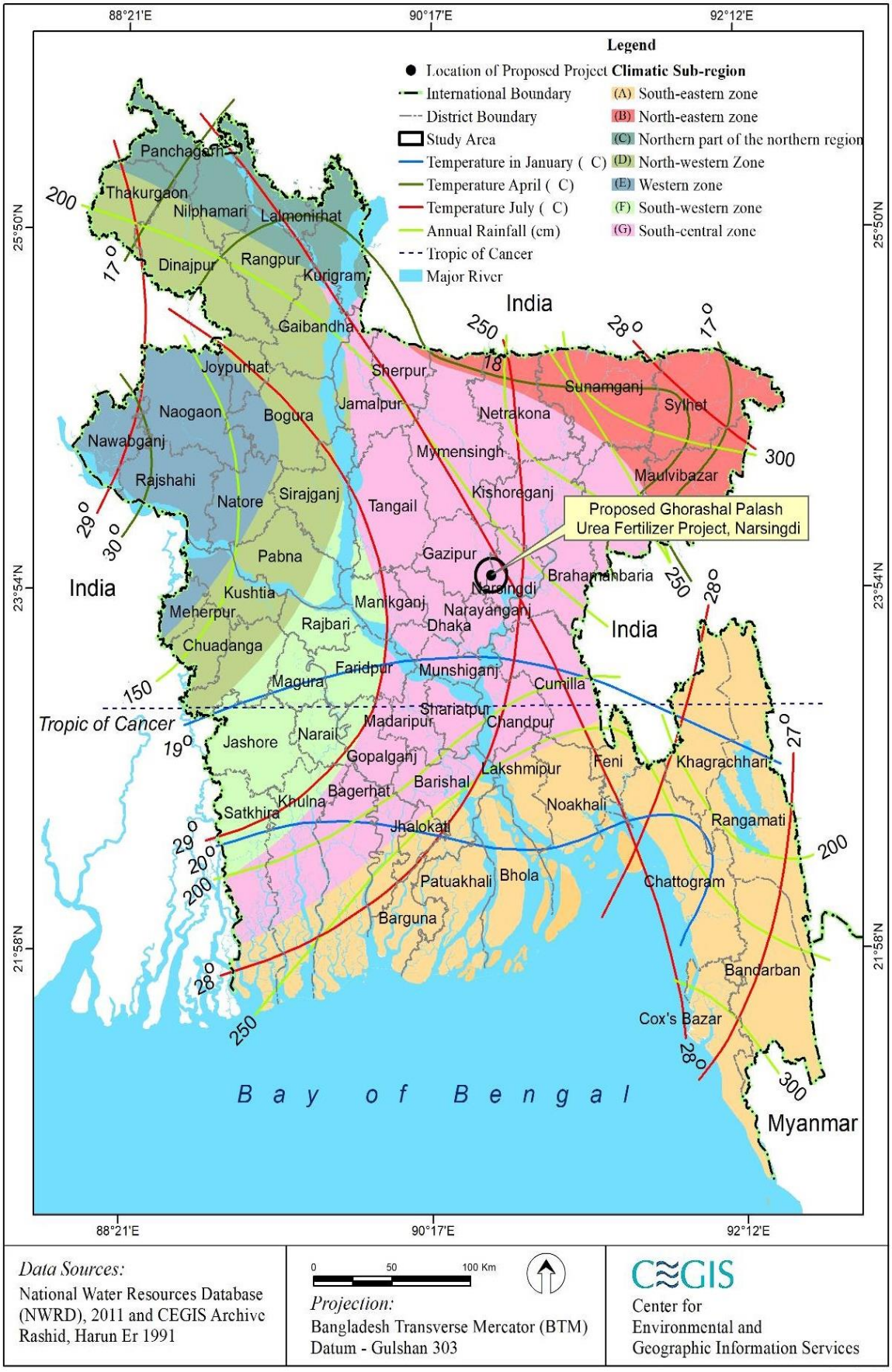



**Figure 6.16: Climatic zone of the proposed Urea Factory**

416. The summary of the analysis of the climatic and meteorological parameters are discussed in the following sections:

*Temperature*

417. Temperature data of Dhaka Station from Bangladesh Meteorological Department (BMD) for 34 years (from January 1987- December 2017) has been analyzed to see the monthly variation of the maximum temperature which is between 28.48$^0$C to 37.14$^0$C. The monthly variation of the minimum temperature is 9.5$^0$C to 24.9$^0$C. The maximum recorded temperature in Dhaka station was 39.6$^0$C, which occurred on March, 1999 and April, 2009. On January 1995, the minimum temperature was recorded as 6.5$^0$C in Dhaka. The warmest month of the year is April and the coldest month of the year is January. **Figure 6-17** shows the maximum, minimum, average of maximum and average of minimum temperature of Dhaka station from 1987 to 2017 (Source: BMD).

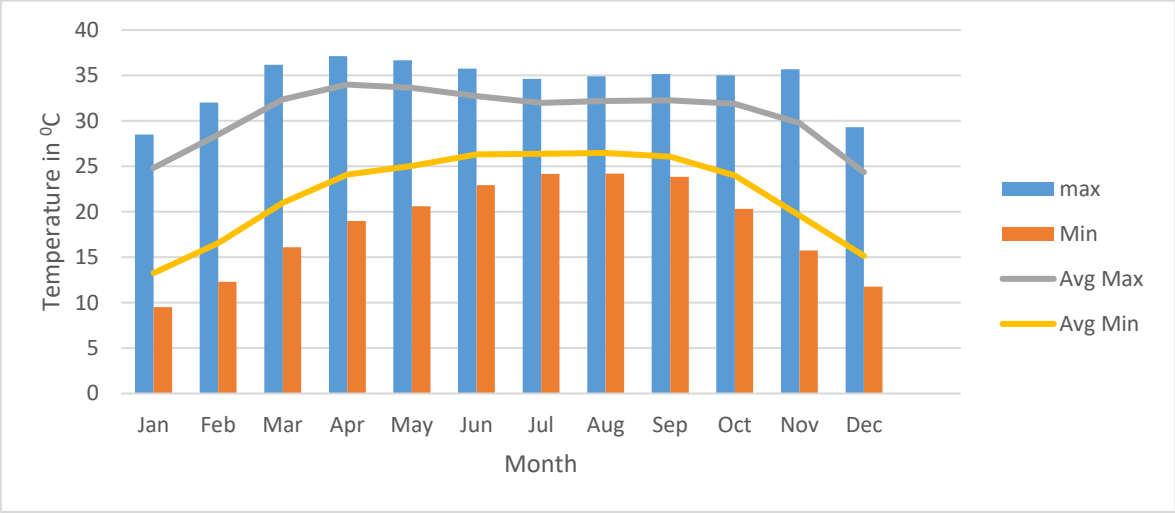



**Figure 6.17: Monthly maximum, minimum and average temperature (1987-2017)**

*Rainfall*

418. Monsoon is a prominent season in this area. The average monthly rainfall during monsoon (June-September) season from 1980-2017 is 332 mm/month. The variance in the maximum rainfall during monsoon season is 836 mm/month to 552 mm/month, whereas the variance in the minimum rainfall is 136 mm/month to 59 mm/month. The maximum 836 mm/month rainfall was recorded during September of the year 2004. Annual average rainfall is 2066 mm/year and the highest recorded yearly rainfall was 3028 mm in the year 1984. The driest period of the year is winter when the average monthly rainfall varies from 21 mm/month to 7.21 mm/month. **Figure 6-18** shows the maximum, minimum and average rainfall from 1980-2017.

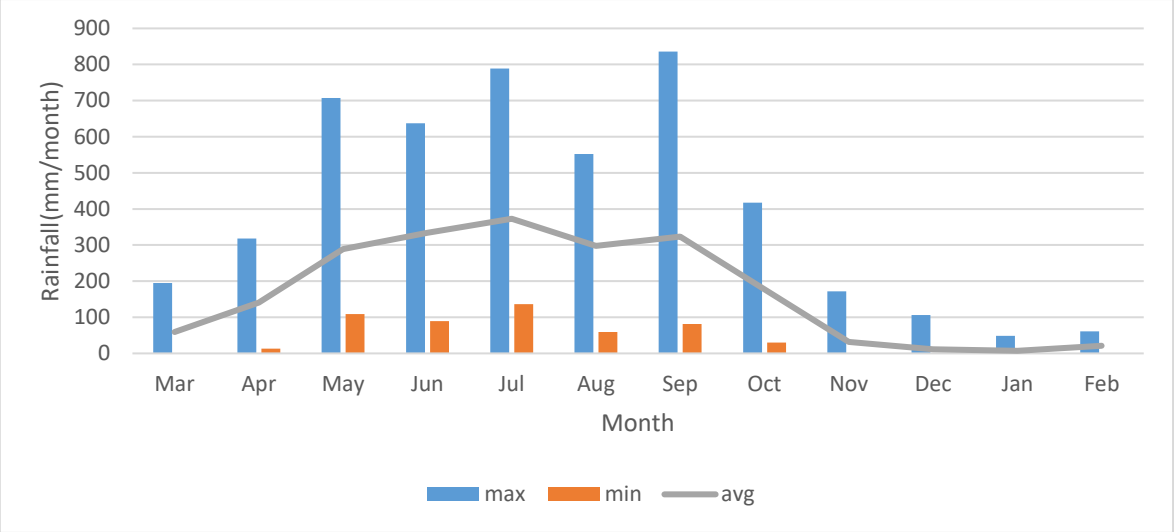



**Figure 6.18: Monthly Maximum, Minimum and Average Rainfall**

419. The drainage system of the area is based on the Shitalakhya River (Figure 6.19). There are many drainage canals in and around the Project site falls into the river carrying the rainfall runoff as storm water. During torrential rainfall, the drainage system of the UFFL and PUFFL sometimes fail to accommodate storm water draianing into the river. At that time, the factory premise as well as the emergency Urea stack (when fertilizer production is in peak level) on the road becomes flooded. As a result, much damage occurs to Urea pile and count substantial financial loss.

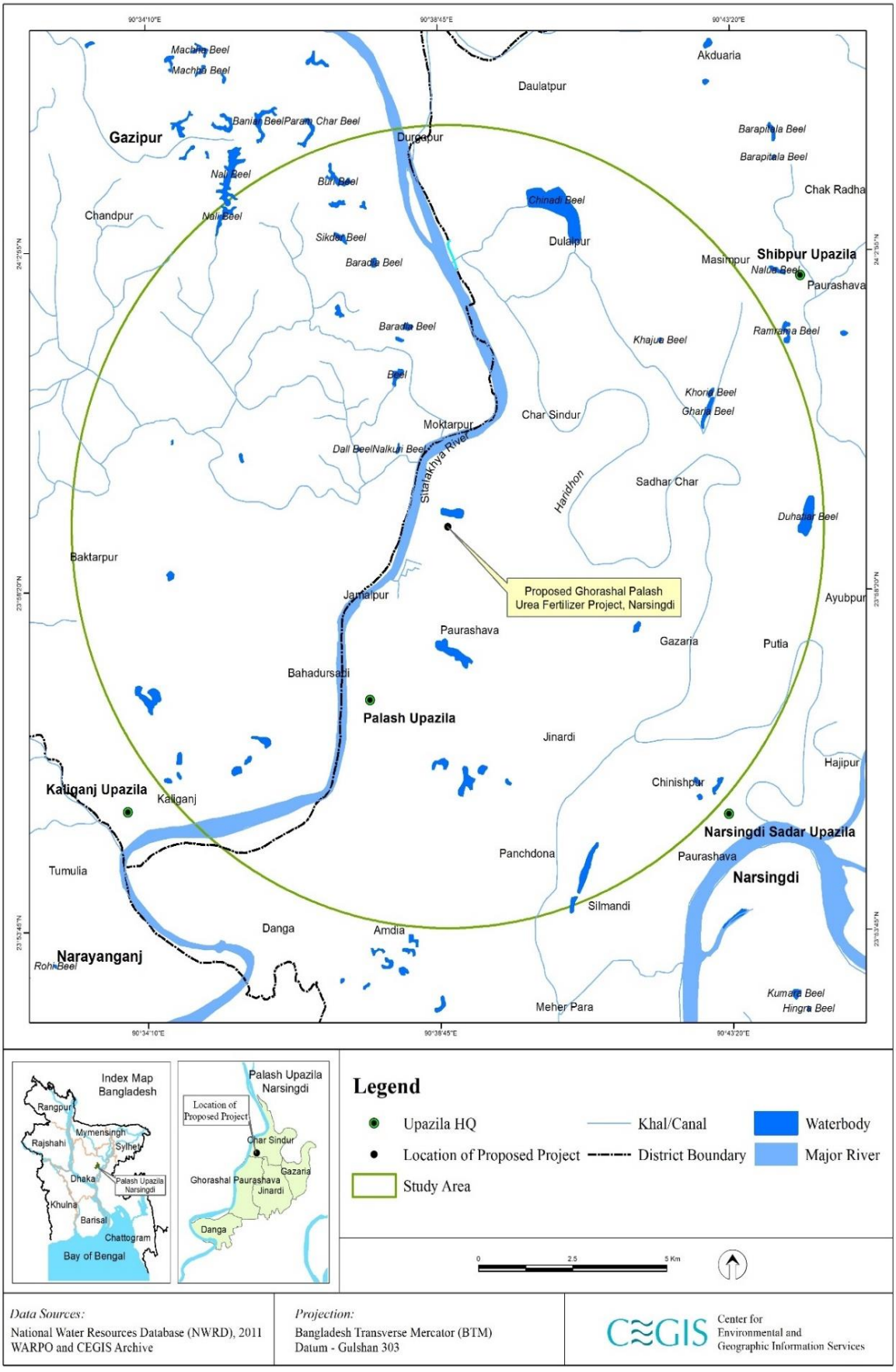



**Figure 6.19: Drainage system network of the study area**

*Humidity*

420. The average relative humidity remains higher during the monsoon season. The variance in the average relative humidity throughout the year is 82.61% to 61.29%, whereas during monsoon the variance is 83.77% to 82.40%. Figure 6.20 shows the maximum, minimum and average relative humidity of Dhaka station from January 1988 to January 2018.

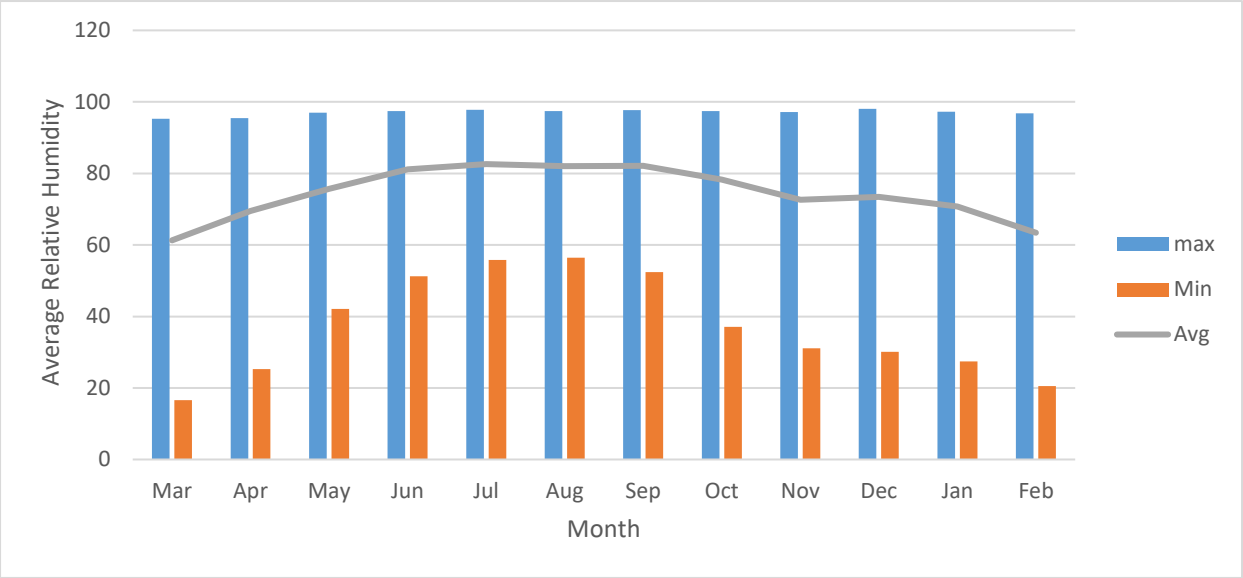
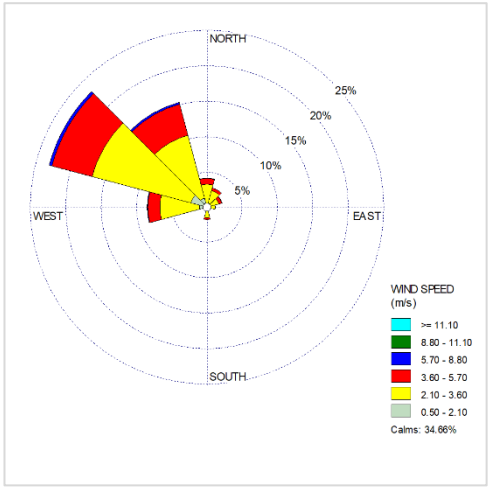



**Figure 6.20: Maximum, Minimum and Average Relative Humidity (1988-2018)**

*Wind Speed and Direction*

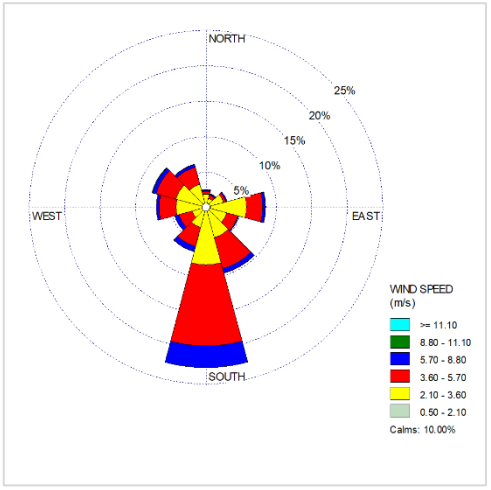
421. The direction of wind varies depending on the seasons. Therefore, whole year has been categorized into four clusters of months and these are: Cluster-1 which is called winter: December-February, Cluster- 2 which is called Pre-Monsoon: March to May, Cluster- 3 which is called Monsoon: June to September, and Cluster- 4 which is called Post Monsoon: October to November. Wind speed data and direction have been collected from the Dhaka BMD station at a height of 10 m from the ground level. During the months of clusters 1 and 4 wind direction is predominantly from northwest to southeast direction, inclined towards East and for clusters 2 and 3 it is predominantly from Suth and southeast to North and northwest. In cluster 1 calm wind prevails for 34.66% of total period, similarly it is 10.0% for cluster 2, 11.42% for cluster 3, and 53.56% for cluster 4, respectively. Figure 6.21 (a, b, c and d) presents the wind speed and direction graphically round the year.

Winter (December to February)



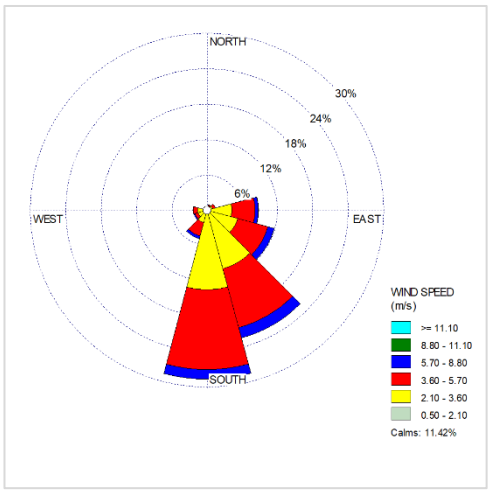

Cluster-1

Pre-monsoon (March to May)



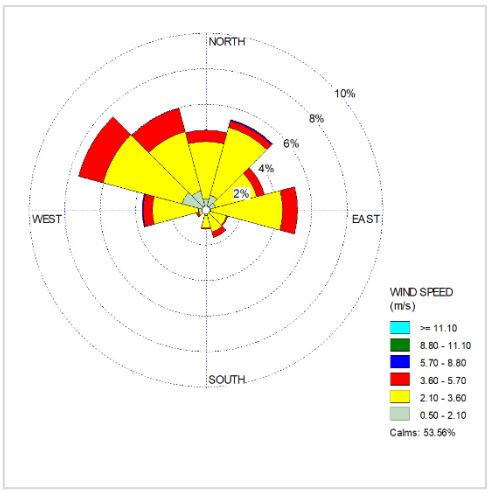

Cluster-2

Monsoon (June – September)




Cluster-3

Post- Monsoon (October – November)




Cluster-4

**Figure 6.21: Wind rose at Dhaka station**

422. The Figure 6.22 shows wind speed and direction round the year for 2018 based on data collected at Dhaka Station and calm wind prevails for 24.8 % time of the year.

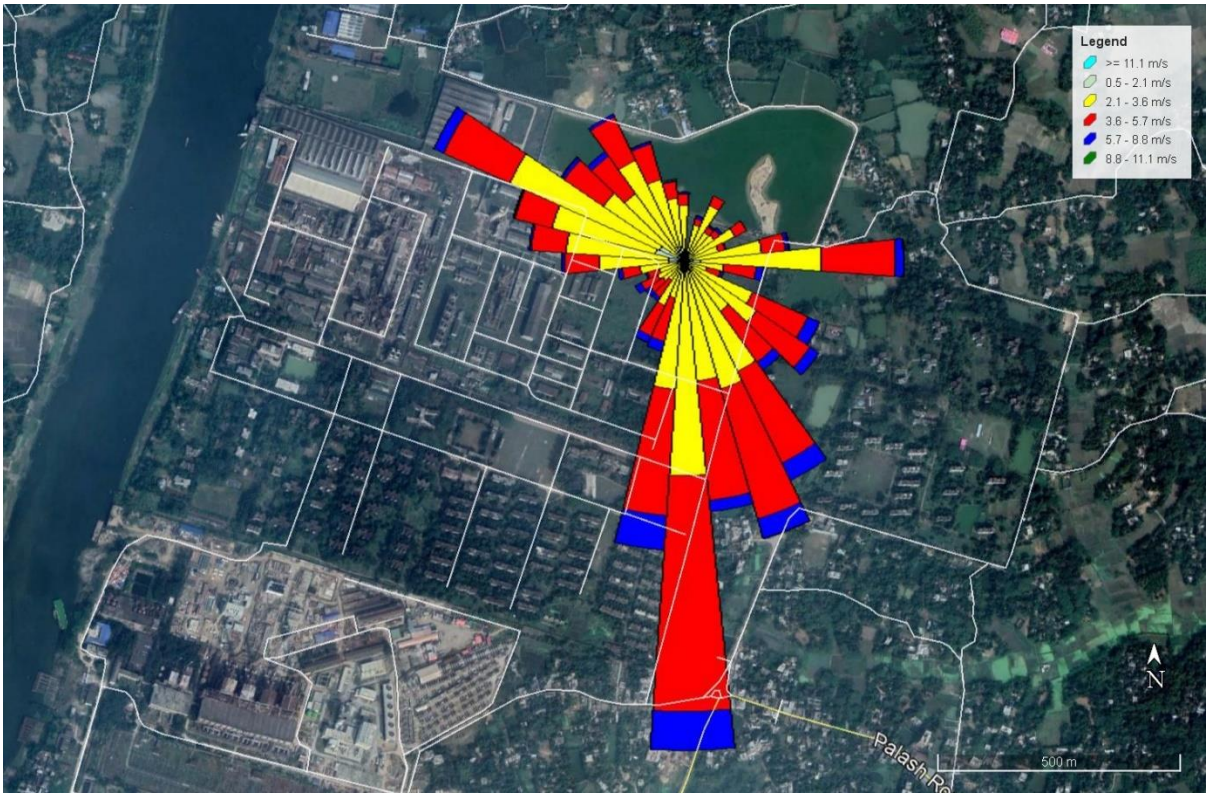



**Figure 6.22: Annual wind rose for 2018**

### *6.2.8 Ambient Air Quality*

423. The ambient air quality of the airshed of the proposed Project area has been monitored primarily. A systematically designed air quality surveillance monitoring program was formed on account of impact assessment on air environment due to proposed project activities. The basic consideration for designing the air quality sampling locations were representativeness of the airshed, sensitivity of the locations, duration of monitoring and monitoring of all relevant and important pollution parameters (ECR 1997 and subsequent amendments).

424. The parameters selected for presenting the ambient air quality are Suspended Particulate Matter (SPM), Particulate Matter ($PM_{10}$ & $PM_{2.5}$), Sulphur Dioxide ($SO_2$), Oxides of Nitrogen ($NO_x$), Carbon Monoxide (CO), Ozone ($O_3$), Ammonia ($NH_3$), Hydrogen Sulphide ($H_2S$) and Volatile Organic Carbon (VOC). The design of the network of ambient air quality monitoring stations in the study area was done based on the following criteria:

- Meteorological conditions basically the wind direction
- Topography on the study area
- Representation of the regional background levels
- Sensitivity of the areas
- Influence of the existing sources
- Major human settlements in the study area

425. The surrounding area of the proposed Project site is semi-urban in nature and consists of major industrial set up along with existing power plants. Considering all these factors, the existing and potential future emission sources of air quality of the project site

airshed monitoring is immensely necessary. Due to the unavailability of monitoring station at nearby the proposed Project Site, the closest CAMS No. 4 (Gazipur Station) of DoE recorded data were studied to get a general overview about the air quality in the proposed project airshed. The measured station data along with the national standards for the major air quality parameters are given in Table 6-8 below. Data results indicate that concentration of $NO_2$ (ppb), $PM_{2.5}$ (in µg/m$^3$) and $PM_{10}$ (in µg/m$^3$) significantly exceeded the National Ambient Air Quality Standard during the winter months. However, the concentration of air particulate matters remain below the maximum allowable limit in the rainy season because of the flushing with rain water. It should be noted that the average rainfall during the monsoon varies between 129 mm and 388 mm. The rest of the parameters were found within the permissible limit, and less likely to pose any significant health hazard to the local residents.

**Table 6.8: Ambient air quality in January and July, 2018 at CAMS-4**

| Parameter | Unit | NAAQS | Summary | CAMS-4 (Gazipur) | |
|---|---|---|---|---|---|
| | | | | Lat.: 23.99N, Long.: 90.42E | |
| | | | | January 2018 | July 2018 |
| $SO_2$- 24 hr | ppb | 140 | Average | 1.42 | 15.9 |
| | | | Max | 4.80 | 35.7 |
| | | | Min | 0.26 | 3.87 |
| $NO_2$- 24 hr | ppb | 53 | Average | 45.1 | 1.65 |
| | | | Max | 76.6 | 3.89 |
| | | | Min | 16.8 | 0.66 |
| CO- 1 hr | ppm | 35 | Average | DNA | DNA |
| | | | Max | DNA | DNA |
| | | | Min | DNA | DNA |
| CO- 8 hr | ppm | 9 | Average | DNA | 1.41 |
| | | | Max | DNA | 2.69 |
| | | | Min | DNA | 0.38 |
| $O_3$- 1 hr | ppb | 120 | Average | DNA | 3.50 |
| | | | Max | DNA | 8.81 |
| | | | Min | DNA | 1.14 |
| $O_3$- 8 hr | ppb | 80 | Average | DNA | DNA |
| | | | Max | DNA | DNA |
| | | | Min | DNA | DNA |
| $PM_{2.5}$- 24hr | µg/m$^3$ | 65 | Average | 208 | 28 |
| | | | Max | 271 | 74.5 |
| | | | Min | 123 | 7.76 |
| $PM_{10}$- 24hr | µg/m$^3$ | 150 | Average | 300 | 52.8 |
| | | | Max | 423 | 117 |
| | | | Min | 203 | 21 |

*Note: CAMS- Continuous Air Monitoring Station; NAAQS- National Ambient Air Quality Standard; DNA*- Data Not Available due to malfunction of the analyzer/sensor (Source: CASE project-Monthly Air Quality Monitoring Report, January and July 2018.*

426. In addition to this air quality has been monitored in the Project site. After reconnaissance of the area and observing the topographical features and review of the available meteorological data and local conditions, the sampling sites were chosen which will be the representative of the project area airshed. A network of five ambient air-sampling locations has been selected for assessment of the existing status of air environment within the study zone (Figure 6.23).


**Figure 6.23: Ambient air sampling locations**

427. Monitoring stations were installed at least 15 m distance from local sources. The height of sampling points was kept between 4-6 m (free from obstructions). Ambient air quality was monitored inside the Project site for continuous 24 hours for each of the location. During sampling period, the weather was sunny and the wind direction was from North-West to South-East. Table 6.9 shows the monitoring result of the ambient air quality at the sampling locations. Maximum ambient air quality monitoring results were found within the standard limit of ECR, 1997 as well as of IFC, 2007 standard except SPM and $PM_{2.5}$. Exceedances of SPM were observed in four locations out of five locations and $PM_{2.5}$ were observed in two locations situated peripherally. In case of NOx, the IFC standard stands for annual and 1-hr where the monitoring data recorded for 24hrs. However, the ambient NOx data will be within the standard limit of IFC annual standard.

**Table 6.9: Ambient air quality in the project airshed**

| Sampling Point | Concentration of Different Parameters in Ambient Air (µg/m$^3$) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **SPM** | **$SO_2$** | **$NO_x$** | **CO** | **$O_3$** | **$NH_3$*** | **$H_2S$*** | **PM $_{10}$** | **$PM_{2.5}$** | **T VOC** |
| AQ-1 | 257 | 7.4 | 35.2 | 0.38 | 24.6 | 34.8 | <10 | 126.4 | 58.2 | 41.46 |
| AQ-2 | 245.2 | 8.5 | 42.4 | 0.87 | 38.7 | 108.2 | <10 | 119.4 | 53.5 | <4.2 |
| AQ-3 | 189.2 | 7 | 38.7 | 0.75 | 26.8 | 36.5 | <10 | 96.7 | 48.6 | 157.1 |
| AQ-4 | 293.4 | 9.2 | 48.6 | 0.98 | 37.7 | 733 | <10 | 140.8 | 76.7 | 227.92 |
| AQ-5 | 293.8 | 8.3 | 40.3 | 1.15 | 30.5 | 173.5 | <10 | 145.2 | 74.8 | 59.37 |
| ECR, 2005 | 200 | 365 | 100 | 10000 | 157 | 3480 | 280 | 150 | 65 | - |
| | 8-Hr | 24-Hr | Annual | 8-Hr | 8-Hr | Max | Max | 24 Hr | 24 Hr | - |
| IFC, 2007 | - | 20 | 40 | - | 100 | - | - | 150 (IT-1) | 75 (IT-1) | |
| | | 24 Hr | Annual | | 8-Hr | - | - | 24-Hr | | |

***Notes:*** **Schedule – 8(Standards for Odor) of ECR 1997 has been used; This monitoring was conducted by - Respirable Dust Sampler (Model-Envirotech India APM-460BL) and Fine Particulate Sampler (Model-Envirotech APM-550).*

428. The monitoring results are a good representative of the status of the proposed Project airshed. Presently, the area is semi-urban in nature and consists of major industrial set up along with existing UFFL and PUFFL, Power Plants and brick kilns etc. Existing road dust from the paved and unpaved road, vehicular movement, emission from the fertilizer and power plant industries, pollen, emission from the lagoons and windblown dust from agricultural lands and exposed earth, domestic cooking are the potential sources of air pollution at present.

### *6.2.9 Odor*

429. Odor can be defined as the "perception of smell" or in scientific terms as "a sensation resulting from the reception of stimulus by the olfactory sensory system" (CPCB 2008). Whether pleasant or unpleasant, Odor is induced by inhaling air-borne volatile organics or inorganic component. Odor emission often consists of a complex mixture of many odorous compounds but for fertilizer factories ammonia ($NH_3$) is the main chemical components that produce strong pungent smell for the human.

430. In ECR 1997, the major chemical constituent of odor are identified and fixed their limit at Schedule-8 which has been shown in Table 6.10 especially for NH3 and H2S.

**Table 6.10: Standard for Odor of ECR, 1997: SCHEDULE – 8**

| Parameter | Chemicals | Standard Limit (ppm) | Maximum Limit (µg/m$^3$) |
|---|---|---|---|
| Ammonia | $NH_3$ | 1 – 5 | 3,480 |
| Hydrogen Sulfide | $H_2S$ | 0.02 – 0.2 | 280 |

431. Odor is one of the major environmental and social problem encountered by the local inhabitants living adjacent to the existing Fertilizer Factories. Particularly, those communities who live around the Lagoon are experiencing serious nuisance by the odor of $NH_3$.

432. Because of the significant environmental hazards of $NH_3$, National Pollutant Inventory, (DEH, 2004) and AP-42 (USEPA, 1998) has estimated typical release of $NH_3$ into the water from Urea Manufacturing process. Around 0.0199 kg/hr/source of $NH_3$ release from fugitive sources from a Urea Fertilizer factory (NPI, 2004: Table-9). It is mixed with the water and release to the lagoon. Volatile gas $NH_3$ is lighter than air and tends to rise, because of this fact it generally does not settle in low-lying areas. According to Aneja. V.P. et.al. in 2001, average emission flux of $NH_3$ from a lagoon is 40.7-120.3 µg/$m_2$-min of fertilizer factories. During the field measurement the quantity of $NH_3$ and $H_2S$ and Total VOC has been presented in Table 6.11.

**Table 6.11: Quantity of odors component at different sampling location**

| Sampling Point | $NH_3$ | $H_2S^*$ | Total VOC |
|---|---|---|---|
| AQ-1 | 34.8 | <10 | 41.46 |
| AQ-2 | 108.2 | <10 | <4.2 |
| AQ-3 | 36.5 | <10 | 157.1 |
| AQ-4 | 733 | <10 | 227.92 |
| AQ-5 | 173.5 | <10 | 59.37 |
| ECR, 1997 | 3480 | 280 | - |
| (Schedule -8, Rule-12) | Max | Max | - |

433. The people who lives near the lagoon suffer a lot due to unpleasant odor which generates from contaminated water and ammonia gas. Ammonia is a colourless and highly irritating gas with a sharp suffocating odor. It dissolves easily in water to form ammonium hydroxide solution which can cause irritation and burns. Gradually, it hampers the entire Aquatic Ecosystem of the Shitalakhya River. It also causes a lot of diseases among the villagers who live nearby the lagoon. The diseases are bronchitis, allergy, eye irritation, skin diseases, belly swollen, even lung cancer, etc.

### *6.2.10 Acoustic Environment*

434. Excessive noise generation from industrial activities, vehicle movements, chattering, chirping of birds etc., might have noticeable negative impacts on surrounding environment. Continuous high noise or impulse noise may cause health hazards to both the people living in the area and the workers.

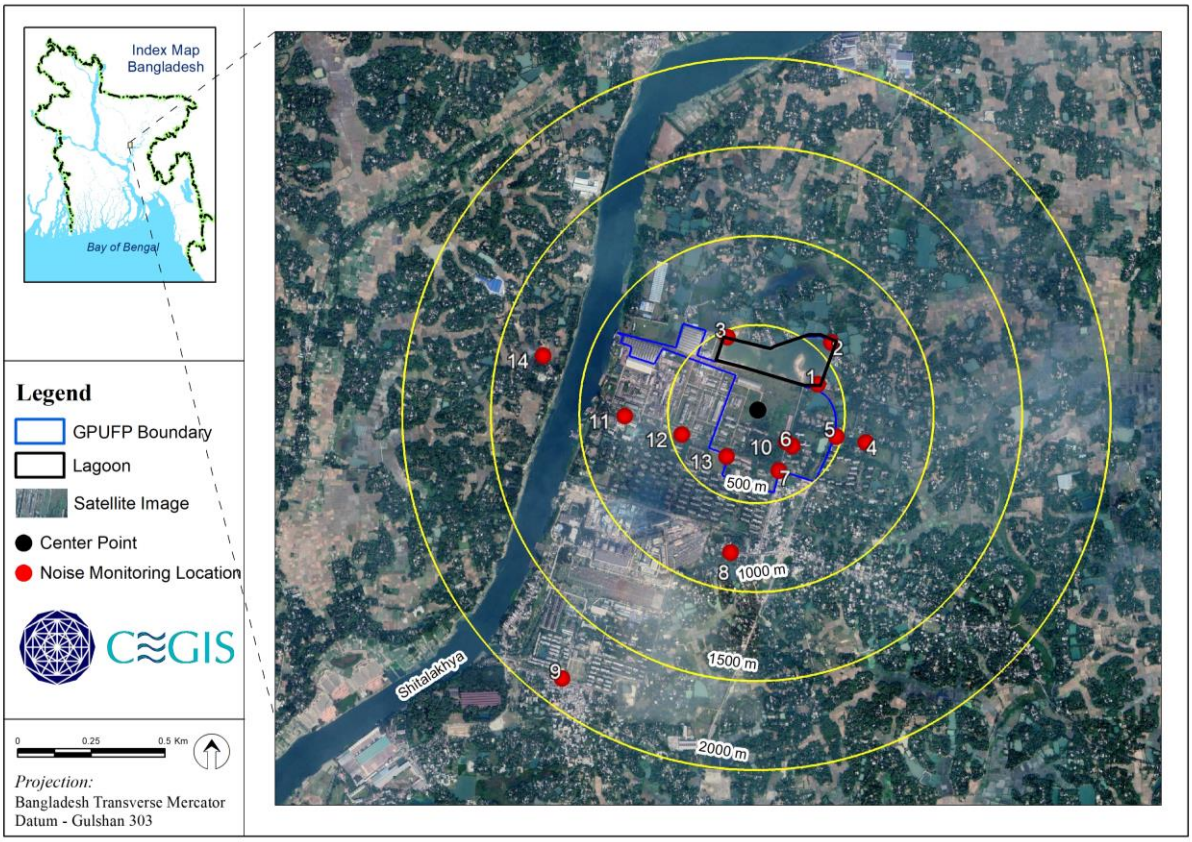



**Figure 6.24: Sampling points of noise levels around the project site**

435. Among the fourteen samples collected, thirteen of those were recorded within one km radius around the proposed project area (Figure 6.24). Only one sampling point was located at 1.75km distance from the center of the proposed GUFF. Noise levels varied between 48.1 dBA to 78.1 dBA during the day time and 42.7 dBA to 65.7 dBA during night time. The noise levels at all of the sample locations showed a comparatively higher variability in daytime (std dev. 8.31) compared to night time (std dev. 6.66), which is usual considering the higher variations of daytime activities at different noise generation sources.

436. As per the ECR, 2006 and IFC 2007, the permissible level of noise were exceeded in several receptors point where the noise level were recorded. Characteristics of the receptors

or the place sensitivity, source type and distance from the sources are the key for recorded noise level in the study area. The major sources of noise are plant operation, winds and chirping of birds, vehicle movement, whistles/horns of buses and trucks, gas transmission, industrial activities, public gathering etc. Table 6.12 shows the noise level in different places during day and night period and its compliance status with respect to ECR, 2006 and IFC, 2007. Noise levels at the UFFL and PUFFL colonies and in front of the TGTDCL's mosque are found exceeded the standards.

**Table 6.12: Measured day and night time noise levels in and around the project site**

| Sl. No. | Name of the Location | Location Types | Measured Noise dB(A) | | ECR, 2006 | IFC, 2007 | Compliance Status |
|---|---|---|---|---|---|---|---|
| 1 | SE corner of the Lagoon | Commercial | Day | 62.4 | 70 | 70 | Yes |
| | | | Night | 56.8 | 60 | 70 | Yes |
| 2 | NE corner of the Lagoon | Commercial | Day | 62.0 | 70 | 70 | Yes |
| | | | Night | 54.9 | 60 | 70 | Yes |
| 3 | NW corner of the Lagoon | Commercial | Day | 63.4 | 70 | 70 | Yes |
| | | | Night | 58.7 | 60 | 70 | Yes |
| 4 | PUFFL colony school | Silent | Day | 48.1 | 50 | 55 | Yes |
| | | | Night | 42.7 | 40 | 45 | No |
| 5 | PUFFL colony mosque | Silent | Day | 60.2 | 50 | 55 | No |
| | | | Night | 43.1 | 40 | 45 | No |
| 6 | PUFFL colony main gate | Residential | Day | 55.0 | 55 | 55 | Yes |
| | | | Night | 46.8 | 45 | 45 | No |
| 7 | UFFL main gate | Industrial | Day | 75.6 | 75 | 70 | No |
| | | | Night | 54.7 | 70 | 70 | Yes |
| 8 | TGTDCL mosque | Commercial | Day | 78.1 | 70 | 70 | No |
| | | | Night | 65.7 | 60 | 70 | No |
| 9 | GPS main gate | Commercial | Day | 68.4 | 70 | 70 | Yes |
| | | | Night | 56.8 | 60 | 70 | Yes |
| 10 | PUFFL main gate | Industrial | Day | 56.9 | 75 | 70 | Yes |
| | | | Night | 46.7 | 70 | 70 | Yes |
| 11 | UFFL Training Institute | Industrial | Day | 61.5 | 75 | 70 | Yes |
| | | | Night | 54.4 | 70 | 70 | Yes |
| 12 | Officer's Club | Industrial | Day | 60.8 | 75 | 70 | Yes |
| | | | Night | 52.7 | 70 | 70 | Yes |
| 13 | Road side corner of UFFL school field | Industrial | Day | 55.3 | 75 | 70 | No |
| | | | Night | 51.6 | 70 | 70 | No |
| 14 | Nargana Purbo Para School | Silent | Day | 56.3 | 50 | 55 | No |
| | | | Night | 46.2 | 40 | 45 | No |

*Source: Measured data by CEGIS, 2019; Note: SE- Southeast, NE- Northeast and NW- Northwest*

### *6.2.11 Water Quality*

#### Methods

437. Major surface water body comprises with Shitalakhya River, Lagoon and Ponds adjacent to the Fertilizer factory. On the other hand, groundwater comprises with shallow and deep tube-well situated at the north side of the fertilizer plant (north side of the lagoon) inside the community. To get the water quality picture extensively, last two consecutive years were observed following dry and wet season of the resources. In addition, discharged effluent quality were also observed here.

438. To cover a wide range of parameters both In-situ and Ex-situ techniques were followed. Parameters of pH, Temperature, Dissolved Oxygen (DO), Total Suspended Solids (TDS) and Hardness were examined In-situ while Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Ammonium ion ($NH_4^+$) Sulphate ($SO_4^{2-}$), Chloride ($Cl^-$), Silica ($SiO_2$) and Total Iron (Fe) were for Ex-situ test.

**Historic Pollution Records of the Shitalakhya River**

439. Around 15 years back, pH values were within the range in the Shitalakhya River, which World Health Organization (WHO) has recommended for drinking water that is, 6.5 to 8.5. In 2001, 2002 and 2003 water pH was respectively average 7.2, 6.6 and 7.0 ppm. In 2015, it has been reduced to 5.6 in pre-monsoon and 6.6 in post monsoon season in an average. Slight acidic in nature due to the discharge of chemicals and other municipal and domestic wastes along with pesticides from agricultural fields.

440. WHO suggest that 4-5 ppm of DO is the minimum amount that will support a large, diverse fish population. The DO level in good fishing waters generally averages about 9.0 ppm. In the Shitalakhya River DO was on an average 6.28 ppm in 2001. Moreover, average 7.0 ppm and 6.3 ppm was in correspondently 2002 and 2003 (Islam, M. J., 2008). DO is changes in the river. This DO reduced to 1.2 ppm in pre-monsoon and 1.6 ppm in post-monsoon season in 2015, which indicated high organic pollution of the river. However, in 2015 and 2016, DO was found around 3.5-4.2 ppm considering both dry and wet seasons (DoE, 2016). This extreme low DO might be due to the variation of seasons and sampling sites. In the pre-monsoon, BOD was less than 4.0 ppm in 2003, which was increased to more than 4.5 ppm in 2015. COD was around 8.8 ppm in pre-monsoon while it reduced a bit (6.5 ppm) in post-monsoon season. TDS was found 112 ppm in pre-monsoon, which was a bit less in post-monsoon season in 2015.

441. Phosphorous is a vital element for all the living beings, especially for plant life. However, if the quantity of phosphorous gets much higher in the water body it speeds up eutrophication of that river and lake. The standard limit of phosphorous for drinking water quality is 4-20 ppm (WHO, 1998 and 2008). In the pre-monsoon season, the range of phosphorous is 392-401 ppm and in post monsoon, it is 39-38 ppm in the Shitalakhya River which is very high than the standard limit.

442. In case of metal pollution, in pre-monsoon season of the year 2008, arsenic (observed 0.002ppm; standard 0.05ppm), lead (observed 0.001ppm; standard 0.05ppm), manganese (observed 0.05ppm; standard 0.ppm), copper (observed 0.0025ppm; standard 1.0ppm) and zinc (observed 0.02ppm; standard 5.0ppm) were found within the acceptable limit of the standards for drinking water of Bangladesh (ECR'1997). Only, cadmium was showed high concentration (0.01 ppm) than the same standard 0.005 ppm. In terms of metal pollution, the entire river reach was not bad at all (Mokadddes et al., 2013).

*Surface Water Quality*

443. Physical parameters such as Temperature, pH, DO, TDS, Total Hardness and Total Alkalinity were analyzed as a part of evaluating the water quality of the river passes beside the Project site along the stretch of the UFFL and PUFFL. Physical quality of the Shitalakhya is presented in Table 6.13**.**

**Table 6.13: Physical quality of the Shitalakhya River**

| Sl. No. | Parameters | Dry Season (February) | | Wet Season (July) | | Standard Value | Reference |
|---|---|---|---|---|---|---|---|
| | | 2017 | 2018 | 2017 | 2018 | | |
| 1 | Temperature (°C) | 24.2 | 23.0 | 29.8 | 29.7 | 30.0 | 2 |
| 2 | pH | 7.4 | 8.1 | 7.2 | 7.0 | 6.5-8.5 | 1 |
| 3 | Dissolve Oxygen (mg/L) | 6.1 | 6.2 | 5.3 | 3.8 | ≥5 | 1 |
| 4 | Total Dissolved Solids (mg/L) | 288 | 264 | 290 | 274 | 1000 | 1 |
| 5 | Total Hardness as $CaCO_3$ (mg/L) | 175 | 192 | 44 | 71 | 200-500 | 1 |
| 6 | Total Alkalinity as $CaCO_3$ (mg/L) | 201 | 202 | 54 | 60 | - | |

444. Physical characteristics of the Shitalakhya River water is quite good except for DO. According to the Table 6.13**,** it was found that water temperature varied 23-24°C in dry period, which increased a bit in the wet season. These changes are usual and all comply with the DoE standards (30 °C). The pH value also meets the standards as it ranges in between 7.0-8.1 (pH standard: 6.5-8.5).

445. DO is the amount of oxygen dissolved in a waterbody such as river, lake or stream. It is vital for underwater life as aquatic creatures need to breathe. From the Table 6.13 analyzed on the physical parameters of Shitalakhya River, it is known that the Value of Dissolved Oxygen was observed to be lower in the Wet Season than in the Dry Season. In 2018, the values were 6.2 and 3.8 in Dry and Wet season respectively. In 2017, the values were 6.1 and 5.3 in Dry and Wet season respectively. In 2018, the value of DO went below the standards (5 mg/L). Several reasons might have contributed to the reduction of DO level. One of the main reasons may be releasing of $NH_3$ mixed water into the river from lagoon.

446. There is no mention of the standard value for Total Alkalinity in the ECR, 1997. But, various sources state that Total Alkalinity as $CaCO_3$ should be within 20-200 (mg/L) to maintain the buffer state. The stabilized pH level also indicates that the buffer state is maintained in the Shitalakhya River. Based on the result, it was found that, total alkalinity in all the observed seasons complied with the range of 20-200 mg/L.

447. Biochemical Oxygen Demand (BOD) is the measure of the quantity of oxygen used by the microorganisms during the oxidation of organic matter in that sample. Aerobic biological organisms break down the organic material present in a waterbody at a certain temperature. In the Shitalakhya River, the BOD range is 3.2-3.8 mg/L in the dry season of 2017 and 2018 respectively and 3.2-8.0 mg/L in the wet seasons of the respective years. For inland surface water quality, the acceptable limit considered by DoE is 10.0 mg/L for BOD (ECR' 2017 Draft Version), Table 6.14.

448. Chemical Oxygen Demand (COD) is an indicative measure of the quantity of oxygen, which can be consumed by reactions of oxidizing soluble and particulate organic matter in water. Similar to BOD, it provides an indication to the assessment of discharging wastewater will have on the surrounding environment. In the dry season, the COD range is 5.6-8.0 mg/L and in the wet season, it is 5.7-9.2 mg/L in the Shitalakhya River. The permissible limit of COD for inland surface water is 25 mg/L (ECR' 2017 Draft Version). The Shitalakhya River showed good quality of water in terms of its oxygen demand for decomposing inorganic nutrients available in the waterbody.

**Table 6.14: Organic Pollution status of Shitalakhya River**

| Sl. No. | Parameters | Dry Season (February) | | Wet Season (July) | | Standard Value | Reference |
|---|---|---|---|---|---|---|---|
| | | 2017 | 2018 | 2017 | 2018 | | |
| 1 | BOD (mg/L) | 3.2 | 3.8 | 8.0 | 3.2 | ≤10 | 1 |
| 2 | COD (mg/L) | 5.6 | 8.0 | 9.2 | 5.7 | 25 | 1 |

449. Among the chemical parameters, Ammonium ($NH_4^+$), Chloride ($Cl^-$), Sulfate ($SO_4^{2-}$), Silica (as $SiO_2$), Total Iron was determined using methods of volumetric analysis. Data is presented in the Table 6.15.

**Table 6.15: Chemical quality of the Shitalakhya River**

| SL | Parameters | Dry Season (February) | | Wet Season (July) | | Standard Value | Reference |
|---|---|---|---|---|---|---|---|
| | | 2017 | 2018 | 2017 | 2018 | | |
| 1 | Ammonium $NH_4^+$ (mg/L) | 10 | 0.3 | 0.35 | 0.09 | 1.5 | 1 |
| 2 | Chloride (mg/L) | 22 | 8 | 4.8 | 8.2 | 150-600 | 2 |
| 3 | Sulfate (mg/L) | 1 | 4 | 10.5 | 4.2 | 400 | 2 |
| 4 | Silica (mg/L) | 25.2 | 24 | 6 | 5.7 | - | - |
| 5 | Total Iron (mg/L) | 0.01 | 0.05 | 0.5 | 0.09 | 2 | 2 |

450. Values for Chloride, Sulfate and Total Iron are well within the standards appraised by DoE (ECR' 2017 Draft Version). Sulfates are discharged into water from mines and smelters and from Kraft pulp and paper mills, textile mills and tanneries. The low concentration of Sulfates indicates the water quality (in the vicinity of the project area) is not polluted by chemical wastes of these types of industries. Values for Chloride, Sulfate and Total Iron are well within the standards in this area.

451. Only in the dry season of 2017, the value of NH4+ (10) was beyond the limit. The levels of NH4+, was well above the limits starting from January 2017 to April 2017. In fact, the recorded levels of NH4+ from January to April were 5.0 mg/L, 10.0 mg/L, 5.0 mg/L & 3.8 mg/L. All of these values are well above the standards mentioned in the ECR. Therefore, in the dry period, Shitalakhya River has an issue of high ammonia. This was happened probably because of releasing of ammonia mixed water from the lagoon into the water in 2018.

452. There is no standard value for Silica in water. But there is a significant drop of value of Silica between the dry and wet season. In March, April, May and June, the recorded amount of Silica was 26.7 mg/L, 21.0 mg/L, 16.0 mg/L and 5.2 mg/L respectively. This indicates that in the dry season there were more Silica in the River of Shitalakhya than in the wet season. High upstream water might dilute Silica concentration vastly.

*Ground Water Quality*

453. Water quality was checked for drinking water at several locations around the Project site especially at the north side of the lagoon where communities reside the most. Water samples were collected from various depths below the ground level. Here, depths of less than 40m have been termed as 'Shallow' and depths of more than 40m have been termed as 'Deep' tube wells.

454. The value of pH, $NH_4^+$ and $NO_3^-$ were analyzed to determine the chemical characteristics of drinking water available in the region of the proposed Project site. The detail field observation is presented in Table 6.16.

455. The value of pH, $NH_4^+$ and $NO_3^-$ at all the observed locations are within the standard values. This indicates that the groundwater available in that area is suitable for drinking water purposes after disinfection only.

**Table 6.16: Water quality of the observed tube-wells around the project site**

| No. | Location | Category | Depth (m) | Dry season pH | | Wet season pH | | Dry season $NH_4^+$ | | Wet season $NH_4^+$ | | Dry season $NO_3^-$ | | Wet season $NO_3^-$ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Standards* | | | | *6.5-8.5* | | | | *1.5 mg/L* | | | | *10 mg/L* | | | |
| *Observation Year* | | | | *2017* | *2018* | *2017* | *2018* | *2017* | *2018* | *2017* | *2018* | *2017* | *2018* | *2017* | *2018* |
| 1 | North of Lagoon | Deep | 75 | 6.4 | 7.3 | 6.4 | 7.3 | 0.2 | 0.1 | 0.1 | 0.1 | 1.4 | 0.4 | 0.4 | 0.4 |
| 2 | Fouzi Jute Mill | Deep | 63 | 6.9 | 7.2 | 6.9 | 7.2 | 0.4 | 0.1 | 0.1 | 0.1 | 2.8 | 0.4 | 0.4 | 0.5 |
| 3 | Deep Tube well no. 6 | Deep | 150 | 6.1 | 6.7 | 6.1 | 6.7 | 1.2 | 0.2 | 0.1 | 0.2 | 6.0 | 0.8 | 1.3 | 0.8 |
| 4 | North of Lagoon | Shallow | 15 | 6.7 | 7.1 | 6.7 | 7.1 | 1.3 | 0.1 | 0.1 | 0.2 | 1.4 | 0.4 | 0.6 | 0.6 |
| 5 | North of Lagoon | Shallow | 21 | 7.0 | 7.2 | 7.0 | 7.2 | 0.4 | 0.9 | 0.1 | 0.1 | 1.1 | 0.5 | 0.5 | 0.4 |

### 6.2.12 Effluent Analysis Report

456. The physical parameters of Temperature, Color, pH, DO, Total Dissolved Solids (TDS), and Total Suspended Solids (TSS) were analyzed as a part of evaluating the quality of the effluent discharged into the Shitalakhya River/lagoon around the Project site. Data of Physical parameters are presented in the Table 6.17.

**Table 6.17: Physical quality of the effluents of Ghorasal Fertilizer Factory Ltd.**

| Sl No | Parameters | Dry Season (February) | | Wet Season (July) | | Standard Value | Reference |
|---|---|---|---|---|---|---|---|
| | | 2017 | 2018 | 2017 | 2018 | | |
| 1 | Temperature (°C) | 25.3 | 22.0 | 29.5 | 30.2 | 40-45 | 4 |
| 2 | pH | 7.7 | 7.9 | 7.3 | 7.0 | 6.0-9.0 | 1 |
| 3 | DO | 6.7 | 6.4 | 5.6 | 6.9 | 4.5-8 | 4 |
| 4 | Total Dissolved Solids | 390 | 300 | 284 | 330 | 2100 | 4 |
| 5 | Suspended Solids | 18 | 10 | 10 | 62 | 100 | 1 |
| 6 | Color | Not Objectionable | Not Objectionable | Not Objectionable | Not Objectionable | - | - |

457. All the physical parameters were found to comply with the DoE standards. It is stated in Draft ECR 2017, Schedule 8 that the temperature of the effluent to be discharged into the river must not be greater than by 3°C than the temperature of the river water. Temperature of river water in Shitalakhya varies from 22°C to 30°C (Mottalib et al., 2016). So, the temperature of the effluent must be within 25-30°C. The recorded temperature of the effluent complies with this standard as well. The rest of the parameters such as pH, DO, TDS and Suspended solids were also complied with the ECR Standard (Table 6.18) (Water Quality Standard for Fertilizer Factory). The color of the effluent was unobjectionable in every aspects.

458. Analysis of organic pollution was also performed to check the condition of effluent quality. The values and analysis are presented in Table 6.18. Values of BOD are within the standard values mentioned in the ECR. The values in dry period are less than the values in wet period in 2017. The BOD values were 7.4 mg/L and 6.9 mg/L respectively in the dry and wet season in 2017. In 2018, there was not much difference from the values that were recorded in 2017.

459. A similar trend was observed in case of COD values. The values exhibit a decline in 2017 from the dry period to wet period. COD values went down from 12.3 mg/L in dry period to 9.7 mg/L in wet period. However, in 2018, the values are stabilized and are 7.8 mg/L & 7.2 mg/L in dry & wet period respectively.

460. After doing a trend line analysis, it was observed that both BOD and COD values increase rapidly in dry season, but stay relatively constant over the wet period.

**Table 6.18: Organic pollutants in the effluent quality, Urea Fertilizer Factory Ltd, Ghorasal, Narsingdi**

| Sl.No. | Parameters | Dry Season (February) | | Wet Season (July) | | Standard Value | Reference |
|---|---|---|---|---|---|---|---|
| | | 2017 | 2018 | 2017 | 2018 | | |
| 1 | BOD | 7.4 | 7.0 | 9.0 | 6.9 | 30 | 1 |
| 2 | COD | 12.3 | 7.8 | 9.7 | 7.2 | 200 | 1 |

461. Methods of volumetric and gravimetric analysis were performed to determine the amount of the following chemical pollutants present in the effluent- Ammoniacal Nitrogen ($NH_3$-N), Chloride as NaCl, Sulphate, Phosphate, and Iron. The observed data analysis is presented in Table 6.19.

**Table 6.19: Chemical quality of the effluents of Ghorasal Fertilizer Factory Ltd.**

| SL | Parameters | Dry Season (February) | | Wet Season (July) | | Standard Value | Reference |
|---|---|---|---|---|---|---|---|
| | | 2017 | 2018 | 2017 | 2018 | | |
| 1 | $NH_3$-N | 22.4 | 7.0 | 4.8 | 0.75 | 40 | 1 |
| 2 | Chloride as NaCl | 88.7 | 15.4 | 16.4 | 23.0 | 600 | 1 |
| 3 | Sulphate ($SO_4^{2-}$) | 3.4 | 3.3 | 8.9 | 3.5 | 400 | 3 |
| 4 | Phosphate ($PO_4^{3-}$) | 1.2 | 0.5 | 1.2 | 0.8 | 2 | 3 |
| 5 | Iron | 0.03 | 0.18 | 0.35 | 0.07 | 2 | 4 |

462. It is observed from the data presented in Table 6.18 that chemical parameters of effluent water are well within the ECR standards. The amount of $NH_3$-N shows a rapid declination between the dry period and wet period. In 2017 February, the amount was 22.4 mg/L and in July, the value went down to 4.8 mg/L. The same trend can be observed in 2018. The value in the dry period was 7.0 mg/L and the value in wet period went down to 0.75 mg/L.

463. Values of Phosphate also exhibits a similar trend. In both 2017 & 2018, the amount of $PO_4$ present in the sample was 1.52 mg/L. In the wet period, the values were 0.54 mg/L and 0.62 mg/L respectively.

464. Amount of Chloride exhibited maximum values in the dry period of 2017. It was well within the limits of ECR values.

**Loading of Pollutants into the Shitalakhya River**

465. Loadings of pollutants from the existing UFFL and PUFFL and proposed factory (GPUFP) is estimated here. The constituent load at any given time can be determined if the constituent concentration and the discharge at the time of sampling is known. The load is computed as follows:

$$L = \frac{C * Q}{(1000 * 907.18)}\ ton/day$$

466. Where, L is the constituent load, in short tons per day; C is the constituent concentration, in milligrams per liter; Q is discharge at time of sampling, in cubic feet per/day; and the result is divided by 1000 for the conversion of mg into Kg and then by 907.18 for the conversion of Kg into short ton (US ton). In calculating loadings, concentrations of pollutants are fixed here as only one sample has been analyzed in the sampling day. In addition, discharge (20 L/sec or 0.71 $ft^3$/sec) is also calculated by taking one reading at the sampling

point of effluents disposal channel. Therefore, daily and monthly loadings of pollutants are estimated and presented in Table 6.20.

**Table 6.20: Estimated daily ad monthly pollutant loadings into the Shitalakhya by existing UFFL and PUFFL**

| Parameters | Daily Loading (ton) | Monthly Loading (ton) |
|---|---|---|
| $NH_3$-N | 1.51 | 45.20 |
| Sulphate | 0.34 | 10.09 |
| Phosphate | 0.08 | 2.42 |
| Iron | 0.03 | 0.81 |

467. On the other hand, the loadings from the proposed Fertilizer Factory is calculated and presented in Table 6.21. This estimation is calculated by the above equation also. Only discharge is considered by the thumb rule of IFC, which is, each factory releases 500$m^3$ of effluents to produce 1000 ton of Urea Fertilizer per day. The proposed factory will produce 2800-3000 ton of urea per day. Therefore, discharge rate of 1500$m^3$/day (52972 $ft^3$/day) of effluents is used to estimate the loadings from the proposed factory into Shitalakshya River. Besides, the concentrations of pollutants are mainly the highest limit set by standards for Waste From Industrial Units or Projects Waste, SCHEDULE 10 of ECR' 1997. Any Effluent Treatment Plant (ETP) has to meet the criteria.

**Table 6.21: Estimated daily and monthly pollutant loadings into the Shitalakhya by the proposed GPUFP**

| Parameters | Daily Loading (ton) | Monthly Loading (ton) |
|---|---|---|
| Ammonical Nitrogen (as elementary N) | 2.9 | 87.6 |
| Nitrate (as elementary N) | 0.6 | 17.5 |
| Dissolved Phosphorous | 0.5 | 14.0 |
| Iron | 0.1 | 3.5 |

### *6.2.13 Communication System*

468. The proposed Project site is accessible by three different modes of communication. These are: roads, railway and waterway. One of the major regional highway (R-301) from Tongi to Ghorashal via Kaliganj passes through the project area. Another important regional highway adjacent to the project area is the Dhaka Bypass road which is a shorter route between Dhaka-Chittagong highway and the Jamuna Bridge. From these regional roads, there are Upazila roads to access the GPUFP project site.

469. Ghorashal Railway Station is the nearest railway facilities from the GPUFP and the distance from the site is about 5 km in the south. The Shitalakhya River is a scheduled navigation route which provides 22 km of water ways. Figure 6.25 shows the photographs of different communication systems and Figure 6.26 shows the map of the same system for accessing the project area.

Photo: Village road communication system

Photo: Water way beside the proposed Project site

**Figure 6.25: Photographs of the communication systems**

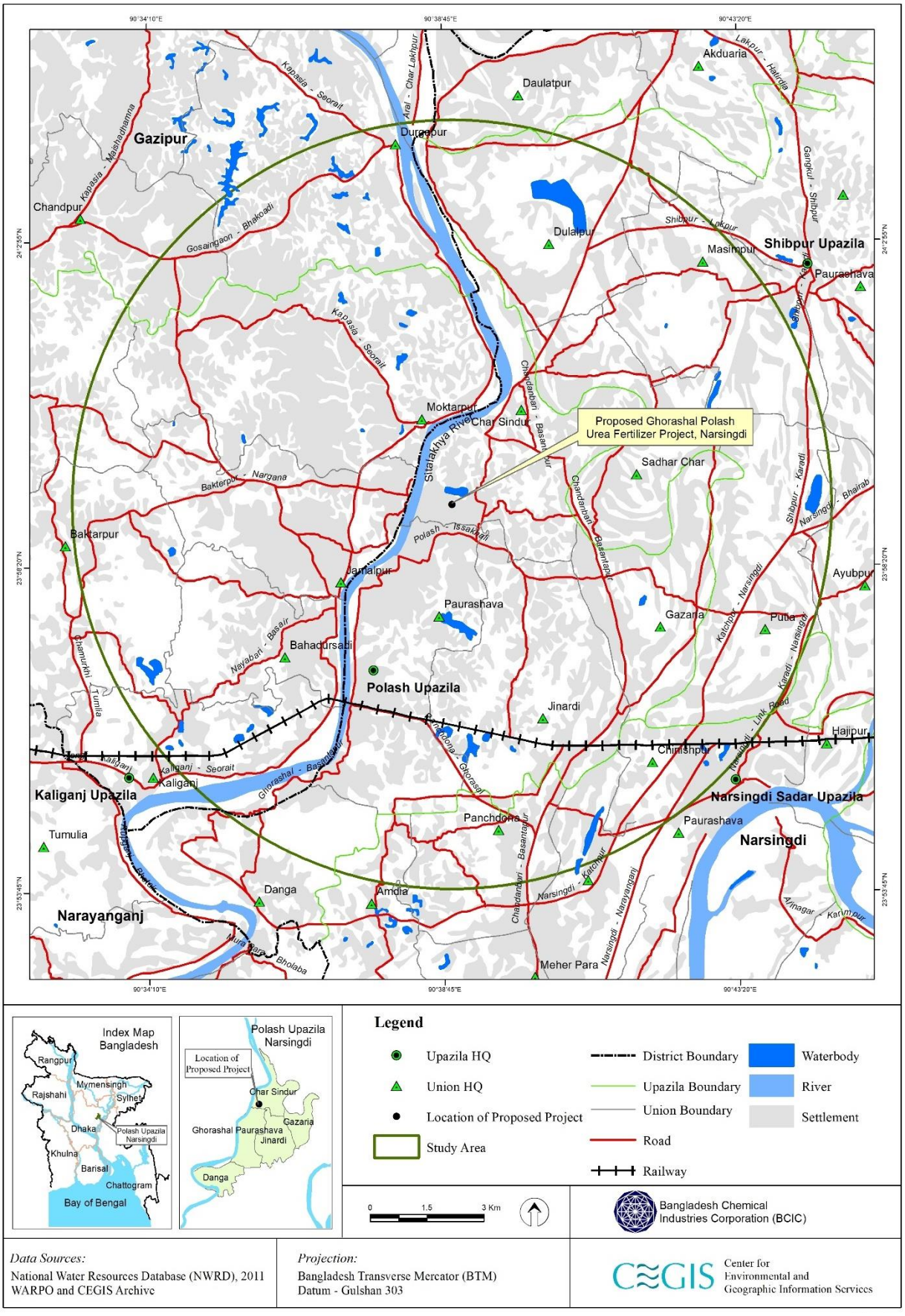



**Figure 6.26: Road, railway and water ways networks of the study area**

## 6.3 Biological Environment

### *6.3.1 Agriculture Resources*

*Farming Practices*

470. Farming practices largely depend on the cropping seasons. The Kharif-I season starts from March and ends in June. This season is characterized by the uncertainty of weather of alternating dry and wet spells. Vegetables, HYV Aus and Jute crops are grown in this season. The Kharif–II season starts from July and ends in October. The Kharif-II season comprises wet and cloudy environment and heavy rainfall but uneven distribution, low solar radiation, high temperature and humidity. Only T. Aman rice, both local and HYV, are grown under rainfed condition.

471. The Rabi season starts from November and ends in February. During this season, crops are favored with high solar radiation, low humidity and temperature, but lack of adequate soil moisture depresses the crop yield. Wide range of crops are grown in this season. In the study area, HYV Boro, Rabi crops such as Wheat, Kheshari, and Mustard and winter vegetables are grown. HYV Boro and wheat are grown under irrigated condition.

*Cropping Pattern and Intensity*

472. The project area has been considered within the boundary of the existing project site. There are no crop land within the project area. However, the outside of the project area are mainly cropland and rural settlement. The most prominent cropping pattern of the outside of the project area (study area) is Fallow – HYV. Aman – Rabi crops which covers about 25% of net cultivated area (NCA), then Fallow – Fallow – Boro which covers about 21% followed by others. The cropping intensity of the study area is 203%. The detailed cropping pattern and cropping intensity by land type in the study area is presented in Table 6.22.

**Table 6.22: Present cropping pattern by land type in the study area**

| Land type | Kharif-I (Mar-Jun) | Kharif-II (Jul-Oct) | Rabi (Nov-Feb) | Area (ha) | % of NCA |
|---|---|---|---|---|---|
| High land (F0) | Vegetables | HYV Aman | HYV Boro | 954 | 7 |
| | HYV Aus | HYV Aman | Vegetables | 1,567 | 11 |
| | Vegetables | Vegetables | Vegetables | 924 | 7 |
| Medium high land (F1) | Fallow | HYV. Aman | Rabi crops | 3,519 | 25 |
| | Jute | Fallow | HYV Boro | 1,932 | 14 |
| Medium low land (F2) | Fallow | LT. Aman | HYV Boro | 2,226 | 16 |
| Low land (F3) | Fallow | Fallow | HYV Boro | 3,012 | 21 |
| Total | | | | 14,134 | 100 |
| Cropping intensity | | | | 203 % | |

*Source:CEGIS estimation from field information, 19-21th December, 2018.*

*Crop Production and Damage*

473. The project area comprises of shrubs, trees, a number of old civil structures like buildings, etc. Crop lands are situated around 1 to 1.5 km away from the site. In the study area, the total cropped area is about 28,761 ha of which rice is about 62% and the non-rice is about 38%. Total annual crop production is about 120,720 tons after loss of 4,745 tons. Among the crop production, rice production is about 49,462 tons (40%) and non-rice is about 71,258

tons (60%). Crop production loss occur due to periodically pollution (industrial wastes), drought, shortage of surface water, pest and disease infestation etc. Details are presented in Table 6.23.

**Table 6.23: Crop production, damage and production loss of the study area**

| Crop name | Crop area | Damage free area | | Damaged area | | Total Production | Production loss |
|---|---|---|---|---|---|---|---|
| | | Area (ha) | Yield (ton/ha) | Area (ha) | Yield (ton/ha) | | |
| HYV Aus | 1,567 | 1,202 | 2.8 | 365 | 1 | 3,731 | 657 |
| HYV Aman | 6,040 | 6,040 | 2.4 | - | - | 14,496 | - |
| LT. Aman | 2,226 | 2,226 | 2 | - | - | 4,452 | - |
| Boro | 8,124 | 6,080 | 3.8 | 2,044 | 1.8 | 26,783 | 4,088 |
| **Total rice** | **17,957** | **15,548** | **-** | **2,409** | **-** | **49,462** | **4,745** |
| W. Vegetables | 2,491 | 2,491 | 15 | - | - | 37,365 | - |
| S. Vegetables | 2,862 | 1,878 | 12 | - | - | 22,536 | - |
| Rabi crops | 3,519 | 3,519 | 1.8 | - | - | 6,334 | - |
| Jute | 1,932 | 1,932 | 2.6 | - | - | 5,023 | - |
| **Total non-rice** | **10,804** | **9,820** | **-** | **-** | **-** | **71,258** | **-** |
| **Total** | **28,761** | **25,368** | **-** | **2,409** | **-** | **120,720** | **4,745** |

*Source:CEGIS estimation from field information, 19-21th December, 2018.*

**Figure 6.27: Seed bed (HYV Boro) of Khanepur village**

*Inputs used in the study area*

474. Seed, labor, fertilizer, pesticide and irrigation are the major inputs for crop production.

*Seeds, Labors, Fertilizers and Pesticides*

475. The major fertilizers used in this area are Urea, TSP, MP and Gypsum. The use of pesticides depends on the degree of pest infestation. According to local farmers, the major insects are aphids, stem borer, green leaf hopper and rice bug. Local farmers reported that they are using different types of pesticides such as Diazinon, Dursban, Ferterra, etc. Farmers also use branches of trees, bamboo and jute sticks etc. to make favorable perches for birds in fields with standing crops. The birds eat the insects which help control infestation. In this

process, the crops are protected without applying pesticides. Detailed information on seed, labor, fertilizer use, pesticides doses are presented in Table 6.24.

**Table 6.24: Seed, labor, fertilizer and pesticide use in the crop fields**

| Crops name | Seed (kg/ha) | Labor (No./ha | Farmers using fertilizer (Kg/ha) | | | | Pesticide using by farmers | |
|---|---|---|---|---|---|---|---|---|
| | | | Urea | TSP | MP | Gypsum | No. of application | Liq. (ml/ha) approx |
| HYV Aus | 50-55 | 140-160 | 130 | 50 | 40 | 30 | 1 | 400-500 |
| HYV Aman | 40-50 | 160-170 | 160 | 80 | 60 | 40 | 2 | 600-700 |
| Lt. Aman | 50-60 | 140-180 | 130 | 50 | 40 | 30 | 1 | 300-400 |
| HYV Boro | 50-60 | 160-180 | 200 | 100 | 70 | 40 | 2 | 500-600 |
| Vegetables | 2-4 | 120-160 | 200 | 100 | 80 | - | 1-2 | 600-700 |
| Jute | 7-8 | 130-140 | 80 | 20 | 0 | 0 | 1 | 300-400 |
| Rabi crops | 60-100 | 80-100 | 50-80 | 50-120 | 50-80 | - | 2 | 400-500 |

*Source: CEGIS estimation from field information, 19-21th December, 2018.*

*Irrigation*

476. Both surface and ground water are being used for irrigation in the crop land. The T. Aman crop is grown mainly under rainfed condition. Sometimes, supplementary irrigation is provided during HYV Aman. In dry season, Boro rice, Vegetables and Rabi crops are grown with the help of irrigation. Local people reported that, the Ghorasal Power Plant cooling water (BADC canal) is also being used as a source of surface water irrigation while irrigation done in nearby places through Low Lift Pump (LLP) from the Shitalakhya River. In addition, Saldah beel and Jeerkuri beel are also being used for irrigation purposes in Khanepur village under Polash Upazila. Detailed crop wise irrigated area is presented in Table 6.25.

**Table 6.25: Crop wise irrigated area**

| Crop Name | Study area | | | | | |
|---|---|---|---|---|---|---|
| | Irrigation (Surface water) | | | Irrigation (Ground water) | | |
| | Irrigated area (ha) | % of NCA | Low Lift Pump (Tk/ha) | Irrigated area (ha) | % of NCA | STW/ DTW Wells (Tk/ha) |
| HYV Boro | 2,468 | 17 | 10,500 | 5,656 | 40 | 12,000 |
| Vegetables | 1,048 | 7 | 8,000 | 1,443 | 10 | 8,500 |
| Rabi crops | 1,276 | 9 | 8,000 | 2,243 | 16 | 8,500 |

*Source: CEGIS estimation from field information, BADC, 20th December, 2018.*

### *6.3.2 Fisheries Resources*

*Introduction*

477. The Project site is devoid of any kind of fisheries activities because it is a raised land situated within the boundary of the PUFFL. However, the Shitalakhya River that passes less than a half km west side of the proposed site has fisheries potential. But the river has multiple functions of both in-stream and off-stream uses including industrial, power plant, irrigation,

navigation and domestic uses. The river is also a receiving end of the effluents carrying contaminants from the industries, power plant and other point and non-point sources. These phenomena exert detrimental impacts on aquatic biodiversity including fisheries resources. The study area contributes nearly 3,546 tons of fish to the national fish production.

*Habitat Characteristics*

478. The seasonal and perennial Beels (depressions) along with floodplains of the study area become connected to the Shitalakhya River during pre-monsoon through a number of drainage canals (Khals). The Shitalakhya River, perennial in nature, feeds water to the floodplain in the wet season and supports fisheries in this area. Alteration of river morphology, confinement effect on lateral migration of Beel and river fish breeders, water pollution and above all, over fishing of river and Beel habitats have contributed to decline of fisheries.

479. Connectivity is usually restored on the onset of monsoon and Beels become inundated earlier followed by the vast floodplains. These seasonal and perennial waterbodies function as fresh water fish habitats. Open water fish habitats that are found in the study area are; (i) river, (ii) Khal, (iii) Beel and (iv) floodplain (Figure 6.28). A number of Beels such as Chinadi Beel, Buri Beel, Nali Beel, are perennial in nature as well as many seasonal Beels, e.g Bagdi Beel, Nargana Beel, etc. serve as fish over wintering refuges, mother fishery, feeding and breeding grounds of the study area.

480. The dominant fish culture practice of the study area is the improved extensive culture in commercial fish ponds though there is a recent introduction of excavated ponds merely for intensive fish culture. In most cases, two cycles of fish culture is practiced in commercial ponds as the pond water availability period is 40-45 weeks annually supplemented with irrigation though one cycle of fish culture practice is seen in the homestead or traditional pond particularly during wet season. Statistics of Polash Upazila fisheries is given in following Table 6.26.

**Table 6.26: Fisheries statistics of Polash Upazila**

| Particulars | Quantity | Particulars | Quantity | Particulars | Quantity |
|---|---|---|---|---|---|
| Pond | 2,718 nos. | Fish production | 3,170 tons | Fish whole seller | 03 nos. |
| River | 02 nos. | Fish demand | 3,474 tons | Fish retailer | 12 nos. |
| Drainage canal | 02 nos. | Fishers | 350 nos. | Fry seller | 15 nos. |
| Beel (depression) | 15 nos. | Fish farmers | 1,987 nos. | Fish Arat | 09 nos. |
| Nursery farm | 09 nos. | Fisher Assoc. | 01 no. | Hat/Bazar | 21 nos. |
| Fry production/yr | 41.9 Lakh | Farmer Assoc. | 08 nos. | Ice factory | 04 nos. |

*Source: Upazila Fisheries Office, Polash, 2016.*

481. The Polash Upazila possesses about 350 numbers of fisher which are basically concentrated on the Shitalakhya River and some Beels. The study area also contains some villages of the Kaliganj Upazila of Gazipur District. Considering two Upazilas of two districts, the estimation revealed that about 100 households are involved in fishing activities. The number of study area fishers is also more or less 125.

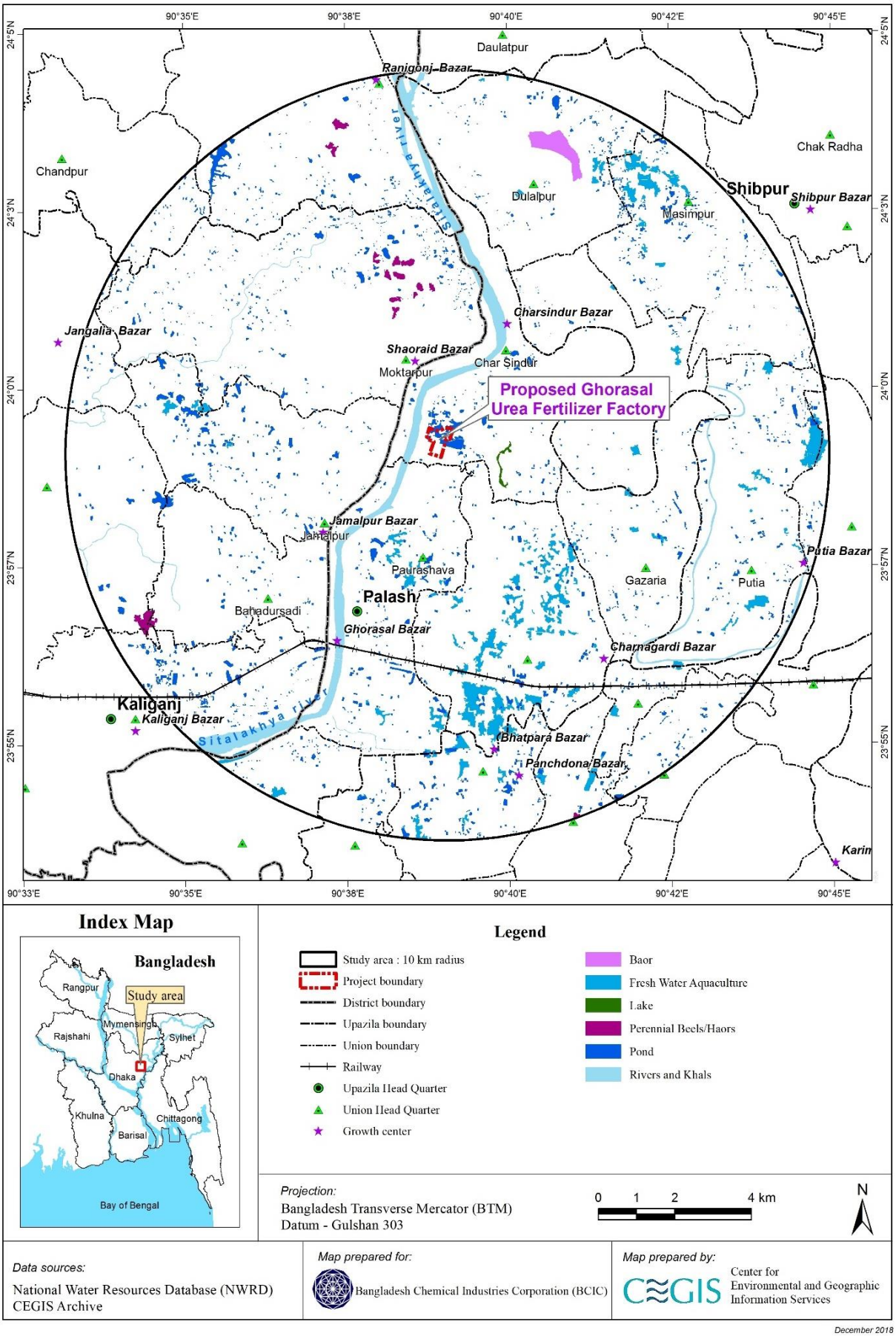



**Figure 6.28: Fish habitats of the study area**

*Fisheries Habitat*

482. The estimated overall fish habitats of the study area accounts as 7,016 ha. In totality, capture fishery constitutes of about 6,352 ha (about 90%) and the rest is shared by the culture fishery. Among the fish habitats, floodplain occupies the most, about 80%, followed by cultured fish pond, river and Khal, Beel and Extensive Fish Pond as shown in Figure 6.29 below. Of the capture habitats, floodplain occupies the most around 80%, followed by river and Khal 10% Semi intensive fish pond 9% and Beel 1% respectively. Table 6.27 presents the distribution of fish habitats.

**Table 6.27: Analysis of fish habitat area of the study area**

| Sl. No. | Fishery Type | Habitat Type | Study Area (Ha) | Project Area (Ha) |
|---|---|---|---|---|
| 1 | Capture Fishery | River and Khal | 649 | - |
| 2 | | Beel | 69 | - |
| 3 | | Floodplain | 5,622 | - |
| | | Lake | 12 | |
| | | *Sub-Total=* | *6,352* | - |
| 4 | Culture Fishery | Semi-intensive Fish pond | 649 | - |
| 5 | | Extensive Fish Pond | 15 | - |
| | | *Sub-Total=* | *664* | - |
| | | Grand Total= | 7,016 | - |

*Source: CEGIS estimation using field data, NWRD of WARPO archived in CEGIS, Imagery*

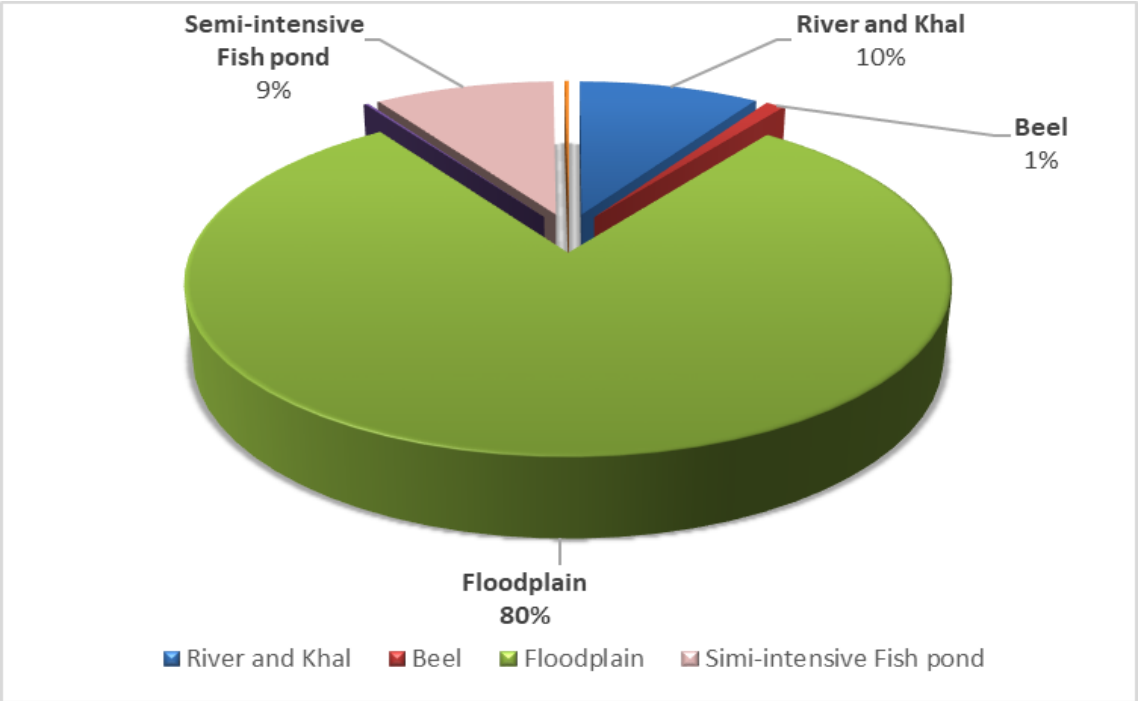



**Figure 6.29: Percentage of fish habitat area in the study area**

*Riverine fish habitat*

*Floodplain fish habitat*

**Figure 6.30: Photographs of fish habitats in the study area**

*Climatic Factors and Fisheries*

483. Climatic parameters that have influence on fish culture practices in case of both capture and culture fisheries include temperature, rainfall, wind speed, evaporation and humidity. Climatic factors can directly affect the fish population by altering their physical habitat and their physiology and life cycle by altering growth rate, development, reproductive capacity and mortality. These factors also have direct impact on the behavior of fish population and often reflected in the migration pattern as well as feeding and breeding patterns. Moreover, the climatic factors also affect the fish community indirectly by changing species diversity and composition, growth as well as the physiology by altering thermal tolerances, metabolism/assimilation and food consumption. Under the Köppen climate classification, Dhaka has a tropical wet and dry climate with a distinct monsoon season.

*Commercial fish pond*

*Culturable fish pond*

**Figure 6.31: Culture fish habitat**

*Present Affect Pattern of Culture Fish*

484. In the study area, mainly Common Carp, Rui, Silver Carp, Grass Carp, Tilapia, Thai Punti are usually cultured. But, these cultured fishes of nearby culture ponds are affected badly due to $NH_3$ gas which is injected or disposed into lagoon water when factory becomes shutdown. Death to fishes and other aquatic organisms occurs by seepaging of lagoon water into those culture fish ponds. This event causes death toll to fish largely along with other aquatic organisms. Among the fishes, Silver Carp and Common Carps are the most victim as they float on the surface most of the time though other fishes are also affected severely. Within two (02) km buffer area from the project site, there are two (02) Beels namely Jeerkuri and Saldah Beel located on the northeast of the site. The Jeerkuri Beel was fragmented into ponds

where fishes are being cultured but was passively affected by discharge of $NH_3$ into the lagoon. On the other hand, the Saldah is a seasonal Beel that contains water for nine (09) months and is abundant with small indigenous species of fish. The production of culture fish increased in the last 18 months due to lockout of fertilizer factory.

*Fish Production*

485. The yearly production of the capture fishery resources in the study area is derived from river and Khal, Beel and floodplain. The yearly production of culture fishery resources is derived mainly from the Extensive Fish Pond. The fish farmers around the lagoon earned BDT 4-4.5 lakh per year by selling fish from one hectare of pond during normal operation of the urea plant. The estimated total fish production of the study area is about 3,546 tons, where culture fishery contributes the most amounting to 67% and the rest is shared by the capture fishery. The yearly production of different fish habitats is presented in Table 6.28 for 2018.

**Table 6.28: Fish production assessment**

| Sl. No. | Fishery Type | Habitat Type | Yield/production (MT) | | |
|---|---|---|---|---|---|
| | | | Study Area | % of Production | Project Area |
| 1 | Capture Fishery | River and Khal | 48 | 1 | - |
| 2 | | Beel | 30 | 1 | - |
| 3 | | Floodplain | 1108 | 31 | - |
| 4 | | Lake | 1 | 0 | |
| *Sub-Total=* | | | *1187* | *33* | - |
| 4 | Culture Fishery | Semi-intensive Fish pond | 2,338 | 66 | - |
| 5 | | Extensive Fish Pond | 21 | 1 | - |
| *Sub-Total=* | | | *2,359* | *67* | - |
| Grand Total= | | | 3,546 | 100 | - |

*Source: CEGIS analysis using FRSS, 2016-17 published data and on-field calculation*

*Fisheries Diversity Species Composition and Biodiversity*

486. Local fishermen reported that the fish biodiversity has been declining over the years. The major factors responsible for the downturn of the species diversity are: (i) abstraction of river water for different industrial use; (ii) reduction of fish habitats; (iii) deteriorating water as well as habitat quality; (iv) increasing fishing pressure; (iv) obstruction in fish migration routes; (vi) aggradation of riverine habitats due to geo-morphological processes; (viii) alteration of fish breeding grounds; (ix) transformation of beel habitat into paddy fields and (x) expansion of culture fishery. The capture habitats of the study area are dominated by small indigenous species (SIS) of fish. It is reported that in the Shitalakhya river major carp and SIS fishes which were once in abundance is now rather meager. Indicative fish species of the study area is given as follows:

487. The riverine major fish species are: Kalibaus *(Labeo calbasu*), Chital (*Notopterus chitala*), Juary/Joya (*Aspidoparia jaya*), Tit punti (*P. ticto*), Boro baim (*Mastacembelus armatus*), Batasi (*Pseudeutropius atherinodes*), Golsha (*Mystus cavasius*), Narkali chela (*Salmostoma bacaila*), Kaski (*Corica soborna*), Tengra (*Mystus tengara*), Ayer (*Sperata aor*), Kajoli (*Ailia punctata*), Ghero (*Clupisoma garua*), Kaikya (*Xenontedon cancila*), Chanda (*Chanda nama*), Bele (*Glossogobius giuris*), Golda chingri (*Macrobrachium rosenbergii*), Gura chingri (*Leander styliferus*), Taki (*Channa punctatus*).

488. The floodplain and beel fish species include: Meni (*Nandus nandus*), Shol (*Channa striatus*), Taki (*C. punctatus*), Punti (*Puntius spp*.), Shingi (*Heteropneustes fossilis*), Magur (*Clarias batrachus*), Bujuri tengra (*Mystus vitatus*), Foli (*Notopterus notopterus*), Guchi baim (*Mastacembelus pancalus*), Kolisha/chopra (*Colisa fasciatus*), Boicha (*C. lalia*), Boal (*Wallago attu*), Koi (*Anabas testudineus*), Rui (*L. rohita*), Katol (*Catla catla*), Gura chingri (*Leander styliferus*), etc.

489. Culture fish species include: Common carp (*Cyprinus carpio*), Rui (*Labeo rohita*), Katol (*Catla catla*), Kalibaus (*Labeo calbasu*), Mrigel (*Cirrhina mrigala*), Silver carp (*Hypophthalmichthyes molitrix*), Grass carp (*Ctenopharyngodon idela*), Mirror carp (*C. carpio.*), Thai pangus (*Pangasius sutchi*), Tilapia (*Tilapia mossambicus*), Nilotica (*Tilapia nilotica*), Sharpunti (*Puntius sarana*), etc.

490. Rarely available fish species of the study area include: Rani, Tara baim, Baghayer, Shilong, Potka, Kanpona, Cheka, Chebli, Kajoli, Napitkoi, Nephtani, Chital, etc.

*Mixed catch of study area*

*Prawn*

**Figure 6.32: Fish species composition of catches**

*Fish Migration*

491. The Shitalakhya River functions as longitudinal fish migration for a number of fish species of which dominants are Kalibaus, Chital, Golda Chingri, Ayer etc. A number of Khals, such as Haridhon Khal, Nagda Khal, Naljuri Khal etc. connecting the floodplains and beels to the rivers and act as major arteries of lateral fish migration of river and beel breeders into the study area. The fish species that migrates laterally include Tengra, Punti, Chingri, Bele etc. Many fish species migrate horizontally to these waterbodies as part of their life cycle. Fish migration is usually restored during pre-monsoon to some extent and largely during peak monsoon.

*Fish Habitat Degradation*

492. River water quality has been degrading due to discharge of untreated or improperly treated effluents of cement factory, power plant, fertilizer factory, paper and pulp industry, dying factory, etc. Power plant also contributes in deteriorating the water quality by raising local water temperature at the effluent disposal end. At the same time, it entertains some fish species those prefer velocity. The discharge of industrial effluents and municipal wastes into the neighboring rivers, dust and cement from the cement factory contaminate river water. Cumulative effects of all contaminants along with inadequately treated or untreated effluents of the proposed plant may cause fatality to fish species along with other aquatic eco-elements. Local people as well as fishermen reported that suffocating fishes are seen occasionally

particularly during dry season when water remains very low and suspected the release of untreated effluents and gaseous substances from the fertilizer factory are responsible for such death toll of fish. Mostly affected fish include carps, Bata, Ayeer etc.

*Fishermen Status and Effort*

493. There are several fishermen villages around the study area, namely (i) Alinagar; (ii) Betua; (iii) Raban; (iv) Nasra, and all these villages are situated along the Shitalakhya River. There are about 100 households of fishermen who carry out their livelihoods by catching fish in different habitats. Increasing pressures on open water fish habitats, such as, river and beel during the dry season and floodplain during wet season by the amateur fishermen those come from the Muslim caste, has created severe pressure on the professional life and economic condition of the fishing community those are traditionally Hindus. Pollutants from various point and non-point sources are responsible for the decline of fish growth and fish production. Various types of gears that are used for catching fish are Moi net, khora net, seine net, cast net, lift net, push net etc.

### *6.3.3 Ecological Resources*

494. Vegetation and wildlife communities of aquatic and terrestrial ecosystems are key components of ecological resources. Both the study area and project site contains diverse types of flora and fauna. The identified major ecosystems include homestead/settlements, crop-field, roadside vegetation, woodland, Sal forest, river, seasonal wetlands and ponds etc.

*The Bio-ecological Zone*

495. The International Union for Conservation of Nature (IUCN), Bangladesh has divided the whole country into 25 Bio-ecological Zones in context of biological diversity (Nishat et al. 2002). The study area falls under two Bio-ecological Zones: a) Brahmaputra-Jamuna Floodplain and b) Madhupur Sal Tract (Figure 6.33). The project component site mainly comprises terrestrial ecosystem having moderate biodiversity. The Department of Environment (DoE)'s report revealed that the Shitalakhya river, which passess beside the proposed fertilizer factory was declared as Ecologically Critical Area (ECA) in 2009 to improve water quality of the river (DoE 2015). This river functions as a migratory corridor of the Gangetic River Dolphin (*Platanista gangetica*) particularly during wet season. This dolphin is assessed as 'Vulnerable' by IUCN. The IUCN red list conservation status of the terrestrial and aquatic flora and fauna are given in *Appendix 6-1*.

*Ecosystem of the Study Area*

**a) Terrestrial Flora**

496. The major terrestrial flora can be categorized based on ecosystems of the study area:

- Homegarden;
- Crop-field;
- Roadside;
- Woodland; and
- Sal forest.

<u>*Homestead Flora*</u>

497. The major plant species found in this ecosystem during field visit were: Palmyra Palm *(Borassus flabelifer)*, Jackfruit *(Artocarpus heterophyllus)*, Coconut *(Cocos nucifera)*, Papaya *(Carica papaya)*, Aam *(Mangifera indica)*, Queen's crepe-myrtle *(Lagerstomia speciosa)*, Rain Tree *(Albizia saman)*, Papuan wattle *(Acacia auriculiformis)*, Eucalyptus *(Eucalyptus citriodora)*, Bamboo *(Bambusa Spp.)* etc. Besides these, there were some herbs and shrubs also existent in this ecosystem.

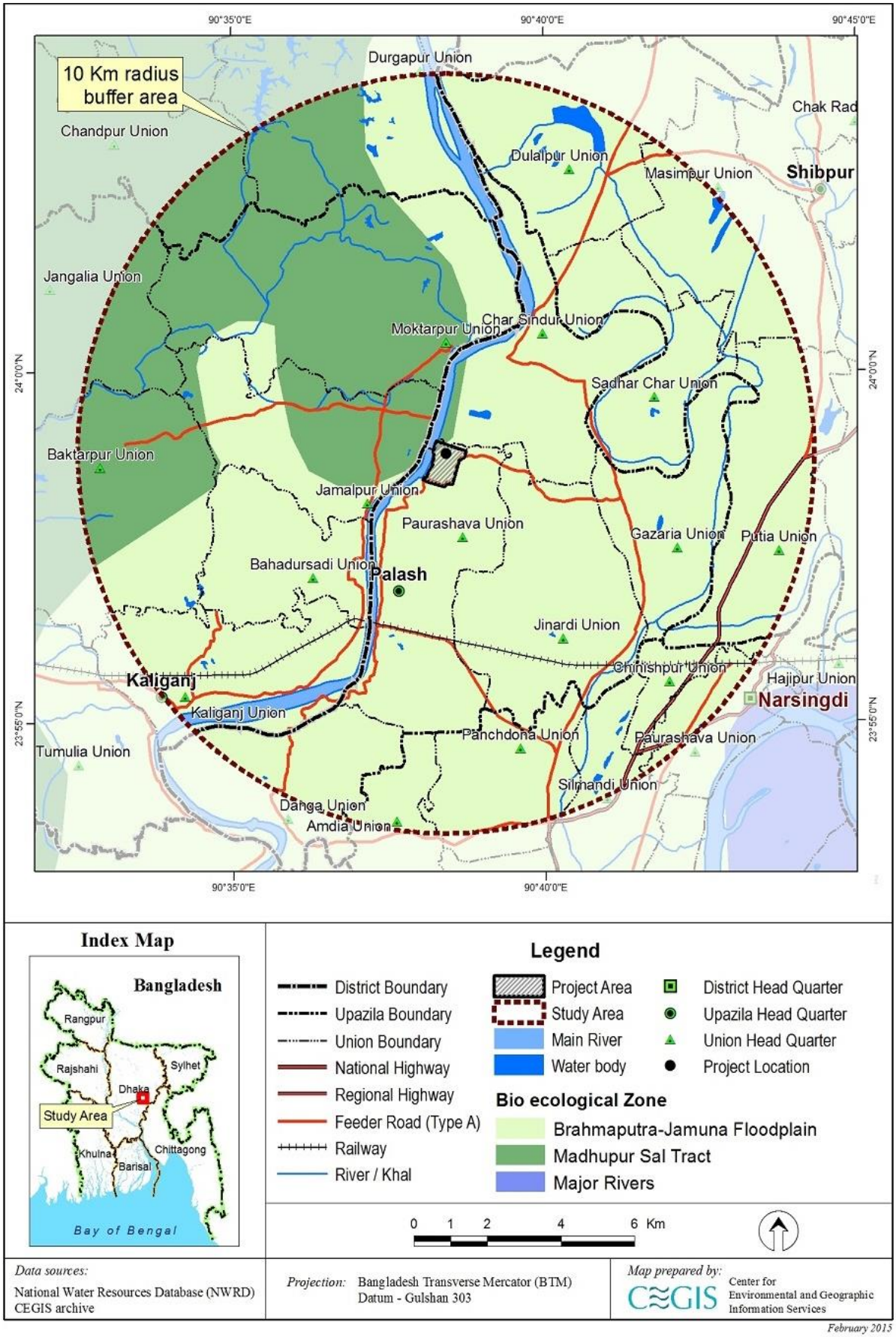



**Figure 6.33: Bio-ecological zone of the study area**

*Crop-field Flora*

498. This ecosystem supports vegetations in association with the crop varieties like rice, jute, pineapple, etc. Detailed information on cropping pattern is available in the agricultural section of this report. Different species of weeds like *Echinochloa colonum, Paspalum distichum, Heliotropium indicum, Drypopteris Sp, Nicotiana plumbaginifolia, Croton bonplandianum, Chynodon dactylon, Panicum repens, Cheratopteris Sp, Heliotropium indicum, Amaranthus spinosus, Centipeda orbicularis and Cyperus Sp*. were found during the field visit. This type of vegetation provides feeding habitats to wildlife.

*Roadside Flora*

499. The slopes and edges of the roads function as roadside ecosystem. The forest department and villagers planted trees under the social forestry program with the aim to generate financial benefits as well as protection of roads from soil degradation. Strip plantation with the mixture of exotic and local species on both sides of the railway line was implemented by the Bangladesh Railway. The major species found during field visits were Rain Tree *(Albizia saman)*, Mahogany *(Swietenia mahagoni)*, Eucalyptus *(Eucalyptus citriodora)*, Goraneem *(Melia azadirachta)*, Sil Koroi *(Albizia procera)*, Bamboo *(Bambusa tulda)*, Akashmoni *(Acacia auriculiformis)* and Sisu *(Dalbergia sissoo)* etc.

*Woodland Flora*

500. Woodland ecosystem mainly observed in the premises of industrial units, power plants, offices within the study area. This ecosystem was dominated by monoculture plantation. Some of the major species were: Mahogany (*Swietenia mahagoni*), Rain Tree (*Albizia saman*) and Papuan Wattle (*Acacia auriculiformis*). Addition to the tree species, mosses, ferns and lichens of different species were also available. This ecosystem supports the community by providing timber, fuel wood and also protection from natural disasters like tornado, cyclone, etc.

*Sal Forest Flora*

501. The forest, which is quite remarkable comprises of Sal or Gajari as a major species. However, due to poor coppicing capability and poor management practices their population has now become very limited. Majority of the area has been replanted by short rotation exotic species and some have been brought under social forestry or participatory agroforestry schemes. Biodiversity has declined rapidly and many animal species have become locally extinct. The abundant plant species of this ecosystem include: Sal *(Shorea robusta)*, Koroi *(Albizzia spp.)*, Raintree (Albizzia saman), Sissoo *(Dalbergia sissoo)*, Bohera *(Terminalia belerica)*, Horitaki *(Terminalia chebula)*, Kanchan *(Bauhinia acuminata)*, Polash *(Butea monosperma)* etc.

**b) Aquatic Flora**

502. The aquatic ecosystem consists of different wetlands such as rivers, canals, ponds and ditches. The wetlands were divided into two types based on the duration of inundation namely: i) Seasonal wetland, and ii) Perennial wetland. The inundated area supports numerous hydrophytes in this study area i.e Lily (*Nymphaea nouchali*), Helencha (*Enhydra fluctuans*), Lotus (*Nelumbo nucifera*) etc. Other dominant aquatic species were Water Hyacinth (*Eicchornia crassipes*), *Ipomoea aquatica*, *Ludwigia repens*, *Pistia strateotes*, *Salvinia natans* and *Azolla pinnata* etc.

### c) Terrestrial Fauna

*Homestead Fauna*

503. The homestead vegetation plays an important role in sheltering a variety of wild animals. Among them, the major ones were: Common Toad *(Duttaphrynus melanostictus),* Cricket Frog *(Fejervarya limnocharis)*, Common Tree Frog *(Polypedates maculates)* under amphibian group; Common Garden Lizard (*Calotes versicolor*), Bengal Monitor (*Varanus bengalensis*), Common Skink (*Mabuya carinata*) as reptiles; Common Myna (*Acridotheres tristis*), Asian Pied Starling (*Sturnus contra*), Red-vented Bulbul (*Pycnonotus cafer*), Oriental Magpie Robin (*Copsychus saularis*), Spotted Dove (*Streptopelia chinensis*), Blue Rock Pigeon (*Columba livia*), Coppersmith Barbet (*Megalaima haemacephala*) and Black-hooded Oriole (*Oriolus xanthornus)* under avifauna; Common Mongoose (*Herpestes edwardsii*), Small Indian Mongoose (*Herpestes auropunctatus*), Asian Palm Civet (*Paradoxurus hermaphroditus*), Common House Rat (*Rattus rattus*), Irrawaddy Squirrel (*Callosciurus pygerythrus*), Greater Short-nosed Fruit Bat (*Cynopterus sphinx)* and Indian Pipistrelle (*Pipistrellus coromandra*) as mammals.

*Crop-field Fauna*

504. The faunal diversity of this ecosystem is a mixture of terrestrial and aquatic wildlife as the crop fields have both terrestrial and aquatic habitats. The major wild fauna of this ecosystem are: Indian Bullfrog *(Hoplobatrachus tigerinus)* as amphibian; Checkered Keelback *(Xenochrophis piscator)* and Buff-striped Keelback *(Amphiesma stolata)* under reptiles; of the avian fauna Black Drongo *(Dicrurus macrocercus)*, Crested Serpent Eagle *(Spilornis cheela)*, Brahminy Kite *(Heliastur indus)*, White-breasted Kingfisher *(Halcyon smyrnensis)*, Pied Kingfisher *(Ceryle rudis)* and Brown Fish Owl *(Ketupa zeylonensis)* available in this type of ecosystem. Of the mammals, Little Indian Field Mouse (*Mus booduga*), Common Mongoose (*Herpestes edwardsii*) and Bengal Fox (*Vulpes bengalensis*) were observed during the major field investigation.

*Roadside Fauna*

505. This ecosystem consists of following wildlife such as Common Tree Frog *(Polypedates maculates)* and Ornate Microhylid *(Microhyla ornata)* under amphibians; Common Garden Lizard (*Calotes versicolor*), Bengal *Monitor* (*Varanus bengalensis*), Common Skink (*Mabuya carinata*), Checkered Keelback (*Xenochrophis piscator*) and Buff-striped Keelback (*Amphiesma stolata*), etc. under reptiles. Common Myna (*Acridotheres tristis*), Asian Pied Starling (*Sturnus contra*), Red-vented Bulbul (*Pycnonotus cafer*), Oriental Magpie Robin (*Copsychus saularis*), Spotted Dove (*Streptopelia chinensis*), Blue Rock Pigeon (*Columba livia*), Coppersmith Barbet (*Megalaima haemacephala*) and Black-hooded Oriole (*Oriolus xanthornus*), etc. frequently found among the avifauna; and Common Mongoose (*Herpestes edwardsii*), Large Indian Civet (*Viverra zibetha*), Little Indian Field Mouse (*Mus booduga*), Irrawaddy Squirrel (*Callosciurus pygerythrus*), and Indian Pipistrelle (*Pipistrellus coromandra*), etc. were observed mammals within the bushes and undergrowths of roadside vegetation.

*Woodland Fauna*

506. The major woodland fauna includes Common Garden Lizard *(Calotes versicolor)*, Common Skink *(Mabuya carinata)*, etc. under reptiles; Common Myna *(Acridotheres tristis)*, Asian Pied Starling *(Sturnus contra)*, Red-vented Bulbul *(Pycnonotus cafer)*, Oriental Magpie Robin *(Copsychus saularis)*, Spotted Dove *(Streptopelia chinensis)* under avifauna; and

Irrawaddy Squirrel *(Callosciurus pygerythrus)* and Indian Pipistrelle *(Pipistrellus coromandra)* as mammalian species.

*Sal Forest Fauna*

507. This ecosystem supports a variety of wildlife, such as Rhesus macaque (Macaca mulatta), Barking deer (*Muntiacus muntjac*), Common Langur *(Semnopithecus entellus)*, Fishing cat *(Prionailurus viverrinus)*, Common Mongoose *(Herpestes edwardsii)*, Irrawaddy Squirrel *(Callosciurus pygerythrus)*, and Indian Pipistrelle *(Pipistrellus coromandra)*, and Bengal Fox *(Vulpes bengalensis)* etc. under mammals; Common Garden Lizard *(Calotes versicolor)*, Bengal Monitor *(Varanus bengalensis)*, under reptiles; Common Myna *(Acridotheres tristis)*, Asian Pied Starling *(Sturnus contra)*, Oriental Magpie Robin *(Copsychus saularis)*, Spotted Dove *(Streptopelia chinensis)* and Black-hooded Oriole *(Oriolus xanthornus)*, etc. under avian fauna; Common Palm Civet *(Paradoxurus hermaphroditus)* habituated in forests, and plantations, farmed areas and human habitations, Sal and mixed-evergreen forests in the study area. Figure 6.34 shows the photographs of the terrestrial ecosystem elements.

*Homesteads vegetation*

*Crop-field vegetation*

*Road-side vegetation*

*Woodland vegetation*

*Sal forest*

*Water monitor*

**Figure 6.34: Terrestrial vegetation of the study area**

### d) Aquatic Fauna

508. The lifecycle of aquatic fauna in the study area depend on the natural fluctuations of water and connectivity with the Shitalakhya River and other wetlands during monsoon. The Skipper Frog (*Euphlictys cyanophlytis*), Indian Pond Heron (*Ardeola grayii*), Little Egret (*Egretta garzetta*), Cattle Egret (*Bubulcus ibis*), White-throated Kingfisher *(Halcyon smyrnensis)*, Common Kingfisher *(Alcedo atthis)*, Asian Openbill *(Anastomus oscitans)*, Little Cormorant *(Microcarbo niger)* and Gangetic River Dolphin *(Platanista gangetica)* were

reported by the local fishermen and boatmen and were sighted during the field investigation of other studies. Figure 6.35 shows the photographs of the aquatic ecosystem elements.

*Shitalakhya River System*

*Wetland in Kanthaliapara of Polash, Narsingdi*

**Figure 6.35: Partial views of aquatic ecosystem**

*Ecosystem of the Project Area*

a) Flora of the Project Area

*Terrestrial Flora*

509. The proposed site was a terrestrial land dominated by woody species such as Mahogany (*Swietenia mahagoni*), Rain Tree (*Albizia saman*) and Papuan Wattle (*Acacia auriculiformis*). Woodland ecosystem mainly observed in the project component area as well as in the surrounding areas of the project site. Apart from woody species, there were some herbs and shrub species found during the field visit. The undergrowth vegetation includes tall grasses, local herbs, and creepers. A few numbers of small fruit yielding trees were also found. Winter vegetable crops such as Beans, Onion, Eggplant, Sweet potato, Daikon Raddish, Cauliflower, Dhundul and Tomatoes were also observed (please see the agriculture section for more details). According to the local people's opinion, crop and fruit yielding plants were damaged for the last couple of years due to ammonia emission from the existing fertilizer industry.

*Terrestrial Fauna*

510. Abundance of grasses, seasonal herbs, creepers and trees support good habitat in terms of roosting and nesting for local birds like Munia (*Lonchura punctulata*), Larks (*Alaudala spp.*), Flycatchers (*Myiarchus crinitus*), Cape starling (*Lamprotornis nitens*), Dove (*Zenaida macroura*), Domestic pigeon (*Columba livia domestica*), Spotted dove (*Spilopelia chinensis*), Shalik (*Acridotheres tristis*), Black drongo (*Dicrurus macrocercus*) etc. Two major types of fox species Bengal Fox (*Vulpes bengalensis*) and Golden Jackal (*Canis aureus*) are most abundant within the proposed industry site. In addition to this, some other faunal species are common dwarf mongoose (*Helogale parvula*), rats and snakes etc available within the project area. Surprisingly, one rare species called Civet Cat (*Viverra zibetha*) was available according to the local people. Most of the wild dwellers are habituated with the present noise limit generated from existing fertilizer industry.

*Aquatic Flora*

511. The existing fertilizer industry area has a lagoon aquatic ecosystem which was used for liquid ammonia storage and discharge. Therefore no aquatic vegetation is available there because of the excessive ammonia effect. In addition to this, the Shitalakhya River flows close to the proposed industry where waste water, warm water and untreated water is currently released. In Shitalakhya River, some aquatic plants like Kochuripana (*Eicchornia crassipes*) and Topapana (*Pistia stratiotes*) were observed during the field visit.

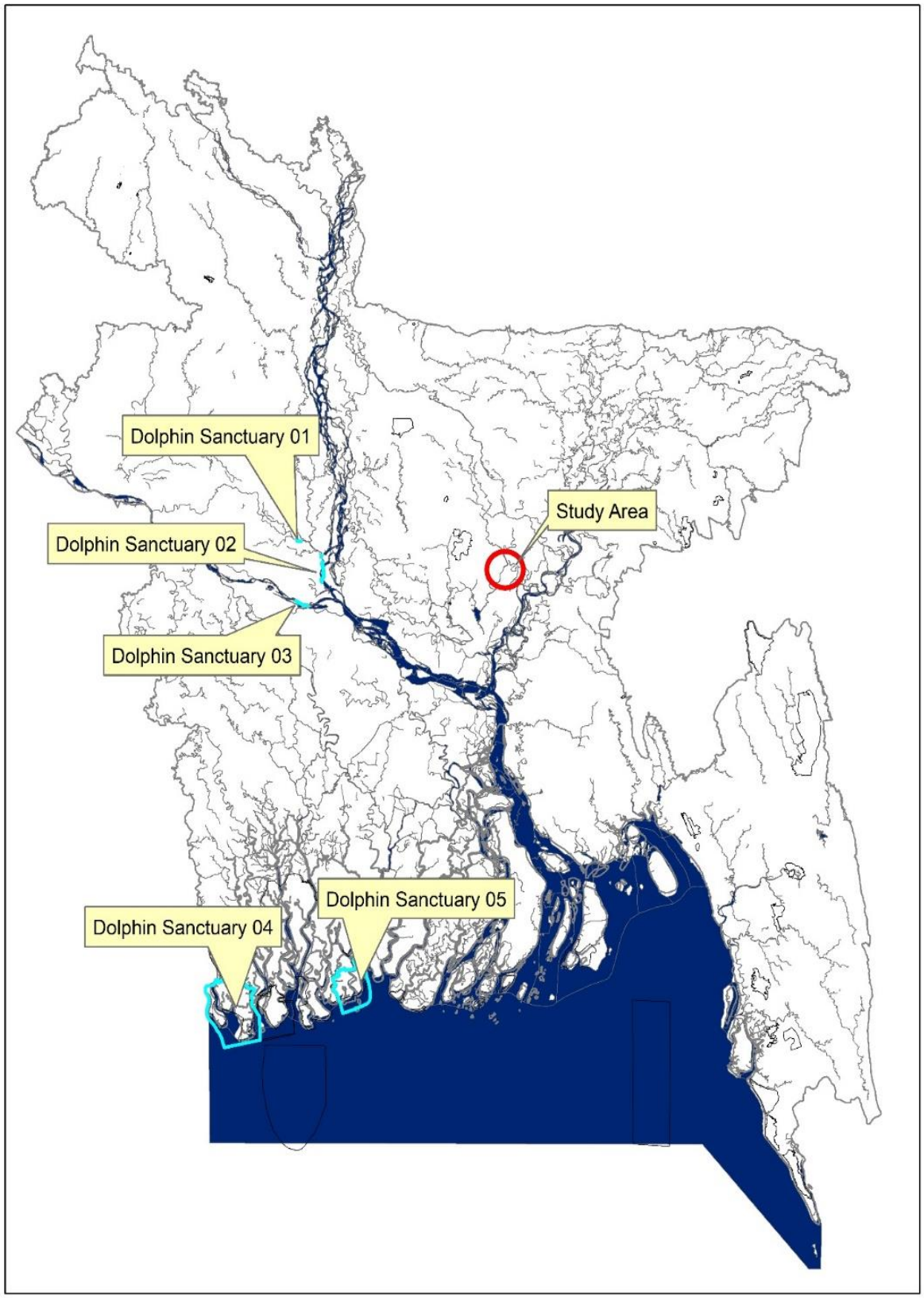
*Aquatic Fauna*

512. Some of the observed birds found in the waterbodies of Shitalakhya River during the field visit were little egret (*Egretta garzetta*), large egret (*Ardea alba*) and little black cormorant (*Phalacrocorax sulcirostris*). (To know more about the fishery resources see the fishery resources section of this report). In addition to this, the Gangetic River Dolphin in the Shitalakhya River near the proposed fertilizer factory was occasionally observed by the locales when waste water discharge was low and in the wet season.

***Presence of Dolphin in the Shitalakhya River***

513. Global population of the Ganges River dolphins is estimated at less than 5,000 while the national population is about 451 individuals (225 in the Sundarbans, 125 in the Karnaphuli River, 38–58 in the Jamuna River and 34–43 in nine groups in the Kushiyara River) (IUCN 2015). There are five established dolphin sanctuaries in Bangladesh territory of which the nearest one (Sanctuary in the Jamuna River) is located approximately 150 km far from the proposed Project site along the river course (Figure 6.36). Given these results, it can be said that the dolphins that are available in the Sitalakhya River are migratory and stay for a very short time during the monsoon.

514. Even though the Shitalakhya River is polluted due to large scale industrial effluents mostly in the downstream, during rainy season the river water becomes diluted and the water become less polluted. Seasonal variation of water quality data from 2014-2018 shows that concentration of all observed water quality parameters increases during dry period compare to wet season (Table 6.29). This indicates that water is less polluted during the monsoon. This less polluted water together with availability of food (such as fish) attracts few river dolphins in the Shitalakhya River for surfing from nearby habitats. However, during dry season water level goes down tremendously as upstream connectivity becomes very weak with the Old Brahmaputra and insigficant water comes from the Banar River (see 6.2.5 Water Resources and Hydrology section). This lower water level reduces fish abundance and increase water pollution which discourage the river dolphins to migrate to the Shitalakhya River. It is important to note that Government of Bangladesh took an initiative for dredging the old Brahmaputra and Dhaleswari river to increase water flow/level of the Shitalakhya River which will surely facilitate dolphin migration during dry season (GoB 2015).




Note: [DS-1: Silanda Nagdemra DS; DS-2: Nagarbari-mohonganj DS; DS-3: Nazirganj DS; DS-4: Dhangmari DS, DS-5: Chandpai and Dudmukhi DS]; Map is not in scale.

**Figure 6.36: Map showing dolphin sanctuaries in Bangladesh and the study area**

**Table 6.29: Seasonal variation of Water Quality in the Shitalakhya River**

| Parameter | Dry season | | | | | Wet Season | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2014 | 2015 | 2016 | 2017 | 2018 | 2014 | 2015 | 2016 | 2017 | 2018 |
| Temp -dry | 25.85±4.57 | 25.85±4.57 | 25.85±4.37 | 28.05±2.49 | 25.4±4.37 | 27.61±0.71 | 27.61±0.71 | 31.11±1.42 | 29.25±2.3 | 28.68±1.62 |
| PH | 8±0.42 | 8±0.42 | 8±0.22 | 7.95±0.25 | 7.53±0.24 | 7.46±0.23 | 7.46±0.23 | 7.68±0.61 | 7.1±0.12 | 7.18±0.24 |
| Conductivity | 471.16±141.93 | 471.16±141.93 | 471.16±53.47 | 376.33±105.66 | 323.05±51.75 | 184.5±99.06 | 184.5±99.06 | 165.96±84.28 | 117±19.93 | 150.33±28.24 |
| Turbidity | 13.56±7.56 | 13.56±7.56 | 13.56±7.05 | 9.93±12.30 | 13.61±2.15 | 64.03±69.37 | 64.03±69.37 | 31.75±37.2 | 68.25±33.98 | 122.9±110.42 |
| Total Hardness | 174.51±15.19 | 174.51±15.19 | 174.51±17.50 | 157.91±25.48 | 158.91±15.26 | 90.33±48.79 | 90.33±48.79 | 78.31±30.17 | 74.48±19.91 | 72.91±12.11 |
| Mg-hardness | 74.93±14.15 | 74.93±14.15 | 74.93±21.01 | 49.78±10.23 | 41.66±7.04 | 42.1±23.47 | 42.1±23.47 | 25.38±16.54 | 39.93±25.82 | 26.58±7.7 |
| Total Alkalinity | 163.45±15.20 | 163.45±15.20 | 163.45±27.20 | 184.5±40.67 | 165.48±10.66 | 84.25±48.01 | 84.25±48.01 | 87.15±35.19 | 77.7±20.31 | 65.51±5.09 |
| Ammonium | 2.08±1.20 | 2.08±1.20 | 2.08±2.07 | 2.28±3.61 | 4.06±0.13 | 0.26±0.16 | 0.26±0.16 | 0.49±0.35 | 0.36±0.1 | 0.5±0.83 |
| Chloride ion | 10.88±3.01 | 10.88±3.01 | 10.88±3.33 | 8.02±5.09 | 13.45±0.49 | 9.61±5.77 | 9.61±5.77 | 6.83±2.82 | 5.95±2.84 | 8.36±1.4 |
| Sulphate ion | 5.88±2.00 | 5.88±2.00 | 5.88±2.41 | 5.05±1.27 | 3.28±0.61 | 4.5±1.77 | 4.5±1.77 | 2.9±0.48 | 4.95±2.78 | 4.23±1.28 |
| Silica | 17.63±8.54 | 17.63±8.54 | 17.63±6.77 | 18.38±5.44 | 21.7±4.32 | 7.53±3.56 | 7.53±3.56 | 4.56±0.49 | 8.4±4.07 | 9.43±2.58 |
| Total Iron | 0.01±0.00 | 0.01±0.00 | 0.015±0.02 | 0.05±0.06 | 0.06±0.02 | 0.01±0 | 0.01±0 | 0.07±0.03 | 0.16±0.16 | 0.05±0.03 |
| Total Dissolve Solid | 266.16±57.08 | 266.16±57.08 | 266.16±50.84 | 293.83±17.47 | 271.5±25.84 | 201.16±36.48 | 201.16±36.48 | 306.5±64.3 | 265±56.26 | 294.33±76.38 |
| Suspended Solid | 76.25±161.14 | 9.5±6.016 | 76.25±1.72 | 5.83±2.42 | 8.66±1.63 | 65.83±65.65 | 65.83±65.65 | 7.16±0.98 | 11.6±3.2 | 40.33±31.73 |
| Do | 5.5±0.77 | 5.5±0.77 | 5.5±0.85 | 6.31±1.31 | 6.43±0.29 | 4.28±0.63 | 4.28±0.63 | 6.13±0.59 | 5.86±0.57 | 4.45±0.87 |
| BOD | 3.28±0.78 | 3.28±0.78 | 3.28±0.54 | 4.18±1.77 | 5.06±1.35 | 2.90.72 | 2.9±0.72 | 4.71±0.86 | 6.7±2.13 | 4.28±1.1 |
| COD | 8.85±1.43 | 8.85±1.43 | 8.85±1.42 | 8.96±2.14 | 8.48±1.29 | 8.66±1.34 | 8.66±1.34 | 10.88±0.66 | 9.93±1.37 | 6.76±1.25 |

*Source: BCIC, 2018*

### *Biomass and Carbon Stock in Trees of the Project Site*

515. A total of eight plots were established within the project bounding site. All the plots were 10x10m except one road side plot which is 20x5m. All the individual tree species >5 cm were identified. Later, diameter at breast height (1.37 m) and height was measured in the field. Total biomass of trees were estimated by adding above and below ground biomass. A non-destructive method of biomass and carbon estimation was applied in this study. A generic allometric model developed by Chave et al. (2014) was used for measuring the biomass because of its wide acceptability in measuring tropical region tree biomass. Below ground biomass was calculated considering 15% of above ground biomass (Mac-Dicken 1997). After calculating biomass, carbon content was calculated based on the assumption that carbon content is 50 percent of the woody biomass (Brown 1997). Above Ground Biomass (AGB) is identified as Y and carbon was calculated on a per-hectare (ha) basis. The model for above ground biomass estimation is as follows:

$$AGB=0.0673 \times (\rho D^2 H)^{0.976}$$

Where, Y = above ground biomass in Kg; H = Height of the trees in meter; D = Diameter at breast height (1.37m) in cm; ρ = Wood density (i.e. Wood density is the oven dry mass per unit of green volume) in units of g/cm$^3$.

516. Table 6.30 shows the total biomass and organic carbon stock. Total average biomass and carbon stock of the investigated plots were 2479 and 1239 t/ha respectively. There was no strong variation exist in the biomass and carbon stock of the investigated transect (Table 6.31). However, Plot- 5 has the highest amount of biomass (700 t/ha) and carbon (350 t/ha) among all the observed plots. This is because of the presence of large size trees. Among the observed tree species Mahagony (*Swietenia macrophylla*) has the highest amount of biomass (1,816 t/ha) and carbon (1,044 t/ha). All the other species has less amount of biomass and carbon storage because of less density of those species. Hence, it can be said that because of massive tree felling, a large amount of carbon will release to the atmosphere which will contribute to global warming.

**Table 6.30: Total average biomass and carbon stock**

| Plot | AGB (t/ha) | BGB (t/ha) | Total Biomass (t/ha) | AGC (t/ha) | BGC (t/ha) | Total Carbon (t/ha) |
|---|---|---|---|---|---|---|
| 1 | 173.66 | 26.05 | 199.71 | 86.83 | 13.02 | 99.85 |
| 2 | 331.88 | 49.78 | 381.66 | 165.94 | 24.89 | 190.83 |
| 3 | 182.43 | 27.36 | 209.79 | 91.21 | 13.68 | 104.90 |
| 4 | 191.55 | 28.73 | 220.28 | 95.77 | 14.37 | 110.14 |
| 5 | 609.05 | 91.36 | 700.40 | 304.52 | 45.68 | 350.20 |
| 6 | 102.27 | 15.34 | 117.61 | 51.14 | 7.67 | 58.81 |
| 7 | 177.90 | 26.69 | 204.59 | 88.95 | 13.34 | 102.29 |
| 8 | 387.17 | 58.08 | 445.25 | 193.59 | 29.04 | 222.62 |
| Total | **2155.90** | **323.39** | **2479.29** | **1077.95** | **161.69** | **1239.64** |

*Note: AGB-Above ground Biomass, BGB-Below ground biomass, AGC-Above ground carbon, BGC-Below ground carbon*

**Table 6.31: Species wise average biomass (t/ha) and carbon (t/ha) stock in the sampled plots**

| Species | AGB (t/ha) | BGB (t/ha) | Total Biomass (t/ha) | AGC (t/ha) | BGC (t/ha) | Total Carbon (t/ha) |
|---|---|---|---|---|---|---|
| *Acacia auriculiformis* | 104.58 | 15.69 | 120.27 | 52.29 | 7.84 | 60.14 |
| *Terminalia arjuna* | 28.71 | 4.31 | 33.02 | 14.36 | 2.15 | 16.51 |
| *Syzygium cumini* | 28.49 | 4.27 | 32.77 | 14.25 | 2.14 | 16.38 |
| *Albizia saman* | 177.19 | 26.58 | 203.77 | 88.60 | 13.29 | 101.89 |
| *Swietenia macrophylla* | 1816.92 | 272.54 | 2089.46 | 908.46 | 136.27 | 1044.73 |

*Note: AGB-Above ground Biomass, BGB-Below ground biomass, AGC-Above ground carbon, BGC-Below ground carbon*

## 6.4 Social Environment

517. Baseline scenario on the state of socio-economic environment is sketched out for the study area. The clipped areas were matched with the existing administrative boundaries and in doing so, the required data were collected from both primary and secondary sources. Here, methods for primary data collection include Rapid Rural Appraisal (RRA), Key Informant Interviews (KIIs), Group Discussions (GDs), Observation and Informal Consultations. On the other hand, relevant secondary data/information were collected from Population and Housing Census, 2011 (BBS, 2012).

### *6.4.1 Area and Location*

518. Unions located into the delineated study for the proposed fertilizer plant were considered for assessing the Socio-Economic baseline condition. Thus, the study area includes 22 unions under 5 Upazilas of two districts: Gazipur and Narsingdi. The habitations/villages around the Project site are as follows: Khanepur on the North, Nargana on the West, Ghorasal Pourashava/Municipality on the South and Uttar Deora on the East. The population of the habitations are (in 2018): Khanepur- 10,483; Nargana- 6,022; Uttar Deora- 4,595 and Ward No. 1 of Ghorasal Municipality- 4,182.

### *6.4.2 Population*

*Demography*

519. The study area has a population of 526,463 (BBS, 2012) comprising of 114,503 households. Of the total population; 261,856 (49.7%) are male and 264,607 (50.3%) female. The average population density is 2,088 per square kilometer which is more than double compared to national average (1,055), Table 6.32. Most of the households, about 69%, (Figure 6.37) in the study area comprises of four or more members. The average size is 4.6, which is slightly higher than the national average of 4.46 (BBS, 2012).

**Table 6.32: Basic demographic profile of the study area**

| District | Upazila | Unions/ Paurasavas | HHs[8] | Population | | | HH size | Population density [sq. km] |
|---|---|---|---|---|---|---|---|---|
| | | | | Male | Female | Total | | |
| Gazipur | Kaliganj | Bahadursadi | 6,659 | 15,511 | 16,303 | 31,814 | 4.8 | 1709 |
| | | Baktarpur | 3,325 | 6,957 | 7,421 | 14,377 | 4.3 | 1111 |
| | | Jamalpur | 7,323 | 16,400 | 16,404 | 32,804 | 4.5 | 1652 |
| | | Jangalia | 1,088 | 2,535 | 2,657 | 5,192 | 4.8 | 785 |
| | | Kaliganj Paurashava | 8,219 | 20,580 | 17,842 | 38,422 | 4.7 | 1456 |
| | | Moktarpur | 8,691 | 19,400 | 19,735 | 39,135 | 4.5 | 1049 |
| | Kapasia | Chandpur | 601 | 1,408 | 1,380 | 2,788 | 4.6 | 732 |
| | | Durgapur | 3,574 | 7,681 | 8,326 | 16,007 | 4.5 | 956 |
| Narsingdi | Narsingdi Sadar | Amdia | 1,922 | 4,731 | 4,644 | 9,375 | 4.9 | 2078 |
| | | Chinishpur | 5,516 | 12,880 | 12,559 | 25,440 | 4.6 | 10672 |
| | | Narsingdi Paurashava | 6,804 | 15,873 | 16,150 | 32,024 | 4.7 | 2150 |
| | | Panchdona | 5,720 | 13,507 | 13,168 | 26,675 | 4.7 | 2491 |
| | | Silmandi | 3,276 | 7,848 | 7,277 | 15,125 | 4.6 | 3301 |
| | Polash | Char Sindur | 5,959 | 12,817 | 13,354 | 26,171 | 4.4 | 1902 |
| | | Danga | 4,916 | 11,609 | 11,191 | 22,800 | 4.6 | 2659 |
| | | Gazaria | 5,693 | 12,829 | 13,330 | 26,159 | 4.6 | 1968 |
| | | Ghorasal Paurashava | 6,755 | 14,803 | 15,447 | 30,250 | 4.5 | 2250 |
| | | Jinardi | 6,755 | 14,803 | 15,447 | 30,250 | 4.5 | 1190 |
| | Shibpur | Dulalpur | 4,648 | 10,187 | 11,030 | 21,218 | 4.6 | 475 |
| | | Masimpur | 3,076 | 6,938 | 7,508 | 14,446 | 4.7 | 1587 |
| | | Putia | 9,533 | 21,412 | 21,800 | 43,212 | 4.5 | 2458 |
| | | Sadhar Char | 4,449 | 11,146 | 11,633 | 22,779 | 5.1 | 1302 |
| Total/Average | | | 114,503 | 261,856 | 264,607 | 526,463 | 4.6 | 2088 |

*Source: BBS, 2012.*

[8] HHs refers to households