmanbaria has a number of government and private hospitals and clinics offering healthcare services to the local population.
- **Sports and Recreation:** The district offers various sports activities, especially in fields like cricket, football, and volleyball, contributing to community health and youth engagement.

Narsingdi

Narsingdi is also known for its vibrant community life, with various social and cultural amenities that reflect its cultural diversity and agricultural significance.

i. Cultural Events and Festivals

- **Annual Cultural Festivals:** Narsingdi hosts several cultural festivals, including book fairs and science exhibitions. These festivals highlight local literature, arts, and innovations, and are important cultural events for the district.
- **Traditional Music:** Much like Brahmanbaria, Narsingdi also has a rich tradition of folk music. Local performances often include traditional songs, dances, and dramas, especially during festivals.

ii. Historic and Archaeological Sites

- **Historic Mosques and Temples:** The district has several historic mosques and temples that reflect its religious and cultural heritage.

iii. Educational and Cultural Institutions

- **Narsingdi Community Center:** This center acts as a hub for various cultural and social activities, where local residents can participate in performances, art exhibitions, and social gatherings.
- **Local Libraries and Cultural Spaces:** Libraries and cultural institutions in Narsingdi support education, providing a space for local writers, artists, and the youth to engage in creative activities.

iv. Social Amenities

- **Healthcare Facilities:** Narsingdi has both government and private healthcare facilities that serve its population, though access to healthcare in rural areas can be a challenge.
- **Public Amenities:** The district has several public parks, sports complexes, and recreational centers that promote social well-being and community engagement.

v. Sports and Recreation

- The district is home to various sports complexes where local tournaments, especially in football, cricket, and badminton, are held. These activities help engage the youth and promote fitness.
- **River Tourism:** The rivers surrounding Narsingdi, including the Baleshwar River, offer opportunities for river-based tourism, fishing, and leisure activities.

Physical Infrastructure and Service

Ashuganj-Palash is an area located in Brahmanbaria district, known for its agricultural activities, irrigation systems, and some key infrastructural developments. Below is a detailed overview of the physical infrastructure and services in the Ashuganj-Palash region:

Road Network: Ashuganj is connected to major highways, including the Dhaka-Sylhet Highway, and it is served by important roads linking the area to Palash and nearby towns. However, recent development activities such as the Ashuganj-Akhaura Four-Lane Expansion Project have impacted the local infrastructure, particularly the irrigation canals, which have been disrupted due to road construction.

Port: Ashuganj River Port is a significant port in the region, contributing to the transport of goods, particularly agricultural products. It plays a crucial role in the logistics and trade of goods, especially those coming from the nearby agricultural fields.

Public Transport: Bus services connect Ashuganj with major cities, including Dhaka. Local transportation is also available, though it may be limited in rural areas.

Ashuganj Power Station: Ashuganj has a major power station that contributes significantly to the national grid. The Ashuganj Power Plant is one of the largest power plants in Bangladesh, providing electricity not only to the local area but also to neighboring regions.

Electricity Distribution: The region is connected to the national electricity grid, and most of the population has access to power. However, power outages can occasionally occur, particularly in rural and remote areas.

Schools and Colleges: Ashuganj-Palash has a number of primary schools, secondary schools, and colleges. However, educational facilities may be limited in more remote areas, requiring further development in rural parts of the region.

Healthcare Facilities: Ashuganj has a Upazila hospital and several private clinics that serve the local population. However, healthcare services in rural areas may be limited, and there is a need for more medical facilities to improve the overall health infrastructure.

Telecommunication: Mobile network coverage is generally available, with major providers like Grameenphone, Banglalink, and Robi offering services in the area. However, internet connectivity can be inconsistent, particularly in rural locations, which affects communication and access to information.

Agricultural Support Services: The region has government agencies such as the Bangladesh Agricultural Development Corporation (BADC) providing support for farmers, although the disruption to irrigation systems has caused increased costs for agricultural activities.

Marketplaces and Trade: Ashuganj is known for its agricultural trade, particularly in the form of rice, vegetables, and other crops. The region's markets, however, suffer from irregularities due to water supply issues affecting the yield of crops.

Flood Management: Ashuganj-Palash is prone to flooding during the monsoon season, which can damage infrastructure and agriculture. Flood control embankments and other structures are in place, but these have also been affected by the infrastructural developments and changes in land use.

Communication

Road, waterways and rail ways are functional in the study area. Dhaka is about three hour's journey by road. The district is accessible via national highways, with regular bus services connecting Brahmanbaria to major cities like Dhaka and Chittagong. Local transportation within the district includes rickshaws and auto-rickshaws, ensuring mobility for residents and visitors. Brahmanbaria Railway Station serves as a crucial hub, with multiple trains passing through daily, linking the district to various regions.

Ashuganj River Port, located on the Meghna River in Brahmanbaria District, is a pivotal hub in Bangladesh's inland waterway network, facilitating both domestic and international trade. Beyond riverine transport, Ashuganj is integrated into multimodal communication systems, connecting to national highways and facilitating efficient cargo movement to various regions. In summary, Ashuganj River Port's comprehensive communication system, encompassing inland waterways and multimodal connections, plays a vital role in regional trade and economic development.

The Shitalakshya River serves as a crucial waterway for Polash Upazila, facilitating the movement of people and goods. This riverine route supports local trade and contributes to the socio-economic development of the area.

Economic Activities

The area of study is an important economic region, where economic activities are carried out in a combination of different sectors. Some of the major economic activities are described below.

Agriculture: The main economic sector of Study area is agriculture. Paddy, jute, wheat, mustard, potatoes, vegetables, and various types of fruits are produced here. The agriculture-based economy is the main source of livelihood for the rural population of the district.

Industries and Factories: Various industries and factories have been developed in the district, such as textile mills, food processing factories, brick kilns and other small and medium-sized enterprises. These industries play an important role in the local and national economy.

Commerce and Services Sector: Commercial activities are quite active in Brahmanbaria city and the surrounding areas. Various markets, shopping centers, banks, insurance companies and other service institutions contribute to the economy of the district.

Communication System: The road and railway communication system of the district is developed, which facilitates the transportation of goods and commercial activities. This helps in the marketing of locally produced products and contributes to economic development. Additionally, the presence of modern telecommunication services enhances connectivity, allowing businesses to operate more efficiently and reach broader markets

Historical, cultural and Archaeological resources

There are some archaeological heritage and relic's site in the area. It is found that there are several archaeological sites in the study area. Archaeological and Historical Sites: Isa Khan's Capital, Arunodaya Kali Temple, Arifail Mosque, Aripail Mazar, Hatkhola Jami Mosque, Twin Grave, Laxman Saha Zamindar House and etc. are the main archaeological sites. Cultural Significance: Dhoronti Haor, Musical Legacy, Shivpur Sri Sri Radha Govinda Temple and Ashuganj Shiva Mandir.

6. Stakeholder Consultation

6.1 Introduction

Stakeholder consultation is an inclusive and regulatory process that involves stakeholders in meaningful consultations by which the local people's input on matters affecting them is sought. This requires an open and transparent engagement with all relevant stakeholders during project planning and throughout the project cycle. It is mandatory for the Environmental and Social Impact Assessment (ESIA) study of any development project according to the IEE/EIA Guidelines of the DoE.

6.2 Objectives and Purpose of Stakeholder Consultation

The consultations have different mandates among the stakeholders from the local beneficiary to the project proponent. For the stakeholders, it is an opportunity to obtain project information, and raise issues and concerns. For the project proponents, the consultation process helps to understand the needs and aspirations of the stakeholders and their suggestions to draw potential and sustainable design and planning of the proposed project by controlling external risks. It can also form the basis for future collaboration and partnerships.

The main objectives of the stakeholder consultation/meetings were to:

- Developing and maintaining communication links between the project proponents (BADC) and stakeholders;
- Sharing of information with stakeholders on the proposed project activities and providing key project information to the stakeholders, and asking their views on the project and its potential or perceived impacts;
- Understanding the stakeholders' concerns regarding various aspects of the project with different phases of activities;
- Receiving feedback on environmental and social impacts with their significance and their possible sustainable management accordingly;
- Managing any misconceptions related to the project and preparing stakeholders' engagement plans in different project activities;
- Interaction with the project affected/beneficiary population and other relevant stakeholders for collection of primary and secondary data on the environment and social aspects; and
- Engaging stakeholders for O&M of the project interventions and maximization of the project benefits;

6.3 Approach and Methodology

The participatory approach was followed for identifying the stakeholders for conducting consultations. The study team consulted the project proponent (BADC) for understanding the project brief and identifying the potential stakeholders. Therefore, the key stakeholders include occupational groups, such as farmers, fishermen, Political and elite persons, laborers, etc. whose activities are likely to be impacted due to the proposed irrigation project. Furthermore, the local population, interested groups, and local administration officials were considered the potential stakeholders and were also consulted at this ESIA stage.

An expert multidisciplinary team made a number of visits to the study area for conducting consultations with the predefined stakeholders to collect/record their opinions and views. The consultants used maps of the project area in establishing the baseline condition and identifying a

proper management plan for the project. The facilitators explained all relevant points and issues in order to enable the participants to comprehend the proposed activities properly and to respond accordingly. The consultants took utmost care in recording the participants' opinions and views relevant to the study. Besides, a number of Focus group discussions (FGDs), and informal discussions were carried out as public consultation process. A list of stakeholders is given respectively in **Appendix-D**. The consultation specific photographs are presented in **Appendix-E**.

6.4 Identification of Stakeholders

Stakeholders include all those who may affect or are being affected by policies, decisions, or actions within a particular system. Stakeholders can be groups of people, organizations, institutions, and sometimes even individuals. Stakeholders can be divided into primary and secondary categories. In the consultation meeting, both the primary and the secondary stakeholders have been selected. The following **Table 6.1** presents the identified stakeholders at a glance.

Table 6.1: Stakeholders Involved in the Study

SL.	Type of Stakeholders	Stakeholders
1	Primary	Affected Landowners, household owners, Union Parishad, and Private STW owners
2	Secondary	Upazila Administration, DAE, DOF, Civil society representatives, Political leaders, and others.

Source: CEGIS, 2025

6.5 Stakeholder Consultation and Community Meetings

The stakeholders' meetings and community-level discussions were conducted within the project area and in the study, area using different consultation techniques. The details of consultation meetings are presented below:

Informal consultation: A number of occupational groups and other relevant stakeholders were consulted through informal group discussions when the team visited the project area. This was done to understand the present environmental and socio-economic status of the project area and the study area as well. The local needs and demands have been discussed by giving equal opportunity to all participants attending the meeting. During the consultation meeting, all relevant issues within the water resources, land resources, socio-economic resources, and disaster aspects were discussed in detail. The team also informed the stakeholder about the project activities and potential impacts that may surface during the construction and operation of the project.

Expert/Institution Consultation: Experts with professional knowledge like BADC, DoE, DAE, DOF, etc. were consulted through individual and group meetings during the study. The meetings were conducted with the objective to brief about the project components, and to discuss potential environmental and social impacts of the Project. The outcomes of those consultations were used to identify valued environmental components, stakeholders for public consultation, and institutional strengthening of BADC to implement the EMP.

Table 6.2: Location of Consultation and Discussion during the Field Visit

SL. No.	Type of Consultation	Location of Meeting	Date of Meeting	No. of Participants
1.	Consultation at Union Parishad	Tarua Union, Ashuganj	9/4/2025	49
2.	Consultation at Union Parishad	West Talsohor, Ashuganj	10/04/2025	27
3.	Consultation at Union Parishad	East Talsohor, Ashuganj	10/04/2025	29
4.	Consultation at Union Parishad	Noagaon Union, Ashuganj	11/04/2025	20
5.	Consultation at Union Parishad	Kalikaccha Union, Ashuganj	12/04/2025	17
6.	Consultation at Union Parishad	Panishwar Uttar, Ashuganj	12/04/2025	19
7.	Consultation at Union Parishad	Ashuganj (Rice mill owners)	13/4/2025	24
8.	Consultation at Union Parishad	Ghorasal Pourosova, Polash	10/04/2025	25
9.	Consultation at Union Parishad	Char Sindur union, Palash	11/04/2025	27
10.	Consultation at Union Parishad	Amdia union, Narsindi Sadar	11/04/2025	21
11.	Consultation at Union Parishad	Macimpur union, Shibpur	11/04/2025	27
12.	Consultation at Union Parishad	Jinardi Union, Polash	12/04/2025	21
13.	Consultation at Union Parishad	Dulalpur union, Shibpur	13/04/2025	28
14.	Group Discussion	Battoli bazar, Natai, Ashuganj	03/03/2025	7
15.	Group Discussion	Bhabanipur, Arishidha, Ashuganj	03/03/2025	7
16.	Group Discussion	Kalikocha-nondipara, Ashuganj	05/03/2025	10
17.	Group Discussion	Chinadi Beel, Dulalpur, Polash	06/03/2025	7

6.6 Community Concerns and Suggested Solutions

A total 17 consultation meeting were conducted at the community level and 358 people were consulted during the consultation meeting throughout the project area. During all the Consultation Meeting, the project and its related activities as well as several issues with reference to the project were discussed. The CEGIS team found that the people of the area showed an overall positive attitude toward the proposed project in general as they feel that implementation of this project would play great role for their livelihood and agricultural sector along with the development of the region. However, the participants expressed their concerns on several issues which seemed reasonable. But, a brief outcome of the consultations and the people's suggestions and perceptions about the are presented below:

- Local people expressed a positive attitude toward the proposed project as the farmers will be benefitted by increasing crop production, get employment opportunities, and the cost for irrigation will be reduced;
- The land acquisition and compensation process should be in a proper way;
- Proper compensation should be ensured to the legal owner(s) according to the provisions in the existing Land Acquisition and Requisition Act of Bangladesh;
- Affected people should get proper compensation in terms of grants/allowances for structure and for displacement;
- Give priority to the affected people by engaging them in different project activities based on their skills;
- An appropriate resettlement plan may be prepared to specify affected persons and estimate compensation for all types of their losses for payment;

During consultations, local people identified that the proposed project might create some problems but they showed keenness proactively to resolve these minor problems. They expressed that after implementation, the project would be beneficial for the region as well as for the country.

The outcomes of the group discussions and consultation meetings in terms of concerns and the suggested solutions were noted and organized by themes are presented in the **Table 6.3** below.

Table 6.3: Major Problems and Suggested Solution by the Stakeholders

Place	Concerns/Issues/Problems	Suggested Solution/Remedies
Tarua Union, Ashuganj	<ul style="list-style-type: none"> • The primary irrigation source, Talla Khal, has become heavily silted and filled with water hyacinths, which obstructs the flow of water necessary for agricultural activities. This blockage leads to insufficient water supply for crops, particularly during critical growing periods. • Water for Boro rice cultivation arrives late, typically in February or March, which is not ideal for the growth cycle of the crop. This delay results in reduced yields and affects the overall productivity of the farming community. • The presence of iron in the groundwater negatively impacts the growth of paddy crops, leading to lower yields. This issue is particularly concerning as it affects the quality and quantity of the harvest, ultimately impacting food security and farmer income. • The RCC canals become damaged. Therefore, leakage often cause water loss. This not only reduces the amount of water available for irrigation but also leads to significant crop losses, particularly in mustard fields adjacent to the canals. • Some buried pipes have deteriorated. This inefficiency exacerbates the water scarcity issue. • There has been a noticeable increase in crop damage caused by rodents. This issue can lead to substantial financial losses for farmers, as their crops are destroyed before harvest. • The current costs of irrigation range from Tk. 2,000 to Tk. 3,000 per kani (1 kani= 30 decimal), which places a heavy financial burden on farmers. • The khal (canal) has become heavily silted due to the lack of regular re-excavation, resulting in poor water flow and drainage issues. • The regulator structure is in disrepair 	<ul style="list-style-type: none"> • Damaged portions of the RCC canals should be repaired; • Clogged canals should be excavated (Talshahar-Tarua and Ashuganj-Tarua Canal); • Repair and maintain existing water regulators to ensure proper functionality • Ensure timely supply of cooling water through better coordination. • Desilt the Talsohor khal to restore water flow. • Reduce dependence on arsenic-contaminated groundwater by promoting safer water sources. • Repair leaks and holes in RCC canals to prevent crop damage. • Increase surface water usage through restoration of canals, ponds, and reservoirs. • Promote homestead tree planting and agroforestry to restore biodiversity. • Implement natural pest control measures to manage field mouse populations. • Encourage community participation in maintenance and monitoring of water infrastructure. • Excavate Talla Khal to improve water flow and availability. • Excavate the canal from Talshohor to enhance water availability. • Availability and usage of green project water will solve this issue. • Repair and maintain RCC canals to prevent leakage and damage. • Repair damaged pipes to minimize water loss. • Protection of local forest will act as a habitat of foxes. Thus, the rodents will be controlled naturally.

Place	Concerns/Issues/Problems	Suggested Solution/Remedies
	<ul style="list-style-type: none"> • Cooling water supply arrived late this year, only reaching the area around February to March, which affected agricultural activities. • The khal from Talsohor is silted, further hindering surface water movement and irrigation. • The use of arsenic-contaminated groundwater has damaged crops, making irrigation hazardous in some areas. • In Union No. 6 and 7, mustard fields suffered severe damage due to leakages and holes in the RCC canal system. • Previously, 60% of irrigation relied on surface water, but now it has dropped to only 20%, increasing dependency on less sustainable groundwater sources. • The homestead forest area has significantly decreased, leading to a decline in the jackal population. As a result, field mice populations have increased, causing widespread crop damage in the area. • RCC canal is being damaged by the local peoples for providing water to their own crop land; • Secondary canals are being clogged (Talshahar-Tarua and Ashuganj-Tarua Canal). • Existing two regulators in Tarua Mouza is not functioning. • The current irrigation system is not sufficient to provide water to farmers' agricultural lands; • Crops are being damaged due to less rainfall. • There is no problem of waterlogging. • Recent flood occurred in 2004, floodwaters lasted for 1 month and the water level were about 3 feet high. • Both surface water and groundwater are used for irrigation. • Water quality of surface water (RCC canal) is quite good but there is contamination of Arsenic in groundwater which reduces crop production; • Powerplant discharged water is used during dry season for irrigation. • Power plant discharged water is much more suitable for irrigation water, as it increases crop production. Furthermore, the water is suitable for aquatic ecosystems. • Ponds are filled with water for 6 months in a year. 	<ul style="list-style-type: none"> • Access to water from the Green Project could significantly reduce irrigation costs. • Sanitation system should be improved; • Restrict local peoples from direct discharge of waste and faecal into the canal water.

Place	Concerns/Issues/Problems	Suggested Solution/Remedies
	<ul style="list-style-type: none"> • Fish availability in the canals is not enough due to the lack of water. If canals are re-excavated, canals will be filled with water and fish will also be available. • Fishermen are very interested to use the water of Ashuganj Palash Green Project for fish culture. • There is a beel named 'Eidgah Mather Beel'. • Comparatively less migratory birds visit this beel than before. • Canals are filled with large number of water hyacinth, so birds usually don't come to these wetlands. 	
Talsohor, West, Ashuganj	<ul style="list-style-type: none"> • The RCC canals used for irrigation are experiencing significant leakage, which not only wastes water but also leads to damage in adjacent crops. • The main RCC canal is being damaged by local people, and siltation is also occurring gradually; • The reduced canal height results in water overflow during the wet season, leading to wastage. • The current irrigation system is sufficient to provide water to farmers' agricultural lands; • Crops are being damaged due to less rainfall; • There is no problem of waterlogging. • Recent flood occurred in 2004, floodwaters lasted for 1 month and the water level were about 2 feet high. • Both surface water and groundwater are used for irrigation. • Water quality of the RCC canal is good for irrigation but high-water temperature is observed hardly. Existing water reservoir decreases temperature but due to siltation, water retention capacity of the reservoir has been decreased. • Powerplant discharged water is used during dry season for irrigation, local people discharge solid and liquid waste into the canal directly, medical wastes are being discharged into the canal by the nearest hospital (La Vida Hospital). • Ponds are filled with water for 9 months in a year. • Fishermen would use the green project water for fish culture if the canals are full of water. • Water of the irrigation canals are beneficial for fish culture. 	<ul style="list-style-type: none"> • Construct new infrastructure for RCC canals to prevent leakage as stones and rods are exposed. • Damaged portions of the RCC canal should be repaired. • Canal height should be increased to prevent overflow of water. • Depth of the reservoir is needed to be increased for improving water holding capacity. • Examine the current interventions and implement the requisite measures to facilitate their restoration. • The main RCC canal should be enclosed to prevent the direct discharge of waste.

Place	Concerns/Issues/Problems	Suggested Solution/Remedies
	<ul style="list-style-type: none"> • No fruits are cultivated. Different types of vegetables are cultivated. • Migratory winter birds don't come to this area. • Sometimes, small meetings are held in the Sadar about bird conservation. 	
Talsohor, East, B, Baria Sadar	<ul style="list-style-type: none"> • Canals are silted up due to disposal of waste from homesteads and hospitals, and the overgrowth of water hyacinth. • From Ashuganj to Anadil Sial Market, about 3 feet of the canal is silted with accumulated waste. • Saifun - Talsohor Paschim Para area is filled with solid waste, causing severe blockage. • The regulator at Anadil is not functioning properly. • KCC khal is heavily silted, affecting water flow and usage. • On the east side of Tili Nogor, there is no access to cooling water for agricultural land. • The groundwater level is decreasing, increasing the risk of water scarcity for irrigation. • During heavy rainfall, water remains stagnant for 15 to 20 days due to silted-up canals (khal), causing 20% damage to Aman rice crops. • Since the construction of a road around 3 years ago, nearly 5 villages in the union have been unable to access cooling water for agriculture—with Mohisharkhal being the most affected. • In Telinagar and Jamalpur, around 2,000 hectares of agricultural land were previously cultivated, but cultivation is now decreasing due to water management problems. • The RCC canals used for irrigation are experiencing significant leakage, which not only wastes water but also leads to damage in adjacent crops. • Accumulation of sediment at the bottom of the RCC canals obstructs water flow, making it difficult for farmers to draw water for irrigation. • Waterlogging is a significant issue, with some areas retaining water for 15-20 days. This prolonged situation can damage crops, particularly Aman paddy. • Due to insufficient water supply, approximately 2,000 hectares of land in 	<ul style="list-style-type: none"> • Villagers are requesting the construction of a canal from Sial Market to Kamal Miar to improve water flow and support agriculture. • Residents are demanding the re-excavation of a 2 km khal on the east side of Austogram to Suhilpur for better irrigation and drainage. • Villagers from Ward No. 6 of Dhansar and Sonasar are requesting the re-excavation of a 3 km connecting khal. This will enable cultivation of vegetables, Aush rice, and Rabi crops. The initiative will benefit both Wards 5 and 6. • Villages including Mohonpur, Sonapur, Dhansar, and Telinagar have jointly demanded the re-excavation of a total of four khals to enhance water flow and agricultural productivity. • Construct new infrastructure for RCC canals to prevent leakage as stones and rods are exposed. • Regularly excavate and maintain RCC canals to ensure proper water flow. • Improve drainage systems to alleviate waterlogging issues. • Restore water supply to previously cultivated areas to encourage agricultural production. • Restore damaged canals (Nos. four) to ensure consistent water. • The community has proposed the formation of a committee to address and prevent water pollution in the area. • Local villagers have expressed strong support for khal re-excavation efforts and are committed to participating in related activities.

Place	Concerns/Issues/Problems	Suggested Solution/Remedies
	<p>Telinagar are no longer cultivated. This abandonment represents a loss of agricultural potential and economic opportunity for local farmers.</p> <ul style="list-style-type: none"> The expansion of the Ashuganj-Sarail road has disrupted the water supply to five out of six villages in the area. This disruption has significant implications for agricultural productivity. 	
Noagaon Union, Sarail	<ul style="list-style-type: none"> Irrigation of surface water has been halted since 2021, and groundwater is currently being used for irrigation. The declining groundwater level significantly impacts farmers, resulting in higher costs and lower production in HYV Boro rice. 4 secondary canals from Astogram to Suhilpur are being silted up; Crops are being damaged due to less rainfall; 4 villages (Mohanpur, Sonapur, Dhansar, and Telinagar) within 5 no. and 6 no. wards are being affected by waterlogging problems frequently due to heavy rainfall; Recent flood occurred in 2004, floodwaters lasted for 15-20 days and the water level were about 3 feet high. Both surface water and groundwater are used for irrigation; The level of groundwater has recently decreased. Local residents are unable to utilize water discharged from the power plant for 3 years due to road construction. Canal water is being polluted due to direct discharge of the solid waste. Local residents obtained water for irrigation from the main canal next to the Ashuganj-Sarail highway until 2021. Due to road construction, they are no longer able to access water. Some canals (Jafar Khal, Lawai Khal, Budda Khal, Borkhal, Hasna Khal, Nandipara) are becoming silted, which is reducing their water-holding capacity. The current irrigation system is not sufficient to provide water to farmers' agricultural lands; Regulators in the east side of Kutrapara, Bariura, Shahbazpur are not functioning well. Both less rainfall and excessive rainfall are impacting crop production in this area; 	<ul style="list-style-type: none"> Re-excavation of major canals in this area, such as Jafar Khal, Lawua Khal, Budda Khal, and Kumtala Khal, can ensure proper distribution of water from the Green Project. The main RCC canal should be repaired; 4 secondary canals from Astogram to Suhilpur should be excavated as the farmers of those villages get sufficient water for irrigation; The existing siphon in this area should be cleared from the trash; Regulator gate in Andadil village should be dismantled; The connecting canal of the four villages (Mohanpur, Sonapur, Dhansar, and Telinagar) should be re-excavated for approximately 3 kilometers; A committee can be established to regulate water pollution at various point source locations, which would help enhance water quality to maintain irrigation quality standards. Re-excavation of major canals in this area, such as Jafar Khal, Lawua Khal, Budda Khal, and Kumtala Khal, can ensure proper distribution of water from the Green Project. A sufficient amount of water must be provided for irrigation by ensuring that the main canal is flowing correctly. The mentioned canals should be re-excavated to ensure unimpeded water flow and reduce the impact of waterlogging. The regulators on Budda Khal and the northern side of Lawar Khal require repair.

Place	Concerns/Issues/Problems	Suggested Solution/Remedies
	<ul style="list-style-type: none"> • Recent flood occurred in 2004, floodwaters lasted for 45 days and the water level were about 3 feet high. • Water logging problem exists in Majlishpur Union (from Maina Village to the west side of the Mazar of Lalan Shah Pir). • Both surface water and groundwater are utilized for irrigation; however, farmers primarily rely on groundwater during the dry season. • The presence of arsenic and iron in groundwater negatively impacts crop production. • Water quality of surface water (RCC canal) is quite good for irrigation. • There is contamination of Arsenic in groundwater which reduces crop production; • There is a BSCIC industrial zone in the Nandanpur area that discharges wastewater directly into the main canal, resulting in acidification of agricultural land and posing community health issues for local residents. • Fishing activity is both capture and culture. • If canals are filled with enough water, then fishes are available for the whole year. • There are some beels nearby, named 'Kuntana', 'Bagla', 'Dullai' and 'Akashi Shapla or Jaira'. • Most of the migratory birds come to the Akashi Shapla or Jaira beel during winter. • Common wildlife species are Golden Jackal, Checkered Keelback, Monocled Cobra etc. • There is no conflict between humans and Golden Jackal. Golden Jackals have proper shelter and food. • Sometimes, villagers kill Checkered Keelback in fear of being attacked. But they don't try to kill Monocled Cobra, as it is venomous snake. • Migratory birds were hunted frequently by villagers few years ago, but now it has been declined. 	<ul style="list-style-type: none"> • Direct discharge of wastewater into the canal by the BSCIC industrial area should be banned and strictly regulated. This measure would help to protect the local ecosystem and ensure the health and safety of nearby communities. • Awareness programs on bird conservation are arranged, and village members attend on these programs.
Kalikaccha Union, Sarailj	<ul style="list-style-type: none"> • Local residents obtained water for irrigation from the main canal until 2020. Due to road construction and garbage dumping, the canal is blocked. • Some canals (Sarail to Galania Khal, Monai Khal and Galania Dakkhin Para Khal) are becoming silted. 	<ul style="list-style-type: none"> • Restore the blocked portion of the main canal for continuous water flow. • Sarail to Galania Khal needs to be re-excavated for approximately 5 km. • Galania Dakkhin Para Khal needs to be re-excavated for approximately 1.5 km'

Place	Concerns/Issues/Problems	Suggested Solution/Remedies
	<ul style="list-style-type: none"> • The current irrigation system is not sufficient to provide water to farmers' agricultural lands. • Four sluice gates exist in Galania ward; • Less rainfall is impacting crop production in this area. • Recent flood occurred in 2004, floodwaters lasted for 20 days and the water level were about 2-3 feet high, affected villages are: Galania, Chanpur, Dharonti and Dharmatit. • Water logging problem exists in this area from 3-4 years. • Both surface water and groundwater are utilized for irrigation; however, farmers largely rely on groundwater during the dry season. • The presence of iron in groundwater negatively impacts crop production. • Water quality of surface water (RCC canal) is good for irrigation which increases crop production. • The water quality of the main canal may be impacted by a variety of point source pollutions in Sarail, such as waste discharge from households and the local market. • Checkered Keelback is frequently found, and local people kill it in fear of being attacked. • There is no conflict between humans and Golden Jackal. Golden Jackals have proper shelter and food. • There is no program or committee for wildlife conservation. 	<ul style="list-style-type: none"> • Sluice gates in Galania should be repaired or reconstructed where necessary; • The direct discharge of household and local market waste into the canal should be regulated by promoting community participation.
Panishwar Uttar, Sarail	<ul style="list-style-type: none"> • For the past 4 years, cooling water in the Bertola to Titghar khal has been almost unavailable. • In Shitahoron village, the khal used to be 12 feet wide, but due to erosion and unmanaged excavation, it has now expanded to 150 feet, reducing flow efficiency. • DTW (Deep Tube Well) irrigation can now support only 10-15 acres of land, which is insufficient for the area. • The groundwater level has dropped to 250 feet, whereas previously water was available at 60-70 feet depth. • Earlier, when cooling (surface) water was available, 1 LLP (Low Lift Pump) could irrigate a large area. Now, due to lack of surface water, farmers are relying on groundwater, leading to an increase in LLP 	<ul style="list-style-type: none"> • Villagers emphasize the need for a proper drainage system. Without it, once khals are re-excavated, rainwater will carry silt back into the channels, making them unusable again. • The community strongly demands the re-excavation of Jafor Khal to restore water flow and improve agricultural irrigation. • Kuttapara to Naibur Khal Re-excavation: Residents are also requesting the re-excavation of the khal from Kuttapara to Naibur, which is critical for drainage and farming in the area. • Construct a secondary brick canal to ensure proper irrigation supply.

Place	Concerns/Issues/Problems	Suggested Solution/Remedies
	<p>usage—now about 35 machines are in operation.</p> <ul style="list-style-type: none"> • Agricultural weeds are increasing, likely due to unregulated water use and changes in irrigation practices. • The canal from Bertala to Bitghor has become much wider (up to 150 ft) compared to its original width of 12 ft. This widening has disrupted the irrigation supply, making it difficult for farmers to access water for their crops. • Jafar Khal has become silted up. This siltation reduces the canal's water retention capacity, limiting the availability of water for irrigation, particularly for vegetable production during the dry season. 	<ul style="list-style-type: none"> • Re-excavate Jafar Khal to restore its year-round water retention capacity, enabling increased vegetable production in the dry season.
Ashuganj (Rice mill owners)	<ul style="list-style-type: none"> • In Sohagpur, the drain is leaking and blocked, causing waterlogging and sanitation issues. 	<ul style="list-style-type: none"> • In Sonarapur (south side), the community requests covered drainage at every 50-meter interval, totaling approximately 1 km of coverage needed. • Residents demand the construction of a culvert on the road and a bridge in front of the mill to ensure proper water flow and access. • The community requests the construction of an RCC (reinforced concrete) closed canal for improved and long-lasting drainage.
Ghorasal Pourashava, Palash	<ul style="list-style-type: none"> • Saldoho canal is narrow and polluted, unusable for irrigation. • 700m canal stretch from Atoshi Para to Sosan Ghat needs retaining wall. • Drainage problems and waterlogging from Polash Upazila to Sosanpara. • BADC water not available from January to April • Invasive species (e.g., Water hyacinth) are excessive propagation in canals and obstruct smooth water flow. • New weeds damaging crops. • Limited aquatic fauna. • Lack of awareness about wildlife conservation. • Reduced water supply affects crop production. • Waterlogging another site causes hinders Aus paddy cultivation in here. • Low of fish production due to poor water quality. • Pond water shortage for 6 years. 	<ul style="list-style-type: none"> • Construct retaining walls along the 700m canal stretch. • Improve drainage infrastructure. • Develop alternative water sources during dry season. • Regular garbage cleaning by plant authority. • Give proper financial support to the actual farmers group to improve the activity of siphon • Remove invasive species and improve canal maintenance. • Conduct ecological research and awareness campaigns. • Form local wildlife conservation groups. • Canal dredging for improved flow. • Enhance irrigation scheduling and water use efficiency. • Ensure year-round water supply through BADC canal. • Improve pond water retention.

Place	Concerns/Issues/Problems	Suggested Solution/Remedies
	<ul style="list-style-type: none"> • Boring system is expensive to the local farmers. • Lack of awareness; households dump waste into the canals. 	<ul style="list-style-type: none"> • Launch targeted awareness programs on waste management and environmental care.
Jinardi union, Palash	<ul style="list-style-type: none"> • Due to low water availability, crop production has halved. • Farmers can only cultivate one crop annually. • Reduced fish population due to low water flow and agricultural insecticides. • Pond water only available for 6 months a year. • No migratory birds sighted in recent years. • Lack of wildlife conservation awareness. • Invasive species harming local ecosystems. • Kuraitoli canal is too narrow with limited water flow. • Sedimentation and blockage from Bagpara to Atosipara reduce flow. • Water quality is deteriorating in canals and ponds. • Current canal limitations hinder agricultural use of surrounding land. 	<ul style="list-style-type: none"> • Re-excavate and widen the Kuraitoli canal. • Remove sediment and obstacles from the canal stretch. • Ensure year-round water availability to allow multi-crop farming. • Increase clean water supply in canals and ponds. • Promote environmentally friendly farming to reduce pesticide runoff. • Organize awareness programs for wildlife conservation. • Control and remove invasive species. • Encourage ecological research and monitoring. • Improve water quality through re-excavation. • Introduce canal-side plantation to support water retention and ecosystem balance. • If canal is properly cut and restored, approximately 2000 kani of land can be brought under cultivation
Fulbaria, Charsindur, Palash	<ul style="list-style-type: none"> • The primary and secondary canals are not functioning properly. The canals have become silted up. The name of the canal is Shaldhar Beel Canal. It needs to be excavated from the hospital to Malitha, covering a length of 5 km. • the current irrigation system is not meeting the demand. • The condition of sluice gates and regulators is very poor and needs urgent repair. • No flood has occurred since 2006. • Some parts of Shaldhar Beel have stagnant water due to silted-up canals. Ownership of the beel: Government + Private. • The water quality is very poor due to battery factory acid waste mixing with the water. • Very little power plant water is used for agriculture. • Toilets from houses are directly connected to the canal, causing pollution. 	<ul style="list-style-type: none"> • The canal needs to be re-excavated, and water management should be ensured in the first week of January. • The canal should be re-excavated. People need to be made aware of water pollution, and awareness should be raised among others as well. Administrative efforts must be strengthened, and local committees should be formed. • Villagers claim that rice production will increase if the project is implemented. • People are interested in the project. If land is needed, they are willing to give it if fair compensation is provided. • Provide training and raise awareness, ensure canal flow and water quality, raise awareness on crop production, promote fruit gardening initiatives.

Place	Concerns/Issues/Problems	Suggested Solution/Remedies
	<ul style="list-style-type: none"> • Battery factory acid waste is polluting water, leading to skin diseases among villagers. • Tube well water is not drinkable. • Waste accumulates on both sides of the drain and is not cleaned. • Yield is decreasing due to water pollution and lack of timely water supply. • Decomposing water hyacinth is degrading water quality in Shaldhar Beel. • Shaldhar Beel with connecting Canal: it is being used for irrigation despite being polluted. • Due to delayed water supply and waterlogging in lowlands caused by BADC irrigation, crops are being damaged, and production is not increasing. • Due to polluted water in the beels, birds, frogs, snakes, and fish are not seen. Sometimes dead birds are found due to this pollution. • Water hyacinths need to be removed. Battery factory waste must be stopped from entering the beel. Total land of Shaldhar Beel is 3,000 acres. 150 bighas are uncultivated; the rest are cultivated, but with low productivity and a high percentage of unfilled grains. • Local people can be involved through employment opportunities in the project. • Acid-contaminated wastewater from the factory is damaging arable land. • The factory discharges water underground via pipes, making tube well water undrinkable. 	
Belabo, Amdia, Narsiingndi Sadar	<ul style="list-style-type: none"> • The main and secondary canals are not functioning properly. The canals have become silted up. The name of the canal is Amdia Canal. It needs to be excavated from Chatal to Shitalakshya, a length of 25 km. A new canal also needs to be excavated from Shimulia Bridge to Amdia, a length of 7 km. • The current irrigation system is not sufficient. When water is pumped from the canal by BADC, the canal dries up quickly, which limits pump operation time. • The condition of sluice gates and regulators is very poor and they urgently need repair. New sluice gates are needed in Kanda Para, Hatia Gaon, and Ollar Tek areas • The water quality is poor. BADC water is good up to the outlet gate, but after that, 	<ul style="list-style-type: none"> • The canal needs to be re-excavated. BADC provides water starting from early February, but farmers need water from late December or the first week of January. • The canal should be re-excavated. People must be made aware of water pollution and others should also be made aware. Administrative oversight should be strengthened. A community committee should be established. • If the project is implemented, rice yields will increase. • Re-excavate canals, clear vegetation on canal banks, modernize irrigation, remove waterlogging, keep canals pollution-free, provide

Place	Concerns/Issues/Problems	Suggested Solution/Remedies
	<p>garbage is dumped into it, degrading the quality.</p> <ul style="list-style-type: none"> • Due to garbage in the canals and uncleaned drains, water is getting polluted. • Amdia Canal is polluted and its water is used for irrigation. • The land is triple-cropped. High-yielding rice (Aman, BR29, 11, 92, 103, BINA29), fruits (jackfruit, litchi, mango), and mustard are grown. Previously, one bigha produced 25 maunds of rice; now it is down to 20 maunds due to delayed and polluted water supply. • No significant expansion due to water supply delays. In low-lying areas, waterlogging from BADC water is damaging crops. • About 7 months. Ponds dry up during Agrahayan and Poush (Nov–Jan). 	<p>agricultural training, and create self-employment opportunities.</p>
Dulalpur, Shibpur	<ul style="list-style-type: none"> • The canal from Chinadi Beel to Shitalakshya River is blocked, During in dry season, insufficient water flow in Dhawan Khali Khal. • Due to garbage in the canals and uncleaned drains, water is getting polluted. • Household waste is being dumped into the canal. • Rainwater does not stay for long. • In Kazi char village, even slight rain causes waterlogging in 20–25 bighas of land due to poor drainage systems. • Dewan Khali Canal: From Chinadi to Rampur to Velanagar to Goirar Beel to Machimpur Union; currently in silted up and polluted condition in water. • Around 1,000 acres of land are waterlogged about seven villages (Shimulia, Chinadi, Dorgapur, Beel chinadi and other areas). • In Ashwin and Kartik months (Bengali calendar), planting seedlings is not possible due to waterlogging, excessive propagation of water hyacinth, and siltation. 	<ul style="list-style-type: none"> • Re-excavation of Dhawan Khali Khal • Embankments should be repaired. • Re-construction of Sluice gate on Shakerdarer Khal at the Beel chinadi under Dulalpur Union • Canal encroachment should be protected and restricted to other anthropogenic pressures • Developed in rainwater harvesting system for paddy and vegetable cultivation purpose • Should be raise awareness program to the local peoples for household waste management • Plantation program should be needed at the both side of canal banks after re-excavation activities, • If the Dhawan Khali Khal is cleaned and re-excavated, Boro rice cultivation will be possible and increase crop production • Excavating the canal will have benefited of 25–30 villages. • There are still fish in Chinadi Beel, but less than before; if water flow is restored, fish availability would be increased. • If canal excavation is done, there is no objection to placing the excavated soil on both sides of the land.

Place	Concerns/Issues/Problems	Suggested Solution/Remedies
		<ul style="list-style-type: none"> • No problem if excavation machinery moves over farmland. • A water management committee needs to be form by the local farmers
Masimpur, Shibpur	<ul style="list-style-type: none"> • Dewan Khali Canal: Currently abandoned. • Phultala Canal: Also, in an abandoned state. • No activities are ongoing under the BADC irrigation project. • Main source of irrigation is deep tube wells; for 45 decimals of land, costs are around 20,000 BDT. Diesel is used during the Boro season. • Previously, jute was cultivated but is no longer feasible due to lack of irrigation facilities. • Fish are being reduced using magic nets. 	<ul style="list-style-type: none"> • If the canal is excavated, it will help water flow into Khajua Beel. • Restricted to illegal fishing • Bringing the BADC irrigation project from Sadachar to Machimpur would be benefited to the local farmers. • Kaluakanda sluice gate should be repaired under the Water Development Board. • Pipe allocation is necessary. • Given to sufficient fertilizer for cropping practices. • If BADC establishes a water management system, crop production will have increased. • With irrigation available, three crops can be cultivated: Aus, Aman, and Boro. • Machine operation is costly; excavation of the canal would facilitate better drainage. • If 10 cusecs of water are pumped from the Shitalakshya River into the canal, it would be beneficial. • By installing a sluice gate at Paratala and supplying water through irrigation, water availability in the area can be improved. • If the excavated soil is placed on the fields, residents will accept temporary inconvenience for greater benefit. • The local people are enthusiastic and willing to work on the canal excavation.

7. Important Environmental and Social Components

7.1 Identification of IESCs and Rationale

All environmental and social components (IESCs) will not be impacted by the proposed interventions of the Ashuganj-Palash Green Project of BADC. Some components may be impacted while others will be independent of the proposed interventions. IESCs likely to be impacted by the establishment of the proposed Ashuganj-Palash Green Project of BADC in respect of water resources, environmental quality, land resources, agricultural resources, fisheries resources, ecological resources, and socio-economic condition, and their rationales for selections are presented in the following table.

IESC	Rationale for Selection
Water Resources	
Drainage	The project involves construction and rehabilitation of regulators and excavation of multiple canals. During the construction phase, drainage patterns may be temporarily disrupted due to physical obstruction, machinery movement, or temporary damming/diversion, potentially causing localized waterlogging and affecting agricultural land and homestead areas. However, in the long term, the canal excavation works are expected to enhance drainage capacity, reduce flood risks, and improve water conveyance and agricultural productivity. Therefore, drainage is a critical IEC to evaluate both potential adverse impacts during construction and beneficial outcomes in post-implementation period.
Groundwater	Currently, irrigation in the Ashuganj-Palash area heavily depends on groundwater, leading to stress on aquifer levels and posing risks of long-term depletion. The project proposes to shift the irrigation source from groundwater to surface water by utilizing treated cooling water from nearby thermal power plants through constructing and rehabilitating regulators and excavating canals. This transition is expected to significantly reduce groundwater abstraction, allowing for natural recharge and improvement in groundwater levels over time. Hence, groundwater has been considered as an IEC.
Surface Water Availability	Surface water availability is crucial for irrigation, fisheries, and domestic uses in the project area. The excavation of canals under the Ashuganj-Palash Sabuj Project will enhance the conveyance and storage capacity of surface water systems facilitating utilizing treated cooling water from nearby thermal power plants for irrigation by appropriate infrastructures. This will improve seasonal water availability, support agriculture with more reliable water access, and reduce dependency on groundwater. Hence, surface water availability has been considered as an IESC.
Water level of Chinadi Beel	Two canals will be re-excavated beside the Chinati Beel, which is privately owned. As a result, water level of the Beel will decline affecting fish and other aquatic species, migratory birds and wildlife etc. Conflict may also arise between the owner of the Beel and BADC. To avoid the adverse consequence, water level of the Beel needs to be maintained through appropriate mechanism. As such, Water level of the Chinadi Beel has been considered as an IEC.
Environmental Quality	
Surface Water Quality	The main interventions of the project are construction of a number of RCC canals, construction/reconstruction/upgrading of regulators, dismantling of old

IESC	Rationale for Selection
	structures, construction of syphons, and other hydraulic structures, excavation of canals, construction of buried pipes etc. These activities would generate a substantial amount of solid and liquid wastes. Water quality might deteriorate, if the construction related wastes viz. empty cement bags, litters, residuals of coarse aggregates, surplus concrete, Kitchen wastes and WC wastes from labor sheds, oil and lubricants from construction equipmen etc. are directly released to the surrounding rivers and other water bodies. Water quality may also deteriorate during the re-excavation activities. Improper management of construction waste can also cause siltation and ecological harm to downstream aquatic environments. As such, surface water quality has been considered as an IEC.
Noise Level	The noise level would be increased due to the operation of construction related equipment (mixture machine and vibrator etc.) for making concrete for construction of RCC canals, construction/reconstruction/upgrading of regulators, construction of syphons, and other hydraulic structures, dismantling of old structures, as well as due to operation of excavator for re-excavation/excavation of canals. As such, Noise Level has been considered as an IEC.
Air quality	The ambient air quality could be deteriorated due to fugitive dust production during the construction of long paved RCC irrigation canals, excavation and re-excavation of earthen and intake channels, construction/reconstruction/upgrading of regulators, construction of syphons, aqueducts, culverts, and hydraulic structures. In addition, the emission of gases from construction equipment, excavator and vehicles may deteriorate the ambient air quality around the excavation/construction site and nearby areas. Fugitive dust emissions from the material stockyards may also deteriorate the ambient air quality of the locality. As such, air quality has been considered as an IEC
Land Resources	
Land Use	The implementation of the interventions is expected to change current agricultural land use. Farmers would be encouraged to cultivate additional crops, and previously fallow lands may be converted to agricultural production due to improved irrigation facilities. For this reason, land use has been identified as an IEC.
Changes in Land Quality and environmental pollution	Construction activities under the project, including the construction/reconstruction/upgrading of regulators, dismantling of old structures, excavation of canals, construction of buried pipes and development of RCC-lined canals etc. are expected to generate a substantial amount of solid and liquid waste. This includes materials, such as concrete debris, metals, oils, lubricants, and excavated earth. If the excavated materials and construction related wastes are not properly collected stored and haphazardly disposed of in the surrounding land, may adversely impact land quality and cause environmental pollution. As such changes in land quality and environmental pollution has been selected as an IESC.
Agriculture Resources	
Irrigated Area	Surface water is preferable to groundwater for irrigation, both due to its lower cost and the beneficial sediment content that helps maintain soil nutrient status. The proposed measures including re-excavation of khals and repair/upgrading of irrigation infrastructure are projected to increase the availability of surface water and improve irrigation facilities. Hence, irrigated area is an important IEC.
Cropping pattern and intensity	The availability of enhanced surface water irrigation is expected to encourage changes in cropping patterns with increased cultivation of HYV crops. In turn, this

IESC	Rationale for Selection
	could lead to higher cropping intensity and a diversification of crops. Therefore, cropping pattern and intensity have been selected as an IEC.
Crop damage	Currently, waterlogging resulting from heavy rainfall is the main cause of crop damage. The proposed interventions including improved drainage through re-excavation of khals are anticipated to reduce waterlogging and prevent crop losses. Because of this, it has been considered one of the IEC.
Crop production	Crop production may be lost in the study area, if excavated/re-excavated earth materials are disposed of on the agricultural land. On the other hand, excavation/re-excavation of canals, construction of RCC canal, construction/reconstruction/upgrading of regulators, construction of siphons, aqueducts, buried pipelines etc. are expected to ensure a more reliable and timely supply of irrigation water as well as remove drainage congestion, which in turn will boost crop production. Moreover, crop production might increase due to changing of the cropping patterns, introduction of HYV/Hybrid varieties and improved cultivation practice under the conducive environment. Accordingly, crop production is designated as an IEC.
Fisheries Resources	
Fish Production	The proposed interventions i.e. Canals excavation/re-excavation, construction/rehabilitation of regulators may alter physical characteristics and condition of the intervened habitats. The resultant effect of the proposed interventions may influence the production of natural fish species especially non-commercial fishes of canals. Therefore, fish production has been considered as an IEC.
Ecological Resources	
Vegetation	Vegetations including tress, herbs and shrubs is an important and main component of environment, which may be changed due to construction activities (i.e. syphon, regulator, guardrail etc.), excavation/re-excavation of canals and excavated material disposal activities. The proposed interventions might change both the terrestrial and aquatic vegetation within the project area. One the other hand, overall terrestrial vegetation is expected to change due to improvement of drainage condition as well as improvement of canal bank line vegetation coverage. Proposed tree plantation program at the disposal sites of excavated material is expected to change existing ecological setting, especially vegetation coverage. Any change of physical environment might cause change of habitat quality both terrestrial and aquatic i.e. tropic level, food webs, food chain etc. Moreover, the vegetation provides habitat for wildlife and other biota, so vegetation is considering as an IEC.
Wildlife habitat	Terrestrial and aquatic wildlife habitats would be temporarily destroyed or changed due to the proposed interventions, i.e., construction of RCC canal, canal excavation/re-excavation, construction of siphon, aqueduct, regulator and other hydraulic structures etc. of Ashuganj-Palash Green project. The existing aquatic wildlife habitats have declined and are in a poor condition due to the development works for the six-lane highway from Ashuganj to Sarail. The aquatic faunal habitat in secondary and tertiary canals have decreased due to the loss of connectivity. RCC main canal, secondary and tertiary canals in urban and rural areas, have been greatly polluted due to the anthropogenic activities including dumping of household waste, sewage, industrial waste etc. So, some aquatic ecosystems and habitats will be improved by the project interventions and proper management. Terrestrial wildlife habitats like crop fields,

IESC	Rationale for Selection
	homesteads etc. will be enriched with wildlife due to enough water supply in the wetlands. Therefore, wildlife habitat has been considered as an IEC.
Socio-economic Condition	
Improved Livelihoods	The proposed project aims to enhance agricultural production, thereby increasing income of farmers. Additionally, the project will convert a significant portion of uncultivable land into productive farmland, thereby improving the livelihoods of local landholders. Consequently, "Improved Livelihoods" has been identified as an Important Social Component (ISC).
Increase food security	The Irrigation Project enhances food security and stabilizes prices by boosting agricultural production and ensuring a dependable food supply. Reliable water access enables farmers to cultivate multiple crops, including IRRI-Boro paddy, even during dry seasons. This leads to increased food production, reduced price fluctuations, and benefits for both farmers and consumers. Therefore, "Increased Food Security" has been identified as a key Important Social Component (ISC).
Employment Generation	Employment opportunities serve as a key indicator of economic conditions. During the construction phase, the proposed project is expected to generate temporary employment opportunities for unskilled and semi-skilled laborers in the study area. Additionally, the project's intervention will enhance crop production through increased agricultural activities, further creating employment opportunities. Therefore, "Employment Generation" has been recognized as an Important Social Component (ISC).
Poverty Reduction	A significant portion of the population in the project area (55%) currently falls below the Lower Middle-Income threshold. The primary goal of the project is to alleviate poverty by reducing the number of individuals living in hardship, thereby contributing to a gradual reduction in the poverty headcount ratio. Additionally, the project seeks to address income disparities across different socioeconomic groups, fostering positive economic outcomes. Therefore, "Poverty Reduction" has been identified as an Important Social Component (ISC).
Occupational health and safety	The workers may face accidents during operation of construction equipment and excavation/re-excavation of canals. Inadequate waste disposal and improper fuel storage at campsites may pose safety risks, while deteriorating air quality can lead to health complications. Unsanitary conditions and limited access to safe drinking water can increase the spread of waterborne diseases, and insufficient toilet facilities may contribute to contamination. Besides, increased noise level and fugitive dust in the construction area might affect the health of the labors and cause inconveniences like hearing problem, breathing problem etc. For this reason, occupational health and safety has been considered as an ISC.
Community health and safety	The influx of workers for construction of the project interventions can significantly impact the health, safety, and well-being of the local community. Additionally, the presence of a large workforce may heighten the risk of communicable disease transmission and potentially disrupt local law and order. Therefore, " Community Health & Safety" has been identified as an Important Social Component (ISC).

8. Impact Assessment

8.1 Introduction

This chapter identifies the environmental and social impacts that may potentially be caused by various project phases, and also proposes appropriate mitigation measures to avoid, reduce, or compensate these impacts. Potential intervention which may cause significant environmental impacts during pre-construction, construction and post-construction phases has been identified in Chapter 4. The following process has been carried out to assess the impacts:

- Generation of future-with-project situation of the IESCs through professional judgment and feedback received from the stakeholders at various stages of the study;
- Considering the difference between the status of the IESC under future-with-project and future-without-project situation as the potential impact;

8.2 Impact Screening

As part of the environmental impact assessment process, a screening matrix was used tailored specifically to the proposed Project, focusing on the potential environmental impacts during the pre-construction, construction and post-construction phases. The matrix examined the interaction of project activities with various components of the environment. The potential impacts thus predicted (**Table 8.1**) were characterized as follows:

- Likely to be impacted (√); and
- No impact (-);

Table 8.1: Impact Screening

Project Phase/ Activities	Water Resources				Environmental Quality			Land Resources/ Agriculture						Fisheries Resources		Ecological Resources		Socio-economic condition					
	Drainage	Groundwater	Surface Water Availability	Water level of Chinadi Beel	Surface Water Quality	Noise Level	Air Quality	Land Use	Changes in land quality and environmental pollution	Irrigated Area	Cropping Pattern and Intensity	Crop Damage	Crop Production	Fish Production	Vegetation	Wildlife habitat	Improved Livelihood	Increase Food Security	Employment Generation	Poverty Reduction	Community health and Safety	Occupational health and safety	
Pre-construction Phase																							
Geotechnical investigation for the design of different hydraulic structures and regulators.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Construction of site office, labor shed with toilet, installation of batching plant and fabrication yard.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	√	-	-	-	√	-	-	-	
Demarcation of hydraulic structures sites; main, secondary and tertiary irrigation canals, buried pipeline alignments.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	√	-	-	-	
Clearing of vegetation and debris within the demarcated alignment.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	√	√	-	-	-	-	-	-	
Procurement and transportation of labor, construction equipment and materials.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	√	√	-	-	√	-	√-	-	
Identification of the earthen materials disposal places.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	√	-	-	-	
Display of Billboard	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Construction Phase																							

Project Phase/ Activities	Water Resources				Environmental Quality			Land Resources/ Agriculture						Fisheries Resources		Ecological Resources		Socio-economic condition					
	Drainage	Groundwater	Surface Water Availability	Water level of Chinadi Beel	Surface Water Quality	Noise Level	Air Quality	Land Use	Changes in land quality and environmental pollution	Irrigated Area	Cropping Pattern and Intensity	Crop Damage	Crop Production	Fish Production	Vegetation	Wildlife habitat	Improved Livelihood	Increase Food Security	Employment Generation	Poverty Reduction	Community health and Safety	Occupational health and safety	
Construction of RCC irrigation canal.	-	-	-	-	√	√	√		√	-	-	-	-	√	√	√	-	-	√	-	√	√	
Construction of siphon and medium & small-scale hydraulic structures.	√	-			√	√	√	-	√	-	-	-	-	-	√	√	-	-	√	-	√	√	
Construction of silt trap basin, double barrel box type closed conduit and trash rack.	√	-	-	-	√	√	√	-	√	-	-	-	-	-	√	-	-	-	√	-	√	√	
Installation of protection system (GI pipe guardrail) on both sides of open main irrigation canal.	√	-	-	-	√	√	√	-	√	-	-	-	-	-	√	√	-	-	√	-	√	√	
Earthwork for stabilizing the bank of the reservoir canal.	√	-	-	-	√	-	√	-	√	-	-	-	-	-	√	√	-	-	√	-	√	√	
Construction/re-construction of regulators and water retention structures.	-	-	-	-	√	√	√		√	-	-	-		√	√	√	-	-	√	-	√	√	
Construction of aqueducts.	-	-	-	-	√	√	√	-	√	-	-	-		√	√	-	-	-	√	-	√	√	
Repair/upgrading of weir and existing regulators.	-	-	-	-	√	√	-		√	-	-	-		√	√	√	-	-	√	-	√	√	
Dismantling of damaged, broken and useless regulators.	√	-	-	-	√	√	√	-	√	-	-	-		-	√	√	-	-	√	-	√	√	

Project Phase/ Activities	Water Resources				Environmental Quality			Land Resources/ Agriculture						Fisheries Resources		Ecological Resources		Socio-economic condition					
	Drainage	Groundwater	Surface Water Availability	Water level of Chinadi Beel	Surface Water Quality	Noise Level	Air Quality	Land Use	Changes in land quality and environmental pollution	Irrigated Area	Cropping Pattern and Intensity	Crop Damage	Crop Production		Fish Production	Vegetation	Wildlife habitat	Improved Livelihood	Increase Food Security	Employment Generation	Poverty Reduction	Community health and Safety	Occupational health and safety
Excavation/re-excavation of earthen channels, canals and intake channels.	√	-	-	-	√	√	√	-	√	-	-	-	-		√	√	√	-	-	√	-	√	√
Construction of slabs over canal.	-	-	-		-	-	-	-	√	-	-	-	-	-	-	-	-	-	-	-√	-	-	-√
Disposal of excavated/re-excavated materials	-	-	-	-					√							√	√			√			
Post-Construction Phase																							
Maintenance of irrigation canals, earthen channels and intake channels.	√	√	-	-	-	-	-	-		√	√	√	√	-	-	√	√	√	√	√	√	-	√
Operation and Maintenance (O&M) of regulator, siphon, aqueduct, water retention structure, silt trap basin, double barrel box type closed conduit, trash rack and medium & small-scale hydraulic structures.	√	√	-	√	-	-	-	-		√	√	√	√	-	-	√	√	√	√	√	√	-	√

8.3 Environmental and Social Impact Assessment

8.3.1 Pre-Construction Phase

Ashuganj-Palash Green Project

The major activities under this phase are presented in the following section:

- Geotechnical investigation for the design of different hydraulic structures and regulators.
- Construction of site office, labor shed with toilet, installation of batching plant and fabrication yard.
- Demarcation of hydraulic structures site; main, secondary and tertiary irrigation canals, buried pipeline alignments.
- Clearing of vegetation and debris within the demarcated alignment.
- Procurement and transportation of labor, construction equipment and materials.
- Identification of the earthen materials disposal places.
Display of billboard.

Impact of these activities on the selected IESCs in the pre-construction phase are described in the following sections.

a) Agricultural Resources

There is no potential impact in this phase due to project related activities.

b) Fisheries Resources

There is no potential impact in this phase due to project related activities.

c) Ecological Resources

Vegetation

Vegetation will be damaged at the footprint areas due to construction of site office, labor shed and material stockyard. The proposed construction sites are mainly covered with small grasses (Poaceae and Cyperaceae are the dominant family) along the canals side. Negligible amount of local grasses like Java grass, Goose grass, Bermuda grass, Umbrella sedge, Justicia, Basket grass, Cocklebur etc. will be damaged due to preparation of construction sites, labor shed and material stockyards. This type of undergrowth vegetation usually seasonally grown and their life time will not more than one year. However, the loss of vegetation is expecting to regrow within one year after the completion of construction activities.

Wildlife Habitat

Clearing of vegetation and debris will cause damage of wildlife habitats. Removing of weeds and plants can create displacement of dragonflies, insects and terrestrial small animals like Common Garden Lizard (*Calotes versicolor*) and Common Skink (*Eutropis carinata*). Vegetation clearing will also impact on the habitat of wildlife i.e., grasshoppers, spiders etc., which prefer bushy areas for their habitat. Cutting down of trees within the demarcated alignment will decrease the availability of birds, their resting and roosting places.

Transportation of construction equipment and materials will create unnecessary noises which is a disturbance for wildlife movement and their daily activities

d) Socio Economic Condition

Employment Generation

Impact: The pre-construction activities such as site preparation, construction of labor shed, carrying construction materials and equipment will create employment opportunity for both areas including both semiskilled and unskilled labor particularly for the local workers.

8.3.2 Construction Phase

The major activities under this phase are listed in the following section:

Ashuganj

- Construction of paved/RCC irrigation canal.
- Construction of siphon and medium & small-scale hydraulic structures.
- Construction of silt trap basin, double barrel box type closed conduit and trash rack.
- Installation of protection system (GI pipe guardrail) on both sides of open main irrigation canal.
- Earthwork for stabilizing the bank of the reservoir canal.
- Construction/re-construction of regulators and water retention structures.
- Construction of aqueducts.
- Repair/upgrading of weir and existing regulators.
- Dismantling of damaged, broken and useless regulators.
- Excavation/re-excavation of earthen channels, canals and intake channels.
- Construction/extension of buried pipe line.
- Disposal of Excavated/re-excavated materials.

Palash

- Construction of RCC secondary and tertiary canals.
- Re-excavation of canals/intake channels.
- Construction of slabs over canal.
- Construction hydraulic structures.
- Construction of trash rack.
- Construction/extension of buried pipe line.
- Disposal of re-excavated materials.

Impact of the above activities on the selected IESCs in the construction phase are described in the following sections.

a) Water Resources

Drainage

Impact: During the construction phase, excavation works and physical barriers created by construction materials or temporary bunds may disrupt the natural drainage flow. This could cause localized waterlogging in agricultural fields and homesteads, especially during monsoon. However, these impacts are likely to be temporary and will subside upon completion of canal excavation and rehabilitation of regulators.

Water Level of Chinadi Beel

Water level of Chinadi Beel may decline due to excavation of canals beside it and restoration of connectivity with the canal.

Surface Water Quality

Impact: Water quality might deteriorate, if empty cement bags, litters, residuals of coarse aggregates, surplus concrete, kitchen wastes, WC wastes from labor sheds etc. are directly released into the rivers, canals, and other water bodies. Water quality may also deteriorate during excavation/re-excavation of canals. Re-excavation will increase the suspended matters at the re-excavated sites and at their close vicinity. In addition to that, these suspended matters will be distributed to downstream of the rivers/canals, and may affect their water quality. High-suspended matters in the water body will cause high turbidity and low dissolved oxygen. Poor management of excavated materials may result in sediment runoff during rainfall, further degrading water quality and potentially affecting aquatic ecosystems and downstream water users.

b) Environmental Quality

Noise Level

Impact: Noise will be generated due to operation of equipment (mixture machine, vibrator etc.) for making concrete for construction of RCC irrigation canals construction/reconstruction/upgradation of regulators, construction of syphons, aqueducts, culverts, and hydraulic structures, as well as due to the operation of excavator for excavation/re-excavation of canals/channels. Additionally, the movement of construction vehicles, use of demolition equipment, and erection of steel and concrete structures are significant sources of elevated noise in both Ashuganj and Palash area. In particular, the workers and the settlements near the work areas will be exposed to noise generated by the project activities.

Air Quality

Impact: Fugitive dust will be generated during the transportation of sand, shingles and cement for making concrete for construction of RCC irrigation canals, construction/reconstruction/upgradation of regulators, construction of syphons, aqueducts, culverts, and hydraulic structures, Dust might also generate during dismantling of non-functional structures and disposal of re-excavated materials. This can lead to an increase in particulate matter in the atmosphere and contribute to a decline in air quality. Additionally, the operation of equipment, such as mixture machines, excavators etc. can emit pollutants that negatively impact air quality. Furthermore, the open burning of waste materials can further worsen the situation. The resulting air pollution can pose health risks to both workers and local people.

c) Land Resources

Changes in Land Quality and environmental pollution

Impact: In the construction phase, various wastes would be generated, such as empty cement bags, litters, residuals of coarse aggregates, waste concrete, kitchen wastes, WC wastes from labor

sheds, etc. If these wastes are not properly managed and disposed of in the surrounding land would deteriorate the land quality as well as cause environmental pollution.

d) Agricultural Resources

Crop production

Impact

During the project implementation period, construction activities will temporarily alter irrigated areas, affecting agricultural production for a single crop season (primarily Rabi). About 80.69 hectares of irrigated agricultural land will experience temporary impacts due to:

- Re-excavation of existing canals (38.10 hectares)
- Construction of secondary and tertiary irrigation canals (28.80 hectares)
- Installation of buried pipelines (13.79 hectares)

These activities will result in partial and temporary disruption to irrigation systems and agricultural production of about 1,640 metric tons in the affected areas until construction is completed.

Of this total, around 445 metric tons are expected to be irrigated crops, specifically Boro rice and winter vegetables. This temporary impact will be limited to a single growing season in the directly affected areas along the construction corridor.

e) Fisheries Resources

Fish production

Impact: Excavation and re-excavation of canals/channels can temporarily disrupt the habitats of demersal and benthic fish species due to sediment removal from canal beds. Habitat of fish species, such as Taki (*Channa punctata*), Shol (*Channa striata*), Koi (*Anabas testudineus*), Bele (*Glossogobius giuris*), Guchi Baim (*Macrornathus aculeatus*), Shing (*Heteropneustes fossilis*), and Magur (*Clarias batrachus*) may be affected. During the construction phase, particularly during excavation/re-excavation of canals, fish may migrate away from the area due to excessive suspended sediment and increased water turbidity. Additionally, fish eggs, fry, larvae, and juveniles may suffer damage in the re-excavation zones. The removal of aquatic plants, which serve as food and shelter for fish, can further negatively impact fish populations. Increased turbidity in the water column can hinder fish respiration and affect the propagation of primary producers, thereby reducing food availability and degrading spawning beds. Furthermore, the construction activities of regulators may act as physical barriers, obstructing the natural movement of fish and may reduce fish production. Consequently, fish production may be hampered due to habitat deterioration caused by the above-mentioned factors.

f) Ecological Resources

Vegetation

Impact: Vegetation would be damaged at footprint areas due to construction of RCC irrigation canal, Siphon, Regulators, buried pipeline etc. All the grasses, herbs and shrubs will be buried at the sites where excavated materials would be placed. Only undergrowth seasonally grown vegetation would be damaged at most of the proposed disposal sites. So, terrestrial vegetation would be changed at disposal sites. Moreover, there will be significant change in floral and faunal composition in the newly filled area, which were previously ditches. Ditches will be converted as terrestrial forms and would be the place for succession of tall grasses and seasonal herbs. But in

long run, filled area (disposal area) will be developed as settlement and squeezing natural vegetation. Human influence vegetation will be enhanced and some cases that would lead to relocation of wildlife at nearer suitable locations like Jackal, mongoose, monitors etc. from there. Overall vegetation diversity, density and coverage will be improved in terms of terrestrial habitat. On the other hand, aquatic vegetation will be damaged due to disposal of excavated material at the ditches, ponds and adjacent wetland areas, such as Galania Haor and Chinadi beel.

The existing vegetation inside the canals area of the proposed construction activities would need to be cut or pruning before starting the construction and other works. Though most of the portions of the alignment fall inside bushy jungles and few of homestead's vegetation, so, occurrence of tree felling is low within the main canal-1 areas. There are a total 102 numbers of trees with different size and heights need to be cut or pruned at the main canal-1 (Ashuganj to Sarail Junction, 8.183 km long) areas, whereas number of cut off trees are 77 and number of tree pruning are 25. Brief local species name with number of trees needs to be cut or pruned are presented below:

Table 8.2: Trees to be Cut or Trimmed within the Proposed Interventions of Main Canal-1 Sites

No.	Local name	English name	Family	Scientific name	Tree pruned	Cut off trees
1	Jibon	Indian Nettle tree	Cannabaceae	<i>Trema orientalis</i>	3	17
2	Pitali	Mallotus	Euphorbiaceae	<i>Trewia nudiflora</i>	1	4
3	Kadolm	Burflower-tree	Rubiaceae	<i>Neolamarckia cadamba</i>	0	3
4	Mahogany	Brazilian mahogany	Meliaceae	<i>Swietenia mahagoni</i>	4	2
5	Pepey	Papaya	Caricaceae	<i>Carica papaya</i>	0	3
6	Dumur	Indian fig tree	Moraceae	<i>Ficus racemosa</i>	0	1
7	Khantal	Jackfruit	Moraceae	<i>Artocarpus heterophyllus</i>	0	1
8	Jum	Java plum	Myrtaceae	<i>Syzygium cumini</i>	3	2
9	Reri	Castor Oil plant	Euphorbiaceae	<i>Ricinus communis</i>	0	3
10	Aum	Mango	Anacardiaceae	<i>Mangifera indica</i>	1	4
11	Sirish	Monkey pod	Fabaceae	<i>Albizia lebbek</i>	2	0
12	Narikel	Coconut	Arecaceae	<i>Cocos nucifera</i>	2	1
13	Boroi	Indian jujube	Rhamnaceae	<i>Ziziphus mauritiana</i>	1	2
14	Kola	Banana	Musaceae	<i>Musa paradisiaca</i>	0	33
15	Ata	Custard apple tree	Annonaceae	<i>Annona squamosa</i>	1	0
16	Neem	Indian lilac	Meliaceae	<i>Azadirachta indica</i>	0	1
17	Chalta	Elephant Apple tree	Dilleniaceae	<i>Dillenia indica</i>	1	0
18	Bash	Bamboo	Poaceae	<i>Bambusa vulgaris</i>	6	0
Total					25	77



Figure 8.1: Cut off Major Trees and Tree Pruned inside the Proposed Main Canal-1

Wildlife Habitat

Impact: Majority of the interventions, i.e., construction of RCC irrigation canal, siphon, regulators, hydraulic structures, silt trap basin, trash rack, repair of existing regulators, excavation of canals etc. would be implemented on canals. The existing canals of the project areas are full with aquatic vegetation like water hyacinth, water velvet etc. In the construction phase, this aquatic vegetation will be cleared up, which will be a minor impact for the aquatic wildlife habitat. Habitat of aquatic fauna like, Skipper Frog (*Euphlyctis cyanophlyctis*), Checkered Keelback (*Xenochrophis piscator*) will be lessened and this aquatic wildlife will migrate to other suitable wetland habitats. Besides this, phytoplankton, zooplankton and benthic communities like mollusks, will be temporarily decreased due to the construction works. Food items for wetland dependent birds, like White-breasted Waterhen (*Amaurornis phoenicurus*), Common Kingfisher (*Alcedo atthis*), Bronze-winged Jacana (*Metopidius indicus*), Little Cormorant (*Microcarbo niger*) will be declined and canalside mudflats would be impacted in the construction period. As a result, the resting and feeding habitat of these birds would also be changed temporarily.

Interventions wise flora and fauna with activities and existing features are given in **Annexure B**.

g) Socio Economic Condition

Employment Generation

Impact: The construction and re-excavation of canals, along with other project-related activities, will create employment opportunities for both technical and non-technical workers, benefiting local communities near the project area. This employment will be prioritized for local residents, offering them a chance to improve their livelihoods.

Occupational Health and Safety

Various activities will be carried out during the construction phase of the project, e.g construction of RCC irrigation canals, construction/reconstruction/upgradation of regulators, construction of syphons, aqueducts, culverts, and hydraulic structures, excavation/ re-excavation of canals, disposal of excavated materials etc. The labors may be injured during carrying out these activities. Sometimes, these injuries may turn into casualty, if the labors are not well conscious and properly treated.

Community Health and Safety

Impact: The arrival of construction workers can negatively impact the environment, increase health risks, and potentially disrupt local law and order.

8.3.3 Post-Construction Phase

The major activities under this phase are described in the following section:

Ashuganj Project

- Maintenance of irrigation canals, earthen channels and intake channels.
- Operation and Maintenance (O&M) of long paved RCC canal, regulator, siphon, aqueduct, water retention structure, silt trap basin, double barrel box type closed conduit, trash rack and medium & small-scale hydraulic structures etc.

Palash Project

- Maintenance of secondary & tertiary canals and canals/intake channels.
- Operation and Maintenance (O&M) of hydraulic structures, slabs, trash rack etc.

Impact of these activities on the selected IESCs in the post-construction phase are described in the following sections.

a) Water Resources

Assumption: Assumptions for assessment of the impacts in the baseline, (FWOP) and (FWIP) conditions are provided in the following **Table 8.3**.

Table 8.3: Impacts on water resources/morphology in post project condition

IEC	Baseline Condition	Future-without Project	Future-with-Project	Impact
Drainage	Natural drainage condition is moderate though partially inefficient in some areas.	Drainage conditions may degrade over time due to siltation and lack of intervention.	Drainage condition will improve due to construction/rehabilitation of regulators, excavation/reexcavation of canals as well as proper operation and maintenance of canals, regulators and other hydraulic structures.	+2
Groundwater	Groundwater is being used heavily for irrigation, putting stress on aquifer levels.	Over-extraction may continue, worsening aquifer depletion and reducing long-term groundwater yield.	Reduced abstraction due to surface water irrigation will help aquifer recharge and improve groundwater levels.	+2
Surface water Availability	Limited due to silted canals, and dilapidated/inadequate water control structures.	No improvement in water availability; seasonal shortages would persist.	Improved canal systems and water retention structures will increase surface water availability throughout seasons.	+3
Water Level of Chinadi Beel	There is currently no excavation work being carried out near the Chinadi Beel area.	Continuous siltation in the Beel and feeder/drainage	Canal re-excavation will deepen adjacent channels below the Beel bed level, creating a hydraulic gradient	-1

IEC	Baseline Condition	Future-without Project	Future-with-Project	Impact
	Water levels fluctuate seasonally.	channels raises the Beel bed and reduces its water storage capacity. Combined with likely inadequate maintenance of existing regulators, this will lead to progressively lower effective dry-season water levels (due to reduced holding capacity) and potentially higher flood peaks during wet seasons.	that could drain Beel water during dry periods. However, the presence of two controllable regulators and implementation of a specific Beel Water Management Plan (including dry-season closure protocols for these regulators) is designed to minimize dewatering. While some seasonal drawdown may occur, the net effect is expected to stabilize or improve dry-season levels compared to the degraded Future-without-Project scenario by slowing siltation inflow and enabling active level management.	

b) Land Resources

Land Use

Impact: Currently, agricultural land in the study area is 29,839 ha. If the project is not implemented, there would be a change in land-use practices, but at a slower rate. Within a period of 10 years, about 1491.95 ha (5%) of agricultural lands would be converted to for urban areas.

The project intervention would improve the hydrological condition of the study area during the post-project situation. With proper irrigation facilities, farmers are expected to adopt better crop management practices (CMP) and restrict the conversion of agricultural land for urbanization. This will improve the per hectare yield level of crops. The improved water management infrastructure would enable previously marginal lands to become productive. The impact matrix on change in land use in the post-construction phase is presented in the table below.

IEC	Baseline Condition	Future-without Project	Future-with-Project	Impact
Land Use	Total agricultural land is about 29,839 ha.	If the project is not implemented, it is estimated that; the total 1491.95 ha agricultural land might be converted to urban and other uses.	If the project is implemented with modern irrigation facilities, the same amount of land i.e. 1491.95 ha of land would remain under intensive cultivation.	+2

c) Agricultural Resources

Irrigated area

Impact: The implementation of the Ashuganj Palash Green Project is expected to significantly enhance water availability through a modern surface water irrigation system. The farmers are expected to adopt better crop management practices (CMP) with creation of appreciable irrigation facilities. This will improve the per hectare yield level of crops. Based on the assessment data, the project will increase overall irrigated coverage.

In Ashuganj, the irrigated area is projected to increase from the baseline of 17,145 ha (includes ground water and surface water coverage) to 18,061 ha after project implementation, representing a gain of 916 ha compared to baseline and a recovery of 2,790 ha from the future without-project (FWOP) scenario of 15,271 ha. In particular, the farmers of Sarail, Shahbajpur, Kalikaccha, and Panishar in Sarail Upazila of the Ashuganj area will greatly benefit from the green project's surface water irrigation.

For Palash, the irrigated area will increase from the baseline of 10,565 ha to 11,272 ha post-implementation, adding 707 ha compared to baseline. This represents a significant improvement of 2,650 ha when compared to the projected FWOP scenario of only 8,622 ha. Moreover, groundwater usage about 12,656 ha for irrigation will also reduce in this area. The impact matrix on change in Irrigated area in the post-construction phase is presented in the table below.

Cropping Pattern and Intensity

Impact: Currently, the cropping intensity of the Ashuganj and Palash project areas stands at 208% and 222%, respectively. The data indicates that without the implementation of rehabilitation works (FWOP scenario), there would be a decline in cropping intensity to 196% in Ashuganj and a more severe drop to 185% in Palash.

After rehabilitation of the project through modern irrigation facilities, cropping intensity is projected to increase significantly. In Ashuganj, intensity will rise from the baseline of 208% to 226%, representing an 18-percent improvement over baseline and 30 percentage points above the FWOP scenario. For Palash, intensity will increase from 222% to 237%, showing a 15-percentage point gain over baseline and a remarkable 52 percentage point improvement compared to the FWOP scenario. Cultivation of HYV Boro and winter vegetable will be added to the future cropping pattern and eventually enhance the cropping intensity with the improved irrigation facilities. The impact matrix on change in cropping pattern and intensity in the post-construction phase is presented in the table below.

Crop Damage

Impact: Presently, average crop damage in the project area is about 02-03% of total annually crop production. If the project is not implemented, the crops would continue to be exposed to lack of irrigation water and monsoon flooding due to heavy rainfall. So, crop damage might increase to about 06-07% of total annual crop production in FWOP conditions. After the rehabilitation of the project, there would be significant improvement in irrigation systems and drainage patterns, resulting in reduced crop damage. About 06-07% of crops would be saved annually compared to the FWOP scenario. The impact matrix on crop damage in the post-construction phase is presented in the table below.

Crop Production

Impact: Currently, total crop production of Ashuganj and Palash are 159,626 metric tons and 196,504 metric tons respectively, of which the rice crop is 99,834 metric tons and 41,897 metric tons and the non-rice crop is 59,792 metric tons and 154,607 metric tons respectively. If the project is not implemented, crop production would decrease due to lack of irrigation facilities and increase of flooding/drainage congestion. Total crop production would decrease to 134,785 metric tons in

Ashuganj and 156,981 metric tons in Palash under the future without project (FWOP) condition. Combined rice production would decline to 105,800 metric tons (84,402 in Ashuganj and 28,517 in Palash) while non-rice production would decrease to 168,602 metric tons (50,382 in Ashuganj and 128,464 in Palash).

It is expected that the project area will be facilitated with updated irrigation facilities and the drainage pattern would be improved after rehabilitation. In a post-project situation (FWIP), crop production would increase significantly. Total crop production would reach 179,619 metric tons in Ashuganj and 218,828 metric tons in Palash. Rice production would increase to 129,404 metric tons in Ashuganj and 69,717 metric tons in Palash (total 199,120 metric tons), while non-rice production would reach 50,215 metric tons in Ashuganj and 149,111 metric tons in Palash (total 199,325 metric tons). The impact matrix on crop production in the post-construction phase is presented in the table below.

IEC	Baseline Condition	Future-without Project	Future-with-Project	Impact
Irrigated area	The existing irrigation coverage is about 27,710 ha (Ashuganj: 17,145 ha; Palash: 10,565 ha).	Irrigated area would decline to 21,255 ha (Ashuganj: 15,271 ha; Palash: 8,622 ha).	Irrigated area will increase to 29,333 ha (Ashuganj: 18,061 ha; Palash: 11,272 ha).	+4
Cropping Pattern and Intensity	Cropping intensity: Ashuganj 208%, Palash 222%.	Cropping intensity: Ashuganj 196%, Palash 185%.	Cropping intensity: Ashuganj 226%, Palash 237%.	+3
Crop damage	Average crop damage about 02–03% annually.	Crop damage expected to increase to 06–07% annually.	About 06–07% crops would be saved annually compared to FWOP condition.	+1
Crop production	Total crop production: Ashuganj 159,626 MT, Palash 196,504 MT. Rice crop: Ashuganj 99,834 MT, Palash 41,897 MT. Non-rice crop: Ashuganj 59,792 MT, Palash 154,607 MT.	Total crop production: Ashuganj 134,785 MT, Palash 156,981 MT. Rice crop: Ashuganj 84,402 MT, Palash 28,517 MT. Non-rice crop: Ashuganj 50,382 MT, Palash 128,464 MT.	Total crop production: Ashuganj 179,619 MT, Palash 218,827 MT. Rice crop: Ashuganj 129,404 MT, Palash 69,717 MT. Non-rice crop: Ashuganj 50,215 MT, Palash 149,111 MT.	+4

d) Fisheries Resources

Fish Production

Assumption: In the aftermath of the canal excavation and re-excavation, fish habitats characteristics would be changed. In the long run, the excavation/re-excavation of canals, along with repairs and new construction of water control structure will increase water depth, and extend seasonal water retention period. These conditions may also facilitate breeding and nursing of resident fishes, such as fishes like Snake Head, Barbs, Catfish, Baim, Bele etc. Furthermore, enhanced water availability in the canals may supports in aquaculture pond watering during dry season. On the other hand, dry-season water use for crops may reduce water of main canal when fish need it most for spawning or juvenile growth. While, improved habitat connectivity may facilitate fish movement routes. Resultant effect of all elements discussed above would contribute to fish production positively. Considering the above-mentioned causes, the total increase in fish production is estimated at about 6 MT, with 5 MT attributed to Ashuganj and 1 MT to Palash.

Impact on the fisheries related IECs are summarized in the following table.

IEC	Baseline Condition	Future-without Project (FWOP)	Future-with-Project (FWIP)	Impact (FWIP-FWOP)
Fish production	<ul style="list-style-type: none"> Fish production has declined due to habitat degradation, lack of water round the year and during fish breeding seasons. Overfishing and destructive fishing during moonson and reduced natural recruitment have impacted fish production. River and canal fish production in Ashuganj and Palash is 313 and 95 MT respectively. 	<ul style="list-style-type: none"> Further decline in fish production due to worsening habitat conditions and increased habitat degradation. Breeding success and natural recruitment would continue to decline. River and canal fish production in Ashuganj and Palash is 310 and 94 MT respectively. 	<ul style="list-style-type: none"> Fish production would increase due to improved regulation of water control structures which may enhances fish breeding and growth conditions. Enhanced canal water holding capacity and water retention period would support a more sustainable production of non-commercial fish. Improved canal connectivity may facilitate fish movement. River and canal fish production in Ashuganj and Palash is 316 and 96 MT respectively. 	<ul style="list-style-type: none"> Fish production in rivers and canals will be increased by 6 MT in Ashuganj and by 2 MT in Palash.

e) Ecological Resources

Vegetation

Positive Impact: In the footprint area, proposed plantation plan at disposal sites and canals side would be creating greenery environment and also provision to conservation for local faunal habitat. At the 22 locations whereas two upazilas would be selected of plantation program. Which are implemented by BADC in this project. Saplings collection from local nursery is major concern to protect variable plant disease whereas specific native species and local fruit, medicine, timber or ornamental plants should be collected. For the reason, local people who are beneficiaries would be also benefited in this plantation program. Moreover, the vegetation provides habitat for wildlife and other biota. Vegetation would be improved for water availability in canals and improving flooding condition.

The interventions namely re- excavation of canals, aquatic vegetation will improve due to expansion of canals (number of 32 canals, whereas 29 canals are Ashuganj and 3 are in Palash) depth as well as water area and also support to aquatic organism's whole of the year that will provide a positive impact to the wildlife and other fauna like invertebrates. After re-excavation activities of the canals, it is expected to improve water velocity for enhance more flow in Main canals, Secondary and tertiary canals. As a result, the possibility of propagation of free-floating hydrophytes like water hyacinth will be minimized and surface area of canals would be clear. It will be help to grow submerged and marginal vegetation that improve vegetation composition. The area, as well as quality of aquatic habitat, might be enhanced through the above-mentioned activities. Water availability will surely provide nourishments to all Aquatic habitat by growing green algae and other organisms. Existence of more plant species derives more functionality of an ecosystem. If this trend of vegetation pattern will be continued, it may be continuous the food chain of aquatic ecosystems. Water depended animals like fishes, egrets, herons, cormorants and other reptiles will be frequently roaming there from the surrounding wetland areas. Therefore, it is anticipated that execution of the proposed interventions will enhance the way to improve the current status of the wildlife habitat both terrestrial and aquatic. **Figure 8.2** showing Ecosystem functions are improved after canals re-excavation.

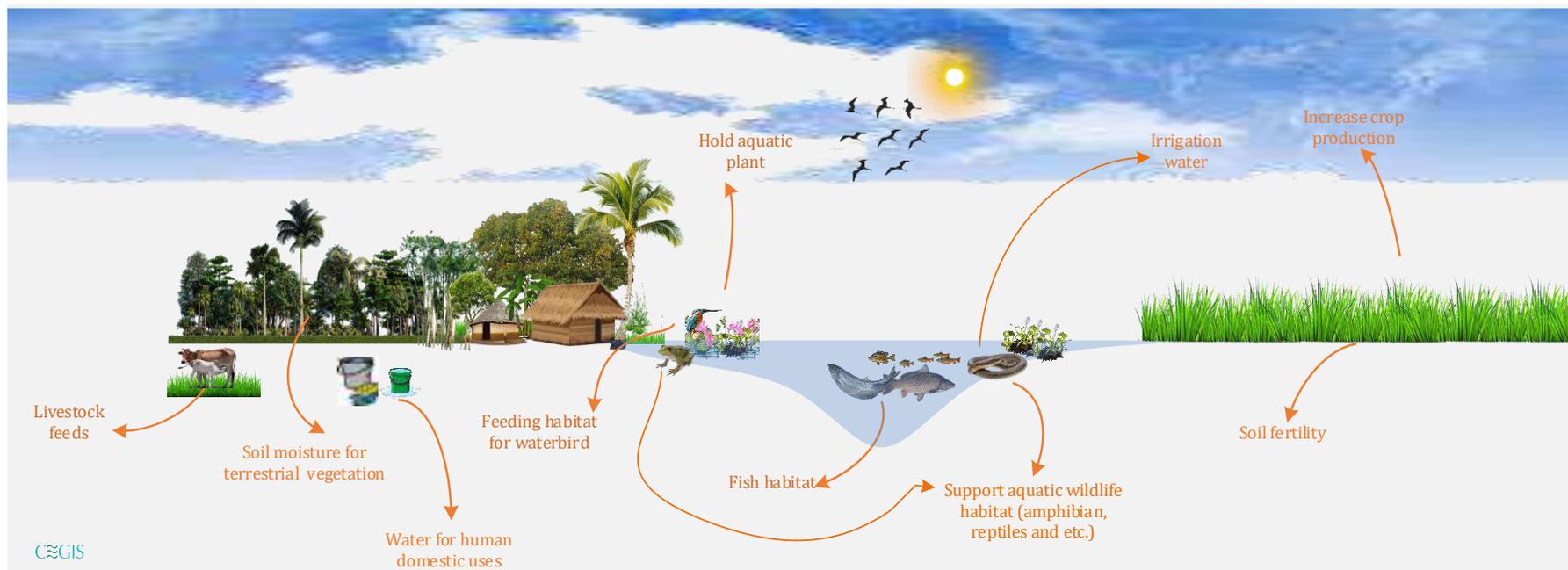


Figure 8.1: Ecosystem Functions are Improved After Canals Re-excitation

Wildlife habitat

Positive Impact

- The aquatic wildlife habitats of the project areas will be restored by getting enough water flow in the canals.
- The biodiversity and wildlife in aquatic and terrestrial habitats, of the project areas will be increased due to the habitat restoration.
- Population of wetland visiting birds will rise in the canals, ditches, ponds, beels and other wetlands, and the canal banks will serve as an important habitat.
- Species richness and abundance of wildlife will be improved, and the faunal composition of the project areas will be enriched.
- Huge number of migratory birds will visit in important wetlands like Galania haor, Chinadi beel etc.
- Irrigation canals will flourish terrestrial habitat like agricultural fields, which is home to numerous terrestrial fauna like rat snakes, birds etc.

Impact on the ecological resources related IECs are summarized in the following table.

IEC	Baseline Condition	Future-without Project	Future-with-Project	Impact
Vegetation	<ul style="list-style-type: none"> • Homesteads, River, Haor, beel, ponds, agricultural lands and river and canal levees are the major vegetation forms of this ecosystem. • Various types of aquatic flora are dominant in the beel and canals areas. 	<ul style="list-style-type: none"> • Aquatic floral diversity deteriorates • Excess propagation of water hyacinth will reduce floral diversity in the secondary and tertiary canals 	<ul style="list-style-type: none"> • Increase of terrestrial and amphibians' plants at the both side of re-excavated canal dykes • Increase aquatic floral diversity in the secondary and tertiary canals 	Improve vegetation density and coverage. (+2)
Wildlife habitat	<ul style="list-style-type: none"> • Amphibians, reptiles, birds and mammals are the major faunal group of Ashuganj and Palash project sites. • Wetlands like haor, beels are important hotspot of wildlife. • Aquatic wildlife habitats have been declined due to the lack of enough water flow in the canals. 	<ul style="list-style-type: none"> • The existing aquatic habitat condition will deteriorate due to pollution and lack of water supply. • Wildlife population in aquatic habitats, will be decreased. • Wetland dependent birds will not be frequently seen due to the lack of food availability. 	<ul style="list-style-type: none"> • Aquatic habitat conditions will be improved for increasing the depth and water area of the excavated canals. • Water availability will provide enough food items to aquatic fauna by growing vegetation and aquatic organisms. 	Wildlife habitat will be improved (+2)

f) Socio Economic Condition

ISC	Baseline Condition	Future-without-Project	Future-with-Project	Impact
Employment generation	Presently employment in agricultural sector is not optimum compared to potential.	No change or deteriorate from the present condition.	This Project is poised to significantly impact employment generation on this area. Currently, 27,710 hectares of land is being cultivated with irrigation, if the project is implemented, additional 1,492 hectares of land will come under cultivation. This will create 186,500 man-days of employment opportunities. The increased agricultural activity stimulates demand for services, such as transportation, equipment repair, and input supply, thereby generating additional employment.	+3
Improved Livelihoods	Low production and insufficient irrigation water disrupt income, employment, and overall livelihoods in the study area.	No change or deteriorate from the present condition.	Implementing the intervention will enhance crop production and ensure food security. Increasing cropping intensity and overall production will, in turn, boost employment in the agricultural sector and improve livelihoods.	+3
Increase food security	Insufficient irrigation water hinders crop production, leaving communities at risk of food shortages.	No change or deteriorate from the present condition.	The availability of irrigation water will significantly boost crop production, ensuring food security in the area.	+3
Poverty Reduction	Without adequate irrigation, large areas of arable land remain fallow, resulting in seasonal unemployment for many.	No change or deteriorate from the present condition.	Adequate irrigation increases the amount of land available for cultivation, which creates more employment opportunities, boosts crop yields, raises income levels, and helps reduce poverty.	+2

Significance of the impacts assessed under sections 8.3.1, 8.3.2 and 8.3.3 without mitigation have been determined in **Table 8.1** considering;

- Duration of the potential impact;
- Spatial extent of the potential impact;
- Reversibility;
- Likelihood; and
- Sensitivity.

Residual impact after mitigation/enhancement measures has also been assessed in **Table 8.4**.

Table 8.4: Summary Matrix on Impact Assessment and Residual Impact

IESC	Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance* (Before mitigation)
Pre-Construction Phase							
Vegetation	Damages of vegetation due to construction activities	Short term	Within the footprint area	Reversible	Likely	Low	Negligible
Wildlife habitat	Temporary loss of wildlife habitat	Short term	Local	Reversible	Likely	Low	Negligible
Employment Generation	The pre-construction activities will create employment opportunity.	Short term					Positive
Construction Phase							
Drainage	Temporary waterlogging and obstruction of local drainage due to canal excavation and construction works.	Short-term	Localized	Reversible	Likely	Low	Negligible
Water Level of Chinadi Beel	Water level of Chinadi Beel may decline due to excavation of canals beside it and restoration of	Short-term	Localized	Reversible	Likely	Medium	Moderate

IESC	Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance* (Before mitigation)
	connectivity with the canal.						
Surface Water Quality	Surface water quality might deteriorate due to disposal of construction related wastes, through turbidity and sedimentation from canal excavation, Poor management of construction materials and excavated spoils may result in contamination of water bodies through runoff during rainfall events.	Short term	Local	Reversible	Likely	Medium	Moderate
Noise Level	The noise level will increase due to operation of construction equipment (mixture machine, vibrator etc.) operation of excavator for excavation and re-excavation of earthen and intake channels	Short term	Local	Reversible	Likely	Medium	Moderate

IESC	Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance* (Before mitigation)
	and dismantling of damaged structures.						
Air quality	The air quality might deteriorate due to emission of fugitive dust from various construction activities, during disposal of excavated materials, Operation of construction related equipment (i.e. exhaust emissions from construction equipment, excavator); vehicle movement etc.	Short term	Local	Reversible	Likely	Medium	Moderate
Fish production	Construction activities may temporarily reduce non-commercial fish production by altering habitat conditions and damaging spawning and nursing habitats.	Short term	Localized	Reversible	Likely	Medium	Moderate

IESC	Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance* (Before mitigation)
Changes in Land Quality and environmental pollution	Changes in Land Quality and environmental pollution due to disposal of construction wastes in the surrounding lands.	Short term	Local	Reversible	Likely	Medium	Moderate
Crop production	Construction activities will temporarily alter irrigated areas, affecting agricultural production for a single crop season (primarily Rabi).	Short term	Local	Irreversible	Likely	Medium	Moderate
Vegetation	Damages of vegetation due to construction activities.	Short term	Within the footprint area	Reversible	Likely	Medium	Moderate
Wildlife habitat	Loss of wildlife habitat due to damage of vegetatopn.	Short term	Local	Reversible	Likely	Medium	Moderate
Employment Generation	People who live in the project area's	Short term	Within study area				Moderately positive

IESC	Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance* (Before mitigation)
	vicinity will have more opportunities for temporary work.						
Community health and safety	The arrival of a large number of construction workers can have negative impacts on the environment and increase the risk of communicable disease transmission. Additionally, it may also create potential for disruption to the community's law and order.	Short term	Within the entire project area	Reversible	Likely	Medium	Moderate
Occupational Health and Safety	The workers might be injured during various construction activities, excavation and disposal of excavated materials. Some of these	Short term	Within the entire project area	Irreversible	Likely	Medium	Moderate

IESC	Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance* (Before mitigation)
	injuries may turn into the casualty, if not properly treated.						
Post-Construction Phase							
Drainage	Improved drainage performance due to rehabilitated canals and regulators; reduces flood risk and waterlogging.	Long-term	Within Project Boundary				Moderately Positive
Groundwater	Groundwater levels expected to improve gradually due to reduced abstraction for irrigation and improved recharge opportunities.	Long-term	Regional (aquifer-wide)				Moderately Positive
Surface water Availability	Surface water availability will be enhanced through increased conveyance and retention capacity due to construction of adequate water control structures and canal excavation/re-excavation	Long-term	Project area				Major Positive
Fish Production	Increase non-commercial fish production due to	Long term	Within the study area	-	-	-	Moderately positive

IESC	Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance* (Before mitigation)
	improved habitat condition.						
Land use	Land use would be changed due to assured irrigation supply i.e fallow land will be used for cultivation and urbanization will be stopped.	Long term	Local		Likely		Positive
Increase Irrigated area	Irrigated area will increase due to increased waater availability	Long term	Project area				Moderately positive
Change in cropping pattern and increase of cropping intensity	Cropping pattern will be changed and cropping intensity will be increased due to increased waater availability	Long term	Project area				Moderately positive
Crop damage would be saved	Crop damage would not occur due to improved drainage condition.	Long term	Project area				Positive
Crop production	Crop production will increase due to assured irrigation.	Long term	Project area	Likely	High	Major	Moderate
Vegetation	Improve vegetation coverage and density	Long term	Within the footprint area				Moderately positive

IESC	Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance* (Before mitigation)
Wildlife habitat	Improve wildlife habitat	Long term	Local				Moderately positive
Improved Livelihoods	The livelihood improvement is expected to significantly increase income through enhanced crop production, ensuring both sustenance and a sense of security for the inhabitants.	Long term	Within the entire project and surrounding area				Moderately positive
Increases food security	The Irrigation Project boosts food security and stabilizes prices by increasing agricultural productivity. Reliable water access allows farmers to grow multiple crops, ensuring stable production and food security.	Long term	Within the entire project area				Moderately positive
Poverty Reduction	It is anticipated that a significant reduction in the poverty rate within	Long term	Within the entire project area	Reversible			Moderately positive

IESC	Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance* (Before mitigation)
	the study area over the next decade, accompanied by a notable decrease in discrimination among the inhabitants.						
Employment generation	The interventions will drive changes in cropping patterns and intensify agricultural activities, leading to expand employment opportunities in agricultural sector.	Long term	Within entire project area				Moderately positive

9. Environmental Management Plan

9.1 Introduction

The Environmental Management Plan (EMP) has been prepared with the aim of ensuring avoidance, minimization, and offsetting of adverse environmental impacts and enhancement of beneficial impacts. The EMP includes mitigation and enhancement measures to be taken during pre-construction phase, construction phase and post-construction phase. An environmental monitoring plan has been suggested at the end with mention of agencies responsible for implementing the monitoring plan.

9.2 Objective of Environmental and Social Management Plan

The basic objective of the EMP is to manage the adverse impacts of the proposed interventions, which minimizes the adverse impact on the environment and surrounding community. The specific objectives of the EMP are to:

- Facilitate the implementation of the mitigation measures identified during the present EIA study to comply with regulatory requirements and discussed earlier in the document.
- Maximize potential project benefits and control negative impacts.
- Include measures beyond compliance to enhance the community well-being.
- Draw responsibilities for project proponent, contractors, consultants, and other members of the Project team for the environmental and social management of the project.

Define a monitoring mechanism and identify monitoring parameters in order to:

- Ensure the complete implementation of all mitigation measures
- Ensure the effectiveness of the mitigation measures

Table 9.1 contains details of mitigation measures to minimize the negative impacts on the IESCs and enhancement measures for increasing the benefits of the positive impacts. The environmental monitoring plan has been presented in **Table 9.2** followed by EMP costs in **Table 9.3**.

Table 9.1: Environmental and Social Management Plan

IESC	Impact	Mitigation/ Compensation/ Contingency/ Enhancement measure	Residual Impact*	Cost (Million BDT)	Responsible Agency
Pre-Construction Phase					
Vegetation	Damage of undergrowth vegetation at the footprint areas area of labor shed and material stockyard	<p>Mitigation measures</p> <ul style="list-style-type: none"> • Select barren land as much as possible for construction of labor sheds and stock of construction materials. If not possible, plant vegetation at other suitable locations. • Various soil ameliorants may be necessary to promote plant growth, if soil condition of the area is not satisfactory. These include fertilizers (where there is low chemical fertility, ie, low N, P, K, S etc), gypsum (to reduce soil swelling and dispersion and to improve soil structure), and lime (for treating acid soils or increasing calcium content). 	Negligible	0.03	Contractor under supervision of BADC and DoE

IESC	Impact	Mitigation/ Compensation/ Contingency/ Enhancement measure	Residual Impact*	Cost (Million BDT)	Responsible Agency
Wildlife habitat	Temporary loss of wildlife habitat	<p>Mitigation measures</p> <ul style="list-style-type: none"> • The wildlife will relocate to nearby suitable place. • The mitigation measures mentioned under vegetation will help restore the habitat to inhabit the relocated wildlife. • Instructions should be given to employees, contractors, and site visitors not to disturb wildlife (courtship or nesting). • Avoid excess lighting and use shaded lights at construction sites <ul style="list-style-type: none"> • Avoid cutting down the larger trees for faunal habitat 	Negligible	0.02	Contractor under supervision of BADC, DoE and IUCN

IESC	Impact	Mitigation/ Compensation/ Contingency/ Enhancement measure	Residual Impact*	Cost (Million BDT)	Responsible Agency
Employment Generation	The pre-construction activities (construction of labor shed, stockyard etc.) will create employment opportunity.	<p>Enhancement</p> <ul style="list-style-type: none"> • Project affected local people should get priority in recruitment; • Labor wage should be fixed based on the current wage rate of the project area; • Equal employment opportunities should be given to women; • Provide the skill enhancement training to locals to carry out specific tasks and enhance the skill of local people; • Process of labor recruitment and their payment process should be transparent 	-	ECoP	BADC and local government agencies
Construction Phase					
Drainage	Temporary waterlogging or obstruction	<p>Mitigation measures</p> <ul style="list-style-type: none"> • Work in the dry season. • Prepare proper drainage planning • Ensure phased canal excavation and construction works, and early clearing of silted sections. 	Negligible	ECoP	BADC PMU/ Contractor

IESC	Impact	Mitigation/ Compensation/ Contingency/ Enhancement measure	Residual Impact*	Cost (Million BDT)	Responsible Agency
		<ul style="list-style-type: none"> • Create temporary bypass channels. 			
Water Level of Chinadi Beel	Water level of Chinadi Beel may decline due to excavation of canals beside it and restoration of connectivity with the canal.	<p>Mitigation measures</p> <ul style="list-style-type: none"> • Operation of the existing regulator and new weir should be done in such a way that water level of the Beel does not fall below the designated level to ensure ecosystem services of the Beel. (Detail management plan provided in Appendix F: Chinadi Beel Management Plan). 	Negligible	1.00 for construction of weir. From PMU	Contractor and BADC PMU
Surface Water Quality	Surface water quality might deteriorate due to disposal of construction related wastes, through turbidity and sedimentation from canal excavation, Poor management of construction materials and excavated spoils may result in contamination of water bodies through runoff during rainfall events.	<p>Mitigation measures</p> <ul style="list-style-type: none"> • Throwing/Releasing of construction and other wastes (unused concrete, washed-off coarse aggregates, litters, cut pieces of steel, wood, nails etc.) into the water body should be prohibited; • At first, the wastes should be segregated into biodegradable and non-biodegradable waste; and put in separate bins. 	Negligible	ECoP	Contractor under supervision of BADC

IESC	Impact	Mitigation/ Compensation/ Contingency/ Enhancement measure	Residual Impact*	Cost (Million BDT)	Responsible Agency
		<ul style="list-style-type: none"> • The contractor should arrange to transport the bins to the designated landfill site; selected by BWDB and contractor in consultation with the Local Government Institute and Local Administration, before starting of the project activities, if there is no existing land fill/dumping place. • Biodegradable waste or organic waste should be disposed of at the land fill site or gathered for composting • The non-biodegradable waste should be segregated into recyclable and rejected waste. • Recyclable wastes to be collected and sent to the licensed traders for recycling • The rejected wastes should be disposed of in the land fill site. 			

IESC	Impact	Mitigation/ Compensation/ Contingency/ Enhancement measure	Residual Impact*	Cost (Million BDT)	Responsible Agency
Noise Level	The site-specific noise level may slightly have elevated due to operation of construction equipment (mixture machine, vibrator etc.) operation of excavator for excavation and re-excavation of earthen and intake channels and dismantling of damaged structures.	<u>Mitigation measures</u> <ul style="list-style-type: none"> • Construction equipment should have proper mufflers and silencers and maintained properly in order to restrict noise level within national noise standards (Noise control rules, 2006); • Movement of equipment and vehicles should be restricted/ limited during the daytime; • Labors should use ear mufflers and plugs during noisy works; 	Moderate	ECoP	Contractor under supervision of BADC PMU
Air Quality	The air quality might deteriorate due to emission of fugitive dust from various construction activities, during disposal of excavated materials, operation of construction related equipment (i.e. exhaust emissions from construction equipment, excavator); vehicle movement etc. However, this can create very site-specific dusts and particulate matter for a	<u>Mitigation measures</u> <ul style="list-style-type: none"> • Water should be sprayed at the construction yard and connected road twice a day in order to suppress fugitive dust; • Construction equipment namely batching plant/mixer machine, washing plant and grader, excavator, etc. should be properly maintained; 	Moderate	ECoP	Contractor under supervision of BADC

IESC	Impact	Mitigation/ Compensation/ Contingency/ Enhancement measure	Residual Impact*	Cost (Million BDT)	Responsible Agency
	<p>very short period of time. No changes in gases like CO, NOX, SOX will be made by the project interventions.</p>	<ul style="list-style-type: none"> • Loading of the construction materials (sand, shingle, cement) for concrete mixing should be done carefully to avoid dispersion of dust to the extent possible; • Excavated materials should be carried carefully and under cover to avoid dispersion of fugitive dust. • Construction materials should be kept covered to avoid dispersion in air; • Construction wastes should be properly transported and dumped outside immediately from the site after generation; • Vehicles and equipment should use clean air technology. • Avoid earthen roads for carrying the construction materials to the extent possible; 			

IESC	Impact	Mitigation/ Compensation/ Contingency/ Enhancement measure	Residual Impact*	Cost (Million BDT)	Responsible Agency
		<ul style="list-style-type: none"> • Switch off / throttle down all site vehicles, water vessels, generators, excavator and machinery when not in use; • Vehicle speed restriction must be enforced to control dust generation; 			
Fish Production	Construction activities (e.g. excavation/ re-excavation of canals, construction of regulators etc.) may temporarily reduce non-commercial fish production by altering habitat conditions and damaging spawning and nursing grounds.	<ul style="list-style-type: none"> • Mitigation • Minimize excavation activities during fish breeding seasons (e.g., monsoon period). • Avoid complete dewatering of canals to maintain minimal habitat during construction period. • Implement fish-friendly construction techniques (e.g., alternative fish passage provision) • Avoid disposal of excavated materials in or near water bodies. Select specific places for 	Negligible	-	BADC/Project Contractor

IESC	Impact	Mitigation/ Compensation/ Contingency/ Enhancement measure	Residual Impact*	Cost (Million BDT)	Responsible Agency
		disposal that are far from waterbodies.			
Changes in Land Quality and environmental pollution	Changes in Land Quality and environmental pollution due to disposal of construction wastes in the surrounding lands.	<p>Mitigation measures</p> <ul style="list-style-type: none"> • The onsite wastes should be properly contained and prevented from escaping into surrounding lands; • The process of disposing of the wastes mentioned under IEC-surface water quality should be followed. 	Negligible	0.2	BADC PMU and contractor
Crop production	Construction activities will temporarily alter irrigated areas, affecting agricultural production for a single crop season (primarily Rabi).	<p>Mitigation measures</p> <ul style="list-style-type: none"> ▪ The farmers should be informed well ahead (before the start of cropping season) about the construction activities so that they would not take any initiative for the cultivation of any crops in the project area. ▪ The contractor should avoid cultivable fields during construction. 	Negligible	ECoP	BADC, Contractor, and DAE

IESC	Impact	Mitigation/ Compensation/ Contingency/ Enhancement measure	Residual Impact*	Cost (Million BDT)	Responsible Agency
		<ul style="list-style-type: none"> ▪ The contractor should ensure that no vehicular movements take place through cultivation fields. ▪ The contractor should ensure that no material is dumped inside cultivation fields. ▪ Canal excavated materials should not be dumped on the agricultural lands. ▪ The contractor should maintain liaison with the communities. ▪ Contactor should prepare site-specific excavated material management and disposal plans for each site to be followed upon approval by the DDCCS & PMSC Consultant and PMU. <p>Compensation</p> <ul style="list-style-type: none"> ▪ Proper compensation should be paid to the farmers whose lands would be used for construction works. 			

IESC	Impact	Mitigation/ Compensation/ Contingency/ Enhancement measure	Residual Impact*	Cost (Million BDT)	Responsible Agency
		<ul style="list-style-type: none"> The compensation amount should be calculated in consultation with the local Department of Agriculture Extension (DAE) officials. 			
Vegetation	Damages of vegetation due to construction activities.	<p>Mitigation</p> <ul style="list-style-type: none"> Select barren land as much as possible for dumping of excavated materials and canal excavation; If not possible, plant vegetation at other suitable locations. Aware labors about plant conservation before starting the work Various soil ameliorants may be necessary to promote plant growth, if soil condition of the area is not satisfactory. These include fertilizers (where there is low chemical fertility, ie, low N, P, K, S etc), gypsum (to reduce soil swelling and dispersion and to improve soil structure), and lime 	Negligible	ECoP	Contractor in coordination with BADC, DoF, local Union Parisad and Stakeholders.

IESC	Impact	Mitigation/ Compensation/ Contingency/ Enhancement measure	Residual Impact*	Cost (Million BDT)	Responsible Agency
		<p>(for treating acid soils or increasing calcium content).</p> <p>Compensation</p> <ul style="list-style-type: none"> • Give proper compensation to the tree owners against tree felling or pruning. 			
Wildlife habitat	Loss of wildlife habitat due to damage of vegetatopn.	<ul style="list-style-type: none"> • Aware local people about wildlife conservation so that the relocated wildlife can escape easily and take secured shelter in nearer habitat • Avoid construction activities during favorable time of wild life movement (early morning and night) • Use low sound emitting machineries 	Negligible	-	Contractor under supervision of BADC, DoE and IUCN
Employment Generation	People who live in the project area's vicinity will have more opportunities for temporary work.	<p>Enhancement</p> <ul style="list-style-type: none"> • Local labors should be given priority in recruitment for the construction activity. • Project authorities should consider this issue and include a clause in the 	-	ECoP	BADC, Contractor

IESC	Impact	Mitigation/ Compensation/ Contingency/ Enhancement measure	Residual Impact*	Cost (Million BDT)	Responsible Agency
		<p>contract document for local labor recruitment based on their potential and availability for employment in the different project activities.</p> <ul style="list-style-type: none"> • Provide the skill enhancement training to locals to carry out specific tasks and enhance the skill of local people; • Process of labor recruitment and their payment process should be transparent. • Observe statutory requirements relating to minimum age for employment of children and meeting international standards of not 			

IESC	Impact	Mitigation/ Compensation/ Contingency/ Enhancement measure	Residual Impact*	Cost (Million BDT)	Responsible Agency
		employing any persons under the age of 16 for general work and no persons under the age of 18 for work involving hazardous activity.			
Community Health and Safety	The arrival of a large number of construction workers can have negative impacts on the environment and increase the risk of communicable disease transmission. Additionally, it may also create potential for disruption to the community's law and order.	<p>a. Mitigation</p> <ul style="list-style-type: none"> • Public awareness training and workshops on safety and health risks should be conducted for local communities prior to and during construction operations. • All workers must be provided with appropriate Personal Protective Equipment (PPE). First aid must be provided and there would be procedures in place to access appropriate emergency facilities. • The construction sites should have protective fencing to avoid any unauthorized entry, where appropriate and possible 	Moderate	0.50	BADC and local government agencies

IESC	Impact	Mitigation/ Compensation/ Contingency/ Enhancement measure	Residual Impact*	Cost (Million BDT)	Responsible Agency
Occupational Health and Safety	The workers might be injured during various construction activities, excavation and disposal of excavated materials. Some of these injuries may turn into the casualty, if not properly treated.	<p>Mitigation</p> <ul style="list-style-type: none"> - The contractors should prepare site specific HSE Plan and obtain approval from the project authority. - Formulate and implement an emergency risk management plan (by the contractor). - The construction sites should have protective fencing to avoid any unauthorized entry. - An experienced H&S Manager must be engaged by the contractor prior to start of construction. - Safety instruction by the H&S Manager should be provided to the workers. - Prior to starting work, a toolbox meeting should 	-	ECoP	BADC PMU and Contractor

IESC	Impact	Mitigation/ Compensation/ Contingency/ Enhancement measure	Residual Impact*	Cost (Million BDT)	Responsible Agency
		<p>be arranged by the H&S Manager for the workers.</p> <ul style="list-style-type: none"> - First Aid Box and PPE (such as safety helmets, safety shoes, eye protection glasses, ear plugs/muffs, waist belts, masks, hand gloves, body protective aprons and insulating boots) must be provided to the workers and ensure their use by the workers. - Public awareness training and workshops on safety and health risks should be conducted for local communities prior to and during construction operations. - Ensuring rigorous standards for occupational health and safety are in place. - Contractor should establish a labor 			

IESC	Impact	Mitigation/ Compensation/ Contingency/ Enhancement measure	Residual Impact*	Cost (Million BDT)	Responsible Agency
		<p>grievance mechanism and documenting its use for complaints about unfair treatment or unsafe living or working conditions without reprisal.</p> <ul style="list-style-type: none"> - Provide insurance for accidents resulting in disabilities or death of employees for the duration of their contracts. - Employ a community liaison officer (this could be full time or part of another post's responsibilities). - Emergency phone numbers (including hospitals, fire department, and police) should be displayed at key locations within the site. - Aware local community to take care of their children 			

IESC	Impact	Mitigation/ Compensation/ Contingency/ Enhancement measure	Residual Impact*	Cost (Million BDT)	Responsible Agency
Post-Construction Phase					
Drainage	Improved drainage performance due to rehabilitated canals and regulators; reduces flood risk and waterlogging.	<p>Enhancement Measure</p> <ul style="list-style-type: none"> • Siltation in canals should be monitored and maintenance excavation should be done when needed. • Hydraulic structures should be properly operated to ensure smooth drainage. • Regular inspections, particularly following rainfall should be conducted to ascertain the operation of outlet structures and also ensure smooth flow of runoff through the drainage system. • Adequate budget should be provided for operation and maintenance of drainage system. • Create and strengthen community-led drainage monitoring. 	-	ECoP	BADC/ Contractor

IESC	Impact	Mitigation/ Compensation/ Contingency/ Enhancement measure	Residual Impact*	Cost (Million BDT)	Responsible Agency
Groundwater	Groundwater levels expected to improve gradually due to reduced abstraction for irrigation and improved recharge opportunities.	<u>Enhancement Measure</u> <ul style="list-style-type: none"> Promote surface water irrigation; monitor groundwater levels; restrict new deep tube-wells in the project area. 	-	ECoP	BADC
Surface Water Availability	Surface water availability will be enhanced through increased conveyance and retention capacity due to construction of adequate water control structures and canal excavation/re-excavation	<u>Enhancement Measure</u> <ul style="list-style-type: none"> Maintenance re-excavation of canals should be carried out as and when required. Operation of hydraulic structures should be properly done. 	-	ECoP	BADC/ Contractor
Surface Water Quality	Deterioration of water quality during maintenance activities.	<u>Mitigation</u> <ul style="list-style-type: none"> Mitigation measures similar to the construction phase. ; 	Negligible	ECoP	Contractor under supervision of BADC PMU
Noise Level	Noise levels may deteriorate during the O&M of regulator, siphon, aqueduct, water retention structure, silt trap basin, double barrel box type closed conduit, trash rack and medium & small-scale hydraulic structures.	<u>Mitigation</u> Mitigation measures similar to construction phase should be taken.	Negligible	ECoP	Contractor under supervision of BADC
Air Quality	Ambient air quality may deteriorate due to dust production during the O&M of hydraulic	<u>Mitigation</u>	Negligible	ECoP	Contractor under supervision of BADC PMU

IESC	Impact	Mitigation/ Compensation/ Contingency/ Enhancement measure	Residual Impact*	Cost (Million BDT)	Responsible Agency
	structures and maintenance excavation of canals.	Mitigation measures similar to construction phase should be taken.			
Fish Production	Increase non-commercial fish production due to improved habitat conditions, better breeding, and natural stock replenishment.	Enhancement measures <ul style="list-style-type: none"> • Regular stocking of species of indigenous fishes. Monitor fish populations to assess long-term production trends. 	Negligible	-	BADC PMU and ECoP
Land Use	Land use would be changed	Enhancement measures <ul style="list-style-type: none"> ▪ Fallow land should be used for further development. ▪ Fallow and Low laying area should be taking into crop production by proper water management. • Restrict the use of agriculture land in urbanization work. 	Negligible	-	BADC PMU and ECoP
Irrigated area	Irrigated area would be increased with modern irrigation facilities	Enhancement measures <ul style="list-style-type: none"> ▪ Water Management Organizations (WMOs) should be formed as per the guidelines of GPW 2002. 	-	0.50	BADC PMU and DAE

IESC	Impact	Mitigation/ Compensation/ Contingency/ Enhancement measure	Residual Impact*	Cost (Million BDT)	Responsible Agency
		<ul style="list-style-type: none"> ▪ A good water management plan should be prepared for the proper utilization of surface water. Supply of adequate amount of water during the critical period of the crop should be ensured. ▪ The irrigated cropped fields should be leveled for uniform distribution of irrigation water. ▪ Irrigation water should be applied in alternate wetting and drying (AWD) system instead of continuous submergence. ▪ Farmers need training in the field for proper use of surface water for irrigation. • Irrigation should be provided up to the optimum level with minimum conveyance loss. 			
Cropping patterns and Intensity	Change in Cropping patterns and increase of cropping Intensity due	<p>Enhancement measures</p> <ul style="list-style-type: none"> ▪ Introduction of new and modern/HYV/Hybrid 	-	-	BADC, DAE

IESC	Impact	Mitigation/ Compensation/ Contingency/ Enhancement measure	Residual Impact*	Cost (Million BDT)	Responsible Agency
	to availability of irrigation water and appartinant structures.	<p>crops cultivars along with crop diversification need to be practiced.</p> <ul style="list-style-type: none"> ▪ Farmer should be encouraged to use organic and green manure to increase the soil fertility as well as avoid water contamination of water sources. ▪ Farmers should be encouraged to cultivate leguminous crops (N₂ fixing) to enhance the soil quality as well as the soil productivity. Farmers need training in the field for crop diversification and crop management in high cropping intensity. 			
Crop damage	Crop damage will be reduced due to drainage improvement.	<p>Enhancement</p> <ul style="list-style-type: none"> • Maintenance re-excavation of canals should be carried out as and when required. • Operation of hydraulic structures should be properly done. 	-	-	BADC PMU, DAE

IESC	Impact	Mitigation/ Compensation/ Contingency/ Enhancement measure	Residual Impact*	Cost (Million BDT)	Responsible Agency
Crop production	Crop production will be increased due to ensured irrigation and appartinant structures.	<p>Enhancement measures</p> <ul style="list-style-type: none"> ▪ Agricultural extension services should be provided to farmers and the availability of good quality seeds (including submergence varieties), fertilizers, and irrigation water should be ensured for sustaining and improving production. ▪ The farmers of the study areas would likely be very much encouraged to apply more irrigation, as they would have easily grown the HYV crop. In this case, farmers need good support from the Govt. for a timely supply of inputs e.g fertilizers, pesticides, seeds, credits, etc. ▪ Capacity building and awareness-raising of the farmers should be carried out regarding the use of practice Integrated Crop Management (ICM) and Good Agricultural Practices (GAP) to 	-	1.0	BADC PMU, DAE

IESC	Impact	Mitigation/ Compensation/ Contingency/ Enhancement measure	Residual Impact*	Cost (Million BDT)	Responsible Agency
		<p>minimize the usage of chemical inputs.</p> <ul style="list-style-type: none"> ▪ Farmers should be encouraged through training to use organic and green manure to increase soil fertility as well as avoid contamination of water sources. Farmers should be encouraged by training to cultivate leguminous crops (N₂ fixing) to enhance the soil quality as well as the soil productivity. 			
Vegetation	<ul style="list-style-type: none"> • Increase of terrestrial and amphibians' plants at the both side of re-excavated canal dykes <p>Increase aquatic floral diversity in the secondary and tertiary canals</p>	<p><u>Enhancement measures</u></p> <ul style="list-style-type: none"> • Keep some excavated material disposal locations to facilitate wildlife dwelling. • Aware local people about plantation and wildlife conservation. 		-	BADC, and local stakeholders
Wildlife habitat	The aquatic wildlife habitats will be restored.	<p>Enhancement measures</p> <ul style="list-style-type: none"> • Use low sound emitting machineries • Avoid dumping industrial, household and commercial wastages on the canals. 		-	Contractor under supervision of BADC, DoE and IUCN

IESC	Impact	Mitigation/ Compensation/ Contingency/ Enhancement measure	Residual Impact*	Cost (Million BDT)	Responsible Agency
Improved Livelihoods	Increasing cropping intensity can boost employment in agriculture and improve livelihoods.	<p><u>Enhancement measures</u></p> <ul style="list-style-type: none"> • The EMP should include GO and NGOs to provide insurance for crops and other agricultural producers of the farmers harmed by erosion. • Creating alternative employment opportunities 		-	BADC and local government agencies
Increases Food Security	Implementation of the intervention boosts food security increasing agricultural productivity allowing to grow multiple crops, ensuring stable production and food security.	<p><u>Enhancement measures</u></p> <ul style="list-style-type: none"> • Introducing modern agricultural equipment and system • Cultivation of HYV crops and increasing crops intensity • Introducing social safety net program 		-	BADC and local government agencies
Poverty Reduction	Adequate irrigation systems will expand agricultural land, create employments, boost crop production, raise incomes, and reduce poverty.	<p><u>Enhancement measures</u></p> <ul style="list-style-type: none"> • Ensure irrigation water • Introducing modern agricultural equipment and system • Cultivation of HYV crops and increasing crops intensity • Improvement of transport facility and creating business center 		-	BADC and local government agencies

IESC	Impact	Mitigation/ Compensation/ Contingency/ Enhancement measure	Residual Impact*	Cost (Million BDT)	Responsible Agency
		<ul style="list-style-type: none"> Ensuring value chain for local crops. 			
Employment Generation	Implementation of the proposed intervention will increase agriculture production, which resulting increased employment for the local people	<p>Enhancement measures <u>Local labors should be trained in improved cultivation system</u></p>		ECoP	BADC and DAE
Total				3.45	-

Detailed Environmental Code of Practice is presented in **Appendix H**.

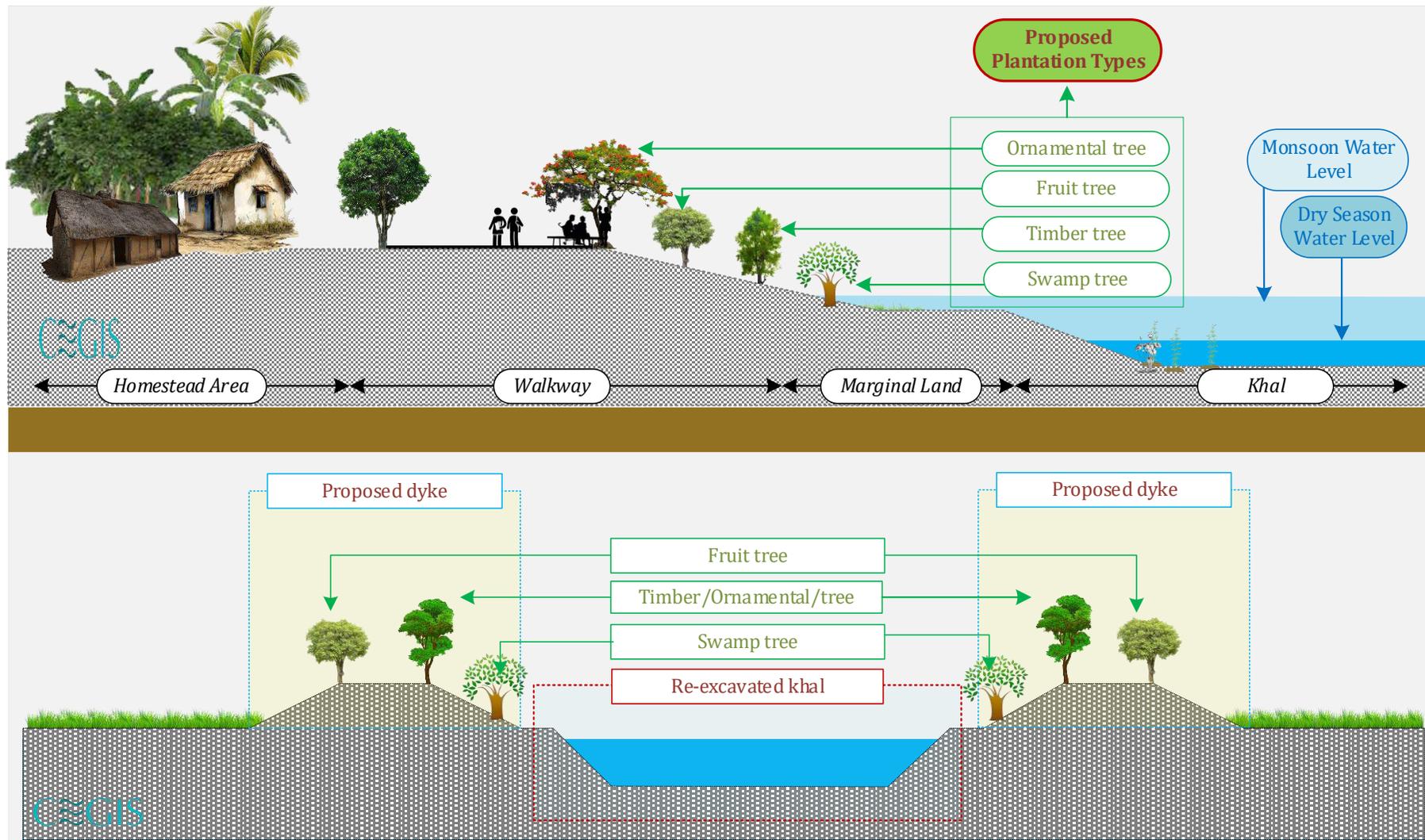


Figure 9.1: Designed of Plantation Program Beside the Canal Area (if applicable)

Table 9.2: Environmental and Social Monitoring Plan

IESC/ Indicator	Method	Location	Frequency	Responsible Agency	Cost (Million BDT)
Pre-Construction Phase					
Land Use	<ul style="list-style-type: none"> Ocular observation 	<ul style="list-style-type: none"> Ashuganj-Palash Green Project Area 	15 days interval during the pre-construction phase	BADC	0.15
Vegetation along the footprint area and proposed construction sites	<ul style="list-style-type: none"> Direct observation 	<ul style="list-style-type: none"> Each of construction sites (Labour shed, Stock Yard, Materials stocking etc.) 	Once before starting of construction	Independent monitor engaged by BADC PMU	0.04
Wildlife occurrence	<ul style="list-style-type: none"> Direct observation 	<ul style="list-style-type: none"> Each of construction sites (Labour shed, Stock Yard, Materials stocking etc.) 	Once before construction and once during construction	Independent monitor engaged by BADC PMU	0.02
Construction Phase					
Drainage	<ul style="list-style-type: none"> Observation and local feedback 	<ul style="list-style-type: none"> Construction zones and adjacent areas 	Weekly during rainy season	BADC PMU / Contractor	0.25
Surface Water Quality	<ul style="list-style-type: none"> Water sampling and analysis for parameters including DO, BOD, COD, pH, turbidity, TDS, TSS, Nitrate and Phosphate; Visual inspection of construction sites; Monitoring of sediment control measures; 	<ul style="list-style-type: none"> Main canal excavation sites Near concrete works Downstream of earthwork operations Near material storage areas At siphon construction sites 	Bi-weekly during construction	DoE, BADC PMU	2.70
Noise level	<ul style="list-style-type: none"> Field investigation (Noise Meter) 	<ul style="list-style-type: none"> At excavation/re-excavation, construction sites, earthwork, and concrete pouring sites. 	Twicely in a month during construction phase	BADC PMU	1.00

IESC/ Indicator	Method	Location	Frequency	Responsible Agency	Cost (Million BDT)
Air quality	<ul style="list-style-type: none"> Field investigation (Air Quality Machine) 	- At excavation/re-excavation, construction sites, earthwork, and concrete pouring sites.	Monthly during construction phase	BADC PMU	1.50
Fish Habitat Condition	<ul style="list-style-type: none"> Inspection of turbidity, sediment levels and sampling water quality (e.g., dissolved oxygen, pH, EC, TDS, etc.). Survey of aquatic vegetation and fish presence. 	- Project canals and adjacent areas	Monthly during construction	BADC PMU	1.00
Fish Production	<ul style="list-style-type: none"> Fish catch surveys to assess temporary declines. 	- Study area canals	Monthly during construction	BADC PMU	1.00
Changes in Land Quality due to Waste Disposal	<ul style="list-style-type: none"> Soil samples collection and analyzed the samples: pH, Salinity (EC), (Organic Matter (OM), Nitrogen (N), Phosphorus (P), Potassium (K), Sulphur (S), Lead (Pb), and Cadmium (Cd) 	- Study area and vulnerable locations	Twice a year	BADC PMU	1.00

IESC/ Indicator	Method	Location	Frequency	Responsible Agency	Cost (Million BDT)
Crop Damage	<ul style="list-style-type: none"> FGD with local people and consultation with DAE personnel/ Crop cutting, Compare the production with the baseline 	- Ashuganj-Palash Green Project Area	During the harvest period	BADC PMU	0.30
Damages of existing vegetation due to disposal of excavated material	<ul style="list-style-type: none"> Direct observation 	- Within the proposed disposal sites	Once after completion of excavation at the respective sites	Independent monitor engaged by BADC PMU	0.07
Wildlife habitat	<ul style="list-style-type: none"> Direct observation 	- Within the proposed disposal sites	Once before construction and once during construction	Independent monitor engaged by BADC PMU	0.02
Safety of workers Monitoring and reporting accidents	<ul style="list-style-type: none"> Visual inspection of usage of Personal Protective Equipment, Safety Sign, Safety Documentation, safety training, checking record book etc. 	- At project sites	Daily	Independent monitor engaged by BADC PMU	2.00
Emergency Response Plan	<ul style="list-style-type: none"> Inspection of Emergency Preparedness and Response 	- At project sites	Monthly	Independent monitor engaged by BADC PMU	2.00

IESC/ Indicator	Method	Location	Frequency	Responsible Agency	Cost (Million BDT)
	mechanism and facilities				
Post-Construction Phase					
Drainage	<ul style="list-style-type: none"> Inspection and community feedback 	- Rehabilitated canals	Bi-annually	BADC PMU	0.30
Groundwater	<ul style="list-style-type: none"> Groundwater level and quality monitoring 	- Monitoring wells across command area	Quarterly	BADC PMU	0.40
Surface water Availability	<ul style="list-style-type: none"> Water flow and availability monitoring 	- Main canals, retention structures	Monthly	BADC PMU	0.35
Surface Water Quality	<ul style="list-style-type: none"> Water sampling and analysis for parameters including DO, BOD, COD, pH, turbidity, TDS, TSS, Nitrate and Phosphate; Inspection of trash racks and silt traps; Visual assessment of water flow and clarity; 	<ul style="list-style-type: none"> - At regulators - Near siphons with trash racks - Along covered canal sections - At silt trap basins - Downstream of hydraulic structures 	Quarterly during maintenance period	DoE, BADC PMU	1.80
Air quality	<ul style="list-style-type: none"> Field investigation (Air Quality Machine) 	- Proposed construction and stocking site, labor shed.	Once after construction	BADC PMU	0.20
Fish Habitat Condition	<ul style="list-style-type: none"> Monitoring water quality parameters (e.g, dissolved oxygen, pH, EC, TDS, etc.). 	- Project footprint area	Quarterly in each year and will continue 3 years	BADC PMU	1.50

IESC/ Indicator	Method	Location	Frequency	Responsible Agency	Cost (Million BDT)
	<ul style="list-style-type: none"> • Measure water depth, flow, and retention period. • Assess connectivity through fish surveys. • 				
Fish Production	<ul style="list-style-type: none"> • Fish population surveys (e.g., catch assessment survey). 	- Study area	Quarterly in each year and will continue 3 years	BADC PMU	1.00
Changes in land use	<ul style="list-style-type: none"> • Ocular observation 	- Ashuganj-Palash Green Project Area	Twice a year	BADC PMU	0.15
Irrigated area	<ul style="list-style-type: none"> • FGD with local people and consultation with BADC personnel 	- Ashuganj-Palash Green Project Area	During irrigation time	BADC PMU and DAE	0.60
Cropping patterns and Intensity	<ul style="list-style-type: none"> • FGD with local people and consultation with DAE personnel 	- Ashuganj-Palash Green Project Area	Three times in a year	BADC PMU and DAE	0.30
Crop damage	<ul style="list-style-type: none"> • FGD with local people and consultation with BADC and DAE personnel/ Crop cutting, Compare the production with the baseline 	- Ashuganj-Palash Green Project Area	During harvest period	BADC PMU and DAE	0.30
Crop production	<ul style="list-style-type: none"> • FGD with local people and consultation with BADC and DAE personnel/ Crop 	- Ashuganj-Palash Green Project Area	Three times in a year	BADC PMU and DAE	0.30

IESC/ Indicator	Method	Location	Frequency	Responsible Agency	Cost (Million BDT)
	cutting, Compare the production with the baseline				
Population of major wild life habitat	<ul style="list-style-type: none"> Direct observation 	2 sites of Chinadi beel and Galania haor - 3 sites of river reach (Shitalakshya River, Meghna and Titas River)	Half yearly at post construction period for a 3-year monitoring plan	Independent monitor engaged by the BADC PMU and IUCN	0.06
Employment opportunities in agriculture will be created	<ul style="list-style-type: none"> SES once a year on 'percentage of households employed in agriculture' 	- Within the entire project area	Half yearly	BADC PMU	1.00
Reduction of poverty and improvement of livelihood and food security	<ul style="list-style-type: none"> SES once a year on 'percentage of households living in deficit level' 	- Within the entire project area	Half yearly	BADC PMU	1.00
				Total	21.06

Table 9.3: Summary of EMP Cost

Item	Cost (Million BDT)
	Total
Environmental and Social Management Plan	3.45
Environmental and Social Monitoring Plan	21.06
Total	24.51

Through their project implementation and monitoring budget, the BADC Project Management Unit will bear the EMP and monitoring cost.

10. Waste Disposal Plan

According to the Bangladesh Environment Conservation Act of 1995, waste encompasses substances that could pose harm to the environment, including solid, liquid, or radiative forms. Sustainable waste management practices are essential for maintaining a healthy environment, as improper waste disposal can lead to pollution and health hazards. Additionally, inadequate waste management contributes to climate change and air pollution, affecting various ecosystems and species. Effective waste management strategies involve implementing the 3R approach—Reduce, Reuse, and Recycle.

The Ashuganj-Palash Green Project involves re-excavation of canals, construction and rehabilitation of regulators, and RCC main canal development for sustainable surface water irrigation. These activities will generate a range of solid and liquid wastes.

Construction-generated waste has the potential to significantly impact the environment. Therefore, it is imperative to adhere to regulations concerning pollution control and waste disposal, particularly during RCC main canal construction works and re-excavation activities. Compliance with these regulations is necessary to mitigate the environmental impact and ensure the sustainability of such projects.

10.1 Waste Management

It is challenging to find safe ways to dispose of waste, especially non-biodegradable and hazardous wastes. Such wastes pose significant risks to the environment and human health. Therefore, it is important to dispose of waste properly to keep the environment clean and to protect people from contamination. Disposal of labor shed waste, re-excavating wastes and solid waste into the river significantly pollutes the water. Before disposing of waste, proper management is required. A waste management system is the strategy to reduce, reuse, and recycle waste. After proper waste management, it should be disposed of at a designated site.

10.2 Potential Waste of the Project

The Ashuganj-Palash Green Project involves key interventions such as re-excavation of existing canals, construction and rehabilitation of regulators, development of RCC-lined main canals, and supporting irrigation infrastructure improvements. These activities will be implemented both on agricultural lands and near existing water bodies.

Waste will be generated across three distinct phases of project implementation: pre-construction, construction, and post-construction (operation and maintenance). Various types of solid and liquid waste, if not properly managed, may lead to environmental degradation at both local and regional scales, particularly affecting agricultural lands, surface water bodies, and downstream users.

The nature and type of waste likely to be generated in each phase are summarized as follows:

10.3 Waste of Pre-Construction Phase

During the pre-construction phase of the Ashuganj-Palash Green Project, preliminary activities such as the establishment of labor sheds, sanitation facilities, material storage yards, and site clearance will take place. These activities are expected to generate a considerable amount of both solid and liquid waste. Laborers residing on-site will produce domestic waste, including plastic packaging (e.g., chip's packets, bottles, polythene), organic kitchen waste, and human excreta from temporary sanitation units.

In addition, the mobilization of construction equipment, particularly excavators, transport vehicles, and concrete mixers, to canal and regulator construction sites may cause incidental oil and fuel spills.

10.4 Waste of Construction Phase

The construction phase will involve intensive civil works such as the excavation and re-excavation of canals, construction of RCC-lined main canals, and installation or rehabilitation of hydraulic regulators. This phase is expected to generate significant volumes of waste due to both construction operations and labor camp activities.

Types of construction-related waste include:

- Excavated soil and silt from canal beds;
- Residual coarse aggregates, broken bricks, and waste concrete from RCC canal works;
- Metal fragments, wire cuttings, and discarded rebar;
- Oil and grease leaks from heavy machinery and pumps;
- Packaging materials (cement bags, plastic sheets);

Additionally, labor force concentration at the sites will contribute to household waste (plastic, food scraps), human excreta, and greywater. Poorly managed disposal can lead to localized pollution of surface water systems and degradation of soil quality, particularly in areas close to irrigated fields and canal banks.

10.5 Waste of Post Construction Phase

During the post-construction phase, the project will enter its operation and maintenance (O&M) period. Periodic cleaning of re-excavated canals, desilting of drainage structures, and minor repairs to regulators and embankments may generate small amounts of structural debris, vegetation waste, and silt.

Although large-scale labor presence will be reduced, continued O&M activities may still produce some sanitary and household waste from workers. In areas where canals pass near residential or communal spaces, informal access may lead to littering and improper disposal of plastic, food waste, or agricultural refuse.

If recreational access or community interaction with canal-side infrastructure increases, there may be an added risk of solid waste accumulation unless local waste governance is strengthened.

10.6 Waste Disposal Plan

To mitigate the adverse environmental impacts of solid and liquid waste generated during the implementation of the Ashuganj-Palash Green Project, a comprehensive waste disposal plan has been developed. This plan aligns with the Environment Conservation Rules (ECR) 2023 and other national environmental guidelines.

Waste Segregation

- All waste generated will be segregated into biodegradable and non-biodegradable categories.
- Separate bins will be designated for each waste type at various locations throughout the project site.

Bin Placement

- Red-coloured bins will be allocated for non-biodegradable waste.
- Green-coloured bins will be designated for biodegradable waste.
- Bins will be placed at:
 - All major work fronts (canal sites, regulator construction zones);
 - Labor camps and sanitation points;
 - Access roads and laydown areas;

Waste Collection and Transport

- Trained waste collectors will be responsible for collecting waste from the designated bins.
- Collected waste will be transported in covered vans or pickups to prevent spillage and contamination during transportation.
- Waste will be logged and tracked through a site waste register.

Biodegradable Waste Management

- Organic waste will be composted at temporary on-site composting pits or transported to nearby composting facilities.
- Composting facilities can be established onsite or at designated locations nearby.
- The generated compost will be reused for landscaping along canals or distributed to local farmers.

Non-Biodegradable Waste Management

- Non-biodegradable waste will be further sorted into recyclable and non-recyclable categories.
- Recyclable materials like plastic bottles, metal scraps, and construction debris will be collected and sent to licensed recycling vendors or workshops.
- Non-recyclable and hazardous waste (e.g., oil-soaked rags, chemical containers) will be disposed of at designated landfill sites as per DoE guidelines.

Excavated and Re-excavated Material Management

- Excavated soil and silt from canal and regulator construction will be carefully stockpiled in designated, low-impact areas away from water bodies.
- Materials will be reused as much as possible for:
 - Canal bank strengthening and backfilling;
 - Construction of service roads or maintenance paths;
- Excess or unsuitable materials will be transported to approved disposal sites identified in consultation with local authorities.
- Erosion and sediment control measures (e.g., silt fences, retention pits) will be installed to prevent runoff into adjacent agricultural fields or waterways.
- Stockpile sites will be rehabilitated after construction, including vegetation cover to minimize dust and erosion.

Waste Storage and Inspection

- On-site bins and temporary storage areas will be routinely inspected by the Contractor and monitored by the PMU.

- Any observed cross-contamination or overflow will be immediately corrected.
- Inspections will be documented in monthly site reports.

Training and Awareness

- All workers, supervisors, and field staff will be trained on:
 - Waste segregation and safe handling practices;
 - Spill response and hygiene protocols;
- Awareness posters will be displayed at all work zones and camps to reinforce good practices.

Compliance and Monitoring

- The waste disposal plan will comply with all relevant environmental regulations and guidelines in Bangladesh.
- Continuous third-party monitoring of waste management practices will be conducted to ensure compliance and effectiveness throughout the project duration.

By implementing this comprehensive waste disposal plan, BADC and CEGIS aims to minimize adverse environmental impact, promote sustainable practices of waste management, and contribute to the overall success of the project.

Excavated Materials Management Plan

The excavated material management plan is presented in **Appendix G**.

11. Conclusion and Recommendations

The Ashuganj-Palash Green Project, implemented by the Bangladesh Agricultural Development Corporation (BADC), represents a critical step toward sustainable agricultural development by shifting irrigation dependency from groundwater to surface water sources. This Environmental and Social Impact Assessment (ESIA) has systematically evaluated the project's potential impacts, mitigation measures, and long-term benefits, ensuring compliance with national regulations (ECR 2023, ECA 1995) and international standards (IFC Performance Standards, World Bank EHS Guidelines).

11.1 Conclusion

Environmental Sustainability

- *Water Resource Management:* The project will reduce groundwater depletion by utilizing treated cooling water from thermal power plants, improving irrigation efficiency across 8.18 km of RCC-lined canals in Ashuganj and Palash.
- *Biodiversity Conservation:* While short-term disruptions to aquatic ecosystems (e.g., Chinadi Beel, Galania Haor) are expected, long-term benefits include enhanced fish habitats and wetland restoration.
- *Pollution Control:* Baseline data shows acceptable surface water quality (pH: 7.2–8.6, TDS <1000 mg/l), but industrial discharge near Ashuganj Power Plant requires stricter monitoring.

Agricultural and Economic Benefits

- *Increased Crop Yields:* The project will support Boro rice cultivation, reducing irrigation costs from BDT 3,000 to 1,500 per kani, benefiting over 38,534 ha in Ashuganj and 25,070 ha in Palash.
- *Reduced Losses:* Current crop losses (3,552 MT in Ashuganj, 4,486 MT in Palash) will decline with improved water supply and drainage.
- *Livelihood Enhancement:* Stakeholder consultations (358 participants across 17 sessions) confirmed strong community support, with 85% favoring the project for its economic benefits.

Socio-Economic Improvements

- *Employment Generation:* The construction phase will create temporary jobs, while long-term agricultural growth will strengthen rural incomes (average BDT 10,301–26,163/household).
- *Gender and Equity:* Female literacy rates (73.10% in Brahmanbaria, 77.56% in Narsingdi) indicate growing participation, though further empowerment initiatives are needed.
- *Health and Sanitation:* Improved irrigation will reduce reliance on arsenic-contaminated groundwater, while proper waste management will mitigate pollution-related health risks.

Challenges and Mitigation Measures

- *Land Acquisition & Infrastructure Risks:* The six-lane highway in Ashuganj threatens canal integrity, necessitating RCC-lined alternatives and smart-card-based pipelines to minimize disruptions.

- *Climate Vulnerabilities:* Erratic rainfall (1,350 mm peak in Sylhet) and drought risks (2014–2016) require adaptive water management strategies.
- *Stakeholder Concerns:* Local demands include canal re-excavation, pollution control, and compensation for affected landowners, which must be addressed through community-based water-user committees.

11.2 Stratgic Recommendations

- *Strengthen Environmental Monitoring:* Regular water quality checks (pH, DO, TDS, heavy metals) and biodiversity assessments to ensure compliance with ECR'2023.
- *Enhance Community Engagement:* Expand Focus Group Discussions (FGDs) and Public Consultation Meetings (PCMs) to maintain transparency.
- *Adopt Climate-Resilient Design:* Implement flood-resistant infrastructure and drought contingency plans based on historical climate trends.
- *Promote Sustainable Practices:* Encourage organic farming, integrated pest management (IPM), and aquaculture diversification to boost ecological resilience.

11.3 Final Assessment

The Ashuganj-Palash Green Project is a transformative initiative that aligns with Bangladesh's National Agricultural Policy 2018 and Sustainable Development Goals (SDGs 2, 6, 13). While short-term environmental and social disruptions are inevitable, the Environmental Management Plan (EMP) provides a structured approach to mitigation, ensuring long-term sustainability.

By modernizing irrigation infrastructure, reducing groundwater stress, and empowering rural communities, the project sets a benchmark for climate-smart agriculture in Bangladesh. Successful implementation hinges on strong regulatory compliance, stakeholder collaboration, and adaptive management, ensuring that economic progress does not come at the cost of environmental degradation.

11.4 Way Forward

- *Immediate Action:* Expedite canal rehabilitation and silt trap installation before the next irrigation season.
- *Long-Term Vision:* Integrate GIS-based water monitoring and AI-driven crop advisory systems for precision agriculture.
- *Policy Alignment:* Advocate for stronger enforcement of industrial waste discharge regulations to protect aquatic ecosystems.

In conclusion, the Ashuganj-Palash Green Project is a viable, necessary, and forward-looking intervention that balances agricultural productivity, environmental conservation, and social equity—paving the way for a sustainable and food-secure future in Bangladesh.

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Appendix A: Approved DoE ToR for the Study

Government of the People's Republic of
Bangladesh
Ministry of Environment, Forest and Climate
Change
Department of Environment
Environment Clearance Section
www.doe.gov.bd

Record Number: 22.02.0000.018.72.001.25.7

Date: 30/01/2025

Subject: Approval of Terms of Reference (ToR) for the EIA of Ashuganj-Palash Sabuj Project by Bangladesh Agricultural Development Corporation

Reference: 12.06.0000.251.14.003.22.1103, Dated: 15.01.2025

With reference to the subject mentioned above, the Department of Environment hereby gives approval of the Terms of Reference (ToR) for the Environmental Impact Assessment (EIA) of **Ashuganj-Palash Sabuj Project** by Bangladesh Agricultural Development Corporation subject to fulfilling the following terms and conditions:

- I. The project authority shall conduct a comprehensive Environmental Impact Assessment (EIA) considering the overall activity of the said project in accordance with the ToR submitted to the Department of Environment (DoE). The EIA study shall be conducted as per the provision laid down in the Environmental Conservation Rules, 2023.
- II. The EIA report shall be prepared in accordance with the guidelines provided in Schedule 11 and Rules-15, 16 of the ECR, 2023.
- III. Multidisciplinary experts are required in the study team to prepare the EIA report.
- IV. Consultation with Stakeholders/Public Consultation should be done in accordance with Rule 16 of the Environmental Conservation Rules, 2023.
- V. The project authority shall submit the EIA report to the Head Office of DoE in Dhaka.

Without approval of the EIA report by the Department of Environment, the project authority shall not make any land and infrastructure development.


30-01-2025
Masud Iqbal Md Shameem
Director
222218342
direc@doe.gov.bd

Deputy Chief Engineer-1, Ashuganj-Palash Sabuj Project BADC, Krishi Shaban, 4/8-31, Dikusha C/A, Dhaka 1000.

Record Number: 22.02.0006.018.72.001.25.71 (3)

Date: 30/01/2025

Copy for Kind Information and Necessary Action (Not in the order of seniority):

1. Deputy Director, Brahmanbaria District Office, Department of Environment, 1360/8, Nayanpur, Sadar, Brahmanbaria.
2. Deputy Director, Department of Environment, Narsingdi District Office, 388/1, West Brahmand, sadar, Narsingdi and
3. Assistant Director, Office of the Director General, Department of Environment, E-15, Agargaon, Sher-e-Bangla Nagar, Dhaka.




30-01-2025
Masud Iqbal Md Shamsam
Director

Table of Content of EIA Report as suggested in

তফসিল-১১ (পরিবেশগত প্রভাব নিরূপন প্রতিবেদন)

Executive Summary: Brief description of the project and study findings including Environmental Management and Monitoring plan.

1.0 Introduction

- 1.1 Background of the Project
- 1.2 Objective of the study
- 1.3 Scope of Work
- 1.4 Approach and Methodology
- 1.5 Proponent, Name, address, telephone number and email address of responsible official
- 1.6 Consulting firm name and address; name, educational qualification, years of experience of EIA Study Team members.
- 1.7 Report structure

2.0 Legal, Policy and Administrative Framework

- 2.1 Introduction
- 2.2 Environmental Policies and Legislation
- 2.3 Environmental Compliance Requirement

3.0 Project Description

- 3.1 Rationale, objective and benefits;
- 3.2 Requirement of land: Required amount of land, land ownership and land acquisition, if any
- 3.3 Project location and surrounding environment: Project Location in a map, layout plan showing utilities, materials stockyard, equipment yard, infrastructure and transportation route;
- 3.4 Project activities and implementation period: Land development of the project, major activities and Phase of implementation and implementation schedule
- 3.5 Raw materials needed and source: Oil, gas, electricity, fuel, water, etc.
- 3.6 Pollution Potential; and
- 3.7 Options: Description of Alternatives and the selected options and rationale of the selected option

4.0 Existing Environmental Condition

4.1 Physical Environment

- 4.1.1 Environmental Quality
 - 4.1.1.1 Water Quality
 - 4.1.1.2 Air Quality
 - 4.1.1.3 Noise
 - 4.1.1.4 Existing Sources of Pollution
- 4.1.2 Meteorology

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স্বাক্ষরিত ও সত্যায়িত
(পরিবেশ মন্ত্রণালয়)
আবদুল হকিম (সিই ডিও-১)
১৫/০৫/১৯

- 4.1.2.1 Rainfall
- 4.1.2.2 Temperature
- 4.1.2.3 Relative Humidity
- 4.1.2.4 Evaporation
- 4.1.2.5 Sunshine Hours
- 4.1.3 Topography
- 4.1.4 Geology
- 4.1.5 Geo-morphology
- 4.1.6 Land Resources
 - 4.1.6.1 Location and Land Use: Location map
 - 4.1.6.2 Land Type
 - 4.1.6.3 Soil Texture
 - 4.1.6.4 Available Soil Moisture
 - 4.1.6.5 Drainage
 - 4.1.6.6 Soil Salinity
- 4.1.7 Water Resources
 - 4.1.7.1 Water Resources System
 - 4.1.7.2 Morphology
 - 4.1.7.3 Hydrology
 - 4.1.7.4 Drainage
 - 4.1.7.5 Flooding

4.2 Biological Environment

- 4.2.1 Ecological Resources
 - 4.2.1.1 Problems and Issues
 - 4.2.1.2 Bio-ecological Zones
 - 4.2.1.3 Terrestrial Ecosystem (Flora and Fauna)
 - 4.2.1.4 Aquatic Eco-system (Flora and Fauna)
 - 4.2.1.5 Endemic/Threatened/ Endangered Species
 - 4.2.1.6 Nearest Reserved/ Sensitive/ Critical Habitat
 - 4.2.1.7 Ecosystem Services and Functions
- 4.2.2 Fisheries Resources
 - 4.2.2.1 Problems and Issues
 - 4.2.2.2 Habitat Description
 - 4.2.2.3 Fish Production
 - 4.2.2.4 Fish Migration
 - 4.2.2.5 Fish Species Composition and Bio-diversity
 - 4.2.2.6 Fisheries Management
- 4.2.3 Agriculture
 - 4.2.3.1 Problems and Issues
 - 4.2.3.2 Farming Practices
 - 4.2.3.3 Cropping Patterns and Intensity
 - 4.2.3.4 Cropped Area
 - 4.2.3.5 Crop Damage
 - 4.2.3.6 Crop Production
 - 4.2.3.7 Input Use

4.3 Socio-economic Environment

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संस्थागत विकास

- 4.3.1 *Problems and Issues*
- 4.3.2 *Demography*
- 4.3.3 *Economic Activities*
- 4.3.4 *Physical Infrastructure and Services*
- 4.3.5 *Social and Cultural Amenities*
- 4.3.6 *Public Health*
- 4.3.7 *Poverty*
- 4.3.8 *Gender*
- 4.3.9 *Indigenous People*
- 4.3.10 *Communication*
- 4.3.11 *Historic, Cultural, Archaeological Resources*

5.0 Stakeholder Consultation

- 5.1 *Overview*
- 5.2 *Methodology*
- 5.3 *Stakeholder Classification*
- 5.4 *Consultation Sessions*
- 5.5 *Suggestions from consultation sessions*
- 5.6 *List of participants*
- 5.7 *Photographs*

6.0 Important Environmental and Social Components

- 6.1 *Physical Environment*
- 6.2 *Biological Environment*
- 6.3 *Social Environment*

7.0 Impact Prediction and Evaluation: Impacts at different stages (Pre-construction, Construction and Post-construction Phases)

- 7.1 *Physical Environment*
 - 7.1.1 *Environmental Quality*
 - 7.1.2 *Water Resources*
 - 7.1.3 *Land Resources*
- 7.2 *Biological Environment*
 - 7.2.1 *Ecological Resources*
 - 7.2.2 *Fisheries*
 - 7.2.3 *Agriculture*
- 7.3 *Social Environment*

8.0 Environmental Management Plan: at different stages (Pre-construction, Construction and Post-construction Phases)

- 8.1 *Physical Environment*
 - 8.1.1 *Environmental Quality*
 - 8.1.2 *Water Resources*

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- 8.1.3 Land Resources
- 8.2 Biological Environment
 - 8.2.1 Ecological Resources
 - 8.2.2 Fisheries
 - 8.2.3 Agriculture
- 8.3 Social Environment

9.0 Environmental Monitoring Program (Pre-construction, Construction and Post-Construction Phases)

- 9.1 Physical Environment
 - 9.1.1 Environmental Quality
 - 9.1.2 Water Resources
 - 9.1.3 Land Resources
- 9.2 Biological Environment
 - 9.2.1 Ecological Resources
 - 9.2.2 Fisheries
 - 9.2.3 Agriculture
- 9.3 Social Environment

10.0 Conclusion and Recommendations

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Appendix B: Flora and Fauna

Table 1: Diversity Index in Homestead Areas (Quadrate 10m*10m)

Sl. No.	Local Name	Ashugonj Green Project Area					Ashugonj Green Project Area			Total Number of individuals	Diversity Index
		Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8		
1	Mango	10	5	9	8	3	8	11	3	57	2.06
2	Jum	2	1		2				5	10	
3	Papaya	4	2			4				10	
4	Jackfruit	6		5	6	1	9			27	
5	Akasmoni	5		7	2		1	4		19	
6	Shirish	3				2				5	
7	Jibon	2						2		4	
8	Pitali	5		4		9				18	
9	Mahogoni	3	5		4			8	38	58	
10	Bananna	3		10		7	9	6	2	37	
11	Minjium	1								1	
12	Eucalyptus	3	2	6		1				12	
13	Dumur		1							1	
14	Keora	1								1	
15	Coconut		5	3	3	3	10			24	
16	Royna		1							1	
17	Boroi		2			2	2			6	
18	Bansh			215			85			300	
19	Tal			2			4	2		8	
20	Khejur			1			1			2	
21	Guava			2		2				4	
22	Lichi						5			5	
23	Bel				1		-			1	
24	Supari				4					4	
25	Barun					1				1	
26	Ata					2				2	
Total		48	24	264	30	37	134	33	48	618	2.06



Figure 1: Location of vegetation survey areas (Trees)

Table 2: Diversity Index in Canal-side Areas (Quadrates 1m*1m)

Sl. No.	Local Name	Ashugonj Green Project Area				Palash Green Project Area				Total Number of individuals	Diversity Index
		Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8		
1	Lajjaboti	20	-	-		-		-		20	3.67
2	Shaknote	5	-	-	36	-	9	-		50	
3	Kakmachi	8	6	-		-		24		38	
4	Kanaibashi	12	-	-	12	20		12		56	
5	Telakucha	3	-	9		3		-		15	
6	Katanote	8	-	-				-		8	
7	Kachu	2	5	4		5		-		16	
8	Apang	5	-	-			6	-		11	
9	Unknown	2	-	3	4	5	2	-		16	
10	Holda Mutha	-	20	-		-		8		28	
11	Shathdrone	-	8	9		-		-		17	
12	Sialmutra	-	6	14		-		-		20	
13	Jagotmadan	-	-	-		15		-		15	
14	Bhant	-	-	-	15	22		-		37	
15	Bonjal	-	-	-		3		-		3	
17	Bon Jaba	-	-	6		-		-		6	
18	Kalkasunda	-	-	9		-		-		9	
19	Cyperus	-	-	18		-		-	5	23	
20	Hatisur						17	-		17	
21	Lantana						4	-		4	
22	Jara dan						16	-		16	
23	Asamlata						5	-		5	
24	Bansarisha				5		13	-		18	
25	Dutura						2	-		2	
26	Amrul Shak							45		45	

Sl. No.	Local Name	Ashugonj Green Project Area				Palash Green Project Area				Total Number of individuals	Diversity Index
		Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8		
27	Chalaghaca							35		35	3.67
28	Cynodon							42	25	67	
29	Boronakha								15	15	
30	Pistia								47	47	
31	Mutha grass								22	22	
32	Busket grass								13	13	
33	Katabegun				2					2	
Total		65	45	72	74	79	74	166	127	702	



Figure 2: Location of vegetation survey areas (Herbs & Shrubs)

Table 3: List of Terrestrial Floral Recorded within the Project Area

SL. No.	Local name	Scientific Name	Family	Average height (Feet)	Abundances	Usage
1	Akashmoni	<i>Acacia moniliformis</i>	Mimosaceae	25-30	*	T & Fu
2	Atha	<i>Annona squamosal</i>	Annonaceae	15-20	*	Fr
3	Shimul	<i>Bombax ceiba</i>	Malvaceae	30-35	*	Co & Fu
4	Bakul	<i>Mimusops elengi</i>	Sapotaceae	30-35	*	T & Fu
5	Bot	<i>Ficus benghalensis</i>	Moraceae	25-30	*	M
6	Mahagoni	<i>Swietenia mahagoni</i>	Meliaceae	35-40	**	T & Fu
7	Aum	<i>Mangifera indica</i>	Anacardiaceae	25-30	**	Fr & T
8	Koroi	<i>Albizia lebbeck</i>	Fabaceae	55-65	***	T & Fu
9	Kanthal	<i>Artocarpus heterophyllus</i>	Moraceae	25-30	**	Fr, Fu & T
10	Narikel	<i>Cocos nucifera</i>	Arecaceae	30-35	**	Fr & Fu
11	Neem	<i>Azadirachta indica</i>	Meliaceae	20-25	*	M

SL. No.	Local name	Scientific Name	Family	Average height (Feet)	Abundances	Usage
12	Indian Bot	<i>Ficus elastica</i>	Moraceae	30-35	*	Fu
13	Sheora	<i>Streblus asper</i>	Utricaceae	25-30	*	Fu
14	Tal	<i>Borassus flabelifer</i>	Arecaceae	30-35	*	Fr, Fu & T
15	Arjun	<i>Terminalia arjuna</i>	Combretaceae	20-25	**	T & M
17	Gamari	<i>Gmelina arborea</i>	Verbenaceae	30-35	*	T & Fu
18	Segun	<i>Tectona grandis</i>	Verbenaceae	45-50	*	T
19	Baroon	<i>Crataeva nurvala</i>	Cappiridaceae	15-20	*	Fu
20	Aswath	<i>Ficus religiosa</i>	Moraceae	25-30	*	M
21	Krisnochura	<i>Delonix regia</i>	Fabaceae	40-45	**	Or &Fu
22	Kadom	<i>Anthocephalus chinensis</i>	Rubiaceae	35-40	*	Or &Fu
23	Chambul	<i>Albizia richardiana</i>	Leguminosae	40-45	**	T & Fu
24	Shirish	<i>Albizia lebbek</i>	Leguminosae	55-60	***	T & Fu
25	Pitali	<i>Trewia nudiflora</i>	Euphorbiaceae	15-20	*	Fu
26	Hijol	<i>Barringtonia acutangula</i>	Barringtoniaceae	15-20	*	Fu
27	Bansh	<i>Bambusa spp.</i>	Poaceae	65-70	***	Thatching
28	Debdaru	<i>Polyalthia longifolia</i>	Annonaceae	35-40	*	T & Fu
29	Gaab	<i>Diospyros embryopteris</i>	Ebenaceae	15-20	*	Fr & T
30	Lichu	<i>Litchi chinensis</i>	Sapindaceae	25-30	**	Fr
31	Dewaphal	<i>Artocarpus lacucha</i>	Moraceae	15-20	*	Fr
32	Eucalyptus	<i>Eucalyptus globulus</i>	Myrtaceae	60-65	**	T & Fu
33	Dumur	<i>Ficus hispida</i>	Moraceae	25-30	*	Fr & Fu
34	Payara	<i>Psidium guajava</i>	Myrtaceae	10-12	**	Fr
35	Khajur	<i>Phoneix sylvestris</i>	Arecaceae	20-25	*	Fr & Fu
36	Jarul	<i>Lagerstromia speciosa</i>	Lythraceae	25-30	*	Or
37	Kala	<i>Musa paradisiaca</i>	Musaceae	10-12	**	Fr
38	Jam	<i>Syzygium cumini</i>	Myrtaceae	20-25	*	Fr, Fu & T
39	Bishkatali	<i>Polygonum lanatum</i>	Polygonaceae	-	***	M
40	Fulkuri	<i>Ageratum conyzoides</i>	Compositae	-	**	-
41	Kanchira	<i>Commelina benghalensis</i>	Commelinaceae	-	*	-
42	Kash	<i>Saccharum spontaneum</i>	Poaceae	-	**	-
43	Akand	<i>Calotropis gigantea</i>	Asclepidaceae	5-7	*	M
44	Bhant	<i>Clerodendrum inerme</i>	Verbenaceae	1-2	**	M
45	Durba	<i>Cynodon dactylon</i>	Poaceae	-	***	M
46	Ulu	<i>Imperata cylindrical</i>	Hydrocharitaceae	-	**	M
47	Apang	<i>Achyranthus aspera</i>	Amaranthaceae	-	**	M
48	Bonjal	<i>bonplandianum</i>	Euphorbiaceae	-	***	M
49	Dakishake	<i>Dryopteris spp.</i>	Dryopteridaceae	-	**	M
50	Khachu	<i>Colocasia esculenta</i>	Araceae	-	**	Ve

SL. No.	Local name	Scientific Name	Family	Average height (Feet)	Abundances	Usage
51	Sarnolata	<i>Cascuta australis</i>	Convolvaceae	-	*	M
52	Katanota	<i>Amaranthus spinosus</i>	Amaranthaceae	-	***	M
53	Busket grass	<i>Oplisma burmaniaii</i>	Poaceae	-	**	M
54	Kakmachi	<i>Solanum nigram</i>	Solanaceae	-	***	M
55	Bontamak	<i>Nicotiana plumbaginifolia</i>	Solanaceae	-	**	M

Note: T=Timber, Fr=Fruit, M=Medicine, Fu=Fuel, Or=Ornamental, Th=Thatting, Co=Cotton, Ve=Vegetable

Source: CEGIS EIA field visit, March, 2025

Table 4: List of Terrestrial & Aquatic Fauna Recorded from the Project Area

Class	Order	Family	English Name	Local Name	Scientific Name	IUCN Status
Amphibia	Anura	Bufo	Common Toad	Kuno Bang	<i>Duttaphrynus melanostictus</i>	LC
	Anura	Dicroglossidae	Indian Bull Frog	Sona Bang, Kola Bang	<i>Hoplobatrachus tigerinus</i>	LC
	Anura	Dicroglossidae	Skipper frog	Kotkoti Bang	<i>Euphlyctis cyanophlyctis</i>	LC
	Anura	Rhacophoridae	Common Tree Frog	Dorakata Gecho Bang	<i>Polypedates leucomystax</i>	LC
Reptilia	Squamata	Scincidae	Common Skink	Anchil, Anchila	<i>Eutropis carinata</i>	LC
	Squamata	Agamidae	Common Garden Lizard	Roktochosa	<i>Calotes versicolor</i>	LC
	Squamata	Gekkonidae	House Lizard	Tiktiki	<i>Hemidactylus flaviviridis</i>	LC
	Squamata	Colubridae	Indian Rat Snake	Darash Shap	<i>Ptyas mucosa</i>	LC
	Squamata	Natricidae	Checkered Keelback	Dhora Shap	<i>Xenochrophis piscator</i>	LC
	Squamata	Elapidae	Monocellate Cobra	Gokhra Shap, Goma Shap	<i>Naja kaouthia</i>	NT
Aves	Columbiformes	Columbidae	Eastern Spotted Dove	Tila Ghughu	<i>Spilopelia chinensis</i>	LC
	Columbiformes	Columbidae	Eurasian Collared Dove	Konthighughu	<i>Streptopelia decaocto</i>	LC
	Gruiformes	Rallidae	White-breasted Waterhen	Dahuk	<i>Amaurornis phoenicurus</i>	LC
	Gruiformes	Rallidae	Purple Swampphen	Beguni Kalem	<i>Porphyrio porphyrio</i>	LC
	Ciconiiformes	Ciconiidae	Asian Openbill	Samukhol	<i>Anastomus oscitans</i>	LC
	Pelecaniformes	Ardeidae	Indian Pond Heron	Deshi Kanibok, Kani Bok	<i>Ardeola grayii</i>	LC
	Pelecaniformes	Ardeidae	Green Backed Heron/ Little Heron	Khudey Bok, Shobuj Bok	<i>Butorides striata</i>	LC
	Pelecaniformes	Ardeidae	Cattle Egret	Go-Boga	<i>Bubulcus ibis</i>	LC

Class	Order	Family	English Name	Local Name	Scientific Name	IUCN Status
	Pelecaniformes	Ardeidae	Great White Egret	Boro Boga	<i>Ardea alba</i>	LC
	Pelecaniformes	Ardeidae	Intermediate Egret	Majhla Boga	<i>Ardea intermedia</i>	LC
	Pelecaniformes	Ardeidae	Little Egret	Chhoto Boga	<i>Egretta garzetta</i>	LC
	Suliformes	Phalacrocoracidae	Little Cormorant	Chhoto pankouri	<i>Microcarbo niger</i>	LC
	Charadriiformes	Jacaniidae	Bronze-winged Jacana	Dol Pipi, Jol Pipi	<i>Metopidius indicus</i>	LC
	Charadriiformes	Charadriidae	Red-wattled Lapwing	Hot Titi	<i>Vanellus indicus</i>	LC
	Accipitriformes	Accipitridae	Black Kite	Bhubon Chil	<i>Milvus migrans</i>	LC
	Accipitriformes	Accipitridae	Brahminy Kite	Shonkho Chil	<i>Haliastur indus</i>	LC
	Coraciiformes	Alcedinidae	Common Kingfisher	Pati Maachranga	<i>Alcedo atthis</i>	LC
	Coraciiformes	Halcyonidae	White-throated Kingfisher	Dholagola Maachranga	<i>Halcyon smyrnensis</i>	LC
	Piciformes	Alcedinidae	Black-rumped Flameback	Bangla Kaththokra	<i>Dinopium benghalense</i>	LC
	Piciformes	Alcedinidae	Fulvous-breasted Woodpecker	Batabi Kathkurali	<i>Dendrocopos macei</i>	LC
	Piciformes	Alcedinidae	Rufous Woodpecker	Khoira Khathkurali	<i>Celeus brachyurus</i>	LC
	Passeriformes	Dicruridae	Black Drongo	Kala Fingey	<i>Dicrurus macrocercus</i>	LC
	Passeriformes	Corvidae	House Crow	Pati Kak	<i>Corvus splendens</i>	LC
	Passeriformes	Corvidae	Jungle Crow	Dar Kak	<i>Corvus levaillantii</i>	LC
	Passeriformes	Sturnidae	Common Myna	Bhat Shalik	<i>Acridotheres tristis</i>	LC
	Passeriformes	Sturnidae	Jungle Myna	Jhuti Shalik	<i>Acridotheres fuscus</i>	LC
	Passeriformes	Sturnidae	Asian Pied Starling	Pakra Shalik	<i>Sturnus contra</i>	LC
	Passeriformes	Sturnidae	Chestnut-tailed Starling	Khoiralej Kathshalik	<i>Sturnus malabaricus</i>	LC
	Passeriformes	Muscicapidae	Oriental Magpie Robin	Doel	<i>Copsychus saularis</i>	LC
	Passeriformes	Pycnonotidae	Red-vented Bulbul	Bangla Bulbul	<i>Pycnonotus cafer</i>	LC
	Passeriformes	Hirundinidae	Barn Swallow	Pati Ababil	<i>Hirundo rustica</i>	LC
	Passeriformes	Cisticolidae	Zitting Cisticola	Bhomra Soton	<i>Cisticola juncidis</i>	LC
	Cuculiformes	Cuculidae	Greater Coucal	Boro Kubo, Kanakukhra	<i>Centropus sinensis</i>	LC
	Cuculiformes	Cuculidae	Asian Koel	Kala Kokil	<i>Eudynamis scolopaceus</i>	LC
	Cuculiformes	Cuculidae	Indian Cuckoo	Bokothakou Papia	<i>Cuculus micropterus</i>	LC
	Strigiformes	Strigidae	Spotted Owlet	Khuruley Pecha	<i>Athene brama</i>	LC

Class	Order	Family	English Name	Local Name	Scientific Name	IUCN Status
	Bucerotiformes	Upupidae	Common Hoopoe	Pati Hoodhood	<i>Upupa epops</i>	LC
	Coraciiformes	Meropidae	Green Bee-eater	Shobuj Shuichora	<i>Merops orientalis</i>	LC
	Passeriformes	Aegithinidae	Common Iora	Pati Fotikjol	<i>Aegithina tiphia</i>	LC
	Passeriformes	Laniidae	Long-tailed Shrike	Lenja Latora	<i>Lanius schach</i>	LC
	Passeriformes	Oriolidae	Black-hooded Oriole	Kalamatha Benebou	<i>Oriolus xanthornus</i>	LC
	Passeriformes	Sylviidae	Common Tailorbird	Pati Tuntuni	<i>Orthotomus sutorius</i>	LC
	Passeriformes	Passeridae	House Sparrow	Pati Chorui	<i>Passer domesticus</i>	LC
	Passeriformes	Ploceidae	Baya Weaver	Deshi Babui	<i>Ploceus philippinus</i>	LC
	Passeriformes	Estrildidae	White-throated Munia	Dhola Munia	<i>Lonchura malabarica</i>	LC
	Passeriformes	Motacillidae	White-browed Wagtail	Dholavru Khonjon	<i>Motacilla madaraspatensis</i>	LC
	Anseriformes	Dendrocygnidae	Lesser Whistling Duck	Pati Shorali	<i>Dendrocygna javanica</i>	LC
	Coraciiformes	Coraciidae	Indian Roller	Bangla Neelkanto	<i>Coracias benghalensis</i>	LC
Mammalia	Carnivora	Canidae	Golden Jackal	Shial, Pati Shial	<i>Canis aureus</i>	LC
	Carnivora	Herpestidae	Small Indian Mongoose	Chhoto Beji	<i>Herpestes auropunctatus</i>	LC
	Carnivora	Herpestidae	Common Mongoose	Boro Beji, Neul	<i>Herpestes edwardsii</i>	LC
	Rodentia	Sciuridae	Irrawaddy Squirrel	Badami Kathbirali	<i>Callosciurus pygerythrus</i>	LC
	Rodentia	Sciuridae	Five-striped Palm Squirrel	Dora Kathbirali	<i>Funambulus pennantii</i>	LC
	Rodentia	Muridae	Lesser Bandicoot Rat	Khet-indur, Metho-indur	<i>Bandicota bengalensis</i>	LC
	Rodentia	Muridae	Large Bandicoot Rat	Dhari Indur, Boro Indur	<i>Bandicota indica</i>	LC
	Rodentia	Muridae	Common House Rat	Indur	<i>Rattus rattus</i>	LC
	Eulipotyphla	Soricidae	House Shrew	Chika, Chucho	<i>Suncus murinus</i>	LC
	Chiroptera	Pteropodidae	Indian Flying Fox	Baro Badur	<i>Pteropus giganteus</i>	LC



Common Hoopoe



Baya Weaver at Coconut tree



Asian Koel



Asian Openbill



Asian Pied Starling



Baya Weaver



Black Kite



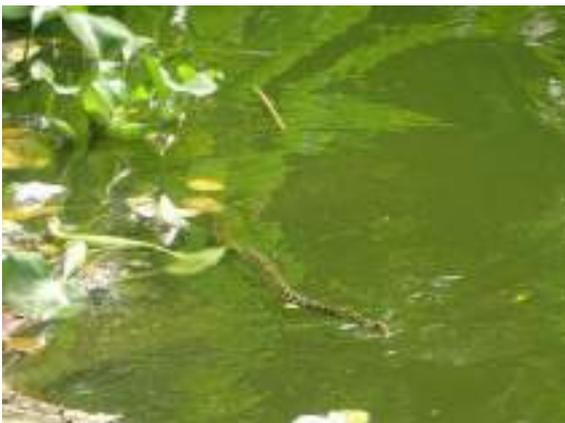
Brahminy Kite



Bronze-winged Jacana



Cattle Egret



Checked Keelback



Chestnut-tailed Starling



Common Iora



Common Kingfisher



Indian Pond Heron



Indian Roller



Irrawaddy Squirrel



Jungle Crow



Little Cormorant



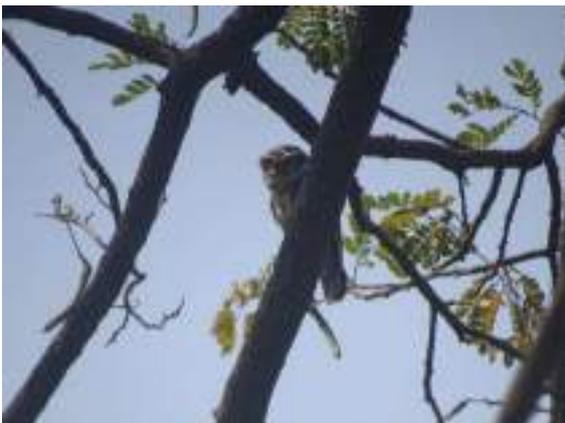
Long-tailed Shrike



Purple Swamphen



Spotted Dove



Spotted Owlet



White-browed Wagtail



White-throated Munia



Nest of Baya Weaver



Chinadi Beel



Galania Haor



White-breasted Kingfisher



Fulvous-breasted Woodpecker



Lesser Whistling Duck

Table 5: Interventions wise flora and fauna with activities and existing features

Name of interventions	Location	Existing scenario of flora and fauna	Activities		Existing features	
			Total number of activities	Individual number of activities		
Ashuganj - Palash Green Project- Ashuganj Part						
1.Construction of RCC main canal-1	Ashuganj to Sarail junction (8.183 km long)	Vegetation: Naturally grown in herbs & shrubs, Bushy land, Number of 102 trees are found, Homestead vegetation Wildlife habitat: Habitats of lizards, snakes, birds etc. are seen.	Total Labor shed-56 Total Plantation Program- 1 nos. (Main canal-1)	Labor shed- 4 Plantation Program (1 nos.) Earthwork management (1nos.), Canals side & adjacent settlement areas	Photo-1 & 14	
2.Construction of Guard Rail main canal-1 & 2	Ashuganj to Sarail junction (Canal_1) & Sonarampur (Canal-2)	Vegetation: Negligible number of herbs & shrubs, two trees (Payara and Boroi) are found at main canal-2, Wildlife habitat: Dragonflies, damselflies and aquatic insects are food items for birds like sparrows, drongos etc.		Labor shed- 1	Photo-2	
3. Construction of siphon (1 nos.) & Trash rack (4 nos.)	Talshahar & Sonarampur	Vegetation: Negligible number of herbs & shrubs, no trees found, Major aquatic species is water hyacinth Wildlife habitat: Mongooses, snakes and birds are common inhabitants.		Earthwork management (29 nos.), Excavated material would be dumped of Canals side & adjacent settlement areas	Labor shed- 1	Photo-3
4. Electrification & modernization of 2 Regulators Re- construction of five regulators Construction of five regulators (New)	Ashuganj Power plant premises	Vegetation: Negligible number of herbs & shrubs, no trees found, Major species is Tridhara, Barmuda grass, Cyperus etc. Wildlife habitat: Some common birds are seen including myna, starling, sparrow etc. Aquatic wildlife is absent as it is an artificial environment made of concrete.		Labor shed- 1	Photo-4	
	Main canal-1 & 2, Saiyadtula,	Vegetation: Aquatic & Terrestrial types, Dominant	Labor shed- 5			

Name of interventions	Location	Existing scenario of flora and fauna	Activities		Existing features
			Total number of activities	Individual number of activities	
Dismantling of damaged, broken, and useless 13 regulators	Bagmara, Puthai	species are water hyacinth, Lemna, Pistia etc. Wildlife habitat: Foraging and roosting habitat of kingfishers, herons etc.			Photo-7, 8, 10, 17
	Sarail Part (2 nos.), Terokanda to Budda canal (1 nos.)	Vegetation: Aquatic & Terrestrial types, Dominant species are water hyacinth, Lemna, Pistia etc. Wildlife habitat: Some birds like Cattle Egret, Indian Pond Heron, Little Cormorant etc. forages in this area.		Labor shed- 3	
	Terokanda to northside canal (1 nos.)	Vegetation: Aquatic & Terrestrial types, Dominant species are water hyacinth, Lemna, Pistia etc. and Cyperaceae & Poaceae are common terrestrial types Wildlife habitat: A suitable habitat for Little Cormorant, Great White Egret, Little Egret, Skipper Frog etc.		Labor shed- 1	
	Naiur canal (1 nos.)	Vegetation: Aquatic & Terrestrial types, Dominant species are water hyacinth, Lemna, Pistia etc. Wildlife habitat: Habitats of Jacanas, Egrets, Kingfishers, Herons etc. are found.		Labor shed- 1	
	Ashuganj (6 nos.), Sarail (5 nos.), B. Baria Sadar (2 nos.)	Vegetation: crop weeds, swamp trees, seasonal aquatic species Wildlife habitat: Frogs, snakes, wetland dependent birds etc.		Labor shed- 13	
5. Construction of water retention structure (2 nos.)	Budda canal (1 nos.)	Vegetation: Aquatic & Terrestrial types, Dominant species are water hyacinth, Lemna, Pistia etc. and Cyperaceae & Poaceae are common terrestrial types		Labor shed- 1	Photo-5

Name of interventions	Location	Existing scenario of flora and fauna	Activities		Existing features
			Total number of activities	Individual number of activities	
		Wildlife habitat: Common Kingfisher, White-breasted Kingfisher, Little Egret etc. are seen.			
	Sonarampur canal (1 nos.)	Vegetation: Aquatic & Terrestrial types, Dominant species are water hyacinth, Lemna, Pistia etc. and Cyperaceae & Poaceae are common terrestrial types Wildlife habitat: Prominent wildlife species are White-breasted Waterhen, Indian Pond Heron, Cattle Egret etc.		Labor shed- 1	
6. Reconstruction of Panisar weir	Panisar, Sarail Upazila	Vegetation: crop weeds, homestead trees, seasonal aquatic species Wildlife habitat: Roosting and foraging habitats of Bronze-winged Jacana, Intermediate Egret, Common Kingfisher etc.		Labor shed- 1	Photo-16
7. Construction of buried pipe line about 172.4 km.	Sarail, Ashuganj, B, Baria Sadar	Vegetation: Cyperaceae & Poaceae are common terrestrial types Wildlife habitat: Habitats of wildlife like Common Hoopoe, Asian Openbill, Shrike etc.		If needed	Photo-9 & 13
8. Canal re-excavation about 52.42 Km. (28 canals) Construction of RCC (Secondary & Tertiary canal) about 23 Km.	Sarail, Ashuganj, B, Baria Sadar	Vegetation: Seasonal grown in herbs and shrubs, Dominant species are water hyacinth, Lemna, Pistia, salvinia etc. Wildlife habitat: Habitats of aquatic fauna like skipper frogs, keelback, cobras, kingfishers, herons, lizards etc. are prominent in these Upazilas.		Labor shed- 17 Earthwork management (28 nos.), Canals side & adjacent settlement areas Labor shed-6	Photo-11, 12, 13 & 15
Ashuganj - Palash Green Project- Palash Part					
1.Canal re-excavation	Shibpur, Dewan Khali canal (Dulalpur),	Vegetation: Aquatic & Terrestrial types, Dominant species are water hyacinth, Lemna, Pistia etc. and croton,	Total Labor shed-8 Total Plantation	Labor shed- 2 Plantation Program (if needed)	Photo-1

Name of interventions	Location	Existing scenario of flora and fauna	Activities		Existing features
			Total number of activities	Individual number of activities	
Construction of RCC (Secondary & Tertiary canal) about 13 Km.	Bala gram (Palash)	bhant, Justicia etc. are common terrestrial types Wildlife habitat: Frog, snakes, lizards and skinks habitats are found. Kingfishers, dromos, etc. are also seen.	Program-1 Nos (if needed) Earthwork management plan (Excavated material would be dumped of Canals side & adjacent settlement areas)	Earthwork management (Canals side & adjacent settlement areas) Labor shed-4	
2. Construction of slabs over 3 Km.	Palash	Vegetation: Herb, Shrub and trees, some undergrowth species are pruning due to intervention Wildlife habitat: Skipper frogs, snakes and birds are common.		Labor shed- 1	Photo-2
3. Construction & extension of buried pipe line about 53.7 km.	Palash, Shibpur, Narsingdi Sadar,	Vegetation: Crop weeds, fallow land vegetation, Cyperaceae, Asterculaceae, Lamiaceae & Poaceae are common terrestrial types Wildlife habitat: Black Drongo, Shrikes, rodents like field mice, frogs etc. are the common inhabitants of these areas.		If needed	Photo-4 & 5
4. Construction of Trash rack (1nos.)	Panditpara, Jinardi Union,	Vegetation: Dominant aquatic species are water hyacinth, Lemna, Pistia etc. Wildlife habitat: Habitats of lizards, snakes, birds etc. are found.		Labor shed- 1	Photo-3

1. Interventions wise photo folder

Ashuganj Palash Green Project (Ashuganj Part)



Photo1: Construction of RCC main canal-1 at Ashuganj



Photo 2: Construction of Guard rail at main canal- 2 at Ashuganj



Photo 3: Construction of syphon & trash rack at Sonarampur Khal, Ashuganj



Photo 4: Electrification & modernization of 2 Regulators at Ashuganj Power Plant area



Photo 5: Reconstruction of weir at Shabajpur, Sarail



Photo 6: Canal re-excavation at Araishidha, Ashuganj



Photo 7: Dismantling of Regulator at Nanadipara, Kalikaccho



Photo 8: Re-construction of Regulator at Galania, Sarail



Photo 9: Tertiary canal at Bitghor, Panisar



Photo 10: Re-construction of Regulator at Galania



Photo 11: Re-excavation of Jafor Khat at Sarail



Photo 12: Re-excavation of Kalikaccho Khat at Sarail



Photo 13: Re-excavation of Secondary & Tertiary canal at Sarail



Photo 14: Construction of RCC main canal-1 at Ashuganj



Photo 15: Re-excavation of Budda canal at Sarail



Photo 16: Re-construction of Weir at Panisar, Sarail



Photo:17 Dismantling of Regulator on Budda canal at Sarail

Ashuganj- Palash Green Project (Palash Part)



Photo 1: Canal re-excavation of Dawankhali Khal at Shibpur, Narshingdi



Photo 2: Construction of slabs (municipality area) at Palash



Photo 3: Construction of Trash rack at Jinardi Union



Photo 2: cusec 4 LLP Pump, Belabo, Danga



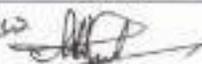
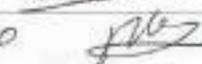
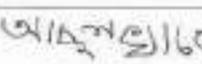
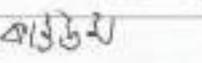
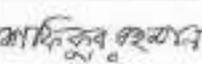
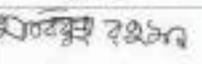
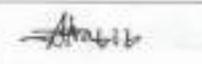
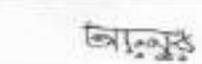
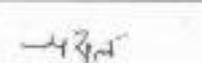
Photo 5: Tertiary canal, Kandapara, Amdia

Appendix C: Administrative Boundary of the Project and the Study Area

District	Upazila	Union	Area Coverage (%)
Brahmanbaria	Ashuganj	Araisidha	100
		Ashugang	98
		Char Chartala	60
		Durgapur	84
		Lal Pur	92
		Talshahar Pashchim	100
		Sharifpur	100
		Tarua	100
	Brahmanbaria Sadar	Brahmanbaria Paurashava	67
		Budhal	100
		Dakshin Natai	95
		Suhilpur	42
		Majlishpur	41
		Purba Talsahar	100
		Sadekpur	91
		Uttar Natai	100
	Nabinagar	Barail	89
	Sarail	Chunta	83
		Kalikachchha	98
		Noagaon	84
		Pakshimul	52
		Sarail	100
		Shahbazpur	39
Shahjadapur		17	
Uttar Panisar		92	
Narsingdi	Narsingdi Sadar	Amdia	100
		Panchdona	100
		Chinishpur	100
		Meher Para	100
		Silmandi	100
		Narsingdi Paurashava	10
		Palash	Char Sindur
	Danga		100
	Gazaria		65
	Ghorashal Paurashava		87
	Jinardi		24

District	Upazila	Union	Area Coverage (%)
	Shibpur	Chak Radha	76
		Dulalpur	100
		Masimpur	100
		Putia	100
		Sadhar Char	100
		Shibpur Paurashava	5

Appendix D: Stakeholder Participant List

Participant List				
EIA of Ashuganj Palash Green Project				
Location: Nayagaon Union			Date: 11/04/2025	
Sl No.	Name of participants	Occupation	Mobile/contact no.	Signature
১.	শাহজাদ আলী	UP Chairman	০১৭২২৭৩২৭৬০	
২.	শ্রী মাহালা ডিবি	ডিবি	০১৭৪৪৪২৬৪০০	
৬.	আব্দুল খালেক	কৃষি	০১৭৫৭৫৭৭৭১২	
৫.	হাজিরা	BAB Manager	০১৭৬৫৩৪২৪৬২	
৭.	মহিবুল হক	কৃষি	০১৭১১২৫৩৩১৭	
৬.	হাবিবুল হক		০১৭১২৪১৩৩১	
৭.	শাহ আলী	কৃষি	০১৭১১২৪২৪৫৭	
৬.	আব্দুল হক		-	
৩.	আব্দুল কলাম	কৃষি		

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Participant List
EIA of Ashuganj Palash Green Project
 Location: Noyagaon Union Date: 11/04/2025

Sl No.	Name of participants	Occupation	Mobile/contact no.	Signature
10.	শ্রীমতী বসন্ত দেবী	আবু	01710928586	
11.	শ্রীমতী বসন্ত দেবী	আবু	01751292090	
12.	শ্রীমতী বসন্ত দেবী	আবু	01919400710	
13.	শ্রীমতী বসন্ত দেবী	আবু	01918909188	
14.	শ্রীমতী বসন্ত দেবী	আবু	01929167959	
15.	শ্রীমতী বসন্ত দেবী	আবু	01302-927179	
16.	শ্রীমতী বসন্ত দেবী	আবু	01622290872	
17.	শ্রীমতী বসন্ত দেবী	আবু	01705403076	
18.	শ্রীমতী বসন্ত দেবী	CEGIS		

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Participant List
EIA of Ashuganj Palash Green Project

Location: *Noyagaon Am. on* Date: *1/04/2025*

Sl No.	Name of participants	Occupation	Mobile/contact no.	Signature
<i>20.</i>	<i>Chayan Biswas</i>	<i>Research Consultant, CEGIS</i>	<i>01775381232</i>	<i>[Signature]</i>
<i>20.</i>	<i>Selina Poreen</i>	<i>Research Consultant CEGIS</i>	<i>01717613734</i>	<i>[Signature]</i>

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Participant List
EIA of Ashuganj Palash Green Project

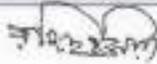
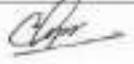
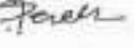
Location: কামিছাড়া ইউনিয়ন Date: 12/04/2025

Sl No.	Name of participants	Occupation	Mobile/contact no.	Signature
০১.	শাকুর সিদ্দিক	Field Manager BAPC	01796128526	শাকুর সিদ্দিক
০২.	আব্দুল হক	কৃষি	01720813251	আব্দুল হক
০৬.	ফরিদ হুসেইন	কৃষি	—	ফরিদ হুসেইন
০৪.	শীল- লাহার	কৃষি	0199229391	শীল সিদ্দিক
০৫.	আব্দুল আজিজ	কৃষি	—	আব্দুল আজিজ
০৮.	জাওয়াজ আমিন	Field Manager	01735108337	জাওয়াজ আমিন
০৭.	হাদীজ সিদ্দিক	কৃষি	01719889866	হাদীজ সিদ্দিক
০৬.	নব্বু সিদ্দিক	কৃষি	—	নব্বু
০১.	ইকবাল সিদ্দিক	আইস পুসিক	0199627605	ইকবাল

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Participant List
EIA of Ashuganj Palash Green Project

Location: **আশুগঞ্জ হেউরিখন** Date: **12/04/2025**

Sl No.	Name of participants	Occupation	Mobile/contact no.	Signature
১০.	হেউচ- ডিগ্রা	Field Manager	01705403076	
১১.	জুবায়ের শিকিয়ারা	UP অফিস	01716-778172	
১২.	Chayon Biswas	Research Consultant CEGIS	01778381233	
১৩.	সি. কুতুব উদ্দিন	Subst Pump Man. manager	01713646414	(সি: কুতুব উদ্দিন)
১৪.	সাব্বান হোসেন	ইতি	01922590925	সাব্বান
১৫.	সুবীর চন্দ্র দেব	ইতি	01736-509243	সুবীর
১৬.	সানিফা সাব্বান	ইতি	01965-360869	সানিফা
১৭.	সানিফা নাবীল	Research Consultant CEGIS	01717613734	

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Participant List
EIA of Ashuganj Palash Green Project

Location: Talsahar Date: 10/04/2025

Sl No.	Name of participants	Occupation	Mobile/contact no.	Signature
০০.	আব্দুল্লাহ	কৃষি	০১৩০৭১০১০৫০	আব্দুল্লাহ
০১.	আব্দুল হক	কৃষি	০১৭১৫৩৪৭২১	আব্দুল হক
০২.	আব্দুল হক	কৃষি	০১৭৭৭০০১৯৭	আব্দুল হক
০৩.	আব্দুল হক	কৃষি	০১ —	আব্দুল হক
০৪.	আব্দুল হক	কৃষি	—	আব্দুল হক
০৫.	আব্দুল হক	কৃষি	০১৩১৫৬৬৭৭৩	আব্দুল হক
০৬.	আব্দুল হক	কৃষি	০১৪৩৩৪১১১০২	আব্দুল হক
০৭.	আব্দুল হক	BADC অফিস	০১৩০৭২৪২৭৫	আব্দুল হক
০৮.	আব্দুল হক	কৃষি	০১৭৭১৫১০৭৭৭	আব্দুল হক

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Participant List
EIA of Ashuganj Palash Green Project

Location: Talshohore Date: 01/04/2025

Sl No.	Name of participants	Occupation	Mobile/contact no.	Signature
১৯.	জমিী হাওলা	কৃষি	০১৪৩০৯০৭৬৭৭	
২০.	দাউদুল হক	কৃষি	০১৭৭৫৩২১৯৩৪	
২১.	শেখ হাফিজ হোসেন	কৃষি	০১৭৭৩৭৬২৪৩০১	
২২.	শ্রী: শহিদুল হক	বি.এ. ডি. সি. এলি সংগঠন	০১৭১৩৪২৫৯০৯	
২৩.	শ্রী: কামাল	কৃষি	০১৪৩০৩৪১৩১৩	
২৪.	শ্রী: মাহমুদ হোসেন	কৃষি	০১৭৪৫৯৬০২৭	
২৫.	শ্রী: মাহমুদ হোসেন	কৃষি	০১৬১৪-০৫৬৪১৫	
২৬.	শ্রী: জাহিদ হোসেন	কৃষি	০১৪৫০-৪২৫৭৫৫	
২৭.	শ্রী: মাহমুদ হোসেন	কৃষি	০১৩৩৭-৫৪৩০১৬	

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Participant List
EIA of Ashuganj Palash Green Project

Location: ঘোড়াঝাল গৌড়ভাঙ্গা Date: 10/04/2025

Sl No.	Name of participants	Occupation	Mobile/contact no.	Signature
1.	ফিরোজ আলম	কৃষিক	০২৪২৬৫৩৭৬৯	ফিরোজ
২.	রুহান কাদের লুৎফাথ	কৃষি	০১৩১০১৩০৭১	রুহান
৩.	ফিরোজ আলম রহমান	কৃষক	০১৭৬৪১৬৪৭৬৪	ফিরোজ
4.	স্বাতি সিনা	কৃষক	০১৭২৫৭৭২৩০৭	স্বাতি
5.	স্বাক আলম	কৃষক	০১৭৫০৭৫৬০০	স্বাক
6.	মিষ্টা সিনা	কৃষক	০১৭৩৭৭০৩৭১	মিষ্টা
7.	লাজলুৎ	কৃষক/মালিক	০১৭৩২১৫০১০	লাজলুৎ
8.	সালিম হোসেন	কৃষক	০১৭৩১১২০৬০০	সালিম
9.	সাহাবা বেগম	কৃষিক	০১৪৩৪০০৭৬২৭	সাহাবা

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Participant List
EIA of Ashuganj Palash Green Project

Location: আমনাদি লোকজা Date: 10/04/2025

Sl No.	Name of participants	Occupation	Mobile/contact no.	Signature
10.	আব্দুল হুসেন	শ্রমিক	01732095002	আব্দুল হুসেন
11.	সুজা বেগম	শ্রমিক	01781925960	সুজা
12.	— সুজা —	— শ্রমিক —	01631-277192	— সুজা —
13.	শ্রী. জাহাঙ্গীর আলী, প্রকল্প	ব্যবসায়ী	01779-311960	শ্রী. জাহাঙ্গীর আলী
14.	শ্রী. মিল হুসেন	কৃষক	0177900790	শ্রী. মিল হুসেন
15.	আব্দুল মনি	শ্রমিক	0167930526	আব্দুল মনি
16.	আব্দুল মনি	শ্রমিক	0173085212	আব্দুল মনি
17.	আব্দুল মনি	শ্রমিক	0175962020	আব্দুল মনি
18.	আব্দুল মনি	শ্রমিক	0175962020	আব্দুল মনি

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Participant List
EIA of Ashuganj Palash Green Project

Location: আশুগঞ্জ পৌরসভা Date: 10/04/2025

Sl No.	Name of participants	Occupation	Mobile/contact no.	Signature
19.	শেখ	শ্রমিক	-	
20.	জোয়না বেগম	গৃহিণী	০১৭৪৬৫৩৩৬৪৪	
21.	শেখ বেদ্য জাহাঙ্গীর	গৃহিণী	০১৫১৬৪৬১৩৬	
22.	মোঃ ফিরোজ আলী	চাকুরী	০১৪৭৫৪৫২২৪৭	
23.	শেখ	শ্রমিক	০১৩১৭৫৪৬০১৩	
24.	শ্রীমতী	গৃহিণী	০১৭৭২২০১৩৭৭	
25.	শেখ	শ্রমিক	-	

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Participant List
EIA of Ashuganj Palash Green Project
 Location: *Char Shindur* Date: 11/04/2025

Sl No.	Name of participants	Occupation	Mobile/contact no.	Signature
1.	সংগেতা সুলতা দিহা	ছাত্রী	01717782759	দিহা
2.	সাদিয়া আরাফিন	ছাত্রী	01874222982	সাদিয়া
3.	মোছা. ময়ন	সহীনি	01718819545	ময়ন
4.	রুবিয়া	সহীনি	01820900859	রুবিয়া
5.	আনোয়ার	সহীনি	01 -	আনোয়ার
6.	বেলাল হোসেন	কৃষক	0176083890	বেলাল
7.	বাবুল আকন্দ	কৃষক	01233574246	বাবুল
8.	ASADUR ISLAM	কৃষক	01618375011	আসাদুর
9.	সাজিদ গাফী	কৃষক	01842637474	সাজিদ

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Participant List
EIA of Ashuganj Palash Green Project

Location: *Char Sindur* Date: /04/2025

Sl No.	Name of participants	Occupation	Mobile/contact No.	Signature
10	সারতা সান	কৃষক	016-388448866	সারতা সান
11	সায়ম রেজা	কৃষক	01731120600	সায়ম রেজা
12	শ্রীমতী	কৃষক	01875852281	শ্রীমতী
13	সায়ম	কৃষক	0199486019	সায়ম
14	সায়ম	কৃষক	01712813769	সায়ম
15	সায়ম	কৃষক	01987401970	সায়ম
16	সায়ম	কৃষক	01874013298	সায়ম
17	সায়ম	কৃষক	01769155541	সায়ম
18	সায়ম	কৃষক	0153243035	সায়ম

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Participant List
EIA of Ashuganj Palash Green Project

Location: *Char Sindur* Date: *04/2025*

Sl No.	Name of participants	Occupation	Mobilo/contact no.	Signature
19.	সাহেব সাক্তী	কৃষক	01930482015	<i>Mouf</i>
20.	সাহেব সাক্তী	কৃষক	01756870153	<i>সাহেব</i>
21.	শ্রী: ফারাহ বেগম	ছাত্র	01754995988	<i>Fahad</i>
22.	হাদিউল্লাহ	কৃষক	01717282759	<i>হাদিউল্লাহ</i>
23.	হুমায়ুন মিয়া	কৃষক	01720282225	<i>হুমায়ুন</i>
24.	সানা	কৃষক	01949114605	<i>সানা</i>
25.	নূরুল হক	কৃষক	—	<i>নূরুল হক</i>
26.	জামাল আহমদ	স্থানীয়	01538388524	<i>জামাল</i>
27.	জামাল	স্থানীয়	01720176452	<i>জামাল</i>

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Participant List
EIA of Ashuganj Palash Green Project

Location: খুলশি, আশুগঞ্জ Date: 11/04/2025

Sl No.	Name of participants	Occupation	Mobile/contact no.	Signature
1	সাইফুল	অফিসার/ইন্স	01737968131	সাইফুল
2	উজ্জ্বলিকা	কিছাওয়া	01725722637	উজ্জ্বলিকা
3	সাদিকুল	ইন্স	0171944699	সাদিকুল
4	সাব্বির হুসেইন	ইন্স	01715494426	সাব্বির
5	সাদিক	ইন্স	01990222468	সাদিক
6	সাদিকুল	ইন্স	01919461950	সাদিকুল
7	সাব্বির হুসেইন	ইন্স	01719640364	সাব্বির
8	সাব্বির হুসেইন	ইন্স	01754564146	সাব্বির
9	সাদিক	01960946970		সাদিক

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Participant List
EIA of Ashuganj Palash Green Project

Location: বোলাব, আশুগঞ্জ Date: 11/04/2025

Sl No.	Name of participants	Occupation	Mobile/contact no.	Signature
10	শ্রী: হালিম হোসেন	কৃষি	০১৩৩.৮৪৪৭২৫	<i>[Signature]</i>
11	শ্রী: মুনোয়ার	কৃষি	০১৭২৩-২৭২৪৭৪	<i>[Signature]</i>
12	শ্রী: হালিম হোসেন	কৃষি	০১৭১২৫২৫৬৬০	<i>[Signature]</i>
13	শ্রী: হালিম হোসেন	কৃষি	০১৭২৩৫১১৭৬১	<i>[Signature]</i>
14	শ্রী: সাদেক হোসেন	কৃষি	০১৭১১১২০৬০০	<i>[Signature]</i>
15	শ্রী: আব্দুল হাকিম	চাষা	০১৪৭৫৪৫২২৪৭	<i>[Signature]</i>
16	শ্রী: হালিম হোসেন	কৃষি	০১৭৩২৭২৫১৬৫	<i>[Signature]</i>
17	শ্রী: হালিম হোসেন	কৃষি	০১৭২৩৫২৫১৩০	<i>[Signature]</i>
18	শ্রী: হালিম হোসেন	কৃষি	০১৭১৩৫১২৩১৫	<i>[Signature]</i>

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Participant List
EIA of Ashuganj Palash Green Project

Location: ব্রহ্মাব, অশুগঞ্জ Date: 11/04/2025

Sl No.	Name of participants	Occupation	Mobile/contact no.	Signature
19	সুখান্ত কলি	কৃষক	01918276901	সুখান্ত কলি
20	সিদ্দিক আলী	কৃষক	01996385074	সিদ্দিক আলী
21	মাসুদ রহমান	কৃষক	01912189998	মাসুদ

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Participant List
EIA of Ashuganj Palash Green Project

Location: সাত্তিপুৰ, শিবদুৰ্গ Date: 11/04/2025

Sl No.	Name of participants	Occupation	Mobile/contact no.	Signature
১	শ্রী/শ্রীমতী মোহন চন্দ্র	কৃষি	০১৭২২৭১৬৯৪ ০১৭১২১৮৭২৬০৩	
২	শ্রী/শ্রীমতী সৌন্দর্য	"	০১৭২২৭১৬৯৪	
৩	শ্রী/শ্রীমতী মিস্ত্রী	"	০১৭৪১৩৬২৯২৭	
৪	শ্রী/শ্রীমতী মিস্ত্রী	"	০১৭২৭৫০১৬৭০	
৫	শ্রী/শ্রীমতী সৌন্দর্য	"	০১৭২৫৩৫৬৪২৬	
৬	শ্রী/শ্রীমতী মিস্ত্রী	"	-	
৭	শ্রী/শ্রীমতী সৌন্দর্য	কৃষি	০১৭২০৩২৭২৩৯	
৮	শ্রী/শ্রীমতী সৌন্দর্য	"	০১৭২০৪২১৬২	
৯	শ্রী/শ্রীমতী সৌন্দর্য	"	০১৭৬৬৪৫৭৭১০	

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Participant List
EIA of Ashuganj Palash Green Project

Location: আশিগঞ্জ, মিয়নগঞ্জ Date: 11/04/2025

Sl No.	Name of participants	Occupation	Mobile/contact no.	Signature
১০	হাজিরা হানী	কৃষি	০১৪৫৫০৪২২৭১	হাজিরা
১১	মোঃ হারুন হোসেন	।।	০১৭২৫৬৯৯০০৯	মোঃ হারুন
১২	মুহঃ উলীস	।।	০১৭৪৭১১১০৭	
১৩	মুহঃ কামরুজ্জামান	।।	০১৭৪৪২০৭১১ ০১৭৪৭১১১০৭	মুহঃ কামরুজ্জামান
১৪	মোঃ আমিন হুসেইন	।।	০১৭৭০৫২১৭৭৯	মোঃ আমিন
১৫	মোঃ আমিন হুসেইন	।।	০১৭২৭১৭৬৬৫৭	মোঃ আমিন হুসেইন
১৬	মোঃ কামরুজ্জামান	।।	০১৭৩২১৭৪৪৭২	মোঃ কামরুজ্জামান
১৭	মোঃ মাহমুদুল হক	।।	০১৭১৪২১১৬৩৬	মোঃ মাহমুদুল হক
১৮	মোঃ মৌসুম মোল্লা	।।	০১৭৫১৬২৭৭৪	মোঃ মৌসুম

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Participant List
EIA of Ashuganj Palash Green Project

Location: আশিগঞ্জ, সিবপুর Date: 11/04/2025

Sl No.	Name of participants	Occupation	Mobile/contact no.	Signature
১৯	সার্বজনীন শিক্ষা	শ্রমিক	০১৭১২১৭২৬০৩	
২০	শ্রী: নাজিম হুসেইন	"	০১৭১৫৪২৪৭০০	নাজিম হুসেইন
২১	শ্রী: মাহমুদ হুসেইন	"		
২২	শ্রী: মাহমুদ হুসেইন	"	০১৯১৭৬০০৭৬৫	মাহমুদ হুসেইন
২৩	শ্রী: মাহমুদ হুসেইন	"	-	মাহমুদ
২৪	শ্রী: মাহমুদ হুসেইন	"	০১৭১৫৭৩৪০৪৪	শ্রী: মাহমুদ হুসেইন
২৫	শ্রী: মাহমুদ হুসেইন	"	০১৭৫৭৭২০২৫১	মাহমুদ
২৬	শ্রী: মাহমুদ হুসেইন	"	০১৭৪৪৪৪৭৭৪৪৪	মাহমুদ
২৭	শ্রী: মাহমুদ হুসেইন	"	০১২২৬১৭৭২৭৩	মাহমুদ

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Participant List
EIA of Ashuganj Palash Green Project

Location: কুপার্ডিওলী, জিলাবরগুণী, পলাশ Date: 12/04/2023

S.No.	Name of participants	Occupation	Mobile/contact no.	Signature
১	বরন ধা	কৃষি	০১৪০ ৬৪২০১৭৫	বরন ধা
২	বিপ্লব দাস	কৃষক	০১৭১৬২৪৩৬২৭	বিপ্লব দাস
৩	সনি জোয়ারা গুপ্ত	কৃষক	০১৪২৬৩০৬৫৩২	সনি জোয়ারা গুপ্ত
৪	সিদ্দিক গুপ্ত	কৃষক	০১৭৪২২৫৪০২১	সিদ্দিক গুপ্ত
৫	সুজান্না গুপ্ত	কৃষক	০১৩০৫২৬০৭৪১	সুজান্না গুপ্ত
৬	সুজান্না গুপ্ত	কৃষক	০১৩০৫২৬০৭৪১	সুজান্না গুপ্ত
৭	সুজান্না গুপ্ত	কৃষক	০১৭২০৬৫৩০৪৭	
৮	সুজান্না গুপ্ত	কৃষক	০১৭২০৬৫৩০৪৭	সুজান্না গুপ্ত
৯	সুজান্না গুপ্ত	কৃষক	০১৭৪৫২৪১৩৪৭	সুজান্না গুপ্ত

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Participant List
EIA of Ashuganj Palash Green Project

Location: কুষ্টিয়া, ডিঙ্গাইল, পলাশ । Date: 12/04/2023

S No.	Name of participants	Occupation	Mobile/contact no.	Signature
১০	শ্রীমতী সাধন	কৃষি	০১৭৬৫৫৫৫১	
১১	সালিম	কৃষক	০১৭১৩৫৭৬০১২	
১২	তারানি	কৃষক	০১৯২৫৬০১২১৭	তারানি
১৬	শ্রীমতী সার্ব	কৃষক	০১৯৫৫-৫২৬৫২	
১৮	সার্ব সার	কৃষক	০১৩০১২৬১১০২	
১৯	সার্ব সার	কৃষক	০১৬৭২৫৬২৫০৯	
২১	সার্ব সার	কৃষক	০১০১৯২৫৬০১৯	
২৭	সার্ব সার	কৃষক	০১৭৬৫৫৫৫১	সার্ব
৩৬	সার্ব সার	কৃষক	০১৭৬৫৫৫৫১	সার্ব

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Participant List
EIA of Ashuganj Palash Green Project

Location: কুলাইতলী, তিলাই, লক্ষা। Date: 12/04/2025

Sl No.	Name of participants	Occupation	Mobile/contact no.	Signature
১০	সুজাতা রায়	কৃষক	০১৪৭৪৬২২২৭৫	সুজাতা
১১	হরিমান	"	০১৭২৩৬৭৫১৩০	হরিমান
১২	ম/ম (অবস্থান)	কৃষক	০১৪২১৫৩৫৭১৫	ম/ম

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Participant List
EIA of Ashuganj Palash Green Project

Location: কুলেঙ্গাপুর, গিরিশপুর Date: 13/04/2025

Sl No.	Name of participants	Occupation	Mobile/contact no.	Signature
১	শ্রী: আব্দুল হামিদ	কৃষি	০১৭২০২৯৩৫২৫	আব্দুল হামিদ
২	শ্রী: আব্দুল মাজিদ	কৃষি	০১৭৭৪৫৭৭৭০৬	আব্দুল মাজিদ
৩	শ্রীমতী সুলতানা	কৃষি/বাগান	০১৭১৩৫১৪৯৯৫	শ্রীমতী সুলতানা
৪	শ্রীমতী সুলতানা	কৃষি	০১৭১৩৩১৪৯৯৫	শ্রীমতী সুলতানা
৫	শ্রীমতী সুলতানা	কৃষি	০১৭৬৬০৭২০৭৬	শ্রীমতী সুলতানা
৬	শ্রীমতী সুলতানা	কৃষি	০১৭৫১২২৩২৭	শ্রীমতী সুলতানা
৭	শ্রী: আব্দুল হামিদ	কৃষি	০১২১২৪২২৯৬৬	আব্দুল হামিদ
৮	শ্রীমতী সুলতানা	কৃষি	০১৮৭২২২৫৪০৬	শ্রীমতী সুলতানা
৯	শ্রীমতী সুলতানা	কৃষি/বাগান	০১২৪৪-৩৫৫৪৪১	শ্রীমতী সুলতানা

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Participant List

EIA of Ashuganj Palash Green Project

Location: টুলনাপুৰ, শিৱসাগুৰ

Date: 13/04/2025

Sl No.	Name of participants	Occupation	Mobile/contact no.	Signature
১০	জনাব জনাব	কৃষক	০১৬২৩১৬৯৬০	
১১	জনাব হৈনানন্দ	কৃষক	০১৭৪৩৫৬৪০০	জনাব হৈনানন্দ
১২	জনাব হৈনানন্দ	কৃষক	০১৭২৪৬১৬৩২৭	হৈনানন্দ
১৩	জনাব: মনুজ হৈনানন্দ	কৃষক	০১৭২৯৬৪০৩৪১	মনুজ হৈনানন্দ
১৪	জনাব জনাব	কৃষক	০১৩৩৫৪১৬৬১৪	জনাব জনাব
১৫	জনাব জনাব	কৃষক	০১৬২৬৫৬৫৪২৭	জনাব জনাব
১৬	জনাব জনাব	কৃষক	০১৭১০১০৪৩৬৫	জনাব জনাব
১৭	জনাব জনাব	কৃষক	০১৭২৯৩৬৬০২	জনাব জনাব
১৮	জনাব জনাব	কৃষক	০১৭১৫০৭২৪৪৯	জনাব জনাব

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Participant List

EIA of Ashuganj Palash Green Project

Location: দুলালপুর, গিরিশা

Date: 13/04/2025

Sl No.	Name of participants	Occupation	Mobile/contact no.	Signature
১৯	শ্রী: ইয়াসমিন আক্তার	কৃষি	০১৭৫৭২২০১৪	[Signature]
২০	শ্রী: মুনিন্দ্র কান্ত	কৃষি	০১৪০৪৪০৬৫৭৪	[Signature]
২১	শ্রী: আমিন হোসেন	কৃষি		[Signature]
২২	শ্রী: মাসুম হোসেন	কৃষি/স্বাক্ষর	০১৭২৬৬৪০১৪	[Signature]
২৩	শ্রী: মাসুম হোসেন	কৃষি	০১৭৫৫৪৫৪৫০৬	[Signature]
২৪	শ্রী: আমিন হোসেন	কৃষি/স্বাক্ষর	০১৭২৬৬৪০৩৪	[Signature]
২৫	শ্রী: মোহাম্মদ আলী	কৃষি	০১৩১৭৪৫৬৪ ৩৫	[Signature]
২৬	শ্রী: মোহাম্মদ আলী	কৃষি	০১৭২৬৬৪০১৪	[Signature]
২৭	শ্রী: মাসুম হোসেন	কৃষি	০১৫১৫৫৫৫৫	[Signature]
২৮	শ্রী: মাসুম হোসেন	কৃষি	০১৪৫৫৫৫৫৫	[Signature]

Participant List
EIA of Ashuganj Palash Green Project
 Location: ৪ নং প্রান্তিক রাস্তা উল্লাহ ইউনিয়ন, অরফা
 Date: 12/04/2025

Sl No.	Name of participants	Occupation	Mobile/contact no.	Signature
1	আব্দুল করিম	কৃষি	01580919109	
2	শ্রী: আব্দুল করিম	কৃষি	01726662671	আব্দুল করিম
3	শ্রী: আব্দুল বাসম	ক	01760601720	আব্দুল বাসম
4	শ্রী: মঞ্জিল উদ্দিন	ক	01764200335	মঞ্জিল
5	শ্রী: বাজিদ মিয়া	ক	01728913788	বাজিদ
6	শ্রী: মিসবাহ আলী	ক	01998391411	মিসবাহ
7	শ্রী: সার্বক মিয়া	ক	—	সার্বক মিয়া
8	শ্রী: হুমায়ুন হোসেন	ক	01212335651	হুমায়ুন
9	শ্রী: মোহন মুন্সুর রহমান	ক	01905921023	মুন্সুর

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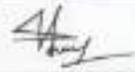
Participant List
EIA of Ashuganj Palash Green Project
 Location: ৬ নং পানিস্রাৱ উক্ত ১৯৩০ ইকবিমান, জয়হিন্দা Date: 12/04/2025

Sl No.	Name of participants	Occupation	Mobile/contact no.	Signature
10	তরুণালি কলিতা	কৃষি	—	RK
11	শ্রী. আনোয়ার হোসেন	কৃষি	০১৭২৩৩৫৬৫১	আনোয়ার হোসেন
12	শ্রী. মুজিব হোসেন	কৃষি	০১৭৪৪২২৬০৬২	মুজিব
13	শ্রী. মোস্তাফিজ হোসেন	কৃষি	০১৭০৩৪০৪৪৪৭	মোস্তাফিজ
14	শ্রী. মুজিব হোসেন	কৃষি	০১৫৪০-৩১৩১০৩	মুজিব
15	শ্রী. মোস্তাফিজ হোসেন	কৃষি	০১৭৪০১৬০২২১	মোস্তাফিজ হোসেন
16	শ্রী. মোস্তাফিজ হোসেন	কৃষি	০১৭০৪৬৬৪৪২১	মুস্তাফিজ হোসেন
17	শ্রী. মোস্তাফিজ হোসেন	কৃষি	০১৭০৫০৬৬৪৬২	মুস্তাফিজ হোসেন
18	শ্রী. মোস্তাফিজ হোসেন	কৃষি	০১৭৪৬১৭৯০৩৭	মুস্তাফিজ হোসেন

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Participant List
EIA of Ashuganj Palash Green Project

Location: ৬-নং সার্বিকায় উত্তর সিইপিএ, ময়মনসিংহ Date: 11/04/2025

Sl No.	Name of participants	Occupation	Mobile/contact no.	Signature
19	M.O. Hossain Sabir	Research Consultant	01751350167	

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Participant List
EIA of Ashuganj Palash Green Project

Location: আশী জলস্রাব গ্রহণ স্থানটি মিল অফিস, আশুগঞ্জ Date: 13/04/2025

Sl No.	Name of participants	Occupation	Mobile/contact no.	Signature
1.	শ্রী: মোহাম্মদ হিমুজ্জামান	স্বতন্ত্র - বিজ্ঞান মিল অফিসে কর্মরত কর্মচারী। ১৪ বছর।	01717 250075	[Signature]
2.	শ্রীমতী মো: জাহিদা ইসলাম	আজম ক. শ্রীপ কামিলে - স্বতন্ত্র কর্মচারী	01845969478	[Signature]
3.	মাসুম হোসেন	স্বতন্ত্র কর্মচারী	0297292602	[Signature]
4.	মো: মাহমুদুল হক	স্বতন্ত্র	07972278694	[Signature]
5.	মুহাম্মদ হোসেন	স্বতন্ত্র কর্মচারী	06725516 01720448450	[Signature]
6.	শ্রীমতী সিমিতা	স্বতন্ত্র	01988747019	[Signature]
7.	শ্রীমতী	"	01762-244390	[Signature]
8.	মোহাম্মদ হোসেন	"	00972200000	[Signature]
9.	মো: মাহমুদুল হক	"	0298209199	[Signature]

C&GIS

Participant List
EIA of Ashuganj Palash Green Project

Location: *আশুগঞ্জ পলশ গ্রিন প্রকল্পের জন্য পরিবেশ মন্ত্রণালয়, ঢাকা* Date: *13/04/2025*

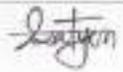
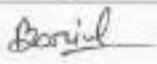
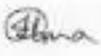
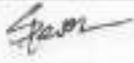
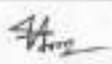
Sl No.	Name of participants	Occupation	Mobile/contact no.	Signature
10.	<i>শ্রী: লি. দেব</i>	<i>01715288580</i>		<i>[Signature]</i>
11.	<i>শ্রী: দুলাল মিয়া</i>	<i>01720-653381</i>		<i>[Signature]</i>
12.	<i>শ্রী: মোহাম্মদ মিয়া</i>	<i>কৃষক</i>	<i>01720240472</i>	<i>[Signature]</i>
13.	<i>শ্রী: হাফিজ মিয়া</i>	<i>ইসি ফ্লোরিডা</i>	<i>01712078822</i>	<i>[Signature]</i>
14.	<i>শ্রী: ফাহিম</i>	<i>কৃষক</i>	<i>01720393403</i>	<i>[Signature]</i>
15.	<i>শ্রী: রফিকুল হক</i>	<i>কৃষক</i>	<i>01711-970745</i>	<i>[Signature]</i>
16.	<i>শ্রী: মোল্লা মিয়া</i>	<i>কৃষক</i>		<i>[Signature]</i>
17.	<i>শ্রী: আব্দুল গণি</i>	<i>022226360</i>	<i>0171-970745</i>	<i>[Signature]</i>
18.	<i>শ্রী: মোহাম্মদ মিয়া</i>	<i>কৃষক</i>	<i>01705066862</i>	<i>[Signature]</i>

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Participant List

EIA of Ashuganj Palash Green Project

Location: পালাশ গ্রীন এন্ড প্যাকিং, বিল জাঙ্গাল, অশুগঞ্জ Date: 13/04/2025

Sl No.	Name of participants	Occupation	Mobile/contact no.	Signature
19	Chayan Biswas	Research Consultant CEGIS	01778381233	
20.	আলমগীর মল্লিক	বিল জাঙ্গাল রিপোর্টার	017148179034	
21.	MD. Barriul Musabbir	Research Consult. CEGIS	01728162622	
22.	Umme Habiba Uma	Research Consultant, CEGIS	01896313757	
23.	Selina perveen	Research Consultant CEGIS	01917613734	
24.	MD. Plaxen Sahit	Research Consultant	01751350167	

CEGIS

Participant List
EIA of Ashuganj Palash Green Project

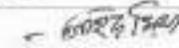
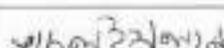
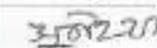
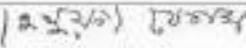
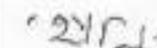
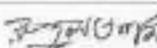
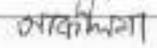
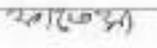
Location: ৭ নং অক্ষয়ল পূর্ব ইউনিয়ন, রাঙ্গাবাড়িয়া সদর Date: 10/04/2025

Sl No.	Name of participants	Occupation	Mobile/contact no.	Signature
1	অনিকম হোসেন	ডেপুটি	০১৭১৭৩৮৬৭১৫	
2	অক্ষয়ল বর্মা	লোকাল	০১৭২৬১৪৪০১৭	
3	ছাঃ সাদিক মিয়া	কৃষি মালিক	০১৭৭১৭৬২৪৩৪	
4	ছাঃ হাবিবুল হোসেন	লোকাল	০১৭৪৬৬৫৬৭৭০	
5	ছাঃ আব্দুল হান্নান	সিস্টেম ডায়ালগ	০১৭১৬৪৭২৩৭৭	
6	ছাঃ মিলন মিয়া	কৃষি মালিক	০১৭২২৪৪৪৪০৪	
7	ছাঃ মিলন মিয়া	কৃষি	০১৭৫৩৪০১১৪১	
8	অক্ষয়ল মিয়া	লোকাল	০১৭১৬৬৩৭৫৪১	
9	ছাঃ বাহার	লোকাল	০১৭৭২৩৪৩১৭০	

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Participant List
EIA of Ashuganj Palash Green Project

Location: ৭ নং অলমহাছা পূর্ব ইউনিয়ন, শ্রীমঙ্গল উপজেলা, সুনামগঞ্জ জেলা
Date: 10/04/2025

Sl No.	Name of participants	Occupation	Mobile/contact no.	Signature
10	শ্রী: বদরুল আলম	কৃষি	01716801803	
11	শ্রী: হুমায়ুন	মেসার -	01703920522	
12	শ্রী: হুমায়ুন আলম	কৃষি	01762004503	
13	শ্রী: হুমায়ুন আলম	মেসার -	01799147169	
14	শ্রী: হুমায়ুন আলম	মেসার -	01714426971	
15	শ্রী: হুমায়ুন আলম	কৃষি	01741373861	
16	শ্রী: হুমায়ুন আলম	কৃষি	0172083513	
17	শ্রী: হুমায়ুন আলম	কৃষি	01705052487	
18	শ্রী: হুমায়ুন আলম	কৃষি	01738227933	

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Participant List
EIA of Ashuganj Palash Green Project

Location: ৭ নং জোন মতল গার্ড সিইকিউর, সারাদেশ বাসিন্দা সড়ক Date: 01/04/2025

Sl No.	Name of participants	Occupation	Mobile/contact no.	Signature
19	মিঃ মোস্তাফিজ (মুস্তাফিজ)	শ্রমিক	01304283475	মুস্তাফিজ
20	আব্দুল হক	গ্রাম পুনিক (সিইকিউর)	01705052437	আব্দুল হক
21	শাহজাদা নাহারীত	Junior Specialist CEGIS	01705366867	A. Perveen
22	Chayan Biswas	Research Consultant CEGIS	01778381233	Chayan
23	মিঃ মোস্তাফিজ হোসেন	Research Consultant CEGIS	0614372777	Astam
24	MD. Baruil Musabbir	Research Consultant CEGIS	01728162622	Baruil
25	Umme Habiba Ilma	Research Consultant, CEGIS	01896313757	Ilma
26	Satyendra Nath Barman	Research Consultant CEGIS	01748179034	Satyendra
27	Selina Perveen	Research Consultant CEGIS	01717613734	Selina

CEGIS

Participant List
EIA of Ashuganj Palash Green Project

Location: ৭ নং জলাশয় পুকুর, সাজাপাড়া / মাদে Date: 01/04/2025

Sl No.	Name of participants	Occupation	Mobile/contact no.	Signature
28	Mr. Asim Hossain	Technical consultant	01614372282	Asim
29	MD. Hasan Saibit	Research Consultant	01751350167	Hasan

CEGIS

Participant List
EIA of Ashuganj Palash Green Project
 Location: 8 No. Tarua, Ashuganj Date: 09/04/2023

Sl No.	Name of participants	Occupation	Mobile/contact no.	Signature
1.	শ্রী: সার্বজনীন সচিব	সিটি মার্কেট	০১৪৩০-৬৩১৬২৭	
2.	সরকারী ডিকার্সার	সিটি মার্কেট	০১৭২৬৫৫১৭৭৩	
3.	সাব্বু বিয়া	সচিব	-	সাব্বু বিয়া
4.	সিদ্দিক বিয়া	সচিব	-	
5.	স্বপ্না	সচিব	-	০১৭২২২৭৭০৪৩ স্বপ্না
6.	হাসু বিয়া	সচিব	-	হাসু বিয়া
৭.	শ্রী: সার্বজনীন (স্বপ্না)	সচিব	০১৭১২২০৭৬৪২	সার্বজনীন
৮.	সরকারী সচিব	সচিব	০১৭২৪২৩১৫২৪	সরকারী
9.	সরকারী (স্বপ্না)	সচিব	-	সরকারী

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Participant List
EIA of Ashuganj Palash Green Project

Location: 8 No. Tarua, Ashuganj Date: 09/04/2025

Sr No.	Name of participants	Occupation	Mobile/contact no.	Signature
10.	ফরিদুল ইসলাম	কৃষক	01729356074	ফরিদুল ইসলাম
11.	আব্দুল হক	কৃষক	01615913169	আব্দুল হক
12.	আব্দুল হক	কৃষক	01767851432	আব্দুল হক
13.	Abdullah Al SHUHAYY	—	01744997018	Abdullah Al SHUHAYY
14.	আব্দুল হক	—	01977238377	আব্দুল হক
15.	শ্রী: আব্দুল হক	কৃষক	01734324266	আব্দুল হক
16.	শ্রী: আব্দুল হক	কৃষক		আব্দুল হক
17.	শ্রী: আব্দুল হক	কৃষক	01778650278	আব্দুল হক
18.	শ্রী: আব্দুল হক	কৃষক	0140607770	আব্দুল হক

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Participant List
EIA of Ashuganj Palash Green Project
 Location: 8 No. Tareea, Ashuganj
 Date: 02/04/2025

Sl.No.	Name of participants	Occupation	Mobile/contact no.	Signature
19.	আব্দুল হুসাইন	স্থানিক	01838030935	আব্দুল
20.	আব্দুল হুসাইন	ম	02929206266	আব্দুল হুসাইন
21.	শুভ সিং	ম	01772052420	শুভ সিং
22.	ডাঃ মনোজ কুমার	-	019196908	-
23.	আব্দুল হুসাইন	ম	-	-
24.	আব্দুল হুসাইন	ম	-	আব্দুল হুসাইন
25.	আব্দুল হুসাইন	ম	01714-204140	Mudakarim
26.	ডাঃ মোস্তাফিজুল আলম	ম	01788444025	আব্দুল হুসাইন
27.	ডাঃ মোস্তাফিজুল আলম	মসজিদ	01792116894	আব্দুল হুসাইন

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Participant List
EIA of Ashuganj Palash Green Project
 Location: 8 No. Tarua, Ashuganj Date: 09/04/2025

Sl No.	Name of participants	Occupation	Mobile/contact no.	Signature
28	আব্দুল হক মিলান	সহকারী শিক্ষক	01918166425	আব্দুল হক মিলান
29	আব্দুল হক	৯	01733454200	আব্দুল হক
30	শাহিনুর রহমান *	কৃষি	01734311429	শাহিনুর
31	শ্রী: জন শাহিন	৯	01796334722	শাহিন
32	শ্রী: শাহিনুর রহমান	৯	01912197147	শাহিনুর
33	শ্রী: শাহিনুর রহমান	কৃষি সহকারী	01725912995	শাহিনুর
34	শ্রী: শাহিনুর রহমান	কৃষি	—	শাহিনুর
35	শ্রী: শাহিনুর রহমান	কৃষি	—	শাহিনুর
36	শ্রী: শাহিনুর রহমান	৯	01987436926	শাহিনুর

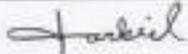
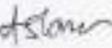
CGIS

Participant List
EIA of Ashuganj Palash Green Project
 Location: S No. Tarua, Ashuganj. B. Burdwan Date: 09/04/2025

Sl No.	Name of participants	Occupation	Mobile/contact no.	Signature
37.	উজ্জ্বল কুমার মন্ডল	Associate Specialist CEGIS	01911688751	Ujjwal Mondal
38.	কবিতা কলিতা হারহারা	Research Consultant CEGIS	01672493021	Kabita
39.	কাজুনা গাওঁী	Junior Specialist CEGIS	0120506686X	K. Juna
40.	জ্যোতিষ গাওঁী	Research Consultant CEGIS	01712613734	Jyoti
41.	শ্রী: কামাল হুসেন	বিশেষ জ্যোতিষ জিওগ্রাফার		
42.	Chayan Biswas	Research Consultant, CEGIS	01778381233	Chayan
43.	শ্রী: সত্যনাথ (সত্য)	বিশেষ জ্যোতিষ কম্পিউটার ইঞ্জিনিয়ার	01614322772	Satyanath
44.	MD. Bariul Muabbir	Research Consultant CEGIS	01728162422	Bariul
45.	Uma Habiba Ilma	Research Consultant CEGIS	01896313757	Uma

CEGIS

Participant List
EIA of Ashuganj Palash Green Project
 Location: 8 No. Tarua Union, Ashuganj Date: 09/04/2025

Sl No.	Name of participants	Occupation	Mobile/contact no.	Signature
46.	Md. Tazbiul Islam	Research consultant	01809909556	
47.	Md. Aslam Hossain	Technical consultant	01614772777	
48.	MD Hasan Sabir	Research Consultant	01751350107	
49.	Satyendra Nath Bannan	Research consultant, CEGIS	01748179034	
50.				
51.				
52.				
53.				
54.				

CEGIS

Appendix E: Photographs of Consultation Meetings



Tarua Union, Ashuganj



West Talsohor, Ashuganj



East Talsohor, B, Baria Sadar



Noagaon Union, Sarail



Kalikaccha Union, Sarail



Panishwar Uttar, Sarail



Ashuganj (Rice mill owners)



Ghorasal Pourashava, Palash



Dulalpur union, Shibpur



Char Sindur union, Palash



Amdia union, Narsindi Sadar



Macimpur union, Shibpur



Kuraitoli Jinardi, Palash



Battoli bazar, Natai



Bhabanipur, Arishidha



Dulalpur, Shibpur

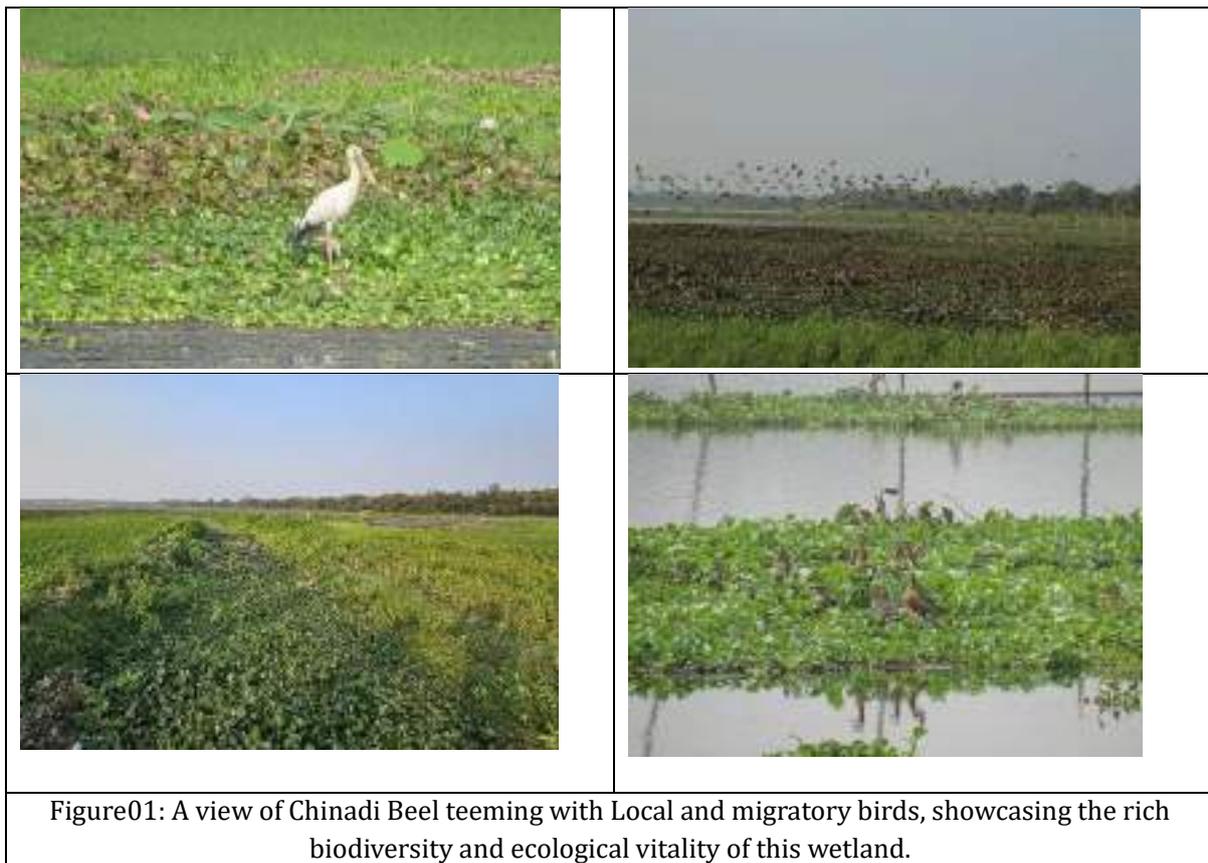
Appendix F: Chinadi Beel Management Plan

- **Background:**

Chinadi Beel, situated in Shibpur Upazila of Narsingdi district, represents a critical wetland ecosystem of high ecological and hydrological value. Its mosaic of aquatic habitats; including open water zones, littoral shallows, floating macrophyte beds, wetland grasslands, and shrublands, supports a complex assemblage of flora and fauna. Notably, the beel provides critical habitat for numerous avian species such as the Purple Swamphen (*Porphyrio porphyrio*), Bronze-winged Jacana (*Metopidius indicus*), Lesser Whistling Duck (*Dendrocygna javanica*), Asian Openbill (*Anastomus oscitans*), Common Kingfisher (*Alcedo atthis*), White-breasted Waterhen (*Amaurornis phoenicurus*), Great White Egret (*Ardea alba*), Red-wattled Lapwing (*Vanellus indicus*), and Little Cormorant (*Microcarbo niger*).

During winter, Chinadi Beel transforms into a sanctuary for migratory birds, attracting herons, kites, kingfishers, cormorants, and wild ducks, creating a vibrant and dynamic ecosystem. The shallow margins are essential for wading birds due to their ideal water depth for foraging.

Functionally, Chinadi Beel acts as a natural hydrological buffer and ecosystem service provider. It serves as a breeding and nursery ground for aquatic species, stores monsoonal runoff, contributes to local flood attenuation, and sustains agricultural water needs through irrigation. However, this multifunctional role has become increasingly jeopardized due to progressive siltation, anthropogenic encroachment, and suboptimal management practices. Addressing these challenges necessitates an integrated conservation strategy that prioritizes both ecological integrity and sustainable water resource governance.



- **Significance of the Beel:**

Chinadi Beel performs a suite of critical environmental and socio-economic functions, serving as a keystone landscape feature within its hydrological and ecological context:

- It acts as a seasonal reservoir, facilitating agricultural irrigation and enhancing water availability during dry periods.
- Its high fisheries productivity underpins local food security and economic sustenance, functioning as a key inland fishery and reproductive habitat for aquatic taxa.
- The wetland constitutes an essential avian habitat, supporting both endemic and migratory bird populations such as the Purple Swamphen, Lesser Whistling Duck, and Asian Openbill, among others.
- It sustains a high level of aquatic biodiversity, positioning it as a regional biodiversity hotspot.
- The beel contributes to subsurface hydrological processes through groundwater recharge mechanisms.
- It plays a pivotal role in flood attenuation, operating as a natural retention basin during high-precipitation events.

Despite being under private ownership, the beel sustains the livelihoods of approximately 2,600 households that depend directly on its services for subsistence fishing, agriculture, and water use. As such, its conservation is imperative for maintaining ecological resilience, regional agro-ecological equilibrium, and the socio-economic viability of adjacent rural communities.

- **Consequence of the Project Intervention:**

As part of the Ashuganj-Palash Sabuj Project, canal re-excavation in the vicinity of Chinadi Beel is being pursued to augment surface water conveyance and improve hydrological connectivity to adjacent agricultural zones. This intervention is intended to optimize irrigation infrastructure and ensure more reliable water availability during the dry season.

However, should the re-excavation activities depress the outflow channel to elevations below ecologically sustainable thresholds, and if not counterbalanced by the integration of engineered control structures, there exists a significant risk of hydrological destabilization. Specifically, the premature drainage of stored surface water may occur, particularly during the dry season, yielding a cascade of ecological and socio-economic repercussions:

- Accelerated dewatering of low-lying basin zones, diminishing wetland hydrological permanence.
- Interruption of aquatic species' reproductive cycles, leading to attenuated fishery yields.
- Degradation of marginal shallow-water habitats essential for foraging and nesting by wetland-dependent avifauna.
- Decline in groundwater recharge potential due to reduced water residence time.
- Diminished livelihood security for an estimated 2,600 resource-dependent households reliant on wetland fisheries and irrigated agriculture.

An area-elevation curve generated for the beel and its buffer zone reveals that substantial surface area, approximately 30,200 square meters, resides below 1.63 mMSL, functioning as a perennial water-body. Also, the total beel area, which is about to 89 hectares fall within 2.52 mMSL. The curve

substantiates the hydrological recommendation that dry-season water levels must be actively maintained at or above 2.8 to 3.0 m MSL to safeguard the wetland's ecological integrity and the socio-ecological functions it supports.

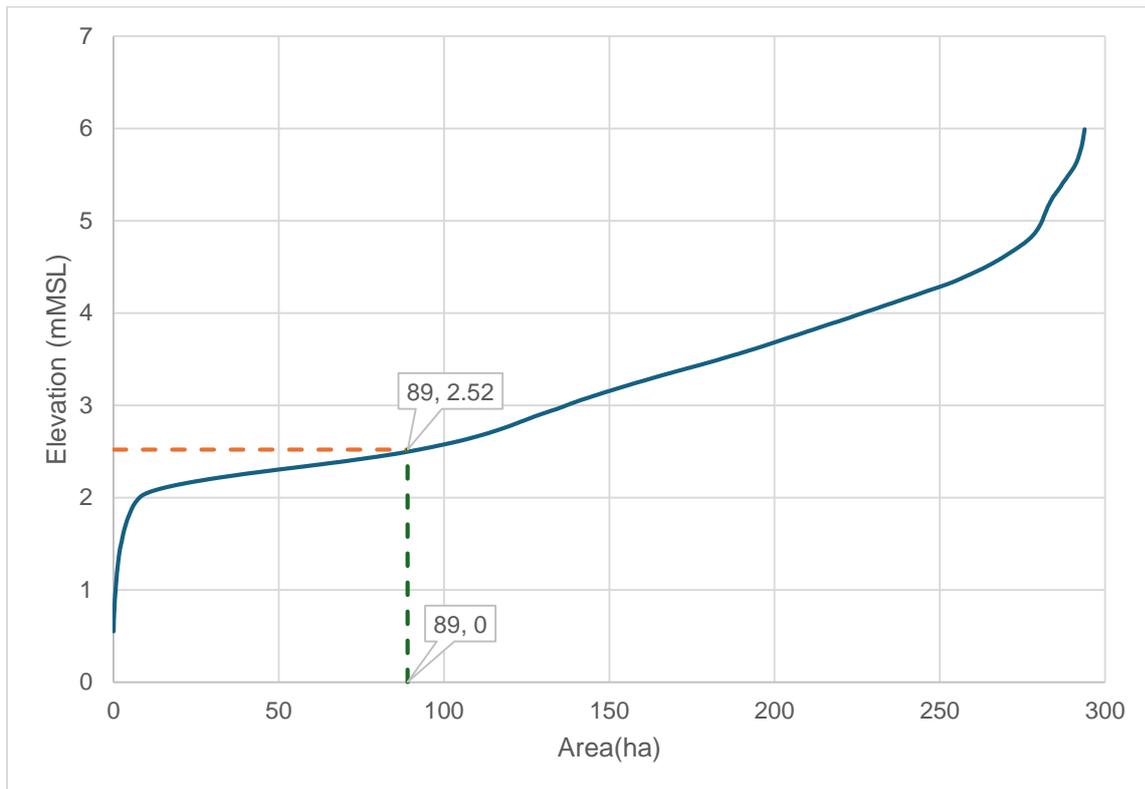


Figure 02: Area-Elevation curve of the Chinadi Beel

- **Management of the regulator:**

There are two regulators near the chinadi beel area; one on the Dewankhali khal at Dulalpur and the other is on the wapda khal at Paratola.

The details of the Regulator Shown in the Following table 01.

Table 01: Location and the details of Regulator around Chinadi Beel

No. of Vent	Barel Length (m)	Opening			Reduce Level of Structure			Position		Location
		Width per Vent (m)	Total Width (m)	Height (m)	Deck (MSL)	Soffit (MSL)	Sill (MSL)	Easting (m)	Northing (m)	
4	2.5	1.10	6.06	1.80	6.8	4.7	2.9	263922	2661532	Dulalpur, Shibpur, Narsingdi
3	5.8	1.80	5.8	1.88	8.07	3.51	1.63	261089	2661628	Wapda Khal, Paratola



Figure 03: Location and condition of the Sluice gate at Dulalpur



Figure 04: Location and condition of the Sluice gate at Wapda Khal

The optimal performance and management of hydraulic infrastructure are indispensable to sustaining the ecological integrity and agronomic utility of the Chinadi Beel system. The water regime within this

wetland is currently regulated by two principal sluice gates: one situated along Dewankhali Khal at Dulalpur and the other along Wapda Khal at Paratola.

These control structures are instrumental in modulating hydrological dynamics, particularly under dry-season conditions when ecological thresholds and socio-economic dependencies converge most critically. The area-elevation analysis underscores that a substantial portion of Chinadi Beel functions as a perennial aquatic system, reinforcing the necessity of maintaining water levels above defined ecological minima to preclude systemic degradation.

Key technical and operational recommendations are as follows:

1. The Paratola sluice gate at the Wapda canal, with a lower sill level of 1.63 m MSL, requires regulation to prevent unnecessary outflow during dry season. It is advised that the gate remains closed throughout this period, with exceptions made only for emergency discharges or in response to extreme hydrometeorological events.
2. The Dulalpur sluice gate, with a sill level of 2.9 m MSL, should consider as the main water control structure to regulate water within ecological safe limits.
3. The bed level of the Canal after re-excavation should not exceed 2.8 mMSL to safeguard against unintentional drainage.
4. Installation of staff gauges at both locations to facilitate real-time water level monitoring.
5. Formation of Regulator Management committee/ Water management Committee and including representatives from BWDB, BADC, and community members, to ensure proper maintenance and monitoring of the regulator.

The maintenance of hydrological equilibrium through precise and adaptive control of these regulators is central not only to preserving the wetland's ecological functionality but also to securing the agricultural productivity and fishery-based livelihoods of approximately 2,600 dependent households within the region.

Appendix G: Location Specific Excavated Material Disposal Sites Management Plan

Under the project, approximately 585,810 cubic meters of earth materials will be excavated from the khals (canals) of the Ashuganj and Palash project areas. In this context, identifying suitable disposal sites for the excavated materials is a critical consideration.

The khals and associated channels are ecologically significant due to their unique biodiversity and the ecosystem services they provide. Therefore, the effective and responsible management of excavated materials is essential to ensure the project's benefits are fully realised.

If not disposed of in a planned and controlled manner, the excavated materials could lead to environmental degradation such as deterioration of water quality in nearby water bodies, adverse impacts on agricultural lands, and potential social conflicts.

Thus, it is imperative to manage these materials through a systematic, environmentally sound, and socially responsible approach, taking into account all relevant ecological and community-related factors within the project area.

1. Basic Considerations in the Preparation of the Excavated Material Management Plan

The Excavated Material Management Plan was prepared considering all the basic issues, including regulatory, preparatory, execution, and socio-environmental aspects, in the interest of the proposed Project. The basic considerations followed are briefly mentioned below.

1.1 Regulatory Aspects

The management of excavated earth materials adheres strictly to the "Balumahal and Soil Management Act, 2010 and Balumahal and Soil Management Rules 2011," which regulates the extraction, conservation, and utilization of sand and soil resources. The act-rules ensure transparency and good governance in resource management.

1.2 Preparatory Aspect

The following strategies were taken for preparing the plan in the management of the excavated earth:

Potential Disposing Locations: Excavated material can be disposed primarily in the riverbank and adjacent floodplains, depending on the requirement of the Project's interventions (e.g. tourism site development and widening of 1 regional, 1 district and 2 upazila roads) as well as demand from the locality for developing/heightening residential land area and common properties like eidgah of mosque, playground of educational institutions, hat/bazar, Mondir, Govt. office area etc.

Selection of Locations: Based on the volume of estimated excavated material the disposal locations were selected considering important environmental and social parameters identified through the EIA study. In this process necessary consultation/discussion/interview with the Project Proponent, Officials and Public Representatives of LGIs, Knowledgeable Persons, Key Informants, Local Community and Project Beneficiaries were ensured.

Estimation of Site-specific Requirement: Necessary calculation was made for estimating the site-specific requirement. In this regard, approximate area of disposal site (in decimal), average filling height required (in meter) and volume of earth to be disposed (in cubic meter) in the selected disposing sites were estimated.

1.3 Execution Aspect

The execution phase involves mobilization of the necessary resources and equipment for re-excavation. The equipment i.e. long boom tracked excavators would be used for this work. Disposal may be done through mechanical equipment or by using manual labour. The execution plan includes:

- Site Preparation: Preparing the site by setting up necessary infrastructure for excavation operations.
- Dredging/Excavation Operations: Conducting re-excavation activities based on the planned alignment and timing to ensure the efficient removal of excavated earth.
- Transporting Dredged/Excavated Material: Using floating delivery pipes and shore pipes for the dredgers and truck for excavators to transport the dredged material to designated disposal sites.

Re-excavation work would be carried out according to above-mentioned three criteria to ensure that the earth management plan is executed more accurately.

1.4 Socio-Environmental Aspect

The disposal of excavated earth must be performed in a manner that does not adversely impact the aquatic and terrestrial ecosystems as well as the socioeconomic and cultural resources. Continuous monitoring and evaluation need to be undertaken for mitigating any potential environmental and socio-cultural adverse effects.

Considering the above four (04) basic aspects of regulatory, preparatory, execution and socio-environment, the Excavated Material Management Plan has to be implemented in three (03) project execution phases i.e. pre-excavation, during excavation and post-cavation which is presented in the Figure 1.

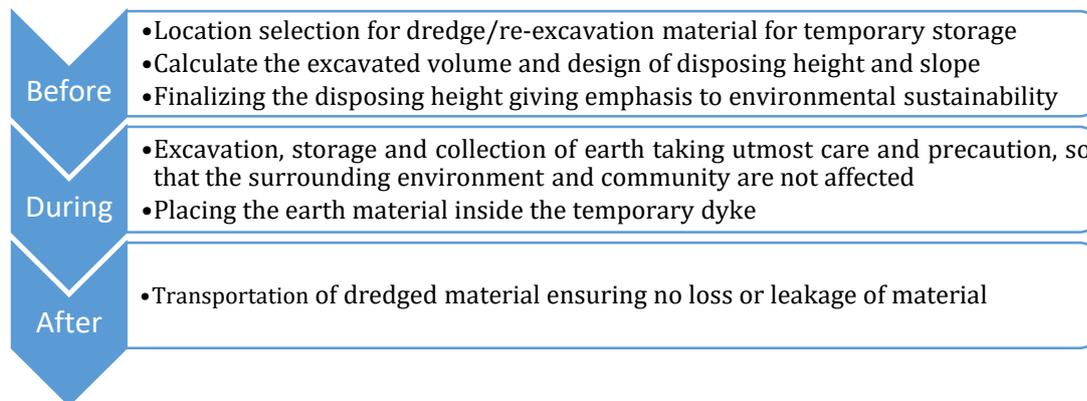


Figure 1: Phase Wise Activities of Dredged/Excavated Material Management

2. Preparation of the Excavated Material Management Plan

The dredged/excavated material disposal plan has been prepared, maintaining the basic requirement along with the defined process of action. The major outcome of the plan is given below.

2.1 Estimation of Excavated Materials

According to the Feasibility Study, the approximate excavated earth volume of Ashuganj and Palash is about 5,85,810 cubic meters. The distribution of earth volumes is mentioned in Tables 1 and 2 accordingly. Considering the estimated volume of the Earth, potential disposal locations (Figures 2 and 3) have been identified initially through remote sensing tools and the ground-truthing process. The distribution of earth volumes has been mentioned in Tables 2 and 3.

Table 1: Ashuganj Project

A	Improvement of Canal Network	Volume (m3)
A1	Improvement of canal by re-excavation in Sarail for about 35.33 km in 13 khals.	395080.47
A2	Improvement of canal by re-excavation in Ashuganj-B Baria area for about 17.59 km in 14 khals.	124680.00
B	Earth work of RCC lined Canal to deliver irrigation water to the command area of eastern side of Sarail Upazila Town	
B1	Earthwork in re-excavation for the RCC canal from the Sarail municipality area towards east for 500.00 meter	11400.00
Total		5,31,160.00

Table 2: Palash Project

	Improvement of canal network	Volume (m3)
5.1	Improvement of canal by re-excavation in Balagram near Khilpara for about 5.00 km.	17,500.00
5.2	Re-excavation of intake channel of Balagram Khal to bring water through the intake channel for pumping of water for irrigation purpose. 200 m length	1,300.00
5.3	Improvement of canal by re-excavation in Shibpur for about 6.50 km.	29,250.00
5.4	Re-excavation of intake channel of Dewankhali Khal to bring water through the intake channel for pumping of water for irrigation purpose. 400 M length.	6,600.00
Total		54,650.00

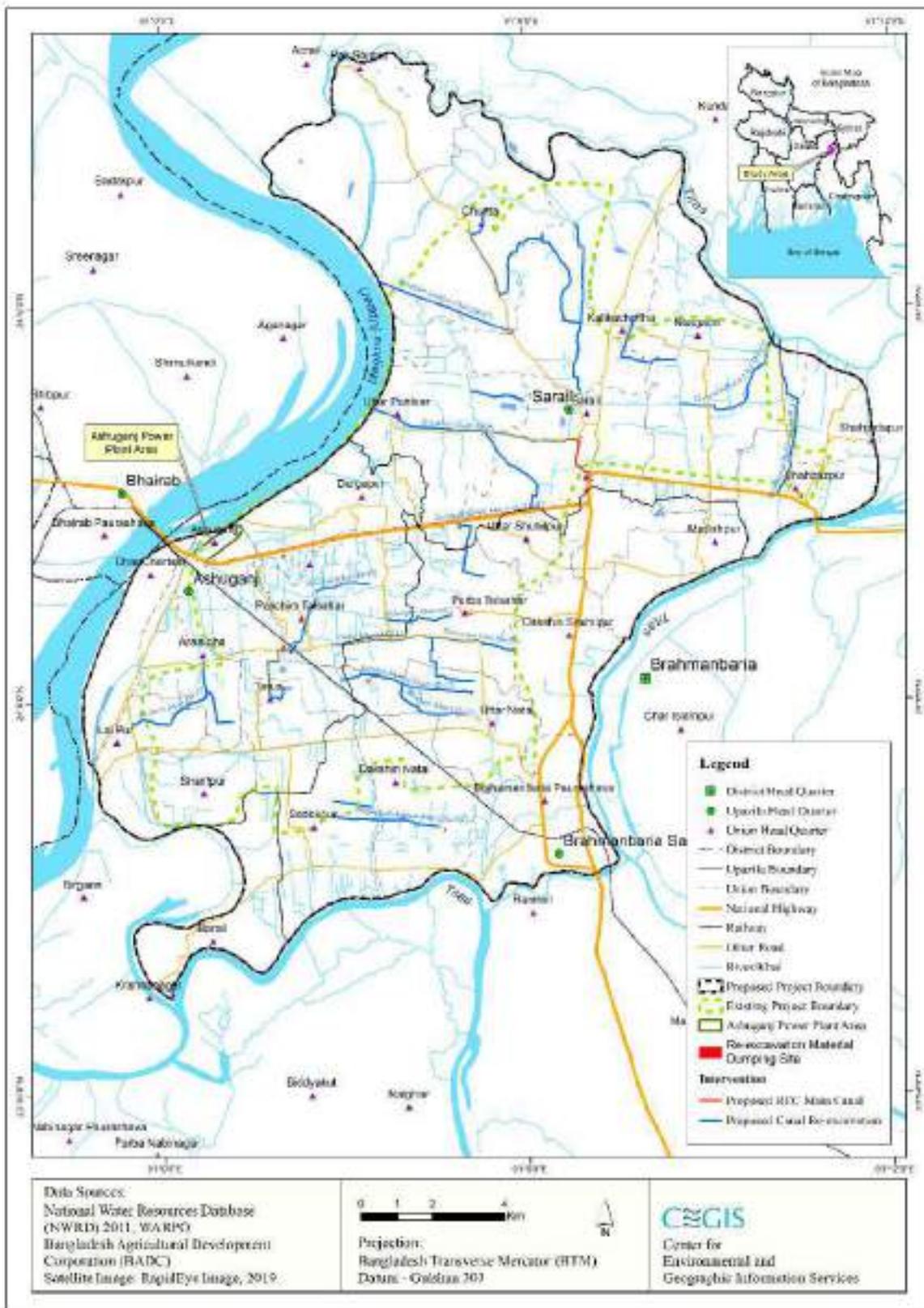


Figure 2: Excavated Earth Material Management locations for Ashuganj Site

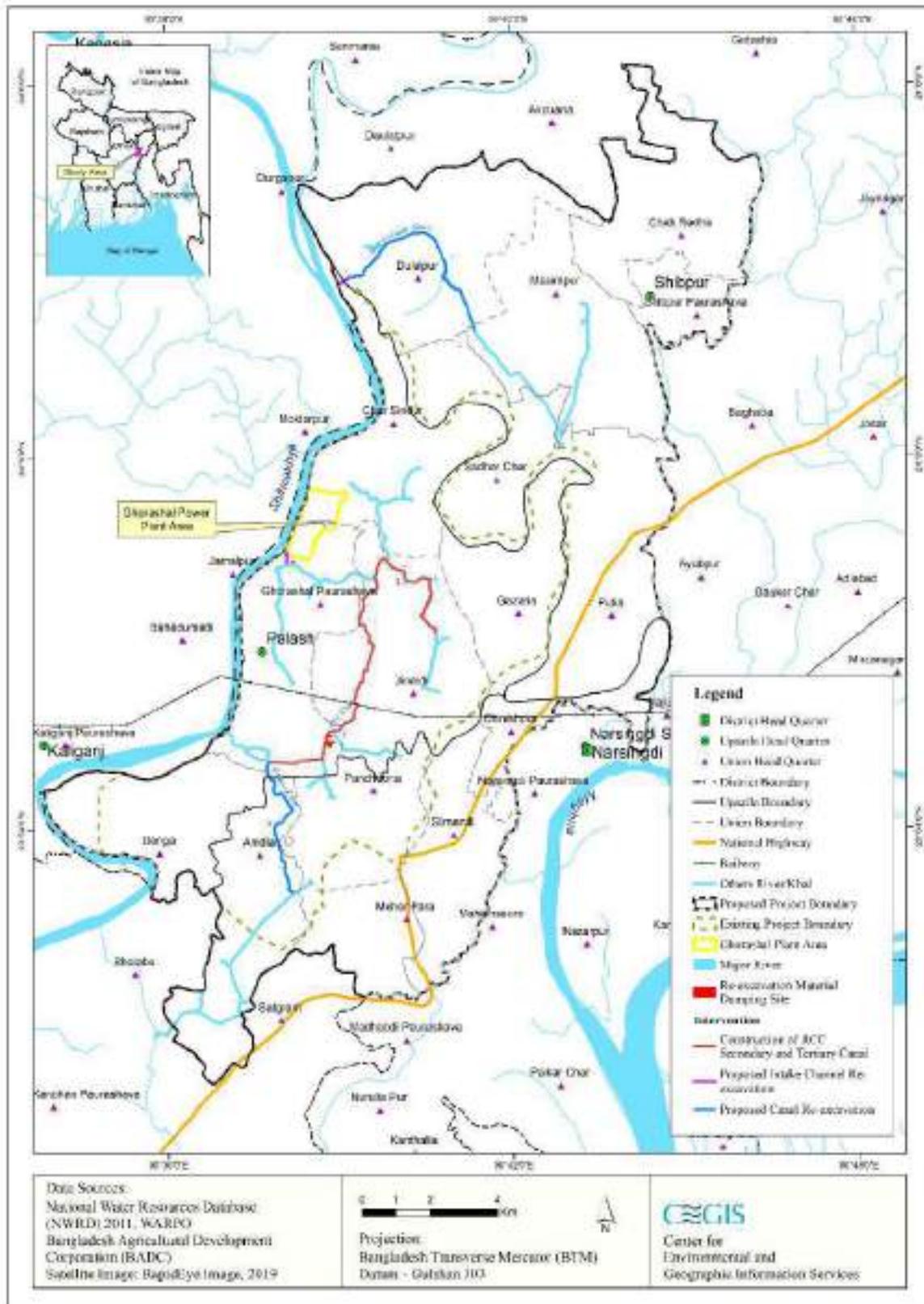


Figure 3: Excavated Earth Material Management locations for Palash Site

Table 3: Excavated Earth Dumping Locations at Ashuganj

Sl	Name	Class	Area in Ha	Volume (m3)
1	Narshingsar Playground	Playground	0.22	13561.6
2	Payag Narshingsar A Bari High School	Playground	0.08	5123.8
3	Adampur Kabarsthan	Graveyard	0.28	17124.0
4	Village field	Playground	0.12	7666.5
5	Village field	Playground	0.01	857.7
6	Village field	Playground	0.39	24114.7
7	Village field	Playground	0.08	5178.3
8	Village field	Playground	0.10	6471.8
9	Bitghar Sgimna Madinatul Ulum Islamia Madrasah	Playground	0.05	3196.6
10	Haji Abdul Kuddus School And College	Playground	0.14	8526.9
11	Naila Govt. Primary School	Playground	0.07	4227.9
12	Panishwar High Schoolpanishwar High School	Playground	0.05	3176.5
13	Primary School	Playground	0.05	3178.5
14	Talshahar A A I High School	Playground	0.31	19345.6
17	Bertola Kabarsthan	Graveyard	0.31	19021.0
18	Bhultara Kabarsthan	Graveyard	0.08	4966.1
22	Asrafali Primary School	School/College/Madrasah	0.07	4040.5
23	Darul Arkam (Ibtedayi) Madrasah	School/College/Madrasah	0.10	6388.4
24	Haji Abdul Kuddus School And College	School/College/Madrasah	0.11	6695.8
25	Jamalpur Hazi Nowaz Ali Govt. Primary School	School/College/Madrasah	0.05	2870.6
26	Madrasah	School/College/Madrasah	0.16	9641.9
27	Saiful Islam Babul School	School/College/Madrasah	0.07	4299.7
28	Talshahar A A I High School	School/College/Madrasah	0.16	9986.8
29	Talshahar Budhai Shaha High School	School/College/Madrasah	0.10	6156.2
31	Talshahar Notun Bazar Eidgah	Eidgah	0.21	13303.2
33	Golania Miftahul Ulum Islamiya Madrasah	Playground	0.13	8049.9
34	Kuttapara High School	Playground	0.10	6304.6
35	Kuttapara Playground	Playground	0.77	47620.7
37	Baganbari Kabarsthan	Graveyard	0.11	6590.2

Sl	Name	Class	Area in Ha	Volume (m3)
38	Monu-Mura Kabarsthan	Graveyard	0.19	11496.4
39	Budda Nur E Madina Islamia Madrasah	School/College/Madrasah	0.08	4722.8
40	Dighirpar Government Primary School	School/College/Madrasah	0.11	6661.9
41	Surjokandi Government Primary School	School/College/Madrasah	0.08	4908.8
42	Syedtula Master'S Mission School	School/College/Madrasah	0.03	1622.9
45	Solabari Govt. Primary School	Playground	0.07	4071.8
46	Notun Chak Bazar	Area Under Development	0.07	4063.2
47	Bitghar Central Mosque Eidgah	Eidgah	0.04	2398.9
48	Shantinagar Central Mosque Eidgah	Eidgah	0.04	2386.7
49	Shantinagar Cemetery	Graveyard	0.29	17749.3
50	Kaliseema Kabarsthan	Graveyard	0.25	15565.7
51	Adampur Purbopara Jame Mosque Eidgah	Eidgah	0.03	1619.1
52	Brahmanbaria Jame Masjid Eidgah	Eidgah	0.06	3911.7
53	Khudra Brahmanbaria Kabarsthan	Graveyard	0.28	17194.4
54	Mohonpur Govt. Primary School	Playground	0.32	20002.2
55	Ajabpur Government Primary School	School/College/Madrasah	0.03	2009.7
56	Needs Kindergarten	School/College/Madrasah	0.09	5646.1
57	Narsinghapur Purbopara Jame Mosque Eidgah	Eidgah	0.03	1891.9
58	Bara Bolla Kabarsthan	Graveyard	0.08	5117.5
59	Rasulpur Kabarsthan	Graveyard	0.34	21073.1
60	Rasulpur Playground	Playground	0.25	15727.6
61	Kurbanali Primary School	School/College/Madrasah	0.06	3925.7
62	Shri Shri Dakhinashori Kalimata Mondir	Temple	0.07	4192.9
63	Chunta Dakhin Government Primary School	School/College/Madrasah	0.14	8688.3
64	Dakhinpara Mosque Eidgah	Eidgah	0.02	1358.8
65	Uttar Kalikaccha Model School And College	Playground	0.12	7522.0
66	Kusharpara Eidgha	Eidgah	0.18	11041.1
67	Dighirpar Government Primary School	Playground	0.07	4525.4
68	Shahbazpur Playground	Playground	0.68	42377.9
			8.58	531160.0

Table 4: Excavated Earth dumping locations at Palash

Sl	Name	Class	Area in Ha	Volume (m3)
1	Badamtali Cremation Kali Mandir, Darihaolapara, Palash	Temple	0.01	95.55
2	Panditpara Sri Sri Cremation Kali Mandir	Temple	0.07	658.13
3	Saner Bari Panchavati and Hari Mandir	Temple	0.20	1847.49
4	Shiv Gouri Mandir	Temple	0.04	386.31
5	Bhuiyam High School	Playground	0.29	2672.54
6	Football Minibar Field	Playground	0.07	632.98
7	Palash Shilpanchal Government College	Playground	0.34	3149.25
8	Co-Operative Eidgah	Eidgah	0.14	1344.13
9		Temple	0.01	104.30
10	Bangladesh Natural Study and Science Park	Park	0.46	4288.69
11	Bangladesh Natural Study and Science Park	Park	1.88	17475.65
12	Bangladesh Natural Study and Science Park	Park	1.32	12255.33
13		Playground	0.19	1792.62
14	Taordi Bitul Jannat Jame Mosque	Eidgah	0.03	299.35
15	Belabo Primary School	School/College/Madras ha	0.11	977.91
16	Saner Bari High School	Playground	0.22	2033.89
17	Paratala Eidgah	Eidgah	0.07	643.94
18	Bilpar Eidgah	Eidgah	0.10	908.39
19	Dulalupr Rokeya Smriti Girls High School	School/College/Madras ha	0.09	832.17
20	Moradanga Eidgah	Eidgah	0.24	2251.38
	Total		5.89	54650.00

Appendix H: Environmental Code of Practice with Monitoring Plan

1. Environmental code of practice with Monitoring Plan for “Environmental and Social Impact Assesment (ESIA) for Ashuganj-Palash Green Project (Proposed) of BADC”

Intervention: Construction of RCC irrigation canal.		
Environmental Code of Practice		
Pre-Construction phase	Construction Phase	Post-Construction Phase
Select barren land as much as possible for construction of labor sheds and stock of construction materials.	Instructions should be given to employees, contractors, and site visitors not to disturb wildlife (courtship or nesting).	Siltation in canals should be monitored and maintenance excavation should be done when needed.
The farmers should be informed well ahead (before the start of cropping season) about the construction activities so that they would not take any initiative for the cultivation of any crops in the project area.	Avoid excess lighting and use shaded lights at construction sites.	Hydraulic structures should be properly operated to ensure smooth drainage.
Proper compensation should be paid to the farmers whose lands would be used for construction works.	Avoid cutting down the larger trees for faunal habitat.	Create and strengthen community-led drainage monitoring.
Give proper compensation to the tree owners against tree felling or pruning.	Create temporary bypass channels.	Fallow land should be used for further development.
Local labors should be given priority in recruitment for the construction activity.	Construction equipment should have proper mufflers and silencers and maintained properly in order to restrict noise level within national noise standards (Noise control rules, 2006).	Aware local people about plantation and wildlife conservation.
Public awareness training and workshops on safety and health risks should be conducted for local communities prior to and during construction operations.	Water should be sprayed at the construction yard and connected road twice a day in order to suppress fugitive dust.	Water Management Organizations (WMOs) should be formed as per the guidelines of GPW 2002.
	Loading of the construction materials (sand, shingle, cement) for concrete	Farmers need training in the field for proper use of

Intervention: Construction of RCC irrigation canal.		
Environmental Code of Practice		
Pre-Construction phase	Construction Phase	Post-Construction Phase
	mixing should be done carefully to avoid dispersion of dust to the extent possible.	surface water for irrigation.
	Excavated materials should be carried carefully and under cover to avoid dispersion of fugitive dust.	Avoid dumping industrial, household and commercial wastages on the canals.
	Construction materials should be kept covered to avoid dispersion in air.	
	All workers must be provided with appropriate Personal Protective Equipment (PPE). First aid must be provided and there would be procedures in place to access appropriate emergency facilities.	

Environmental Monitoring Plan: Construction of RCC irrigation canal.

Indicator	Location	Frequency	Responsible Agency
Disposal of excavated earth	Near the Canal embankment	Weekly during construction	Contractor / BADC / PMU
Drainage function	Along canal alignment	Monthly	Contractor / BADC / PMU
Sedimentation	Within and near canal bed	Bi-weekly during rainfall events	Contractor / BADC / PMU
Water Quality (DO, TDS and pH)	Selected reaches	Monthly	Contractor / BADC / PMU
Occupational safety of the construction workers	Construction site	During construction	Contractor / BADC / PMU
Safety of the local people	Construction site	During construction	Contractor / BADC / PMU

2. Environmental code of practice with Monitoring Plan for “Environmental and Social Impact Assesment (ESIA) for Ashuganj-Palash Green Project (Proposed) of BADC”

Intervention: Construction of siphon and medium & small-scale hydraulic structures.		
Environmental Code of Practice		
Pre-Construction phase	Construction Phase	Post-Construction Phase
Choose sites that minimize disruption to ecosystems.	Cover trucks transporting materials.	Hydraulic structures should be properly operated to ensure smooth drainage.
Proper compensation should be paid to the farmers whose lands would be used for construction works.	Avoid excess lighting and use shaded lights at construction sites.	Create and strengthen community-led drainage monitoring.
Develop protocols for managing and disposing of construction waste, oils, and hazardous materials.	Use covered storage for cement and other water-sensitive materials.	Fallow land should be used for further development.
Local labors should be given priority in recruitment for the construction activity.	Create temporary bypass channels.	Aware local people about plantation and wildlife conservation.
Public awareness training and workshops on safety and health risks should be conducted for local communities prior to and during construction operations.	Dispose of construction debris in designated, approved sites.	Water Management Organizations (WMOs) should be formed as per the guidelines of GPW 2002.
Develop a construction timeline that avoids the rainy season to reduce erosion and water contamination risk.	All workers must be provided with appropriate Personal Protective Equipment (PPE). First aid must be provided and there would be procedures in place to access appropriate emergency facilities.	Establish a post-construction inspection schedule (e.g., quarterly or biannually) to check for damage, corrosion, or displacement.
	Provide alternate safe access routes for locals where roads or paths are blocked.	
	Install proper signage, barriers, and flagmen near work zones.	

Environmental Monitoring Plan: Construction of siphon and medium & small-scale hydraulic structures.

Indicator	Location	Frequency	Responsible Agency
Functionality of WCS	Water control structure entry/exit points	Quarterly	Contractor / BADC / PMU
Presence of debris	Upstream and downstream of the regulator	Monthly	Contractor / BADC / PMU
Sedimentation	Upstream and downstream of siphon and structures	Monthly during construction and post-monsoon	Contractor / BADC / PMU
Fish migration	Only in fish migration channel	June-July September-October	Contractor / BADC / PMU
Occupational safety of the construction workers	Construction site	During construction	Contractor / BADC / PMU
Safety of the local people	Construction site	During construction	Contractor / BADC / PMU

3. Environmental code of practice with Monitoring Plan for “Environmental and Social Impact Assesment (ESIA) for Ashuganj-Palash Green Project (Proposed) of BADC”

Intervention: Construction of silt trap basin, double barrel box type closed conduit and trash rack.		
Environmental Code of Practice		
Pre-Construction phase	Construction Phase	Post-Construction Phase
Avoid environmentally sensitive zones (wetlands, , breeding areas) for construction of labor sheds and stock of construction materials.	Regularly sprinkle water on access roads and stockpiles.	Re-vegetate disturbed areas using native species to control erosion and enhance aesthetics.
Minimize land disturbance by selecting optimal alignment for conduits and trash racks.	Prevent direct discharge of construction wastewater or sediment into nearby streams.	Test water for turbidity, sediment levels, and pollutants downstream of the interventions.
Identify land that will be permanently or temporarily used.	Cover soil, sand, and debris during transport.	Restore roads, footpaths, or utility lines disrupted during construction.
Local labors should be given priority in recruitment for the construction activity.	Dispose of debris, concrete waste, and oil-contaminated materials at authorized sites.	Install permanent fencing, safety signage, and railings around open or submerged structures (e.g., trash rack, inlet/outlet).
	Maintain equipment to reduce excessive noise and vibration near residential areas.	Inspect joints, seals, slopes, and inlet/outlet structures for defects.
	All workers must be provided with appropriate Personal Protective Equipment (PPE). First aid must be provided and there would be procedures in place to access appropriate emergency facilities.	Schedule periodic removal of accumulated sediment from the silt trap basin.
	The construction sites should have protective fencing to avoid any unauthorized entry, where appropriate and possible.	

Environmental Monitoring Plan: Construction of silt trap basin, double barrel box type closed conduit and trash rack.

Indicator	Location	Frequency	Responsible Agency
Mechanical Functionality of structures	Silt trap basin and conduit, and trash rack locations	Monthly during operation phase	Contractor / BADC / PMU
Sedimentation	Inside silt trap basin and closed conduit	After every heavy rainfall event	Contractor / BADC / PMU
Functionality of WCS	Water control structure entry/exit points	Quarterly	Contractor / BADC / PMU
Presence of debris	Upstream and downstream of the regulator	Monthly	Contractor / BADC / PMU
Occupational safety of the construction workers	Construction site	During construction	Contractor / BADC / PMU
Safety of the local people	Construction site	During construction	Contractor / BADC / PMU

4. Environmental code of practice with Monitoring Plan for “Environmental and Social Impact Assesment (ESIA) for Ashuganj-Palash Green Project (Proposed) of BADC”

Intervention: Installation of protection system (GI pipe guardrail) on both sides of open main irrigation canal.		
Environmental Code of Practice		
Pre-Construction phase	Construction Phase	Post-Construction Phase
Select barren land as much as possible for construction of labor sheds and stock of construction materials.	Set out guardrail posts with consistent spacing, alignment, and height as per approved design.	Fallow land should be used for further development.
Proper compensation should be paid to the farmers whose lands would be used for construction works.	Avoid cutting down the larger trees for faunal habitat.	Check all bolts, nuts, and fasteners. Re-tighten or replace any loose or corroded hardware.
Local labors should be given priority in recruitment for the construction activity.	Minimize excavation activities during fish breeding seasons (e.g., monsoon period).	Apply additional protective coatings to the base of posts where water accumulation is common.
Aware local community to take care of their children.	All workers must be provided with appropriate Personal Protective Equipment (PPE). First aid must be provided and there would be procedures in place to access appropriate emergency facilities.	Cut back vegetation around the guardrails to maintain clear visibility.
	Avoid unnecessary vegetation clearing along canal edges.	Periodically remove dirt, leaves, or any objects that may obstruct the guardrail or reduce visibility.
	Handle GI (galvanized iron) materials carefully to avoid damaging the zinc coating.	Establish a post-construction inspection schedule (e.g., quarterly or biannually) to check for damage, corrosion, or displacement.

Environmental Monitoring Plan: Installation of protection system (GI pipe guardrail) on both sides of open main irrigation canal.

Indicator	Location	Frequency	Responsible Agency
Functionality of Guard Rail	Along both sides of main canal	Quarterly	Contractor / BADC / PMU
Occupational safety of the construction workers	Construction site	During construction	Contractor / BADC / PMU
Safety of the local people	Construction site	During construction	Contractor / BADC / PMU

5. Environmental code of practice with Monitoring Plan for “Environmental and Social Impact Assesment (ESIA) for Ashuganj-Palash Green Project (Proposed) of BADC”

Intervention: Earthwork for stabilizing the bank of the reservoir.		
Environmental Code of Practice		
Pre-Construction phase	Construction Phase	Post-Construction Phase
Select barren land as much as possible for construction of labor sheds and stock of construction materials.	Excavate in planned layers (benches) rather than steep cuts to reduce slope steepness and improve stability.	Establishes vegetation cover to prevent surface erosion.
Instructions should be given to employees, contractors, and site visitors not to disturb wildlife (courtship or nesting).	Ensure balanced cut and fill to reduce soil movement and minimize stress changes in the slope.	Trees and shrubs with deep root systems stabilize slopes by reinforcing the soil.
Give proper compensation to the tree owners against tree felling or pruning.	Construct temporary diversion channels or berms to prevent surface water from flowing over unprotected slopes.	Placement of rocks or boulders along the slope or waterline to prevent erosion from wave action.
Local labors should be given priority in recruitment for the construction activity.	Reduces slope height and erosion by breaking long slopes into smaller sections.	Fallow land should be used for further development.
	Build embankments or slopes in stages to allow for consolidation and monitor stability after each stage.	Aware local people about plantation and wildlife conservation.
	Keep construction equipment and stockpiled materials away from slope edges.	Synthetic or natural fiber mats help retain soil on steep slopes until vegetation is established.
	Avoid construction activities during favorable time of wild life movement (early morning and night).	Wire mesh baskets filled with rocks, should be placed along the bank to protect against erosion and add mass stability.
	All workers must be provided with appropriate Personal Protective Equipment (PPE). First aid must be provided and there would be procedures in place to access appropriate emergency facilities.	Regular inspections to identify early signs of erosion, seepage, or slope instability.
		Immediate repair of any damaged structures (e.g., riprap displacement, cracked drains).

Environmental Monitoring Plan: Earthwork for stabilizing the bank of the reservoir.

Indicator	Location	Frequency	Responsible Agency
Sedimentation depth	Along reservoir bank	Bi-annually	Contractor / BADC / PMU
Maintenance excavation	Identified silted-up sections	As needed, based on inspection	Contractor / BADC / PMU
Occupational safety of the construction workers	Construction site	During construction	Contractor / BADC / PMU
Safety of the local people	Construction site	During construction	Contractor / BADC / PMU

6. Environmental code of practice with Monitoring Plan for “Environmental and Social Impact Assesment (ESIA) for Ashuganj-Palash Green Project (Proposed) of BADC”

Intervention: Construction/re-construction of regulators and water retention structures.		
Environmental Code of Practice		
Pre-Construction phase	Construction Phase	Post-Construction Phase
Select barren land as much as possible for construction of labor sheds and stock of construction materials.	Instructions should be given to employees, contractors, and site visitors not to disturb wildlife (courtship or nesting).	Regular visual and technical inspections for cracks, seepage, joint displacement, scouring, or settlement.
Instructions should be given to employees, contractors, and site visitors not to disturb wildlife (courtship or nesting).	Avoid excess lighting and use shaded lights at construction sites.	Regulators should be properly operated to ensure smooth drainage.
Proper compensation should be paid to the farmers whose lands would be used for construction works.	Create temporary bypass channels.	Regular removal of silt from regulators and water retention structures to maintain storage and flow capacity.
Give proper compensation to the tree owners against tree felling or pruning.	Movement of equipment and vehicles should be restricted/limited during the daytime.	Aware local people about plantation and wildlife conservation.
Provide insurance for accidents resulting in disabilities or death of employees for the duration of their contracts.	All workers must be provided with appropriate Personal Protective Equipment (PPE). First aid must be provided and there would be procedures in place to access appropriate emergency facilities.	Develop and follow schedules for opening/closing gates based on seasonal flow, irrigation demand, and flood risk.
Local labors should be given priority in recruitment for the construction activity.	The construction sites should have protective fencing to avoid any unauthorized entry, where appropriate and possible.	Water Management Organizations (WMOs) should be formed as per the guidelines of GPW 2002.
	Water should be sprayed at the construction yard and connected road twice a day in order to suppress fugitive dust.	Ensure connectivity for aquatic life, where structures obstruct natural migration paths.
		Avoid dumping industrial, household and commercial wastages on the canals and water retention structures.

Environmental Monitoring Plan: Construction/re-construction of regulators and water retention structures.

Indicator	Location	Frequency	Responsible Agency
Functionality of structures	At regulator and water retention sites	Quarterly and after monsoon	Contractor / BADC / PMU
Occupational safety of the construction workers	Construction site	During construction	Contractor / BADC / PMU
Safety of the local people	Construction site	During construction	Contractor / BADC / PMU

7. Environmental code of practice with Monitoring Plan for “Environmental and Social Impact Assesment (ESIA) for Ashuganj-Palash Green Project (Proposed) of BADC”

Intervention: Construction of aqueducts.		
Environmental Code of Practice		
Pre-Construction phase	Construction Phase	Post-Construction Phase
Select barren land as much as possible for construction of labor sheds and stock of construction materials.	Prevent contamination of nearby water bodies through proper waste management.	Remove temporary structures, equipment, and debris.
Determine flow patterns, seasonal variations, flood risks, and water availability for proper aqueduct sizing.	Avoid excess lighting and use shaded lights at construction sites.	Create and strengthen community-led drainage monitoring.
Proper compensation should be paid to the farmers whose lands would be used for construction works.	Avoid cutting down the larger trees for faunal habitat.	Conduct regular inspections of the aqueduct for signs of leakage, cracks, or subsidence.
Schedule work to avoid monsoon or flood seasons, especially for excavation and foundation work.	Create temporary bypass channels.	Aware local people about plantation and wildlife conservation.
Design to minimize the need for pumping and reduce risk of landslides or erosion.	Throwing/Releasing of construction and other wastes (unused concrete, washed-off coarse aggregates, litters, cut pieces of steel, wood, nails etc.) into the water body should be prohibited.	Water Management Organizations (WMOs) should be formed as per the guidelines of GPW 2002.
Local labors should be given priority in recruitment for the construction activity.	Movement of equipment and vehicles should be restricted/limited during the daytime.	Maintain open communication with local communities regarding aqueduct operation and maintenance activities.
Public awareness training and workshops on safety and health risks should be conducted for local communities prior to and during construction operations.	All workers must be provided with appropriate Personal Protective Equipment (PPE). First aid must be provided and there would be procedures in place to access appropriate emergency facilities.	
Provide insurance for accidents resulting in disabilities or death of employees for the duration of their contracts.		

Intervention: Construction of aqueducts.		
Environmental Code of Practice		
Pre-Construction phase	Construction Phase	Post-Construction Phase
Aware local community to take care of their children.		

Environmental Monitoring Plan: Construction of aqueducts.

Indicator	Location	Frequency	Responsible Agency
Functionality of structures	At aqueduct sites	Quarterly	Contractor / BADC / PMU
Sedimentation	Upstream and downstream channels	Monthly during flow season	Contractor / BADC / PMU
Irrigated area			
Occupational safety of the construction workers	Construction site	During construction	Contractor / BADC / PMU
Safety of the local people	Construction site	During construction	Contractor / BADC / PMU

8. Environmental code of practice with Monitoring Plan for “Environmental and Social Impact Assesment (ESIA) for Ashuganj-Palash Green Project (Proposed) of BADC”

Intervention: Repair/upgrading of weir and existing regulators.		
Environmental Code of Practice		
Pre-Construction phase	Construction Phase	Post-Construction Phase
Select barren land as much as possible for construction of labor sheds and stock of construction materials.	Instructions should be given to employees, contractors, and site visitors not to disturb wildlife (courtship or nesting).	Regular visual and technical inspections for cracks, seepage, joint displacement, scouring, or settlement.
Instructions should be given to employees, contractors, and site visitors not to disturb wildlife (courtship or nesting).		Regulators should be properly operated to ensure smooth drainage.
Proper compensation should be paid to the farmers whose lands would be used for construction works.	Create temporary bypass channels.	Regular removal of silt from regulators and water retention structures to maintain storage and flow capacity.
Give proper compensation to the tree owners against tree felling or pruning.	Throwing/Releasing of construction and other wastes (unused concrete, washed-off coarse aggregates, litters, cut pieces of steel, wood, nails etc.) into the water body should be prohibited.	Aware local people about plantation and wildlife conservation.
Aware local people about wildlife conservation so that the disturbed wildlife can escape easily and take secured shelter in nearer habitat.	Construction equipment should have proper mufflers and silencers and maintained properly in order to restrict noise level within national noise standards (Noise control rules, 2006).	Develop and follow schedules for opening/closing gates based on seasonal flow, irrigation demand, and flood risk.
Local labors should be given priority in recruitment for the construction activity.	Movement of equipment and vehicles should be restricted/limited during the daytime.	Water Management Organizations (WMOs) should be formed as per the guidelines of GPW 2002.
Provide insurance for accidents resulting in disabilities or death of employees for the duration of their contracts.	Construction equipment namely batching plant/mixer machine, washing plant and grader, excavator, etc. should be properly maintained.	Ensure connectivity for aquatic life, where structures obstruct natural migration paths.
	Loading of the construction materials (sand, shingle, cement) for concrete mixing should be done carefully to avoid	Avoid dumping industrial, household and commercial wastages on the canals and water retention structures.

Intervention: Repair/upgrading of weir and existing regulators.		
Environmental Code of Practice		
Pre-Construction phase	Construction Phase	Post-Construction Phase
	dispersion of dust to the extent possible.	
	Avoid construction activities during favorable time of wild life movement (early morning and night).	
	All workers must be provided with appropriate Personal Protective Equipment (PPE). First aid must be provided and there would be procedures in place to access appropriate emergency facilities.	

Environmental Monitoring Plan: Repair/upgrading of weir and existing regulators.

Indicator	Location	Frequency	Responsible Agency
Functionality of irrigation structures	Weir and existing regulator sites	After repair completion	Contractor / BADC / PMU
Occupational safety of the construction workers	Construction site	During construction	Contractor / BADC / PMU
Safety of the local people	Construction site	During construction	Contractor / BADC / PMU

9. Environmental code of practice with Monitoring Plan for “Environmental and Social Impact Assesment (ESIA) for Ashuganj-Palash Green Project (Proposed) of BADC”

Intervention: Dismantling of damaged, broken and useless regulators.		
Environmental Code of Practice		
Pre-Construction phase	Construction Phase	Post-Construction Phase
Identify hazardous materials (e.g., asbestos, lead paint) that may require special handling.	Avoid direct dumping of debris or dismantled parts into canals.	Ensure all debris and dismantled materials are removed from the site.
Inform local communities, water users, and nearby landowners about the planned dismantling.	Store and transport dismantled materials to authorized disposal or recycling facilities.	Verify that hazardous materials (e.g., lead-based paint, oil residues) were disposed of in compliance with environmental regulations.
Address concerns and incorporate feedback into planning where feasible.	Provide full PPE (e.g., helmets, gloves, goggles, life vests near water).	Monitor water flow and sedimentation downstream to ensure no long-term impacts on water quality or aquatic habitats.
Develop an emergency plan for accidental spills, flooding, or injuries during dismantling.	Install safety barriers, fencing, and warning signs around the worksite.	Monitor return of flora and fauna in and around the dismantled area.
Plan for safe storage and proper disposal of waste, including concrete, metals, and hazardous substances.	Restrict public access to the dismantling area.	Inspect and secure any adjacent infrastructure (e.g., embankments, bridges) that may have been affected by the dismantling.
Schedule dismantling outside of sensitive periods such as breeding seasons.	Inform nearby residents of potential hazards like noise, vibrations, or temporary access restrictions.	
	Use low-noise machinery where feasible.	
	Movement of equipment and vehicles should be restricted/limited during the daytime.	

Environmental Monitoring Plan: Dismantling of damaged, broken and useless regulators.

Indicator	Location	Frequency	Responsible Agency
Structural Integrity of Adjacent Infrastructure	Surrounding area of dismantled regulator	Before and after dismantling	Contractor / BADC / PMU
Debris Management	Upstream and downstream of the regulator	Monthly	Contractor / BADC / PMU
Water Quality (TSS, pH)	Upstream and downstream of the regulator	Monthly	Contractor / BADC / PMU
Noise Level	Construction site	During construction	Contractor / BADC / PMU
Occupational safety of the construction workers	Construction site	During construction	Contractor / BADC / PMU
Safety of the local people	Construction site	During construction	Contractor / BADC / PMU

10. Environmental code of practice with Monitoring Plan for “Environmental and Social Impact Assesment (ESIA) for Ashuganj-Palash Green Project (Proposed) of BADC”

Intervention: Excavation/re-excavation of earthen channels, canals and intake channels.		
Environmental Code of Practice		
Pre-Construction phase	Construction Phase	Post-Construction Phase
Design should be prepared on the basis of stakeholders’ opinion. A detailed work plan based on the design and stakeholders’ opinion should be submitted to the proper Authority.	All works should be executed in accordance with design and plan and are to be displayed at site office so that stakeholders are able to understand them.	Monitor drainage performance of the Channel.
Plan should include all activities starting from mobilization of materials and equipment to handover of the scheme.	Safety measures should be taken up for every activity.	Check whether there is any obstacle to flow or for fish migration. Any obstacle in water bodies should be strictly prohibited.
Site office and labor shed with provision of hygienic toilet and pure drinking water facility for all must be ensured.	First Aid box should be at hand so that it is readily available or can be used as and when required.	Vegetation or debris should be cleaned up regularly as it obstructs flow.
Effluent from toilet must not be disposed into khals or any other water bodies and should be handled properly.	Construction work should be monitored properly and regularly by BADC so that the work can be completed in accordance with design specification and plan.	-
Season when crops are likely to be in the field, should be avoided. Alternately, farmers should be notified ahead of schedule and compensated for loss of crops.	Check whether the channel bed level and longitudinal slope are as per design	Excavated earth, if dumped on agricultural land, should be removed before the next cropping season.
Excavated earth must not be deposited on agricultural land. Stake-holder’s opinion should be taken and reflected in handling of excavated earth.	During construction, the depth and slope of channel should be maintained properly. As per schedule, some part of each khal should be constructed with a depth more than the other part, so that water can exist around the year. This deeper part of the khal will facilitate different layer dependent fishes and also help to increase benthos and primary producer for fishes. The primary	Fish sanctuary should be constructed in deeper part of the channel. Awareness program should be conducted for protection. Fisheries laws and regulations should be enforced.

Intervention: Excavation/re-excavation of earthen channels, canals and intake channels.		
Environmental Code of Practice		
Pre-Construction phase	Construction Phase	Post-Construction Phase
	producer will strengthen the aquatic food cycle.	
The channel should not be fully de-watered at a time. It should be de-watered partly or section wise (if water exits) to allow survival of the parent stock of fish and help to propagate the fish bio-diversity in the area.	The contractor should be instructed to implement the work as per BADC guide lines.	Monitoring should be conducted by BADC, DoF and project contractor.
Avoid early rainy season for re-excavation works to prevent damages and for germination of aquatic plants.	Select, to the extent possible, barren land or common property (play grounds, school field etc.) for soil dumping.	Monitoring of planted saplings by BADC and local stakeholder till they are matured.

Environmental Monitoring Plan: Excavation/re-excavation of earthen channels, canals and intake channels.

Indicator	Location	Frequency	Responsible Agency
Functionality of the channels and canals	Throughout re-excavated channels/canals	Monthly	Contractor / BADC / PMU
Soil Erosion & Sedimentation	Canal banks and bed	During excavation	Contractor / BADC / PMU
Slope Stability	Along embankments and excavated sections	Bi-annually	Contractor / BADC / PMU
Water Turbidity	Upstream and downstream of canals and channels	Monthly	Contractor / BADC / PMU
Vegetation Loss & Restoration	Along excavation sites, canal banks, and adjacent buffer zones	Pre-construction baseline, Monthly during works, Quarterly for 2 years post-construction	Contractor / BADC / PMU with DoE oversight
Occupational safety of the construction workers	Construction site	During construction	Contractor / BADC / PMU
Safety of the local people	Construction site	During construction	Contractor / BADC / PMU

11. Environmental code of practice with Monitoring Plan for “Environmental and Social Impact Assesment (ESIA) for Ashuganj-Palash Green Project (Proposed) of BADC”

Intervention: Construction of slabs over canal.		
Environmental Code of Practice		
Pre-Construction phase	Construction Phase	Post-Construction Phase
Design should be prepared on the basis of stakeholders’ opinion. A detailed work plan based on the design and stakeholders’ opinion should be submitted to the proper Authority	All works should be executed in accordance with design and plan and are to be displayed at site office so that the stakeholders can be able to understand them.	Provision for training and working stakeholders can get maximum opportunity.
Plan should include all activities starting from mobilization of materials and equipment to handover of the scheme.	Safety measures should be taken up for every activity.	Monitor the performance of the regulators
Season when crops are likely to be in the field, should be avoided.	Prevent construction debris from entering the canal; enforce proper disposal of materials.	Establish routine inspection and cleaning to prevent blockages Train local users on slab use and canal upkeep to enhance long-term utility

Environmental Monitoring Plan: Construction of slabs over canal.

Indicator	Location	Frequency	Responsible Agency
Water Flow Disruption	Upstream and downstream of slab sites	Weekly during construction	Contractor / BADC / PMU
Structural Stability	Slab structure over canals	Post-construction and annually	BADC/ Third Party
Occupational safety of the construction workers	Construction site	During construction	Contractor / BADC / PMU
Safety of the local people	Construction site	During construction	Contractor / BADC / PMU

12. Environmental code of practice with Monitoring Plan for “Environmental and Social Impact Assesment (ESIA) for Ashuganj-Palash Green Project (Proposed) of BADC”

Intervention: Disposal of excavated/re-excavated materials		
Environmental Code of Practice		
Pre-Construction phase	Construction Phase	Post-Construction Phase
Avoid agricultural land	Select barren land as much as possible for dumping of excavated materials;	Implement plantation on disposal area after completion of excavation or re- excavation activities;
Schedule excavation to avoid fish breeding seasons (e.g., monsoon); identify sensitive aquatic habitats.	Minimize excavation activities during fish breeding seasons (e.g., monsoon period)	Maintenance excavation work should be conducted properly.
Season when crops are likely to be in the field, should be avoided. Alternately, farmers should be notified ahead of schedule and compensated for loss of crops.	The contractor should ensure that no disposal material is dumped inside cultivation fields. Canal excavated materials should not be dumped on the agricultural lands.	Excavated earth, if dumped on agricultural land, should be removed before the next cropping season. The compensation amount should be calculated in consultation with the local Department of Agriculture Extension (DAE) officials.
Avoid selecting disposal sites near surface water bodies to reduce contamination risks.	Excavated materials should be removed as soon as possible to minimize turbidity;	Remove excavated materials quickly to reduce water turbidity
	Excavated materials should be carried carefully and under cover to avoid dispersion of fugitive dust.	

Environmental Monitoring Plan: Disposal of excavated/re-excavated materials

Indicator	Location	Frequency	Responsible Agency
Soil Contamination	Disposal sites, nearby agricultural lands, and adjacent water bodies	Monthly during disposal activities; Post-monsoon (to assess leaching risks)	Contractor / BADC / PMU (with lab testing by environmental consultants if required)
Erosion & Sedimentation	Disposal sites and nearby drains/canal	After every rainfall event and bi-weekly during dry season	Contractor / BADC / PMU
Site Rehabilitation	Former disposal sites, disturbed lands, and adjacent buffer zones	Quarterly for first year post-construction; Annually thereafter for 3 years	Thereafter for 3 years Contractor / BADC / PMU (with oversight from environmental agencies)
Occupational safety of the construction workers	Construction site	During construction	Contractor / BADC / PMU
Safety of the local people	Construction site	During construction	Contractor / BADC / PMU



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