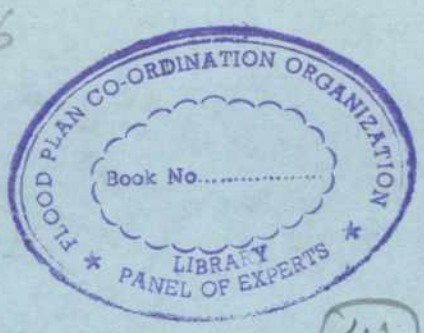


The People's Republic of Bangladesh

Ministry of Irrigation, Water Development and Flood Control

BANGLADESH FLOOD ACTION PLAN

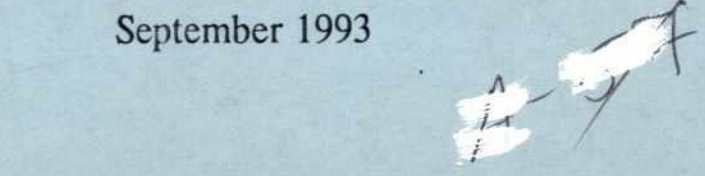
FAP 16 Environmental Study

Environmental Impact Assessment Skills Training Work Shop

MASTER TRAINING FILE

SECTION II

September 1993



IRRIGATION SUPPORT PROJECT FOR ASIA AND THE NEAR EAST
Sponsored by the U.S. Agency for International Development

The People's Republic of Bangladesh

Ministry of Irrigation, Water Development and Flood Control

BANGLADESH FLOOD ACTION PLAN

FAP 16 Environmental Study

Environmental Impact Assessment Skills Training Work Shop

MASTER TRAINING FILE

SECTION II

September 1993

ISPAN
IRRIGATION SUPPORT PROJECT FOR ASIA AND THE NEAR EAST
Sponsored by the U.S. Agency for International Development

MODULE 1 & 2
EXERCISE, HANDOUT AND OTHER MATERIALS

August 7, 1993

TO THE PARTICIPANT:

Attached are two documents outlining our course activities for the next month. Because the EIA process lends itself to being broken down into discrete steps, we have organized the course in a modular manner. These EIA modules are however very inter-related and although each one addresses a discrete aspect of the EIA process, its' information is built upon by the other modules.

The first attachment is our weekly schedule broken down by the number of sessions we will in each module. It is organized as a daily calendar of activities so that you will be able to see where you are in the course sequence. The next document is a brief description of the objectives we wish to acomplish fro each module we work on during the workshop.

CALENDAR OF EVENTS EIA TRAINING WORKSHOP II

WEEK 1

August 16	
8:00 - 9:30	Welcome and Opening Ceremonies
9:40 - 11:15	Workshop Introduction
11:30 - 1:00	Project Development 1
1:15 - 2:30	Project Development 2
August 17	
8:00 - 9:30	Project Development 3
9:40 - 11:15	Project Development 4
11:30 - 1:00	Project Development 5
1:15 - 2:30	Project Development 6
August 18	
8:00 - 9:30	Peoples Participation 1
9:40 - 11:15	Peoples Participation 2
11:30 - 1:00	Peoples Participation 3
1:15 - 2:30	Peoples Participation 4
August 19	
8:00 - 9:30	Peoples Participation 5
9:40 - 11:15	Peoples Participat.... 6
11:30 - 1:00	Scoping and Bounding 1
1:15 - 2:30	Synthesis

WEEK 2

August 22

8:00 - 9:30	Scoping and Bounding 2
9:40 - 11:15	Scoping and Bounding 3
11:30 - 1:00	Scoping and Bounding 4
1:15 - 2:30	Scoping and Bounding 5 & Field Trip Brief

August 23

FIELD TRIP ALL DAY - LEAVE APPROXIMATELY 8:00 AND RETURN APPROXIMATELY 5:30

August 24

8:00 - 9:30	Field Trip Debrief
9:40 - 11:15	Study Methods 1
11:30 - 1:00	Study Methods 2
1:15 - 2:30	Study Methods 3

August 25

8:00 - 9:30	Study Methods 4
9:40 - 11:15	Study Methods 5
11:30 - 1:00	Study Methods 6
1:15 - 2:30	Study Methods 7

August 26

8:00 - 9:30	Study Methods 8
9:40 - 11:15	Study Methods 9
11:30 - 1:00	Study Methods 10
1:15 - 2:30	Study Methods 11 & Synthesis

WEEK 3

August 29	
8:00 - 9:30	Study Methods 12
9:40 - 11:15	Study Methods 13
11:30 - 1:00	Study Methods 14
1:15 - 2:30	Study Methods 15
August 30	
8:00 - 9:30	Study Methods 16
9:40 - 11:15	Study Methods 17
11:30 - 1:00	Study Methods 18
1:15 - 2:30	Study Methods 19
September 1	
8:00 - 9:30	Hazard and Risk 1
9:40 - 11:15	Hazard and Risk 2
11:30 - 1:00	Hazard and Risk 3
1:15 - 2:30	Hazard and Risk 4
September 2	
8:00 - 9:30	Impact Assessment and Evaluation 1
9:40 - 11:15	Impact Assessment and Evaluation 2
11:30 - 1:00	Impact Assessment and Evaluation 3
1:15 - 2:30	Impact Assessment and Evaluation 4
September 4	
8:00 - 9:30	Impact Assessment and Evaluation 5
9:40 - 11:15	Communicating and Reporting 1
11:30 - 1:00	Communicating and Reporting 2
1:15 - 2:30	Synthesis

WEEK 4

September 5

8:00 - 9:30	Environmental Management Plan 1
9:40 - 11:15	Environmental Management Plan 2
11:30 - 1:00	Environmental Management Plan 3
1:15 - 2:30	Field Trip Brief/Group Discussion

September 6

FIELD TRIP ACTIVITIES ALL DAY

September 7

8:00 - 9:30	EIA Review 1
9:40 - 11:15	EIA Review 2
11:30 - 1:00	EIA Review 3
1:15 - 2:30	EIA Review 4

September 8

8:00 - 9:30	EIA Review 5
9:40 - 11:15	EIA Review 6
11:30 - 1:00	EIA Review 7
1:15 - 2:30	EIA Review 8 & Post Test

September 9

8:00 - 10:00	Evaluation
10:00 - 11:30	Closing Ceremonies

COURSE OBJECTIVES BY MODULE

Project Development

- Explain the place of EIA in the project development cycle.
- Explain the importance of EIA in project development.

Engineering and Engineering Effects

- Identify the various types of engineering works currently used in flood control projects.
- Identify the various positive and negative effects of these projects.
- Explain how engineering projects can benefit from properly carried out EIAs.

==========

Peoples Participation

- Understand the importance of peoples participation in the overall EIA process and indicate where it should occur.
- Interact with local people and obtain information from them in either a formal or informal method.

==========

Scoping and Bounding

- Distinguish between scoping and bounding, understand their inter-relationship and their importance in the EIA process.
- Identify important environmental considerations (IEC's) by using the scoping procedures.
- Define the boundaries of a study area.

==========

Study Methods

- Develop the plans necessary to perform all field work.
- Define a baseline for an environmental impact analysis.

- Measure and qualify impacts.
- Perform trend and impact analysis.
- Explain the importance of being able to correlate interdisciplinary data.
- Distinguish between RRA, PRA and HHS and explain their uses.
- Be able to select the appropriate techniques (within discipline) given knowledge of field conditions and data needs.

Geographic Information Systems

- Understand the importance and limitations of remote sensing and (potential) importance of GIS to the EIA process.
- Integrate different types of information (i.e fisheries and agriculture) from several such maps onto a single map.
- Interact with GIS staff in order to develop digital maps that can be used as outputs in an EIA.

Hydrological Models and Their Use

- Understand the general purpose of the hydrological models used in Bangladesh.
- Explain the types of model outputs useful for EIA work.

Hazard and Risk Assessment

- Identify hazards from information provided.
- Determine potential types of risks given a knowledge of the hazards.
- Determine data needs based on use of a dummy table.
- Interview local people in order to gain knowledge about hazards.

Impact Assessment and Evaluation

- Assign appropriate weights to individual impacts.
- Determine what impacts are significant.

- Explain how impact evaluation effects other aspects of the EIA.

Environmental Management Plan

- Use the data from the EIA report to develop an EMP.

==========

Communicating and Reporting

- Document EIA activities in reports.
- Communicate amongst the team and with project officials and local people.
- Develop and maintain EIA files.

==========

EIA Review

- Understand that the EIA review is part of the planning process.
- Determine whether an EIA has been adequately performed.

Legal & Institutional Aspects of EIA

- Understand the various laws regulating or potentially affecting practice of the EIA in Bangladesh.
- Understand the probable institutional mechanisms by which the EIA will by managed in Bangladesh.

Pre- and Post-test Questions

1. How does environmental impact assessment (EIA) fit into the overall project development scheme?

2. At what major points in the EIA cycle should peoples participation be sought?

3. How is scoping used to identify important environmental components?

4. What is the relationship between scoping and bounding in determinig EIA study area?

5. What are the steps in developing an EIA study plan?

6. How is the baseline data used in trend analysis?

7. Explain the difference between risk and hazard.

8. How does impact assessment and evaluation affect other aspects of the EIA process?

9. What are the major chapters of the EIA Report?

10. What is the purpose of the environmental management plan?

MODULE - 2
EXERCISE, HANDOUT AND OTHER MATERIALS

Carpenter, R.A. and J.E. Maragos [editors/authors]

1989 How To Assess Environmental Impacts on Tropical Islands and Coastal Areas. Environmental and Policy Institute, East West Center, Univ. of Hawaii, Honolulu, HI, USA.

V. ENVIRONMENTAL SCIENCES AS THE BASIS OF EIA

V.A. ECOLOGY AND ECOSYSTEMS

As in any science, ecological data from observations and experiments lead to generalizations that explain cause-effect relationships. As these explanations are accepted and found to hold true, they become principles, concepts, or theories useful to environmental managers. Some of the more important principles for tropical island ecosystems are discussed here.

1. Ecological Principles and Concepts

The four higher levels of ecological organization are the individual organism (plant or animal), a population of the same organism (species), a community of different plants and animals, and an ecosystem (i.e., a biotic community in interaction with its physical environment--sunlight, water, air, and soil). People are a part of the ecosystems in which they live.

a. Productivity. The source of energy in ecosystems is sunlight that is converted in photosynthesis, combining carbon from the carbon dioxide in the atmosphere with water to form plant matter. Primary productivity is the weight of plant material formed daily.

b. Biomass is the amount of material that accumulates per unit area, and this plant food is eaten by a succession of animals. Only a portion of the chemical energy stored in plants and animals is passed on to the next higher stage as is shown in Figure V.1. The pyramid of productivity means that the plant community controls the size of animal populations. Thus in EIA, the primary productivity of an ecosystem is an important clue to its health, sustainability, and usefulness in development.

c. The biosphere comprises all the ecosystems of the world and people depend on its continued functioning for many services such as oxygen generation and water purification.

d. Populations grow at a rate determined by the excess of births over deaths, which, in turn, depend on many environmental factors such as food supply, predators, habitat, and nutrients.

e. Limiting Factors. The health and productivity of an ecosystem depend on many factors, any one of which may set a limit on its biological potential. For land plants, these include nutrient elements (nitrogen, phosphorus, potassium, carbon), water, pests, energy, and soil organic matter. For marine plants, light, water circulation, nitrogen, phosphorus, and substrate composition are the most important limiting factors. Understanding and manipulating these limiting factors are valuable in environmental management.

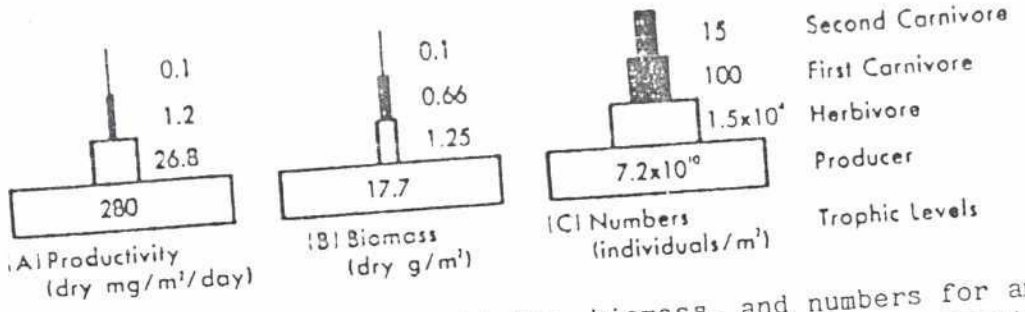


Figure V.1. Pyramids of productivity, biomass, and numbers for an experimental pond. (Reprinted with permission of Macmillan Publishing Company from Communities and Ecosystems by Robert H. Whittaker. Copyright © 1975 by Robert H. Whittaker.)

f. Food Webs, Trophic Levels. Energy flows through an ecosystem according to who eats whom. Primary producers (green plants) fix solar energy into plant material (biomass). Consumers include detritovorous (detritus eating), herbivorous (plant eating), and carnivorous (meat eating) animals that complete the chain. At each consumption level, only a part (up to ~ 10 percent) of the energy is converted to the consumer's own biomass so rarely are there more than five to six steps in the chain. Species that eat the most different foods are the most successful. The large number of species in tropical ecosystems offers many trophic interactions and thus confer stability and resilience. The major components of the food web of tropical insular reef systems in Oceania are shown in Figure V.2.

g. Carrying capacity is the number of individuals that an environment can support, but the exact level fluctuates with weather, natural hazards, and human management actions. Carrying capacity is more difficult to define quantitatively for natural systems compared to managed systems. For example, intensive agriculture supports far more plants and biomass per unit area than in an undisturbed field, but this carrying capacity is dependent on constant inputs of fertilizer and mechanical energy from outside the system (see Figure V.3), and constant protection from competitors and pests (e.g., weeds, insects).

h. Natural Variation. Nature is not balanced or constant over time and space but continually fluctuates within a range of conditions. For example, the number of young fish "recruited" each year from a spawning ground will vary widely; or the composition of communities of reef animals or forest plants changes with time as well as location. Many development activities attempt to force uniformity and stability on natural systems. For example, monocrop agriculture and constant year-to-year crop yields are economically desirable. Countering natural variability always entails extra management costs (e.g., labor, energy, fertilizer) and often risks degradation of the environment if not carefully and adequately carried out.

i. Succession. The number and kind of species in an ecosystem change over time from immature to mature stages. Natural and human disturbances such as dredging, earthquakes, lava flows, catastrophic

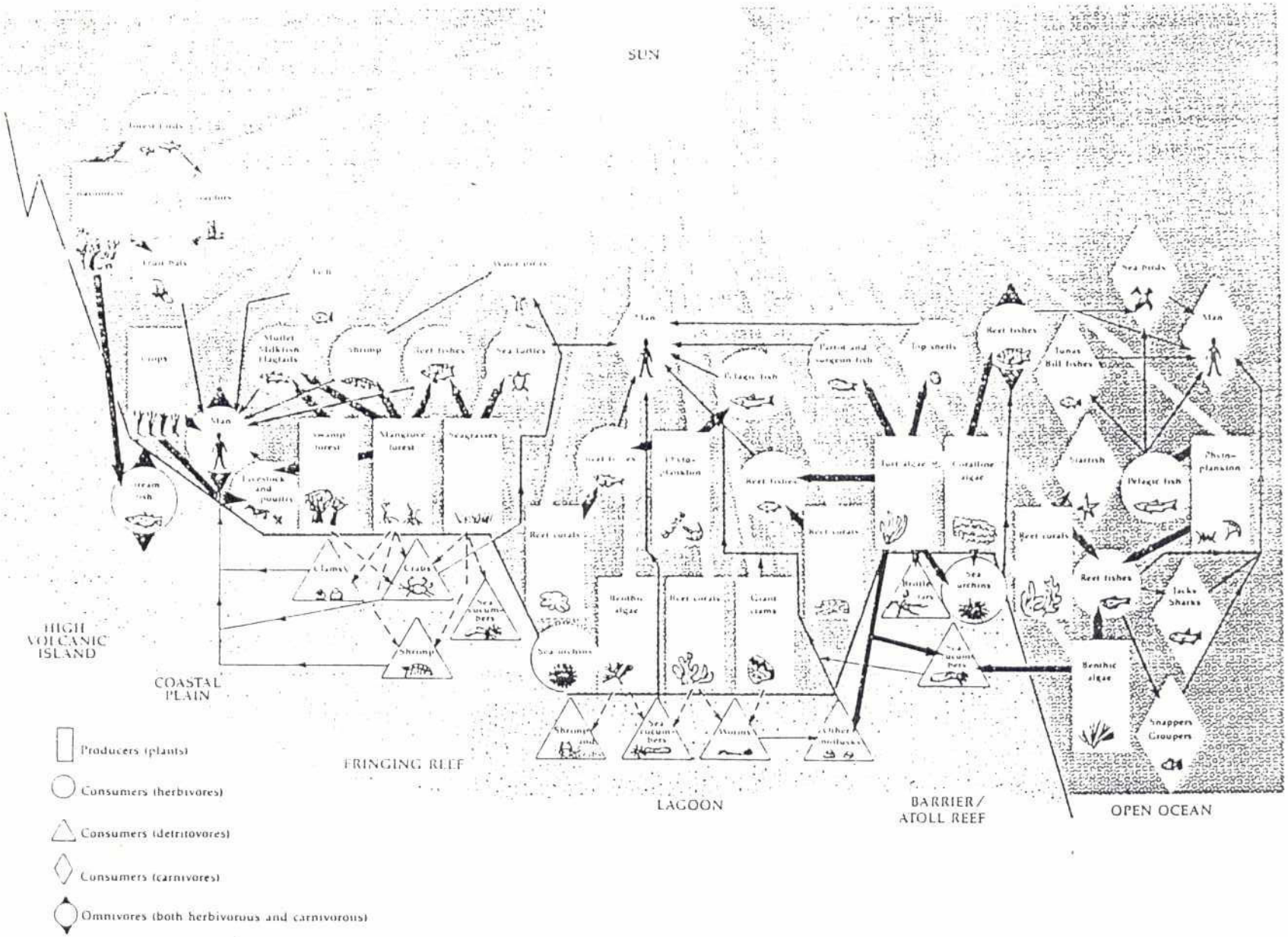


Figure V.2. Flow of energy from the sun and through the food webs of major ecological and subsistence systems characterizing the tropical reefs and islands of Oceania.

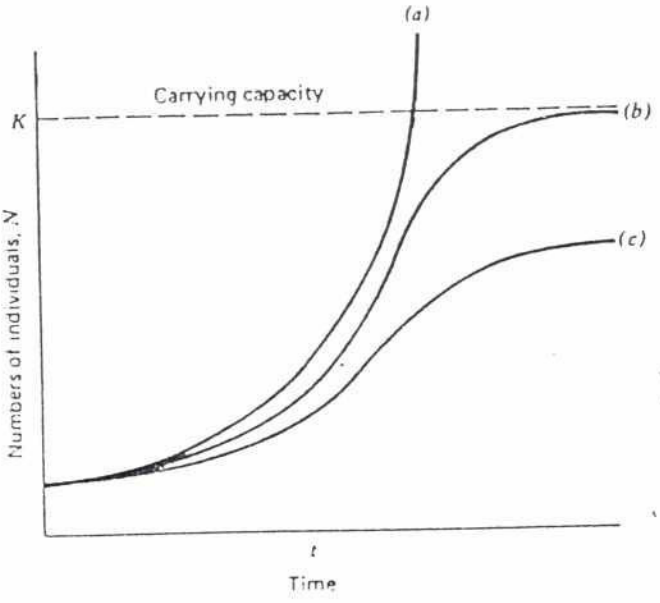


Figure V.3. Population growth and carrying capacity. (a) The exponential curve of population growth; (b) the sigmoidal or logistic curve of population growth of a species in the presence of a limiting resource. K is the maximum sustainable population, or "carrying capacity," on this resource base. (c) A possible growth curve of a species in the presence of competition from another species for the limiting resource (Source: Ecology, Impact Assessment, and Environmental Planning, by Walter E. Westman. Copyright © 1985. Reprinted by permission of John Wiley & Sons, Inc.).

---

storms, or fire disrupt the trend and set back the biological community to a less mature stage. Young ecosystems have higher net primary productivity (photosynthesis), few species, respond rapidly to nutrients, and produce higher yields. For these reasons, aquaculturalists, farmers, and foresters continually disrupt the maturation process and return the system to an immature stage to exploit the "net" or exportable production. Mature systems (e.g., coral reefs or forests) are more complex, maintain themselves, and are not displaced except by a catastrophe. They may have high gross production, but net production is low or near zero. Mature systems are valuable for recreation, aesthetics, and many subsistence economies.

j. Biogeochemical Cycles. Organic matter, including living organisms, is mostly the product of interactions between carbon dioxide, oxygen, and water, controlled by limiting substances termed "nutrients," including nitrogen and phosphorus. In this sense, nutrients act as fertilizers to stimulate plant growth, are eaten, and then become waste by-products of animal growth and decay. The nutrients that make up and maintain organisms flow from the inorganic environment of air, water, and soil to plants and animals. When these die or shed leaves and skin, the chemical elements are returned to the environment, each along a different pathway and at a different rate. Some nutrients, such as nitrogen, cycle through the air on a worldwide

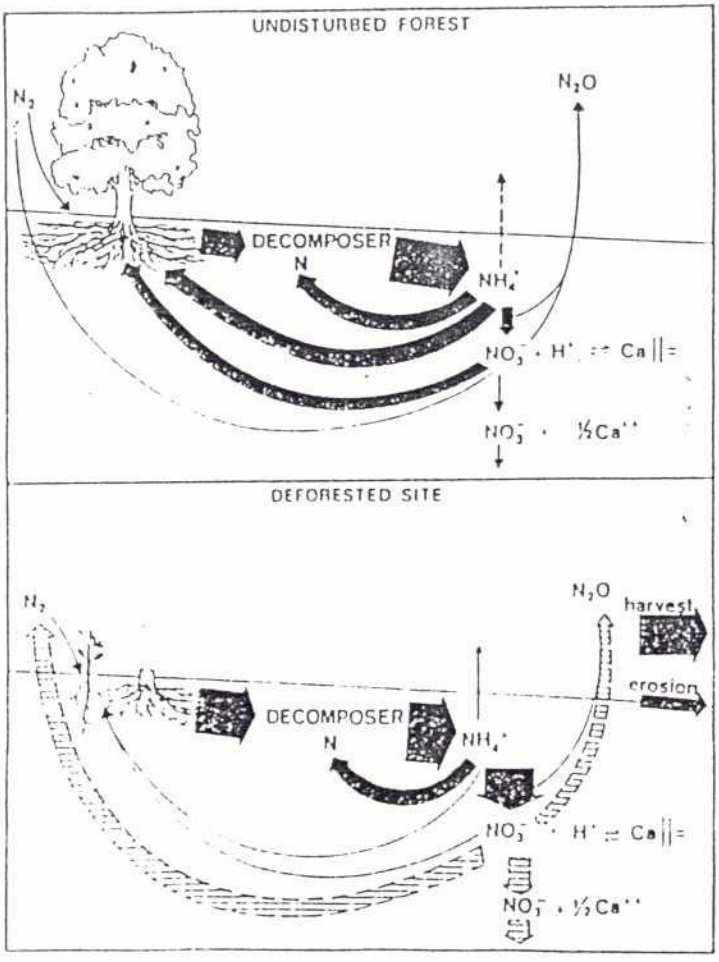
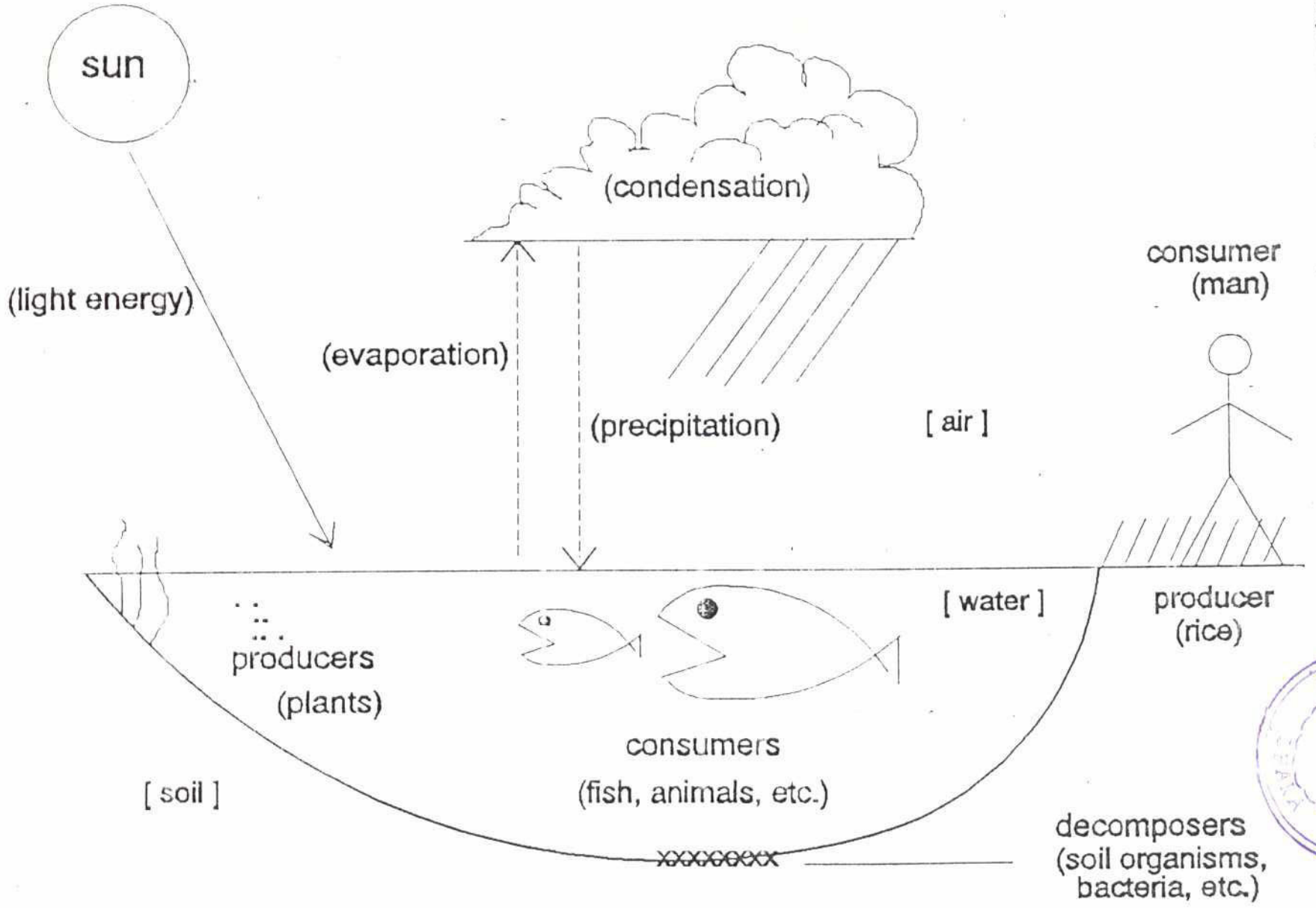


Figure V.4. The nitrogen cycle in an undisturbed forest and a deforested site. The system represented is a relatively fertile site before and 2-3 years after deforestation. Dashed arrows represent possible alternative pathways for losses of nitrogen from the site (Source: Vitousek 1983:230. Reprinted with permission of the publisher).

scale while others, such as phosphorus, move locally within a small area of forest. Figures V.4 and V.5 show two typical biogeochemical cycles.

k. Diversity. The ability of an ecosystem (coral reef, mangrove forest, salt marsh) to persist and recover from storms or development disturbances depends, to some extent, on the variety of animals and plants that it contains. While there is no rigorous connection between diversity and stability or maturity, the simplification of a community composition due to the actions of development often means less resistance to subsequent stresses and less capacity for resilience or recovery. Gross productivity is also less (but net productivity is more) in simplified natural systems than in those with a large number of species. Stated in another way, the greater number of species allows the system to be more efficient. There are few outside opportunities for exploitation, unless the diverse mature system is disrupted.

Simplified example of an ecosystem:



Glossary

Adverse impact: An impact which is harmful to human interests over either the short or long term.

Aman: Rice grown during *kharif-2* season with the exception of broadcast aman which is sown in the *kharif-1* season and harvested in the *kharif-2* season.

Aus: Rice grown during the *kharif-1* season

Baseline studies: Work done to collect and interpret information on the status/trends of the environment likely to be affected by a development action.

Beneficial Impact: Impacts which improve resources, the economy and/or quality of life for a population and improve resources.

Biodiversity: The variety of species within a given area or region. Areas of high diversity are characterized by a great variety of species; with relatively few individuals or any one species. Areas with low diversity are characterized by a few species with often relatively large numbers of individuals of each species.

Biophysical : The part of the natural environment which includes physical, chemical and biological components such as air, soil, water, plants and animals.

Bounding : Is a process for determining spatial and temporal boundaries within which that an environmental impact assessment will be conducted, based upon physical, chemical, biological, social, economic, jurisdictional, and administrative factors.

Broadcast aman: Broadcast aman is grown in the kharif season in deeply flooded area.

Char: An alluvial island that periodically emerges from the river-bed as a result of accretion. Chars may be seasonal or may remain in existence for several decades.

Coliform: A group of bacteria used as an indicator of faecal contamination in water.

Community : All animals, which live in the same locality under the influence of similar environmental factors and affect the existence of each other through their activities. Communities are usually named after their dominant species.

Compensation plan : The portion of the environmental management plan that describes the compensation measures that will be undertaken and committed to if a project proceeds. It includes how much compensation will be paid to whom, by whom, and under what conditions.

Compensation : Compensation is the provision for enhancement, replacement, restoration, and restitution to recipients of unavoidable negative residual impacts. Often there is payment in funds or replacement in-kind for losses attributed to a development. Funds may also be used to

recreate lost habitat or other valued resources.

Conservation : The preservation of natural resources so as to maintain supplies and qualities at levels sufficient to meet present and anticipated needs.

Cost-Benefit Analysis: Technique used in comparing the ratio of costs to benefits for a development activity. Comparison is made through conversion of costs/benefits to monetary units. e.g.. the taka value. It has not yet been successfully used to incorporate all environmental, social and health impacts of concern.

Critical habitat: The area of land, water and airspace required for normal needs and survival of a plant or animal species.

Cropping pattern. The arrangement of crops (including crop varieties) on a plot of land within a year (or sometimes more than one year if one crop or a complete cropping cycle occupies the plot for more than one year). Examples are: mixed Aus and Aman followed by rabi crops; BR3 boro followed by BR4 transplanted Aman; pineapples (2 years) followed by 5 years natural fallow.

Cumulative impact: The environmental impact that results from actions which are added to others of the past, present, and the foreseeable future. Cumulative impact are caused by multiple human activities and/or natural events;which are either repeated or occur in combination. Examples include lowering of the groundwater in a large regional aquifer or water pollution in the large river such as the Ganges. Global climate change is a type of cumulative effect involving the whole planet.

Dike or dyke: A natural or man-made structure to impound or curtail the flow of water from one place to another. Synonymous with embankment or levee.

Ecological niche: The physical space in a habitat occupied by an organism; its functional role in the community (e.g. its trophic position); and its position in environmental gradients of temperature, moisture, pH, soil, and other conditions of existence.

Ecosystem : Ecosystem is a marine, freshwater or terrestrial sustainable system or combination of systems that include some or all of the living and non-living components. Boundaries of an ecosystem are often specified for a particular application.

Embankment: see Dike.

Environment: Environment can be defined in many ways. A common definition is "the sum total of all the physical and biological components and processes which make up the surroundings of man". The term includes:

a. biophysical components and resources such as agricultural lands and crops, fisheries, wetlands and wildlife and the physical and biological factors and processes which support these resources

b. social components made up of the human communities and populations which utilize the various resources.

Environmental effects monitoring plan (EEMP) : EEMP is the taking of repetitive measurements over time of environmental components to detect changes

caused by external influences directly or indirectly attributable to a specific man-made activity or development. It is undertaken for many reasons such as;

a. to improve environment understanding of cause effect relationships,
b. to provide an early warning of undesirable change in the environment,
c. to verify earlier EIA predictions,
d. to evaluate uncertainty, and
e. to check on the effectiveness of the Environmental Management Plan.

Environmental protection plan (EPP): EPP is a plan that describes specific actions that will be undertaken during project preconstruction, construction, operation, rehabilitation and abandonment to lessen the effects of the project on the environment usually with specific instructions for personnel involved in project activities. It is a key component of the Environmental Management Plan that integrates existing legislation, codes of good engineering practice, proponent commitment, and designated mitigation measures.

Environmental enhancement: Improvement of the resource base or amplification or the anticipated positive impact of the project on an environmental component.

Environmental impact assessment (EIA): An environmental planning procedure whereby the potential effects of a proposed project on the environment are studied and predicted before the project is undertaken, and where by a plan for avoiding or dealing with the negative impacts is formulated.

Environmental impact :

a. any change that a project may cause to an environmental component;
b. any change to the project that may be caused by the environment which then leads to change in environmental components;
c. any cumulative effects caused or exacerbated by the project.

Environmental management plan (EMP): Plan to undertake an array of follow-up activities which provide for the sound environmental management of a project so that adverse environmental impacts are minimized and mitigated, beneficial environmental effects are maximized, and sustainable development is ensured.

Eutrophication: The process by which the enrichment of beel waters with surface runoff containing nitrogen and phosphorus causes an increase in aquatic plant biomass.

Floodplain : Belt of low, flat ground, present on one or both sides of a stream channel, subject to flood.

Ground-truth (remote sensing): A process by which remotely sensed data can be verified in the field.

Groundwater : Subsurface water moving under the force of gravity that accumulates in the pores and cracks of rocks and soil.

Habitat : Subdivision of the plant environment having a certain combination of slope, drainage, soil type, and other controlling physical factors. Also,

a place where one lives, including the surroundings needed to sustain one.

Haor : Water body formed in the monsoon season by the inundation of several beels forming a continuous water body in a large geological depression.

Hazard: Chance event in the bio-physical environment that has consequences harmful to humans.

Hundred-year flood. A flood of a size that, on average, recurs once in every hundred years as estimated on the basis of past records of flood stages.

Impact matrix : a square or rectangular array of rows (project activities) and columns (important environmental components) used for organizing the analysis of positive and negative environmental impacts of a project.

Important environmental component (IEC) : Environmental components of biophysical or socio-economic importance to one or more interested parties. The use of important environmental components helps to focus the environmental assessment.

Indicator species: Any organism that by its presence or absence, its frequency, or its vigor indicates a particular property of its surrounding environment. For example, a particular plant may indicate a soil type or the presence or absence of an air or water pollutant, or a particular fish species that could indicate water quality.

Initial environmental evaluation (IEE) : The initial environmental assessment report prepared for a regional or pre-feasibility level study for identifying and assessing possible environmental impacts.

Interested Party : Residents of a regional or project area, elected representatives, government officials in various departments, Bangladesh professionals, non governmental organizations (NGOs), the general public, and donor organizations and international agencies.

Intervention: The specific action caused by a project which creates an environmental impact, e.g. obstruction of a drainage canal by an embankment.

Kharif 1 : Early summer (March through June)

Kharif 2 : Late summer and fall (July through October)

Land use plan: A coordinated composite of information, ideas, policies, programs, and activities related to existing and potential uses of land within a given area. A land use plan is frequently the key element in a comprehensive plan for an area under development for public and private land uses, such as residential, commercial, industrial, recreational, and agricultural activities.

Levee : see Dike, Natural levee.

Magnitude: Magnitude is the degree of change in a important environmental component that results from a project activity.

Mitigation: Elimination, reduction or control of the adverse environmental impacts of a project. Mitigation measures are specified in the Environmental Management plan.

Natural levee : Belt of higher ground paralleling a meandering alluvial river on both sides of the stream channel and built up by deposition of fine sediment during periods of overbank flooding.

Peoples Participation: Process to ensure that the right problems and all available resources are identified and that the ensuing programs or projects are understood, accepted and brought to full effectiveness.

Plankton : A general term for micro-organisms in water; includes plants (phytoplankton) and animals (zooplankton).

Pollution : The introduction into the biosphere of materials that, because of their quantity, chemical nature, temperature or differently in disposal by natural recycling process. have a negative impact on the ecosystem.

Project : A project includes,

a. a physical work such as proposed construction, operation, modification, decommissioning, rehabilitation, abandonment or other undertaking in relation to that physical work, and

b. a regional, pre-feasibility, feasibility, design or conceptual plan or study undertaken to ascertain the desirability of proceeding with physical works and associated activities such as flood proofing, sector development, etc.

Project area: The actual project location provided by project officials.

Project phase : The main categories of project activities expressed sequentially including preconstruction, construction, operation and abandonment.

Project stage : The main stage of project planning including pre- feasibility (regional study) and feasibility.

Rabi: Winter season and associated crops (November through February)

Reconnaissance survey: A preliminary survey, usually executed rapidly and at relatively low cost in which information obtained is recorded, in written form or as reconnaissance maps or sketches.

Remote sensing : The collection of spatial information through a system of sensors mounted on an aeroplane or satellite.

Residual impacts: Environmental impacts which remain after application of mitigation measures and which cannot practically be overcome.

Reversible impact: An environmental impact which recovers either through natural process or with human assistance.

Salinity : The content of salts in sea water, soil or brackish water.

Scoping : The process by which the environmental issues, project alternatives and important environmental components are identified by the interested parties.

Significant environmental impact : An adverse residual environmental impact that is not justified in the circumstances.

Socio-economic : Refers to the human environment which includes social and economic components that are not termed biophysical.

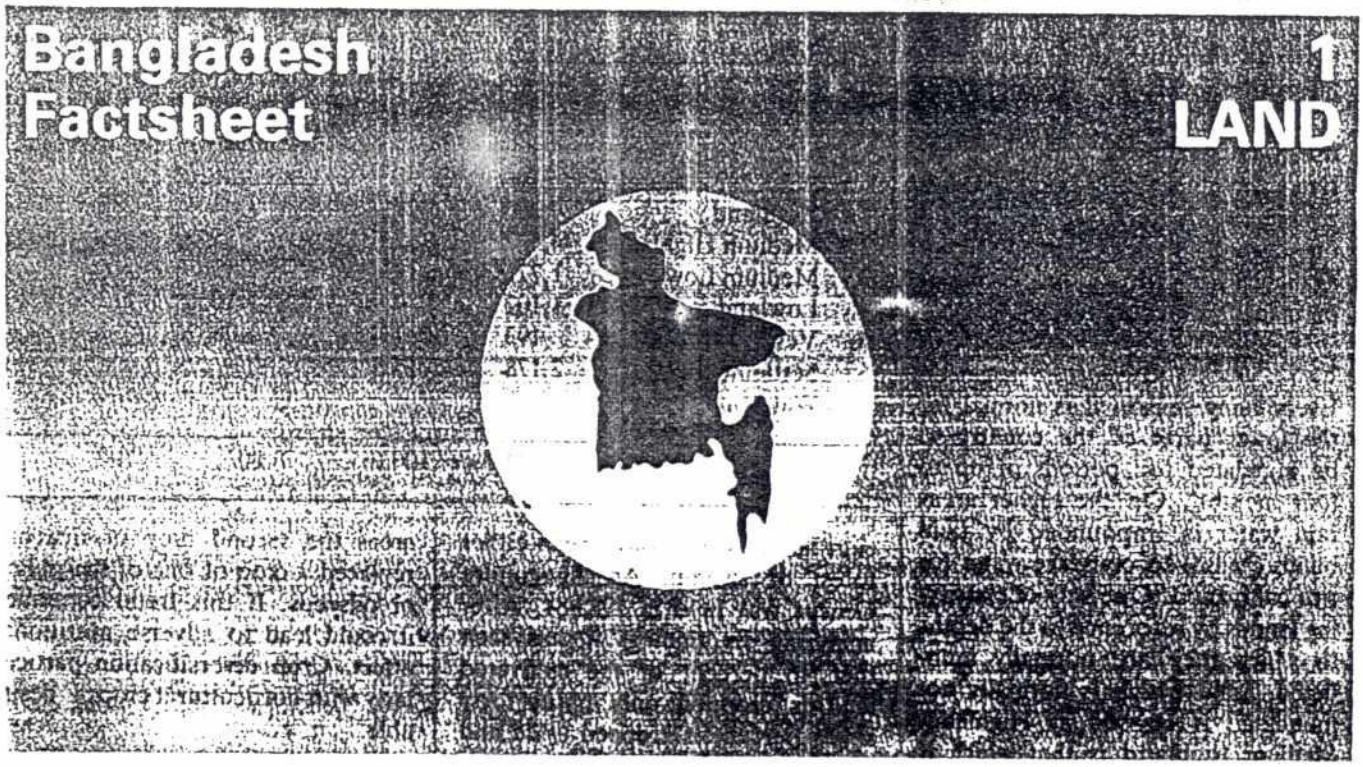
Study area: The total area affected by a proposed project and its impact considered for EIA field study and data collection.

Sustainable development : Development that ensures preservation and enhancement of environmental quality, and sound and sustainable use of natural resources thereby providing for economic growth which meets the needs of the present without compromising the ability of future generations to meet their own needs (adapted from the Brundtland Commission, 1987).

Thana: The main rural administrative unit in Bangladesh consisting of several unions with an average population of around 200,000.

Union: Smallest administrative unit of the local government (usually consisting of 12 to 15 villages).

Water-logged: Condition of soil saturation due to the rise of a ground water-table, which may happen due to various factors, such as excessive irrigation, seepage from adjoining highlands, seepage of water through canals, impervious obstruction, excessive rains, flood etc.



Extent of Land

The total continental area of Bangladesh is 14.79 million hectares, of which approximately 13.70 million hectares is land and the rest is inland waterbodies. In addition there is over 10 million hectares of marine area, which is comprised of the territorial waters and the Exclusive Economic Zone. Despite its relatively small size Bangladesh has a surprisingly high number of complex agro-ecological regions. This is due to the interaction of temperature and rainfall gradients with topography and normal flood levels. Of the total area 12 percent is hilly or mountainous, 8 percent consists of raddish soil uplands and 80 percent is floodplains[1]. Only one-fourth of the floodplains is normally flooded every rainy season, and another one-fourth is liable to experience floods once every five years.

From north to south (Langalbandha to Jinjiradwip) the distance (in a straight line) is 790 kilometers, and from west to east (the maximum distance) is 500 kilometers. The coastline along the Bay of Bengal is 1200 kilometers long including the coastlines of numerous islands, but not measuring minor indentations. A large area in the south is therefore in the Coastal Zone, which has its own dynamics and deserves special attention as a very distinctive area.

Land Use in Bangladesh (1986-87)

		Area (mha)	Percent of total
1.	Net cropped land	8.85	59.8
2.	Current Fallow	0.39	2.6
3.	Culturable Waste	0.27	1.8
4.	Forest Land	1.99	13.5
5.	Not available for cultivation	3.29	22.2
6.	Total area	14.79	100.0

Land Use

In Bangladesh land is generally classed into five categories (shown in the table)[2]. Of the total area 60 percent is forest land (but not necessarily forested), less than 2 percent is culturable waste land, nearly 3 percent is current fallow and over 22 percent is not available for cultivation. Due to favourable climate conditions and the development of irrigation ever fifty percent of the land is cultivated twice a year and ten percent is cultivated three or more times. Gross cultivated area is therefore more than 15 million hectares[3]. Current fallow is land that is cultivable but not cultivated during the year of enumeration. On the other hand culturable waste is land that lies fallow at least one year.

Forest land is that land which is designated for forests but necessarily under tree cover. The area not available for cultivation includes land in urban areas, under rural housing, rivers and other water bodies, uncultivable sandy chars etc. About one-third of the area classed as "not available for cultivation" is under permanent waterbodies.

Land Types

Every rainy season it is normal for the lower parts of the country to be inundated for periods of up to four months[3]. On the higher areas rain water is impounded by field bunds ("ails") to conserve water for rice cultivation. One way of classifying land is by reference to the depths to which they are normally inundated. Land which is normally not inundated is classed as Highland. Medium Highland is that which is normally shallowly inundated but may have as much as 90 cm of water for short periods. Medium Lowland is normally inundated from 90 to 180 cm., Lowland is inundated to between 180 to 300 cm., and Very Lowland is inundated deeper than 300 cm. during the main rainy period (July to September). As much as 29 percent of the country is therefore normally inundated by river flows and 35 percent is shallowly inundated by impeded drainage (often man made) during three to six months of the year. During rest of the year even this land is mostly dry. The remaining 36 percent of the land consists of well-drained plains, red soil tracts at levels well above the floodplains and hilly areas.

Cultivated Land

Nearly 60 percent of the total land area of Bangladesh is cultivated. This is a high proportion in comparison with most countries of the world. It is made possible by the abundance of water, the fertility of the delta soils and the skill of the farmer in utilizing land which in other circumstances would have been either forest or swamp. An Agriculture Cencus was held in 1983-84. After analyzing its findings it was seen that 46 percent of the cultivated land is cropped only once, forty seven percent is cropped twice and seven percent is cropped three times in a year[4]. The Gross Cultivated Area of the country was therefore 61 percent more than the Net Cultivated Area. Irrigated area has increased several fold in the past twenty years, but this has not increased the Gross Cultivated Area proportionately because in many areas the second crop of rice has replaced a crop of one of the pulses or oilseeds. If this trend continues it could lead to adverse nutritional effect. Crop diversification particularly with horticultural crops is desirable.

Inundation Level Land Types

		Area (000 ha)	Percentage	Net Cultivable area (mha)	Percentage
1.	Highland	4.200	29.9	3.04	36
2.	Medium Highland	4.567	32.6	3.15	35
3.	Medium Lowland	1,771	12.6	1.43	16
4.	Lowland	1.102	7.9	1.10	12
5.	Very Lowland	193	1.4	0.08	1
6.	Settlements, Waterbodies etc.	2.178	15.5	-	-
		14.011	100.0	8.80	100

Current Fallow

This refers to cultivated land that is kept fallow for one or two seasons formerly a fairly high proportion of the land used to be under current fallow, but with growing demand for land there is no land under this category in many areas, particularly

Densely cultivated land in the Madhupur Tract

in these which have fertile soils. Most of the current fallow is found now a days in upland areas of the Barind and Madhupur tracts, and in the eastern Hills.

Cultivable Waste

This is another category of land which has been reduced rapidly in the past two decades. Whatever remains is concentrated mainly in the Barind and Madhupur tracts. The large area of Unclassed State Forest (USF) in the Hill areas could be classified in this category if the definition is changed to include timber and fuelwood trees as crops.

Urban Land

Urbanization has increased fairly rapidly in the past two decades and much good agricultural land has been converted to urban/industrial use. It is estimated that about 0.15 mha. is under urban and industrial use. This is one percent of the total land area. This is relatively a small percentage but has already affected horticulture adversely because urban expansion is usually on scarce highland, which is obviously the best horticultural land. In future urban growth may accelerate, and if so, it is likely to negatively affect horticulture, field crops and even forests, unless Land Use Plans are prepared and zoning is enforced[6].

Forest Lands

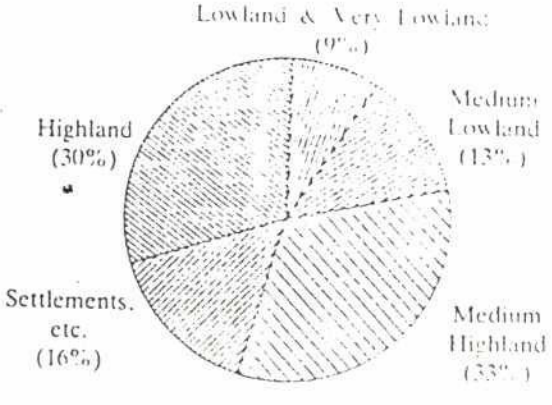
Even though 2.1 million hectare are said to be under forest only 57 percent of it is under tree cover[7]. Half of the forest land is in the Hill Tracts districts where the Unclassed State Forests (USF) have very few trees. A large part of the Sal forests in the Madhupur Tract has also been lost to encroachers and illegal feeling. The only remaining substantial forests are now in the Sunderban, Kassalong and the Teknaf peninsula.

Land Degradation

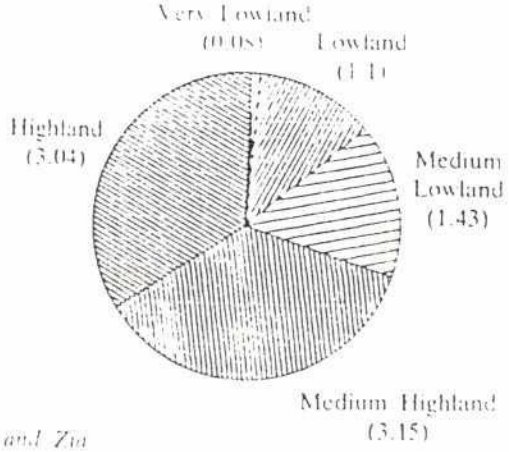
Deforestation, hill-cutting, cultivation on steep slopes and drying up of wetlands are causing widespread land degradation. Deforestation is the major cause of land degradation in Bangladesh. The Madhupur Tract, virtually in the centre of the country, used to be well forested just thirty years ago, but now only five percent of it is under forest. Large areas are now denuded, exposing the sloping land to increased leaching and erosion. The floodplains of all four sides of this important watershed are being increasingly affected by rapid run-off and excessive sediment load. The foot of the Garo Hills have also been largely denuded and this has also led to the choking of the network of streams in the piedmont from heavy sediment load in the run-off. These problems are also encountered all along the east, from Tamabil to Teknaf because of the same problem of deforestation, leading to increased erosion and consequent degradation of both the watershed and the river basins[8]. Hill-cutting is an increasing problem although the Government has banned it. Hillsides are cut away for material to fill lowland for building sites or for making bricks. This not only destroys flood-free land which is very suitable for horticulture and settlements but also contributes sharply increased amounts of sediments to the waterways, whose beds are then raised up leading to more frequent floods. Cultivation of sloping land is yet another major cause

INUNDATION LEVEL LAND TYPES

Total Area

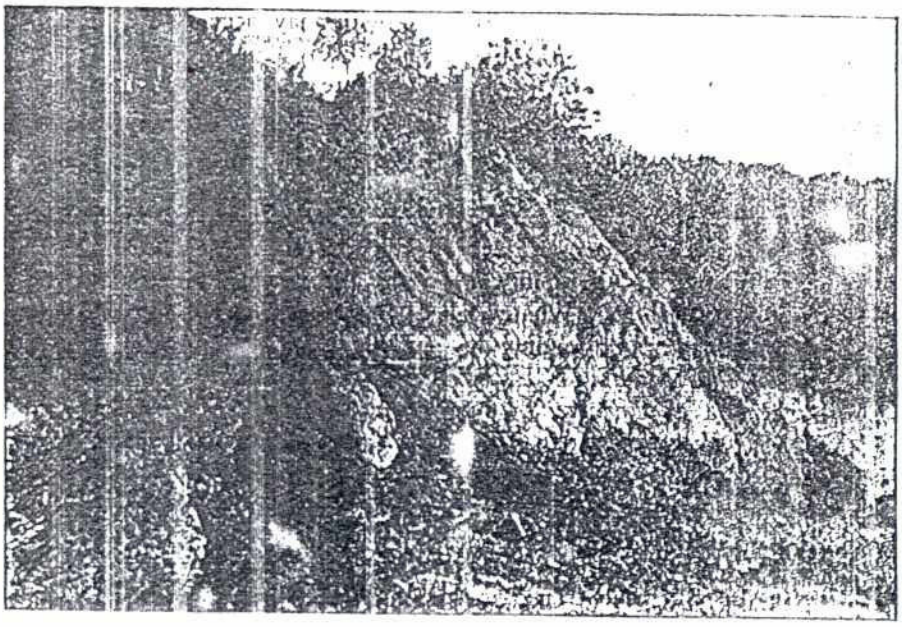


Cultivable Area (mha)



Graphs by Mostafa Rashid and Zia

of land degradation. Large numbers of settlers have moved into the hill areas in recent years due to population pressure, but they are not aware of hill cultivation practices. By cultivating steep slopes, removing trees and shrubs, not paying attention to contour lines, and leaving loose soil at the beginning of the monsoon rains, they are causing immense loss of top soils in these hill areas. This is rapidly degrading the hill land and also creating conditions for recurring floods in the floodplains below. Drying-up of wetlands for rice cultivation is also causing degradation, by reducing soil moisture, changing the microclimate reducing the fish catch and affecting biodiversity. Some compromise has to be found between the need to grow more cereal food and the need to increase fish production and preserve the wetlands for environmental reasons[10]. The future of agriculture in Bangladesh is in large measure tied up with the manner in which the wetlands will be treated by development projects.



Forest and Hill Land Destroyed by Hill cutting

References :

1 UNDP/FAO, Land Resources Appraisal of Bangladesh for Agricultural Development, Rome, 1988.
2 Yearbook of Statistics, 1990, BBS, Dhaka, 1990.
3 H.Rashid, Land Use in Bangladesh, Agriculture Sector Review, 1989.
4 H.Rashid, Geography of Bangladesh, UPL, Dhaka, 1991.
5 Census of Agriculture, 1983-84, BBS, Dhaka.
6 National Conservation Strategy, MOEF/IUCN, Dhaka, 1991.
7 Khan, A.W. Forestry and Forest Management ; background paper for the NCS, Dhaka, 1990.
8 R. Rahman, Land Management ; background paper for the NCS, Dhaka, 1990.
9 WRI /USAID, Bangladesh : Environment and Natural Resource Assessment, Washington D.C., 1990.
10 National Environment Management Action Plan, MOEF, UNDP, Dhaka, 1991.

POUSH

5/7, Sir Syed Road
Block-A, Mohammadpur
Dhaka-1207, Bangladesh
Phone : 812430

With the assistance of PACT - Bangladesh

Designed by : Zia

Written by Haroun Er Rashid

Bangladesh Factsheet

2

INDUSTRY

Status of Industrial Growth

Bangladesh is not an industrialised country but one which is in the early stages of industrialisation. The share of industrial sector in the national GDP is 10.8%. From 1985 to 1990, the sector achieved an average annual growth rate of about 4%[1], but the sector remains small in terms of both value added and employment.

Though the first modern textile mill was set up as early as 1908, the beginnings of an industrialization initiative was first felt in the early fifties. The first two decades since then saw the contribution of industry to GDP rise to about eight percent. However, since 1970 the increase in contribution has been very modest[2].

It has been estimated that presently there are about thirty thousand industrial units in the country, out of which 24 thousand are small and cottage industries and the rest are medium and large[3].

In recent years the major source of industrial growth has been primarily in textiles. Garment manufacture expanded from insignificant levels in the 1970s to the leading export earner today. Leather exports have also grown quickly and are likely to continue to do so in future. Frozen food industries (particularly shrimp), have grown quickly. It is, however, apprehended that brackish water shrimp farming may have already harmed agriculture, coastal forests and drinking water supplies[4].

Large-scale industries produce jute goods, sugar, cement, paper, newsprint, TSP and urea fertilizer. There is a large steel mill, several thermal power plants and a petroleum refinery plant.

Whatever industrial growth has been achieved so far, has generally been made without seriously taking environmental considerations into account. In most of the industries health and safety measures for workers are non-existent. Nor do they exist for the communities that adjoin such industrial units.

Types of Industries

Majority of the industrial units are of small and cottage level. These include weaving factories, rice mills, fabrication and repair workshops, plastic industries, etc. Large and medium industries and the number of units in each category are as follows: Sugar (16), Food (193), Paper and pulp (5), Cement (2), Fertilizer (6), Textile Hosiary (140), Jute (114), Distillery (5), Garments (704), Pharmaceuticals (185), Leather Products (31), Beverage (7), Tobacco (18), Industrial Chemicals (21), Petroleum refining (1), Pottery and China ware (8), Plastic Board mill (14), Rubber (65), Glass (34), Matches (19), Iron and Steel fabricated metal products (108), Edible Oil mills (210), and Tanneries (119), Textile (Cotton) factories (63), Drydock and Shipbuilding (18)[5]. Major part of the industrial sector is still agro-based.

Employment in Industry

The share of employment in industries sector increased from 3.9% in 1950-51 to 10.8% in 1989-90. The

Industrial Production (1988-90)		
Products	Total Production	
Sugar	185,844	metric tons
Tabacco	11,221	million cigarettes
Cottonyarn	12,289	thousand pounds
Paper Products	65,791	metric tons
Fertilizer	4,707	metric tons
Matches	10,633	thousand gross boxes
Pharmaceutical	10,112	thousand Taka worth
Petroleum Products	982	thousand metric tons
Cement	337.359	metric tons
Steel ingot	75.029	metric tons
Glass sheet	14.261	thousand sq. ft.
Jute goods	235.106	metric tons

rise was gradual but steady[2]. Whereas small and cottage industries employ atleast 1,400,000 persons[7], medium and large industries employ only about 467,000 persons[8].

Resource Use in Industries

Most of Bangladesh industries are still agro-based including jute, tea, textile, tobacco, sugarcane etc. Nearly 10% (0.79-1.12 million ha) of the total cropped area is devoted to production of agricultural resources for industrial use[9].

Both renewable and non-renewable resource based industries exist in the country. Renewable resource based industries include pulp, paper and board, safety match (using all together about 343,985 m^3 of wood, 590,000 tons of bamboo and reed and 66,000 tons of agricultural residues annually), leather (annual processing of 10 million cow, goat, sheep and buffalo hides), sugarcane, jute, tobacco, cotton etc[2].

Among non-renewable resource based industries, there are five existing urea fertilizer and two more under construction (using natural gas amounting to 50.965 million cft. in 1987-88), thermal power plants (using natural gas amounting to 61,959 million cft. in 1987-88 and fuel oil), ceramic, steel, petroleum refinery, pharmaceutical etc. are important[6].

Most of the older industries are based on inefficient technology with little regard to economy of energy and raw materials. It is apprehended that even the industries based on renewable resources may be over-exploiting local resources in some places.

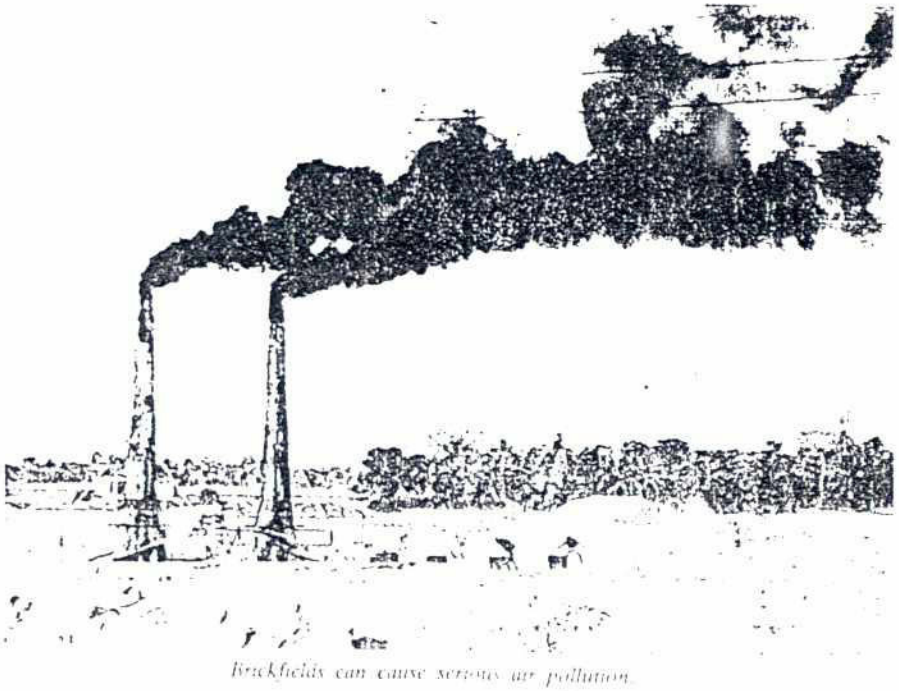
Locational Patterns

There is no 'National Industrial Siting Plan' and there exists only a few designated industrial areas in the country. These include a large number of BSCIC developed industrial estates for small and cottage industrial units, which are scattered throughout the country.

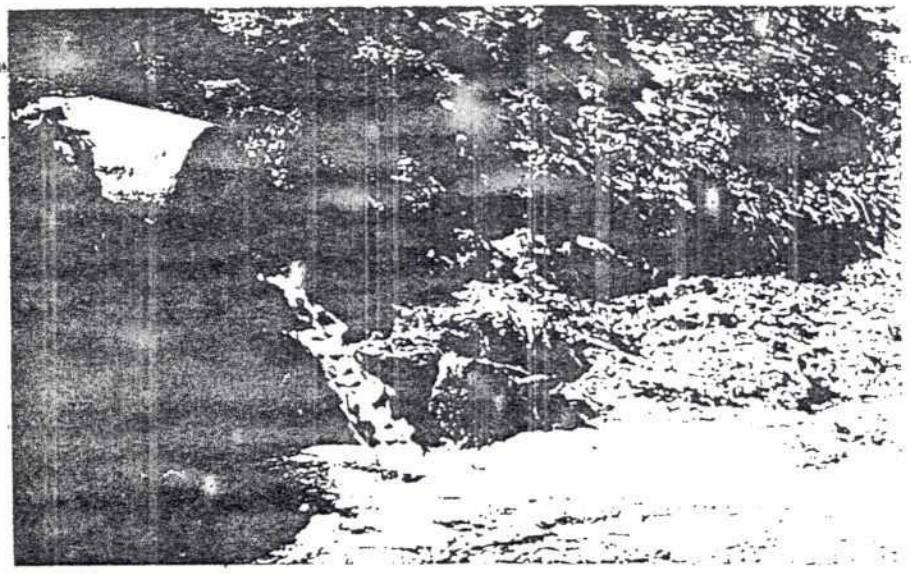
Industrial growth is currently limited mainly to urban areas. The major industrial locations are – Dhaka (Tejgaon, Hazaribagh, Demra, Tongi, Gazipur), Chittagong (Kalurghat, Nasirabad, Patenga, Sholashar), Khulna (Shiromoni, Khalishpur, Rupsha), Narayanganj, Ghorashal, Narshingdi, Tarabo, Fenchuganj and Bogra. Of late fiscal (tax) incentives have been provided to encourage the spread of industries to other areas of the country. Two export promotion zones have also been created.

It is common to find industrial units located intermingled with human settlements. Many polluting industries have been located near and even within thickly populated urban areas without provision for treatment of polluting wastes.

Industries with large effluent load or water intake requirement often locate themselves on the bank of major waterbodies, generally discharging untreated effluent into these water bodies.



Brickfields can cause serious air pollution



Industrial effluents are discharged into rivers

Industrial Pollution

Industrial pollution is caused by untreated effluent, emission, solid wastes and noise. Though the level of overall industrial pollution in the country is not alarming as yet, it is still quite significant, on the increase and disturbing in some areas.

In Bangladesh industrial wastes contain mostly organic degradables, but the problem of hazardous toxic wastes from chemical industries, tanneries, electroplating and other non-primary industries is on the increase. In many areas brickfields not only degrade the land but also cause serious air pollution.

With increasing industrialisation, it is almost certain that there will be serious industrial pollution problems in the very near future.

Location Hazards

Location hazards caused by industries are significant. There is overall lack of zoning facilities even within an industrial zone, including BSCIC industrial estates.

The location pattern of various industrial units is very often not environmentally acceptable. Among other extremely hazardous units located close to habitations are the high-voltage electrical (transformer) sub-stations and high-voltage electric cables whose electro-magnetic influence have long term effects on health.

Industrial units in residential urban areas are common. Sometimes an industrial unit or workshop will occupy the ground floor, while the first floor is a residential unit. There are noisy units working 18-20 hours a day and still located in residential or mixed use area. There are moulding workshop, saw mill, oil mill etc. just next to residential blocks or engineering workshop close to educational institutions.

Legislation

The existing Environment Pollution Control Ordinance 1977 has been found inadequate to control industrial pollution in respect to coverage of polluting activities. Its enforcement is also weak. The proposed Environment Preservation Ordinance 1991 provide for improved and pragmatic provisions for control and enforcement but it still awaits final approval and promulgation.

Factories Act 1965 basically deals with the shopfloor environment and occupational health hazards, but fails to make provisions for industrial pollution control. It does not also specify the need for environmentally sound location of a particular manufacturing unit.

Institutions

Permission to set up an industry is provided by various agencies including the Board of Investment Bangladesh Small and Cottage Industries Corporation (BSCIC), Department of Textiles, Export Processing Zone Authority, Local Government authorities. There is lack of coordination among agencies involved in industrial development of the country.

Cottage Industries, 1983

	Items	Number of Enterprises	Number of Workers
1	Carpets, Rugs, Rope Bags & Nets	25,650	73,531
2	Food Drink and Tobacco processing	84,749	232,414
3.	Glass & Ceramics	17,294	80,899
4.	Jewellery & Ornaments	12,265	26,600
5.	Leather Work	2,219	5,394
6.	Metal Work	23,191	60,148
7.	Miscellaneous	9,775	55,953
8.	Salt	28,544	66,702
9.	Tailoring	46,340	103,184
10.	Wood, Cane & Bamboo Works	70,787	215,449
11.	Yarn & Textile Fabrics	198,200	853,532

Other agencies involved include Inspectorate of Factories and Establishment, Department of Environment, Commercial Banks, and the Development Finance Institutions such as SABINCO, IDLC, BSB, BSRS and ICB.

Industries identified by DOE as highly polluting ones have not been compelled to take mitigating measures, due to weakness in enforcement of existing laws.

Standards

Bangladesh has Environmental Quality Standards prepared by Department of Environment and approved by an Expert Committee formed by the Government. Standards have been set for industrial effluent discharge and emissions[11]. It is hoped that these standards will now be strictly enforced.

Industrial Policy

The Industrial Policy (1991)[12] provides incentives to the private sector but does not adequately safeguard environmental concerns. The National Conservation Strategy (NCS) and The National Environment Management Plan (NEMAP), both of which were drafted in 1990, have suggested several ways in which the industrial sector can be both more productive and at the same time environmentally compatible, so that the cost of managing a depleted and destroyed environment is not passed on to future generations.

References

1. MOEF (1991) - 'Bangladesh Country Report for UNCED (2nd draft)' - Ministry of Environment and Forest, Dhaka, Bangladesh.
2. Mahmud I, Rahman K, and Omar I (1991) - 'Towards sustainable development : Industries of Bangladesh' - Ministry of Environment and Forest and IUCN, Dhaka, Bangladesh.
3. DOE (1990) - 'Bangladesh Environment and Department of Environment' - Department of Environment, Dhaka, Bangladesh.
4. IUCN (1991) - 'Bangladesh National Report for UNCED' - The World Conservation Union, Geneva, Switzerland.
5. MOI (1988) - 'Directory of Selected Industries' - Ministry of Industries, Dhaka, Bangladesh.
6. BBS (1991) - 'Statistical Yearbook of Bangladesh 1991', - Bureau of Statistics, Dhaka, Bangladesh.
7. Rashid, H. (1991) - "Geography of Bangladesh", University Press Limited, Dhaka, Bangladesh.
8. BBS, Statistical Yearbook of Bangladesh, 1990.
9. MOEF and IUCN (1991) - 'Towards Sustainable Development. The National Conservation Strategy of Bangladesh' - Ministry of Environment and Forest and IUCN, Dhaka, Bangladesh.
10. Islam, M.A. (1991) - 'Bangladesh National Environmental Legislation - an overview' Department of Environment, Dhaka, Bangladesh.
11. DOE (1991) - 'Environmental Quality Standards of Bangladesh' - Department of Environment, Dhaka, Bangladesh.
12. MOI (1991) - 'Industrial Policy 1991' - Ministry of Industries, Dhaka, Bangladesh.

December 1991

POUSH

5/7, Sir Syed Road
Block-A, Mohammadpur
Dhaka-1207, Bangladesh
Tel : 812430
Fax : 880-2-863060
Tlx : 642986 MASIS BJ

"With the assistance of PACT — Bangladesh

Written by M. Anwarul Islam and Mamun-ur-Rashid

Designed by : Zia *Printed by BRAC Printers* *Published by : Atuar Ali*

Bangladesh Factsheet

3 FOREST

Extent

Bangladesh has 2.46 million ha of forest land according to an official estimate, covering about 17 per cent area of the country[1]. Actually forested land is much less as this official estimate includes all land recorded as forest land irrespective of tree cover. Except for 0.27 million ha of village forests, all forest land is state owned and more than 90 per cent of the state owned forest land is concentrated in 12 districts in the eastern and south western region of the country. Out of 64 districts, 28 districts have no state owned forest at all. Village forests, spread all over the country on homestead lands, consist of groves and orchards around rural homesteads.

Hill Forests

The hill forests of Chittagong, Cox's Bazar, Rangamati, Bandarban and Khagrachari Hill Tracts, Sylhet, Moulovibazar and Habiganj districts cover approximately 1.40 million ha, of which 0.67 million ha is under the control of the Forest Department and the remaining 0.73 million ha is under the control of the hill district councils. In high forests, activities of the Forest Department are mainly confined to raising of single-species plantations to convert so called low value natural semi- evergreen and evergreen high forest into high valued plantations by practising a silvicultural system of clearfelling followed by artificial regeneration. So far over 100,000 ha of high forest has been converted into plantations, mostly of Teak mixed with other hardwood species. Inventory shows most of these plantation will not give desired yield since the plantation programme sufferes from certain technical, social and administrative problems. Most of the remaining high forests are in the inaccessible areas of hill districts which are subjected to shifting cultivation by hill tribes. Forest lands under the control of the three Hill Tracts districts councils (amounting to about 0.73 million ha) are termed as Unclassed State Forests (USF) and the hill tribes are entitled to practice shifting cultivation there. This has resulted in the total destruction of these tropical evergreen forests. The USF, now, is a forest only in name and comprises mostly of scrub forest[2, 3].

Mangrove Forests

The mangrove forests of Bangladesh fall under two broad categories : namely natural managrove forests known as Sundarban and the plantations of mangrove species which have been established all along the coast and along off-shore islands in the Bay of Bengal.

The Sundarban, extending over 0.57 million ha, in the districts of Khulna, Bagerhat and Satkhira, is the largest single mangrove forest in the world[4]. Out of 0.57 million ha, 0.17 million ha is occupied by rivers, channels and other watercourses. The Sundarban has been exploited since time immemorial but has been managed by the Forest Department for the last 100 years. Silvicultural system followed for Sundarban is selection felling followed by natural regeneration. Sundarban is the natural habitat for a large number of wild animals including the Royal Bengal

Tiger and the Spotted Deer and is considered as one of the richest natural wildlife habitat in this part of the world. It may be the last viable Tiger reserve in the world[2].

Plantation of mangrove species along the coast and in the offshore islands is a very imaginative and progressive undertaking by the Forest Department. It was initiated with indigenous technology to accelerate accretion of land deposits, stabilize the ecosystem and also produce logs and fuelwood. Forest Department has so far planted an area of about 100,000 ha. in the coastal area.

Village Forests

These are tree groves grown in and around the homestead land by rural people and usually composed of multipurpose fast growing trees, fruit trees, bamboo, clumps of rattans and shrubs. Even though the quantity of wood supply from village forests is not accurately known, it is certain that a major share of fuelwood and timber consumed in the country comes from these forests.

Information on growing stock in different forests have become available after the recent inventories.

Table 1 : Forest : Area and Growing Stock

Forest Type	Area in Million Ha	Tree Coverage in Per cent of area	Growing Stock in Million m^3
a) Hill Forests (Tropical Moist) Evergreen)			
1. Forests under the control of FD	0.67	54	28.32[4]
2. Unclassed State Forests	0.73	Not known (Mostly Scrub Forest)	Not known
b) Mangrove (Tropical Evergreen)			
1. Sundarban	0.57	70	13.19[4]
2. Coastal Plantations	0.10	70	5.05[4]
c) Plainland Sal Forests	0.12	30	1.13[4]
d) Village Forests	0.27	100	54.68[5]

Plainland Forests

Plainland forests, which is more commonly known as Sal forest, is spread out in small patches over Gazipur, Tangail, Mymensingh, Jamalpur, Dinajpur and Rangpur districts and covers an area of 120,000 ha. These are generally very degraded forests of very low productivity. There is considerable evidence to suggest that as much as 50 per cent of this land may have been cleared and settled under temporary agriculture.[6] Felling of trees in these forests were suspended (at least officially) since 1972.

Official estimate of area, tree coverage and growing stock of different forests are shown in table 1.

Bamboo Resources

Bamboo, grown both in state owned and homestead forest, is a very important resource since it is the poor man's timber. Bamboos occur in individual patches and also as an undergrowth in forests. The growing stock was estimated in 1984 as 0.78 million air-dried (AD) tons in state forests and 1.8 million AD tons in privately owned land[11]. Recent study by BBS reported about 21.49 million bamboo clumps of eight different varieties in villages. The total number of bamboos in these clumps was estimated at 2,047 million pieces[12].

Trend in Resource Use

The gap between demand and supply is widening continuously and there will be a net deficit of 5.96 million m^3 of logs by the year 2000 assuming no change in the present demand/supply trend[13]. The consequence of a widening demand/supply gap are (1) un-authorized felling of trees from state owned forests, (2) overcutting of village forests, (3) increased use of non-traditional energy sources and (4) raw material scarcity for wood based industries.

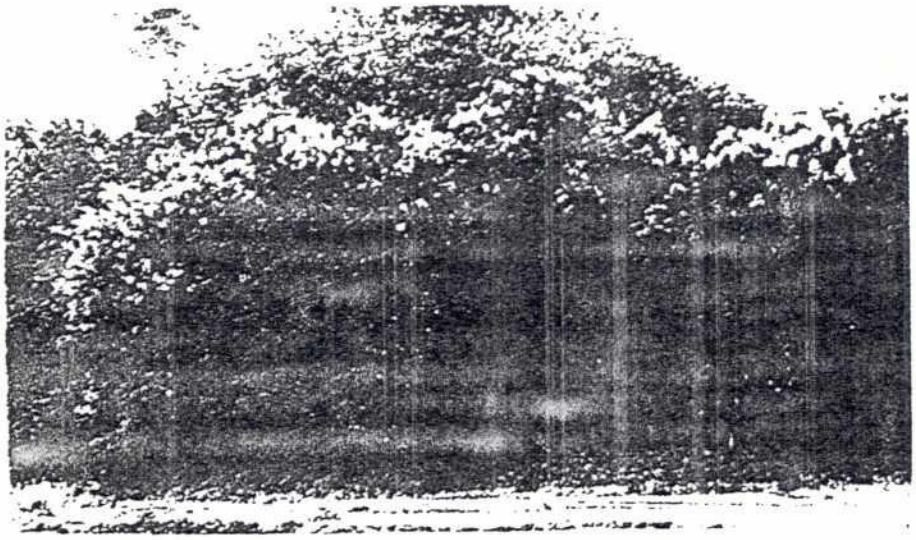
State forests contribute only 26 and 10 percent of total timber and fuelwood supply; whereas homestead forests contribute 74 and 90 percents of total supply of timber and fuelwood respectively.[14]

The per capita consumption of fuelwood and timber is estimated at 0.07 m^3 and 0.01 m^3 respectively[15]. These figures are quite low when compared to those of the neighbouring countries (Table 2). If trees continue to be depleted at current rate, annual fuelwood availability in rural areas will further decline to 0.02 m^3.[2] This low figure is mainly due to a shift in use pattern from tree biomass to agricultural residues (60 per cent of consumption) and cowdung (20 per cent)[16].

Paper, pulp, board and match industries at present use 343,985 m^3 of wood and 90,000 metric tons of bamboo and reed per annum as raw materials[17]. The wood and bamboo for industrial use comes mostly from Sundarban and Hill Forests, and it is apperehended that the raw material supply source is being depleted.

Shifting Cultivation

Shifting cultivation, based on the



A teak Plantation in flower

traditional practice of slash and burn argiculture by tribes of the hill districts, mainly in the unclassified state forests, was a stable and self sustaining system only three decades ago with a fallow period of 10-15 years enabling adequate restoration of soil fertility. But increased population pressure has reduced the fallow period to about three years, resulting in irreversible impacts on the natural ecosystems. Demand for forested land for shifting cultivation has become so acute that reserve forests of hill districts are being encroached. In Kassalong and Rankhiang reserves, shifting cultivation had destroyed an area of approaximately 65,000 ha by 1985[18]. This process of shifting cultivation is the single greatest threat to the remaining natural forests of the hill districts.

Resource Degradation

Inventories show that there has been an overall depletion in forest resources in all major state owned forests. The growing stock in the Sundarban has been depleted from 20.3 million m^3 in 1960[19] to 13.2 million m^3 in 1984[19].

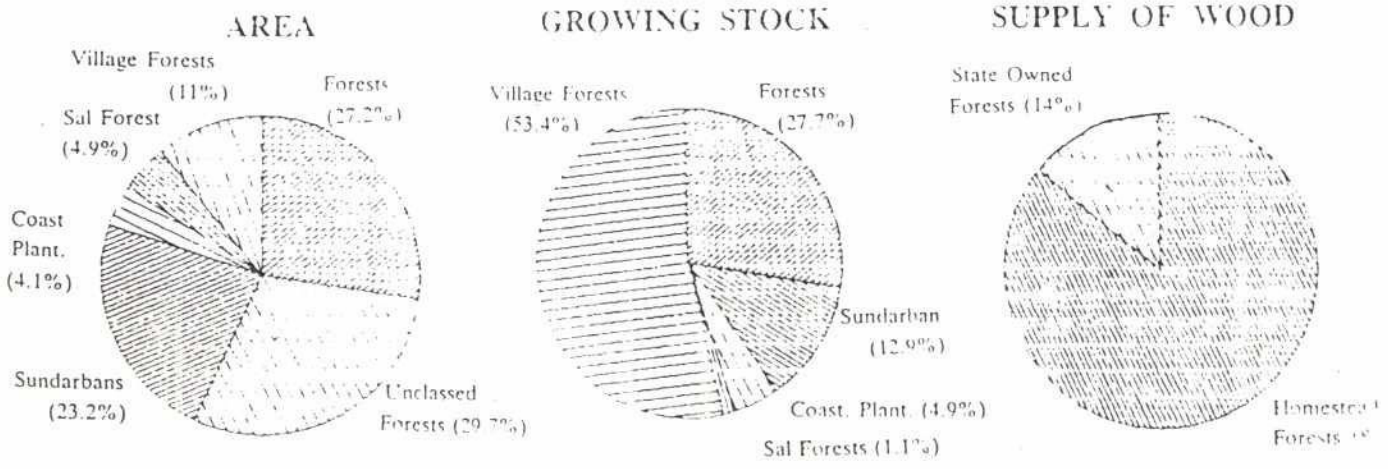
Table 2 : Per Capita Fuelwood and Timber Consumption in Different Countries.

Country	Fuelwood (m^3)	Timber (m^3)
Nepal	0.69	0.04
Burma	0.63	0.07
Thailand	0.25	0.13
India	0.20	0.02
Bangladesh	0.07	0.01

In the hill forests of hill tract districts the growing stock has depleted from 23.8 million m^3 in 1964[20] to less than 19.8 million m^3 in 1985.

Since 1960, two major approaches regarding the role of forestry in development have been reflected in the forestry sector of Bangladesh. Bangladesh as a part of Pakistan in the 1960s and then as an independent nation has followed an "industrialization approach" consonant with the international conventional wisdom of that time. As a result, Forest Department raised large scale industrial plantations which were seen as conversion of low yielding natural forest into artificial plantation of species

Forest by area, growing stock and supply of wood



Graph by Zia

(mostly Teak) of high economic importance. This conversion of evergreen and semi-evergreen forest into deciduous Teak plantation was largely concentrated in Kassalong Reserve Forest, the only important catchment area of the Karnafuli River falling within the political boundary of this country. During plantation raising, local people were generally not consulted, and often they did not derive any benefit from these plantations. The lack of support by the local people in combination with lack of silvicultural knowledge and lack of proper maintenance contributed to widespred failure of the plantations. In the name of plantation raising genetic resources of the evergreen and semi-evergreen forests were lost.

In the 1980s, following a change in thinking regarding the role of forestry in development, peoples' participation in forestry activity was encouraged, and a tendency for spending of development resources for rural forestry was observed. In many cases early attempts to implement people oriented forestry programmes failed since the Forest Department, with whom responsibility of implementing such programmes lies, was out of touch with what the people wanted. In the past two years interaction between the Forest Department and people has improved due to implementation of the Upazilla Banayan Prakalpa and WFP- supported Peoples Participatory Forestry by NGOs. The Upazila Banayan Prakalpa has created widespread awareness of the need to systematically plant and protect trees. This project is carrying out a successful training programme for both Government officials and the staff of NGO's involved in forestry. The numbers of NGO's involved in tree-planting has increased in the past three years and the World Food Programme is assisting many of them by providing wheat grants for nurseries, planting work and maintenance workers.

References :

1. GOB, 1990. The Draft Fourth Five Year Plan.
2. Hussain, Z. 1991. Development of Forest Resources in Bangladesh.
3. Rashid, H. Land Use in Bangladesh, Bangladesh Agriculture Sector Review, UNDP, Dhaka, 1988.
4. Alcorn, J. and Johnson, N., "Conservation of Biological Diversity in Bangladesh : Status, Trends and Recommended Responses", World Resources Institute, 1989.
5. MOEF, 1991. Draft National Conservation Strategy.
6. Byron, R.N. 1985 Rural Versus State Forestry in Bangladesh, CRES Working Paper the Australian National University.
7. Chowdhury, R.A. and Hussain, Z. 1989 Forest Management Practices in Bangladesh: Traditional practices and alternate approaches.
8. Chaffey, D.R. et al 1985. A Forest Inventory of Sundarbans.
9. Forest Department 1990. Resource Information Management Data Bank.
10. Hammermaster, E.T. 1981. Final Report of the Village Forest Inventory.
11. Chowdhury, M.R. 1984. Field Document No. 9. UNDP/FAO Project BGD/78/010.
12. BBS 1990. Report on Survey of Farm Forestry, 1988.
13. Row, M.K. 1987. Forestry Sector Planning and Development in Bangladesh.
14. Sydnesmith, S. 1985. Contribution of the Forestry Sector to Bangladesh GDP.
15. Douglas, J.J. 1981. Consumption and Supply of Wood Bamboo in Bangladesh.
16. Bangladesh Energy Planning Project 1985 Rural Energy and Biomass Supply.
17. De Mildes R. et. al. The Kassalong and Rainkheong Reserved Forests in the Chittagong Hill Tracts.
18. Mahamud, I et al 1991. Towards Sustainable Development: Industries of Bangladesh.
19. Forestal 1960. Inventory of Sundarban Forests.
20. Forestal 1966. Chittagong Hill Tracts Soil and Landuse Survey.

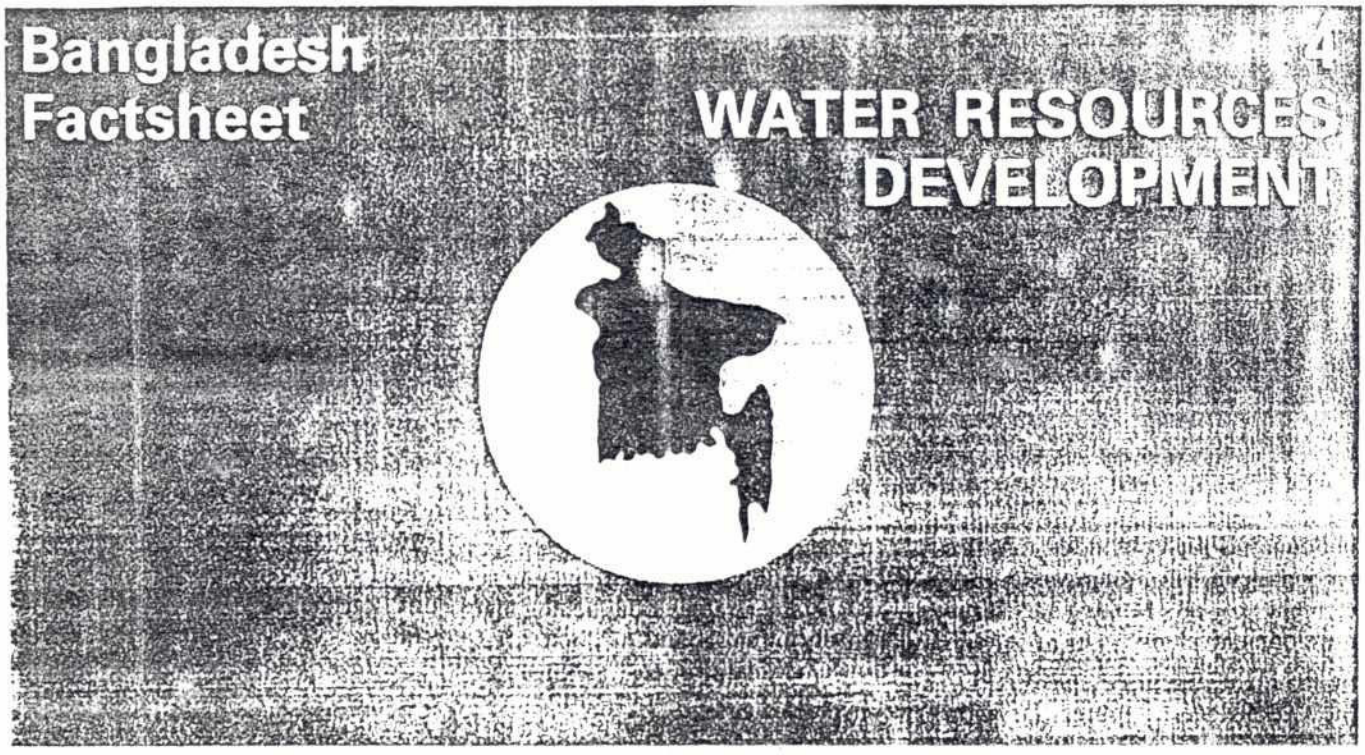
POUSH

5/7, Sir Syed Road
Block-A, Mohammadpur
Dhaka-1207, Bangladesh
Phone: 812430

With the assistance of PACT — Bangladesh
Written by Monoj K. Roy and Haroun er Rashid.

Designed and composed : Zia

December 1991



Introduction

A rhythm in the annual water cycle dominates life in Bangladesh : excessive water during the monsoon causing flood and insufficient water during the dry season creating drought like situation. These two extremes influence the planning for water resources development in Bangladesh requiring effective measures in flood control, irrigation and drainage. Development in irrigation sector together with flood control and drainage infrastructures, in areas where it has already been completed, has created a regime when other agricultural inputs may be effectively utilized to enhance the yield rate. But this trend in water resources development with single objective of increasing production level in agriculture has led to neglect to other water sectors such as fisheries, navigation, control of salinity level in the coastal area, etc. Concerns are being expressed about the various adverse aspects of present day water development activities specially the decline in open water fisheries due to construction of embankments and drainage projects. It is expected that environment will be made integrate part of all future project planning in Bangladesh though it is yet to be reflected at implementation stage (Nishat 1990, BARC 1991).

Need of Irrigation and Flood Mitigation

Fig. 1 shows a generalised cropping pattern on a flood prone area in Bangladesh along with time and duration of occurance of floods and need for irrigation water. Thus for improvement of Kharif I and Kharif II crops efforts in flood protection is necessary. For Boro and Rabi crops irrigation water supply is the main input (together with HYV seed and fertilizer). In areas where there is risk of early monsoon flood protection from flooding is essential. Land type F0, F1 and F2 (see Table 1 for details) representing high land, medium high land and medium low land constitute 36%, 35% and 16% (87% in total) of cultivable area respectively. Rest of the land belongs to F3 (i.e. low land) and F4 (very low land) types (MPO 1991). Thus if low and very low land are left out to remain under flooding condition, the probable flood depth for the rest of the area is less than 2m and it should be possible to bring these areas under flood protection. However, total elimination of flood may not be possible and desirable. Provision of adequate regulatory structures should be ensured in the embankment system that would allow controlled flooding (World Bank 1989). There is need of irrigation facilities round the year: for HYV Aman, the need is for supplimentary irrigation in flood-free as well as in flood protected areas, and in dry months primary irrigation is a prerequisite.

Trends in Resource Use

The predominantly agrarian society evolved in the then East Bengal, now Bangladesh, over the centuries with full dependence on climate and weather. Excepting for lifting water from ponds and streams, by indigenous methods no major effort in water development was there. The importance of water management was realised after the successive floods of 1954 and 1955. In 1957 an inter-

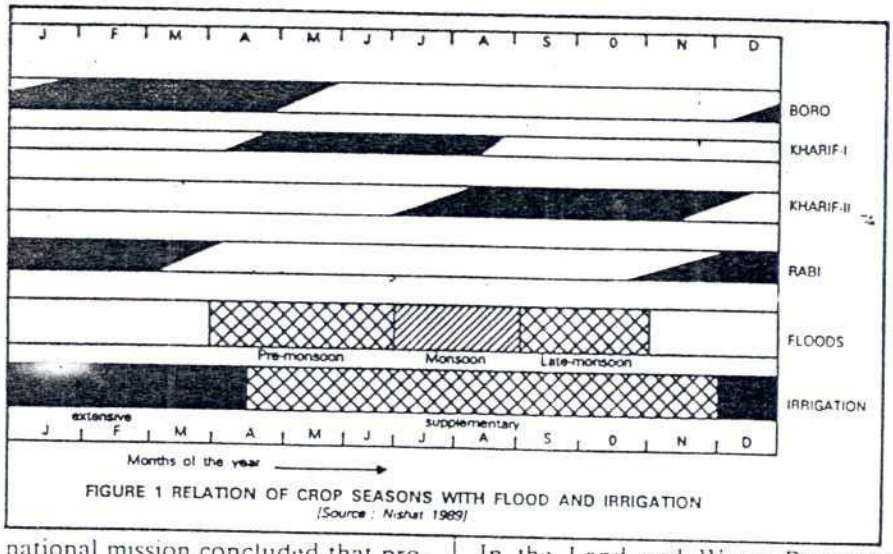


FIGURE 1 RELATION OF CROP SEASONS WITH FLOOD AND IRRIGATION
(Source : Nishat 1989)

national mission concluded that protection against flooding was the key element of all future agriculture development plans.

In 1959, the erstwhile, EPWAPDA (now Bangladesh Water Development Board, BWDB) was established and assigned the responsibility for planning design, construction, and operation and maintenance of water development schemes. A Water Master Plan was prepared in 1964. The broad strategy of the Plan was to reduce damage to crops first by providing flood protection and then boosting production through introduction of modern agricultural techniques including use of fertilizers. Irrigation was to be introduced at a later stage. Such a strategy required large and massive flood-protection schemes and was never taken up for implementation in a coordinated way. However BWDB implemented many of the projects recommended in the Master Plan.

Meanwhile, EPADC (now Bangladesh Agriculture Development Corporation, BADC) had been set up in 1961 and entrusted with the task of procuring and distributing tractors, low lift pumps (LLPs), tubewells (TWs) and other inputs like seeds, fertilizers and pesticides and succeeded in bringing in very fast growth in food grain production.

In the Land and Water Resources Sector Study, 1972, completed by IBRD, the strategy of attaching high priority to small and medium sized, quick yielding, low cost, labor-intensive projects with long term projects to be formulated at a later date was recommended. This strategy constituted a major ingredient in the programs formulated by BWDB and BADC, and was manifested in all the Five Year Plans of the country, formulated so far. The National Water Plan (MPO 1991) prepared by Master Plan Organisation (MPO) has also been based on this strategy, but with main emphasis on development in agriculture sector (Nishat 1990).

Flood Mitigation

Flood is a recurring phenomena in Bangladesh. The various factors that singly or in combination create flood in Bangladesh are the huge monsoon inflows of water that come from upstream catchment areas coinciding

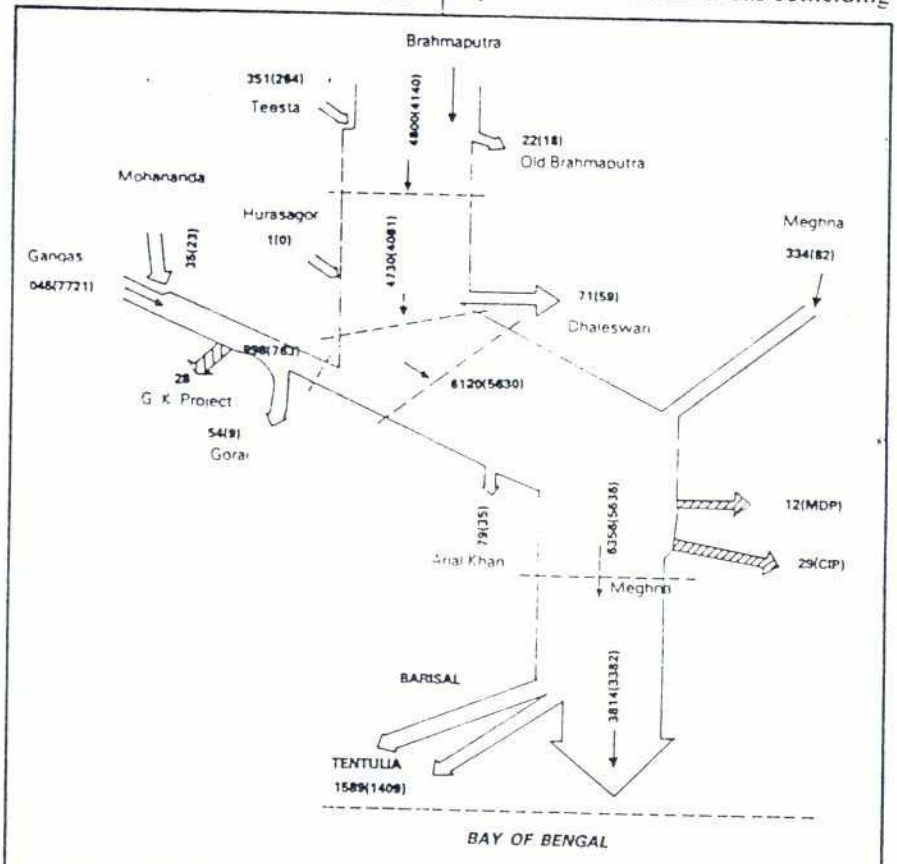


FIG 2 : STREAMFLOW DISTRIBUTION, MARCH 1990 [SOURCE, MPO 1991]

NOTE :

1. FIGURES ARE MEAN MONTHLY STREAMFLOW IN CUBIC METRES/SECOND
2. FIGURES IN THE PARENTHESIS ARE FIVE-YEARS, ONE-MONTH LOW FLOW IN CUBIC METRE/SECOND
3. STREAMFLOW FIGURES SHOWN FOR THE GANGES RIVER AND THE PADMA RIVER ARE POST-FARAKKA CONDITION (WATER YEAR 1975-89)

with heavy monsoon rainfall over Bangladesh, low floodplain gradient, congested drainage channels, and the influence of tides and storm surges. Only 8% of the 1.72 million square kilometers of the catchments of the Ganges, the Brahmaputra and the Meghna lie inside country. In Bangladesh four major types of flood occur, viz :

- monsoon floods from major river;
- local flooding due to heavy rainfall and drainage congestion;
- flash floods in the eastern and northern rivers; and
- floods due to high tides and storm surges in the coastal areas.

In recent times in 1987 and 1988, Bangladesh experienced two of the most severe floods on record. These floods were a major setback to the country's economy and stimulated the Government to undertake a comprehensive review of the planning approach. A flood policy study and a flood preparedness study were carried out and a set of eleven guiding principles (Table 2) was developed. Studies were also carried out by professionals from Japan, France and U.S.A. Based on these studies the World Bank recommended an integrated approach for flood mitigation based on the concept of "controlled flooding" and "compartmentalisation" for management. Under the "Flood Action Plan" six regional plans for water development and management are presently under preparation.

Table 2
The Eleven Guiding Principles of the Flood Action Plan
(source, World Bank 1989)

- Phased implementation of a comprehensive Flood Plan aimed at protecting infrastructure and controlling flooding to meet the needs of rural activities and the environment.
- Effective land and water management in protected and unprotected areas.
- Strengthening disaster preparedness and management.
- Improvement of flood forecasting and early warning.
- Safe conveyance of large cross border flood flows through the major river systems to the sea.
- River training to protect embankments and urban centres.
- Flood flow reductions in the major rivers by diversions into major distributaries and flood relief channels.
- Channel improvements and structures to ensure efficient drainage.
- Flood plain zoning where feasible and appropriate.
- Coordinated planning and construction of road and railway embankments with provision for unimpeded drainage.
- Encourage popular support by involving beneficiaries in the planning, design and operation of flood control and drainage works.

Irrigation

Irrigation has been the leading factor in agricultural development. The development of irrigation started in the 1950's with the exploitation of surface water using low lift pumps which irrigate, on average, about 15 hectares. By mid-1970's, 600,000 hectares were irrigated with surface water and most of the easily accessible resources had been developed. Groundwater development started with deep tubewells (irrigating on average 25 hectares) in the 1960s and continues today. The further exploitation of groundwater with farmer-owned shallow tubewells (irrigating on average 4 hectares each) started in the late 1970s and is now a major form of groundwater irrigation.

Through the 1970s and 1980s there was a rapid spread of minor irrigation and of high-yielding rice varieties and fertilizers. The total area

Table 1
MPO Land Types Based on Flood Depth and Cropping Patterns (source, MPO 1991)

Land Type	Description	Flood Depth (cm.)	Nature of Flooding	Identifying Crop
F0	Highland	less than 30	Intermittent	Land suited to HYV rice in the wet season.
F1	Medium-high	30-90	Seasonal	Land suited to local varieties of Aus and transplanted Aman.
F2	Medium-low	90-180	Seasonal	Land suited to broadcast Aus and broadcast Aman in the wet season.
F3	Lowland	Greater than 180	Seasonal	Land on which only broadcast Aman can be grown in the wet season.
F4	Low to Very-low	Greater than 180	Seasonal/ Personnel	Land on which either the depth, or rate, or timing, of flooding does not permit growing of broadcast Aman, but does support local Boro in the dry season.

under irrigation has increased from 1.2 million hectares in 1973 to 2.6 million hectares in 1990.

Surface Water Resources

The river system that flows through Bangladesh comprises the third largest source of fresh water discharge to the oceans. Only the Amazon in Brazil, and the Congo in Africa, have larger discharges that the Ganges-Brahmaputra-Meghna river system (MPO 1991). The annual volume of flow past Baruria just below the confluence of the Brahmaputra and Ganges in 795,000 million cubic metre which is equivalent to 5.52 metres of depth over the 14.4 million hectare of land area of Bangladesh. In contrast the average annual rainfall for the country is 2.32 metre. Figure 2 shows the distribution of flows of the main rivers for a typical dry month.

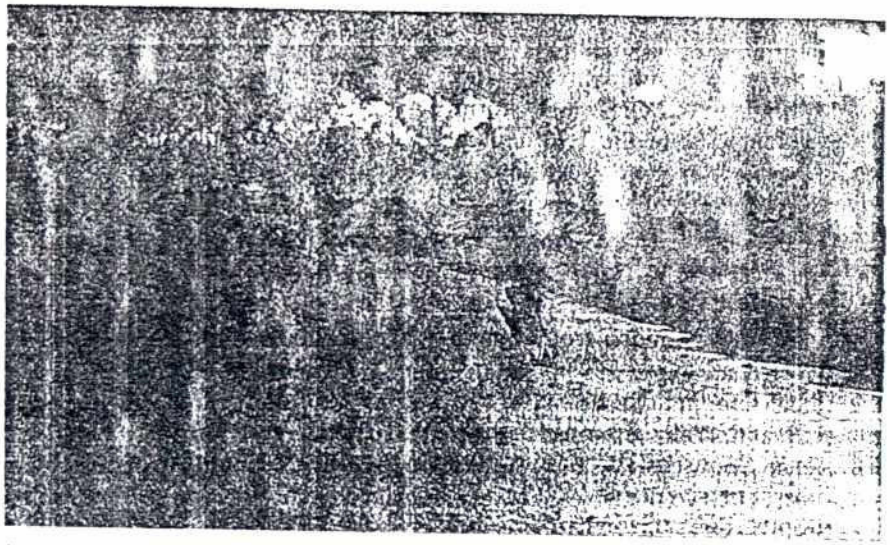


Table 3
Groundwater Recharge (MPO 1991)

Region	Annual Net Recharge	Existing Irrigation	Available For New Use	Potential New Area Irrigated
	—(Billion cubic meters)—			—MHa—
NW	9.5	2.1	6.1	0.9
NE	9.6	1.8	7.4	1.1
SE	1.5	0.3	1.1	0.2
SC	1.8	0.1	1.2	0.2
SW	2.0	0.6	1.2	0.2
AFP	1.3	0.3	0.9	0.1
Total	25.7	5.2	17.9	2.6

Ground Water Resources

Bangladesh lies over a subsiding basin of tectonic origin with a huge thickness of sedimentary stata. This quatenary alluvium constitutes a huge aquifes, mainly with good to reasonable transmission and storage properties. Because of high rainfall and wide spread annual flooding, this aquifes has good recharge characteristics and is normally saturated almost to the ground level. The ground water is of good quality except in the estuarine south, where under the influence of tidal condition, most of the shallow aquifer are saline.

In recent years exploitation of ground water for irrigation has increased in a very fast pace. Table 3 shows the volume of existing ground water use, together with potential recharge (MPO 1991).

Concluding Remarks

Water resources development including flood management has been and will continue to be a key factor in the economic development of Bangladesh. Failure to utilize the water resources in an integrated, balanced and comprehensive manner will not only cause stagnation in growth, specially in agriculture sector but also will give rise to many environmental problems.

References

1. BARC (1991), National Conservation Strategy, Bangladesh Agricultural Research Council and Ministry of Environment, Govt. of Bangladesh.
2. MPO (1991), National Water Plan, Draft Report, Ministry of Irrigation, Water Dev. and Flood Control.
3. World Bank (1989), Flood Action Plan for Bangladesh, Washington.

December, 1991

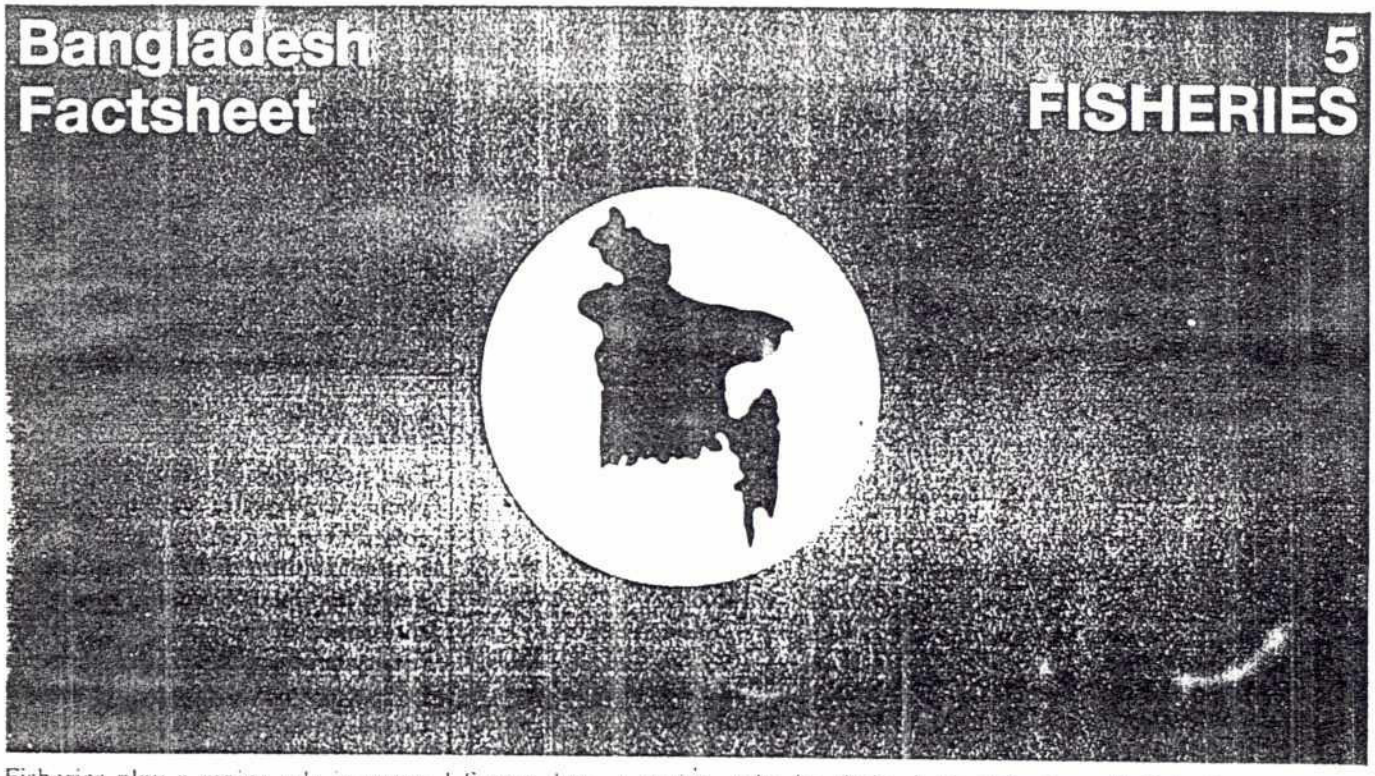
POUSH

5/7, Sir Syed Road
Block—A, Mohammadpur
Dhaka-1207, Bangladesh
Tel : 812430
Tlx : 642986 MASIS BJ
Fax : 880-2-863060

With the assistance of PACT – Bangladesh
Written by Dr. Ainun Nishat and Harounr Er Rashid
Designed by : Zia, Printed by BRAC Printers

Bangladesh Factsheet

5 FISHERIES



Fisheries play a major role in nutrition, employment, exports and domestic economy of the country. There are extensive fisheries in the country due to the nature of the country. Bangladesh covers a total continental area of 14.79 million hectares, of which approximately 1.09 million hectares are inland water bodies. In addition there is over 10 million hactares of marine area, which is comprised of the territorial waters and Exclusive Economic Zone[1]. Of the total area, 80% is flood plains. One fourth of the flood plains is normally flooded every rainy season and another one fourth is liable to experience floods once every year.

The flood plains include fisheries in rivers, haors, beels, baors, lakes and irrigation reservoirs. However, the fisheries in different water bodies have been categorised broadly into capture and culture, inland and marine.

Management

Almost all water bodies are government owned and as such the Public Sector has a major role in their management though exploitation mainly rests with the private sector. NGOs are increasingly active in this sector.

Key Institutions

Ministry of Fisheries and Livestock heads this sector's management and gives policy guidelines and decisions. The Director of Fisheries, Bangladesh Fisheries Development Corporation and Bangladesh Forest Research Institute and Upazilas are the implementation bodies in respect of their own share of responsibilities. The Ministry of Environment and Forest, the Ministry of Land and the Ministry of Irrigation, Flood Control and Water Resources, the Ministry of Local Government Rural Development and Cooperation and the Bangladesh Water Development Board are also involved when they own or manage water bodies. The Ministry of Environment and Forest is particularly interested in the preservation of wetlands, which will of course be beneficial for the protection of fisheries.

Contribution of Fisheries

The total fish catch in 1986-87 was about 815,000 tons. Of this 597,000 tons were from inland waters and 218,000 tons from the sea[2]. Total demand is expected to rise to 1.6 million tons by the year 2005[3].

Fish is an integral part of traditional Bengali diet, and the main source of animal protein particularly for the low income group. It contributes [illegible]% to agriculture and 3.5 to the total GDP and provides 80% of the animal protein requirements. Export of fisheries products, particularly shrimp, earns over US$ 10 million in foreign exchange.

Fisheries sector employs about 1.5 million full-time fishermen in addition to about 11 million part timers. In recent year rapid expansion in shrimp cultivation in the saline and semi-saline belts in the coastal area have led to development of a major exportable commodity.

The Table below reflects the contribution of different categories of fishery water bodies to fish produc-

Annual Total Catch and Area Productivity of Fisheries (in 1988-89)

Sectors of Fisheries	Total catch (M.tons)	Water area hec.	Catch/Area Kg/hec.
A. Inland fisheries			
a) Capture			
1. Rivers including estuaries	181,140	1,031,563	176
2. Sundarban	6,416	—	—
3. Beels	47,019	114,161	412
4. Kaptai lake	3,439	68,800	50
5. Flood lands	186,126	28,32,792	66
Capture total	424,140	40,47,316	—
b) Culture			
1. Ponds	155,012	146,890	1,055
2. Baors	1,321	5,488	241
3. Shrimp farms	27,172	108,280	251
Culture total	1,83,505	2,60,658	—
Inland total	6,07,645	43,07,974	—
B. Marine fisheries			
a) Industrial fisheries (trawl)	10,353	—	—
b) Artisanal fisheries	222,928	—	—
Marine total	233,281	—	—
Country total catch	840,926	—	—

Source :
1) Fisheries Resources Survey system of the Directorate of Fisheries
2) Marine Fisheries Deptt.

tion during 1985/86. The predominance of capture fisheries is noticeable.

Fish Production Trend

Open water capture fisheries contribute most of fisheries production (61% in 1985) followed by closed water culture fisheries (16%) and marine fisheries (23%). The productivity of all these fisheries is in decline and specifically that of inland fisheries. During the 80's there was a declining trend in production and it is apprehended that by the year 2000 this may seriously affect the nutritional status of the lower income groups.

Fish Species

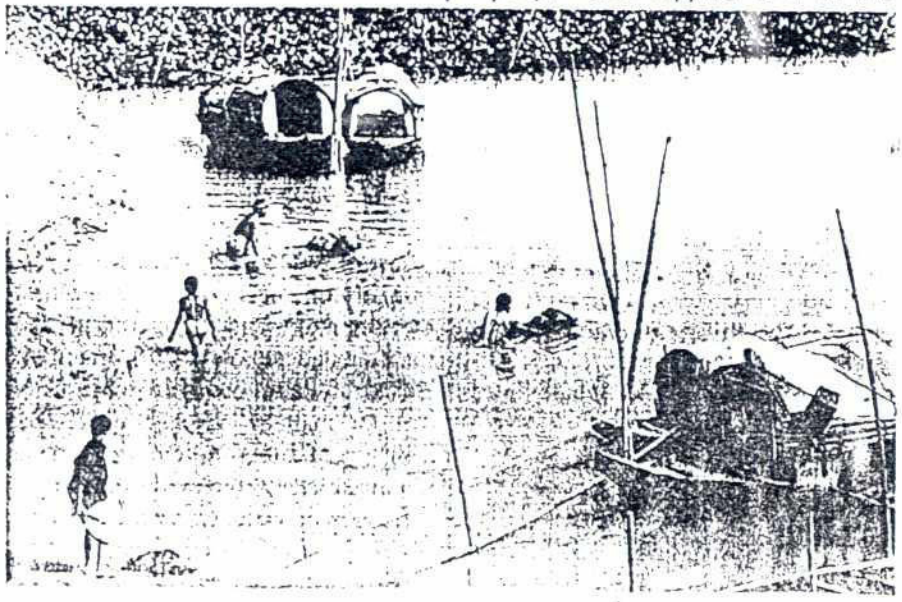
A total of 260 species of fresh water fish belonging to about 55 families have been reported. About 56 species of prawn occur in the country. The species of tortoise and turtle number about 25 and in marine water the species of fin fish recorded so far are 475. A total of 13 exotic species have been introduced in the country for augmenting production.

Types of Fishery

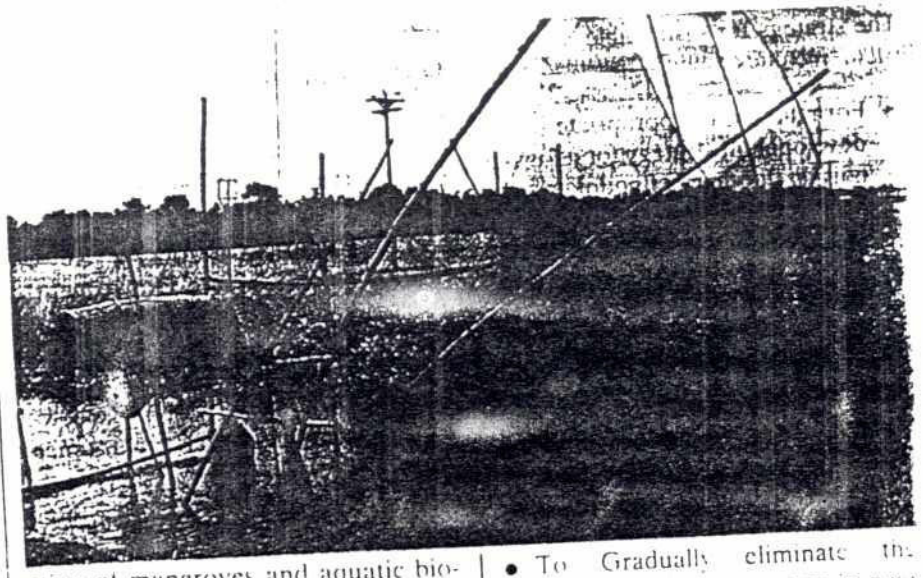
Fish production system is based on open inland water capture fishery, colsed water culture fishery and marine capture fishery. The inundated floodplains are central to the sustenance of the open inland water fishery production system, which is fast declining. On the other hand closed water fisheries in ponds and reservoirs are expanding rapidly. Brackish water aquaculture in coastal area is expanding both in area and application of technology; however, the cultural practices are still basic. Marine fishery sector is also threatened due to over exploitation.

Pond Fishery

A special aspect of fisheries in Bangladesh is the importance of pond fishery, which supplies 15% of the



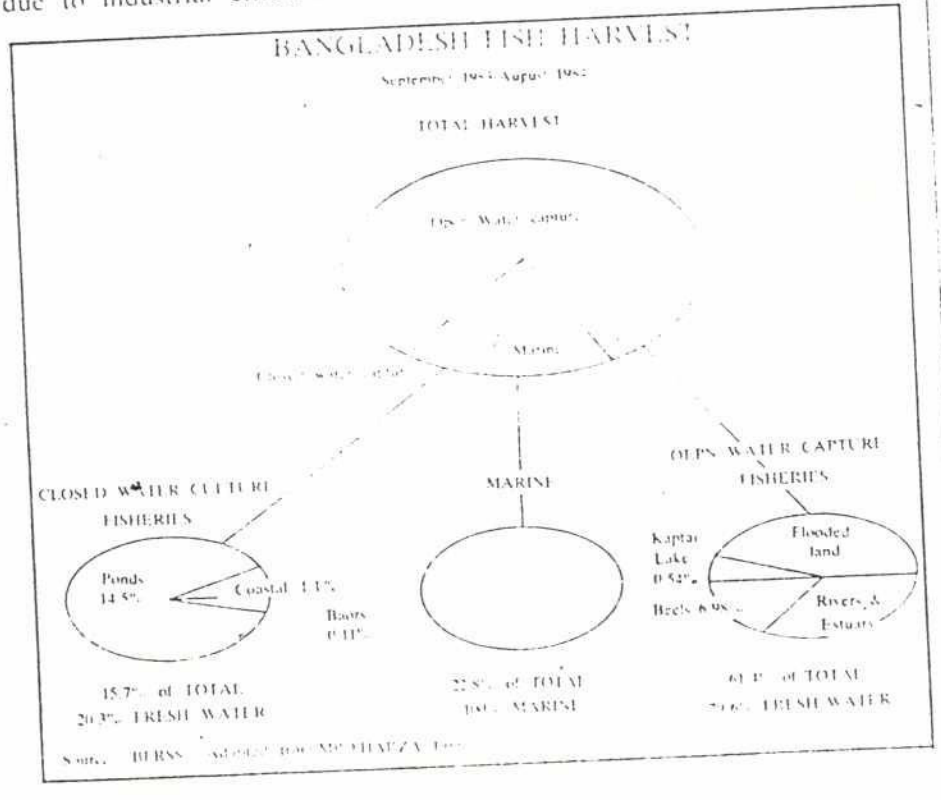
total fish catch. There are nearly 1.3 million ponds, covering an area of 147,000 hectares, which are used as a source of domestic water supply and also for raising fish. A large number of ponds are lying virtually uncared for, and in most of the remaining ones fish rearing is somewhat casual. Average yield is therefore only 1,050 kg. per hectare per year, whereas it could be raised to 2,500 kg./ha., or more. Pond fishery has the potential to be the fastest growing element in the fishery sector.



Constraints to fishery

Fisheries sector is at a corss-road now. Over exploitation of water bodies, mainly due to the existing leasing mechanism of "Jalmahals", and conversion of fish migration and nursery grounds due to flood control embankments are major factors leading to a decline in open water fisheries. Other causes of decline are modification in aquatic environment due to human interventions such as cut off, siltation and shoaling of rivers, degradation in water quality due to industrial effluents, destruction of mangroves and aquatic biosystem, fish harvesting timing and method, and prevalence of fish diseases. While in the fresh water zone water bodies have been drained off for enhancing agricultural productivity, in the coastal belt shrimp cultivation is in conflict with rice growers and mangrove forestry. In order to enhance productivity and at the same time ensure equity a New Fisheries Management Policy was introduced in 1986. This policy has the following objectives:

- To Gradually eliminate the short-term leasing system in near future;
- To save the fishermen from exploitation by influential middle-men;
- To increase fish production through introduction of production-oriented biological management systems in public inland water bodies by replacing the existing revenue-oriented lease system;
- To amelorate the socio-economic condition of fishermen by liberating them from exploitation by intermediary beneficiaries like lease holders and money lenders. Under this policy, only the bonafide fishermen, living permanently around a selected fishery resource, are entitled to harvest the resources, either individually or in groups, on the strength of renewable annual licenses issued to them by the Department of Fisheries (DOF).



Sustainable Development

The National Conservation Strategy has suggested several means by which the Fisheries sector can be revived and further development can be on a sustainable basis.

The strategy for sustainable development includes :

- Formulation of appropriate water development strategy for allowing normal flooding in floodplains and prevention of over drainage;
- Allocation of permanent water bodies such as beels, haors etc. for fish production and enhancing their productivity by stocking;
- Control over fish harvesting timing and technique and reivew leasing mechanism for "jalmahals";
- Control over introduction of exotic varieties of fishes specially in floodplains and beels;
- Institutional strengthening and improved management including stocking of open water fisheries and remedial measures against prevailing diseases;
- Preservation of spawning grounds.

In order to achieve this strategy it has been suggested, inter alia, that the following measures be taken":

- Recognition of Openwater Fishery Resource as "Common Property Renewable Natural Resource";
- Due recognition to Fisheries needs in Water Resources developement;
- Change in current land and water use policy which currently favours agricultural crops balanced development with due towards more emphasis on wetlands;
- Action to fully implement the New Fisheries Management Policy;
- Reduction of water pollution;
- Study of the biology of all fish and prawn in different openwater habitats.

References :

1. Rashid, H., Land Use in Bangladesh, Agriculture Sector Review, UNDP, Dhaka, 1989.
2. BBS, Statistical Yearbook of Bangladesh, 1990.
3. MPO, National Water Plan, 1986.
4. Fisheries Sub-sector Review by IDA mission in 1983. (South Asia Projects Department Agro-Industries and credit Division World Bank, Washington D.C.
5. Institutional Imporvement of the Department of Fisheries, World Bank mission Draft report, December 15,1986.
6. Agriculture Sector Review Report, 1988, BGD/87/023-OPS.
7. Draft National Environment Management Plan, An action Plan for Bangladesh, MOEF—UNDP, Dhaka, November, 1991.
8. Minkin, Stephen F., Steps for Conserving and Developing Bangladesh Fish Resources.
9. Nuruzzaman, A.K.M., Perspectives on Fisheries Development in Bangladesh, BARC, 1990.
10. Ali, M. Youssouf, Towards Sustainable Development : Fisheries Resource of Bangladesh, National Conservation Strategy of Bangladesh; IUCN, 1991.
11. Islam, Aminul, A Review of some aspects of Fisheries sub-sector, UNDP, ASR, 1988.
12. Fallon, L., Aquatic Resources and Fisheries in Bangladesh, background paper for World Resources Institute review of environment and natural resources in Bangladesh.

December, 1991

5/7, Sir Syed Road
Block-A, Mohammadpur
Dhaka-1207, Bangladesh
Tel : 812430
Fax : 880-2-863060
Tlx : 642986 MASIS BJ

POUSH

With the assistance of PACT — Bangladesh
Written by A. B. Chowdhury and Haroun Er Rashid
Designed and composed by : Zia *Published by : Atuar Ali*

BANGLADESH
ACTION PLAN FOR FLOOD CONTROL

GUIDELINES FOR PEOPLE'S PARTICIPATION

FLOOD PLAN COORDINATION ORGANIZATION
MINISTRY OF IRRIGATION, WATER DEVELOPMENT
AND FLOOD CONTROL

March, 1993

ACTION PLAN FOR FLOOD CONTROL
GUIDELINES FOR PEOPLE'S PARTICIPATION

CONTENTS

PREFACE

The Guidelines for **People's Participation** in the Flood Action Plan (FAP) are addressed to a diverse, multi-disciplinary audience including the people who would be affected by any future FAP activities, GOB policy makers and the FAP planning teams. Evaluations of a cross-section of FCD/I projects completed in the past show that the agricultural and socio-economic benefits resulting from these projects can be greatly enhanced, their sustainability assured, by **integrating local people and their representatives in all stages of project activities.**

Indeed, it is now accepted by everyone concerned with development policies and practices that **people's participation is the key** not only **to sustainable** flood control, mitigation and water management activities, but overall **economic development and growth.** These Guidelines suggest a flexible approach to the integration of considerable local knowledge, experience and insights of people living in a given area with professional expertise, resources and efforts. This cross-fertilization will strengthen the process of decision making with regard to local needs assessment, project formulation and implementation, long-term operation and maintenance. The process will also help address fully the **needs of diverse local groups** - fishermen, boatmen, the destitute entrapped in poverty, disadvantaged women and children, those living outside the embankments, for instance - and minimize the negative effects stemming from conflict of interests.

The Guidelines for People's Participation (GPP) form a part of a series of guidelines that incldue the Guidelines for General Project Assessmetn (GPA) and the Guidelines for Environmental Impact Assessment. Other guidelines to be developed in the future would bear on Land Acquisition and Resettlement, Project Implementation, Operation and Maintenance, Monitoring and Evaluation. Interlinked, these guidelines would form the corpus of the Guidelines for Project Planning (Development) in the Flood Action Plan.

The Guidelines stipulate not merely a commitment to a methodology, but a whole hearted adherence to a process that will translate this commitment to **a rigorous and invariable practice of all development activities.** It therefore follows that these Guidelines will be modified and improved as regional and local experience is accumulated from implementing them in Bangladesh.

ACTION PLAN FOR FLOOD CONTROL
GUIDELINES FOR PEOPLE'S PARTICIPATION

1. INTRODUCTION

1.1 Flood Action Plan (1990-95)

The Flood Action Plan (FAP) issues from a comprehensive review of flood policy in Bangladesh in the aftermath of the devastating floods of 1987 and 1988. The FAP marks the initial phase in the development of a long-term phased programme of flood control, drainage and water management activities in Bangladesh. The development imperatives of Bangladesh stipulate that comprehensive technically, economically, environmentally and socially sound solutions to the problem of recurrent flooding be found urgently. This principle is reinforced by all FAP supporting studies and strongly endorsed by both the Government of Bangladesh and the World Bank.

1.2 Objective

The objective of the FAP is to bring about an environment secure enough to stimulate intensive agriculture, fisheries and integrated rural and urban development. FAP would seek to achieve this by a combination of controlled flooding and drainage measures and a much enhanced state of flood forecasting and early warning, flood proofing, flood preparedness and other related actions. This would facilitate sustained economic and social growth, welfare and security and to ensure a higher quality of life for the people dwelling on the floodplain.

1.3 People's Participation

In the light of considerable field experience gathered over the years and recent FAP evaluations, it is evident that to ensure sustainable flood control, drainage, water development planning and management, diverse socioeconomic groups of people affected by recurrent flooding must have the opportunity to articulate their needs, identify problems and work out solutions. Experience gained from the process of development planning in Bangladesh demonstrates clearly that due to a lack of an appreciable measure of people's participation, programmed activities in social and economic development have had only limited success in achieving the stated objectives and ensuring sustained delivery of project

benefits. In keeping with the new development perspective of the Government to align participatory democracy with the need for accelerated and sustainable economic development of the country, it is essential that local people participate in full range of programmed activities including needs assessment, project identification, pre-feasibility, feasibility, design and construction, operation and maintenance, monitoring and evaluation. This is intended to replace the traditional approach limiting decision making to a remote centre dominated by professionals and specialists. This alternative development strategy is expected to stimulate the evolution of the process of decentralization in development planning and implementation. The most notable gain would be commitment of the people to generating and sustaining socio-economic development relevant to their needs.

1.4 Perspective Plan

The FAP's central concern relates closely to GOB policies embodied in the Fourth Five Year Plan (1990-95), which clearly recognizes the crucial importance of people's participation in the process of planning and development, and the necessity to give policy and institutional support in order to direct increasing degrees of that effort to accelerate the pace of economic growth. The FAP would seek to derive as much benefit as it can from people's participation augmented by human resources development, defined in the Perspective Plan (1990-2010) as "the ability of the people, particularly in the rural areas, to identify their problems and plan and implement these plans by themselves in areas which concern them most."

2. PEOPLE'S PARTICIPATION IN PLANNING

2.1 Overview

People's participation in planning is a vital process which will enable different socio-economic interest groups in an area develop their capabilities to play a dynamic role in development initiatives. It will also strengthen the commitment to development of a wide cross-section of affected people, elected representatives, government employees, professional groups, voluntary groups including NGOs, development practitioners and others **by giving them an opportunity to share responsibility for key decisions.**

2.2 Parameters

People's Participation involves:

- **assessment** of local perception/needs assessment through extensive dialogue with all social groups likely to be affected;
- **identification** of and consultation with groups likely to be affected both inside and outside the programme area and analysis of conflicting interests likely to affect the project;
- **attention** to in particular marginal groups, including
  - . rural poor
  - . ethnic groups
  - . minorities
  - . women
  - . fishermen
  - . boatmen
  - . other disadvantaged people dependent on fragile resources
- **identification** of all land and water resources
- development of an organizational structure for
  - guaranteed representation
  - briefing
  - consultation about technical components
  - negotiations for mitigation, compensation, etc.

2.3 Salient Features

The process can identify **local issues** that conventional socio-economic surveys do not fully estimate or clearly bring to light. Close and active participation of people is the device to ensure that these are taken into account in **project formulation and planning.**

2.3.1 People's participation will ensure that projects take fully into account essential local data on environment, land and water regimes, informal and customary rights, resource usage, and the most directly affected social groups among others, in order to assure that projects do **minimum damage to habitats, livelihoods of the people and natural resources.** It will also help develop **equitable standards for compensation and mitigation.**

2.3.2 The process will facilitate identification of diverse beneficiary/disbeneficiary socio-economic interest groups and their leaders, traditional organizations and institutions. This will ensure that their collective views are reflected in project development and its management.

2.3.3 Early forging of **partnership between the Planning Team and the local people** is the key to their effective **participation in the subsequent stages** of construction, operation and maintenance, monitoring and evaluation.

2.3.4 It also sharpens the focus on the **needs of the poor and disadvantaged** with a view to ensuring that their interests are taken into consideration **in assessing project impacts** and to target short - and long - term benefits to them.

2.4 Linkages

People's participation is not an isolated activity; rather **complements** information gathering techniques such as RRA, PRA, sample surveys and key informant interviewing, etc. It involves activities and institution building at different levels of society and administration. The institutional development will involve Ministries, NGOs and other interest groups and help establish extensive **inter-organizational linkages,** with well-defined accountability at all administrative levels. The objective at the project level is to achieve **effective co-ordination.**

3. PROJECT CYCLE

3.1 Project Scale Factor

This intensive participatory planning process might not be equally practicable for water management projects of different sizes. Some FAP efforts have a distinctly local focus, for example, compartmentalization, flood response, flood proofing, small scale FCD and irrigation structures. Other FAP projects are much larger in scope. The scale of the project will largely determine the approach used.

a. Small: Local Area Development

For small projects restricted to a village, union or thana, it should be possible to optimize the active involvement of the people in all project stages through local level groups.

b. Large: Larger Area Development

Large scale projects covering larger areas are common in the FAP and pose special problems of their own in terms of people's participation. Methods of organizing the project development process are of necessity quite different from those appropriate in smaller localities. It is especially difficult to conduct large area feasibility studies in a participatory manner. Planning teams, however, must still foster participation by organizing extensive consultation sessions in selected locations to elicit predominant development issues and concerns of the people. Multidisciplinary teams of ecologists, social scientists, engineers and other appropriate specialists could assess needs, describe development alternatives, likely benefits/disbenefits, environmental effects and socioeconomic benefits of each. These projectwide consultation programmes for needs assessment and appraisal of environmental and social effects would suffice provided that all concerned parties receive essential information and opportunities for consultation.

Note: Details of composition of the Planning Team and expected inputs are at Annexure-A.

3.2 Stages

People's participation in the FAP projects and programmes should effectively begin at the inception or the **prefeasibility** stage with preliminary survey of an area for needs assessment, and continue throughout the life of any given project. Broadly speaking, at least the following **six stages of people's participation can be identified:**

3.2.1 **Prefeasibility study:** local people, their elected representatives and local officials are to be involved in **needs assessment. This includes technical, environmental and social appraisal** of an area's problems, **analysis of alternative project options, and possible selection** of project or programme. **The results may be used to adjust any existing project concept in accordance with the findings.**

3.2.2 **Feasibility study:** As a project takes shape local people are involved in mo**re detailed technical, environmental, social and economic appraisal.** Also, at this stage the representatives of diverse local socio-economic groups and the local councils can interact, discuss and concur in project concept including mitigation and land compensation measures. This process will help develop methods of **people's involvement in project design, construction, management, operation and maintenance, monitoring and evaluation.**

3.2.3 **Detailed design: once a project is deemed feasible,** there must be **ongoing interaction between local people and technical planners in developing criteria and specifications** for many vital project or programme considerations, e.g., the location, size, and distribution of project works, land acquisition, relocation plans and mitigation measures. **A Project Co-ordination Committee (PCC)** should be set up at this stage to ensure that these issues are satisfactorily resolved. PCC will continue.

3.2.4 **Implementation/Construction:** PCC will monitor implementation in order to ensure that design standards and implementation are carried out as agreed. Both formal and informal communications with local people should be as open as possible. The plan itself and any modifications should be explained to them and their views taken into account. **The monitoring group would identify and analyze unforeseen problems and offer suggestions to resolve them.** It may also seek expert advice if problems are severe or threaten the projects.

3.2.5 **Operation and Maintenance:** the operation and maintenance stage should directly involve the local population. However, **the degree of direct local control and management will vary according to the nature of the infrastructural** works to be built and operated. Operational manuals must be drawn up with this in mind including the legal responsibilities for ownership, labour and financial resource provision, day to day operation, routine and emergency maintenance and repair work. The **criteria for deciding operational procedures must be drawn up with the consensus of local people.**

3.2.6 **Monitoring and Evaluation:** In order to learn from experience of a project and influence future development, the PCC should constantly monitor performance, and initiate remedial actions as necessary. This will require intensive liaison with local people both directly in the area and those affected outside it. It will need to **address both the positive and negative ways in which people are affected at all stages of project development.**

4. PEOPLE'S PARTICIPATION IN PREFEASIBILITY PLANNING

4.1 Rationale

The FAP will seek to enhance the economic security and quality of life of the floodplains population by means of improved water management techniques. Sustained and extensive consultation with the people in particular areas and their active participation in the process is essential to assess local needs, highlight topographic, hydrographic and other geophysical characteristics, potential opportunities and constraints as well as the associated socioeconomic conditions that will crucially affect the probability of success in planning and implementing projects.

4.2 Techniques

The following techniques may be useful in gaining a multidisciplinary perspective:

i. Village scoping sessions in which Planning Team presents these priority development choices. This consultative/iterative process should include relevant levels of all concerned GOB departments, elected officials, GOB specialists, and most importantly, the people of the proposed programme, and adjacent areas.

ii. Consults various socioeconomic groups and their representatives in a series of meetings, or public hearings, Official representatives of these interest groups also may be consulted;

iii. Questionnaire surveys of sampled households to elicit views of a truly representative cross-section of the affected population;

iv. Discuss with local people and their representatives positive and negative environmental, social, economic implications. If any or all are unacceptable to any interest group, this should be noted.

The prefeasibility study must show that any proposed development alternative is:

- consonant with the expressed needs and wishes of the local peoples including social and environmental imperatives
- likely to be institutionally, administratively practicable.
- capable of being implemented without creating major social disruption or irretrievable damage to any social group, particularly the poor.

5. PEOPLE'S PARTICIPATION IN FEASIBILITY PLANNING

At the Feasibility Planning Stage which involves indepth examination of the technical, economic, financial, environmental and social viability of a programme or project concept in a particular area, planning and engineering study groups would move to detailed baseline studies of environmental and social effects (FAP Manual for Environmental Impact Assessment), local surveys and overall blueprint designs. All study and design groups must interact with each other and with the local community or communities during the Feasibility Study stage.

5.1 Needs Assessment

Inputs for the feasibility study would accrue from

i. crucial identification of the needs of various interest groups and the potential of a proposed project area is the most crucial activity at the feasibility stage. In a departure from the traditional dependence on assessment performed by professionals or specialists in a detached, "top down" fashion, the emphasis now is on the people belonging to different social groups voicing their own perceptions of the existing problems, potential solutions, including ideas about technical solutions, their implications and probable impact. Projects conceived, designed and implemented on the basis of complementary needs of the people or an appreciation and/or reconcilia' ion of the competitive interests of the various socioeconomic groups in the area have better than average possibility of yielding sustained FCD/I benefits over time.

ii. Interviews a wide range of concerned groups of people and individuals to solicit the views and comments of:

- landholders
- assetless/landless people
- farmers, fishermen, artisans
- women
- transporters, shopkekepers etc.
- those who manage or operate existing projects, to learn from their successes and failures
- elected officials or existing multi-agency task forces
- NGOs or others in a position to represent large interest groups;

iii. **Data collection** by a multi-disciplinary team, cross-checking data by triangulation, carrying out a diagnostic RRA prior to a PIE to assess probable

- o direct impact on hydrological conditions.
- o changes in fisheries, livestock, agriculture, ecological, social and economic parameters
- o combined impact of several factors, such as, physical, biological, human and environmental, especially potential negative impacts;

iv. The needs assessment **should elicit from the various interest groups their perception of:**

- o present water management regime;
- o main flood control and drainage problems and trends; and
- o preferred solution to any problems identified.

v. The needs assessment survey also should **include communities living outside** the proposed programme area, who are likely to be affected by any interventions under consideration.

vi. The **needs of poor and marginal groups** must be given special attention during feasibility planning. Special efforts would be required to

- o consider the several technical possibilities available to bring about a change in their circumstances
- o enable marginal groups voice their interests, consider the several technical possibilities available to bring about a change in their circumstances
- o offer their own suggestions
- o choose leaders to represent them in various deliberations

vii. Formation of consultative groups in wards, thanas, districts, and creation of regular forums for regional planning deliberations in which discussions of specific issues, even negotiations between competing groups, can occur.

Direct Planning Team efforts, contract with government rural development agencies or suitable NGOs are some of the ways to perform local organizing functions. Experience also confirms that development of existing potentials might be thwarted by numerous factors. A multidisciplinary approach leavened by wide participation of people is therefore essential not only to acquire detailed information about the prospective command area, but also develop appropriate solutions and programmes.

5.2 Environmental and Social Considerations

Planning Team specialists should seek to understand people and their perceptions, detail basic data on local environmental and social conditions, and enumerate:

- all socioeconomic groups in order to identify, analyze and understand the livelihood strategies of diverse groups and conflict of interests. Special efforts would be necessary to identify and involve the poor and marginal groups -landless, poor fishermen, destitute men and women, groups depending on scant resources etc. in any intervention planned;
- all land and water resources, local assessment of these resources and interdependencies and importance of livelihood strategies;
- all customary and formal/informal rights to use particular natural resources;
- major cultural properties;
- local leaders and officeholders, organizations and associations including traditional groups, cooperatives, development organizations e.g., Grameen Bank, etc., and
- government institutions and agencies.

5.3 Development Alternatives

The information gathered from each of the interest groups should be combined into **need assessments "pictures"**, in which all natural and social elements are integrated into a coherent whole. The Planning Team should add to these assessments other development targets based on national

priorities and the judgements of team specialists. These various needs would then be translated into development alternatives, and grouped into major types of interventions and evaluated both generally as well as by a simplified version of the multicriteria analysis specified in the Guidelines for Project Assessment (GPA). Once prioritized, the two or three major options should be developed in more detail, describing each in terms of:

- **needs** addressed
- expected **positive effects**
- expected **negative impacts**, and
- the **structural** and **institutional measures** needed to implement them.

5.4 Consultation Process

Feasibility planning would require the planning team to play an energetic role. It would be required to initiate a series of relatively structured consultations in multiple locales.

All comments and suggestions gained in this **consultation process should be recorded.** Sectoral specialists should then review all the issues that emerge from the consultative exercise, and **note key questions, comments, and areas of conflict.**

5.5 Recommendation

The Planning Team should evaluate the feedback gained in the consultation exercise and revise each development alternative as necessary and/or possible. Finally, the Planning Team should recommend one development alternative to be taken on to the Feasibility Study stage. Before making this recommendation it is essential that actual or potential conflicts e.g., outsiders vs. insiders, large vs. small farmers etc. are identified, their implications assessed, and the possibilities for compensating those adversely affected are worked out. It would be futile, even counter-productive, to allow a project to proceed without addressing such conflicts and attempting to resolve them.

6. PEOPLE'S PARTICIPATION IN DETAILED DESIGN

There is now a wide recognition that despite the dominance of the technical construction aspects, water management activities are no less social than they are technical processes. Indeed, one broad reason for the failure of many such schemes is the insufficient attention given to social aspects of project design. Many of the problems could have been avoided if local people had been closely consulted. Projects are distinctly shaped by their respective contexts, objectives, approach, anticipated achievements, financial basis and so forth. Hence, it is essential that the PCC (3.2.3) is formed at this stage and carefully briefed on issues that emerge during detailed design. The main task of the PCC during this stage is to **prepare for a role in the implementation of the project.** Depending on the project, PCC will perform specific roles in construction, operation, and maintenance. In projects with a substantial irrigation component, beneficiary groups might form **Water Users Associations** either independently or as subcommittees of the original PCC. These latter **Water Users Association** should be configured in such a way that they eventually can take over ownership of small scale irrigation systems.

6.1 Interest Group Organization

In this phase **people's participation ought to grow from the individual and unorganized level to that of formal organized interest group representation.** It may be noted here that at the interest group level large landholders, shopkeepers and businessmen, transporters and transport workers, leasehold fishermen, NGOs and Cooperatives already will be well organized. On the other hand, landless labour, women especially destitute women (single heads of households), capture fishermen, brick kiln workers, marginal groups depending on foraging for grass or wood, etc. may not be organized at all. This has two major aspects:

i. Encourage specific socioeconomic interest groups and resource users, especially this second collection of social groups, to **organize themselves** sufficiently to ensure that their interests are taken into consideration in project planning. This denotes choosing leaders to represent them on the **Project Coordination Committee** (PCC) to define interests, determine positions, and decide on acceptable compensation and mitigation measures.

ii. Organize a Project Coordination Committee (PCC) at the project level.

6.2 Composition of Project Coordination Committee (PCC)

i. The responsibility for organizing the committee should be that of the Ministry of Irrigation, Water Development and Flood Control. In the case of distinct and identifiable FAP components, relevant ministries/agencies, such as Local Government and Co-operatives Division, BRDB etc., would have to take the initiative to form PCC to help implement programmed activities.

ii. Once a development alternative has been selected, chosen representatives of the likely affected social groups should be organized into a Project Coordination Committee (PCC). In addition to area socioeconomic interest groups, including women, this Committee should include representatives of government technical departments, local NGOs, those responsible for project design, as well as members of the former Planning Team. It should be chaired by the elected officeholder closest in the governing hierarchy to the project level.

iii. Interest groups should be encouraged to get organized at the appropriate project level - village, ward, union, district, multidistrict with membership clearly reflecting the size and complexity of the project. Despite the size of the project area, all social and resource user groups must have representation on the committee. This includes the poor, marginal groups, and women.

iv. The Project Coordination Committee exists primarily to represent the interests of the affected social groups at the detailed design, implementation and O&M stages. Specifically, the committee will

- discuss with the Design Team all aspects of programme or project design;
- resolve conflicts between social groups over aspects of project design;
- develop acceptable compensation and mitigation plans as necessary.

6.3 Sub-Committees

Sub-Committees of the PCC may be formed depending on project needs.

7. PEOPLE'S PARTICIPATION IN IMPLEMENTATION

The emphasis in these guidelines is on participation of the people in comprehensive decision-making on the

- o definition and articulation of key issues
- o formulation of viable solutions
- o initiation of project implementation activities

This is based on the recognition that goals of development interventions can not be reached without the understanding and support of local communities, whose knowledge of local conditions and resources, ideas and cooperation are crucial to the technical success of a project.

7.1 Role of Project Coordination Committee (PCC)

Resolution of issues of implementation, operation and maintenance (O&M) would depend on several factors such as the goals of each intervention, the sources and terms of funding, and most importantly, the broad direction given by national policy makers. The PCC would provide the all-purpose vehicle for the participation of individuals and groups of people directly in the activities of the project, enabling them to gain better understanding of its objectives and likely impacts, and develop pride in the work carried out. PCC's efforts would be best directed to help

- o develop human resources and promote active participation
- o design and adjust a flexible implementation schedule as the requirements and constraints of the people become more clearly understood
- o review implementation to agreed schedule and standards
- o develop and adjust recommendations for operation and maintainance (O&M) of any assets created by the project, togethern with continuous monitoring and evaluation (M&E)
- o equitably distribute project benefits.

Further,

i. a strong indication that planning and design are based on the needs of local people would be their participation by contributing in cash or labour during the construction of tertiary structures and other works, particularly the re-excavation of khals and the (re)building of embankments

ii. Where appropriate to the specifications earth works should be contracted to the maximum possible extent to Landless Contracting Societies (LCS) in order to benefit landless people. If LCSs do not exist in the project area, they should be encouraged to be formed with the assistance of BRDB or local NGOs. At least half of the earth work should be reserved for female LCSs

iii. these LCSs should be made up of disadvantaged groups both within and outside the protected area. Providing opportunities to participate through LCSs in the implementation/construction of the project should be a major concern of the PCC.

8. PEOPLE'S PARTICIPATION IN OPERATION AND MAINTENANCE

8.1 Operation

The operation of FCD/I structures varies from making or cutting open temporary closures of tertiary and secondary channels, to opening and closing multi-vent regulators along major rivers and the operation of pump houses. In consequence

I. operating manuals must be produced in simple Bangla for all projects and for all levels at which operation takes place within projects. These manuals will present technical, operationally useful information in language that even those who are not highly educated can understand. There must be a procedure for training people in their use and updating them regularly in the light of experience gained and changing field requirements;

II. the operating manuals will have to cover the operating options at all levels, given the whole range of possible external parameters. This range will have to include a number of possible disaster scenarios including structural failure, sabotage, flood levels surpassing design levels, etc.;

III. the PCC will have the freedom to operate the system as needed in accordance with rules and, of course, within the operating options and external parameters as determined by the BWDB; PCC will be also responsible for setting up training programmes.

IV. facilitate sustainable water management, i.e. acceptable to all concerned (conflicting interests), Relevant GOB department officials may advise and assist the committee members, or any other affected person who might wish to discuss aspects of a given project.

8.2 Maintenance

i. Yearly maintenance needs for a local system can be assessed by the PCC after each flood seaon. The relevant GOB officials will be charged with preparing a detailed proposal, including a budget, for the maintenance of all works under the authority of the committee. The budget should include financial provisions for contingencies that might arise from time to time.

ii. Upon verification and adjustments as necessary, the committee will formally approve the maintenance proposal. In the case of self-governing irrigation systems that can levy users fees to fund maintenance, the Committee should be able to do all of this themselves.

iii. Regular maintenance of roads and road and embankments may be awarded to local group including women's groups. In all cases employment of women's groups should be encouraged. Experiments may be conducted to find ways of combining such maintenance with the use by these women of roadside, embankments, borrow pit, etc. for productive purposes.

iv. Earthwork and turfing wherever appropriate to the specification will be done by LCSs.

8.3 Funding of O&M

Funding of O&M must be seen in the wider context of project sustainability and resource generation at the grassroots level. No easy solutions are expected, and experimentation together with ongoing monitoring and evaluation will be needed for workable arrangement. Planning and Design Teams should investigate the following in particular and suggest ways and means:

i. Local resource commitment for income - producing FCD/I projects is most likely where resources generated are directly ploughed back into the project. Tertiary committees would need some freedom to decide on a fair way to levy charges.

ii. The larger the area covered by a project (i.e., secondary and primary level committees), the more difficult it will be to generate local resources for O&M. Possible sources are:

- market/sales tax
- land taxes
- property tax
- licence fees
- service fees etc.

iii. A system of government subsidies perhaps in the form of a matching grant, may be needed to stimulate local resource generation.

ANNEXURE: "A"

FEASIBILITY PLANNING TEAM COMPOSITION AND INPUTS

1. Composition

a. The Feasibility Planning Team, part and parcel of the overall project planning team, is drawn in the main from the staff of the project. Its composition should reflect the principle features of the socioeconomic setting of the prospective programme or project area.

In general the Participatory Planning Team would include at least:

- a male sociologist or social anthropologist,
- a female sociologist or social anthropologist
- a water and land use specialist (or drainage, irrigation engineer),
- a fisheries specialist (riverine or marine),
- an agronomist (in most cases rice),
- an institutional specialist,
- an ecologist, and
- male and female village organizers (to serve as a bridge to poor and marginal groups),
- co-opt local body representative.

b. The **Planning Team Leader** should be a senior specialist with experience in conducting Rapid Rural Appraisals (RRA), possibly including Particularly Rural Appraisals (PRA), which is an emerging RRA methodology and should be increasingly tested and employed in Bangladesh. His or her main assignment is leading the team. This means in leading the team the team leader would be responsible inter alia for framing and scheduling the general approach, organizing logistics, overseeing reporting schedules, mediating disputes among team members, and taking responsibility for the quality of work performed.

c. **The Planning Team members be:**

- **willing and able to conduct extensive field** work and learn **from people** (i.e., experts who are too sure of what they know or will find before they go into the field may not be suitable for this kind work);

- **trained** and preferably **have experience in RRA** methodologies;

- have experience of FCD/I projects; and
- able to report their findings in written English and Bangla.

Specialists covering such areas as infrastructure, communications (river and road transport), marketing, wildlife, forests, urbanization, industrialization, etc. should **be added as needed.**

4. Flexible Timing and Schedules

Planning for the appropriate water management project or nonstructural program in an area is a time consuming process. Although theoretically project phases are timed linearly e.g. needs assessment, tentative development alternatives, consultation about alternatives, etc., in practice each phase may reveal issues that are as yet unclear and for which part of the pervious phase(s) may have to be repeated. Depending on the complexity of the situation, the extent to conflicts of interest, and the experience of the Planning Team, the planning process may take more time than originally planned.

5. Needs Assessment and Project Formulation

A careful preliminary survey of the area should precede actual needs assessment in the field. The following information should be collected and analyzed:

- contour and other maps (4" and 8" to the mile);
- satellite and aerial photography;
- district gazetteers (relevant for historical data and long term trends);
- national, regional and unionwise socioeconomic statistical data;
- the social and political history of the area, with reference to national, regional and local politics;
- national, regional and local water management projects completed, being implemented, or planned in the proposed programme area, or which are or may affect the area;
- all other GOB projects at all phases that have a bearing on the environment, or could affect fisheries and agricultural development in the proposed programme area;

- NGOs and their programmes in the area
- women in development programmes/projects

RRA/PRA methods should be used to conduct fieldwork for the needs assessment. The needs assessment must spring from the likely affected socioeconomic groups passed over by the specialists conducting the assessment. It is most important to listen and learn from the people, instead of pressing one's own insights and views on local people. The ability to ask non-leading but probing questions during needs assessment interviews will determine the quality of the work during this phase. Pre-fieldwork training and seminars should specially focus on this. Only those Specialists should be included on RRA/PRA teams who respect the knowledge that local people have about the land and water resources upon which they depend. To this end, Specialists should use Participatory Rural Appraisal methods wherever appropriate, thus allowing local people to assemble their own information and devise their own simple scales to prioritize needs and measure effects. This includes hydraulic charts, social mapping, resource and resource usage mapping, work diagramming, local calendars (agrarian, fishing, social), listing and diagramming customary and informal rights, etc.

6. Logistics

i. The Planning Team may need a variety of means of transport (including one or more small 4WD vehicles) to move from area to area. Once in the area, local transport - rickshaw, vans, boats, etc. may be used. Care should be taken by the team to keep as low a profile as possible. In practice, this often will mean walking into and around the area where interviews/consultations are to be held.

ii. Team interaction is of great importance. This would help verify the importance and trustworthiness of information gathered by the different specialists. If gaps or discrepancies are found, it would still be relatively easy to return to the area to collect more information. It would also help all team members gain an integrated view of the area. Very often potential social and environmental effects can only be identified and understood when specialists combine their knowledge and data.

iii. To facilitate such intensive team interaction, common lodging facilities for the whole team are necessary, preferably in or as close as possible to the proposed project area.

7. Reporting

i. Team members should use their own notebooks and diaries, and their own methods, to record data collected in the field. However, team members should have prior agreement on the checklist to be used by each of the team members.

ii. At appropriate times during the study, each specialist should report his/her information to the Planning Team in a predetermined form. This report should include the following:

- o agreed-upon chapter headings, subheadings, tables, etc. (use FPCO standardization);
- o a chapter entitled: "Own Views and Observations" to record his/her own perceptions/observations/ recommendations. Separate sections on the views expressed by local people will thus remain free of the specialist's judgements;
- o a chapter containing issues that need to be followed up, either because;
  - there was not sufficient time to get the information, or
  - the information collected from different people or interest groups is conflicting; or
  - the information collected differs from the generally accepted opinion in the relevant field of specialization, or
  - the information collected was found to be unique to that specific locality or interest group.

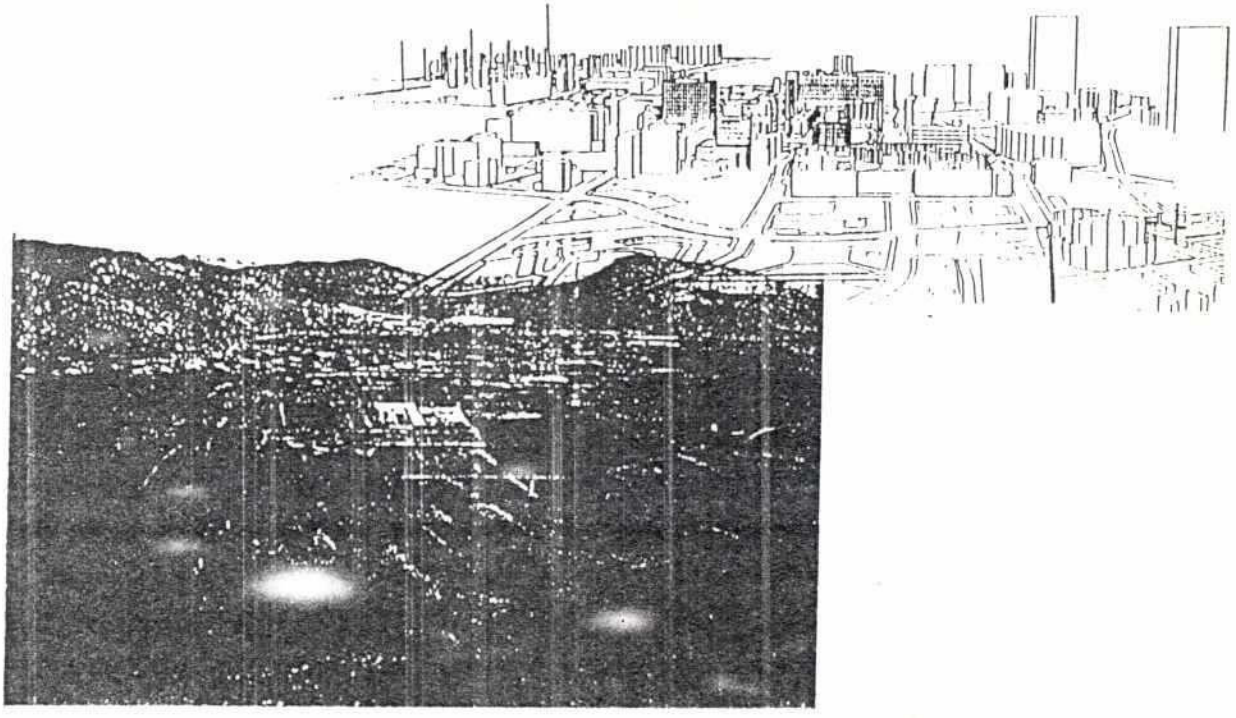
iii. Planning Teams need secretarial support to ensure that reporting requirements are met. Given the complexity of the research and interaction among specialists, portable computer, printing and photocopying facilities should be available at the field office.

C:MA:PEOPLE:tc

UNITED NATIONS
ENVIRONMENT PROGRAMME

Environmental Impact Assessment

Basic procedures for developing countries



UNITED NATIONS
ENVIRONMENT PROGRAMME

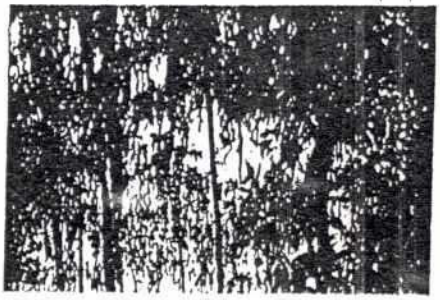
Environmental Impact Assessment

Basic procedures for developing countries

1988

Regional Office for Asia and the Pacific

What is Environmental Impact Assessment?



Environmental Impact Assessment, or 'EIA' for short, is a formal study process used to predict the environmental consequences of a proposed major development project. Such projects may include, for example, building a hydroelectric dam or a factory, irrigating a large valley, or developing a harbour.

An EIA concentrates on problems, conflicts or natural resource constraints that could affect the viability of a project. It also examines how the project might cause harm to people, their homeland or their livelihoods, or to other nearby developments. After predicting potential problems, the EIA identifies measures to minimise the problems and outlines ways to improve the project's suitability for its proposed environment.

The aim of an EIA is to ensure that potential problems are foreseen and addressed at an early stage in the project's planning and design. To achieve this aim, the assessment's findings are communicated to all the various groups who will make decisions about the proposed project: the project developers and their investors, as well as regulators, planners and politicians. (In some countries, a report - called an Environmental Impact Statement - is prepared at the end of the EIA study, and this is submitted to a Government department as part of a permit application for the project.) Having read the conclusions of an Environmental Impact Assessment, project planners and engineers can shape the project so that its benefits can be achieved and sustained without causing inadvertent problems.

The EIA is an important phase in the process of deciding about the final shape of a proposed project. It helps officials make decisions about a project and it helps the project's proponents achieve their aims more successfully:

- A project that has been designed to suit the local environment is more likely to be completed on time and within budget, and is more likely to avoid difficulties along the way.
- A project that conserves the natural resources it relies upon will continue to be sustained by the environment for years to come.
- A project that yields its benefits without causing serious problems is more likely to bring credit and recognition to its proponents.

In summary, an Environmental Impact Assessment:

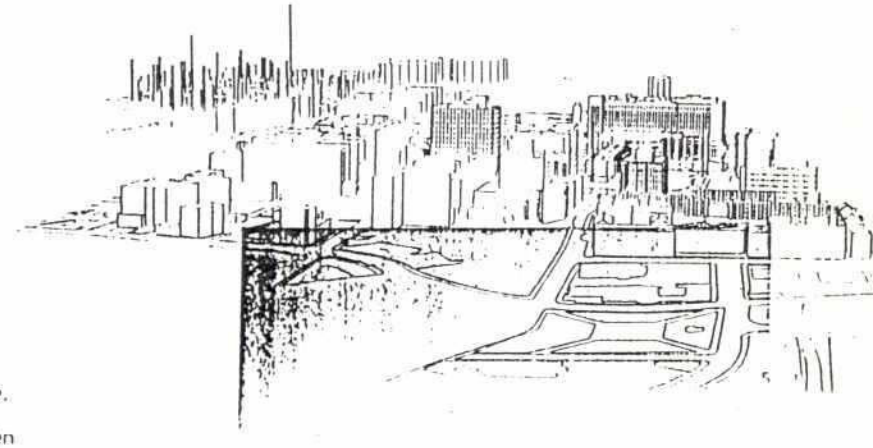
- Predicts the likely environmental impacts of projects
- Finds ways to reduce unacceptable impacts and to shape the project so that it suits the local environment
- Presents these predictions and options to decision makers.

EIA is a management tool

Like economic analysis and engineering feasibility studies, EIA is a management tool for officials and managers who must make important decisions about major development projects.

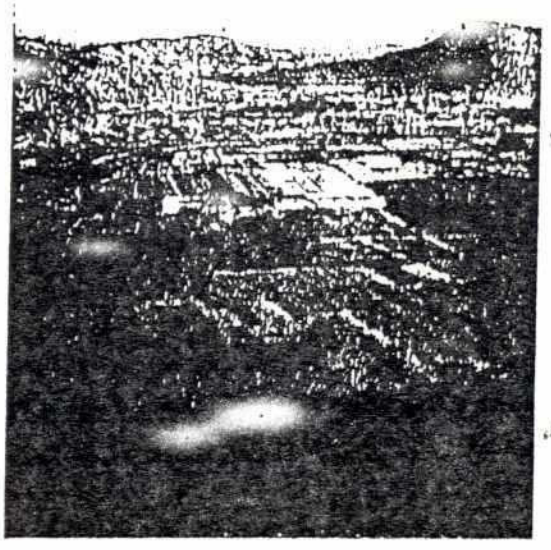
All developers are familiar with economic and engineering studies. These tools provide the basis for designing robust, economically-viable projects. EIA is now seen as an equally important tool in designing a viable project.

In recent years, major projects have encountered serious difficulties because insufficient account has been taken of their relationship with the surrounding environment. Some projects have been found to be unsustainable because of resource depletion. Others have been abandoned because of public opposition, financially encumbered by unforeseen costs, held liable for damages to natural resources and even been the cause of disastrous accidents.



Given this experience, it is clearly very risky to undertake, finance, or approve a major project without first taking into account its environmental consequences - and then siting and designing the project so as to minimise adverse impacts. For instance, the following questions need to be asked about any major project:

- Can it operate safely, without serious risk of dangerous accidents or long term health effects?
- Can the local environment cope with the additional waste and pollution it will produce?
- Will its proposed location conflict with nearby land uses, or preclude later developments in the surrounding area?
- How will it affect local fisheries, farms or industry?
- Is there sufficient infrastructure, such as roads and sewers, to support it?
- How much water, energy and other resources will it consume, and are these in adequate supply?
- What human resources will it require or replace, and what social effects may this have on the community?
- What damage may it inadvertently cause to national assets such as virgin forest, tourism areas, or historical and cultural sites?



The illustration to the right, and similar illustrations throughout this booklet, visually represent the relationship between an existing environment and a proposed development plan. This particular plan is for a new town, which is to include gas works and storage. These images evoke questions like the ones above about the project's compatibility with its surroundings and the available resources.

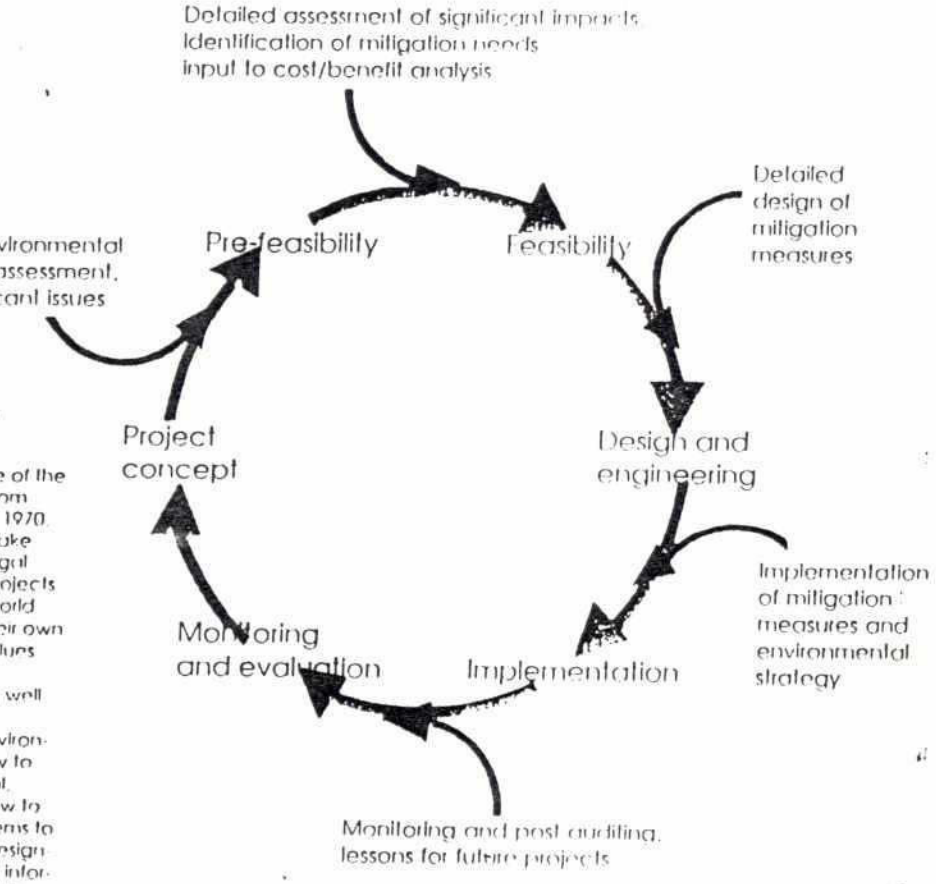
Who is involved in the EIA process?

An EIA review is normally undertaken by those responsible for the development - the 'developer'. In some cases, the developer is a private company; in other cases, the developer is the government authority responsible for the relevant sector (eg. transportation or agriculture).

Increasingly, governments and international agencies are adopting regulations that legally require developers to undertake EIAs. In such cases, the EIA report may need to be submitted as part of the application to a permit-granting government department - the 'competent authority'. But many developers, on their own initiative, are incorporating the EIA process into their routine project cycle. They recognise that environmental problems not only lead to risks and costly liabilities, but that they also cause concern about the developer's effectiveness across the full range of its responsibilities. A prudent developer uses all the management tools available to ensure a project's success in advance.

Although the developer is usually responsible for undertaking the EIA, the 'competent authority' also has a role to play:
- By providing general guidance, past EIA formats or examples to follow
- After the EIA is done, using its results to reach a decision on the project, and later ensuring that all the mitigation measures are implemented.

The concerns and points of view of all the various groups interested in and affected by the project should be taken into account throughout the EIA process. Each of these participants will have a different use for the results of the EIA:
- The *developer* needs to know where to site a project and how to reduce adverse environmental impacts
- The *investor* needs to know how the impacts will affect the viability of the project, and what liabilities are incurred
- The *competent authority* uses the EIA's results to decide on a response to the permit application
- Other *government authorities* will want to know the implications of the project's adverse impacts for other projects they may wish to promote
- The *regulator* needs to know the extent of environmental impacts and whether they are 'acceptable'
- The *regional planner* needs to know how the impacts will interfere with adjacent developments and land uses
- The *local community* or its representatives will need to know how the project's impacts will affect their quality of life
- The *politician* needs to know who is affected and in what way, and what issues should be of concern.

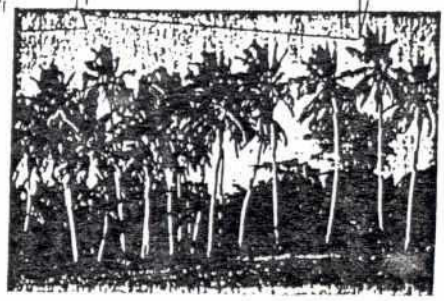


EIA should be integrated with the project cycle

Most governments are now well aware of the possibility of undesirable side effects from large scale industrial development. In 1970, the USA became the first country to make Environmental Impact Assessment a legal requirement for major development projects. Since then, countries throughout the world have enacted similar laws, suited to their own constitutions, economies and social values.

Governments of all these countries - as well as international lending agencies and organisations like the United Nations Environment Programme - are still learning how to make EIA a practical management tool, useful in day to day decisions about how to build a country's economy. The key seems to lie in the management of the EIA - by designing the process so that it provides useful information to decision makers at just the right time in the project cycle. EIA can have a real effect on projects. In other words, EIA should enhance and augment the project planning process. Only by actually shaping projects can EIA become an important instrument for protecting the environment and ensuring sustainable economic success.

Illustrated here is a generalised project cycle, showing when and how an Environmental Impact Assessment can contribute positively to the cycle's progress.



Important principles in managing an EIA

Principle 1

Focus on the main issues.

It is important that an Environmental Impact Assessment does not try to cover too many topics in too much detail.

At an early stage, the scope of the EIA should be limited to only the most likely and most serious of the possible environmental impacts. Some EIAs have resulted in large and complex reports running to several thousand pages. Such extensive work is unnecessary, and can be counter-productive, because the EIA's findings must be readily accessible and immediately useful to decision-makers and project planners.

When mitigation measures are being suggested, it is again important to focus the study only on workable, acceptable solutions to the problems. It is easy for the study to waste time considering measures that are impractical or totally unacceptable to the developer or to the Government.

When it is time to communicate the conclusions, the EIA should provide a summary of information relevant to the needs of each group for making its decision. Supporting data should be provided separately.

Principle 2

Involve the appropriate persons and groups.

Just as it is important not to waste time and effort on irrelevant issues, it is also important to be selective when involving people in the EIA process. Generally, three categories of participants are needed to carry out an EIA:

- Those appointed to manage and undertake the EIA process (usually a co-ordinator and a staff of experts)
- Those who can contribute facts, ideas or concerns to the study, including scientists, economists, engineers, policy makers, and representatives of interested or affected groups
- Those who have direct authority to permit, control or alter the project - that is, the decision makers - including for example the developer, aid agency or investors, competent authorities, regulators and politicians.

Principle 3

Link information to decisions about the project.

An EIA should be organised so that it directly supports the many decisions that need to be taken about the proposed project. It should start early enough to provide information to improve basic designs, and should progress through the several stages of project planning. In a typical sequence:

- When the developer and investors first broach the project concept, they consider likely environmental issues
- When the developer is looking for sites or routes, environmental considerations are used to aid the selection process
- When the developer and investors are assessing the project's feasibility,

an EIA is in progress, helping them to anticipate problems
- When engineers are creating the project design, the EIA identifies certain standards for the design to meet
- When a permit is requested, a completed EIA report is submitted, and also published for general comment
- When the developer implements the project, monitoring or other measures provided for in the EIA are undertaken.

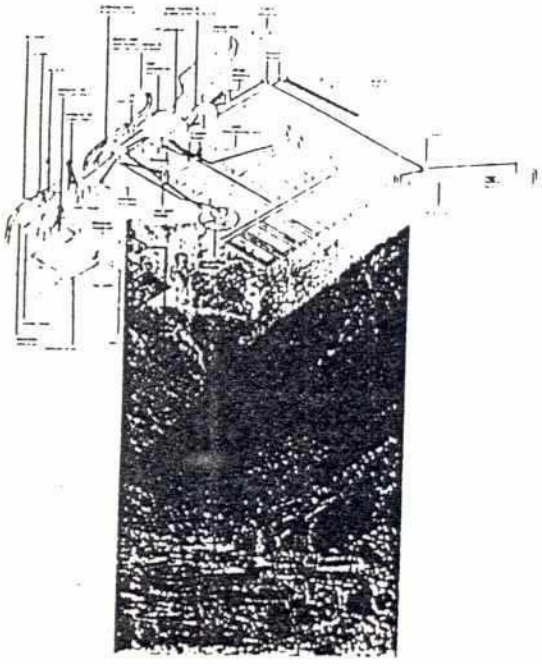
Principle 4

Present clear options for the mitigation of impacts and for sound environmental management.

To help decision-makers, the EIA must be designed so as to present clear choices on the planning and implementation of the project, and it should make clear the likely results of each option. For instance, to mitigate adverse impacts, the EIA could propose:
- Pollution control technology or design features
- The reduction, treatment or disposal of wastes
- Compensation or concessions to affected groups.

To enhance environmental compatibility, the EIA could suggest:
- Several alternative sites
- Changes to the project's design and operation
- Limitations to its initial size or growth
- Separate programmes which contribute in a positive way to local resources or to the quality of the environment.

And to ensure that the implementation of an approved project is environmentally sound, the EIA may prescribe:
- Monitoring programmes or periodic impact reviews
- Contingency plans for regulatory action
- The involvement of the local community in later decisions.



Principle 5

Provide information in a form useful to the decision-makers.

The objective of an EIA is to ensure that environmental problems are foreseen and addressed by decision-makers. To achieve this, decision-makers must fully understand the EIA's conclusions. Most decision-makers are unlikely to use information, no matter how important it is, unless it is presented in terms and formats immediately meaningful:
- Briefly present 'hard' facts and predictions about impacts, comment on the reliability of this information, and summarise the consequences of each of the proposed options
- Write in the terminology and vocabulary that is used by the decision-makers and the community affected by the project
- Present the essential findings in a concise document, supported by separate background materials where necessary
- Make the document easy to use, providing visuals whenever possible.

The Environmental Impact Assessment process

Before starting the EIA

Despite its usefulness in finding ways to make projects more successful, the full EIA process is not necessary for every kind of development project. For a major project, an EIA may use considerable resources and expertise. If a detailed EIA is not really needed, these resources can be put to better use elsewhere.

There are two 'tiers' of assessment which should be applied to the project before proceeding with a full EIA: *screening* and *preliminary assessment*. Where these first tiers of assessment are a regulatory requirement, the developer normally does the work and submits the results to the regulatory agency. The agency may then decide:

- There is nothing to be concerned about, or
- The evaluation should proceed to the next tier.

The advantage of a tier approach is that the extent of the inquiry expands with the advancing development of the project plans. 'Screening' is appropriate when the project is only a rough concept. Later, when the project is under more general discussion, a 'preliminary assessment' can look deeper into possible sites and potential impacts. Then, just before the preliminary stages of feasibility and design work get underway, a full 'EIA study' can commence, so that it can influence the detailed decisions to come. This tier approach also ensures that impacts are examined at a very early stage in the project planning, and not later when sites or designs are already decided by other factors.

Screening

Screening is the first and simplest tier of project evaluation. Screening helps to clear types of projects which in past experience are not likely to cause serious environmental problems. The exercise may take one of several forms:

- Measuring against simple criteria such as size or location
- Comparing the proposal with lists of project types rarely needing an EIA (eg. schools) or definitely needing one (eg. coal mines)
- Estimating general impacts (eg. increased infrastructure needed) and comparing these impacts against set thresholds
- Doing complex analyses, but using readily available data.

Preliminary Assessment

If screening does not automatically clear a project, the developer may be asked to undertake a *Preliminary Assessment*. This involves sufficient

research and expert advice to:

- Identify the project's key impacts on the local environment
- Generally describe and predict the extent of the impacts
- Briefly evaluate their importance to decision makers.

The preliminary assessment can be used to assist early project planning – for instance, to narrow the discussion of possible sites – and it can serve as an early warning that the project may have serious environmental difficulties. It is in the developer's interest to do a preliminary assessment, since in practice, this step can clear projects of the need for a full EIA.

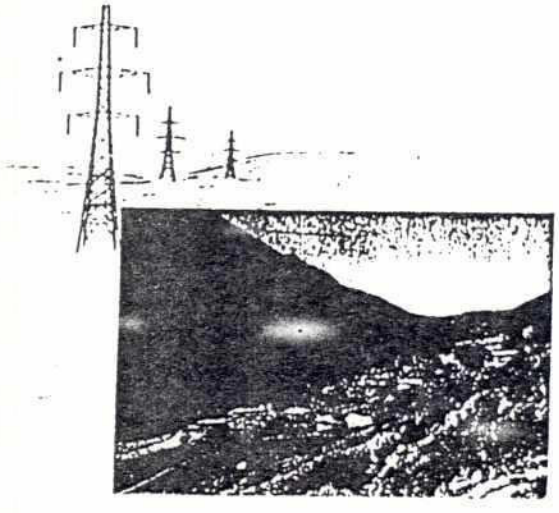
Organisation

If after reviewing a preliminary assessment the competent authority deems that a full EIA is needed, the next step for the project developer is the *Organisation* of the EIA study. This entails:

- Commissioning and briefing an independent co-ordinator and expert study team (the disciplines that will be represented are decided after the 'scoping' stage, but the team always includes a communications expert)
- Identifying the key decision-makers who will plan, finance, permit and control the proposed project, so as to characterise the audience for the EIA
- Researching laws and regulations that will affect these decisions
- Making contact with each of the various decision makers
- Determining how and when the EIA's findings will be communicated.

Scoping

The first task of the EIA study team is *'Scoping'* the EIA. The aim of scoping is to ensure that the study addresses all the issues of importance to the decision makers. First the study team's outlook is broadened – by discussions with the project developers, decision makers, the regulatory agency, scientific institutions, local community leaders, and others – to include all the possible issues and concerns raised by these various groups. Then the study team selects primary impacts for the EIA to focus on, choosing on the basis of magnitude, geographical extent, significance to decision makers, or because of special local sensitivities (eg, soil erosion, the presence of an endangered species, or a nearby historical site).



The EIA study

After 'scoping', the EIA study itself begins. Simply put, the EIA study attempts to answer five questions:

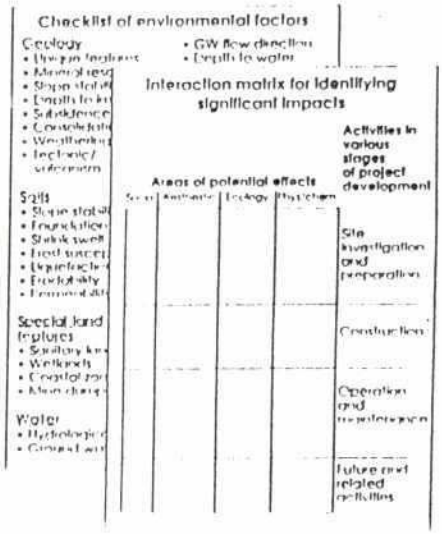
i) *What will happen as a result of the project?*
ii) *What will be the extent of the changes?*
iii) *Do the changes matter?*
iv) *What can be done about them?*
v) *How can decision-makers be informed of what needs to be done?*

After controls on the project's impacts are proposed in answer to question *(iv)*, the study team may again ask: 'What will happen as a result of the (now revised) project?' Thus the EIA often becomes a cyclical process of asking and re-asking the first four questions, until decision-makers can be offered workable solutions.

Identification

The answer to the first question – *'What will happen as a result of the project?'* – has already been partly addressed, but only in general terms: if a 'preliminary assessment' has been done, it will have broadly reviewed the project's effects; also, 'scoping' will have focused the study on the most important issues for decision makers. Taking these findings into account, the full EIA study now formally identifies those impacts which should be assessed in detail. This *Identification* phase of the study may use these or other methods:

- Compile a candidate list of key impacts – such as changes in air quality, noise levels, wildlife habitats, species diversity, landscape views, social and cultural systems, settlement patterns and employment levels – from other EIAs for similar projects. This should draw on as many examples of similar projects as possible.
- Name all the project's 'sources' of impacts (eg. smoke emissions, water consumption, construction jobs) using checklists or questionnaires; then list possible 'receptors' in the environment (eg. crops, communities using the same water for drinking, migrant labourers) by surveying the existing environment and consulting with interested parties. Where the 'sources' may affect the 'receptors', a potential impact is suspected.
- Identify impacts themselves through the use of checklists, matrices, networks, overlays, models and simulations.



Checklist and matrix as used for impact identification

Prediction

The next step, called *Prediction*, answers the EIA's second question: *'What will be the extent of the changes?'* As far as is practicable, prediction scientifically characterises the impact's causes and effects, and its secondary and synergistic consequences for the environment and the local community. Prediction follows an impact within a single environmental parameter (eg. a toxic liquid effluent) into its subsequent effects in many disciplines (eg. reduced water quality, adverse impacts on fisheries, economic effects on fishing villages, and resulting socio-cultural changes). Prediction draws on physical, biological, socio-economic, and anthropological data and techniques. In quantifying impacts, it may employ mathematical models, photomontages, physical models, socio-cultural models, economic models, experiments or expert judgements.

To prevent unnecessary expense, the sophistication of the prediction methods used should be kept in proportion to the 'scope' of the EIA. For instance, a complex mathematical model of atmospheric dispersion should

Water quality model based on a one-dimensional segmenting of a river system.

not be used if only a small amount of relatively harmless pollutant is emitted. Simpler models are available and are sufficient for the purpose. Also, it is unnecessary to undertake expensive analyses if they're not required by the decision-makers for whom the EIA is being done.

All prediction techniques, by their nature, involve some degree of uncertainty. So along with each attempt to quantify an impact, the study team should also quantify the prediction's uncertainty in terms of probabilities or 'margins of error'.

It has been a shortcoming of many EIAs that social and cultural impacts are not given the prominence they deserve in describing the extent of changes expected to result from a major development project. This has probably been due to the bias of physical and biological scientists against the comparatively younger disciplines of cultural anthropology and sociology. This is an unfortunate bias, since socio-cultural impacts are the ones that the local community will feel most acutely in their everyday lives. A consideration of socio-cultural impacts should be integrated, wherever possible, into every discussion of physical/biological change, and not just treated separately in a minor chapter or appendix.

Examples of standards used in the evaluation of predicted impacts

National ambient air quality standards

Sulfur dioxide	80 µg/m³ annual arithmetic mean 365 µg/m³ max 24 hr concen
Particulate matter	75 µg/m³ annual geometric mean
Hydrocarbons	160 µg/m³ (0.24 ppm) max 3 hr concen
Nitrogen dioxide	100 µg/m³ annual arithmetic mean
[illegible]	[illegible] (0.12 ppm) concen
[illegible]	[illegible] (9 ppm) concen
[illegible]	[illegible] daily avg

Quality required for shellfish waters

pH between 7.9	Only by electrometry
Temperature discharges must not cause rise > 2°C	Only by thermometry measurement in shade at the time of sampling
Coloration (after filtration) mg Pt/l discharges must not cause deviation > 10 mg Pt/l	Only, after through 0.45 µm membrane, photometric method using platinum/cobalt scale
Suspended solids (mg/l) discharges must not cause solid content to increase more than 30%	Only, filter through 0.45 µm membrane dry at 105°C, and weigh, centrifuge dry, weigh

Evaluation

The third question addressed by the EIA – *'Do the changes matter?'* – is answered in the next step, *Evaluation*, so called because it evaluates the predicted adverse impacts to determine whether they are significant enough to warrant mitigation. This judgement of significance can be based on one or more of the following:

- Comparison with laws, regulations or accepted standards
- Consultation with the relevant decision-makers
- Reference to pre-set criteria such as protected sites, features or species
- Consistency with government policy objectives
- Acceptability to the local community or the general public.

Mitigation

If the answer to the third question is 'Yes, the changes do matter', then the EIA proceeds to answer the fourth question – *'What can be done about them?'* In this phase, the study team formally analyses *Mitigation*. A wide range of measures are proposed to prevent, reduce, remedy or compensate for each of the adverse impacts 'evaluated' as significant. Possible mitigation measures include:

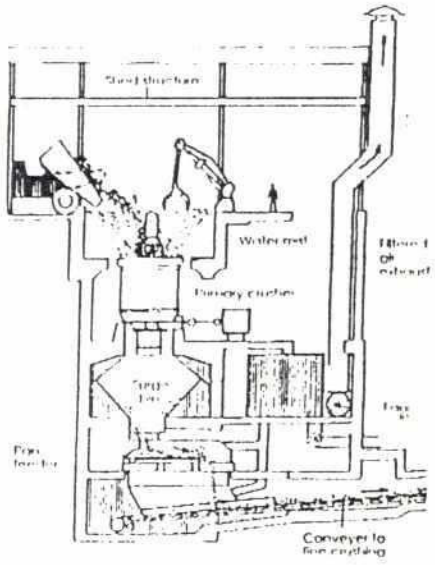
- Changing project sites, routes, processes, raw materials, operating methods, disposal routes or locations, timing, or engineering designs
- Introducing pollution controls, waste treatment, monitoring, phased implementation, landscaping, personnel training, special social services or public education
- Offering (as compensation) restoration of damaged resources, money to affected persons, concessions on other issues, or off-site programmes to

enhance some other aspect of the environment or quality of life for the community.

All mitigation measures cost something, and this cost must be quantified too.

These various measures are then compared, trade-offs between alternative measures are weighed, and the EIA study team proposes one or more 'action plans', usually combining a number of measures. The action plan may include technical control measures, an integrated management scheme (for a major project), monitoring, contingency plans, operating practices, project scheduling, or even joint management (with affected groups). The study team should explicitly analyse the implications of adopting different alternatives, to help make the choices clearer for decision-makers. Several analytical techniques are available for this purpose:

- Cost/benefit analysis, in which all quantifiable factors are converted to monetary values, and actions are assessed for their effect on project costs and benefits (Be cautioned, however, that the unquantifiable and qualitative aspects can be equally important, and often need to be taken into account in the decision making process.)
- Explaining what course of action would follow from various broad 'value judgements' (eg, that social impacts are more important than resources)
- A simple matrix of environmental parameters versus mitigation measures, containing brief descriptions of the effects of each measure
- Pairwise comparisons, whereby the effects of an action are briefly compared with the effects of each of the alternative actions, one pair at a time.



Example of mitigation technology: designs for dust control in a primary crusher, used in mining industries

Documentation

The last step in the EIA process, which responds the last question - *'How can decision makers be informed of what needs to be done?'* - is the *Documentation* of the process and the conclusions. Recall that the purpose of an EIA is to ensure that potential problems are foreseen and addressed in the project's design. Many technically first-rate EIA studies fail to exert their importance and usefulness because of poor documentation. The EIA can achieve its purpose only if its findings are well communicated to decision makers.

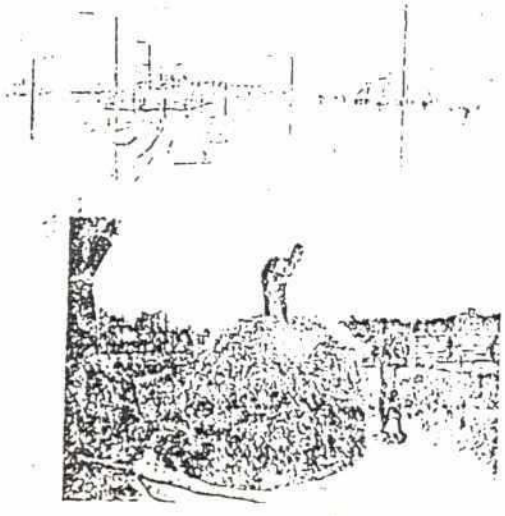
Generally, to produce effective communications, one must identify the target audience or audiences, and then shape and style the publication to meet their specific needs. In documenting an EIA, this means identifying the key decision makers, perceiving the questions they will be asking, and providing them with straightforward answers, formatted for easy interpretation in relation to their decision-making (eg, tables, graphs, summary points). Successful EIA documentation is more readily produced if the audience and their needs are established at the start of the EIA, and then made to affect how the research is focused and reported. It is the job of the study team's communications expert to make this happen.

So that decision-makers can look more deeply into particular issues, the EIA report should also include a record of the EIA process and the judgements made by the study team. An EIA report typically contains:

- An executive summary of the EIA findings
- A description of the proposed development project
- The major environmental and natural resource issues that needed clarification and elaboration
- The project's impacts on the environment (in comparison with a baseline environment as it would be without the project), and how these impacts were identified and predicted
- A discussion of options for mitigating adverse impacts and for shaping the project to suit its proposed environment, and an analysis of the trade-offs involved in choosing between alternative actions
- An overview of gaps or uncertainties in the information
- A summary of the EIA for the general public

All of this should be contained in a very concise, easy to read document, with cross references to background documentation, which is provided in an appendix. (The short document is sometimes called an 'Environmental Impact Statement', especially when it is submitted as part of a permit application.)

Using the results



Decisions based on the EIA are usually made by persons who have not been closely involved with the day to day progress of the EIA study. Their first consideration of the project may well be the moment they pick up and skim through the EIA report. The EIA will hopefully tell them all they need to know about 'what will happen as a result of the project', 'the extent of the changes', 'whether the changes matter', and 'what can be done about them'. But the decision-makers themselves must also consider political realities when selecting a course of action. Only decision makers are in a position to balance the project's needs and problems with the other needs, and problems over which they have jurisdiction. They must take into account not only the facts of the situation, but also people's perceptions.

If the project is accepted, perhaps with recommended modifications, then the decision maker may need to take two further actions:

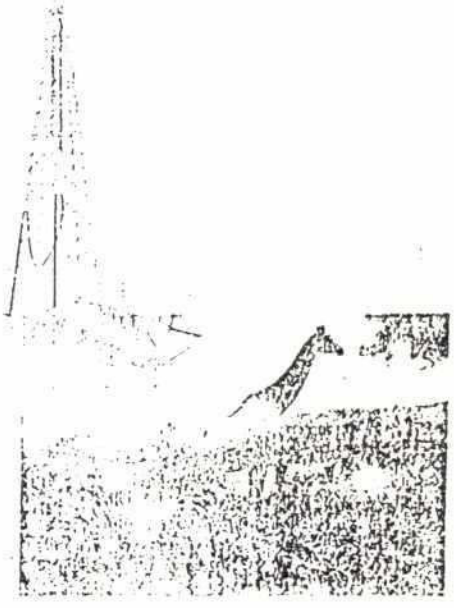
- Prepare a plan for reducing conflicts about the project; this may include public participation in planning, public education, and actions to compensate affected groups
- Allocate institutional responsibilities for overseeing the developer's adherence to its environmental requirements, for incorporating environmental management into further planning, and for enforcing any restrictions or carrying out any monitoring

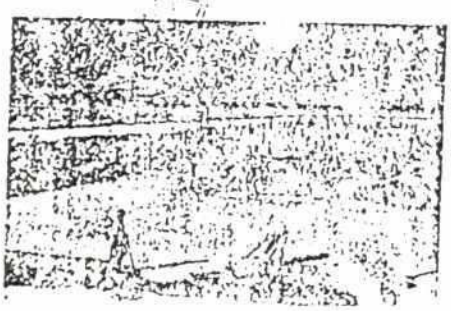
Sometimes, the competent authority sends the EIA to a review panel for comment on its adequacy and quality, before reaching its decision. The decision-maker may call for further study to answer additional questions about the project. The decision maker may also ask that an opportunity be provided for public review and involvement. The competent authority simply places copies of the report on public display, and invites the public to comment. The EIA team may then be asked to re-draft the EIA to take account of the comments made, before a decision is taken. In cases where the decision maker chooses to reject the proposed project altogether, there should be an appeal process open to the project developers.

The EIA's usefulness does not end with the decision on a course of action about the project. It still has several further contributions to make to the project's success:

- If the project goes ahead with recommended changes, the EIA's findings should be used to help shape the project to suit the environment, by influencing engineering designs
- Decisions that need to be made in the latter phases of project planning, such as precisely where to route supporting road or rail links, should be based on the EIA
- The EIA's precautions on environmental impacts can be part of the brief for tendering on contracts, and should be re-drafted as environmental safety guidance for workers.

Lastly, after the project is completed, a 'post audit' can be done to determine how close the EIA's predictions were to the project's real impacts. This forms a valuable record for others doing EIAs on similar projects in the future.





Resources needed for an EIA

Because of the EIA's acknowledged importance in planning a country's sustainable economic growth, EIAs are now undertaken throughout the world, even in places with very few resources to give to planning initiatives. There are, however, certain minimum resources needed to perform EIAs that can successfully shape major projects:

- **Qualified multi-disciplinary staff.** This includes a skilled manager (to co-ordinate the activities, communicate with decision makers, and motivate the study team), trained specialists (in fields such as environmental science, rural and urban planning, economics, waste and pollution control, process engineering, landscape design, ecology and cultural anthropology), and a communications expert.
- **Technical guidelines, agreed with the competent authority,** for carrying out the various phases of the EIA process, especially screening, scoping, prediction, evaluation and mitigation.
- **Information about the environment** (especially relating to the impacts being considered after 'scoping') which can be sorted and evaluated.
- **Analytical capabilities** for doing field work, laboratory testing, library research, data processing, photomontage, surveys and predictive modelling.
- **Administrative resources** for the day to day running of the EIA process, including office staff, meeting rooms and support, communications facilities and records management.
- **Institutional arrangements,** including a formal procedure for consultation with the decision makers and other interested groups, the authority to obtain the necessary information of the proposed project, and a formal process for integrating the EIA into decision making about projects.
- **Review, monitoring and enforcement powers,** to ensure that accepted mitigation measures are included in the development.

Among the resources needed to perform an EIA, not least are **money** and **time**. As concerns time, the following are averages for a sampling of recent EIAs: preliminary assessments take between 2 and 10 weeks to complete; full EIAs may last between 3 months and 2 years. Regarding costs, officials often balk at some of the figures they hear, but developers and investors will realise that they represent but a very small percentage of the costs of any major development project – usually always less than 1%. Indeed, it is a relatively small price to pay to prevent costly unforeseen problems, to promote development that can be sustained, to help prevent potentially ruinous environmental catastrophe – and to obtain approval and acceptance. EIAs mean better, more successful projects: they are a good investment in the future, for both the developer and the economy as a whole.

What to do next

If you want to know more about Environmental Impact Assessments done in your own country, consult these likely sources:

- The Ministry in charge of environmental protection
- Authorities empowered to grant building or other permits
- Environmental research centres
- Universities and related research establishments

To find out more about how to do Environmental Impact Assessment, contact the United Nations Environment Programme (UNEP) at one of the following addresses:

- **United Nations Environment Programme**
  Regional Office for Asia and the Pacific
  The United Nations Building, Rajadamnern Avenue
  Bangkok 10200 Thailand
- **United Nations Environment Programme**
  Industry and Environment Office
  Tour Mirabeau
  39-43, Quai Andre Citroen
  75739 Paris Cedex 15, France
- **United Nations Environment Programme Headquarters**
  PO Box 30552 Nairobi, Kenya

UNEP can provide guidelines on the EIA process, examples of EIAs done throughout the world, reference materials on EIA techniques, and assistance finding the necessary resources, including expert advice.

The Governing Council of UNEP has adopted "Goals and Principles of Environmental Impact Assessment". In brief, the goals are:

- To take environmental effects into account in decisions by competent authorities
- To promote beneficial EIA procedures in all countries
- To encourage consultation between States on projects involving impacts across national boundaries.

First among UNEP's principles for EIA is that environmental effects should be considered before doing any project, and that EIAs should be done when significant effects are expected. The other principles cover many of the points about the EIA process which are discussed in this booklet: who to involve, how to focus the process, and how to integrate it with decision-making about the proposed project.

Environmental Impact Assessment
Basic procedures for developing [illegible]

Published with the support [illegible]
Government of the Neth[illegible]

Prepared for UNEP by
Environmental [illegible]

ENVIRONMENT, DEVELOPMENT AND EIA IN BANGLADESH

ISPAN

Environment

The word Environment has been defined in many ways. The World Commission on Environment and Development defined Environment as 'Where we all live.' Alternatively, the environment is the resource capital of a country (Figure 1). In other words environment is the totality of the natural and human surroundings and includes:

* Biophysical components of the natural environment of land, water and air, including all layers of the atmosphere, all inorganic and organic matter both living and dead; and

* Socio-economic components of the human environment including social, economic, administrative, cultural, historical, archeological, land and associated resource usage, structures, sites, human health, nutrition and safety.

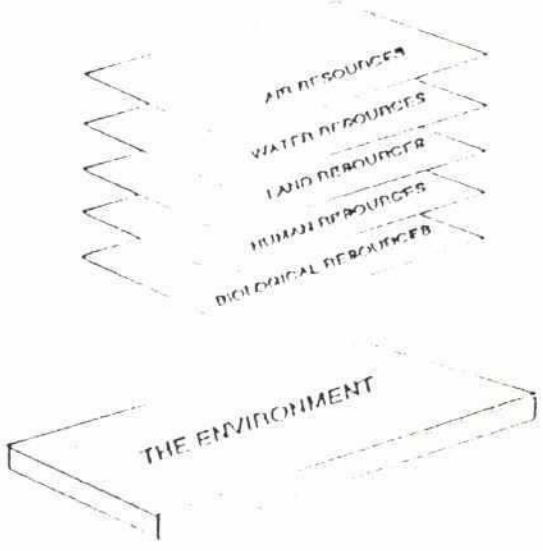


Figure 1. Diagrammatic Representation of the Environment.

The environment we live in is polluted and degraded by human and other technological and development activities. Moreover, natural disasters such as repeated floods, storms, cyclones, tidal surges and river bank erosion create a threat to the human environment. The resources of a country can sustain only a certain size of population. The population of Bangladesh is increasing at a pace faster than the production rate of most of the essential commodities. The over-exploitation of resources is accelerating depletion of important resources such as water, soils, forests and fisheries.

Symptoms of serious environmental degradation exist in many parts of the country. For instance, in some areas of the northern region, use of deep tubewells along with the effects of the Farakka Barrage on the Ganges River have lowered the water table. Similarly, withdrawal of Ganges water combined with siltation at the Gorai River,

off-take are greatly increasing the salinity in the south-western part of the country. Indiscriminate use of pesticides and release of industrial effluents, unplanned development of urban infrastructures and rural road networks, and construction of brickfields in agricultural land are further examples of negative impacts on resources.

Natural disasters may also lead to environmental degradation. For instance, the floods of 1987 and 1988 caused considerable damage to lives, properties, crops, plants and animals. Similarly, the devastating cyclone of 29 April 1991 accompanied by tidal surges killed nearly 139,000 people in the coastal areas. It is estimated that about one million people are displaced annually due to river bank erosion. To highlight the importance of conservation of land, water, forests, and fisheries resources of Bangladesh, a series of fact sheets, published by POUSH are made available.

In view of Bangladesh's limited resources, it is essential to slow down human population growth and to stop depletion of forests, soil fertility, water and land resources. There is an urgent need to understand key factors needed for environmental assessment and sustainable development. **Sustainable management needs sustainable planning and sustainable planning needs the feedback from environmental impact assessment (EIA) of developmental interventions.**

Development on Environmental Policy

At the national and Institutions levels environmental management was confined to the 'Department of Environment Pollution Control (DEPC)' under the 'Ministry of Local Government, Rural Development and Co-operatives (MLGRDC)'. The DEPC was mandated to deal mainly with the issue of pollution control. In 1989 a separate 'Ministry of Environment & Forest' (MOEF) was created. In August 1990 the DEPC was renamed 'Department of Environment' (DOE) and was placed under the newly created ministry with broader objectives and mandates for environmental management. The Government of Bangladesh (GOB) considers environmental protection as a part of development, since development cannot be properly attained without sustainable management of environment.

Given the importance of environmental management, the **International Centre for Science, Technology and Environment** for densely populated regions, is being set up in Dhaka with the cooperation of Nobel Laureate Professor Abdus Salam and his Third World Academy of Science.

The GOB has also approved an **Environmental Policy**, and developed the **National Conservation Strategy (NCS)** and the **National Environmental Management Action Plan (NEMAP)**. These national documents have identified national issues, and formulated action plans for the implementing agencies. Also some environmental laws have been revised and additional new ones passed.

At international level Bangladesh is a member of some international organizations such as the South Asian Cooperation of Environment Program (SACEP), the International Board of Plant Genetic Resources (IBPGR) and the United Nations Environment Program (UNEP). During the Rio Earth Summit held in June 1992 in Brazil, the GOB prepared a Country Report for United Nations Conference on Environment and Development (UNCED). During the UNCED conference the GOB signed three interna-

tional documents on environmental development. These are:

Agenda 21 - an action plan for all governments;
Convention on Climatic Changes -aimed at reducing greenhouse effects; and
Convention on Biodiversity - for protecting plant and animal species.

Bangladesh has also taken part in other numerous environmental forums and signed treaties, conventions and agreements (Table 1).

The above mentioned agreements make it binding for GOB to implement the projects and proposals therein. It also became imperative for the GOB to implement the national environmental policy and the recommended **action plans** in NCS and NEMAP. The national documents particularly recognized the Environmental Impact Assessment (EIA) as an important tool for the sustainability of each major development project.

Environmental Impact Assessment (EIA)

EIA is a formal study process, **which predicts the environmental consequences of development projects,** such as flood control drainage and irrigation (FCD/I), mining for exploitation of energy and minerals, hydropower generation and industrial development.

An excellent description of the **EIA process** is given in the booklet 'Environmental Impact Assessment - Basic Procedures for Developing countries' produced by the United Nations Environment Program (UNEP) and made available.

Development of EIA in Bangladesh

Most national documents have emphasized the environmental changes that occurred during the last few decades because of the introduction of flood control, drainage and irrigation (FCD/I) structures, sinking of deep tubewells (DTWs) and shallow tubewells (STWs) and the extensive use of low lift pumps (LLPs). For instance, adverse environmental impacts have occurred because of the lowering of the ground water table, blocking of the natural drainage system and fish migrations and creation of a narrow gene pool for rice species.

Given these problems, emphasis has to be given to projects and programs that promote economic development and enhance sustainable ecosystem. Thus, EIA study needs to be incorporated in all development projects that may implicate environmental degradation.

EIA Practice in Bangladesh

Only a few agencies in Bangladesh have so far, taken initiatives for implementing EIA in development projects. World Bank included EIA study for the 'Third Chittagong Water and Sanitation Authority (WASA) Project'. DOE carried out rapid EIA for 'Hatiya-Sandwip Cross Dam Project', and for two cement factories namely, 'Messrs Elias Brothers PVT. Ltd.' at Rangadia and 'Confidence Cement Factory' at Sitakundu of Chittagong. Besides, some consultancy firms such as Bangladesh Consultants Ltd. (BCL), Aqua Consultants Ltd., House of Consultants (HOC), Resource Control Company (RCC), Envirocare, Environment Associates, and Bureau of Research, Testing and Consultation of Bangladesh University of Engineering & Technology (BRTC/BUET) have also undertaken EIA-studies for various

development projects. Follow-up studies are being undertaken as per recommendations of the EIA (as a part of Feasibility Study) for 'Jamuna Multipurpose Bridge'.

The Irrigation Support Project for Asia and the Near East (ISPAN), in collaboration with the Flood Plan Coordination Organization (FPCO) and Department of Environment (DOE) have developed EIA Guidelines (Figure 2) and corresponding EIA Manual for the use of water development project. The Guidelines and Manual were tested in the field through three case studies in proposed water development projects of Surma Kushiyara, Tangail Compartmentalization Pilot Project (CPP) and Bhola Bhelumia-Bheduria Early Implementation Project (EIP) area. The case studies were undertaken by a multidisciplinary environmental study team of Flood Action Plan Environmental Study (FAP 16). The Guidelines has been approved by DOE and the revised version is now available for use. All FAP components are required to do EIA as part of project feasibility studies.

EIA training has been undertaken by various agencies and NGOs in Bangladesh. In 1992-93 DOE, DANIDA and UNDP have undertaken training programs on environmental management of which EIA was a component. Recently, in May 1993 Winrock International organized a two week training program on environment and economic assessment. The objective of the workshop was to develop EIA skill in mid-level and senior scientists and technocrats.

The above overview of the environment, environmental development and EIA practice in Bangladesh would lead to the following conclusions:

* The sustainability of a development project depends upon the extent to which its adverse consequences on the surroundings can be reduced.

* The EIA study process concentrates on resources, livelihood of the people, their homestead and other potential problems and conflicts that may affect the viability of the project.

* An EIA study process usually ends with necessary mitigation measures for the modification of the project.

* **It is essential to institutionalize EIA in Bangladesh.** It is imperative for the GOB to make EIA mandatory through executive order or by Act of Parliament.

Reading Material

A short list of important publications is given as additional reading materials:

Alcron, J. and Johnson, N. 1989. **Conservation of Biological Diversity in Bangladesh: Status, Trends and Recommended Responses.** World Resources Institute. Washington, D.C. USA.

DOE (Department of Environment). 1990. **Bangladesh Environment and Department of Environment.** DOE, Dhaka.

DOE (Department of Environment). 1991. **Environmental Quality Standards of Bangladesh,** DOE, Dhaka.

DOE (Department of Environment). 1992. **Training Manual on Environmental Management in Bangladesh,** DOE, Dhaka.

FPCO (Flood Plan Coordination Organization). 1992. Bangladesh Flood Action Plan: **Guidelines for Environmental Impact Assessment.** FPCO, Dhaka.

GOB (Government of Bangladesh). 1991. **Report of the TASK FORCES on Bangladesh Development Strategies for the 1990's: Environment Policy.** Volume Four. University Press Limited (UPL), Dhaka.

GOB (Government of Bangladesh). 1991. **The Fourth Five Year Plan,** Planning Commission, Ministry of planning, Government of the People's Republic of Bangladesh, Dhaka.

ISPAN (Irrigation Support Project for Asia and the Near East). 1992a. Bangladesh Flood Action Plan. FAP 16 Environmental Study **Manual for environmental impact assessment (EIA).** Banani, Dhaka.

ISPAN (Irrigation Support Project for Asia and the Near East). 1992b. Bangladesh Flood Action Plan. FAP 16 EnvironmentalStudy-**Environmental impact assessment case study: Surma-Kushiyara Project.** Banani, Dhaka.

ISPAN (Irrigation Support Project for Asia and the Near East). 1992c. Bangladesh Flood Action Plan. FAP 16 **Environmental impact assessment case study: Tangail Compartmentalization Pilot Project (CPP).** Banani, Dhaka.

MOEF/IUCN (Ministry of Environment & Forest/International Union for Conservation of Nature). 1992a. **Towards Sustainable Development: The National Conservation Strategy of Bangladesh.** MOEF/IUCN, Dhaka.

MOEF/UNDP (Ministry of Environment & Forest/United Nations Development Program. 1992b. **National Environmental Management Action Plan (NEMAP).** Ministry of Environment & Forest, Dhaka.

MOEF (Ministry of Environment & Forest). 1992c. **Environment Policy & Implementing Action Plan (in Bangla).** Ministry of Environment & Forest, Dhaka.

MOEF (Ministry of Environment & Forest). 1992d. **Bangladesh Country Report for United Nations Conference on Environment & Development (UNCED). Ministry of Environment & Forest** . Dhaka.

MPO/WARPO (Master Plan Organization/ Water Resources Planning Organization). 1991. **National Water Plan, Draft Report.** WARPO, Ministry of Irrigation, Water Development and Flood Control, Dhaka.

MOI (Ministry of Industries). 1991. **Industrial Policy 1991.** MOI, Dhaka.

IUCN/UNEP/WWF (International Union for Conservation of Nature/United Nations Environment Program/World Wildlife Fund). 1990. **Caring for the World : A Strategy for sustainability**. IUCN, Dhaka.

Rashid, H. 1989. **Land Use in Bangladesh, Agriculture Sector Review.** UNDP, Dhaka.

Rashid, H. 1991. **Geography of Bangladesh**, University Publication Limited (UPL), Dhaka.

Scott, D.A. 1989. **A Directory of Asian Wetlands**. IUCN, Gland, Switzerland.

UNDP/FAO. (United Nations Development Programs/Food and Agricultural Organization). 1988. **Land Resources Appraisal of Bangladesh** (a series of 7 volumes of 29 Parts), Rome, Italy.

UNEP (United Nations Environment Program). 1988. **Environmental Impact Assessment-Basic Procedures for Developing Countries, UNEP**, Bangkok, Thailand.

WB (World Bank). 1989. **Flood Action Plan for Bangladesh**. Washington, D.C. USA.

Table 1. Titles of Treaties, Conventions and Agreements of Environmental Concern and Dates of Signing by the GOB.

Feb. 1992	Convention on International Important Wetland as Waterfowl Habitat
18.2.1992	Convention on International Trade in Endangered Species of Wild Fauna and Flora
30.11.1990	International Convention on Oil Pollution Preparedness, Response and Cooperation.
18.9.1990	Convention of the Phycotropic Substances.
31.5.1990	Montreal Protocol on Substances that Deplete the Ozone Layer.
27.6.1990	Montreux Conference on Lake Geneva.
31.5.1990	Vienna Convention for the Protection of the Ozone Layer.
14.4.1990	Agreement on the Network of Aquaculture Centers in Asia and the Pacific (NACA).
7.2.1988	Convention on Early Notification of a Nuclear Accident.
14.1.1986	Treaty on Principles Governing the Activities of States in the Exploration and use of the outer space including the Moon and other Celestial Bodies.
13.3.1985	Convention on the Prohibition of the Development and Stockpiling of Bacteriological (Biological) and Toxic Weapons, and on their Distribution.
13.3.1985	Treaty Banning Nuclear Weapon Tests in the Atmosphere, in outer space and under water.
10.12.1982	United Nations Convention on the Law of the Sea.
4.2.1982	International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties.
28.12.1981	International Convention for the Prevention of Pollution of the Sea by Oil (as amended on 11 April 1962 and 21 October 1969).
3.10.1979	Convention Concerning the Protection of the World Cultural and Natural Heritage.
3.10.1979	Convention on the Prohibition of Military or any other Hostile Use of Environmental Modification Techniques.
23.8.1979	Treaty on Non Proliferation of Nuclear Weapons.
4.12.1974	Plant Protection Agreement for the South East Asia and Pacific Region.

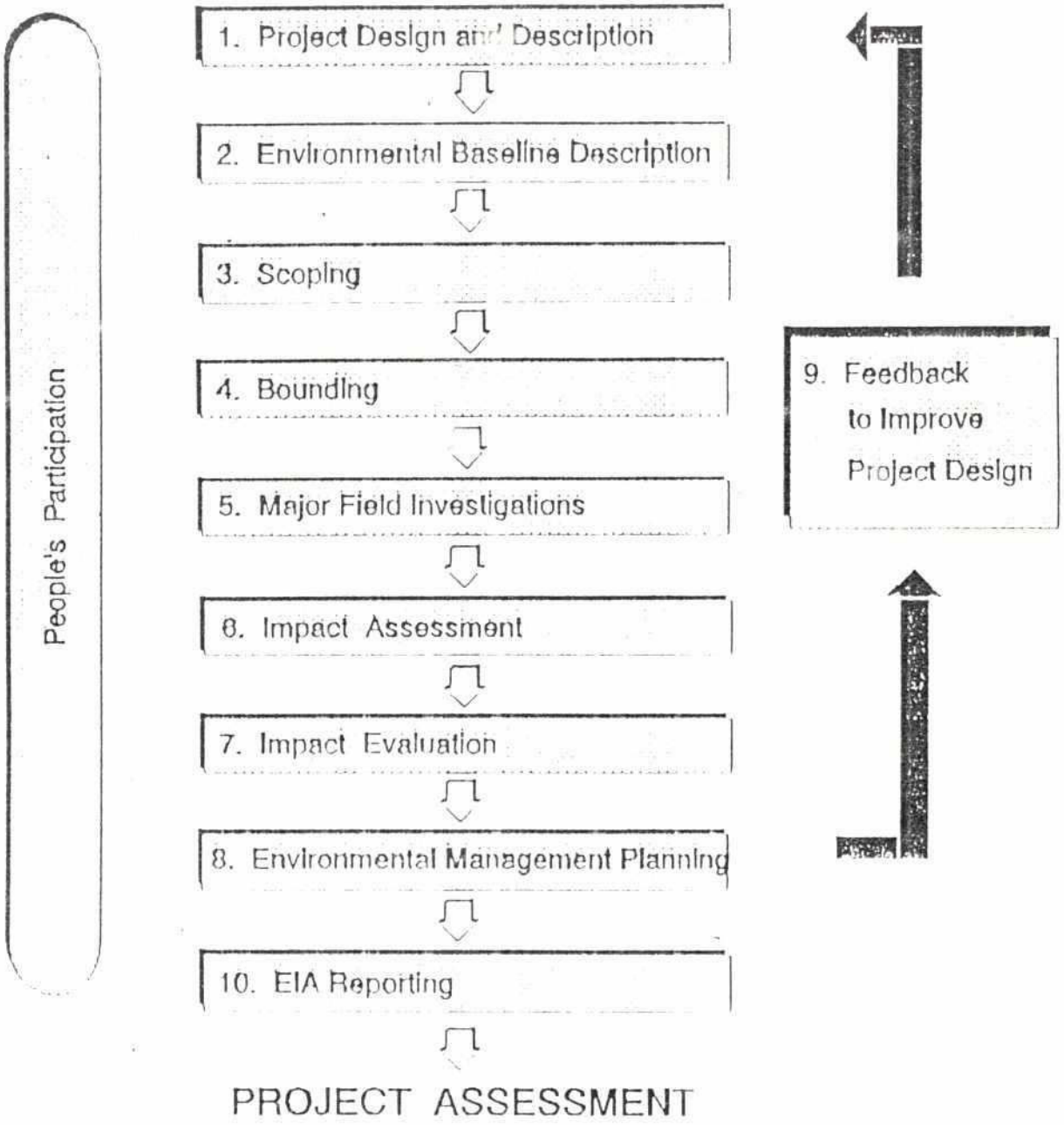


Figure 2. Procedural Steps in Environmental Impact Assessment (EIA) for the Bangladesh Flood Action Plan.

Exercise 1

Using your knowledge of Bangladesh, identify as many indivdiual habitats and ecosystems as you can.

Exercise 2

The purpose of this exercise is to develop a set of expectations on how (or whether) the EIA process might improve project planning and planning outcomes. Group will be divided into teams by instructor. They are to identify a team leader and a reporter within each group. Prepare flip charts on what you think the potential improvements and problems might be in the Bangladeshi context.

Exercise 3

The point of exercise is to review hypothetical case study materials, identify the environmental resources and project consequences.

As a team interested in determining what the potential environmental impacts of the project will be, your job is to describe the environment the environment of the study area and determine what the potential impacts of the project might be.

In order to describe the environment you must be able to determine what kinds of environmental resources are in the project area. The team must first decide approximately where the project is located. You must then use your knowledge of the area in order to identify the resources in the environment.

The next step is to determine the potential impacts of the project based on your environmental description.

Below is the project description for the exercise and a map of the project area. Make any assumptions you wish to in proceeding with the exercise.

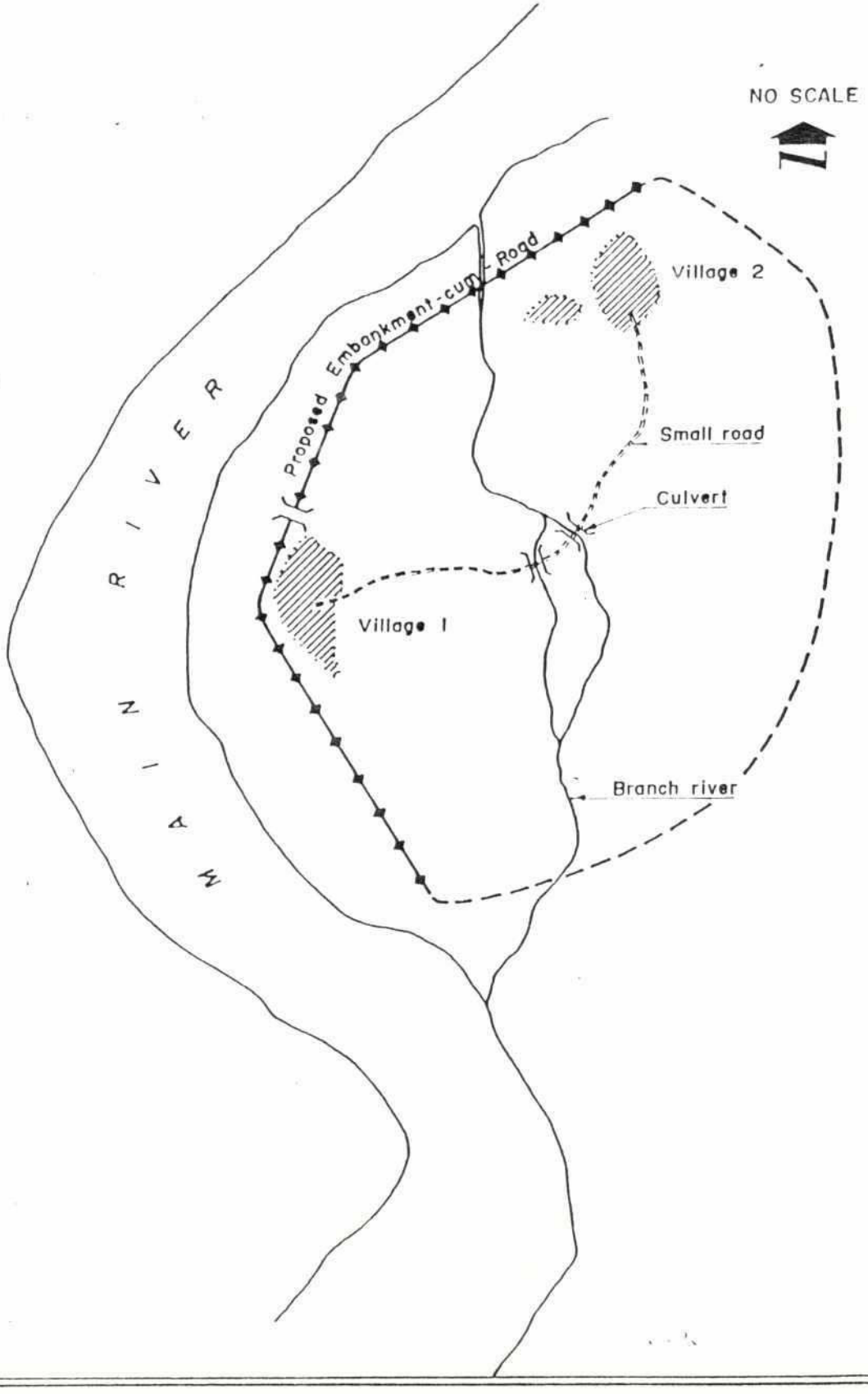
Project Description:

A FAP flood-control and project was proposed following a flood event in which several villages were inundated and there was loss of crops and property in several villages. The purpose of the proposed project is to reduce or eliminate flooding and thereby improve protection of property, sustainable agricultural production, and general public safety.

Assume that the project area (attached figure) includes two villages. There is a branch river that flows through center of the project area. The main river forms the north and west boundaries of the project area as shown in the figure. A small road joins the two villages. This road has culverts that are currently improperly operating. During the flooding, Village 1 was completely inundated and Village 2 was partially inundated.

The proposed project action is to build an embankment-cum-road along the main river to protect Villages 1 and 2. The embankment is anticipated to be approximately 5 km long and take two years to construct. Project amenities will include restoration and rehabilitation of the branch river drainage in the project area.

HYPOTHETICAL PROJECT



Exercise 4

The purpose of this exercise is to review an IEE and determine which of the proposed project options should move forward. Review the IEE handed out by the instructor and determine which option should move forward. Record your reasons for or against the project moving forward on the flip chart and be prepared to defend your answers.

Government of the People's Republic of Bangladesh
Bangladesh Water Development Board
Flood Plan Coordination Organisation

FLOOD ACTION PLAN

NORTHEAST REGIONAL WATER MANAGEMENT PROJECT (FAP 6)

PRE-FEASIBILITY STUDY

UPPER SURMA-KUSHIYARA PROJECT

April 1993

NOT FOR CIRCULATION
PRELIMINARY DRAFT

Shawinigan Lavalin (1991) Inc.
Northwest Hydraulic Consultants

in association with

Engineering and Planning Consultants Ltd.
Bangladesh Engineering and Technological Services
Institute For Development Education and Action
Nature Conservation Movement

Canadian International Development Agency

C.2.5 Field Investigations (Step 5)

Field investigations were limited to seven to ten days of informal reconnaissance by a multi-disciplinary team.

C.2.6 Impact Assessment (Step 6)

At this level of detail, a screening matrix (Table C.1) was filled out by the project team. The same matrix was used for both Alternatives 1 and 2, but the impacts of 'surface water irrigation' (operation phase) do not apply to Alternative 1 which is under consideration here. Impacts are designated by:

- \+ positive impact
- \- negative impact
- • neutral impact (such as conversion from one productive land use to another)
- ? insufficient information to designate

Impacts are discussed in Section 7.8.

C.2.7 Quantify and Value Impacts (Step 7)

Quantification and evaluation of impacts is documented in Section 7.8 and Tables 7.10 and 7.11 (multi-criteria analysis).

C.2.8 Environmental Management Plan (Step 8)

At a pre-feasibility level, this section focuses on "identification of broad management options and major constraints" (p. 28, ISPAN, 1992).

Mitigation and enhancement. Flushing sluices for water exchange to maintain water quality and some fish passage. Resettlement of homesteads left outside the embankment, in an attempt to prevent embankment cutting when channel water levels are high, should be considered during the feasibility study.

Compensation. Mandated requirements for land acquisition must be adhered to. Beyond this, consideration should be given to:

- In-kind rather than cash compensation for households whose homestead land is taken.
- Compensation for persons other than landowners who are impacted negatively by land acquisition and construction/infrastructure-related land use changes. Example: project implementation could be made contingent upon successful resettlement of squatters displaced from embankment/structure sites under local initiative; local communities could work with NGOs to accomplish this.

Monitoring. There is a need to define monitoring needs and methodologies at regional, institutional (BWDB), and projects levels. This exercise should reflect (i) the need for greater people's participation in all project activities, which would include monitoring project function and opportunities for discussion with BWDB and (ii) the need for greater emphasis on operation and maintenance, of which monitoring can play an important role.

People's participation. There is a need at regional, institutional, and project levels to maintain enthusiasm for people's participation, and to develop effective and efficient public participation modalities.

Disaster management (contingency planning). Once the flood protection is operational, investment in agriculture will likely rise. This increases the total amount of farmers' assets that are at risk should an extreme flood event occur or the embankment fail for any reason. Currently in Bangladesh, these risks are borne by individual investors (in this case farmers). Unsustainable solutions (such as government subsidy of crop insurance) should be avoided however.

EMP institutionalization. Arrangements for sharing EMP responsibility between BWDB and local people would need to be worked out. Project implementation should be contingent upon agreement on this matter between BWDB and local people.

Residual impact description. This should be generated as part of the feasibility-level EIA.

Reporting and accountability framework. This is an institutional question that needs to be looked at on a national or regional scale. DOE is responsible for reviewing EIAs, but has no authority to enforce compliance to the terms of an EMP. In any case, project implementation should be contingent upon the preparation at the feasibility stage of satisfactory reporting/accountability arrangements.

Budget estimates. These should be generated as part of the feasibility study.

C.3 Alternative 2: Proposed FCD Project with Surface Water Irrigation Component

Note that Alternatives 1 and 2 are identical except for the addition of a surface water irrigation component to Alternative 2.

.3.1 Project Design and Description (Step 1)

As in Section 8.3. Project Description.

3.2 Environmental Baseline Description (Step 2)

As in Chapter 2. Biophysical Description, and Chapter 3, Settlement, Development, and Resource Management.

.3.3 Scoping (Step 3)

Technical:

Literature review: Presented in Chapter 4, Previous Studies.

Local community: As described in Section 3.1.9, People's Perception.

.3.4 Bounding (Step 4)

Physical:

Gross area: 49,200 ha.

Impacted (net) area: 33,600 ha.

Impacted area outside project: possible downstream effects:

(1) Peak water levels at downstream end could increase by up to 0.5 m due to confinement effects. During feasibility studies, the impact of this on external areas should be assessed.

(2) Fish brood stock overwintering in the Kushiyara River downstream of the pumping station could be adversely affected due to lower water levels, lower flow rates, and poorer water quality. The lowest 90%-dependable flow rate is 17.8 $m^3 s^{-1}$, and the pumping station capacity is 7.5 $m^3 s^{-1}$ or 42% of the lowest 90%-dependable flow. Of particular concern would be the reduced flushing and dilution of industrial pollutants from the Fenchuganj fertilizer factory and other sources.

Temporal:

Preconstruction: year zero through year three (Table 8.5).
Construction: year one through year four (Table 8.5).
Operation: year five through year 29.
Abandonment: after year 29.

Cumulative impacts:

With other floodplain infrastructure: This will be looked at in the context of the Regional Plan impact assessment.
With pre-existing no-project trends. These are noted in Chapter 5.

C.3.5 Field Investigations (Step 5)

Field investigations were limited to seven to ten days informal reconnaissance by a multidisciplinary team.

C.3.6 Impact Assessment (Step 6)

At this level of detail, a screening matrix is used (Table C.1). The same matrix is used here as for Alternative 1, and the impacts of 'surface water irrigation' (operation phase) do apply to this Alternative. Impacts are discussed in Section 8.8.

C.3.7 Quantify and Value Impacts (Step 7)

Quantification and evaluation of impacts is documented in Section 8.8 and Tables 8.8 and 8.9 (multi-criteria analysis).

C.3.8 Environmental Management Plan (Step 8)

At a pre-feasibility level, this section focuses on "identification of broad management options and major constraints" (p. 28, ISPAN, 1992).

The EMP is the same as for Alternative 1 except for the following.

Mitigation and enhancement. Options to mitigate the fisheries impact of the irrigation water withdrawal need to be investigated.

Environmental Screening Matrix

Screening matrix / PHASE	Normal/ Abnormal	Activity / Important Environmental Component	Land Use	Agri-culture	Fisheries	Water Quality	Water Quantity	Human Health	Social Issues	Wild Plants & Animals	Hazards	Other
Construction (continued)	Abnormal (cont'd)											
Operation	Normal	Pre-monsoon flood protection		+	-		+				+	
		Monsoon flood protection		+	-		+		+	-		
		Surface water irrigation (ALT 2 ONLY)		+	-		+					
		Ground water irrigation N/A										
		Drainage		+	-		+			-		
		Agriculture: operation of institutions, extension, credit, seed distribution, fertilizer and pesticide storage and use, farmer groups							+	-		
		Water management: activities of BWDB, subproject implementation committee, local water user groups, structure committees and guards							+		-	
	Abnormal (relative to FWO, not FW normal)	Pre-monsoon flooding (due to extreme event, infrastructure failure)									-	
		Monsoon flooding (due to extreme event, infrastructure failure)									-	
		Embankment overtopping										
		Under- and over-drainage										
		Improper operation (public use, mistuning of scheduled O&M events etc)										
		Riverbed aggradation/degradation										
Abandonment	Normal	Re-occupation of infrastructure sites										
		Reclamation of materials										
	Abnormal											

Environmental Screening Matrix

Screening matrix / PHASE	Normal/ Abnormal	Activity / Important Environmental Component	Land Use	Agri-culture	Fisheries	Water Quality	Water Quantity	Human Health	Social Issues	Wild Plants & Animals	Hazards	Other
Construction (continued)	Abnormal (cont'd)											
Operation	Normal	Pre-monsoon flood protection		+	-		+				+	
		Monsoon flood protection		+	-		+		+	-		
		Surface water irrigation (ALT 2 ONLY)		+	-		+					
		Ground water irrigation N/A										
		Drainage		+	-		+			-		
		Agriculture: operation of institutions, extension, credit, seed distribution, fertilizer and pesticide storage and use, farmer groups							+			
		Water management: activities of IIWDB, subproject implementation committee, local water user groups, structure committees and guards							+		-	
	Abnormal (relative to FWO, not FW normal)	Pre-monsoon flooding (due to extreme event, infrastructure failure)									-	
		Monsoon flooding (due to extreme event, infrastructure failure)									-	
		Embankment overtopping										
		Under- and over-drainage										
		Improper operation (public cuts, mistuning of scheduled O&M events etc)										
		Riverbed aggradation/degradation										
Abandonment	Normal	Re-occupation of infrastructure sites										
		Reclamation of materials										
	Abnormal											

2. BIOPHYSICAL DESCRIPTION

2.1 Location

The Surma-Kushiyara Project covers a gross area of 49,200 ha in the northeastern part of Sylhet district, between latitude 24° 43' and 25° 02' North, and longitude 91° 59' and 92° 30' East. The project area is confined by the Surma and Kushiyara Rivers from the bifurcation of the Barak River in the east to the hills between Golapganj and Manikkona near Fenchuganj in the west (Figure 1).

2.2 Climate

The climate of the project area is monsoon tropical with hot wet summers and cool dry winters. The highest temperature in the area was recorded at 40.6 C in May and the lowest at 8.9 C in December and February. The lowest monthly temperature is in January, when the mean is 18.7 C and the highest monthly temperature is in July, when the mean is 28.8 C.

Rainfall distribution shows a general pattern of gradual increase from south to north. Average annual rainfall in the area ranges from about 3000 mm in the south near Fenchuganj to about 5000 mm in the north near the outfall of Lubha into the Surma River. Mean monthly rainfall varies from 9.2 mm in January to 916.5 mm in June, and mean annual rainfall is 3833.7 mm. Potential evapotranspiration is lowest in December at 102.6 mm/month and highest in March at 162.4 mm/month.

2.3 Land (Physiography)

2.3.1 General Description

The Surma-Kushiyara Project area consists of two topographically distinct sub-areas: a saucer shaped plain of the Sada Khal basin in the eastern part of the area, and hills plus the old Kushiyara (Kura Gang) floodway in the western part.

The area is dotted with beels and laced with a dense network of internal khals. Most of the khals originate from the surrounding Surma and Kushiyara Rivers, and drain into the main drainage channels of the area, the Sada Khal and the Kura Gang, (each of which have several names along their courses). Several of the khals pass through beels and supply them with fresh water from the rivers during the monsoon.

The ground elevations of the area vary from about 6.5 m to above 17 m PWD. The high ridges along the river banks are about 3 m to 4 m above the lowlands in the interior part of the basin.

The locations of low-lying and hilly areas within the project are shown in Figure 1. The project basin elevation versus cumulative area relation is given in Table A.3 and graphically presented for the area upstream from the Sheola-Charkhai Road (Area A) in Figure 2, and for the area downstream from the Sheola-Charkhai Road (Area B) in Figure 3.

2.3.2 Soils

Soils in the Surma-Kushiyara project area were developed from alluvial sediments laid down by the Surma and Kushiyara Rivers. Heavy clay soils occur in the deeply flooded basins. Silty clay soils occur on low, smoothed-out ridges and basin edges. Silty clay loams are found primarily on ridges while medium texture soils (loam to silt loam) occupy the highest topographical positions.

The finely textured soils (silty clays and clays) are poorly to very poorly drained, grey to dark grey in colour and have low available moisture holding capacity. Moderately fine textured (silty clay loam) and medium textured (silt loam) soils are olive brown to grey in colour, imperfect to poorly drained and have high to moderately high available moisture holding capacity. The natural fertility of these soils is moderate and they are capable of producing fairly good crops.

2.4 Water (Hydrology)

2.4.1 Runoff Patterns

The hydrological regime of the Surma-Kushiyara basin is governed by the Surma and Kushiyara Rivers, distributaries of the Barak River.

The Barak River is about 400 km long and has a drainage basin of 25,263 km^2 which is located in India. The upper part of the basin is hilly with mountains reaching 3000 m above sea level. The river descends to about 30 m PWD in the flood plain before it enters Bangladesh at Amalshid, where it bifurcates into the Surma to the north and into the Kushiyara to the south.

The Surma and Kushiyara Rivers, which flow on the higher ridges, define the natural boundaries of the project basin. As the interior part of the basin is below the banks of the rivers, the rivers dominate the flooding and also control drainage from the project area.

The Kushiyara River does not have any tributaries within the project boundary (the Sonai River channel in India has been closed), and all the discharge of the river comes from the Barak.

The Surma has three right bank tributaries, the Baliachara, the Gumra, and the Lubha Rivers. The Baliachara and the Gumra Rivers have small catchments (132 km^2 total), and as they pass through a large flood plain before joining the Surma their floods are moderate. The Lubha River has a catchment of about 724 km^2, most of which is in the Cachar Hills of Assam in India. It carries high peak flash floods which discharge into the Surma at Bandarbari about 40 km downstream from Amalshid. During the monsoon, following rainstorms, the Lubha flood inflows cause the current in the Surma to reverse in the entire reach from Bandarbari to Amalshid. This condition can last for several hours.

The Surma and Kushiyara Rivers are in their flood stage between April and November and water enters the area at this time through open khals and by overbank flow.

2.4.2 Flooding

The Surma-Kushiyara Project area experiences two types of floods: the pre-monsoon flash floods occurring from March to May, and normal monsoon floods occurring between June and October. In some years, flash floods may also appear during the post-monsoon period from October to December.

Most of the pre-monsoon floods (up to 1:10-year before 15 May) are within the riverbanks but water can enter the project area through several open spill channels.

During the construction of the Surma embankment all left bank spill channels were closed. Subsequently, several khals are being reopened and closed annually. The Kakura Khal, which was also closed has been opened and now remains open.

According to local residents, the Kakura Khal used to be a small channel and the Surma water would enter the khal only during high river stages. Since the embankments were constructed, flow in the Kakura Khal increased and its channel is eroding at high rate. Presently this khal is the main source of pre-monsoon floods in the lower parts of the project area near Sheola and Erali Beel.

The estimated inflow through the Kakura Khal is about 200 m^3/s. Since the Sada Khal is silted downstream of the Sheola Road Bridge, the inflow from the Kakura Khal causes flooding of the lands in the upper part of the basin. In the post-monsoon the Kakura Khal drains back into the Surma River.

In addition to the open khals, during the monsoon, the Surma left embankment is breached or cut by the public in several places. Some cuts are made to facilitate navigation across the Surma-Kushiyara basin and other are made by farmers, apparently to bring silt into the low beel areas.

Five khals remain open on the Kushiyara River: Jagirdari, Napit, Kharati (an outfall of the Sada Khal), Aval and Karam Khal. The offtakes of these khals are partly silted and they serve as Kushiyara high water spill channels during the monsoon season. Other Khals are closed or completely silted.

Intensive siltation in the lower section of the Sada Khal, coupled with flood inflows from the Surma through the Kakura Khal prevent drainage and intensify basin flooding during the pre-monsoon and monsoon seasons.

At present the project is embanked along the entire Surma boundary and along the Kushiyara from Amalshid to Chandrapur. However, due to the existence of the open khals (mainly the Kakura Khal) the middle and lower part of the area is subjected to pre-monsoon flooding. During the monsoon between June and October), about 80% of the project area is flood affected. During this period, the Surma and Kushiyara Rivers stages are close to or above their banks. Also during this period, most of the flood inflow into the basin is from the Surma, and during peak floods, the two rivers are interconnected through the Kakura-Sada and other khals.

2.4.3 Drainage

Water levels in the Surma and Kushiyara Rivers remain above the basin level for most of the monsoon season, which restricts gravity drainage.

Drainage from the project is effected through the centrally located Sada Khal in the upper part of the basin and through the Kura Gang (an old Kushiyara channel) in the lower part of the project. The Sada Khal basin has a dense network of khals and beels which retain as well as drain local runoff into the Sada Khal. However, the outfall of the channel is partially silted and most of its monsoon discharge flows across the floodway into the Kura Gang which empties into Damrir Haor near Fenchuganj.

At the end of monsoon the Kushiyara and Surma stages fall rapidly, the water accumulated in the project basin drains into the rivers; initially through several of the open khals and later on only through the Kura Gang and the Sada Khals.. Since the lower section of the Sada Khal is silted, towards the end of the drainage period the part of the basin upstream from the Charkhai-Sheola road drains only to the Surma through the Kakura Khal. As a result, post monsoon drainage is slow.

2.4.4 Water Bodies

Open water bodies

About 65% (22.850 ha) of the project area is seasonally inundated to a depth of greater than 0.3 m of which 3% (700 ha) is perennial beels. The larger permanent water bodies are: Anwa Gang, Balai Haor, Chechua Beel, Chatal Beel, Chapti Beel, Chunnia Beel, Dubail Beel, Dubag Beel, and Erali Beel. Sada Khal and Kura Gang are the two major drainage systems in the area. Most of the khals which drain into these systems are spill channels of the Surma and Kushiyara Rivers. Most of the khals in the Surma-Kushiyara basin are seasonal. The size of these open water bodies is decreasing due to siltation.

Closed water bodies

In addition to the open beels and khals there are over 10,000 ponds and ditches used mainly for fish production. There are 4594 ponds in the project area covering about 355 ha of land, and more than 6000 ditches suitable for seasonal fish production. More than half of homesteads in on high land have ponds.

2.4.5 Surface Water Availability

The Surma and Kushiyara Rivers are the external source of water in the Surma-Kushiyara Project area. During the rainy season, spills from these two rivers augment the discharge in the Sada Khal and in the Kura Gang which are the main drainage collectors of the upper and lower part of project area respectively. Towards the end of the dry season the internal khals dry up.

Surma River

Within the project boundary, the Surma River conveys a part of the Barak River discharge and the discharges of its right bank tributaries; the Lubha, Gumra, and Baliachara Rivers. The Gumra and Baliachara are small streams which are dry during winter season.

At the bifurcation, the channel bed of the Surma is higher than that of the Kushiyara, and as a result the inflow from the Barak into the Surma is lower. It varies from about 40% of the Barak discharge at high stages to nothing at the low stages.

In an average year, during the dry months between January and March, there is no flow in the Surma between Amalshid and the outfall of the Lubha River. The dry season flows in the Surma measured at Kanaighat Station No. 266 originate mostly from the Lubha River.

The mean monthly discharges in the Surma River recorded at Kanaighat range from a 2.7 m^3/s minimum in March to a 1960.3 m^3/s maximum in August. For details on water levels and discharges refer to the tables in Annex A.

Kushiyara River

Starting at the bifurcation, [illegible], the Kushiyara River has a higher bed slope and [illegible] deeper than the Surma River. The distribution of the Barak flow into the Kushiyara [illegible] from about 60% during high river stages to about 100% during low river stages.

The Kushiyara does not have any branches within the project bou[illegible], since the left bank Sonai River channel in Karimganj in India has been closed. All the [illegible]hiyara right bank khals within the project are spill channels. The Sada Khal (Kharati K[illegible] at the outfall) and the Kura Gang convey spill waters of the Surma and Kushiyara Rive[illegible] and local basin runoff.

There are three hydrometric stations on the Kushiyara within the project: Station No. 172 at Amalshid, Station No. 173 at Sheola, and Station No. 174 at Fenchuganj. Long-term stage and discharge data are available at Sheola, and stage data are available at Amalshid and Fenchuganj.

The mean monthly discharges in the Kushiyara River recorded at Sheola range from a 37.0 m³/s minimum in March to a 2188.1 m³/s maximum in August. The water level and discharge data are presented in Annex A.

Sada Khal

The Sada Khal, which has different names at various locations, is the main drainage collector of the upper basin of the Surma-Kushiyara Project. It originates as Rahimpur Khal at the eastern end of the basin and falls into the Kushiyara as Kharati Khal about 10 km downstream of Sheola Bridge. During the rainy season it carries the inter-riverine rainfall runoff and the combined flood spills from the Surma and Kushiyara Rivers. During the rising river stages, when water from the rivers enters the basin, the Sada Khal does not drain into the Kushiyara through its outfall (the Kharati Khal), but rather is diverted over the floodplain into the Kura Gang which empties into Damrir Haor at the western end of the project. As river levels begin falling, the basin drains back to the rivers through the open khals. However, due to siltation of the channel downstream of the Sheola Bridge, late post-monsoon drainage (through the end of December) from the Sada Khal basin is into the Surma via the Kakura Khal.

A gauging station was installed in the Sada Khal at the road crossing at Sheola in 1952. Water level and discharge data for the wet months from June to November are available until 1977. The highest flow was 1970.6 m³/s, recorded on 4 August 1964 at a stage of 13.05 m PWD, and the highest stage was 14.06 m PWD recorded in 1966. The Sada Khal water records represent a combined flow of the local runoff and the spills from the Kushiyara and Surma Rivers. The water data from the Sada Khal Station No. 173A are provided in Annex A.

2.4.6 Ground Water

The area is a part of the Upper Meghna Valley alluvium. Sediments carried by the Surma and Kushiyara Rivers have gradually built up the land. The deposits are predominantly fine textured silts and clays which have poor water bearing capacity. Therefore, there is a limited possibility of locating a good aquifer at a shallow depth.

Seven exploratory bore holes were drilled within the Surma-Kushiyara basin in 1965 as part of the Upper Kushiyara Project feasibility investigation. The results of the boring (Table A.13) show that the upper soil strata contains mostly clay and silt. This indicates that there may not be sufficient ground water pote[illegible]al to support a reliable tube well irrigation system.

There is, however, sufficient ground water to meet domestic requirements. Department of Public Health Engineering (DPHE) installed over 2000 hand tube wells in the area by 1990. Findings of the field investigations conducted in the area in 1992 under the FAP 16 Environmental Study reveals that most of the HTWs have adequate water supply during the dry months of March and April. Many wells, however, are not in an operating condition (ISPAN, 1992).

2.5 Land/Water Interactions

2.5.1 Siltation

Serious siltation occurs at the offtakes and outlets of the khals which flow into and out of the Kushiyara River.

There is no siltation associated with khals originating in the Surma River. This may be attributed to the fact that the Surma has a higher water profile than does the Kushiyara. The corresponding velocities are also higher and prevent sediment deposition at the offtakes of the Surma's distributaries. The sediments carried with the flows from the Surma are deposited in the beels and in lower reaches of the basin drains.

Intensive siltation takes place in various khals and beels. These include Rahimpur Khal upstream and downstream of the regulator, offtakes and upper sections of Senapati, Muskendar, Shiker Mohal Khal, Dubail Beel, July and Urban Beel. Also, the lower section of the Sada Khal and its outfall (Kharati Khal) have seriously infilled with sediment. With the exception of the Sheola Khal, all of the Kushiyara right bank khals downstream from Sheola are partly or completely silted at their outfalls.

Water flows from the rivers into the basin, and siltation of the khals and beels in the upper part of the project area impacts on fisheries. Siltation of the khals in the lower part of the project causes drainage congestion and intensifies flooding, primarily during the pre-monsoon season.

2.5.2 River Erosion

River bank erosion and breaching of the embankments occur along both the Kushiyara and Surma River. Erosion rates are generally low and occur due to progressive migration of the river's meander pattern. This process is driven by secondary currents in the channel which deposit sediment on the convex side of the meander bend and scour material from the outer (concave) side of the bend. As a result, local sloughing and slow bank retreat are occurring at virtually each of the sharp bends in the rivers. Erosion rates on the Kushiyara and Surma Rivers are limited by the cohesive nature of the banks and the low velocities of the river.

The highest rates of bank erosion have occurred near Amalshid at the point where the Barak River divides to form the Surma and Kushiyara Rivers. According to available historic maps, the location of the bifurcation appears to have shifted considerably over the last 40 years. This shifting has produced erosion rates of 15 m/year on the Surma and Kushiyara Rivers. Recent surveys have shown that the banks are continuing to retreat in spite of temporary protective works that have been constructed.

2.5.3 Crop Damage

Flood damages agricultural crops almost every year. Because of poor drainage, flood water remains in the fields for long periods. This delays seedbed preparation and transplanting of both aman and boro. As a result, some lowlands and medium-lowlands remain fallow. During April

and May, flash floods often destroy the early growth of aus and broadcast aman. These floods can also damage standing boro prior to harvesting. Transplanted aman is affected by seasonal floods and by late flash floods.

At present, due to the inadequate drainage and flooding the agricultural potential of the project area is not fully utilized. Part of the cultivable land remains fallow, and the present crop production is low due to flood damage.

2.6 Wetlands and Swamp Forest

2.6.1 Natural Wetlands

There are two very important wetlands situated within this project. The most important is *Balai Haor* consisting of four perennial beels (Dubail, Jugni, Khagra, and Singaikuri) with a combined area of about 300 ha. The haor is situated in between Sada Khal and Kushiyara river and on the west side of Atgram Zakiganj by-pass road. It is a medium sized, flat-shallow wetland which is a very good habitat for numerous submerged and rooted floating plants. It also acts as an important stopover for large numbers of migratory waterfowls — particularly ducks. In terms of wildlife, the threatened Smooth Indian Otter still inhabits this haor. *Rana temporalis*, a very rare amphibian is also reported in this wetland. This wetland meets at least three of the criteria for wetlands of international importance under the Ramsar Convention: criterion 1(d), it is an example of a specific type of wetland, rare or unusual in the appropriate biogeographical region; criterion 2(b), it is of special value for maintaining the genetic and ecological diversity of a region because of the quality and peculiarities of its flora and fauna; and criterion 3(b), it regularly supports substantial numbers of individuals from particular groups of waterfowl, indicative of wetland values, productivity and diversity.[1]

The second most important wetland is *Erali Beel* with an area of about 320 ha. The main beel has two sister beels — Boomail beel and Chatal beel which are near and are connected by Kura Gang. Erali Beel is relatively small in size but deep and is surrounded by small hills. There are three small islands inside the beel created by those hills. These islands and the surrounding hills have a unique mixed plant community consisting both wetland and hilly plants. This beel is also a preferred stopover for migratory birds and the very rare Hen Harrier was observed in this beel[2]. The small islands serve as a nesting ground for freshwater turtles. This area is also populated by some other smaller mammals including otters, fishing cats, and civets.

2.6.2 Swamp Forest Trees

There is no swamp forest within this project area, but individuals of these species can be found in homestead groves.

[1] Montreux Proceedings, Vol I, Annex I, Rec. C.4.2 (Rev)

[2] Dr. D. Scott and S.M.A. Rashid, Ornithology Main Survey, NERP, 1992

3. SETTLEMENT, DEVELOPMENT, AND RESOURCE MANAGEMENT

3.1 Human Resources

3.1.1 Land Use and Settlement Pattern

Land Use
Current land use is summarized in Table 3.1.

Table 3.1: Current Land Use

Use	Area (ha)
Cultivated (F0 + F1 + F2 + F3)	33,600
Homesteads	1230
Beels	713
Ponds	800
Channels	490
Hills	4537
Fallow[1]	4900
Infrastructure[2]	2930

[1] Multi-use land, wetlands, grazing lands, village grounds. Includes F4 land.
[2] Government-owned land not appearing elsewhere.

Settlements
Villages are mainly found along the levees of the Surma-Kushiyara Rivers and along various road sides. Exceptions are along the hills of Golapganj and the Beanibazar area. The river banks and Sylhet-Zakiganj road sides are densely settled, while settlements tend to be more sparsely scattered along the foot of the hills. While settlements are also found along the various roads, they are extremely sparse in areas where the land elevation is very low.

Flood Damage to Housing
Generally, there has been very little monsoon flood damage to the villages, except erosion of homesteads at certain levels along the Kushiyara River. More recently, however, many villages along the Kushiyara as well as along the interior sides are reporting damage to homesteads as a result of flash floods between July and September. The damage mainly results from overbank Kushiyara flow and from water intrusion through the breaches. Obviously, the lower the elevation at which homesteads are placed, the worse is the risk of flooding.

Coping Strategies
Homestead platforms are usually raised up to one meter to avoid monsoon flooding. Wave action which erodes homestead platforms in some areas of the region is almost non-existent here. Flood waters from the monsoon flash floods usually recede from the homesteads within two or three days. If there is severe flooding, villagers generally make platforms inside their houses and shift their belongings to a safer place. In such situation, the poor suffer the most.

3.1.2 Demographic Characteristics

The total population of the project area is estimated to be 376,000 of whom 184,300 are female. The gender ratio is calculated to be 104 (males to 100 females). The total households, are estimated to be 60,200 within 470 villages. The population increased by 27.7% between 1981-91 in the district of Sylhet.

Table 3.2: Population Distribution by Age Group (%)

Sex	Population Age Group (Years)						Total
	0-4	5-9	10-14	15-54	55-59	> 60	
Male	16.4	15.9	14.0	45.6	2.0	6.1	100.00
Female	17.5	16.9	13.6	46.2	1.3	4.5	100.00
Total	16.9	16.4	13.7	45.7	1.6	5.6	100.00

Source: BBS, 1981 Population Census

The cohort distribution for males is: 32% are below 10 years of age, 45% are between 15 and 54 years of age, and 6% are above 60 years of age. The corresponding distribution for females is 35%, 46% and 4% (see Table 3.2).

The average population density is 764 persons per km^2, with density ranging from a maximum of 893 persons per km^2 in Golapganj to 456 persons per km^2 in Kanaighat. The average household size in the area is estimated to be 6.25 persons.

3.1.3 Quality of Life Indicators

Quality of life is usually determined by several key indicators. Those described here are literacy, access to health, sanitation, and pure drinking water facilities.

Literacy

In the project area the literacy rate is found to be extremely varied. According to the 1981 census, the literacy of the population at 5 years of age and above varied from 14% in Kanaighat thana to 28% in Beanibazar thana. The corresponding figures for females were 6% and 21% respectively for the same thanas. The rate appears to have increased over the last 10 years. According to the 1991 census, the literacy rate for all people of Sylhet district is recorded as 25% for both male and female.

According to the 1981 census, school attendance in the project area for all children 5 - 9 years of age varies from 22% in Kanaighat thana to 40% in Beanibazar thana. Attendance for females in this age cohort in these two thanas varies from 16% to 37% respectively. Attendance for all youths between the ages of 5 and 24 is 18% and 32% for these thanas while the corresponding attendance for females is 10% and 26%.

The situation is worse for the rural poor. They can not afford to send their children to school. Moreover, many villages, especially in Kanaighat, and Zakiganj thanas, have no primary schools. The average number of primary schools per 10,000 population is estimated to be 5.5 for Sylhet district (BANBEIS, 1990).

Access to Health Services

The district headquarters of Sylhet has a medical college with a hospital and all thanas have hospital facilities located at their headquarters. Access to health services is generally limited for rural villagers and is out of reach of the poor. According to the Directorate General of Health Services (1992), there is one hospital for every 162,190 persons and one doctor for every 9915 persons in the district of Sylhet. One hospital bed is meant for 2351 people. Immunization coverage of children below two years of age is quite high for the project area. The rate varies from 45% in Zakiganj thana to 65% in Golapganj thana (1990).

Rural Water Supply

Detail information on access to rural water supply for drinking purposes are not available for the project area. However, for the rural areas of the district of Sylhet, DPHE[1] reports the availability of one working tube well for 134 persons. In 1990, 59% of the households had access to potable water in the district. It is noted that most tube wells are located in the houses of the rich. This results in the poor having very limited access to potable water.

Sanitation

Specific information on sanitation facilities are not available at the project level. During field reconnaissance, it was noted that open space defecation is a common practice in the rural villages, particularly for males. Women generally use kutcha latrines or defecate at a fixed spot which is protected by banana or betel nut leaves. Sanitary latrines are uncommon in the village environment, except for the very well-off and educated families.

3.1.4 Employment and Wage Rates

Village employment opportunities are mainly limited to agricultural activities. The major crop in the area is t aman; employment for men is mainly limited to transplanting which occurs between August and September and harvesting which occurs in late November and December. Employment during boro cultivation is limited to the labourers living in low-lying villages.

The wage rates for male agricultural labourers varies from Tk 40 - 50 with or without a meal per day during peak agricultural months. During months when there is no agriculture work, the wage rate varies from Tk 25 - 35. It is reported that during the monsoon months, some labourers work on sand and stone carrying activities. They are usually involved in transporting these materials from the quarries at the Sarigoyain and Lubha rivers to various construction and sale centres throughout Sylhet district. The average daily income from this activity varies from Tk 60 - 100. During months when employment opportunities in agriculture are limited, some poor people migrate to Sylhet city to work as rickshaw pullers, as construction workers, or sometimes in household activities. Employment opportunities for women is very limited in the area, except for the Rural Maintenance Program of CARE, where a few poor women are employed. Women generally migrate to Sylhet city to perform household works, but their numbers are very limited. Many villages have no such migrant woman labourers.

Migration to outside countries, particularly to the UK, is common in Golapganj and Beanibazar thanas. However, such migration is less in other thanas of the project area.

[1] DPHE, 1991-92

There is in-migration into the project area, mainly from Mymensingh and Noakhali. They come to the project area and stay seasonally to work on harvesting of rice crops and earth work.

3.1.5 Land Ownership Pattern

Land ownership is extremely skewed in the project area. Nearly half of the households are landless (with cultivable land less than 0.2 ha). Among the landless, about 1.5% have no homesteads of their own. If the definition of landless includes landholdings up to 0.4 ha, the number of households included increases by an additional 10%. Among the others, the small (0.21 - 1.00 ha), medium (1.01 - 3.00 ha) and large farmers (more than 3.00 ha) are 26%, 19% and 5% respectively.

The project area has little uncultivable land except for the deeper wetlands. As such, there are no community pastures in the area. The price of agricultural land varies from tk 15,000 to tk 40,000 per ker (0.12 ha) depending on the quality of the land and the intensity with which it can be cropped.

3.1.6 Land Tenure

Owner operation is common in the area. A few large land owners, particularly from Golapganj and Beanibazar thanas, share out their lands to tenants for operation. The share cropping system is that one-half of the produce is retained by the land owners but they provide no inputs. The leasing out of land in kind (chukti) is almost nonexistent in the area. However, leasing out of land with advance cash (pattani) is practised in some cases. The usual rate for such arrangements varies from tk 500 to tk 2000 per ker (0.12 ha) and this is paid in advance to the land owner for one year. Landless people have very little access to land under this tenurial arrangement due to their inability to provide the cash after which they must still purchase agricultural inputs.

3.1.7 Fishermen

Traditional fishermen in the project area are very small in number. However, fishing is now practised as a profession by many poor people, particularly during monsoon months when they can fish in open water. Such non-traditional fishermen are increasing and they are larger in number in the low lying beel areas. Additional information on fishing practices and so on is given in Section 3.5.1.

3.1.8 Situation of Women

The strict gender division of labour in farming households entails the high dependance of men and women in agriculture production. Women's contribution, however, tends to be be less recognized. In Konaighat, Jaintiapur, and Gowainghat thanas, female seclusion is enforced more strictly than elsewhere in Sylhet. While in the city of Sylhet, women move with some freedom, their movement elsewhere in the District is highly restricted. Some poor women are reportedly working outside their homes in the CARE Road Maintenance Program. Others collect wild vegetables, fuel, and even catch fish with small fishing traps. These activities, however, tend to lower their families prestige. Education levels in the project area are also very low for both females and males and contraceptive acceptance is low. It is important to recognize that an accurate reading of women's situation in the context of the proposed project will require an extra effort since these women are not easily accessible -- particularly by male outsiders.

3.1.9 People's Perception

General

Local people's perception of their problems were solicited. These were related mainly to water and its impact on their livelihood and their suggestions as to the nature of interventions which solve these problems. These were collected through personal interviews, group discussions and meetings with various cross-sections of people during the relatively short (7 - 10 day) field work in the project area. These are described below.

Problems

Flooding, both pre- and monsoon, was described as a major problem of the area. This flooding mainly damages rice crops. Boro and aus are affected by pre-monsoon floods between April and May and accumulated rainfall. These flash floods enter through various breaches/canals from the Kushiyara river. There are also a number of smaller pockets so affected throughout the project area.

Monsoon flash floods during July and September damage t aman, particularly in Zakiganj and Kanaighat thanas. The flood waters enter from the Kushiyara and the Surma Rivers overtopping roads and embankments and last for 3 to 5 days in the upper areas. There are 2 to 3 such occurrences reported in every monsoon period.

Drainage congestion is another important issue as perceived by the farmers, particularly around the lower beels, where boro is grown. Similar congestion problems are reported by farmers from other localities of the area. This is because of silting up of the internal drainage canals as well as the rivers. In this context, Rahimpur khal and Sada khal are mentioned as a major problem since they have silted up in many places. Silting of the Surma and the Kushiyara Rivers was also referred to as a serious cause of flooding in the area.

Erosion of the Kakura khal is also mentioned as a serious problem of the area.

Subsistence and poor fishermen stated that the prohibition of open water fishing by jalmohal leasees was for them a major problem. This practice was attributable to the influential and powerful leasees. The fishermen cooperatives under the New Fisheries Management Policy generally did not adopt this practice. It was also noted that where the leases were taken by local fishermen, much more care was taken to ensure the sustainability of the resource. Fishermen considered that the major problem for fisheries was overfishing though they also stated that roads and embankments in the flood plain also reduced fish production. Concern was expressed that fish migration into the project area would be reduced if a project was constructed which closed the Sadar and Rahimpur Khals.

People generally expressed the need for the water transportation network. If a proposed project did not provide for this transport, there would be a need to cut embankments during the early monsoon months.

Suggestions

Numerous suggestions were put forward by local people. However, some suggestions are meant for very small and localised issues. The most common are:

- Re-excavate the Sada khal and Rahimpur khal to the extent necessary for internal navigation and drainage purpose.
- Develop the entire Kushiyara right bank and Surma left bank to protect intrusion of flood water into the project area.
- Dredge the Surma and the Kushiyara rivers.
- Construct sluice gate at Kakura khal with provision for boat passage.
- Lease jalmohals only to local fishermen.
- Allow poor and subsistence fishermen to catch fish in the flood plain.
- Conserve sufficient fish habitat, particularly in the kanda, for normal production of fish.
- Retain adequate provision for fish movement from the rivers to the beels.
- Any structures on the Sada and Rahimpur Khals should allow provision for navigation.

3.1.10 Local Initiatives

Information on specific local initiatives to avert flood-related problems in the project area were not collected during the field visit. However, people stated that it is their traditional practice to organize local people to counteract crisis which arise as a result of flash floods and drainage congestions. The main activity is to construct dams on various localised canals to stop the intrusion of pre monsoon flash floods to save the boro crop. They would also assemble to re-excavate canals for quick drainage. This is generally done on a voluntarily basis by the villagers around a particular canal which is threatening their property. More recently the Union Parishad also allotted wheat for this purpose.

3.2 Water Resources Development

3.2.1 Flood Control & Drainage

The existing water development infrastructure in the project area includes flood embankments along the Surma and Kushiyara Rivers, three flushing/drainage regulators, and river bank protective works at the Amalshid bifurcation and at Zakiganj town.

Surma Embankment

Construction of the Surma left embankment, locally called the "Surma Dyke", begun in the early 1950s. The main purpose of the embankment was to protect homesteads along the river. Records of design or construction of the first embankment are not available, but the 1960 irrigation maps show a continuous embankment from Sylhet to Charkhai. Construction of the section from Charkhai to Amalshid was begun in 1963 and continued until completion in 1985. In 1973 the SARM Upper Kushiyara Project Feasibility Report was accepted by BWDB, and the remaining portion of the embankment was constructed according to the design criteria set out in the Feasibility Report. The 1973 design was for protection of the area with embankments designed for 1:10-year return period flood. The proposed cross-section of the embankment was: 4.27 m crest width and side slopes 1:3 on river side and 1:2 on country side. Since 1985 BWDB carries annual maintenance and repairs of the Surma embankment under FFW Programme.

The Surma embankment, as constructed, varies greatly in height and cross-section. It is about 1.0 to 2.5 m high, has about 2.4 to 3.0 m crest width and about 1:2 side slopes. The embankment does not have a sufficient set back and in many places it is located right on the river bank. Embankment erosion by river flow and public cuts frustrate the objective of flood prevention.

Kushiyara Embankment

Kushiyara embankment construction has been carried out locally over the last 30 years, and at present it extends from Amalshid to Chandrapur (about 65 km). The main purpose of the embankment is to protect homesteads along the river. The alignment of the embankment is along the high ridge, in some places close to the river bank, it is about 1.5 m high, has a 2.4 m crest width and 1:1 side slopes. Unlike the Surma embankment, there are no public cuts in the Kushiyara embankment, but because of its proximity to the river, erosion and breaching during peak floods is a problem.

Structures

Along the Surma there are twd flushing/drainage regulators: a single-vent (1.5 x 1.8 m) Moulavir Khal Regulator in the Surma embankment to control the flow to Erali Beel, and a two-vent (1.5 x 1.8 m) Sunam Khal bridge cum regulator located about 1 km inland from the Surma River. These regulators, constructed in 1980 and 1985 respectively are in good operating condition. The Moulavir Khal was re-excavated in 1991.

One three-vent (1.8 x 2.4 m) bridge cum regulator was constructed in 1987 along the Kushiyara at Rahimpur. This regulator is used for flushing during monsoon, mainly for pisciculture. The structure is in good condition but the khal, which was closed prior to the construction of the regulator, fills with silt and needs to be re-excavated every year.

3.2.2 Irrigation

At present boro crops are grown in about 5,000 ha, using water conserved in local beels and khals at the end of monsoon. Traditional irrigation methods are used for irrigating the local boro grown in lower lands and low lift pumps are used for irrigating HYV boro rice (about 1,700 ha) grown in relatively higher lands. Only one deep tube well and several shallow tube wells are in operation in the project area.

Surface Water

There is no externally planned surface water development in the area. Local farmers manage the existing low lift pump irrigation which is based on the internal water stored in the basin at the end of monsoon. There is no irrigation from the Surma and Kushiyara Rivers within the project boundary.

Ground Water

Essentially the present ground water development in the project area is limited to hand tube wells for the supply of drinking water. The water potential of the deep aquifer is poor, which limits development of tube well irrigation (Section 2.4).

3.3 Other Infrastructure

A Roads and Highways Department regional highway runs through the project area from Golapganj to Zakiganj via Amalshid and from Charkhai to Sheola. Feeder roads connect the Highway with Mirganj Bazar, Sunampur, Chagli Bazar, Kanaighat, and Zakiganj with Atgram and Kaliganj Bazar. These roads are above the average annual flood level and suffer little flood damage.

Table 3.3 Present Crop Production

Crop	Damage Free Area			Damaged Area			Total Production
	(ha)	(t/ha)	(t)	(ha)	(t/ha)	(t)	
b aus	1830	1.25	2,287.5	6750	1.15	7,762.5	10,050.0
hyv aus	125	3.75	468.8	700	3	2,100.0	2,568.8
b aman	3530	1.75	6,177.5	1760	1.45	2,552.0	8,729.5
lt aman	2590	2.05	5,309.5	9500	1.85	17,575.0	22,884.5
hyv aman	275	3.95	1,086.3	1350	3.55	4,792.5	5,878.8
l boro	7910	2.25	17,797.5	1750	1.75	3,062.5	20,860.0
hyv boro	2310	4.55	10,510.5	1450	3.75	5,437.5	15,948.0
pulses	176	0.85	149.6				149.6
oilseeds	587	0.75	440.3				440.3
spices	59	2.25	132.8				132.8
vegetables	353	3.75	1,323.8				1,323.8

Construction was started on a new feeder road linking Zakiganj with Sheola along the right bank of the Kushiyara in the late 1980s. With 20 bridges and culverts completed, this work has been deferred.

There are about 90 km of village roads in the project area, out of which about 40 km are not accessible during the monsoon season due to flooding. The flooded roads are damaged annually, with an average damage rate estimated at about 15% of the capital cost. This translates into average annual flood damage of Tk 1,140,000.

3.4 Agriculture

Agricultural crops are damaged almost every year in the project area by floods and drainage congestion. During April and May, flash floods often destroy maturing local and high yielding varieties of boro rice. The situation is further aggravated by the accumulation of rainfall due to poor drainage. Water levels build up during pre-monsoon and during the monsoon season, and damage occurs to all rice types. The present cropping patterns and the crop production are given in Tables 3.3 and 3.4.

Information with respect to average yields obtained under damage-free conditions, crops damaged, percent of the crop area damaged, yield reduction due to crop damage etc. were collected by interviewing farmers in the project. These data were analyzed to obtain the total production and are presented in Table 3.4.

Table 3.4 Present Crop Patterns

Crop Pattern	F0	F1	F2	F3	Total
b-aus - hyv aman	525 (15)	1100 (22)			1625
b-aus - lt aman	1925 (55)	3600 (72)	1080 (12)		6605
b aus - rabi	350 (10)				350
hyv aus - lt aman - rabi	525 (15)	300 (6)			825
lt aman - fallow	175 (5)		5310 (59)		5485
h aman - fallow			2070 (23)	3220 (20)	5290
hyv boro - fallow			540 (6)	3220 (20)	3760
l boro - fallow				9660 (60)	9660
Total	3500	5000	9000	16100	33600

Numbers within parenthesis indicate percent of cultivated area under the respective land types.

Crop marketing patterns within the project area, like in other areas of Bangladesh, are largely traditional. Producers are compelled to dispose of part or, in some cases, all of their crops immediately upon harvest. The reason for farmers' inability to store their crops is variously: i) a need for cash; ii) lack of proper storage facilities (these typically consist of granaries located inside the household's main house); iii) crop loan obligations; or iv) tenure crop division arrangements. The producers are then frequently obliged to replace this food grain at a much higher price to meet daily consumption requirements. It is estimated that only 20 to 25% of the production actually enters commercial markets. Private traders handle about 90% of this amount.

Homestead agriculture production varies with the level and size of homesteads. On higher homesteads, which tend to be larger as well, trees (banana, mango, jackfruit, betel nut, bamboo, and so on) are common, providing fruit, fuel, and building material for use/consumption or sale. Lower, smaller homesteads have fewer trees. Most of the vegetables consumed by farming families are produced on the homestead plot, or on lower land adjoining it. Most farms keep poultry and many have cattle.

Homesteads are an integral part of the farming system. Courtyards are used for post-harvest activities (threshing, winnowing, parboiling, drying). Cow dung and compost made of domestic waste are used to fertilize agricultural land.

3.5 Fisheries

3.5.1 Floodplain fishery

About 15 important permanent beels exist within the project area of which the Erali beel complex, Dubail beel, Jugni beel, Khagra beel are the most renowned for fish production. Beels serve as overwintering refuges for the species present in the area. During the monsoon season, water from the Surma and Kushiyara Rivers flows in through open khals, breached dykes, and

Table 3.5 Major Fish Species in the Surma-Kushiyara Flood Plain

BOROMACH	CHOTOMACH
Catla, rui, mrigel, kalibaus, ghonia, boal, air, rita, chital, gazar, shoal.	Singi, magur, koi, tatkini, pabda, kanipabda, bashpata, batashi, bacha, tengra, gulsha, bajori, taki, chela, darkina, mola, dhela, titputi, puti, balichata, rani, foli, chapila, tara baim, baim, boicha, napit, bheda, chanda, kaikka, icha.

by overtopping both the rivers banks. Most of the beels are isolated basins and in a few cases they are interlinked with each other by narrow channels.

Most of the large fisheries are leased by a few rich influential persons for a period, usually of three years. They generally reside outside the area and appropriate the profits from the catch. This system deprives local fishermen of access to the fisheries resources. Neither is there much opportunity to serve as labourers for the final catch since fishermen from outside areas are generally hired for this purpose.

Conflicts and tension are common over the issue of fishing the jalmohals in the area, particularly between farmers and fishermen. The jalmohal lessees construct and maintain water retention dams on the beels drainage canals which prevents timely boro cultivation in the peripheral zone of the beels. On the other hand, annual beel fishing in mid-winter is a common practice in the area which results in completely draining the beels to maximize the catch. Neither of these practices are in the interests of the farmers.

It was reported that lessees do not permit fishing by either traditional or non-traditional fishermen in the vicinity of the jalmohals even during the monsoon months. This assertion was not cross-checked but it is in agreement with another study in the area (Minken, 1992). The extent of the jalmohal lessees' control over the area needs to be verified more closely during feasibility since this will have a significant bearing on the operability of any proposed intervention.

3.5.2 Species present in the area

Of the 133 species identified in the region, about 56 species inhabit the Surma-Kushiyara floodplain and beels. The most common of these species are listed in Table 3.5.

3.5.3 Duar fishery

Duars, which are an indispensable part of a typical floodplain fishery, act as a refuge for the larger mother fish during the winter season. These fish then migrate to a suitable spawning ground for breeding when water levels begin to rise. There are 4 duars in the Surma River and 20 duars in the Kushiyara River adjacent to the project boundary.

3.5.4 Sources of fish and breeding

It is generally understood that early rain, thunder, flooding, temperature, grassy or rocky land influence spawning of freshwater fish. If conditions are favourable, during the flooding time, fish migrate from beels to adjacent grassy areas, to the rivers, and vice-versa.

It is considered that the Erali beel area is a breeding ground for many carp species as well as other commercially important fish varieties. Large numbers of carp fry and fingerlings were seen by local people during the month of May in 1991 and 1992. The Erali Beel complex includes three beels with islands surrounded by small hills. These special topographical features combined with coarse sand in the vicinity of the beels make this a very favourable environment for carp breeding. The Erali Beel is also renowned for live fish production.

Other than carps, most species of fish could breed in other locations within the project area. Makria Khal near Bahar village, Rahimpur Khal, Jigirdari Khal, Napit Khal and Kharati Khal are the major channels linking the floodplain and the Kusaiyara River. The presence of deep duars in the surrounding rivers combined with the extensive floodplain makes the area an ideal place for fish production.

3.5.5 Production trends

Fish production in the Surma-Kushiyara area has apparently declined by 30-40% over the last 5 years. While no real estimates have been made of overall fish production for the project area, the estimated production is 1700 metric tons per year (see Table 3.6).

According to the NERP study, fish abundance is directly related to the level and duration of flooding, and access to the flood lands. The fish production in the project area has been declining. The identified causes of the fish decline are outlined below:

- Siltation of beels. The beel area has been reduced by about 30-35 percent; both, the depth of water and the water hectare-months are declining.
- Construction of sluice gates and closures of khals along the Surma left bank and the Kushiyara right bank. Regulators on Rahimpur, Sunam and Moulavir Bazar khals and closing or siltation of Pagli, Senapati, Dubail, and other khals have restricted fish migration to and from the floodplain, which reduces fish resources in the area.
- Reduction of the fish population due to over fishing and loss of fish habitat.
- Reduction of reproductive stock due to indiscriminate use of some fishing gear in the duars (kona jal, current jal, jam jal in the duars).
- Increased fish mortality due to fish diseases caused by water pollution in the beels, particularly during the months of December and January.
- Lack of proper extension services for the pond owners to develop culture based fish farming in the existing ponds.

- Reduction of fish habitat by encroachment of agriculture onto the fish producing beels.

3.5.6 Fishing practice

Floodplain

Open water fisheries are the major source of fish in the area (floodplain 60%, beels 23% and ponds 17%). Subsistence fishing occurs mainly during the flooding period and large-scale beel fishing occurs from November to February. In most cases, beel fishing is done on an annual basis.

Table 3.6: Present Fish Production

Types of water body	Area (ha)	Rate of Production (kg/ha)	Total Production (mt)
Beel	713	550	392
Floodplain	23000	44	1012
Pond	355	800	284
Total	24068		1688

Source: BFRSS

Piles are not maintained as a part of the biological management of the fishery resource, but for annual fishing, the installation of katha is common. Since hizal and koroch trees are very scarce in the area, jarul, tetul, and mango tree branches are widely used. Kathas are installed in the months of August and September during the time when the water recedes from the floodplain.

Closed Water

Pond fish culture practices are different here than in other parts of the country. Most pond owners in the project area release an uncounted number of fingerling into their ponds without undertaking other basic management activities such as predatory fish eradication and regular application of feed and fertilizer. Monitoring the growth and health of the fish is also not done on a regular basis. The fish are usually harvested during the dry season. It should be noted that the many ponds that adjoin homestead land provide domestic water supply for a wide variety of activities (bathing, washing clothes and dishes, occasionally watering homestead vegetable plots, and so on).

Recently some absentee landowners started pond construction and fish culture in the Golapganj area.

3.6 Navigation

Of the two project boundary rivers, the Kushiyara is navigable year-round and the Surma is navigable only during the monsoon season. During the dry season there is no flow in the Surma River between Amalshid and the outfall of the Lubha River, and downstream from the Lubha to Sylhet there is too little water for navigation.

During the monsoon most of village roads located in the low lying areas of the project are submerged and country boats are the only means of transportation. At present, small and medium-sized motorized country boats operate for about seven months a year between Surma and Kushiyara through the Kakura and the Sada Khals, but the navigation in the Sada Khal downstream from the Sheola Bridge is hampered by siltation. When the Surma-Kushiyara basin

is flooded, boats enter the project area from the Surma River through public cuts in the flood embankment. The Kakura-Sada Khal route is used mainly for transport of boulders and shingles from Lubhachara.

3.7 Wetland Resources Utilization and Management

The most important use of these natural wetlands product is fodder. Plants such as *Hygroryza aristata* (phutki), *Oryza rufipogon* (jhara dhan), and *Panicum paludosum* (local name not found) are common and the people who are living in and around the beels are dependant on these lands for cattle feed, particularly during the monsoon. In Balai Haor, the most productive area, people are collecting and selling fodder for about Tk 150 per boat and it was estimated that the whole haor area is producing about 100 boats full of fodder per week. This is equivalent to Tk 15,000. The harvesting period is about 12 weeks. As a result, the gross total value could reach Tk 180,000 per year. Taking the fodder-producing area of Balai Haor to be about 4000 ha, this is a yield of Tk 30 ha. The other seasonal wetlands of the area (F2 + F3 + F4) occupy about 25,000 ha and are probably only half as productive.

The next important use is food. These wetlands are producing starchy food as well as various types of vegetable. Both types have market value and vegetables like Nymphaea's floral stalk (shapla shaluk). The yield is probably of the same magnitude as for fodder or Tk 40/ha in Balai Haor and half this elsewhere.

Another important use of these resources is bio-fertilizer. People in these area generally do not use chemical fertilizer. Rather they produce green manure from the weeds of the wetlands. In this way, they are maintaining soil fertility.

Other uses of the wetlands are:

- Fuel material. Mostly from *Ipomoea fistulosa* (dhol kalmi) and *Lippia javanica* (bhuiokra).
- Medicinal plants. Mostly *Polygonum* (bishkatali, kukra) and *Limnophila* (karpur, bijatighash).
- Thatching material. Various grasses.
- Duck feed. Molluscs are used for this purpose.

These common property resources are of some importance to the poor, who are the most likely to engage in wetland gathering, to eat wetland food in times of scarcity, to depend on income from wetland products, and so on. Fodder and building materials tend to be collected by men, and food and medicinal materials tend to be collected by women. Information on resource management practices is not available.

4. PREVIOUS STUDIES

The area was studied earlier as the *Upper Kushiyara Project*. This study included an area confined between the Surma and Kushiyara Rivers from Amalshid to the Charkhai-Sheola Road, which was the western limit of the project (gross area 35,368 ha).

The original feasibility study report on the *Upper Kushiyara Project* was prepared by The Upper Kushiyara Study Team, Directorate of Schemes, EPWAPDA, Dacca, in accordance with the Scope of Work issued by EPWAPDA in April 1964. The Feasibility Study Report was issued in 1965 (Interim), and in 1966 and 1967 (Final). The Report was reviewed in October 1969 by an IDA Mission of the International Bank for Reconstruction and Development (IBRD), and recommendations were made for collection of additional data, revision and updating of the study.

The Revision and Updating of The Upper Kushiyara Project was carried out by SARM Associates Ltd., Dacca. An Interim report submitted in November 1972 was accepted by the BWDB, and the Final Report was issued in November 1973.

4.1 The *"Upper Kushiyara Project Feasibility Study Report"* by The Upper Kushiyara Study Team, Directorate of Schemes, EPWAPDA

The 1967 Final Report of The Upper Kushiyara Project considered six possible development schemes which are summarized below.

4.1.1 Scheme I

- full protection of 31,580 ha against the 100-year return period flood by an embankment along the periphery of the project area;
- drainage system for 31,580 ha with drainage to a pumping station of 198 m^3/s capacity for 10-year return period, 10-day duration, internal rainfall runoff; and
- irrigation system for 16,194 ha.

4.1.2 Scheme II

- flood protection of 31,580 ha by embankment as under Scheme I;
- a simplified gravity drainage system for 31,580 ha with drainage to a regulator instead of the pumping station; and
- irrigation system for 16,194 ha.

4.1.3 Scheme III

- full protection by flood embankments of 18,623 ha divided into 3 polders;
- drainage systems for each polder, each with its own small pumping station; and
- irrigation systems for each polder, serving a total of 16,194 ha.

4.1.4 Scheme IV

Scheme IV was similar to Scheme III except that there was no provision for drainage water removal by pump, but only by gravity flow to a regulator.

4.1.5 Scheme V

Scheme V was similar to Scheme II except that there was no irrigation. Flood embankments were to be constructed along the Surma and Kushiyara rivers for protection of the project area

from external flood waters and a simplified gravity drainage system provided with a regulator but no pump drainage.

4.1.6 Scheme VI

Under Scheme VI, low flood embankments along the Surma and Kushiyara rivers were to be constructed to delay the sudden rush of water into the project area. These low embankments, submersible by high floods, had to protect 31,580 ha of land (same as under Schemes I, II and V). An area of 18,623 ha of land was to be irrigated.

A preliminary side study was also made to check if diversion of a portion of the Kushiyara flood peak through Rahimpur-Sada Khal could reduce the height of a needed embankment along the Kushiyara River. This study indicated that, as the main flood is by passed through the low-lying areas and embankments would be required along both sides of this floodway in addition to the embankments along the main rivers, this diversion offered no advantage.

4.1.7 The Selected Alternative

Scheme II was found to be the most promising scheme and it was selected for development of the Upper Kushiyara Project. The proposed development for the project area was then as follows:

i) Full flood protection of 31,580 ha against the 10-year frequency flood, by construction of an embankment along the periphery of the project area.

ii) Simplified drainage system with a regulator at the outfall of Sada khal but without pump drainage at the initial stage. About 20,240 ha of land would be provided with a gravity drainage system.

iii) An area of 16,194 ha of land would be provided with irrigation facilities at a later stage, after flood protection and drainage works were completed.

4.2 The *"Upper Kushiyara Project, Revision and Updating of Feasibility Report"* by Sarm Associates Ltd.

This 1973 Upper Kushiyara Project Report considered four alternative development plans:

4.2.1 Alternative I: Flood Protection Only

This project concept envisaged 10-year flood embankments along the Surma and Kushiyara rivers and maintenance of the existing drainage system. All internal runoff would drain through Sada Khal into the Kushiyara River without provision of any structure at its outfall. A navigation lock was proposed at the offtake of Dalumati Khal for transport of boulders from Lubha Chara.

4.2.2 Alternative II: Flood Protection and Irrigation

This plan is identical to Alternative I except that irrigation was introduced for a total area of 9,474 ha. The irrigation water would be supplied to gravity canals from a 17 m^3/s pumping station at Rahimpur.

4.2.3 Alternative III: Flood Protection, Irrigation and Drainage

This plan envisages 10-year flood embankments along the Surma and Kushiyara rivers, a 60-vent gravity drainage sluice on Sada Khal at the Charkhai-Sheola road crossing, and two irrigation

pumping plants — one at Rahimpur and the other at Chiralbag. The Rahimpur plant would supply gravity irrigation to 10,668 ha as in the Alternative II. The Chiralbag plant would pump water into the Sada Khal for LLP irrigation of 5,465 ha with 2 f³/s pumps.

4.2.4 Alternative IV: Flood Protection, Irrigation and Pumped Drainage

Technically this plan is similar to Alternative III, except that the gravity drainage sluice is replaced by a pumping plant with 170 m³/s capacity. Also the irrigation area by the Rahimpur pumping station is increased to 18,826 ha.

4.2.5 The Selected Alternative

Alternative III was identified as the optimum plan and consequently proposed for development of the project area. In the final proposal the following changes were made:

- the size of the drainage sluice was changed to 24 vents 3.05 m x 2.29 m
- 2 gated inlet structures were proposed mainly for fish passage; one near Andua Beel on the Surma Embankment, and the other near Dhaikuri Beel on the Kushiyara Embankment
- the embankment from Charkhai to Zakiganj via Sheola was to be used as a road; the crest width was accordingly increased to 12.19 m as compared to 4.27 m for the other embankments.

4.3 Environmental Impact Assessment Case Study

A feasibility level environmental impact assessment (EIA) study of the Surma-Kushiyara Project was carried out from July 1991 through April 1992 as a case study under the FAP 16 environmental study component of the Bangladesh Flood Action Plan. The case study assessed impacts under two development scenarios: full flood protection with high embankments, and partial flood protection with submersible embankments. Two documents were issued: *Environmental Impact Assessment Case Study, Surma Kushiyara Project Report* dated June 1992, and *Nutritional Consequences of Fisheries Bio-Diversity* issued in March 1993.

4.4 Conclusion

The previous development plans called for limited flood protection that would allow a marginal increase in the monsoon season cropping, and development of winter irrigation with a major increase in area under the boro crops. The project area would be protected from the river peak floods, while in absence of gravity drainage a large part of the medium lowlands would be inundated by local rainfall runoff. According to the previous reports, without the irrigation component the project would not be economical.

5. WITHOUT-PROJECT TRENDS (NULL OPTION)

Independently of any water resources development, certain trends will be occurring in the area:

- Net population growth: about 3% per year. This is above the national average but below the growth rate of the past 10 years.

- Food grain production growth: 0% per year. Without intervention, seasonal floods caused by heavy rainfall would continue to damage broadcast and transplanted aman. April and May flash floods would continue to damage both local and high yielding varieties of aus and boro rice. The current land types would remain much the same though drainage condition could be aggravated because of sedimentation. Consequently, current cropping practices are expected to remain stable and no changes are expected in present agricultural production.

- Floodplain fisheries are expected to decline by 1.5% per year over the next 5 years before stabilizing at a level which is about 8% lower than the present. The decline is due to present management practices which include overfishing of brood stock.

- River course changes: The Kushiyara and Surma channels are quite stable, and no significant changes are expected in the future; the present erosion is considered to be normal.

- Loss of arable land to settlement: negligible.

7. PROPOSED FLOOD CONTROL AND DRAINAGE PROJECT

7.1 Project Rationale

This plan provides for flood control embankments and improved drainage. It will increase total flood-free cultivable area from 3500 ha to about 23,000 ha, an increase of about 19,500 ha. Roads and homesteads located in the area to the east from the Charkhai-Sheola road will be protected from river floods.

7.2 Project Objectives

The objectives of the Surma-Kushiyara Flood Control and Drainage Project are:

i) to reduce flood damage to monsoon and boro rice;

ii) to promote expansion of HYV rice onto lower lands by reducing flood depths on these lands, improving internal drainage, and reducing risk of early flooding; and

iii) to reduce flood damage to homesteads and infrastructure by river floods.

7.3 Project Description

The Surma-Kushiyara Project boundaries have been re-defined from those used in the earlier studies by shifting the western boundary from the Charkhai-Sheola road to the basin divide line across the hills from Golapganj in the north to Manikkona (on the Kushiyara bank upstream from Fenchuganj) in the south. This was done since it conforms more naturally with the topography of the area and takes advantage of the existing embankments along the Surma and Kushiyara Rivers. It has resulted in increasing the project area by 13,832 ha to a gross area of 49,200 ha.

For planning purposes, the project area has been subdivided into two areas (see Figure 4):

Area A — the upper basin extending from Amalshid to Charkhai-Sheola Road, and

Area B — the lower basin covering the remaining part of the project west from the Charkhai-Sheola Road.

At present, Area A is basically protected from the pre-monsoon floods by the existing infrastructure but only about 40% of its cultivable land is flood-free. All the cultivable land in Area B is subject to pre-monsoon flooding. In total, about 90% of the project's cultivable land is subject to annual monsoon flooding; and about 70% of homesteads are also flooded by peak floods every few years. The proposed development offers full flood protection to about 90% of Area A and to about 40% of Area B.

Project designs are based on flood protection of the area with high embankments and improved gravity drainage through an open channel discharging into the Kushiyara at the downstream end of the project area at Manikkona near Fenchuganj. High embankments will prevent entry of

flood waters into the project along the entire Surma border and along the Kushiyara from the Amalshid to Manikkona.

With the project, Kushiyara flow will enter the area at Manikkona which is downstream of the present entry points Kanaighat and Sheola. Kushiyara flood levels are 3 m lower at Manikkona than at Kanaighat and Sheola, so shifting the flood entry point will reduce flooding in the basin. Kushiyara levels will however increase at Manikkona by about 0.5 m, due to the effects of confining the river to its channel, which will increase flood levels at Manikkona, partly cancelling the gains. With hills covering a large part of Area B, the high levels will affect a relatively small area of cultivable land in the narrow flood valley along the Kushiyara River. Since the drainage channel will remain open for local rainfall runoff, there will be no restriction on the migration of fish.

7.3.4 Expected Benefits

The benefits expected from the project mainly relate to agriculture. Changes in land type (Table 7.3) combined with the pre-monsoon land type changes (Table 7.2) are expected to be associated with changes in area under different cropping patterns as shown in Table 7.4. The increase in area under F0 and F1 land types is expected to lead to an increase in the area under local and high yielding varieties of aman rice with a corresponding reduction in the area under b aman. Assuring farmers of a safe harvest would also result in some local boro being converted into hyv boro.

Changes resulting from improved monsoon flood protection were analyzed and integrated with changes resulting from improved drainage to identify changes in the area under various land types within the project area (Table 7.4).

Protection from floods (both flash floods and seasonal floods) would reduce the damage to different types of rice. Projected crop production has been estimated assuming that the yields presently being obtained in areas free of damage would be obtained within the project area (Table 7.5).

Table 7.3 Monsoon Depth of Flooding (by 1:5 Year Max Annual Flood)

Flood Depth (m)	Cultivable Area (ha)	
	Pre-Project	Post-Project[a]
Area A, upstream from Sheola-Charkhai Road		
0.00-0.30	3,500	22,000
0.30-0.90	5,000	2,000
0.90-1.80	6,000	2,000
>1.80	11,500	—
Total	26,000	26,000
Area B, downstream from Sheola-Charkhai Road		
0.00-0.30	—	1,000
0.30-0.90	—	1,500
0.90-1.80	3,000[b]	2,500
>1.80	4,600[b]	2,600
Total	7,600	7,600
Total (A + B)		
0.00-0.30	3,500	23,000
0.30-0.90	5,000	3,500
0.90-1.80	9,000	4,500
>1.80	16,100	2,600
Total	33,600	33,600

[a] These figures do not reflect cultivable land acquired for infrastructure. Production impacts of land acquisition are documented in the Evaluation section.

[b] Estimated from Sheola and Fenchuganj stations.

Cereal production is expected to increase annually by about 46,000 tonnes from 88,000 tonnes (future without) to 134,000 tonnes as a result of the project (exclusive of the land use impacts of land acquisition, see Section 7.8.1), an increase of 52%. Non-cereal production would increase by about 700 tonnes which is a 33% increase.

7.3.5 Mitigation Measures Incorporated

To minimize the negative impacts on fisheries, particularly in the Balai Haor complex and the Erali Beel, regulators are being incorporated to facilitate passage of fish. These regulators would be located at Moulavir Bazar, Kakura Khal, and Sunam Khal (existing). Improvements to current

Table 7.4 Projected Cropping Patterns

Cropping Patterns	F0	F1	F2	F3	Total
b aus - hyv aman	2760 (12)				2760
b aus - lt aman	10350 (45)				10350
b aus - rabi	690 (03)				690
hyv aus - rabi	920 (04)				920
lt aman - fallow	2760 (12)				2760
lt aman - hyv boro	2300 (10)	2100 (60)			4400
hyv aman - fallow	1840 (08)				1840
hyv aman - hyv boro	1380 (06)	1400 (40)			2780
b aman - fallow			675 (15)		675
l boro - fallow			3825 (85)	2600 (100)	6425
Total	23000	3500	4500	2600	33600

Note: Numbers within parenthesis indicate percent of cultivated area under the relevant land type

Table 7.5 Projected Crop Production

Crop	Area (ha)	Yield (t/ha)	Production (t)
b aus	13800	1.25	17,250
hyv aus	920	3.75	3,450
b aman	675	1.75	1,181
lt aman	17510	2.05	35,896
hyv aman	7380	3.95	29,151
l boro	6425	2.25	14,456
hyv boro	7180	4.55	32,669
pulses	242	.85	206
oilseeds	805	.75	604
spices	81	2.25	182
vegetables	483	3.75	1,811

structure designs would need to be incorporated to ensure the functionality of these regulators for the intended purpose. Development of "fish friendly" regulator designs will be undertaken as a separate initiative.

Also, to ensure appropriate post-monsoon drainage while maintaining a water linkage between the Kushiyara River and the various wetlands in the lower half of the project area, no structures are planned where the project drains into the Kushiyara at Manikkona. In combination with the regulators mentioned in the previous paragraph, this is expected to ensure that the integrity of the wetlands are maintained.

7.4 Project Operation and Maintenance

Under this development plan, operation and maintenance requirements would be minimal. Mainly, requirements would be to open and close the flushing/drainage regulators which are provided for fish passage. In addition, maintenance of the flood embankments and the drainage channels would be required to assure effective flood control and drainage. An Environmental Management Plan, detailing actions necessary to achieve acceptable environmental impacts, will need to be prepared and costed as part of the feasibility study.

7.5 Organization and Management

During the early part of the feasibility study process, at least two client groups would need to be organized to oversee project development (one would be responsible for the upper part A of the area, the other would be responsible for the lower Part B area). These client groups would be composed of representatives from the local farming community, fishing community, and would include relevant thana-level technical officers. The groups would ensure that the problems of the area are clearly understood and adequately reflected in the feasibility work and that the technical solutions being proposed address the problems in an acceptable manner. They would be continually briefed as the feasibility work was carried out and would need to confirm the conclusions of the exercise. They would also be informed as to details of designs being proposed by BWDB design engineers which designs, in the end, would require their approval. The groups would also monitor the construction program which would be carried out by BWDB.

BWDB would be responsible for undertaking technical work related to implementation of the project in accordance with current practice but would be responsive to the client group described above. The general tasks include completion of final designs, preparation of tenders, pre-qualification of contractors, contract awards and construction supervision. The general management of BWDB activities would be under the Executive Engineer stationed in Sylhet. Construction supervision would be carried out by sub-divisional field staff.

The Department of Agricultural Extension (DAE) is responsible for the provision of extension services to the farmers within the project.

In summary, the organization and management of this project has a high dependency on central government for key inputs. The extent to which project targets are realized will be determined by how effectively it serves people's needs and how actively the local community participates in all stages of project development.

Bangladesh Rural Development Board (BRDB) is responsible for assisting with command area development through farmers' training and by organizing farmers into cooperatives which will then have access to short term crop production loans. Medium term credits are available to these cooperatives from all nationalized banks.

The supply of all agricultural inputs has been deregulated and the distribution placed into the hands of the private sector.

7.6 Cost Estimates

Total project costs are Tk 844 million.

The estimates of land requirement and physical works are based on preliminary designs and lay-out plans prepared using 4 inch to 1 mile topographic maps, and historic hydrological data.

Land costs reflect the current prices obtained from field interviews: land which was single cropped was estimated at Tk 120,000/ha; land that could be double cropped was Tk 300,000/ha; and, land suitable for homesteads and gardens (including high ridges along the rivers) was Tk 500,000/ha. Earthwork costs are based on BWDB Schedule of Rates for Sylhet indexed to June 1991 prices. Structure costs are based on parametric costs developed for the Region, also indexed to June 1991 prices in accordance with the FPCO Guidelines for Project Assessment.

The summary of total costs is presented in Table 7.6 with details provided in Annex B.

Table 7.6 Capital Cost Summary

Item	('000 Tk)
Structures	28,250
Embankments	173,710
Channels	98,519
Bridges	79,740
Buildings	1,250
Land Acquisition	205,624
BASE COST	587,093
Physical Contingencies (25%)	146,773
SUBTOTAL	733,866
Study Costs[1] (15% of Subtotal)	110,080
TOTAL	843,946
Net Area (ha)	33,600
Unit Cost (Tk/ha)	25,117

[1]Includes preparation of EIA and Environmental Management Plan.

7.7 Project Phasing and Disbursement Period

Five years are required to implement the project. One year (year zero) is required for completion of feasibility studies and conducting field surveys. Preparation of detail designs should start in year one and be completed in year two. Land acquisition should commence in year one, be implemented in phases preceding construction, and completed in year three. Construction activities should start in year one and be completed in year four. An itemized implementation schedule is shown in Table 7.7.

7.8 Evaluation

7.8.1 Environmental

The key areas of environmental impact for this project are described briefly below. Additional information is given in Annex C, Initial Environmental Evaluation.

Table 7.7 Implementation Schedule

Activity	Year (% Completion)				
	0	1	2	3	4
Preconstruction Activities					
Feasibility Study	100				
Engineering Investigation	70	30			
Detail Designs		70	30		
Land Acquisition		30	45	25	
Construction Activities					
Construction of Embankments		20	30	30	20
Excavation of Channels		30	30	30	10
Construction of Structures		20	40	40	
Construction of Bridges				40	60
Project Buildings				100	

Agriculture

The project is expected to facilitate annual cereal production to increase from 88,000 tonnes (FWO) to 134,000 tonnes (FW), an increase of 46,000 tonnes (+52%) (exclusive of the land use impacts of land acquisition, see below). This increase is mainly due to: shifts from b aman to l aman and hyv aman; shifts from l boro to hyv boro; and an increase in the area cultivated to hyv boro. The production increase implies a per person increase in cereal availability 308 (FWO) to 469 (FW) gm per person per day, an increase of +52% (Table 7.8). Current Bangladesh average consumption is 440 gm per person per day.

Non-cereal production is expected to increase from 2100 tonnes (FWO) to 2800 tonnes (FW) (+33%). This results from a 400 ha increase in area cultivated to non-cereals from 1200 ha to 1600 ha and implies an increase in the availability of non-cereals from 7 grams per person per day to 10 grams per person per day (Table 7.8).

Fisheries

There are generally three types of impacts considered of importance. The first relates to reduced flood plain fisheries resulting from reduced grazing areas, the second relates to reduced beel fisheries resulting from drainage and destruction of water links between beels and rivers, and the third relates to impacts on spawning resulting from destruction of water links between spawning grounds and rivers.

The flood control infrastructure will reduce the seasonally flooded area of the project by about 65%. The reduction will occur mainly in the Area A, the project area upstream of the Charkhai-

Sheola Road. Only a small reduction in floodplain area will occur in Area B, the area downstream of Charkhai-Sheola Road. Most of the lowlands in the Area B, which include the Erali Beel complex will remain flooded during the monsoon months by backflow from the Kushiyara River through the open Kura Gang channel.

Table 7.8: Indicators of Food Availability (grams/person/day)

Food Group	Present (1993)	FW (2000)	FW (2020)	FWO (2020)
Cereals	634	796	469	308
Non-Cereals	15	17	10	7
Fish	10	5	3	5

Floodplain fisheries have been declining within the project area by an estimated 1.5% per year. This on-going process combined with project implementation is expected to reduce floodplain fisheries annually from its current level estimated at 1,000 tonnes to a post implementation level of 370 tonnes. Implementation of this project would directly account for 550 tonnes or about 90% of this decline. It is estimated that the level of effort required to capture 1 kg of fish on the flood plain is two person days, implying that project-related fishing employment losses would be about 1.1 million person days.

The project is not expected to have a negative impact on beel fisheries or spawning grounds. The water linkage between the Surma river and Balai Haor complex (including Erali Beel), which is considered to be a spawning ground for carp, will be maintained.

In summary, fisheries production is expected to decrease from 930 tonnes (FWO) to 370 tonnes (FW) (-60%). This implies a decrease in fish availability per person due to the project from 5 (FWO) to 3 (FW) gm per person per day (Table 7.8).

Homestead flooding

Homestead flood damage would be significantly reduced. Due to the lack of historical data on flood damage costs, a simple model was used to estimate future costs. There are about 60,200 homesteads in the area, and the average plinth level is at about the 1:5 year flood level. About half of homesteads are affected by flooding of 10-20 cm in the 1:10 to 1:25 year floods. The estimated annualized economic value of reduced flood damage is Tk 8 million.

Wetlands

The seasonally flooded area will be reduced by about 65%. This has several implications:

- Incremental economic output: decrease of Tk 0.6 million/yr. Yields are estimated to be (economic prices) Tk 50/ha in Balai Haor and Tk 25/ha elsewhere.
- Incremental labour in gathering wetland products: decrease of nine thousand person-days per year.

- Ecological character of Balai Haor will be adversely affected. One of the terms of the Ramsar convention is that Contracting Parties are to maintain the ecological character of internationally-valuable wetlands.

- Because this is a key site for the region, regional biodiversity will be threatened, in particular some aquatic plants, small wetland-dependent mammals, and migratory birds.

Land Use

Land use changes are summarized in Table 7.9. A total of 517 ha of land (about 1% of the project gross area) will be required for embankments, drains, and regulators. Of this, 378 ha will be taken from cultivated area; assuming average yields and that this is all under rice, this corresponds to incremental production foregone of about 1000 tonnes per year or about 2% of total incremental cereal production; this impact has been incorporated in the economic analysis. Another 131 ha will be taken from fallow (mostly F4) areas; assuming Tk 80/ha of wetland products, this corresponds to wetland production foregone of Tk 10,000 per year. The remaining 8 ha will be taken from homestead area; this is 0.7% of total homestead area, which implies that 400 households or about 2500 persons will be displaced. Also, homestead agricultural production from these sites will be lost: Tk 1.6 million per year, very roughly estimating homestead agricultural production at Tk 1000 per decimal or Tk 200,000 per ha.

Transportation/navigation

Transportation in Area A will be transformed from navigation-based for seven to eight months of the year, to road-based. Transportation in Area B will remain largely unchanged. The total length of existing roads in the project is 29 km of which 12 km is inundated every year. The project would make these roads flood-free (up to the 1:25 year flood). Assuming a capital cost of Tk 190,000/km and 15% flood damage, the annual benefit of flood protection is Tk 342,000.

Higher Kushiyara flood levels

Kushiyara flood levels could increase by not more than 0.5 m at Manikkona. This could affect areas outside the project, most likely un-embanked haors to the south (Hakaluki, Bardal). Improved understanding of this impact requires regional flooding analysis, which is ongoing as a part of NERP.

7.8.2 Social

The key areas of social impact (or lack thereof) for this project are described below. Additional information is given in Annex C, Initial Environmental Evaluation.

Employment

There will be an overall increase in employment of 1.31 million person-days per year. This is composed of:

- an increase in owner-labour employment of + 1.73 million pd yr^{-1}, of which very roughly 20% is post-harvest processing activities traditionally done by women of the household. This increase is partly cancelled out by . . .

- an net decrease in employment opportunities for landless people of -0.42 million pd yr^{-1}, composed of changes in the following areas:

  - Agricultural hired labour: +0.69 million pd yr^{-1}, of which about 10% is for post-harvest processing traditionally done by women hired in (mainly by larger farmers) for the purpose.

  - Fishing labour: -1.10 million pd yr^{-1}; in addition to this, there would be a corresponding loss in support activities such as net-making and post-catch processing (mainly drying) much of which is done by women.

  - Wetland labour (gathering wetland products): -0.009 million pd yr^{-1}. Fodder and building material is gathered mainly by men. Food, fuel, and medicine is gathered mainly by women.

Table 7.9: Changes in Land Use

Use	Change in area (ha)
Cultivated	-378
Homesteads	-8
Beels	-
Ponds	-
Channels	+139
Hills	-
Fallow[1]	-131
Infrastructure[2]	+378

[1] Multi-use land, wetlands, grazing lands, village grounds.
[2] Government-owned land not appearing elsewhere.

Displacement impacts due to land use changes

Households whose homestead land is acquired, for proper cash compensation, by the project may have difficulty relocating. This is because suitable homestead lands are so scarce that availability of replacement land for purchase is not assured.

Two mitigation options bear consideration. Embankments could be constructed with berms at strategic locations to support homesteads. Alternatively, provision could be included for the construction of raised housing platforms to facilitate relocation. The experience of BWDB in resettling landless people on embankments in the Cyclone Protection Project may be relevant to the requirements of this project area.

Conflicts

Improved drainage will encourage farmers to extend cultivation further into Balai Haor. This will bring them into conflict with fishermen who will find the fishing area reduced. This conflict will affect the way the regulator is operated and will have a direct bearing on the extent to which some of the crop production benefits are realized.

In Area A, the flood protection will transform monsoon-season transport from navigation to roads. This would eliminate the present reason for some embankment cuts would no longer be cut to facilitate navigation, but This will increase the distance that boatmen must ply to move goods and materials within the area. Improvement in the internal road network may offset this consideration

Households that are left outside the embankment can also be a source of conflict. When water levels are high, river side residents may cut the embankment in an attempt to relieve flooding in their area. Detailed settlement surveys will be required to assess the magnitude of this problem in this area.

Equity

The net equity impact would appear to be strongly *regressive*. Who benefits?

- Landowners, in proportion to landholdings, benefit directly from investment in agriculture production. This is the main benefit (96% in economic terms) of the project and its distribution is quite *regressive*.

Who loses?

- Families dependent upon fishing labour. These families are mainly landless and tend to be poorer than average. *Regressive*.

- Families involved in gathering wetland products. These families are mainly landless and tend to be very poor. *Regressive*.

- Families displaced from their homesteads by project land acquisition. Insofar as more wealthy families can influence infrastructure siting/alignment, this is *regressive*.

Gender Equity

The net equity impact would appear to be somewhat *progressive*. Employment opportunities for women will increase in all categories except wetland gathering. Reduced homestead flood damage will disproportionately favour women, given that most women still spend most of their lives within the homestead. By the same token, the adverse effects of acquisition of 8 ha of homestead land (400 households or 1250 women) may fall mainly on the women in those households. Nevertheless, women's gains are proportionately less then mens since they do not generally have control of the incremental production.

7.8.3 Economic

The project has an economic rate of return of 18%, which compares well to the required rate of 12% as prescribed by government. It is a relatively high investment project, at Tk 844 million or Tk 25,117 per hectare, and it covers a large geographic area (49,200 ha gross). The rate of return, however, is quite sensitive to increases in capital costs (a 20% increase in capital costs would reduce the rate of return to 16%). The other sensitive variable is the timing of the benefits, and a delay in benefits by two years would reduce the ERR to 14%.

The foreign costs associated with the project are low, at 6% (excluding FFW contributions), making it a relatively small project from a donor perspective. Donor funding considerations would clearly need to include funding local costs.

Almost all of the benefits of the project relate to increased rice production, mostly resulting from shifts to hyvs. Average crop yields would increase as a result of reduced flood damage, and cropping intensity would increase by 30%. Non-cereal production would increase by 33%, but floodplain fish production fall to about 40% of future-without-project production. The value of the lost fisheries output amounts to about 6% of the value of increased agricultural output. About 4% of project benefits would result from reduced homestead flooding. A small amount of

disbenefits would result from loss of food, shelter, and tree products that are currently harvested from the seasonal wetlands. A summary of salient data in provided in Table 7.10.

It is anticipated that the established crop marketing system will handle incremental crop production without any reduction in prevailing average price levels. Assuming the current annual growth in the demand for grain remains about 3%, the increased cereal production is unlikely to present any marketing difficulties.

A significant caution is that the economic benefits are based largely on assumed shifts in cropping patterns, and if this did not occur, the project would not be viable. Lessons of the past have shown that producers have not always responded as predicted, and this case warrants special efforts in predicting producer responses.

7.8.4 Summary Analysis

From a multi-criteria perspective (Table 7.11), the project is not attractive:

- Benefits derive almost entirely from increased rice production, at the expense of fisheries and wetlands.
- The net employment impact is positive, but is composed of a large gain in employment for owners at the expense of a significant number of jobs for hired labourers.
- A number of households would lose their homestead land to project land acquisition.
- The project would adversely affect regional biodiversity by changing the ecological character of Balai Haor, a wetland of international importance.
- Kushiyara flood levels would increase somewhat.
- Conflicts between farmers and fishermen, and between families living within and outside the embankment, would increase.
- The project has a high dependency on central government for implementation.

The positive aspects of the project would be:

- Rate of return is acceptable.
- Substantial increase in rice production.
- Increased economic returns to land owners.
- Reduced flood damage to homesteads and roads.
- Small increment in non-cereal production.
- Gender equity of impacts is somewhat progressive.
- Project responds to some public concerns.

Table 7.10: Summary of Salient Data

Economic Rate of Return (ERR)	18%			
Capital Investment (Tk million)	844			
Maximum O+M (Tk million / yr)	31			
Capital Investment (Tk/ha)	25,117			
Foreign Cost Component	6%			
Net Project Area (ha)	33,600			
Land Acquisition Required (ha)	517			

AGRICULTURAL IMPACTS		Present	FWO	FW
Incremental Net Econ Output (Tk million / yr)	213			
Cropping Intensity		1.3	1.3	1.7
Average Yield (tonnes/ha)		2.1	2.1	2.5
Average Gross Margins (Tk/ha)		11222	11404	13373
Owner Labour (md/ha)		122	122	126
Hired Labour (md/ha)		25	25	32
Irrigation (ha)		13420	13420	13605
Incremental Cereal Prod'n ('000 tonnes / yr)	46			
Incremental Non-Cereal ('000 tonnes / yr)	0.7			
Incremental Owner Labour ('000 pd / yr)	1731			
Incremental Hired Labour ('000 pd / yr)	692			

FISHERIES IMPACTS		Flood plain	Beels	Spawning
Incremental Net Econ Output (Tk million / yr)	-12	-12	0	0
Impacted Area (ha)		14600	0	0
Average Gross Margins (Tk/ha)		1448	23290	-
Remaining Production on Impacted Area, %		0%	-	-
Incremental Fish Production (tonnes / year)		-550	0	-
Incremental Labour ('000 pd / yr)		-1,100	0	0

FLOOD DAMAGE BENEFITS				
Households Affected		30100		
Reduced Econ Damage Households (Tk M / yr)	8			
Roads/Embankments Affected -km		12		
Reduced Econ Damage Roads (Tk M / yr)	0.3			

OTHER IMPACTS				
Wetland Incr Net Econ Output (Tk million / yr)	-0.6			
Wetland Incremental Labour ('000 pd / yr)	-9			
Acquired Cult. & Homestead Lands, Incr Net Econ Output (Tk million / yr)	-4			
Persons Displaced by Homestead Acquisition	2500			

Ta... Multi-Criteria Analysis

Economic		
Indicator	Units	Value
Economic Internal Rate of Return (EIRR)	per cent	18
EIRR, Increase Capital Costs by 20%	per cent	16
EIRR, Delay Benefits by Two Years	per cent	14
Net Present Value	Tk	275,296

Quantitative Impacts			
Indicator	Units	Value	Percent[1]
Incremental Cereal Production[2]	tonnes	45,000	+51
Incremental Non Cereal Production	tonnes	700	+33
Incremental Fish Production	tonnes	-550	-60
Change in Floodplain Wetland/Fisheries Habitat	ha	-14,600	-66
Homesteads Displaced Due to Project Land Acquisition	homesteads	400	-0.7
Homesteads Protected From Floods	homesteads	+30,100	+100
Roads Protected From Floods	km	+12	+100
Kushiyara Flood Levels	m PWD	+0.5	-
Owner Employment	million pd/yr	+1.73	+50
Hired Employment (Agri + Fishing + Wetland)	million pd/yr	0.42	-13

Qualitative Impacts (ranked from -5 ...0... +5)	
Impact	Rank
Ecological Character of Key Wetland Site (Balai Haor)	-4
Regional Biodiversity	-3
Road Transportation	+1
Navigation	-3
Flood Levels Outside Project Area	-2
Conflicts	-3
Socioeconomic Equity	-4
Gender Equity	+1
Decentralized Organization and Management	-3
Responds to Public Concerns	+2
Conformity to Regional Strategy	?

[1] Percent changes are calculated relative to future-without-project values of total production of cereal, non-cereal, and fisheries; total floodplain area; total number of homesteads (for displacement due to land acquisition); flood affected homesteads; flood-affected roads; Kushiyara water level; and total employment for owners and hired labourers.

[2] Includes incremental production foregone due to acquisition of cultivated land

Table 8.8: Summary of Salient D·

Economic Rate of Return (ERR)				
Capital Investment (Tk million)	1398			
Maximum O + M (Tk million / yr)	41			
Capital Investment (Tk/ha)	41,620			
Foreign Cost Component	7%			
Net Project Area (ha)	33,600			
Land Acquisition Required (ha)	690			

AGRICULTURAL IMPACTS		Present	WO	FW
Incremental Net Econ Output (Tk million / yr)	301			
Cropping Intensity		1.3	1.3	1.8
Average Yield (tonnes/ha)		2.1	2.1	2.7
Average Gross Margins (Tk/ha)		11,222	11,404	14,043
Owner Labour (pd/ha)		122	122	127
Hired Labour (pd/ha)		25	25	37
Irrigation (ha)		13420	13420	18205
Incremental Cereal Prod'n ('000 tonnes / yr)	69			
Incremental Non Cereal ('000 tonnes / yr)	0.7			
Incremental Owner Labour ('000 pd / yr)	2364			
Incremental Hired Labour ('000 pd / yr)	1134			

FISHERIES IMPACTS		Flood plain	Beels	Spawning
Incremental Net Econ Output (Tk million / yr)	-15	-12	-3	0
Impacted Area (ha)		14600	713	0
Average Gross Margins (Tk/ha)		1448	23290	-
Remaining Production on Impacted Area, %		05	60%	-
Incremental Fish Production (tonnes / year)		-550	-150	-
Incremental Labour ('000 pd / yr)	-1375	-1,100	-275	0

FLOOD DAMAGE BENEFITS				
Households Affected		30100		
Reduced Econ Damage Households (Tk M / yr)	8			
Roads/Embankments Affected -km		12		
Reduced Econ Damage Roads (Tk M / yr)	0.3			

OTHER IMPACTS				
Wetland Incr Net Econ Output (Tk million / yr)	-0.6			
Wetland Incremental Labour ('000 pd / yr)	-9			
Acquired Cult & Homestead Lands, Incr Net Econ Output (Tk million / yr)	-4.5			
Persons Displaced by Homestead Acquisition	2800			

Table 8.9: Multi ..eria Analysis

Economic		
Indicator	Units	Value
Economic Internal Rate of Return (EIRR)	per cent	15
EIRR If Capital Costs Increase 20%	per cent	- 14
EIRR If Benefits Delayed Two Years	per cent	12
Net Present Value	Tk	254,079

Quantitative Impacts			
Indicator	Units	Value	Percent[1]
Incremental Cereal Production[2]	'000 tonnes	+68	+75
Incremental Non-Cereal Production	'000 tonnes	+700	+33
Incremental Fish Production	tonnes	-700	-50
Change in Floodplain Wetland/Fisheries Habitat	ha	-14,600	-66
Change in Beel Habitat	per cent yield change * ha	-285	-40
Homesteads Displaced Due to Project Land Acquisition	homesteads	450	0.8
Homesteads Protected From Floods	homesteads	+30,100	+100
Roads Protected From Floods	km	+12	+100
Kushiyara Flood Levels	m PWD	+0.5	-
Kushiyara Low Flow	m^3/s	-10.3	-42
Owner Employment	million pd/yr	+2.36	+68
Hired Employment (Agri + Fishing + Wetland)	million pd/yr	+0.03	+0.01

Qualitative Impacts (ra[illegible]d from -5 ...0... +5)	
Impact	Rank
Ecological Character of Key Wetland Site (Balai Haor)	-4
Regional Biodiversity	-3
Road Transportation	+1
Navigation	-3
Flood Levels Outside Project Area	-2
River Habitat for Overwintering Fish Brood Stock	-4
Conflicts	-3
Socioeconomic Equity	-4
Gender Equity	+1
Decentralized Organization and Management	-4
Responds to Public Concerns	+2
Conformity to Regional Strategy	?

[1] Percent changes are calculated relative to future-without-project values of: total production of cereal, non-cereal, and fisheries; total floodplain area; total number of homesteads (for displacement due to land acquisition); flood-affected homesteads; flood-affected roads; Kushiyara water level; and total employment for owners and hired labourers.

[2] Includes incremental production foregone due to acquisition of cultivated land.

Journal 1 (Project Development)

1. What conclusions can I draw about the place of EIA in the project development process?

2. What are the most important things I need to know about how the EIA process improves project planning and outcomes?

3. What are the important things I learned about IEEs?