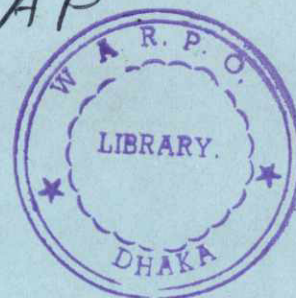


FAP-5

**Gumti Phase II  
Sub-Project Feasibility Study**

FAP

FAP-5



BN-143  
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**DRAFT FINAL REPORT**

**ANNEX F**

**FISHERIES**

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June, 1993

Mott MacDonald Limited  
*in association with*  
Nippon Koei Company Limited  
House of Consultants Limited  
Desh Upodesh Limited

World Bank  
Government of the People's Republic of Bangladesh

# Gumti Phase II Sub-Project Feasibility Study



DRAFT FINAL REPORT

ANNEX F

FISHERIES

MTN-136  
of 62  
C-3

June, 1993

Mott MacDonald Limited  
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House of Consultants Limited  
Desh Upadesh Limited

# GUMTI PHASE II FEASIBILITY STUDY

## FISHERIES

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## Glossary For Fisheries Annex

ADB	-	Asian Development Bank
asl	-	Above sea level
Arottdar	-	Fish market commission agent
Aus	-	Rice grown during the Kharif - 1 season
Bazar	-	Market
BBS	-	Bangladesh Bureau of Statistics
Beel	-	A natural depression which normally remains wet during the year
Beparis	-	Distributor of fish in markets
Boro	-	Rice grown during the Rabi season
Dalal	-	Local agent who collects and purchases fish on a commission basis
DANIDA	-	Danish International Development Agency
District	-	Administrative Unit comprising a number of Thanas under the charge of a Deputy Commissioner
DOF	-	Department of Fisheries
FAO	-	Food and Agriculture Organization of the United Nations
FAP	-	Flood Action Plan
FCD	-	Flood Control and Drainage
FCDI	-	Flood Control, Drainage and Irrigation
FPCO	-	Flood Plan Coordination Organization
FRSS	-	Fisheries Research Survey System
Ha	-	Hectares
Hapa		
HYV	-	High Yielding Variety
ICLARM	-	International Centre for Living Aquatic Resources
IUCN	-	The World Conservation Union
Jalmahal	-	Government leased fishing rights
Katta	-	Fish attracting device consisting of a frame made up of bamboo poles with brushwood in the middle
Kg	-	Kilogram
Khal	-	Natural drainage channel
Km	-	Kilometres
Kutchha	-	Thatched house made of straw or mud
Lac	-	100,000 units
Mohajans	-	Mobile collectors of fish for market
MT	-	Metric Tonnes - 1000 kg
NFMP	-	New Fisheries Management Policy
Nikaris	-	Local fish market retailer, middleman
NGO	-	Non-Government Organization
Paikers	-	Person who handles the wholesale of fish
SPARRSO	-	Space Research and Remote Sensing Organization
TFO	-	Thana Fisheries Officer
Thana	-	Administrative Unit, division of a District, formerly termed Upazila
Thana Parishad	-	Thana Council
Tk	-	Taka, Bangladesh Currency approximately 59 to the Pound Sterling
Union	-	Smallest administrative unit of local government (division of a Thana)
Wetland	-	Area of land saturated with or submerged under water

## **F.1 Introduction**

Freshwater fish are an important source of income and cheap protein for a large proportion of the human population in Bangladesh, and capture and culture fisheries are the two main forms of fishing that are present in the country.

The Gumti Phase II project area has an extensive network of seasonal and perennial rivers with Khals crisscrossing it, making it very important for capture fisheries. Most of the study area lies within the annual flooding area of the country and as such, it is believed to play an important role as fish habitat, especially in those areas isolated during the dry season which often merge into one vast expanse of water during the floods. This extensive flooding enhances the fisheries every year by carrying those species which migrate from the main rivers into the floodplain aquatic habitats for breeding, feeding or dispersal purposes. In addition, the man-made Khals and other type of artificial depressions (estuaries, road-side borrow pits and canals) also found in the area, act as fisheries production sites and are good settings for the cultivation of commercially important species. However, ecological and biological data regarding fish and their utilization is lacking, especially for the smaller species.

Thus it is essential to carry out an evaluation of the existing fish diversity and fisheries in the area and the potential ecological impacts that any flood control project might have on their life cycles and on the natural environment. However, 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.

### **F.1.1 Scope of the Fisheries Study**

The main objective of the fisheries component of the Gumti Phase II Feasibility Study was to carry out an evaluation of the fisheries resources of the area and make an assessment of the impact of FCD and FCDI projects on capture and culture fisheries under a set of different strategies. Comparative assessments have been made on the likely effects of these interventions on the fisheries resources.

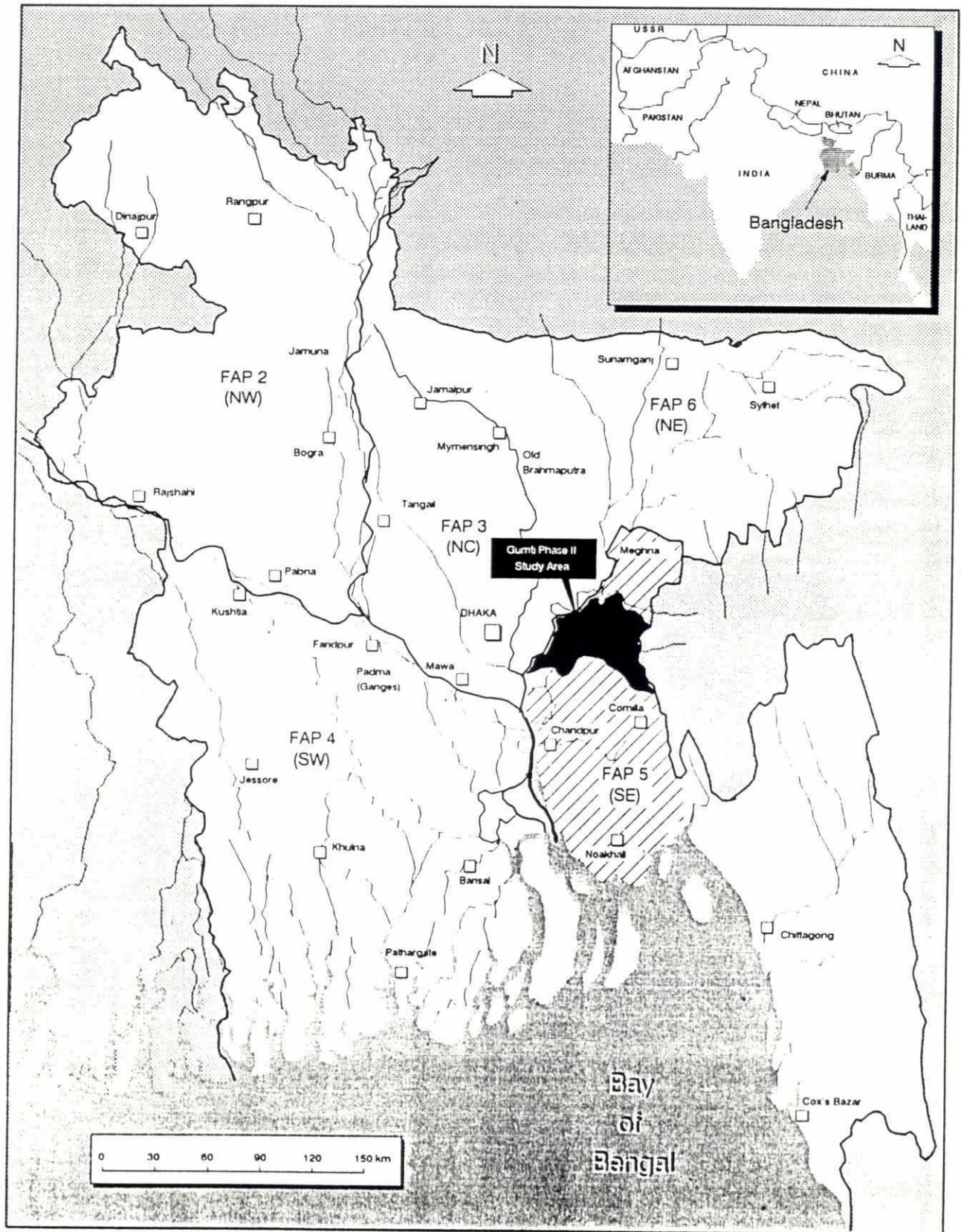
Given the importance of open water floodplain fisheries, the focus was placed on these activities and it is hoped that information gathered in this study will form a much needed baseline for any future analyses, especially at the design level.

### **F.1.2 The Gumti Phase II Project Area**

The Gumti Phase II project area lies to the north of the South East Region (SER) of Bangladesh which borders India to the east; the Chittagong area to the south-east; the North West Region (FAP 6) to the north and north-east; the North Central Region (FAP 3) to the west and the South West Region (FAP 4) to the south-west. To the south, the SER meets with the Bay of Bengal (Figure F.1.1)

2

Figure F.1.1  
Location of the Gumti Phase II Project Area



Within the region, the project area is located to the north-west of Comilla (Figure F.1.2). It is bounded to the south by the Gumti River, to the west by the Meghna River, to the north by the Titas (or Pagla) River and to the east, by the Tripura Hills (India).

The project area is 140,854 hectares in size and generally varies between 2.5 and 6 m above sea level. The exception to this is a small area of relatively high land, rising to 9 m asl, just north of Comilla. Figure F.1.3 shows details of the project area and its main rivers and Khals.

There are an estimated 1.9 million people within the project boundary, with an average density of 1,300 people per square kilometre, which is nearly twice the national average, and substantially higher than that for the South-East Region as a whole (1,078 people per square kilometre).

The Gumti Phase II area is extremely rich in open water fisheries, particularly in those areas situated in the Middle and Old Meghna River Floodplains (Figure F.2.1). Although few studies have been carried out in this area, its proximity to the fish-rich Meghna River and the extent and duration of its floodplain area during the monsoon, make it potentially one of the most productive fisheries areas in Bangladesh.

This situation appears to be confirmed by the findings of FAP 17 (the Fisheries Component), who have recently reviewed the riverine catch statistics from the DOF for the period from 1983-84 to 1990-1991 and found that the Upper and Lower Meghna Rivers were the most productive rivers in the country, especially the latter. In contrast, all the other major rivers in the country show a marked decline since 1985-86 (FAP 17, 1993).

Part of the work carried out by FAP 17 included the addition of the commercial freshwater catch to existing statistics. As a result, the overall national estimates for fish production have increased from approximately 700 thousand MT to over 1.5 million MT (FAP 17, 1993).

### F.1.3 Social and Economic Context of the Capture Fisheries in the Area

Substantial numbers of people in Bangladesh engage in subsistence fishing in contrast to full time and part time fishing, where all or part of the catch is sold for cash. It is therefore important to define subsistence fishing as the utilization of a **free common good resource** by family members in order to supply them with the majority of their animal protein. Subsistence fishing mainly applies to people who are too poor to buy fish at markets and who therefore enter a wageless labour system producing food for their families by catching fish. It is these people, unlike the full and part time fishermen, who are likely to suffer most due to the destruction of capture fisheries by FCD and FCDI schemes. Such poor and marginalised families will find it much more difficult to obtain the necessary levels of nutrients with their low and intermittent wages.

Much of the fish consumed in Bangladesh requires no intermediate market mechanisms, being outside the cash economy, costing families nothing but their labour. The presence of free or low cost fish has important implications for population stability in the rural society. The loss of subsistence fisheries could force many landless families, and small farmers who rely on these fisheries, to move to the city. The importance of the species which make up the bulk of the subsistence catches, usually the ones with lower economic value but high in nutritional merit, lies in their being less regulated by leasing systems, easier to catch with cheap gear and independent of culture fisheries markets and government stocking programmes.

Figure F.1.2

# Regional Planning Context

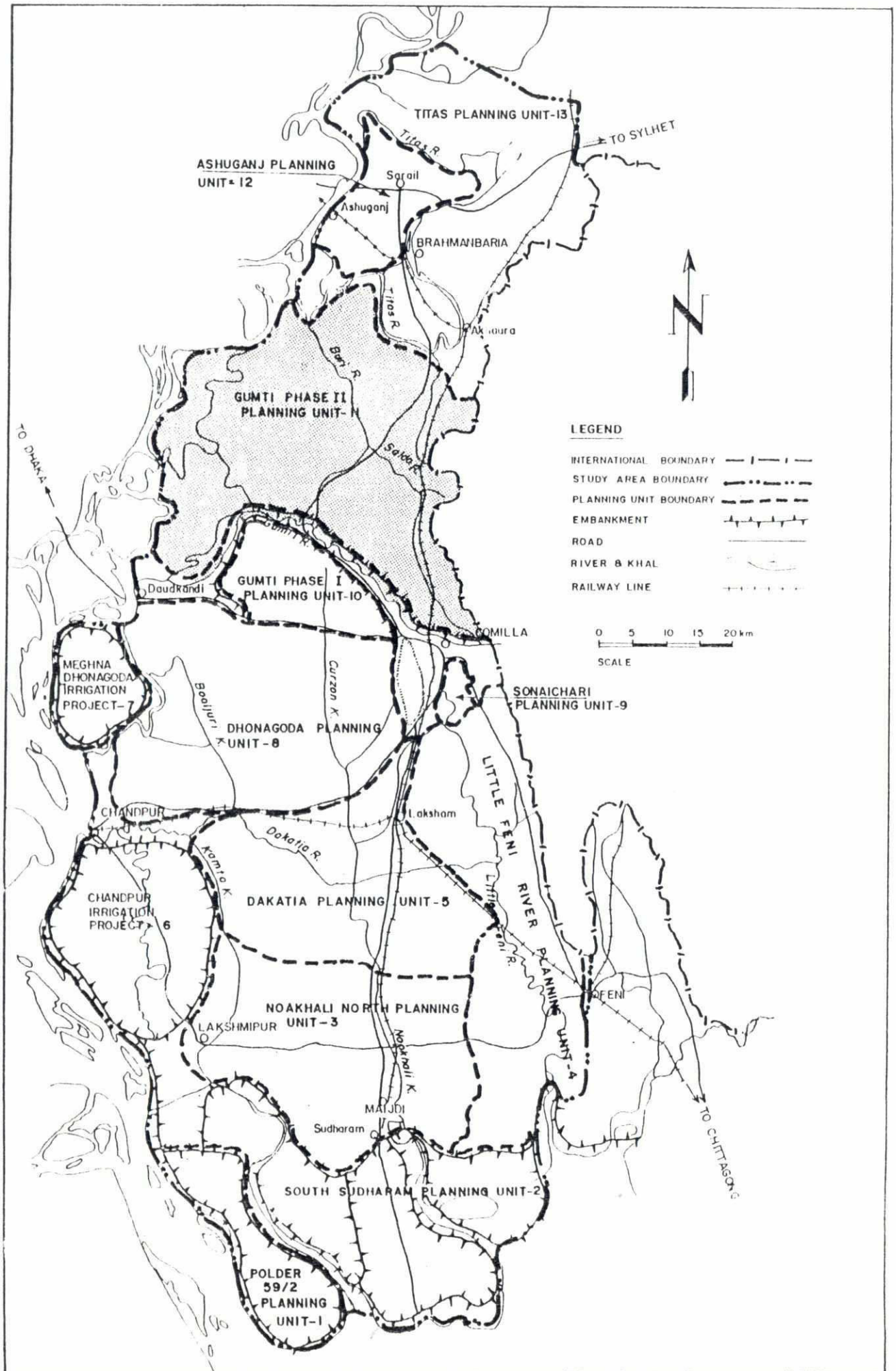
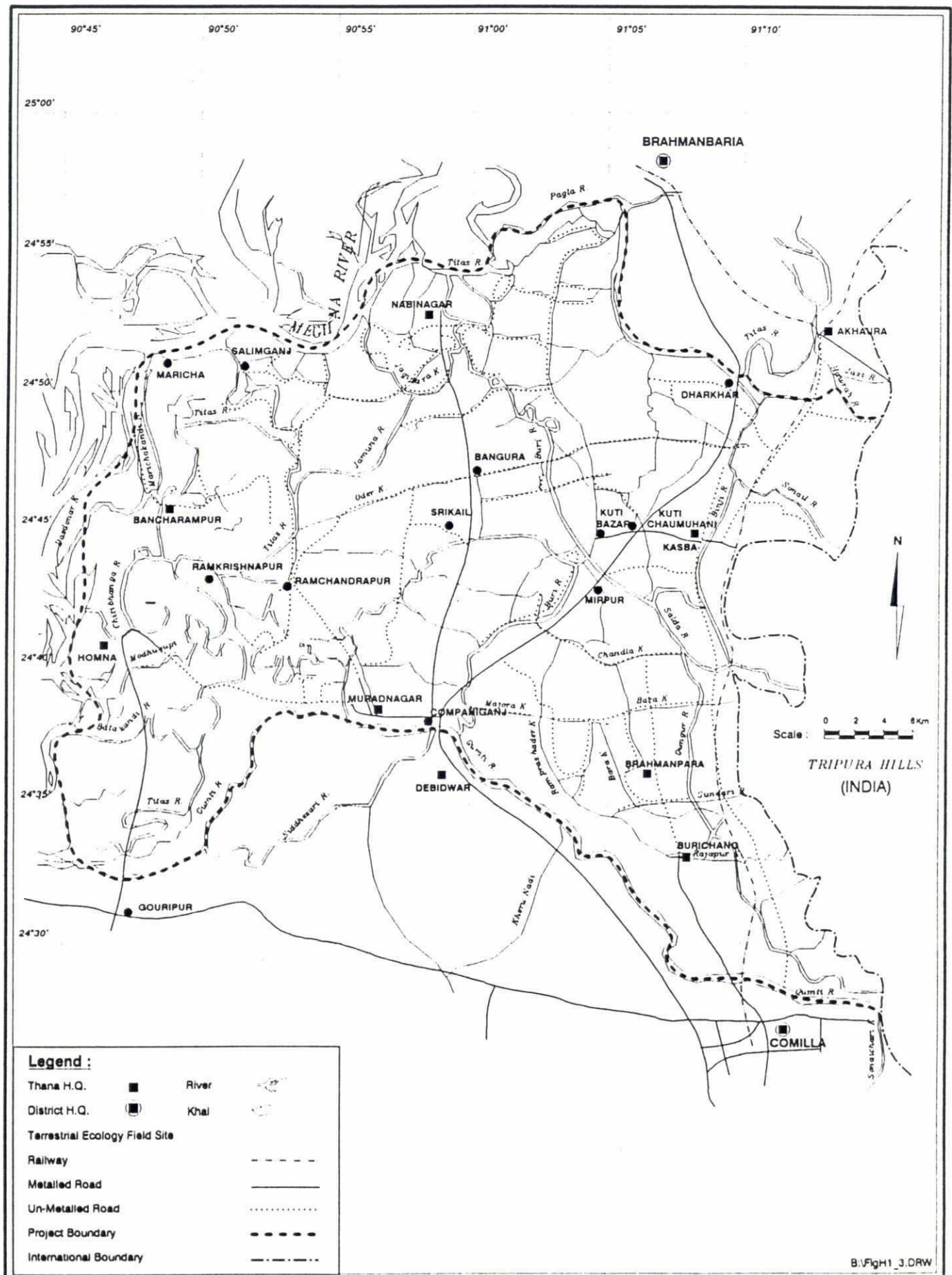


Figure F.1.3  
Project Area Base Map



The 1980-81 Nutritional Survey of Bangladesh found that of 28 g of animal protein consumed per capita, 22 g (nearly 80%) came from fish. This shows the extent to which people, especially the landless, rely on a wide variety of species to meet their protein needs. Species diversity is thus also important to subsistence fishermen and it is a major component of the nutritional profile of the Bangladeshi people.

#### **F.1.4 Biodiversity 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 importance of the Gumti Phase II study area lies not only in its extremely high fish productivity, but also on the remarkable number of aquatic species, 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 will be dealt with in Chapter 7 of this report. It is believed that this number of species would increase if a longer study were to be carried out in the area.



## **F.2                      Physiography**

### **F.2.1                    Agro-ecological Regions**

Figure F.2.1 shows the mapped classification of the Agro-ecological Regions in the study area based upon the 1988 FAO Land Resources Appraisal of Bangladesh. This information, together with information on topography (Figure F.2.2) have been used to link the hydrology of the area. A brief description of the agro-ecological regions in the project area is given below:

#### **F.2.1.1                The Middle Meghna River Floodplain**

The Meghna River Floodplain between Bhairab Bazar and Matlab occupies the area where young Meghna sediments have partially buried the Brahmaputra River floodplain. The unit occupies a group of large and small islands, previously Chars (accreted land) in the Old Brahmaputra channel, as well as young alluvial land which has filled in old channels.

Meghna sediments vary in depth from 20 to 60 cm and overlie the older Brahmaputra sediments or soils. Meghna alluvium occupies both smooth ridge and basin landscapes as well as areas with a complex relief of ridges, inter-ridge depressions and channels. Silty soils occupy ridges and silty clays occupy the basins. Seasonal flooding is generally moderate to deep and flood levels tend to rise early as a result of heavy rainfall in March and April in the Upper Meghna catchment. River channels are tidal in the dry season, but the water is not saline. River banks are mainly stable but bank erosion occurs locally.

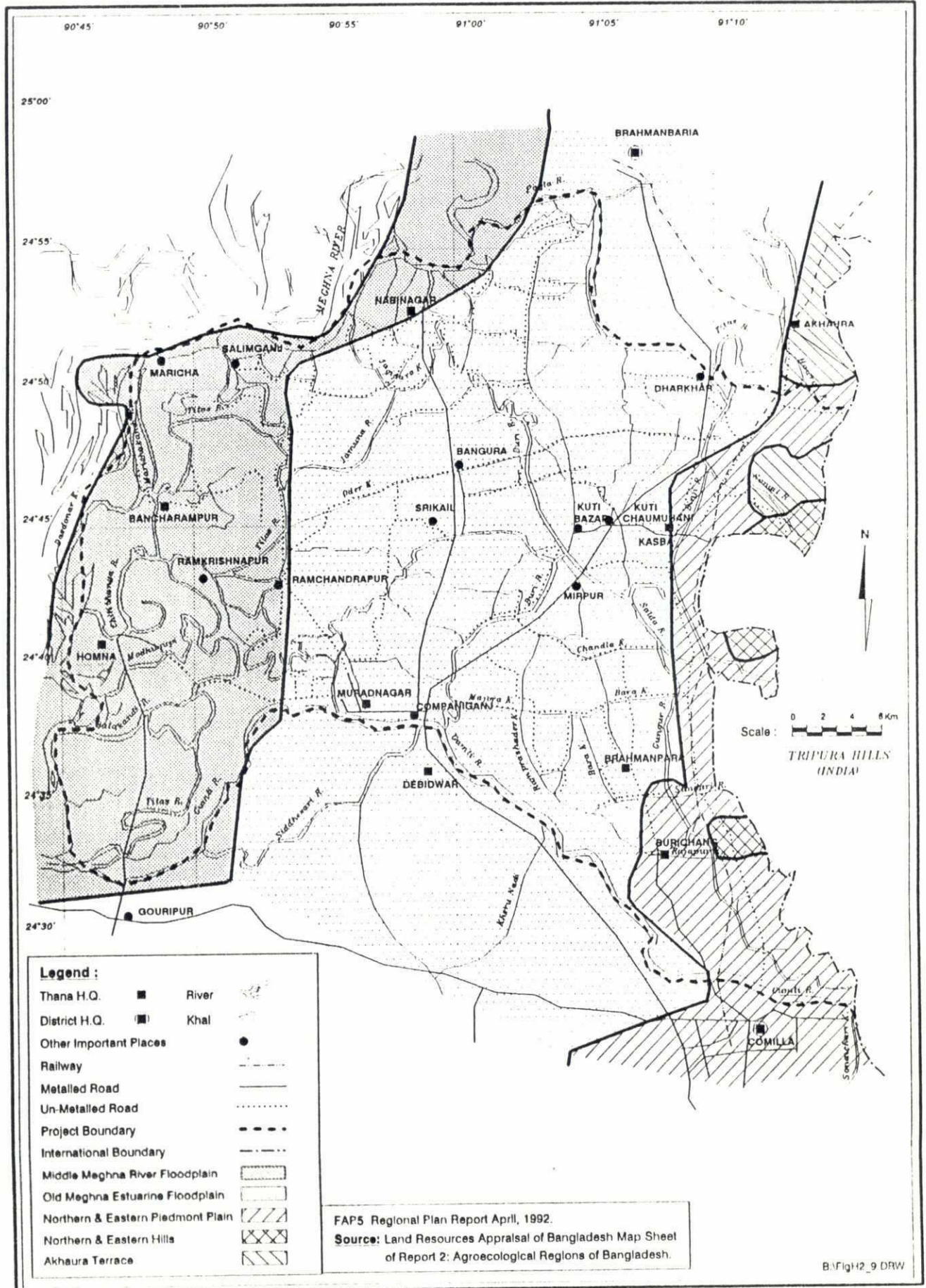
#### **F.2.1.2                Old Meghna Estuarine Floodplain**

From Figure F.2.1, it can be seen that the floodplain occupies the largest portion of the Gumti Phase II study area. The landscape of this sub-unit is almost level, with smooth broad ridges and basins which are underlain by deep silty deposits. This older floodplain has deeply developed soils with well oxidised sub-soils.

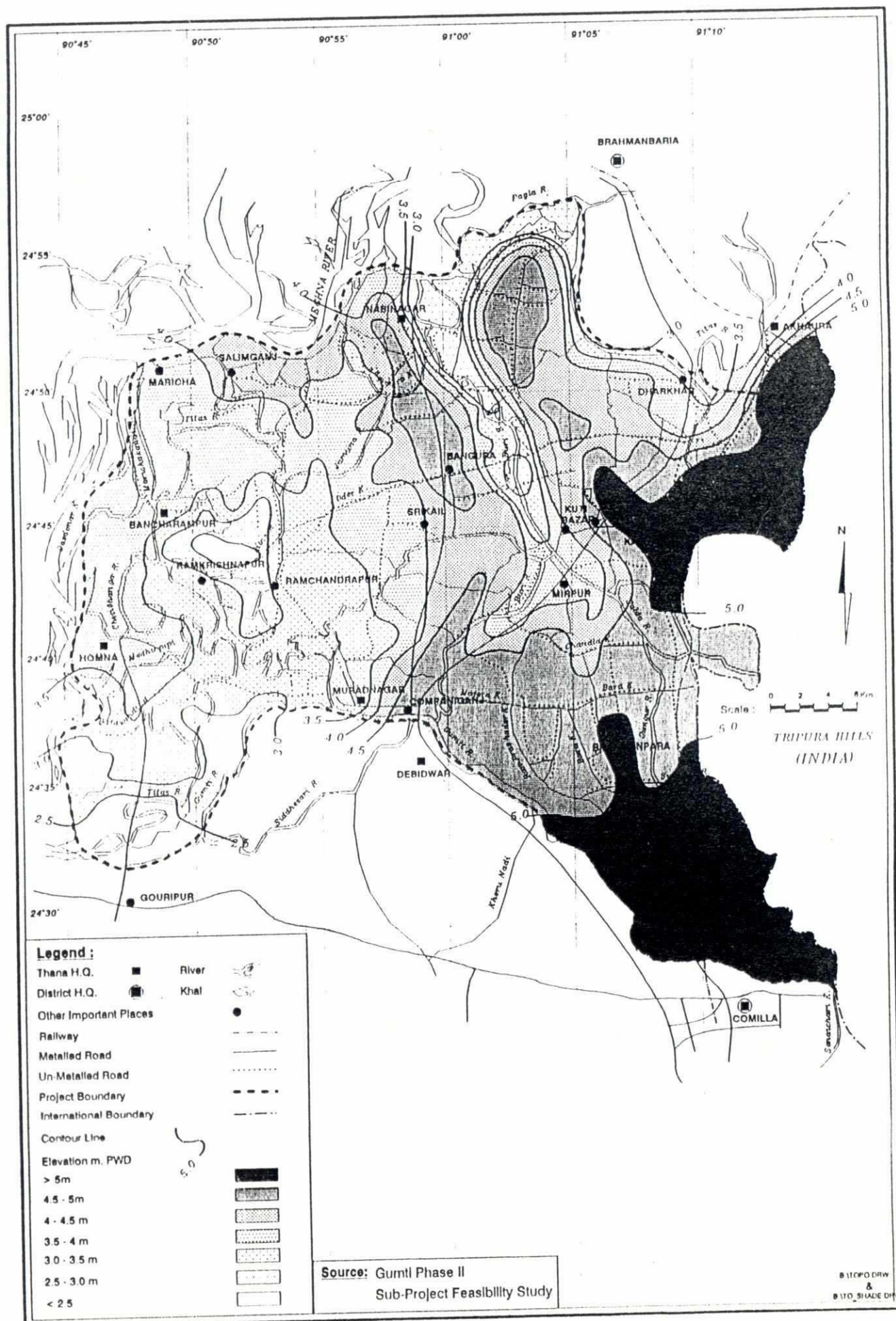
Seasonal flooding is mainly caused by accumulated rainwater and it is moderately deep or deep in the north and west. Only a few rivers such as the Gumti, the Buri and the Jamuna cross this part of the Meghna floodplain. Between these rivers in the Old Comilla District, there is a network of Khals (Bangla term for a channelised river, channel or drain) for drainage and navigation. Silting up of the river channels, especially the Gumti, the Ghungur and Salda rivers, and failure to maintain Khals has increased the risk of catastrophic flooding and also congestion of drainage. Areas close to the eastern hills are subject to flash floods, whereas the central basin is subject to early and rapid flooding, especially the Titas floodplain.

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Figure F.2.1  
Agroecological Regions in Project Area



# Topography Map



### **F.2.1.3 Northern and Eastern Piedmont Plains**

This complete unit runs in a thin strip along the eastern project boundary and borders the Old Meghna Estuarine Floodplain, and the Northern and Eastern Hills. The region comprises emerging alluvial fans which slope gently outward from the foot of the northern and eastern hills into smooth low lying basins. The basins merge imperceptibly with adjoining floodplain basins. The Piedmont Plains are locally irregular in relief, especially where the sediments are sandy. They mainly stand above normal flood levels but are submerged for a few days at a time by flash floods from the hills. The Northern and Eastern Piedmont basins are occupied mainly by heavy clays, some being strongly acid. Except on narrow floodplain ridges, seasonal flooding is mainly moderately deep or deep, while the Comilla basin is mainly shallowly flooded. All the basins are subject to temporary deep flooding during flash floods which discharge into the area due to heavy rain in the hills.

### **F.2.1.4 Northern and Eastern Hills**

A very small part of the eastern boundary is comprised of this land type which has complex relief. Hills have been dissected to different degrees over different rocks. Alluvial sediments mainly comprise sandy and loamy piedmont terrace floodplain deposits. There are areas of dissected low hills, developed over unconsolidated Dupi Tila and Dihing sandstones and shales. The hills are mainly excessively well drained, but in some places there is a narrow strip in valley bottoms which is imperfectly drained.

### **F.2.1.5 Akhaura Terrace**

This region occupies two small areas in the north east of the project area within the Northern and Eastern Piedmont plains region. The region is mainly broad level upland areas standing above broad piedmont valleys. Uplands are closely dissected in some places. The upland soils are moderately well drained, brown and red-mottled acidic clays. The valleys are occupied by a variety of grey to black soils, some of them peaty, and ranging from shallowly to deeply flooded in the rainy season

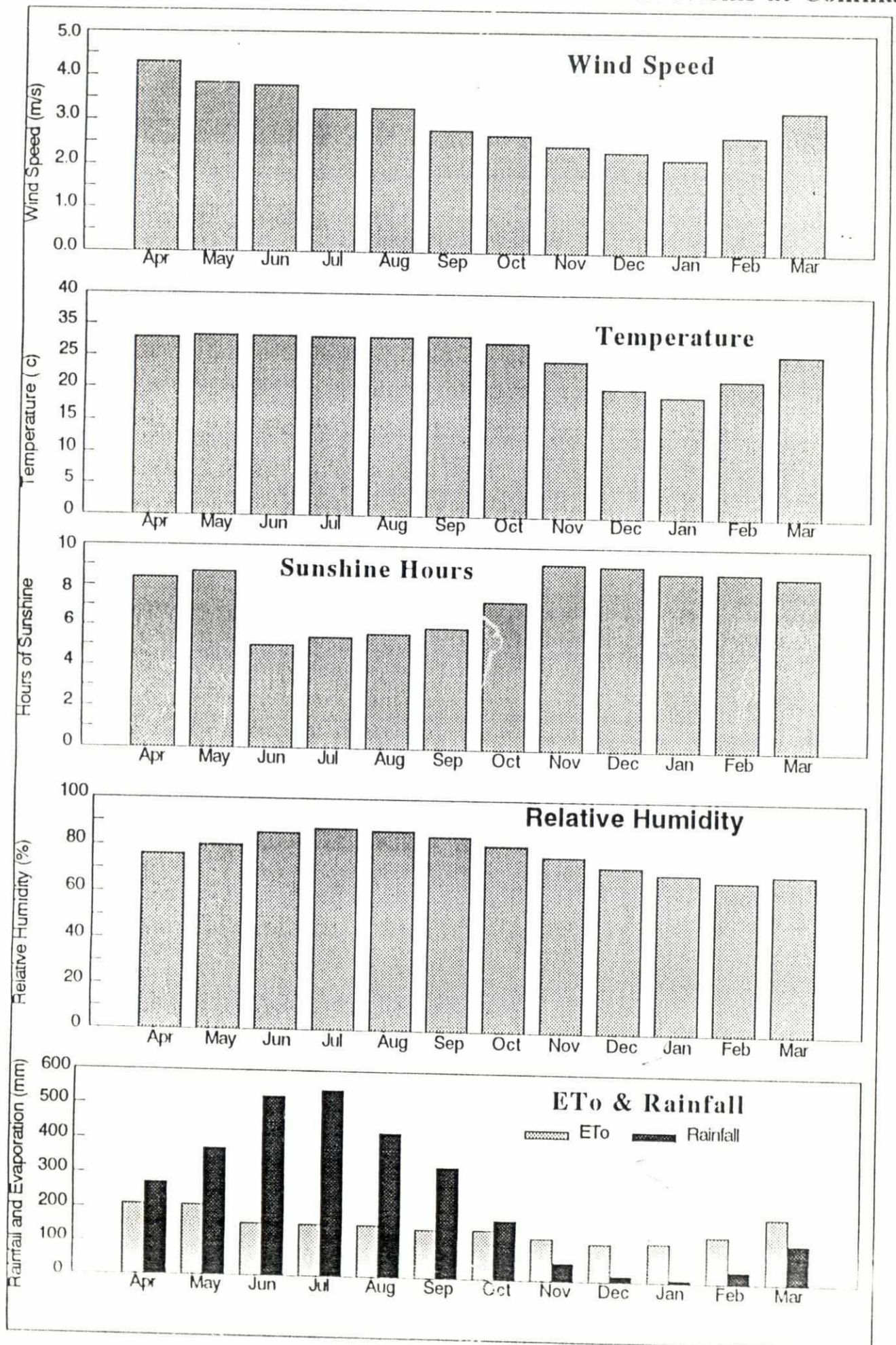
## **F.2.2 Climate**

There are two broadly distinct zones in the project area, the Meghna Floodplain and the higher Piedmont Plains and Hills in the east. Both climatic zones lie where there are 50 to 70 days with an average minimum temperature of less than 15°C and less than 5 days with a maximum temperature of over 40°C. Figure F.2.3 shows the climatic norms in Comilla.

### **F.2.2.1 Meghna Floodplain**

The climatic conditions in the Middle and Old Meghna Floodplain, which make up the majority of the project area are relatively uniform. There is, however, a considerable year to year variation and a high standard deviation in all seasonal parameters.

## Climatic Norms at Comilla



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Figures for mean annual rainfall vary from about 2000 mm at Bancharampur to 2 200 mm at Daudkandi, and over 2 000 mm for most of the Meghna floodplain area. Figures for mean annual temperatures vary from 25.6°C to 26.5°C across the floodplain.

The humid period (BH-EHO) ranges from 155 to 162 days and begins between the 6 and 15 May ending between the 18 and 25 October, with over 2000 mm of rain expected during 5 months of the year.

#### **F.2.2.2 Piedmont Plains and Hills**

This distinct climatic zone occurs in a thin band along the eastern boundary of the project area and includes the Northern and Eastern Piedmont plains, the hills and the Akhaura Terrace (Figure F.2.1). This area is one of the wettest in the country, but as in other places, there is considerable year to year variability and a high standard deviation in all seasonal parameters.

Figures for mean annual rainfall vary from 2000 to 2500 mm. The Akhaura Terrace, however, has a lower average rainfall of between 1985 and 2011 mm. Figures for mean annual temperature vary from 24.7°C and 25.6°C, which is slightly lower than the floodplain temperatures.

The humid period (BH-EHO) ranges from 159 to 168 days beginning between the 3 May in Kasha and the 12 May in Brahmanbaria, and ending between the 12 October in Kasha and 27 October in Comilla, very similar to the Meghna floodplain figures. The number of months with rainfall over 200 mm varies from 5 to 6.

The pattern of wind speed and direction varies over the year and is more or less constant over the entire project area (Figure F.2.3). From November to February, the general wind direction is northerly. This changes to a south-easterly direction from March to May, and by September, the winds are either southerly or south-easterly. In October, the winds are very variable but there is a strengthening of northerly winds at the expense of south-easterlies. Wind velocities for Comilla compiled in 1964 indicate speeds of between 0.63 and 1.25 Km/h between November and March and speeds of 3.5 Km/h and 7 Km/h between April and October. Wind speeds and direction are crucial in the prediction and occurrence of cyclones and other climatic hazards.

Relative humidity across the project area is high. Mean monthly figures compiled in 1964 for Comilla vary from 71.5 in March to 87.3 in August, with a mean annual figure of 80.4%.

#### **F.2.2.3 Climatic Hazards in the Project Area**

Cyclones are extremely intense storms with speeds over 177 Km/h which generate storm surges up to 8 m in height. The Gumti Phase II project area is very much at risk as the Meghna estuary acts as a funnel drawing in typhoons. When high tides, storm surges and high southerly winds coincide, there can be enormous damage. In May 1961, a cyclone and tidal bore hit Comilla and Dhaka. Daudkandi Thana was most affected with 50% of the kutch houses razed to the ground. Extreme damage to agricultural land occurred in the entire Comilla District. 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 which includes the Gumti Phase II project area. In 1969, a severe tornado damaged 118 villages in Comilla and severely damaged Homna, where 30% of the houses were destroyed killing 42 people.

**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 hoarding 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.

The Gumti embankment has breached many times over the past 200 years and caused catastrophic flooding in the project area in 1784, 1788, 1794, 1961 and 1967. High levels in the Ganges, Brahmaputra and Meghna rivers caused abnormally high flooding in 1954, 1970, 1987 and 1988, resulting in damage at Kasba, Bancharampur, Homna and Muradnagar.

**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 Brahmanbaria, 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.

### **F.2.3 Flood Zones**

Figure F.3.1 shows the flood zones in the project area according to MPO (1985). These mapped zones have been very useful in identifying the fisheries systems in the area.

### F.3 Fisheries Environments

The Gumti Phase II project area is a significant and productive wetland which harbours a large number of organisms, important both in economic as well as ecological terms. This importance becomes obvious when fish and fisheries in the area are considered, although fish are just one of the many links in its complex ecological web.

The biodiversity of a place such as the Gumti Phase II basin is due to its proximity to both the Meghna, one of the major rivers in the country, and the Titas (Pagla) Rivers which interact in a complex manner. In addition, a series of internal rivers, Khals, Beels and other aquatic environments make it an ideal feeding, nursery and growing area for a myriad of aquatic animals and plants, of which fish and crustaceans are major components.

A summary of the main aquatic habitats that are important for fish and crustaceans is given below:

#### F.3.1 Major River Systems

The study area is bounded to the west by the Upper Meghna River, which is referred to as the Meghna River in this report. To the north, minor rivers such as the Titas and the Salda join the Meghna to create one of the most important wetlands in the study area, which extends in the monsoon throughout most of the basin. In addition, the north-west portion of the basin adjacent to the Meghna is believed to be an important area for migratory aquatic birds.

It is beyond the scope of this study to attempt to quantify the contribution that the Meghna River makes to the fish production and to the ecological processes of the basin. However, results of the hydraulic model show that the early flooding from the Meghna comes into the basin from the northern part, just east of Nabinagar, and runs southwards through its central part from where it extends to the rest of the basin with the rising floods. In consequence, it is believed that fish, spawn, fry and breeding adults, are carried into the ecosystem at this time. The contribution of this river to the fish production in the Gumti area is thus extremely important.

For the analysis of the fisheries estimates, the area of the Meghna immediately adjacent to both Zones C and D (please refer to Figure F.4.3) has been measured and a productivity assigned to it on a per unit area (Table F.3.1). However, it is likely that this procedure may seriously underestimate the actual contribution of this great river. It is possible that the Meghna's contribution to the fish production in the Gumti Phase II area may be as high as 23 000 MT (41 531 ha; from Astagram to Daudkandi Pump House), or more, although for the purpose of the analyses carried out in this study only about 4 717 MT (8 469 ha adjacent to the project area) have been considered.

It is therefore crucial that further evaluations be made in this regard before any intervention in this critical portion of the basin takes place.

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Figure F.3.1

MPO Flood Zones

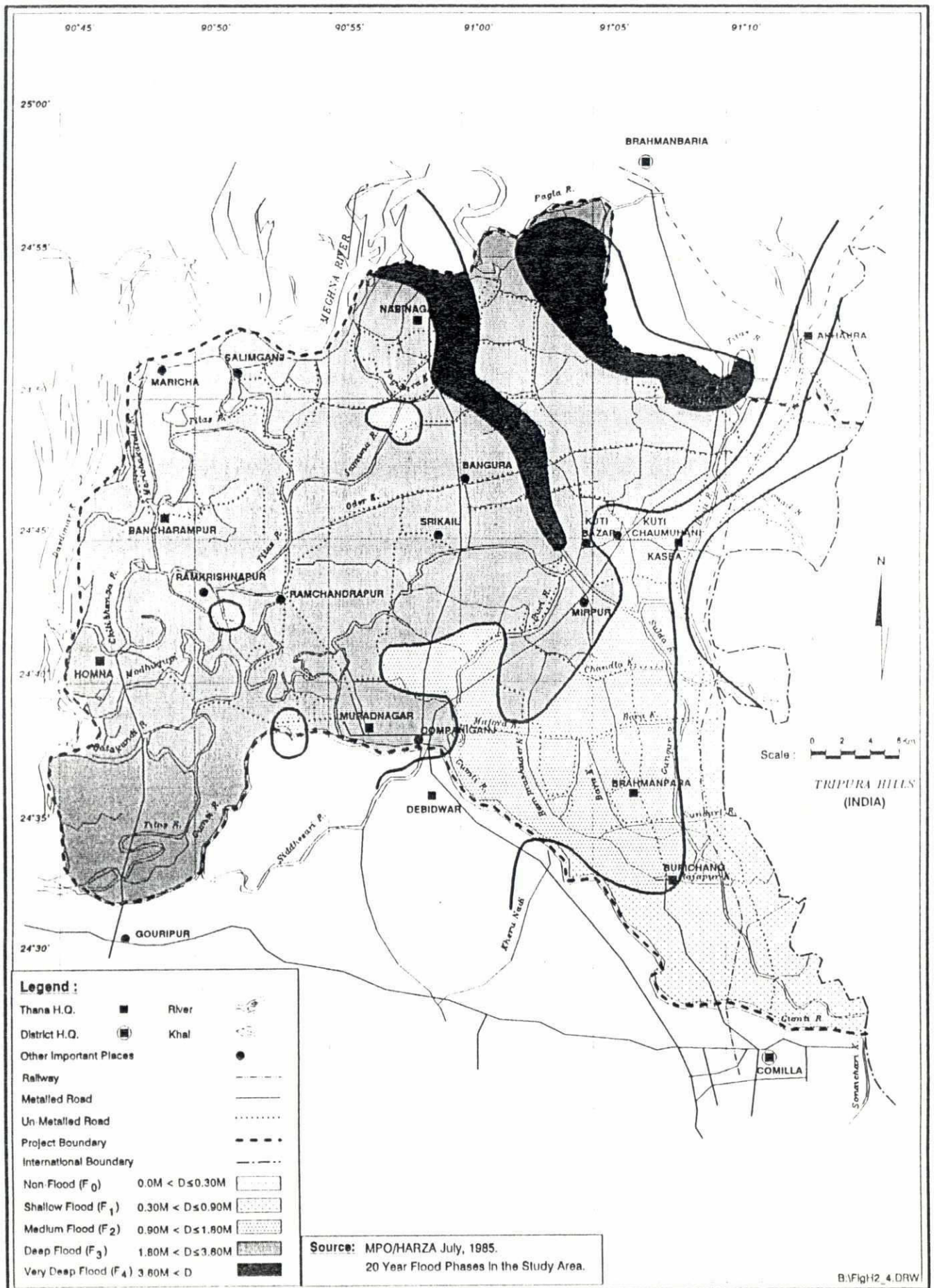


TABLE F.3.1

## Area of Fishery Systems per Zone in Gumti Phase II

Fishery System	Zones (ha)				Total
	A	B	C	D	
Gross Area	31,976	26,782	41,400	40,696	140,854
Meghna River	0	0	1,125	7,344	8,469
Int Rivers & Khals	679	564	856	856	2,955
Beels*	0	174	1,550	606	2,330
Floodplains#	18,094	19,874	35,905	35,344	109,217
Subtotal	18,773	20,612	39,436	44,150	122,971
Ponds@	1,780	738	1,307	377	4,202
GRAND TOTAL	20,553	21,350	40,743	44,527	127,173

\* Source: Thana Fisheries Office Survey carried out during this study

# Area calculated from results of the MIKE 11 hydraulic model

@ Refers to 'Cultured' ponds only

### **F.3.2 Minor Rivers and Khals**

The project area is criss-crossed by a network of internal rivers and Khals which range from permanent to seasonal waterbodies with a total area of approximately 2,955 ha. Table F.3.1 shows the surface areas for some of the internal rivers and Khals in the region by zone. Amongst these, the Titas River figures prominently as it meanders throughout the basin and forms part of the northern boundary of the study area, which runs up to the Hawrah River, in the north-east. The Gumti River still features prominently despite having been embanked for most of its course. Table F.3.2 shows the surface areas of the internal rivers and Khals within the project area.

Other rivers and Khals of note include the Batakandi and the Chitibhanga, on the western side; the Jamuna, Oder Khal and Jogidara Khal on the central part; the Buri, Salda, Bijni, Sonail and Ghungur Rivers, as well as the Chandla, Bata, Majora, Ramprashader Khals on the eastern side (Figure F.1.3).

### **F.3.3 Floodplains**

Floodplains are areas of relatively low lying land seasonally inundated by overspill from adjacent rivers and natural depressions. During the dry season, organic matter (animal excreta, rotting vegetation and other material) accumulates in this vast area. Nutrients rapidly become integrated in the system during the early stages of flooding and in combination with river-borne silts, minerals and nutrients support rapid growth of plants, insects and other aquatic life. This increase in productivity provides essential conditions for reproduction and growth of numerous species of fish and crustaceans which use the floodplain system as breeding, feeding and nursery areas. A schematic representation of the nutrient cycle in a floodplain is shown in Figure F.3.2. The seasonal cycles of events in the floodplain in the study area are shown in Figure F.3.3.

The floodplain is by far the most important aquatic ecosystem in the project area (Figure F.3.4a) and it is extensive, covering approximately 77.5% (109,217 ha) of its total area of 140,854 ha. For this calculation, all the MPO flood phases greater than 30 cm (i.e. F1, F2, F3 and F4), given by the MIKE 11 hydraulic model have been included as they are considered potentially suitable for fish production. Table F.3.1 shows the area of floodplain (F1 + F2 + F3 + F4) per zone within the project area.

### **F.3.4 Beels**

Beels are natural depressions which hold water for long periods of time. In Gumti Phase II, the main areas of Beel concentration are situated in the west, north-west and north-central parts, although there are numerous Beels of various sizes scattered throughout the basin (Figure F.3.4a). The total area of Beels in the Thanas relevant to the project area is approximately 3,241 ha as seen in Table F.3.3 (TFO Survey), of which the Beel area within the project area is approximately 71.8% (2,330 ha) (Table F.3.1). It is therefore possible that this list is not complete, since it may only contain Beel areas important to the TFOs. However, it was not possible to obtain satellite imagery for the wet and dry seasons during this project to cross check and establish the location and area of permanent Beels in the project area. Future work should include this task prior to any fisheries evaluations of Beel production.

Figure F.3.2  
Nutrient Cycle

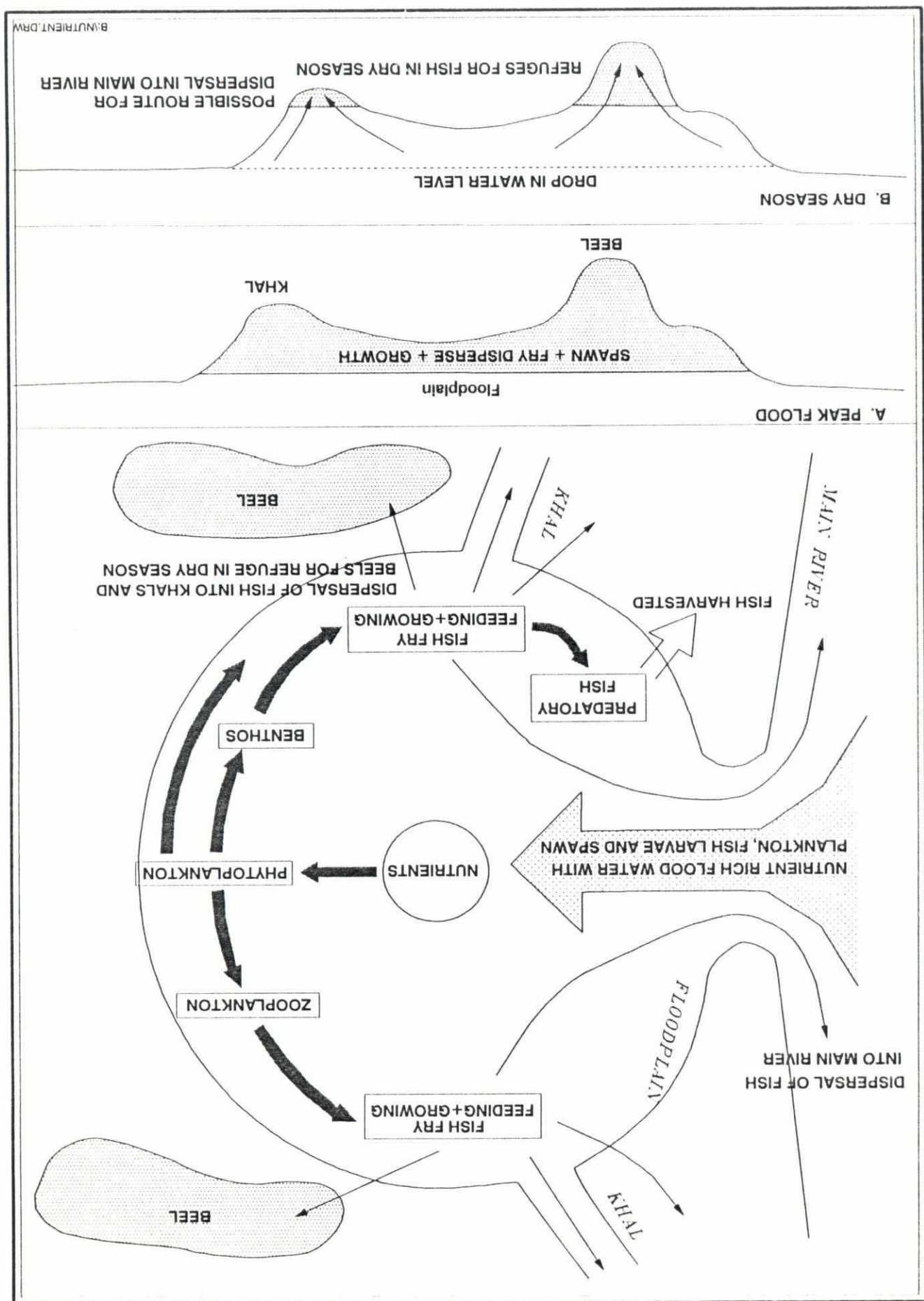
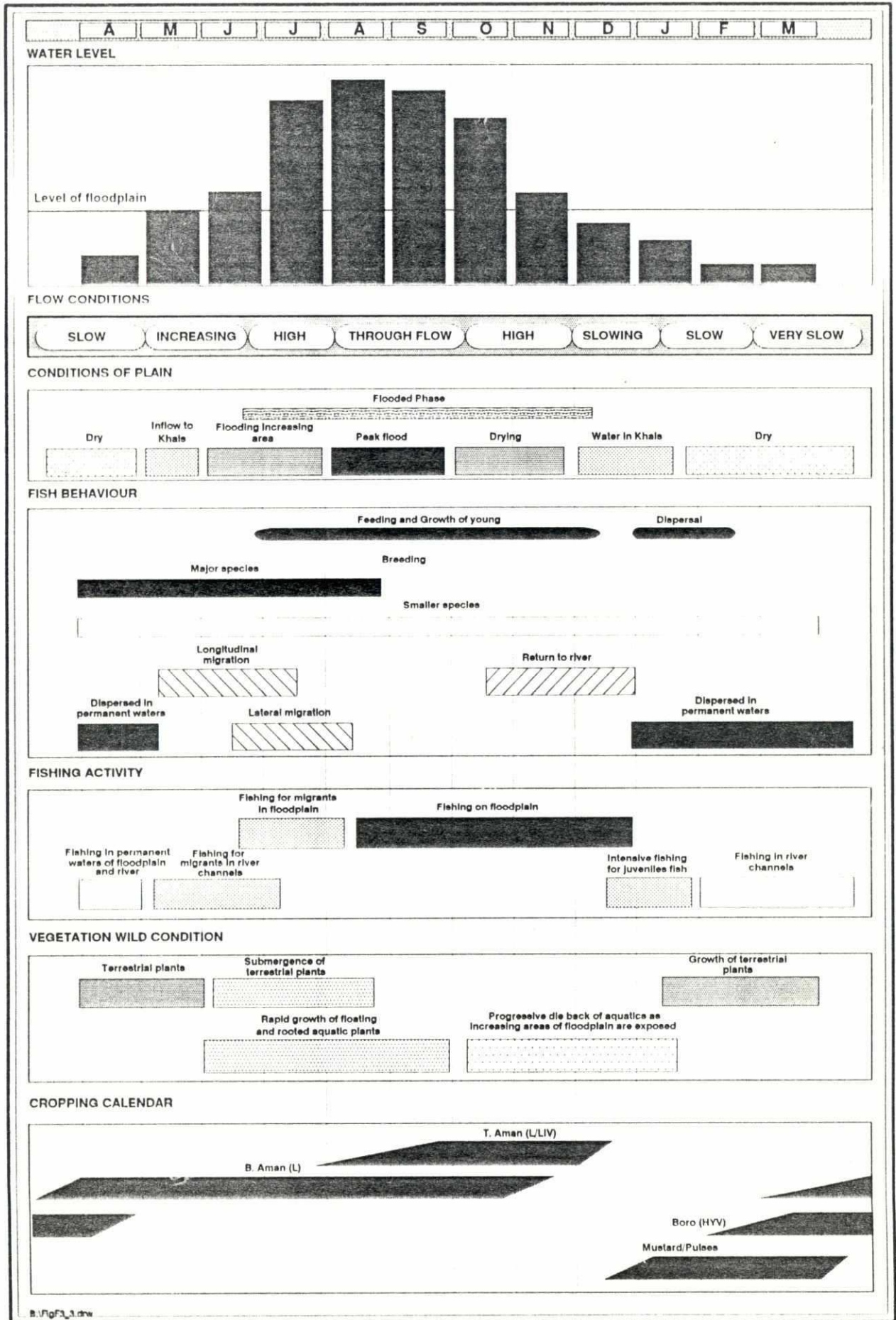
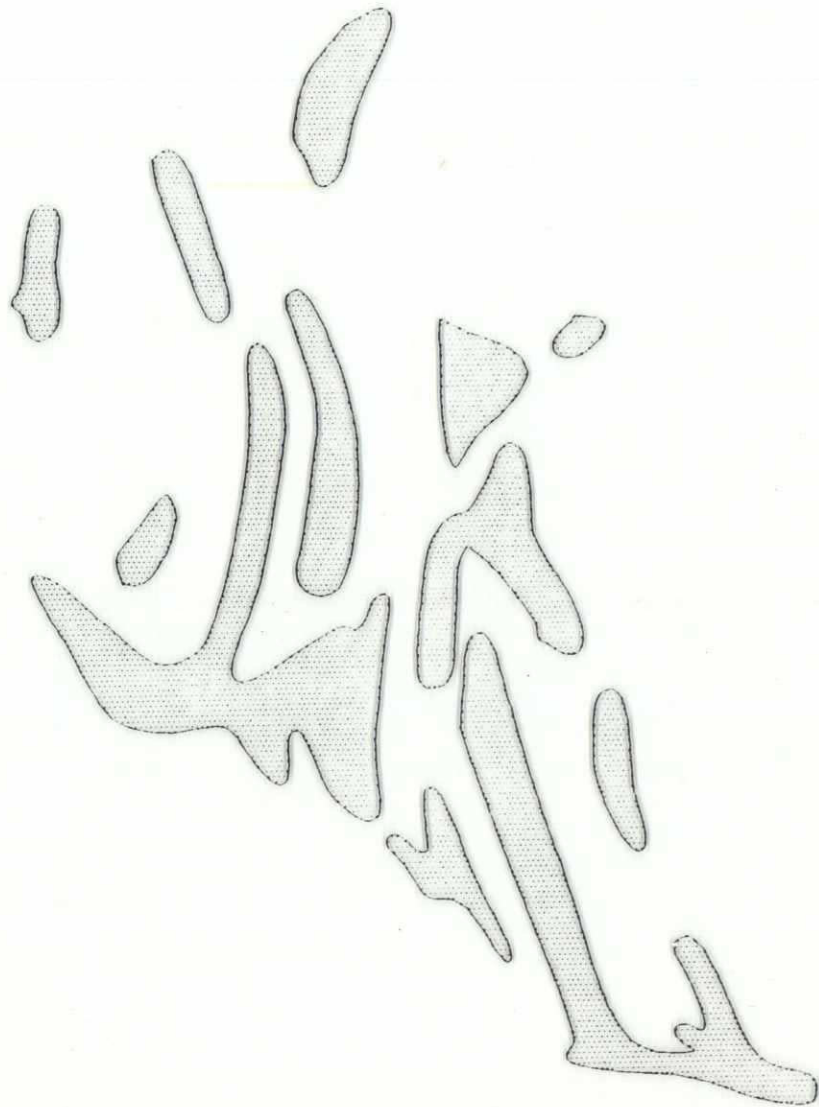


Figure F.3.3  
The Seasonal Cycle of Events in the Floodplain



**Figure F.3.4b**  
**Pond Concentrations**



**Legend :**  
Pond Concentrations



Figure F.3.4a  
Fish Systems

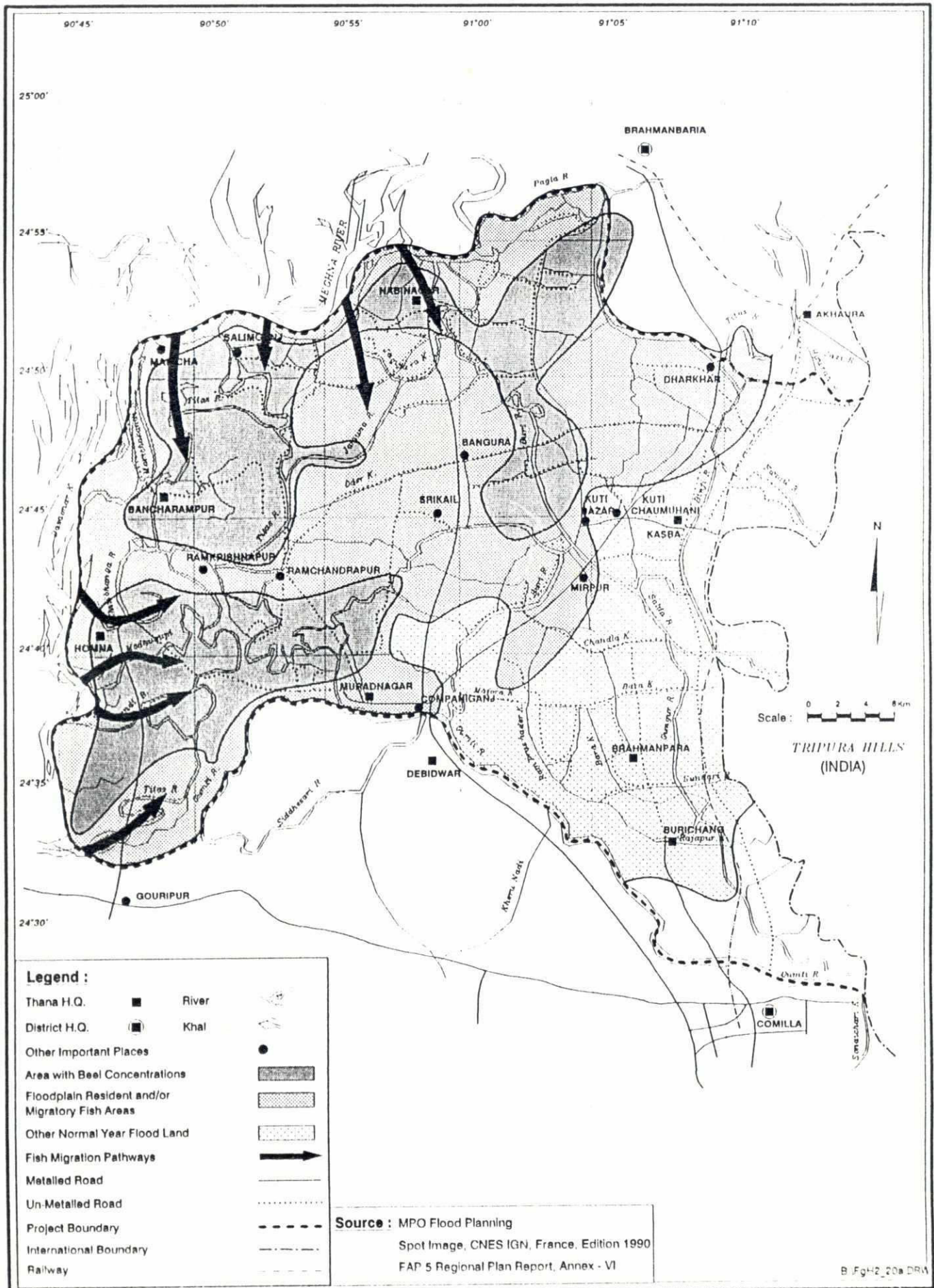


TABLE F.3.2

## Surface Areas of Rivers within Gumti Phase II

Sl. No.	Channel Name	Length (km)	Width (m)	Area (ha)
1	Sundari Bara Khal	18.59	20	37.2
2	Chandla Khal	12.53	20	25.1
3	Arshi Nadi	51.15	70	358.1
4	Chittibhanga River	32.80	170	557.6
5	Ghungur River	25.44	30	76.3
6	Salda River	21.85	45	98.3
7	Titas River	76.80	90	691.2
8	Buri Nadi	50.55	70	353.8
9	Madhu Kupa Nadi	13.60	35	47.6
10	Magora Khal	7.62	15	11.4
11	Matia Nadi (A & D)	7.70	25	19.3
12	Bijni River	26.59	25	66.5
13	Bodagacha Khal	12.85	15	19.3
14	Oder Khal	29.70	25	74.3
15	Jogidara Khal	5.70	35	20.0
16	Kagdi Nadi	6.40	15	9.6
17	Sonaichari Nadi	5.00	10	5.0
18	Rajapur Khal	2.95	15	4.4
19	Dalpa Metangor	8.00	15	12.0
20	Nasimpur Khal	6.80	35	23.8
21	Sidali Khal	6.00	15	9.0
22	Batakandi Nadi	11.00	50	55.0
23	Chapitala Khal	8.70	20	17.4
24	Zia Khal	9.93	30	29.8
25	Jamuna River	19.30	70	135.1
26	Rajapur Khal	8.00	20	16.0
27	Ramprashedar Khal	13.60	20	27.2
28	Majora Khal	4.80	20	9.6
29	Maidaganj-Waruk Khal	5.85	35	20.5
30	Bara Khal	10.81	15	16.2
31	Chittibhanga-Arsi Nadi	2.42	100	24.2
32	Waruk-Kasikara Khal	5.70	20	11.4
33	Roachala Khal	11.20	30	33.6
34	Raja Khal	16.68	20	33.4
35	Chittibhanga-Titas River	0.85	115	9.8
Total		557		2 959

x – sectional width from BWDB study and SER model.

Production of fish from these rivers  
(at the rate 176 kg/ha)

2959 x 176

520 MT

TABLE F.3.3

## AREA OF BEELS PER THANA IN THE GUMTI PHASE II STUDY AREA

Thana	Name of Beels	Location	Area (ha)	Minimum Area	Maximum Area	Remarks
				Dry Season (ha)	Monsoon (ha)	
Homna	Goari Bhang Beel		0.4	0.4	5.0	Closed
	Ruhitar Beel		4.0	2.0	20.0	Closed
	Damuraia Beel		2.0	1.0	5.0	Closed
	Krishnapur Beel		2.0	1.0	8.0	Closed
	Darirchal		1.0	1.0	5.0	Closed
	Viticol Mina Beel		0.1	5.0	4.0	Closed
	Bhashania Beel		4.0	3.0	15.0	Closed
	Sener Char Block "A"		2.0	1.0	20.0	Open
	Sener Char Block "B"		2.0	1.0	25.0	Open
	Sener Char Block "C"		2.0	2.0	30.0	Open
	Nal Char		16.0	8.0	106.0	Open
	Dead Titas	Raghunathpur	5.4		60.0	Open
- Subtotal			40.92	25.40	303.00	
Muradnagar	Dead Titas	Muradnagar	14.00	13.00	16.00	
- Subtotal			14.00	13.00	16.00	
Nabinagar	Renua Borathor Chapiola	Mohana	21.5	6.0	122.0	Closed
	Bi-Chall	Mohana	68.8	20.0	243.0	Open
	Pata Beel	Montala	12.0	1.0	45.0	Open
	Kader Khola	Char Kaderkhola	17.0	4.0	67.0	Open
	South Kaikipur	South Kaikipur	24.0	5.0	73.0	Open
	Sheta Rampur	Sheta Rampur	9.0	3.0	46.0	Open
	Daulatpur	Daulatpur	8.9	3.0	50.0	Closed
	Charkader Khola	Charkader Khola	25.0	10.0	62.0	Closed
	Sadekpur	Sadekpur	10.0	6.0	79.0	Closed
	Bari Kandi	Jairabad	18.0	8.0	92.0	Closed
	Ali Khali	Monipur	14.0	6.0	162.0	Open
	Mushkura	Goshipur	14.0	4.0	52.0	Closed
	Daravanga	Daravanga	11.0	4.0	33.0	Closed
	Mar Khola	Biddahkut	9.0	3.0	41.0	Closed
	Padua	Biddahkut	12.0	3.0	36.0	Closed
	Beel Bachiarra	Biddahkut	9.0	3.0	51.0	Closed
	Tikikata Saldah	Biddahkut	12.0	2.4	49.0	Closed
	Isa Kali	Sadekpur	13.0	4.0	68.0	Closed
	Beri Beel & Gabra Khali	Bisadpur	10.0	3.0	58.0	Closed
	Pupruz	Natghor	11.0	6.0	87.0	Closed
	Bara Kadura Kodal	Rasulpur	9.0	3.0	43.0	Closed
	Rasulpur	Rasulpur	10.0	3.0	73.0	Closed
	Bali Ara	Mashipur	10.0	3.0	32.0	Closed
	Sial Kopa	Alam Nagar	10.5	3.0	65.0	Closed
	Pada Khali	Monipur	12.0	4.0	82.0	Closed
	Adil Kuri Manik Chori	Chander Char	9.0	3.0	45.5	Closed
	Meratoli	Meratoli	12.6	3.0	61.0	Closed
- Subtotal			402.30	126.40	1917.50	

TABLE F.3.3 (Contd.)

Bancharampur	Chandal Beel	Daria Daulat & Pharam Kandi	60.0	60.0	180.0	Open
	Satbila	Hyden Nagar	31.0	28.0	80.0	Open
	Bariadoha Beel	Foradabadh	98.0	85.0	140.0	Open
	Kanchanpur Depa	Chaifulla	13.0	10.0	20.0	Closed
	Bancharampur Gop	Jagannathpur	3.5	3.0	5.0	Closed
	Satdona Beel	Satdona	10.0	8.0	15.0	Open
	Jallaldi Gop	Kallayan Nagar	6.5	6.0	8.0	Open
	Sonarampur Gop	Sonarampur	8.0	7.0	12.0	Closed
	Mayarampur Gop	Radhanagar	6.0	6.0	9.0	Open
	Narirchar Gop	Daskandi	21.5	18.0	30.0	Closed
	Char Sibpur	Char Shibpur	25.5	23.0	30.0	Open
	Marichakandi	Char Marichakal	25.5	23.0	35.0	Closed
	Mirpur Khal	Mirpur	5.0	3.5	5.8	Open
	Jaikalipur	Jaikalipur	5.0	4.5	5.5	Open
	Galachipa Khal	Rupasdi	7.0	6.5	7.5	Open
	Buli Gop	Kalikapur	4.6	4.0	5.5	Open
- Subtotal			330.10	295.50	588.30	
Kasba	Rutimousa	Ruti & Moolgran	10.0	3.0	18.0	Closed
	Beel Sialkopa	Alam Nagar	10.5	3.5	20.0	Open
	Nienda	Bharajangal	10.0	5.0	20.0	Closed
	Sarishadoli Beel	Enayetpur	7.0	3.0	15.0	Closed
	Bely Beel	Kuti	2.0	1.0	5.0	Closed
	Kalamuria Buba	Kalamuria	5.0	3.0	6.0	Closed
- Subtotal			44.50	18.50	84.00	
Akhaura	Kaikajhuri	Akhaura	23.0	20.0	43.0	
	Kuriband	Akhaura	9.0	8.0	29.0	
	Katakhali	Akhaura	9.0	8.0	39.0	
	Kaijuri	Akhaura	4.0	3.0	14.0	
	Ariajala	Akhaura	15.0	12.0	25.0	
	Ruti Beel	Akhaura	10.0	9.0	30.0	
	Donarajuri	Akhaura	1.0	1.0	11.0	
	C&B Daba	Akhaura	6.5	5.6	17.0	
	Harinamoral	Akhaura	47.0	40.0	87.0	
	Chira Fishery	Akhaura	6.0	2.0	26.0	
	Shanla	Akhaura	3.0	1.0	11.0	
- Subtotal			133.5	109.6	332.0	
Grand Total			965	588	3,241	

Source: Thana Fisheries Offices, Thana Survey carried out during this study

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There are two types of Beels, permanent and seasonally flooded. Permanent Beels support an annual fishery and 'Katta' (also known as 'Jag') fishery. For the annual fisheries, fishing is done by traditional netting or by dewatering, which is a common practice at harvest time. The estimated average production per hectare from dewatered Beels has been reported to be as high as 1,890 kg/ha/year (Rahman, 1989).

### **F.3.5 Ponds and Borrow Pits**

According to the TFOs, there are approximately 4,202 ha of cultured ponds in the Gumti Phase II project area as shown in Table F.3.1, and the area of culturable and derelict ponds may be in the region of 35% and 15% of that of the cultured ponds. Figure F.3.4.b shows the area of pond concentration in the study area. In addition, there are numerous borrow pits which have resulted from home and road construction site excavation.

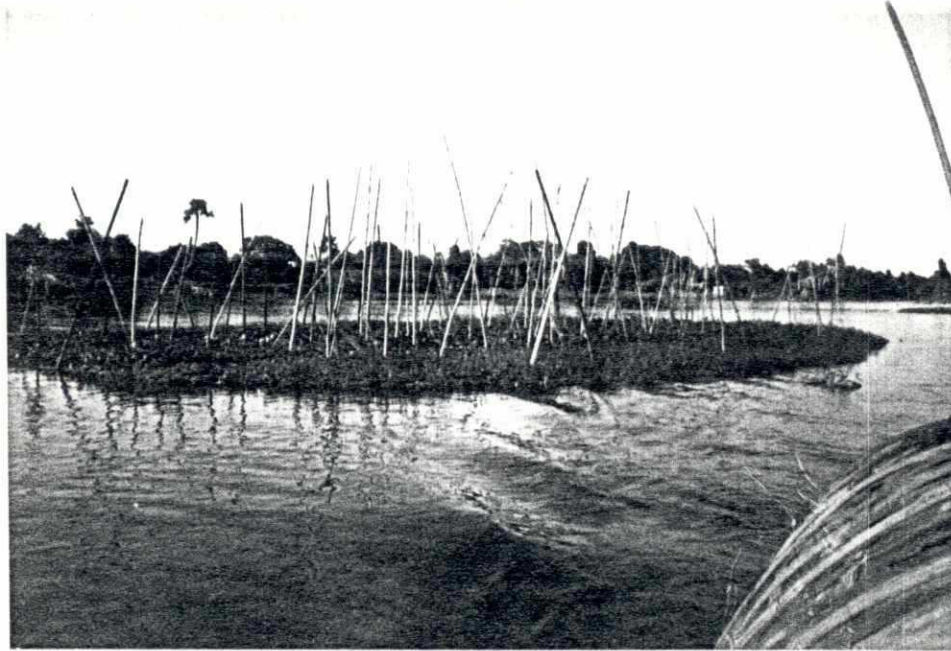
Borrow pits along road embankments may become important micro fishery environments when managed. They are owned by the Roads and Highways Department (R&HD) and are leased out for fishery purposes. Borrow pits created during the course of FCDI construction works are owned by the BWDB and are leased out for fish production by auction. Water supply to these is dependent on river overflow and rainfall, and in general, their fish resource is reliant on movements of fish on to the floodplain during the monsoon.

Fish stocks in borrow pits mostly comprise miscellaneous species which are exploited for subsistence and minor commercial sale. Katta are commonly used during the early dry season to harvest the larger species. Fish fences with basket traps or bunds often subdivide these pits which may be drained later in the season to harvest all fish. Borrow pits are affected by changes in the water supply. As they are usually only about 60 cm to 90 cm deep, those pits which are not drained intentionally will often dry out naturally by the end of the dry season.

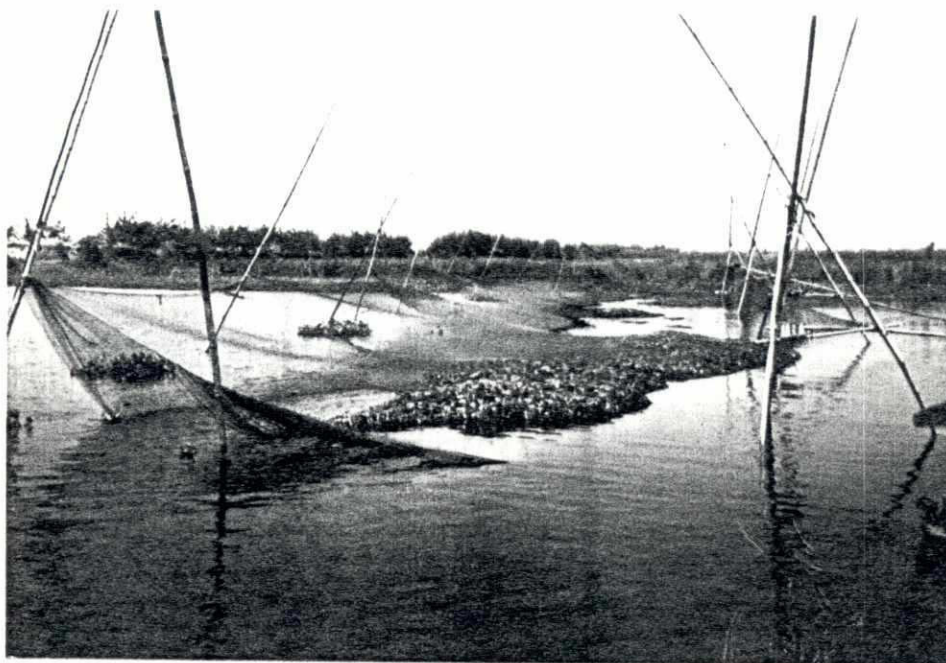
### **F.3.6 Katta Fishery**

Katta fishery can be best described as a 'fish attracting device'. It consists of a frame made out of bamboo poles with brushwood in the middle that is placed at strategic sites within a Beel or along the course of rivers and Khals (see Plate F.3.1.). They are usually about 0.5 to 1 ha in size and serve as valuable feeding, nursery and refuge areas for a wide variety of fish and other aquatic life such as birds, insects, molluscs, crustaceans, etc.

Katta are harvested approximately every 6 to 8 weeks by enclosing them with seine nets mainly and/or with other traditional netting, such as bag, cast, lift nets and traps (Plate F.3.2). The harvest period is usually from October to June in the main rivers, but the Beel season is shorter, from December to February



**Plate F.3.1 Katta Fishing in the Chhitibhanga River Between  
Homna and Bancharampur - October 1992**



**Plate F.3.2 Harvest of Katta Fishery Near Homna**

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## **F.4 Methodology**

### **F.4.1 Data Collection**

#### **F.4.1.1 Secondary Data Collection**

Data collected from secondary sources have been used to evaluate the status of the existing fisheries in the area. The majority of the statistics have been obtained from the Fisheries Resources Survey System (FRSS) of the Directorate of Fisheries (DOF) sources in Dhaka. However, it is recognized that the use of these data is of limited value due to the unavailability of up to date information. The latest complete set of available figures for this study correspond to 1988-89, as riverine data for 1989-90 is missing. Furthermore, the present system has many weaknesses such as small sample sizes, very few sampling villages and a backlog of data due to insufficient processing capacity.

The FRSS was initiated in 1983-1984 to provide a more systematic approach to the collection of fisheries statistics. Prior to that, fish production estimates were based primarily on fish consumption data generated by the Nutrition Surveys of Rural Bangladesh, for the years 1962-1964, 1975-1976 and 1981-1982. This information was complemented with the results of the Household Expenditure Surveys and DOF surveys.

The floodplain fisheries of Bangladesh are extremely complex and thus, the collection of catch statistics is understandably a major task even with adequate resources. Unfortunately, in Bangladesh comprehensive fisheries surveys for project studies are not possible with the present allocated resources and therefore, the accuracy of FRSS data cannot be adequately checked. In addition, the last river fishery frame survey was carried out in 1981-82 with FAO support and the data on number of boats gathered from this survey is still being used today, although the situation is unlikely to have remained unchanged.

A similar situation was found regarding ponds, as the pond production estimates are based on sample data of 40 sample Thanas measured by SPARRSO with infra-red aerial photography taken in February 1983 (DOF, 1983-84). Since no indication is given in the latest available Fish Catch Statistics (DOF, 1989-90) regarding pond areas, it is assumed that the same areas used in 1983-84 are still used for recent estimates without consideration to the actual state of ponds.

Trends in fish production for six years have been calculated from available FRSS catch statistics. However, their validity is questionable for the reasons mentioned above.

At present, raw data is collected by DOF personnel from sampling stations and sent to Dhaka for processing. In an attempt to obtain more up to date data, information at the Thana level was gathered directly from each Thana Fisheries Office. However, the level of detail provided by the various offices varied considerably.

#### **F.4.1.2 Primary Data Collection**

A short fishery survey of eight weeks duration was undertaken in an attempt to gather useful information regarding the project area in particular.

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Although great care was taken at all stages of this study, it should be reiterated that this type of survey is inadequate both in terms of time and funding, to adequately describe the fisheries and to predict future changes in a complex system such as that which exists in the Gumti Phase II area.

This study was carried out during the period from September 1992 to February 1993, and field data were collected during mid-October to 1 December 1992. Fishing patterns, gears used and operators were addressed for each type of capture fishery system. Unpublished data from the TFOs were used for estimations of pond fish production.

Unfortunately, the results from this short field study cannot be cross checked with existing data from the DOF (1983-84 to 1989-90) as their data for the last 3 years is not available as yet. Furthermore, given that this catch assessment survey was carried out in collaboration with the local fishermen, most likely to be full time and part time fishermen, the recorded catches are assumed to be commercial catches, whereas those reported by DOF are for subsistence household fisheries. Subsistence fishing is defined in this report as being carried out by people who directly catch and consume "common good" fish resources for a large proportion of the animal protein in their diet and who are mostly landless and poor.

However, a benchmark has been set for the assessment of the impacts and subsequent monitoring of the fisheries resources of the Gumti Phase II project area.

#### **F.4.2 Fisheries Impact Assessment Methodology**

The FPCO Guidelines for Environmental Impact Assessment recommend that for Feasibility Studies 'detailed investigations entailing data collection and consideration of seasonal cycles should be undertaken.' However, as stated earlier, timing and funding of the present study were grossly under resourced to comply with the basic requirements for ecological and/or biological cycles to be taken into account. Nevertheless, these guidelines were used in the present study where possible and were organized as follows:

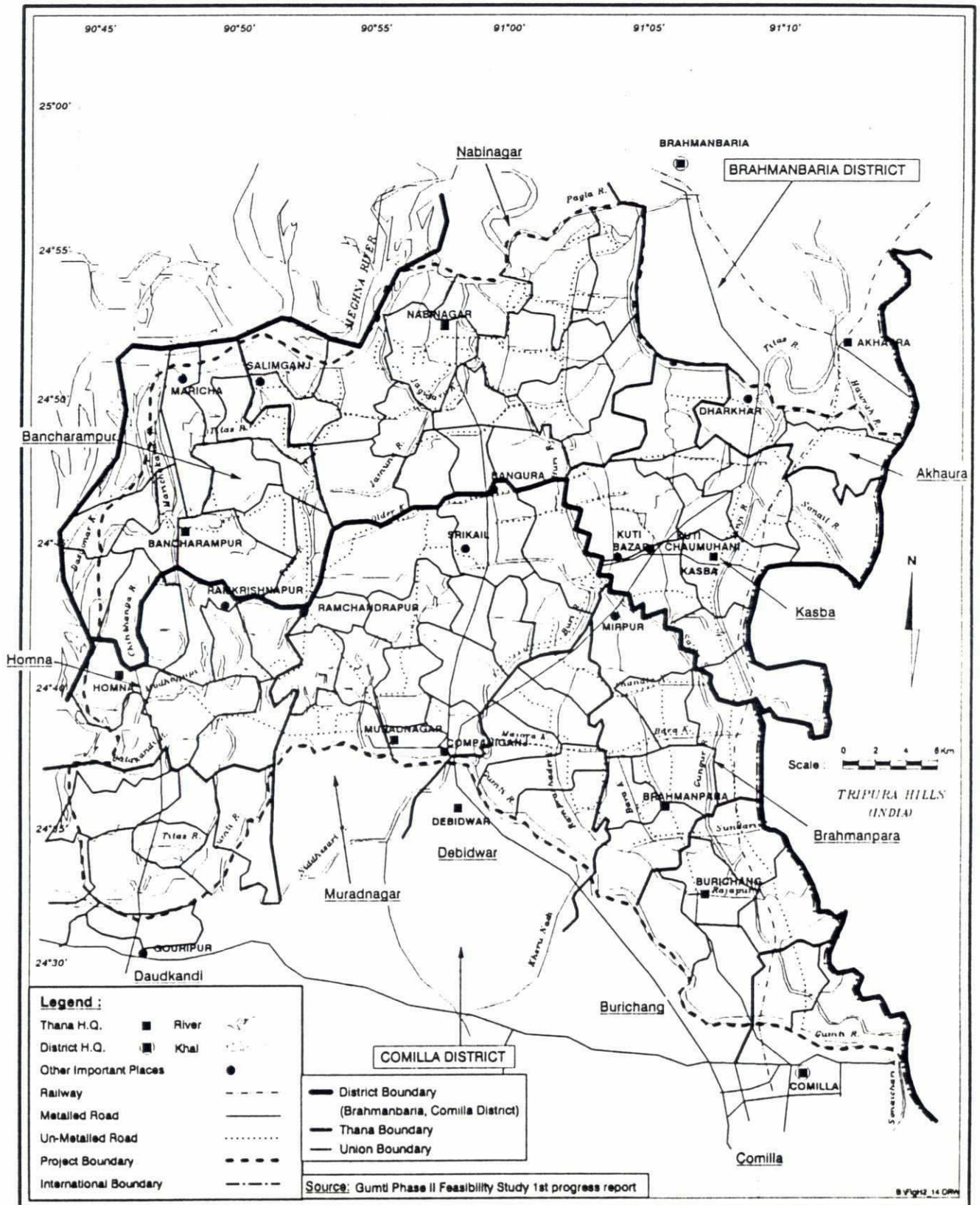
##### **F.4.2.1 Catch Assessment Survey**

The emphasis of the catch assessment survey was placed on the capture floodplain fisheries and thus data were collected for some Beels, Khals and sections of rivers within the project area. The FRSS catch assessment forms were used to record leasing arrangements and fish catches in the area.

##### **F.4.2.2 Thana Fisheries Survey**

All Thanas Fisheries Offices in the project area were requested to provide information on the number of fishermen and categories of operation, i.e. full-time, part-time, occasional (FAO/UN, 1962). Additional information resulting from this survey includes fish production estimates, dominant species caught per Thana, fish species occurring in the area, fisheries developments and main problems related to fisheries in each Thana. Figure F.4.1 shows the Administrative boundaries at the District, Thana and Union level.

Figure F.4.1  
Administrative Boundaries (District, Thana and Union)



#### **F.4.2.3 Fish Market Survey**

Eleven fish markets in Planning Zones B, C and D were surveyed during the same field visit as for the catch assessment (see Figure F.4.2). This has allowed for some fish price analyses and fish availability levels to be detected as well as the type of operators.

#### **F.4.2.4 Agro-Socio-Economic Survey**

This survey was carried out by the agro-socio-economic team, to establish the type of fishing operators. Three surveys relevant to fisheries included a) fish pond, b) fishermen and c) farmers questionnaires. Details of the surveys are presented in Annex G, Sociology and Public Participation.

#### **F.4.2.5 Fish Pond Production**

Data on pond production was also collected through the agro-socio-economic survey, along with published statistics from FRSS and unpublished data from the TFO.

#### **F.4.2.6 Hatcheries and Nurseries**

Information on hatcheries and nurseries in the area was gathered from secondary sources, mainly FRSS, and Thana Fisheries Offices.

#### **F.4.2.7 Public Participation Meetings**

Public participation meetings were also held at the village level. Proposed project development strategies and options were discussed with fishermen and local people in relevant areas. Details of these meetings can be found in Annex G.

#### **F.4.3 Sampling Programme**

Five sampling sites (G1 to G5) were selected in the main floodplain area (Figure F.4.2) of the Gumti Phase II project area, which includes Zones B, C and D. Zone A was not sampled for capture fisheries due to the lack of suitable habitats, e.g. Beels and floodplain, resulting from the unusually dry conditions that year. Field visits had a duration of 4 days during which information on fish catch was collected. Figure 4.3 shows the Planning Zones in the project area.

Figure F.4.2  
Fish Catch Assessment and Market Sampling Sites

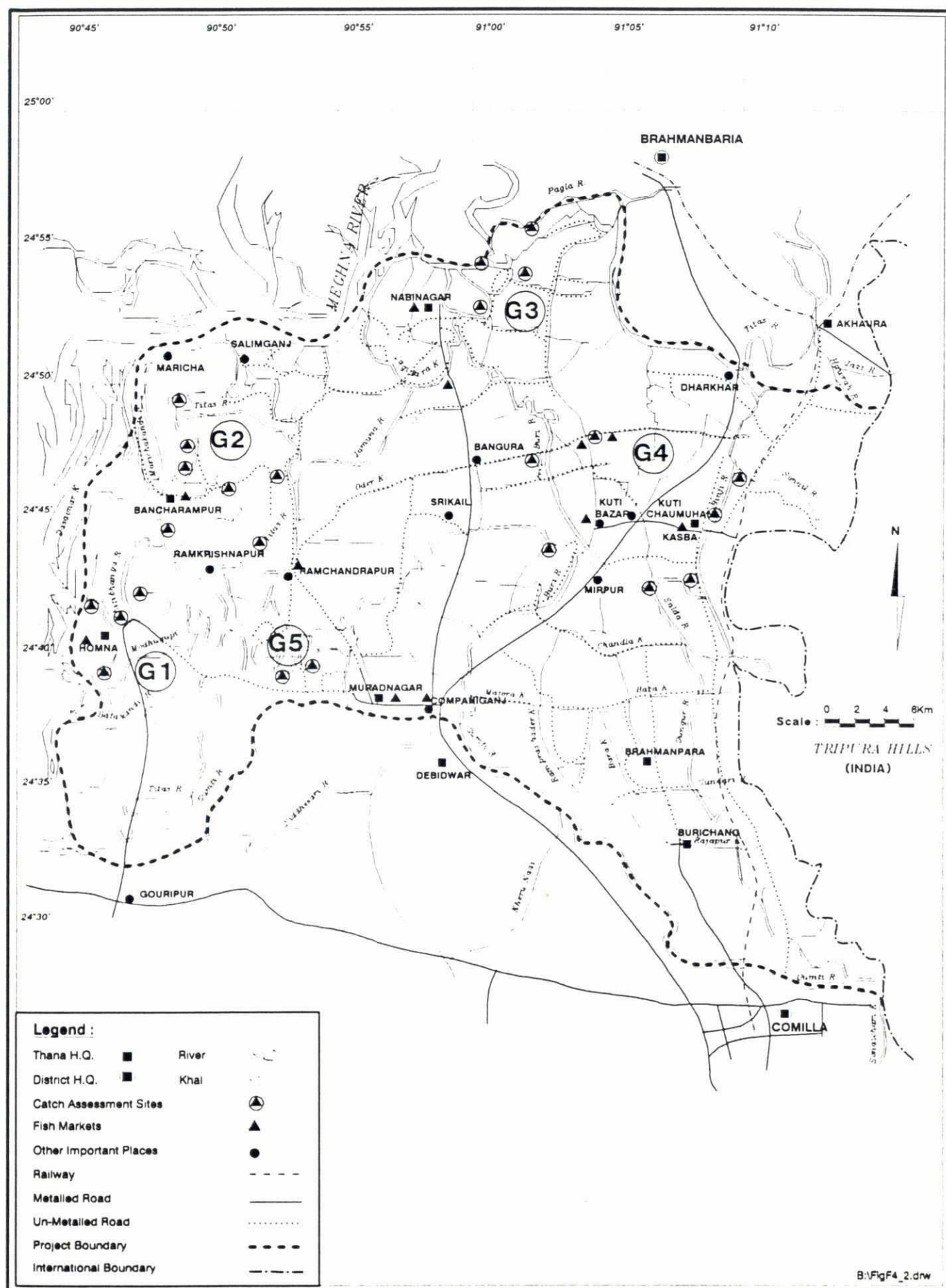
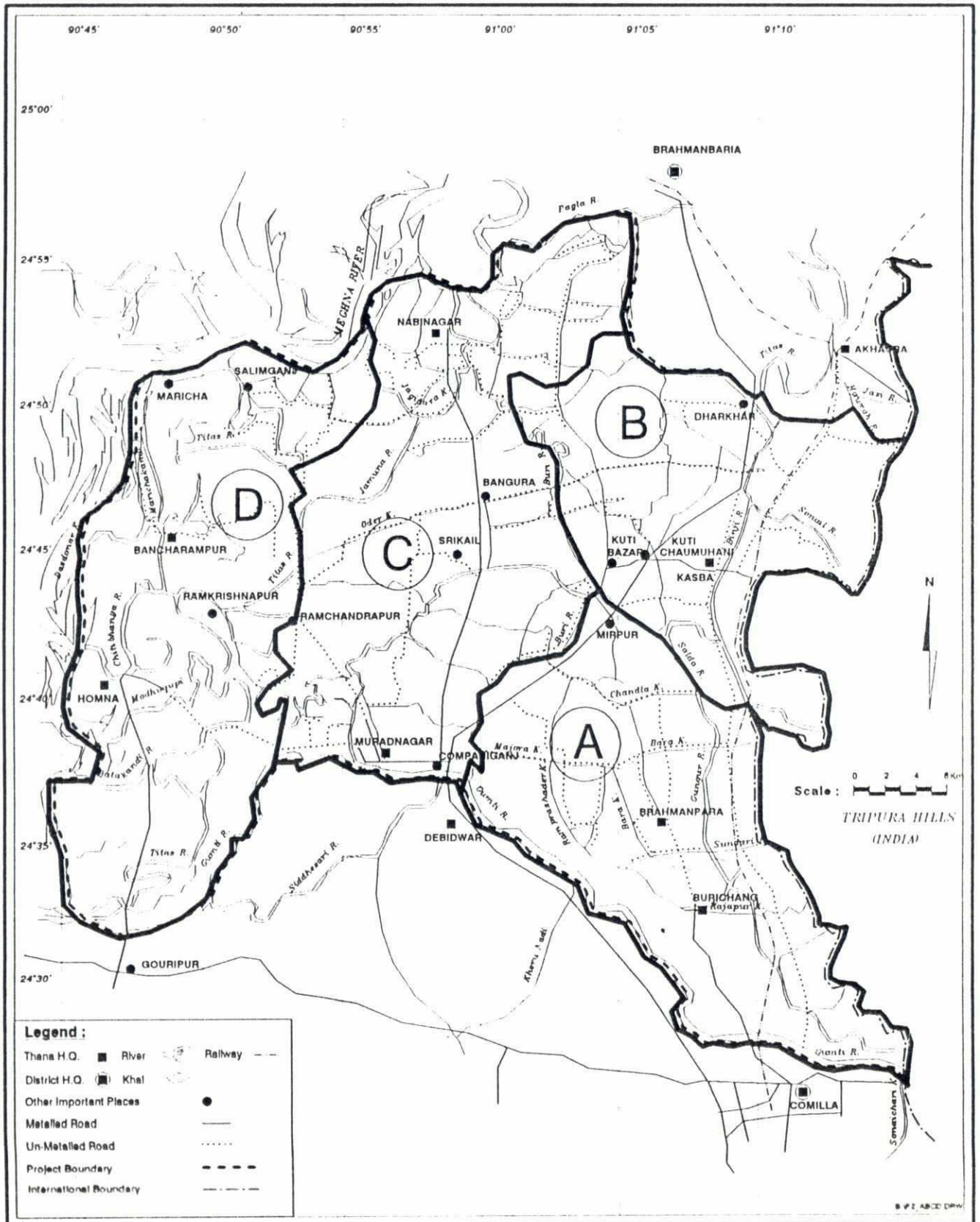


Figure F.4.3  
Planning Zones (A, B, C & D)



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#### F.4.4 The Use of the MIKE 11 Hydraulic Model for Estimating Impacts on Fish Production

The analysis of the potential impacts on the fisheries of the Gumti Phase II project area relied heavily on the results provided by the MIKE 11 hydraulic model, which provides a simulation of water levels and discharges at particular nodes in the schematisation of the river system in response to a set of boundary conditions which effectively comprise upstream flows and downstream water level controls.

For the analyses of fisheries impacts, the minimum water level in three values per decad (10 day period) were used. As the focus of the fisheries component was placed strongly on open water capture fisheries, i.e. the floodplain, it was decided to aggregate all water levels greater than the MPO Flood Phase F0 (30cm). The hydraulic model results were mapped to provide a spatial distribution to changes in the extent and duration of the floods in the Gumti Phase II area. Model runs were carried out for a 1 in 2 year flood (a mean or 'normal' year) over a 25 year period. Results of the rising and falling 1 in 2 year flood patterns are shown in Figures F.4.4 and F.4.5.

Model results clearly indicate that around 85% of the project area is under water at some stage during the wet season. These conditions remain fairly constant for approximately three months, after which the basin drains quite rapidly. However, in addition to the peak flood attained, the timing, rising and duration of the flooding are very important factors influencing the environment, and particularly, the fisheries.

In terms of seasonality, the model showed that there are three main periods:

**Pre-monsoon - April to June:** There is a rapid rise in the water level. Early spawning migration, breeding and first stage development of fish eggs and larvae takes place.

**Monsoon - July to August:** Main river water reaches peak levels and there is prolonged flooding partly due to backing up from the main rivers and reduced gradients for local rainfall.

**Post-monsoon - September to October:** Drainage occurs.

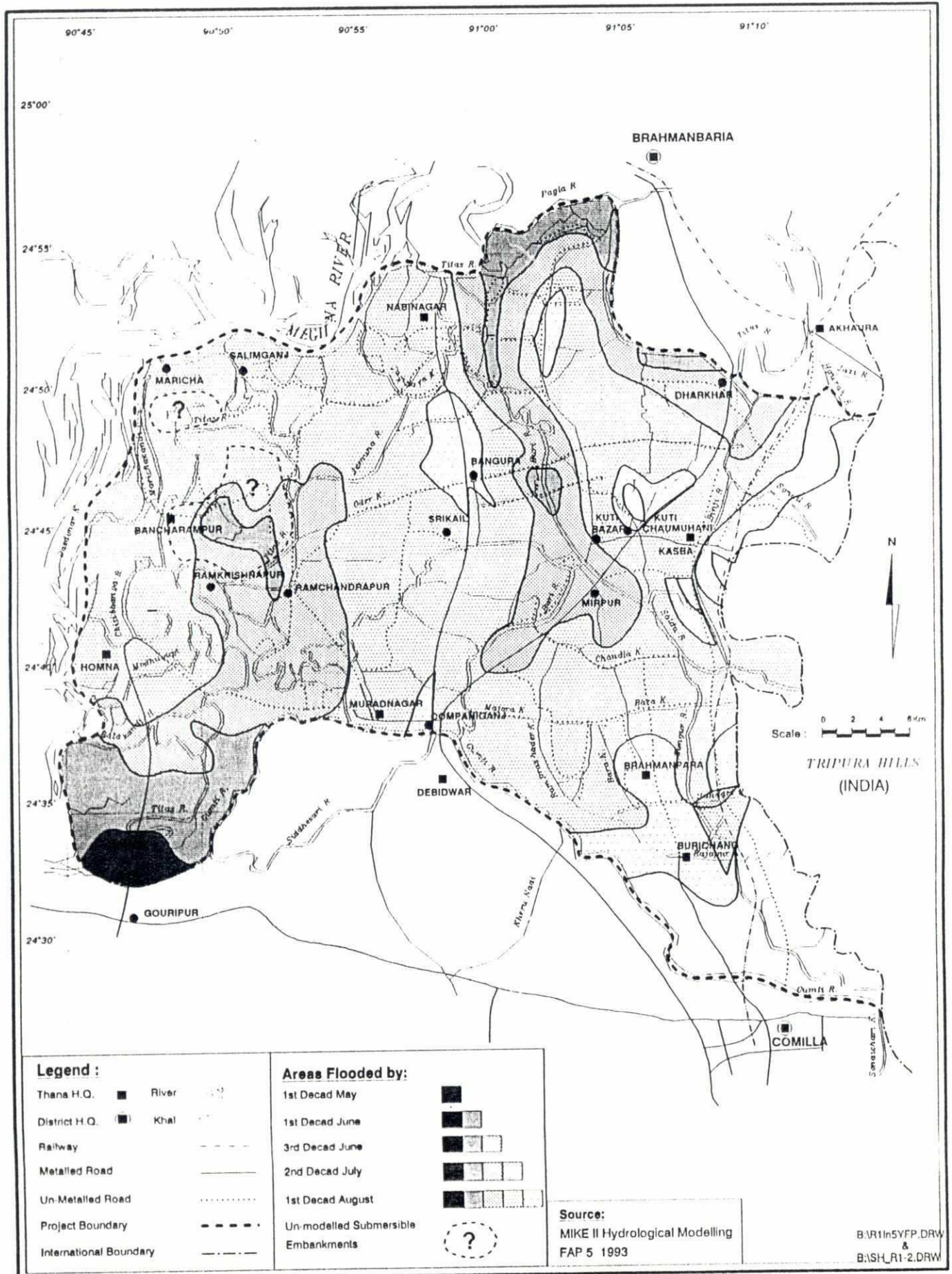
In addition to these flood periods, the general categories under which flooding in the region can be considered are:

- Monsoon floods from the River Meghna and Lower Meghna;
- Flash floods from those rivers rising in the Tripura Hills (India) to the east of the region; and
- Localised flooding as a result of heavy and intense rainfall

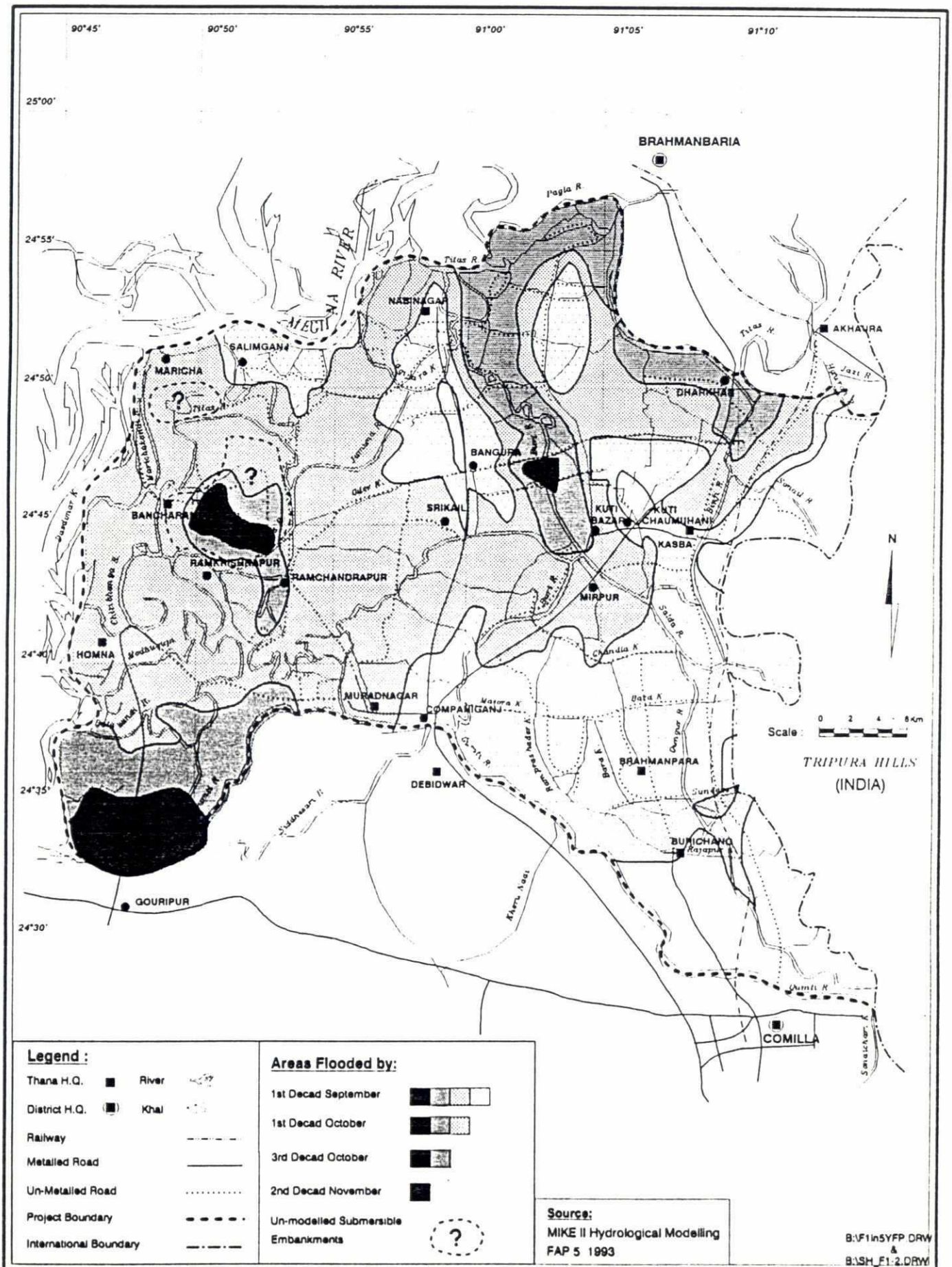
Details of the model are provided in the Hydrology and Hydraulic Modelling Annex, Annex B.

The model was run for a without (WO) and a with project (WI) scenarios. The differences found were very small indeed, demonstrating clearly that the interventions proposed had little effect on water levels as a whole. This would seem to indicate that water levels found within any polder area could be explained in terms of the high local rainfall as all external flood waters into these areas were prevented from entering the areas.

Figure F.4.4  
Rising 1 in 2 Year Flood Pattern



**Figure F.4.5**  
**Falling 1 in 2 Year Flood Pattern**



## **F.5 Production Trends**

### **F.5.1 Production Trends at National and District Levels**

Fish Catch Statistics published by DOF from 1983-84 to 1989-90 have been used to assess National and District production. The annual fish production for each relevant system at these two levels is shown in Table F.5.1 and Figures F.5.1a and F.5.1.b. It can be seen that the contribution of each production system to the total catch is different at these levels. At the National level, rivers and floodplains contribute substantially and in a similar proportion to the annual total catch in the country, with pond production following closely, especially during the last three years up until 1989-90. Beel production remains low and shows a declining trend (Table F.5.1). Overall the levels of production remain fairly constant. At District level the production of these systems is variable throughout this period, with floodplain and ponds contributing mostly to the total catch, followed by rivers. Beel production appears to be virtually negligible. Actual total catch for the various fishing systems in the Old Comilla District are presented in Figure F.5.2.

#### **F.5.1.1 Average Annual Trends**

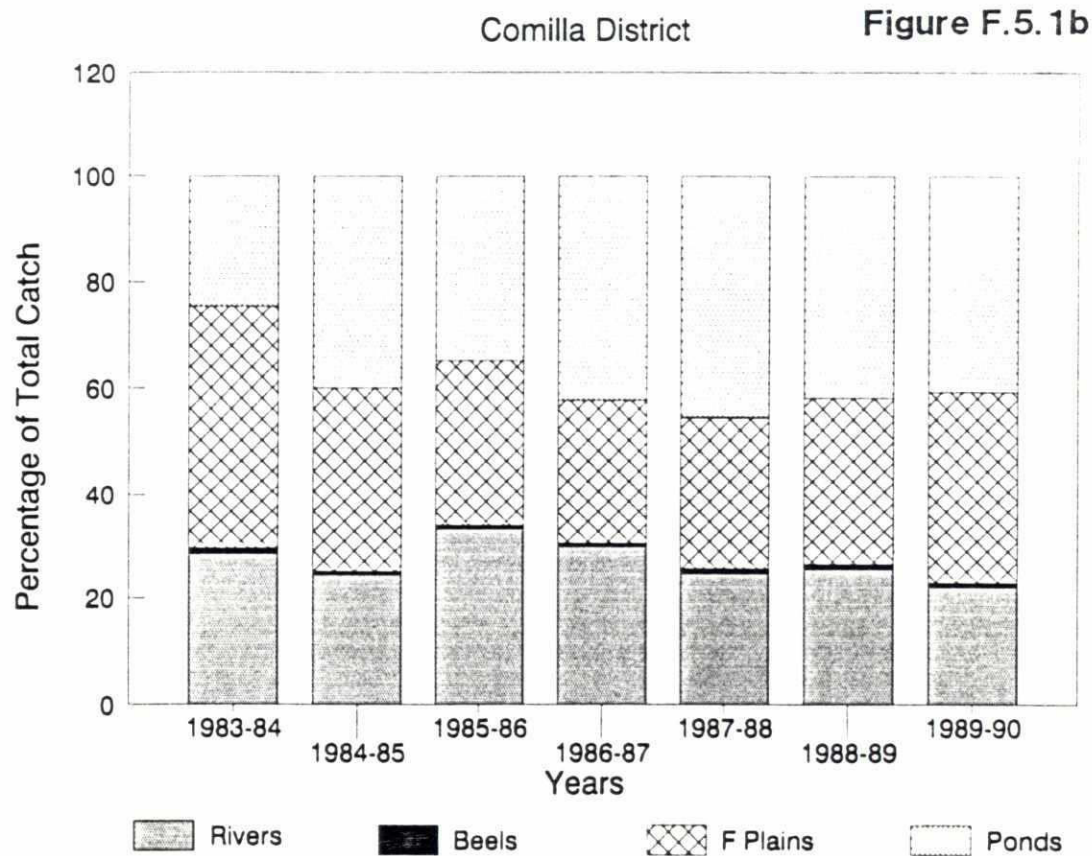
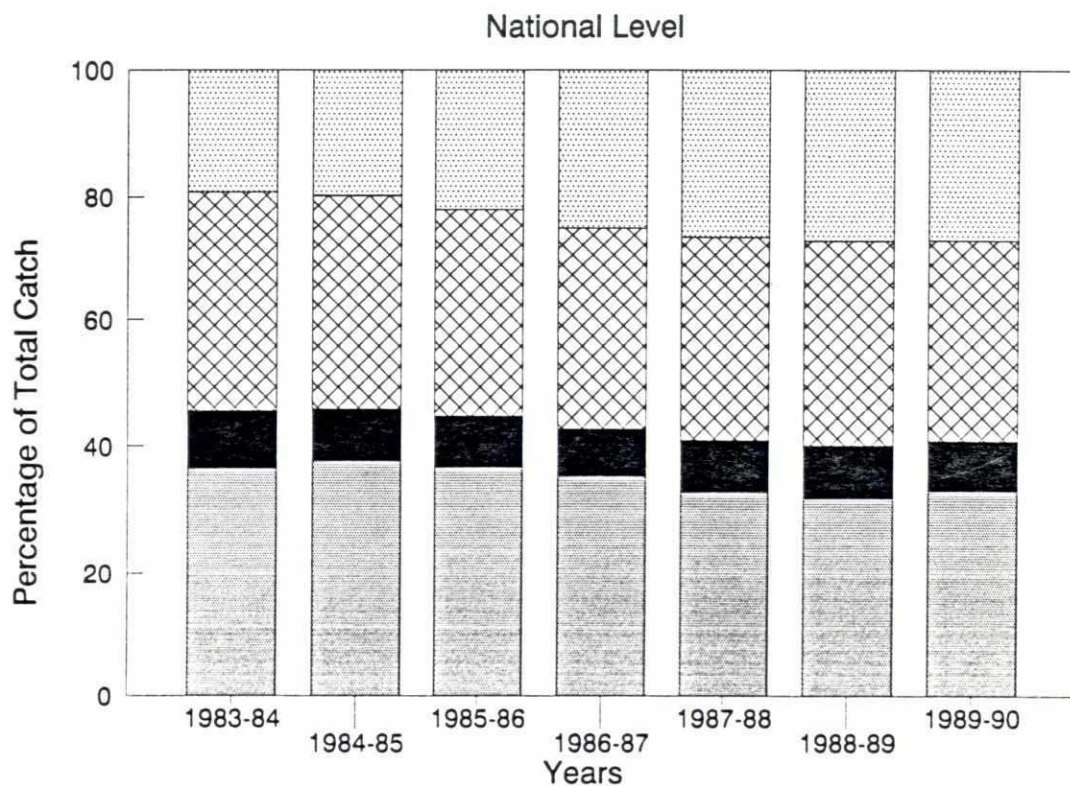
Average annual trends in total fish production at the National and District levels were 0.97% and 5.41% respectively (Table F.5.2). National fish production increased from 569,088 to 603,730 MT (an increment of 34,642 MT), while production in the Old Comilla District rose from 48,022 to an estimated 65,858 MT (an increment of 17,836 MT) (Table F.5.1). Table F.5.2 and Figure F.5.3.a show details of the average annual change in the total catch of the various production systems in the Old Comilla District, and it emphasizes the differences between these and the National trends.

#### **F.5.1.2 Percentage Annual Change**

The percentage annual change per production system at National and District levels is presented in Figure F.5.3.b. Although differences in trends between the two are clearly marked and could be a reflection of the differing fishing systems, it was however considered unjustified to use these District trends for the Gumti study since they are based on a very small sample (FAP 17 personal communication). Details of the percentage annual change in production at the District level are given in Table F.5.3.

Despite the decision not to use the District data, further analyses into trends per production system at District level were carried out and the findings are presented in Figure F.5.4 indicating a very volatile situation.

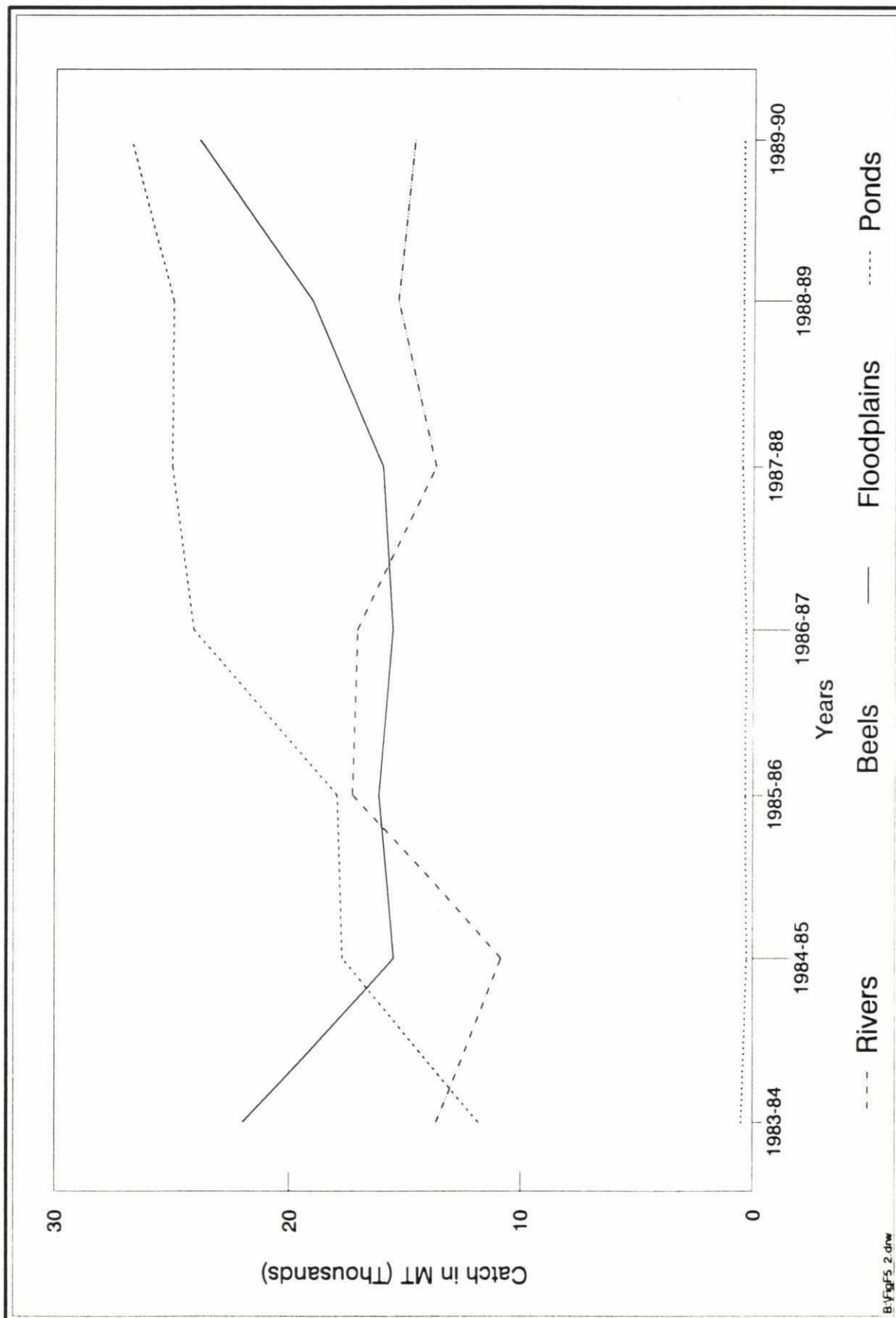
**Figure F.5. 1a**  
**Percentage Catch Composition per Fishery System**



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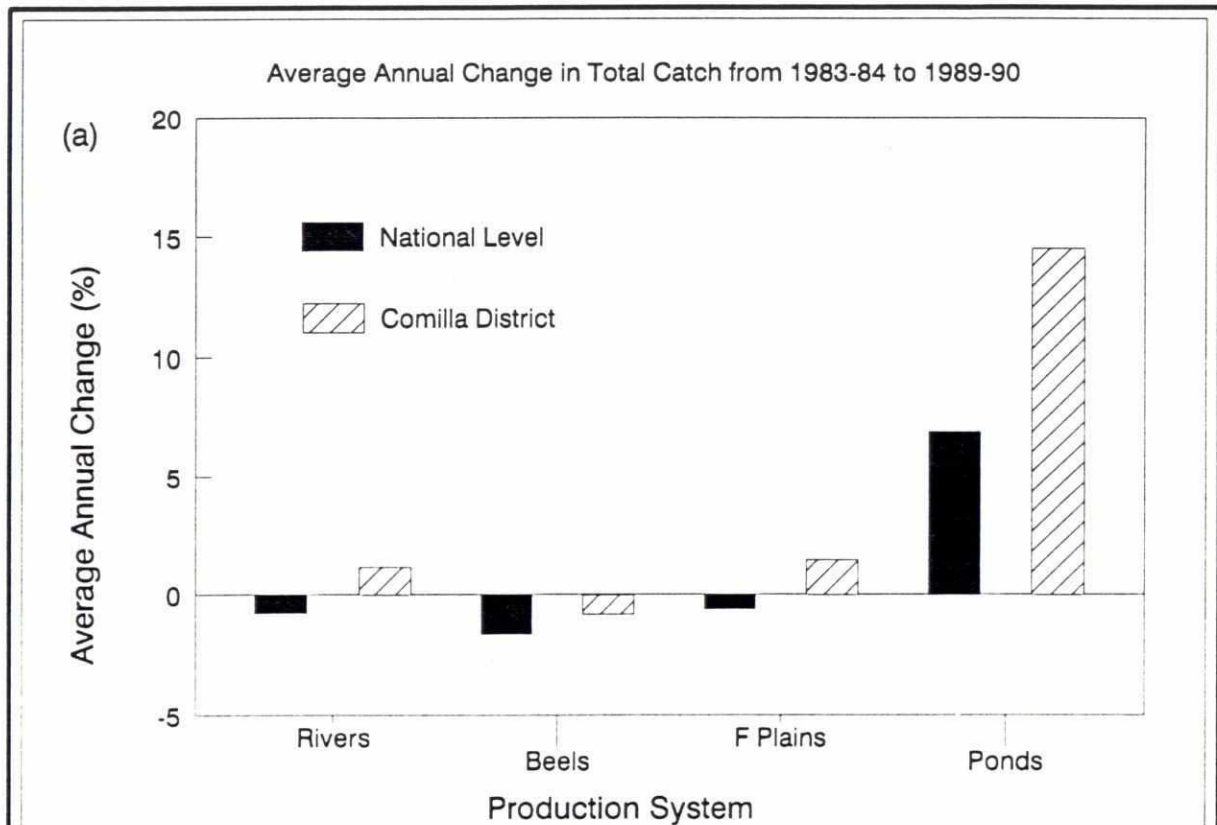
Figure F.5.2

Annual Total Catch in Old Comilla District from 1983-84 to 1989-90



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**Figure F.5.3a**  
**Comparison Between National Level and Comilla District**



**Figure F.5.3b**

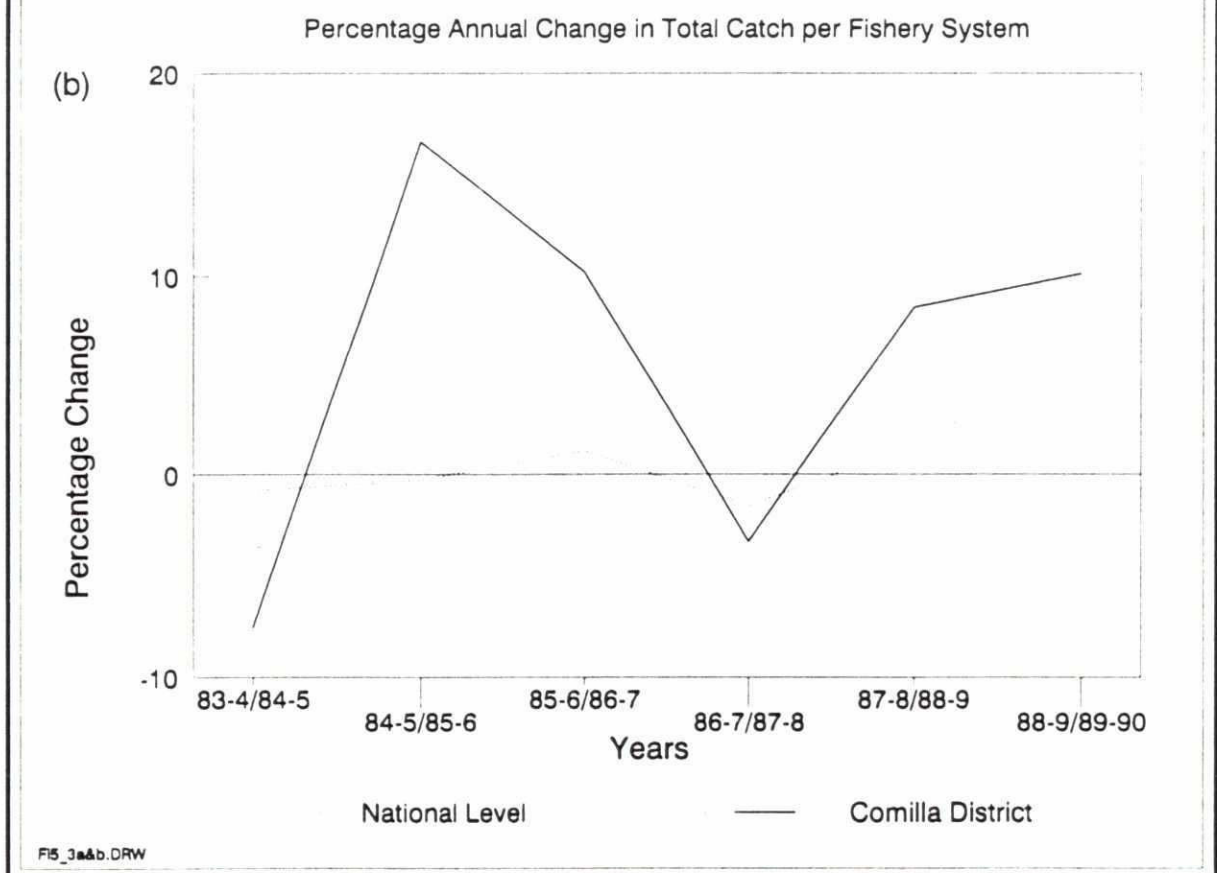


Figure F.5.4  
Percentage Annual Change in Different Systems in  
Old Comilla District

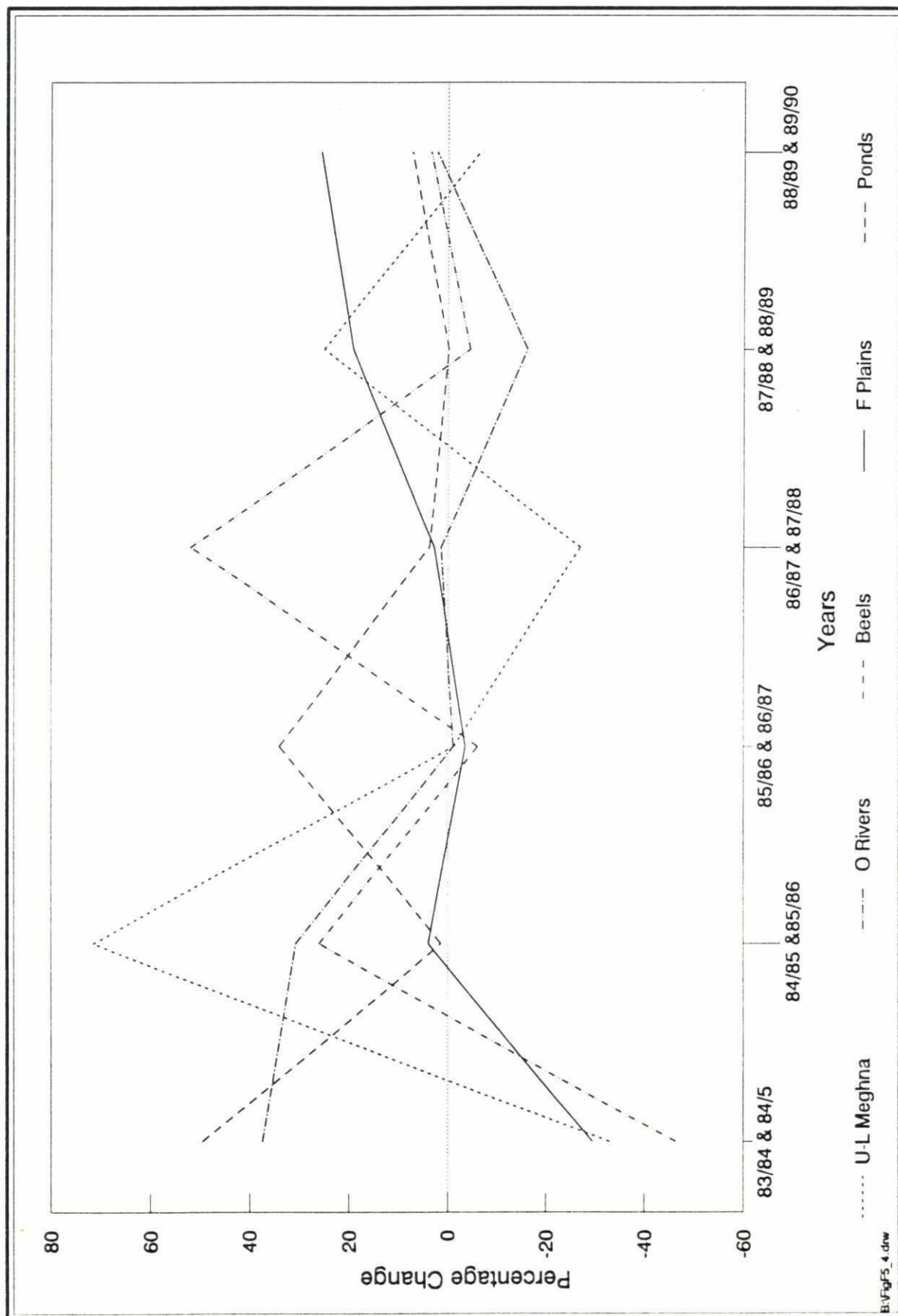


TABLE F.5.1

Total Catch per Fishery System at National and District Levels

National Level

	1983-84	1984-85	1985-86	1986-87	1987-88	1988-89	1989-90
Rivers	207,766	213,057	206,712	201,152	183,817	181,140	198,941
Beels	51,373	45,893	45,258	42,077	45,610	47,019	46,594
F Plains	200,616	194,130	187,396	183,796	182,037	186,126	193,762
Ponds	109,333	111,567	123,804	142,876	149,423	155,012	163,730
Total	569,088	564,647	563,170	569,901	560,887	569,297	603,027

Old Comilla District Level

	1983-84	1984-85	1985-86	1986-87	1987-88	1988-89	1989-90
Rivers	13,678	10,860	17,297	17,082	13,692	15,345	14,659
Beels	497	267	337	316	480	458	474
F Plains	22,002	15,526	16,145	15,563	15,983	19,069	23,972
Ponds	11,845	17,726	17,960	24,077	24,983	24,935	26,753
Total	48,022	44,379	51,739	57,038	55,138	59,807	65,858

Percentage of Total Catch per Fishery System at National and District Levels

National Level

	1983-84	1984-85	1985-86	1986-87	1987-88	1988-89	1989-90
Rivers	36.5	37.7	36.7	35.3	32.8	31.8	33.0
Beels	9.0	8.1	8.0	7.4	8.1	8.3	7.7
F Plains	35.3	34.4	33.3	32.3	32.5	32.7	32.1
Ponds	19.2	19.8	22.0	25.1	26.6	27.2	27.2
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Old Comilla District Level

	1983-84	1984-85	1985-86	1986-87	1987-88	1988-89	1989-90
Rivers	28.5	24.5	33.4	29.9	24.8	25.7	22.3
Beels	1.0	0.6	0.7	0.6	0.9	0.8	0.7
F Plains	45.8	35.0	31.2	27.3	29.0	31.9	36.4
Ponds	24.7	39.9	34.7	42.2	45.3	41.7	40.6
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: FRSS, DOF. Data for riverine catch for 1989-90 represents the average for 6 years  
Total District Catch for 1990-91 derived from National Total from BBS (1992). The rest of the values

TABLE F.5.2

**Average Annual Change in Total Catch per Fishery System at National and District Levels from 1983-84 to 1989-90**

Fishery Systems	National Level	District Level
Rivers	-0.73	1.16
Beels	-1.64	-0.79
F Plains	-0.58	1.44
Ponds	6.96	14.54
Total	0.97	5.41

Derived from FRSS, DOF Data.

TABLE F.5.3

**Percentage Annual Change in Fish Production in Different Fishery Systems**

**Old Comilla District**

Fishery Systems	83-4 & 84-5	84-5 & 85-6	85-6 & 86-7	86-7 & 87-8	87-8 & 88-9	88-9 & 89-90
U-L Meghna	-32.9	71.7	-1.3	-26.9	25.1	-6.5
O Rivers	37.3	30.8	-1.1	1.4	-16.2	2.2
Beels	-46.3	26.1	-6.2	52.0	-4.5	3.49
F Plains	-29.4	4.0	-3.6	2.7	19.3	25.71
Ponds	49.6	1.3	34.1	3.8	-0.2	7.29
Total	-7.6	16.6	10.2	-3.3	8.5	10.10

Riverine Data for 1989-90 calculated from the average catch of 6 years

## **F.5.2 Production Levels in the Old Comilla District**

### **F.5.2.1 Capture Fisheries**

#### **i) Meghna and Other Rivers**

Riverine fish production represented over 22% of the total catch of the District in 1989-90. Trends in river production over 7 years can be seen in Figure F.5.1.b. The percentage change in annual fish production in the Meghna River (Upper and Lower Meghna) contributing to the District's total catch shows wide fluctuations from year to year (Figure F.5.4). However, the two increments in the fish catch in the Meghna River appear to correspond to high water levels in the area and the decrease in production found from 1986-87 to 1987-88 appears to correspond to low water levels recorded during 1986. The production trend of the Other Rivers in the District show a dramatic and steady decline from 1983-84/1984-85 to 1987-88/1988-89, after which it shows a slight improvement (Figure F.5.4). Overall riverine production increased by 1.16% in the District in the 7 years from 1983 to 1990. The overall estimated total riverine catch for the Comilla District for 1988-89 is shown in Table F.5.4.

#### **ii) Beels**

Beel production represented only 0.7% of the total catch in 1989-90 (Table F.5.1, Figure F.5.1.b). However, annual changes varied considerably throughout the period from 1983 to 1990, despite such low levels (Figure F.5.4). The two peaks in the trends in 1984-85/1985-86 and in 1986-87/1987-88 also appear to be a response to increased water levels during those years. Overall Beel production declined by -0.79% from 1983 to 1990.

#### **iii) Floodplain**

There is a general positive trend in floodplain production although not a dramatic one, and it represents over 36% of the total catch in 1989-90 (Figure F.5.1.b). Overall, floodplains contributed slightly more than rivers to the total catch in the 7 year period, showing an increase of 1.44% (Figure F.5.4).

### **F.5.2.2 Culture Fisheries**

The contribution from pond production to the total District catch in 1989-90 was 40.6% (Figure F.5.1.b, Table F.5.1). Overall, the increase in pond production in the District during the period was 14.5%, substantially higher than any of the trends of the other systems. However, there was a sharp decline in production during 1984-85/1985-86.

TABLE F.5.4

Estimated Total Catch of Riverine Fisheries on the Basis of Catch Assessment Survey  
District Total by Rivers in MT

Code	Type of fish	July	Aug	Sep	Oct	Nov	Dec.	Jan.	Feb.	March	April	May	June	Total
01	Major Carp	0	3	3	86	95	109	30	31	30	25	16	12	144
02	Other Carp	0	0	0	13	20	10	6	4	4	4	3	1	22
03	Cat fish	2	4	3	24	44	87	33	33	19	23	17	14	139
04	Snake head	0	0	0	1	1	3	3	4	1	1	0	0	9
05	Live fish	0	0	0	0	0	0	1	1	1	0	0	0	3
06	Other inland fish	177	206	207	814	588	487	450	246	215	278	168	230	1,587
07	Hilsa, ilish	537	979	2,533	240	210	191	3,231	283	230	206	175	611	4,736
08	Bombay duk	0	0	0	0	0	0	0	0	0	0	0	0	0
09	Indian salmon	0	0	0	0	0	0	0	0	0	0	0	0	0
10	Pomfret	0	0	0	0	0	0	0	0	0	0	0	0	0
11	Sharks & Rays	0	0	0	0	0	0	0	0	0	0	0	0	0
12	Other Marine fish	0	0	0	0	0	0	0	0	0	0	0	0	0
13	Big prawns & shrimps	1	2	3	49	18	17	10	7	1	0	7	3	28
14	Small shrimps	40	43	44	53	47	49	49	38	35	46	54	50	272
15	Crabs	0	0	0	0	0	0	0	0	0	0	0	0	0
Total		757	1,237	2,793	1,280	1,023	953	3,813	647	536	583	440	921	6,940

Source: Department of Fisheries  
District: Comilla 1988 & 1989

### **F.5.3 Open Water vs Pond Production**

In general, pond production in the District shows an inverse relationship to capture fisheries production in all open water systems (i.e. rivers, Beels and floodplains) (Figure F.5.4). With the exception of the fish production in the Meghna River, there was an improvement in the production of all other systems during 1988-89/1989-90. This might be due to an increased availability of fish in open water fisheries after the high floods of 1987 and 1988 as shown by the higher catches in these systems during the same period.

### **F.5.4 Production Trends Used in This Study**

Due to the reasons given above, and after discussions with FAP 17 members, it was decided to use national trends similar to those used in the Jamalpur Priority Project Study (FAP 3.1). These were -1.5% per annum for production in open water systems and +4.5% for pond production. However, it should be borne in mind that a major review of DOF data is being carried out and that new production trends will emerge in time. Sadly, they will be available too late for incorporation in this study.

## F.6

## Fisheries Production in the Gumti Phase II Project Area

### F.6.1

### Fish Production per Thana

Fish production in the Thanas with land in the Gumti Phase II Project Area has been estimated based on unpublished data for 1991-92 from the Thana Fisheries Offices (TFO). Table F.6.1 shows the catches for 1991-92 reported by the TFOs and the corresponding dominant species in the catch per Thana. The combined total catch of the eleven Thanas in Gumti Phase II was 38,500 MT; of which 24,063 MT were contributed to the project area. Of these, the largest proportion of this catch corresponded to Muradnagar with 35.6% (8,538 MT), followed by Nabinagar with 18.5% (4,440 MT) and Bancharampur with slightly over 10% (2,460 MT). The lowest proportion of the total catch corresponded to Comilla Sadar and Debidwar with 0.9% (206 MT) and 0.4% (90 MT) (Figure F.6.1). It should be noted, however, that it was not possible to ascertain the fish system source of these catches, as these figures aggregate capture and cultured fisheries. Nevertheless, they provide a baseline as to the fisheries productivity per Thana.

In general, carps dominated the catch with Rui being the greatest followed by Catla, Mrigal and Punti. They next most numerous species caught were the catfish Boal, followed by Silver Carp, the snakehead Shoal, the small catfish Singi, Gazar, Miscellaneous species, Magur and Hilsa (Figure F.6.2). The dominant species in the catch varied from Thana to Thana as seen in Figures F.6.3 to F.6.6. Details of pond areas per Thana and their reported production are given in Table F.6.2.

#### F.6.1.1

#### Zone A

Figure F.6.3 shows details of the catch reported by each Thana. Carps dominated the catch, with Silver Carp being the highest catch in two Thanas, Burichang and Brahmanpara. In **Burichang**, Silver Carp (25%), Rui (20%), Mrigal (15%), Catla (10%), Magur and Singi (10%) were the prominent species. In **Brahmanpara**, Silver Carp, Mrigal, Common Carp, Rui and Catla were the most important species in order of priority. **Comilla Sadar** reported Hilsa as 40% of its total catch followed by Miscellaneous species, Silver Carp, Catla and Rui. The dominance of Hilsa in this catch was surprising and needs further investigation. It is possible that this fish is actually caught somewhere else and brought to Comilla for selling, or else, that it may be able to enter the area via the Gumti River.

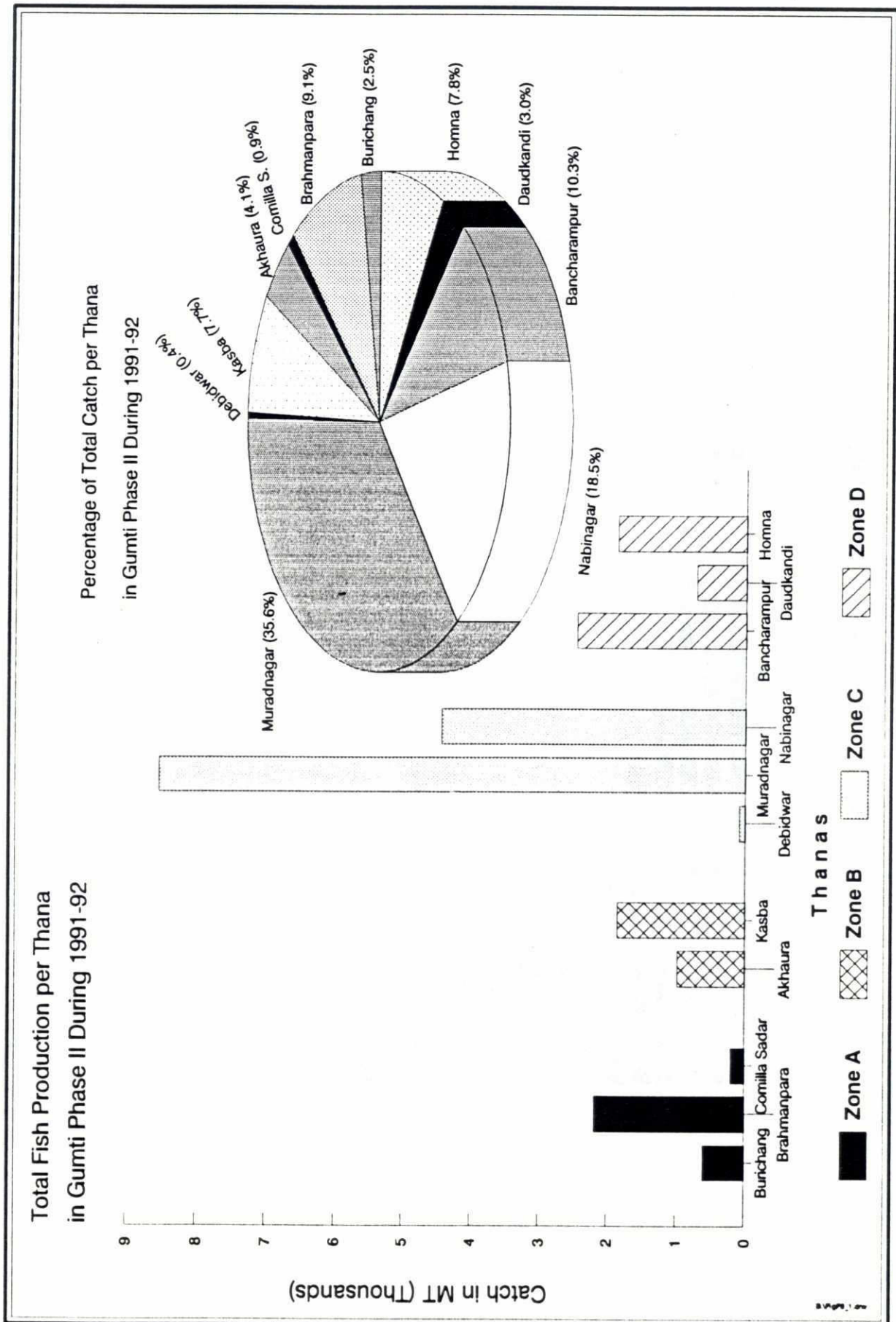
#### F.6.1.2

#### Zone B

Carps were again the dominant group in this Zone (Figure F.6.4). In **Akhaura**, the main species were Rui, Catla and Silver Carp with similar catches, followed by Miscellaneous species and Mrigal. Singi, Magur and Mirror Carp followed with similar catches. **Kasba**'s catch consisted mainly of Rui, Catla and Silver Carp, with similar catches, followed by Mrigal, Singi, Common Carp and Koi.

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Figure F.6.1  
Fish Catch By Thana



20

Figure F.6.2

Total Catch of Main Species in Gumti  
Phase II During 1991-92

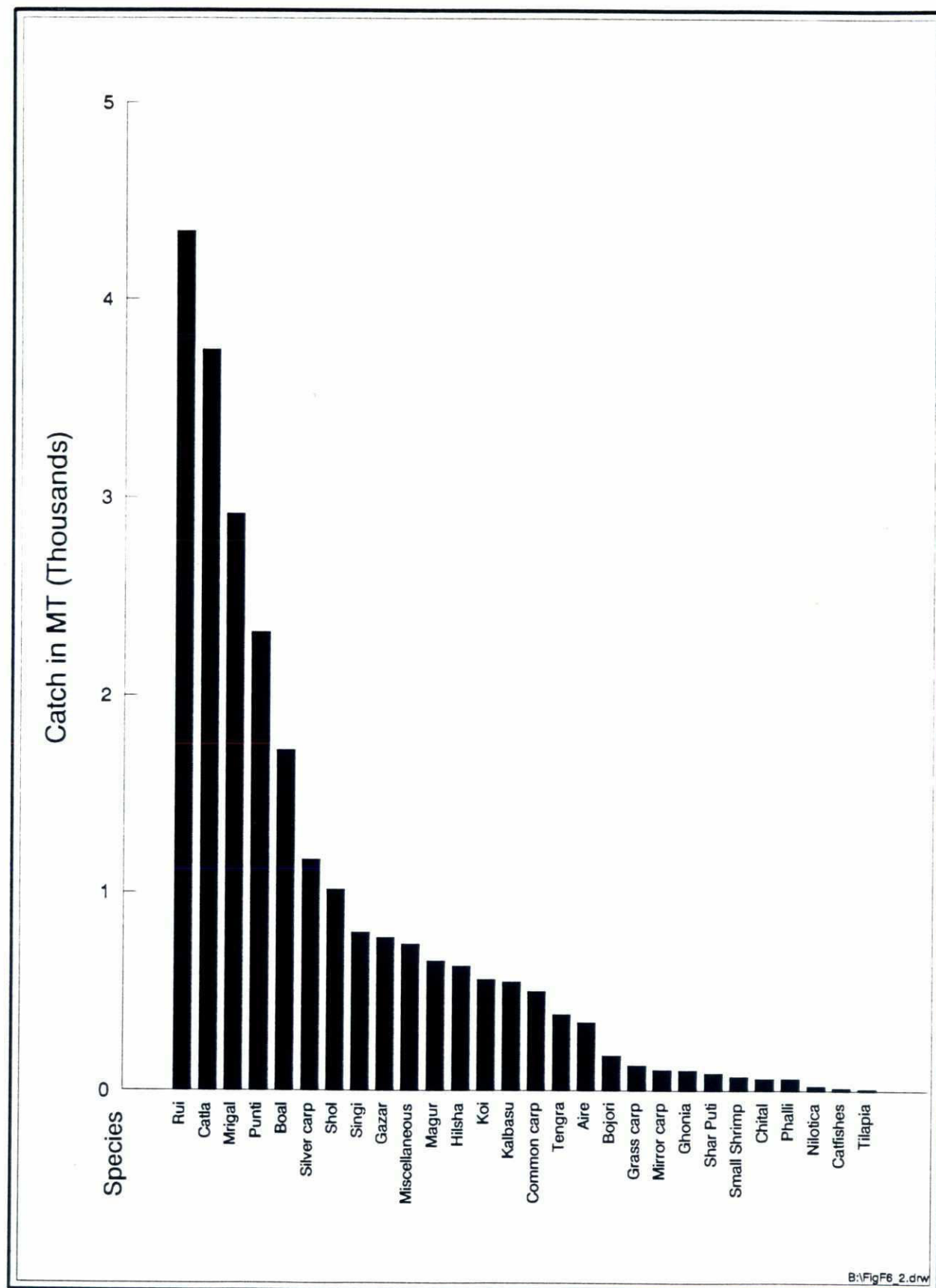
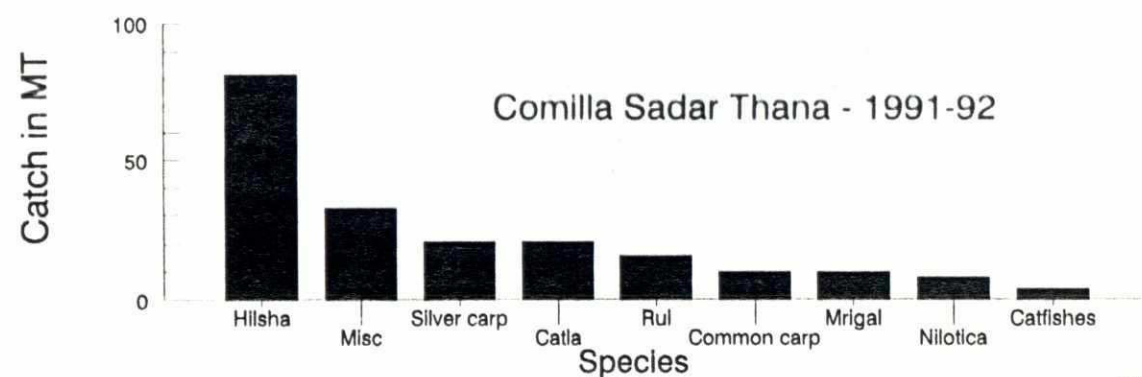
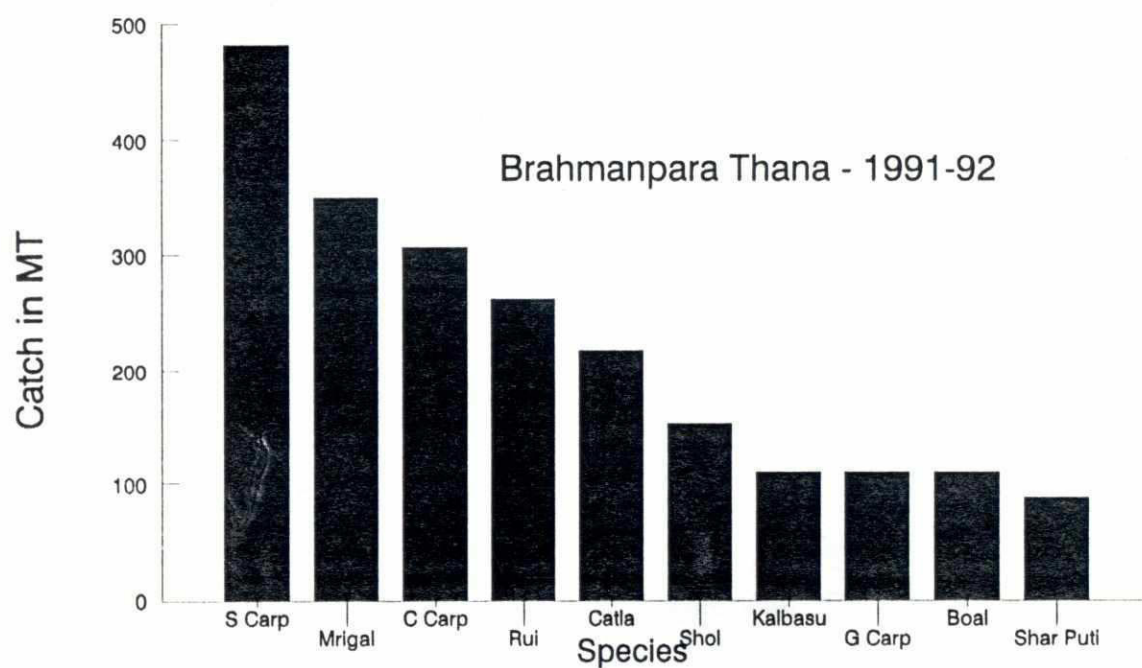
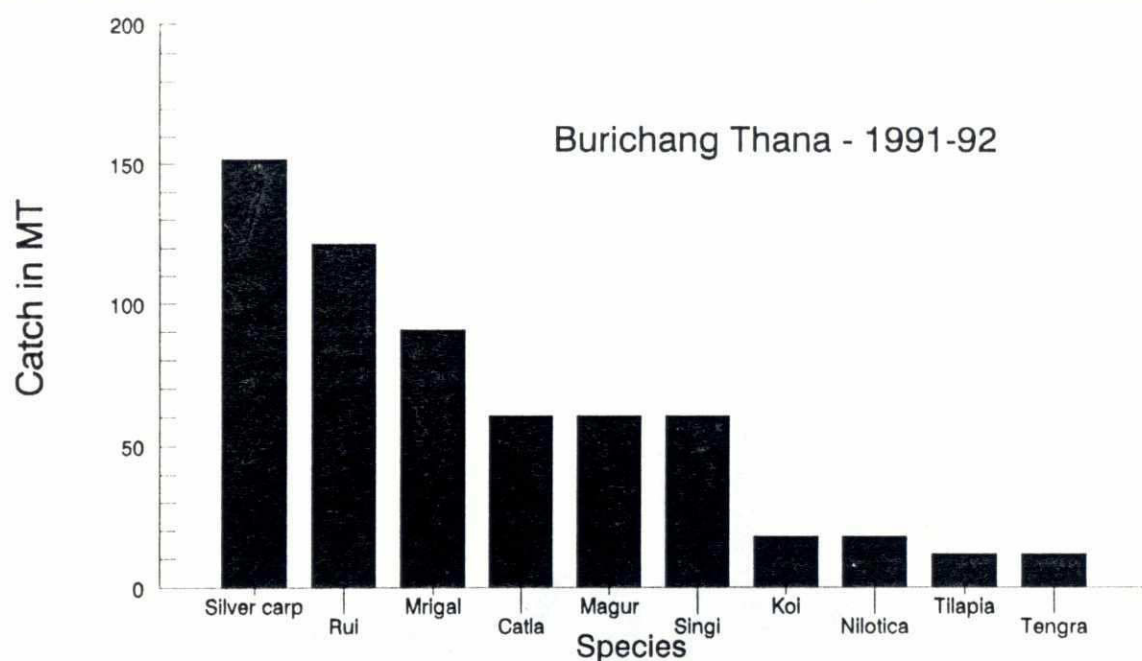


Figure F.6.3

Annual Catch of Key Commercial Species

(Sheet 1 of 4)

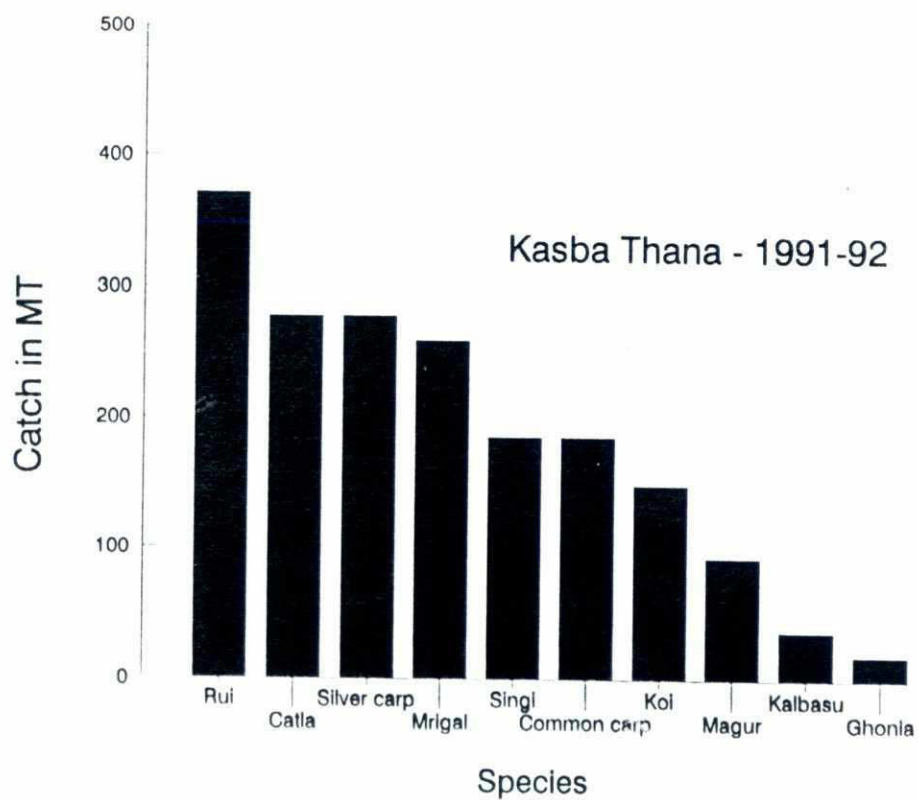
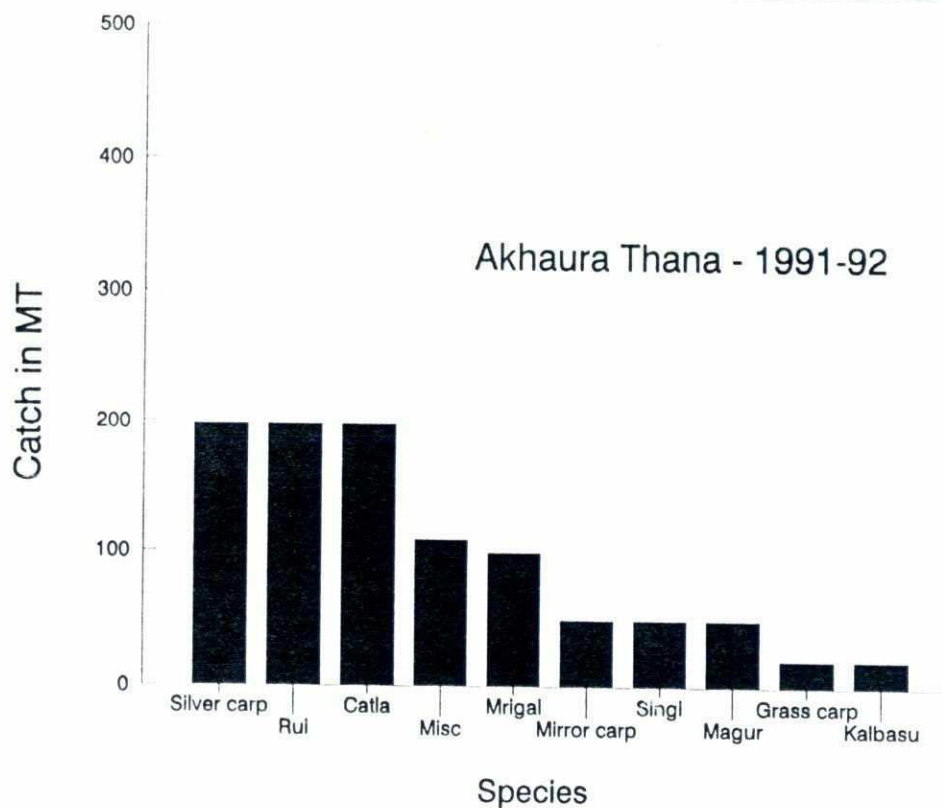


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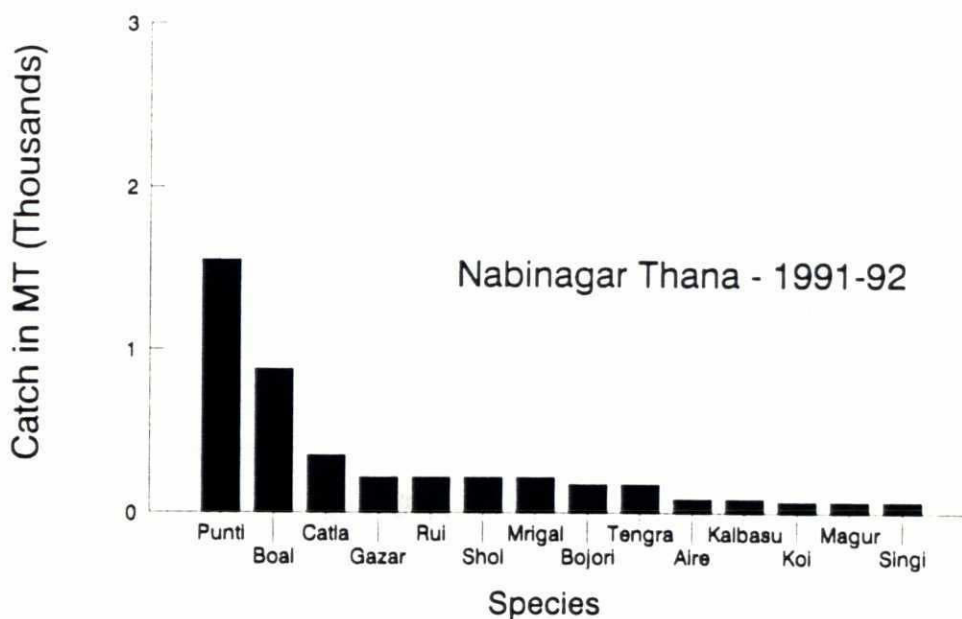
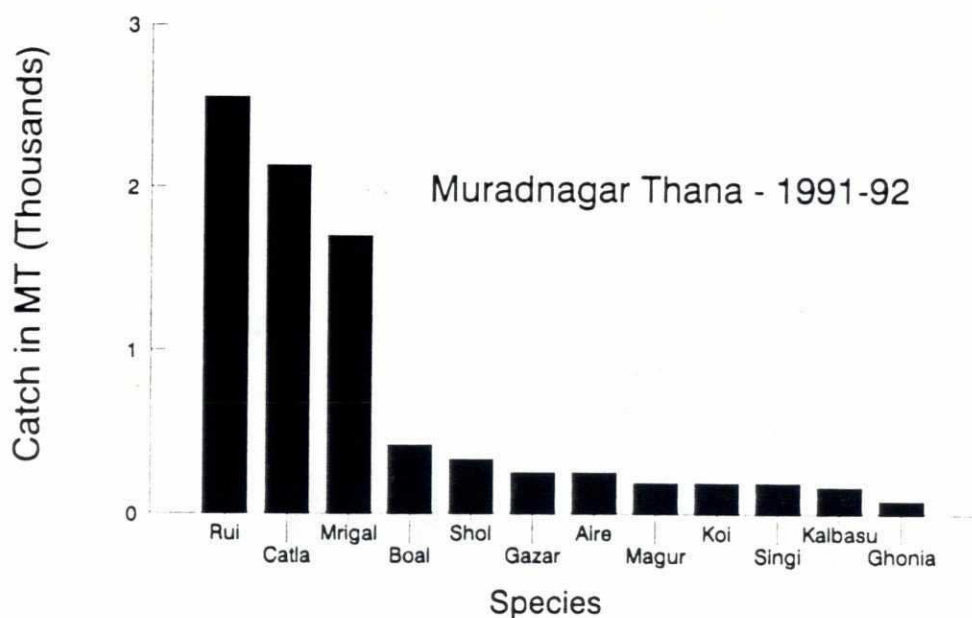
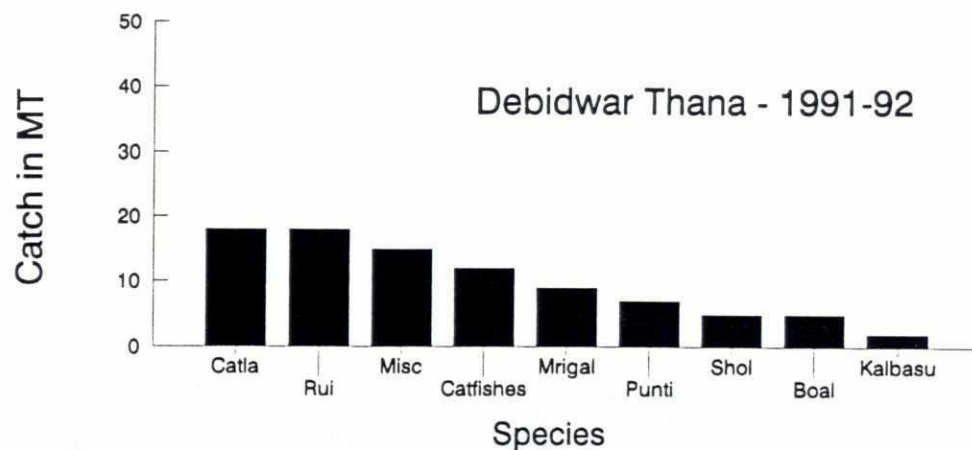
Figure F.6.4

Annual Catch of Key Commercial Species

(Sheet 2 of 4)



**Figure F.6.5**  
**Annual Catch of Key Commercial Species**  
 (Sheet 3 of 4)



22

Figure F.6.6

Annual Catch of Key Commercial Species

(Sheet 4 of 4)

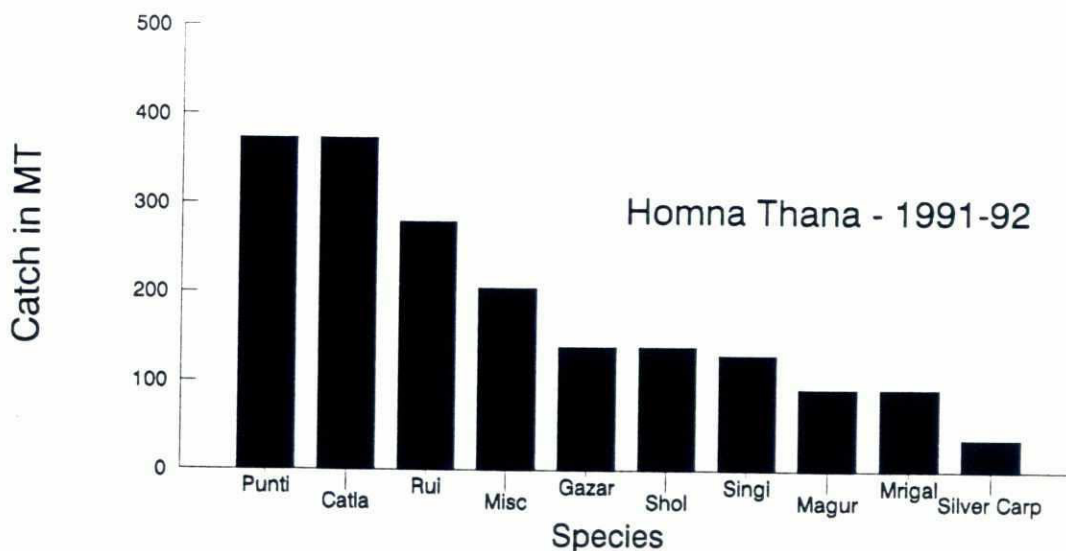
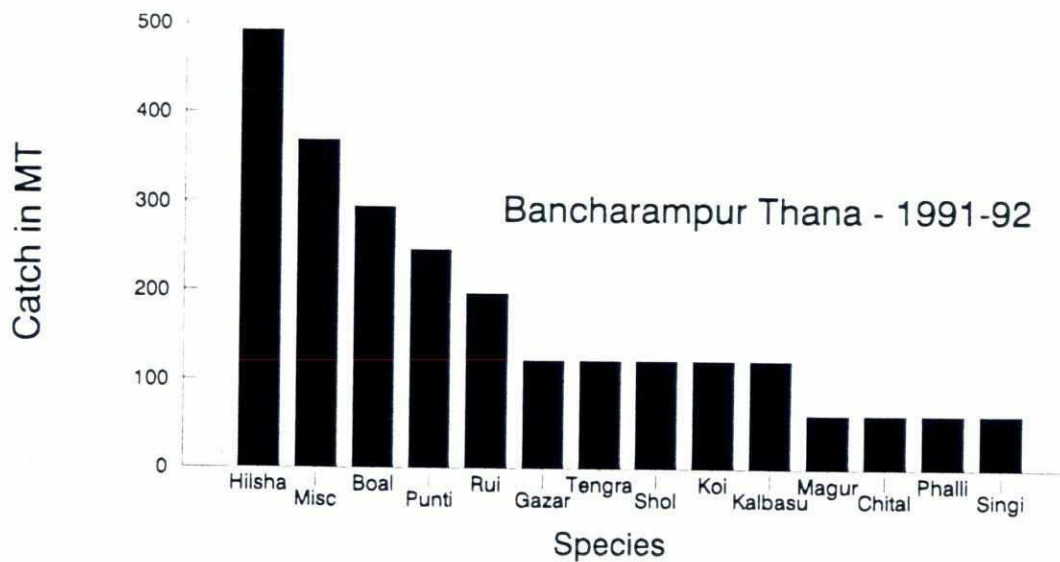
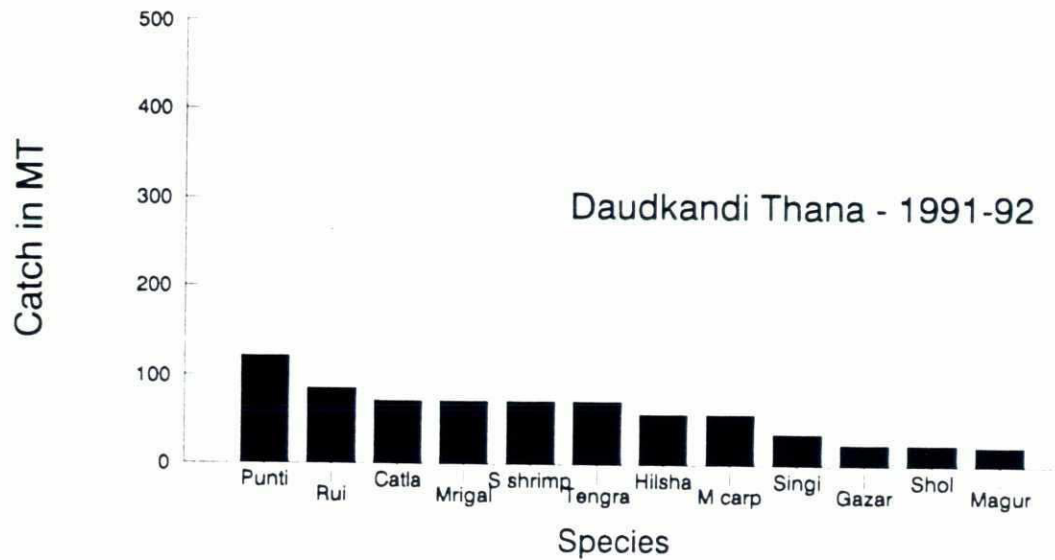


TABLE F.6.1

Catch Species Composition per Thana Contributed to the Gumti Phase II Area in 1992

Total Catch MT	2460	4440	608	988	2190	1856	90	719	8538	206	1968	Total (MT)
Species	ancharampur Catch (MT)	Nabinagar Catch (MT)	Burichang Catch (MT)	Akhaura Catch (MT)	rahmanpara Catch (MT)	Kasba Catch (MT)	Debidwar Catch (MT)	Daudkandi Catch (MT)	uradnagar Catch (MT)	omilla Sadar Catch (MT)	Homna Catch (MT)	
Hilsha	492							58		82		632
Rui	197	222	122	198	263	371	18	86	2561	16	295	4,349
Kalbasu	123	89	0	20	110	37	2	0	171	0		551
Boal	295	888	0	0	110	0	5	0	427	0		1,724
Shol	123	222	0	0	153	0	5	25	342	0	148	1,017
Gazar	123	222	0	0	0	0	0	25	256	0	148	774
Singi	62	75	61	49	0	186	0	36	196	0	138	803
Magur	62	75	61	49	0	93	0	22	196	0	98	656
Phalli	62	0	0	0	0	0	0	0	0	0	0	62
Chital	62	0	0	0	0	0	0	0	0	0	0	62
Koi	123	75	18	0	0	148	0	0	196	0	0	562
Punti	246	1554	0	0	0	0	7	122	0	0	394	2,323
Tengra	123	178	12	0	0	0	0	72	0	0	0	385
Shar Puti		0	0	0	88	0	0	0	0	0	0	88
Catla		355	61	198	219	278	18	72	2135	21	394	3,750
Mrigal		222	91	99	350	260	9	72	1708	10	98	2,919
Aire		89	0	0	0	0	0	0	256	0	0	345
Bojori		178	0	0	0	0	0	0	0	0	0	178
Silver carp			152	198	482	278	0	0	0	21	39	1,170
Grass carp			0	20	110	0	0	0	0	0	0	129
Mirror carp			0	49	0	0	0	58	0	0	0	107
Common carp			0		307	186	0	0	0	10	0	502
Tilapia			12		0	0	0	0	0	0	0	12
Nilotica			18		0	0	0	0	0	8	0	26
Catfishes						0	12	0	0	4	0	16
Chapila						0	0	0	0	0	0	0
Chail						0	0	0	0	0	0	0
Ghonia						19	0	0	85	0	0	104
Bele							0	0		0	0	0
Taki							0	0		0	0	0
Misc							0	0		0	0	0
Small Shrimp	369			109			15	0		33	216	742
								72				72

TABLE F.6.2

## Area and Production of Ponds by Thana in the Gumti Phase II Area

	Thana	Total Area in Thana (Ha)	Total Area in Gumti Phase II (Ha)	Annual Yield (MT)	Overall Production Level (MT)
Zone A	Burichang	830	473	1067	1286
	Brahmampara	904	868	1266	1400
	Comilla Sadar	1008	272	1410	1399
	Debidwar	1061	308	300	114
Zone B	Akhaura	377	102	1252	3324
	Kasba	636	636	1550	2438
Zone C	Muradnagar	1133	782	3171	2799
	Nabinagar	657	526	1060	1613
Zone D	Bancharampur	100	69	?	?
	Daudkandi	879	185	1318	1500
	Homna	186	123	?	?

Source: Thana Fisheries Office Survey carried out during this study

#### F.6.1.3 Zone C

Again, major carps were the dominant species in two out of the three Thanas (Debidwar and Muradnagar) (Figure F.6.5). In Debidwar, miscellaneous species and catfishes followed in order of importance, with the rest of the catch made up of Mrigal, Punti, Boal, Shol and Kalbasu. **Muradnagar's** catch was the largest in the project area with Rui, Catla and Mrigal dwarfing the catch of the rest of the Thanas. Other species included Boal, Shol, Gazar, Aire, Singi, Magur, Koi, Kalbasu and Ghonia. In Nabinagar, the Thana with the second largest catch, Punti was the largest single species catch making up to 35% of the total catch, followed by Boal which represented 20%. The remainder of the catch was made up by Catla, Mrigal, Shol, Gazar, Rui, Bojori and others (see Table F.6.1 for details of catches).

#### F.6.1.4 Zone D

The total catch of these three Thanas varied considerably, with Bancharampur contributing 2,460 MT, Homna 1968 and Daudkandi 719 MT as shown in Figure F.6.6. Percentage species composition was also different. In Daudkandi, Punti dominated the catch with 17%, followed by Rui (12%), Catla, Mrigal, Small Shrimps and Tengra, with 10% each. Hilsa and Mirror carps represented 8% of the catch. In Bancharampur, the dominant species were Hilsa (20%), Miscellaneous species (15%), Boal (12%), Punti (10%) and Rui (8%). In Homna, Punti and Catla were followed by Rui and Miscellaneous species, and the catfishes Gazar, Shoal and Singi.

#### **F.6.1.5 Jalmahals Under the NFMP**

Jalmahals are sections of permanent water bodies where fishing rights have been leased by the Government, usually on a three year basis. Table F.6.3 shows the Jalmahals under the New Fisheries Management Policy per Thana. It also gives details of the number of fishermen involved per Jalmahal and Thana.

#### **F.6.2 Fisheries Development Programmes at Thana Level**

Table F.6.4 shows the existing fisheries development programmes per Thana. It can be seen that the majority of these are being carried out as extension programmes through demonstration farms or under the Thana Parishads. According to our Thana survey, only four of the eleven Thana have Integrated Fisheries Programmes and just one, Bancharampur, reported development of Jalmahals under the New Fisheries Management Programme.

A brief summary of the information reported by the Thana Fisheries Offices is given below:

**Bancharampur:** There has been motivation and training of fishermen in modern aquaculture (fish culture) techniques. There are two projects, one under the Second Aquaculture and Development Programme and the other as an Integrated Fisheries Development project. There is development of jalmahals under the New Fisheries Management Policy.

**Nabinagar:** There is an extension programme through demonstration farms.

**Burichang:** In 1991-1992, a fish culture scheme was undertaken in 8 ponds (just over 2 ha) with the economic support of the Thana Parishad. In this scheme, modern fish culture techniques were applied with a net return of Tk 67,500.

**Akhaura:** One demonstration farm has been started under the Second ADB scheme for the year 1992-1993.

**Brahmanpara:** There is no official fisheries scheme. There is a private integrated fisheries programme for African catfish.

**Kasba:** There is an extension programme through demonstration farms.

**Debidwar:** There is a demonstration fish farm at Barkamta Union with an area of 4,900 square metres. The following fish species were released: Silver Carp (1,600), Catla (800), Rui (1,350), Mrigal (800), Common Carp (550), Grass Carp (270). Target achieved was 2,500 kg/year.

**Daudkandi:** One project was reported to have started during 1992 under the 2nd ADB Fisheries Programme which is running smoothly.

**Muradnagar:** A demonstration fish farm under the ADB programme and 2 demonstration fish farms under the Thana Parishad were reported in the survey.

TABLE F.6.3

**Jalmahals under the New Fisheries Management Policy in Gumti Phase II**

SI No	Name of Jalmahals	Location	Area (ha)	Number of Fishermen Involved
1	Daudkandi Thana Fisheries	Daudkandi	70	1 272
2	Kairapur Fisheries	Daudkandi	30	1 216
3	Nalia Fisheries	Muradnagar	33	133
4	Dead Titas	Muradnagar	13	233
5	Noabad Fisheries	Homna	500	1 085
6	Titas Nadi Block "A"	Nabinagar	400	1 200
Total			1 046	5 139

Source: DFO, Comilla & Brahmanbaria. Thana Survey carried out during this study

**Numbers of Fishermen Per Thana**

SI No	Name of Thana	Full Time Fishermen	Part Time Fishermen	Occasional Fishermen	Total Fishermen
1	Nabinagar	14 285	20 590	180 000	214 875
2	Muradnagar	4 150	11 675	25 600	41 425
3	Kasba	2 100	3 250	10 105	15 455
4	Bancharampur	8 000	10 000	19 500	37 500
5	Brahmanpara	480	780	4 310	5 570
6	Homna	5 130	15 650	69 685	90 465
7	Burichang	150	300	2 797	3 247
8	Daudkandi	2 488	5 402	21 089	28 979
9	Debidwar	2 100	2 800	16 802	21 702
10	Kotwali (Comilla)	400	1 200	3 300	4 900
11	Akhaura	270	460	2 600	3 330
Total		39 553	72 107	355 788	467 448

Source: Thana Fisheries Offices. Thana Survey carried out during this study

TABLE F.6.4

## FISHERIES DEVELOPMENT PROGRAMMES IN THE GUMTI PHASE II PROJECT AREA

Name of Thana	Development Programme Under Thana Parishad	Extension Programme Through Demonstration Farms	Integrated Fisheries Programmes	Development of Jalmahal Under NFMP
Bancharampur		✓ (ADB)	✓	✓
Nabinagar		✓		
Burichang	✓			
Akhaura		✓ (ADB)		
Brahmanpara			Programme for African Catfish	
Kasha		✓		
Debidwar	✓			
Muradnagar	✓	✓ (ADB)		
Comilla		✓ (ADB)	Integrated Farming Through Rotary Club	
Homna	✓			
Daudkandi		✓ (ADB)		

Source: Thana Fisheries Office Survey carried out during this study.

**Comilla Sadar:** No specific projects were reported by the Thana Fisheries Office for this Thana. However, the Comilla Rotary Club has an integrated fish, livestock, horticulture and poultry farm programme which is running successfully.

**Homna:** There are development programmes under the Thana Parishad.

### F.6.3 Problems Related to Fisheries at Thana Level

Table F.6.5 shows the most common problems reported during the Thana Survey. These were:

**Lack of extension services:** This was one of the most frequently reported problems by the Thanas in the project area. On the eastern side of Gumti project area, these were Akhaura, Burichang and Kasha, with Debidwar in the south-central part and Homna in the south-west.

**Lack of hatcheries:** Was reported by three Thanas, Bancharampur, Nabinagar and Brahmanpara.

TABLE F.6.5

Fisheries Problems According to Reports from Thana Fisheries Offices

NAME OF Thana	FISHERIES PROBLEMS								
	Lack of Extension Services	Lack of Hatcheries	Lack of Funding	Lack of Transport Facilities	Flooding	Execution of the Fish Act	Disease	Multiple Ownership of Ponds	Siltation
Bancharampur		✓		✓		✓			
Nabinagar		✓	✓				✓		✓
Akhaura	✓		✓			✓		✓	
Burichang	✓		✓					✓	
Brahmanpara		✓	✓		✓				
Kasba	✓		✓	✓					
Debidwar	✓				✓				
Daudkandi						✓	✓		
Muradnagar									
Cornilla									
Homna	✓				✓	✓			✓

Source: Thana Fisheries Office Survey carried out during this study.

**Lack of funding:** Approximately half of the Thanas reported the need for increased funding, these were: Nabinagar, Akhaura, Burichang, Brahmanpara and Kasba.

**Lack of transport facilities:** These were cited to be a problem for the Thanas of Bancharampur and Kasba, where access is difficult.

**Flooding:** Interestingly, two of the three Thanas that reported flooding as a problem are found in relatively higher grounds (Brahmanpara and Debidwar). Results of the socio-economic survey show that people in the Thanas in the deeper flooded parts of the project area are better prepared or able to deal with it. Most of these homesteads were found to be at or above the level of a 1 in 20 year flood.

**Execution of the Fish Act:** Bancharampur, Akhaura, Daudkandi and Homna reported this as a problem, although no details were provided. Further work is needed on this aspect which is bound to become increasingly important in the country as a whole in the future. See Appendix F.I for details of the Fish Act of 1985.

**Fish Disease and Parasites:** Reported in only two Thanas (Nabinagar and Daudkandi) during the Thana survey. However, fish disease (ulcerations, white spot) and infestations by parasites (*Argulus* sp.) were also reported by the fishermen in Muradnagar, Kasba, Homna during the catch assessment survey.

In general, *Argulus* was reported to be attached to Small Shrimps, while white spot was reported on carps and catfish. Heavy ulcer infestations were found on Shoal, Gazar, Singi, Magur, Punti and Taki amongst other fish.

**Multiple Ownership of Ponds:** Reported as a problem by Akhaura and Burichang. This is not surprising as the number of ponds in these two areas is proportionally higher than in other parts of the project area.

**Siltation:** Reported for two Thanas, Nabinagar and Homna, both well within the floodplain area of Gumti Phase II and near main river confluences.

Akhaura, Nabinagar and Homna were the Thanas which reported more problems as a whole.

**Pollution:** An additional problem, not reported by the Thana Fisheries Offices, was the presence of agro-chemicals which are causing fish mortality according to reports by the local fishermen in the Gumti Phase II project area. It is possible that these agro-chemicals may be causing some of the fish diseases by affecting the skin condition of the fish or by lowering their resistance to external negative factors and thus, encouraging disease.

#### F.6.4 Hatcheries and Nurseries per Thana in the Gumti Phase II Area

Table F.6.6 shows the number of fish hatcheries and their production in the project area. It is clear that this activity has thrived under the private sector which produces 93.6% of the total. It is likely that they will continue to do so in the future, especially if new schemes such as integrated farming are to spread throughout the region.

Table F.6.7 shows a similar pattern as the previous table with privately owned nurseries producing more than 95% than government owned nurseries.

#### F.6.5 The Inland Fisheries Project

In 1984, the Inland Fisheries Project was started with the assistance of the Rotary Foundation of the Rotary International Club. The main aim of the project was to make available quality fish fry, at a reasonable price for the promotion of fish culture. To carry out this, Union Fish Nurseries (UFN) were established in every union of the Comilla District through carefully selected trained Union Fish Culturists (UFC). The initial target was to establish 171 UFNs in Comilla District alone. At the end of 1988, the final year of project implementation, 250 UFNs (208 in Comilla) had been established and the activities of the project had extended to neighbouring Districts such as Brahmanbaria. Fifty UFCs have organised improvised hatcheries for production of spawn through induced spawning.

TABLE F.6.6

Number of Fish Hatcheries in the Gumti Phase II Area

Zones	Thana	Government Owned	Production (Kg)	Privately Owned	Production (Kg)
Zone A	Burichang	1	8	5	250
	Brahmampara	-	-	4	240
	Comilla	1	58	6	120
Zone B	Akhaura	-	-	1	20
	Kasba	-	-	3	150
Zone C	Nabinagar	1	NO	1	12
	Muradnagar	-	-	3	243
Zone D	Homna	1	NO	-	-
Total		4	66	23	1035

Source: Thana Fisheries Office. Data collected during this study.  
NO = Not operational

TABLE F.6.7

Number of Fish Nurseries with Fry Production

Zone	Thana	Government Owned	Production in Lacs	Privately Owned	Production in Lacs
Zone A	Burichang	-	-	8	30
	Brahmampara	-	-	27	150
	Comilla	6	62	28	80
Zone B	Akhaura	-	-	15	34
	Kasba	-	-	40	800
Zone C	Nabinagar	-	-	10	30
	Muradnagar	-	-	21	124
Zone D	Homna	-	-	4	20
	Daudkandi	-	-	9	54
Total		6	62	162	1322

Source: Thana Fisheries Office. Data collected during this study.

A summary of the production data for this project is presented in Tables F.6.8 and F.6.9, which clearly illustrate trends in production. From these tables it can be seen that the number of fry produced and disposed of during the years from 1984 to 1988 showed an increasing trend. In addition, fry produced per nursery increased from 350,000 in 1984 to 961,735 in 1988; the production increased by nearly three times in that time. There was an increase in the production per acre of more than 4 times from 1984 to 1988.

From 1984 to 1988, total fish production in ponds increased from 1855 to 157 921 MT. There were heavy losses suffered by fish culturists due to the flooding in 1987-1988 as a result of lost fry. The lost fry however, hopefully did not perish as it escaped into open waters. Fish availability in rivers and open waters would thus have increased, though there was a decrease in potential pond production.

The project has hence definitely contributed to production of fish and increased supply of fish to markets in the Comilla District.

#### **F.6.5.1 Employment Opportunities**

The project also provided opportunities for employment for a large number of persons, both directly and indirectly. The Union Fish Culturists (UFC) are engaged full time in their nursery and hatchery business. Each UFC employs on average 5 persons full time besides some of their family members. Part-time employment is also provided by each UFC to 5 persons. Large groups of people are engaged in hauling fish fry, netting and marketing fish. Increased employment opportunities have also been created due to the increasing use of ponds for fish culture.

The project has been successful in achieving the aims and objectives for which it was established. The initial target of setting up 171 UFNs in Comilla has been exceeded to 250 in total. Besides these accomplishments, 35 modern mini hatcheries and 16 hapa hatcheries have been set up.

The influence of the project on fish production in ponds and on creating employment opportunities in the area has been substantial (see Table F.6.9).

#### **F.6.5.2 Integrated Farming in Bangladesh**

The Integrated Farming in Bangladesh project, also an activity of the Rotary Club of Comilla, started in 1990. The objectives of the project include the cultivation of fish, livestock, horticulture and forestry as an integrated activity. Amongst other things, the project aims to help farmers to increase their income through these activities, to provide training and to increase employment opportunities for members of farm families. It was also set up to facilitate the growth of farmer's associations; to promote the extension of similar activities in other parts of the country and to follow up the work under the Inland Fisheries project. More importantly, it aims to make quality fish available from nurseries and hatcheries already in operation and to facilitate the rearing of poultry and livestock in conjunction with fish ponds, as well as to provide seeds or saplings of selected fruit and timber trees, vegetables and fodder plants from dependable sources.

TABLE F.6.8

**Production and Disposal of Spawned Fry During 1984-1988  
by the Inland Fisheries in Bangladesh**

Year	1984	1985	1986	1987	1988
UFN	18	51	115	175	250
Area in acres	134	301	706	1004	1430
Fry production in no.	5600000	28881200	70587352	137561620	240438310
Fry disposed of in no.	5565950	27650250	57451479	91931600	122492480
Yield per nursery	350000	566298	613803	786066	961735
Yield per acre	41791	95950	99982	137013	168139
Estimated flood loss				24067780	107969620
No of hatcheries		9	22	36	51
Production of spawn in kg		330	1152.25	1423.25	2232.75
Disposal of spawn in kg		286	1076.75	1253.75	1951.50
Spawn stocked in fish nurseries in kg		44	75	169.5	281.25
Fry available in no from spawn disposed of		51480000	193815000	225675000	351270000
Total quantity of fry available in no	5565950	79130250	251266479	317606600	473762480
Total water area covered in acres	1855	26377	83755	105869	157921
Total production in tons, estimated at 1 ton per acre	1855	26377	83755	105869	157921

Source: Rotary Club Comilla (1988)

TABLE F.6.9

## Employment Opportunities as a Result of the Inland Fisheries Project in Comilla

Year	1984	1985	1986	1987	1988
Number of UFC's	18	51	115	175	250
Employment provided - Full time	90	255	575	875	1250
Part Time	90	255	575	875	1250
Persons engaged in hauling fish fry	360	1020	2300	3500	5000
Fish farmers	5565	27650	57451	91932	122492
Fishermen for catching fish	33390	165900	344706	551592	734955
Fish traders	254	1263	2623	4198	5593
Consumers per year	92750	460850	957500	1532200	2041540

Source: Rotary Club of Comilla

Eighty integrated farms with credit support had successfully been established by 1991 and 20 more were expected to be selected by 1992. A further 50 were intended to be set up by 1992 without credit facilities. Training takes place over a 15-day period and is conducted by experts in the respective fields.

From January to December 1991, trained farmers have produced 637 Kg of carp spawn; 553 Kg were disposed of by fish farmers and 84 Kg were liberated in their own ponds. Clearly, this type of activity could easily become profitable for all concerned. Details on livestock, poultry and plant products can be found elsewhere (Rotary Club of Comilla, 1992).

## F.7 Catch Assessment Survey

As stated earlier, the aims of the catch assessment survey were to provide baseline data on the capture floodplain fisheries in the study area by zone. The field study was carried out during the period from mid October to the beginning of December 1992. Further details of the methodology have already been given in Sections F.4.2.1 and F.4.3.

The results of the fisheries catch assessment survey show that the combined total catch recorded over 4 days (observed catch during sampled day plus 3-day recall data from fishermen) for all zones in the Gumti Phase II area in the eight-week period was over 81 MT, of which 59 MT are attributed to Zone D, followed by Zone C with over 14 MT and Zone B with over 7 MT. The high catches recorded in Zone D can be attributed to the harvest of the katta fishery which was carried out at the end of November mainly in the Titas River section around Homna and Noabad Jalmahal (see Appendix F.II). The total katta harvest for the Titas River section alone during the 4-day period was over 39 MT.

The largest single catches were observed from the Titas River near Homna (27.6 MT) from katta harvest and from Chandai Beel (8.2 MT) from other type of fishing. Both these catches were observed towards the end of November (week 6). Appendix F.II also includes supporting catch data recorded during the study period.

### F.7.1 Calculation of Fish Production from Catch Data

Data resulting from this survey have been analyzed in more detail in order to attempt to estimate total fish production in the project area. To do this, actual catch observed on the sampled day per system (rivers, Khals and Beels) were analyzed in relation to fishing gears for each Zone. In an attempt to reduce the margin of error, information on the catch reported over a 4-day period was not used, as it included recall data over the previous three days. The mean number of days that a particular fishing gear was used in the Gumti Phase II area was calculated from the catch assessment questionnaires and was used for the analyses. Appendix F.III shows the areas of fishing systems sampled during the catch assessment survey.

Thus:

$$P = \frac{\text{catch on sample day/area surveyed}}{\text{total area of system}} \times \text{No days per fishing gear}$$

This procedure was followed for each zone, fishing system and gear. In addition, it was decided to analyse the katta catches separately as they were extremely high. Katta catches were only recorded in Zone D and were further isolated and analyzed for the relevant gears. Results were incorporated to the estimated total catch for each zone (Table F.7.1). Catch figures for Khals were incorporated into river figures as there were only two samples from this type of system.

TABLE F.7.1

## Estimated Fish Catch per Zone by Main Fishing Gears in Rivers/Khals and Beels in Gumti Phase II

Zone B		Catch per day per gear per habitat								Production	
		Gill Net	Seine	Katta	Lift	Bag	Cast	Push	Traps	Total	Level Kg/ha
River/Khal		157	193		26		21			397	2.01
Beel		30	111.5						199.25	341	5.98
									Total	738	2.89
Zone C											
		Gill net	Seine	Katta	Lift	Bag	Cast	Push	Traps	Total	
River/Khal		37	64		17.5	66	90			275	1.36
Beel		28	204						299	531	8.30
									Total	806	3.03
Zone D											
		Gill Net	Seine	Katta*	Lift	Bag	Cast	Push	Traps	Total	
River/Khal		17	48.33	1281.63	61	75.33	28.33	26	882	2,420	9.76
Beel		172.3	568	77	27	28	33	11.5		917	4.52
									Total	3,336	7.57

\* Production from Katta fishing has been estimated separately

Source: Field Survey carried out during this study

TABLE F.7.2

## Production Estimates Considering the Number of Days Fished by Gear per Fishing System

Zone B		Production								Production	
		Gill Net	Seine	Katta	Lift	Bag	Cast	Push	Traps	Total	Level Kg/ha
River/Khal		64,594	138,960		51,102		71,782			326,438	579
Beel		8,242	30,633						40,144	79,019	454
									SubTotal Zone B	405,457	549
Zone C											
		Gill Net	Seine	Katta	Lift	Bag	Cast	Push	Traps	Total	
River/Khal		18,815	56,954		8,528	36,359	76,277			196,933	230
Beel		61,031	444,656						477,933	983,620	635
									SubTotal Zone C	1,180,553	491
Zone D											
		Gill Net	Seine	Katta	Lift	Bag	Cast	Push	Traps	SubTotal	
River/Khal		7,041	35,031		24,213	33,801	19,557	17,948		137,592	161 *
Beel		46,292	152,605		7,254			3,090		209,240	345 *
									SubTotal Zone D	346,832	237 *

\* Excludes Katta fishing

Zone D - Katta Fishing with Seine Nets and Traps over 90 and 66 days respectively

		Production					
		Seine Nets	Traps	SubTotal	Level Kg/ha	Zone D Total	
River/Khal		398,132	200,925	599,057	700	736,650	861
Beel		20,688		20,688	34	229,928	379
			SubTotal	619,745	424	Total Zone D	966,578
							661
						Grand Total for Gumti Phase II	2,552,588
							554

Source: Field Survey carried out during this study

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### **F.7.2 Estimated Catch per Zone per Fishing System Sampled**

From Table 7.2, it can be seen that Zone D had the largest catches (876,554 Kg) with 84% resulting from rivers and Khals and 16% from Beels. Katta fishing contributed 70% to the total catch in Zone D, with 81% corresponding to rivers and Khals and 9% to Beel catch. Zone C was second in importance with an estimated total of 464,145 Kg, of which, rivers and Khals contributed 43% and Beels 57%. In Zone B, rivers and Khals made up approximately 80% while Beels contributed 20%.

### **F.7.3 Estimated Production Levels from Catch Data**

Production levels (kg/ha) per system (internal rivers/Khals, Beels) per surveyed zone (B, C and D) were then calculated and are shown in Table F.7.2. The production levels for rivers and Khals were quite different, with the highest corresponding to Zone D with 861 Kg/ha, which included 700 Kg/ha for katta fishing and 161 Kg/ha for traditional fishing. Zone B followed with a yield of 579 Kg/ha, and lastly, Zone C with a yield of 230 Kg/ha. The high yields found in Zone D, especially in the katta harvest, are not surprising due to its proximity to the rich waters of the Meghna River. In contrast, the lower figures for Zone C were unexpected, as this zone benefits from early and direct flooding from the Meghna River. However, it may be an indication of the ability of the species entering the system to disperse rapidly throughout the basin. On the other hand, it may be a reflection of the limitations of this short sampling programme.

Production levels for Beels were highest in Zone C, an important Beel area, with 635 Kg/ha, followed by Zone B with 454 Kg/ha and lastly, by Zone D with a total of 379 Kg/ha (including katta fishing). It should be noted that Beel dewatering was recorded for several of the Beels, especially in Zones B and C. The lower yields recorded in Zone D are surprising as it contains the largest permanent Beels. This could well be evidence of the impacted Beel areas in Satdona and Chandal where submersible embankments and water control structures have recently been constructed and brought into operation.

For the calculation of the overall fish production in the project area average production levels were used derived from the fishing systems sampled.

The apparently high fish production in the project area observed during this study could be explained on the basis of the timing of the field survey, which took place during the drawdown period after the monsoon (middle of October to the beginning of December). Thus, it is possible that approximately 70% of the total annual production in the Gumti Phase II area was recorded during this short period.

### **F.7.4 Estimated Fish Production in Gumti Phase II**

Fish production in the project area was also calculated using national production levels (provided by FAP 17 based on DOF data, 1988-89) and compared with production levels calculated in this study.

Using national production levels, it can be seen that the estimated annual capture fisheries production in Gumti Phase II amounts to 10,179 MT; with an increasing production from Zone A towards Zone D. Pond production shows a different pattern with highest yields in Zone A (1,878 MT) and C (1,379), followed by Zone B (779 MT) and lastly, Zone D (398 MT). Overall estimated production including ponds amounts to 14,612 MT, which results in a production level of 115 Kg/ha (Table F.7.3).

TABLE F.7.3

Fish Production in MT per Zone in Gumti Phase II Using FRSS National Production Levels

Fishery System	Zones				Production	
	A	B	C	D	Total	Level (Kg/ha)
Meghna River	0	0	198	1,293	1,491	176
Int Rivers & Khals	119	99	151	151	520	176
Beels	0	72	639	250	960	412
Floodplains	1,194	1,312	2,370	2,333	7,208	66
Subtotal	1,314	1,483	3,357	4,026	10,179	
Ponds@	1,878	779	1,379	398	4,433	1055 #
GRAND TOTAL	3,192	2,261	4,736	4,423	14,612	

Production levels used were provided by FAP 17 based on DOF data for 1988-1989

# Production level for 'Cultured' ponds

@ Refers to 'Cultured' ponds only

Source: Gumti Phase II Study 1993

TABLE F.7.4

Fish Production in MT per Zone in Gumti Phase II Using Production Levels  
Estimated During this Study

Fishery System	Zones				Production	
	A	B	C	D	Total	Level (Kg/ha)
Meghna River	0	0	627	4,091	4,717	557 *
Int Rivers & Khals	378	314	477	477	1,646	557 *
Beels	0	85	758	296	1,139	489 *
Floodplains	2,750	3,021	5,458	5,372	16,601	152 **
Subtotal	3,128	3,420	7,319	10,236	24,103	196
Ponds@	3,133	1,299	2,300	664	7,396	1760 @
GRAND TOTAL	6,261	4,719	9,619	10,900	31,499	248

\* Average Production levels estimated from this study's catch assessment survey

\*\* FAP 17's new estimate for floodplain production from DOF data including commercial catch

@ Average Pond Production for 'Cultured' Ponds from Thana Fisheries Office Survey

Zone A: Brahmanpara, Burichang, Debidwar, Comilla Sadar. Zone B: Kasba, Akhaura.

Zone C: Nabinagar, Muradnagar. Zone D: Homna, Bancharampur, Daudkandi.

Source: Gumti Phase II Study 1993

Using the production levels estimated during this study for internal rivers/Khals and Beels, FAP 17's estimated production levels for floodplains (152 Kg/ha) (FAP 17, 1993), which includes the commercial catch, and the average pond production levels reported by the TFO (1 760 Kg/ha), the results are quite different. The estimated total catch for the Gumti Phase II project area, including ponds was 31,499 MT, in a total area of water bodies of 127,173 ha (including a portion of the Meghna River), resulting in a production level of 248 Kg/ha (Table F.7.4; Figures F.7.1 and F.7.2). However, if only the capture fisheries are considered, the resulting estimated total production in open waters is just over 24,100, with a production level of 196 Kg/ha, over an area of 122,971 ha. Both these production levels are comparable to fish production reported for other tropical countries (Lowe-McConnell, 1987).

In general, fish production from open waters in Zones A and B was similar (3,128 and 3,420 MT respectively), but was approximately half the production of Zone C (7,319 MT) and one third of that in Zone D (10,236 MT). The higher production in Zones C and D are believed to be due to the contribution made directly by the Meghna River, one of the most productive major rivers in the country. Overall fish production in Zone A was 6,261 MT, of which 6.04% came from internal rivers and Khals; 43.9% from floodplains and 50% from ponds (cultured ponds only). In Zone B, total production amounted to 4,719 MT, with 6.65% from internal rivers and Khals; 1.8% from Beels; 64% from floodplains and 27.5% from ponds. Total production in Zone C was 9,619 MT, with 6.5% coming from the Meghna River; 4.95% from internal rivers and Khals; 7.88% from Beels; 56.7% from floodplains and 23.9% from ponds. In Zone D, the contribution of the Meghna was substantial (37.5%); with internal rivers and Khals amounting to 4.37%; Beels only to 2.7%; floodplains to 49.28% and ponds to 6.1%.

Not surprisingly, pond production was highest in Zone A (3 133 MT), followed by Zone C (2 300 MT), Zone B (1 299 MT) and lastly, Zone D (664 MT). Overall, ponds contributed 7 396 MT (23.48%) to the total production.

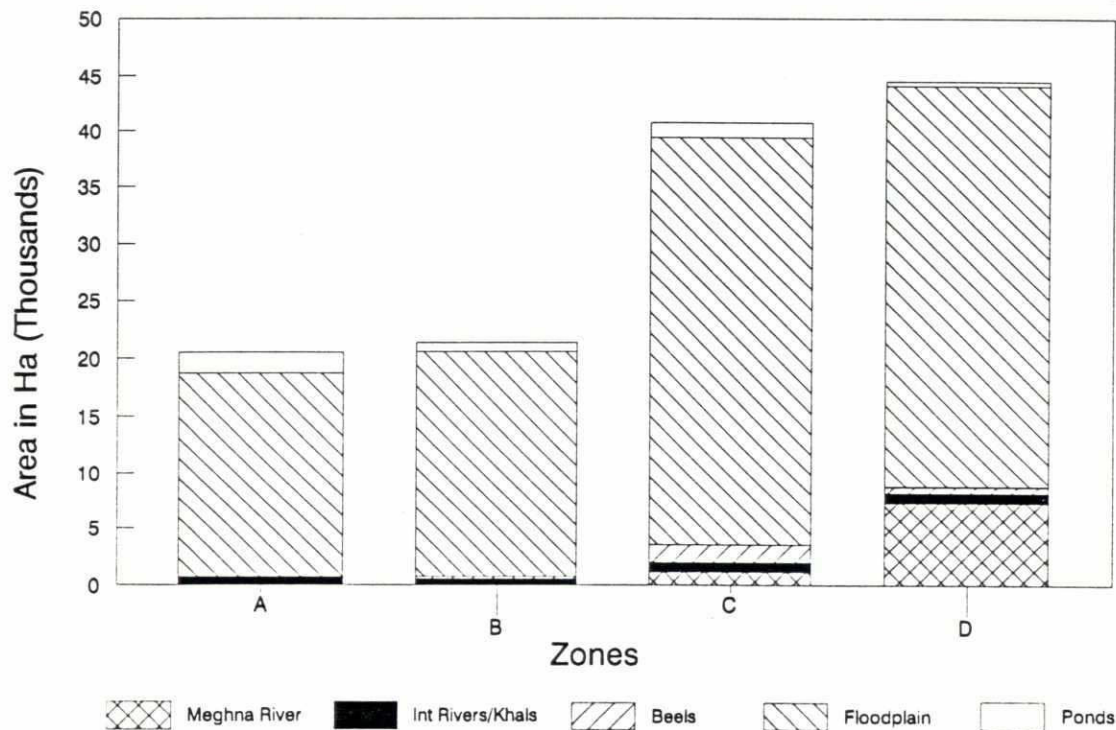
#### **F.7.5 Catch Species Composition in Gumti Phase II**

Of the 260 species of freshwater fish reported for Bangladesh, approximately 47 (18%) were recorded in the study area. However, a preliminary list of species occurring in the area compiled from the catch surveys and fishermen's reports amounted to 90 species which represent 34.6% of the fish species reported for the country. Appendix F.IV shows the preliminary list of fish and prawn species occurring in the Gumti Phase II Project Area.

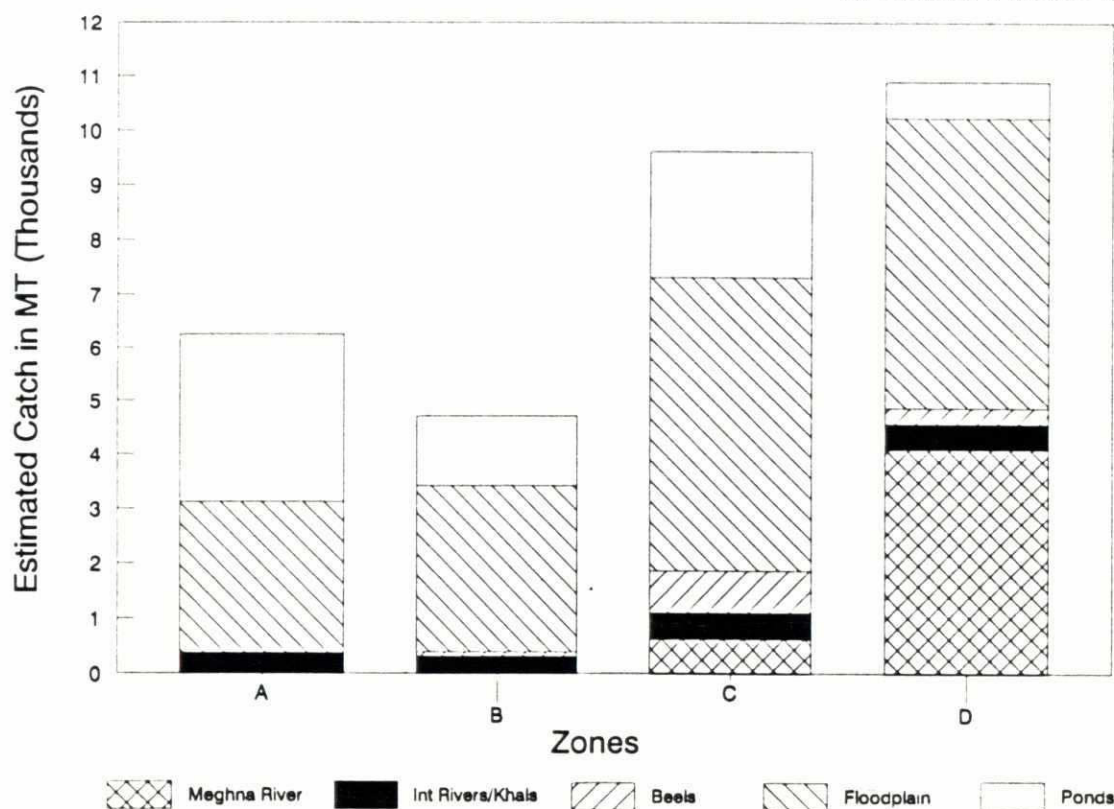
Tables F.7.5, F.7.6 and F.7.7 show the catch species composition in each of the fishing systems per zone. In general, there were similar number of species in all systems. In Zone B (Table F.7.5), there were 17 species in rivers and 14 in Beels, but only 4 species in the Khals. However, this may be explained by the few samples taken from this type of system. In Zone C the difference was also small with 22 species caught in rivers and 27 in Beels (Table F.7.6). In Zone D, the species composition in the three systems was remarkably similar, although actual catches were very different (Table F.7.7). The similarity in species composition has been interpreted as an indication of the ability of the various species to freely move within the floodplain area to reach different habitats in the floodplain and of the importance of this area for all types of fish. Figures F.7.3, F.7.4 and F.7.5 show some of the major species, in terms of their importance in the catch, occurring in the project area.

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**Figure F.7.1**  
**Area of Fishery Systems per Zone**  
**in Gumti Phase II**



**Figure F.7.2**  
**Estimated Fish Production per Zone**  
**in Gumti Phase II**

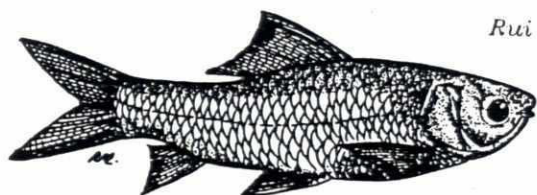


ft

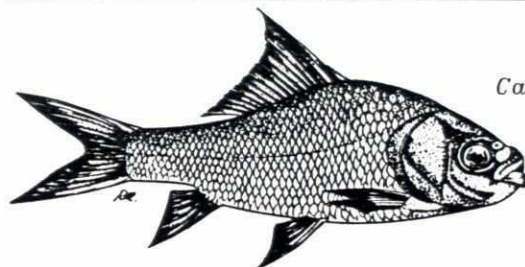
Figure F.7.3

Major Fish Species Occuring in Gumti Project Area

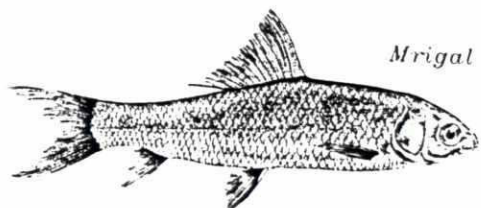
Carps, Barbs and Minnows



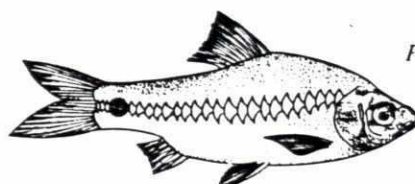
Rui



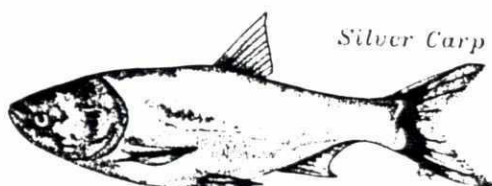
Catla



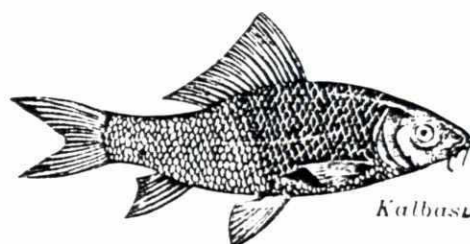
Mrigal



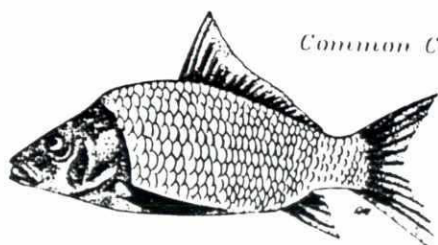
Punti



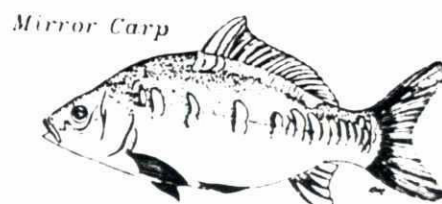
Silver Carp



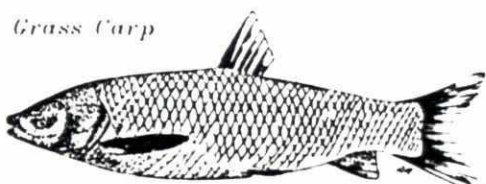
Kalbasu



Common Carp



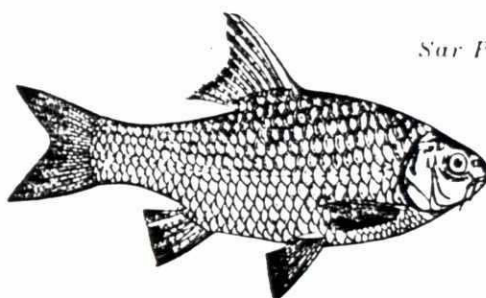
Mirror Carp



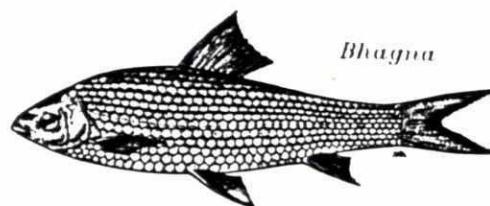
Grass Carp



Ghonia



Sar Punti



Bhagna



Mola

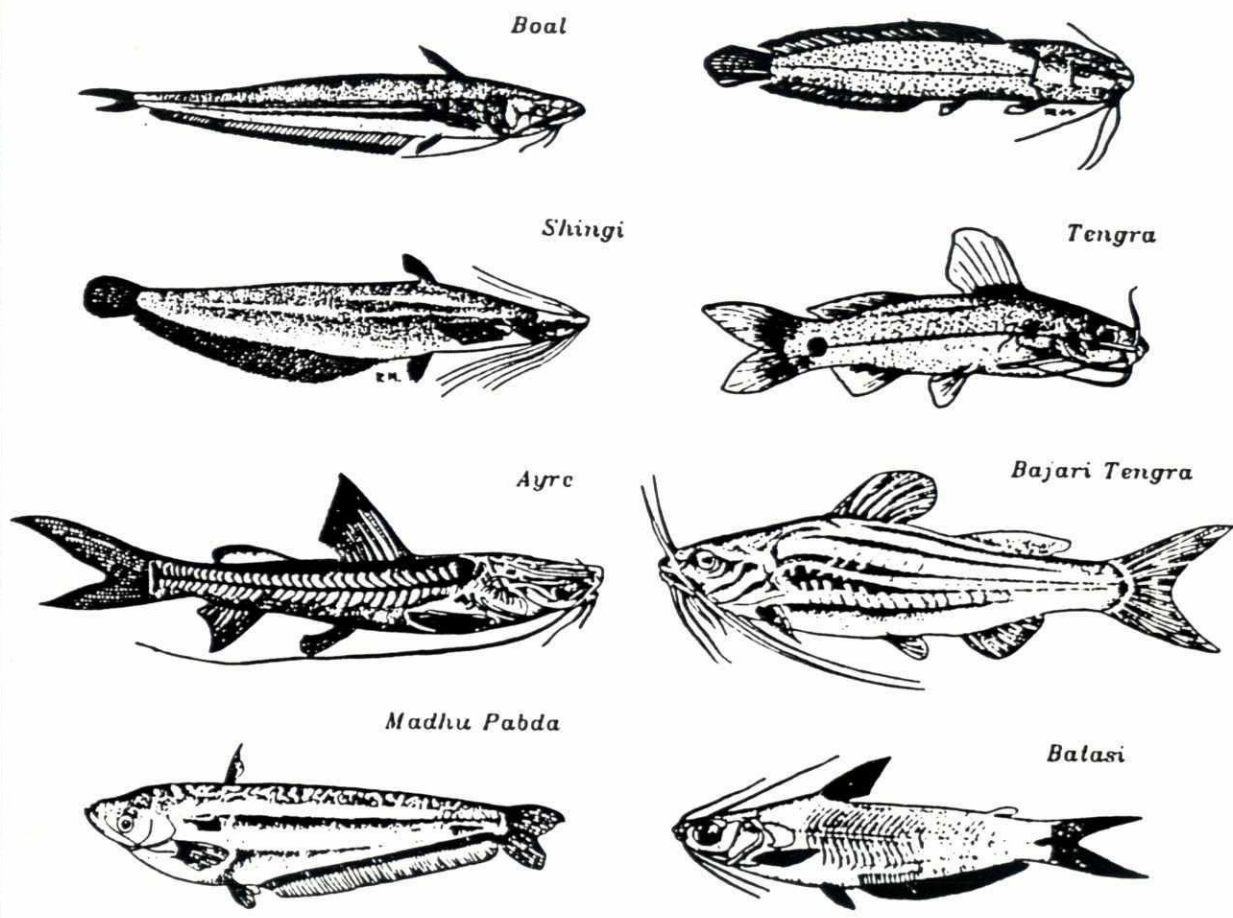


Tit Punti

(Not to Scale)

Figure F.7.4  
Major Fish Species Occuring in Gumti Project Area

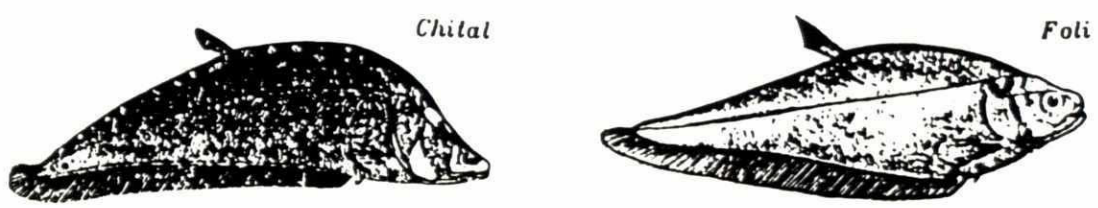
**Catfishes**



**Snakeheads**



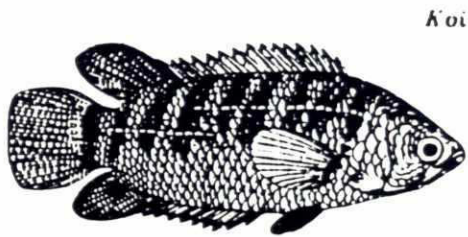
**Featherbacks**



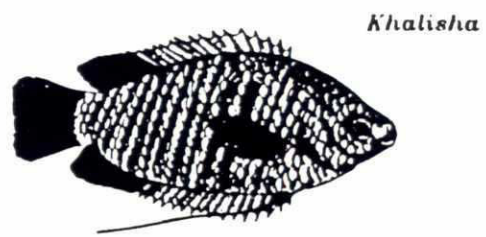
(Not to Scale)

Figure F.7.5  
Major Fish and Prawn Species Occuring in Gumti Project Area

Climbing Perches

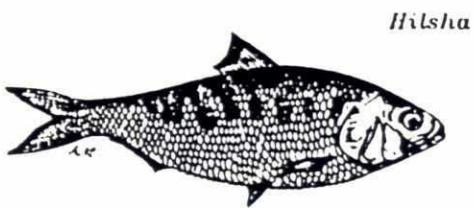


*Koi*

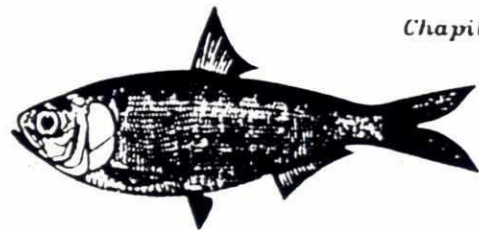


*Khalisha*

Shads, Herrings



*Hilsha*



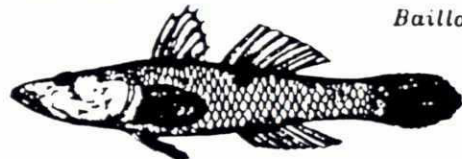
*Chapila*

Loaches



*Gutum*

Gobies



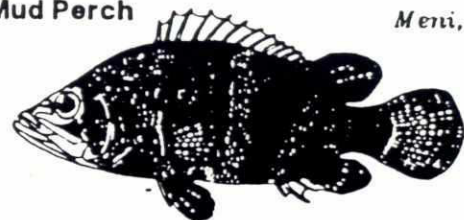
*Bailla*

Spiny Eels



*Baim, Pankal*

Mud Perch



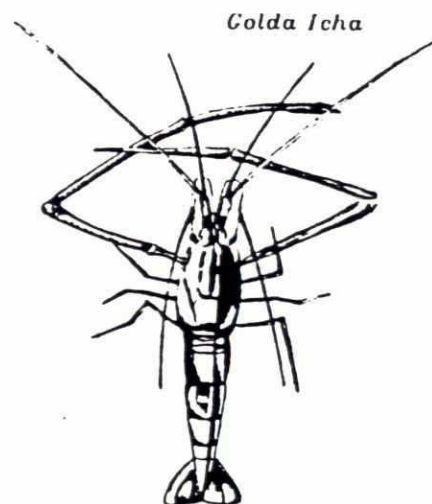
*Meni, Bheda*

Gars



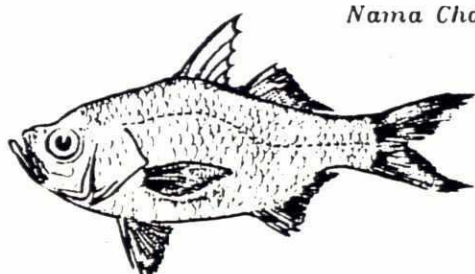
*Karikka*

Big Shrimp



*Golda Icha*

Glass Perch



*Nama Chanda*

(Not to Scale)

TABLE F.7.5  
Total Species Catch in Kg in Zone B

SPECIES	River		Khal		Beel		TOTAL	
		%		%		%		
Ruhi	19.5	5.57					19.5	1.15
Catla	11.0	3.14					11.0	.65
Mrigal								
Kalbasu	2.0	.57					2.0	.12
Ghainna								
Boal	14.0	4.00			133.0	10.22	147.0	8.65
Air								
Shol/Gazar	13.0	3.71			103.0	7.91	116.0	6.83
Chital/Phali	2.5	.71					2.5	.15
Koi	1.0	.29	6.0	12.77	30.0	2.30	37.0	2.18
Singi/Magur	23.0	6.57			95.0	7.30	118.0	6.95
Sar Puntti								
Big Shrimps	59.0	16.86			141.0	10.83	200.0	11.77
Small Srimps	20.0	5.71			110.0	8.45	130.0	7.65
Tengra								
Pabda								
Punti	73.0	20.86	23.0	48.94	452.0	34.72	548.0	32.25
Miscellaneous	32.0	9.14	12.0	25.53	58.0	4.45	102.0	6.00
Chela								
Kakila					27.0	2.07	27.0	1.59
Baim	11.0	3.14			44.0	3.38	55.0	3.24
Taki					58.0	4.45	64.0	3.77
Bheda			6.0	12.77				
Silver carp								
Mola	20.0	5.71			30.0	2.30	20.0	1.18
Gutum							30.0	1.77
Colisha					2.0	.15	2.0	.12
Chapila	1.0	.29					1.0	.06
Chanda	40.0	11.43			19.0	1.46	59.0	3.47
Batasi	8.0	2.29					8.0	.47
TOTAL	350.0	100.00	47.0	100.00	1302.0	100.00	1699.0	100.00

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TABLE F.7.6  
Total Species Catch in Kg in Zone C

SPECIES	River		Khal		Beel		TOTAL
		%		%		%	
Ruhi	39.5	4.89			63.5	2.13	103.0
Catla	25.5	3.16			23.5	.79	49.0
Mrigal	31.0	3.84			7.5	.25	38.5
Kalbasu	52.5	6.51			26.0	.87	78.5
Ghainna							
Boal	64.0	7.93			222.5	7.46	286.5
Air	6.0	.74					6.0
Shol/Gazar	15.5	1.92			192.5	6.45	208.0
Chital/Phali	61.5	7.62			49.0	1.64	110.5
Koi	6.0	.74			149.5	5.01	155.5
Singi/Magur	3.0	.37			100.5	3.37	103.5
Small Srimps	14.0	1.73			204.0	6.84	218.0
Tengra	62.5	7.74			253.5	8.50	316.0
Pabda					2.0	.07	2.0
Punti	132.5	16.42			562.5	18.86	695.0
Miscellaneous	56.5	7.00			100.0	3.35	156.5
Chela					1.0	.03	1.0
Kakila	8.0	.99			60.0	2.01	68.0
Baim	5.0	.62			64.5	2.16	69.5
Bhagna	37.0	4.58					37.0
Baila	52.0	6.44			22.0	.74	74.0
Taki					138.5	4.64	138.5
Bheda	60.0	7.43			90.0	3.02	150.0
Silver carp							
Mola	5.0	.62					5.0
Gutum					17.0	.57	17.0
Colisha					60.5	2.03	60.5
Chapila	31.0	3.84					31.0
Chanda	39.0	4.83			262.5	8.80	301.5
Cutcutia					24.0	.80	24.0
Ghawra							
Batasi					123.5	4.14	123.5
Titputi					160.0	5.36	160.0
69					2.5	.08	2.5
TOTAL	807.0	100.00			2982.5	100.00	3789.5
							100.00

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TABLE F.7.7  
Total Species Catch in Kg in Zone D

SPECIES	River		Khal		Beel		TOTAL	
		%		%		%		
Ruhi	97.0	.88	5.0	1.80	111.0	3.11	213.0	1.44
Catla	54.0	.49	3.0	1.08	63.0	1.76	120.0	.81
Mrigal	15.0	.14	2.0	.72	18.0	.50	35.0	.24
Kalbasu	44.0	.40			58.0	1.62	102.0	.69
Ghainna	22.0	.20			91.0	2.55	113.0	.76
Boal	440.5	4.02	20.0	7.19	158.5	4.44	619.0	4.18
Air	83.0	.76	10.0	3.60	13.0	.36	106.0	.72
Shol/Gazar	473.0	4.31	31.0	11.15	218.5	6.12	722.5	4.88
Chital/Phali	242.0	2.21	10.0	3.60	118.0	3.30	370.0	2.50
Koi	35.0	.32	3.0	1.08	47.5	1.33	85.5	.58
Singi/Magur	171.0	1.56	23.0	8.27	107.5	3.01	301.5	2.03
Sar Puntti	91.0	.83	6.0	2.16	13.8	.39	110.8	.75
Big Shrimps	355.5	3.24	2.0	.72	12.0	.34	369.5	2.49
Small Srmps	539.0	4.91	15.0	5.40	373.5	10.46	927.5	6.26
Tengra	1675.0	15.27	2.0	.72	432.5	12.11	2109.5	14.24
Pabda	105.0	.96	1.0	.36	12.0	.34	118.0	.80
Punti	4177.0	38.09	35.0	12.59	700.0	19.60	4912.0	33.15
Miscellaneous	1618.0	14.75	45.0	16.19	475.5	13.31	2138.5	14.43
Kakila	48.0	.44	5.0	1.80	29.0	.81	82.0	.55
Baim	18.0	.16					18.0	.12
Baila	23.0	.21					23.0	.16
Taki	18.0	.16	18.0	6.47	44.0	1.23	80.0	.54
Bheda	13.0	.12	19.0	6.83	48.0	1.34	80.0	.54
Gutum	7.0	.06	5.0	1.80			12.0	.08
Colisha					95.0	2.66	95.0	.64
Keski							3.0	.02
Chapila		.21	3.0	1.08	149.0	4.17	182.0	1.23
Chanda	23.0		10.0	3.60				
Cutcutia								
Ghavra			5.0	1.80			5.0	.03
Batasi	580.0	5.29			183.0	5.12	763.0	5.15
Titputi								
TOTAL	10967.0	100.00	278.0	100.00	3571.3	100.00	14816.3	100.00

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Results from other fisheries studies in the country have suggested that fish species in the floodplain can be habitat-specific, such as in the Tangail Compartmentalization Pilot Project (de Graaf, personal communication) located in the Jamuna/Dhakatia Floodplains. However, it is not easy at present from the field data to identify these species with certainty in the Gumti Phase II area. In addition, the basic hydrology of Tangail is very different to that of Gumti, the latter being a vast open floodplain. Nevertheless, results from the Gumti Phase II study would indicate that the major carps caught in Zone B came from the main rivers (Table F.7.5), most likely entering the system through the Meghna or Titas Rivers.

A full study on migration and displacement of fish throughout the Gumti Phase II study area as well as on the Meghna River basin is needed before definite assumptions are made in this regard and certainly before any development projects are implemented in the floodplain areas.

#### **F.7.6 Gear Species Selectivity**

Around 30 different types of fishing gears were found to be in use in the project area (see summary in Appendix F.V and Plates F.7.1 to F.7.8). Thus, in order to analyse the catch in relation to gear type, gears were grouped under seven main gear categories (Table F.7.8). The catch species composition per zone and habitat type was summarized (Tables F.7.9 to F.7.16). These results have been used to estimate the proportion of migratory species (long-distance migrants) in relation to the total catch for the fisheries impacts. However, it should be noted that this survey did not cover any seasonal changes in species composition or abundance.

#### **F.7.7 Species Diversity in the Project Area**

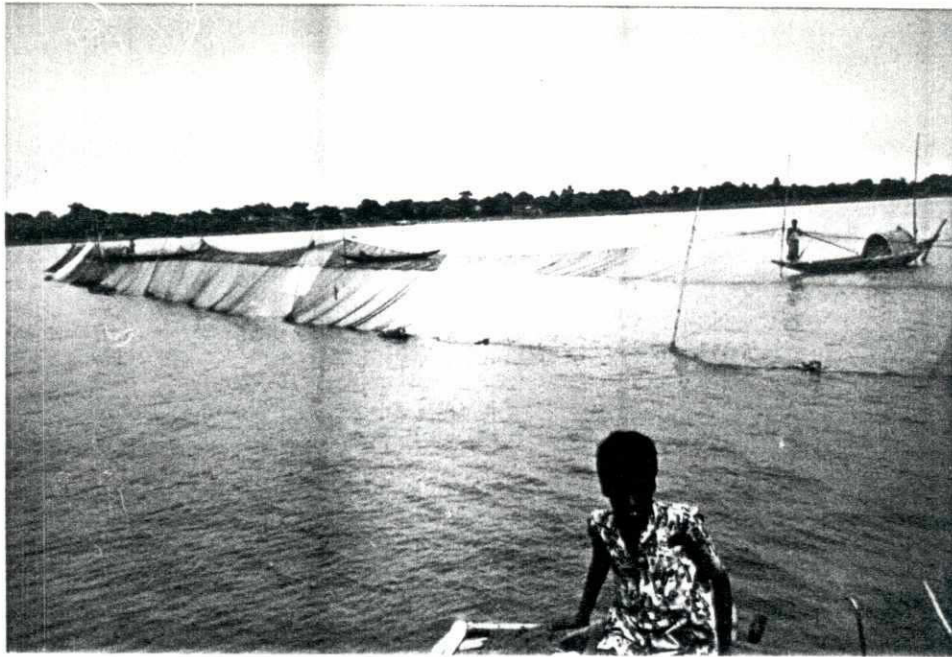
##### **F.7.7.1 Fish Diversity**

Around 90 species belonging to 10 Orders and 25 Families were recorded during the study. Approximately 50% of which were actually observed in the catch (Appendix F.IV). The rest were reported by the fishermen of the area. This represents around 35% of the total number of freshwater fish species currently known in the country.

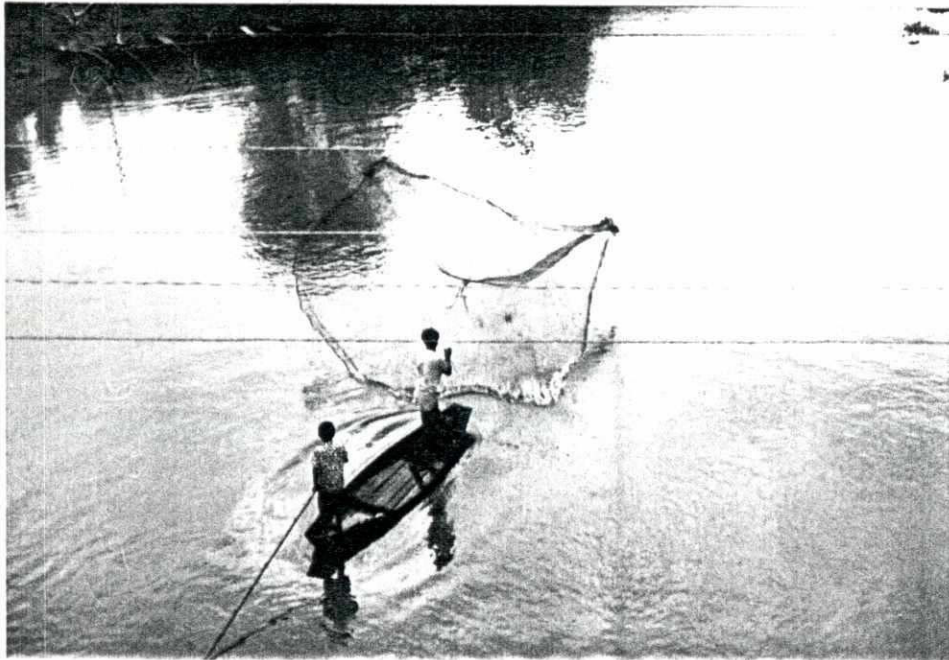
It is very likely that this figure may increase after a more in depth analysis of this fauna, especially if all species are considered and not just the commercial ones.

##### **F.7.7.2 Crustaceans**

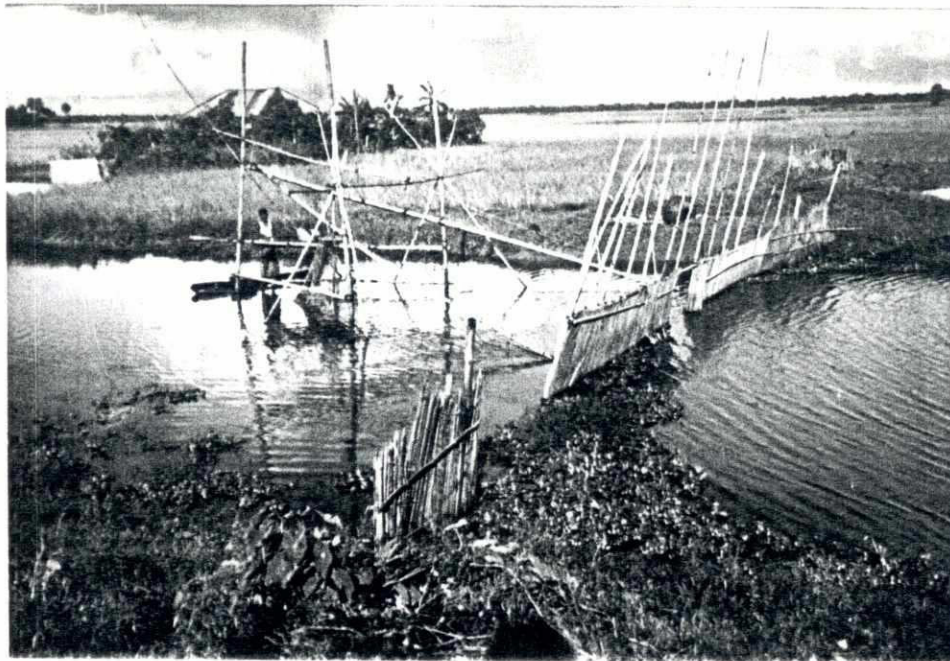
Only *Macrobrachium rosenbergii* and *M. styliferus* were recorded in the catch. However, according to fishermen's reports, 10 species of palaemonids and one ocypodid (*Ocypoda certophtalma*) also occur in the area (Appendix F.IV). Clearly, the number of invertebrates found in this vast floodplain is also expected to increase after due consideration is given to this important aspect of the ecology of the area.



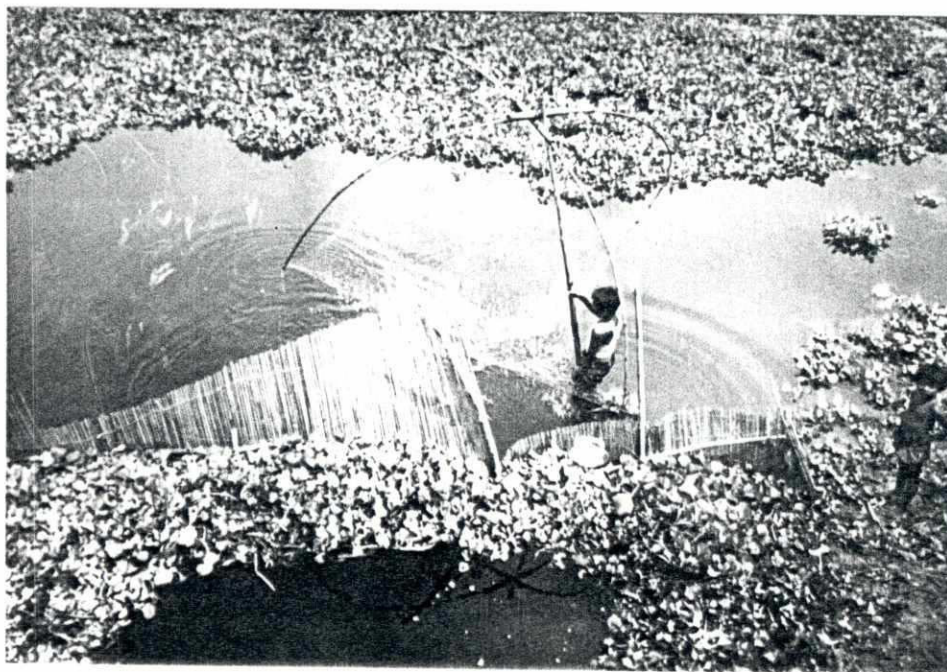
**Plate F.7.1 Large Gill Net Set In an Internal River**



**Plate F.7.2 Jaki Jal or Cast Net in Use**



**Plate F.7.3 Veshal Jal - Lift Net Set In a Minor River.  
Net Being Used in Conjunction with Fish Traps**



**Plate F.7.4 Sitki Jal - Smaller Type of Lift Net  
Used In the Project Area**



Plate F.7.5 Thella Jal - Inexpensive Push Net Commonly Used

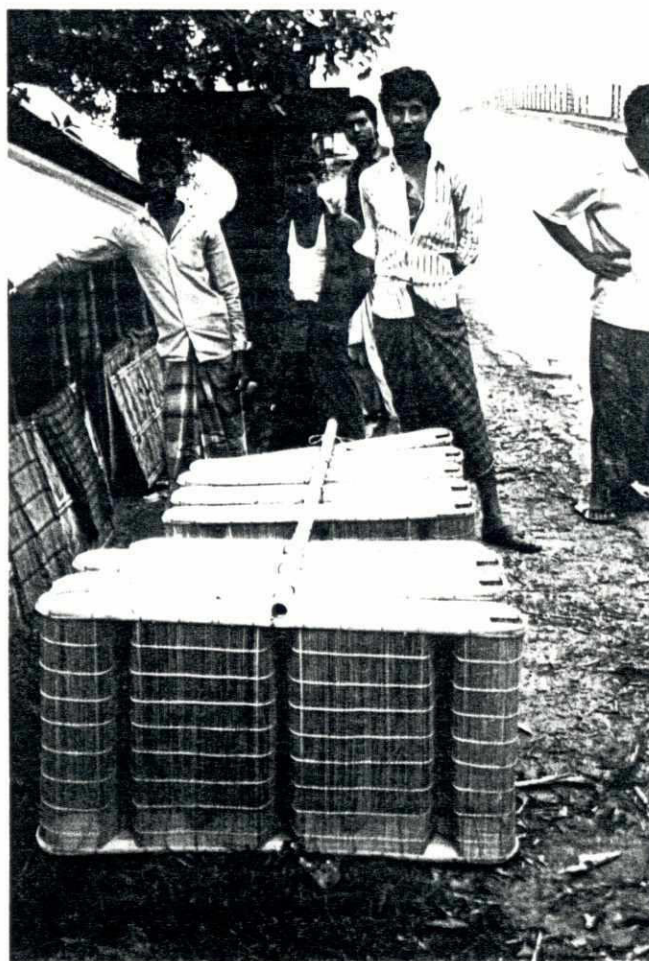
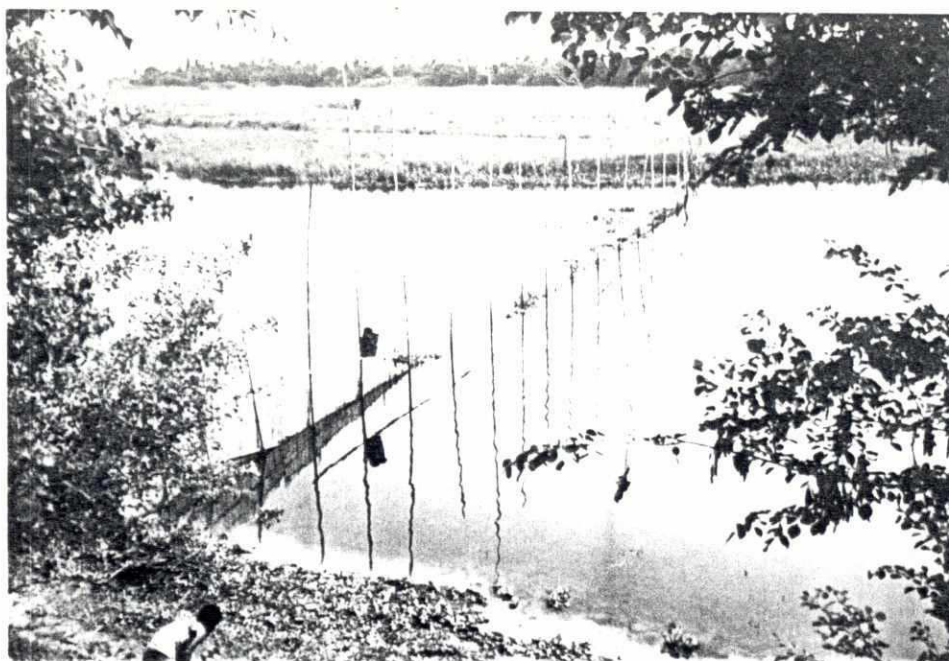


Plate F.7.6 Chai - Small Trap Used Throughout the Project Area



**Plate F.7.7 Trap Being Set Across the Titas River Near Homna**



**Plate F.7.8 Trap Set Across the Span of One  
of the Rivers in Zone D**

TABLE F.7.8

## SUMMARY OF ESTIMATED TOTAL CATCH (KG) BY GEAR

B

	Gill Net	Seine Net	Lift Net	Bag Net	Cast Net	Clap Net	Push Net	Traps	Other	Total
River	157	193								350
Khal			26		21			797		47
Beel	60	446								1302
Total	217	639	26		21			797		1699

## ESTIMATED TOTAL SPECIES CATCH (KG) BY GEAR

C

	Gill Net	Seine Net	Lift Net	Bag Net	Cast Net	Clap Net	Push Net	Traps	Other	Total
River	37	382	35	264	90					807
Khal	56	1427						1495	5	2983
Beel										
Total	93	1808	35	264	90			1495	5	3790

## ESTIMATED TOTAL SPECIES CATCH (KG) BY GEAR

D

	Gill Net	Seine Net	Lift Net	Bag Net	Cast Net	Clap Net	Push Net	Traps	Other	Total
River	17	9271	110	436	201		52	882		10967
Khal		72	134	72						278
Beel	517	2917	54	28	33		23		1	3571
Total	534	12259	297	536	234		75	882	1	14816

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TABLE F.7.9

Estimated Total Species Catch (Kg) by Gear in Rivers in Zone B

River

SPECIES	Gill Net	Seine Net	Lift Net	Bag Net	Cast Net	Clap Net	Push Net	Traps	Other	TOTAL
	%	%	%	%	%	%	%	%	%	%
Ruhi	12.10	.26								5.57
Catla	7.01									3.14
Kalbasu		1.04								.57
Boal	6.37	2.07								4.00
Shol/Gazar	8.28									3.71
Chital/Phali		1.30								.71
Koi		.52								.29
Singi/Magur	9.55	4.15								6.57
Small Srimps	6.37	25.39								16.86
Tengra	7.64	4.15								5.71
Punti	12.74	27.46								20.86
Miscellaneous	10.19	8.29								9.14
Kakila										
Baim	7.01									3.14
Taki										
Silver carp	12.74									5.71
Mola										
Colisha										
Chapila		.52								.29
Chanda		20.73								11.43
Batasi		4.15								2.29
Total	100.00	100.00								100.00

TABLE F.7.10

## Estimated Total Species Catch (%) by Gear in Khals in Zone B

Khal

SPECIES	Gill Net	Seine Net	Lift Net	Bag Net	Cast Net	Clap Net	Push Net	Traps	Other	TOTAL
	%	%	%	%	%	%	%	%	%	%
Ruhi										
Catla										
Kalbasu										
Boal										
Shol/Gazar										
Chital/Phali										
Koi					28.57					12.77
Singi/Magur										
Small Srims										
Tengra										
Punti			50.00		47.62					48.94
Miscellaneous			26.92		23.81					25.53
Kakila										
Baim										
Taki			23.08							12.77
Silver carp										
Mola										
Colisha										
Chapila										
Chanda										
Batasi										
Total			100.00		100.00					100.00

TABLE F.7.11

## Estimated Total Catch (%) by Gear in Beels in Zone B

Beel

SPECIES	Gill Net	Seine Net	Lift Net	Bag Net	Cast Net	Clap Net	Push Net	Traps	Other	TOTAL
	%	%	%	%	%	%	%	%	%	%
Ruhi										
Catla										
Kalbasu										
Boal		14.13						8.79		10.22
Shol/Gazar		15.47						4.27		7.91
Chital/Phali										
Koi	36.97	1.79								2.30
Singi/Magur	15.13	16.37						1.63		7.30
Small Slimps		1.57						16.82		10.83
Tengra		6.05						10.42		8.45
Punti	34.45	27.58						38.73		34.72
Miscellaneous	13.45	3.14						4.52		4.45
Kakila		2.47						2.01		2.07
Baim		1.79						4.52		3.38
Taki		4.48						4.77		4.45
Silver carp										
Mola		.45						3.52		2.30
Colisha		.45								.15
Chapila										
Chanda		4.26								1.46
Batasi										
Total	100.00	100.00						100.00		100.00

2b

TABLE F.7.12

## Estimated Total Catch (%) by Gear in Rivers in Zone C

River

SPECIES	Gill Net	Seine Net	Lift Net	Bag Net	Cast Net	Clap Net	Push Net	Traps	Other	TOTAL
	%	%	%	%	%	%	%	%	%	%
Ruhi		3.93		7.01	6.67					4.89
Catla		4.06	8.70	2.65						3.16
Mrigal		2.62		4.55	10.00					3.84
Kalbasu	5.41	5.90	5.80	5.68	12.22					6.51
Boal	5.41	6.03	20.29	7.95	12.22					7.93
Air			2.90	1.89						.74
Shol/Gazar		2.49	8.70	1.14						1.92
Chital/Phali	5.41	7.99	8.70	6.44	10.00					7.62
Koi		1.05		.76						.74
Singi/Magur		.26	1.45	.57						.37
Small Srims		2.75	5.80	.57						1.73
Tengra	8.11	8.78	5.80	8.33	2.22					7.74
Pabda										
Punti	40.54	19.00	5.80	13.26	8.89					16.42
Miscellaneous		9.04	7.25	3.98	10.00					7.00
Chela										
Kakila		1.05		1.52						.99
Baim				1.89						.62
Bhagna	8.11	5.50	2.90	4.55						4.58
Baila	8.11	5.50	8.70	6.44	8.89					6.44
Taki										
Bheda	5.41	7.21	7.25	7.95	7.78					7.43
Mola				1.89						.62
Chapila	2.70	3.41		3.79	7.78					3.84
Chanda	10.81	3.41		7.20	3.33					4.83
Cutcutia										
Batasi										
Titputi										
69										
Total	100.00	100.00	100.00	100.00	100.00					100.00

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TABLE F.7.13

## Estimated Total Catch (%) by Gear in Beels in Zone C

Beel

SPECIES	Gill Net	Seine Net	Lift Net	Bag Net	Cast Net	Clap Net	Push Net	Traps	Other	TOTAL
	%	%	%	%	%	%	%	%	%	%
Ruhi		3.89						.54		2.13
Catla		1.65								.79
Mrigal		.53								.25
Kalbasu		1.82								.87
Boal		8.66						6.62		7.46
Air										
Shol/Gazar		3.47						9.57		6.45
Chital/Phali		2.80						.60		1.64
Koi	21.43	4.00						5.38		5.01
Singi/Magur	5.36	2.45						3.85	100.00	3.37
Small Srimps		3.82						10.00		6.84
Tengra	10.71	9.81						7.19		8.50
Pabda								.13		.07
Punti	35.71	12.44						24.41		18.86
Miscellaneous		6.31						.67		3.35
Chela								.07		.03
Kakila	3.57	1.82						2.14		2.01
Baim	8.93	2.42						1.67		2.16
Baila								1.47		.74
Taki		3.93						5.52		4.64
Bheda	14.29	2.59						3.01		3.02
Gutum		.74						.43		.57
Colisha		2.31						1.84		2.03
Chapila										
Chanda		7.43						10.47		8.80
Cutcutia		1.54						.13		.80
Batasi		5.54						2.98		4.14
Titputi		9.92						1.24		5.36
69		.11						.07		.08
Total	100.00	100.00						100.00	100.00	100.00

TABLE F.7.14

## Estimated Total Catch (%) by Gear in Rivers in Zone D

River										
SPECIES	Gill Net	Seine Net	Lift Net	Bag Net	Cast Net	Clap Net	Push Net	Traps	Other	TOTAL
	%	%	%	%	%	%	%	%	%	%
Ruhi		.87	.91	2.29	1.00		1.92	.28		.88
Catla	5.88	.42	1.83	2.75	.25					.49
Mrigal		.05	.91	1.72	.75					.14
Kalbasu		.35	.91	1.49	2.24					.40
Ghainna	5.88	.15	.91	.46	1.50		1.92			.20
Boal	2.94	3.85	7.31	8.60	5.99		21.15	1.70		4.02
Air	17.65	.66	3.65	.92	3.49		7.69			.76
Shol/Gazar		4.19	9.59	7.57	9.23		9.62	2.04		4.31
Chital/Phali	2.94	2.05	3.20	4.70	3.49			2.27		2.21
Koi		.26	.91	1.83	.50		1.92			.32
Singi/Magur		1.38	4.57	5.39	5.74		5.77			1.56
Sar Punt		.60	.91	2.18	2.00			2.38		.83
Big Shrimps	35.29	2.27	12.79	13.07	26.18		19.23	.62		3.24
Small Shrimps		4.42	23.74	11.01	5.74		3.85	4.76		4.91
Tengra		17.18	2.28	8.26	1.75		3.85	4.31		15.27
Pabda		1.00	.46	1.83	1.00		3.85			.96
Punti	11.76	40.20	12.33	14.68	10.47		5.77	39.36		38.09
Miscellaneous	17.65	15.72	12.79	11.24	18.70		13.46	5.67		14.75
Kakila		.28						2.50		.44
Baim		.13						.68		.16
Baila		.12						1.36		.21
Taki		.13						.62		.16
Bheda		.07						.74		.12
Gutum		.05						.28		.06
Keski										
Chapila										
Chanda		.13						1.25		.21
Ghawra										
Titputi		3.48						29.15		5.29
Total	100.00	100.00	100.00	100.00	100.00		100.00	100.00		100.00

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TABLE F.7.15

## Estimated Total Catch (%) by Gear in Khals in Zone D

Khal

SPECIES	Gill Net	Seine Net	Lift Net	Bag Net	Cast Net	Clap Net	Push Net	Traps	Other	TOTAL
	%	%	%	%	%	%	%	%	%	%
Ruhi		2.78	1.49	1.39						1.80
Catla			1.49	1.39						1.08
Mrigal		1.39	.75							.72
Kalbasu										
Ghainna										
Boal		12.50	5.22	5.56						7.19
Air		2.78	3.73	4.17						3.60
Shol/Gazar		16.67	10.45	6.94						11.15
Chital/Phali		4.17	2.99	4.17						3.60
Koi		1.39	1.49							1.08
Singi/Magur		4.17	10.45	8.33						8.27
Sar Punti		1.39	2.24	2.78						2.16
Big Shrimps		1.39	.75							.72
Small Srimps		1.39	6.72	6.94						5.40
Tengra		1.39	.75							.72
Pabda		1.39								.36
Punti		19.44	9.70	11.11						12.59
Miscellaneous		9.72	18.66	18.06						16.19
Kakila		1.39	2.24	1.39						1.80
Baim										
Baila										
Taki		4.17	7.46	6.94						6.47
Bheda		4.17	6.72	9.72						6.83
Gutum		1.39	.75	4.17						1.80
Keski										
Chapila		1.39	.75	1.39						1.08
Chanda		2.78	3.73	4.17						3.60
Ghawra		2.78	1.49	1.39						1.80
Titputi										
Total		100.00	100.00	100.00						100.00

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TABLE F.7.16

Estimated Total Catch (%) by Gear in Beels in Zone D

Beel

SPECIES	Gill Net	Seine Net	Lift Net	Bag Net	Cast Net	Clap Net	Push Net	Traps	Other	TOTAL
	%	%	%	%	%	%	%	%	%	%
Ruhi	5.13	2.79	3.71				4.37			3.11
Catla	2.03	1.61		10.71	6.06		2.19			1.76
Mrigal	.29	.57								.50
Kalbasu	2.13	1.45	4.18	7.14			2.19			1.62
Ghainna	6.49	1.77	4.64		6.06		6.56			2.55
Boal	7.26	3.79	8.35	7.14	6.06		8.74			4.44
Air	.97		9.28	10.71						.36
Shol/Gazar	5.37	6.08	11.14	7.14	12.12		6.56			6.12
Chital/Phali	4.60	2.98	9.74				8.74			3.30
Koi	2.08	1.11	3.71	7.14			1.09			1.33
Singi/Magur	2.95	2.72	6.50	14.29	12.12		6.56			3.01
Sar Punti	.68	.21	.24	7.14	6.06		.57			.39
Big Shrimps	.29	.34					2.19			.34
Small Shrimps	11.13	10.47	12.53	10.71			4.37			10.46
Tengra	9.87	12.86	1.86		3.03		19.67			12.11
Pabda	1.16	.21								.34
Punti	17.52	20.18	13.92	7.14	24.24		15.30			19.60
Miscellaneous	20.04	12.09	10.21	10.71	24.24		10.93		100.00	13.31
Kakila		.99								.81
Baim										
Baila										
Taki		1.51								1.23
Bheda		1.65								1.34
Gutum										
Keski		3.26								2.66
Chapila										
Chanda		5.11								4.17
Ghawra										
Titputi		6.27								5.12
Total	100.00	100.00	100.00	100.00	100.00		100.00		100.00	100.00

## F.8 Fish Marketing

Traditional fish marketing systems have evolved over the centuries in Bangladesh. Although most of the fishermen in the past have been Hindus, the fish traders have been predominantly Muslims.

In general, the marketing system works as follows, mobile fish assemblers known as Mohajans visit fishermen and collect their catch, often providing fishermen with credit early in the season to guarantee their business. Mohajans occasionally get local agents (Dadals) to collect and purchase the fish for them on a commission basis. In the case of river fisheries, Mohajans also carry ice to the fish landing centres to preserve the purchased fish. Mohajans then transport the fish to nearby markets and sell the catch to local retailers (Nikaries), wholesalers (Paikers), and distributors (Beparis) through commission agents known as Arotdars.

The way this is done is by public auction, where Arotdars sell fish to the highest bidders receiving 3 to 6% commission of sale value. The process can then be repeated when Beparis transport the fish to markets in other Districts or Thanas for resale by Arotdars to local retailers or wholesalers. This system continues until fish reach the smaller rural markets for final sale to consumers.

There are many variations on the above pattern and fishermen often bypass fish traders, taking fish directly to local markets when fish prices are high. However this is only done when it is cost effective because fishermen prefer to sell on site so they can spend more time actually fishing. Quite often, Paikers (wholesalers) also act as assemblers on fishing grounds and operate boats day and night to purchase fish from several fishing units.

In the Gumti Project area, fish are sold in the markets of most towns. More important retail and wholesale fish markets occur in all District Headquarters towns, from where fish are either sent to secondary markets of smaller towns, to the larger markets of Dhaka, or sold directly to consumers. Little information was obtained in this study on the quantities of fish distributed through the regional marketing system.

### F.8.1 Fish Market Survey

A total of 11 markets were sampled in the eight week period. Figure F.4.2 shows the location of the sampled markets. The eleven Bazaars (markets) sampled per zone were:

Zone B: Kuti, Kasha and Dely

Zone C: Nabinagar, Muradnagar, Bholachong, Companiganj and Ramchandrapur

Zone D: Homna and Bancharampur

Table F.8.1 shows that overall, the largest number of fish dealers was found in Zone D, which was also the zone with the higher fish catches; second was Zone C, the north part of which has reputedly a large number of fish markets. It can be seen that retail dealers dominated in all zones, followed by part time dealers in Zones B and D, while in Zone C, wholesalers were second. Arotdars (dealers) were more numerous in Zone D while there were none recorded in Zone B. Presumably this is a reflection of the larger bulk of fish produce that goes through the market in this zone.

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TABLE F.8.1

**Total Number and Type of Fish Dealers by Zone in the Gumti Phase II Study Area**

Type of Dealer	Zone B	Zone C	Zone D	Total
Arotdar/Stockist		16	40	56
Wholesaler	79	206	221	506
Retailer	451	632	802	1885
Part Time Dealer	108	26	316	450
Total	638	880	1379	2897

Source: Fish Market Survey carried out during this study

**F.8.1.1 Fresh Fish**

There were approximately 50 species being sold as fresh produce (Table F.8.2). The number of species traded per zone varied and there was an apparent increase in these from Zone B (26 species) to Zone C (35 species) and Zone D (48 species). Species found for sale in Zone D only, included Air, Sar Punti, Pabda, Chela, Hilora, Baspata, Batta, Cutcutia, Gangania, Kazali, Ghawra, Napti, Gachua and Patka. Big Shrimps were also for sale in this area only. Chewa/Chering and Fasha were only found for sale in Zone B.

Table F.8.2 shows the total weight and average price of the fish species for sale per zone. It can be seen that the prices, although very similar in general, showed a tendency to increase from Zone B towards Zone D. This pattern was also observed in the fish market prices per Thana as described below. Plates F.8.1 and F.8.2 show a sample of the great fish diversity found in the project area.

These market prices have been used to estimate the economic value of the fish production in the project area.

**F.8.1.2 Dry Fish**

Results of this survey show that there were 34 species sold as dry fish in the eight week period. The number of traded species was higher in Zone C (25 species), followed by Zone D with 21 species and lastly, Zone B with 16 species (Table F.8.3; Plate F.8.3). The higher variety of dry fish species in Zone C is not surprising as the area is a good market territory, especially in the Nabinagar area, where a large number of small fish were observed being dried during field visits.

TABLE F.8.2

## Fish Market Prices for the Main Species Groups in Gumti Phase II

		Zone B		Zone C		Zone D		Total Value Tk	Total Weight Kg	Total Average Tk/Kg
		Weight	Average Tk/Kg	Weight	Average Tk/Kg	Weight	Average Tk/Kg			
Fresh Fish										
Major Carps	Rui	487	55.6	540	65.8	194	76.7	77489	1221	63.46
	Cattla	362	50	334	73.2	114	73.8	50962	810	62.92
	Mrigal	345	50.6	123	63.5	53	72.5	29110	521	55.87
	Kalbasu	2	55	31	60	16	63.3	2982.8	49	60.87
	Silver carp	598	38	578	54.8	98	46.3	58935.8	1274	46.26
	Carpio	310	51.9	120	55.8	10	82.5	23610	440	53.66
Catfishes	Boal	213	44.2	473	63.3	475	55	65480.5	1161	56.40
	Air					116	64.6	7493.6	116	64.60
	Singi/Magur	223	43.8	70.5	71.2	446.5	55.2	39433.8	740	53.29
	Tengra	250	24.1	230	41.2	117	37.5	19888.5	597	33.31
	Pabda					46	67	3082	46	67.00
	Kazali					1	60	60	1	60.00
	Ghawra					6	65	390	6	65.00
	Batasi			108	29.3	5	35	3339.4	113	29.55
Snakeheads	Shol/Gazar	189	36.7	113	42.1	664	50.7	45358.4	966	46.95
	Chital/Phali	26	46.7	55	50.5	202	56.3	15364.3	283	54.29
	Taki	179	23.8	141.5	26.9	371	30.4	19344.95	691.5	27.98
	Chanda	216	23.9	213	19.8	164	19.8	12627	593	21.29
Herrings/Shads	Hilsha	520	35	85	47.5	45	35	23812.5	650	36.63
	Chapila	12	35	28	43.8	48	37	3422.4	88	38.89
	Fasha			12				0	12	0.00
Small Fish/ Miscellaneous	Koi	190	38.8	118	55.7	107	65.9	20995.9	415	50.59
	Ghonnia			4	12	8	55	488	12	40.67
	Sar Punt					25	67.5	1687.5	25	67.50
	Punti	577	22.5	407	24.7	992	29.5	52299.4	1976	26.47
	Miscellaneous	92	21.7	25	15	600	34	22771.4	717	31.76
	Chela					18	25	450	18	25.00
	Kakila			74	20.3	83	26.3	3685.1	157	23.47
	Baim	118	19.1	80.5	43.7	55	43.3	8153.15	253.5	32.16
	Bhagna			45	46	31	44.3	3443.3	76	45.31
	Baila			51	36.7	29	34.2	2863.5	80	35.79
	Bheda	6	35	77	33.7	220	35.5	10614.9	303	35.03
	Chewa/Chering			58	26.3			1525.4	58	26.30
	Mola	5	36	128.5	29.1	23	28.3	4570.25	156.5	29.20
	Gutum			6	22.5	42	28.8	1344.6	48	28.01
	Colisha	3	20	139	25.3	79	27.6	5757.1	221	26.05
	Baicha	293	20		20	2	62.5	5900	375.5	15.71
	Hilora					2	55	110	2	55.00
	Keski	12	25	57	25	162	21.5	5208	231	22.55
	Baspata					12	41.7	500.4	12	41.70
	Batta					6	37.5	225	6	37.50
	Cutcutia					22	18.8	413.6	22	18.80
	Gangania	9	16.7					150.3	9	16.70
	Titputi			130	13.4	80	19	3262	210	15.53
	Napti					30	15	450	30	15.00
	Gachua					57	16.7	951.9	57	16.70
	Patka					5	15	75	5	15.00
	Tilapia	276	29.4	147	37.8	82	35	16541	505	32.75
Shrimps	Big Shrimps					445	246.2	109559	445	246.20
	Small Shrimps	376	26.2	105	30	383	21.5	21235.7	864	24.58
Total		5880	34.4	4895	41.7	6800.5	52.4	807418.35	17668	45.70

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TABLE F.8.3

## Market Prices for Dry Fish per Zone in the Gumti Phase II Area

	ZONE : B		ZONE : C		ZONE : D	
	Weight of dry fish	(Tk./kg)	Weight of dry fish	(Tk./kg)	Weight of dry fish	(Tk./kg)
Dry fish	7.0	70	9.0	100	2.0	80
Kalbasu					15.0	70
Ghainna			22.0	60	24.0	125
Shol/Gazar			199.0	123		
Chital/Phali			2.0	110		
Singi/Magur						
Sar Punti	20.0	98	346.0	60	10.0	43
Small Srimps	341.0	98	266.0	104	2.0	100
Tengra	410.0	117	869.0	92	65.0	89
Punti	569.0	84			16.0	88
Miscellaneous			105.0	90	8.0	80
Kakila	11.0	88	15.0	50	67.0	54
Hilsha	12.0	80	160.5	86	11.0	88
Baim	138.0	84	67.5	85		
Baila	1.0	60	5.0	80		
Taki			16.5	93		
Bheda			5.0	80		
Chewa/Chering			115.0	31	3.0	60
Mola			43.0	78		
Colisha			89.0	88	41.0	82
Baicha	206.0	77	81.0	100	7.0	50
Keski	154.0	68	5.0	70		
Chapila	163.0	73	401.0	56	28.0	73
Chanda	198.5	75	205.0	58		
Baspata	10.0	50				
Fasha	70.0	55			3.0	60
Churi						
Rup-chanda	10.0	120	132.0	90	5.0	65
Loitta					49.0	69
Batta			60.0	83	8.0	45
Rita					27.0	45
Cutcutia			39.0	83	22.0	40
Batasi			47.0	33	1.0	40
Titputi						
Gachua						
Total	2320.5	84	3304.5	83	414.0	74

Source: Fish Market Survey carried out during this study



Plate F.8.1 Fresh Fish at Market. Note Diversity of Species



Plate F.8.2 Fresh Fish at Market. Note the Difference  
in Species and Sizes



Plate F.8.3 Dry Fish for Sale at Nabinagar Market, Zone C

A more erratic pattern in the prices of dry fish was found in relation to zones. Particular disparities were exhibited by the price of Small Shrimps, which declined from 98 Tk/Kg in Zone B to 60 Tk/Kg in Zone C and 43 Tk/Kg in Zone D, a drop in price of 56%. The price for Hilsa was over 30% higher in Zone B than in Zone D, which lies in its migration route. Prices for Rita, Batasi and Keski were higher in Zone C than in the other zones. Price differences in these cases were around 50%. It is possible to explain these differences on the grounds of availability of fish and the relative surplus of fresh produce from the various zones.

Dry fish found for sale in Zone B only, included Sar Punti, Fasha and Rup Chanda. Those fish only reported for sale in Zone C were Kalbasu, Singi/Magur, Taki, Bheda, Chewa/Chering, Colisha and Loitta; whereas Churi, Batta, Cutcutia, Gachua and Miscellaneous species were found only in Zone D.

### **F.8.2 Fish Market Prices in Selected Thanas**

Fish market prices during 1992 were collected in the Thanas of Bancharampur, Homna and Daudkandi and are shown in Table F.8.4. The average market prices in Bancharampur and Homna are similar but not so in Daudkandi, where the price of the larger carps was noticeably lower. Average price for Snakeheads, Shol and Gazar was similar in all Thanas as well as prices for some of the smaller species e.g. Singi, Magur and Punti. The average price for Tengra was higher in Daudkandi than in the other two Thanas. Shrimp prices were higher in Daudkandi, especially for the Big Shrimps, which were more than three times that for Bancharampur. It is unclear at the moment why prices vary so much, but it may be simply a reflection of the ability of fish dealers to shift produce faster in Daudkandi than in Homna or Bancharampur due to its closeness to a main road. In the case of shrimps, the consistently higher prices in Daudkandi may be a result of the poorer availability of the species in this area.

### **F.8.3 Estimated Economic Value of the Fish Catch in Gumti Phase II**

To obtain an estimate of the market value of the catch in Gumti, the information collected during the eight week market survey was linked by species to the catch data. Following this procedure, it was possible to separate the fish data from the catch assessment survey into three categories: high, medium and low value fish. From the market price survey, an average price for fish was obtained for each of these categories as follows: high value: 58 Tk/Kg, medium value: 39 Tk/Kg and low value: 27 Tk/Kg.

Table F.8.5 shows the proportion of the different value fish in each of the sampled zones. From this table, it can be seen that the vast majority of high value fish was caught in Zone D, followed by catches in Zone C and B. In fact, this pattern is repeated when the medium and low value fish are considered (Figure F.8.1).



Figure F.8.1  
Proportion of Estimated Fish Production  
with Different Market Values

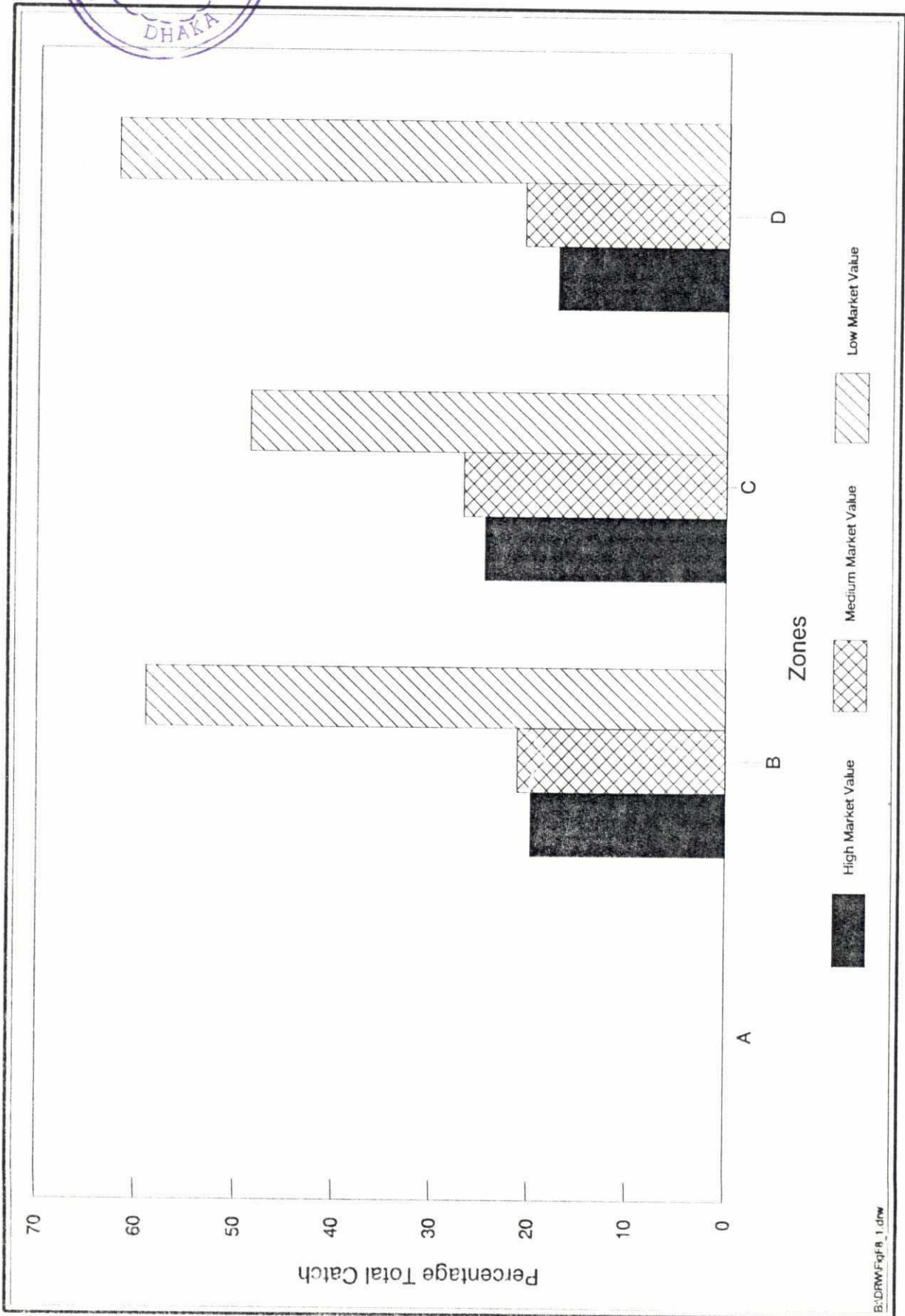


TABLE F.8.4

Fish Prices in Selected Markets in Gumti Phase II Project Area During 1992

## Bancharampur

Fish Prices (Tk/Kg)							Average
	Jan-Feb	Mar-Apr	May-Jun	Jul-Aug	Sept-Oct	Nov-Dec	Price
Rui	70	80	100	100	90	80	87
Catla	70	80	100	100	90	80	87
Mrigal	50	60	70	70	70	60	63
Silver Carp	30	40	40	40	40	50	40
Mirror Carp	50	50	55	60	50	50	53
Shol/Gazar	30	30	40	50	50	30	38
Singi	50	50	70	80	70	60	63
Magur	60	60	70	80	80	70	70
Koi	70	70	80	90	90	80	80
Punti	15	25	30	40	40	25	29
Tengra	20	30	35	30	40	30	31
S Shrimp	15	20	25	30	30	30	25
M Shrimp	30	40	40	50	40	30	38
B Shrimp	80	90	125	100	100	100	99

## Homna

Fish Prices (Tk/Kg)							Average
	Jan-Feb	Mar-Apr	May-Jun	Jul-Aug	Sept-Oct	Nov-Dec	Price
Rui	85	75	110	100	100	100	95
Catla	80	70	75	75	75	75	75
Mrigal	70	55	60	60	60	65	62
Silver Carp	40	30	30	35	40	40	36
Shol/Gazar	30	35	40	50	50	45	42
Singi	60	60	70	75	80	80	71
Magur	55	60	70	80	80	70	69
Punti	20	20	25	30	30	30	26
Tengra	25	30	30	35	30	30	30

## Daudkandi

Fish Prices (Tk/Kg)							Average
	Jan-Feb	Mar-Apr	May-Jun	Jul-Aug	Sept-Oct	Nov-Dec	Price
Rui	40	35	35	50	55	35	42
Catla	35	32	32	55	65	35	42
Mrigal	25	20	20	40	50	30	31
Silver Carp	20	20	20	40	45	25	28
Mirror Carp	35	35	35	50	50	30	39
Shol/Gazar	25	30	40	50	50	30	38
Singi	45	50	60	65	70	40	55
Magur	55	60	70	80	80	45	65
Punti	25	30	35	40	40	25	33
Tengra	30	40	50	50	50	30	42
S Shrimp	25	30	35	40	40	30	33
B Shrimp	200	300	300	400	400	200	300

Source: Fish Market Survey carried out during this study

TABLE F.8.5

Proportion of Estimated Fish Production with Different Market Value in the Gumti Phase II Study Area

	ZONES								TOTALS	
Market Price	A		B		C		D			
	Kg	%	Kg	%	Kg	%	Kg	%	Kg	%
High	NA	NA	337	19.8	933	24.6	2555	17.3	3825	18.8
Medium	NA	NA	360	21.2	1014	26.8	3069	20.7	4443	21.9
Low	NA	NA	1002	59	1843	48.6	9192	62	12037	59.3
Total	NA	NA	1699	100	3790	100	14816	100	20305	100

Source: Catch assessment and market surveys carried out during this study

Therefore, the current market value of the capture fisheries production (24,103 MT, including Zone A) in the project area can be estimated to be **Tk 855 million**, of which by **Tk 263 million** was contributed by the high value species, **Tk 206 million** by the medium value species and **Tk 386 million** by the low value species.

It should be remembered that these estimates refer only to commercial catches, as far as it is known. The subsistence catch (i.e. that directly consumed which does not pass through the market) has hence not been taken into account in this analysis. The total value of the catch would thus be expected to be even higher than this estimate, although it is unknown by how much.

It is thus clear, that any proposed engineering intervention will need to take into account the loss of income to the members of the intricate local economic web such as the fishermen, market dealers, Jalmahal leaseholders, boat builders, net and trap makers, as well as those who benefit by supplying transport, ice and other services. It is granted that many fishermen would have already been performing several of these tasks themselves. However, it is unquestionable that any disruption created to the fishing system and hence to its dependent community will have serious consequences to the local and regional economy.

## **F.9 Agro-Socio-Economic Survey - Fishermen Survey**

The fishermen survey was carried out by the Agro-Socio-Economic Team and was completed by 169 respondents. In general, just under half (48.5%) are exclusively involved in fishing and thus have no other source of income than the sale of fish. Of the remainder, 84% report fishing as their main source of income with farming cited as the second major source (53%) (Table F.9.1).

### **F.9.1 Days Spent Fishing**

Out of the total 169 fishermen interviewed, 155 (92%) are essentially dependent on fishing for their livelihood and this is reflected in the number of days spent fishing (Table F.9.2). The average number of days spent fishing per year increased from Zone A to Zone D, which confirms the importance of fishing in relation to the area of floodplain available. This is also supported by the catch assessment surveys and by the fish production estimates from the Thana survey carried out during this study.

### **F.9.2 Distribution of Fishermen**

When each Zone is considered individually, differences in the distribution of full-time fishermen can be appreciated. Table F.9.1 shows that a large proportion (80%) of fishermen in Zone A have other sources of income, while in Zones B and C, the proportion is lower than in Zone A but roughly similar. In Zone D, however, the situation is reversed with only 37% of fishermen reporting other sources of income. This is not surprising as Zone D is located in the main deeper and longer flooded area.

### **F.9.3 Source of Fish**

Table F.9.3 shows the sources of fish per zone and it can be seen that most of the fishing was carried out in permanent bodies of water such as the internal rivers and Khals, especially in Zones A and B. In Zones C and D fishing in the floodplain and permanent Beels was more important for most of the year.

Gill nets are the most popular means of catching fish, followed by cast nets. Gill net fishing is invariably done in groups and often at night.

### **F.9.4 Annual Catch**

Around half the total annual catch (including ponds) is harvested during the monsoon (Aman) season, ranging from 53% in Zone D to 42.5% in Zone B. Around 30% is harvested during the Aus season and the remainder during the Rabi season (Table F.9.4). A similar pattern can be seen in open waters, with the largest harvests reported for Zone C (52.7 MT), followed by Zone D (41 MT) and Zones A (15 MT) and B (13 MT) respectively.

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TABLE F.9.1  
Distribution of Fishermen by Sources of Income

Other Sources of income	Zone : A		Zone : B		Zone : C		Zone : D		Total	
	#	%	#	%	#	%	#	%	#	%
No	5	20.0	19	51.4	17	40.5	41	63.1	82	48.5
Yes	20	80.0	18	48.6	25	59.5	24	36.9	87	51.5
Total	25	100.0	37	100.0	42	100.0	65	100.0	169	100.0
Main sources of income	#	%	#	%	#	%	#	%	#	%
Fishing(capture)	17	85.0	17	94.4	20	80.0	19	79.2	73	83.9
Farming	2	10.0							2	2.3
Operator of fish ponds	1	5.0							1	1.1
Agriculture labour							2	8.3	2	2.3
Rural industry							1	4.2	1	1.1
Rickshaw/other transport					1	4.0			1	1.1
Trader/shop			1	5.6	4	16.0	1	4.2	6	6.9
Government job							1	4.2	1	1.1
Total	20	100.0	18	100.0	25	100.0	24	100.0	87	100.0
Second sources of income	#	%	#	%	#	%	#	%	#	%
Fishing(capture)	1	5.0	1	5.6	4	16.0	5	20.8	11	12.6
Farming	12	60.0	8	44.4	15	60.0	11	45.8	46	52.9
Operator of fish ponds	2	10.0							2	2.3
Agriculture labour	1	5.0			2	8.0	1	4.2	4	4.6
Other daily labour					1	4.0			1	1.1
Rickshaw/other transport	1	5.0							1	1.1
Trader/shop	2	10.0	9	50.0	3	12.0	5	20.8	19	21.8
Other							1	4.2	1	1.1
No second sources	1	5.0					1	4.2	2	2.3
Total	20	100.0	18	100.0	25	100.0	24	100.0	87	100.0

TABLE F.9.2

Number of Days Spent Fishing Per Year

	Zone : A	Zone : B	Zone : C	Zone : D
Minimum	125	150	180	162
Maximum	360	350	365	355
Average	245	262	286	292
Standard Deviation	59	61	47	51

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TABLE F.9.3

Total kg catch per year

ZONE : A

Sources of fish	Aus		Aman		Robi	
	kg	%	kg	%	kg	%
Parmanent beel	620	13.2	1135	16.0	60	1.5
Seasonal beel	960	20.4	1945	27.4		
Flood plain	1615	34.3	2325	32.8	180	4.5
Khal/internal river	220	4.7	100	1.4	320	8.0
River(major)	1295	27.5	1585	22.4	3464	86.1
Fish pond						
Total	4710	100.0	7090	100.0	4024	100.0

Total kg catch per year

ZONE : B

Sources of fish	Aus		Aman		Robi	
	kg	%	kg	%	kg	%
Parmanent beel	60	.7	250	1.9	50	.6
Seasonal beel	860	10.1	1515	11.8	60	.7
Flood plain	220	2.6	1775	13.8	30	.3
Khal/internal river	2595	30.4	5122	39.9	295	3.3
River(major)	155	1.8	180	1.4	106	1.2
Fish pond	4659	54.5	3984	31.1	8282	93.9
Total	8549	100.0	12826	100.0	8823	100.0

TABLE F.9.3 (Contd.)

Total kg catch per year

ZONE : C

Sources of fish	Aus		Aman		Robi	
	kg	%	kg	%	kg	%
Parmanent beel	6691	35.2	12760	39.7	650	4.8
Seasonal beel	435	2.3	45	.1	35	.3
Flood plain	6350	33.4	9800	30.5	4743	35.2
Khal/internal river	3474	18.3	6780	21.1	930	6.9
River(major)	2056	10.8	2781	8.6	7107	52.8
Fish pond						
Total	19006	100.0	32166	100.0	13465	100.0

Total kg catch per year

ZONE : D

Sources of fish	Aus		Aman		Robi	
	kg	%	kg	%	kg	%
Parmanent beel	2620	22.2	5950	27.3	2981	39.8
Seasonal beel	170	1.4	1310	6.0	205	2.7
Flood plain	4063	34.4	2990	13.7	20	.3
Khal/internal river	2355	19.9	6567	30.2	2592	34.6
River(major)	2530	21.4	4915	22.6	1638	21.8
Fish pond	87	.7	25	.1	61	.8
Total	11825	100.0	21757	100.0	7497	100.0

#### **F.9.5 Average Daily Catch**

The average catch per day in 1992 was approximately 2 Kg which was sold for between Tk 35-40 per Kg, giving a gross daily return of between Tk 70-80. Catches in 1992 declined by about 30% from nearly 3 Kg per day in 1991, presumably as a result of the very dry conditions. Declining catches are also reflected in the claims of 67% of fishermen to use a smaller mesh than they did five years ago, as compared to 33% who use the same size mesh. Further evidence of declining catches could be inferred from the survey which suggests that 93% of fishermen spend more time fishing than they did five years although, of course there could be other reasons for the increase such as the higher cost of living.

#### **F.9.6 Declining Catches**

Fishermen themselves are in no doubt that catches have declined as Table F.9.4 shows. Table F.9.5 lists the reasons which fishermen gave for the decline. In spite of this, fishermen relegated the decline in fish catch to second place when asked to rank their problems. Access to capital was the most frequently mentioned, followed by falling fish catches, with the theft of fish (from reserved waters) third. Marketing of fish was only mentioned as a major problem by 3% of respondents.

#### **F.9.7 Proposed Strategies**

Strategies proposed by fishermen to improve their incomes are presented below in order of importance:

- 1) Improve credit facilities for the purchase of boats and gear
- 2) Increase the depth and area of water
- 3) Ban the use of mist nets
- 4) Maintain existing water levels for longer
- 5) Improve the control of fishing, i.e. enforce fishing regulations

TABLE F.9.4

Changes in Fish Catches Over Last 5 Years (Responses)

	Big Decrease				Small Decrease				Any Increase			
	A	B	C	D	A	B	C	D	A	B	C	D
Permanent beel	-	1	-	30	-	-	-	1	-	-	-	-
Seasonal beel	9	14	34	7	1	1	4	-	-	-	-	-
Khal	19	25	33	44	2	4	4	2	-	-	-	-
	1	4	15	12	1	-	-	1	-	-	1	-
	16	8	5	46	2	4	1	1	-	-	-	-

TABLE F.9.5

Reasons Given for the Decline in Fish Catches (%)

	A	B	C	D
Over fishing	2	6	26	27
Decline in Amount of Water	69	64	28	27
Obstruction of fish Migration	7	3	9	27
Pollution	-	13	3	4
Fish Diseases	20	14	34	11
Other	2	-	1	4
Total	100	100	100	100

## **F.10 Project Interventions**

The definition and description of the intervention strategies are dealt with in more detail in the Environmental Annex (Annex H) of the 1993 Gumti Phase II Final Report. The relevant strategies that were considered for fisheries impact analysis have been summarised as follows:

### **F.10.1 Strategy C**

A mixed strategy including controlled flooding using submersible embankments, non-submersible embankments, small flood water exclusion polders and improved drainage.

The seven elements of this mixed strategy include the rehabilitation and rationalisation of existing embankments (particularly road embankments) and construction of new ones, possibly including submersibles, to allow flooding to be controlled and managed. In some cases, this will entail the complete exclusion of river flood water, but in many the aim is to delay the early river floods. This is the main objective of submersible embankments along with the protection they offer from diminishing the effects of flash floods, particularly outside the peak flood times. These will have also long reinforced weirs set into them as well as gate control structures, to allow for a more managed control of water regimes. In addition, a Khal re-excavation programme will be carried out, aimed at improving drainage of flooding caused by local rainfall. There is also likely to be provision of a surface water source for irrigation in those areas where groundwater use is constrained by water quality. This is to be achieved by both pumping water into a deepened Khal network and also by gravity flow into deepened Khals from the Meghna River in the dry season. These are shown in Figures F.11.1 and F.11.2.

### **F.10.2 Strategy D: Full Polderization, Drainage and Groundwater Irrigation**

This strategy was suggested in the 1990 Report. It excludes all external river flooding into the protected area by construction of full embankments (Figure F.10.1). In addition, there was a provision for improved drainage by Khal excavation and a targeted programme to promote uptake of irrigation using groundwater sources.

### **F.10.3 Strategy E: Full Polderization, Drainage and Surface Water Irrigation**

This strategy was also suggested in the previous feasibility study and has the full embankment provision of D aimed at excluding all external surface inflow into the area. The same Khal re-excavation programme was proposed which would have been linked to promotion of surface irrigation by pumping water back into the drainage system during the dry season, rather than a promotion of groundwater irrigation provision. These pumps would also be used for polder drainage in the monsoon season. Figure F.10.2 shows details of this proposed scheme.

Figure F.10.1  
Map of Strategy D

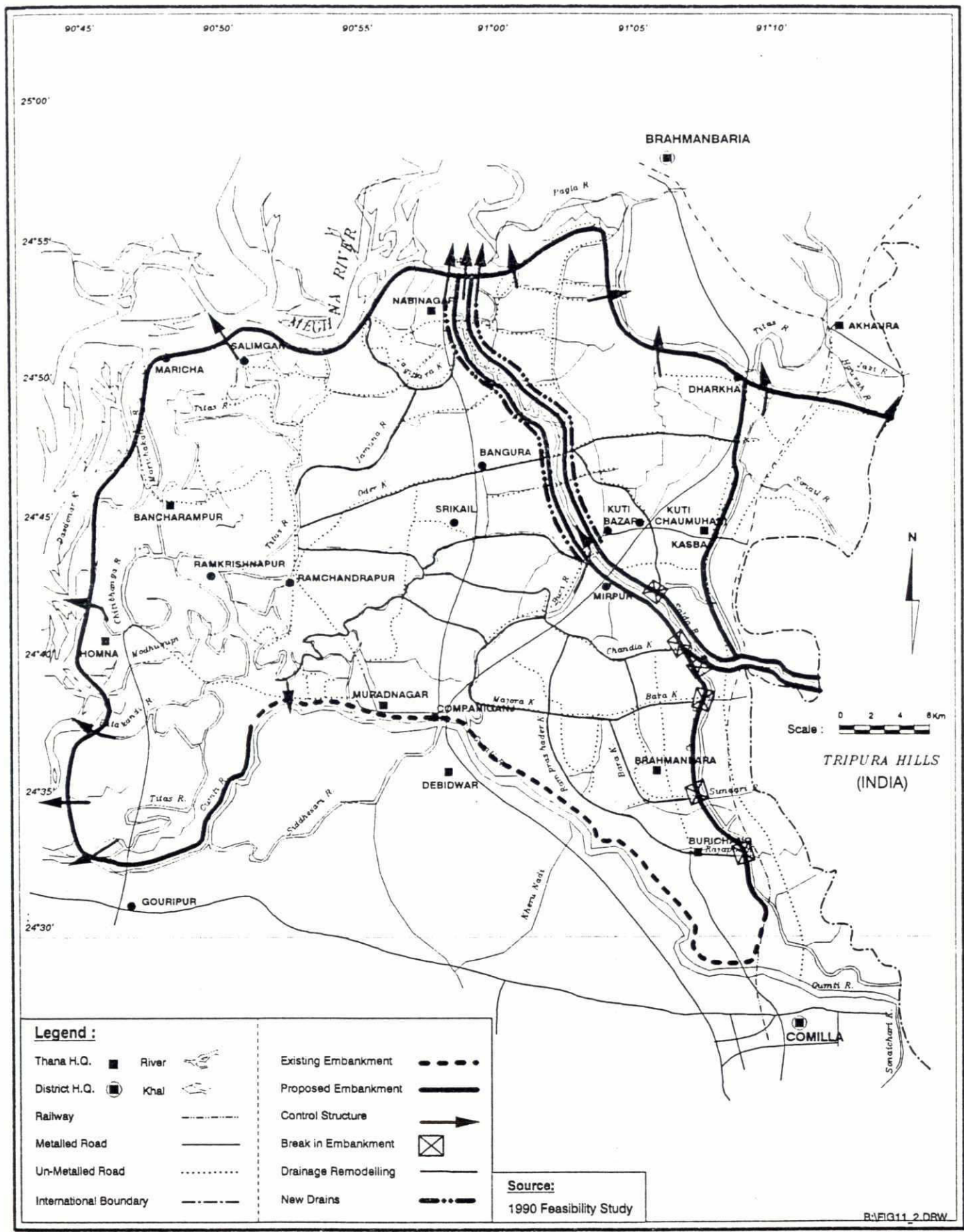
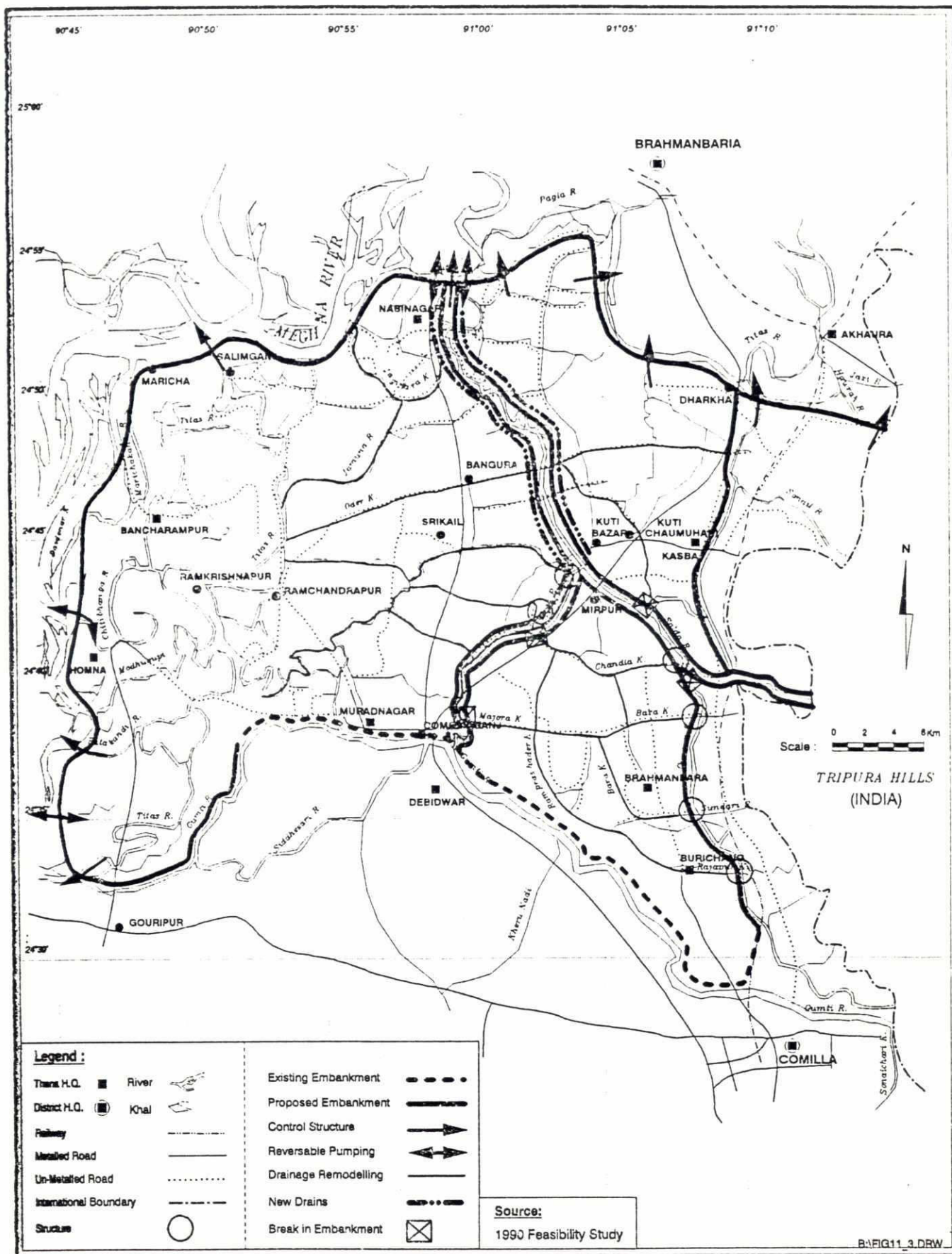


Figure F.10.2  
Map of Strategy E



## **F.11            Impacts on Fisheries in the Area - Submersible Embankments**

### **F.11.1           Lessons Learnt from the Existing Schemes in Satdona and Chandal Beels**

These are existing submersible embankments enclosing Beels in two important fisheries areas (Figure F.11.1). The likely effects of these type of embankments are the delay in the recruitment of fish eggs and fry, which for most species shows a rather regular pattern over the years. Since eggs and fry are passively transported by the current, they will only be able to enter the 'protected' area after overtopping of the embankment occurs in the monsoon season. Thus, early recruitment will be seriously affected, resulting in a shorter growth period and the potential loss of a proportion of the fry through stress associated factors.

At present, there are no specific studies in the project area which will assist us in the assessment of this type of intervention. However, discussions with local fishermen in the Satdona and Chandal Beels, located in Zone D, where submersible embankments and water control structures were constructed approximately 18 months ago, indicate that fisheries have been more seriously affected than previously thought due not only to the lack of egg/fry recruitment, but also to the inability of adult fish to enter the area within the submersible embankment. The fishermen's daily income has dropped from Tk 50-75 in 1991 to Tk 25-35 (interviews with fishermen in the Beels) during the year following closing of the embanked area.

In addition, during the public participation meetings, people were requesting for fish sensitive water management to be carried out and for gates to be re-designed to allow the passage of fish and thus to improve Beel fisheries. Therefore, a loss to the Beel fisheries within a submersible embankment scheme and/or polder has been estimated to be approximately 50% in the first year. A further 8% was also calculated representing subsequent losses of the floodplain resident species. This proportion has been used as the basic assumption for the impact analyses but the proportion has been altered according the individual circumstances surrounding each intervention.

**Figure F.11.1**  
**Un-Modelled Interventions**

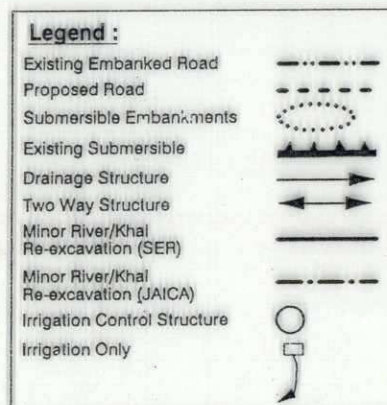
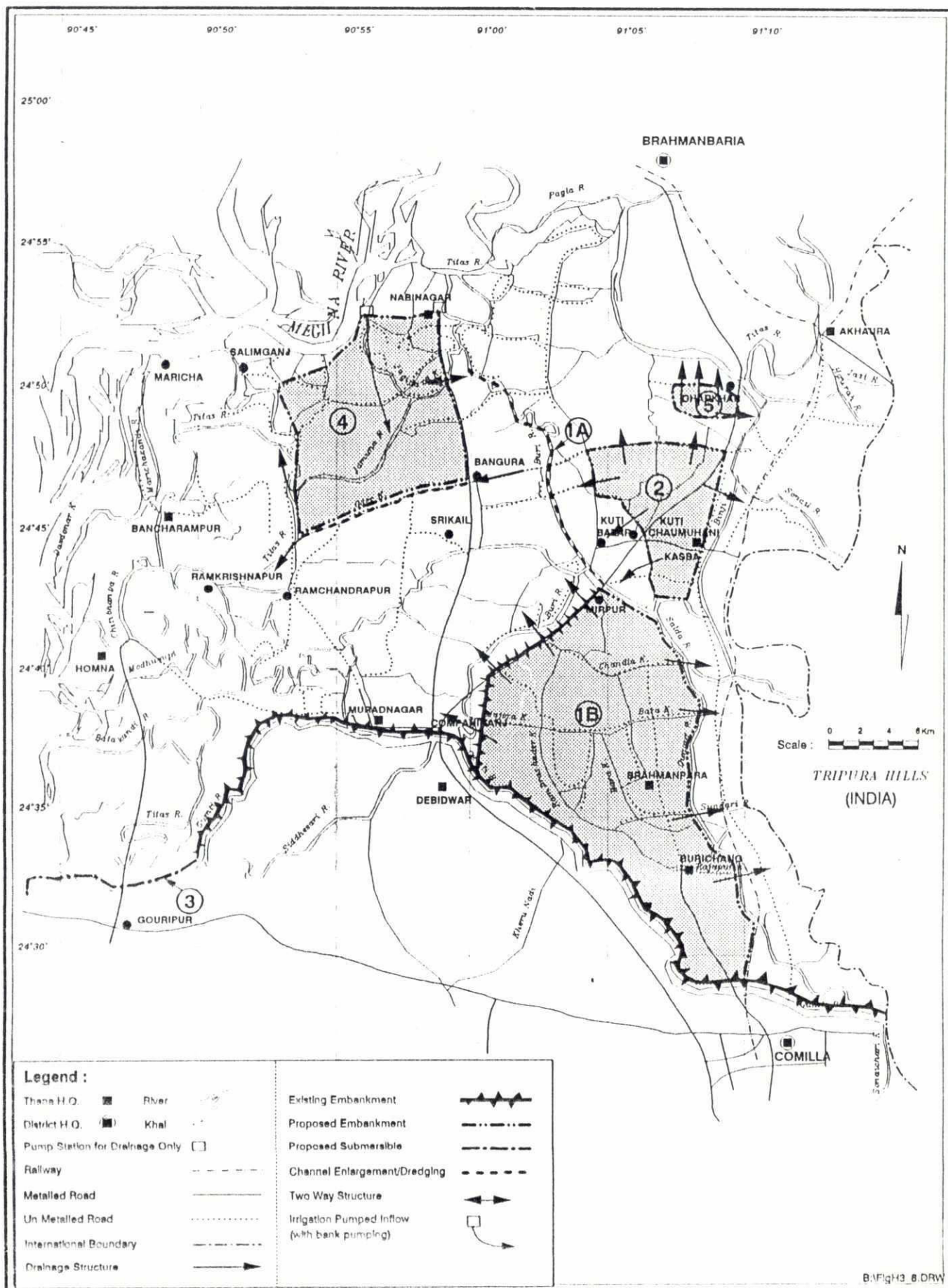


Figure F.11.2  
Modelled Detailed Interventions



## **F.12 Rationale for Estimating Impacts on Fisheries**

Attempting to estimate fisheries losses due to FCD and FCDI schemes in a complex area such as Gumti Phase II in the period of time and with the funding available for this project is extremely difficult, especially since 1992, the year when the short field work was carried out, was a dry one. However, the major issues concerning these type of interventions in the area were identified and those concerned directly with the interventions under consideration are described below. Figure F.11.2 shows details of the modelled interventions for the mixed Strategy C in the project area and Figure F.12.1 shows the rising 1 in 2 Flood Pattern with all the interventions that have been modelled. It should be noted that it was not possible to model the existing and proposed submersible embankments. The with intervention, falling flood situation is shown in Figure F.12.2.

The analysis of the impacts has been carried out for a six year period starting after the end of the construction period.

### **F.12.1 Intervention 1A - Channel Enlargement and Dredging Parts of the Buri Nadi and Salda Rivers**

Re-excavation of this section is an intrinsic part of intervention 1B, which is controlled flooding to prevent flash flooding in Zone A. It is required so as to prevent induced increased flooding of the unprotected areas in Zone A. Difficulties in estimating changes in fish production in this intervention arise from not having enough information on the ecology and biology of the various species which inhabit this type of system. However, it has been assumed that in general, the expected increase in water volume in this intervention will be beneficial to fish, and thus increase production.

In order to calculate the change in depth of water due to Khal excavation, existing bed and water levels, and thus mean water depths, were looked at for each month during a 'normal' 1 in 2 year at suitable intersections. Further analyses were carried out using the modelled output, and the new bed, water levels and water depths were calculated. The overall difference in the mean water depths for a without (WO) and a with project (WI) situation in all deepened Khals showed a 50% increase in water depths in the channel. Thus, this factor was taken into account for estimating benefits to fish production, assuming a direct relationship between water depth and fish production.

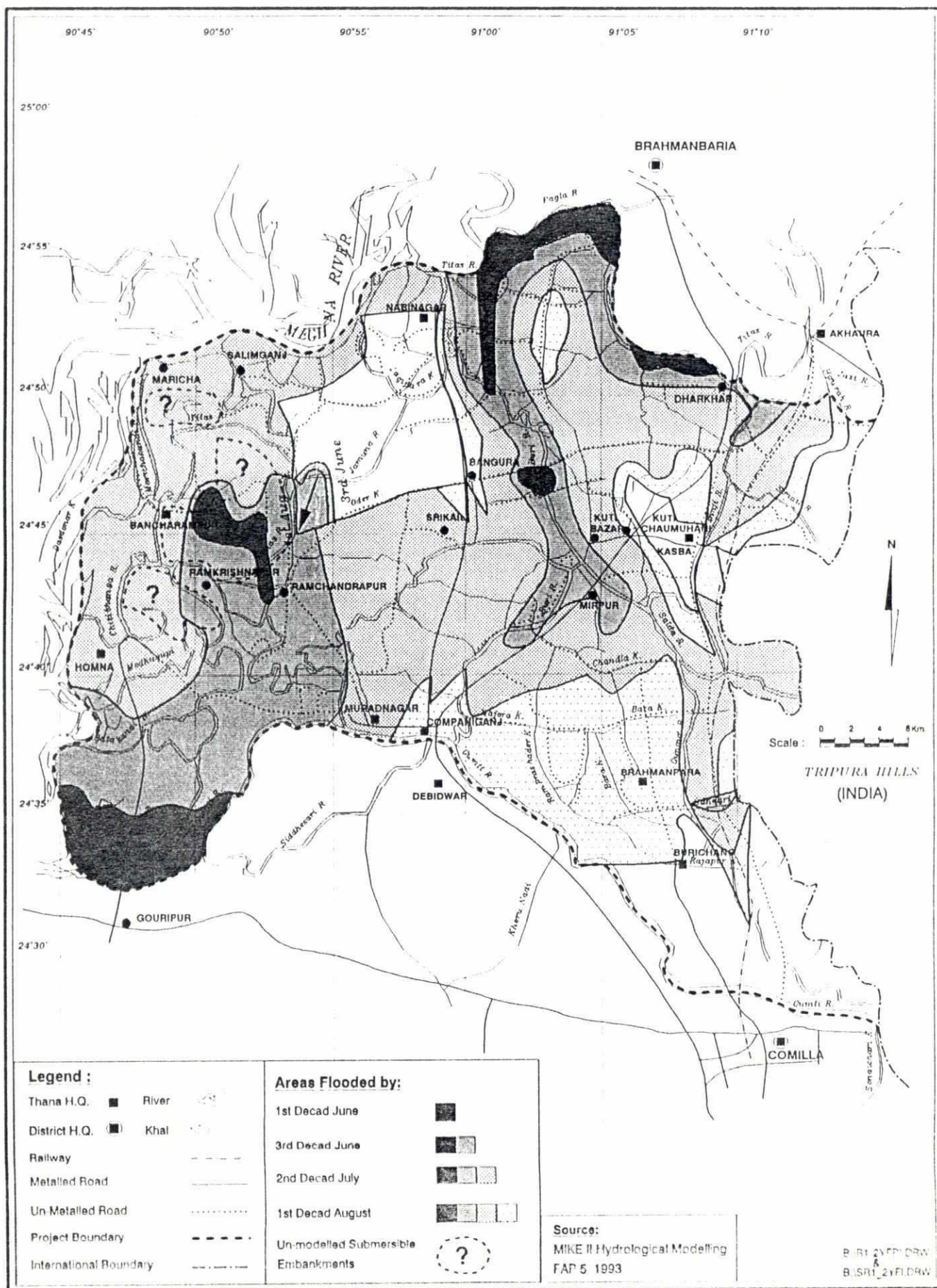
In addition, since this intervention borders several Zones (A, B and C), a proportion of the resulting increase in production has been allocated to them (despite the fact that the intervention is needed as a result of the Zone A controlled flooding proposal) and has been absorbed in the figures for internal rivers and Khals for these zones.

### **F.12.2 Intervention 1B - Flood Protection in Zone A.**

Water within the embanked area will be drained from it during the wet season and water inflow to this zone will be controlled by 8 gated structures, four in the east and four in the northwest. At present, there are at least 20 ungated structures in the northwest side road embankment between Companiganj and Mirpur and although the water exchange is not very good, it does take place through the embankment.

Figure F.12.1

**Rising 1 in 2 Year Flood Pattern with Interventions**





Under this intervention it is planned to reduce the number of openings on the northwest side from 20 open structures to 4 gated channels. The allowance made for fish to re-enter the poldered area consists of fish-friendly gates (Figure F.12.3) which would be kept open until the middle of June, or until increased water levels threaten the agricultural crops in the area. Under this scheme a proportion of the migratory species is expected to be able to enter the area. From preliminary work by FAP 17, it would appear that hatchling numbers may show a peak in July in other parts of the country. However, without a suitable survey to look at migratory fish within the basin and the timing and extent of the migration, it is not possible to estimate accurately at present what this proportion might be in the project area.

Nevertheless, it has been estimated from the catches recorded during this short survey that approximately 16% of the species contributing to the total catch in Zone A are long-distance migrants, i.e. species that enter the Gumti Basin from the main rivers, mainly the Meghna and the Titas, in order to reproduce, grow or feed (e.g. Rui, Catla, Migral, and others) (see Table F.12.1). The migration paths of these species, and many other short-distance migrants, such as most of the floodplain resident species, will be seriously obstructed and many species may not be able to return of their own accord to any of the aquatic habitats within Zone A, unless they are assisted. Therefore, it has been assumed that these long-distance migrants represent a direct loss of 16% of the total fisheries of the zone.

TABLE F.12.1

Estimated Percentage of Long-Distance Migratory Fish Entering the Gumti Phase II Project Area

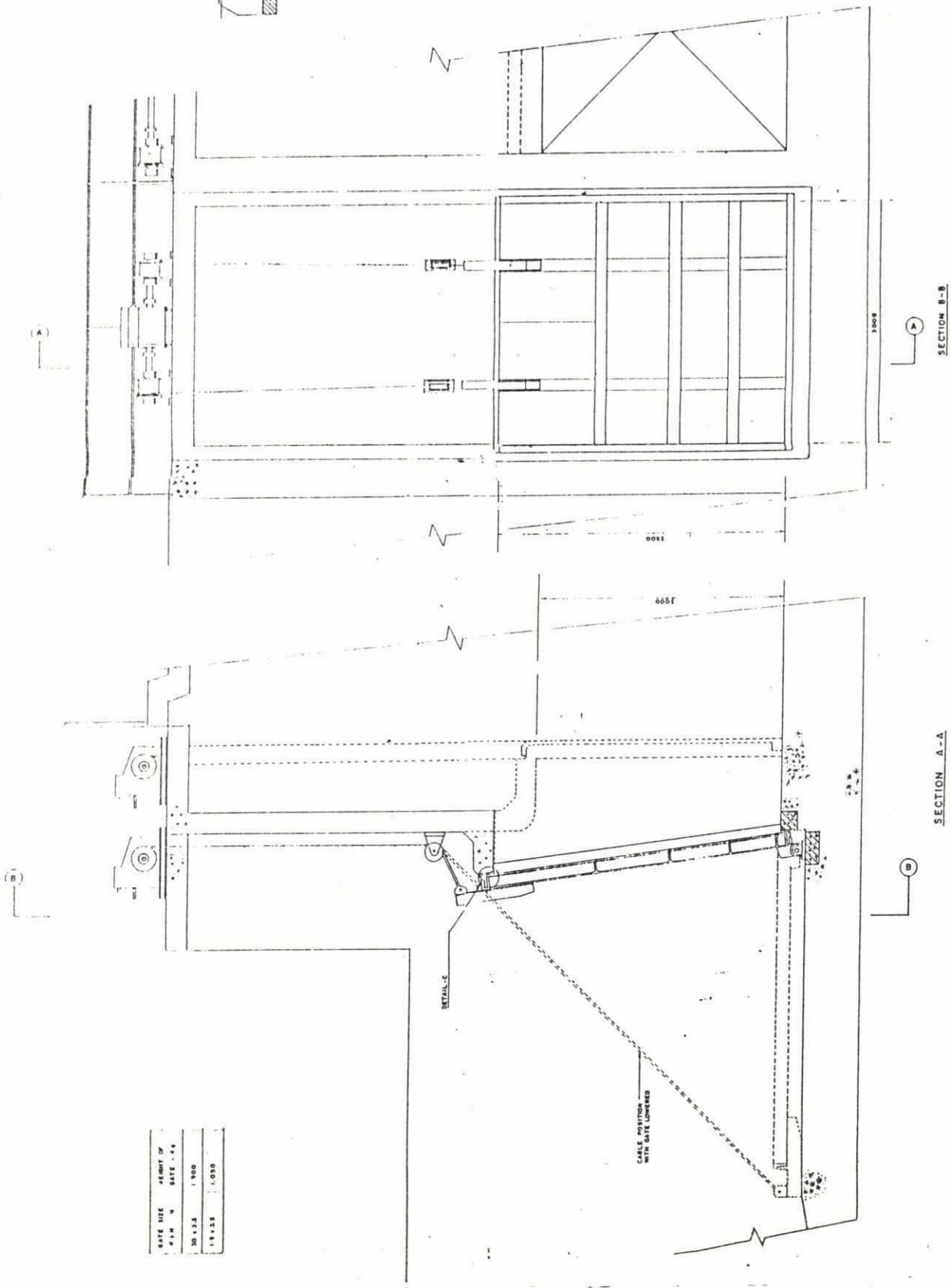
Fishing System	Zone A*	Zone B	Zone C	Zone D
Rivers	16	26.85	32.33	12.27
Khals	0	0	0	13.32
Beels	0	10.83	12.52	23.75
Combined Total	15.3	13.84	16.75	15.1

\* Mean of the combined percentage for Zones B, C and D

Source: Catch Assessment Survey carried out during this study

For the analysis of floodplain production, it has been assumed that there is a linear relationship between area of floodplain and production in the floodplain. Thus it has been estimated that under this intervention there would be a mean reduction of 32% in the area of floodplain within the embankment. However, it cannot be assumed that the remaining reduced floodplain will still be able to produce the previous catch levels after polderization as most of the access for fish to the area would have been severely reduced. Hence, of the remaining floodplain resident species, a loss of 50% has been assumed to occur due to poldering. This proportion has been estimated on the basis of the losses reported for the Chandpur Irrigation Project and the Meghna Dhonagoda schemes which found a 35% reduction in fish production after construction and a further

Figure F.12.3  
Fish Friendly Gate



GATE SIZE	HEIGHT OF
1.8 x 3.3	GATE - 4.4
3.0 x 3.3	1.800
1.8 x 3.3	1.050

MINISTRY OF IRRIGATION WATER DEVELOPMENT AND FLOOD CONTROL BANGLADESH WATER DEVELOPMENT BOARD	MINISTRY OF IRRIGATION WATER DEVELOPMENT AND FLOOD CONTROL BANGLADESH WATER DEVELOPMENT BOARD
GUMTI PHASE II SUB-PROJECT	GUMTI PHASE II SUB-PROJECT
TYPICAL COLLAPSIBLE GATE FOR CONTROL STRUCTURES (FISH FRIENDLY)	TYPICAL COLLAPSIBLE GATE FOR CONTROL STRUCTURES (FISH FRIENDLY)
MOTT MACDONALD LTD. UK	MOTT MACDONALD LTD. UK
NIPPON KOEI CO. LTD. JAPAN	NIPPON KOEI CO. LTD. JAPAN
HOUSE OF CONSULTANTS LTD. BANGLADESH	HOUSE OF CONSULTANTS LTD. BANGLADESH
DESIGNER: S. P. JAYASINGHE	DESIGNER: S. P. JAYASINGHE
DRAWN: E. I. BHUTIA	DRAWN: E. I. BHUTIA
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decline of 15% in the next few years (Thompson, 1990; FAP 12, 1992). A sensitivity analysis was carried out to test the assumption of 50% loss in fish production and analyses using 35%, 50% and 90% figures were carried out. The overall difference between these analyses, for Zone A, was  $\pm 8\%$ , indicating that the result was not particularly sensitive to these changes to the floodplain reduction factor.

Further to this post construction reduction, the fish production was projected over a six year period using the national trend of -1.5% for open water fisheries and +4.5% for pond production. This value was incorporated in all calculations when trend data was used.

Potential fish production lost to the zone has been estimated on the basis on the following construction considerations:

1. Construction will take place during the dry season and thus, most fish species would have moved to deeper water areas (Khals, rivers, etc.) within the Gumti Phase II area for refuge. These few left, would have been subjected to heavy fishing by the local human population during the dry season. This situation has been confirmed by the fishermen in the area.
2. Construction would ideally finish before the monsoon season and thus, all free access to the fish into the poldered area would have been cut before the rise in water levels. Sensitive management of the gates and careful planning of their operation will be crucial factors in ensuring a degree of successful access for fish during the reduced period of time available in the monsoon.
3. Model results show a considerable reduction in the area of floodplain within the controlled flooding area after construction (Figures F.4.4, F.12.1, F.4.5 and F.12.2). The area of floodplain declines from 81% of the total protected area to 56% after intervention. It is expected that water coming from the Meghna River will still enter the area in the monsoon but fish access will depend directly on the effectiveness of the fish-friendly gates and on the provisions made to keep them opened for as long as possible, perhaps, until July.
4. Although part of the floodplain will still exist, 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 in this zone was also confirmed by the local fishermen who reported fish in breeding condition being caught during their spawning migration within it. At this time, species such as Ghonnia tend to group in large numbers in the Khals and are easy prey to the fishermen, who actively catch them. Up to 15 Ghonnia have been reported to have been caught using a 'Polo' trap by one man in a single attempt.

Further key issues to consider are the sustainability of the remaining floodplain resident species and the species composition within the protected area, and indeed, of the zone as a whole. It is clear from fishermen's field reports, that fishing continues through the year, moving from floodplain fishing during the monsoon (including Beels and Khals), to Beel and Khal fishing in the dry season, where fish are easily caught.

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**Ponds:** In Zone A, these are filled by rainwater and by seepage. There is already a strong interest in pond culture in this area as many houses have a pond with fish in it. Pond fish are the main source of fish during the dry season and are already important in the local economy (Fishermen's reports during field visits). Pond production has been assumed to remain unchanged. However, there must be concern that some ponds may not be so easily filled as before if water levels are to be reduced. Conversely some ponds previously damaged by flooding may no longer be as a result of controlled flooding.

#### **F.12.3 Interventions 2 and 5**

These interventions are similar in nature being, full polderization of approximately 22% of Zone B, with some 19% corresponding to Intervention 2 and 3% to Intervention 5. This entails the exclusion of all external flood water into the area and reliance upon gravity for drainage through a limited number of structures. The percentage of the total catch in the intervention area contributed by migratory species to the internal rivers and Khals has been calculated to be 26.85% and that for Beels as 10.8%. This gives a figure for the total intervention area catch of nearly 14% (Table F.12.1), and these can be considered as direct losses to the fisheries within the poldered areas within this zone. The reduction in the floodplain species has been based on similar considerations as in intervention 1B (50%) and losses to Beel fisheries have been estimated to be 58%, based on the experiences in Satdona and Chandal Beels.

#### **F.12.4 Intervention 3**

This intervention involves extending the existing right bank embankment of the Gumti River all the way to Gouripur. A small proportion of the neighbouring floodplain will be lost and thus, some of its fish production. However, the assumption made here is that the fisheries in the Gumti River are likely to remain the same. Potential dispersal of fish entering the system via the Gumti River to other areas may change. However, it is not possible to estimate this change at present.

#### **F.12.5 Intervention 4**

This intervention is an enclosed polder which covers 21.4% of Zone C and 4% of Zone D. This will also include a two-way water pumping system within the poldered area. The intention here is to increase the area available for agricultural purposes by pumping it dry during the wet season. Khal re-excavation will also take place which aims to ensure wet season drainage flow to the pumps and dry season irrigation. The methodology for this is dealt with separately as Intervention 7, but it is included in the intervention 4 figures for the internal polder area.

Fish losses as a direct result of preventing the inflow of migratory species (through recruitment of eggs and fry, or by breeding adults) have been calculated to be as follows: Zone C: 32% for rivers and 12.5% for Beels (combined loss of 16.8%) and Zone D: 12.3% for rivers, 13.3% for Khals and 23.8% for Beels (combined loss of 15%) (Table F.12.1). Since the intention is to completely drain the poldered area (see Figures F.12.1 and F.12.2), losses to floodplain resident species have been assumed to be at least 90%.

## F.12.6 Interventions 6A and 6B

These interventions propose the construction of submersible embankments which together cover approximately 6.4% of the total area of Zone D. The rationale used for estimating fish losses with these interventions has been detailed above under the explanation of the existing schemes in Satdona and Chandal Beels.

## F.12.7 Intervention 7

Khal re-excavation in various parts of the Gumti Phase II Basin.

In general, this will result in deeper and wider channels with a slope of 1:1.5 on the sides, designed to maintain interconnection between main rivers, internal rivers and Khals (Figure F.10.3). Two types of channels will result, those with smooth sides (hand dug) and those with a parabolic shape (dredged by a mini dredger). In Zone D, excavation will involve deepening small Khals which are designed to be kept full of water in the dry season. It will also have the added function of assisting drainage during the flood season, which might result in faster current speeds.

According to Welcomme (1979), channelization has much the same effects on species composition and abundance of fish and other aquatic organisms as other flood-control measures. Although it is appreciated that channelization is not the same as Khal re-excavation, deeper Khals are likely to assist in draining the floodplain areas faster, with flow perhaps being diverted from one internal river or Khal to another (e.g. water transfers), or by bypassing major floodplain or retention areas. Conversely in the dry season, the deepened Khals, particularly those in Zone D, will have at least 0.30 m of water in them all the time and overall could be beneficial to fisheries.

The effects of dredging on the biota of the Khals in the Gumti Phase II study area can not be quantified at present. However, it is believed that the breeding, nursery and/or feeding grounds of some fish species will certainly be seriously disturbed during construction. Obviously, a great deal will depend on the length of the Khals to be dredged, the phasing and seasonality of the construction programme, the new depths of water achieved and the width and the amount of water that they are expected to carry. Increased current speeds may stress fish eggs/fry and flush out valuable nutrients.

Under the present intervention, nearly all Khals being remodelled will have more water for a longer period of time. In most instances, re-excavated Khals will hold water throughout the year when previously they did not. Thus, it has been assumed that Khal re-excavation will result in increased refuge areas for fish during the dry season. However, this may also result in heavier fishing in these restricted areas.

Estimating the benefits or dis-benefits of Khal re-excavation is complex as it is very site specific and variable according to changed surface area and water volumes. It also influences the way other interventions will affect the ecology and biology of the flora and fauna of the project area. Thus, calculations followed the procedure explained under Intervention 1A and were carried out for each individual intervention separately.

The results of the assessment of all 7 interventions are presented in Table F.13.1. and in Figure F.13.1.

**Strategy D: Full Polderization, Drainage and Groundwater Irrigation**

Figure F.10.1 shows details of the proposed polders for the project area under the previous Gumti Phase II study. Basically, the area was to be divided in two main sections, with two further small portions on the eastern side isolated even further. There was also a Khal re-excavation component, but this was for drainage assistance, there being no provision for retaining water in these locations during the dry season. It has thus been assumed that the long-distance migrants would be a straight loss to the area and the respective proportions of these migrants to each fishing system for each zone have been calculated.

To estimate the loss of the remaining floodplain resident species is extremely difficult as it is related to the existing levels of catch activity and how this is likely to continue. However, lessons from the impacts reported in Chandpur and Meghna-Dhonagoda projects after polderization (35% loss directly after construction and a further 15% over the next few years) were used and based on these, proportional changes in fish production in the Gumti Phase II study area were estimated for this strategy. The basic criterion was that the smaller the polder, the greater the loss proportionally to the area. Thus, 90% loss figures were used for the systems within the small blocks on the eastern side (Bijni Block east of Kasha, and the one north of Comilla); a 50% loss in the north-eastern block and a 35% loss in the main block.

**Strategy E: Full Polderization, Drainage and Surface Water Irrigation**

This strategy is a development of Strategy D with a further polder in Zone A (Figure F.10.2). Thus, changes in fish production were assumed to be similar to that under Strategy D, except for the area in Zone A, where losses would have increased from 35% to 50% as it would have resulted in a much smaller polder. Khal re-excavation was also part of this intervention for Zones B, C and D, and these were to be kept full of water from irrigation by pumping. A similar increase to that assumed under Strategy C in the estimated production was incorporated to their respective production figures.

### **F.13 Estimated Fisheries Benefits and Dis-benefits under Strategies C,D & E**

Table F.13.1 and Figure F.13.1 shows details of changes in estimated fish production for each intervention and for each system being considered under Strategy C. The combined fish production loss for all interventions in the project area was of 3,119 MT representing a mean loss of 30.8% within direct intervention areas. Changes in estimated fish production for each intervention are detailed below.

#### **F.13.1 Intervention 1B**

Under this intervention, there will be a reduction of 3.3% in the estimated fish production of internal rivers and Khals within the polder area, from 252 to 244 MT by Year 6. Seasonal Beels have been assumed to remain unchanged as they are situated outside the polder and will continue to be filled with water, and hopefully fish. Unfortunately, no Beels were reported by the relevant TFO in Zone A and thus, it was not possible to estimate their production. This will have to be taken into account if any interventions are going to go ahead in this area.

Floodplain fisheries production is estimated to be reduced by over 71%, from 1,838 MT to 525 MT by Year 6. However, very little is known regarding their sustainability, or their ability to recover. It has been assumed that pond production will follow the national trend of 4.5% increase per annum. Since pond production is high in this area, it provides some compensation for the losses to the natural systems but is unable to balance the them as the production and consumption systems are essentially independent of each other. Overall, there was a loss of 26% within the intervention area representing an estimated 1,321 MT.

#### **F.13.2 Interventions 2 and 5**

The loss in fish production in the internal rivers and Khals for both of these interventions was estimated to be 26.9%, declining from 54 to 39 MT for intervention 2, and from 9 to 6 MT for intervention 5. Beel production was difficult to estimate as there was no suitable wet period satellite imagery available to locate the areas of permanent Beels within the project area. According to the information available, the polders did not appear to impinge too much on the known Beel areas and thus losses were estimated to be 5 MT and 2 MT respectively. However, this will have to be verified before any interventions take place. The loss to the floodplain fishery was severe in both cases, nearly 71%, with 491 MT loss in intervention 2 and 81 MT in intervention 5. Pond production was relatively low in the intervention 2 area. In addition, no production from ponds was allocated to intervention 5 as it would appear from the 1989 dry season SPOT satellite imagery that there were not many ponds within this small polder. Further verification will need to be carried out if this proposal is taken any further.

The total loss resulting from intervention 2 was 47.5% (510 MT) and that for intervention 5 was 67.4% (85 MT).

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Figure F.13.1  
Estimated Fisheries Impacts  
in Gumti Phase II

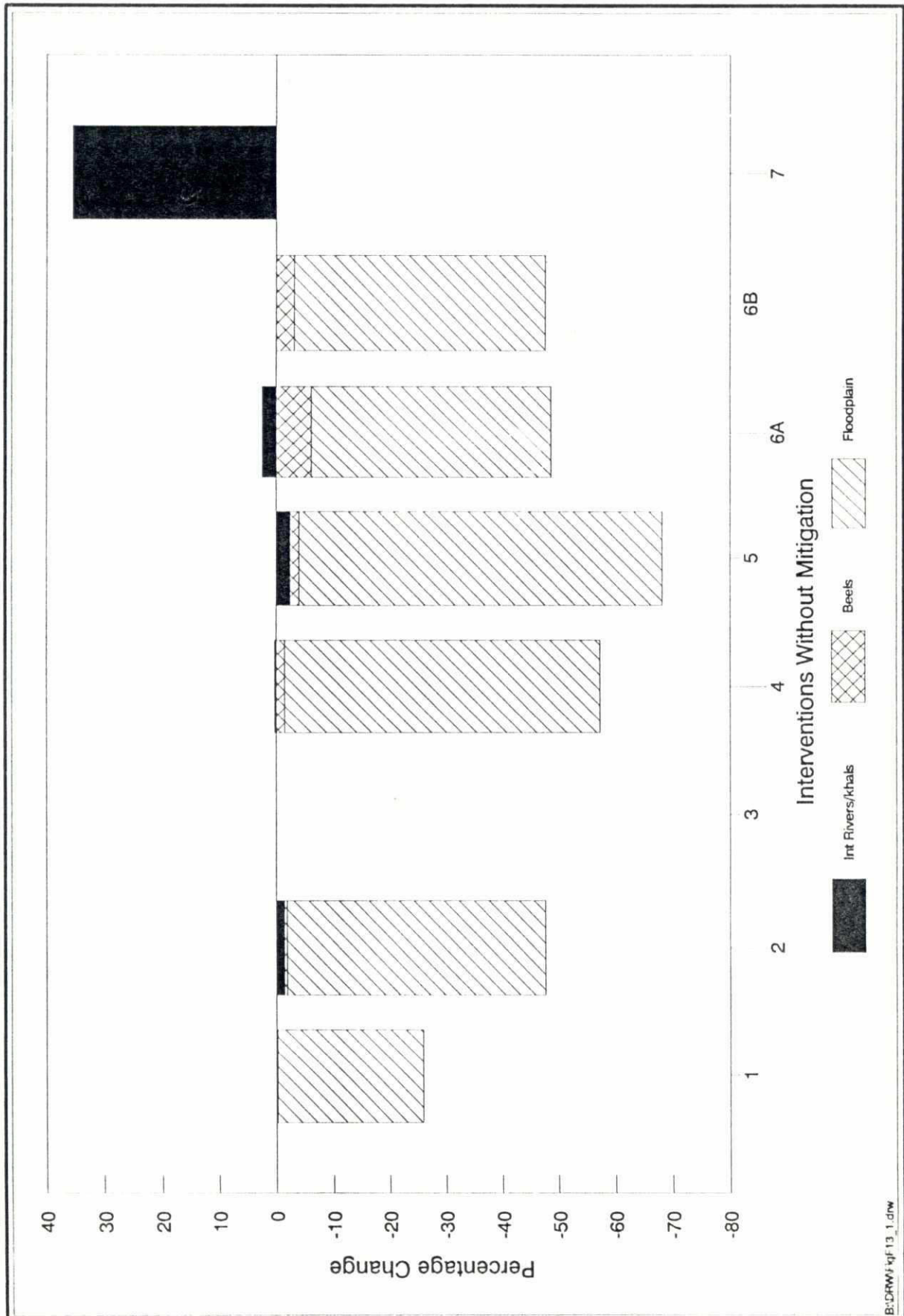


TABLE F.13.1

Estimated Fisheries Impacts in Gumti Phase II Due to Strategy C by Interventions Without Mitigation and Management

Gross Area (ha)	1 (1) 23,400	2 (2.1) 5,000	3	4 (3.1) 10,459	5 (2.11) 823	6A (4.11) 1,560	6B (4.111) 1,060	7
Systems								
Int Rivers/ Khals								
NOW	276	59	?	156	10	18	12	1,111
WO Yr 6	252	54	0	142	9	17	11	1,015
WI Yr 6	244	39	?	150	6	24	11	1,374
Change (%)	-3.3	-26.9	0.0	5.6	-26.9	40.8	-6.1	35.4
Beels								
NOW	0	8.5	0	67	3	33	12	0
WO Yr 6	0	8	0	61	3	30	11	0
WI Yr 6	0	3	0	26	1	12	5	0
Change (%)	0.0	-58.0	0.0	-56.8	-58.0	-58.0	-58.0	0
Floodplain								
NOW	2,013	760	0	1,590	125	237	161	0
WO Yr 6	1,838	694	0	1,452	114	217	147	0
WI Yr 6	525	203	0	145	33	91	62	0
Change (%)	-71.4	-70.7	0.0	-90.0	-70.7	-58.0	-58.0	0
Ponds*								
NOW	2,293	243	0	528	0	25	17	0
WO Yr 6	2,986	316	0	688	0	33	23	0
WI Yr 6	2,986	316	0	688	0	33	23	0
Change (%)	0	0	0	0	0	0	0	0
TOTAL								
NOW	4,582	1,070	0	2,340	138	313	203	1,111
WO Yr 6	5,077	1,072	0	2,343	126	296	192	1,015
WI Yr 6	3,755	502	0	1,009	41	160	99	1,374
Change (MT)	-1321	-510	0	-1334	-85	-136	-92	359
Change (%)	-26.0	-47.5	0	-56.9	-67.4	-45.9	-48.1	35.4
Total								
								9,758
								10,120
								7,001
								-3119
								-30.8

\* Includes cultured ponds only

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### **F.13.3 Intervention 3**

It was not possible to estimate changes in fish production under this intervention as there was insufficient information available and it could not be collected within the constraint of the study. Further studies will need to be carried out if this scheme is to be considered seriously for implementation.

### **F.13.4 Intervention 4**

Internal river and Khal production was assumed to benefit from the Khal re-excavation proposed on the southern part of the polder. Accordingly, fish production was estimated to increase by 5.6% over the six-year period from 142 to 150 MT. Beels are an important wetland ecosystem in the northern part of Zone C and thus, estimated to be seriously affected by the polder and pumping scheme. Beel fisheries were calculated to decline from 61 MT to 26 MT, a decline of nearly 57%. However, the floodplain in this area is undoubtedly the system which will suffer most as a result of polderization and water extraction. Therefore, losses to floodplain fisheries were estimated to be severe, declining from 1,452 MT to 145 MT, a loss of 90% by Year 6. Pond production is very small in this area and its potential for increase is unable to compensate for the decline in capture fisheries.

The overall losses to the total production under this intervention were substantial and amounted to 1,334 MT, representing nearly 57% of the total production.

### **F.13.5 Interventions 6A and 6B**

Internal river and Khal production increased by 40.8% for intervention 6A but there was a decline of 6.1% for 6B. This difference is the result of Khal re-excavation in the first scheme. Beel production decline by 58% in both interventions, from 30 to 12 MT for 6A and from 11 to 5 MT for 6B. Floodplain fisheries also declined by the same proportion from 217 to 91 in 6A and from 147 to 62 MT in 6B. Pond production was assumed to be proportional to the area of the intervention area within the zone and thus, very small. Overall losses due to intervention 6A were 45.9% (136 MT) and for 6B they were 48.1% (92 MT).

### **F.13.6 Intervention 7**

Changes in fish production as a result of this intervention have been amalgamated, although they have an influence throughout all zones. Overall, an increase of approximately 359 MT has been estimated to occur under this intervention, representing an increase of over 35%. However, fish production in this type of system only represents 5.5% of the total catch as a whole in the project area. It should be borne in mind that Khal re-excavation has been assumed to be positive as a whole, but in reality, this can only be ascertained after a detailed study looking at resulting changes in current velocities, depths, extent and duration of the water in Khals is carried out.

In addition, it should be pointed out that structures will also be placed at several Khal intersections and that design, management and operation of these will be a crucial factor in determining future fish production. A post-construction monitoring programme should be implemented to look into the effects of Khal re-excavation on fish biomass, species composition, and their biology and ecology.

#### **F.13.7 Estimated Changes in Fish Production Under Strategy C**

Within the actual intervention areas it is estimated that 3,119 MT (30.8%) will be lost if all these were to be simultaneously carried out. This amounts to an overall loss of 11.4% to the fisheries within the study area under Strategy C, despite the predicted increase in the production from both internal rivers and Khals, and ponds (Table F.13.1). Table F.13.2 shows the changes in fish production per system in relation to the total production estimates of the study area per zone. This loss in open water fish production has a cash market value of Tk 66 million which will be a direct loss to the economy of the project area. There are also possibly other multiple effects on this.

It is arguable that fish which are unable to enter the intervention areas may simply move to other sections within the study area and thus, they would not be lost to the system. However, this prospect was not included in the analyses as it is not possible at present to estimate the proportion of fish which will thrive under those conditions and the proportion of fish which may perish due to the loss of their favoured breeding, nursery, feeding and growing grounds. Undoubtedly, they would be caught by the fishermen in the system.

As a whole, the greatest losses will be reflected in the floodplain catch (22.4%), followed by those for Beels (6.3%). The loss of the floodplain in Zone A is particularly severe (over 52%), followed by that in Zone C (over 22%) and Zone B (nearly 21%). In Zone D, the loss of Beel production was higher than for the other zones (10%), followed by Zone B (9%) and Zone C (4.6%). Beel production in Zone A was assumed to be zero in the study this year as Beels in this zone are seasonal and were reported dry at the beginning of the sampling period. Even the Thana Fisheries Offices in this zone reported no Beels at all in the Thana Survey.

#### **F.13.8 Estimated Changes in Fisheries Production Under Strategy D**

Under this strategy, overall losses were estimated to be around 34%, that is approximately 9,223 MT, having a market cash value of Tk 328 million (Table F.13.3). Because there was to be no Khal re-excavation that could result in increased water availability (Figure F.9.1), the heavy losses estimated as a direct result of the prevention of species' access to the areas within the polders could not be compensated for. In addition, all other fishing systems are seriously impacted, especially the floodplain catch in Zone A which suffers significant losses (nearly 71%) and Zone B (56%), and declines by a similar amount in Zones C and D. The decline in Beel production is approximately the same for Zones B, C and D.

TABLE F.13.2

Change in Fish Production Estimates in Gumti Phase II Due to Strategy C Without Mitigation and Management

Zone	Fishery System	Existing Situation		WO		Year 6		Strategy 'C' Year 6		Difference in Year 6	
		WO	% Total Catch	WO	% Total Catch	Year 6	% Total Catch	'C' Year 6	% Total Catch	'C' and WO	%
Zone A	Int Rivers/Khals	(MT)		(MT)				(MT)			
	Beels	378	1.41	345	1.26	332	1.37	332	1.37	-3.70	
	Floodplain	0	0.00	0	0.00	0	0.00	0	0.00	0.00	
	Ponds*	2,750	10.27	2,512	9.19	1,199	4.95	1,199	4.95	-52.28	
Zone B	Int Rivers/Khals	314	1.17	287	1.05	331	1.37	4,080	16.85	0.00	
	Beels	85	0.32	78	0.28	71	0.29	71	0.29	-9.02	
	Floodplain	3,021	11.28	2,759	10.09	2,187	9.03	2,187	9.03	-20.73	
	Ponds*	1,299	4.85	1,692	6.19	1,692	6.99	1,692	6.99	0.00	
Zone C	Int Rivers/Khals	477	1.78	436	1.59	585	2.42	585	2.42	34.28	
	Beels	758	2.83	692	2.53	660	2.73	660	2.73	-4.62	
	Floodplain	5,458	20.38	4,985	18.23	3,877	16.01	3,877	16.01	-22.23	
	Ponds*	2,300	8.59	2,995	10.96	2,995	12.37	2,995	12.37	0.00	
Zone D	Int Rivers/Khals	477	1.78	436	1.59	603	2.49	603	2.49	38.41	
	Beels	296	1.11	270	0.99	243	1.00	243	1.00	-9.99	
	Floodplain	5,372	20.06	4,906	17.95	4,496	18.57	4,496	18.57	-8.36	
	Ponds*	664	2.48	865	3.16	865	3.57	865	3.57	0.00	
Total	Int Rivers/Khals	1,646	6.15	1,503	5.50	1,851	7.65	1,851	7.65	23.16	
	Beels	1,139	4.25	1,040	3.81	974	4.02	974	4.02	-6.34	
	Floodplain	16,601	61.99	15,162	55.46	11,759	48.56	11,759	48.56	-22.44	
	Ponds*	7,396	27.62	9,632	35.23	9,632	39.77	9,632	39.77	0.00	
Grand Total		26,782		27,337		24,216		24,216		-11.42	

\* Includes cultured ponds only

strat-c2.wk1

TABLE F.13.3

Change in Fish Production Estimates in Gumti Phase II Due to Strategy D Without Mitigation and Management

Fishery System	Existing Situation		WO	% Total Catch	WO Year 6 (MT)	% Total Catch	Strategy 'D' Year 6 (MT)	% Total Catch	Difference in Year 6 'D' and WO %
	WO								
Zone A	Int Rivers/Khals	(MT) 378		1.41	345	1.26	146	0.80	-57.80
	Beels	0		0.00	0	0.00	0	0.00	0.00
	Floodplain	2,750		10.27	2,512	9.19	732	4.04	-70.85
	Ponds*	3,133		11.70	4,080	14.92	4,080	22.52	0.00
Zone B	Int Rivers/Khals	314		1.17	287	1.05	72	0.40	-74.93
	Beels	85		0.32	78	0.28	35	0.19	-55.42
	Floodplain	3,021		11.28	2,759	10.09	1,210	6.68	-56.15
	Ponds*	1,299		4.85	1,692	6.19	1,692	9.34	0.00
Zone C	Int Rivers/Khals	477		1.78	436	1.59	186	1.03	-57.23
	Beels	758		2.83	692	2.53	394	2.17	-43.14
	Floodplain	5,458		20.38	4,985	18.23	2,615	14.44	-47.54
	Ponds*	2,300		8.59	2,995	10.96	2,995	16.54	0.00
Zone D	Int Rivers/Khals	477		1.78	436	1.59	248	1.37	-43.02
	Beels	296		1.11	270	0.99	134	0.74	-50.44
	Floodplain	5,372		20.06	4,906	17.95	2,711	14.97	-44.75
	Ponds*	664		2.48	865	3.16	865	4.77	0.00
Total	Int Rivers/Khals	1,646		6.15	1,503	5.50	652	3.60	-56.62
	Beels	1,139		4.25	1,040	3.81	562	3.10	-45.95
	Floodplain	16,601		61.99	15,162	55.46	7,268	40.12	-52.07
	Ponds*	7,396		27.62	9,632	35.23	9,632	53.17	0.00
Grand Total		26,782			27,337		18,113		-33.74

\* Includes cultured ponds only

### **F.13.9                      Estimated Changes in Fisheries Production Under Strategy E**

Overall estimated losses were slightly lower than those of the previous strategy due to some benefits being accrued from Khal re-excavation for gravity irrigation in the dry season. However, losses in floodplain production were increased in Zone A as a result of further sub-divided empolderment of this area (Figure F.10.2). The rest of the fishing systems were assumed to be impacted to the same extent as under the Strategy D (Table F.13.4).

### **F.13.10                      Estimated Fish Production Losses Under Strategies C, D and E**

Table 13.5 shows the changes in estimated fish production under these strategies. Overall, far less losses are likely to be incurred under Strategy C (11.42%) which included a selection of interventions, some of which, were deliberately designed from the outset to try and mitigate for potential fish losses. Under this intervention, it is assumed that some of the fish which would be unable to enter individual intervention areas would be able to move to other areas within the Gumti Phase II study area.

In contrast Strategies D and E, by deliberately intending to exclude the Meghna and its flooding from the project area, caused considerably greater damage to the fisheries as reflected in the heavy fish loss estimates which were made for these schemes.

TABLE F.13.4

Change in Fish Production Estimates in Gumti Phase II Due to Strategy E Without Mitigation and Management

Fishery System	Existing Situation		WO		Year 6		Strategy 'E' Year 6		Difference in Year 6 'E' and WO	
	WO	(MT)	% Total Catch	(MT)	% Total Catch	(MT)	% Total Catch	%		
Zone A	Int Rivers/Khals	378	1.41	345	1.26	171	0.94	-50.53		
	Beels	0	0.00	0	0.00	0	0.00	0.00		
	Floodplain	2,750	10.27	2,512	9.19	525	2.89	-79.11		
	Ponds*	3,133	11.70	4,080	14.92	4,080	22.44	0.00		
Zone B	Int Rivers/Khals	314	1.17	287	1.05	108	0.59	-62.39		
	Beels	85	0.32	78	0.28	35	0.19	-55.42		
	Floodplain	3,021	11.28	2,759	10.09	1,210	6.65	-56.15		
	Ponds*	1,299	4.85	1,692	6.19	1,692	9.30	0.00		
Zone C	Int Rivers/Khals	477	1.78	436	1.59	279	1.54	-35.85		
	Beels	758	2.83	692	2.53	394	2.16	-43.14		
	Floodplain	5,458	20.38	4,985	18.23	2,615	14.38	-47.54		
	Ponds*	2,300	8.59	2,995	10.96	2,995	16.47	0.00		
Zone D	Int Rivers/Khals	477	1.78	436	1.59	373	2.05	-14.46		
	Beels	296	1.11	270	0.99	134	0.74	-50.44		
	Floodplain	5,372	20.06	4,906	17.95	2,711	14.91	-44.75		
	Ponds*	664	2.48	865	3.16	865	4.76	0.00		
Total	Int Rivers/Khals	1,646	6.15	1,503	5.50	931	5.12	-38.09		
	Beels	1,139	4.25	1,040	3.81	562	3.09	-45.95		
	Floodplain	16,601	61.99	15,162	55.46	7,060	38.82	-53.44		
	Ponds*	7,396	27.62	9,632	35.23	9,632	52.97	0.00		
Grand Total		26,782		27,337		18,185		-33.48		

\* Includes cultured ponds only

TABLE F.13.5

Change in Fish Production Estimates in Gumti Phase II Under the Strategies C, D and E Without Mitigation and Management

Fishery System	NOW	% Total Catch	WO Year 6	% Total Catch	Strategy C Year 6	% Total Catch	Strategy D Year 6	% Total Catch	Strategy E Year 6	% Total Catch
	(MT)		(MT)		(MT)		(MT)		(MT)	
Zone A										
Int Rivers/Khals	378	1.41	345	1.26	332	1.37	146	0.80	171	0.94
Beels	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Floodplain	2,750	10.27	2,512	9.19	1,199	4.95	732	4.04	525	2.89
Ponds*	3,133	11.70	4,080	14.92	4,080	16.85	4,080	22.52	4,080	22.44
Zone B										
Int Rivers/Khals	314	1.17	287	1.05	331	1.37	72	0.40	108	0.59
Beels	85	0.32	78	0.28	71	0.29	35	0.19	35	0.19
Floodplain	3,021	11.28	2,759	10.09	2,187	9.03	1,210	6.68	1,210	6.65
Ponds*	1,299	4.85	1,692	6.19	1,692	6.99	1,692	9.34	1,692	9.30
Zone C										
Int Rivers/Khals	477	1.78	436	1.59	585	2.42	186	1.03	279	1.54
Beels	758	2.83	692	2.53	660	2.73	394	2.17	394	2.16
Floodplain	5,458	20.38	4,985	18.23	3,877	16.01	2,615	14.44	2,615	14.38
Ponds*	2,300	8.59	2,995	10.96	2,995	12.37	2,995	16.54	2,995	16.47
Zone D										
Int Rivers/Khals	477	1.78	436	1.59	603	2.49	248	1.37	373	2.05
Beels	296	1.11	270	0.99	243	1.00	134	0.74	134	0.74
Floodplain	5,372	20.06	4,906	17.95	4,496	18.57	2,711	14.97	2,711	14.91
Ponds*	664	2.48	865	3.16	865	3.57	865	4.77	865	4.76
Total										
Int Rivers/Khals	1,646	6.15	1,503	5.50	1,851	7.65	652	3.60	931	5.12
Beels	1,139	4.25	1,040	3.81	974	4.02	562	3.10	562	3.09
Floodplain	16,601	61.99	15,162	55.46	11,759	48.56	7,268	40.12	7,060	38.83
Ponds*	7,396	27.62	9,632	35.23	9,631	39.77	9,631	53.17	9,631	52.96
Grand Total	26,782	100.00	27,337	100.00	24,215	100.00	18,113	100.00	18,184	100.00
Percentage Change			2.07		-11.42		-33.74		-33.48	

\* Includes cultured ponds only

highland

## F.14 Social, Economic and Nutritional Implications to the Fishing Community in the Area Resulting from FCD and FCDI Interventions

Most of the sections of rivers, Khals and Beels in the country are already leased by the government (Jalmahals) to specific groups of fishermen within the Thana Parishads, or within the Unions. Thus, fishermen who find that they have lost their livelihood as a result of FCD and/or FCDI schemes will not be able to easily move to new fishing grounds, since most areas are already taken by other fishermen's groups. Furthermore, currently productive Jalmahals which become empoldered will most certainly grow into poorer areas with the resulting loss in income for all concerned.

Under the present leasing system, middlemen engage fishermen under various sub-leasing arrangements which usually results in the exploitation of fishermen since the largest portion of the benefits go to the middlemen. With the decline of the fisheries resource, aggravated by FCD/FCDI interventions, the income of professional fishermen will decline sharply as the catch will be reduced but the middlemen's fees will not.

It is therefore a considerable mistake to assume that fishermen will be able to become farmers or take up another profession immediately. In addition, the vast majority of the full time fishermen in the project area are low caste Hindus (as was the case in Meghna-Dhonagoda) and thus, traditionally hold jobs as fishermen and little else. Even if they were to change jobs, they will most likely be subjected to hardships, severe in most cases, before they are able to re-establish themselves.

In addition, after FCD/FCDI projects, the resulting species composition inside the polder area will be dominated by lower value species, such as those shown in Plate F.14.1. A similar result has been found in submersible embankments, which significantly obstruct fish migration and result in major changes in species composition from high-medium value to low value species. This situation was reported by fishermen in Chandai Beel (Zone D), who are catching a decreasing number of 'big fish' after the submersible embankment -built there to prevent early monsoon flooding of the boro crop- which has a sluice gate on the Mangal Khal that interconnects the Beel to the river network via the Titas River.

The reduction in open water fish catch from Beels and floodplains has a major negative impact which has significant social implications. During the monsoon floods, fish are a **free common property resource** within the reach of all in the community, especially the poor in the rural society. The resulting subsistence fishing thus becomes an important activity for most when agricultural related works are naturally limited. Furthermore, fishing provides full time employment and is the main source of income for a small but significant number of households, especially in Zone D (3% in 1981).

### F.14.1 Number of Fishing Households

The number of fishing households in the Gumti Phase II area has been estimated from information received from the Thana Fisheries Office survey. This indicates the number of fishermen per Thana and the number of households in the area as per the 1981 census (BBS, 1981). It has been assumed that there was one fisherman per fishing household and that these households were uniformly distributed through the project area. It would be valuable to verify these data from the 1991 BBS census when this becomes available.



Figure F.14.1  
Percentage of Fishing Households  
in Gumti Phase II

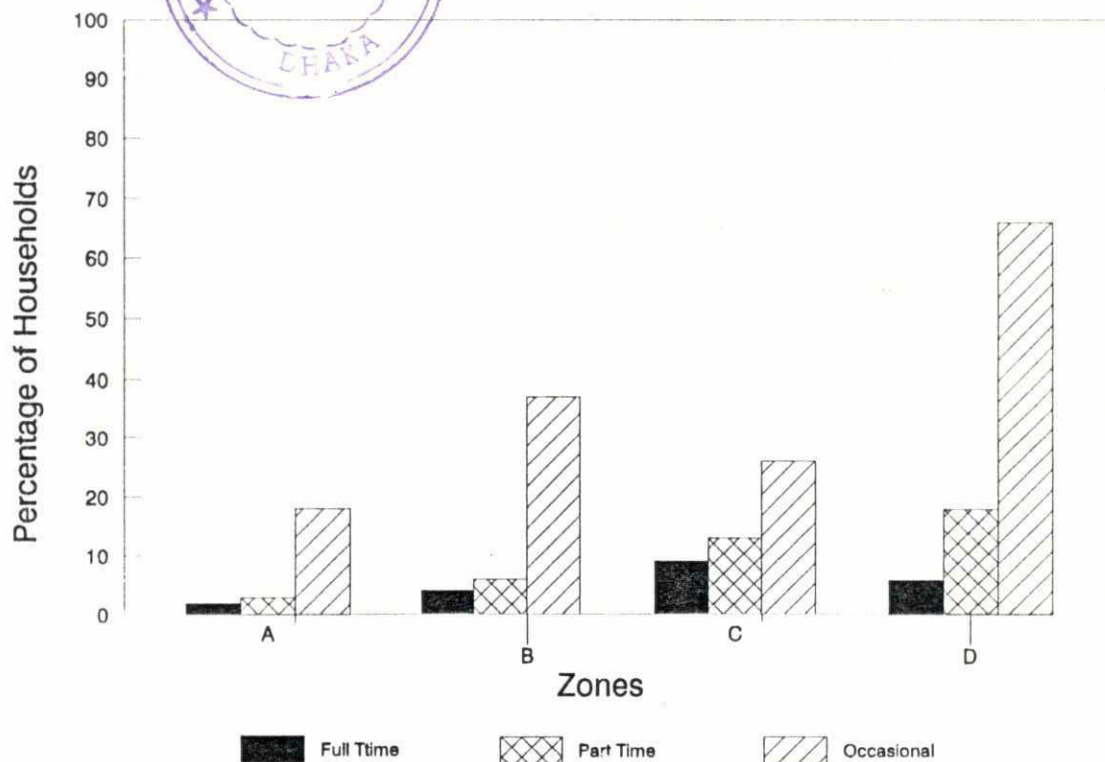
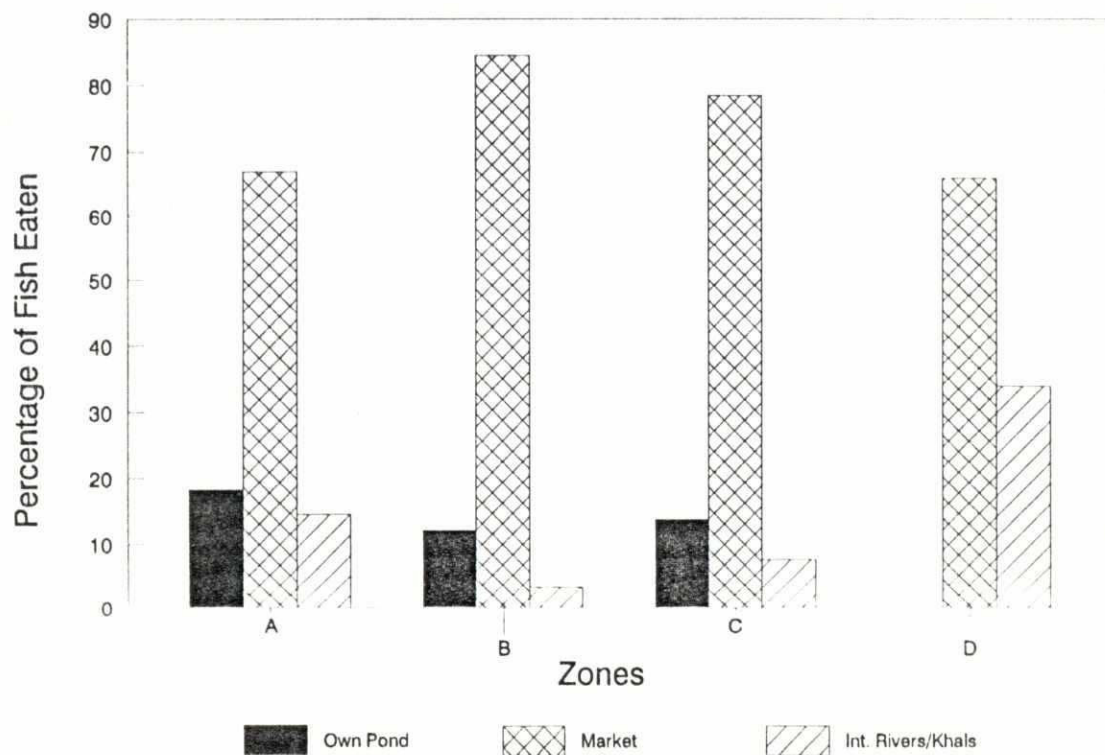


Figure F.14.2  
Source of Fresh Fish by Household  
in Gumti Phase II





**Plate F.14.1 'Lower Value' Fish for Sale at a Market**



**Plate F.14.2 Small Fish are Key to the Nutritional Requirements of the Rural Population**

Table F.14.1 shows details of these results per zone. In total, there were 167,162 fishing households in the Gumti Phase II area equal to 57% of the total households in the area. Of these, 16,458 (5.6%) were full time, 34,895 (11.9%) were part time and 115,809 (39.5%) were occasional. In Zone A, the total number of households was 14,129, 23% of the total number of households in the study area, and represented 23% of the total number of households in that zone. The proportion of fishing households was very similar in Zones B and C with 47.7% (25,354) in Zone B and 48.6% (40,012) in Zone C. Not surprisingly, the largest number of fishing households was found in Zone D, which had 87,667 (90%) (Figure F.14.1).

This interesting progression in the number of fishing households per zone from Zone A to Zone D follows a similar pattern to the one shown by the production figures for open waters in the project area (see Table F.7.4).

**TABLE F.14.1**

**Number of Fishing Households in the Gumti Phase II Study Area**

	Number of Fishing Households								
	Number of Households	Full - Time	%	Part - Time	%	Occasional	%	Total	%
Zone A	61,140	1,207	2	1,888	3	11,034	18	14,129	23
Zone B	53,193	2,173	4	3,374	6	19,807	37	25,354	47.7
Zone C	82,281	7,650	9	11,270	13	21,092	26	40,012	48.6
Zone D	96,653	5,428	6	18,363	18	63,876	66	87,667	90
Total	293,267	16,458	5.6	34,895	11.9	115,809	39.5	167,162	57

Source: BBS 1981 Census for Number of Households.

Gumti Phase II Thana Fisheries Office Survey for Number of Fishermen

**F.14.2 Nutritional Contribution of Fish to Human Diet in Gumti Phase II**

The health and nutrition of the rural population in the country is intimately linked to the amount of protein and vitamins that they are able to consume. Throughout Bangladesh, nutritional studies indicate that fish provide up to 80% of the animal protein intake to the human population. In the Gumti Phase II area, nutritional studies found fish to be the leading source of protein intake over Dal and meat. Fish and vegetables were reported to be the main food items consumed by the rural population. Both fresh and dry fish were found to be consumed in large proportions with around 60% of the households reported to have eaten fish during their last meal, 90% within the last three days and almost 100% within the past week.

This definite preference for fish over Dal (normally a cheap form of protein) in all zones confirms the importance of fish as a free common good for the poor, as even when other popular forms of protein are available, fish are favoured mainly as Dal is imported into the area and has to be bought for cash. Plate F.14.2 shows the type of fish usually within the reach of the rural population.

When the source of fish per household is considered, a more complete picture regarding fish production and consumption can be appreciated. Table F.14.2 show that the largest proportion (nearly 22%) of pond fish is eaten in Zone A, which is the zone with the largest pond production (Tables F.7.3 and F.7.4; Figure F.14.2). Zones B and C follow with nearly 13% and 16% respectively. Similarly, this pattern is mirrored in these two zones which have an estimated fish pond production of 1 299 and 2 300 MT. In Zone D, no consumption of pond fish was reported which is not surprising, as the estimated fish pond production from the zone was the lowest (664 MT) while the proportion of capture fish caught was the highest (24 103 MT) (Table F.7.4).

TABLE F.14.2

## Source of Fresh Fish by Household in Gumti Phase II

	Own Pond		Market		Int Rivers/Khals	
	Number	%	Number	%	Number	%
Zone A	15	18.3	55	67.1	12	14.6
Zone B	7	12.1	49	84.5	2	3.4
Zone C	9	13.8	51	78.5	5	7.7
Zone D	0	0.0	33	66.0	17	34

Source: Health and Nutrition Component of the 1993 Gumti Phase II Study

Markets play an important role as suppliers of fish to the community. Interestingly, Zones B and C showed the highest proportion of bought fish, followed by Zone A and Zone D. It would appear that in Zone D, the need to purchase fish is much reduced as it is extremely easy for the fishermen and/or their families to catch fish in this area. This is confirmed by the proportion of fish caught in internal rivers and Khals (34%), which was highest in this zone. Surprisingly, this activity was followed in order of importance by households in Zone A, C and B (Table F.14.2).

The source of dry fish was equally revealing as seen in Table F.14.3. Home dried fish amounted to 30% in Zone D, followed by just over 12% in Zone C and around 3% in Zone A. Zone B reported no home dried fish and people in this zone appeared to obtain all their dry fish from markets. Market sources of dried fish were high in Zone A with 91%, Zone D had 70% and lastly, Zone C with 68%.

**F.14.3 Land and Pond Tenure**

The development of any fish farm practices in the region will only be feasible for those people with access to ponds. Land and pond tenure is thus believed to be a major issue for consideration as the vast majority of the existing ponds are the property of local farmers or land owners. Since some mitigation measures might involve the development of pond culture practices, pond tenure, or leases/hire, will have to be taken into account.

TABLE F.14.3

## Source of Dried Fish by Household in Gumti Phase II

	Home Dried Fish		Market	
	Number	%	Number	%
Zone A	2	2.89	63	91.3
Zone B	0	0.0	55	100
Zone C	7	12.28	39	68.42
Zone D	15	30.0	35	70

Further details of the Health and Nutrition situation can be found in Appendix H.IV of the Environmental Annex (Annex H).

## **F.15 Possible Mitigation Measures**

In general, the main issues concerning possible mitigation measures centre around water and fisheries management. These two aspects have been described briefly below.

### **F.15.1 Water Management**

Water resources management is, and will continue to be, possibly the most crucial factor in the development of any activities in the country, the region and the sub-region. It will thus be vital to establish priorities as to how and where the water will be directed to, and for whom. It includes the following components and possibilities for fisheries.

#### **F.15.1.1 Re-excavation of Khals**

Possible re-excavation of Khals, and their interconnections to Beels, with an aim of ensuring free and timely flow of water and fish (both breeding adults and fry). This could be most important during the dry season when Khals become refuge areas for some species.

#### **F.15.1.2 Gate Design and Operation**

Gate design, operation and location of structures is extremely important. These would ensure the timely flow of water and fish, and would be crucial for maintaining water levels in the system throughout the year, and particularly at times critical for fish.

### **F.15.2 Improved Fisheries Management**

The continued improvement of fisheries management in the area should receive the highest priority, especially for those activities and/or policies that should take place despite interventions. Some of these activities include:

#### **F.15.2.1 Restocking with Fry and/or Fingerlings**

Restocking of suitable areas such as specific Beels and Khal sections with fry or fingerlings. However, this will need to take into account the ecology of the existing resident species in the area so as to prevent a major environmental unbalance due to any introduction of species. Restocking programmes should therefore only be carried out using indigenous species which occur naturally in the selected areas.

Pond culture improvement, especially of those ponds at present under utilised. Leasing of existing ponds to fishermen groups, especially displaced ones. Use of borrow pits by displaced people who are the groups most likely to suffer the nutritional losses resulting from any reduction in their ability to fish. Training and extension programmes to ensure that suitable technology becomes available and to provide alternative sources of income for fishermen. Promotion of integrated farming schemes such as those underway in Comilla, as well as those such as the small/seasonal pond project in Mymensingh carried out by the Fisheries Research Institute (FRI) and ICLARM. The incorporation of local NGOs into the setting up and management of fishing groups could be instrumental in these type of fisheries projects.

## F.15.2.3

## Enforcement of Existing Fisheries Regulations

The enforcement of existing regulations should particularly be carried out in relation to important areas such as Satdona and Chandal Beels, along with other known breeding, nursery and feeding areas for fish and other commercially important groups such as shrimps.

The following section deals with possible mitigation measures specific to each intervention.

## F.15.3

## Intervention 1B

**Rivers and Khals:** To a large extent, mitigation for this intervention will be dictated by the management, design and operation of the fish-friendly gates which are an integral part of the scheme. At present, it is hoped that these gates may be able to be kept opened until at least the middle of June. Under this situation and with 4 sets of gates in operation, the fish production inside the polder area has been estimated to potentially being able to increase by 7 MT, a 20% increase in relation to the percentage of migratory species which would be entering the area. This 20% gain due to the opening of the fish-friendly gates until mid-June may also be reflected in the floodplain catch and thus, an increase from 919 MT (nearly 184 MT) to 1 103 MT is possible.

Mitigation outside the embanked area is difficult to assess as little is known at present about migratory and floodplain resident species. In addition, it is assumed that there will be no structures on the Salda River at the northern end of Zone A and that there will therefore be free access for fish to the area on the Salda River. Similarly, with the embankment in place, there will be 4 openings on the eastern side of the embankment where previously there was complete free interaction between the species and the systems.

Therefore, it must be emphasized that water management will be the crucial mitigation factor in this area, as any benefits to fish will depend directly on the flow of water within the embankment. Gate operation will also be critical, especially if it is being planned to retain water inside the embanked area during the dry season.

Fish pond culture as a possible mitigation measure against fish production losses appears to be relatively limited in the area, as fish farming is already being developed successfully in the Thanas in Zone A. Potential for increasing this activity further is currently unknown but is expected to include under-utilised ponds. Integrated

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farming, fish, poultry, livestock and rice, activities have started also under a Comilla Rotary Club scheme as mentioned in Chapter F.6 of this report. However, there may be room for improvement and increasing the participation of displaced fishermen and/or landless people, especially women, in general. An aquaculture extension project in Mymensingh supported by DANIDA is already actively involving women in the programme with excellent results. In this project, women operating homestead aquaculture projects have achieved equal, and in many cases, higher yields than the men involved in the same activity.

The stocking of fish fry or fingerlings may not be worthwhile in the Khals if they are going to be dry, except in the Buri River which is outside the embanked area.

#### **F.15.4 Interventions 2 and 5**

At present no provision has been made for water to enter the area. The only water entering the polders will be from rainfall. The only apparent possibility in these two interventions would be to delay the managed gravity drainage of the areas.

#### **F.15.5 Intervention 3**


Since no estimations of fish impacts were made under this intervention, no mitigation has been considered at present.

#### **F.15.6 Intervention 4**

This intervention is the one with the highest fisheries losses in the whole range of interventions as it includes pumping of the water in addition to polderization. Possible mitigation measures regarding fish production include fingerling stocking of the deepened Khals, careful management of Khals and water in them, and heavy restrictions on any subsequent fisheries. Since most of the remaining fisheries will be limited to the Khals and possibly some Beels, patrolling of the fishing grounds would have to be carried out to prevent poaching, especially of young fish.

At present, there is scope to intensify fish farming activities to increase pond production. However, it should be emphasized that in general, this activity must be considered as an additional venture **and not** as a replacement for open water fisheries. The two activities are essentially separate economic systems.

Intervention in this area is extremely unadvisable, even if it proves economically feasible due to the perceived agricultural benefits. The importance of this wetland area for the whole of the Gumti Phase II basin cannot be emphasised enough, as it is the main doorway for the long-distance migratory species into the area early in the monsoon season. Especially in its northern part, the confluence of three rivers, the Meghna, the Titas (Pagla) and the Buri Nadi, this area is exceptionally rich, not only in fish and crustaceans which are economically important, but on a myriad of other plants and animals which are an intrinsic part of the complex ecological and biological web of this remarkable floodplain system.



The present understanding of the biology and ecology of this floodplain as a whole is undoubtedly poor and it would be extremely unwise to proceed without further studies in this respect.

#### **F.15.7 Interventions 6A and 6B**

Water management is the crucial issue in these two interventions. These submersible embankments should have two 2-way water control structures, the location of which will have to allow through-flow within them before overtopping takes place. A detail study is needed to identify the best possible places for location of the gates which will have to be fish-friendly. A sound understanding of the hydrology of the area is crucial for deciding where the gates should be placed and the hydraulic modelling needs to be improved to allow this.

In addition, the lessons learnt from the Satdona and Chandal Beels will have to be taken into account. Other key issues will be the hydrology of the Beels, the interconnections between Beels and Khals, and the behaviour and pattern of water flow into the submersible schemes. Similarly, drainage of the proposed embanked areas will have to be considered carefully including studies of the present drainage system and the proposed one after the scheme is in place. Another possible mitigation measure is stocking of Beels, however, this may be a problem because the fish will most likely escape after embankment overtopping in the monsoon.

Regarding internal rivers and Khals, under the present situation there is little that can be recommended as the number of Khals within the schemes is relatively small. In conclusion, these two interventions will have to become properly and carefully managed systems.

#### **F.15.8 Intervention 7**

Water management will become vital if this type of intervention is to have any success from the fisheries point of view. A crucial issue would be the amount of water actually kept in the Khals, to maximise benefits will need to be as much as possible. In addition, a phased construction programme will be required during implementation to minimize disturbance to habitats. This could perhaps be best achieved by working on small sections at a time, on one side of the banks, or in different seasons, returning the following year to finish the remaining pieces. In particular, Oder Khal could be stocked, but this will most likely mean that the area will need to be policed to prevent poaching.

#### **F.15.9 Existing Interventions in Satdona and Chandal Beels**

A review of the schemes recently put in place in Satdona and Chandal Beels is strongly recommended. It would appear that neither the hydrology of these two systems nor the local fish migration patterns were understood or taken into account when these schemes were proposed and constructed. Their present condition could certainly be improved by putting in at least 2 two-way structures, fitted with fish-friendly gates. In addition, the situation regarding the Khals that interconnect the Beels needs to be reviewed, especially the blocked Khal passages that used to feed the Beels from the eastern side.

## **F.16. Specific Recommendations for Improvements to the Proposed Interventions**

### **F.16.1 Gate Structures**

In general, gates will restrict the passage of fish unless they are designed, operated and managed to minimise fish losses. Some of the possible measures to alleviate this problem include:

- Installation of overshot gates, to allow the passage of floating eggs, larvae, hatchlings, surface and midwater species.
- Timely opening of gates to coincide with critical migration periods for fish and other aquatic species, such as shrimps which are commercially important.
- Careful timing of closure to coincide with the end of the monsoon when the floodplain starts to dry out.

### **F.16.2 Khal Re-excavation**

Some of the major constraints in this intervention are the lack of interconnection between some of the points in the Khal network in the project area (Figure F.11.1). In addition, because of the nature of the proposed polder in the northern part of Zone C, under the present intervention, there may be a need to provide a fish bypass to the pump to ensure access of the migrant species into the main channels and rivers in the area. The success of this bypass will depend on the Khal inter-connectivity within the area to ensure timely dispersal of the fish throughout the system and the detailed location of the pump and any stilling basin.

### **F.16.3 Fish Bypasses**

These must allow free and continuous access to the fish -both long and short distance migrants-, and/or their eggs and fry, especially during the main migration period, the early monsoon and the drawdown period.

## F.17 Development Strategy

It is clear from the conclusions of various FAP Regional Studies and from reports by FAP 12 and FAP 17, that capture fisheries have suffered a considerable amount of avoidable damage from FCD interventions and illegal over fishing. It is also clear that unless appropriate action is taken, the future damage will only increase. An effort is therefore needed to promote measures designed to restore part of the fishery losses. The principal components of such a strategy and action programme for achieving the reversal of the present downward trend in production have been outlined by FAP 12 and are summarised below (FAP 12 Appendix J):

- It is recommended that DOF and the Ministry of Fisheries and Livestock give urgent consideration to strengthening and enforcing legislation with the aim of stopping illegal or other damaging methods of fishing.
- The introduction of additional conservation measures to encourage a revival of natural fish stocks should be a priority. Strict controls on the collection of wild spawn and fry from rivers should be implemented. Further restrictions on fishing gears and net mesh sizes, close seasons and restrictive licensing are necessary.

Top priority should be given to stop any further avoidable deterioration of fish stocks, especially in rivers as a preliminary to the restoration of production.


- It is important that all future FCD project planners give particular attention to the impacts on capture fisheries and ensure adjustments in placement and design of structures to minimise adverse effects. Mitigation of fish losses should be built into the project with the aim of assisting affected fishing communities and maintaining fish production as a sustainable resource. DOF must be fully involved throughout the project planning and implementation, and projects should provide for the rehabilitation of publicly owned water bodies to optimise fish production and minimise losses.

Project managers should also aim to minimise conflicts between fishermen and other interests within the project area.

- It is recommended that all remaining public Beels, Khals and other perennial water bodies should be preserved against drainage and that they be improved by re-excavation to increase capacity and thus increase fish production.

All such water bodies should be subject to the New Fisheries Management Policy and leased only to bona-fide fishermen, with suitable arrangement for supervision, such as relevant NGOs. This will help to reduce the continuing loss of fishing grounds and catches from perennial Beels.

- Research is needed to determine the most effective means and the best species to use in the restocking of rivers and Khals with the aim of restoring their productive capacity. For example, stocking large numbers of carp fingerlings into rivers may not prove effective because juveniles are normally floodplain resident. It may be necessary to create conditions for fingerlings to grow to maturity before they are released into the rivers.

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- It is strongly recommended that a review and reinforcement of DOF's agriculture extension services throughout the country be made to take maximum advantage of the opportunities provided by FCD for the expansion of fish culture production.
  - Provision of a source of credit via established rural credit agencies such as Grameen Bank, for pond rehabilitation, to enable newly formed fishermen groups to take advantage of fish culture opportunities and technology. It is important that relevant NGOs assist in the setting up of such groups as many fishermen are poorly educated and illiterate and will need guiding and supervision.

Finally it is also recommended that present data collection and analyses be reviewed and improved due to the poor quantity of historical and existing baseline data. This is important to enable more accurate and reliable FCD planning, to ensure that fisheries development strategies are based on reliable information and to acquire accurate production statistics and trends for monitoring progress year to year.

#### **F.17.1 Beneficiaries, Dis-beneficiaries and the Role of NGO's**

FCD projects have only provided limited fisheries benefits and these have been to those land owners whose property contains ponds which received protection from damaging flooding. In reality the potential benefit has been realised by relatively few pond owners because of a general lack of "know how" and DOF's inability to provide effective field extension support. It is important that pond culture is promoted and encouraged to realise the maximum benefits of FCD.

Capture fishermen and the vast pool of occasional fishermen have invariably been the victims of FCD schemes and have received scant attention and no compensation from FCD designers, manager and financial sponsors. Even where fishermen have formed groups and taken over the management of Jalmahals, with DOF and NGO assistance, the action has been a response to the fishermen's plight rather than a compulsory mitigation proposal attached to the FCD project.

It is proposed that FCD proposals should take the initiative to promote and finance at least some of the activities intended to mitigate and revive fish stocks. FCD projects should also assist the fishing communities to restore their traditional means of livelihood. These activities should be linked into the project cost benefit analyses to ensure that people who have lost access to a common good are fully compensated.

The action should be taken in active cooperation with DOF and the NGOs by providing the necessary resources to enforce their effects.

As well as benefiting full time and part time fishermen, a nutritional improvement programme should be initiated to replace and diminish the dependency on fish protein for subsistence fishermen and their families.

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A number of NGO's are already actively supporting groups of fishermen and fish farmers including BRAC (Bangladesh Rural Advancement Committee), the Grameen Bank, TDH (Terre Des Hommes), CARE, CARITAS, and PEP (Production Employment Programme) which operates under the umbrella of BRDB (Bangladesh Rural Development Board).

Typical projects include assisting small groups of fishermen to restore and operate formerly derelict fish ponds on long term leases, assisting other groups to operate Jalmahals by setting up their management systems and negotiating credit. Given the sufficient resources by FCD projects, NGOs will provide an invaluable contribution by supporting business interests of infant groups in ways that a Government Department could not easily do.

## **F.18 Conclusions and Recommendations**

It is clear that there is a serious conflict between agricultural development and existing capture fisheries in Bangladesh. The scope for developing these two activities is difficult, if not impossible to achieve since the more efficient an FCD/I scheme is, the more damaging it will result for the capture fisheries. In addition, the scope for mitigating against capture fisheries losses is limited because these losses do not only represent a decline in overall production in actual metric tonnes, but also depict irreparable losses in terms of the Biodiversity, i.e. the Natural Heritage of the country which could never be compensated for.

Furthermore, even if increased aquaculture activities are able to boost culture fisheries, they mainly produce high value fish that poor people cannot afford. Restocking certain areas with fry and fingerlings is potentially feasible, but great care should be taken when doing so as they may unbalance existing fishing systems with detrimental results to the ecology and the people of those systems.

It should be realised that there are some areas which are suitable for agricultural growth but there are also others which are highly productive fisheries grounds and should be managed only for this purpose. Decisions will need to be made at the highest levels to try and reach a compromise and a balance in the future development in this country.

It should be noted that the estimated fisheries production in the project area during this study are based on a very short field survey which took place during an unusually dry year and thus, are likely to represent an equally unusual situation. Even so, it is clear that the fisheries production and/or potential of the area is far higher than previously estimated. Results from this study certainly appear to confirm that the Gumti Phase II area is one of the most productive areas in the country. Therefore, further studies should be carried out on the capture fisheries production of the project area targeted to the proposed interventions as a matter of the highest priority and before any FCD and/or FCDI interventions actually take place. The fisheries impact analyses results and their financial valuation have been integrated into the overall economic analysis of each of the seven studied interventions. These have proved to be highly significant in four of the proposed interventions.

A series of recommendations have been put forward regarding some of the main issues considered in this study.

### **F.18.1 Fisheries Management Programme**

A Fisheries Management Programme should be developed jointly with the leading fisheries organizations in the area, such as the District and Thana Fisheries Offices and fishermen's cooperatives. Such a programme should include provisions for proper management of water bodies, fishing gears -including minimum mesh sizes, closed fishing seasons and fishing quotas. The actual details for these proposed provisions would need to be finalized after a more detailed study is carried out. The full implications of these management measures would have to be understood by the fishing community, including part time and occasional fishermen, if the scheme is to be successful.



## **F.18.2 Surveillance of Important Fishing Areas**

It is obvious that under the present situation in the project area, any protective measures will not be respected by the local population. Thus, a system of patrolling important natural fish breeding, nursery and feeding areas, will be needed. Such systems already occur unofficially in the project area, especially regarding Jalmahals, where the lease holder may have a group of fishermen patrolling the area before harvest time to ensure high catches. Surveillance will be most effective if carried out by local fishermen groups.

## **F.18.3 Involvement of Local NGOs**

In addition, the involvement of the various NGOs - such as the Comilla Rotary Club in future activities should be an important factor in any future planning of the fisheries and aquaculture activities in the area. The development of projects targeted towards women, such as the Mymensingh Aquaculture Extension Project run by FRI and ICLARM should be promoted.

## **F.18.4 Aquaculture**

Regarding aquaculture activities, it is important to note that substantial benefits may be obtained by improving pond culture, especially since there is already a large number of ponds currently under utilised. However, it must be emphasised strongly that pond culture should be an additional activity to the existing open water fisheries, and not a replacement of the latter.

Pond culture may help in reducing the overall losses in fish production in the project area, and indeed, of the region or the country as a whole. Nevertheless, by and large, it does not address the issue of displaced occasional fisher-person (which in many occasions may be women and children) or the nutritional loss to the poor, an issue which should be given the highest priority by local and central government. Furthermore, aquaculture *per se* will never compensate for the loss of habitat and species diversity, which in the case of the floodplain in the Gumti Phase II area, stands to be severe (Plates F.18.1 and F.18.2).

### **F.18.4.1 Seasonal and Small Ponds for Aquaculture**

The use of seasonal ponds to increase fish pond production has been tried successfully in the area of Mymensingh. They could provide alternative sources of income and protein to the landless people. Results from the FRI and ICLARM show that small ponds of approximately 0.032 ha stocked with Tilapia and Rajputi in July and harvested in December yielded 100 Kg. Under the same scheme, seasonal ponds holding fish for six months may yield an average of 1500 Kg/ha, while perennial ponds may yield 1000 Kg/ha.

This type of venture should certainly be promoted to use those seasonal and/or small ponds which are expected to be currently under-utilised in the Gumti Phase II area.



**Plate F.18.1 Typical Catch from Aquaculture in Ponds  
Same Species and Size**



**Plate F.18.2 Typical Floodplain Catch - Wide Variation  
in Species and Sizes. This Diversity Would Be  
Reduced Under Any Habitat Alterations**

#### **F.18.4.2      Rice-fish culture**

The activities of the Comilla Rotary Club in this respect will be important for the development of integrated farming in the region. In addition, trials for direct rice-fish culture have been carried out by the FRI and ICLARM in other parts of the country (Mymensingh), with promising results. The possible development of this activity in the Gumti Phase II area should be considered. However, it must be pointed out that results per hectare from this activity tend to be low (average of 92 Kg/ha) and that production cannot be guaranteed. Detailed knowledge of local hydrology is also required and this activity should thus be viewed as a complementary exercise mainly for farmers who will not suffer if the yields fail due to a bad year.

#### **F.18.5      Structural Design and Operation of Gates**

The use of the hydrodynamic model would be critical in deciding the location of these type of structures, if any, in the project area. In addition, given the general lack of understanding of the ecology and biology of the numerous fish groups in the area, it is imperative that further studies be carried out before final decisions are made in this regard.

#### **F.18.6      Improved Knowledge on the Biology and Ecology of Fish Species**

It is extremely important that research into the biology and ecology of at least the key species is carried out in order to provide specific information at the design and construction stages for wholly effective water resource management projects in this country.

#### **F.18.7      Sustainable Use of the Biodiversity of the Area**

Despite the short period of time allowed for this study, it was possible to establish with certainty that the Gumti Phase II area is indeed, an extremely productive floodplain region, as well as being an incredibly important wetland. This is not surprising given its proximity to the Meghna River, the most productive main river in the country (FAP 17, 1993).

It is apparent, that besides utilising the fish resource available in the Gumti Phase II study area in a commercial and subsistence manner, the people in the region also use this important wetland in other ways, such as for food (crustaceans, molluscs to feed their poultry, aquatic plants for self consumption or as animal feed, etc.) and as a source of construction materials for agricultural activities amongst many others.

It is also clear that at present, these natural resources are being utilised intensively by the human population in the region, as is the case throughout Bangladesh. Obviously, a considerable proportion of the people in the area are relying on their ability to use these free resources, especially fish, which are presently within their reach for their every day needs. Any intervention which may substantially alter this pattern will undoubtedly have serious consequences to their health and nutritional status, as well as their economic stability and livelihood.

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It is important to establish that 'conservation' of such resources needs to be considered as a philosophy for the 'sustainable use of the resources'. Due to the high levels of human dependency on these resources it is thus imperative, that any developments in the region, and in the country as a whole, consider conservation as an intrinsic part of development. Interventions should now no longer take place without due consideration to changes to the environment.

Therefore, the integration of conservation and development activities in Bangladesh has become one of the greatest challenges for the international and national communities, and it is a challenge that should be taken on by all concerned.

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**APPENDIX F.I**

**FISH ACT OF 1985**

The  
Bangladesh Gazette



Extraordinary  
Published by Authority

THURSDAY, OCTOBER 17, 1985

GOVERNMENT OF THE PEOPLE'S REPUBLIC OF BANGLADESH  
MINISTRY OF FISHERIES AND LIVESTOCK

NOTIFICATION

Dhaka, the 16th October, 1985

**No. S.R.O. 442-L/85.**—In exercise of the powers conferred by Section 3 of the Protection and Conservation of Fish Act, 1950 (E. B. Act XVIII of 1950), the Government is pleased to make the following rules, the same having been previously published as required by sub-section (5) of that section, namely:—

**THE PROTECTION AND CONSERVATION OF FISH RULES, 1985.**

1. **Short title.**—These rules may be called The Protection and Conservation of Fish Rules, 1985.

2. **Definitions.**—(1) In these rules, unless there is anything repugnant in the subject or context,—

(a) "form" means the form annexed to these rules; and

(b) "Schedule" means a Schedule annexed to these rules.

(2) The words or expression used in these rules but have not been defined shall have the same meaning as assigned to them in the Act under which these rules are made.

3. **Erection of fixed engines prohibited.**—(1) No person shall erect or use fixed engines in the rivers, canals, khals and beels.

(2) Any fixed engine erected or used in contravention of sub-rule (1) and any fish caught by means of such engine may be seized, removed and forfeited.

( 7637 )

Price : Taka 75

4. **Construction of bunds, etc., prohibited for certain purpose.**—No person shall construct bunds, weirs, dams and embankments or any other structure, whether temporary or permanent, in, on, across or over the rivers, canals, khals or beels for any purpose other than irrigation, flood control or drainage.

5. **Destruction of fish by explosives, etc., prohibited.**—No person shall destroy or make any attempt to destroy any fish by explosives, gun, bow and arrow in inland waters or within coastal territorial waters.

6. **Destruction of fish by poisoning prohibited.**—No person shall destroy or make any attempt to destroy any fish by poisoning of water or the depletion of fisheries by pollution, by trade effluents or otherwise in inland waters.

7. **Catching and destruction of certain fish during certain period prohibited.**—No person shall, during the period from 1st day of April to 31st day of August each year, catch or cause to be caught or destroy fry of Shol, Gazar and Taki moving in clusters or the parent fish while guarding them in the rivers, canals, khals, beels or any other sheet of water which ordinarily has direct communication with any river, canal, khal or beel:

Provided that the prohibition shall not extend to the catching or destruction of the fry and the parent fish of the species named above for the purpose of carp culture.

8. **Catching of carp fishes prohibited in certain waters.**—(1) No person shall catch or cause to be caught carp fishes, that is Rui, Catla, Mrigal, Kalbaus and Ghania of any size in the waters of the rivers, khals, etc., specified in the First Schedule during the period mentioned in the said Schedule unless he has a licence therefor issued by a competent officer in this behalf:

Provided that no licence for catching of the abovenamed carp fish shall be allowed for purpose other than pisciculture.

(2) A licence issued under sub-rule (1) shall be issued in the form shown and shall be subject to the conditions as are specified on the face of the licence.

(3) There shall be collected a licence fee of Tk. 100 for each licence issued under this rule.

9. **Sale of fish prohibited.**—No person shall catch, carry, transport, offer, expose or possess fish of the species and sizes mentioned in columns 2 and 3 of the Second Schedule at any time during the period mentioned in column 4 thereof:

Provided that the prohibition shall not apply to the catching, carrying, sale, transport or possession of any fish for the purposes of, or in connection with, pisciculture.

10. **Disposal of forfeited fish.**—Any fish forfeited for a breach of any of these rules shall be disposed of by auction and the auction money thereof shall be deposited in such Head of Account of the Government as it may direct.

11. **Prohibition on catching, carrying, transporting, offering, exposing or possessing of frogs.**—Notwithstanding anything contained in these rules, the Government may, by notification in the official Gazette, prohibit the catching, carrying, transporting, offering, exposing or possessing of any frog dead or alive during such period in such area and with such exceptions as may be specified therein.

## FIRST SCHEDULE

[see rule 8(1)]

Sl. No.	Name of the river, canal, etc.	Period.
1	2	3
1	River Kushiara from the Fenchuganj Railway bridge up to village Lama Gangapur, Upazila Fenchuganj, District Sylhet.	From 1st April to 30th June in any year.
2	River Kushiara from its junction with Lula canal up to village Kakordi, Upazila Beanibazar, District Sylhet.	Ditto.
3	Lula canal from its junction with Kushiara river up to its junction with Hakaluki haor, Upazila Fenchuganj, District Sylhet.	Ditto.
4	Karchar Dala (flowing from the river Kalni also known as Beramohana) from village Karacha to Makalchandi haor, Upazila Baniachang, District Habigonj.	Ditto.
5	Chairer Khal (flowing from the river Kalni also known as Beramohana) from village Halalnagar up to Makalkandi haor, Upazila Baniachong, District Habigonj.	Ditto.
6	Bahushiar Dala (flowing from Bibiana) from village Bahusha up to Mekar haor, Upazila Nabiganj, District Habigonj.	Ditto.
7	Fatepur Khal (flowing from the river Shaka Kushiara) from village Fatepur up to Ghardiar Beel, Upazila Ajmirigonj, District Habigonj.	Ditto.
8	River Surma from its junction with Madhabpur Khal to its junction with Chengar Khal at the southern boundary of the village Parkal, Upazila Chhatak, District Sunamgonj.	Ditto.
9	River Surma from village Karirgaon up to the Chhatak Thanaghat, Upazila Chhatak, District Sunamgonj.	Ditto.
10	River Surma from its junction with Poinda river at the southern border of the Poinda village up to its junction with Rakiti River, Upazila Sunamgonj, District Sunamgonj.	Ditto.

1	2	3
11	River Peain from its junction with Surma river up to village Pedar, Upazila Chhatak, District Sunamgonj.	From 1st April to 30th June in any year.
12	River Garakhal from its junction with river Peain up to its junction with Kurdhara, Upazila Chhatak, District Sunamgonj.	Ditto.
13	River Kataganj from its junction with river Peain up to its junction with Dala Dhalarmukh, Upazila Chhatak, Sunamgonj.	Ditto.
14	River Halda from its mouth in the river Karnafully near Kalurghat bridge up to Sadarghat ferry, Upazilas Panchlaish, Hathazari and Raozan, District Chittagong.	From 15th March to the 30th June in any year.
15	The undernoted channels flowing from the River Halda, within the jurisdiction of Hathazari and Raozan Upazilas, District Chittagong:	Ditto.
	(1) Krishnakhali.	
	(2) Khondakia Khal.	
	(3) Katakhal.	
	(4) Madari Khal.	
	(5) Kumira Khal.	
	(6) Fragabalia Khal.	
	(7) Fatikka Khal.	
	(8) Khandarali Khal.	
	(9) Chengkhali Khal.	
	(10) Baizzakhali Khal.	
	(11) Daccakhali Khal.	
	(12) Mogdair Khal.	
	(13) Kagutia Khal.	
	(14) Sonai Khal.	
16	River Bengali (lower portion of which is locally known as Fuljore) from the northern extremity of village Chaknandan, Upazila Sariakandi, District Bogra, up to the southern extremity of village Simalbari, Upazila Sherpur, District Bogra.	From 1st April to 30th June in any year.

1	2	3
17	River Karatoa (locally known as Fuljore) from the border of Sirajgonj District up to river Baral, bounded on the north by the eastern extremity of village Chandaikona, Upazila Raigonj, District Sirajgonj and on the south by the southern extremity of village Dombaria, Upazila Shahzadpur, District Sirajgonj.	From 1st May to 31st July in any year.
18	River Ichamati from the border of Sirajgonj District up to river Karatoa bounded on the north by the northern extremity of village Brahmagacha and on the south by the southern extremity of village Nalka, Upazila Raiganj, District Sirajgonj.	Ditto.
19	River Tista from Tista Railway bridge near Kaunia Raliway junction up to Chilmari, Upazila Chilmari, District Kurigram.	From 15th May to 15th July in any year.
20	River Jumna falling in the districts of Bogra, Gaibandha, Pabna and Sirajgonj.	From 1st April to 31st July in any year.
21	River Brahmaputra falling in the District of Kurigram.	Ditto.
22	The canal known as Delbasania and Gazaria Khal from its mouth at Putimari river up to Bachadighi at Badekarapara in Bagerhat District.	From 1st October to 31st March in any year.
23	Gaguria khal from its origin from river Jumna up to river Bengali bounded on the east by the eastern boundary of village Simulbari and on the west by the northern extremity of village Sariakandi, Upazila Sariakandi, District Bogra.	From 1st April to 30th June in any year.
24	Belai Khal between rivers Jamuna and Bengali bounded on the east by eastern boundary of village Pakuria and on the west by the northern boundary of village Chhagaldhara, Upazila Sariakandi, District Bogra.	Ditto.
25	River Bengali from Maliandaha, Upazila Shaghata, District Gaibandha up to the border of Bogra District.	From 1st May to 31st July in any year.
26	River Haldia from village Gopinathpur up to Maliandaha Ghat, Upazila Shaghata, District Gaibandha.	Ditto.
27	River Baral from its origin in the river Padma up to the Railway bridge near Arani Railway Station in the District of Natore.	From 15th May to 31st July in any year.

**APPENDIX F.II**

**SUPPORTING CATCH DATA**



## Area of Fishing System per Zone Sampled for the Catch Assessment Surve

Zone B	Name	Area (ha)
Rivers	Bijni	67
	Salda	98
	- Subtotal	165
Khals	Raja	33
- Subtotal		33
Beels	Nainda Fisheries	10
	Hatina Mural	47
	- Subtotal	57
Zone C		
Rivers	Bakdar Fisheries	58
	Nila Fisheries	33
	Titas Block A & B	97
	- Subtotal	188
Beels	Bari	10
	Dead Titas River	14
	Renua Borathor	22
	Santaluk Bural	32
	- Subtotal	78
Zone D		
Rivers	Noabad Jalmahal	68
	Sreemati	5
	Titas	116
	- Subtotal	189
Khals	Bagmara	59
- Subtotal		59
Beels	Bariadoha	98
	Chandal	60
	Satbila	31
	Satdona	10
	Bashania	4
	- Subtotal	203
TOTAL		972

280

TOTAL CATCH (KG) IN ZONE B PER WEEK

Zone : B

WEEK	BIJNA RIVER			HATINA MURAL BEEL			NAINDA FISHERIES BEEL			RAJAR KHAL		
	OTHER	KATA	TOTAL	OTHER	KATA	TOTAL	OTHER	KATA	TOTAL	OTHER	KATA	TOTAL
W1	157.00		157.00				49.00		49.00	47.00		47.00
W2												
W3												
W4												
W6												
W7												
W8												
TOTAL												

(continued)

TOTAL CATCH (KG) IN ZONE B PER WEEK

Zone : B

WEEK	SALDA RIVER			OTHER	KATA	TOTAL
	OTHER	KATA	TOTAL			
W1	193.00		193.00	193.00		193.00
W2				96.00		96.00
W3				157.00		157.00
W4				221.00		221.00
W6				280.00		280.00
W7				326.00		326.00
W8				426.00		426.00
TOTAL	193.00		193.00	1699.00		1699.00

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TOTAL CATCH (KG) IN ZONE C PER WEEK

Zone : C

WEEK	BAKDAR FISHERIES			BARI BEEL			DEAD TITAS RIVER			NILA FISHERIES		
	OTHER	KATA	TOTAL	OTHER	KATA	TOTAL	OTHER	KATA	TOTAL	OTHER	KATA	TOTAL
W1	109.00		109.00				69.00		69.00	56.00		56.00
W2							134.00		134.00			
W3							260.00		260.00			
W4							296.00		296.00			
W5				117.00		117.00	373.00		373.00			
W6				59.00		59.00	282.00		282.00			
W7				62.00		62.00	204.50		204.50			
W8												
TOTAL	109.00		109.00	238.00		238.00	1618.50		1618.50	56.00		56.00

(continued)

TOTAL CATCH (KG) IN ZONE C PER WEEK

Zone : C

WEEK	RENUA BORATHOR BEEL			SANTALUK-BURAL BEEL			TITAS RIVER BLOCK A & B			OTHER	KATA	TOTAL
	OTHER	KATA	TOTAL	OTHER	KATA	TOTAL	OTHER	KATA	TOTAL			
W1							73.00		73.00	142.00		142.00
W2							142.00		142.00	165.00		165.00
W3										276.00		276.00
W4	63.00		63.00							323.00		323.00
W5				557.00		557.00	130.00		130.00	983.00		983.00
W6	266.00		266.00				131.00		131.00	621.00		621.00
W7	240.00		240.00				166.00		166.00	773.00		773.00
W8										506.50		506.50
TOTAL	569.00		569.00	557.00		557.00	642.00		642.00	3789.50		3789.50

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## TOTAL CATCH (KG) IN ZONE D PER WEEK

Zone : D

WEEK	BAGMARA KHAL			BARTADOHA BEEL			CHANDAL BEEL			NOABAD JALMAHAL		
	OTHER	KATA	TOTAL	OTHER	KATA	TOTAL	OTHER	KATA	TOTAL	OTHER	KATA	TOTAL
W1							395.00		395.00	117.00	122.00	239.00
W2												
W3				42.26		42.26				83.00	17.00	100.00
W4										30.50	34.50	65.00
W5										46.00	53.00	99.00
W6	245.00	33.00	278.00									
W7							1863.00		1863.00	95.00	38.00	133.00
W8												
TOTAL	245.00	33.00	278.00	42.26		42.26	2258.00		2258.00	371.50	264.50	636.00

WEEK	SATBILA BEEL			SATDONA BEEL			SREEMATI RIVER			TITAS RIVER		
	OTHER	KATA	TOTAL	OTHER	KATA	TOTAL	OTHER	KATA	TOTAL	OTHER	KATA	TOTAL
W1												
W2	543.00		543.00				48.50	49.50	98.00			
W3	272.50		272.50									
W4				254.50		254.50						
W5										309.00	539.00	848.00
W6											7262.00	7262.00
W7											2123.00	2123.00
W8												
TOTAL	815.50		815.50	254.50		254.50	48.50	49.50	98.00	309.00	9924.00	10233.00

WEEK	BHASHANIA BEEL			OTHER	KATA	TOTAL
	OTHER	KATA	TOTAL			
W1				512.00	122.00	634.00
W2				591.50	49.50	641.00
W3				397.76	17.00	414.76
W4				285.00	34.50	319.50
W5				355.00	592.00	947.00
W6				245.00	7295.00	7540.00
W7				1958.00	38.00	1996.00
W8	124.00	77.00	201.00	124.00	2200.00	2324.00
TOTAL	124.00	77.00	201.00	4468.26	10348.00	14816.26

ESTIMATED TOTAL SPECIES CATCH (KG) BY GEAR IN ZONE B

River

SPECIES	Gill Net	Seine Net	Lift Net	Bag Net	Cast Net	Clap Net	Push Net	Traps	Other	Total
Ruhi	19	1								20
Catla	11									11
Kalbasu		2								2
Boal	10	4								14
Shol/Gazar	13									13
Chital/Phali		3								3
Koi		1								1
Singi/Magur	15	8								23
Small Srmps	10	49								59
Tengra	12	8								20
Punti	20	53								73
Miscellaneous	16	16								32
Kakila										
Baim	11									11
Taki										
Silver carp	20									20
Mola										
Colisha										
Chapila		1								1
Chanda		40								40
Batasi		8								8
Total	157	193								350

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## ESTIMATED TOTAL SPECIES CATCH (KG) BY GEAR IN ZONE B

Khal

SPECIES	Gill Net	Seine Net	Lift Net	Bag Net	Cast Net	Clap Net	Push Net	Traps	Other	Total
Ruhi										
Catla										
Kalbasu										
Boal										
Shol/Gazar										
Chital/Phali					6					6
Koi										
Singi/Magur										
Small Srimps										
Tengra										
Punti			13		10					23
Miscellaneous			7		5					12
Kakila										
Baim										
Taki			6							6
Silver carp										
Mola										
Colisha										
Chapila										
Chanda										
Batasi										
Total			26		21					47

ESTIMATED TOTAL SPECIES CATCH (KG) BY GEAR IN ZONE B

Beel

SPECIES	Gill Net	Seine Net	Lift Net	Bag Net	Cast Net	Clap Net	Push Net	Traps	Other	Total
Ruhi										
Catla										
Kalbasu										
Boal		63						70		133
Shol/Gazar		69						34		103
Chital/Phali										
Koi	22	8								30
Singi/Magur	9	73						13		95
Small Srimps		7						134		141
Tengra		27						83		110
Punti	21	123						309		452
Miscellaneous	8	14						36		58
Kakila		11						16		27
Baim		8						36		44
Taki		20						38		58
Silver carp										
Mola		2						28		30
Colisha		2								2
Chapila										
Chanda		19								19
Batasi										
Total	60	446						797		1302

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## ESTIMATED TOTAL SPECIES CATCH (KG) BY GEAR IN ZONE C

River

SPECIES	Gill Net	Seine Net	Lift Net	Bag Net	Cast Net	Clap Net	Push Net	Traps	Other	Total
Ruhi		15		19	6					40
Catla		16	3	7						26
Mrigal		10		12	9					31
Kalbasu	2	23	2	15	11					53
Boal	2	23	7	21	11					64
Air			1	5						6
Shol/Gazar		10	3	3						16
Chital/Phali	2	31	3	17	9					62
Koi		4		2						6
Singi/Magur		1	1	2						3
Small Srims		11	2	2						14
Tengra	3	34	2	22	2					63
Pabda										
Punti	15	73	2	35	8					133
Miscellaneous		35	3	11	9					57
Chela										
Kakila		4		4						8
Baim				5						5
Bhagna	3	21	1	12						37
Baila	3	21	3	17	8					52
Taki										
Bheda	2	28	3	21	7					60
Mola				5						5
Gutum										
Colisha										
Chapila	1	13		10	7					31
Chanda	4	13		19	3					39
Cutcutia										
Batasi										
Titputi										
69										
Total	37	382	35	264	90					807

ESTIMATED TOTAL SPECIES CATCH (KG) BY GEAR IN ZONE C

Beel

SPECIES	Gill Net	Seine Net	Lift Net	Bag Net	Cast Net	Clap Net	Push Net	Traps	Other	Total
Ruhi		56						8		64
Catla		24								24
Mrigal		8								8
Kalbasu		26								26
Boal		124						99		223
Air										
Shol/Gazar		50						143		193
Chital/Phali		40						9		49
Koi	12	57						81		150
Singi/Magur	3	35						58	5	101
Small Srimps		55						150		204
Tengra	6	140						108		254
Pabda								2		2
Punti	20	178						365		563
Miscellaneous		90						10		100
Chela								1		1
Kakila	2	26						32		60
Baim	5	35						25		65
Bhagna										
Baila								22		22
Taki		56						83		139
Bheda		37						45		90
Mola	8									
Gutum		11						7		17
Colisha		33						28		61
Chapila										
Chanda		106						157		263
Cutcutia		22						2		24
Batasi		79						45		124
Titputi		142						19		160
69		2						1		3
Total	56	1427						1495	5	2983

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## ESTIMATED TOTAL SPECIES CATCH (KG) BY GEAR IN ZONE D

River

SPECIES	Gill Net	Seine Net	Lift Net	Bag Net	Cast Net	Clap Net	Push Net	Traps	Other	Total
Ruhi		81	1	10	2		1	3		97
Catla	1	39	2	12	1					54
Mrigal		5	1	8	2					15
Kalbasu		32	1	7	5					44
Ghainna	1	14	1	2	3		1			22
Boal	1	357	8	38	12		11	15		441
Air	3	61	4	4	7		4			83
Shol/Gazar		388	11	33	19		5	18		473
Chital/Phali	1	191	4	21	7			20		242
Koi		24	1	8	1		1			35
Singi/Magur		128	5	24	12		3			171
Sar Punt		56	1	10	4			21		91
Big Shrimps	6	211	14	57	53		10	6		356
Small Srimps		410	26	48	12		2	42		539
Tengra		1593	3	36	4		2	38		1675
Pabda		93	1	8	2		2			105
Punti	2	3727	14	64	21		3	347		4177
Miscellaneous	3	1458	14	49	38		7	50		1618
Kakila		26						22		48
Baim		12						6		18
Baila		11						12		23
Taki		13						6		18
Bheda		7						7		13
Gutum		5						3		7
Keski										
Chapila										
Chanda		12						11		23
Ghavra										
Titputi		323						257		580
Total	17	9271	110	436	201		52	882		10967

ESTIMATED TOTAL SPECIES CATCH (KG) BY GEAR IN ZONE D

Khal

SPECIES	Gill Net	Seine Net	Lift Net	Bag Net	Cast Net	Clap Net	Push Net	Traps	Other	Total
Ruhi		2	2	1						5
Catla			2	1						3
Mrigal		1	1							2
Kalbasu										
Ghainna										
Boal		9	7	4						20
Air		2	5	3						10
Shol/Gazar		12	14	5						31
Chital/Phali		3	4	3						10
Koi		1	2							3
Singi/Magur		3	14	6						23
Sar Puntl		1	3	2						6
Big Shrimps		1	1							2
Small Shrimps		1	9	5						15
Tengra		1	1							2
Pabda		1								1
Punti		14	13	8						35
Miscellaneous		7	25	13						45
Kakila		1	3	1						5
Baim										
Baila										
Taki		3	10	5						18
Bheda		3	9	7						19
Gutum		1	1	3						5
Keski										
Chapila		1	1	1						3
Chanda		2	5	3						10
Ghavra		2	2	1						5
Titputi										
Total		72	134	72						278

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## ESTIMATED TOTAL SPECIES CATCH (KG) BY GEAR IN ZONE D

Beel

SPECIES	Gill Net	Seine Net	Lift Net	Bag Net	Cast Net	Clap Net	Push Net	Traps	Other	Total
Ruhi	27	82	2				1			111
Catla	11	47		3	2		1			63
Mrigal	2	17								18
Kalbasu	11	42	2	2			1			58
Ghainna	34	52	3		2		2			91
Boal	38	111	5	2	2		2			159
Air	5		5	3						13
Shol/Gazar	28	177	6	2	4		2			219
Chital/Phali	24	87	5				2			118
Koi	11	33	2	2			0			48
Singi/Magur	15	79	4	4	4		2			108
Sar Punt	4	6	0	2	2		0			14
Big Shrimps	2	10					1			12
Small Shrimps	58	305	7	3	1		1			374
Tengra	51	375	1				5			433
Pabda	6	6								12
Punti	91	589	8	2	8		4			700
Miscellaneous	104	353	6	3	8		3		1	476
Kakila		29								29
Baim										
Baila										
Taki		44								44
Bheda		48								48
Gutum										
Keski		95								95
Chapila										
Chanda		149								149
Ghavra										
Titputi		183								183
Total	517	2917	54	28	33		23		1	3571

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Zone : B

SPECIES	River		Khal		Beel	
	KATA	OTHER	KATA	OTHER	KATA	OTHER
Ruhi		19.50				
Catla		11.00				
Mrigal						
Kalbasu		2.00				
Ghainna						
Boal		14.00			133.00	133.00
Air						
Pangas						
Sillon						
Shol/Gazar		13.00			103.00	103.00
Chital/Phali		2.50				
Koi		1.00		6.00	30.00	30.00
Singji/Magur		23.00			95.00	95.00
Sar Punt						
Big Shrimps		59.00				
Small Shrimps		20.00			141.00	141.00
Tengra					110.00	110.00
Pabda						
Punti		73.00		23.00	452.00	452.00
Miscellaneous		32.00		12.00	58.00	58.00
Chela						
Kakila					27.00	27.00
Baim		11.00			44.00	44.00
Bhagna						
Baila						
Taki						
Bheda				6.00	58.00	58.00
Silver carp						
Mola		20.00			30.00	30.00
Gutum						
Colisha					2.00	2.00
Keski						
Chapila		1.00				
Chanda		40.00			19.00	19.00
Cutcutia						
Ghawra						
Batasi		8.00				
Titputi						
Patka						
TOTAL		350.00		47.00	1302.00	1302.00

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TOTAL CATCH (KG) BY SPECIES AND ZONE

Zone : C

SPECIES	River		Khal		Beel	
	KATA	OTHER	KATA	OTHER	KATA	OTHER
Ruhi		39.50			63.50	63.50
Catla		25.50			23.50	23.50
Mrigal		31.00			7.50	7.50
Kalbasu		52.50			26.00	26.00
Gharina						
Boal		64.00			222.50	222.50
Air		6.00				
Pangas						
Silon						
Shol/Gazar		15.50			192.50	192.50
Chital/Phali		61.50			49.00	49.00
Koi		6.00			149.50	149.50
Singi/Magur		3.00			100.50	100.50
Sar Punt						
Big Shrimps		14.00			204.00	204.00
Small Shrimps		62.50			253.50	253.50
Tengra					2.00	2.00
Pabda					562.50	562.50
Punti		132.50			100.00	100.00
Miscellaneous		56.50			1.00	1.00
Chela					60.00	60.00
Kakila		8.00			64.50	64.50
Baim		5.00				
Bhagna		37.00				
Baila		52.00			22.00	22.00
Taki					138.50	138.50
Bheda		60.00			90.00	90.00
Silver carp						
Mola		5.00			17.00	17.00
Gutum					60.50	60.50
Colisha						
Keski						
Chapila		31.00			262.50	262.50
Chanda		39.00			24.00	24.00
Cutcutia						
Ghaura					123.50	123.50
Batasi					160.00	160.00
Titputi					2.50	2.50
Patka						
TOTAL		807.00			2982.50	2982.50

TOTAL CATCH (KG) BY SPECIES AND ZONE

Zone : D

SPECIES	River		Khal		Beel	
	KATA	OTHER	KATA	OTHER	KATA	OTHER
Ruhi	78.00	19.00	1.00	4.00	2.00	109.00
Catla	36.00	18.00	1.00	2.00	5.00	58.00
Mrigal	2.00	13.00	1.00	1.00	1.00	17.00
Kalbasu	32.00	12.00			2.00	56.00
Gharina	15.00	7.00				91.00
Boal	386.50	54.00	2.00	18.00	10.00	148.50
Air	61.00	22.00	2.00	8.00	6.00	7.00
Pangas						
Silon						
Shol/Gazar	419.00	54.00	4.00	27.00	10.00	208.50
Chital/Phali	214.50	27.50	1.00	9.00	2.00	116.00
Koi	23.00	12.00		3.00		47.50
Singli/Magur	119.00	52.00	3.00	20.00	5.00	102.50
Sar Punt	74.50	16.50	1.00	5.00	2.00	11.76
Big Shrimps	318.50	37.00	1.00	1.00	5.00	7.00
Small Srimps	439.00	100.00		15.00		373.50
Tengra	1637.50	37.50	1.00	1.00	1.00	431.50
Pabda	96.50	8.50	1.00		1.00	11.00
Punti	4059.00	118.00	3.00	32.00	5.00	695.00
Miscellaneous	1497.00	121.00	5.00	40.00	20.00	455.50
Chela						
Kakila	48.00			5.00		29.00
Baim	18.00					
Bhagna						
Baila	23.00					
Taki	18.00		1.00	17.00	18.00	44.00
Bheda	13.00		3.00	16.00	19.00	48.00
Silver carp						
Mola						
Gutum	7.00			5.00		
Colisha		7.00				
Keski						
Chapila			1.00	2.00		95.00
Chanda				10.00		149.00
Cutcutia	23.00					
Ghawra			1.00	4.00		
Batasi						
Titputi	580.00					183.00
Patka						
TOTAL	10238.00	729.00	33.00	245.00	77.00	3494.26
						3571.26

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TOTAL CATCH (KG) IN ZONE B PER WEEK

Zone : B

WEEK	BIJNA RIVER		HATINA MURAL BEEL		NAINDA FISHERIES BEEL			RAJAR KHAL		
	OTHER	KATA	OTHER	KATA	OTHER	KATA		OTHER	KATA	
W1	562.00				209.00		209.00	166.00		166.00
W2										
W3										
W4					742.00		742.00			
W6			254.00		896.00		896.00			
W7			920.00		1689.00		1689.00			
W8			917.00		614.00		614.00			
TOTAL	562.00		2091.00		4150.00		4150.00	166.00		166.00

(continued)

TOTAL CATCH (KG) IN ZONE B PER WEEK

Zone : B

WEEK	SALDA RIVER		OTHER	KATA	
	OTHER	KATA			
W1	772.00		772.00		772.00
W2			375.00		375.00
W3			562.00		562.00
W4			742.00		742.00
W6			1150.00		1150.00
W7			2609.00		2609.00
W8			1531.00		1531.00
TOTAL	772.00		7741.00		7741.00

TOTAL CATCH (KG) IN ZONE C PER WEEK

Zone : C

WEEK	BAKDAR FISHERIES		BARI BEEL		DEAD TITAS RIVER			NILA FISHERIES		
	OTHER	KATA	OTHER	KATA	OTHER	KATA		OTHER	KATA	
W1	368.00				381.00		381.00	227.00		227.00
W2		368.00			468.00		468.00			
W3					1000.00		1000.00			
W4					1081.00		1081.00			
W5					722.00		722.00			
W6			395.00		395.00		395.00			
W7			209.00		209.00		209.00			
W8			246.00		246.00		246.00			
TOTAL	368.00		850.00		5707.50		5707.50	227.00		227.00

(continued)

TOTAL CATCH (KG) IN ZONE C PER WEEK

Zone : C

WEEK	RENUA BORATHOR BEEL		SANTALUK-BURAL BEEL		TITAS RIVER BLOCK A & B			OTHER	KATA	
	OTHER	KATA	OTHER	KATA	OTHER	KATA				
W1					286.00		286.00	667.00		667.00
W2					548.00		548.00	595.00		595.00
W3		783.00						1016.00		1016.00
W4					1668.00		1668.00	1783.00		1783.00
W5					538.00		538.00	3287.00		3287.00
W6					524.00		524.00	1641.00		1641.00
W7	1064.00				664.00		664.00	3116.00		3116.00
W8	940.00							2062.50		2062.50
TOTAL	2787.00		1668.00		2560.00		2560.00	14167.50		14167.50

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TOTAL CATCH (KG) IN ZONE D PER WEEK

Zone : D

WEEK	BAGMARA KHAL		BARIADOHA BEEL		CHANDAL BEEL		NOABAD JALMAHAL		
	OTHER	KATA	OTHER	KATA	OTHER	KATA	OTHER	KATA	
W1					1442.00		493.00	457.00	950.00
W2									
W3			142.76				334.00	70.00	404.00
W4							122.00	138.00	260.00
W5							324.00	293.00	617.00
W6	946.00	135.00							
W7					8208.00		383.00	148.00	531.00
W8									
TOTAL	946.00	135.00	142.76		9650.00		1656.00	1106.00	2762.00

(continued)

TOTAL CATCH (KG) IN ZONE D PER WEEK

Zone : D

WEEK	SATBILA BEEL		SATDONA BEEL		SREEMATI RIVER		TITAS RIVER		
	OTHER	KATA	OTHER	KATA	OTHER	KATA	OTHER	KATA	
W1									
W2	2446.00								
W3	1246.50				207.50	207.50			
W4			1029.50						
W5							1236.00	2156.00	3392.00
W6								27600.00	27600.00
W7								8400.00	8400.00
W8									
TOTAL	3692.50		1029.50		207.50	207.50	1236.00	38156.00	39392.00

(continued)

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TOTAL CATCH (KG) IN ZONE D PER WEEK

Zone : D

WEEK	BHASHANJA BEEL		OTHER	KATA
	OTHER	KATA		
W1			1935.00	457.00
W2			2653.50	207.50
W3			1723.26	70.00
W4			1151.50	138.00
W5			1560.00	2449.00
W6			946.00	27735.00
W7			8591.00	148.00
W8	539.00	304.00	539.00	8704.00
TOTAL	539.00	304.00	19099.26	39908.50
				59007.76

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## TOTAL WEIGHT (kg) , AVERAGE PRICE OF SPECIES IN ZONE B

SPECIES	Kuti Bazer			Kasba Bazer			Khara Bazer			Dely Bazer		
	WEIGHT	(Tk/kg)	(SD)	WEIGHT	(Tk/kg)	(SD)	WEIGHT	(Tk/kg)	(SD)	WEIGHT	(Tk/kg)	(SD)
	(kg)			(kg)			(kg)			(kg)		
Ruhi	258.00	55.0	6.1	204.00	58.3	2.9	25.00	50.0				
Catla	212.00	51.0	4.2	120.00	51.7	7.6	30.00	40.0				
Mrigal	207.00	50.0	3.5	138.00	51.7	2.9						
Kalbasu	2.00	55.0										
Boal	91.00	45.0	5.0	35.00	50.0		35.00	37.5	10.6	52.00	43.3	2.9
Shol/Gazar	107.00	40.0	4.1	29.00	40.0	7.1	8.00	30.0		45.00	30.0	
Chital/Phali	15.00	40.0		4.00	60.0		7.00	40.0				
Koi	89.00	37.0	9.1	33.00	41.7	10.4	25.00	40.0	14.1	43.00	38.3	2.9
Singi/Magur	97.00	42.0	5.7	36.00	41.7	7.6	49.00	45.0	14.1	41.00	48.3	2.9
Small Srmps	180.00	29.0	8.2	94.00	25.0	5.0	48.00	30.0	7.1	54.00	20.0	
Tengra	122.00	21.3	2.5	50.00	22.5	3.5	37.00	30.0	14.1	41.00	25.0	
Punti	259.00	23.0	2.7	82.00	21.0	3.6	105.00	22.5	3.5	131.00	23.3	2.9
Miscellaneous	15.00	20.0		77.00	22.5	3.5						
Hilsha	280.00	35.0		240.00	35.0							
Baim	56.00	20.0		12.00	20.0		19.00	20.0		31.00	16.7	2.9
Taki	97.00	25.0	4.1	27.00	25.0	5.0	20.00	20.0		35.00	23.3	5.8
Bheda	6.00	35.0	7.1									
Silver carp	283.00	40.0	6.1	280.00	38.3	2.9	20.00	45.0		15.00	20.0	
Carpio	195.00	55.0	7.9	115.00	46.7	5.8						
Talapia	150.00	28.0	5.7	126.00	31.7	5.8						
Mola	5.00	36.0										
Colisha		20.0		3.00	20.0							
Baicha	112.00	20.0		52.00	20.0		65.00	20.0		64.00	20.0	
Keski				12.00	25.0							
Chapila				12.00	35.0							
Chanda	118.00	29.0	17.5	53.00	15.0	7.1				45.00	20.0	

Grati phase-II  
Analysis data

TOTAL WEIGHT (kg) , AVERAGE PRICE OF SPECIES IN ZONE C

SPECIES	Nabinagar Bazer			Muradnagar Bazer			Bholachoa Bazer			Companiganj Bazer			Ramchandrapur Bazer		
	WEIGHT )		(SD)	WEIGHT )		(SD)	WEIGHT )		(SD)	WEIGHT )		(SD)	WEIGHT )		(SD)
	(kg)	(Tk/kg)		(kg)	(Tk/kg)		(kg)	(Tk/kg)		(kg)	(Tk/kg)		(kg)	(Tk/kg)	
Ruhi	95.00	59.2	12.0				30.00	45.0		55.00	80.0		360.00	83.3	5.8
Catla	35.00	71.7	7.6	11.00	80.0					148.00	72.5	5.0	140.00	73.3	5.8
Mrigal	29.00	58.3	10.4				37.00	45.0		27.00	70.0		30.00	80.0	14.1
Kalbasu	31.00	60.0	9.1												
Ghainna	32.00	49.0	9.6	1.00	55.0					4.00	12.0		400.00	81.7	7.6
Boal	26.00	42.0	5.7				12.00	38.3	2.9	40.00	71.7	5.8	50.00	48.3	10.4
Shol/Gazar	19.00	45.0	11.2				3.00	45.0		25.00	60.0		22.00	60.0	
Chital/Phali	19.00	49.0	8.2	4.00	60.0		20.00	40.0		11.00	40.0		55.00	65.0	5.0
Koi	22.00	65.0	8.7	1.50	75.0		5.00	50.0		20.00	63.8	7.5	29.00	78.3	2.9
Singi/Magur	38.00	23.0	2.7				15.00	22.5	3.5	13.00	80.0	49.5	33.00	23.3	7.6
Small Shrimps	68.00	44.2	5.8				10.00	42.5	3.5	19.00	65.0		57.00	38.3	2.9
Tengra	113.00	27.5	11.3	22.00	15.0		25.00	25.0		95.00	35.0		130.00	26.7	2.9
Punti										117.00	21.3	4.8			
Miscellaneous										25.00	15.0				
Kakila	29.00	27.5	4.2	1.00	10.0		1.00	20.0		11.00	14.8	3.8	32.00	16.7	2.9
Hilsha	85.00	47.5	5.2												
Baim	21.00	43.0	9.1	2.50	45.0		3.00	35.0		19.00	45.0		35.00	48.3	2.9
Bhagna	41.00	45.3	14.3							4.00	50.0				
Baila	32.00	40.0	7.1				9.00	30.0		10.00	30.0				
Taki	20.00	37.6	6.0	3.50	10.0		25.00	32.5	3.5	28.00	21.3	6.3	65.00	18.3	2.9
Bheda	40.00	37.0	4.7				9.00	32.5	3.5	4.00	20.0		24.00	30.0	
Chewa/Chering										8.00	25.0		50.00	27.5	3.5
Silver carp	148.00	41.2	7.8	8.00	50.0		65.00	37.5	3.5	117.00	73.8	2.5	240.00	70.0	
Carpio	40.00	55.0	7.1										80.00	60.0	
Talapia	44.00	41.0	4.2				16.00	35.0	7.1	12.00	30.0		75.00	35.0	5.1
Mola	41.00	33.8	4.8	3.50			12.00	27.5	3.5	48.00	25.0		24.00	29.3	
Gutum	4.00	25.0					2.00	20.0							
Colisha	35.00	28.8	4.8				14.00	25.0		20.00	23.5	4.4	70.00	23.3	2.9
Baicha															
Keski	30.00	27.5	3.5				27.00	22.5	3.5						
Chapila	18.00	47.5	3.5				10.00	40.0	7.1						
Chanda	65.00	22.8	2.5				20.00	25.0		65.00	15.0		63.00	15.0	3.0
Fasha															
Batasi													47.00	25.0	
Titputi	14.00	40.0			12.0					70.00	15.0		60.00	12.3	2.5

TOTAL WEIGHT (kg) , AVERAGE PRICE OF SPECIES IN ZONE D

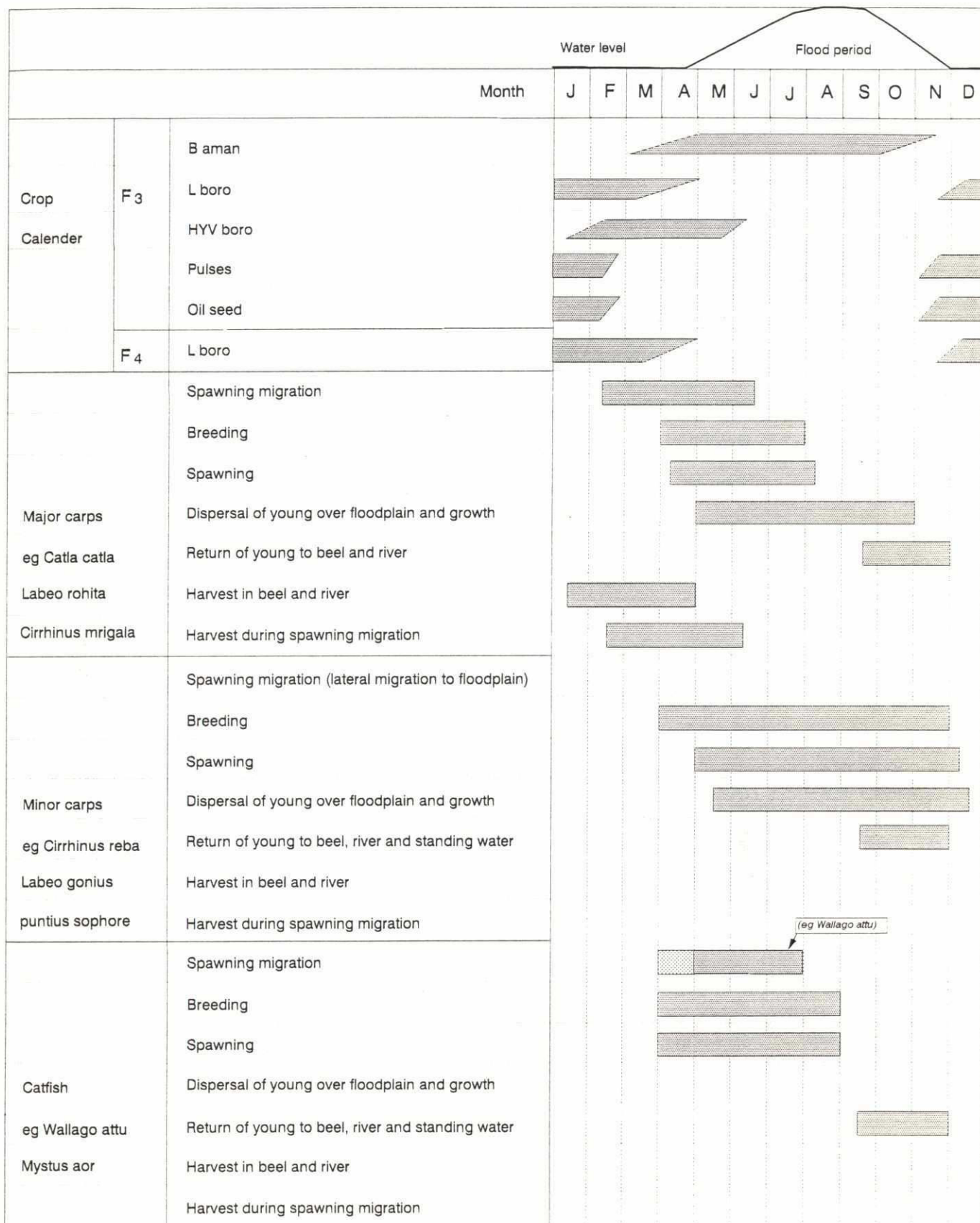
SPECIES	Homna Bazer			Bancharampur Bazer		
	WEIGHT	(Tk/kg)	(SD)	WEIGHT	(Tk/kg)	(SD)
	(kg)			(kg)		
Ruhi	119.00	85.7	14.0	75.00	68.8	5.2
Catla	50.00	88.0	23.9	64.00	63.6	5.6
Mrigal	48.00	75.0	16.2	5.00	60.0	
Kalbasu	4.00	70.0	10.0	12.00	56.7	5.8
Ghainna	1.00	57.5	17.7	7.00	50.0	
Boal	233.00	66.4	16.3	242.00	43.6	3.8
Air	76.00	69.3	8.4	40.00	58.0	11.0
Shol/Gazar	359.00	55.0	12.8	305.00	48.3	4.5
Chital/Phali	68.00	69.3	8.4	134.00	46.1	11.4
Koi	17.00	67.5	2.9	90.00	65.0	5.8
Singi/Magur	214.00	59.4	19.2	232.50	52.9	8.9
Sar Punt	16.00	71.3	10.3	9.00	60.0	14.1
Big Shrimps	430.00	228.6	6.3	15.00	266.7	51.6
Small Shrimps	225.00	24.3	8.4	158.00	19.1	3.2
Tengra	11.00	56.5	13.9	106.00	26.7	5.2
Pabda	8.00	65.0		38.00	67.5	5.0
Punti	527.00	35.0	4.6	465.00	24.0	4.2
Miscellaneous	365.00	45.0	11.2	235.00	23.0	2.7
Chela	4.00	20.0		14.00	30.0	7.1
Kakila	12.00	28.8	2.5	71.00	24.9	7.8
Hilsha				45.00	35.0	
Baim	5.00	52.5	3.5	50.00	41.0	8.1
Bhagna	2.00	52.5	3.5	29.00	41.0	15.2
Baila	16.00	46.7	2.9	13.00	21.7	2.9
Taki	150.00	30.5	10.7	221.00	30.4	6.3
Bheda	128.00	42.5	5.0	92.00	30.8	4.9
Silver carp	38.00	60.0		60.00	32.5	3.5
Carpio	10.00	82.5	10.6			
Talapia	2.00			80.00	35.0	
Mola				23.00	28.3	2.9
Gutum	10.00	40.0		32.00	26.6	5.3
Colisha	7.00			72.00	27.6	4.2
Baicha		70.0		2.00	55.0	
Hilora				2.00	55.0	
Keski	45.00	27.3	2.5	117.00	19.0	3.5
Chapila	17.00	35.0		31.00	37.5	8.7
Chanda	75.00	21.3	2.5	89.00	18.8	2.0
Baspata	1.00	40.0		11.00	42.5	3.5
Batta				6.00	37.5	10.6
Cutcutia		30.0		22.00	15.0	
Gangania	1.00	20.0		8.00	15.0	
Kazali	1.00	60.0				
Ghawra		75.0		6.00	55.0	
Batasi				5.00	35.0	
Titputi				80.00	19.0	1.4
Napti				30.00	15.0	
Gachua				57.00	16.7	2.9
69				5.00	15.0	

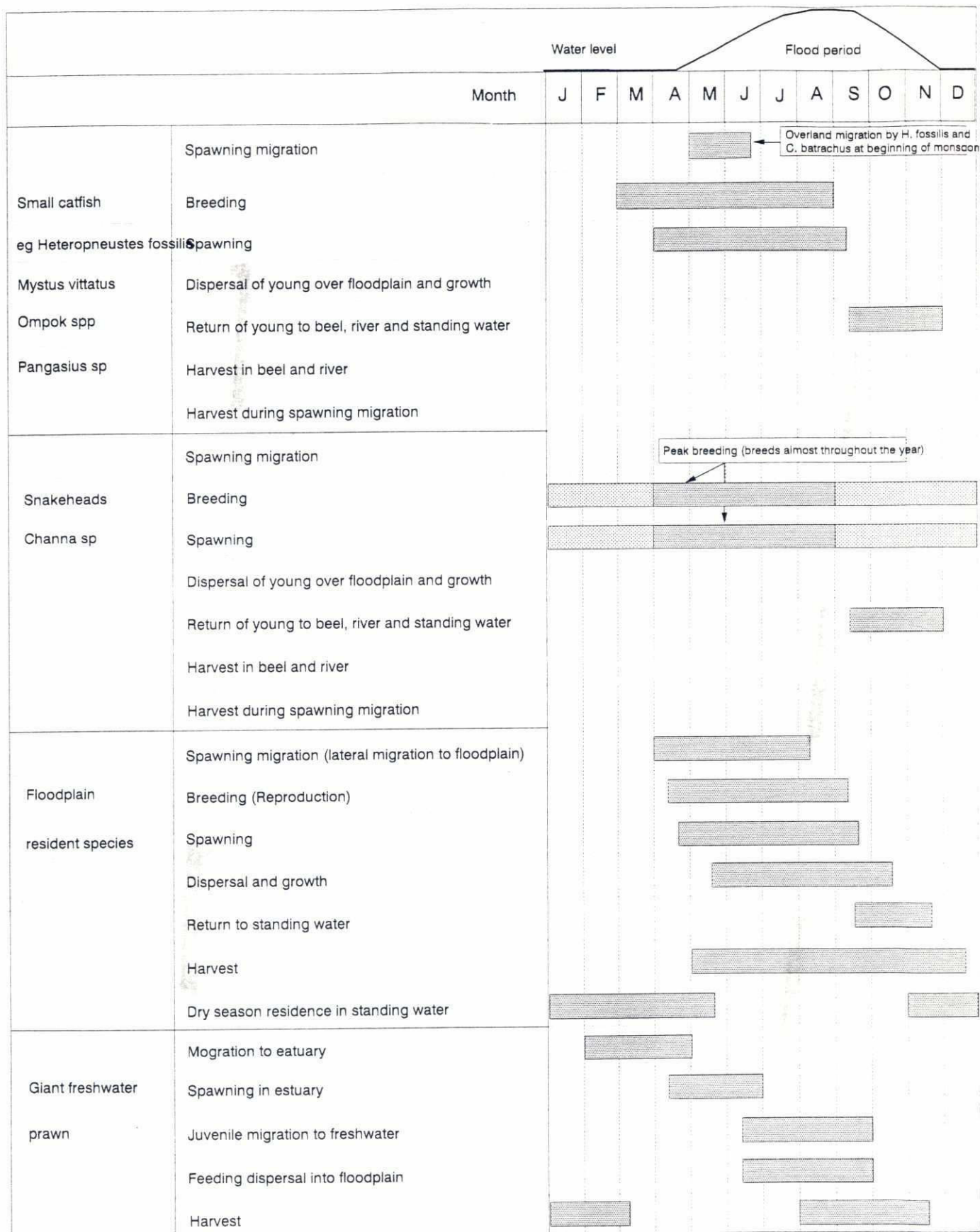
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APPENDIX F.III

CALENDAR OF FISH ACTIVITIES

## Calendar of Fish Activities





**APPENDIX F.IV**

**PRELIMINARY LIST OF FISH AND PRAWNS  
IN THE GUMTI PHASE II AREA**

# PRELIMINARY LIST OF FISH AND PRAWN SPECIES OCCURRING IN THE GUMTI PHASE II PROJECT AREA

Habitat code:

Ecological code:

Distribution code:

Occurrence code:

B = Beel, F = Floodplain, R = Main River, K = Khal, Minor River, P = Pond, IF = Inundated Field, E = Estuary

O = Omnivorous, C = Carnivorous, P = Piscivorous, Mo = Mollusc-eater, I = Insectivorous, Pl = Plankton-feeder, Pr = Predator, H = Herbivorous,

D = Detritus-feeder, M = Mud-eater, DM = Decaying matter-eater

R = Resident, M = Migratory, I = Introduced

1 = Widespread, 2 = Common, 3 = Rare, 4 = Decreasing, 5 = At risk, 6 = Extinct

Scientific Name	Common Name	Habitat	Occurrence		Distribution	Feeding Habits	Sampling Stations				
			Past	Present			G1	G2	G3	G4	G5
Class – Osteichthyes											
Order – Osteoglossiformes											
Family – Notopteridae (Featherbacks)											
Notopterus	chitala										
Notopterus	notopterus										
		R.B.F.P	2	5		C.Pr	8	9	7	1	7
		R.B.F.P.K	2	4		C					
Order – Clupeiformes											
Family – Clupeidae (Herrings, Shads)											
Corica	soborna	R	2	2			1	1			
Gudusia	chapra	R.B.P.IF	2	3			1		5	1	
Gudusia	variegata	R	–	–							
Setipinna	phasa	R	2	3							
Setipinna	taty	R	–	–							
Order – Cypriniformes											
Family – Cyprinidae (Carps, Barbs, Minnows)											
Amblypharyngodon	mola	K.B.F.P.IF	2	3			1		1	3	
Catla	catla	P.R.B.K	1	2		O	5	6	4	1	2
Chela	cachius	K.R.B.P	–	–			1				
Chela	laubuca	K.R.B.P	2	3			1				
Cirrhinus	mrigala	P.R.B.K	2	3		H	5	4	4		1
Cirrhinus	reba	R	2	5		Pl.D					
Crossocheilus	latus	P.K.F.R	2	3							
Cyprinus	carpio	P.R.B	–	2							
Danio	devario	F.R.R.IF	2	4			1				
Hypophthalmichthys	molitrix	P	–	2	1					1	
Labeo	calbasu	R.P.B.K	2	4		H	5	7	6	1	2
Labeo	gonius	P.R	2	5		H	3	5	1	1	
Labeo	rohita	P.R.B.K	1	2		H	6	9	5	2	6
Puntius	chola	K.B.P.F.IF	2	2							
Puntius	conchonius	K.B.F.P	–	–							
Puntius	puntio	K.B.F.P	–	–							
Puntius	sarana	K.B.F	2	5			8	7			
Puntius	sophore	P.R.B.K	1	1			8	9	8	15	8
Puntius	stigma	K.B.R.F	2	2							

Scientific Name	Common Name	Habitat	Occurrence		Distribution	Feeding Habits	Sampling Stations				
			Past	Present			G1	G2	G3	G4	G5
Puntius	ticto	K.B.F.P.IF	2	2		O	1	2			5
Rasbora	daniconius	R.B.K.F.IF	2	3			1				
Salmostoma	bacalla	R.K.B.P.F.IF	2	3		Pr.J			1		
Salmostoma	phulo	R.K.B.P.F.IF	2	3							
Securicula (Oxygaster)	gora	R.K.B.P	-	-		C.Pr.J					
Family – Cobitidae (Loaches)											
Botia	dario	R.B.F	2	5							
Lepidocephalus	guntea	R.K.B.FP	1	3			2	1	1		3
Lepidocephalus	thermalis	R.K.B	-	-	?						
Order – Siluriformes											
Family – Bagridae (Long Barbeled Catfishes)											
Aorichthys (Mystus)	aor	R.B.K.P.IF	1	3			8	4	1		
Mystus	armatus		2	2			8	8	8	10	8
Mystus	bleekeri	R.B.K	2	4							
Mystus	gulio	R.K.B.P.IF	-	-							
Mystus	seenghala	R.B.K.IF	2	3							
Mystus	tengara	K.R.P.F	1	2							
Mystus	vittatus	R.K.B.P	1	3							
Rama (Chandramara)	chandramara	K.B.F	-	-			1				
Rita	rita	R.F									
Family – Siluridae (Butter Catfishes, Freshwater Sharks)											
Ompok	bimaculatus	R.K.B.IF	2	5							
Ompok	pabda	R.K.B.IF	2	5			8	4	1		
Wallago	attu	R.B.K.P	2	3		P.Pr	8	9	6	13	8
Family – Schilbeidae (River Catfish)											
Ailichthys	punctata	R.K	2	5							
Clupisoma	garua	R.K				C.DM	1				
Clupisoma	muris	R.K	2	4							
Eutropiichthys	vacha	R.K	-	-		O					
Pseudotropius	atherinoides	R.K	2	4					2	1	5
Silonia	silondia	R.F			M	Pr					
Family – Pangasidae											
Pangasius	pangasius		2	5		C.Mo	1	1			

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Scientific Name	Common Name	Habitat	Occurrence		Distribution	Feeding Habits	Sampling Stations				
			Past	Present			G1	G2	G3	G4	G5
Family – Sisoridae (Hillstream Catfish)											
Bagarius	Baghair, Acer	R.B	2	6		C.Pr					
Gagata	Gang Tengra	R.K	-	-							
Family – Clariidae (Air – Breathing Catfish)											
Clarias	Magur	B.K.P.F	1	3							
Family – Heteropneustidae (Stinging Catfish)											
Heteropneustes	Shingi	K.B.P.F	1	2			7	8	4	11	6
Family – Chacidae (Square – Head Catfish)											
Chaca	Chaka	K.B.R	-	-			1				
Order – Cyprinodontiformes											
Family – Belontiidae (Gars)											
Xenentodon	Kaikka	K.R.B.F.IF	2	3			1	2	5	8	5
Order – Synbranchiformes											
Family – Synbranchidae (Swamp Eels, Mud Eels)											
Monopterus	Kuchia	B.K.F.P.IF	3	5							
Order – Perciformes											
Family – Centropomidae											
Lates	Coral	E			M						
Family – Ambassidae (Glass Perches, Snook)											
Chanda	Chanda	K.B.P.F	1	4			1				
Chanda	Nama Chanda	K.B.P.F.IF	2	1			1	3	6	6	5
Chanda	Ranga – chanda, Lal Chanda	K.B.P.F.IF	1	2							
Family – Nandidae (Mudperches)											
Badis	Koi Bandi, Napit	K.B.F.P	2	3			1				
Nandus	Meni Bheda	K.B.P	2	3		Pr	1	2	9		5
Family – Cichlidae											

Scientific Name	Common Name	Habitat	Occurrence	Distribution	Feeding Habits	Sampling Stations				
			Past	Present		G1	G2	G3	G4	G5
Oreochromis mossambicus	Tilapia	P.B	-	3	1					
Oreochromis niloticus	Tilapia	P.B	-	3	1					
Family - Mugilidae (Mullet)										
Rhinomugil corsula	Khorsula, Bata, Khalla	R	3	5						
Family - Polynemidae (Threadfins)										
Polynemus paradiseus	Lapasi, Muni, Rishi	R.B.K	-	-						
Family - Gobiidae										
Glossogobius guiris	Belle, Bailla		-	-	C		1	9	1	
Family - Eleotrididae (Gudgeons)										
Awacrus grammepomus	Bele, Nadu Bailla	R.B	2	3						
Butis butis	Tunda Bailla	R.B	-	-						
Eleotiris fusca	Dora Bailla, Kuli	R.B	-	-						
Gobius criniger	Giri Bailla	R.B	1	2						
Gobius melanostoma	Kalthu Bailla	R.B	2	2		1				
Stimatogobius sadanundio	Nandi Bailla	R.B	1	2						
Family - Anabantidae (Climbing Perches)										
Anabas testudineus	Koi	B.K.P	1	4		7	6	4	5	7
Family - Belontiidae (Gouramies)										
Colisa fasciatus	Khalisha	B.K.P.F	2	3				2	1	5
Colisa labiosus	Baicha		1	2	?	1				
Colisa lalius	Lal Khalisha, Boicha	B.K.P	-	-						
Ctenops nobilis	Baicha Neftani	B.K.P	-	-						
Family - Gobioididae (Eel-like Gobies)										
Odontamblyopus rubicundus										
Family - Channidae (Snake Heads, Murrels)										
Channa barca	Pipla, Tila shol	B.K.F	2	6						
Channa gachua (orientalis?)	Telotaki	B	2	5						
Channa marulius	Gajar, Gajal	B.K.R.F	2	4						
Channa punctatus	Laki, Lata	B.K.F-P	2	3		1	2	3	12	5

Scientific Name	Common Name	Habitat	Occurrence		Distribution	Feeding Habits	Sampling Stations				
			Past	Present			G1	G2	G3	G4	G5
Channa	striatus	Shol		2	4	C	8	9	4	12	8
Family – Mastacembelidae (Spiny Eels)											
Macrognathus	aculeatus	Tara Baim	2	3							
Mastacembelus	armatus	Baim, Baim, Sal Baim	2	3							
Mastacembelus	pancalus	Guehi, Baim, Pankal	2	2			1	1	5	6	5
Family – Sironatoidae											
Pampus	chinensis	Rup Chanda			?						
Order – Tetraodontiformes											
Family – Tetraodontidae (Puffer Fishes)											
Chelonodon	patoca	Potka, Fotka	2	3							
Tetraodon	cutcutia	Tepa, Kukuitta	–	–							3
Class Crustacea											
Order – Decapoda											
Family – Palaemonidae											
Macrobrachium	birmaniscus	Thengua Icha	1	2							
Macrobrachium	dalichodactylus	Guda Icha	–	–							
Macrobrachium	dyanus	Kaira Icha	–	–							
Macrobrachium	lamarrei	Knunchu Icha	2	1							
Macrobrachium	malcolmsonii	Chatka Icha	1	2							
Macrobrachium	mirabilis	Latia Icha	–	–							
Macrobrachium	rosenbergii	Golda Icha, Golda Chingri	1	3							
Macrobrachium	rude	Shala Icha	1	2			8	6			
Macrobrachium	styliferus	Small Shrimps	–	–	?		8	9	4	13	8
Macrobrachium	villosimanus	Katholia Icha	–	–							
Family – Ocypodidae											
Ocypoda	certophthalmia	Kakra	–	–							
		B.R.F.K	–	–							



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**APPENDIX F.V**

**LIST OF FISHING GEARS**

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**Fishing Gears Used In Inland Waters with Local Names and Modifications**

English Names	Local Names	Remarks
Cast Net	Jaki Jal, Kharki Jal, Pak Jal, Khapla Jal, Moya Jal	Operated by individual fisherman casting from banks, knee deep water, boat or floats.
Cast Net	Uther Uter	Large in size, operated by two persons from a boat, covers more areas.
Hand-scoop Net	Thela Jal	Hand operated small net fitted in a rectangular bamboo frame
Lift Net	Vel Jal Khara Jal	Net fitted in a 'V' shaped bamboo frame and pivoted on a bamboo pole gantry
	Nouka Veshal	Lift net operated from mobile boat
Stake Net	Mokh Jal Bedge Jal	Funnel shaped, fixed in stakes or buoys, operated by three or four persons from a boat
Seine Net or Shore Seine Net	Ber Jal Bare Jal Jagat Ber Jal	Large net, 50-57 mm. Mesh size, operated by 12-14 fishermen for encircling a large water area
	Dal Jal Khatha Jal Jagh Jal Bichan Jal	Ordinary seine net rectangular shape operated by 5-20 persons depending on size. Sometimes the net is set by two boats one at each end to enclose the area quickly
	Kona Ber Kal Masher Jal Chara Kal	Rectangular seine net with fine mesh, two-eight persons operate the net
	Tona Jal	A very large seine net operated by nine to twenty persons
	Dharma Jal	Small in size operated from a boat
Gill Net	Fash Jal, Koi Jal Moi Jal, Goar Jal Punti Jal	Trap net, placed in a fixed place over night, rectangular. The mesh size determines what kind of fish will be caught.
	Current Jal Chadi Jal	Trap net with fine mesh & made up of nylon twine operated in flowing waters
Dip Net	Chak Jal	Square shaped net tied loosely to crossed bamboos and operated from a boat or a fixed place close to shore
Traps	Chai Ghuni Polo Bhan	Made of netting on a frame, woven bamboo strips or basket works of several shapes and sizes.

**APPENDIX F.VI**

**FISHERIES DEVELOPMENT AND THE FLOOD ACTION PLAN**

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## FISHERIES DEVELOPMENTS AND THE FLOOD ACTION PLAN

### Impacts of FCD and FCDI Projects on Fisheries - Lessons from Existing Schemes in the South East Region

Two main types of fisheries impact due to FCD and FCDI project interventions have been reported. The first relates to pond fish culture, which is usually benefited from FCD, and the second relates to inland capture fisheries which are almost invariably severely damaged. The pond culture benefits are realised mainly by land owners and farmers who also stand to benefit from the positive agricultural impacts obtained by FCD/FCDI. The impact on capture fishing will be experienced by large numbers of landless fishermen, especially occasional fishermen who depend upon the fishery as a **free common good**. The net impact of FCD/FCDI projects on fisheries is negative in the very large majority of cases (FAP 12, 1992; Thompson, 1990).

In the South East Region, two irrigation projects have been constructed, one in the area of Meghna-Dhonagoda and the other one in Chandpur. Some of the chief impacts caused by the FCD schemes in these areas have been summarised below:

**Reduction of the Areas of Open Water Within FCDI Development** This reduction has severely affected subsistence fishing, especially for the poorer section of the rural population who rely on traditionally free fishing rights to provide the bulk of their animal protein food. Immediately affected are those people who cannot afford to purchase fish which previously they were able to catch for themselves. Large numbers of unemployed subsistence fishermen, including women and children, produce food for their families by catching fish in a hidden economy. As well as subsistence fishermen being affected, rural families engaged in part time fishing from floodplains, rivers/Khals and Beels will be effected to a variable extent, depending on the significance of fishing within their household economy.

**Loss of Area of Perennial Water Bodies** Negative impacts on capture fisheries arise from FCDI works which reduce the area of perennial Beels and floodplain, resulting in the loss of breeding, nursery and feeding grounds for fish and other aquatic organisms, e.g. high value shrimps and prawns. The obstruction of migration routes from rivers into Beels and the floodplain, will alter and diminish fish stocks and species composition within and outside FCD boundaries. In addition, changes to the ecology of these areas have also resulted in increased aquatic vegetation. All these changes have detrimental effects on fishermen catch rates and earnings. The loss of high value migratory fish such as the major carps (Rui, Catla, Mrigal, etc.) and Hilsa will be felt immediately.

**Reduction in Fish Stocks and Catches** Reduced fish stocks and lower catch rates endanger the livelihood of fishermen, many of whom have been forced to migrate from the impacted areas in search of alternative employment. Reduced catches also encourages the use of harmful fishing methods and overfishing of remaining waters in an effort to maintain production and income levels.

**Reduction in the Social and Economic Status of Fishermen** Most of the full time fishermen are Hindus and it is unlikely that they will easily find alternative professions, being bound culturally to fishing. As fishermen are displaced they will be forced into unemployment or to find work as day labourers and will also suffer socio-economic difficulties, both at household and community levels.

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**Reduction in Fish Consumption by the Local Population** It is important to determine which members of the society will be most adversely effected. It is likely that the landless and poor will be affected first as they have less resources to purchase replacement sources with resulting nutritional consequences. Fishing opportunity and nutritional losses for poor people must be calculated and incorporated into the economic equation and the importance of the subsistence fishing should be quantified before costs and benefits are estimated. However, this is notoriously difficult to do and require specific detailed studies for the recommended interventions

**Reduction in the Average Size of Fish inside the Poldered Areas** This situation has been observed in the Chandpur Irrigation Project. It appears to be the result of intensified fishing in the remaining open water bodies within the polders, which are thus subjected to overfishing.

**The Meghna-Dhonagoda Irrigation Project** This scheme provides an example of the type of changes that occur due to FCD/FCDI projects. The following is a summary of the findings reported by FAP 12 (FAP 12 Main Report, 1992):

Average fishing days in a year increased from 252 to 276, the average catch per fishermen per day dropped from 4.4 to 2.7 kg. The average catch during 1990-91 decreased from 977 Kg to 680 Kg. The quantity of fish sold by each fishermen dropped from 924 to 639 kg. Net income dropped from 18,266 Tk in the control area to 15,878 Tk inside the project area. Quantity of fish traded per dealer dropped from 29.66 MT to 17.15 MT. All fishermen who responded to the FAP 12 RRA recognised a loss in catch of 25% or greater and attributed this to the project.

The estimated value of lost production was conservatively estimated to be 33 million TK per year. To this must be added losses from internal waters and from river fishes which have lost spawning grounds. In comparison, the total crop output was tentatively estimated at 71 million Tk. Taking into account uncertainties in the data, the impact of lost fishing output may be critical for the economic viability of the project. It is therefore vital that the effect of lost capture fisheries be incorporated in the economic cost benefit analysis as accurately as possible.

In 1985, MPO forecasted a 35% drop in per capita fish consumption by the year 2,005 by relating demand and production. Most of this loss was assumed to be due to a partial loss of the area available to floodplain fisheries. An estimated 3.14 million hectare were proposed to be bought under FCD and FCDI projects by the year 2005, a full 2 million of which will be fully flood-free area and the aquatic environment in 1.4 million hectares will be changed by delaying flooding or reducing the water surface area. According to MPO, if these projects were to happen, one third of Bangladesh's floodplain will vanish over 2 decades (MPO 1985).

Expansion of the areas of irrigated HYV crops within FCD developments has led to increased use of chemical fertilizers and pesticides and resulted in a higher risk of contaminated runoff and potentially residual water bodies. This may lead to higher mortality rates for aquatic species especially in the juvenile stages of all types of resident species and particularly fish which breed in enclosed Beels or adjacent flooded areas.

**Culture Fisheries** There is a potential benefit for culture fisheries in closed water bodies such as ponds, borrow pits and canals. The Meghna-Dhonagoda Irrigation Project has improved conditions for culture fisheries by preventing (except in the serious embankment breach such in the 1987-88 floods) the inundation of ponds and loss of stocked fish. The Inland Fisheries Project of Bangladesh which started in Comilla in 1984 achieved a total production from 1984 to 1987 of 217,856 MT, which was below the predicted production of 375,777 MT. The discrepancy is believed to have been caused by heavy losses suffered due to flooding in 1987 and 1988 (Rotary Club of Comilla, 1988).

Protection against flood overtopping encourages regular restocking, improved culture methods and pond rehabilitation. Moreover, benefits to culture fisheries have not always materialised due to ineffective flood control caused by poor maintenance, the accumulation of water hyacinth, faulty design of FCD infrastructures and lack of credit for fisheries extension programmes.

To conclude, the impact of flood control projects on future fish production should be assessed in the context of rising demand for fish, declining yield, habitat destruction and the obstruction of fish migration routes. Falling fish production trends in areas inside and outside polders suggest that it will be increasingly difficult for the natural processes of replenishment of floodplains to occur.

