FAP- 6

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

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FLOOD ACTION PLAN

NORTHEAST REGIONAL WATER MANAGEMENT PROJECT (FAP 6)

DRIVING FORCES; REGIONAL ANALYSIS and UPDATE OF POTENTIAL INITIATIVES

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Bangladesh Engineering and Technological Services
Institute For Development Education and Action
Nature Conservation Movement

Canadian International Development Agency

ACRONYMS AND ABBREVIATIONS

ADB	Asian Development Bank
BADC	Bangladesh Agricultural Development Corporation
BARC	Bangladesh Agricultural Research Council
BARI	Bangladesh Agriacultural Research Institute
BBS	Bangladesh Bureau of Statistics
BFDC	Bangladesh Fisheries Development Corporation
BGD	Bangladesh
BIWTA	Bangladesh Inland Water Transport Agency
BJRI	Bangladesh Jute Research Institute
BRDB	Bangladesh Rural Development Board
BRRI	Bangladesh Rice Research Institute
BS	Block Supervisor
BTRI	Bangladesh Tea Research Institute
BWDB	Bangladesh Water Development Board
CBM	community-based management
CIDA	Canadian International Development Agency
cm	centimetre
DAE	Department of Agricultural Extension
DOE	Department of Environment
DOF	Department of Fisheries
DPHE	Department of Public Health Engineering
DSSTW	deep set shallow tube well
DTW	deep tube well
EIA	environmental impact assessment
FAP	Flood Action Plan
FCD	flood control drainage
FCDI	flood control, drainage, and irrigation
FFW	Food for Work
FPCO	Flood Plan Coordination Organization
FRI	Fisheries Research Institute
GDP	gross domestic product
GNP	gross national product
GOB	Government of Bangladesh
GSB	Geological Survey of Bangladesh
GWH	gigawatt hours
HTW	hand tube well
HYV	high yielding variety
IBRD	International Bank for Reconstruction and Development

km	kilometre
KSS	farmer cooperative societies
LGED	Local Government Engineering Department
LLP	low lift pump
m	metre
MCM	million cubic meters
MIWDFC	Ministry of Irrigation, Water Development, and Flood Control
MLGRDC	Ministry of Local Government
MOA	Ministry of Agriculture
MOL	Ministry of Land
MOEF	Ministry of Environment and Forests
MPO	Master Plan Organization
MW	megawatt
NERP	Northeast Regional Water Management Project
NGO	non-government organization
PWD	Public Works Department
SPARRSO	Space Research and Remote Sensing Organization
SRTI	Sugarcane Research and Training Institute
STW	shallow tube well
SWMC	Surface Water Modelling Centre
T&V	training & visit
TCCA	*Thana* Central Cooperative Associations
UNDP	United Nations Development Program
USAID	US Agency for International Development
WARPO	Water Resources Planning Organization (formerly the Master Planning Organization)

GLOSSARY OF TERMS

Development	A process based on intervention to improve the well-being of a defined group of people.
Effectiveness	Relationship between outputs and objectives (in a project or program, for example).
Efficiency	Ratio of outputs to inputs.
Equity	Distribution of costs and benefits to societal subgroups.
Goals	A qualitative statement of a development outcome to be achieved, often within a set time frame. Example: reduce unemployment significantly in city *x* by year *y*. See also *objective*.
Initiative	An interventionist action designed to meet development objectives. An initiative can be a policy, program, project, or action, and can be implemented by the public, private, parastatal, community, or NGO sectors.
Issue	An area of contention or debate among informed parties.
Objective	Quantification of a *goal* making it operational in a planning context. Example: reduce unemployment in city *x* by the year *y* to *z*%.
Opportunity	An event or situation through which goals could be achieved. Opposite of *threat*.
Policy	A statement of intent.
Program	A set of interventions at numerous locations based on replication, typically of a successful *project*, for example, a school curriculum replicated in many schools.
Project	An organized intervention to meet development objectives, with a specific geographic location.

Strategy — A set of interventions to achieve desired objective(s) in an efficient manner.

Strategic Planning — A process to create a strategy, characterized by:

- focus on selected issues,
- explicit consideration of resource availability,
- explicit consideration of major changes occurring in the external environment, outside the immediate system of concern, and
- action-oriented, emphasis on results.

Strength — An existing condition conducive to goals achievement; often defined in relation to comparable regions or entities elsewhere. Sometimes called a "plus" or a "pro". Opposite of *weakness*.

Threat — An event or situation (real or potential) which could inhibit or prevent goals achievement. Opposite of *opportunity*.

Weakness — An existing condition detrimental to goals achievement, often defined in relation to comparable regions or entities elsewhere. Sometimes called a "minus" or "con". Opposite of *strength*.

LIST OF FAP 6 DOCUMENTS

The present document represents the consolidation and analysis of information from various sources including various specialist studies, the outcome of a series of public seminars held in the region, and prefeasibility studies of the various initiatives.

The series of FAP 6 documentation completed (or very near completion) to date comprises the following reports:

1. Participatory Development and the Role of NGOs (66 pp)
2. Population Characteristics and the State of Human Development (34 pp plus appendices)
3. Proceedings of the Moulvibazar Seminar (27 pp plus appendices)
4. Proceedings of the Sylhet Seminar (15 pp plus appendices)
5. Proceedings of the Sunamganj Seminar (22 pp plus appendices)
6. Proceedings of the Sherpur Seminar (26 pp plus appendices)
7. Proceedings of the Kishoreganj Seminar (in preparation)
8. Proceedings of the Narsingdi Seminar (in preparation)
9. Proceedings of the Habigang Seminar (in preparation)
10. Proceedings of the Netrokona Seminar (21 pp plus appendices)
11. Fisheries Specialist Study (291 pp plus appendices [in preparation])
12. Wetland Resources Specialist Study (106 pp plus appendices)
13. Agriculture in the Northeast Region (in preparation)
13. Ground Water Resources of the Northeast Region (38 pp plus appendices)
14. Surface Water Resources of the Northeast Region (95 pp plus appendices)
15. Regional Water Resources Development Status (38 pp plus appendices)
16. River Sedimentation and Morphology (173 pp)

Pre-feasibility Studies

1. Upper Surma-Kushiyara Project (58 pp plus appendices)
2. Surma Right Bank Project (45 pp plus appendices)
3. Morir Haor Project (35 pp plus appendices)

REGIONAL PLAN

REPORT OUTLINE

REGIONAL PLAN
REPORT OUTLINE

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10.1.1 Non-Structural Water Management Systems

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11. IMPACT ASSESSMENT

11.1 Biophysical

Flood Protection: % of land protected from flooding; based on x year flood; may apply to specific seasons of year

Natural / Semi-natural Wetlands: Area by condition classes

Degradation of Agricultural Land: % of land severely eroded, sedimented, saline

Decentralised Natural Resource Management: % of land affected

Forest Resources: lowland and upland

Ground water Resources: % of Land with sustainable level of ground water extraction

Fisheries Resources: stock

Water Quality: surface; ground

Major Land Uses: % of land in major uses (land use matrix; map)

11.2 Social

Urbanization: % of population urbanized

Rural Landlessness: % of rural people landless

Gender Equity in Labour Force: % of women in labour force: employed or unemployed; by key sectors

Human Resource Development: literacy rate: male; female

Nutritional Adequacy (index to be developed)

Access: potable water; basic health care; thana center; modern communications media

Regional Food Stocks: amount

11.3 Economic

GRDP: by economic sector; rural, urban

Level of Investment: public, private; by rural, urban

Employment (or major household labour activity): by economic sector

Household Income: mean real household; rural, urban

Economic Diversification (including agriculture)

Foreign Exchange: net regional impact on foreign exchange earnings

12. INITIATIVES

12.1 Policies

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12.3 Projects

CHAPTER 4: DRIVING FORCES

4. DRIVING FORCES

This chapter outlines major driving forces that are apt to significantly affect development in the Northeast Region of Bangladesh over the next two decades. International, national, and regional forces have been identified based on the source of the force in question. However, in many cases, the same forces are occuring at different scales (for example, population pressure or communication system changes).

4.1 International Forces

1. Globalization

World trade barriers are likely to fall through the next decades; this may take the form of three trading blocks (centred in eastern Asia, western Europe and North America) with barriers separating them or overall liberalisation of international commerce (through GATT mechanisms). This driving force represents an opportunity for Bangladesh in that other countries will be spinning off opportunities as they develop into areas of new comparative advantage; in addition, populous markets should become more accessible. However, products will have to be competitive in price, delivered in a timely fashion, and be of consistent quality among other things if suppliers are to survive in the emerging highly competitive globalised economy.

This force is likely to have a differential impact on the region, affecting urban areas and the Dhaka-Sylhet corridor most because it is in these areas that non-agricultural activity is most likely to emerge. Indirect impacts on the region could also surface from this force. For example, demand for market garden products in Dhaka, through increased prosperity generated by taking advantage of global forces, could result in high value agriculture such as fruit, vegetables, and poultry becoming important in those parts of the region closest to Dhaka.

2. SAARC

It is likely that SAARC will continue to give more priority to issues with a goal to reduce tariff barriers between South Asian nations.

This development would have a mixed impact on the region. On one hand, it might reduce the price of consumer goods; on the other hand, it could create more competition for producers of agricultural produce and processed goods in the region.

3. Climate Change

Climate change over long periods, a century or more, may be an important driving force affecting the region's development. Current models of anthropogenic climate change are not yet accurate enough to provide useful information relevant to the planning time frame being utilised by FAP 6 (For example, current models do not agree on whether or how much the monsoon circulation will intensify.) However, regional data suggest that rainfall has been increasing for the past 30 years; it is not clear whether this increase is part of a long-term cycle, or a transition to a new climatic regime. Hydrological changes add urgency to the need to mitigate impacts associated with excessive rainfall.

4. Deforestation and Development in Upstream Areas

Although there is considerable debate on the impacts of upstream deforestation on the region (some argue significant soil erosion in the Himalayas has historically occurred for geophysical reasons and that deforestation is a minor factor in siltation), continued deforestation of the Meghalaya and Tripura hills is likely to result in more extremes in river flows making water sector planning and management more difficult, probably less effective than would otherwise be the case, and almost certainly more expensive.

Large scale development projects in upstream areas which affect water flows can also impact significantly on the region. An important example is the proposed dam at Tipaimukh, India.

5. Biotechnology

Enormous strides are being made in biotechnology; such research and development is occurring primarily in the developed countries. Since primary agricultural activity still accounts for over one third of Bangladesh's economy (as measured by gdp), biotechnological advances will very much affect Bangladesh. This force could be positive for Bangladesh, application of biotechnology is more research than capital intensive.

6. Remittances

Remittances from temporary labour and permanent residents abroad is an important source of capital for Bangladesh. (An estimated 500,000 people, mostly men, work outside the country.) Opportunities for temporary labour abroad may stagnate for reasons such as geographic changes in fossil fuel production patterns, increased competition from other labour supply sources, or more restrictive immigration policies. On the other hand, emerging labour shortages in ASEAN may compensate for stagnation in the demand for labour in the Middle East. (For example, 67,000 Bangladesh citizens currently work in Malaysia.)

This driving force is of particular significance because the region has historically been, and continues to be, an important source for overseas labour with associated remittance benefits flowing back to the region.

7. Changing Export Mixes

Bangladesh has been affected by decreased demand (and/or prices) for key traditional exports, in particular, jute and tea. (The price of tea [.84 US per pound] is virtually the same as five years ago [.83 US per pound] while the current price of jute [$260 US per ton] is considerably less than the price five years ago [$370 US per ton].) Jute is increasingly being replaced by synthetics while taste preferences in tea are changing.

Although these trends could be perceived as threats, Bangladesh is showing considerable promise in restructuring its export base to items such as garments, leather goods, and frozen seafood products; potential exists in terms of electronics, electrical goods, extruded plastic goods, toys, and shoes, among others, to further diversify the export mix.

Since the region is the major tea producing area in Bangladesh, it will be affected by decreases in tea demand or prices; however, the region is much less sensitive to falling prices for jute because the major jute producing areas in Bangladesh are outside the region. As noted earlier, export mix shifts to manufactured goods will affect subregions differentially.

8. Communications

The growth of Asian-wide satellite TV services is removing national barriers to information flows. (Five channel Star TV, broadcast throughout Asia, is doubling its audience every few months. Currently 45 million people in Asia receive Star - four times those accessible in June, 1992.) During the planning period, virtually all households (all classes) in urban areas of Bangladesh will have access to cable networks which will relay programmes from these satellite stations. In most of Asia, videos have permeated virtually all rural areas as a source of information and entertainment.

These international communication forces will increasingly affect Bangladesh in rural areas as well as urban ones; the impact will be (is being) felt first in urban areas such as Dhaka.

9. Development Assistance

Development assistance to Bangladesh is very important, particularly in terms of Bangladesh's development budget (in the 1980s, the development budget was virtually entirely funded by foreign assistance, now approximately 75 to 80% of the development budget is funded by development assistance). Development assistance pledged to Bangladesh totals US $2.15 billion in 1993; although this is down from last year's US $2.5 billion; it is an indication that Bangladesh still has the confidence of donors, given current stiff competition for aid. (The 1993 development assistance allocation is US $120 million more than the Government of Bangladesh had requested.)

The Bangladesh Aid Group (formed in 1974) has given some temporal consistency to development funding, donor assistance is subject to the vagaries of developmental fashions. Although it is impossible to predict future developmental assistance priorities of the international community, any changes that do occur will have a significant impact on Bangladesh.

Since the region benefits from international development assistance flows along with the remainder of the country, changes in levels of developmental assistance or priorities associated with aid flows will affect the region.

10. Asian Region Geopolitical and Economic Change

China is likely to have one of the fastest growing economies in the world during the planning period. The growth of a large middle class in China will have enormous implications on world consumption and production. From the point of view of Bangladesh, this force may be perceived as a threat in that China will be producing many of the same goods ("low end" manufacturing) as Bangladesh, such as garments, leather goods, and high volume mass produced consumer items (toys, extruded plastic items, electronics, electrical goods). However, the fact that Bangladesh has traditionally had good ties with China may mean that Bangladesh can become vertically linked to some production opportunities in China.

Although South Asia is unlikely to grow economically as quickly as China and South-East Asia, there is evidence that the two largest nations of South Asia, India and Pakistan will grow more quickly economically than they have in the past because of structural changes in these countries which are making them more attractive to private enterprise. If this growth is coupled with lowered tariff (and non tariff) barriers within SAARC, a large middle class market could open up for Bangladesh goods (and possibly services in certain niche areas) in neighbouring populous South Asian countries.

As was the case for globalisation, communications, and other driving forces discussed above, the emergence of Asian regional powers is more likely to affect those areas in the North East Region where local economies are less agricultural in nature.

4.2 National Forces

1. Population Growth

Population growth is a key driving force affecting Bangladesh's development. Depending on source, population growth in Bangladesh is estimated at an annualized rate of 2.1 or more. The current population is approximately 117 million up from 71 million measured in the first post independence census in 1974. (The population could reach 235 million by 2025.) Because virtually no new land is available for cultivation, and 10 million of 18.5 million families are already landless (although approximately 20% of families are now urban), population growth has enormous implications for the types of developmental policies that should (must) be pursued.

2. Urbanization

Bangladesh is still largely rural (about 80% of the population); however, in absolute terms Bangladesh already has a large urban population — approximately 27 million people. Urbanization is occurring at a very rapid rate — approximately 6% per year. This rate is unlikely to be less than 4.8% by 2000 and less than 3.6% by 2015. By 2015, it is estimated that the urban population will be approximately 65 to 70 million.

Bangladesh is at an early stage in the rural - urban migration cycle. The Dhaka mega urban region may have added three million people since 1990. If so, it experienced one of the fast rates of growth (if not the fastest) of all global mega cities during the 1990 to 1993 period. It would appear that Bangladesh is now entering the period of most rapid urbanization that it will experience in its history. Although data on intermediate and small cities is much less available and reliable, these smaller centres are also probably currently entering (or about to enter) their fastest periods of growth.

3. Non-Agricultural Employment / Economic Restructuring

Bangladesh's non-agricultural economy is restructuring rapidly; as noted earlier, this is reflected in its rapidly changing mix of exports. This restructuring is occurring primarily in the formal sector; however, the informal sector continues to be very important in terms of production and employment.

In the formal sector, the trends toward garment manufacture (employing perhaps 500,000 people and still growing quickly), leather goods production, and frozen seafood preparation have been well documented. However, potential exists in other manufacturing areas as noted earlier. Ironically, some potential industries, for example shoes, are being lost to competitors such as Vietnam and Sri Lanka because of purported lower real wage rates in competitor countries. (Bangladesh wage rates are high relative to the country's overall economic situation.) Local service industries such as finance, have considerable potential for growth.

The informal small business sector continues to grow. This includes small manufacturing shops, repair shops, rickshaw drivers (employing 500,000 to 800,000), small boat operators (employing 2,000,000), and small retailers, among others.

The informal sector accounts for two-thirds of the employment in manufacturing and one-half of the output of the sector. Real earnings in the informal sector are, on average, much higher than in agriculture and frequently compare favourably with formal sector non-agricultural employment.

Given the non-agricultural sector's (i) promising track record in terms of employment creation, (ii) potential for production and employment growth (through diversification and growth in existing activity areas), and (iii) relatively high wage levels (or informal earnings); this sector represents an enormously powerful driving force in Bangladesh. Although non-agricultural employment is still in early stages of development in the North East Region, the potential for large scale increases in such activity are considerable.

4. Human Resource Development

Human resource development is a key driving force reshaping Bangladesh. Approximately 35% of the population is literate; however, the literacy rate for men is approximately double (although the ratio is narrowing through time) that for women. (Given the fact that females dominate employment in the formal industrial sector, this driving force is related closely to restructuring issues discussed above.) Education receives a fair share of fiscal year routine or operating budgets (approximately 17-20%) but a small share of development budgets (less than 5%).

Enormous strides were made in child immunization during the 1980s which have lowered child and infant mortality and sickness substantially. Real, but lesser, progress was made in terms of delivering health care to adults. The government's goal of universal health care access by 2000 may be achievable then, or in the early years of the next century.

The improvement of health and education levels in Bangladesh represents a key driving force. If human resource development continues to improve, additional developmental opportunities will open up and restructuring of the socio-economic system will be more rapid.

The region generally has lower levels of human resource development (particularly in terms of literacy and education) and well-being than for the country as a whole. However, through time, it is expected that the gap between human resource development levels in the region and Bangladesh as a whole will narrow. If this occurs, there will be significant developmental implications for the region associated with this change.

5. Environment

Many of the environmental driving forces affecting Bangladesh are global, multilateral, or bilateral in nature and were identified above. However, other environmental forces are driven by national forces with impacts in terms of erosion, soil quality, and changes in biodiversity.

Because Bangladesh is still highly dependent on its rural areas for support of most of the population, any deterioration in environmental quality can undermine the ability of the land to support the very large populations dependent on it.

Deforestation is virtually complete in Bangladesh (6% of the country is forested) with associated diminution of fauna. Wetlands pose a complex developmental challenge in terms of balancing food needs with biodiversity objectives; and soil erosion is a problem in some areas as a result of agricultural pressures.

As elsewhere in much of the world, concern with environmental issues is becoming a higher priority in Bangladesh as is indicated by Bangladesh signing international environmental agreements such as the Ramsar Convention, by the increasing numbers of environmental NGOs operating in Bangladesh, and by the acceptance of donor country environmental reports and guidelines. As rapid urbanization occurs over the next two decades, urban environmental issues will become increasingly important and the object of much greater attention.

6. Privatization

Contrary to some stereotypes, Bangladesh has a small public economy which is becoming smaller in relative terms through measures such as privatization and loosening of controls. For example, over 60% of industrial assets are in private hands, almost the entire agricultural sector (which accounts for over one-third of gdp) is in private ownership, and the civil service is relatively small. (Although the Bangladesh Aid Group argues that 20,000 public sector jobs should be cut in this fiscal year [to June 30, 1993] and a further 25,000 in the next fiscal year.) This situation and trend is a key driving force behind restructuring of Bangladesh's socio-economic system.

This driving force is being slowed by a very significant lack of private capital, both from national and international sources. (At the micro, informal sector level, the Grameen Bank, developed by Dr. Muhammad Yunus has attracted positive attention by addressing this need.) The lack of capital is one of the strongest forces working against more rapid restructuring in Bangladesh. (Private investment is currently 5 - 6% of gdp; the Bangladesh Aid Group argues it should be 9 - 10% of gdp to finance the feasible developmental opportunities that exist.)

Lack of capital could be a significant constraint to development in the North East as regions remote from the primate city tend to have more difficulty raising capital. On the other hand, there is considerable private capital in the Sylhet Region which could possibly be mobilised for developmental purposes.

7. Land Availability

Landlessness is a major characteristic of modern Bangladesh. Even if agricultural productivity increases substantially (which will probably be the case), it is unlikely that substantially more people will obtain land because of constraints related to ownership and inheritance. Thus a key driving force in Bangladesh is the fact that the land will probably not absorb many more people in terms of significant positive marginal economic returns to labour and certainly in terms of land ownership. This situation (the end of absorption of population through new rural land owners) has extremely important ramifications for Bangladesh development policy.

8. Revenue Collection

A key driving force, probably negative, in Bangladesh is the very low levels of public revenue collection. Bangladesh collects only about 10% of gdp annually in public revenues (primarily from customs duties and sales taxes rather than income taxes). This is less than half the norm for developing countries and less than one third the norm for developed countries. This lack of public revenue collection constrains strategic actions that could be taken by the government in terms of developing key infrastructure in support of private enterprise, supporting key sectors, or delivering accelerated human resource development programmes.

If Bangladesh were to collect more public revenue, a secondary issue would be the extent to which such incremental revenues would flow to remote regions, such as the Northeast Region.

9. Telecommunications

As noted above, international communications forces are reshaping Asia. Internally in Bangladesh, similar forces are at work. For example, although there is still only one telephone per 465 people; this is up dramatically from 1988 when the ratio was one telephone per 1,000 people. Similar dramatic growth rates are being exhibited in terms of ownership of televisions, radios, and video machines. As telephones increasingly become available in smaller centres, making fax connections possible, rural industrial opportunities will increase significantly (Mobile telephones are currently being introduced in Bangladesh).

This is a key driving force affecting Bangladesh; rural - urban distinctions (in terms of information, behaviour, values, and attitudes) are breaking down, the population is becoming better informed, and modernisation dynamics from telecommunications processes are supportive of economic restructuring.

10. National Political Changes

The change to a democratically elected government in 1990 has opened up public discourse and policy in a variety of areas, among them are water resources development, economic policy, and environmental management. This situation affords an opportunity to re-examine entrenched policies and attitudes toward development. The democratic government is more supportive of public participation.

4.3 Regional (Internal) Driving Forces

1. Pressure on Rural Land

This is the most significant driving force affecting the region. Natural population increase in the region is greater than for Bangladesh as a whole (although net rates are mitigated by higher mortality and out-migration). The mean farms size in the region is already approximately .6 hectares and farms are becoming smaller through inheritance and other processes; with the technology presently available, at approximately .4 hectares (depending on soil fertility, application of technology, and other factors), the ability of farms to support a household (let alone create an exportable surplus) becomes problematic.

Functional landlessness in the region amongst the rural population already exceeds 50% and will increase rapidly because of the lack of new land to develop agriculturally, the small size of existing farms, existing land ownership patterns, and rapid population growth.

With existing technology, agricultural productivity can be increased to levels three times higher than is currently the case in the region. (That is, yields similar to those achieved in Asian countries practising extremely intensive agriculture such as Japan could be achieved.) However, it does not follow that three or four times as many people would or could be absorbed on the land because of human factors noted above, such as ownership patterns, or the desire of landholders to translate higher yields into higher household incomes (rather than the support of more people).

2. *Pressure on Fragile Regional Eco-Systems*

As land becomes scarcer, farming is being carried out on fragile ecosystems. Of particular concern are:

Wetlands Wetland areas are increasingly being encroached upon and drained to support agricultural activities. In addition to serious environmental concerns about such encroachment, farming in these areas exposes farmers to considerable risk in terms of probability of harvest.

Alluvial fans (desilting areas). These areas in the north of the region are increasingly being farmed. This agricultural activity disturbs the silt deposits, resulting in increased silt deposition to the south. As is the case for wetlands, farming in these areas exposes farmers to considerable risk in terms of probability of harvest.

3. Urbanization / Migration

Previously it was noted that Bangladesh is probably just entering its period of fastest urbanization. The region is lagging behind much of the remainder of the country in this regard; partly for cultural reasons (Regional residents have preferred rural life) and partly because of relatively poor accessibility to urban areas (which is improving, see below). However, given the rapidly growing rural population in the northeast, increased landlessness, and population pressure on fragile ecosystems, it is likely that urban centres in the region will experience rapid urbanization and that there will be increased migration from the region to major urban areas such as Dhaka.

At present, cyclical migration does occur, particular from central wetland (haor) areas to urban centres such as Sylhet. Some migrants have settled in northeast urban centres on a permanent basis, but they usual retain ties (frequently through land ownership) to their rural homestead or community.

Given the enormous pressures on rural land, urbanization in the region can represent a positive force, particularly if well managed. Inevitably, a much higher percentage of the gross regional domestic product (grdp) will be accounted for by urban areas. An emerging urban settlement system exists upon which to build; Sylhet has a population in excess of 200,000; Narsingdi over 100,000, while seven urban centres have populations between 25,000 and 100,000; several smaller centres exist. Since all urban centres in the region are still relatively small; they can be shaped to improve future human well-being, environmental prudency, and economic effectiveness.

4. Improvements to Transportation / Accessibility

Accessibility in the region is improving significantly. The most important factor contributing to this change is the mechanization of country boats. To a more limited extent, improvements to road networks are also a contributing factor in improving accessibility. Based on ongoing, committed and planned road programmes and projects, road network improvements are more likely to reflect initiatives in rehabilitation and maintenance rather than network extension.

Improved access facilitates rural-urban physical linkages which contribute to: (i) marketing of agricultural produce (to the extent that surpluses exist); (ii) migration — cyclical and permanent; (iii) better access to private and public services such as health facilities, banks, government offices, located in District and thana centres; and (iv) possible links between local resource user groups and urban-based environmental and community development groups. Improved physical linkages between rural areas and larger settlements increases access of outsiders to local rural resources while at the same time improving the economic bargaining positions of rural residents. That is, improved access can result in beneficial development or outside exploitation of rural areas depending upon other factors at work.

If not planned carefully, highways can alter drainage patterns, impede navigation, and create other negative environmental or economic impacts. Similarly, efforts to improve navigation such as straightening of rivers can cause unexpected hydrological impacts with negative environmental and / or agricultural consequences.

5. Improvements to Communication and Electrical Systems

The number of telephone lines is increasing rapidly (see Interpretive Description of the Region); plans have been approved to approximately double the capacity of the regional telephone system (measured in terms of lines). This development creates potential for rural small scale industry and facilitates communication linkages between rural and urban areas.

Improved access to information by local farmers strengthens (through better communications) their knowledge of market prices, and techniques, and improves service response time for public and private sector services such as health and agricultural inputs. However, at the same time, local rural elites may differentially benefit from increased information available through improved communication linkages.

Improved communications represents an important factor contributing to monetisation of the rural economy; communications systems are the basis of market information.

Rural electrification is occurring in the region; however, in terms of present service and immediate plans, it is highly geographically skewed to major corridors. Associated with rural electrification is a rapid spread in televisions although non-electrified villages often have televisions operated with car batteries. Radios are ubiquitous while video machines will almost certainly become important over the planning period. This information and entertainment infrastructure will contribute to modernisation, monetisation, and associated changes in values, attitudes, and behaviour.

6. Emergence of the Dhaka-Sylhet Corridor

The Sylhet urban centred area is relatively prosperous. Given rail, air, road, and infrastructural linkages between Dhaka and Sylhet, plus other factors such as the linkages between Sylhet and Europe (U.K.), natural gas reserves in the east of the region, commercial agriculture in the east of the region (plantation crops to the north and market gardens to the south), and existing (plus planned) industrialization, the corridor is likely to increase substantially in prosperity. Industrialization, urbanization, and prosperity in the region is likely to be driven increasingly by this dynamic corridor anchored in the north by Sylhet which will increasingly act as a regional growth centre.

7. Regional Economic Diversification

The economy of the Region is becoming more diversified, particularly in urban centres and in the Sylhet-Dhaka corridor. The region is lagging slightly behind the nation in this regard but will soon restructure more rapidly in terms of rural off-farm activity, urban manufacturing and service activity (formal and non formal). Already (1989-90), 62% of the grdp is accounted for by non-agricultural activities; manufacturing (6%), construction (6%), trade (8%), transportation (8%). This restructuring process will be driven by both push factors such as lack of access to land; and pull factors such as demand for non-agricultural products from the region, for example, natural gas.

8. Continued Dependence on Local Resources for Biomass

For most of the Region's residents, local resources (surface and aquatic) are the only source of biomass for fuel and building material; and to a lesser extent, soil nutrients (fertilizer/ compost), medicines, and fodder. In particular, growing rural populations (including the landless who increasingly engage in wetland gathering [gleaning] as a means of livelihood when denied access to land) are placing increased demand on wetland resources. As pressure on local resources increases, over-exploitation is likely to lead to a downward cumulative cycle in terms of production and sustainability unless (i) better management of natural resources occurs, and (ii) population pressures on the land are reduced through development of non-primary agricultural income opportunities.

Given the fast population growth outlined above, sustainable development will be virtually impossible without major changes in developmental trends. Pressure on local surface and aquatic environments will be relieved somewhat through increased rural electrification and increased local household use of the abundant natural gas reserves (which can be converted to LPG) in the region.

9. International Demand for Wetland Products

Although less significant in terms of environmental degradation, wetlands in the region, as they become more accessible, may become subject to increased international demand for species specific products they yield.

10. Adoption of New Agricultural Technologies and Approaches

The rate of adoption of high yielding variety (hyv) technology packages (seeds, irrigation, fertilizer, pesticides) varies throughout the region. The fastest rate of adoption is in the west of the region where extension of irrigated areas is driven by ground water availability and is occuring rapidly.

Although there can be negative impacts of hyv adoption, such as water pollution and encroachment of wetland areas, given the high population growth in the region, with associated food needs; hyv adoption, if managed well, represents a positive force.

Currently, rice yields in the region are increasing at only about 2% a year, slightly less than population growth. Since rice prices are unlikely to increase substantially, and most rice is consumed locally at any rate, there is a need to diversify agriculture in the region for food consumption / nutritional, and economic reasons.

11. Adoption of Other Rural Technologies

In addition to mechanization of boats, introduction and diffusion of communications equipment and technologies, and hyv adoption as discussed above, other technologies are driving change in the life of the North East Region.

Examples of other technologies playing an increasingly important role in the region are: (i) diesel pumps which are being used for drainage (sometimes with negative consequences) and to power irrigation systems, (ii) improved fishing implements, and (iii) increased use of ice plants (to store fish). Innovative uses of the technology are being developed. For example, the same diesel engine might be used part of the year to power a boat and part of the year for irrigation. These,

and other emerging rural technologies, have potential for negative impacts, but if managed correctly can contribute to improved livelihood in the region.

12. Traditional Cultural Emphasis on Rice and Rice Cultivation

Farm management decisions, reflected in the economy of the region, are influenced by factors other than economic return. In Bangladesh society, there is an extremely strong preference for rice. Rice connotes pleasure and plenty; rice cultivators have considerably higher status than those cultivating (or gathering / gleaning or fishing) other crops.

Creating areas suitable for rice cultivation sometimes leads to draining of marginal areas or management practices which inadvertently create secondary impacts such as the silting up of wetlands. Although much of the North East Region is ideally suited for rice cultivation, sometimes rice is planted when other crops would probably yield higher nutritional and/or economic returns, and/or be less environmentally damaging.

13. GOB Ownership of Wetland Areas

Wetland areas (originally defined as permanent water bodies) were identified through various surveys prior to 1956. Tenure over these wetlands and other government owned lands is vested in the Ministry of Land (MOL) which has a revenue collection mandate. MOL generally leases out its holdings — be they fisheries, quarries, grazing lands, or swamp forests.

The major beneficiaries of the current leasing system are the money lenders and lessees who derive high profits from land leases; those paid to collect the tax; and specific government agencies holding accounts to which the tax is credited. The system is not totally in conformity with the national development strategy because:

- The system of rent and taxes stimulates resource depletion rather than sustainable development,
- Rents and taxes on wetlands transfer wealth from rural areas to the centre, and from poor resource gatherers to members of the elite, and
- The land system subsidizes concentration of control over natural resources.

14. Risk

Because of the high risk of flooding and widespread poverty in most of the region, households are, not surprisingly, risk averse. This affects behaviour, particularly in the agricultural sector, to a considerable extent. To the extent that natural hazard risks (particularly those associated with flooding) can be lowered, it is likely that more innovative approaches to agricultural and other activities will emerge.

Certain risks exist in the Region, such as earthquakes, about which little can be done; however, these risks generally do not affect human behaviour to any significant extent.

15. Social Change

The economic role of women in the household and the community is becoming more valued in the region. In part, this trend is a product of necessity; the labour of men and women is required to earn a living in an increasingly densely populated environment.

Also, as noted above, modern communications technologies are contributing to social changes in the region.

The population of the region, as for Bangladesh as a whole, is very young. Although the dominance of the less than 14 years population cohort has recently decreased somewhat, in 1981, 46% of the population of the region was under 14 years of age. Since young people are more amenable to change, it is likely that the youth will be influential in driving change in the region. Given, the age structure, the employment needs to absorb this population over the next two decades will be enormous, labour force growth in the range of 10% or more annually will be needed as the peak of this group enters the regional labour market.

16. Local Initiatives and Decentralization of Power

Historically, local people have requested government assistance for local projects. For example, many BWDB initiatives and plans reflect locally generated project ideas or actions started locally. Of late, with the return to democratic government, there is increased involvement of local people in the identification of local needs in terms of intervention by bodies such as the BWDB.

17. Changes in Agricultural Subsidies and Prices

Recently, subsidies to agricultural production have been reduced. It is not yet clear whether this is a long-term change. If so, it will be a major force driving the type of agriculture practised in the region and consequently will affect the location and types of water initiatives that are most effective.

The price of rice is fallingand this could be a long term trend. If it is a long term trend, it would constitute a significant driving force in the region and would affect what constitutes an effective water management plan for the region.

18. Tectonic Processes

The northern part of the region is subject to subsidence as a result of collision between the northward moving Indian Plate and the stationary Eurasian Plate. However, at the same time, the northern part of the region is subject to considerable sedimentation. To some degree, these two powerful forces seem to be counterbalancing each other.

4.4 Conclusions:

Because of strong driving forces acting in and upon the region, it appears that the region will change significantly in economic, social, demographic, and environmental terms between now and the year 2015. Thus, to develop a water sector plan based on the present characteristics of the region or the region that has existed from 1971 to the present, is unlikely to yield an effective plan. The challenge is to develop a futures view of the region and then devise a water management plan that will support and promote development over the next 22 years rather than one (through "rear view mirror" planning) that reflects the past.

The strongest forces, which interactively are bringing about this change are those related to: (i) relatively rapid population growth, (ii) the end of potential for significant increased numbers of land owners in rural areas (and productive deployment of large numbers of additional labour in agriculture), (iii) urbanization (which is just entering its strongest growth period), and (iv) industrialization and economic restructuring away from land based activities. Improved and

increasingly geographically diffuse communication systems are likely to strengthen the aforementioned driving forces.

At the regional scale, both strong traditional forces (such as emphasis on rice), and modern technological (such as communication systems), forces are at work. Change forces, as is always the case, will be stronger in some areas than others; for example, it appears communications changes and water transportation technology will lead spatial restructuring in the North East Region relative to roads and perhaps rural electrification.

The strongest driving force in the region is population growth relative to land availability. It is almost inevitable that this process will force restructuring in the region's economy and geographic distribution of population. Water management and planning will need to support and protect areas of high value in terms of new income generating activity (in agriculture and non-agricultural activities) if it is to be effective in supporting developmental objectives for the region.

Resources for water management initiatives should be distributed on the basis of future developmental objectives rather than solely on the basis of hydrological analysis or present economic activities and population distribution. In addition to protecting rural areas where most of the population of the region currently lives, urban areas and integrative systems, such as communication, electricity, and transportation, need also to be protected because these latter areas and systems represent the core physical skeleton for change in the region. In rural areas, water management needs to reflect changes in agricultural patterns and activities being brought about by driving forces. Lastly, but very important, water management related strategies need to protect the environmental quality of the rural landscape which is so essential in supporting and improving human livelihood in the region.

CHAPTER 8: REGIONAL ANALYSIS

8. REGIONAL ANALYSIS

8.1 Introduction

This chapter focuses predominantly on the Northeast Region; it builds on material presented in Chapter 4 on Driving Forces. In this Chapter, and in the strategy Chapter (10), the water sector is defined broadly in the sense of integrated water management and development. Much of the material in this Chapter refers generically to the entire region or to many places in it; however, some of the strengths, weakness, opportunities, and threats noted can be geographically identified and are, accordingly, described on Maps 1 to 8.

Strengths and weaknesses refer to the positives and negatives inherent in the present situation. Opportunities and threats refer to the future. Opportunities refer to phenomena or situations which can be turned to advantage if acted upon; threats refer to phenomena or situations which could decrease human or environmental welfare if appropriate management actions (sometimes preventative) are not taken.

Strengths, weaknesses, opportunities, and threats are identified first in terms of the Region's developmental system as a whole (the external environment), then the same sequence of analysis is undertaken for the water sector (the internal environment). The internal structure of the section on the external environment groups analysis of each SWOT category by institutional, human (socio-economic) and natural (biophysical) subcategories. The internal structure of the section on the internal environment (the water sector) is organised somewhat differently because water sector phenomenon is often more geographically identifiable in character. Thus each SWOT category in the water sector section of this Chapter is subdivided into institutional, surface and ground water (non-spatial) and surface and ground water (spatial) subcategories.

A given entity can be both a strength and a weakness or an opportunity and a threat because of the multiplicity of impacts associated with it or because of different possible impacts depending upon how the entity is managed. For example, the city of Sylhet represents a strength in that it has a dynamic economy; however, it represents a weakness in that its economy seems to be overheating creating infrastructural and other problems.

Figures 1 and 2 summarize the material in this Chapter in a balance sheet format. The text which follows contains more detail on the material presented in Tables 1 and 2.

EXTERNAL ENVIRONMENT

Strengths	Weaknesses
Farmers and families show strength and resilience Large , flexible labor force Some urban centres with strong economies The Dhaka-Sylhet and Dhaka-Mymmensingh growth corridors Reasonable arterial roads and extensive water transport system Strong connection between the eastern portion of the region and the UK Structural change in the economy is underway National policy changes — favourable to the region Local varieties of rice appropriate for subsistence farmers and suited to the environment Quarrying and gravel mining Abundant fish habitat Significant natural gas reserves Wetlands with considerable biodiversity Increased emphasis on environmental values GOB legally owns wetlands	Top down development programs Poor human resource development High association between gender and occupational roles Malnutrition, especially in the northwest part of the region High and rapidly increasing landlessness Complex tenurial system Economy focused to a large extent on rice which is facing declining prices Relatively inaccessible central haor area Urban infrastructural, social, and management needs unmet Agricultural inputs and post harvest services limited Lack livestock health services No protected wetlands exist — habitats are threatened Current institutional and information systems for decentralized natural resource management are inadequate
Opportunities	**Threats**
Democratic government provides opportunity for decentralized development programming Construction of key road links Economic and agricultural diversification Improved communications Southwestern part of region is adjacent to the Dhaka mega-urban area with enoromous future markets Increased value added to primary products Crop varieties are continually being developed for difficult environmental conditions Growth of local markets will increase demand for agricultural products	Social breakdown through landlessness and rapid urbanization Rice prices may fall Sylhet economy may overheat Disruption to rural economy due to removal of subsidies Overexploitation and structural impediments may reduce fisheries yield Increased pressure on marginal lands by landless people Biomass and certain species being exploited at higher than sustainable levels, particularly in wetland and forest areas Negative environmental impacts, including siltation, from structural interventions

Internal Environment

Strengths	Weaknesses
Opportunity to learn from past projects GOB committment to address water related problems Most rivers are still natural alluvial systems Large capacity to absorb sedimentation without seriously affecting flood levels Availability of construction materials Capacity to increase ground water extraction in parts of the region Ground water quality is generally good Sylhet Basin: homogeniety facilitates planning potential for multi-purpose projects acts as giant flood reservoir and desilting basin Seasonally Inundated: water management can be achieved throughout the year in the west, 3 crops per year can be produced without costly flood protection Uplands: well drained with little erosion areas of forest cover and unused land exist Piedmont Plains: good drainage Two rainfed crops are possible annually	Bias towards flood protection rather than integrated water development and management Bias towards serving agriculture (rice) rather than the development system as a whole Many projects were not completed as designed Poor operation and maintenance Meaningful public participation absent in projects Inadequate attention to fisheries and navigation losses Surface water shortages in the dry season results in problems related to: inland water transport fish migration pollution concentration irrigation Most flow originates outside the region Settlements near rivers which are at risk and reduce flood management options Syhlet Basin: maintenance costs for infrastructure are high construction season is short conflicts exist between agriculture and fisheries poor land transportation affects construction flood conveyance capacity of major rivers is well below requirements "permanent" engineering solutions are difficult Seasonally Inundated: numerous localized drainage problems surface water for irrigation is scarce western area: shallow aquifer northwestern portion: flash floods eastern portion: interventions on rivers can have far reaching effects Uplands: rapid rainfall runoff; no scope for reservoirs erosion from poor land use practices Piedmont Plains: surface irrigation is not cost effective since benefits are determined by base flows and costs are a function of flood discharges flood hazard is high

Opportunities and Threats continued on next page

Opportunities	Threats
Improved planning Need for a better mix of structural and non-structural initiatives Improved project monitoring Tipaimukh Dam (India) is expected to increase base flows providing opportunities for irrigation, navigation, and fish habitat Expanded channel re-excavation program Possible hydro-power development Agricultural production and effective water management synergistically related Additional ground water for domestic and irrigation uses in parts of the region Additional irrigation from surface sources Sylhet Basin: improved drainage by excavating lower reaches of drainage system flood mitigation by controlling primary inflows from Surma and Kushiyara Rivers protecting cereal crops reducing agriculture and fisheries conflicts through structural means return some "protected" areas to flood plain storage Seasonally Inundated: channelization localized drainage improvements increased afforestation full flood protetion to Surma-Kushiyara inter-Basin area improve navigation routes from quarries to urban markets flood relief channels Piedmont Plains flood relief channels improve Khowai River flood carrying capacity develop local irrigation initiatives Alluvial Fans: Malijhee-Mrigi flood relief channels use of fans for sediment storage and as a floodway	Climate change — particularly increased rainfall More pollution through increased industrialization, agricultural activity, and human settlement Embankments cuts Increased use of surface water in India Natural hazards such as earthquakes in catchment areas Arbitrary loop cuts, channel closures, and channel relocations produce substantial water regime changes Oer exploitation of ground water Sylhet Basin: siltation will affect water regime and hence effectiveness of structural projects Seasonally Inundated: flow regime changes due to construction on the Barak River will modify sediment transport regime of the Surma/Kushiyara Rivers Alluvial Fans: Channelizing rivers could produce substantial downstream impacts

8.2 The Northeast Region's Developmental System: SWOT Analysis

8.2.1 Strengths

The following are key current strengths of the Northeast Region in a developmental context.

Socio-Economic

(i) Families in the region show strength and resilience with the ability to sustain loss and survive adversity.

(ii) The region contains a large work force with an ability to switch from one activity to the other according to seasons and opportunities.

(iii) Voluntary labour can be marshaled when needed at the community level, particularly in cases where no government assistance is likely to be forthcoming.

(iv) Sylhet is an important and dynamic secondary city in the Region. It has reached a critical mass (approximately 220,000 population) whereby it is acting as a growth center for the eastern and central areas of the Region.

(v) As outlined in considerable detail in Chapter 4, the growth corridor between Dhaka and Sylhet is growing in economic and demographic terms. Although improvements are needed, the infrastructure is basically good in the corridor, and thus serves as a basis for development in the eastern area of the Region. The Dhaka - Mymensingh corridor plays a similar, although lesser role to the north west of the Region. (Most of the Dhaka-Mymensingh corridor is located outside the Northeast Region; however, its effect on the western side of the Region is important.)

(vi) Regional road infrastructure in much of the Region is good; a core system exists for extension of road networks where feasible. Numerous ongoing public works projects, particularly bridges, are underway to improve accessibility.

There is an extensive ongoing ADB project in the Region to improve roads. This project will improve the transportation network from Thana headquarters to District headquarters in Sherpur, Mymensingh and Netrokona Districts as well as improving large sections of the main road between between Dhaka and Sylhet.

Water transportation is good; with large numbers of small boats, mechanised country boats and larger vessels. However, portions of many rivers are not navigable during the dry season due to siltation and the total length of year-round navigable rivers is decreasing.

(vii) As discussed earlier (Chapter 4), the strong connection between the region (particularly Sylhet and Moulvi Bazar with London, England) acts as a source of capital and entrepreneurial ideas. However, a portion of the remittance and returnee capital is not invested productively.

(viii) The Region's economy and settlement system are undergoing structural change as indicated by rapid growth in non-agricultural employment in areas such as construction, manufacturing, and services (business and personal); plus rapidly increasing rural to urban intra-regional migration.

(ix) National policy changes to create a more open and market oriented economy are likely to benefit the Region, especially given its history of entrepreneurship.

Biophysical

(i) Local varieties of rice are dominant, especially in the central and eastern parts of the Region. These varieties of rice are less susceptible to disease and require less expensive inputs; for subsistence farmers, these are positive factors.

(ii) The region's soils are rich; the climate can support three crops per year if hydrological conditions are good.

(iii) The abundant water resources of the Region and the associated terrain, make it a fish "mine". The Region contains 25 main rivers totaling 2,150 km. in length, about 5000 (58% permanent and 42% seasonal) beels (totally about 500 square km.), and over 200,000 ponds.

(iv) At least five spawning grounds and about 325 duars exist within the Region, containing about 150 fish species.

(v) Fisheries is a major source of livelihood in the region, accounting for about 9% of the regional labour force.

(vi) The region contains significant natural gas reserves.

(vii) Several wetland areas remain of value in terms of biodiversity; some are of international significance. Important representative habitats still exist.

Most wetland areas are still very productive in terms of biomass production of local and regional value for food, shelter, medicinal, and other purposes.

(viii) There is increased importance being placed on environmental values in Bangladesh, as well as in the region. This is being reflected in areas such as GOB development policies and the emergence of environmental education. National and international environmental NGOs are showing increased interest in the natural resources of the region.

(ix) Because the GOB legally owns wetlands, this could facilitate integrated natural resources and environmental management of the wetlands.

8.2.2 Weaknesses

The following are key current weaknesses associated with development in the Northeast Region.

Institutional

(i) Government development programs and projects in the Region tend to be top-down; the allocation of resources to sectors and the content of initiatives are largely donor and national government determined and driven. This condition tends to slow innovation in the design, delivery and operation of developmental programs.

Socio-Economic

(i) The Region exhibits poor achievement, relative to Bangladesh as a whole, in human resource development, particularly in terms of literacy and basic education. This situation is a reflection of too low investment in human resources in the Region and cultural factors. Poor human resource development performance is probably the biggest single obstacle to improving human well-being and generating faster economic growth in the Region.

(ii) There is a high association between gender and various occupational roles in the Region, especially in more traditional fields such as agriculture. This situation contributes to lesser economic growth than would otherwise be the case and may result in men and women not realising their full potential.

(iii) Malnutrition is a problem in the Region, particularly in the distressed areas in the northwest area of the Region. (See Map ___). This situation is particularly serious in the case of pregnant and lactating women.

(iv) Landlessness in the Region is high (approximately 50% of the rural population) and growing rapidly, although not as high as for Bangladesh as a whole. Although landlessness is not necessarily a problem, it is in the region because most landless people are severely underemployed. Furthermore, the vast majority (perhaps 70 - 80%) of any incremental population added to the region's rural areas is likely to be added to the landless category.

(v) One of the most important problems in the Northeast is that settlement in many areas is already above reasonable carrying capacity for an agriculturally based economy. For example, the haor areas may require considerable infrastructural investment because so many people live there (although densities are still only about half those for the Region as a whole; they are very high given the biophysical environment).

The geographic distribution of population in the Region, although a given in the short run, and something which will change through driving forces in the longer run, is clearly a weakness in developmental terms.

(vi) The extremely complex tenurial system is a major weakness, in part because occupancy does not necessarily match legal rights. In some parts of the Northeast Region, much of the "khas" land, which in theory belongs to the government, has been occupied; and in some cases occupancy rights have been sold several times resulting in conflicts which are difficult to untangle.

In parts of the Northeast Region, for example the haor areas, communities have for generations enjoyed usufructary rights over pasture land, beels, or forest near their homes, but these rights have not been protected by the legal system set in place when the zamindars were abolished. When such "khas" land is leased to outsiders by the government to raise state revenue, it leads to conflicts, and often to a depletion of natural resources by entrepreneurs concerned with short term benefits.

(vii) The Region's economy is still, to too large an extent, focused on production of primary products faced with declining national and world prices. In particular, this is the case with rice. The region's economy is more weighted to declining commodities than Bangladesh as a whole.

(viii) Although the transportation and communications systems are relatively good along the two corridors (see Map ___), transportation and communications (particularly the latter) are much less available in remoter areas of the region, particularly the deeply flooded haor areas. The large central haor area is relatively inaccessible; furthermore, it serves as a transportation and communications barrier between the north east and north west areas of the region.

(ix) Urban areas are growing quickly in the region, particularly Moulvi Bazar, Habiganj, Sherpur, and Sylhet (in order of % growth rates). Because Sylhet is by far the largest urban area in the region, it accounts for the highest annual urban growth increments in absolute terms.

The region's urban areas are suffering from inadequate serviced sites for housing, inadequate water supply and waste systems, and a general lack of effective urban management and planning.

Biophysical

(i) There is a shortage of draught animals in the Region; to a large extent this is a product of the health (and related, size) of draught animals rather than the number. More generally, the health (weight) of livestock in the region tends to vary significantly by season, primarily as a result of fodder availability.

(ii) The considerable importance of the fisheries sector was often not adequately recognised by government.

(iii) The fishermen in the region are not as organised as in some other parts of Bangladesh.

(iv) As is the case for Bangladesh as a whole, no protected freshwater wetland areas exist in the region. Some of the remaining wetland species and habitats are threatened.

(v) Current institutional and information system arrangements for decentralised natural resource and environmental management are inadequate.

(vi) Information on natural resources, landscapes, and environmental systems is often inadequate for good stewardship.

8.2.3 Opportunities

The following opportunities for development in the Northeast Region exist.

Institutional

(i) With the recent return of democratic government in Bangladesh, there is opportunity to develop decentralised regional, sectoral, and local level approaches for human, economic, and environmental improvement.

Socio-Economic

(i) Although an extensive road network is not feasible in much of the haor area; there are opportunities to build key road links in various areas of the region which would greatly improve accessibility within the region. For example, a short (about 6 km) road link (from Sripur to Kazirgaon; see Map ____) could significantly decrease travel time from Sunamganj to Dhaka, and have the added benefit of reducing traffic congestion in Sylhet. Although a rough east-west road exists along the northern boundary of the region, upgrading it would considerably improve accessibility from east to west in the region.

(ii) There is considerable opportunity for increased economic activity and employment in the construction, manufacturing, agro-industry, and service (business and personal) sectors of the region's economy. For example, manufacturing firms making such products as garments, ballpoint pens, and other consumer goods are already establishing in the region. Investment of foreign remittences could be encouraged such that employment opportunities are promoted.

(iii) Improved communication systems will result in better informed populations.

(iv) The southern area of the Region is part of the Dhaka mega urban area, over the planning period, enormous opportunities will exist to supply a city of approximately 15 - 20 million people (by the year 2015) with food and other products which could be produced in the region.

Biophysical

(i) Potential exists for agricultural diversification. Many fruit and vegetable crops grown in the Region already command high prices if they reach market. Improved transportation infrastructure will increase the size of area in the Northeast with economic market access.

Opportunities exist to substantially improve production in the livestock sector, primarily by improving the health of animals and changing the production mix.

(ii) New HYV technologies, including deep water rice varieties will provide farmers in the region with more opportunities for higher production in difficult environments. In some cases, it may be possible to substitute different agricultural systems and technologies for structural interventions.

(iii) The economic and demographic growth of local markets will increase demand for agricultural products from the region.

(iv) In Upland areas, increased production of fruit and horticultural crops, and extension of the forested area, can be achieved through improved management practices.

(v) With better fisheries management there is potential for increases in sustainable fish production.

(vi) There is opportunity to use Liquefied Gas (LNG) and rural electricity to an increased extent to remove pressure from biomass resources.

(vii) Natural resources, including wetland products, could generate more benefits for local residents if more value were added.

8.2.4 Threats

The following threats to development in the Northeast Region exist and could create negative impacts if not foreseen and properly managed.

Socio-Economic

(i) Social breakdown could occur as a result of landlessness. Rapid urbanization could contribute to this social breakdown. Traditional family and community organisations, such as "shalish", will experience diminished power and respect as landlessness and urbanization increase.

(ii) Future commodity prices for rice, an important product in the Region, are likely to continue to fall in real (and probably nominal) terms on national and international markets.

(iii) Sylhet's economy may be overheating. This is partially a product of an under-developed urban system in the region, resulting in too much pressure on Sylhet. Traffic problems are emerging, as well as other social and infrastructural problems noted previously.

Biophysical

(i) Removal of subsidies to agricultural production, although desirable from an economic efficiency sense, will cause disruptions to local farmers. Small farms will not be able to purchase most agricultural inputs at market prices because their production is primarily for subsistence consumption.

(ii) Because of over exploitation and structural impediments to migration, such as embankments, the sustainable fisheries yield could decline in the future unless mitigation measures are adopted.

(iii) There will be increased pressure on marginal lands by landless or land short people who wish to farm. Since currently non-farmed lands are frequently ecologically sensitive, expansion onto these lands can cause significant ecological damage.

(iv) Biomass and certain species are being exploited at levels higher than sustainable, particularly in wetland and forest (lowland and upland) areas. Habitat destruction is occurring.

(v) Drainage improvements, flood control works, and resultant induced siltation may result in negative environmental impacts, particularly to wetlands.

8.3 The North East Region's Water Sector: SWOT Analysis

8.3.1 Strengths

The following are current strengths associated with the water sector of the Northeast Region.

Institutional

(i) There has been some learning from past projects; a limited information base exists in terms of effectiveness (or lack thereof) of past projects.

(ii) There is a commitment from the GOB and the international development community to address water development and management problems in Bangladesh in a manner which is appropriate and cost-effective.

Surface and Ground Water (Non Spatial)

(i) The area at high risk from channel instability and erosion makes up less than 20% of the Region's land area (mainly the alluvial fan areas, some piedmont streams, and parts of the haor and flood basin lands). Most of the Region, particularly the flood plains of the Surma, Kushiyara, Meghna and Old Brahmaputra river is morphologically stable.

(ii) Most of the rivers are still basically natural alluvial systems; they have been modified by engineering works to a limited extent only. The rivers are not highly channelised or trained in spite of some efforts in the past to do so.

(iii) The Region has a very large capacity to absorb sedimentation without seriously affecting flood levels. This is because the active width of the main rivers such as the Kalni or Baulai covers virtually the entire Central Basin lowlands during the monsoon season. Under these conditions, siltation in the main river channels will have very little affect on the overall flow pattern or water levels.

(iv) There is considerable debate concerning the fertility value of fine sediments on agricultural land. Some farmers consider these deposits beneficial. The steep border rivers transport coarse sand and gravel which has a high economic (including employment) value. This is a sustainable resource (from the perspective of

Bangladesh) which could be harvested at greater levels.

(v) The Region contains unused (sustainable use criterion) ground water resources although they vary considerably within the Region. Table 11 describes total use of ground water (domestic and irrigation use). As can be seen, ground water is being used to a much greater extent in the west and northwest of the Region than in the central and eastern areas.

(vi) At present, the quality of ground water in the Region is generally good.

Table 14:: Total Use of Ground Water
Northeast Region

Subregion	Mm^3/year	(%)*
Northwest	576.9	94
West	999.5	57
Central	30	9
East	75.7	36
Regional Total	1682.1	58

* Total use of ground water as a percentage of replenishable ground water (recharge).

Surface and Ground Water (Spatial)

Sylhet Basin

(i) The Sylhet basin is well defined in a hydrological sense; the relative homogeneity of the area facilitates planning.

(ii) There are substantial volumes of (post monsoon) residual surface water available for winter season irrigated agriculture.

(iii) The basin acts as a giant flood reservoir and desilting basin which provides excellent opportunities in water transport.

Seasonally Inundated Areas

(i) Improved water management is an option for most of the land in this subregion.

(ii) The western half of this area is mainly flood free; two to three crops per year can be produced without costly flood control infrastructure.

(iii) In the eastern half of this area, the land can support two crops per year; with irrigation it is possible to shift to high yielding varieties of boro as one of the crops.

Uplands Areas

(i) The upland areas are flood free and well drained with little erosion occurring. While mostly under tea, there are still some areas of forest cover and some unused or undeveloped land. Generally access within these areas is relatively good given the lack of flooding problems.

Piedmont Plains

(i) The piedmont plain areas generally have good drainage. Two rainfed crops are possible.

8.3.2 Weaknesses

The following are weaknesses associated with the water sector of the Northeast Region.

Institutional

(i) In the past, water development and management in the region has been biased toward flood protection for rice rather than toward integrated multi-purpose water management and development.

(ii) BWDB, by its nature, always exhibits an engineering or structural bias in addressing water sector needs, opportunities, and threats.

(iii) Most past water management projects have not been completed as designed because funds have run out. In addition, allocation of operations and maintenance funds are often insufficient for projects to operate as designed.

(iv) Many, if not most, FCDI projects have deficiencies which related to planning, design, construction, management and minimum cost consciousness. Meaningful public participation has generally been lacking in defining local needs and too little attention has been given to potential fisheries and navigation losses in designing projects.

(v) Very limited monitoring and evaluation of water management projects occurs.

Surface and Ground Water (Non-Spatial)

(i) Surface water shortages occur during the dry season when only about 3% of run off occurs. This shortage of water creates the following problems:

- Inland water transportation is restricted to the lower reaches of main river channels for many types of boats.
- Fish migration is often impeded.
- Sediments left behind by receding floods of the preceding wet season accumulate on the river beds causing drainage congestion, and further aggravate the problems of inland water transportation and fisheries by lack of sufficient water.
- Pollution brought into the Region from India, or generated locally, is poorly diluted and tends to accumulate in dead water zones within the rivers and haors during the dry season.
- Supplies of water for irrigation from surface water sources are limited.

(ii) Management of water through use of dams located in the Northeast Region is virtually impossible because there are no dam sites.

(iii) Sixty percent of the regional water supply comes from upstream territory in India and so there is no chance to control either water or sediment problems at their source or even monitor changes that are occurring there.

(iv) The Region's rivers are not extraordinarily unstable; however, the perception of river instability, and real problems, are created by the fact that a large percentage of the Region's population lives in very close proximity to active river channels since river levees are typically the highest land available for residential purposes. These people are exposed to high risk from even minor erosion or channel changes. Thus water hazards are as much a product of the settlement systems as of river processes.

(v) Adequate materials for constructing erosion control works such as revetments and river training structures are often not available. Often stones are undersized and inadequate volumes of stones are available. Also, suitable soil for constructing embankments is in short supply in soem areas.

Surface and Ground Water (Spatial)

Sylhet Basin

(i) Maintenance costs for infrastructure (including platforms on which homesteads are built) within the basin are abnormally high because the infrastructure is subjected to wave action, partial or total submergence, and extreme rainfall.

(ii) The construction season within the Sylhet basin is very short and when coupled with bureaucratic delays (for public sector interventions), construction programs either become protracted leading to cost increases (since flood damage repair is required for uncompleted infrastructure), construction quality is affected or construction is not completed.

(iii) Since many homesteads in the Sylhet basin are constructed on river banks, they restrict optimum placement of flood control infrastructure.

(iv) The unique environment of the basin (deeply flooded in summer, dry in winter) and the relative uncertainty of when and how rapidly the hydrological regime will change, leads to conflicts between production sectors (agriculture and fisheries) as each tries to maximize their yields.

(v) The Sylhet basin has very poor accessibility during the winter season when water transport is not an option; because this period coincides with the construction season, the impact on construction is compounded.

(vi) The flood carrying capacity of the major rivers within the Sylhet basin is well below requirement.

Seasonally Inundated

(i) This subregion is not homogenous which makes planning more difficult. There are numerous localized drainage problems and surface water for irrigation is scarce.

(ii) Where this subregion borders the Indian hills, it is subject to flash floods.

(iii) In the western portion of the area, the shallow aquifer is inadequate to irrigate a substantial percentage of the area.

(iii) In the eastern portion of the Seasonally Inundated area, the following weaknesses exist:

- Existing projects are no performing well which reflects negatively on development possibilities.
- The lower Meghna controls the drainage in this area which limits what can be done for F2 type lands.
- Interventions on the rivers in this area can have far reaching effects. This was evidenced by the loop cuts undertaken on the upper Kushiyara which resulted sediment being transported into the lower Kushiyara. This reduced the navigability of the lower Kushiyara and has impeded drainage for a vast tract of land.
- The flood peaks on many of the tributaries in this area are short but they occur frequently and are very intense.
- There is considerable absentee land ownership which discourages active participation of local residents in development efforts.

Uplands

(i) The Uplands experience rapid rainfall runoff which contributes to a shortage of water in these areas.

Some land use management practices, such as current methods of pineapple cultivation, destabilise the hill sides creating erosion problems.

Piedmont Plains

(i) The base river flows are low while flood flows are high which makes irrigation development from surface water costly. Associated with the extremes in river flows, flood hazards are high in this area.

8.3.3 Opportunities

The following are opportunities related to the water sector in the region which could be capitalised upon during the planning period.

Institutional

(i) There is an opportunity for better coordination of initiatives in the region. For example, transportation corridors (roads, railroads) create embankments as do BWDB projects. Often these work at cross-purposes; in other cases needless duplication of capital expenditure occurs.

There is a need for better coordination of structural and non-structural initiatives. For example, land use planning, local natural resources management, and warning systems can substitute for, or complement, structural interventions.

Better coordination might occur through regional water management authorities (such as a Haor Development Authority — suggested by people in Kishorganj) with total responsibility for planning and coordinating implementation of structural and non-structural water management initiatives within the area of jurisdiction.

(ii) There is a clear need for monitoring long term project impacts on river morphology and sedimentation. Improved project monitoring and systematic documentation of river engineering problems would lead to improved design practices and better formulation of future projects.

(iii) There is an opportunity to strengthen local initiatives wherever they are already occurring. There is considerable evidence of such local initiatives within the deeply flooded areas where people locally address problems related to flood and water management.

Surface and Ground Water (Non Spatial)

(i) India intends to implement the Tipaimukh Dam project and the associated Cachar Plain Irrigation Project. The net effect should be beneficial to the Northeast Region, creating opportunities by generating higher dry season flows and lower wet season flows. It is estimated that the volume of Barak flood water entering the Kushiyara and Surma rivers would by reduced by 5.1 km^3 during the wet season - equivalent to a 20% reduction in flow. Assuming the Cachar Plain Irrigation Project is implemented, corresponding dry season inflow would be increased by 3.5 km^3, equivalent to 60% of the present dry season inflow.

The benefits to the region of these effects would be less severe flooding in the wet season and greater availability in the dry season of river water for irrigation, navigation, and habitat for fish.

(ii) India is considering constructing dams on the Sonai and Dhakeshwari rivers, tributaries of the Barak river. If these dams are constructed, opportunities will be created similar to those described above (i) for the Tipaimukh dam, but on a lesser scale.

(iii) Considerable opportunities exist to improve drainage through:
- expanded dredging programs,
- channel re-excavation work, and
- flood relief channels.

Such channel works can: (a) improve drainage in upstream areas, improving conditions for agriculture; (b) improve navigation; and (c) provide more reliable water supply for irrigation and potable uses.

(iv) Related to (iii) above, opportunities for "preventative" channel maintenance work are considerable. For example, if an eroding spill channel can be closed off early on, a potential avulsion may be avoided. However, if the channel is allowed to grow until it captures a significant portion of the river's main flow, a large structure will be required to prevent the river shifting its course.

(v) It is problematic whether economic hydro electric development opportunities exist in the region. Possibilities for hydro electric projects include:

- Surma river at Sylhet: Preliminary studies indicate that a 25 MW plant could operate from May to September and generate 110 GWH during this period
- Manu river at Moulvi Bazar: A 2.5 MW hydro plant built in parallel with the existing barrage could be operated for eight months of the year and generate a total of 14 GWH. This energy is twice that presently used by the Manu project pumping station.

(vi) Yields of existing crops can be increased by use of high yielding varieties and irrigation and other inputs, while overall value of agricultural production can be increased through diversification into higher value crops.

(vii) Ground water for either domestic or irrigation purposes can be expanded to the limit of replenishable ground water though caution will need to be exercized to ensure that areas such as wetlands are not adversely affected. Table 15 provides estimates of ground water remaining for extraction at sustainable levels by subregion. It is estimated that ground water will be fully utilised, at sustainable levels, by 2015.

(viii) Irrigation opportunities are of high concern in the region since significant production gains can be attributed to them. As available ground water resources are utilized, surface water sources will become relatively more important. Opportunities for additional irrigation water based on surface sources include:

- local initiative earth retention structures
- river sources based on higher dry season river flows as a result of construction of dams in India (as discussed earlier in this Chapter), and
- storage of residual flood waters in haors by closing gates before drainage is complete in autumn.

Table 15: Ground Water Remaining for Exploitation — Northeast Region

Subregion	Mm^3/year	(%)
Northwest	37	6
West	749.5	42.8
Central	316.2	91.3
Eastern	135.8	64.2
Region	1238.5	42.4

Ground Water and Surface Water (Spatial)

Sylhet Basin

(i) There is potential to improve pre- and post-monsoon drainage of the basin by excavating the lower reaches of the drainage system (lower Kushiyara) and improving the conveyance capacity of the upper Meghna.

(ii) While flooding can not be eliminated from the basin, it can be mitigated by controlling spills from the Surma and Kushiyara Rivers.

(iii) Cereal production can be increased substantially in the basin by protecting existing crops from pre-monsoon flooding.

(iv) It is possible that fisheries enhancement technologies (such as by-pass structures) might reduce, but not totally eliminate, the conflict between agriculture and fisheries.

(v) The opportunity exists to improve scheduling of engineering work to take full advantage of the short construction season.

(vi) Rehabilitation of the Kalni river between Ajmiriganj and Madna may be feasible by a combination of river training and dredging.

Seasonally Inundated Area

(i) The negative impacts of flooding from the Kangsha river can be reduced through river "channelisation", loop cuts, and/or diversions.

(ii) Localized drainage can be improved through the Narsunda, Showai, and Suti Nadi rivers.

(iii) There is an opportunity for increased afforestation along the banks of the Old Brahmaputra.

(iv) Channelisation of the Kushiyara river below Sherpur would improve drainage.

(v) There are opportunities to expand flood protection along the Sarai-Goyain, the Surma, and Kushiyara Rivers which would reduce crop damage and facilitate an expansion of irrigated agriculture.

(vi) Improvement of navigation routes between quarrying areas and major urban centers would facilitate expansion of construction materials quarrying.

(vii) Construction of a flood relief channel running from Dilalpur to Nabinagar, around the north side of Bhairab Bazar, would increase the carrying capacity of the upper Meghna river and hence help reduce the extensive flooding of the central zone of the Northeast Region.

Piedmont Plains

(i) The Manu-Dhalai to Hakaluki flood relief channels could be constructed. This channel would divert flood water out of the Dhalai and Manu Rivers and into Hakaluki Haor, and thus reduce flooding in the lower Manu valley. While the town of Moulvibazar would be the primary beneficiary of this flood relief, benefits would also accrue to the Manu River Irrigation Project and the the lower Dhalai river.

(ii) The Khowai river flood carrying capacity could be improved by eliminating sugar cane cultivation within the flood way, by setting back embankments at strategic locations, and by reconstructing bridges at Shastaiganj with longer spans and higher decks.

(iii) There is an opportunity for increased local irrigation initiatives in the subregion similar to those found on the Bilash and Langlia khals and on the Conti Nadi.

Alluvial Fan Areas

(i) Construction of a Malijhee-Mrigi Flood Relief Channel would divert flood water out of the Kangsha river basin into the Old Brahmaputra, and thus reduce flooding along the upper and middle reaches of the Kangsha valley.

(ii) Opportunities exist to protect areas of the alluvial fans against channel erosion and avulsions. This would involve zoning parts of the fans for protection and other areas of the fans as high hazard areas where development would be discouraged. The high hazard areas would be designated for sediment storage and for use as floodways.

8.3.4 Threats

The following are threats associated with the water sector in the region which could detrimentally affect beneficial development of this sector to meet human and environmental objectives during the planning period.

Institutional

(i) The increased proliferation of uncoordinated water projects and schemes represents a threat to the water regime in the Region. The construction of roads and embankments by different organizations, each with their own objectives and without regard to their impact on other aspects of water management has created, or aggravated, flooding and drainage problems in the past, and will continue to do so in the future if not brought under the control of a competent authority charged with coordination of initiatives. The construction of road and railway embankments is a case in point.

Surface and Ground Water (Non-Spatial)

(i) A threat to the Region is climate change. If present trends continue, greater flooding in both volume and intensity, slower drainage, and more severe dry water deficits in the future are likely to result. These conditions would result in a requirement for higher engineering standards for new structural water projects and possible upgrading of existing projects. The financial implications in terms of design of new projects and modification of existing projects could be significant.

(ii) As industrial activity increases in the Region, industrial pollution has the potential to significantly threaten water supplies unless indutries display responsible behaviour (probably as the result of enforcement of discharge or process standards) in regard to minimising the discharge of pollutants into rivers and waterbodies. Processes using hazardous or toxic chemicals represent a particular threat.

The quality of water in the region is also threatened by human (sewage) and animal waste as well as by increased use of fertilisers and pesticides in agriculture.

(iii) The cutting of embankments constructed for the benefit of agriculture alone reflects public frustration over real or perceived adverse impacts on local flooding, drainage, fisheries, and water transport. Such cutting means that economic returns of projects primarily designed for agriculture are low. This trend is likely to continue, or become more severe, unless more sophisticated design work is done based on multiple benefits and input of local impacted populations.

(iv) If irrigation projects in India, particularly the Cachar Plain project are enlarged beyond current expected size, the advantage of higher dry season water flows into the region resulting from Tipaimukh dam are likely to be lost.

(v) Natural hazards in catchment areas, such as an earthquake in one of the Indian catchments, could lead to greater sediment supply to the region in the future. This would produce channel instability on the Meghalaya fans and on piedmont streams.

(vi) As noted above, incremental ground water supplies are likely to be exhausted by 2015. Over exploitation of ground water is a real threat. In fact, in some Thanas in the north west area of the region, over exploitation is already occurring.

In addition to deterioration of ground water quality through over exploitation, there is also a threat of ground water quality deterioration through increased use of fertilizers, pesticides, and through industrial processes. The threat is especially strong in enclosed haors.

If ground water deterioration reaches unacceptable levels, the use of ground water for activities such as domestic supply and agriculture would need to be abandoned.

Surface and Ground Water (Spatial)

Sylhet Basin

(i) Ongoing water regime changes from past developments on the Kalni and Kushiyara river will cause aggradation and increased water levels in pre-monsoon and post-monsoon periods downstream of Sherpur. Ongoing siltation will further worsen navigation conditions along this reach. Increased over bank spills and channel widening can also be anticipated downstream of Markuli. These regime changes will adversely affect submersible embankment projects situated in the Central Basin lowlands between the Baulai and Kalni rivers.

Seasonally Inundated Area

(i) Changes in the flow regime from construction of dams on the Barak river will modify the sediment transport regime of the Surma and Kushiyara rivers. If the river's capacity to transport sediment is reduced, additional sedimentation will occur along the lower reaches of these systems.

Alluvial Fan Areas

(i) Attempts to channelise the steeper piedmont rivers and alluvial fans which carry high sediment loads could produce substantial downstream impacts. For example, channelising these streams would flush sediment that was normally deposited onto the fans or piedmont floodplains into the mainstream rivers which could lead to rapid channel aggradation.

8.4 Conclusion

The strategy chapter which follows (Chapter 10) is based on consideration of the above strengths, weaknesses, opportunities, and threats in the context of likely available resources (financial and human), an established base line regional data system, a defined planning horizon, likely inter-sectoral and inter-regional developmental priorities in Bangladesh, and likely driving forces (previously defined) that will affect the region.

ANNEX A

UPDATE OF POTENTIAL INITIATIVES

ANNEX A

UPDATE OF POTENTIAL INITIATIVES

A NOTE ON THE POTENTIAL INITIATIVES

The potential initiatives described in this Annex broadly fall into two categories: Non-structural and Structural.

The non-structural initiatives are identified regional needs based on investigations which started with the preparation of sectoral studies (specialist reports). The list of initiatives was further refined on the basis of the outcome of subsequent steps in the planning process which included the development of an interpretive description of the region, identification of driving forces and the regional (SWOT) analysis.

The structural initiatives, while generally following a similar approach as that described above, also required the identification of geographical boundaries to ensure that the entire region was addressed. These boundaries were defined, on a preliminary basis, as physiographic units. These units were described in some detail in an earlier report "*Regional Development Considerations*". These physiographic units were then examined in some detail to define the major water management problems that existed within each one. General boundaries were then established which grouped areas with similar problems. Subsequently, these general boundaries were mapped in conformity with what were considered "appropriate" hydrological boundaries[1]. "Appropriate" from the standpoint of physical as well as analytical and impact considerations. The study of these initiatives is being undertaken in a sequence leading from upstream to downstream areas to ensure that downstream impacts of water management interventions are not overlooked.

All potential initiatives presented in the following pages will be processed through the prefeasibility stage of investigation. Not all will conform with the water management strategy for the region (which is under preparation) but the investigations are still required to make this determination. The Regional Plan will present those of the initiatives which conform to the defined strategy and which have successfully passed through the multi-criteria analysis as specified by FPCO.

[1] FAP 6 basin boundaries do not necessarily conform to the planning areas identified by the Master Planning Organization(MPO). While FAP 6 is concerned with identifying and studying all manner of water resource projects, MPO was focusing more extensively on dry season surface water resource estimates. For example, while estimating resources in Planning Area 26, MPO correctly included both banks of the Kushiyara River; FAP 6, in formulating interventions has dealt with the left and right banks separately. Further, FAP 6 integrated Planning Area 25 and the Kushiyara left bank portion of Planning Area 26 since any intervention impacts on both areas.

1. STUDY/OTHER

Agricultural Diversification (NERP study)

Scope: Regional

Description: Rice self-sufficiency has long been the aim of the Bangladesh government. While increased procurement prices for rice encouraged production, the bumper crops of FY 92 and FY 93 resulted in reduced rice prices. The dilemma is that Bangladesh farmers and farm workers suffer from hunger when rice crops fail and from low prices and corresponding low incomes when bumper crops occur. To modulate and increase agricultural incomes and to encourage economic activities, there is some urgency to diversify agricultural production.

More than 100 types of crops are produced in the region, broadly classified as cereals, fibre crops, pulses, oilseeds, root and tuber crops, spices and condiments, vegetables, fruits, tobacco and tea. Rice is the most important, accounting for 85 percent of the total cropped area. The physical environment strongly favours rice cultivation and, perhaps relatedly, people favour rice as a primary food.

Potentially, diversification could involve shifts to: cereals, pulses, oilseeds, tubers, vegetables, cotton, tobacco, fruits and specialty crops for beverage, medicine and dyes. For example, farmers could engage in cotton cultivation and sericulture as a means of reducing cotton and silk imports provided profitable markets exist. Other examples would include production, multiplication, and distribution of improved seeds, livestock development, homestead gardening, food processing and preservation,

The suggested diversification strategy is to: i) identify the most profitable farm enterprises, ii) provide reliable and adaptable technical guidance on promising enterprises, and iii) provide assistance, information and guidance for the marketing of farm products. Implementation of such a strategy would require policy and institutional support and would benefit from general economic development which would increase markets and access to markets for some products.

Status: Study Complete

Alternatives to Turfing (NERP Study)

Scope: Regional

Objectives: reduce embankment erosion
reduce embankment maintenance requirements
increase productivity (fodder, fuel, etc.) of embankment vegetation
make increased embankment production available to targeted groups

Description: The report "*Social Forestry and FCD/I Project Maintenance*" (Sep 92) prepared by FAP 13 reviews past and current efforts to develop social forestry on embankments. None of the mentioned sites mentioned, however, are in the Northeast Region.

Their main recommendation is that a "pilot programme for social forestry on FCD/I embankments linked with improved maintenance of infrastructure should be undertaken." This is a national program that will be acknowledged/included in the Northeast Regional Water Management Plan, but with the following comments/modifications.

It is clear that FAP 13 is recommending that the programme be done in top-down fashion, with BWDB taking the lead. This may not be realistic, given the lack of evidence of BWDB interest and effectiveness in O&M. The FAP 6 counterproposal will be that provision for social forestry on embankments should be a key element of improved and decentralized institutional arrangements for O&M.

FAP 13's list of suggested plants and plant selection criteria is based on existing social forestry on embankment sites, of which none are in the region. Specific recommendations for submersible embankment social forestry are limited to a single line of flood-tolerant trees (*hijal, koroch, or mandur*) along the berm, with turfing for surface protection (some of the other social forestry models include interplanting of annual food crops). There is thus still a need for reconnaissance studies of existing plants (cultivated and wild) on embankments in the region, and for (a) pilot social forestry project(s) on embankments in selected agro-ecological zones of the region, in particular the deeply flooded areas.

Status: Complete. The recommended go-forward process will be a pilot project based on the outcome of the FAP 13 study with modifications as suggested above.

Environment Management, Research, and Education Centre (Programme)

Scope: Regional

Objectives: improve water quality; preserve biodiversity; improve forest resources; benefit fisheries; enhance wetland resources; protect key wetland sites

Description: This project provides a framework for response to the region's most critical environmental issues:

- *Immediate, serious threats to habitats and species, and pressing water quality concerns.* A number of habitats, resources, and species, are under immediate threat, and several pressing water quality concerns have been identified. The Project would undertake actions on a priority basis to address these areas.

  A number of concerns and possible actions have been identified so far, and these are listed below. It is emphasized that flexibility to modify this list based on additional information, institutional considerations, etc, will remain throughout Project preparation and early implementation.

  Habitat: Key wetland sites. *Proposed action:* Work with local people to define and achieve sustainable locally-based management.

  Habitat, resource: Swamp forest and reed land as ecological communities, and as regional resources. *Proposed action:* Work with local people to achieve sustainable locally-based management and economically and socially sustainable afforestation.

  Species: Globally threatened animal and plant species. *Proposed action:* Develop and implement species recovery plans.

  Species, resource: Commercially threatened animal species. *Proposed action:* Develop technical and institutional to meet demand through commercial farming.

  Habitat, water quality: Major river reaches (such as fishery habitats) affected by industrial pollution. *Proposed action*: Develop and implement pollution abatement infrastructure and operational controls at selected industrial facilities.

  Resource, water quality: Need for improved domestic sanitation to reduce surface water contamination and health risks. *Proposed action:* Implement aquatic domestic-wastewater treatment demonstration projects.

- *Need for sustainable institutional structures to address regional environmental concerns on an on-going basis, emphasizing regional self-reliance, appropriate privatization, accountability, and local participation.* The actions described above will not be sustainable beyond the lifetime of the Project, unless needed institutional

capabilities have been appropriately institutionalized. Needed capabilities would include backstopping local resource managers in a variety of ways; carrying out needed ongoing monitoring of environmental conditions; compliance with environmental management plans, etc; undertaking needed research and extension; and so on.

The Project would assist in the creation of an autonomous, self-sustaining Environmental Management, Research and Education Centre. To achieve regional self-reliance, appropriate privatization, accountability, and local participation (all elements of GOB policy), this might best take the form of a new non-governmental organization. NGOs as legally defined in Bangladesh are accountable to a General Membership, which in this case should be open to the public and include representatives of all interested parties (local communities, local and national NGOs and academic institutions, the media, etc). Sustainability would be achieved through autonomous fundraising for specific activities or projects, independently or in partnership with a variety of Government agencies, and assumes that development funds are and will continue to be available for efficient and effective projects addressing priority environmental concerns.

If EMREC is viewed as appropriate and successful, there would be the opportunity to replicate the approach in the other regions of Bangladesh.

- *Need to improve how key regional concerns are reflected in environment and forestry policies, programmes, projects, legislation, and financial and professional resource allocation.* GOB has identified bottom-up planning as an area for increased emphasis. There is a need for regional concerns to feed back up into national level decisions, and for progress at the national level to create conditions within which regional efforts can succeed:

  Wetlands. The need for national institutional action on wetlands is recognized by Government, concerned NGOs, and donors. Actions that have been discussed or initiated include formation of a Wetland Working Group; development of a wetland policy; national wetland inventory; training in wetland-related technical, policy, and management subjects; and others. The Project could support such action through appropriate technical assistance, funding for technical and policy conferences, training activities, and so on.

  Wildlife. The need for national institutional action on wildlife conservation and management is also recognized. Actions that have been discussed or initiated include needed revisions of relevant legislation to allow export of commercially farmed threatened species; formation of a Wildlife Working Group; training; and others. The Project could support such action through appropriate technical assistance, funding for technical and policy conferences, training activities, and so on.

  Large-scale afforestation of swamp forest and reed species. Basic conservation of these threatened habitats has already been mentioned. These efforts will create a body of new information on swamp forest and reedland afforestation and management. There is a need to incorporate this new information into ongoing

Forest Department planning for the region, which currently concentrates almost exclusively on Forest Department-owned upland areas. The Project could support this through provision of technical assistance and training to Forest Department personnel.

Status: Prefeasibility study in preparation. The Ministry of Environment and Forests with the assistance of UNDP consultants is preparing a proposal to the Global Environment Fund that will likely include components addressing key wetland sites, EMREC, and possibly other aspects.

Fish Sanctuaries (Programme)

Scope: Regional

Objective: To reduce fishing pressure on brood fish.

Description: Excessive fishing pressure on brood stocks in critical habitats (mother fisheries, spawning grounds, overwintering grounds) is contributing to declining fish catches. To enhance survival, a multi-component strategy was developed to establish conservation-intensive fish sanctuaries in key localities. Field surveys were undertaken to determine fish migration routes, breeding habitats, and the locations of mother fisheries, and major carp spawning grounds. A comprehensive survey of over-wintering refuge duars in the major rivers of the region was also undertaken. Concurrent with conventional and/or fisheries sector specific management measures, several fisheries habitat/environmental conservation and enhancement measures were also developed. A strategy which includes fisheries management and fisheries environment components has been formulated and published in the Final Draft of the *Fisheries Specialist Study*. Many of the elements of the strategy have received approval from the fisheries sector — this approval was expressed at various meetings and seminars. Based on this work, UNDP/FAO has included establishment of fish sanctuaries in its fishery programme for Bangladesh. Certain fisheries habitat/ environment elements are being developed in greater detail as environmental initiatives by FAP 6. These include lowland forestry and water quality.

Status: A prefeasibility study of these strategy elements is under preparation.

Fisheries-Related FCDI Engineering (Programme)

Scope: Regional

Objective: To reduce or eliminate negative effects of FCD/I projects on fisheries production.

Description: Improving the fisheries performance of FCD/I engineering could reduce, minimize, eliminate, or mitigate many of the negative impacts of such projects. To achieve this, field studies were undertaken to analyze the impacts of existing FCD/I projects on fisheries in the region. Parallel studies were carried out at locations without FCD/I projects for comparison. A variety of fisheries benefitting structural and operational measures for inclusion in existing and future FCD/I projects were formulated. These measures are described in the Draft Final of the *Fisheries Specialist Study* and include embankment routing, beel embankment, haor zoning and artificial duars. A special study was undertaken on the design of fish passes which resulted in the preparation of conceptual designs for these structures. The measures outlined above are being incorporated into design of future FCD/I projects.

Status: This study is in progress and one outcome is criteria which are being incorporated into the conceptualization and design of FCD/I projects.

Gender (NERP Study)

Scope: National

Objectives: To better understand the socially determined characteristics of men and women and with developments in the water sector, find opportunities to improve one's position in relation to others with greater advantage and power.

Description: The objective of FCD/I has been to increase rice production. To the extent this was achieved, women, who own less than 5% of the land, have benefited as dependant members in patriarchal households and as paid labourers. But, in these two positions, women have benefited less than men. Resources including food are not equally shared amongst male and female household members. As labourers, women are employed for shorter periods and are paid half of men's wages. The recommendations to address this imbalance are:

Commit Resources to the Protection of Homesteads which Improves the Productivity and the Quality of Life for Women: There is a need for a different conceptual approach to farm production systems. This requires an adequate recognition of the numerous and key functions performed in homesteads and the meaningful role women play there. These roles include drying and storing grain, preserving seeds, keeping draught animals, and all are essential components of rice production systems. Other activities, such as poultry raising, and vegetable gardening are carried out independently of rice production. Homesteads provide for essential needs such as shelter, storage, sanitation, privacy, boundaries, space to live and

work, fuel, food, and drinking water. Most of these productive homestead activities are the responsibility of women and some of the activities are of direct benefit to them. The small surface area of homesteads are highly productive (much more so than the less intensively cultivated rice fields). In addition to their productive value, a well maintained homestead promotes better health, ensures safety, and enhances the quality of life.

Given the above, adequate consideration should be directed to homestead security in FCD/I projects. Attention and resources should be directed towards protecting homesteads; especially where severe flood and erosion affect a large number of people. The protection of homesteads requires small scale projects, solutions adapted to the local geography, and a high degree of community participation but would impact directly on the quality of life of women.

Strengthen Women's Participation in Water Management and Flood Control Works at Community Level: In many, though not all, BWDB projects, women participate as paid labourers in earth moving work. In a few rare cases, they have formed their own Labour Contracting Societies. Womendays of employment and wages, however, are considerably less than men. Women are largely absent from community management and decision making positions and this is also the case in water management schemes both where local initiatives are concerned as well as in BWDB (public sector) projects. There has been some pioneering work done through projects such as the Delta Development Project and the Land Reclamation Project which promoted the collaboration of BWDB with NGO's and technical assistance. These projects have demonstrated the difficulty of ensuring women's participation in this sector and in building on these experiences, possibly better methods could be devised. However, the objectives pursued are important to uphold in a gender equity strategy. These objectives are to highlight the visibility of women as workers, to promote their active and informed participation in public works and public affairs, and to encourage women taking their share of project benefits directly and in their own right.

Increased Involvement of Women Professionals: The overwhelming majority of professionals working in the preparation of projects and programmes in the water sector are men. Women share only to a very small degree the benefits of income, authority and power these positions entail. Gender equity requires the employment of more women professionals. Moreover, sensitization to social gender issues would benefit from a different mix of professional disciplines amongst the managers of the water sector.

Status: Study nearing completion.

Protecting Industrial and Service Sectors (NERP Study)

Scope: Regional

Objective: To identify the options for providing flood protection, and how such measures might relate to the needs for improved infrastructure and communications.

Description: It is expected that the manufacturing and service sectors in the Northeast Region will provide employment to an additional 0.3 to 0.5 million people by the year 2000, and at least 1.5 million people by the year 2015. The businesses will be located in both urban and rural areas, and they will be based largely on agriculture, fisheries, and domestic trade.

The major requirement for facilitating this level of development will be to provide adequate flood protection, infrastructure, and communications.

Status: This study, which is in process, aims to provide as far as possible some quantification of the impacts (benefits) of providing such protection. The engineering interventions of the protection (which provide the costs) are being carried out under the structural initiatives (the Manu River Improvement Project would include provision of flood mitigation for Moulvibazar; the Khowai River Embankment Project for Habiganj; and so on).

Aggregate (Nerp Study)

Scope: Regional

Objective: To facilitate aggregate transport.

Description: The Northeast Region supplies almost all of the aggregate used for construction in Bangladesh. This is major industry, involving hundreds of boats and thousands of people — many of whom are poor. The market value of the aggregate is in the order of Tk 3000 million per year, and the economic value is substantially greater.

The aggregate industry is at risk due to siltation of the rivers, which may restrict and, in some cases close, the river transportation systems. The matter is being studied in terms of options and costs of keeping the river transportation system open, and in terms of alternate transportation courses.

Status: A study of the production and marketing side of the industry is in process. The technical (transportation) options are being examined in the context of development possibilities of the affected river systems on the alluvial fans (such as the Dhalai and Jadhukata rivers).

Livestock Development (NERP Study)

Scope: Regional

Objective: To investigate the potential for increased poultry and livestock in the region.

Description: The demand for poultry and livestock will increase significantly as incomes increase over the next several years, which will result in rapidly increasing prices or higher imports, neither of which are desirable from an economic, equity and nutritional perspective.

The study concluded that there is good potential for increases in ducks (possibly integrated with rice and fish production) if the disease problems are addressed. There is however limited opportunities for increases in chickens and livestock unless food is diverted from the people. This however is an increasingly feasible scenario as Bangladesh moves towards food self-sufficiency, and is already occurring to a limited degree in the Sylhet area. It would have its largest application in increased milk production, and in serving the higher priced "niche markets". The industry will continue to be driven by the private sector, and the only specific interventions required are in the control of diseases, and the development of hatcheries.

Status: Completed.

Ground Water Investigation (Programme)

Location: Regional

Objectives: To facilitate the development of ground water for domestic, industrial, and agricultural use in a sustainable manner.

Description: Within the region, the area irrigated by ground water is estimated at 213,000 ha and is a key source of domestic water supply. The occurrence of ground water throughout the region is variable and not well known and the rate of extraction and its sustainability is uncertain. While ground water development occurs mainly in the private sector, there is a need to ensure that future development (which could fully utilize available ground water within the next 15 years) does not exceed sustainable limits. A review of the region's ground water resources resulted in the identification of the following programs to facilitate sustainable ground water development:

Ground Water Level Monitoring: The long term impact of existing large ground water withdrawals needs to be established. The oldest available ground water level records from the monitoring network could facilitate identification of a "baseline ground water level" to which all subsequent ground water levels would be referred. Such a study would also serve to identify the various local, intermediate, and regional water flow systems.

Assessment of Impact of Ground Water Development: Recent planning and development, while paying attention to estimates of recharge, the number of wells to be constructed, and the selection of suitable technology, is all based on the assumption that aquifers are fully recharged every year and that, hence, the influence of previous withdrawals is not carried over from one year to the next. This assumption needs to be tested through regional water balance modelling before further large scale ground water development proceeds beyond the sustainable limits of the resource. This is of particular importance to the western part of the region.

Exploratory Drilling and Aquifer Testing in the Eastern Part of the Region: Assessments of ground water resources in the eastern part of the region differ, and there are areas, such as that south of Moulvibazar, which are evidently not suitable for development by deep tube wells.

A program of exploratory drilling and aquifer testing is required to fill information gaps on water occurrences in these areas; such a program could be carried out as part of a drilling and production well construction project. Ground water dating should be attempted and would involve the application of environmental isotope techniques to ground water samples taken from each aquifer encountered by boreholes penetrating the multi-aquifer sequences known to occur in the subregion.

Data from this project should be used to develop and calibrate a new mathematical model appropriate for the multi-aquifer sequence encountered. This model should then be used to simulate recharge of this sequence.

Baseline Survey of Ground Water Quality and Subsequent Monitoring: A baseline survey of ground water quality throughout the region should be carried out as an extension of the pilot survey made by the BGS in 1992. The methodology for this baseline survey should closely follow that adopted for the BGS pilot survey, but nitrates should be added to the list of chemical constituents to be analyzed and the number of trace elements for which determinations were made in the BGS survey could be reduced to those shown to be significant in the BGS survey. In respect of regional coverage the BGS network of sampling points has to be supplemented in the eastern part of the region and a sampling network should also be established in the Northwestern part of the region.

A regular ground water quality monitoring program should follow after the baseline survey is completed. This program is to facilitate early detection of any deterioration in the quality of ground water in any area, and so enable timely corrective measures to be taken. The monitoring of any contamination of the ground water which occurs will be an important feature of this program since it is extremely difficult to decontaminate aquifers once they are polluted; early detection of contaminants enables early identification of the source and, hence, control of contamination at the source.

Status: Study complete. The program defined as "*Ground Water Level Monitoring*" has been initiated under the ADB financed Northeast Minor Irrigation Project with some assistance from FAP 6.

Operation and Maintenance of Regional Water Resources Infrastructure (NERP Study)

Scope: National

Objectives: Investigate options for achieving improved operation and maintenance of water development projects;
Identify ways in which infrastructure could be constructed so as to reduce operation and maintenance requirements;
Identify means to devolve responsibilities for selected aspects of operation and maintenance to the beneficiary community; and
Improve institutional aspects of operation and maintenance.

Description: The "*Operation and Maintenance Study*" (FAP 13) reviewed O&M activities in Bangladesh and its neighbouring countries. The study identified constraints and proposed a set of recommendations placing emphasis on institutional arrangements for O&M involving local people at all stages of project development.

The Northeast Regional Water Management Project (FAP 6) assessed the performance of all 67 water development projects in the region. The need for improved level of direct and positive public participation in project development, operation and maintenance was identified as essential if these projects were to perform efficiently.

The Systems Rehabilitation Project (SRP) of BWDB has adopted O&M as one of its major components as is also the case with the Small Scale Water Control Structure III Project and the Early Implementation Project (EIP). SRP is studying the need for rehabilitating existing projects with special emphasis on O&M throughout Bangladesh including the Northeast Region. FAP 6 as far as possible, is collaborating with SRP in rehabilitation, operation and maintenance of existing water development projects in the Northeast region.

A review of the findings from the referenced programmes and projects will result in FAP 6 adopting the following principles relative to operations and maintenance of infrastructure for the region.

Focus on support for institutions which engender maximum beneficiary participation in project development and subsequent operation and maintenance. This will include, but not be limited to, the involvement of appropriate NGOs.

Promote the provision of adequate post-project budgets for infrastructure modification. This will include establishing realistic cost estimates for operation and maintenance requirements.

Provide for a transitional phase between implementation and O&M during which "beneficiaries" would be familiarized with actual project capabilities as well as operational constraints and requirements. This would include documentation (in Bengali) of operational requirements..

Initiate programs oriented towards partial cost recovery which would also serve to

promote a sense of ownership.

Promote afforestation programmes including lowland forestry for protection of infrastructure — particularly from wave action.

Status: Ongoing

Public Participation in Water Resources Infrastructure Planning, Implementation, and O&M (NERP Study)

Scope: National

Objective: Address the need to make investments more responsive to the publics needs and thereby ensure that the performance of these investments is improved.

Description: The report "*Guidelines for People's Participation*" prepared by FPCO provides direction for involving people at all stages of water development projects. Key recommendations are that local people, their elected representatives and local officials be involved in need assessment at the pre-feasibility stage. Then at the feasibility stage diverse socio-economic groups are to be involved in identifying development alternatives leading to the recommendation of the selected option. This is to be followed by group formation at various levels which is to occur at the detailed design stage. Landless Contracting Societies (LCS), particularly including women, are to be involved at the implementation stage. O&M manuals are to be prepared in Bengali to facilitate improved operation and maintenance and at this stage, the services of the LCS's are to be incorporated.

FAP 6 reviewed current initiatives in public participation in five areas of the region: Kaliagota Haor (which has no public sector infrastructure); Shanir Haor (a BWDB project); The Manu River Project (a BWDB project); the Moharoshi/Malijhee River Irrigation Schemes (includes some BWDB infrastructure); and, Peoples Cross-dams on the Netai River. Results of this review are being published in a document entitled "*Local Initiatives and Peoples Participation in the Management of Water Resources in the Northeast Region*". The main findings of this study are that:

Within projects planned and financed through the public sector (BWDB), peoples participation is very evident but occurs in a manner which was not consistent with the planned operation of the project. In fact, the people's participation, in some cases, works at cross purposes to the objectives of the project as outlined by the planners.

People's participation was not generally exercised through formal project committees but usually through informal power structures and groups which operated through unofficial channels and for very explicit purposes.

The extent to which local government representatives become involved is largely a function of the extent to which they have financial resources at their disposal to affect project operation. The misuse of funds by authorities served as a powerful disincentive to people's participation in project related activities.

There are traditional practices and institutions in Bengali society which play an important role in promoting community participation. The institution of *Chanda* or community contributions which are made in cash, kind, or labour to pay for public services is one such institution. This practice (*Chanda*) was perceived, in the region, as facilitating activity at a community level.

Effective and meaningful public participation requires that at least two conditions be fulfilled:

- There need to be strong local organizations capable of articulating the common interests of particular occupational and socio-economic groups of men and women; and,
- There must be channels and procedures which allow local organizations to participate in the projects.

Status: Completed.

Review of Inland Water Transport for the Region (NERP study)

Scope: Regional

Objective: To establish the role of the sector, and its contribution to the economy with a view to better understanding the linkages between water transport and water management infrastructure.

Description: The regional environment is such that water transport plays a key role in moving people and goods. Water transport is used for agricultural purposes, domestic purposes (including attending markets and schools, collecting fodder and firewood, visiting doctors and family) and for fishing. It is a major employer in the region. The study provides an overview of the sector, it identifies the pattern of country boat traffic in the region, the volume of cargo with its intermodal share and maps the river routes with draft restrictions. Also identified are navigational problems created by various types of infrastructure such as roads, embankments, bridges, sluice gates, regulators, and river closures.

The main findings (to date) of the study are:

- Total inflow and outflow of cargo to and from 15 markets (15 Apr 92 through 14 Apr 93) was 12 million tonnes and 11.3 million tonnes respectively. The intermodal share of this cargo was: country boats (63% and 42%), Inland Water Transport Authority (28% and 27%), Road (8% and 30%) and rail (1% and 0.06%).

- Water transport earned Tk 2,790 million (US$ 73 million)during the year mentioned and the country boat's share of this was Tk 1,800 million (US$ 47 million).

- Of the existing 66 water resources projects in the region, 19 have had a serious negative impact on navigation, 14 have had some negative impacts, 25 have had no impacts, and in 7 projects navigation and in some cases, road transport was improved.

It is generally noted that water transport is the most cost effective way of moving people and goods within the region. A high percentage of the public cuts which occur in existing water resources projects are made to improve navigation and that where dreging or khal excavation has been carried out, navigation has improved.

Status: The study is 80% complete.

2. PARTIAL FLOOD CONTROL

Sonai-Bardal-Hakaluki Haor Project

Location: Golapganj and Beanibazar, Sylhet District, Sylhet

Gross area: 2,130 ha

Objectives: Flood protection and improved drainage to prevent pre-monsoon flash floods and thus to increase boro production.

Description: Two projects (Bardal River Project and Hakaluki Haor Project) were merged into an area water resources development project since developments in one area impacted on developments in the other area. The Bardal River Project recently underwent feasibility level analysis as part of the Project. The feasibility study was reviewed in the context of FAP 6 and it was concluded that potential benefits had been over-estimated and that the rate of return at 5% was to low to warrant further analysis.

The Hakaluki Haor component of this study was discarded as a water management for agriculture project since this haor has been identified for development both as a "mother fishery" and as a "key wetland site". The option of diverting peak flood discharges from the Manu River basin into Hakaluki Haor is being explored. Development in Hakaluki Haor will need to be re-assessed against this option and infrastructure may be required to mitigate the effects of the additional inflow.

Status: Analysis Complete. Report preparation pending. Interventions in Hakaluki Haor will be re-analyzed in the context of a flood diversion from the Manu River Basin.

Chalti Haor Project

Location: Bishwamvarpur, Sunamganj District, Sylhet

Gross area: 9,170 ha

Objectives: To reduce flood damage to monsoon and *boro* rice and to promote improved drainage.

Description: Rivers surrounding the haor are silting up and sand is being deposited on agricultural lands. People report that there is occasional damage to *boro* and *aus* crops. Preliminary analysis indicates that the re-excavation of the Rakti River (which is being examined under the Jadukati and Ratki Beel Project) will substantially improve the flooding and drainage characteristics of this area. It is unlikely that any further intervention will be proposed.

Status: About 10% complete.

Dharmapasha Rui Beel Project

Location: Dharmapasha & Mahanganj, Sunamganj & Netrokona Districts, Sylhet & Mymensingh

Gross area: 9300 ha

Objectives: increase *boro* production

Description: *Boro* crops are damaged frequently between the Someswari and Kangsha Rivers. Project would protect *boro* crops from pre-monsoon flooding. If Kangsha or Someswari flood levels rise as a result, embankments of adjacent projects would have to be raised.

Status: Work to commence in August.

Maidur Haor Project

Location: Lakhai, Habiganj District, Sylhet

Gross area: 2500 ha

Objectives: reduce damage to *boro*

Description: Located adjacent to Lakhai Thana Centre on Kalkalia River, a branch of the Dhaleswari. Project would protect *boro* crops from pre-monsoon flooding. Physical works are limited to re-sectioning 10 km of village road along the Kalkalia.

Status: Work to commence in August.

Morir Haor Project

Location: Beanibazar, Sylhet District, Sylhet

Gross area: 7,410 ha

Objectives: Reduce damage to boro and aman crops resulting from cross border and flash floods.

Description: The Morir Haor has a typical haor topography with cultivable lowlands and beels in the central part and homesteads on highlands and river levees on the outer part of the basin. There is no gravity drainage from the project during the pre-monsoon as the elevation of its lowlands is below the water levels in the Kushiyara and Sonai Rivers. During this period rainfall runoff fills the Morir Haor basin, with part of the runoff (40%) coming directly across the border from India and the remaining part (60%) coming from the Kushiyara and Sonai Rivers.

People of the area described rainfall run-off as a major problem and indicated that boro crops were subjected to some damage in every year by pre-monsoon run-off. They also stated that silting of drainage canals delayed drainage and transplanting of boro seedlings in addition to reduced navigability.

The project development concept which appeared most viable was based on pre-monsoon flood control and involved the construction of an interceptor canal along the eastern boundary of the project from Baragram to Sarapur village. This would be intended to divert cross border flows into the Sonai River. The flash floods would then be reduced through the construction of drainage/flushing regulators on open canals which serve as distributaries of the Sonai River.

A summary of salient data, including disbenefits and costs, is shown in Table A.1.

Status: Analysis Complete. Draft report complete. Not yet circulated.

Table A.1: Morir Haor Project
Summary of Salient Data

Economic Rate of Return (ERR)	(-)10%			
Capital Investment (Tk million)	77.7			
Maximum O+M (Tk million / yr)	2			
Capital Investment (Tk/ha)	15,090			
Foreign Cost Component	9%			
Net Project Area (ha)	5,150			
Land Acquisition Required (ha)	30			

AGRICULTURAL IMPACTS		Present	FWO	FW
Incremental Net Econ Output (Tk million / yr)	2			
Cropping Intensity		1.4	1.4	1.4
Average Yield (tones/ha)		2.2	2.3	2.4
Average Gross Margins (Tk/ha)		11,246	11,378	11,944
Owner Labor (md/ha)		118	118	119
Hired Labor (md/ha)		33	34	38
Incremental Cereal Prod'n (tones / yr)	972			
Incremental Non-Cereal (tones / yr)	0			
Incremental Owner Labor (' 000 pd / yr)	6			
Incremental Hired Labor (' 000 pd / yr)	28			

FISHERIES IMPACTS		Flood plain	Beels	Spawning
Incremental Net Econ Output (Tk million / yr)	(-)1			
Impacted Area (ha)		1600	120	0
Average Gross Margins (Tk/ha)		1340	18450	-
Remaining Production on Impacted Area, %		70%	80%	
Incremental Fish Production (tones / year)		-14	-21	
Incremental Labor ('000 pd / yr)	-20			

Tangua Beel Project

Location: Madhayanagar & Taherpur, Sunamganj District, Sylhet

Objectives: Reduce damage to *boro* and/or enhance the environment to better support the region's fisheries.

Gross area: 10,400 ha

Description: A low-lying area adjacent to Bangladesh-India border. The Tangua Beel is located on the periphery of an alluvial fan and avulsions (rapid river course changes) on the fan alter sediment deposition patterns. Such changes can have a negative effect on the quality of the area as a fisheries habitat. The option of protecting *boro* crops from pre-monsoon flooding will be examined but given the designation of this site as a "key wetland" and as a "mother fishery", interventions will also be examined which could potentially enhance these components.

Status: Study scheduled to start in August.

3. OTHER WATER RESOURCES INFRASTRUCTURE

Amalshid Permanent River Training Works Project

Location: Amalshid, Sylhet

Objectives: Reduce Kushiyara high flood flows and enhance Surma (high and low) flows with the aim of reducing flooding in the Kushiyara basin, and improving navigation on the Surma.

Description: BWDB has constructed aprons to reduce erosion at the bifurcation of the Barak River. The impact of this work is being monitored with a view to better understanding options to alter the flow split between the Surma and Kushiyara.

Status: In cooperation with BWDB, work is on-going. Additional field surveys are planned for early September.

Kushiyara River Bank Protection Project

Location: Zakiganj, Sylhet District, Sylhet

Objectives: Stabilize the river system and reduce the negative impacts from channel bank erosion.

Description: BWDB has started constructing revetment works to reduce erosion at Zakiganj. This work needs is being reviewed from an engineering and economic perspective.

Status: On-going

Sand Entrapment Dam/Reservoir Systems (Sabo Dams) on Selected Rivers (Programme)

Location: Durgapur & Kalmakanda, Netrokona District, Mymensingh

Objectives: The aim of this programme is to construct sabo dams to create reservoirs in which the sand can be accumulated.

Description: The inflows of certain trans-border rivers carry large quantities of coarse sand. When these rivers spill onto cultivated land and sand deposition occurs, soil fertility is compromised; heavy deposition renders land uncultivable, at least until cultivable sediments can accumulate over the sand layer.

Status: Analysis complete. Report in preparation.

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4. FULL FLOOD CONTROL/CONTROLLED FLOODING

Narayanganj-Narsingdi Project

Location: Narsingdi & Narayanganj Districts, Dhaka

Gross area: 99000 ha

Objectives: reduce monsoon flood depth
expand HYV cultivation
improve drainage

Description: Surrounded by the Lakhya, Old Brahmaputra and Meghna, crop production is affected by overbank spills. Project components include full flood embankments, drainage structures, and reversible pumping stations drainage and irrigation distribution systems

Status: Work scheduled for September.

Upper Surma-Kushiyara Project

Location: Zakiganj, Beanibazar, & Kanaighat, Sylhet District, Sylhet

Gross area: 49,200 ha

Note: Project gross area is 49,200 ha composed of an area of 31,580 ha previously studied under the same project name plus 13,832 ha added to conform to topography and take advantage of existing embankments along the Surma and Kushiyara. The additional area lies between the Charkhai-Sheola Road and the basin divide line across the hills from Golapganj in the north and Manikkona in the south.

Objectives: FCD component: To reduce flood damage to monsoon and boro rice; to promote expansion of HYV rice onto lower lands through lower flood depths, improved drainage, and reduced early flood risk; and to reduce homestead and infrastructure damage from river floods.

Irrigation component: Irrigate 5600 ha in the upper part of the project area.

Description: Two options were investigated. Option 1 is flood control and drainage only. Option 2 adds surface water irrigation to this.

Option 1 would increase total flood-free cultivable area from 3500 to 23,000 ha by provision of continuous 1:20 year full flood embankments along the Surma and Kushiyara Rivers, with eight (three existing, five new) regulators at major khals.

Upgrading would be needed on about 155 km of existing embankment, and about 26 km of new embankment would be needed. The agricultural benefits relate to reduced flood damage to crops, increased cropping intensity (cropped area increases in all seasons), and shifts from local to high-yielding varieties.

Option 2 would in addition provide irrigation from the Kushiyara to 5600 ha in the upper part of the area, with the construction of a pumping station and distribution structures and canals. The incremental agricultural benefits would be increased cropping intensity (reflecting a shift from winter fallow to hyv boro on a small area), and shifts from local to high-yielding boro and aman varieties.

Multi-criteria analyses of Options 1 and 2, including disbenefits and costs, are shown in Tables A.2 and A.3 respectively.

Status: A draft final pre-feasibility study is being circulated for comments.

Table A.2: Upper Surma Kushiyara Project without Irrigation
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	'000 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 A.3: Upper Surma Kushiyara Project with Irrigation
Multi-Criteria 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	'000Tk	254,079

Quantitative Impacts			
Indicator	**Units**	**Value**	**Percent**
Incremental Cereal Production	'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 (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
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	?

5. DRAINAGE IMPROVEMENT

Baulai Dredging Project

Location: Jamalganj, Dharmapasha, & Mahanganj, Sunamganj & Netrokona Districts, Sylhet & Mymensingh

Objectives: improve drainage
improve dry season navigation

Description: The Baulai River's bed has aggraded increasing water levels and delaying post monsoon drainage. To facilitate *boro* cultivation and navigation, deepening the Baulai's main channel from the Someswari outfall to the Kangsha Outfall will be considered.

Status: Analysis more than 50% complete.

Kushiyara Dredging Project

Location: Lower Kushiyara River

Objectives: improve drainage
improve dry season navigation

Description: Approximately 25,000 m^3 of sediment has been deposited in the main channel of the Kalni River between Ajmiriganj and Madna over the last 25 years. This aggradation has caused bed levels to rise by as much as 5 m. During this same period, pre-monsoon water levels have risen by at least 1 m in Markuli and Ajmiriganj. If aggradation continues at its current rate, the possibility of the river abandoning its present channel and shifting to a new course in the next 10 years or so can not be ruled out. Preliminary results from the hydrodynamic model indicated that to lower pre-monsoon flood levels by 0.5 m would require removing approximately 60 million m^3 of channel bed material. Reducing the scale of the project would result in a corresponding reduction to the flood control benefits.

Any major capital dredging project would require an ongoing program of annual maintenance dredging to prevent the channel from filling back in to its present configuration. Preliminary calculations suggest that maintenance dredging could be in the order of 1 million m^3 per year.

Alternate measures for increasing channel depths and reducing flood levels on the Kalni River need to be investigated. Possible alternatives to dredging include constructing river training works to confine the channel below Ajmiriganj, constructing loop cuts downstream of Ajmiriganj to initiate head cutting, and re-opening the Markuli closure.

Status: A preliminary technical report entitled "Kushiyara River Dredging Study" was circulated in December 1992. Further analysis is required to refine estimates and impacts.

Habiganj Drainage Improvement Project

Location: Habiganj & Ajmiriganj, Habiganj District, Sylhet

Objectives: increase *boro* production
improve drainage

Description: Flash floods damage *boro* crops. Late drainage is partly caused by siltation in channels affected by backflow from the Kalni and Meghna Rivers. Improvements will involve increasing the capacity of the major drainage channels of the area.

Status: Scheduled for September.

Jadukata and Ratki Rivers Improvement Project

Location: Kotwali, Tahirpur, Bishwamvarpur, Jamalganj, Sunamganj District, Sylhet

Gross area: 37,000 ha

Objectives: To reduce pre-monsoon damage to *boro* rice by improving drainage which facilitates earlier planting; to improve navigation; to reduce siltation in Tangua Beel which has been classified as a "mother fishery".

Description: The objectives are to be achieved by re-excavating the Jadukata and Rakti Rivers at strategic locations. In addition, the inclusion of a low closure dam across the Maharram River is being assessed along with bank protection upstream and downstream of the closure dam.

Status: Work is in progress; about 10% complete.

Mrigi River Drainage Improvement Project

Location: Sribardi and Sherpur, Sherpur District, Jamalpur

Gross area: 24,400 ha

Objectives: To reduce crop damage resulting from drainage congestion without negatively affecting fisheries or navigation.

Description: The project as proposed includes; re-excavation of 28.2 km of the Mrigi River from Boysha Beel to Char Betmari; rehabilitation of the left bank of the Old Brahmaputra River from Nij Kharmarer Char to Gogra Kandi (35 km); and enhancement of fisheries in 10 ox-bow shaped lakes by establishing nurseries and setting in place a weed eradication program.

Primary project benefits relate to increased cereal production (6% over the future without project case) and a projected increase in non-cereal production (7% over the future without project case). The economic rate of return for the project is estimated at 52%. The multi-criteria analysis is not yet complete.

Status: 90 % complete.

6. AREA WATER RESOURCES DEVELOPMENT

Kangsha River Basin Development Project

Location: Parts of Sherpur, Mymensingh, and Netrokona districts

Objectives: The study objectives are to protect crops, homesteads, and infrastructure from flooding by the Kangsha River and its tributaries, subject to the condition that development of one area in the basin does not negatively affect other basin areas.

Description: The study has subdivided the river into reaches based on flooding and drainage problems:

- Nalitabari-Sarcharpur reach. Options being investigated are:
  - straightening the reach to improve drainage of higher lands
  - extending the Konapara embankment along the left bank to stop overbank spill which damages monsoon crops (right bank is mostly single-cropped boro and would be left open as a floodway)

- Sarchapur-Jaria reach. Option 1: Right bank embankment from Kharia River outfall to Jaria connecting with Kangsha River Project embankment. This option looks promising as the right bank flooding affects a large area which drains away from the Kangsha to the south, thus the embankment would not cause drainage congestion. (The left bank area drains back to the Kangsha.) Option 2: Diversion of Kangsha River flow to the Mogra/Saiduli River. The Nalitabari-Sarcharpur reach straightening (see above) could increase flows in this reach. Closure of Atrarchali Channel, which would divert Someswari flow into the Kangsha, is also being considered (see below). Additional flow from these developments could be diverted in this reach.

- Jaria-Thakurakona reach. Possibility of embanking the left bank will be investigated (right bank is already embanked).

The new avulsion of the Someswari into the Atrarchali Channel is accelerating siltation in the Sitli Beel area, which in turn may lead to enlargement of the Atrarchali, and eventually another avulsion. The possibility of closing the Atrarchali to revert the flow through the abandoned channel will be investigated. Complete channelization of the Someswari through the Kangsha Channel may cause aggradation and lateral expansion in the Kangsha and attack of the existing embankments (Kangsha, Thakurakona, and any left bank embankments).

Status: Pre-feasibility study 10% complete.

Khowai River Embankment Project

Location: Habiganj District, Sylhet

Objectives: reduce flood damages to agriculture, homesteads and infrastructure along the Khowai River.

Description: There are two main options for reducing flood damages along the Khowai River System.

- Upgrade the existing embankments to prevent breaching by providing adequate set-back and by constrictions and flow obstructions; or

- Split the flood inflows at the Indian border between the Khowai, Karangi, and the Sutang Rivers. A diversion structure would be required near Ballah and channel improvements and new embankments would be required to contain the spills into the Karangi and/or the Sutang Rivers.

It is noteworthy that so far, failures on the Khowai embankment have not been caused by overtopping by other processes including piping failures at structures, bank erosion, and scour at the toe of the embankment. Some past breaches have occurred at relatively small flood flows (such as 1985) when the discharge was less than 500 m^3/s. Therefore, even if part of the flood discharges were diverted into other drainage basins, this would not eliminate the chance of breaching on the Khowai embankment. Therefore the second option would not solve the basic problem of breaching on the Khowai without other measures being implemented on the Khowai River itself.

The following measures are being proposed for upgrading the Khowai Project so that it can provide protection against floods having a return period of 50 years:

- enforce regulations to prevent construction of unauthorized structures such as sluices. This would reduce the risk of breaching at local works;

- re-align the embankment to provide adequate set-backs so the embankment is not subjected to high velocities and undermining by scour;

- acquire land between the embankment and the river to control floodway encroachments due to vegetation and other obstructions;

- consider raising the three bridges between Habiganj and Shastaiganj and increasing their spans so they do not produce backwater;

- upgrade the embankments so that they can contain a 50 year flood with a freeboard of at least 1 m. Based on historic records, this discharge is estimated to be around 1270 m^3/s at Shastaiganj. However, if upstream spills into other river systems were eliminated, then the total flood inflow would be greater, say in the order of 1500 m^3/s. Preliminary computations show that it should be feasible to achieve this capacity. However, more detailed hydraulic analysis is required to verify this;

- monitor sediment sediment accumulation in the reach below Habiganj and plan on periodic maintenance in the future to reduce the afflux caused by aggradation;

- assess impacts of future extensions to the embankments downstream of Habiganj by hydraulic model computations. Further channelization of the lower river will raise water levels upstream.

The magnitude of the flood spills upstream of Chunarghat out of the Khowai River system are very uncertain at this time. Extending the embankments upstream to Ballah could result in further increases in flood discharges on the lower reach of the Khowai River. The impact of these increased flows on the performance of the project needs to be resolved before the embankments are extended to the border. It may be more practical to allow some flow to spill into either the Karangi or Sutang Rivers. This would require preparing a floodway and raising existing bridges to accommodate the periodic spills.

Status: Analysis is ongoing — about 60% completed.

Kushiyara-Bijna Inter-Basin Development Project

Location: Baniachong, Ajmiriganj, Nabiganj, Habiganj, Madna, Derai, Moulvibazar

Gross Area: 100,000 ha

Objectives: To protect boro crops from pre-monsoon flood damage; to a lesser degree, to protect monsoon crops from flood damage; to provide supplemental monsoon-season irrigation; and to protect homesteads and roads from flood damage.

Description: Protecting a gross area of about 100,000 ha, project infrastructure would consist of 48.5 km of full flood embankment, 33 km of submersible embankment, 13 drainage regulators, five irrigation inlets, and 55 km of channel re-excavation, in the following places:

- To protect from Kushiyara overbank spill, full flood embankment from Sherpur to Markuli; submersible embankment from Markuli to Ajmiriganj;

- To protect from Shakaborak and Bijna River flooding, a regulator at the Shakaborak and a strategically placed submersible embankment along the Bijna below Terapasha; and

- To protect from Sutki River overbank spill, extension of the Sutki River right embankment from its current position to the Baniachong-Nabiganj road.

Expected benefits relate mainly to agriculture; total paddy production would increase by about 13%, and non-cereal production would also increase. About

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370 ha or 0.4% of project gross area would be taken for infrastructure; of this 10 ha would be homestead land belonging to about 600 families. Additional information on impacts and economics is in preparation.

Status: Prefeasibility study 80% complete.

Manu River Improvement Project

Location: Moulvibazar District, Sylhet

Objectives: Solve the problem of flooding in Moulvibazar town
Facilitate revitalization of the Manu River Irrigation Project
enable Dhalai River Project objectives to be achieved

Description: An analysis of the hydrology of the Manu basin indicates that flood peaks have increased by a factor of about 1.7 over the past decade which appears consistent with increases in causative rainfall. Rainfall patterns tend to be cyclical and it is expected that, at least, the current rainfall patterns will persist for another decade, perhaps longer.

Below its confluence with the Dhalai River, the Manu is confined between Moulvibazar town (on its left bank) and the embankments of the Manu Irrigation Project (on its right bank). The extent of the confinement is such that peak Manu and Dhalai flows are unable to pass through the town without causing extensive inundation and damage to property and infrastructure. To mitigate the adverse effects of this flooding, it is necessary to find alternate routes for peak flows.

A possible solution to the problem, which is under investigation, is the diversion of Manu and Dhalai flows into Hakaluki Haor.

Status: Hydrological analysis is complete. Application of the NAM/MIKE11; HEC2 and HEC6 models to confirm this analysis is in process. This will then be followed by an analysis of biophysical and other impacts.

Mogra - Old Brahmaputra Inter-Basin Development Project

Location:	Kishorganj & Netrokona Districts, Mymensingh
Gross area:	446,200 ha
Objectives:	improvement of *boro* crops
Description:	The area is little affected by floods but there is drainage congestion due to siltation of drainage channels. The analysis based on available information identifies the following channels in need of re-excavation: Narsunda River (Kishorganj); Showai Nadi (Gourirpur); Suti Nadi (Nikli); Dhalai River (Atpara); Kodalnati Nadi (Bhairab Bazar); Sitalpati River (Bhairab Bazar); and, Baruni River (Kendua). These are, to a large extent, minor channels for which cross-sectional information is unavailable with the result that impacts of the proposed channel improvement work can not be refined.
Status:	Study is 80% complete.

Narsingdi District Development Project

Location:	Narsingdi District, Dhaka
Description:	Five projects have been completed and various others proposed for this area, evidently on a piece-meal basis. Potential exists to provide additional integrated full flood protection with flushing, which would support further ground water development.
Status:	Scheduled for September

Sarigoyain-Piyain Basin Development Project

Location: Kotwali (Sylhet Sadar), Jaintiapur, Gowainghat, Chhatak, Companiganj, Dowarabazar

Objectives: Various, at three sites; see below.

Description: Water resources infrastructure in this area consists of three projects identified and designed on the basis of discussions with area residents and preliminary technical analyses:

- *Rauchunni Beel Project* (gross area 3200 ha). Project would provide flood protection (19.5 km full embankment with two regulators), drainage improvement (21 km channel re-excavation, and increased beel area (6 km beel bunds). Expected benefits are mostly agricultural, with monsoon rice, boro rice, and rabi crop production each estimated to increase by about 90%. Flood damage to 100 homesteads and 6 km of roads would be reduced. Total (beel + floodplain) openwater fish production is expected to decrease by about 10%, reflecting a trade-off between a 50% decrease in floodplain fish habitat and a 15% increase in beel area due to the beel bunding. The estimated internal rate of return is 39%. Additional information on impacts and economics is in preparation.

- *Nainda Haor Project* (gross area 8070 ha). Project would provide pre-monsoon flood protection (20 km submersible embankments with six regulators), improved management of accumulated rainfall (15 km of compartmental bunds), and drainage improvement (31 km channel re-excavation). Expected benefits are mostly agricultural, from reduced flood risk and flood damage to boro rice. Analysis of impacts and economics is in preparation.

- *Dhalai Gang Project* (Rauti beel flood protection/drainage improvement gross area 1225 ha; bounding for other impacts in preparation). Project objectives are to shorten the navigation route used to bring boulders out of Bholaganj quarry; to reduce the risk to homesteads and agricultural land from avulsion of the Dhalai Gang distributary channel; to protect boro crops in the Rauti beel area from pre-monsoon flooding; to reduce siltation, allow dry season water storage, and improve drainage in Rauti beel, which has been identified as a mother fishery. Infrastructure consists of a low-height closure dam across the distributary channel; a set of spurs on the main channel left bank upstream of the present avulsion site; partial re-excavation of 4 km of the main channel up- and down-stream of the avulsion site; 4 km submersible embankment along the right bank of the Piyain River to the south with a regulator at the Rautir Khara channel; and re-excavation of 2 km of Rautir Khara. Analysis of impacts and economics is in preparation.

Status: Pre-feasibility study 80% complete.

Surma Right Bank (Kanaighat to Sylhet) Project

Location: Kotwali (Sylhet Sadar), Kanaighat, Jaintiapur, Gowainghat, Golapganj

Objectives: To increase monsoon and boro season agricultural production.

Description: The project consists of full flood embankments to prevent overbank spill along the upper Surma River right bank and along both sides of a short reach of the Lubha River. Submersible embankments were judged too vulnerable to erosion, given that Lubha flows are flashy with high peak velocities. The Lubha left bank embankment is a mitigation measure, to protect left bank areas from floods displaced by the Lubha right bank embankment. To lessen fisheries damage and navigation disruption, the three major drainage channels would be left open. Two smaller channels would be closed, and a regulator would be built at another.

Expected agricultural benefits are mainly from increased monsoon production (about four-fifths of incremental paddy production); the remainder is from increased boro production.

Multi-criteria analysis, including disbenefits and costs, is shown in Table A.4.

Status: A draft final pre-feasibility study is being circulated for comments.

Table A.4: Surma Right Bank Project
Multi-Criteria Analysis

Economic		
Indicator	**Units**	**Value**
Economic Internal Rate of Return (EIRR)	per cent	53.5
EIRR, Increase Capital Costs by 20%	per cent	47.3
EIRR, Delay Benefits by Two Years	per cent	33.6
Net Present Value	Tk '000	198,011

Quantitative Impacts			
Indicator	**Units**	**Value**	**Percent[1]**
Incremental Cereal Production[2]	tonnes	9600	+13
Incremental Non-Cereal Production	tonnes	1200	+11
Incremental Fish Production	tonnes	-430	-16
Change in Floodplain Wetland/Fisheries Habitat	ha	-5350	-87
Homesteads Displaced Due to Project Land Acquisition	homesteads	100	0.2
Homesteads Protected From Floods	homesteads	11000	100
Roads Protected From Floods	km	19	100
Surma Flood Levels (if Surma Left Bank Project also built)	m PWD	1.5	
Owner Employment	'000 pd/yr	+418	
Hired Employment (Agri+Fishing+Wetland)	'000 pd/yr	-567	

Qualitative Impacts (ranked from -5 ...0... +5)	
Impact	**Rank**
Ecological Character of Bara Haor	-5
Regional Biodiversity	-3
Road Transportation	5
Navigation	-3
Flood Levels Outside Project Area	-5
Conflicts	-2
Socioeconomic Equity	-4
Gender Equity	3
Decentralized Organization and Management	-4
Responds to Public Concerns	+4
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.

Surma-Kushiyara-Baulai Basin Project

Location: Biswanath, Golapganj, Fenchuganj, Sylhet Sadar (Sylhet District), Chhatak, Derai, Dowarabazar, Jagannathpur, Jamalganj, Sunamganj (Sunamganj District), Khaliajuri (Netrokona District), Itna (Kishorganj District)

Gross Area: 319,300 ha

Objectives:
- to prevent the winter and pre-monsoon flood damage of *boro* rice
- to reduce flood damage of *aus* and deep water *aman*
- to promote expansion of hyv's onto lower lands by reducing flood depths, improving internal drainage, and reducing risk of early flooding
- to avoid disruption of navigation and fish migration routes by limiting the project infrastructure to peripheral submersible embankments and by providing hydraulic structures with navigation and fish pass facilities.
- to provide Balaganj town with protection from erosion

Description: The project area corresponds to the natural drainage basin bounded by the Surma, Kushiyara and Baulai Rivers and the Surma Khal. At present the boundary rivers are almost completely embanked. However, crops grown in the lower areas of the basin are damaged by floods. These floods can be pre-monsoon which enter the area from the Surma and Kushiyara via open channels or they can be unseasonal. In December 1991, the Kushiyara River overtopped its banks and near Markuli eroding large sections of the Tangua Haor and Bhana Beel embankments. Extensive flooding of young *boro* rice occured in the northern part of the basin after heavy rainfall over the region in February 1993.

A continuous submersible flood embankment along the right bank of the Kushiyara-Kalni River and the left bank of the Surma-Nawa-Baulia River system with control structures at the spill channels is proposed to actively protect the Sylhet plain and the upper part of the Sylhet basin. The lower part of the Sylhet basin (the area south of the Piyain River) with an elevation which is below 3 m would be provided with a passive type of flood protection, which means an open (U-shaped) embankment. In this case, flood discharges from the Baulai and Kalni Rivers would enter as a result of backflow from the lower (open) end of the embankment. This would ensure that drainage remains unobstructed.

A preliminary assessment of the impacts of the project indicate that it would be economically viable (ERR > 20%). However, further analytical work is required on impacts to draw firm conclusions.

Status: Engineering analysis nearly complete; non-engineering and impact analysis 60% complete.