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BGD/86/037

Noakhali North Drainage and Irrigation Project
Feasibility Study
Volume 3 - Annex D
Ecology

October, 1993

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NOAKHALI NORTH DRAINAGE AND IRRIGATION PROJECT
FEASIBILITY STUDY

ANNEX D - ECOLOGY

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CHAPTER D.1

INTRODUCTION AND ENVIRONMENTAL SETTING

D.1.1 General

The floodplains of Asia have been inhabited and modified for many centuries and as a result, works for transport, settlements, irrigation, drainage, flood protection and other infrastructure have caused the disappearance of many of the original features of the floodplain. Bangladesh is no exception as much of the country is a dynamic delta region with approximately 80% of its total land lying within the floodplains of the Ganges-Brahmaputra-Meghna, a delta of some 40,225 square kilometres (Verghese, 1990; Rashid, 1991).

Habitat alterations have continued to occur throughout most of the country and more recently within the South East Region, substantial schemes include the Chandpur Irrigation Project and the Meghna-Dhonaghoda Scheme, both of which are now known to have caused considerable changes to the aquatic habitats in the region.

Recently, there has been an increase in the awareness regarding the effects that these changes are causing to the environment and there has also been a realisation that some of these changes are detrimental to the natural resources on which the people of Bangladesh rely for their every day lives and survival. As a result, some of the projects currently being proposed have started to take the environment into account and have produced a few precious accounts of the ecology and/or environmental situation in their particular areas. The recent reports produced by FAP 2 on the functional ecology of the North West Region and the Wet lands Specialist Study produced by FAP 6 on the environments of the North East Region are especially important. However, with the exception of a recent study on the ecology of the Gumti Phase II area, there are no studies that can be directly linked to the ecology of the Noakhali North study area in particular.

D.1.1.1 Scope and Limitations of the Ecology Study

The main objective of the ecology component of the Noakhali North Feasibility Study was to carry out an evaluation of the biological natural resources of the area, in terms of existing floral and faunal species, in order to form a baseline towards a better understanding of the interaction between the natural and the human environments.

In general, both the terrestrial and aquatic ecology surveys focused on a variety of habitats within the study area such as Khals, marshes, ponds, fields, etc. Unfortunately, 1992 -the year when the field data was collected- was an unusually dry year and the floodplain was virtually non-existent. Other habitats of note within the floodplain were also identified and preliminary findings are presented in the following chapters. Given that the purpose of the study was to provide guidance in predicting the likely ecological changes due to FDC/I interventions, the approach adopted for this study was to attempt to identify the biodiversity in the area, in terms of existing species and main habitats to try to unravel the links between the natural resources and their utilisation by the human population in the study area.

The term 'Biodiversity' as defined in the Global Biodiversity Strategy (WRI/IUCN/UNEP, 1992) includes the totality of genes, species and ecosystems in a region or the world. It is divided into three hierarchical categories: genetic, species and ecosystem diversity.

The ecological importance of the Noakhali North study area lies in its role as a breeding, feeding and nursery area for a large number of species, both terrestrial and aquatic, of which fish occupy a significant place. This was confirmed by the high number of fish species recorded, both directly during the catch surveys as well as indirectly from fishermen's reports. This aspect has been dealt with in the Fisheries Annex F and is also included in the fish ecology section of this Annex. It is believed that this number of species would increase if a longer study were to be carried out in the area. In addition, the area lies in the main migration route path for an important number of migratory species which travel upstream and downstream of the Meghna River.

It must be emphasized that to carry out such an evaluation properly, a detailed ecological assessment of the interactions between the ecosystem and the use of these resources by the local human population is indispensable. It is therefore beyond the scope of this project to attempt to assess the existing environmental situation in detail, given the short period of time available.

D.1.1.2 The Noakhali North Study Area

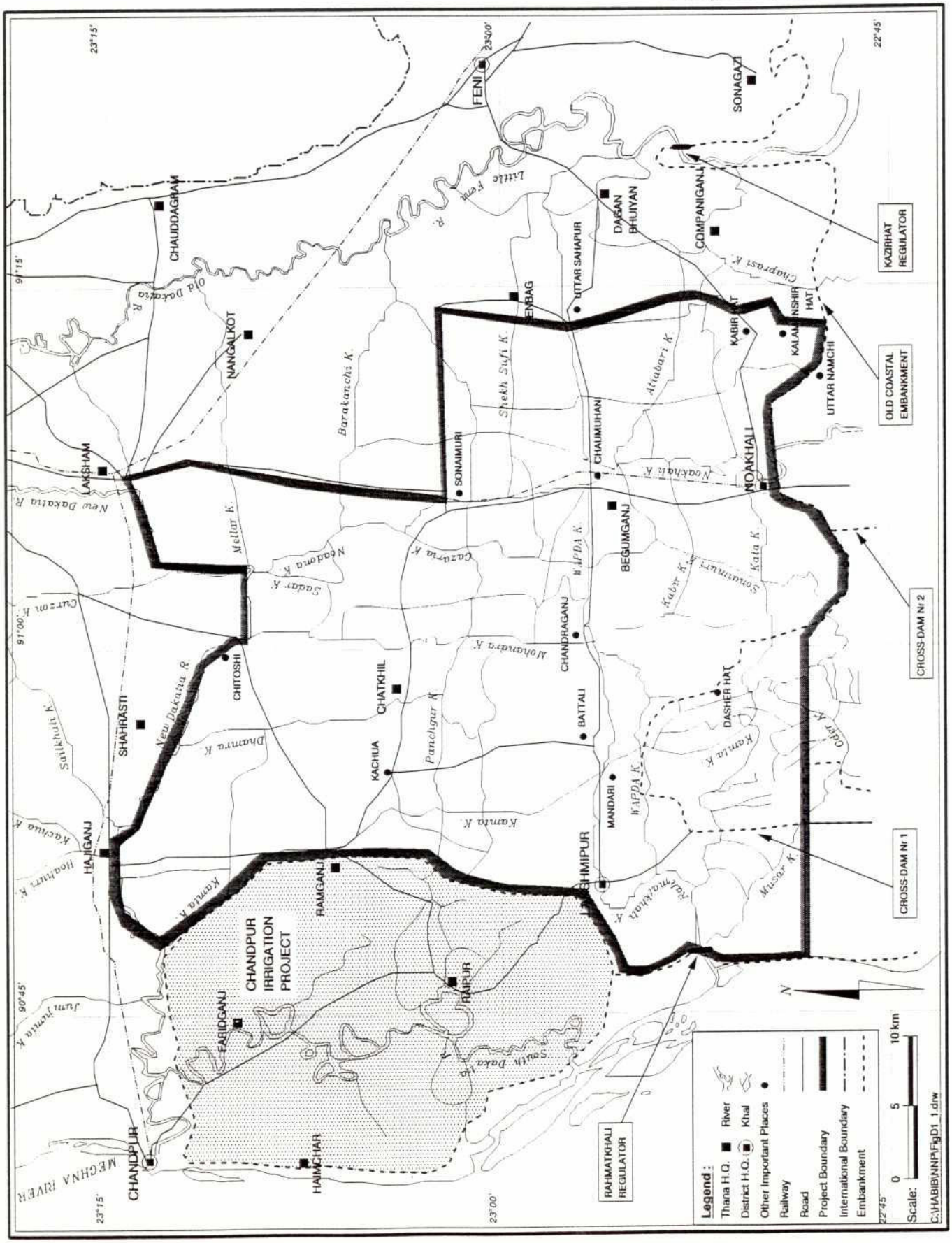
The Noakhali North Drainage and Irrigation Project, referred to in this Annex as the Noakhali North study or project area, is bounded to the north by the Dakatia River; to the east by the divide between the Little Feni and the Noakhali Khal basins; to the south by the old coastal embankment which it follows. The western boundary comprises the left embankment of the Meghna River in the southern parts and the eastern embankments of the Chandpur Irrigation Project up to the Dakatia River.

The Noakhali North project area is 160,814 ha in size with approximately 46% of its area covered by various water bodies. The dominant feature of the area is the Begumganj Depression, centred on Begumganj, with a land elevation of approximately 3 m PWD and almost completely encircled by higher ground.

Despite the habitat alterations already carried out in this area (i.e. the Chandpur Irrigation Project and the Meghna Dhonagoda scheme), the Noakhali North study area still has a substantial area of floodplain (73,984 ha or 46% of its total area of 160,814 ha) which in a 'normal' wet year must harbour a large number of plant and animal species. The use of the natural resources in this area is very intense but although the local people of the area have a deep knowledge of the wildlife of the region, little information has been published regarding the study area in particular. The project area is important in open water fisheries, particularly in the confluence areas of the Meghna and the Dakatia Rivers (Figure D.1.1) which are both highly productive. Few studies have been carried out in this area in terms of its fisheries potential and there appears to be little or no information available regarding the ecological processes taking place in the study area. Its proximity to the fish-rich Meghna River -and the extent and duration of its floodplain area during the monsoon, could make it potentially a very productive fisheries area. It is extremely likely that prior to the construction of the Chandpur Irrigation Project, the Noakhali North study area may have been an extremely productive fisheries area in Bangladesh. Complex fisheries such as this one can only be possible as a result of a complex ecological system. Details of the fisheries component of this report are given in the Fisheries Annex F.

Figure D.1.1

Project Area Base Map



The study area is substantially covered by the floods during the monsoon with the exception of the area within Zone A, where the floodplain in negligible, and areas of elevated homestead land. The area is cris-crossed by a network of interconnecting Khals which are influenced by the Meghna and Dakatia Rivers and by rainwater.

Figure D.1.2 (agroecological regions) shows the agro-ecological regions within the Noakhali North project area are the Old Meghna Estuarine Floodplain which covers most of the area, the Lower Meghna River Floodplain towards the south and west, and beyond that the saline Young Meghna Floodplain. The depth and seasonality of flooding from the various sources are the primary influences which determine the ecology, settlement pattern and land use found in any particular area. The species diversity in the project area includes a large number of faunal and floral species and a range of different habitat types.

D.1.1.3 Major Terrestrial and Aquatic Habitats

Floodplain rivers are usually very dynamic environments and result in a wide range of habitats both terrestrial and aquatic. This situation is clearly seen in the range of habitats which exist in the study area. For the purpose of this study, several of these habitats were selected and those which were sampled for terrestrial ecology are briefly described below:

River Banks: Plant species is high, with all three major group of plants represented of which trees were the dominant community. Herbs are also important.

Pond Banks: Permanent ponds are only found in highland areas and strictly speaking, they are aquatic habitats. However, they were sampled for terrestrial ecology because they provide unusual environmental conditions around their margins. Plant diversity is high with trees and herbs dominating the plant community as in the previous habitat.

Embankments: Flood control embankments provide essential refuges for people and wildlife during peak floods. Where villages have been destroyed by lateral encroachment of the river channels, displaced families often set up their homes on embankments.

Homestead Areas: These are permanent settlements which are often deliberately managed by planting a variety of crops, fruit trees, timber and vegetables. They are often local centres of high species diversity.

Agricultural Fields and Margins: Species diversity is rather low with herbs being the dominant plant community.

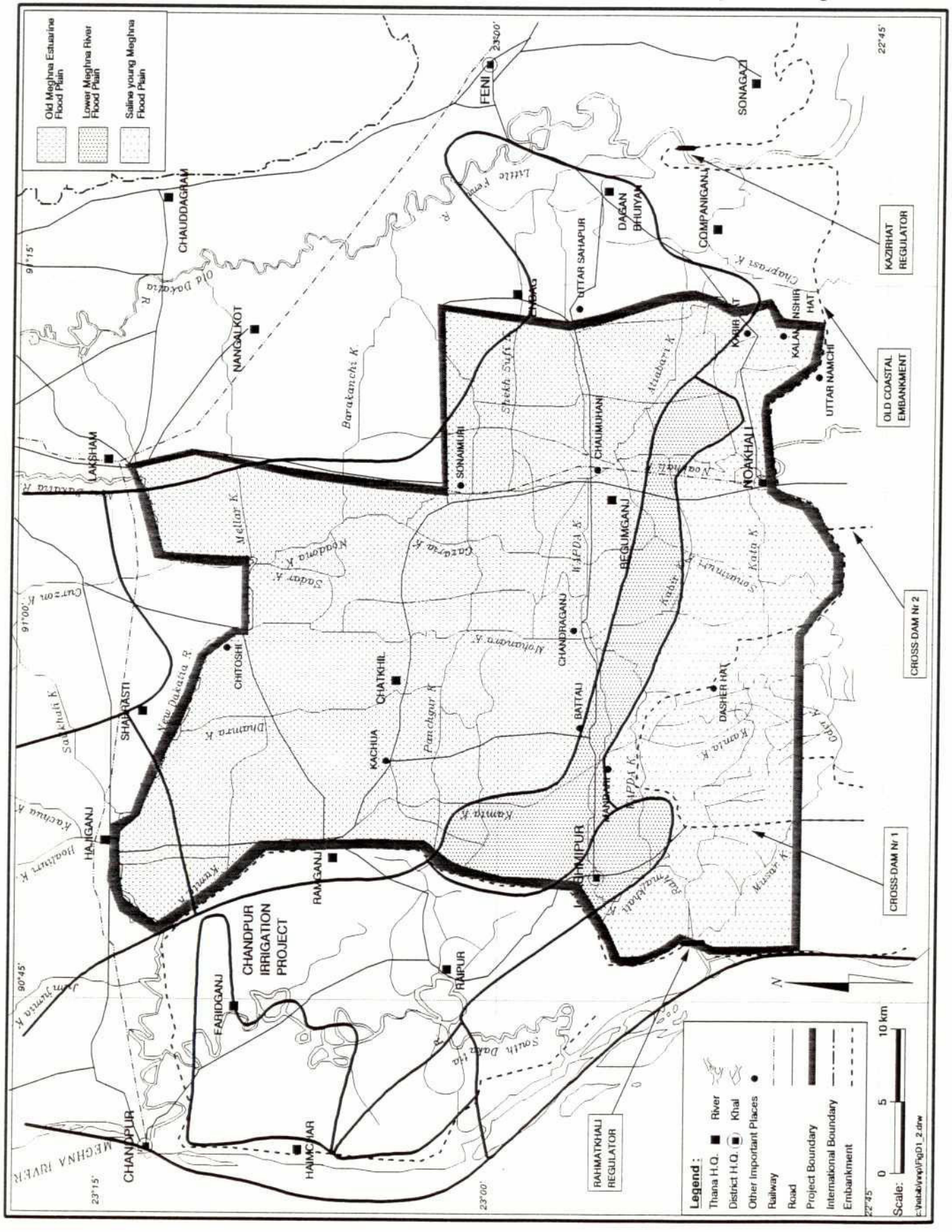
Mono species Woodlands: These are generally old plantations which have been deliberately established by man but may have become invaded subsequently by secondary species. Bamboo stands are a good example of this type of habitat, although Bamboo is not a tree but a herb member of the grass family Graminae.

Road Side: Usually harbour a large variety of species both plants and animals. Plants are sometimes intentionally planted but often have been in place naturally. During the floods this type of habitat acts as refuge areas for a large number of animals species.

Aquatic habitats included rivers and Khals, inundated Charlands, ponds, roadside ditches, marshes and irrigated rice fields. The main aquatic habitats which were sampled have been summarised as follows:

Figure D.1.2

Agroecological Zones



Rivers: Permanent water bodies usually flowing through long established channels. Large rivers carry high silt loads throughout the year preventing the establishment of aquatic flora.

Khals: Most of them are temporary channels which may dwindle during the dry season to a series of shallow, stagnant pools in which the silt settles out allowing for light penetration and the growth of phytoplankton.

Ponds: Artificial water bodies used mainly for the cultivation of fish although they are also used for a wide variety of purposes such as irrigation, bathing, washing and others.

Marshes: Waterlogged lowland areas which are periodically flooded.

CHAPTER D.2

METHODOLOGY AND DATA COLLECTION

D.2.1 Secondary Data Collection

At present there is little information available regarding the effects of FDC/I interventions on the ecology of flora, fauna and people of the affected areas. By and large, it would appear that the ecological studies being undertaken in Bangladesh, have focused on detailed specific processes relevant to branches of pure and applied Botany and Zoology. Regarding the Noakhali North study area in particular, there is no available information on either the flora or the fauna, especially of aquatic waterbodies. A few mentions of marsh plants have been made in the District Gazetteers although there are no remarks on the distributional patterns of these plants. Therefore, from the ecological point of view, the aquatic water bodies such as Khals, ditches, floodplain, rivers, marshes and ponds located in the project area are totally unexplored.

Relevant reference material used in this study included the works of Khan *et al.* (1974), Husain and Sarker (1979 and 1980), Islam (1970), and Sarker and Sarker (1983, 1984, 1986). In addition, a number of reference books were also consulted (Rashid, 1991; Sarker and Sarker, 1988; Harvey, 1990; Khan, 1982) during the study with a view to collecting information on terrestrial life forms (plants and animals). Information was also gathered from the District Gazetteers of Comilla and Noakhali (Khan, 1977a and 1977b), several publications by the Bangladesh National Herbarium and a report on Bangladesh by the Asian Wetland Bureau (Akonda, 1990), a background paper prepared for the National Conservation Strategy - Bangladesh (Khan, 1990) and from a number of Flood Action Plan (FAP) reports such as FAP 2 Final Report, FAP 5 Regional Plan Report (Annex IV Environment), FAP 3 Preliminary Supporting Report V Ecological Assessment, FAP 3.1 Final Feasibility Report, FAP 16 Report on an Environmental Impact Assessment Case Study and FAP 6 Wetland Resources Specialist Study.

Regarding aquatic ecology in particular, little information exists on the ecology and biodiversity of aquatic organisms with the exception of a few pond ecosystems. Begum and Alam (1987) studied two permanent ponds in Maijdee Court and showed a potential relationship between the different physico-chemical parameters and the abundance of the plankton population in semi-intensively and traditionally managed ponds. Limnological studies of some pond ecosystems adjacent to the project area, i.e. Raipur and Chandpur Fisheries Campus were also carried out by Ameen *et al.* (1986) and Ali *et al.* (1985). However, these works are very specific and offer little guidance regarding broader ecological aspects in the project area.

The most useful information, especially regarding historical records, was provided by the District Gazetteers which contain details of terrestrial and aquatic plants and animals of the Greater Comilla and Noakhali Districts. However, this information was obviously insufficient for the ecological appreciation of the target areas. Therefore, a short field programme to cover both the wet and dry seasons was devised in order to gather information on the present and past distribution, abundance and species diversity of the terrestrial and aquatic ecosystems in the project area. Valuable information was also gathered from indigenous sources.

D.2.2 Field Data Collection

After a reconnaissance trip to the project area (mid November 1992), ten sampling locations (henceforth named as station/s) were selected (Figure D.2.1 and Table D.2.1). The study stations are located throughout the project area covering all planning Zones (A, B, C & D). Two field trips, covering the wet and dry seasons, each of one week duration were conducted in the area in order to collect samples and field data. The first field visit took place from the 20 to 23 December 1992 and the second one from the 4 to 12 March, 1993. There was an extra trip from the 2 to 3 January 1993 for aquatic ecology. In general, the same sites were sampled for terrestrial and aquatic ecology.

D.2.2.1 Terrestrial Ecology

Transect Surveys

Terrestrial ecological data were generally collected during transect walks within the survey sites. At each type of habitat encountered in the transect, field notes and plant species collection were made, to record the presence and abundance of each plant and vertebrate species. It should be pointed out that, with a few exceptions, the invertebrate fauna was not recorded since it required additional expertise not available to the study. In addition to direct observations, it was considered important to tap the existing knowledge available through the local people who were asked about the occurrence of species other than those recorded on the day of the field visit as well as those species which appeared to be in decline. It was thus possible in this way to assemble a more complete picture of the fauna of the study area. These records generally related to mobile species such as birds, mammals and reptiles. Local people were also asked to describe the uses that they made of the species, particularly regarding medicinal plants found within the study area.

A similar methodology to that used in the North West Regional Study and the Gumti Phase II Feasibility Study for assessing species abundance was followed, this was simple, institutive and subjective. Those plants and animals which appeared to be dominant or extremely common were recorded as 'widespread'. Less dominant or widespread species were then allocated to one of five groups: common, occasional, uncertain, rare and at risk.

Unfamiliar species recorded in the field were identified after consulting the literature (Ali *et al.*, 1983; Khan, 1985b; Khan, 1987) for fauna, whereas any unidentified plants were sampled and preserved for subsequent identification at the National Herbarium in Dhaka.

D.2.2.2 Surveys for Data Collection

Within the Noakhali North study area there are a number of terrestrial habitats which cover a remarkable portion of the system, especially in the dry season. The stations selected for terrestrial samples (see Figure D.2.1) listed in Table D.2.1 and briefly described below.

Figure D.2.1

Ecology Habitat Zones and Sampling Sites

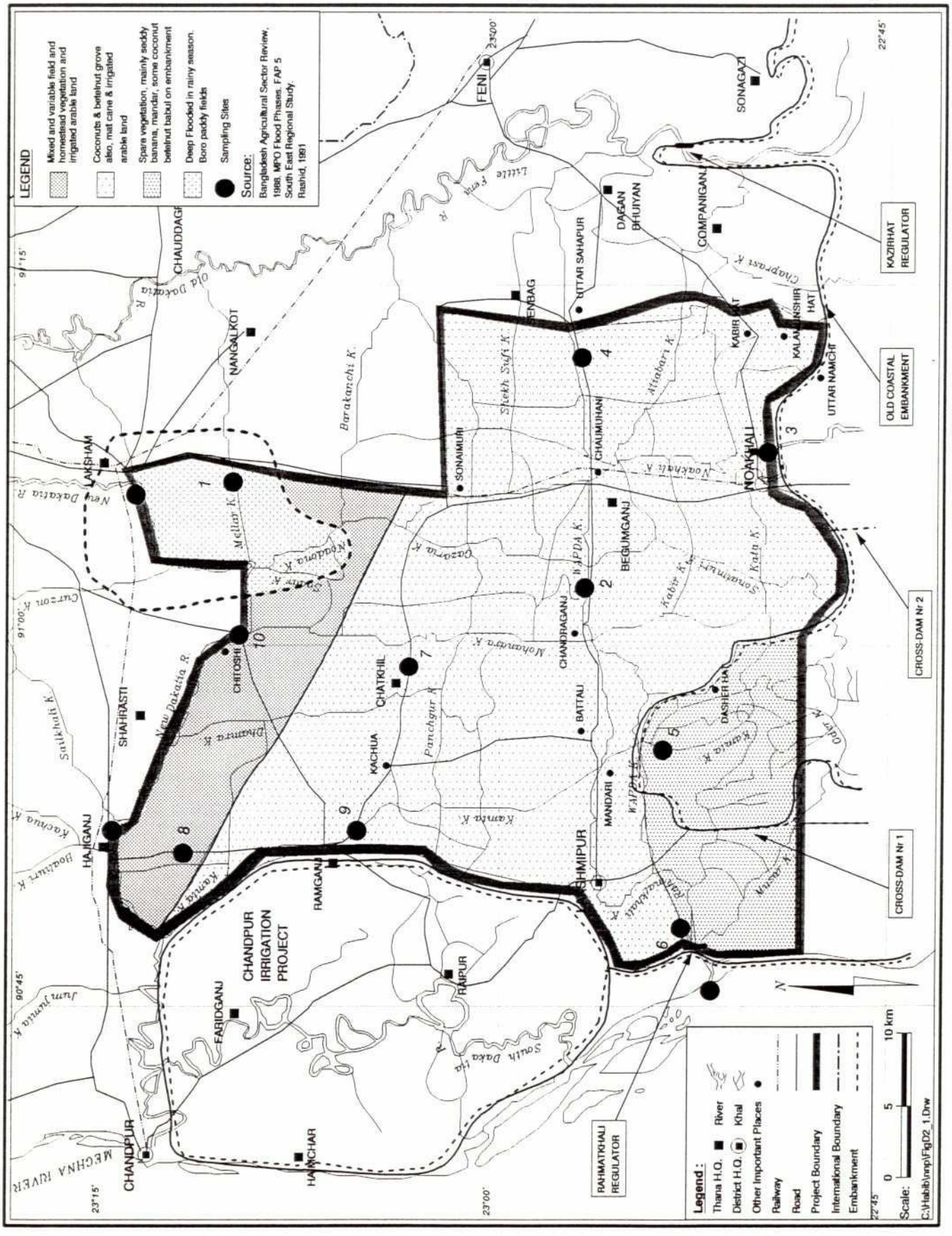


TABLE D.2.1

Site Location for Terrestrial Ecology Field Data Collection

Sampling Station No.	Location	Village	Union	Thana	District
1	North East Part of the Project Area	Rajapur	2 Pashim Uttar Daya	Laksham	Comilla
3	Surrounding Noakhali Khal	Madhyam Karimpur	3 Maijdi Paurasava	Maijdi Sadar	Noakhali
2	Surrounding WAPDA Khal	Joynarayanpur	Ameenullahpur	Begumganj	Noakhali
4	Eastern Part of the Project Area	Ajijpur	6 Kabilpur	Senbagh	Noakhali
5	Old Charland	Diguli	14 Diguli	Lakshmipur	Lakshmipur
6	Rahmatkhali sluice gate	Madhyam Char Romoni Mohan	17 Shakchor Union	Lakshmipur	Lakshmipur
7	Middle of the Project Area	Joyag	1 Joyag	Begumganj	Noakhali
8	North West Part of the Project Area	Hajipara	1 Kanchanpur	Hajiganj	Chandpur
9	Near Ramganj	Uttar Darbeshpur	4 Ramganj	Ramganj	Lakshmipur
10	Dakatia River	Chitoshi Bazar	Purba Chitoshi	Shah Rashti	Chandpur

Short description of stations in reference with studied habitats are given below:

Station 1 : Study area covers the transect at least 800 m including the habitats agricultural field and margin, homestead road side and khal side.

Station 2 : Study area covers the transect at least 800 m beginning from the WAPDA Khal side towards North part of its surrounding. The studied habitats are agricultural field and margin, khal side road side, pond bank and homestead area.

Station 3 : This study station situated in just exit point of Noakhali khal within the project area. The transect covering approximately 1000 m beginning from the Noakhali khal bridge upto a homestead land village Madhyam Karimpur. The habitats studied within the area are khal side, homestead, agricultural field and margin and babul dominated WAPDA bandh (road side).

Station 4 : This study area covers nearly 1200 m beginning from the WAPDA khal toward the North of the village Azijpur. During the transects visit khal side, road side, agricultural field and margin and homestead habitats were studied.

Station 5 : This study area was actually a charland of river Meghna and according to the local people once river Meghna was at the Digali village (before 40 years). But now a days the charland characteristics has been lost probably due to over population and human interference. The studied habitats are agricultural field and margin, road side, pond bank home stead land and monospecies woodland.

Station 6 : The study area covering the region of south west corner of the project area surrounding the mouth of Rahmatkhali khal inside and outside the sluice gate.The study area covers 1000 m approximately with habitats embankment, homestead, khal side, agricultural field and margin and river side.

Station 7 : The study area covering at least 1000 m beginning from the main road (going from Chatkhil to Sonaimuri) towards north of the village Joyag during the transect walks studied habitats area road side, agricultural field and margin, homestead land and mono species wood land.

Station 8 : The study area covers 1000 m. approximately, beginning from the khal Dakatia towards the east of the village Hajipara including the studied habitats khal side, road side, pond bank homestead.

Station 9 : The study areas covers 800 m. approximately beginning from the main road (Chatkhil Ramganj) toward the south of the village Uttar Darbeshpur. Transect walk covers the habitats road side, khal side, mono species woodland (bamboo), pond bank and homestead land.

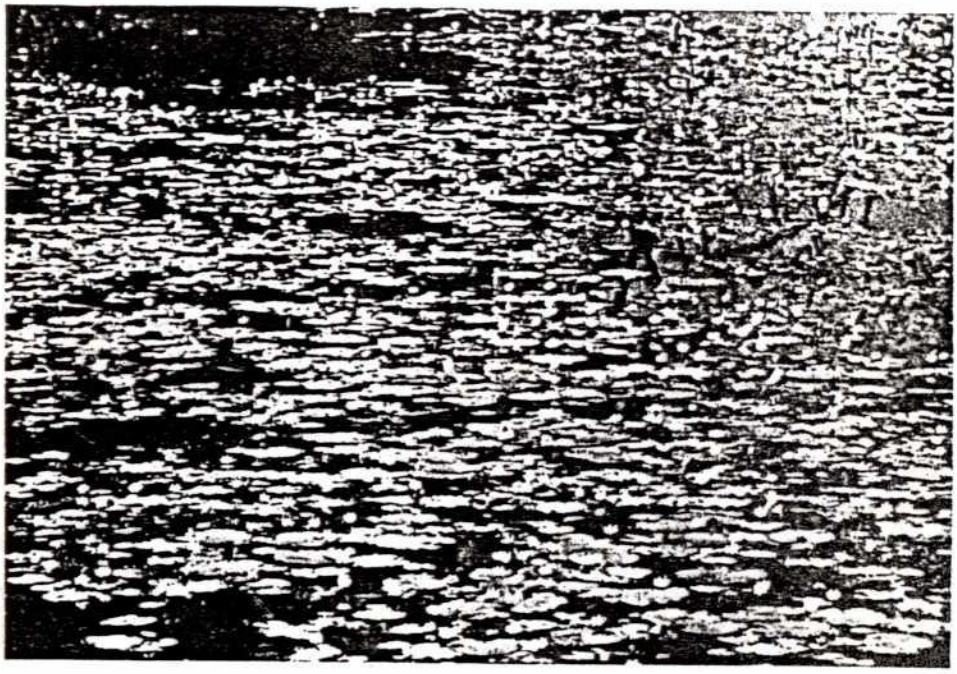
Station 10 : The study covers about 800 m. around the river Dakatia. The studied habitats are both the bank of the river, agricultural field and margin, road side and homestead land.

D.2.3 Aquatic Ecology

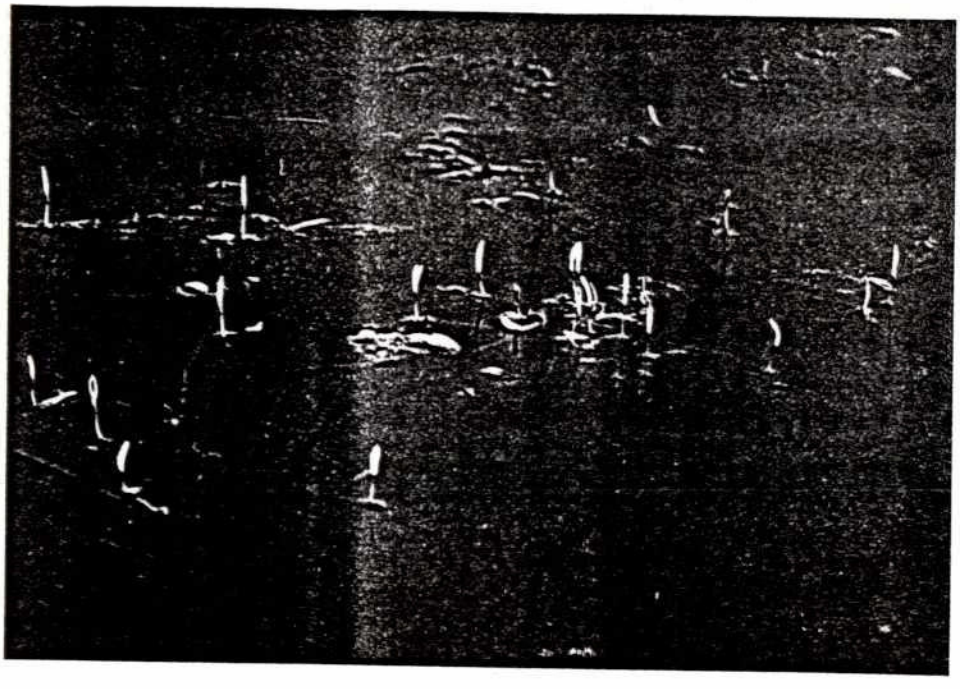
D.2.3.1 Field Data Collection

The total area of aquatic habitats in the Noakhali North project area amounts to approximately 82,000 ha, including the floodplain, minor rivers and Khals and ponds. During the reconnaissance trip of November 1992, luxuriant macrophytes together with other macro and micro organisms of plant and animal origin were noticed in the Laksham Depression (Plate 1a), the Begumganj Depression (Plate 1b), Noakhali Khal, WAPDA Khal (Plate 2b), small irrigation channels and road side ditches. There is a large number of pond ecosystems and some of them were observed to support algal blooms and mats of duckweed. As for terrestrial ecology, ten sampling sites were selected a brief description of which is given in Table D.2.2. The first samples were collected during 20 to 23 December 1992 and from 2 to 3 January 1993. The second sampling was carried out from 4 to 12 March 1993. Altogether, there were 110 samples of plankton, tychoplankton, periphyton and benthos. At least 10 species of macrophytes were collected and processed for identification. Other macrophytes were analyzed *in situ*.

Plates 1(a) and 1(b)



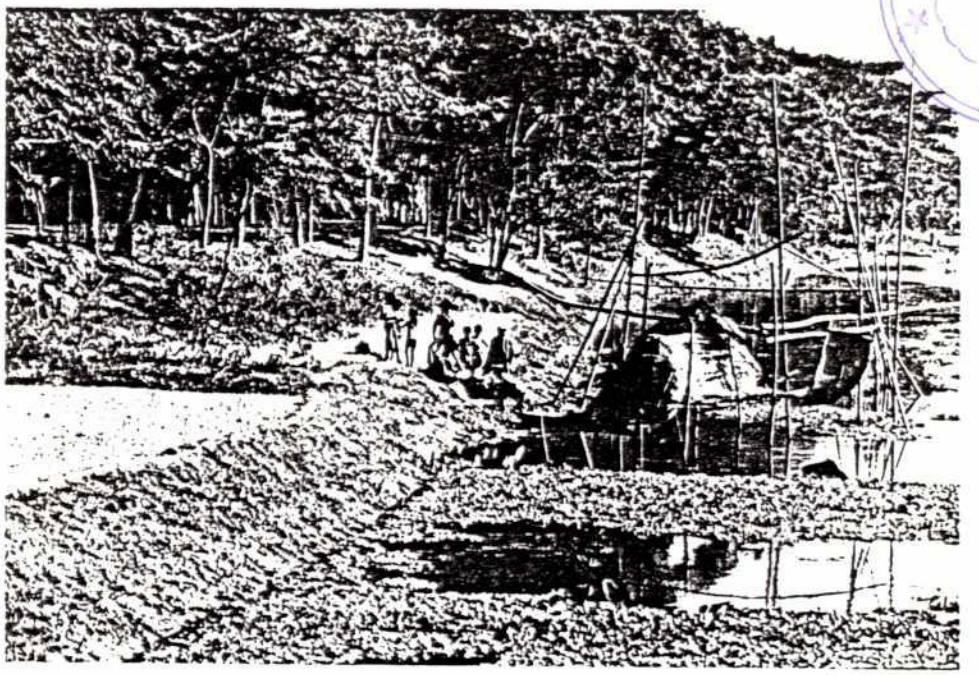
(a)



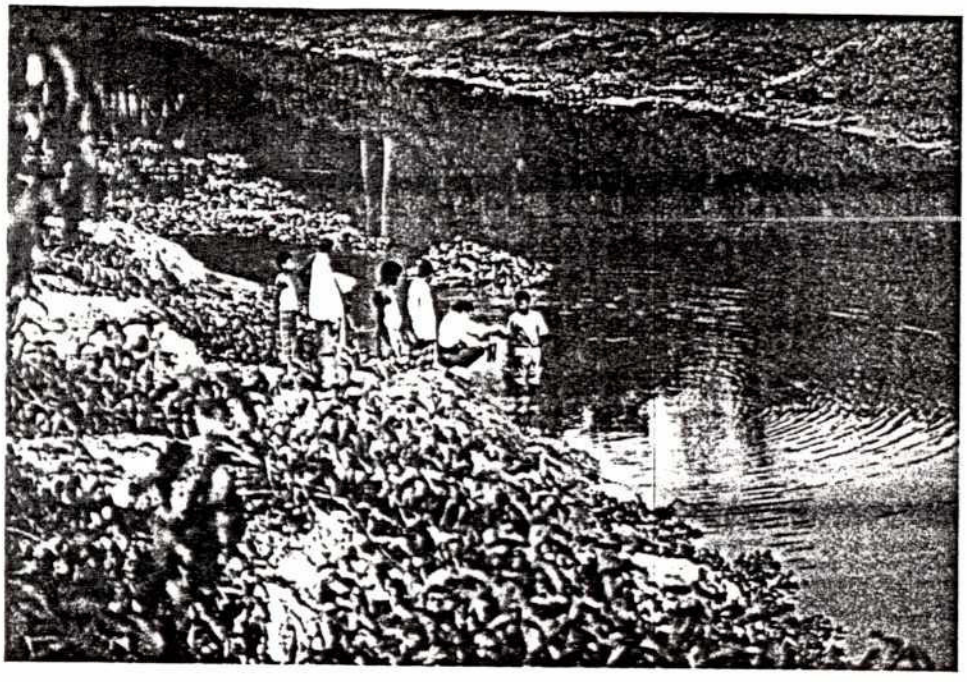
(b)

Sampling habitats, (a) Water lily - Laksham depression, (b) *Blyxa echinosperma*, submerged aquatic macrophyte with white aerial flower at Begumganj depression.

Plates 2(a) and 2(b)



(a)



(b)

Khal ecosystem, (a) sampling of bottom fauna at Barakhal, Ramganj; (b) sampling of phytoplankton at WAPDA khal (Site 2).

TABLE D.2.2

Brief Description of Sampling Sites

Number of Sampling Site	Location Within the Project	Habitats Covered	Village	Union	Thana	District
1.	North Eastern part	Pond, Ditch & Marsh	Rajapur	2 Paschim Uttardaya	Laksham	Laksham
2.	WAPDA Khal	Pond, Ditch, Khal, Marsh	Joynarayanpur	Ameemullapur	Begumganj	Noakhali
3.	Noakhali Khal	Khal, Ditch WAPDA dighhi	Madhayam Karimpur	3 Maijdee Pourashava	Maijdee Sadar	Noakhali
4.	Eastern part	Khal	Ajijpur	6-Kabilpur	Senbagh	Noakhali
5.	Old Charland	Pond, ditch	Dighali Bazar	14 Dighali	Lakshmipur	Lakshmipur
6.	Rahmat Khali Sluice	Eastern and western part of the sluice, Meghna river, ditch.	Madhayanchar Ramanimohan	17 Shakchar	Lakshmipur	Lakshmipur
7.	Middle	Pond, ditches	Joyag	1 Joyag	Begumganj	Noakhali
8.	North West Part	Khal, pond, ditches	Hajipara	1 Kanchpur	Ramganj	Lakshmipur
9.	Near Ramganj	Khal	Uttar Darbeshpur	4 Ramganj	Ramganj	Noakhali
10.	Northern fringe	Dakatia River, rice fields, ditches, ponds	Bazar Chittoushi	Purba Chittoushi	Shah Rasti	Chandpur

D.2.3.2 Methodology

A summary of the main techniques used to preserve aquatic flora and fauna samples is given below:

Phytoplankton The sedimentation technique described by Wetzel and Likens (1979) was used for the collection of microplankton. First, 5 ml of Lugol's iodine was put in a one litre glass bottle. Water from the habitat concerned was then collected in the bottle (Plate D.2b). The bottle contents were allowed to settle in a dark cupboard for 48 h. After sedimentation, the overlaying water was removed by suction and approximately 15 ml of the concentrate were then transferred to a labelled glass vial for microscopic identification in the laboratory.

Zooplankton Twenty to forty litres of habitat water were passed through a plankton net (55 μm mesh size). The zooplankton concentrate accumulated in the container at the bottom of the net was then transferred to a plastic vial. The sample was preserved in 4% formaldehyde, labelled and taken to the laboratory for identification.

Tycoplankton First, parts of submerged aquatic plants were collected gently and were put in a container after which, a small amount of water was added and the sample was shaken vigorously to loosen the life forms. Finally, plant parts were compressed and the concentrate was transferred to a labelled plastic vial where the material was fixed with 4% formaldehyde for further study.

Periphyton Any submerged objects seen to exhibit luxuriant life forms attached to them were sampled for the study of this community. The attached layer of organisms was scrapped off with the help of a scalpel and put in a plastic vial with 4% formaldehyde for further study.

Bottom Fauna Mud samples were collected with the help of a plastic container (Plate D.2a). The sample was then passed through different plastic sieves having different mesh widths. The resulting fauna was then preserved in 7% formaldehyde with a few drops of glycerine.

Shell Bearing Organisms Shells of gastropods and bivalves were observed in places where casts nets were used for fishing as well as free floating in various other areas. The shells were collected and preserved from the target areas and identified subsequently.

Aquatic Macrophytes Samples of aquatic plants that could not be identified *in situ* were collected and placed on a piece of newspaper covered by blotting paper. All plants were kept under constant pressure in a metallic plant press to extract any water present in them. The blotting paper and the newsprint were changed every 24 h to prevent bacterial attack. Plant specimens were finally pasted on a standard herbarium sheet for identification.

Light and compound microscopy were used to identify all samples except for the gastropod shells and microphytes, which were identified using a Nikon (SE) microscope. Their abundance was estimated by the number of occurrence of a particular organism in three randomly selected ocular grids. The information was organized according to the scaling used in Table D.4.1, (See Chapter 4) which also contains the taxa identified during this study.

The following literature was used for animal and plant identification: Ali and Chakraborty (1992), Biswas and Calder (1954), Desikachary (1959), Germain (1981), Gojdics (1953), Huber-Pestalozzi (1955), Huq (1986), Islam (1970, 1974 and 1977), Islam and Begum (1970), Islam and Chowdhury (1979), Islam and Haroon (1975 and 1980), Islam and Khair (1978), Islam and Khatun (1966), Islam *et al.* (1991), Islam and Mendes (1976), Islam and Moniruzzaman (1981), Islam and Nahar (1967), Islam and Zaman (1975), Khan and Halim (1987), Mellanby (1986), Pringsheim (1956), Smith (1950) and Subrahmanyam (1974).

CHAPTER D.3

STUDY FINDINGS TERRESTRIAL ECOLOGY

D.3.1 Fauna

A list of faunal species is given in Table D.3.1 which includes common and scientific names, taxonomic position, habitat, past and present occurrence, status, feeding habit and sampling stations where the species were recorded.

A total of 16 species of mammals, 60 birds, 17 reptiles and 5 amphibians were recorded within the project area during the field study and their distribution according to the sampling stations is presented in Table D.3.2.

D.3.1.1 Mammals

From Table D.3.2 it can be seen that the largest number of mammals was found in stations 5 and 6, within the Lakshmipur District whereas the lowest species numbers were recorded in stations 8 and 9, close to the eastern embankment of the Chandpur Irrigation Project. Small mongoose and rats were found throughout the study area. The Ganges River Dolphin *Platanista gangetica*, a species listed internationally as Vulnerable (IUCN, 1990) was found in the Dakatia and the Meghna Rivers during the monsoon. Mammals are important components of the ecosystem as many of them are predators and as such occupy top positions in the food chain, predating on a range of small animals as well as feeding on crops in the field and in storage.

D.3.1.2 Birds

A total of 60 bird species were identified of which 36 were terrestrial and 24 were aquatic or water dependent. The majority of the birds were found to be residents with only a few migratory ones. The distribution of aquatic and terrestrial birds by station is shown in Table D.3.3. Aquatic birds were found mainly around rivers, the little floodplain available this year and around ponds, as these habitats offer suitable breeding, feeding and resting grounds for the many species. Aquatic birds were found to feed on fish, molluscs and aquatic plants and seeds.

Many insectivorous birds were recorded throughout the project area. These birds play an important role in the local and regional agro-economy by acting as biological controls of agricultural pests. Predators also play a similar role by consuming rats which pose a serious threat to the paddy cultivation. Birds are particularly valuable as environmental indicators as they are obvious components of the ecosystem and many bird species are both restricted to specific habitats and are very susceptible to any changes to them.

According to the local people, birds are gradually decreasing in numbers every year due to the loss of their natural habitats and as a result of human activities such as shooting and poaching.

TABLE D.3.1

Uptodate identified species list (Fauna) with systematic arrangement and their feeding habits are given below in reference with survey sites

Food code : O=Omnivorous; C=Carnivorous; S=Scavenger; P=Pscivorous; M=Molluse eater; I=Insectivorous; TV=Terrestrial vegetation; G=Grainivorous; F=Fructivorous; AV=Aquatic vegetation.

Taxonomy code : P=Phyllum; C=Class; O=Order; F=Family.

Taxonomy	Scientific Name		English Nmae	Bengali Name	Foods	Sampling Stations									
	Genus	Species				1	2	3	4	5	6	7	8	9	10
P: Chordata															
C: Mammalia															
O: Insectivora															
F: Soricidae	*Suncus*	*murinus*	House shrew	Chika/suchey	I	+		+	+	+	+				+
O: Chiroptera															
F: Pteropidae	*Pteropus*	*giganteus*	Flying Fox	Boro Badur	F	+	+	+		+	+	+	+		+
F: Vespertilionidae	*Pipistrellus*	*coromandra*	Indian pipistrelle	Khudeychamchika	F	+			+	+	+	+	+		+
O: Pholidota															
F: Manidae	*Manis*	*crassicaudata*	Indian Pangolin	Benrui	I	+?									
O: Carnivora															
F: Canidae	*Vulpes*	*bengalensis*	Bengal Fox	Khek Shial	C			+		+	+				
	Canis	*aureus*	Jackal	Shial	C	+	+	+	+	+	+	+		+	+
F: Mustelidae	*Lutra*	*sp.*	Otter	Udbiral	P	+	+	+	+	+	+	+			+ **
F: Viverridae	*Vivericula*	*indica*	Civet	Kattas	C		+	+				+			+
F: Herpestidae	*Herpestes*	*auropunctatus*	Small Mangoose	Beji	C	+	+	+	+	+	+	+	+	+	+
F: Felidae	*Felis*	*chaus*	Jungle cat	Ban Biral	C	+	+	+		+		+			
O: Artiodactyla															
F: Leporidae	*Lepus*	*nigricollis ruficaudatus*	Rufous tailed hare	Khorgosh	TV					+	+				
O: Rodentia															
F: Sciuridae	*Callosciurus*	*pygerythrus*	Squirrel	Kathbiraly	F	+	+			+	+	+	+	+	+
F: Muridae	*Bandicota*	*bengalensis (Pest)*	Rat	Indur	G	+	+	+	+	+	+	+	+	+	+
	Bandicota	*indica (Pest)*	Bandicoot rat	Methoindur	G	+	+	+	+	+	+	+	+	+	+
	Mus	*musculus (Pest)*	House Mouse	Nengti Indur	G	+	+	+	+	+	+	+	+	+	+
F: Hystricidae	*Hystrix*	*indica*	Indian crested porcupine	Sajaru/Hejakanta	TV,F		+	+	+	+	+			+	
O: Cetacea															
F: Platanistidae	*Platanista*	*gangetica*	Gangetic Dolphin	Seshu	P,AV					+*					+**

Taxonomy	Scientific Name		English Nmae	Bengali Name	Foods	Sampling Stations									
	Genus	Species				1	2	3	4	5	6	7	8	9	10
C: Aves															
O: Pelecaniformes															
F: Phalacrocorocidae	*Phalacrocorax*	*niger*	Little cormorant	Pancowri (Aquatic)	P,M,I	+	+	+	+	+	+	+	+	+	+
O: Ciconiformes															
F: Ardeidae	*Bubuleus*	*ibis*	Cattle Egret	Go Bok	I	+	+	+	+	+	+		+	+	+
	Ardeola	*grayii*	Pond Heron	Kani Bok (Aquatic)	P,M,I	+	+	+	+	+	+	+	+	+	+
	Ardeola	*alba*	Great Egret	Boro Bok (Aquatic)	P,M,I			+		+	+	+	+	+	+
	Egretta	*garzetta*	Little Egret	Choto Bok (Aquatic)	P,M,I				+	+	+	+		+	+
F: Ciconiidae	*Anastomus*	*oscitans*	Openbill Stork	Shamuk Khor (Aquatic)	P,M		+	+		+	+				+
O: Anseriformes															
F: Anatidae	*Nattapus*	*coromandelianus*	Cotton Teal	Balihans (Aquatic)	P,M,AV	+				+	+			+	+
	Dendrocygna	*javanica*	Lesser whistling teal	Sorali (Aquatic)	P,M,AV			+		+	+		Ext		+
O: Falconifromes															
F: Accipitridae	*Haliaster*	*indus*	Brahminy Kite (Predator)	Shankho Chil (Aquatic)	P	+	+	+	+		+	+	+	+	+
	Accipiter	*budius*	Shikra (Predator)	Turki Baj	C	+			+	+	+	+		+	+
	Gyps	*bengalensis*	Vulture (Predator)	Sowkoon	S	+			+		+	+		+	+
	Ichthyophaga	*ichthyaetus*	Grey Headed Fishing Eagle(Preda	Kura (Aquatic)	P		+			+	+	+	+	+	
	Milvus	*migrans*	Paiah Kite	Bhuban Chil		+	+				+	+			+
O: Gruiformes															
F: Rallidae	*Amaurornis*	*phoenicurus*	White Breasted Water Hen	Dahuk (Aquatic)	P,M,I	+	+	+	+	+	+	+	+	+	+
	Porphyrio	*porphyrio*	Purple moorhen (Pest)	Kalim (Aquatic)	M,G,AV			+	+						+
	Gallicrex	*cinerea*	Water Cock	Kura	P,M,AV					+					
O: Charadriiformes															
F: Jacanidae	*Metopidius*	*indicus*	Bronze winged Jacana	Dalpipi (Aquatic)	I,AV		+	+	+		+	+			+
F: Charadriidae	*Vanellus*	*indus*	Redwattled lapwing	Hottiti (Aquatic)	I,G			+		+	+				+
	Tringa	*hypoleucos*	Common sandpiper	Chapakhi (Aquatic)	I						+				+
	Gallinago	*henura*	Pintail Snipe	Kadakhocha (Aquatic)	P,I	+		+	+	+		+		+	+
	Charadrias	*dubius*	Little ringed plover	Little jiria (Aquatic)	I						+				+
O: Charadriiformes															
F: Laridae															
	Larus	*brunnicephalus*	Brownheaded Gull	Gang Koiltor	P						+				
	Chlidonies	*hybrida*	Whiskered Tern	Gangchil	P						+				
O: Columbiformes															
F: Columbidae	*Treron*	*phoenicoptera*	Yellow footed pigeon	Botkol	G	+		+	+			+		+	
	Columba	*livia*	Blue Rock Pigeon	Jalali Kabutor	G	+	+	+	+	+	+	+	+	+	+
	Streptopelia	*decaocta*	Ring Dove	Dhobal Ghughu	G	+	+	+	+	+	+	+	+	+	+
	Streptopelia	*chinensis*	Spotted Dove	Tila Ghugu	G	+	+	+	+	+	+	+	+	+	+

D.3-3

B:Tab_2.wk1

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Taxonomy	Scientific Name		English Nmae	Bengali Name	Foods	Sampling Stations									
	Genus	Species				1	2	3	4	5	6	7	8	9	10
O: Psittaciformes															
F: Psittacidae	*Psittacula*	*krameri*	Parakeet (Pest)	Teya	G,F	+	+	+	+	+		+	+	+	
O: Cuculiformes															
F: Cuculidae	*Eudynamys*	*scolopacea*	Koel	Kokil	I	+	+	+	+	+	+			+	
	Centropus	*sinensis*	Crow – Pheasant	Kanakuka	I,F	+	+	+	+			+		+	+
O: Strigiformes															
F: Strigidae	*Bubo*	*zeylonensis*	Brown Fish Owl (Predator)	Mecho Pancha	C,P	+		+	+	+	+	+		+	+
	Bubo	*bubo*	Great Horned Owl (Predator)	Hutum Pencha	C	+	+	+	+	+		+	+	+	+
O: Coraciiformes															
F: Alcedinidae	*Alcedo*	*atthis*	Common King Fisher	Choto Machranga (Aquatic)	P	+	+	+	+	+	+	+	+	+	+
	Halcyon	*smyrnensis*	White Breasted King Fisher	Shadabuk Machranga (Aquatic)	P	+	+	+	+	+	+	+	+	+	+
F: Meropidae	*Merops*	*orientalis*	Bee eater	Sui – chora	I	+	+	+		+	+	+	+		+
F: Upupidae	*Upupa*	*epops*	Hoopoe	Hudhud	I			+				+	+		
O: Piciformes															
F: Picidae	*Dinopium*	*bengalense*	Wood peacker	Kat – thokra	I	+		+	+	+	+	+	+		
F: Capitonidae	*Megalaima*	*haemacephala*	Coppersmith	Choto basanta Bauri	I	+	+		+			+	+	+	+
O: Passeriformes															
F: Nectariniidae	*Necterinia*	*zeylonica*	Purplerumped Sunbird	Mautushi	I	+				+		+			+
F: Oriolidae	*Oriolus*	*xanthornus*	Black Headed Oriole	Kutum Pakhi	I,F		+	+		+		+	+	+	+
F: Dicruridae	*Dicrurus*	*adsimilis*	Black drongo	Finga	I	+	+	+	+	+	+	+	+	+	+
F: Sturnidae	*Acridotheres*	*fuscus*	Jungle Myna	Jhuti Shalik	I				+		+		+		
	Acridotheres	*tristis*	Common Myna	Bhat Salik	G	+	+	+	+	+	+	+	+	+	+
	Sturnus	*contra*	Pied Myna	Go Salik	I	+	+	+	+	+	+	+	+	+	+
F: Corvidae	*Dendrocitta*	*vagabunda*	Treepie	Harichacha	C,I,F	+	+		+	+			+		
	Corvus	*macrorhynchos*	Jungle Crow	Dar Kak	S	+	+	+	+	+	+	+	+	+	+
	Corvus	*splendens*	House Crow	Pati Kak	S	+	+	+			+	+		+	+
F: Pycnonotidae	*Pycnonotus*	*cafer*	Red Vented Bulbul	Bulbul	I	+	+	+	+	+	+	+	+	+	+
F: Muscicapidae	*Orthotomus*	*sutorius*	Tailor Bird	Tuntuni	I	+	+	+	+	+	+	+	+	+	+
	Copsychus	*malabaricus*	Shama	Shama ?	I,F		+	+					+		
	Copsychus	*saularis*	Magpie – robin	Doyal	I	+	+	+	+	+	+	+	+	+	+
F: Ploceidae	*Passer*	*domesticus*	**House Sparrow**	Chorai	G	+	+	+	+	+	+	+	+	+	+
	Ploceus	*philippinus*	Buya	Babui	G	+	+	+	+	+	+	+	+	+	+
	Lonchura	*punctulata*	Spotted Munia	Munia	G	+	+			+			+		+

D.3-4

Taxonomy	Scientific Name		English Nmae	Bengali Name	Foods	Sampling Stations									
	Genus	Species				1	2	3	4	5	6	7	8	9	10
C: Reptilia															
O: Chelonia															
F: Emydidae	*Kachuga*	*tectum*	Common roofed turtle	Kori Katta	AV	+	+	+	+	+	+	+	+	+	+
	Hardella	*thurji*		Kali Katta	AV	+	+	+	+	+	+	+	+	+	+
O: Squamate															
F: Gekkonidae	*Hemidactylus*	*brooki*	House Wall Lizard	Tiktiki	I	+	+	+	+	+	+	+	+	+	+
	Gekko	*gecko*	Gecko	Tokkhok	I	+?						+?			
F: Agamidae	*Calotes*	*versicolor*	Common Garden Lizerd	Roktachosa	I	+	+	+	+	+	+	+	+	+	+
	Mabuya	*carinata*	Skink	Angila	I		+	+		+			+		
F: Varanidae	*Varanus*	*bengalensis*	Monitor lizard	Gui	O	+	+	+	+	+	+	+	+	+	+
	Varanus	*flaviscens*	Yellow monitor lizard	Sonagui	O	+	+	+	+	+	+	+	+	+	+
Sub Order: Ophidia															
F: Natricidae	*Xencchrophis*	*piscator*	Checkered Keelback Water	Dhora shap	P	+	+	+	+	+	+	+	+	+	+
	Atretium	*schistosum*	Olive Keelback Water Snake	Mete shap	P	+	+	+	+	+	+		+	+	+
F: Colubridae	*Ptyas*	*mucosus*	Rat snake	Daraj shap	C	+	+	+		+		+	+	+	+
F: Elaphidae	*Bungarus*	*caeruleus*	Common Krait	Kalkaute	C		+	+	+	+			+		+
	Naja	*naja*	Cobra	Gokhra shap	C	+	+	+	+			+	+		+
	Bungarus	*faclatus*	banded krait	Sonkhine	C			+		+	+		+		
F: Viperidae	*Vipera*	*russellii*	Russells viper	Chandra bora	C			+	+				+	+	+
C: Amphibia															
O: Anura															
F: Bufonidae	*Bufo*	*melanostictus*	Toad	Kuno Bang	I	+	+	+	+	+	+	+	+	+	+
F: Ranidae	*Rana*	*tigrina*	Bull Frog	Sona Bang	I	+	+	+	+	+	+	+	+	+	+
	Rana	*cyanophlyctis*	Skipper frog	Kotkoti Bang	I	+	+	+	+	+	+	+	+		+
	Rana	*limnochanis*	Cricket frog	Jhi – jhi Bang	I			+		+					+
F: Rhacophoridae	*Rhacophorus*	*sp*	Tree frog	Gecho Bang	I	+	+	+	+	+	+	+	+		+

* Only in the Meghna River

** In the Dakatia River during monsoon

D.3-5

TABLE D.3.2

Group Distribution of Animals According to Different Sampling Stations

Group (Animal)		Sampling Station									
		1	2	3	4	5	6	7	8	9	10
Mammals	16	11	11	13	09	14	16	11	07	07	12
Birds	60	37	35	40	34	39	42	38	36	37	44
Reptiles	17	13	13	16	12	13	10	09	15	10	13
Amphibians	05	04	03	04	03	05	04	04	03	02	05
Total	98	65	62	73	58	71	72	62	6	56	74

TABLE D.3.3

Group Distribution of Birds on Terrestrial and Aquatic According to Availability in Different Sampling Stations

Group (only Birds)		Sampling Station									
		1	2	3	4	5	6	7	8	9	10
Terrestrial	36	30	26	26	25	26	22	26	25	25	25
Aquatic	24	07	09	14	09	12	20	12	11	12	19
Total	60	37	35	40	34	39	42	38	36	37	44

D.3.1.3 Reptiles

There were 17 species of reptiles recorded in the Noakhali North project area (Tables D.3.1 and D.3.2). In addition to the turtles, monitor lizards and skinks were also observed close to waterbodies for feeding. Water snakes are very common in the floodplain. Highly poisonous snakes belonging to the family Elapidae were recorded with the help of local people. Freshwater turtles, monitor lizards and water snakes found in the study area are carnivores feeding on fish and other small animals in the freshwater habitats.

D.3.1.4 Amphibians

Only five species of amphibians were recorded during the field study (Tables D.3.1 and D.3.2). Frogs are important to the agricultural production because they help to control various kinds of pests in cultivated land. The Bull frog *Rana tigrina* was previously common and widely distributed throughout the country but its population has sharply declined both at a national as well as a local level.

The decline in frog populations is currently a worldwide problem and relatively little in known regarding the cause of this decline. A Specialist Group to look at this problem was set up recently by the Species Survival Commission of the IUCN - The World Conservation Union.

D.3.1.5 Terrestrial Species Distribution by Habitat

In general, the largest number of animals in the project area was recorded on roadsides, followed by embankments. Khals were found to have the lowest number of animals, and not surprisingly, birds were the largest group present as shown in Table D.3.4(a). Fish were not included in this table but have been dealt with in the fish ecology section. The largest number of plants was also reported from roadsides, followed by homesteads and Khals (Table D.3.4(b).

TABLE D.3.4

Distribution of Animals (A) and Plants (B) by Habitat

A.

Animals Group	H	RS	A	K	E	WM	P	R
Mammal	06	08	05	01	08	09	02	02
Birds	25	37	19	20	27	23	23	31
Reptiles	03	10	09	06	10	08	06	05
Amphibians	01	01	03	03	01	01	03	03
Total	35	56	36	30	46	41	34	41

B.

Plants Group	H	RS	A	K	E	WM	P	R
Tree	28	37	00	25	17	01	19	09
Shrub	11	14	02	10	09	00	10	05
Herb	12	16	12	16	07	01	19	10
Total	51	67	14	51	33	02	48	24

H = Homestead; RS = Road side; A = Agricultural field and margin; K = Khal and bank; E = Embankment; WM = Mono species Woodland; P = Pond and bank; R = River and bank.

D.3.1.6 Feeding Behaviour

The feeding habits of the recorded mammals, birds, reptiles and amphibians are presented in Table D.3.5. With the exception of the mammals, most of the animals in the study area are insectivorous and are believed to consume a large number of agricultural pests. Fish figured prominently as a food item for birds, which is not surprising since a large proportion of the birds found in the area were aquatic. Grain eaters were also important and this reflects the ability of the bird species to take advantage of the existing resources.

TABLE D.3.5

Distribution of Groups of Animals According to Their Feeding Habits

Group	Omn.*	Car.*	Sca.*	Pes.*	Mol.*	Ins.*	Ter.*	Gra.*	Fru.*	AV.
Mammals	00	05	00	02	00	01	02	03	04	01
Birds	00	03	03	20	11	33	00	11	05	04
Reptiles	02	06	00	02	00	05	00	00	00	02
Amphibians	00	00	00	00	00	05	00	00	00	00
Total	02	14	03	24	11	44	02	14	09	07

Note:
Omn.* = Omnivorous; Car.* = Carnivorous; Sca.* = Scavengers; Pes.* = Pescivorous; Mol.* = Mollusceater; Ins.* = Insectivorous; Ter.* = Terrestrial vegetation; Gra.* = Graminivorous; Fra.* = Fructivorous; AV.= Aquatic vegetation.

D.3.1.7 Breeding

The present understanding of the breeding cycles of recorded species is mainly based on the information supplied by the local people living in the project area. The breeding season for many of the species spans almost through the year, as follows:

May to July	-	for Bull frogs
November to June	-	for water snakes
April to August	-	for Cobras and Krait
Mid April to October	-	for Monitor lizards
May to September	-	for many aquatic birds such as cormorants, herons, storks, water hens, etc.
October to April	-	for predatory birds like, Kites and Vultures
February to September	-	for many land birds like doves, myna, Kingfishers, etc.

Rats breed almost throughout the year.

Yearly flooding clearly influences the fauna and their breeding strategies in the project area.

D.3.1.8 Wildlife Pests

Some of the animal species found in the project area are considered as agricultural pests (Table D.3.1), causing damages to crops in the different stages of cultivation or harvest. These include the Indian Crested Porcupine, various species of rats such as the Indian field rats, bandicoot rats and domestic rats among the mammals; and parakeets and purple moorhens among the birds. The effects of terrestrial birds like parakeets were reported by the local farmers from most of the project area. Rats are widely distributed in the project area. It is possible that the rat population may increase in Zones B, C and D due to the drier conditions resulting from draining of the floodplain in these zones.

D.3.1.9 Endangered and Threatened Species

According to Khan (1991) and Sarker and Sarker (1988), 21 animal species recorded during this Study are nationally Threatened or Endangered. Field records suggest that 16 more species are rare. The rest of the species are either common or occasionally observed by the local people. Two internationally threatened mammal species (IUCN, 1990), the Bengal Fox and the Ganges River Dolphin, also known as Gangetic Dolphin, were recorded in the project area.

According to the Gazetteer for the Greater Comilla and Noakhali Districts (Khan, 1977a and 1977b), several mammal species such as the Barking Deer, Swamp Deer, Hog Deer, Sambar, Spotted Deer, Gayal, Buffalo, Wild Dogs, Hyaena and tigers occurred in the region. These species are now all extinct in the area due to the loss of their natural habitat. It was possible to confirm some of this information with the help of the elderly local people in the study area.

D.3.2 Terrestrial Flora

A list of the flora recorded in the project area by sampling station is presented in Table D.3.6 which also includes details of the scientific, English and Bengali names, habitat, past and present occurrence, and of some of the uses made of the species. The plant species were divided into three main groups: trees, shrubs and herbs. The distribution of these plants by group in the sampling stations is presented in the Table D.3.7, where it can be seen that sampling station 2, 5 and 6 had the largest number of species and station 4 had the lowest.

Terrestrial plant communities are capable of using sunlight to accumulate large biochemical reserves, which form the primary energy source for the rest of the consumers. During the flood season this process is interrupted on the flood lands, because terrestrial plants can not respire under water. Besides their vital role as primary producers in the floodplain ecosystem, plants offer crucial resting, feeding and breeding grounds for many wild mammals, birds and reptiles.

The natural vegetation found in the project area also fulfils many of the needs of the local people, being used for fuel, medicinal and construction purposes, and as food items in order of importance (see Table D.3.8). More than 50% of the floral species in the study area are used by the local people for medicinal purposes to cure various diseases and injuries in preference to the high cost modern medicine which may have adverse side effects. It is evident from the reports by the local people that medicinal plants are indeed, extremely important to them. Details on the medicinal plants found in the study area, together with their scientific and local names, their chemical composition and their use are given in Table D.3.9.

From Table D.3.6 it can be seen that Station 5 had the highest number of medicinal plants, representing nearly 90% of the total number of medicinal plants recorded for the study area. Stations 6 and 8 each had 66% of the total and Station 7 had the lowest, representing 49% of the medicinal plants in the study area.

TABLE D.3.6

Species list (Flora) with Relevant Information are given below in reference with survey sties of Noakhali North study area.

Habitat code: H = Homestead; RS = Road side; A = Agricultral field and margin; K = Khal Bank; E = Embankment; WM = Monospecies woodland; P = Pond Bank; R = River Bank.
Occurance Code: 1 = Very common; 2 = Common; 3 = Uncommon; 4 = Uncertain; 5 = Rare.

Type code: T=Trees; S=Shrubs; H=Herbs

Utility code: T=Timber; M=Medicinal; F=Food; FU=Fuel; FO=Fodder; C=Construction; O=Ornamental; CR=Craft; R=Religious; FI=Fibre.

Family Name	Scientific Name		English Nmae	Bengali Name	Habitat	Occurance		Type	Utiliy	Sampling Stations									
	Genus	Species				Past	Present			1	2	3	4	5	6	7	8	9	10
Anacardiaceae	*Mangifera*	*indica*	Mango Tree	Aam	H,RS,K,P,R	2	3	T	T,F,FU	+	+	+	+	+	+	+	+		+
Myrtaceae	*Syzygium*	*sp*	Indian Black Berry	Jam	H,RS,K,P,R	2	3	T	T,F,FU,C	+			+		+	+	+	+	+
Moraceae	*Artocarpus*	*heterophyllus*	Jack Fruit Tree	Kathal	H,RS,P	2	3	T	T,F,FU,FO	+	+		+		+	+	+	+	+
Moraceae	*Ficus*	*benghalensis*	Banyan Tree	Bot	RS,K,P	2	3	T	T,M,FU,FO					+					+
Palmae	*Cocos*	*nucifera*	Coconut	Narikel/Dab	H,RS,K,P,R	1	2	T	T,F,FU,C,CR	+	+	+	+	+	+	+	+	+	+
Palmae	*Areca*	*catechu*	Betel Nut Palm	Supari/Gua	H,RS,K,WM,P,R	1	1	T	T,F,FU	+	+	+	+	+	+	+	+	+	+
Elaeocarpaceae	*Elaeocarpus*	*robustus*	Olive	Jalpai	RS,P	1	2	T	T,F,FU		+	+		+		+			
Ebenaceae	*Diospiros*	*peregrina*	Nigerian Ebony	Gab	H,RS,K,P	2	3	T	T,M,F,FU		+		+	+		+		+	
Urticaceae	*Streblus*	*asper*		Shaorah	RS,K,E,P,R	2	3	T	T,FU					+	+		+	+	+
Annonaceae	*Polyalthia*	*longifolia*	Mast Tree	Debdaru	RS	2	3	T	T,FU,O							+			
Moraceae	*Ficus*	*religiosa*		Pipal/Aswatha	RS,E,K	2	3	T	T,M,FU	+		+	+		+		+	+	
Bombacaceae	*Bombax*	*ceiba*	Red Silk Cotton	Simul	RS,E,K,P,R	2	2	T	T,FU,FI			+	+	+	+	+		+	+
Lythraceae	*Lagerstroemia*	*sp*		Jarul	RS,E	2	3	T	T,FU,C	+			+			+		+	
Capparaceae	*Crataeva*	*nurvala*		Bannay	H,K	2	3	T	T,FU	+	+		+	+	+				
Rhamnaceae	*Zizyphus*	*mauritiana*	Indian Palm	Borai/Kul Gach	H,RS,K,P,R	2	2	T	F,FU,FO	+	+	+	+	+	+	+	+	+	+
Palmae	*Borassus*	*flabellifer*	Palmyra Palm	Tal	H,RS,K,P,R	2	2	T	M,F,FU,C,O,CR	+	+	+	+	+	+	+	+	+	+
Leguminosae	*Tamarindus*	*indica*	Tamarind	Tetul	H,E	2	3	T	T,M,F,FU,FO	+	+	+		+	+	+			
Palmae	*Phoenix*	*sylvestris*	Wild Date Palm	Khejur	H,RS,E,K	2	2	T	F,FU,C,CR	+	+	+	+	+		+	+		
Euphorbiaceae	*Trewia*	*polycarpa*		Pituli/Madda	H,RS	2	2	T	T,FU,C				+	+	+	+	+	+	+
Rutaceae	*Citrus*	*grandis*	Grape fruit	Jambura	H	2	3	T	F,FU	+		+	+	+		+			+
Annonaceae	*Anona*	*squamosa*	Custard-apple	Ata	H	2	3	T	M,F,FU	+	+	+	+	+			+		
Combretaceae	*Terminalia*	*catappa*		Kath badam	H,RS,P	2	2	T	T,F,FU	+	+	+		+		+		+	
Lequminosae	*Acacia*	*nilotica*	Babul	Babla	RS,K,E	2	3	T	T,M,C	+	+	+							
Moraceae	*Artocarpus*	*lakoocha*		Deua/Deophal	RS,K,P	2	2	T	T,F,FU	+	+			+				+	+
Leguminosae	*Dalbergia*	*sissoo*		Sisu	RS,K,E	2	3	T	T,FU,C	+							+		
Maliaceae	*Aphanamixis*	*polystacya*		Roina	H,RS,E,P	2	2	T	T,FU,C				+			+		+	
Leguminosae	*Butea*	*monosperma*		palash	H,RS,K,E,P	2	2	T	M,FU,C,O				+	+		+			
Moraceae	*Ficus*	*glomerata*		Jogdumur	RS,K,E	2	3	T	M,FU	+	+		+		+			+	+

Family Name	Scientific Name		English Nmae	Bengali Name	Habitat	Occurance		Type	Utiliy	Sampling Stations									
	Genus	Species				Past	Present			1	2	3	4	5	6	7	8	9	10
Annonaceae	*Annona*	*reticulata*		Nona	H,RS	2	3	T	M,F,FU					+		+			
Moringaceae	*Moringa*	*oleifera*		Sajna	H	2	3	T	M,F,FU	+		+	+		+				+
Meliaceae	*Azadirecta*	*indica*	Margosa	Neem	RS,K,E	2	2	T	T,M,FU	+	+	+	+	+	+		+	+	+
Leguminosae	*Albizia*	*sp.*		Koroi	H,RS,K,E,P	2	3	T	T,FU	+	+	+	+	+	+	+		+	+
Lecythidaceae	*Barringtonia*	*acutangula*		Hijal	H,RS,K,E	2	3	T	T,FU	+	+			+		+		+	
Rutaceae	*Aegle*	*marmelos*	Bengal Quince	Bel/Bela	H	2	3	T	M,F,R	+	+	+	+	+	+	+	+	+	+
Anacardiaceae	*Spondias*	*pinnata*	Hong palm	Amra	RS	2	4	T	F,FU			+	+			+	+		+
Averrhoaceae	*Averrhoa*	*carambola*		Kamranga	H	2	5	T	M,F,FU	+	+	+	+		+	+	+		+
Rubiaceae	*Anthocephalus*	*chinensis*	Kadam	Kadam	H,RS,K	2	2	T	T,FU,FO	+				+	+	+	+	+	+
Meliaceae	*Aphanamixis*	*polystachya*		Pitraj	H,RS,E,P,R	2	3	T	T,M,FU	+	+	+	+	+		+	+		+
Meliaceae	*Melia*	*sempervirens*	Mahaneem	Mahaneem	RS	2	4	T	T,M,FU						+		+	+	
Meliaceae	*Swietenia*	*mahagoni*		Mehagini	RS	2	3	T	T	+	+						+	+	
Leguminosae	*Acacia*	*farnesiana*		Guhiya Babul	RS,K,E	2	3	T	T,FU		+	+		+	+				
Dilleniaceae	*Dillenia*	*indica*		Chalta	H	2	2	T	T,M,F,FU	+	+		+	+	+	+		+	
Leguminosae	*Erythrina*	*variegata*		Mandar	H	2	3	T	T,F,FU	+	+	+	+	+	+	+	+	+	+
Combretaceae	*Terminalia*	*arjuna*		Arjun	RS	2	3	T	T,M,FU,C	+	+	+		+				+	
Leguminosae	*Cassia*	*fistula*	Indian Laburnum	Sonalu	H,RS,K,E,P	2	2	T	FU,C		+	+	+	+	+	+	+	+	
Apocynaceae	*Alstonia*	*scholaris*		Chatim	RS,K	2	2	T	T,M,FU,C	+	+	+		+	+		+	+	+
Sapindaceae	*Lichi*	*chinensis*	Litchi	Lichu	H	2	3	T	F,FU				+	+	+				
Sterculiaceae	*Abroma*	*augusta*		Ulatkombal	K,E	2	5	S	M		+	+		+	+			+	
Boraginaceae	*Heliotropium*	*indicum*		Hatishur	R	2	5	S	M	+	+			+	+	+			
Asclepiadaceae	*Calotrophis*	*gigantia*		Akanda Pata	RS,K,E	2	3	S	M,FU,O,R	+		+	+	+	+		+	+	+
Liliaceae	*Aloe*	*barbadensis*		Ghitakanchan	RS,E	2	4	S	M								+		
Labiatae	*Ocimum*	*sp*		Tulshi	H,RS	2	3	S	M	+		+		+	+				+
Acanthaceae	*Adhatoda*	*vasica*		Basak	K,E	2	3	S	M,FU	+	+	+	+		+	+	+	+	+
Solanaceae	*Datura*	*fastuosa*		Dhutra/Dhutura	RS,K,E,P,R	2	2	S	M,FU		+	+		+	+		+	+	+
Euphorbiaceae	*Ricinus*	*communis*		Reri	H,RS,E	2	2	S	M,FU	+			+		+		+	+	
Convolvulaceae	*Ipomoea*	*fistulosa*		Dhol Kalmi	H,RS,K,P,R	2	2	S	FU	+	+	+		+	+	+	+	+	
Caricaceae	*Carica*	*papaya*	Papaya	Pepe	H	2	2	S	M,F	+	+	+	+	+	+		+	+	
Euphorbiaceae	*Phyllanthus*	*reticulatus*		Sitki	H,RS,P	2	2	S	FU	+	+			+	+	+	+	+	
Rutaceae	*Glycosmis*	*arberoea*		Datmajan	H,K,P	2	2	S	M,FU	+			+	+	+	+	+	+	
Malvaceae	*Hibiscus*	*rosa – sinensis*		Jaba	H	2	2	S	O,R	+	+					+		+	+
Verbenaceae	*Vitex*	*negundo*		Nishinda	H	2	4	S	M				+					-	
Euphorbiaceae	*Croton*	*bonplandianum*		Boncroton	RS,K,E,WM,P,R	2	2	S	M,FU	+	+	+	+	+		+	+	-	-

Family Name	Scientific Name		English Nmae	Bengali Name	Habitat	Occurance		Type	Utiliy	Sampling Stations									
	Genus	Species				Past	Present			1	2	3	4	5	6	7	8	9	10
Verbenaceae	*Clerodendrum*	*viscosum*		Bhant	RS,K,E,P,R	2	2	S	M,FU	+	+	+	+	+	+				
Compositae	*Xanthium*	*indicum*		Gagra	RS,A,K,E,P,R	2	2	S	FU	+	+	+		+	+	+	+	+	+
Marantaceae	*Clinogyne*	*dichotoma*		Sitalpati	RS,P,R	2	2	S	CR		+	+	+	+	+	+	+	+	
Palmae	*Calamus*	*sp.*		Bet	RS,K,P	2	2	S	CR		+	+		+		+	+		
Verbenaceae	*Duranta*	*repens*		Duranta	H,RS	2	2	S	FU			+			+		+	+	+
Bromeliaceae	*Ananas*	*sativus*	Pine apple	Anaras	H	2	3	S	F							+	+		
Orchidaceae	*Vanda*	*tessellata*		Rasna	H	2	4	S	FU								+		
Araceae	*Alocasia*	*indica*		Man Kachu	H	2	3	H	M,F	+		+	+	+	+	+	+	+	
Amaranthaceae	*Amaranthus*	*spinosus*		Kanta Note	RS,A,K,P	2	3	H	M,F	+	+	+	+	+	+	+	+	+	+
Amaranthaceae	*Amaranthus*	*viridis*		Note	H,A,K,P	2	2	H	M,F,FO	+		+	+	+	+	+	+	+	+
Graminae	*Bambusa*	*sp.*	Bamboo	Bans	H,WM	2	2	H	M,FU,C,O,CR	+	+	+	+	+	+	+	+	+	+
Leguminosae	*Cassia*	*occidentalis*		Jhanjhani	RS,K,E,P	2	2	H	FU		+	+			+	+	+		+
Graminae	*Chrysopogon*	*aciculatus*		Chorekanta	H,RS,A,K,E,P	2	2	H	M,FU	+	+	+	+	+	+	+	+	+	+
Umbelliferae	*Centilla*	*asiatica*		Thankuni	H,RS,A,K,E,P,R	2	2	H	M,F	+	+	+	+	+	+	+	+	+	+
Labiatae	*Leonurus*	*sibiricus*		Raktadrone	H,A,K,P	2	5	H	M,FU		+	+			+	+			+
Araceae	*Colocasia*	*esculenta*		Kachu	A,K,P	2	3	H	M,F	+	+	+	+	+	+				+
Graminae	*Cylodon*	*dectylon*		Durbaghas	H,RS,A,K,P,R	2	2	H	M,FO,R	+	+	+	+	+	+	+	+	+	+
Musaceae	*Musa*	*sp.*	Banana	Kala	H,RS,P,R	2	2	H	M,F,FO	+	+	+	+	+	+	+	+	+	+
Graminae	*Oryza*	*sp.*	Rice	Dhan	A	2	2	H	F,FU,FO	+	+	+	+	+			+	+	+
Solanaceae	*Solanum*	*nigrum*		Futi Begun	RS,K,E,P,R	–	2	H	FU	+	+	+		+	+	+	+		+
Cucurbitaceae	*Coccinea*	*cordifolia*		Telakucha	E,P	–	3	H	M,FU	+			+		+	+		+	
Caryophyllaceae	*Polycarpon*	*prostratum*		Gimashak	RS,P	–	3	H	M,F		+	+		+	+		+		
Polygonaceae	*Polygonum*	*hydropiper*		Bishkatali	K,P,R	2	2	H	M	+	+	+		+		+	+	+	+
Graminae	*Saccharum*	*spontaneum*		Kash	RS,A,K,R	2	3	H	FU,CR		+	+			+		+	+	
Apocynaceae	*Ichnocarpus*	*frutescens*		Dudhilata	H,RS,K,E,P,R	2	2	H	M,FU	+	+	+	+	+	+	+	+		+
Compositae	*Mikania*	*cordata*		Assmlate	H,RS,K,E,P,R	2	2	H	FU		+	+	+				+		+
Chenopodiaceae	*Chenopodium*	*album*		Bethoshak	A	2	2	H	F	+	+				+				
Amaranthaceae	*Achyranthes*	*aspera*		Upatlangra	H,RS,A,K,P	2	2	H	M,FU	+	+	+	+	+	+	+	+	+	+
Labiatae	*Leucas*	*aspera*		Swetadrone	RS,A,K,P	–	2	H	M,FU	+	+	+	+	+	+	+	+	+	+
Sterculiaceae	*Buettneria*	*pilosa*		Harjora	H	2	5	H	M		+				+	+		+	
Cucurbitaceae	*Hodgsonia*	*macrocarpa*		Makal	R	2	3	H	F (birds)		+	+		+	+				+
Gramineae	*Iperata*	*cylindrica*		Ulu	RS,R	2	2	H	FU,CR		+							+	
Marsilea	*Marsilea*	*quadrifoliata*		Sushnishak	A,K,P,R	2	3	H	F					+	+				+
Convolvulaceae	*Cuscuta*	*reflexa*		Swarnalata	RS	–	3	H	M										+
Rubiaceae	*Paedaria*	*foetida*		Gandhaveduli	RS,P	–	3	H	M,FU	+	+	+						+	+

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TABLE D.3.7

Groupwise Distribution of Plants According to Different Sampling Stations

Group (Plant)		Sampling Station									
		1	2	3	4	5	6	7	8	9	10
Tree	47	32	29	26	20	33	27	30	24	28	24
Shrub	22	13	13	13	09	14	15	11	16	15	08
Herb	28	18	23	22	15	18	23	17	18	17	21
Total	97	63	65	61	44	65	65	58	58	60	53

TABLE D.3.8

Distribution of Plants According to Their Major Utility

Group (Plant)	**Group of Major use**									
	T	M	F	FU	FO	C	O	CR	R	FI
Tree	33	19	16	44	05	13	02	03	00	01
Shrub	00	13	01	12	00	00	02	02	00	00
Herb	00	19	11	14	04	01	01	03	01	00
Total	33	51	28	70	09	14	05	08	01	01

T = Timber; M = Medicinal; F = Food; FU = Fuel; FO = Fodder; C = Construction; O = Ornamental; CR =Craft; R = Religions; FI = Fibre

TABLE D.3.9

Medicinal Plants Recorded in the Noakhali North Study Area

Scientific Name	Local Name	Chemical Composition	Use
Ficus bengalensis	Bot	Milky juice, sterols, glycoside, terpenoide, albuminoids, ficosterol, glutathiome cellulose, lignin	Nasal bleeding, Burning sensation of whole body, Strain, Toothache, Pendulus breast
Diospyros peregrina	Gab	Tannin, acids viz., tannicacid, malic acid, fatty acid	Chronic dysentery, Diabetes, Excessive bleeding during menustration
Ficus religiosa	Asawatha	Protein, Inorganic elements viz., calcium, phosphorus, glycosides, Resins, tannin, caoutchouc, traces of alkalsids	Burn, Ear infection, Infected cut, Vomitting
Borassus flabellifer	Tal	12% surcros, butyric acid	Diabetes, Digestive, Weakness
Tamarindus indicusm	Tetul		Refrigerant, Carminative, laxative
Annona squamosa	Ata	Anonaine (Alkaloid 0.03%. The pulp contains Moisture 73.2%; Glucose 14.5%; Saccharose 17%; Proteins 0.8%; Vitamin C. Oven Dried Kernels of Seeds contain 30.0% of oil	Applied to malignant tumours to haster suppuration. Drastic purgative, Powerful irritant of the conjunctiva.
Alstonia scholaris	Chhatim		Dysentery
Acacia nilotica	Babul		Relieven local pains
Butea monosperma	Palash	A yellow tasteless oil, Proteolytic and lypolytic enzymes, Butein, butin butrin.	Chronic dysentry, Polyurea, Worm infestation, Piles, Night sweat, Polyurea Bite from scarpion & other poisonous insects, Hydrocele.
Ficus glomerata.	Jogdumur	Leaves contains: Carotenoid, meliatin, and an alkaloid. Pericarp contains: bakayanin, neutral nubstance (neo-bakayanin and bakayanic acid) Fruit contains : an alkaloid, azaridine (also called margosine), a sterol, tannins, glucose and starch. Seeds contain : drying oil 40%, unsapon matter 1.26%, saturatedfatty acids 11.4% (palmitic and stearic) and unsaturated fatty acids 88.6% (oleic and linoleic), unsaponifiable matter (phytosterol and aromatic hydrocarbons). Bark contains:alkalorids (azaridine and paraisine)and active substance mp. 154 degree. Heartwood contains: a crystalline lactons (baka lactons), a liquid with terpenic odour, a resinous material and tanins.	Prevention of acne, Increase sight and hearing, Asthma.

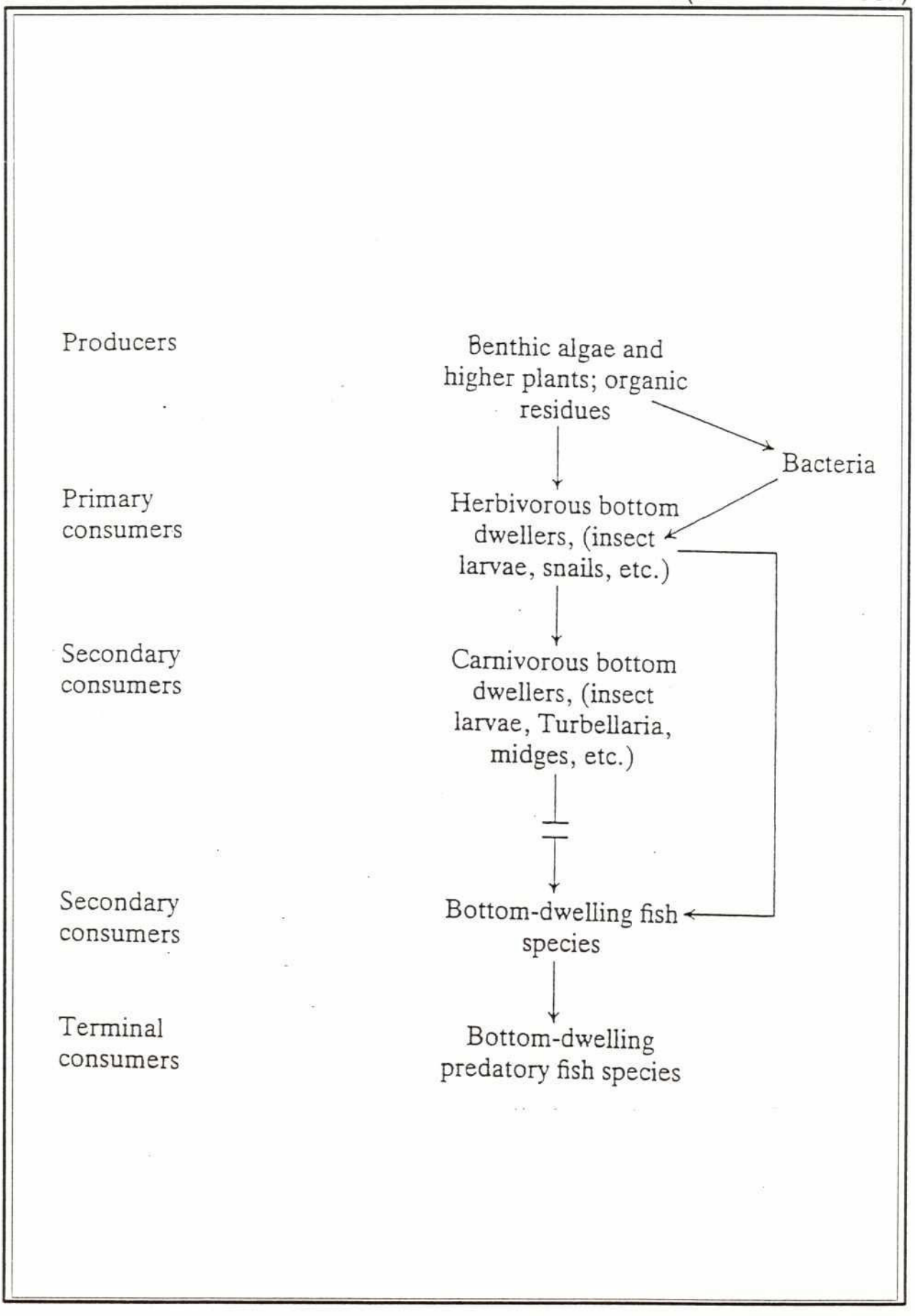
Scientific Name	Local Name	Chemical Composition	Use
Annona reticulata	Nona	Alkaloid, anonaine 0.12% in bark, alkaloid, reticulin in root bark moisture 72.3%, glucose 12.5% and proteins 2%	Powerful astringent, vermifuge
Moringa oleifera	Sajna		Tonic and cooling agent, in bites of snakes, dogs and monkeys. Gastric complains.
Azadirecta indica	Neem	Alkaloids viz. nimbin, nimbinin, nimbidin, nimbosterin, nimbecetin, bakayanin, Fatty acids (different types) Highly pungent essential oil	Jaundice, Skin diseases, Diabetes, Dry cough, Hyperacidity
Aegle marmelos	Bel		Astringent, Digestive tonic, Stomachic, Laxative
Aphanamixis polystachya	Pitraj	Aphanamixin, aphanamixol, aphanamixinine	Piles, Menorrhagia, Importance Worm infestation, Gonorrhoea, Liver disease
Melia sempervirens	Mahaneem	Leaves contain: Carotenoid, meliatin and an alkaloid. Pericaps contains: bakayanin, neutral substance (neo-bakayanin and bakayanic acid). Fruit contains: an alkaloid, azaridine (also called margosine), a sterol, tannins, glucose and starch. Seeds contain: Dry oil 40%, unsapon matter 1.26%, saturated fatty acids 11.4% and unsaturated fatty acids 88.6%, Unsaponifiable matter (Phytosterol and aromatic hydrocarbons). Bark contains: Alkaloids (azaridine and paraisine) and active substances mp. 154°	Painin chest, Worm infection, Stomach pain, Treatment for louse.
Dillenia indica	Chalta	Tannin, glucose, malic acid	Foodpoison, Boldness Maldigestion, Weakness
Averrhoa carambola	Kamranga	Moisture 93.9%, protein, 0.5%, fat 0.2%, vitamin A, iron 0.6 mg, potassium oxalate	Long grade fever, Liver pain
Terminalia arjuna	Arjun		Cardiac tonic
Abroma augusta	Ulatkambal	An alkaloid 0.01% and some water soluble bases 0.01%, mixed oil and resins	Gynecological complains, dysentery etc.
Heliotropium indicum	Hatisur		Use in eye infection
Calotropis gigantes	Akanda	Akundarin, calotropin, uscharin, calactin, calotoxin, calactin, B-calotropeol, B-amyrin, calcium oxalate, gigantin, glutathoine, giganteol, iso-giganteol. A proteo clastic enzyme similar to papain. Crystalline alcohols, long chain fatty acids, Tetracyclic terpenes, esters of waxy acids and alcohols	Asthma, Hyperacidity, External application: Piles, Bite of scorpion, Eczema and scabien
Aloe barbadensis	Ghitakanchan	Aloin, isobarbaloin, emodin chrysophanic acid, urnic acid, gum, resin, glycosides	Worm, Gynecoganic problem, Children digestive problem, Eczema

Scientific Name	Local Name	Chemical Composition	Use
Ocimum sp.	Tulshi		In cold, Fever, Skeen diseases, Headaches, etc.
Adhatoda vasica	Basak	Vasicine, I-peganie, small amount of essential oil	Asthma, Respiratory disorder, Painful piles, Water purifier
Datura fastuosa	Dhatura	Alkaloids viz., hyoscyamine, hyoscine, atropine, scopolanine, norhyoscyamine, vitamin C, other constituents viz., fixed oil and allantoin	Bite from mad dog of fox, Baldness, Madness, Mastitis, Asthma
Ricinus communis	Reri/ Bherenda		Rheumatic pains
Carica papaya	Pepe	Surcrose, inverted sugar; paparin, malic acid; salts of tartaric acid and citric acid; a resinous substances; pectins; vatamins (vitamine - A, thiamine, riboflavin niacin and ascorbic acid)	Gartric troubles
Glycosmis arberoea	Datmajan		Tooth cleaner
Vitex negundo	Nishinda	Alkaloids viz, nishindine & unidentified alkaloids, Essential oil, Sterols, Terpenoid constituents.	Boil, Dendruff, Arthritis sciatica, Roundworm infestation Dyspepsia, Asthma, Pharysgitis, Bedsore.
Croton bonplandianum	Boncroton		Accidental wound in the body.
Clerodendrum viscosum	Bhant	Clerodin, Sterol, Zanthophyll, Carotene, Ash 8.0%, Protein 2.12%, Crude fibre 14.8% Reducing sugars 3.0%, Total sugars 17.0%, Linolenic acid, Oleic acid, Stearic acid, ligneceric acid.	Rheumatism and skin diseases of cattle
Alocasia indica	Mankachu	Pur white starch	In rheumatism
Amaranthus spinosus	Kanta note	Moisture 85%, Protein 3.0% Fat 0.3%, Carbohydrates 8.1%, Mineral matter 3.6%, Calcium 0.8% Phosphorus 0.05%, Iron 22.9 mg/100g	Blood dysentery, Gynecological problem, Caugh, Accidental cut or wound
Amaranthus viridis	Note		Blood dyscentery, Caugh, Gynecological problem
Bambusa sp.	Bans		Externally use for anticephic
Chrysopogon aciculatus	Chorkanta		Hemicrania
Centilla asiatica	Thankuni		Dysentery, Leprosy
Leonurus sibiricus	Raktadrone		Earache
Colocasis esculenta	Kachu		Head skin diseases
Cynodon dectylon	Durbaghas		Haematuria, juice use to cuts and wounds

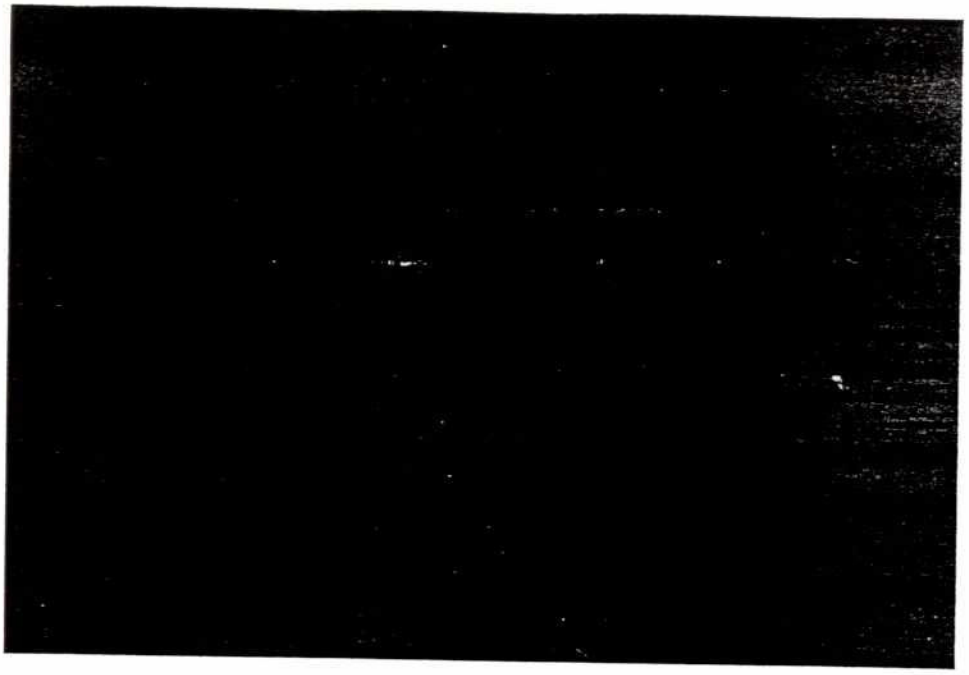
Scientific Name	Local Name	Chemical Composition	Use
Musa sp.	Banana	Carbohydrates, minerals, vitamins (b-groud), acetate, amy l butyrate, acetaldehyde, elthy l and meth l alcohols, l-malic acid, serotonin, norepinephrine and dopamine.	Worm infection, Caugh, Diabetes, Trusty during cholera infection, pain in ear
Coccinia cordifolia	Telakachu	Engyme, hormone, amylase, trace of alkaloids, vitamin - A, Vitamin C	Diabetes, Cold, Caugh
Polycarpon prostratum	Gimashak		Anti worm & blood purification
Polygonun hydropiper	Bishkatali		Anti haemorrhage
Ichnocarpus frutescens	Dudhilata		Anti haemorrhage
Achyranthus aspera	Upatlangra/ upaug	Pungenti oil, sterols viz., ß- and r-sitosterol, terpenoid constituents	Diuretic, in bites of poisonous animals
Leucas aspera	Swetadrone		In psoriasis, Eruptions of skin and in rheumatism
Buettneria pilosa	Harjora		Tied round the Limbs in fractures.
Cuscuta reflexa	Swarnalata	The stem contains: Cuscutin and cuscutalin, The seed contains: The pigments of amarbelin, cuscutin. Wax (esters), Greenish yellow semi drying oil (linolenic 9.9%, linolic 17.2%, oleic 25.%, stearic 27.2%, and palmitic acid 11.5% and unsapnifiable substance (phytosterol).	Low grade fever, Liver pain, Worm infection, Extend use: Trauma, washing wound
Paedaria faetida	Gandhaveduli		Diarrhoea, Dysentery

Figure D.4.1

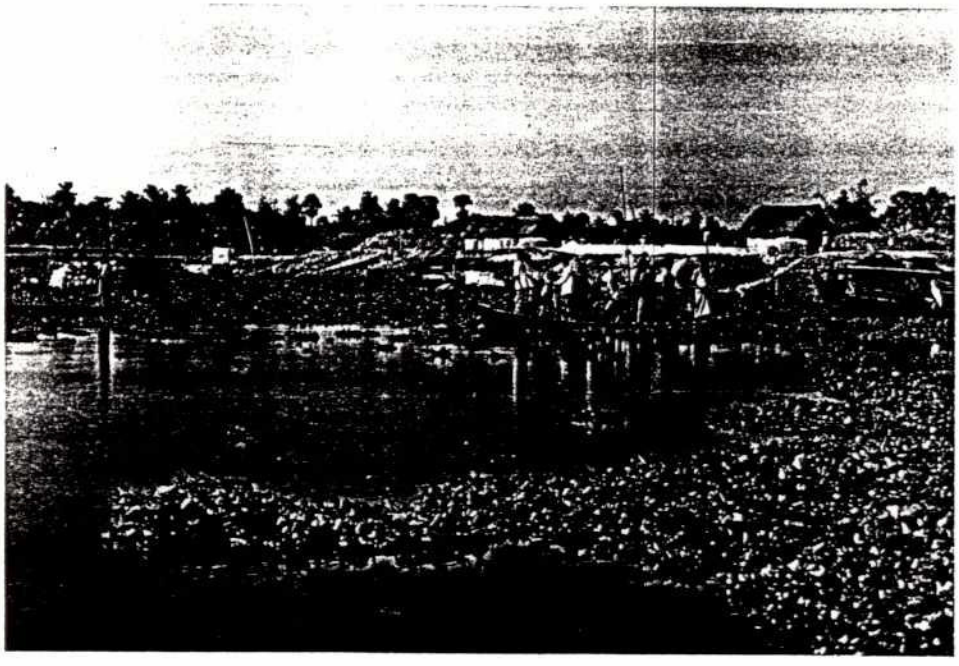
Schematic Representation of a Benthic Consumer Food Chain (Schowerbel 1987)



Plates 3(a) and 3(b)



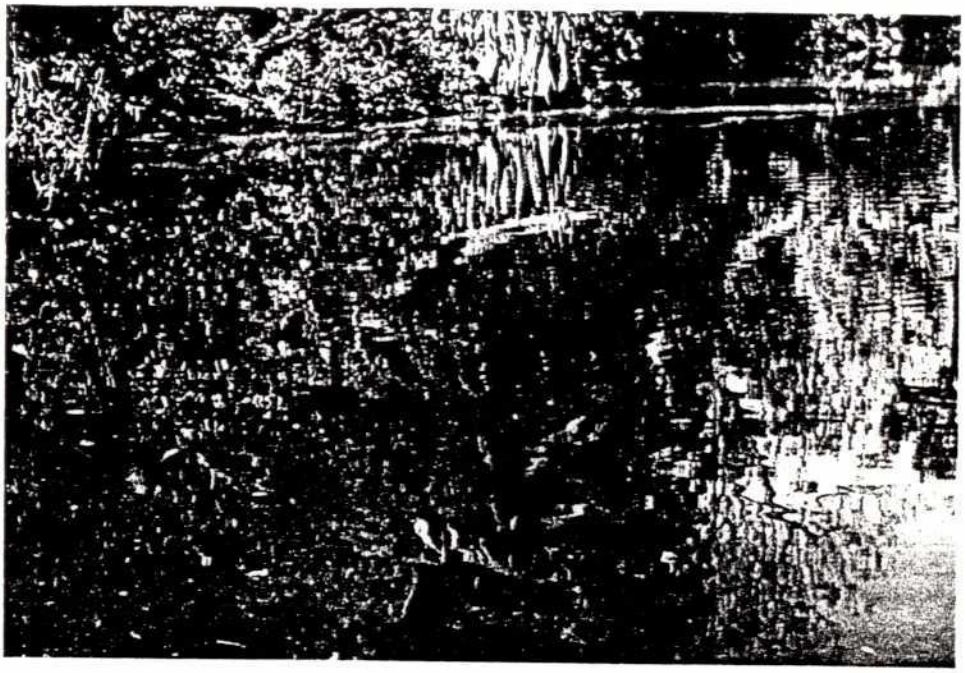
(a)



(b)

River ecosystems, (a) Meghna, (b) river Dakatia at office Chittoushi.

Plates 4(a) and 4(b)



(a)

(b)

Algal bloom in ponds, (a) a fertilized homestead pond showing the bloom by *Carteria* sp., green patches; (b) bloom by *Botryococcus braunii*, unfertilized pond.

CHAPTER D.4

FINDINGS - AQUATIC ECOLOGY

D.4.1 Findings Aquatic Ecology

The list of aquatic flora and faonna found in the project area together with details of their habitat and abundance at each site are presented in Table D.4.1.

The highest number of aquatic micro algae taxa (50) was found in Site 10 (Table D.4.2). Habitats included in this site were the Dakatia River (upstream, middle course and downstream), some submerged rice fields, ditches and ponds. The Dakatia River was found to contain scanty phytoplankton populations and thus, most of the algae were collected from the other type of habitats. Human interference as a result of fishing, coupled with the tidal flow could be the reason for the low plankton in this river, although this assumption could not be confirmed during this study. The second highest number of taxa (34) was recorded from Site 7 (Table D.4.2), where the main habitats were ditches and ponds. A luxuriant population of desmids was found in a roadside ditch in a domestic outflow. Fish ponds also supported good populations of phytoplankton. Sites 2 and 3 (Begumganj Depression and Noakhali Khal) supported almost similar number of taxa (Table D.4.2). Habitats in the Laksham Depression (Site 1) and on the north-west part of the project area (Site 8, Hajipara), yielded a record 20 and 22 taxa respectively. The eastern and western part of the Rahmatkhali regulator supported very few planktonic taxa. The water around the sluice gate gave the appearance of being oligotrophic (poor) in nature.

Around mid December 1992, the western part of the sluice gate was fully covered with *Eicchornia crassipes* or water hyacinth. However, the nearby Meghna River (Plate D.3a) supported a good population of *Melosira* sp. and *Stephanodiscus* sp. Examination of the plankton samples collected in the interconnecting channels between the Rahmatkhali regulator and the Meghna River revealed that the river plankton was not entering the channel and the Rahmatkhali Khal. Thus, the food chain in this area might be of a benthic consumer type (Figure D.4.1).

Ponds and ditches in the area supported a good number of plankton species. As a whole, 20 taxa were collected from Site 8 (Table D.4.2). The irrigation channels in the area contained little plankton (Sites 4 and 8) probably due to the fact that they remain covered with free-floating macrophytes and thus the light penetration is impeded. In addition, as the water is constantly withdrawn for irrigation, its level fluctuates drastically and the continuous removal of nutrient rich deeper water from the site results in a nutrient deficient condition for the macrophytes.

The number of zooplankton and benthic fauna recorded varied from 7 to 11 taxa in all sites except in Station 7, where 5 taxa were collected (Table D.4.3). Ponds and small roadside ditches supported good number of zooplankton species as they often have good nutrient sources. Examples of these habitats include a fish pond in Hajipara (Plate D.4a and D.4b), a ditch near Begumganj (*Chowrasta*) and a roadside channel (Barakhal) near Ramganj (Plate D.2a).

TABLE D.4.1

ALGAE, ZOOPLANKTON AND BENTHIC MACROINVERTEBRATES
FOR NOAKHALI NORTH DRAINAGE AND IRRIGATION PROJECT

Taxonomy	Common English Name of the group	Species with habitat	Habitat	Sampling Sites									
				1	2	3	4	5	6	7	8	9	10
CRYPTOGAMS													
THALLOPHYTA (ALGAE)													
Cl. : Chlorophyta													
Or. : Volvocales													
Fa. : Polyblepharidaceae	Volvocalean algae	*Spermatozoopsis*	P,D					1					2
Fa. : Chlamydomonadaceae		*Chlamydomonas*	P,K		2	3		2		2			3
		Chlorogonium euchlorum	K			2							
		Platymonas	D										1
Fa. : Phacotaceae		*Coccomonas*	P										2
		Dysmorphococcus	RF										1
		Carteria	K			2							
		Pandorina morum	P,D			1						1	
Fa. : Volvocaceae		*Eudorina*	D		2								
		Gonium pectorale	D,RF		2								2
		Pleodorina	D							2			
		Volvox	D							2			
Fa. : Spondylomoraceae		*Pyrobotrys gracilis*	D			1							
Or. : Tetrasporales													
Fa. : Palmellaceae		*Sphaerocystis*							2				
Fa. : Coccomyxaceae		*Elakatothrix*	K						2				
Or. : Ulotrichales	Ulotrichalean												
Fa. : Chaetophoraceae		*Uronema*	D		3								
		Stigeoclonium	P		3								
Or. : Oedogoniales	Oedogoniales												
Fa. : Oedogoniaceae		*Oedogonium*	P		2								

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TABLE D.4.1 CONTD.

Taxonomy	Common English Name of the group	*Species with habitat*	Habitat	Sampling Sites									
				1	2	3	4	5	6	7	8	9	10
Or. : Chladophorales	Chlodophoralean												
Fa. : Chladophoraceae		*Rhizoclonium*	K		1								
		Pithophora	K						2				
Or. : Chlorococcales	Chlorococcales												
Fa. : Characiaceae													
Fa. : Hydrodictyaceae		*Schroederia setigera*	K,P	3		2			2				3
Or. Zygnematales	NK	*Pediastrum duplex*	K,P,MR		2				2		3		2
Fa. Zygnemataceae		*P.biradiatus*	P		2				2				
		Sorastrum	P								3		
Fa. : Coelastraceae		*Coelastrum microporum*	P						3				3
Fa. : Oocystaceae		*Westella*	P								3		
		Radiococcus	M			3							
		Planktosphaeria	K										3
		Oocystis	P							3			
		Nephrocytium agardhianum	P		3								
		Nephrocytium sp.											
		Ankistrodesmus falcatus	P,K	2		3			2				
		A. spiralis	P	2									
		Closteriopsis	P,K	3	3	2			3	3	2		
		Kirchneriella	P										2
		Tetraedron trigonum	P								2		
		Tetraedron sp.	P										3
Fa. : Scenedesmaceae		*Scenedesmus acuminatus*	P					2					
		S. bijuga	M			2							
		S. biradiatus	M			2							
		S. dimorphus											
		S. obliquus	P,K							2			2

TABLE D.4.1 CONTD.

Taxonomy	Common English Name of the group	*Species with habitat*	Habitat	Sampling Sites									
				1	2	3	4	5	6	7	8	9	10
		S. opoliensis	P										2
		S. quadricauda	M			2							
		Scenedesmus spp.	P		2				2		2		3
		Crucigenia rectangularis	P										2
		C. tetrapedia	P,K	2	2	2			3		2		2
		C. crucifera	P						2		2		
		Actinastrum hantzschii	P,K	3		2					3		
Or. : Zygnematales													
Fa. : Zygnemataceae	Conjugales	*Spirogyra*	D		2								
		Mougeotia	D							1			
		Zygnema	D							2			
		Netrium	D							3			
		Closterium	P,K		2								
		Pleurotaenium trabecula	D							3			3
Fa. : Desmidaceae		*Micrasterias foliaceae*	D							2			
		M. mahabuleshwarensis	D							2			
		M. radians	D							2			
		M. tropica	D							3			
		M. zeylanica	D							3			
		Micrasterias sp.	D							2			
		Euastrum spinulosun	D							3			
		Euastrum sp.	D							2			
		Cosmarim binum	M							3			
		C. cymatopleurum	D							2			
		C. granatum	D,K							2			
		C. lundelli	P		2					2		3	
		C. maculatiforme	D,K									2	
		C. margaritatum	M			2							
		C. pardalis	D							2			

TABLE D.4.1 CONTD.

Taxonomy	Common English Name of the group	*Species*	Habitat	Sampling Sites									
				1	2	3	4	5	6	7	8	9	10
		Cosmarium sp.	D			3				2			
		Xanthidium	K										3
		Staurastrum	P,K								2		3
		Spondylosium	M			2							
		Desmidium	D							2			
		Bambusina brebisonii	D							3			
		Arthrodesmus	D							3			
Cl. : Euglenophyceae	Euglenoid	*Euglena acus*	P		2				2				2
Or. : Euglenales		*E. sanguinea*	P		1								
Fa. : Euglenaceae		*E. spirogyra*	M			3							
		Euglena spp.	P,K		2	2			2				2
		Lepocinclis	P							3	3		
		Phacus longicauda	P		3								
		P. pyrum	K			2							
		P. suecicus	P										2
		Trachelomonas acanthophora	P	2									
		T. flava	P		2								
		T. hispida	P										3
		T. playfairii	P										2
		T. verrucosa var. spirogyra	D			3							
		T. volvocina	P	2	3								2
		T. volvocina var. punctata	P										3
		Trachelomonas spp.	P,K	2							2		2
		Strombomonas	K,P			3							3
Fa. : Astaciaceae		*Astasia*	K,P			1							2
Cl. : Xanthophyceae		*Botryococcus braunii*	P,D	2									1
Cl. : Chrysophyceae													
Fa. : Chrysomonadaceae	Chrysomonad	*Dinobryon*	M			1							

TABLE D.4.1 CONTD.

Taxonomy	Common English Name of the group	*Species*	Habitat	Sampling Sites									
				1	2	3	4	5	6	7	8	9	10
Cl. : Bacillariophyceae													
Or. : Centrales	Diatom	*Melosira*	P,MR	2	3				1		2		3
		Cyclotella meneghiniana	P										1
		Stephanodiscus	MR						2				
Or. : Pennales													
Fa. : Fragilariaceae		*Fragilaria intermedia*	P		1								
		Fragilaria sp.	D							2			
		Synedra	MR,K						2		2		3
Fa. : Achnanthaceae		*Asterionella*	K										2
		Cocconeis											
Fa. : Naviculaceae		*Navicula*	K										2
		Pinnularia											
		Gyrosigma	K			2							2
Fa. : Gomphonemataceae		*Gomphonema acuminatum*	P	2									
		Gomphonema sp.		2									2
Fa. : Cymbellaceae		*Cymbella cistula*	MR										2
		Cymbella sp.	MR										3
		Rhopalodia	K									2	3
Fa. : Nitzschiaceae		*N. ascicularis var. closteroides*	K,P,M			3					2		
		N. fasciculatus	K										3
		N. fruticosa	K										3
		N. frigmoidea	K		2								
		Nitzschia sp.	P	2									3
Fa. : Surirellaceae		*Surirella*	MR						2				
Cl. : Dinophyceae													
Or. : Peridinales													
Fa. : Peridiniaceae		*Peridinium*	PK		2	3			3		1	3	
Fa. : Ceratiaceae		*Ceratium hirundinella*	PK	2									

TABLE D.4.1 CONTD.

Taxonomy	Common English Name of the group	*Species*	Habitat	Sampling Sites									
				1	2	3	4	5	6	7	8	9	10
Cl. : Myxophyceae	Blue–green	*Microcystis aeruginosa*	P								1		
Or. : Chroococcales		*M. flosaquae*	D		2								
Fa. : Chroococaceae		*Merismopedia tenuipunctata*	P		2						2		
		Merismopedia sp.	P								2		3
Or. : Oscillatoriales		*Spirulina laxigsima*	K			2							
Fa. : Oscillatoriaceae		*Spirulina major*	P		3								
		Oscillatoria chalybea	D							2			
		O. princeps	P		2								
		O. proteus											
		Oscillatoria spp.	P										3
		Romeria	K,P			3				2			
		Phormidium	P	2									
		Lyngbya majuscula											
		Lyngbya spp.	K,D					2		3			2
Fa. : Nostocaceae		*Anabaena spiroides*	P		2								
		A. spiroides fa. minima	P		2								
		A. raciborskii	P	1						2			
		A. circinalis	P	1					2	2	2		
		A. arnoldi	P,K	2		1							
		Anabaena sp.	P	2									
Fa. : Scytonemataceae		*Scytonema*											
Fa. : Rivulariaceae		*Raphidiopsis*	P										1
Cl. : Cryptophyceae													
Or. : Cryptomonadales	Cryptomonad												
Fa. : Cryptochrysidaceae		*Rhodomonas*	P,K		2		2		2		3		2
Fa. : Cryptomonadaceae		*Cryptomonas ovata*	P		2				2		2		2

TABLE D.4.1 CONTD.

LIST OF THE ABBREVIATIONS USED IN TABLE D.4.1

Habitat Code:

MR = Main River
SR = Minor River
M = Marsh
K = Khal
P = Pond
D = Ditch
RF = Rice Field
BD = Begumganj Depression
LD = Laksham Depression

Density Code:

1 = Abundant/Bloom
2 = Common
3 = Occasional

Role in the Ecosystem:

NA = Nutrient Absorber
NF = Nitrogen Fixer
FHF = Food for Harbivorous Fishes
FB = Food for Birds
S = Shelter/Nests/Breeding ground for aquatic animals
SB = Soil Binder
NK = Not Known

Role in the Economy:

PE = Pest
KF = Used as Shelter for Kata Fish
FH = Parts used as Food for Human
FA = Parts used as Food for Animal
PA = Ornamental Plant for Aquaria
M = Medicinal
CP = Commercial Products
BF = Biofertilizer

Station Code:

1 = Jiol Pukur, Rajapur; Ditch, Barakanchi, Laksham.
2 = Homestead pond, ditch, Joynarayanpur and Uttar Nabipur, Begumganj.
3 = Noakhlai khal and Dighi at WAPDA char; a marshy land near Begumganj.
4 = C&B canal, Azizpur.
5 = Pond at Dighali Bazar.
6 = Rahmatkhali regulator, eastern and western part and the river Meghna.
7 = Road side pond and ditch Joyag village.
8 = Kazir pond and Barakhal, Hazirpara, Ramganj.
9 = Barakhal, Darbeshpur, Ramganj.
10 = River Dakatia, upstream (Laksham), downstream (Haziganj) and the middle (office Chitoushi); homestead pond, rice fields and ditches of Paschimgaon (Laksham); Toragarh, Kaliarpar (Shahrasti); Mirzapur and Barnaia.

Abbreviations used in the Taxonomy:

Ph. = Phyllum
Div. = Division
Cl. = Class
S.Cl. = Sub Class
Or. = Order
Fa. = Family
Gr. = Group of uncertain systematics

TABLE D.4.1 CONTD.

ZOOPLANKTON AND BENTHIC MACROINVERTEBRATES

Taxonomy	Common English Name of the group	Species with habitat	Habitat	Sampling Sites									
				1	2	3	4	5	6	7	8	9	10
Zooplankton													
Ph. : PROTOZOA													
Cl. : Rizopoda													
Fa. : Amoebidae	Amoeba	Amoeba radiosa	P	3						3			
Ph. : ROTIFERA													
Cl. : Monogononta													
Fa. : Trichocercidae	Rotifers	*Brachionas calyciflorus*	P								3		1
		B. diversicornis	P,K				2				1		
		B. forficulata	P,K	3	1	3	3				1		
Fa. : Notommatidae		*Notholea*	K						1			1	
Fa. : Synchaetidae		*Polyartha*	P,D		1			2			3		3
Fa. : Testudinellidae		*Filinia longiseta*	P		3								
Fa. : Gastropodidae		*Keratella cochlearis*	P,K,SR	3	3				1				2
		K. stipitata	K				3		3				
		K. volga	P,K,SR	1	1	1	1		1	2		3	2
Ph. : NEMATODA													
Cl. : Phasmidia													
Fa. : Rhabditidae	Nematode	*Paradoxorhabditis*	P							2			
Fa. : Hoplolaimidae		*Helicotylenchus*	K						2				
Fa. : Monhysteridae		*Monohystrella pseudomacrura*	M			2							

TABLE D.4.1 CONTD.

Taxonomy	Common English Name of the group	*Species with habitat*	Habitat	Sampling Sites									
				1	2	3	4	5	6	7	8	9	10
Ph. : ANNELIDA													
Cl. : Oligochaeta													
Fa. : Naididae	Annelids	*Eiseniella*	K										3
Ph. : MOLLUSCA													
Cl. : Gastropoda	Gastropod	*Turbonella*	K			2							
		Valvata piscinalis	K									2	
Ph. : ARTHROPODA													
Cl. : Crustacea													
Or. : Clodocera	Cladocera												
Fa. : Polyphemoidae		*Polyphemus*	P	3									
Fa. : Sididae		*Diaphanosoma*	K										3
Fa. : Daphnidae		*Daphnia carinata*	K									3	
Fa. : Bosminidae		*Bosmina longirostris*	MR,K	3					1			1	
Fa. : Diaptomidae		*Diaptomus*	M,K	1					2		3	3	
Fa. : Cyclopoidae		*Cyclops*	P,K,D,SR	1	3	3	3	3	3	2		1	1
		Nauplius larva	P,K,D,SR,MR	1	1	2	1		1	3	1	1	1
		Metanauplius larva		1	1	2	1		1	2	3	1	1
		Hydrophylus triangularis	K						2				
		Corynoneura (larva)	K									2	
		Chironomus (larva)	K									2	

TABLE D.4.1 CONTD.

AQUATIC MACROPHYTES

Taxonomy	Common Name of the group	Species	Habitat	Role in the Ecosystem	Role in the Economy	Sampling Sites									
						1	2	3	4	5	6	7	8	9	10
PHANEROGAMS															
DICOTYLEDONEAE															
Fam. : Amarathaceae	*Malancha*	*Alternanthera philoxeroides*	P,LD	NA	FH	2									
Fam. : Ceratophyllaceae	Cattail *Jhanjhi*	*Ceratophyllum demersum*	BD	FHF	PA			2							
Fam. : Compositae	*Helancha*	*Enhydra fluctuans*	P,K	NA	FH					2		2		3	
Fam. : Convolvulaceae	*Dholekalmi* *Kalmi*	*Ipomoea fistulosa* *Ipomoea aquatica*	LD	SB	NK	2									
Fam. : Holaragaceae		*Myriophyllum tuberculatum*	K	NA,S	PA									2	
Fam. : Lentibulariaceae	Bladderworts *Jhangi*	*Utricularia exoleata*	K	S		2		2			2			2	
	Bladderworts *Jhagi*	*U. inflexa*	D								2				
Fam. : Menyanthaceae	Water lily *Chand malla*	*Nymphiodes indicum*	LD,BD,P	S,FB	M	2	2						3		
	Water lily *Chandmalla*	*N. cristatum*	BD	S,FB	NK		2								
Fam. : Nymphaeaceae	Red water lity *Shapla*	*Nymphaea nouchali*	BD,P	S	FH		2	2							
	Kesaardam	*Ludwigia adscendens*	LD,K	S	M	2					2				2
	Bunlang	*Ludwigia sp.*	LD	S	NK	1									
Fam. : Papilionaceae	*Bhatsola*	*Aeschynomene aspera*	LD	S	CP	1									

TABLE D.4.1 CONTD.

Taxonomy	Common Name of the group	Species	Habitat	Role in the Ecosystem	Role in the Economy	Sampling Sites									
						1	2	3	4	5	6	7	8	9	10
Fam. : Polygonaceae	*Panimarich*	*Polygonum*	BD	S	M		2								
MONOCOTYLEDONEAE															
Fam. : Alsmataceae	Arrowhead	*Sagittaria sagittifolia*	LD	S,FB	FA	2		2							
Fam. : Aponogetonaceae	Poldweed	*Aponogeton*	P,K	FB	FH,FA							1			
Fam. : Araceae	*Topapana*	*Pistia stratiotes*	LD,BD,K,P,D	S,NA	PE	1	1		1	2		2	2		
	Kanta kachu	*Lasia heterophylla*	D	NK	NK		1								
Fam. : Cyperaceae	*Gola methi*	*Cyperus platystylis*	LD,BD,K	S	CP	2	2	2							
		Mariscus compactus	P	S	NK							2			
	Chenchra	*Schoenoplactus articulatus*	D	S	NK	1									
Fam. : Gramineae	*Denga gur*	*Coix aquatica*	LD,K	S	FA	1					2			2	
	Janglidhan gur	*Hygroriza aristata*	LD,K	S	FH	2								3	
	Arali	*Leersia*	LD,K	S		2		3						3	
	Sheyala	*Blyxa echinosperma*	BD	S	NK			1							
	Jhangi	*Hydrilla verticillata*	K	S	PA									2	
	Panikala	*Ottelia alismoides*	K	S	FH									2	
	Patseola	*Vallisneria spirales*	LD,K	S	PA	2		2							
Fam. : Lemnaceae	Duckweed	*Spirodela polyrhiza*	P,D	NA,FHF	PE										2
		Lemna perpusilla	P,D	NA,FHF	PE										2
Fam. : Najadaceae		*Najas*	P	S	NK									1	

TABLE D.4.1 CONTD.

Taxonomy	Common Name of the group	Species	Habitat	Role in the Ecosystem	Role in the Economy	Sampling Sites									
						1	2	3	4	5	6	7	8	9	10
Pontederiaceae	Water hyacinth *Kachuripana*	*Eicchornia crassipes*	LD.BD.K.P.D.SR	S	PE.BF	3	2		2	2	2		3		2
	Baranukha	*Monochoria hastata*	D	S	NK					2					2
Potamogetonaceae	Pondweed	*Potamogeton*	LD.P	NA	FA	2				2					
Typhaceae	Bulrush *Hogla*	*Typha angusta*	BD.D	SB	SB		1		1						
CRYPTOGAMS															
BRYOPHYTA															
Fa. : Ricciaceae	Aquatic Liverworts	*Riccia fluitans*	D.SR	NA	NK									1	1
	Aquatic Liverworts	*Ricciocarpus natans*	LD.D		NK	1									
PTERIDOPHYTA															
Fa. : Polypodiaceae	Aquatic ferm	*Ceratopteris thalictroides*	D.K	FA.S	NK			3							
Fa. : Salviniaceae		*Salvinia cuculata*	LD.D.P.BD	S	PE	1	1					1	2	3	2
		S. natans	LD.D.P.BD	S	PE	1	1					1	1		
		Azolla pinnata	D.P	NF	BF	1	2	2							
Fa. : Marsileaceae		*Marsilea quadrifoliata*	LD.P	S	HF.M	2							2		

TABLE D.4.2

Class- distribution of aquatic algal genera/species occurring in different stations of Noakhali North Drainage and Irrigation Project

Class	Sampling Station									
	1	2	3	4	5	6	7	8	9	10
Chlorophyceae	6	15	17	-	3	12	27	10	3	20
Euglenophyceae	3	6	6	-	-	2	1	2	-	10
Xanthophyceae	1	-	-	-	-	-	-	-	-	1
Chrysophyceae	-	-	1	-	-	-	-	-	-	-
Bacillariophyceae	4	3	2	-	-	4	1	3	1	13
Dinophyceae	1	1	1	-	-	1	1	1	3	-
Cyanophyceae	5	6	3	-	1	1	5	4	-	4
Cryptophyceae	-	2	-	1	-	2	-	2	-	2
Total	20	33	33	1	4	22	34	22	7	50

TABLE D.4.3

Class distribution of Zooplankton and bottom fauna (number of genera/species) occurring in different stations of Noakhali North Drainage and Irrigation Project

Class	Sampling Station									
	1	2	3	4	5	6	7	8	9	10
Rizopoda	1	-	-	-	-	-	1	-	-	-
Monogonota	3	5	2	4	1	4	1	4	2	4
Phasmidia	-	-	1	1	-	-	-	-	-	-
Oligochaeta	-	-	-	-	-	-	-	-	-	1
Gastropoda	-	-	1	-	-	-	-	-	1	-
Crustacea	6	3	3	3	1	6	3	3	8	4
Total	10	8	7	7	2	11	5	7	11	9

Populations of macrophytes were larger in the Laksham and Begumganj Depression, with a total of 22 and 12 taxa respectively. Ten taxa were recorded from the Noakhali Khal area (Table D.4.4.) Only 3 taxa were recorded from site 4.

TABLE D.4.4

Group distribution of aquatic macrophytes (number of genera/species) occurring in different stations of Noakhali-North Drainage and Irrigation Project

Class	Sampling Station									
	1	2	3	4	5	6	7	8	9	10
Dicotyledoneae	7	4	3	-	1	3	1	1	3	1
Monocotyledoneae	10	5	5	3	4	2	3	2	6	4
Pteridophyta	4	3	2	-	-	-	2	3	1	1
Bryophyta	1	-	-	-	-	-	-	-	1	1
Total	22	12	10	3	5	5	6	6	11	7

The algal genera found in the Noakhali North project area (Table D.4.5) as a whole represent 56% of the total number found in the country based on the information furnished by Islam (1991). In addition, the number of aquatic macrophytes occurring in Bangladesh has been estimated after Khan and Halim (1987) and are presented in Table D.4.6. From this information it has been estimated that approximately 51% of the country's macrophytes occur in the project area. These results are very similar to those obtained in the Gumti Phase II project area, a parallel study carried out in the northern part of the South East Region. However, there were some noticeable qualitative differences between these two studies. Blooms of *Batryococcus braunii*, *Spermatozzopis*, *Platymonas*, *Carteria*, *Dysmorphococcus*, *Pryobotrys*, *Typha angusta*, *Lasia heterophyla* and *Ricciocarpus natans* were not recorded in the Gumti Phase II project area during the period of study.

In the Noakhali North area, ponds and canals are important aquatic ecosystems. A large proportion of the ponds are fertilized in order to achieve a good level of fish productivity, which can only mean a similar level of plankton production. This has been confirmed by studies of plankton samples from homestead ponds. Bright green stream like blooms by the unicellular algae *Carteria* sp. were observed in many ponds (Plate D.4). In a study of two ponds in Maijdee Court, Begum and Alam (1987) reported Cyanophyceae (blue-green algae) as the dominant group. However, in the present study the Chlorophyceae (green algae) were found to be the dominant group in almost every habitat. Since the present study included only two periods of field collection, these results may simply represent seasonal variations in algal dominance.

TABLE 4.5

Comparative study of planktonic algal genera recorded from the country and Noakhali North Drainage and Irrigation Project (NNDIP)

Class	Algal Genera	
	Country	NNDIP
Chlorophyceae	92	51
Bacillariophyceae	29	15
Cyanophyceae	21	10
Euglenophyceae	7	6
Dinophyceae	2	2
Xanthophyceae	2	1
Chrysophyceae	1	1
Chloromonadaceae	-	-
Cryptophyceae	2	2
Total	156	88

S.7

TABLE D.4.6

Comparative Study of planktonic algal genera recorded from the country and Noakhali North Drainage and Irrigation Project (NNDIP)

Name of the Group	Number of genera	
	Country	NNDIP
Dicotledons	29	11
Monocotyledons	38	21
Pteridophyta	6	4
Bryophyta	2	2
Total	75	38

Species diversity in the canals varied throughout the study area. One canal (Barakhal) near Ramganj (Plate D.2a) was found to support a good number of taxa for almost all the communities present within it such as plankton, macrophytes and benthic fauna, but samples from other canals contained very few taxa. Due to the limited time and resources available for this study, it was not possible to establish the reasons for these variations. However, it is clear that further studies should be carried out to assess the biodiversity of the Noakhali North project area. Robust growth of *Rhizoclonium*, a species usually found in areas with high salinity, was observed in the Noakhali Khal area, where salinities are known to be higher than in the rest of the project area.

Marshes were another prominent habitat found in the project area, especially in the Laksham and Begumganj Depression and in the northern extreme of the study area. These habitats supported great quantities of aquatic macrophytes comprising duckweed, pondweed, bladder warts, bulrushes, cattails, water lilies, water hyacinth and various aquatic ferns. This ecosystem was found to be similar to the floodplain system in the Gumti Phase II area. The plant mass acts as shelter, feeding and breeding ground for fish and birds. As the dry season advances and after the final fish harvest, local people accumulate and burn these plant masses and the ashes are used in the agricultural fields as nutrient supplement for soil improvement.

The River Dakatia near Laksham dried out after November and by December only small depressions in the riverbed contained some water and consequently they were found to have very few species of flora and fauna. Mud samples did not contain any organisms. Samples from the Dakatia River itself also contained a negligible amount of plankton, but the Meghna River still supported a reasonable planktonic population, composed mainly of centric and pennate diatoms.

CHAPTER D.5

FISH ECOLOGY

D.5.1 Introduction

The Fisheries Annex F includes details of the main issues relating to the exploitation of fish as a resource. The following account is a summary of the main ecological characteristics of various fish species and how they fit in general into the ecology of the floodplain in the Noakhali North Study Area. The list of species can also be found in Annex F and is repeated here as Table D.5.1.

D.5.2 Fish Diversity in the Noakhali North Study Area

Bangladesh has recorded fish fauna of over 260 freshwater fishes (Rahman, 1989) and it is likely that this figure will rise in the next few years as a result of the increasing amount of work currently being done by various organizations, especially the FAP projects. In addition, there is a need to complement existing listings to assess the full extent of the fish diversity of the country and its conservation status. It is expected that this type of information will also complement knowledge on fisheries by highlighting those species in need of attention with populations that may be able to recover to more sustainable levels in the future.

With this purpose, a preliminary list of fish species (Table 5.1) occurring in the area has been prepared from information collected during the field work by direct observations from the fishermen's catch and by gathering knowledge from local fishermen, Thana Fisheries Offices and from published material. A list of fish species in the project area was compiled and notes on their main biological and ecological characteristics were also included.

It should be noted that most of the species found in the study area have 'commercial' value as they either appear in the markets, are traded amongst the fishermen and/or are used by the people, including women and children, for their own consumption. The so called 'Miscellaneous' species, usually small fish, being the most important group of fishes in subsistence and self-provisioning for the people in the rural areas.

Fish Diversity Over 80 species belonging to 10 Orders and 31 Families were recorded during the study through a combination of direct observations in the catch and from reports by the fishermen of the area. This represents around 32% of the total number of freshwater fish species currently known in the country. The fish Order with more species was the Perciformes (perchs, croakers, gobies and eels) which had 24 representatives; followed by the Cypriniformes (carps, barbs and minnows) with 23 species and lastly by the Siluriformes (catfishes) with 15 species. The family with the largest number of species was the Cyprinidae with 21 species. It is very likely that this figure may increase after a more in depth analysis of this fauna, especially if all species are considered and not just the commercial ones.

TABLE D.5.1

PRELIMINARY LIST OF FISH AND PRAWN SPECIES OCCURRING IN THE NOAKHALI NORTH PROJECT AREA

Habital code: B = Beel, F = Floodplain, R = Main River, K = Khal, Minor River, P = Pond, IF = Inundated Field, E = Estuary, M = Marine
Ecological code: O = Omnivorous, C = Carvivorous, P = Piscivorous, Mo = Mollusc-eater, I = Insectivorous, Pl = Plancton-feeder, Pr = Predator, H = Herbivorous, D = Detritus-feeder, M = Mud-eater
DM = Decaying matter-eater
Distribution code: R = Resident, M = Migratory, I = Introduced
Occurrance code: 1 = Widespread, 2 = Common, 3 = Rare, 4 = Decreasing, 5 = At risk, 6 = Extinct

Scientific Name		Common Name	Habitat	Occurrence		Distribution	Feeding	Sampling Stations			
Class – Osteichthyes				Past	Present		Habits	N1	N2	N3	N4
Order – Osteoglossiformes											
Family – Notopteridae (Featherbacks)											
Notopterus	chitala	Chital	R,K,F,P	2	5	R	C,Pr				
Notopterus	notopterus	Foli	R,F,P,K	1	2	R	C			1	
Order – Anguilliformes											
Family – Ophichthidae (Worm Eels, Snake Eels)											
Pisodonophis	boro	Kharu, Hijra	R,IF,E			R,M					
Order – Clupeiformes											
Family – Clupeidae (Herrings, Shads)											
Corica	soborna	Kachki	R	2	3	R					
Gudusia	chapra	Chapila	R,B,P,IF	2	4	R	Pl				
Hilsa	ilisha	Hilsa, Ilish	R,E			R,M			1		
Family – Engraulididae											
Coilia	dussumieri	Olua	E,R			R,M					
Setipinna	phasa	Phasa	R,E			R					
Stolephorus	spp.		R,E			R					
Order – Cypriniformes											
Family – Cyprinidae (Carps, Barbs, Minnows)											
Amblypharyngodon	mola	Mola	R,K,B,F,P,IF	2	3	R					
Barilius	vagra	Khoksa,Koksa	R,K			R					
Brachydanio (Danio)	rerio	Anju	R,K,F,IF			R					
Catla	catla	Catla	P,R,B,K,F	1	2	R,M	O			1	

Scientific Name		Common Name	Habitat	Occurrence Past	Occurrence Present	Distribution	Feeding Habits	Sampling Stations N1	N2	N3	N4
Chela	cachius	Chep Chela, Pata Chela	K,R,B,P	2	3	R					
Chela	laubuca	Laubuca	K,R,B,P	2	5	R					
Cirrhinus	mrigala	Mrigal	R,B,K,F,P	2	2	R	H				
Ctenopharyngodon	idellus	Grass Carp	P		2	I	H				
Cyprinus	carpio	Carpio	P			I					
Danio	aequipinnatus	Sepli, Chebli	F,R,IF			R					
Hypophthalmichthys	molitrix	Silver Carp	P		2	I	Pl				
Hypophthalmichthys	nobilis	Bighead	P			I	Pl				
Labeo	calbasu	Kalbasu, Kalibaus	R,K,B,F,P	2	5	R	H			1	
Labeo	gonius	Ghonia	R,K,P	2	5	R	H		1		
Labeo	rohita	Rui, Rohit	R,K,B,F,P	2	2	R	H			1	
Osteobrama (Rohtee)	cotio	Keti, Chela, Dhipali	R,K,F,P			R					
Puntius	chola	Chala Punti	R,K,B,P,F,IF	1	2	R					
Puntius	sarana	Sar Punti	R,K,B,F	2	5	R					
Puntius	sophore	Punti	R,B,K,F,P	2	2	R			1		
Puntius	ticto	Tit Punti	K,B,F,P,IF	1	2	R	O				
Rasbora	daniconius	Darkina	R,B,K,F,IF	2	3	R	Pl				
Salmostoma	acinaces	Chela	R,K,			?					
Family – Cobitidae (Loaches)											
Botia	dario	Rani, Batia	R,B,F	2	3	R					
Lepidocephalus	guntea	Gutum, Puiya	R,K,B,F,P	2	2	R					
Order – Siluriformes											
Family – Bagridae (Long Barbeled Catfishes)											
Aorichthys (Mystus)	aor	Ayre, Guji Air	R,B,K,P,IF,F	2	4	R		1			
Mystus	armatus	Tengra	R,K			R					
Mystus	cavasius	Golsha	R,B,K,F,IF	2	4	R					
Mystus	tengara	Kalo Bujuri, Bajari tengra	K,R,P,F,B	2	2	R					
Mystus	vittatus	Tengra	R,K,B,F,P	2	2	R			1		
Rita	rita	Rita	R,F,E			R	C				
Family – Siluridae (Butter Catfishes, Freshwater Sharks)											
Ompok	bimaculatus	Kani Pabda, Boali Pabda	R,K,B,IF	2	4	R					
Ompok	pabda	Madhu Pabda	R,K,B,IF,P	2	4	R					
Wallago	attu	Boal	R,K,F,B,P			R	P,Pr	1	1	1	

Scientific Name		Common Name	Habitat	Occurrence Past	Occurrence Present	Distribution	Feeding Habits	Sampling Stations N1	N2	N3	N4
Family – Schilbeidae (River Catfish)											
Clupisoma	garua	Ghaura	R,K	2	5	R	C,DM				
Eutropiichthys	vacha	Bacha	R,K			R	O				
Silonia	silondia	Shilong	R,E			R,M	Pr				
Family – Pangasiidae											
Pangasius	pangasius	Pangas	R,E			R,M	C,Mo	1			
Family – Sisoridae (Hillstream Catfish)											
Bagarius	bagarius	Baghair, Acer	R,K,B,F			R	C,Pr				
Family – Clariidae (Air–Breathing Catfish)											
Clarias	batrachus	Magur	B,K,P,F,IF	2	4	R					
Family – Heteropneustidae (Stinging Catfish)											
Heteropneustes	fossilis	Shingi	K,B,P,F,R	2	4	R					
Family – Chacidae (Square–Head Catfish)											
Chaca	chaca	Cheka	R,K,B,F,P								
Order – Cyprinodontiformes											
Family – Belonidae (Gars)											
Xenentodon	cancila	Kaikka	K,R,B,F,IF,P	2	2	R					
Family – Oryziidae (Ricefishes)											
Oryzias	melastigma	Bechi, Kanpona	R,K,E,P			R	Pl,I				
Order – Syngnathiformes											
Family – Syngnathidae (Pipefishes)											
Microphis	cuncalus	Kumirer Khil	E,R			R					
Order – Synbranchiformes											
Family – Synbranchidae (Swamp Eels, Mud Eels)											
Monopterus	cuchia	Kuchia	B,K,F,P,IF	2	3	R					
Order – Perciformes											
Family – Centropomidae (Barramundis)											
Lates	calcalifer	Coral, Bhetki	E,R			R,M					

Scientific Name		Common Name	Habitat	Occurrence Past	Occurrence Present	Distribution	Feeding Habits	Sampling Stations N1	N2	N3	N4
Family – Ambassidae (Glass Perches, Snook)											
Chanda	beculis	Chanda	K,B,P,F	2	2	R					
Chanda	nama	Nama Chanda	K,B,P,F,IF	2	1	R					
Chanda	ranga	Ranga – Chanda, Lal Chanda	K,B,P,F,IF	2	3	R					
Family – Sciaenidae (Drums, Croakers)											
Pama	pama	Poa	R,E			R,M					
Family – Nandidae (Mudperches)											
Badis	badis	Koi Bandi, Napit	K,B,F,P	2	3	R					
Nandus	nandus	Meni, Bheda	K,B,F,P	2	3	R	Pr				
Family – Cichlidae (Cichlids)											
Oreochromis	mossambicus	Tilapia	P			I					
Oreochromis	niloticus	Tilapia	P			I					
Family – Mugilidae (Mullets)											
Rhinomugil	corsula	Khorsula, Bata, Khalla	R,E			R					
Family – Polynemidae (Threadfins)											
Polynemus	paradiseus	Tapasi, Muni, Rishi	R,B,K			R					
Family – Gobiidae (Gobies)											
Apocryptes	bato	Chiring	R,K,E			R					
Glossogobius	guiris	Belle, Bailla	E,R,K	2	2	R	C				
Periophthalmus	koelreuteri	Mudskipper	E			R					
Family – Eleotrididae (Gudgeons, Sleepers)											
Elcotiris	fusca	Dora Baila, Kuli	M,E,R,	2	3	R					
Family – Gobioididae (Eel like Gobies)											
Odontamblyopus	rubicundus	Lal Chewa	R,K,E			R					
Family – Anabantidae (Climbing Perches)											
Anabas	testudineus	Koi	B,K,F,P	2	3	R			1		

Scientific Name		Common Name	Habitat	Occurrence Past	Occurrence Present	Distribution	Feeding Habits	Sampling Stations N1	N2	N3	N4
Family – Belontiidae (Gouramies)											
Colisa	fasciatus	Khalisha	B,K,P,F	2	3	R					
Colisa	labiosus	Baicha	R			?					
Colisa	lalius	Lal Khailsha, Boicha	B,K,P			R					
Family – Channidae (Snake Heads, Murrels)											
Channa	marulius	Gajar, Gajal	B,K,R,F	2	3	R	C		1	1	
Channa	orientalis	Cheng, Gachua	R,K,B,F,P	2	4	R	C				
Channa	punctatus	Taki, Lata	B,K,F,P	2	3	R	C,Pr				
Channa	striatus	Shol	B,R,K,F,P,IF	2	2	R	C		1		
Family – Mastacembelidae (Spiny Eels)											
Macrognathus	aculeatus	Tara, Baim	B,K,F,R,IF,P	2	3	R					
Mastacembelus	armatus	Baim, Bam, Sal Baim	R,K,F,B,IF,P	2	4	R					
Mastacembelus	pancalus	Guchi, Baim, Pankal	K,F,B,P,IF	2	2	R					
Order – Tetraodontiformes											
Family – Tetraodontidae (Puffer Fishes)											
Chelonodon	fluviatilis	Potka	R,F,E			R,M					
Tetraodon	cutcutia	Tepa, Kutkuitta	R,K,F,B,P			R					
Class Crustacea											
Order – Decapoda											
Family – Palaemonidae											
Macrobrachium	dalichodactylus	Guda Icha	R,B,F			R					
Macrobrachium	dyanus	Kaira Icha	R,B,F			R					
Macrobrachium	lamarrei	Knunchu Icha	R,B,F,P	2	1	R					
Macrobrachium	malcolmsonii	Chatka Icha	R,B,F			R					
Macrobrachium	mirabilie	Latia Icha	R,B,F,P			R					
Macrobrachium	rosenbergii	Golda Icha, Golda Chingri	R,B,F	1	4	R			1		1
Macrobrachium	styliferus	Choto Chingri, Small Shrimps				?				1	1
Macrobrachium	villosimanus	Katholia Icha	R,B,F			R					

Crustaceans Only Golda Chingri or Golda Icha *Macrobrachium rosenbergii* and small shrimps or Choto Chingri *M. styliferus* were recorded in the catch, but it should be pointed out that the occurrence of other species may be masked by the use of the common names, i.e. Choto and Boro Chingri. This was confirmed by the fishermen in the area who reported that at least 8 species of palaemonids also occur in the area (Table D.17). Clearly, the number of invertebrates found in this floodplain is also expected to increase after due consideration is given to this important aspect of the ecology of the area.

D.5.3 Summary of the Life History of the Major Carps

Major Carps These are important commercial species of which Rui is probably the favoured food fish in Bangladesh. It is thought that different geographical carp populations may exist. There are four carp species usually referred to this group: Rui, Catla, Mrigal and Kalbasu and all four are thought to have similar reproductive strategies. In the Noakhali North study area, these four species were important in the fish catches.

Broodstock overwinter the dry season in large rivers and beels with the spawning migration occurring in the early monsoon. In general, brood stock move from the beels into the Khals and rivers, from where they move upstream to shallower areas suitable for spawning. According to Tsai *et al.* (1981), it appears that ox-bow bends in particular are favoured, probably because they possess unusual hydrological features (deep pools in the outer bend, turbulence, upwelling and backwater current in the inner bend). Eggs are non-adhesive and drift with the current, embryos hatch in 5 to 24 hours depending on the species. Major carp spawning grounds can be found from the sightings of drifting eggs and hatchlings.

No spawning sites for these species were located within the Noakhali North study area. However, there was not enough time available in the study to carry out a thorough field survey in this regard. According to fishermen in the North East Region, major carps also spawn in Beels (FAP 6, 1993), although no Beels were reported for the Noakhali North area. Increasing Beel water levels during the early monsoon may be enough stimulus to induce them to spawn in their overwintering Beels. Broodstock which have overwintered in rivers may have the option of carrying a spawning migration upstream at the onset of the monsoon, or to remain in the vicinity of the overwintering grounds, wait until the river banks are overtopped and then move laterally onto the floodplain to spawn.

Given its closeness to the Lower Meghna River, the possibility of major carp spawning in quiet areas located within the Noakhali North study area needs to be investigated further, since major carps have been observed to continue to enter the area through the Rahmatkhali regulator despite of the obstacle that this regulator and its unfriendly gates represent for successful fish migration at present. It is hoped that improved gate design and operation will enhance fish access, and thus fish productivity, to the Noakhali North area.

The following section is a brief summary of information available on selected species from the Noakhali North study area.

D.5.4 Notes on Some Biological and Ecological Characteristics of Some Fish Species Found in the Noakhali North Study Area

General information presented below has been based on Rahman (1989), Tsai and Ali (1985), Talwar and Jhingran (1992) and FAP 6 (1993). Other information has been collected in the field from the local fishermen.

MAJOR CARPS

RUI *Labeo rohita*

Distribution: A riverine species which may attain 1 m in length. It is a bottom feeder that feeds on decaying vegetation and plant matter.

Spawning: Spawning migration occurs in early monsoon when the brood stock swim out of beels, down the khals and into rivers. They swim upstream to reach favoured shallow spawning localities, e.g. oxbow lakes. Spawning takes place in flooded rivers with the monsoon and it may also occur in flooded fields. Fishermen have reported Rui spawning in beels. Thus floodplain may also be important for this species. Fecundity: Varies from 226,000 to 2,984,000 eggs.

CATLA *Catla catla*

Distribution: Riverine species which may reach over 1.20 m in three years in favourable conditions. Feeding takes place in mid and surface waters. It is a non-predator which feeds mainly on plant matter (algae and higher plants), although it may also take crustaceans.

Spawning: Breeds in rivers, spawning season coinciding with the monsoon (May to August). Peak spawning appears to occur between June and July. Fecundity is reported to be between 1,564,875 and 3,630,708 eggs.

MRIGAL *Cirrhinus mrigala*

Distribution: Inhabits rivers and tanks. It may reach up to 1 m in nature. A bottom-feeder, it feeds on decaying vegetation and detritus.

Spawning: Occurs during the monsoon in shallow pockets, in marginal areas and in bunds. Depth of water in breeding grounds has been recorded to be between 0.5 and 1 m. It may spawn in flooded fields adjacent to rivers. Fecundity is reported to be 106,220 to 815,475 eggs.

KALBASU *Labeo calbasu*

Distribution: Inhabits rivers, beels, haors and ponds and may reach up to 90 cm in length. Essentially a bottom feeder, feeds on plant matter and decaying vegetation. Fecundity is reported to be 193,000 to 238,000 eggs.

MINOR CARPS

GHONIA *Labeo gonius*

Distribution: Widespread throughout the country but not abundant. Attains a length of 1.5 m.

Spawning: Occurs in early monsoon in rivers and beels.

CARPLET

MOLA *Amblypharyngodon mola*

Distribution: It may reach up to 20 cm, although it is more common to find specimens of about 9 cm. It is found extensively in rivers, canals, beels, ponds and inundated fields.

Spawning: Spawns during May to October. Females lay approximately 500 eggs.

BARBS

PUNTI *Puntius sophore*

Distribution: It attains a length of 13 cm, usually maturing at 7 to 8 cm. It inhabits plains and submontain regions. It is very abundant throughout Bangladesh. It is one of the most important subsistence catches for the rural populations. It also has important medicinal value in Tamil Nadu, India.

SAR PUNTI *Puntius sarana sarana*

Distribution: A medium sized fish (30-40 cm). It is found in rivers, lakes, beels and other freshwater areas in the country.

Spawning: It breeds during the monsoon in running waters amongst submerged boulders and vegetation.

TIT PUNTI *Puntius ticto*

Distribution: Attains lengths of 10 cm. It is commonly found in streams, canals, beels, ponds, ditches and inundated fields throughout Bangladesh.

Spawning: The breeding season from May to October.

LARGE CATFISHES

BOAL *Wallago attu*

Distribution: This catfish may reach lengths of 2 m. It inhabits freshwater and tidal waters. In Bangladesh, it is found in rivers, beels, haors, pools and ponds. It thrives well in rivers and tanks, especially beels with grassy margins. When in captivity, it prefers muddy tanks subject to periodical flooding from rivers. It is a voracious and predatory bottom feeder.

Spawning: Pre-monsoon summer breeder. It spawns in June and July, as soon as streams and tanks are flooded by rain, they run up to shallow water for breeding. It builds nests for breeding and offers parental care.

AIR *Aorichthys (Mystus) aor*

Distribution: Inhabits rivers, khals, beels, ponds, lakes, channels, reservoirs, inundated fields and ditches. It commonly attains lengths of 1 m, although it may grow up to nearly 2 m.

Spawning: Spawning may take place from early April to the end of August. A nest or breeding pit is dug out in soft mud in sluggish current.

SMALL CATFISHES

SINGI *Heteropneustes fossilis*

Distribution: This medium sized catfish is capable of breathing air and may attain lengths of 30 cm. Primarily a fish of ponds, ditches, swamps and marshes, it is also found occasionally in muddy rivers. During the dry season it lives in semi-liquid or semi-dry mud.

Spawning: Spawning takes place during the monsoon April to July in confined waters. Spawning has been observed in swampy patches within flood regions of rivers. It is also capable of breeding in ponds, (including derelict ones) and ditches. It cannot be stocked in ponds because it migrates to other water bodies over land at the beginning of the monsoon. It produces between 4,200 to 15,750 eggs.

Medicinal value: It is in great demand due to its medicinal value (invigorating qualities of flesh).

TENGRA *Mystus vittatus*

Distribution: This very common small sized catfish may reach up to 20 cm in length. It inhabits a variety of standing and flowing water bodies such as pools, lakes, rivers, etc. It is highly prized as a commercial and subsistence food fish.

The term 'Tengra' refers collectively to a small group of bagrid catfishes of the genera *Mystus* and *Batasio*.

PABDA *Ompok pabda*

Distribution: This small catfish (17 cm) inhabits all types of inland waters, beels and rivers, including inundated fields.

Feeding: An omnivorous species.

SNAKEHEADS

SHOL *Channa striatus*

Distribution: It may attain a length of 75 cm. Inhabits ponds, streams, beels, haors, ditches and swamps where it is abundant. Prefers stagnant muddy waters and grassy tanks. It buries itself deep in the bottom mud during the dry season.

Feeding: It is a voracious predator which feeds on fish, frogs, snakes, insects, earthworms and tadpoles.

Spawning: Breeds almost throughout the year, especially during the onset of the monsoon, in ditches, ponds and flooded paddy fields.

GAJAL *Channa marulius*

Distribution: This snakehead may reach over 120 cm in length, although it is more commonly caught when around 46 cm. It inhabits large lakes and rivers and prefers deep, clear stretches of water with sandy or rocky bottom.

Feeding: Predacious, carnivorous habits, similar to Shol.

Spawning: Breeding almost throughout the year, eggs laid in nests guarded by parents.

TAKI *Channa punctatus*

Distribution: Lives in the floodplain, in large beels, ponds, tanks and swamps. Prefers stagnant waters in muddy streams.

Feeding: A carnivorous, voracious predator, it feeds on small fish and fry.

Spawning: Prolific breeder, breeds in ponds almost throughout the year by building circular nests with weeds. Peak breeding takes place during the monsoon.

KNIFEFISHES

CHITAL *Notopterus chitala*

Distribution: It may attain over 120 cm in length, although market specimens are usually around 26 cm long. It inhabits beels, rivers, canals and ponds and prefers clean waters.

Feeding: Carnivorous and predatory. It feeds on aquatic insects, molluscs, shrimps and small fishes.

Spawning: It migrates onto the floodplain during the rainy season. Breeding takes place in June-July. It dugs a nest in the bottom mud which is guarded by parents.

MISCELLANEOUS SPECIES

NEDDLEFISHES

KAKILA *Xenentodon cancila*

Distribution: It may reach approximately 40 cm in length. It is a surface-living fish common in rivers, beels, floodlands, clear perennial streams, ponds and inundated fields throughout the country.

SHADS

CHAPILA *Gudusia chapra*

Distribution: Maximum length of 15 cm. Inhabits rivers, beels, floodlands, ponds, ditches and inundated fields.

Feeding: It is a surface feeder. It is an important subsistence species.

SPINY EELS

TARA, BAIM *Macrognathus aculeatus*

Distribution: May reach up to 38 cm in length. It is found mainly in khals, beels, haors and rivers. Prefers running water but it is able to survive in stagnant waters.

Feeding: It feeds mainly on algae, mud/sand and other plant material.

BAIM *Mastacembelus pancalus*

Distribution: Up to 18 cm in length. Inhabits small rivers, beels, floodlands, canals, streams, ponds and inundated fields. It is very abundant during the rainy season.

CLIMBING PERCHES

KOI *Anabas testudineus*

Distribution: Attains a length of 25 cm. Inhabits fresh and brackish waters, mostly canals, lakes, ponds and swamps. Prefers stagnant waters, derelict pits, pools and puddles. It is a very hardy fish which possesses a breathing organ that enables it to survive for days or weeks out of water provided its breathing organ is kept moist. It remains buried in the mud during the dry season.

Spawning: Breeding starts in April with the onset of the monsoon and may last until July. It produces between 39,700 and 86,100 eggs.

It is a staple subsistence food item, very tasty.

KHALISHA *Colisa fasciatus*

Distribution: Maximum length of 12 cm. All large freshwater areas in Bangladesh such as large rivers, tanks, ditches and ponds.

GLASSFISHES

CHANDA *Chanda nama*

Distribution: Attains a length of 11 cm. Widely distributed in clear fresh and brackish waters, both in standing and running water such as streams, canals, beels, ponds and inundated paddy fields. Abundant during the rainy season.

Could be used effectively for malaria control.

FRESHWATER HERRINGS

KACHKI *Corica soborna*

Distribution: It is a small fish (4 cm). It inhabits rivers and estuaries.

GOBIES

BAILLA *Glossogobius guiris*

Distribution: Attains lengths of 30 cm. Found in freshwaters, estuaries and the sea.

MUD PERCHES

BHEDA (MENI) *Nandus nandus*

Distribution: Attains lengths of 20 cm. Inhabits fresh and brackish waters and is common in ditches and inundated fields. Common in the summer months.

It is a very popular highly prized fish.

SHRIMPS

BIG SHRIMPS *Macrobrachium rosenbergii*

Distribution: Widespread in rivers and beels.

Spawning: Adults migrate downstream to spawn in estuaries and the sea. Juveniles move back into rivers to grow and mature.

It is economically very important.

PARASITES *Argulus* sp.

A common ectoparasite copepod has been found to infect several of the fishes in the project area and causes heavy mortalities in ponds.

DISEASES

White spot has been observed in several species.

D.5.5 Fish Migrations and Movements

In an area of floodplain as relevant as the Noakhali North study area, fish migration is rather a significant issue for the whole energetics of the system, especially since the number of fish species is so large. In addition, it is important to note that although some fish are in general referred to as 'migratory' fish, by and large all fish species migrate or move from one area to another in the floodplain and in the Khal network.

According to Welcomme (1979), most fish have two distinct centres of concentration, their wet and dry season habitats, and thus they have to travel sometimes over long distances in order to reach them. The two main components of such migratory movements recognised for tropical species are longitudinal and lateral migrations. Longitudinal movements taking place within the main river channel (i.e. 'long-distance' migrants), and lateral migrations being those where fish leave the main channel and distribute themselves over the floodplain, or the 'floodplain residents'. It is now known that both of these migrations are active since often fish migrate against the current to gain access to the main floodplain. Most healthy adult fish tend to direct their movements rather that drift in the current although fish eggs and larvae do drift.

In general, fish initiate their riverine migrations with the onset of the floods and lateral migrations when the banks spill onto the floodplain. In addition, fish appear to move actively against the current rather than to enter passively on incoming flows. Migration also appears to be an ordered sequence of species with some species moving first. Adult fish tend to leave the floodplain before the young-of-the-year, which appear to stay in the floodplain until the later stages of its emptying.

D.5.6 Environmental Stimuli Influencing Fish Breeding and Migration

a) Breeding

Breeding begins during the pre-monsoon flood and depending on the rain and water volume in the river and floodplain, most of the catfish, live fish and other species such as Magur, Singi, Koi, Tengra, Pabda, Air, Boal, Gazar and Sol, start breeding towards the end of March and early April. It would appear that piscivorous fish such as some of the catfishes Boal, Gazar and Sol breed earlier than the non-piscivorous species. Optimal environmental conditions for breeding are tempestuous and include flash floods, heavy continuous rain and thunder, which together stimulate fish breeding, especially for Ghonia, Boal, Pabda, Koi, Batasi, Puti and Laso.

It should be noted that the intervention under consideration in the Noakhali North project area will result in the loss of 62% of the floodplain within the study area and a reduction of 69% of the floodplain area immediately outside the project area. It also includes the re-excavation of approximately 17% of the existing Khals which are located mainly in the southern portion of the project area, and re-design of the gate structures in the Rahmatkhali regulator which is expected to improve fish access from the Lower Meghna River to the area.

However, the operation of the gates will be dictated by the agricultural patterns in the area and by the tides in the Meghna River (please refer to the Fisheries Annex F). This proposed intervention will result in improved access for fish to the area, initially into a greater area of Khals. However, because this re-excavated Khal system will also be draining the floodplain (62% of it), the fish will not have a floodplain to disperse onto. In

addition, it is expected that without the floodplain in the vicinity of the main fish access areas and the probable lack of Khal inter-connectivity to allow fish to reach the remaining floodplain area in the northern part of the project area, this situation will result in crowding of fish in certain areas where they will most likely be readily caught by the fishermen. Any migratory fish in breeding condition may not be allowed to fulfil its life cycle with the resulting loss to the following year's fish production. It is also likely that fish diversity in the area may suffer if this situation is allowed to happen in any long-term basis.

It could be argued that part of the floodplain will still exist in the northern section of the project area, however, it must be emphasized that it will not be available for fish to the same extent as prior to construction. Thus, the loss of a substantial portion of the floodplain area as valuable feeding, nursery and refuge areas for fish and other aquatic organisms will occur. This key role of the floodplain has been confirmed by the local fishermen throughout the region. The consequences of this loss of floodplain and the added disturbance to the ecology of the area resulting from the re-excavation programme are expected to be severe.

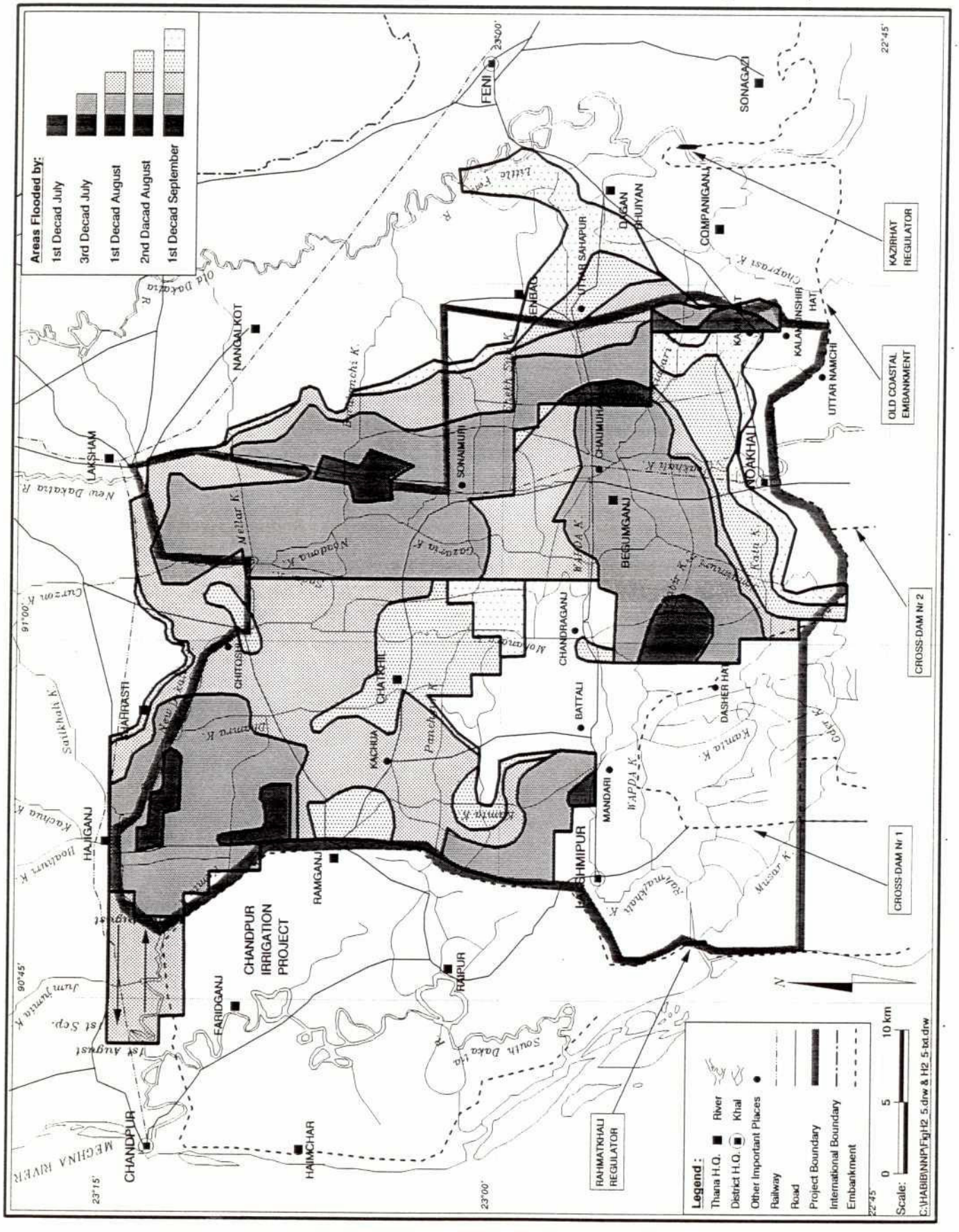
It is thus strongly recommended that this situation be analyzed further before the proposed scheme goes ahead. The Fisheries Annex F has full details of the estimated fish losses in the area due to the proposed intervention.

Fish Migration

In general, a series of environmental factors appear to trigger fish migrations, although these may not always be effective as fish are on occasions left stranded. Some of the main factors influencing fish movements include depth of water, (there seems to be a general tendency for bigger fish to leave the floodplain earlier than the smaller fish), dissolved oxygen concentrations, temperature, light (many fish prefer to move at night) and lunar phase.

In the present study it was not possible to examine fish migration and/or movements in the floodplain or the channels as the period of time and the resources available to carry out the present study were seriously under provided for. However, since fish access to the river channels and floodplain areas is crucial to the ecology and to the fisheries as a whole in the Noakhali North study area, it is strongly recommended that such a study be carried out before any intervention takes place in areas already identified as important for access, such as the Meghna and Dakatia Rivers which are the main access routes for fish into the system (Figure D.5.1 rising flood 1 in 2 years). Such a study should also consider other possible areas important for species migration as well as the location of any natural breeding grounds.

Figure D.5.1
Extent of Rising Flood, 1 in 2 Year



D.5.7 Declining Fish Species in the Noakhali North Study Area

A preliminary list of declining fish species from the study area was compiled from fishermen's accounts and from information gathered from the Thana Fisheries Officers. Table D.5.2 shows that approximately 50 species of fish and one crustacean appear to be declining in certain Thanas. The overall change has been noted in the preliminary list of fish and prawns in the study area (Table D.5.1) but it should be pointed out that this list is incomplete and further work should be carried out before any conclusion may be drawn from it. However, it does highlight the fact that several species have noticeably declined in the last few years. In addition, the Noakhali North area as a whole has already been subjected to drastic changes resulting from the construction of the Chandpur Irrigation Project, which must have severally altered the natural flood dispersal pattern in the area. Unfortunately, there are no records of the fish diversity of the area before and after this intervention and it is thus impossible to assess the loss of fish diversity more accurately. Nevertheless, important information in this regard has been provided by Thompson (1990) who reported a 35% reduction in fish production within the CIP area after construction of the Chandpur Irrigation Project and a further 15% decline in the next few years. This information coupled with reports from fishermen indicate a severe loss in fish production, and consequently, in fish diversity.

Therefore, the decline of these species should be viewed not only from the conservation perspective, but from the economic viewpoint as well. The sustainability of these fisheries resources should become one of the top priorities for the local and central governments since the livelihood of many people is based upon them.

D.5.8 Increasing Species in the Noakhali North Study Area

From Table D.5.3 it can be seen that a total of nine species of fish and one crustacean were reported as increasing in the Thanas in the study area although some of these same species had already been reported as declining in other Thanas. It is possible that these changes are real and that the species simply move within the region from one less favourable area to a more suitable one. However, this situation is likely to change substantially if the proposed scheme for the area goes ahead as a considerable proportion of the floodplain in the project area, and its immediate surrounding area, will be lost.

A more detailed study of these fluctuations in species abundance is strongly recommended as the changes in distribution and abundance could be an indication of the health of the floodplain species. In addition, a long term monitoring programme to look at changes in species diversity should be implemented in order to understand the complex ecology and diversity of the area as a whole.

TABLE D.5.2

Decreasing Fish and Crustacean Species
in the Noakhali North Project Area

Bangla Name	Scientific Name		Reported decrease in following thanas
Class - Osteichthyes			
Order - Osteoglossiformes			
Family - Notopteridae (Featherbacks)			
Chital	Notopterus	Chitala	S,H,R
Phali	Notopterus	Notopterus	S,H,R
Order - Clupeiformes			
Family - Clupeidae			
Kachi	Corica	Soborna	S,H
Chapila	Gudusia	capra	S,H,R
Order - Cypriniformes			
Family - Cyprinidae(Carps, Barbs and Minnows)			
Mola	Amblypharyngodon	Mola	S,H
Catla	Catla	catla	S,H
Chep Chela, Pata Chela	Chela	cachius	S,H
Laubuca	Chela	laubuca	R
Bhagna, Raik, Lasu	Cirrhinus	reba	
Ghonia	Labeo	gonius	S,H,R
Kalbasu, Kalibaus	Labeo	calbasu	S,H,R
Chala punti	Puntius	chola	S,H
Sarpunti	Puntius	Sarona	S,H,R
Tit Punti	Puntius	ticto	S,H
Darkina	Rasbora	daniconius	R
Family - Cobitidae (Loaches)			
Rani, Batia	Botia	dario	H
Gutum, Puiya	Lepidocephalus	guntea	S

Family - Bagridage (long Barbeled Catfishes)

Ayre, Guji Air	Aorichthys (Mystus)	aor	S,H,R
Golsha	Mystus	cavasius	S,H
Kalo Bujuri	Mystus	tengara	
Tengra	Mystus	vittatus	R
Rita	Rita	rita	

Family - Siluridae (Butter Catfishes, Freshwater Sharks)

Kani Pabda, Boali Pabda	Ompok	bimaculatus	S,H
Madhu Pabda	Ompok	pabda	S,H,R

Family - Schilbeidae (River Catfishes)

Kajuli, Kazali, Baspata	Ailiichthys	Punctata	
Ghaura	Clupisoma	garua	H
Bacha	Eutropiichthys	vacha	
Batasi	Pseudeutropius	atherinoides	

Family - Pangasiidae

Pangas	Pangasius	pangasius	

Family - Clariidae (Air-Breathing Catfishes)

Magur	Clarias	batrachus	S,H,R

Family - Heteropneustidae (Stinging Catfish)

Shingi	Heteropueustes	fossilis	S,H,R

Order - Cyprinodontiformes
Family - Belonidae (Gars)

Kaikka	Xenentodon	cancila	S,R

Order - Synbranchiformes
Family - Synbranchidae (Swamp Eels, Mud Eels)

Kuchia	Monopterus	cuchia	S,H

Order - Perciformes

Family - Centropomidae

Kata Chanda	Chanda	beculis	S
Lal Chanda	Chanda	ranga	S

Family - Nandidae (Mudperches)

Koi Bandi, Napit	Badis	badis	S,H
Bheda	Nandus	nandus	R

Family - Polynemidae (Theadfins)

Tapasi Muni Rishi	Polynemus	paradiseus	

Family - Gobiidae

Nanda Bailla	Awaous	grammepomus	
Belle, Bailla	Glossogobius	guiris	S

Family - Fleotrididae (Gudgeons)

Dora Baila Kuli	Eleotris	fusca	S

Family - Anabantidae (Climbing Perches)

Koi	anabas	testudineus	S

Family - Belontiidae (Gouramies)

Khalisha	Colisa	fasciatus	S
Baicha	Colisa	labiosus	

Family - Channidae (Snakebeads, Murrels)

Telotaki	Channa	gachua	S,H,R
Gajar, Gajal	Channa	marulis	S,R
Taki, Lata	Channa	punctatus	H,R
Shol	Channa	striatus	S,R

Family - Mastacembelidae (Spiny Eels)

Tara, Baim	Macrognathus	aculeatus	S
Baim, Bam, Sal Bam	Mastacembelus	armatus	S

Class - Crustacea

Order - Decapoda

Family - Palaemonidae

Golda Chingri,Golda Icha	Macrobrachium	rosenbergii	S,H,R

Source - Weekly field reprots
- Personal communication wi8th fishermen
- Thana Fisheries Office survey carried out during this study

Thana Key: S - Shahrasti
H - Hajiganj
R - Ramganj

TABLE D.5.3

Increasing Fish and Crustacean Species in the Noakhali North Project Area

Bangla Name	Scientific Name		Reported increase in following Tahnas
Class - Osteichthys			
Order - Clupeiformes			
Family - Clupeidae			
Ilish	Hilsa	ilisha	
Order - Cypriniformes			
Family - Cyprinidae			
Mola	Amblypharyngodon	Mola	
Chela	Chela	laubuca	
Darkina	Rasbora	daniconius	
Order - Perciformes (Croakers)			
Family - Centropomidae			
Chanda	Chanda	beculis	R
Nama Chanda	Chanda	nama	H,R
Family - Sciaenidae			
Poa	Pama	pama	
Family - Nandidade			
Koi Bandi Napti	Badis	badis	
Family - Mastacembelidae (Spiny Eels)			
Guchi, Baim, Pankal	Mastacembelus	Pancalus	H
Class - Crustaeca			
Order - Decapoda			
Family - Palaemonidae			
Kucha Icha	Macrobrachium	lamarrei	S,H,R

Sources:
- Weekly field reports
- Personal communication with fishermen
- Thana Fisheries Office survey carried out during this study

Thana Key:
S - Shahrasti
H - Hajiganj
R - Ramganj

CHAPTER D.6

THREATS TO BIODIVERSITY

D.6.1 Introduction

In the context of Bangladesh, many of the threats that wildlife face are also being met by its human population. Many of them are natural such as the cyclones, tornados, droughts, floods and earthquakes. A brief summary of the natural factors affecting the wildlife and the people is given below:

D.6.2 Natural Factors Affecting Biodiversity:

Cyclones Cyclones are extremely intense storms with speeds sometimes reaching 177 Km/h which generate storm surges up to 8 m in height. The Noakhali North project area is at risk as the Meghna estuary acts as a funnel. When high tides, storm surges and high southerly winds coincide, there can be enormous damage. Areas especially at risk from cyclones are the middle Meghna floodplain and the Old Meghna Estuarine floodplain.

Tornados These also threaten the project area and according to Rashid (1991), the most severe tornados have been recorded in the south central climatic sub-zone.

Droughts These have occurred in 1779 and 1783 in Comilla due to failure of the rains and this resulted in the banning of grain exports from the region. More recently in 1974, a drought caused a severe famine in the whole of Bangladesh. A combination of factors including the withdrawal of food aid and hording of grain, led to a massive food entitlement failure. International pressure eventually persuaded the USA to resume PL480 food-aid shipments in the face of a famine but not before considerable loss of life.

Flooding This is a climatic hazard in the project area as a whole. The Meghna floodplain is affected by deep and early seasonal flooding and also by flash floods. The northern and eastern plains and hills are also affected by flash floods and as vegetation becomes more degraded, flooding will increase in severity and cause induced erosion rates to be higher.

Earthquakes Another hazard in the project area is from earthquakes. These are especially concentrated in the piedmont plains and the hills to the east. In 1897, an earthquake affected Brahmambaria in the northern part of the South East Region, destroying buildings, river banks and roads. If such an earthquake should occur in the project area today, liquefaction of embankments and settlement mounds could happen with associated catastrophic flooding, if this was during the rainy season as is normally the case. Earthquakes in the hills cause landslides, destroying agricultural land, choking rivers and causing heavy loss of life.

D.6.3 Human Interventions in the Noakhali North Study Area

Some of the main human interventions affecting the wildlife of the study area include habitat alterations, over-exploitation of the resources, introduction of species and increased pests, organic pollution, domestic waste and agro-chemical effluent from agricultural fields amongst others. A brief summary of these impacts is given below:

D.6.3.1 Habitat Alterations:

These have occurred for centuries, such as in the case of river embankments, but it is in the last decades when they have been felt more dramatically. Amongst these alterations, the most important one must be related to the Flood Action Plan currently underway in the country. Unfortunately until very recently, little attention, if any, had been given to the impacts of flood control on the ecology and biodiversity of a given area. It is granted that extremely important issues such as increasing the production of food, were at the top of the agenda of the organizations concerned. However, it is increasingly clear that any further development programmes in Bangladesh must address the issue of habitat deterioration and should try to minimise them by all means possible.

It must be emphasised that it is not only the wildlife, both flora and fauna species, who are affected by habitat alterations. The consequences of polderization and controlled flooding have already been felt by several of the human communities in the areas of the Chandpur Irrigation Project and the Meghna-Dhonagoda scheme who have lost their livelihoods or who no longer have access to the free-common fisheries. These consequences have obviously also been felt by the floral and faunal communities, especially fish, that used to inhabit the area. The Fisheries Annex F includes further details of the impacts of these schemes on the fisheries.

D.6.4 Over-exploitation of the Natural Resources:

The use of the natural resources in Bangladesh, as in the whole of the study area, is extremely intense with little or no resulting wastage. However, with an increasing human population, it is likely that this utilisation will only increase in the future. From the information presented in Tables D.3.8 and D.3.9), it can be seen that the people of the study area already utilise the local resources efficiently and intensively. It would thus seem necessary to carry out a full inventory of the species in the area to account for the existing biodiversity of species, habitats and genes. Consideration will need to be given to the possibility of protecting examples of the biota and/or habitats with a view of developing programmes directed towards the achievement of sustainable use of the resources.

D.6.5 Introduced Species

There are several ongoing programmes in the country which are attempting to improve the fisheries and the agriculture potential in several areas. From the fisheries point of view, aquaculture of so called 'exotic' species and fingerling releasing programmes should exert extreme care so that they do not place indigenous or local species under threat. Throughout the world, escapees from fish farms are known to be a major cause for competition with the native species for vital space, food and breeding grounds. In addition, introduced species often prey on the native ones causing their demise. It should be pointed out that introduced species also include native species which have been taken from one area of the country to another which they did not naturally inhabit previously. These introduced species also include translocation or transplantation of species. A similar situation has been assumed to occur with agricultural crops.

An added risk to both agricultural crops and the people is the increase in the rat population in areas which become drier after flood control schemes are set into place. Thriving rat populations are virtually impossible to control.

D.6.6 Pollution

In the Noakhali North study area, pollution mainly includes domestic, organic and agro-chemical runoffs from nearby fields. There is some navigation within the study area but by and large, they are small crafts which may be contributing to the pollution of the system in a small scale. However, in general, the annual flooding is believed to be able to flush away most of these pollutants. Any schemes intending to alter this pattern will need to take into account the potential accumulation of discharges, both organic and inorganic, in areas where flood control and/or polderization are proposed.

D.6.7 International Activities

Bangladesh is party to the Convention concerning the Protection of the World Cultural and Natural Heritage (World Heritage Convention). It also participates at the Unesco Man and the Biosphere Programme, although not actively. Bangladesh is also a signatory to the Convention on Wetlands of International Importance especially as Waterfowl Habitat known as the Ramsar Convention. This convention provides a unique mechanism for international cooperation in the management of aquatic resources and although this convention was originally established mainly for waterfowl, its provisions also allow for other species groups to be covered. It is unquestionable that the wetlands of this country are amongst the world's most important ones and that the natural resources associated with them, in particular its fisheries, are also on a similar scale.

CHAPTER D.7

CONCLUSIONS AND RECOMMENDATIONS

Floodplain environments are very dynamic in nature and provide a whole mosaic of shifting types of habitats for all species inhabiting them. The result is a wide variety of floral and faunal species that are extremely valuable to the local people both in ecological and economic terms. Despite the short period of time available for this study it was possible to establish that the Noakhali North study area is an important reservoir of biodiversity.

As far as the species are concerned, both animals and plants are extremely critical to the functioning of the floodplain ecosystem but they are also exceedingly significant because most of them are utilised by the local people in the area for their every day needs. Undeniably, the use of these resources is extremely intense in the study area as well as in the rest of the country but a certain equilibrium, presumably very fragile, appears to exist between the natural resources and the people in the area. It is also likely that in certain areas such as embankments, road sides, ponds and fields, the animal and plant species are interdependent with the people of the area mutually benefiting each other. Economical benefits are also numerous as the local people of the project area utilise many of the natural products found in the floodplain as food, timber, fuel, animal fodder, construction material and for medicinal purposes. Without this natural reservoir they would have to rely on man-made products and in modern medicine often well beyond their reach.

The productivity of the study area in terms of fish yield has been addressed in the Fisheries Annex F, and it is believed to be directly related to the luxuriant plant biota, both micro and macro, available in the floodplain which serve as shelter, feeding and reproductive grounds for fish. Thus, to maintain this level of productivity in general as well as in fish production terms, and to maintain the healthy state of the floodplain it is indispensable that periodic flooding be allowed in the main areas of the floodplain, especially in areas such as Zones B, C and D. Without the flooding existing aquatic habitats which are still to be studied, will perish.

It is therefore imperative that water management and the sustainability of the resources are given the highest priority in any proposed and future developments. In addition, further studies need to be made before any intervention takes place in order to establish with certainty the extent of the diversity of the study area and of its value, in ecological and economic terms, which stands to be great in the light of the close associations identified between the natural resources and the people of the Noakhali North study area. All indications to date point to an area which still harbours an important Biodiversity which should be catalogued, managed and utilised in a sustainable manner in accordance to international standards for conservation, human health and resource utilization.

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