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## CHAPTER 1 ENVIRONMENTAL POLICIES AND INSTITUTIONS

### 1.1 National Policies and Legal Framework

#### (1) Basic Law and Policies

The National Environmental Policy (NEP, 1992) concerns in the water sector are broadly similar to the fisheries policy, and this was echoed as a result of the National Environmental Management Action Plan studies. The objectives of the NEP are to: (1) maintain ecological balance and overall development through protection and improvement of the environment, (2) protect the country against natural disasters, (3) identify and regulate activities which pollute and degrade the environment, (4) ensure environmentally-sound development in all sectors, (5) ensure sustainable, long-term and environmentally sound use of all national resources, and (6) actively remain associate with all international environmental initiatives to the maximum possible extent.

The National Environment Management Action Plan (NEMAP) is published in 1992. NEMAP highlights the need for integrated management of wetlands, for emergency response systems and improved disaster preparedness, and for the Char management systems. Main action regard to environment is follows:

- Environmental audit on an emergency basis is to be conducted. Steps to mitigate the adverse impact of on the environment identified in the audit will be taken through modification of the projects
- EIA will be incorporated in all new projects and adverse impacts will be prevented through proper steps and adequate investment
- Treatment of domestic water before discharging into water bodies is to be strictly enforced, and also water and road developments should not impede drainage and sewerage
- Rivers, canals and other water bodies to be dredged to increase water holding capacity and navigability
- Artificial recharge of aquifers and rectification of projects to prevent further decline of the aquifer to be taken up

#### (2) Laws Regulating Environment

The Environmental Conservation Act (ECA, 1995) is currently the main legislative framework document relating to environmental protection in Bangladesh, which repealed the earlier Environment Pollution Control Ordinance of 1977. It is expedient to provide for the conservation, improvement of environmental standard and control and mitigation the pollution of the environment. The ECA provides general legislation laying down principles for obtaining environmental clearance for major new development projects or expansion and modernization of

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existing industry in Bangladesh. The Act will be implemented through the Rules and Regulations document and subsequent revisions by the Department of Environment (refer to Figure 1.1).

The Environment Conservation Rules (ECR, 1997) are the first set of rules, promulgated under the Environmental Conservation Act. The rules address three main issues, (1) to establish new procedures to be complied with by the developer of a new facility or operator of any exists facility, to obtain environmental clearance to operate the facility, (2) to establish the National Environmental Quality Standards for ambient air, various types of water, industrial effluent, emission, noise, vehicular exhaust, etc., and (3) requirement of IEE/EIA according to categories of industries and other development interventions (refer to Table 1.1 to 1.6).

### National Water Policy (1998)

The policy sets forth herein is considered essential for addressing the objectives of improved water resources management and protection of the environment. Every public agency, every community, village and each individual should play an important role in ensuring that the water and associated natural resources of Bangladesh are used judiciously so that the future generations can be assured of at least the same, if not better, availability and quality of those resources. It comprises the following important issues: (1) River Basin Management, (2) Planning and Management of Water Resources, (3) Water Rights and Allocation, (4) Public and Private Involvement, (5) Public Water Investment, (6) Water Supply and Sanitation, (7) Water and Agriculture, (8) Water and Industry, (9) Water, Fisheries and Wildlife, (10) Water and Navigation, (11) Water for Hydropower and Recreation, (12) Water for the Environment, (13) Water for Preservation of Haor, Baors, and Beels, (14) Economic and Financial Management, (15) Research and Information Management, and (16) Stakeholder Participation Management, (15) Research and Information Management, and (16) Stakeholder Participation.

### The Protection and Conservation of Fish Act, 1950

This Act is applicable for the protection and conservation of fish in Bangladesh. The Act can prohibit or regulate the construction, temporary or permanent, of weirs, dams, bunds, embankments and other structures.

### The Acquisition and Requisition of Immovable Property Ordinance, 1982

Establishes a procedure for the acquisition and requisition of immovable property for development, which may be applicable when acquiring the land necessary for the different components of the project, (1) Land Acquisition: Whenever it appears to the Deputy Commissioner that any property in any locality is needed or is likely to be needed for any public purpose or in the public interest, they shall cause a notice to be published at convenient places on or near the property in the prescribed form and manner stating the property is proposed to be acquired, (2) Compensation: There is a well defined procedure set out in the legislation relating to land acquisition when it comes to paying compensation for an acquired piece of land.

### **(3) Procedure for Initial Environmental Examination and Environmental Impact Assessment**

#### Initial Environmental Examination (IEE)

This document aims to fulfill the needs of an IEE. The study will:

- Identify the project's key environmental issues
- Evaluate their potential significant impact
- Recommend possible mitigation/abatement measures
- Monitoring program for the significant environmental issues.

This document is the out come of the preliminary study, it sets out to scope the likely to issues to be raised by the project and to identify mitigation measure as seen fit at this early stage of planning. All issues will be investigated and evaluated in more depth during the EIA study.

#### Environmental Impact Assessment (EIA)

The EIA is a detailed study of both the positive and negative impacts arising from the proposed development. The study aims to identify relevant issues at an early stage, therefore, allowing for their incorporation in the planning and design process. Within the EIA, impacts arising from both construction and maintenance of the probable structures for flood proofing need to be assessed, in terms of its individual and cumulative effects upon existing environment. In addition to identifying potential impacts the EIA will provide an environmental management and monitoring plan for the development activities.

#### Environmental Clearance

In order to obtain environmental clearance from DOE a developer must undertake a number of steps. The procedures for individual projects vary depending on its classification. Proposed developments can fall under four categories, Green, Amber-A, Amber-B and Red.

The rural development focusing on flood proofing project falls into the Red category and therefore the several steps should be undertaken.

Following the ECR 1997, the DOE divisional authority issues their decision within 30 working days for IEE and 60 working days for EIA. The clearance issued is valid for one year and requires renewal 30 days prior to the expiry date (refer to Figure 1.2 to 1.4).

### **1.2 Environmental Administration**

Key government institutions that are involved in environmental management along with their

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relevant implementing agency and the key pieces of environmental legislation that fall within each institution's jurisdiction are:

### Ministry of Environment and Forest (MOEF)

The MOEF is the key government institution in Bangladesh for all matters relating to national environmental policy and regulatory issues. The MOEF oversees the activities of the following technical / implementing agencies.

- Department of Environment (DOE)
- Forest Department (FD)
- Bangladesh Forest Industries Development Corporation (BFIDC)
- Bangladesh Forest Research Institute (BFRI) and Institute of Forestry
- Forestry Division of the Bangladesh Agricultural Research Council (BARC) and
- National Herbarium.

#### 1) Department of Environment (DOE)

The DOE was set up in 1989 under the jurisdiction of the MOEF, and is the executing agency for planning and implementing of all environmental issues. The DOE has at present a total of 173 staff, headed by a Director General (DG) who is supported by a team of Directors, Deputy Directors, Assistant Directors, Engineers, and other technical staff (e.g. chemists and laboratory technicians). The DOE has four regional offices, 30 monitoring stations (not functional) and one laboratory, which contain outdated equipment with little analytical capability. The main problem is that the DOE is both technically and financially under researched and cannot as yet make adequate provision for training, routine monitoring or analysis.

And main activities are:

- Reviewing environmental impact assessments and issuing of environmental clearance where appropriate;
- Implementing environmental monitoring program including ambient environment monitoring and enforcement measures
- Control, monitor and mitigate pollution of the environment
- Provide environmental clearance for proposed industrial projects.

#### 2) Forest Department

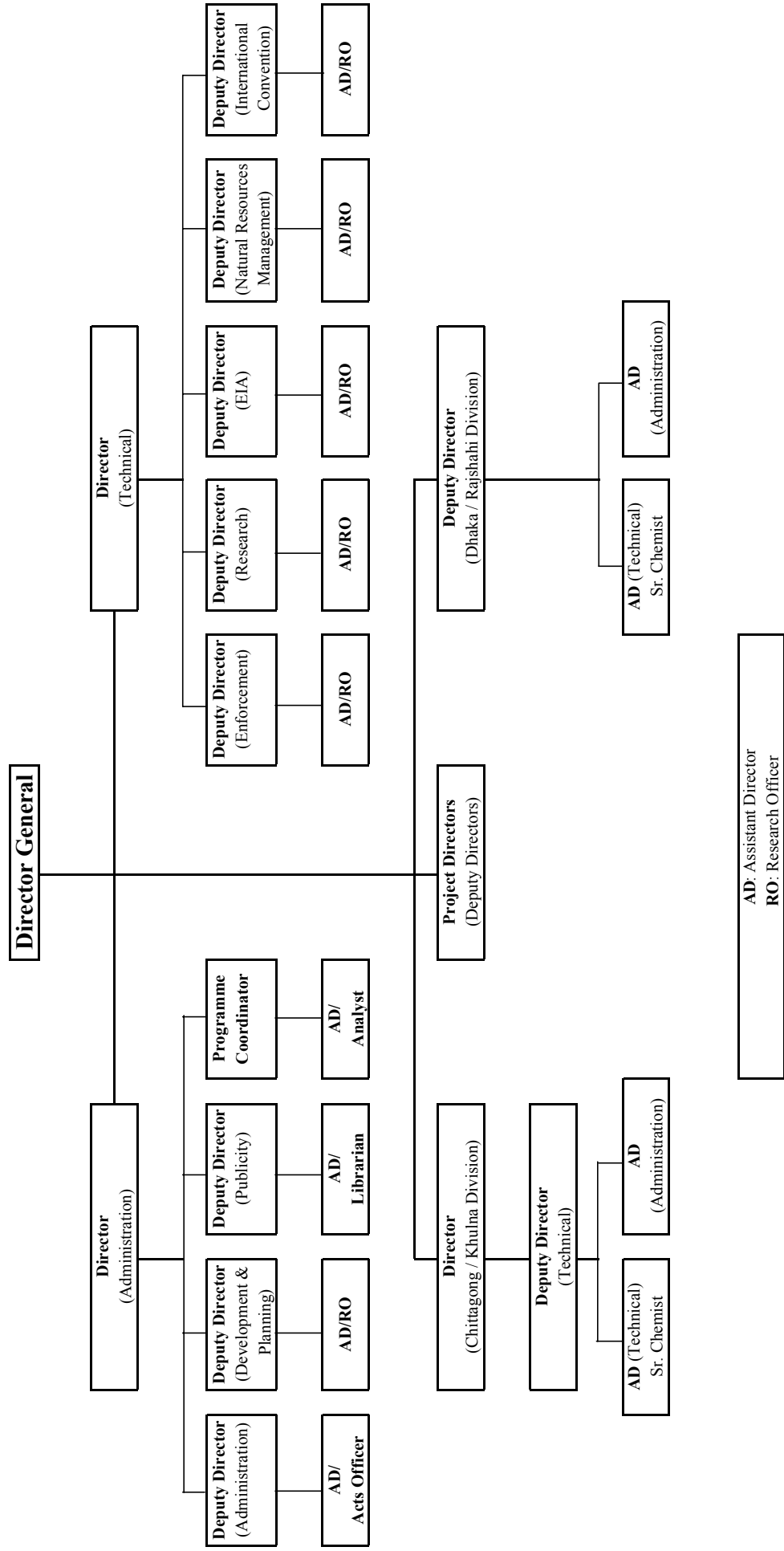
This Department under the Ministry of Environment and Forest is responsible for protection and management of all Reserve Forests of the country. Its manpower extends down to the union level in areas where there are Reserve Forests. It has recently started some agro-forestry programs. The Forestry Department officers are also responsible for protection of wildlife in the forests.

### **1.3 Main International Legislation Related to Environment**

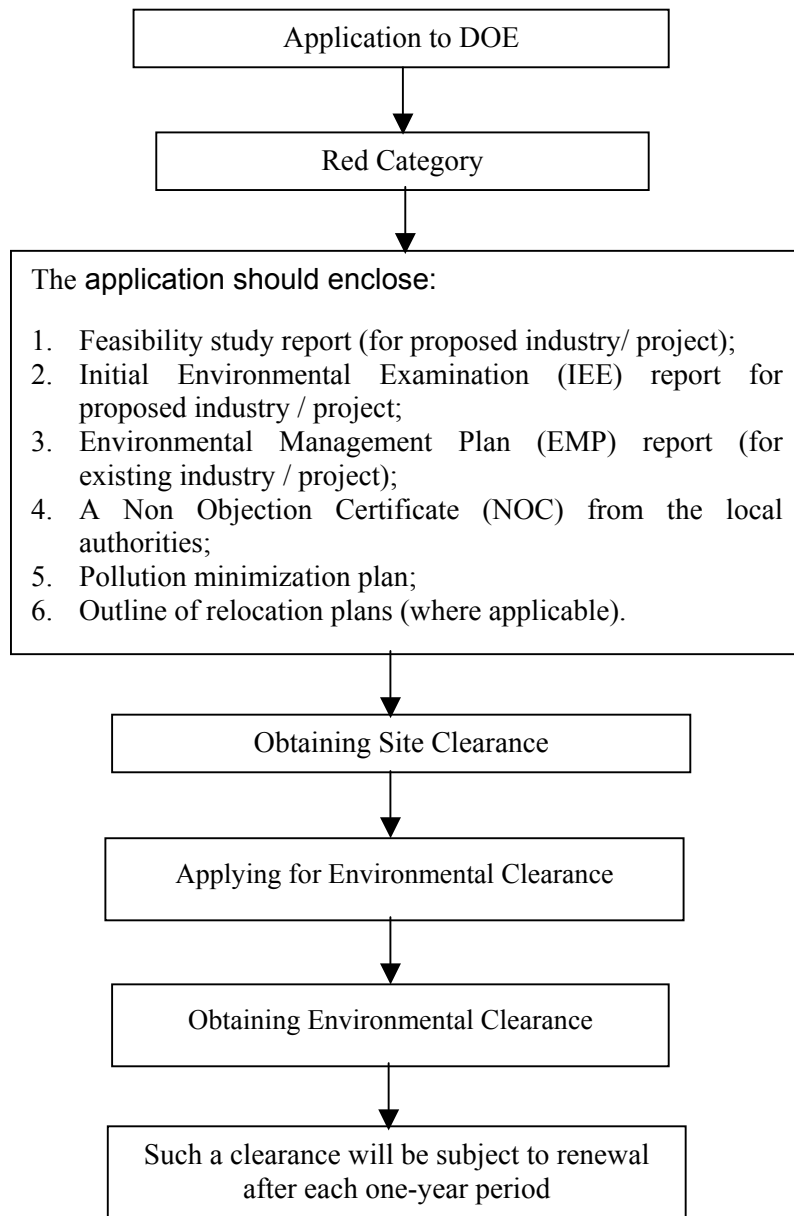
The Convention of Biological Diversity (1992) signed by over 150 countries and ratified by Bangladesh in 1994 requires each signatory nation to develop national strategies, plans or programs for the conservation and sustainable use of biological diversity. No rare or sensitive ecosystems have been observed within the biological habitats of the area.

Convention on Wetlands of International Importance as Waterfowl Habitats (1971) RAMSAR is ratified by Bangladesh in 1992. Aims to stem encroachment on habitats including coastal beaches, coastal waters and tidal flats through promoting the wise use of all protected areas.

Convention Concerning the Protection of the World Cultural and Natural Heritage (1972) (World Heritage Convention) ratified by Bangladesh in 1983. Aims to protect the outstanding natural or man-made features considered the heritage of more than one state. Mankind as a whole has certain rights with respect to conserving such features. The Convention can be applied to habitats but is unlikely to be applicable within the study area.

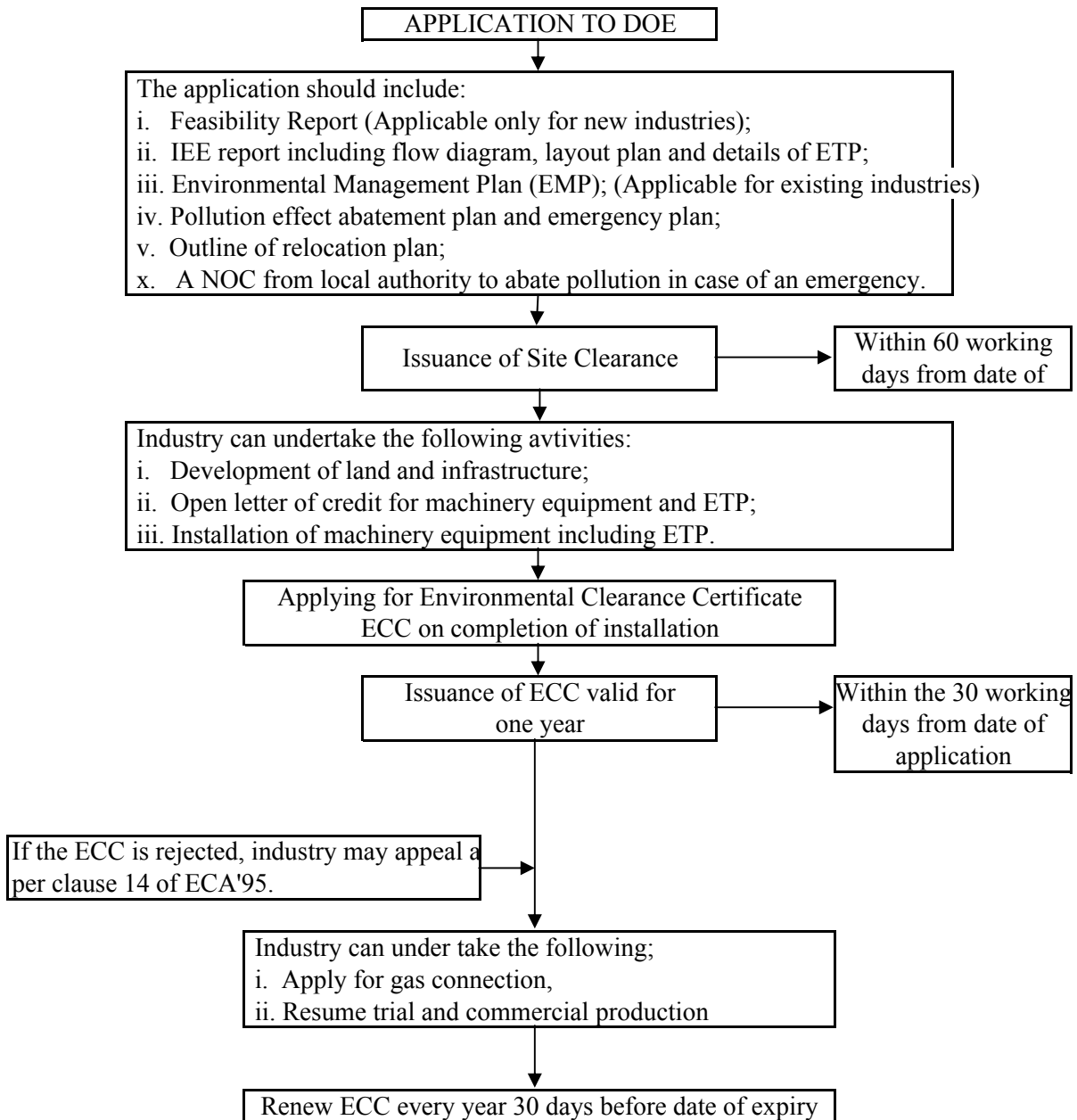


**Figure 1.1 Organizational Structure of the Department of Environment (DOE)**



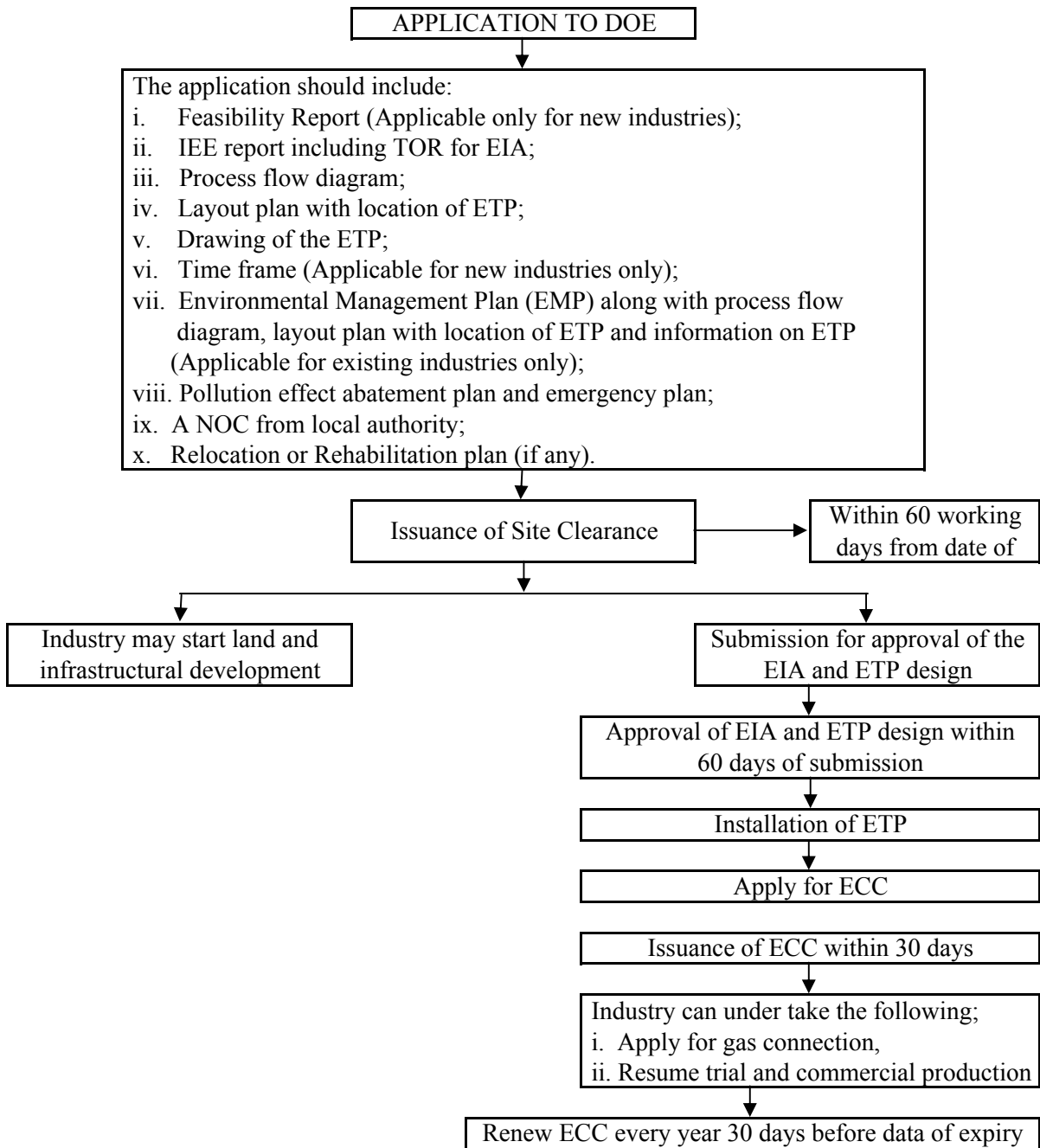
**Figure 1.2 Steps Involved in Environmental Clearance**





Note: 1) IEE; Initial Environmental Examination  
 2) EIA; Environmental Impact Assessment  
 3) ECA'95; Environmental Conservation Act  
 4) ETP; Effluent Treatment Plant  
 5) NOC; No Objection Certificate  
 6) ECC; Environmental Clearance Certificate  
 Source: Environmental Conservation Rules, 1997

**Figure 1.3 Steps Involved in Environmental Clearance for Orange B Category of Industries**



Note: 1) IEE; Initial Environmental Examination  
 2) EIA; Environmental Impact Assessment  
 3) TOR; Terms of Reference  
 4) ETP; Effluent Treatment Plant  
 5) NOC; No Objection Certificate  
 6) ECC; Environmental Clearance Certificate  
 Source: Environmental Conservation Rules, 1997

**Figure 1.4 Steps Involved in Environmental Clearance for Red Category of Industries**

**Table 1.1 Classification of different Industrial Units or Projects Based on Impact and Location related to the Proposed Projects/Programs**

<b>Classification</b>	<b>Industrial Units or Projects</b>
<b>A. Green Category</b>	(1) Rope, Mat, Floor Mat (Cotton, Jute and synthetic) (2) Motor Cycle, Bicycle, Toy Bicycle Assembly (3) Bamboo, and Cane Products (4) Candle
<b>B. Orange A Category</b>	(1) Cattle Farm (2) Poultry (up to 1,000 birds in rural area) (3) Agriculture Machinery and Equipment
<b>C. Orange B Category</b>	(1) Brick/Tile (2) Stone Crushing, Cutting, Grinding (3) Fish, Meat, Food Processing (4) Electrical Cable (5) Poultry (above 1,000 birds in rural area) (6) Road Construction/Reconstruction/Extension (feeder road, local street) (7) Bridge Construction/Reconstruction/Extension (below 100 meters length)
<b>D. Red Category</b>	(1) Flood Control Dam, Polder, Dike etc. Construction/Reconstruction/Extension (2) Road Construction/Reconstruction/Extension (3) Bridge Construction/Reconstruction/Extension (width 100 meters or over)

Note: 1) Green and Orange A category don't need Initial Environmental Examination (IEE) report on the steps involved in environmental clearance for the application to Department of Environment (DOE).

2) Orange B category is needed IEE report including flow diagram, layout plan details of effluent treatment plant.

3) Red category is needed IEE report including terms of reference for Environmental Impact Assessment (EIA).

Source: Environmental Conservation Rules, 1997

**Table 1.2 Air Quality Standards**

Sl. No.	Area	Density in micrograms per m <sup>3</sup>			
		Suspended Particulate Matter (SPM)	Sulfur Dioxide	Carbon Monoxide	Nitrogen Oxide
a)	Industrial & mixed	500	120	5,000	100
b)	Commercial & mixed	400	100	5,000	100
c)	Residential & Rural	200	80	2,000	80
d)	Sensitive	100	30	1,000	30

Note: 1) National monuments, health center/hospital, Archeological site, educational institute and areas declared by government are included under Sensitive Area.

2) Industrial units not located in designated industrial areas shall not discharge or emit any pollutant which may deteriorate the air quality in the areas c) and d) of above Table.

3) Suspended Particulate Matter (SPM) means airborne particles of diameter of 10 microns c

**Table 1.3 Inland Surface Water Quality Standard**

<b>Best Practice based classification</b>	<b>pH</b>	<b>BOD mg/l</b>	<b>Dissolved Oxygen mg/l</b>	<b>Total Coliform Bacteria quantity/ml</b>
(a) Potable water source supply after bacteria freeing only	6.5 - 8.5	2 or less	6 or above	50 or less
(b) Water use for recreation purpos	6.5 - 8.5	3 or less	5 or above	200 or less
(c) Potable water source supply after conventional processing	6.5 - 8.5	3 or less	6 or above	5,000 or less
(d) Water used for pisciculture	6.5 - 8.5	6 or less	5 or above	5,000 or less
(e) Industrial use water including chilling and other processes	6.5 - 8.5	10 or less	5 or above	-
(f) water used for irrigation	6.5 - 8.5	10 or less	5 or above	1,000 or less

Note: 1) Maximum amount of ammonia presence in water are 1.2 mg/l (as nitrogen molecule) which is used for pisciculture.

2) For water used in irrigation Electrical Conductivity: 2.25 mS/cm (at 25 °C)

3) Sodium: less than 26 mg/l

4) Boron: less than 2 mg/l

Source: Environment Conservation Rules, 1997

**Table 1.4 Potable Water Quality Standard**

<b>Sl. No.</b>	<b>Parameter</b>	<b>Unit</b>	<b>Standard Limit</b>
1	Aluminium	mg/l	0.2
2	Ammonia (NH <sub>3</sub> )	mg/l	0.5
3	Arsenic	mg/l	0.05
4	Barium	mg/l	0.01
5	benzene	mg/l	0.01
6	BOD (20°C)	mg/l	0.2
7	Boron	mg/l	0.005
8	Cadmium	mg/l	75
9	Calcium	mg/l	150 - 600
10	Carbon tetrachloride	mg/l	0.01
11	1,1 Dichloroethylene	mg/l	0.001
12	1,2 Dichloroethylene	mg/l	0.03
13	Tetrachloroethylene	mg/l	0.03
14	Trichloroethylene	mg/l	0.09
15	Pentachlorophenol	mg/l	0.03
16	2,4,6 Pentachlorophenol	mg/l	0.03
17	Chlorite	mg/l	0.2
18	Chloroform	mg/l	0.09
19	Coliform (fecal)	nos./100ml	0
20	Coliform (total)	nos./101ml	0
21	Color	Huyghens unit	15
22	Copper	mg/l	1
23	Cyanide	mg/l	0.1
24	Detergents	mg/l	0.2
25	DO	mg/l	6
26	Fluoride	mg/l	1
27	Alkalinity (as CaCO <sub>3</sub> )	mg/l	200 - 500
28	Iron	mg/l	0.3
29	Nitrogen (total)	mg/l	1
30	Lead	mg/l	0.05
31	Magnesium	mg/l	30 - 35
32	Manganese	mg/l	0.1
33	Mercury	mg/l	0.001
34	Nickel	mg/l	0.1
35	Nitrate	mg/l	10
36	Nitrite	mg/l	Less than 1
37	Odor	-	Odorless
38	Oil and Grease	mg/l	0.01
39	pH	-	6.5 - 8.5
40	Phenolic compounds	mg/l	0.002
41	Phosphate	mg/l	6
42	Phosphorus	mg/l	0
43	Potassium	mg/l	12
44	Radioactive materials total alpha radiation	Bq/l	0.01
45	Radioactive materials total beta radiation	Bq/l	0.1
46	Selenium	mg/l	0.01
47	Silver	mg/l	0.02
48	Sodium	mg/l	200
49	Suspended solid particles	mg/l	10
50	Sulfide	mg/l	0
51	Sulfate	mg/l	400
52	Total soluble matter	mg/l	1,000
53	Temperature	°C	20 - 30
54	Tin	mg/l	2
55	Turbidity	J.T.U.	10
56	Zinc	mg/l	5

Source: Environmental Conservation Rules (ECR), 1997

**Table 1.5 Noise Quality standards**

Sl. No.	Zone Class	Limits in dB <sub>a</sub>	
		Day	Night
a)	Silent	45	35
b)	Residential	50	40
c)	Mixed	60	50
d)	Commercial	70	60
e)	Industrial	70	70

- Note: 1) The day time is considered from 6 am to 9 pm. The night time is considered from 9 pm to 6 am.  
 2) From 9 at night to 6 am in the morning is considered night time.  
 3) Area within 100 meters of hospital, educational institution, and designated government are considered Silent Zones. Use of motor vehicle horn or other signals and loudspeaker are forbidden in Silent Zones.  
 4) Mixed Zone is used combinedly as residential, commercial and industrial purposes.

**Table 1.6 Noise Quality Standard for Motor vehicle or Mechanised Vessel**

Vehicle Type	Standard Limit	Remark	Unit in dB <sub>a</sub>
Motor Vehicle*	85	Measured at 7.5m from exhaust pipe	
	100	Measured at 0.5m from exhaust pipe	
Mechanised Vehicle	85	Measured at rest and empty at 2/3 of rotation speed at 7.5m from vessel	
	100	Measured in same position at 0.5m from vessel	

- \* During measurement, the motor vehicle should be at rest and the condition of engine as follows:  
 a) Diesel Engine at maximum rotation speed.  
 b) Gasoline Engine at 2/3 of maximum rotation speed and weightless acceration.  
 c) Motor Cycle at 2/3 of maximum speed for above 5,000 rpm, 3/4 of maximum speed upto 5,000 rpm.

## CHAPTER 2 EXISTING ENVIRONMENTAL CONDITION

### 2.1 Natural Conditions

#### 2.1.1 Meteorology

##### Char Area

Seasons: The seasons of Char area are not different then those of the country in general. As a rule January and February months are cold and dry seasons. March, April and May are hot, but have some wet days, and there are occasional storms from the northwest varied by breezes from the south and southeast. June, July and August are almost entirely wet, while September is wet and steamy with a hot sun. From June to September is the monsoon season. October has 7 or 8 wet days while November usually has 3 to 4 stormy days, but otherwise the weather is fine and dry and a northerly wind blows. December is cold and fine.

Temperature: The monthly average maximum temperature is lowest in December (23.4 °C) and highest in May (36.3 °C) at the Rangpur station. The monthly average minimum temperature is lowest in January (9.8 °C) and highest in August (26.4 °C) at the Rangpur station. At the station Bogra the monthly average maximum temperature is lowest in December (24.2 °C) and highest in June (33.8 °C). The monthly average minimum temperature is lowest in January (11.2 °C) and highest in August (26.5 °C) at the station Bogra.

Humidity: In Char area the humidity of the atmosphere is lowest in March from April there is a steady increase till July. With the commencement of the monsoon in June there is a large increase; but though cloud is greatest and rainfall heaviest, humidity does not reach its maximum till September, when there is about 89% of saturation. During the whole monsoon it varies from 82% to 89% (for the year 1997, BBS).

Rainfall: Bangladesh Meteorological Department (BMD) has established two stations for monitoring climate Bogra and Rangpur. The monthly rainfall in millimeter of these two station for the year 1997 are presented in the following:

Month Station	January	February	March	April	May	June	July	August	September	October	November	December	Total
Bogra	10	11	9	140	102	199	298	245	220	29	2	27	1,292
Rangpur	19	14	3	113	230	276	523	338	467	16	2	27	2,028

Source: Bangladesh Meteorological Department



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### Haor Area

Seasons: There are four, more or less, distinct seasons in Haor area relative to the annual hydrological cycle. Calendar period December to March is the dry season, which is the drought hydrological cycle. Pre-monsoon season with flash floods hydrology is within the calendar months April and May. From June to September the area is belonging to the flooding hydrology and this is known as monsoon season. And post-monsoon season from October to November rules another with drainage hydrology.

Temperature: The monthly average maximum temperature is lowest in January (25.1 °C) and highest in August (32.6 °C) at Sylhet station. The monthly average minimum temperature is lowest in January (12.1 °C) and highest in August (25.5 °C) at the Sylhet station. At the station Mymensingh the monthly average maximum temperature is lowest in December (23.9 °C) and highest in May (32.1 °C). The monthly average minimum temperature is lowest in January (10.6 °C) and highest in August (26.4 °C) at the station Mymensingh.

Humidity: The humidity of the atmosphere is lowest in February from April there is a steady increase till June. With the commencement of the monsoon in June there is a large increase; but though cloud is greatest and rainfall heaviest, humidity does not reach its maximum till August, when there is about 89% of saturation. During the whole monsoon it varies from 84% to 89% (for the year 1997, BBS).

Rainfall: Rainfall in Haor area, due to differences of elevation and the increasing height of the hills towards the east and northeast, it varies considerably from place to place, the amounts usually augmenting towards the north.

The Bangladesh Meteorological Department (BMD) has established two stations for monitoring climate, namely Sylhet and Mymensingh. The monthly rainfall in millimeter of these two station for the year 1997 are presented in the following:

Month Station	January	February	March	April	May	June	July	August	September	October	November	December	Total
	Sylhet	1	27	112	170	347	797	678	492	947	31	23	19
Mymensingh	1	12	31	172	131	410	524	424	488	8	11	20	2,232

Source: Bangladesh Meteorological Department

### 2.1.2 Physiography

The Jamuna and the Old Brahmaputra with their main tributary the Tista and a good number of small tributaries constitute the largest flood plain of Bangladesh. Excepting for a small portion in the north, the entire flood plain lies within the Table Land region. The flood plain and the Table Land almost completely cover the Char area. The elevation of the major part of the flood plains of the area varies from 3m to 14m above mean sea level. The average elevation of the Table Land is most likely to be more than 15m above mean sea level. Small swamps have formed in the shallow valleys of the Table Land due to poor drainage. The Table Land, a product of Pleistocene vertical upheaval looks like a chain of isolated circular or elongated low hillocks standing at a higher level than the surrounding flat alluvium. The Table Land and the sediments underlying it are affected by a series of faults.

#### Haor Area

Flood Basin, Lowland Floodplains, and Uplands these three main landform units are found in the Study Area. The Flood basin landform unit is characterized by large saucer-shaped seasonally flooded, inter fluvial area known as haors which small, permanent lakes, called beels, exist. Flood Basin is the dominant landform throughout the unit, occupying almost two-thirds of the project area. The basin is believed to have evolved as an alluvial and shallow lacustrine deposition into a rapidly subsiding trough. Land elevations typically range between 3 and 7 m PWD. Distributary spill channels and other old partially infilled channels, which at one time connected the Surma River system to the Kushiara River, traverse much of the land.

The Lowland Floodplains have been created as a result of deposition and erosion from the Surma and Kushiara rivers. The Upland landform occurs in the northeastern and south-western part of the Study Area.

### 2.1.3 Soil Resources

General soil type and soil textures in Char and Haor area are quite different and are shown below:

<b>Char Area</b>		<b>Haor Area</b>	
Soil type	% of total	Soil type	% of total
Non Calcareous alluvium	56	Non calcareous alluvium	6
Non Calcareous gray flood plain	13	Non calcareous gray flood plain	48
Non Calcareous dark gray flood plain	1	Non calcareous dark gray flood plain	3
Non calcareous brown flood plain	<1	Acid Basin Clays	31
Calcareous brown flood plain	<1	Peat	<1
Calcareous dark gray flood plain	<1	Grey piedmont soil	1
Total	73	Total	90
<b>Soil texture</b>		<b>Soil texture</b>	
Organic matter	-	Organic matter	<1
Sandy	27	Sandy	<1
Loamy	72	Loamy	12
Clayey	1	Clayey	87
Total	100	Total	100

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Source: FAO/ UNDP, 1988. Report 2: Land Resources Appraisal of Bangladesh for Agricultural Development.

The percentage of soil types are calculated on the basis of 73 percent and 90 percent respectively for Char and Haor area. Approximately 27 percent of Char area and 10 percent of Haor area excluded for homestead, water bodies, etc. during calculation of soil types.

The soils of Haor area are normally clay to clay loam, high in organic matter. pH is 4.7 to 4.9 and potassium (K) bearing minerals are medium where as in Char area, the soils are sandy to silty loam, very low in organic matter. and sub soil pH is 7.5 to 7.9 and K-bearing minerals are medium.

In Char area two major soil types Non-calcareous alluvium (56%) and Non Calcareous Grey Flood plain (13%) occur and a brief description these two types are given below.

**Non-Calcareous Alluvium:** This soil type comprises gray olive-green soil of newly deposited sand and silt and moderately developed silt loam or silty clay loam sub-soil. Topsoil pH is 5.5-7.0 and subsoil pH is neutral to alkaline (pH 7-8) but not calcareous. Organic matter content is 1.5 percent.

**No calcareous Gray Flood Plain Soils:** This soil type comprises gray silt loam to silty clay loam. Organic matter content is 1-2 percent in the topsoil and less than 1 percent in the sub-soil. Topsoil pH is 5.0-7.3 and sub-soil pH is neutral to moderately alkaline (pH 6.6-8.1).

In Haor area also two major soil types exist viz., non-calcareous Gray Flood Plain and Acid Basin Clay that are described bellow:

**Non-Calcareous Gray Flood Plain Soils:** These are seasonally flooded soils. Topsoil is generally Grey or olive Grey. Texture ranges from loam in ridge soil to clay in basin soil. Soil pH is acidic (pH 4.5-5.5). Organic matter content ranges between 0.5-2 percent in ridge soil and 2-4 percent in basin soil. Sub-soil pH is 6-7 in ridge soil but basin soil pH is 4.8-6.7.

**Acid Basin Clays:** This soil type comprises gray and dark gray heavy clay and is strongly acidic (pH < 5) and occupy in the basin centers. The organic matter content is 2-5 percent. Soil becomes very hard on drying and is being cracked.

### 2.1.4 Land Resources

The present Study Area for Char consists of 14 Upazilas within 4 districts having, 150,000 ha under Agro-Ecological Zone (AEZ)- 7. The Char area comprises unstable alluvial land along the Brahmaputra-Jamuna Rivers where land is constantly formed and eroded by shifting river channels. The Haor area consists of 4 districts and 29 Upazilas covering almost entire Sylhet basin and occupies the lower, western side of the Surma-Kushiyara flood plain under AEZ-21 having 400,000 ha of land.

Land Type : The land types as reflected by the depth of flooding during peak monsoon in Char and

Haor area are shown below:

Area (%)	High Land F <sub>0</sub>	Medium High Land F <sub>1</sub>	Medium Low Land F <sub>2</sub>	Low Land F <sub>3</sub>	Very Low Land F <sub>4</sub>	Homestead and Water bodies	Total
Char	5	37	20	8	0	30	100
Haor	< 1	4	19	43	23	11	100

Source: FAO/ UNDP, 1988. Report 2: Land Resources Appraisal of Bangladesh for Agricultural Development

The Char area is also subjected to early flash and sometime late floods. In Char area, 7 Upazilas flash, 4 Upazilas early and 3 Upazilas reported late flood out 10 Upazilas visited. The flooding is shallow on higher part and deep on lowest part.

The Haor area is subjected to early and flash floods causing damages to Boro and summer crops. In Haor area, 11 Upazilas out of visited 13 Upazilas have been reported occurrence of flash floods. Drainage congestion is reported from Sunamganj, Derai, Jamalganj, Habiganj, Baniachang, Kishoreganj and Netrokona in Haor area and Gaibanda, Belkuchi, Sirajganj and Sarishabari in Char area. The flooding is caused by both clear and silty water. Floodwater drains out rapidly from the ridges but the basins (Haor) stay wet for most or whole dry season.

Land Use: Single Boro rice area both local and HYV ranges 32 % in Kishoreganj and 98% in Ajmiriganj and Mitamain of Haor area. Deep-water Aman is grown on some basin margins and transplant Aman on higher ridges. Dry land Rabi crops are grown on higher land near the rivers. The cropping intensity is the lowest 95% in Mitamain of Kishoreganj district and highest 210% in Netrokona Sadar Upazila. The cropping intensity of Mohanganj, Madan and Khaliajuri Upazilas are 144, 161 and 105 percent respectively (DAE, Netrokona, 2000). Some Haor areas are under reed- swamp or grassland for dry season cattle grazing.

The Char land is brought under cultivation within 2-3 year of alluvial deposits. The common crops are early Aush rice, transplant Aman, wheat, Jute Cheena, Rabi Pulses, Groundnut, and Sugarcane. Boro rice is gradually replaced by Wheat. The cropping intensity is 95% in Nageswari and 150% in Belkuchi Char area.

### 2.1.5 Surface Water Quality

During the FAP-6 study surface water quality was measured for the river Kalni near Gazaria and downstream of Kakailseo. And the test results revealed that the river water quality in all sections is relatively good and characterized by high turbidity and concentrations of suspended solids. The concentrations of oxygen consuming organic matter, nutrients, heavy metals and toxic elements are within the permissible limits for natural surface water in Bangladesh.

In the Kalni River at Ajmiriganj and Markuli, the suspended sediment concentrations averaged from 500 to 1,000 mg/l during the monsoon season, with peak values exceeding 1,400 mg/l at high

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flows. During the dry season, background suspended sediment concentrations were typically 50 to 100 mg/l. the total suspended sediment load carried by the Kalni river in 1995 was estimated to be approximately 8 million tons.

### 2.1.6 Ground Water Quality

It is very essential to know about the quality of ground water as because exceeds of arsenic and iron especially arsenic in the ground waters in most parts of the country. For one of the components of the flood proofing study the ground water quality has been measured under “Agriculture and Water Use Survey”. This data was averaged for Char and Haor area. Ground water quality (pH, Fe and As) of Char and Haor area is given below:

No.	Parameters	Unit	Char Area	Haor Area
1.	PH	-	6.60 – 7.13	6.30 – 7.13
2.	Iron (Fe)	mg/l	0.05 – 9.30*	0.62 – 19.2**
3.	Arsenic (As)	mg/l	0.00 – 0.025	0.00 – 0.055

\* 9.30 in Shaghata, Gaibandha

\*\* 19.2 in Baniachang, Habiganj

Drinking water standard in Bangladesh is 6.5-8.5 as pH, 0.3-1.0mg/l as iron. Though not a danger to human health, iron in concentrations exceeding standard has been identified, especially Haor area. On the other hand, Arsenic is a major threat to human health. The GOB currently adopts a standard of 0.05mg/l as the limit of acceptability of arsenic in water for human consumption, compared with the WHO standard of 0.01mg/l. It is now generally accepted that the source is geological, transported by rivers from sedimentary rocks in the Himalayas.

And in the Arsenic Mitigation Water Supply Project, arsenic contents of tube-well in Sirajganj district were surveyed on 360 wells. The 2 wells are shown arsenic contents than 0.05 mg/l of water quality standard limited in Bangladesh (refer to Table 2.1).

## 2.2 Ecological Conditions

The study was carried out in the four districts of Char area and four districts of Haor area. About 23 Char and Haor areas under the 23 Upazilas of 8 Districts have been studied. The preliminary assessment of existing flora (wetland and terrestrial) and wildlife including fishes were investigated. A detailed and comprehensive ecological study needs to be under taken as a part of the EIA study.

### 2.2.1 Habitats

#### (1) Char Area

##### Gaibandha

The major chars are Kharjani char, Kundarpara char of Sadar Upazila, Rasulpur of Fluchari Upazila under Gaibandha district. These areas are rich in wildlife including migratory birds and aquatic fauna. The big river flows besides the district. As a result aquatic flora is not good but endangered fauna is present. The floral diversity is interesting. Many species are newly growing. Every year, succession diversity of char land is distinct in this way. The existing flora and fauna are listed in the Table 2.2, 2.3, 2.4, 2.7 and 2.8.

##### Jamalpur

There are many chars in the district of Jamalpur. Such as Pachalia char of Sadar Upazila, Baghmara char, Helanchabari char, Chataria char, Awalgacha char, Maznabari char, Shishua char of Sharishabari Upazila and Kalikapur char, Baniamir char, Chandkumarir char, Madanir char of Dewanganj Upazila. These areas are mostly under cultivation of Rice, Chenabadam, Dhaincha, Sugarcane, Jute, Til, Kowan, and other vegetables. The char areas are rich in biodiversity including fauna (various birds, fishes, dolphin) and flora. The plant diversity is almost same as various char area. The existing flora and fauna are listed in the Table 2.2, 2.3, 2.4, 2.7 and 2.8.

##### Kurigram

There are many important chars in the Kurigram district such as Nonkhaowa char, Berubari char, Ancharer hat char, Kutibari char, Muria char, Pathmatha char, Narayanpur char of Nagerwari, Ramnar char, Bandalar char of Chilmari and Madhabram char of Sadar Upazila etc. These areas are rich in migratory birds, and wildlife including endangered fauna. The floral diversity of Char area is minimum as every year sediment formation in char area is going on and thus floral diversity is hampered regularly. The existing flora and fauna are listed in the Table 2.2, 2.3, 2.4, 2.7 and 2.8.

##### Sirajganj

The mighty Jamuna River flows through the district of Sirajganj and there are many branches of river within Sirajganj. The major chars are Shohag pur char, Sardul char, Khijirmitta char; Bardul

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char and Bigga char of Sadar and Delwar char, Enayetpur char, Makimpur char, and Betil char of Belkuchi. During this time different types of crops were cultivated in char area e.g. Jute, Chenabadam, Sugarcane, Til, Kowan, Dhan-cha, etc. Some sisso (*Dalbergia sisso*) plant died by the pathogen attacked in the stem-root system of the plant. About 200 plants died of this species by the roadside from Kaddar more to Belkuchi Upazila office under Sirajganj district. The existing flora and fauna are listed in the Table 2.2, 2.3, 2.4, 2.7 and 2.8.

### (2) Haor Area

The project area supports two types of wetland e.g., permanent wetland (includes rivers, canals, perennial water bodies and fishponds) and seasonal wetland. Most of the Study Area supports seasonal wetland; while permanent wetlands provide refuge and shelter for most of the aquatic flora and fauna, the seasonal wetland serve as the grazing ground for fish and other aquatic animals like freshwater turtles. It may also provide substratum of many species of turtles to lay eggs. The changes in the physical characteristics of wetland have direct impacts on its dependent flora and fauna. The fluctuation or changes in the population dynamics of the biological diversity define the biomass productivity of the wetland.

#### Habiganj

The major haors of Habiganj district are the Hazaora haor, Mondia haor, Gardair haor, borzini haor (Ajmirigonj), Talan haor, Sundar haor, Chatal haor, marabat haor, Khumarbon haor (Baniachang), Gungajhury haor (Sadar), etc.

The experts visited three or more haors in the district of Habiganj e.g. Gungajhuri haor of Sadar Upazila, Halia haor of Ajmirigonj and Abda haor of Baniachung Upazila. Every year the haor areas remain under water for six months. This is the main feature of the haor area. In dry season, farmers cultivate the land of haor and thus produce huge amount of rice. The haor areas are rich in bio-diversity e.g. flora and fauna especially fishes, birds, aquatic fauna, etc. The indicator plants of haor e.g. Hijal, Korocho, Bongolap, etc. are depleted in the haor areas. The existing flora and fauna are listed in the Table 2.5, 2.6, 2.7 and 2.8.

#### Kishoreganj

The common haor of Kishoreganj district are the Janshi haor of Bajitpur, Holanghahi haor of Mithamain, Baksuvilla haor of Sadar Upazila. The wildlife and flora are very much depleted for the cultivation.

Pesticide and chemical fertilizer uses in the haor basin ultimately affected the fish and important aquatic flora and fauna. As a result degradation of wetland habitats of haor areas is continuing. The existing flora and fauna are listed in the Table 2.5, 2.6, 2.7 and 2.8.

#### Netrokona

The investigation was done in the major haors of Netrokona district e.g. Kaira haor (Madan), Kaliabgua haor (Barhatta) and Netrokona Sadar. These areas are mostly under cultivation of rice. The diversity of flora is minimum and fauna especially the migratory birds and fishes are very rich in these haor areas. The adverse effects on flora and fauna of haor basin are still going on for the encroachment by the local people. The indicator plants of haor e.g. Hijal, Barun, Koroch, Ban golap is depleted in the haor basin for unwise uses of haor land. The existing flora and fauna are listed in the Table 2.5, 2.6, 2.7 and 2.8.

### Sunamganj

Bangladesh has been a contracting party to the Ramsar convention since 1992, and the Sundarbans is the only Ramsar site of Bangladesh. Tanguar haor, which is in the district of Sunamganj, is the proposed wetland protected area under Ramsar Act.

There are many haors in Sunamganj District e.g. Tanguar haor (Taherpur), Dekhar haor, Shanir haor, Maittani haor and Khar chala (Sadar), Spetir haor, Chayer haor, Katua haor, Nalua haor of Derai Upazila, etc. This is locally called Haor District. Three or more haor areas were visited in which Dekhar haor is typically rich in bio-diversity. The haor has the trees like Hijal, Koroch, and Ban golap but unfortunately did not find the Satamuli-Asperagus racemosus. Different types of other wetland flora are also present in this haor basin. The aquatic or wetland fauna including fishes and birds are present in the haor basin. The Halir haor of Jamalganj Upazila is under plantation in some part by Koroch tree. Hijal tree minimum and other aquatic or wetland flora and fauna are also present and the encroachment of Gucchagram (organized village) at the haor basin is observed. Spetir haor, Chayer haor of Derai Upazila have almost the same wetland flora and fauna. The existing flora and fauna are listed in the Table 2.5, 2.6, 2.7 and 2.8.

### **2.2.2 Wetland Flora**

Wetland flora plays a vital role for bio-diversity conservation. There are many areas of the wetlands in the country. The areas of wetlands have been estimated at 7 to 8 million hector or about 50% of the total land surface of Bangladesh. Unfortunately, these resources have been suffered considerably from the impacts of burgeoning human population. The wetland habitat is characterized by anaerobic condition, which prohibits plant growth. A group of plant knows as hydrophytes, adapted to withstand these conditions colonize wetland habitat length of hydro-period, soil type and flood tolerance is keys to the vegetation development and community dynamics. The following types of aquatic or wetland flora exists in the Study Area e.g., submerge, free floating, rooted floating, sedges, meadows, reed swamps, freshwater swamp, forestland marginal plants. Wetland floral diversity is maxim from June to December of the year. So, further study will be needed knowing the detailed about the wetland floral diversity in both Char and Haor areas (refer to Table 2.2 and 2.5).



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### 2.2.3 Wetland Fauna

#### Char Area

The Char area is quite different from Haor area of Bangladesh but rich in bio-diversity. It supports faunal habitat and also play an important role for fish breeding ground during the rainy season. The areas have very few or no trees but bushes and the ground soil act sometime as a habitat for some amphibia, reptile, birds and mammals. Some endangered wildlife is also identified during the field survey (refer to Table 2.7).

#### Haor Area

The Haor area is rich in bio-diversity especially for the fauna including fishes. Different type of native fishes is still present in Haor area in a moderate number. These haor areas also support different seasonal wildlife and their habitat as the areas inundate for six month of the year and the rest of the months it is dry up. Some endangered wildlife and fishes are identified during the field survey (refer to Table 2.7).

### 2.2.4 Terrestrial Flora

Many terrestrial flora in Char area including medicinal, food, fodder, timber yielding plants, etc. were observed and listed in the Table 2.3.

Many important plant species were observed in Haor area like medicinal plant e.g. Chatim (*Alstonia scholaris*), Bontulshi (*Ocimum sanctum*), Sonalu (*Cassia fistula*), Swetadron (*Leucas arpera*), Akond (*Calotropis procera*), Fodder, Timber yielding, etc (refer to Table 2.6).

### 2.2.5 Terrestrial Fauna

#### Char Area

The Char area of Bangladesh is a suitable habitat for some terrestrial wildlife. It also supports two types of wildlife in two different seasons as the area inundates for six months of the year. In rainy season, some local migratory birds come here and stay for some months to breed and then backed. Some endangered wildlife is identified during the field survey. A list of terrestrial fauna for char area is listed in the Table 2.8.

#### Haor Area

Different types of the wildlife species are the core component of the terrestrial fauna in Haor area. Wildlife fauna is abundant during the rainy season. In dry season, Haor acts as nesting ground for the terrestrial wildlife especially for the birds. Both dry and rainy season, Haor naturally produce plenty of food for the terrestrial and wetland wildlife. As a result, different type of migratory birds also visits these areas for some months for taking food, shelter, nesting etc. A list of

terrestrial fauna for Haor area is listed in the Table 2.8.

### **2.2.6 Endangered Plants and Animals**

#### Endangered Plants

Bangladesh has no publication of Red Data Book on endangered plant species. A tentative list of 27 vascular plants threatened in Bangladesh (Khan, 1990). Another reports has about 40 plant species of threatened in Bangladesh (Rahman, 1999). The Char and Haor area is rich in plant diversity. The endangered species of plants may be present. Further study will be needed in the Study Area to get more detail information.

#### Endangered Animals

The World Conservation Union (IUCN) has identified a total of 54 freshwater fishes and 147 wildlife species. But more study is needed for knowing the whole information/picture of the endangered wildlife and fish fauna for the Char and Haor areas. Based on the secondary data a list of Critically Endangered, Endangered & vulnerable wildlife and fish fauna in the Study Area is listed in Table 2.9.