4.8 Public Health, Nutrition and Flood Preparedness

4.8.1 General

The full assessment of the regional profiles and risks of diseases and vector borne diseases is given in the IEE for the regional planning. Only the salient conclusions for Gaibandha are summarised here together with the results of the surveys carried out for the study by the Women and Child Development Centre.

The major human health considerations in the study area are water-related diseases, nutrition and a wide range of public health considerations. The health problems of the GIP are generated mainly by the poor socio-economic status of the population. The lack of access to income and employment are major benefits which are hoped to be associated with CFD interventions. The annual flood regimes exerts an important influence in controlling the habitats of pests and diseases and is a biological control mechanism on population levels of some diseases and disease vectors.

The project proposals for the GIP will affect the distribution, timing, depth and duration of the flooding and recession of water across the monsoonal and dry season landscape. This will change the habitats conditions for a number of existing or potential disease vectors and water-related diseases. To ensure proper controls and assist in the alleviation of malnutrition may well involve diversifying the cropping pattern and crop rotations. This would help break the stagnation of background habitats and environmental conditions that encourage vector breeding habitats and reproduction cycles. It would also help minimise the corridors of transmission in the mono-cropping systems that have become dominant in the landscape.

The issue of health, disease and disease vectors is as important for fish, livestock and other flora and fauna, as it is for humans. Without adequate planning considerable economic loss and strains on future productivity could occur. The same general principles of good planning would apply to ensuring that flushing of the water bodies, management of habitats and biological controls could continue. Problems of snail vectors that carry livestock liver fluke are known and a range of diseases affecting other aquatic flora and fauna. The feasibility study must give high priority to designs and system operations which will minimise the enhancement of habitats and maximise the biological controls affecting disease vectors. Detailed epidemiological and other field surveys will be required during the detailed design study to establish the different vector species and their habitat distribution before a proper mitigation response and operational management plan can be established.

4.8.2 Water-Related Diseases

Out of the main vectorborne diseases reviewed in the IEE those that can be confidently predicted to be of concern in GIP include malaria (mosquito vector), kala azar (sandfly vector), filariasis (mosquito vector), japanese encephalitis (mosquito vector). The water-related diseases requiring particular attention in the operations of the project would include diarrhoea, dysentery, cholera, hepatitis and typhoid which are all related to polluted sources of drinking water. Further problems will requiring attention include the water-washed diseases like scabies, yaws, leprosy, typhus, trachoma and conjunctivitis.

Malaria

The primary endemic regions for malaria in Bangladesh are in the Chittagong area and in the hill areas close to the border in India which would include those areas on the left bank the Teesta. The

natural process of flooding is known to act as a physical control on the extent and permanence of habitats suitable for the breeding of mosquito vectors. Any disruption to this pattern needs to be taken seriously.

The District Gazetteer clearly records the high degree of malarial prevalence in the past for the GIP area. The success of eradication campaigns when DDT was in full use have been replaced by chemical resistance and a resurgence in cases. The statistics show that the numbers of detected cases in the NWR has oscillated between 250 in 1988 to around 2 800 in 1981. One major focus of attacks is in Rangpur District. The available epidemiological statistics for GIP show that during 1991 more malaria is reported (slide collected) and positive cases detected from the riverine Upazilas as against the mainland Upazilas. The positive cases were 131 were Gaibandha Upazila and 8 from Sunderganj Upazila. No positive cases were noted from any other Upazilas. The increased rate behind embanked area is because at the time of recession pools of dirty flood water are left stagnant. These soon become ideal breeding habitats for malarial vector mosquitos.

The development of the canal irrigation systems from barrage offtakes on the Teesta and the proposals for compartmentalisation in the GIP both involve considerable risks of enhancing the habitats suitable for vector breeding. The long standing existence of intra and inter-regional seasonal migration of labour and the international migration to and from Indian again confirm the high priority which must be attached to serious mitigation efforts to prevent the spread of malaria.

The vector carriers for malaria in the GIP area are not researched or understood. It has more recently been established that *A. aconitus* is also a vector in the NWR. Historically in Bangladesh it was transmitted through a relatively fragile species (*Anopheles philippinenis*). FAP 16 studies indicate that malaria transmission is also occurring via the more common species (*Anopheles aconitus*) which is more robust and a cause for concern. The GIP area can be regarded as a place of historical endemism and of medium risk for the environmental modifications that will be associated with the scheme as currently designed.

Kala Azar (visceral leishmanaiasis)

Although the surveys for GIP did not record a local occurrence of kala azar in the GIP it is felt that the risks of spread cannot be ignored and careful monitoring and checking of this situation is required in the years to come. For instance, there is a known concentration of Kala azar at Madarganj in the Jamulpur Priority Project area.

Filariasis

Seasonal migration flows and poor environmental management under FCD influence will all be directly influential in the rate of increase of this disease. The GIP area will be at risk from this problem. No local data was available or collected on filariasis.

Japanese Encephalitis

This disease is also a potential risk that cannot be ruled out. This is believed to have been a occurred in the area but is likely to be constrained by the rarity of pigs due to religious factors and the decrease in numbers of water birds due to habitat change and human population pressure.

Water-borne Disease and Parasites

The faeco-oral diseases of diarrhoea, dysentery, cholera, hepatitis and typhoid are all related to polluted sources of drinking water and to oral-faecal contact. Contamination of shallow handpumps and poor sanitation and the practical problems of sources of drinking water taken from rivers, canals, beels and khaors means that proper protected water supplies, community health education, sewage disposal and sanitation programmes are the only solution.

There is a higher rate of diseases occurrence in the riverine Upazilas which have a definite flood related pattern. Figure 4.4 indicates these results during the 1991. During 1987 and 1988 epidemic and fatal cholera cases were reported from two beel villages under Shaghata Upazila, which is also an area with higher prevalence of Giardia. There are also widespread parasite problems. There may be a low incidence of jaundice indicating that hepatitis is not a problem.

Water Washed Diseases and other Problems

Water-washed diseases include the skin and eye infections, such as scabies, yaws, leprosy, typhus, trachoma and conjunctivitis. They are water-washed and transmitted from person to person due to a lack of water for personal sanitation. These will be less influenced by FCDI but are still integrally linked to the hydrological and drainage changes which FCD brings about. They take a particularly heavy toll on pregnant women and young children. There is widespread incidence of skin problems, particularly scabies, ringworm and fungal diseases. These are linked to bathing in standing water, the high level of humidity for much of the year and the high concentration of population. Respiratory illness is significant, especially pneumonia.

High levels of mental illness are believed to occur generally in Bangladesh compared to other developing. High population densities, the anxieties of epidemic poverty and malnutrition, social and political pressures, the fear of destitution and the trauma of post-disaster events, are all likely factors affecting the landless and women-headed households in particular. The traditional welfare system associated with extended family systems has either broken down to some extent or never been very strong in Bangladesh.

Endemic Goitre

Endemic goitre means that about three in ten people suffer from this iodine deficiency disease. National surveys have shown a much higher rate for the riverine Upazilas as shown in Figure 4.7. No household in any of the villages surveyed uses iodized salt. Goitre is symptomatic of thyroid problems linked to iodine deficiency in the water supply and food intake. It leads to cretinism often compounded in the next generation, particularly amongst mothers. It is also associated with mental health problems which are reportedly dis-proportionately high amongst women and women-headed households. The associated mental health deterioration is believed by some to be of epidemic proportions.

Gaibandha District has been identified an one area that is severely effected. It is probably associated with the naturally low levels of iodine salts coming from the upper catchment or from local water sources. This has been associated with the high rainfall and excessive leaching of alluvial, sandy soils. In some villages as many as 80% of the population have visible goitres including very young children. The GIP is unlikely to change this situation. Integrated planning for sustainable development would not ignore this problem at a local level. There appear strong justification for including a small programme as an additional component to tackle this issue. The situation can be theoretically resolved easily by provision of potassium iodised salt which is a relatively cheap strategy options through the salt factories. However, there are difficulties in motivation, distribution, lack of purchasing power of processed goods amongst the poor and a lack of awareness of the issues at hand.

Figure 4.4

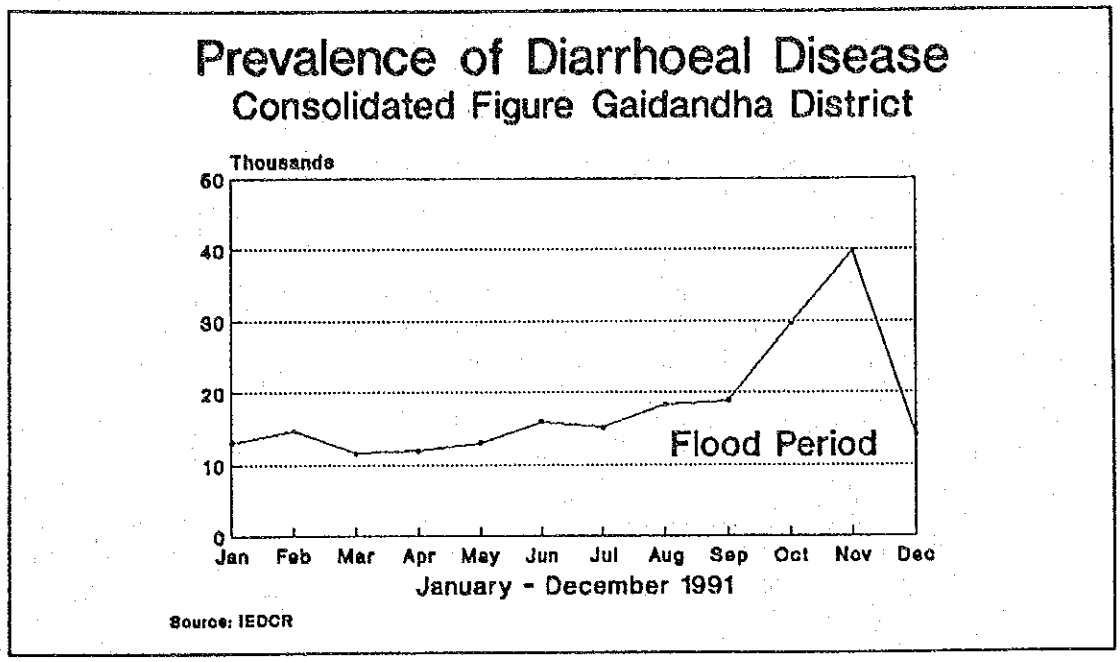
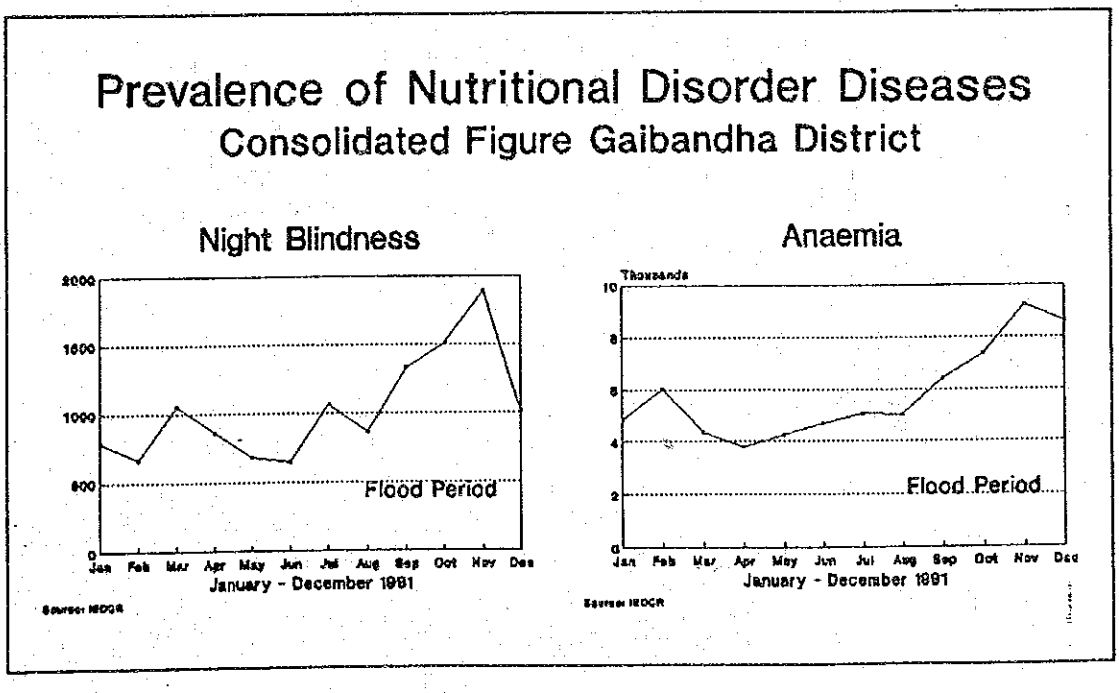


Figure 4.5



4.8.3 The Need for Clean Water

All the issues discussed above are mainly poverty related and work in conjunction with malnutrition and environmental features to amplify poor health conditions. Good public health programmes closely tied to community participation are one aspect of solving these problems. Proper sanitation, health education, good water and environmental management, careful planning, epidemiological studies and disease hazard mapping and monitoring are essential to integrated into the main water development programmes such as FAP.

The condition of any river depends on a dynamic balance being maintained between the quality and quantity of flow, the seasonality of sedimentation and on seasonal ecological and bio-chemical processes taking place within this system. The critical time for planning for water control and management is the conditions in the low flow season when flushing and assimilation capacity is least.

The extremely poor distribution of access to clean water, sanitary latrines and the rising water tables and flood conditions from rainfall and river sources in the monsoon leads to a distinct seasonal pattern in increase in gastro-intestinal and parasitic infection levels. When overlain on the impaired health already prevailing from the nutritional disorders, due to vitamin deficiencies and a lack of perennial diversity of food intake, the amplification effect is far more serious than the effects of both added together. The use of proper sanitary latrines in the District is low, the problem is severe in the riverine areas, particularly in Sunderganj, Fulchari and Shaghata. The access figures collected show one new latrine for between 270-64 people.

Figure 4.5 and 4.6 shows similar tends as for water-borne diseases and the existence of night blindness and anaemia, two nutrient deficient diseases, and lower respiratory tract infection (LRTI) during the flood months. Damp living environment, lack of covered shelter and inadequate protective clothing abet the increase in LRTI.

Availability of safe drinking water is a major problem in the chars lands. Access varies one DPHE tube well for 141-51 people. Even these tube wells often remain non-functioning for a considerable period every year. In Erendabari Union over 75% are submerged every year during the floods. Even tubewells that are recorded as having been installed in practise were removed to avoid being eroded away and have never been re-installed. About 30% of wells are inoperative. Domestic water supplies are taken from a number of sources and, even when tube wells have been installed, surveys have found that families continue to use a variety of other surface supplies, either for drinking water supplies, but more commonly for other uses, such as bathing and washing.

Under CFD, countryside seasonal river systems, close to or downstream of major urban and industrial centres, will be the places where problems of industrial pollution will arise. The Ghagot receive the direct output of sewage and industrial wastes from Rangpur and Gaibandha. The GIP is probably too far downstream to receive any direct impact from Rangpur and will be isolated from river flooding once the embankments are completed.

4.8.4 Nutrition

The problems of poor nutrition for humans and animals are widespread. It is a complex area of research which there have been few resources and insufficient time to appraise properly at this stage. The existing nutrition levels are characterised by unbalanced diets with low diversity of food intake particularly amongst lower socio-economic groups.

The public health and nutrition profile of Gaibandha District presents one of the worst pictures in the country and certainly in the North Western Region. Rates of malnutrition and prevalence of the

Figure 4.6

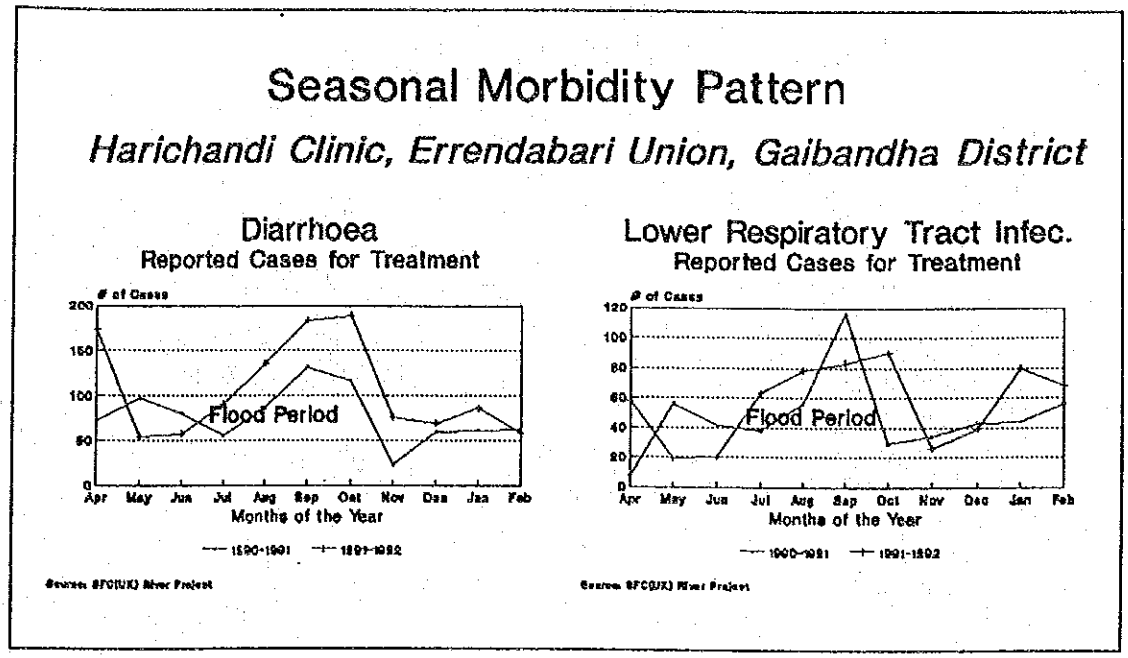
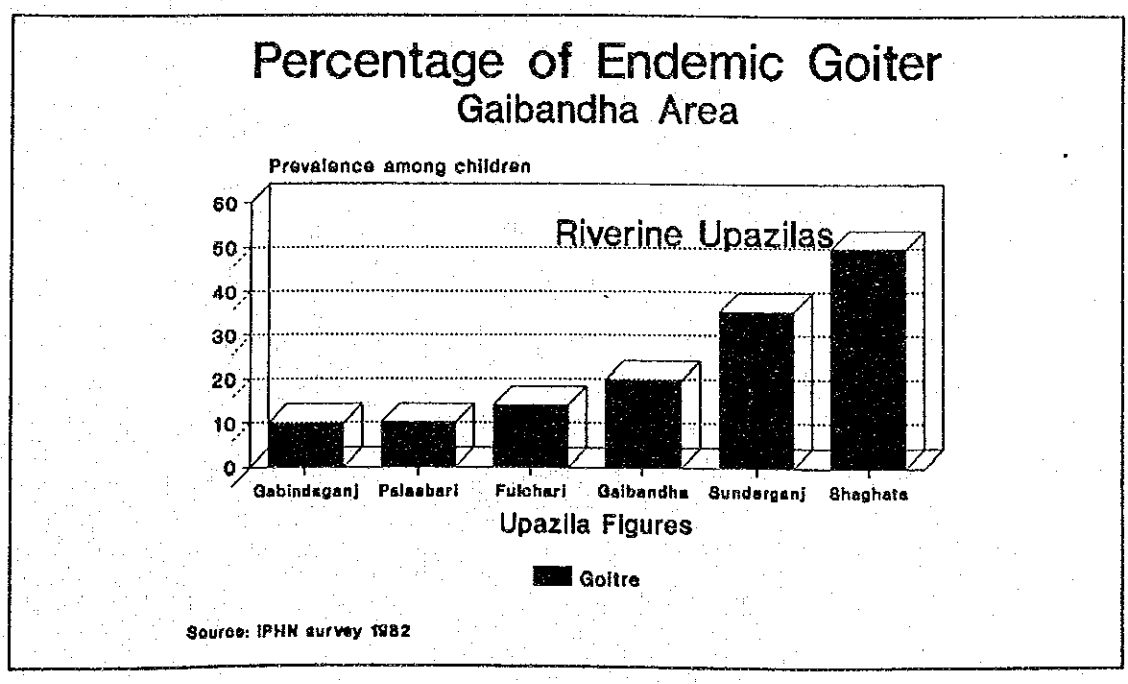


Figure 4.7



common diseases are very high and in the riverine thanas in particular. Changes in hydrology and habitat and their procreated problems are believed to be directly attributable to this condition. The human degradation caused by progressively worsening nutrition is indicated in Table 4.5, 4.8 and 4.9.

The adverse nutritional impacts of FCD schemes particularly affect poor communities who depend on small fish for consumption. Since poor communities eat little or no meat some intake of fish is important since it is high in protein, high in calcium and Vitamin A if eaten whole. The negative nutritional impact especially on growing children and pregnant women is enormous if this source of food is removed by flood control measures.

Consumption of food and its effect on nutrient intake has been seriously diminishing in Bangladesh for a great number of years. This is especially true of fish and pulses which are fairly critical to village dwellers. Table 4.6 indicates the trend in intake of food items over a long period. The effect this decrease in intake of principal food has on nutrition is shown in Table 4.7.

Table 4.6 Trend of consumption of principal food item (1937-1982) Per capita per day in grams

Food	1937	1962-64	1975-76	1982
Animal Food	45.0	56.5	44.0	17.0
Pulses	40.0	28.0	23.8	17.3
Vegetables	284.0	142.0	125.7	120.1
Milk	88.0	19.3	16.7	14.3
Fish	51.1	27.7	22.3	17.7

Source: Health Policy and Planning: 3(4) 325-328, OUP, 1988)

Table 4.7 Trend of nutrient intake in Bangladesh (1937-1982) Per capita per day

Nutrient	1937	1962-64	1975-76	1981-82
Calories	2743	2251	2094	1943
Protein (g)	78.4	57.5	58.8	48.4
Fat (g)	19.7	17.7	12.2	9.8
Carbohydrate	562	476	439	412
Calcium (mg)	470	304	305	260
Iron (mg)	72	9.7	22.2	23.4
Vit A (IU)	1850	1590	730	763
Vit B1 (mg)	-	1.47	1.65	1.38
Vit B2 (mg)	1.42	0.5	0.5	0.68
Vit B6 (mg)	-	22.8	22.21	13.15
Vit C (mg)	86	39.6	9.5	13.26

Source: ibid

The study concluded that nutrition related morbidity, goitre in pregnant and lactating women and anaemia in children had increased enormously during the period as a result of diminishing intakes of healthy food. In the northwest region the decrease in capture fisheries may accelerate this trend if flood action planning does not cater for the communities who make a living from capture fishing in beels and rivers.

Various proposals for creating more balanced diets include different protein types (e.g.poultry and small stock) and vegetables. However the low socio-economic level of the affected population make these difficult to implement and remain sustainable. It requires specifically targeted, welfare orientated approaches to tackle this problem along with nutritional education programmes. The incidence of famine in the area is related to post severe flood situations where food storage is inadequate, standing crops are lost and wage paid employment temporarily ceases. A major aim of the project is to address this issue by flood control and/or flood proofing measures including the consideration of emergency food reserves at household or village level.

There is a significant prevalence of goitre in the GIP. The current access to common property resources, particularly fish, and the diversity of food and tree crop types, have been identified as important dietary implications which ought to be integrated into the agricultural planning. These features of the current system all provide the basic nutritional complements to the main dietary consumption of rice. The diversity of protein, minor nutrients, vitamins and oils provided from these other sources are essential to conserve under the FAP planning if the basic minimum levels of nutrition are to be maintained at current levels, and if any hope of providing the minimum basic needs to all in society in the future. This fundamental need cannot be adequately represented in the economic analysis. Both public health and nutrition issues will need further study and specialist inputs in the detailed design stage.

The household and nutritional anthropometric survey findings show a major difference in the diseases prevalence and nutritional status between a protected village and an exposed village. The table below highlights some key indicators.

Table 4.8 Comparison of Disease Point Prevalence in Exposed and Polder Village.

Diseases	Foliarghop (Exposed Village)	North Ramnathervita (Protected Area)
Diarrhoea	3.53	1.67
Blood Dysentery	7.77	3.67
Goitre	22.00	13.46
Night Blindness (among children)	12.88	7.86
Angular Stomatitis (among children)	25.00	15.26
Scabies (among children)	21.86	16.79

Table 4.9 Comparison of Nutritional Status of Children Under 5 Years in Exposed and Polder Villages

Nutritional Indicator	Foliarghop (Exposed Village)	North Ramnathervita (Protected Area)
Undernutrition (wt/Age <60%)	12.5	6.87
Wasting (Wt/Ht <80%)	17.18	9.16
MUAC <12.5 cms	28.13	18.33

The surveys in the exposed and protected villages in the Gaibandha area found differences in the health complaints experienced during floods. There were increased complaints of dysentery from the polder village and increased gout from the exposed village. The higher level of dysentery problems in the poldered area is associated with frequent domestic use of stagnant, contaminated water. Gout problems are related to staying for long periods of time in submerged areas.

The effect of hydrology on the flora and aquatic fauna has a direct affect on the people's intake of vitamins. Both leafy vegetables and fish are rich in Vitamin A. The lack of green leafy vegetables during and after floods means that a main source of iron and vitamin "A" intake becomes unavailable for the majority of the people. Vitamin A deficiency leads to blindness, particularly amongst communities alongside the Jamuna. Xerophthalmia is a nutritional deficiency disease caused by the lack of vitamin A intake in food and is thus a good indicator of access to these resources. Figure 4.8 shows that the riverine Upazilas record much higher Xerophthalmia cases amongst their children than Upazilas on the main land.

Malnutrition is a general problem for the project area and a major concern for the riverine villages. An annual nutritional survey has established a flood seasonal pattern of prevalence of malnutrition as shown in Figure 4.9. The higher prevalence of malnutrition is during August, September and October. Between the exhaustion of the Aus crop in June and the harvesting of the Aman in November, is the period of off peak wage earnings. This, coupled with the occupance of seasonal floods increases the risk of malnutrition in the flood prone areas of the region.

4.8.5 Use of Medicinal Flora

Over 80% respondents from both the exposed and protected villages reported the past use of flora as traditional medicine. When asked about which disease were not treated due to unavailability of plants, diarrhoea, conjunctivitis, cough, scabies, gout and dysentery were mentioned commonly in both areas. Many of these traditional medicinal plants are now scarce in both areas. Plants used for treatment of scabies and conjunctivitis were more scarce in the exposed area. Ecological surveys also recorded the medicinal flora and these results are given in Volume 4.

The plants mostly used are as follows:

1. Khudimun, Dlulimun: used for : 29% Dysentery cases
   : 25% Diarrhoea "
2. Kalo keshor: used for : 27% Dysentery "
   : 11% Gout "
   : 43% Conjunctivitis "

Figure 4.8

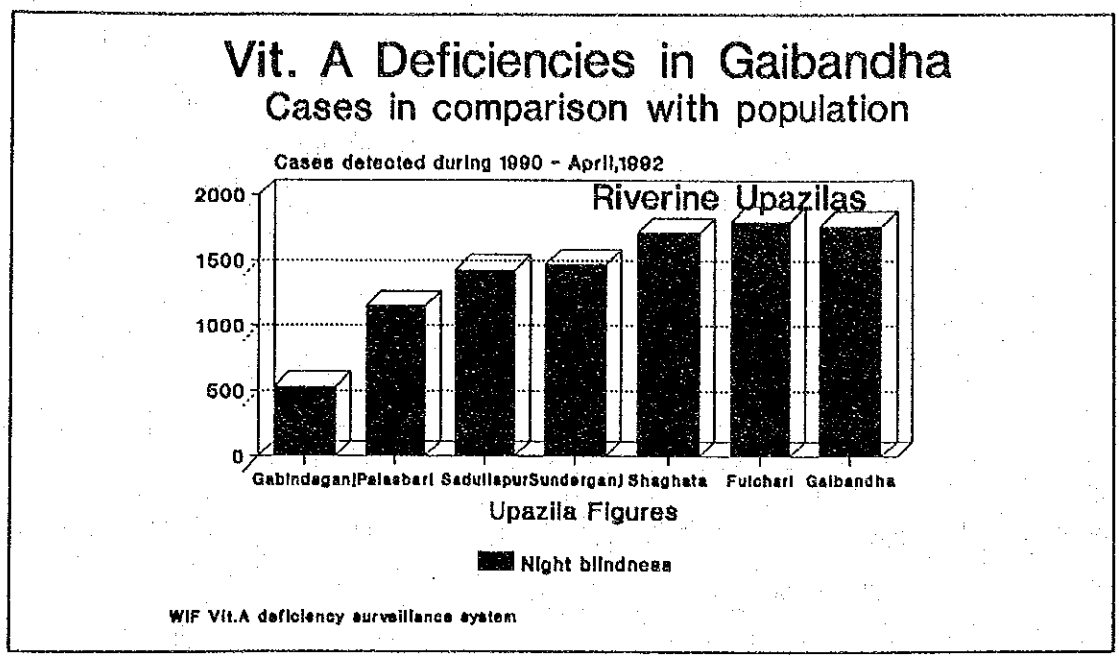
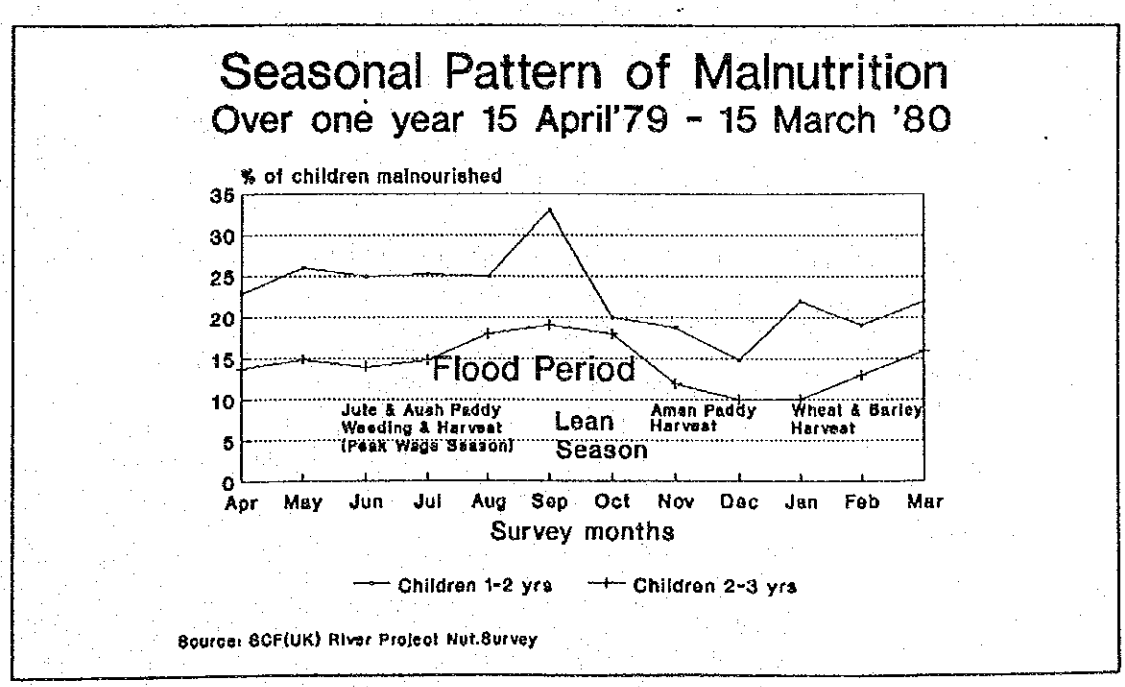


Figure 4.9



3. Lal Gochani: used for	:	13% Dysentery "
	:	50% Blood Dysentery "
4. Tulshipata: used for	:	31% Cough "
	:	56% Conjunctivitis "
5. Harbalasak: used for	:	18% Cough "
6. Nimpata: used for	:	79% Scabies "
7. Obud Nangra: used for	:	33% Gout "
	:	25% Diarrhoea "

The loss of access to these traditional remedies means that people are compelled either to spend a greater proportion of their earnings on treatment or to leave the disease totally untreated. People who want to use traditional remedies often have to travel long distance to find the required flora and herbs.

4.8.6 Government Public Health Services

There are permanent health complexes, with both out-patient and in-patient facilities in the Gaibandha, Sundarganj and Shaghata. Fulchari thana has no hospital building and operates out of a small rented premise.

Even a slight rise in the normal water level during flood months submerges the Shaghata health complex under 4 - 5 feet of water. Due to this, in 1991 the centre abandoned its normal functions for three months and acted only as a temporary flood shelter. The health system in Gaibandha lacks an adequate budget and facilities for delivering emergency medical services during floods, i.e river transport, equipment for setting up mobile medical camps and other logistics. Although provisions for maintaining a buffer medicine stock for flood preparedness exist, due to the inadequacy of supply this can not be adhered to.

The lack of planning and administration of the flood shelters, proper sanitation and supply of safe drinking water mean that dealing with the adverse health problems of the floods always creates a problem.

4.8.7 Non Government Organization

The NGOs operating in the GIP area include World View International (WIF), Bangladesh Women Health Coalition, and until recently the Save the Children Fund (UK). SCF has a project disaster monitoring system and operates supplementary feeding programme for malnourished children in selected chars and for pregnant women and lactating mothers when needed. GUK, USS and FATEMA are three small local NGOs working with children and women groups in the field of health related awareness-building. Both GUK and USS construct and distribute sanitary latrines. However their efforts are limited by resource constraints.

4.9 Infrastructure

The present road system within the project area is poor and ill maintained. This is a constraint to the movement of goods by lorry but less of a problem for passenger traffic which is able to use motorbikes, bicycles and rickshaws and smaller boats. There are serious problems in the stability and construction of embankments and the sizing and foundation conditions of the major structures. The railway runs along the GIP western border with a connection to Fulchari. Road transport is recent and not yet highly developed. Sadullapur has recently received road communication. The two thanas of Sundarganj and Fulchari are badly connected by road.

The proposals for CFD protection using the network of road embankments as a basis would help establish a more reliable network of all weather roads. This would considerably improve access, particularly giving advantage to the movement of lorry mounted goods. There are many institutional problems yet to be worked out as to the responsibilities and accountability for their maintenance.

4.9.1 Navigation

The main navigation routes of significance to major navigation planning are the Brahmaputra, the Teesta and the Ghagot as the boundary rivers. Of these the Brahmaputra is the only river that remains navigable for larger boats throughout the year. The Ghagot is a seasonal river while navigation along the Teesta in the dry season is reduced to the smallest of boats mainly for fishing and domestic purposes.

Of far more significance for local planning and development is the role of the country boats, fishing and domestic craft. Although Gaibandha has no strong tradition as being historically an important regional centre for country boats, nevertheless, a few centres along the Brahmaputra and Teesta provided services to the interior and to the people of charlands. Internally, the only river of importance is the Manas which is seasonal and originates from the low lying Bamandanga beel. Some narrow drainage lines and canals flows through the project area, such as the Matherhat and Burail canals. These are only very seasonal.

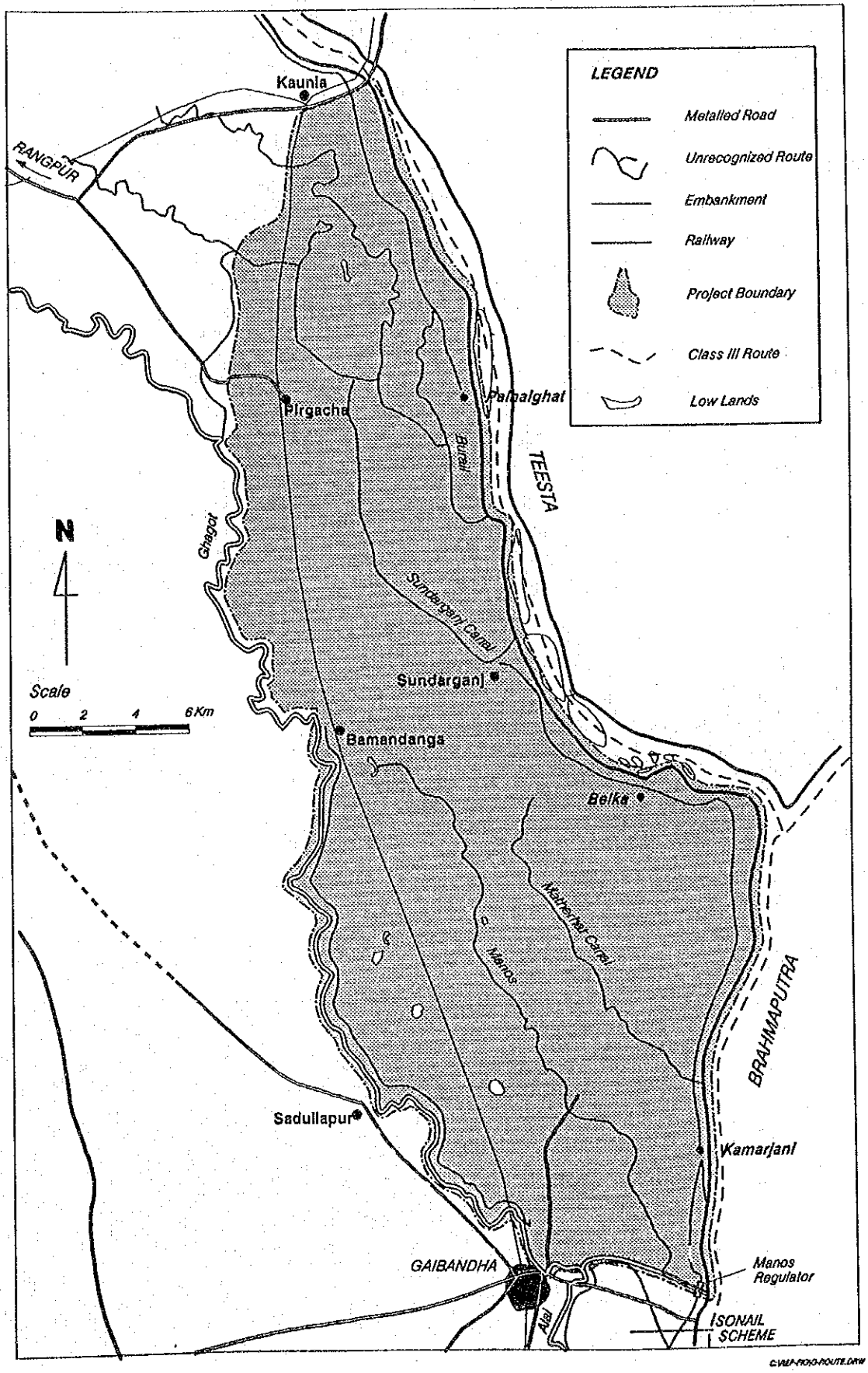
River routes are not currently considered an important means of transportation and communication. Nevertheless this does not reflect the potential possibilities for a low cost seasonal water transport system. Historically, boats regularly used to visit the area through the Ghagot and Manas rivers. Traders and boatmen of Rasulpur, Kamarjani, Sadullapur, Bamondanga and Sundarganj reported that boats would come from Jessore and Khulna with coconut. The boats came in during August and returned in autumn, after the durgapuja. Boats from Pabna and Sirajganj would come with clay pots and return after a month. Both anchored from ghat to ghat and used to sell their goods. Local boats made frequent trips to Dhaka and Narayanganj loaded with paddy and jute and returned with salt, kerosine, oil and stationery. Traders and consumers depended on country boats for internal distribution. This system stopped after the embankments and the sluice gate were constructed. Now in the monsoon very few country boats are seen plying in the river. They are either mechanized or traditional country boats.

A list of the markets and ports on each river follows and are located in Figure 4.10. Only Rasulpurghat, Kamarjani and Sundarganj are connected with class III route called perennial hinterlands route that stretches from Aricha to Chilmary via Nakalia, Sirajganj, Fulchari through Jamuna and Brahmaputra.

The non-recognised seasonal routes remain navigable for only five months in a year. In the monsoon, there would have been village connecting routes. But intensive earth road network has destroyed this possibility. Figure 4.10 shows the route classification.

Figure 4.10

ROUTE CLASSIFICATION - GIP



Transport Cost Comparisons

Surveys found that road transport costs to be two times more than the country boat as indicated in Table 4.10.

Table 4.10 Freight Distances and Cost Comparisons in Gaibandha

Route	Unit	Distance	Freight Costs		Freight Costs	
		Km	(Tk./maund)		(Tk./maund/Km)	
			Boat	Truck	Boat	Truck
Rasulpur-Dhaka	Maund paddy	300	12	25	0.04	0.08
Rasulpur-Dhaka	Bell jute	300	15	28	0.05	0.09
Kamarjani-Dhaka	Maund paddy	305	14	30	0.05	0.10
Kamarjani-Dhaka	Bell jute	305	16	32	0.05	0.11
Sundarganj-Dhaka	Maund paddy	325	16	35	0.05	0.11
Sundarganj-Dhaka	Bell jute	325	18	37	0.05	0.11

Source: * Sundarganj Merchant's Association.

Boat Numbers and Role

There are no current boat statistics for Gaibandha District. Before the construction of the BRE and the Manas regulator most trade was done by country boat and Kamerjani was an important river port and very good boating incomes were possible. Poor people were attracted to work in the boat sector rather than in other activities. The survey results estimate that the number of jobs and income past and present compare as indicated in Table 4.11 and the seasonal use of different transport systems in Table 4.12.

Table 4.11 Comparison of Current and Historical Trade Boat Numbers, Employment and Income.

Boat Category	Period	Number of Boat	Rate of Employment Per Boat	Total Number of Employment	Monthly Income Per Employee	Total Income
Commercial	Pre-BRE District	5,000	3	15,000	150	2,270,000
	Present GIP	700	3	2,100	900	1,890,000
Fishing boat	1977 District	981	3	2,953	200	588,600
	Present	345	3	1,035	1,000	1,035,000

Table 4.12 Seasonality of Road and Water Transport

Place	September to June				July to October			
	Local Trade		Int. Dist. Trade		Local Trade		Int. Dist. Trade	
	Road	Water	Road	Water	Road	Water	Road	Water
Kamerjani	100%	00%	20%	80%	80%	20%	00%	100%
Sadullapur	100%	00%	100%	00%	75%	25%	60%	40%
Sundarganj	100%	00%	80%	20%	90%	10%	00%	100%

Changes in the Country Boat Sector

Typically the changes in the GIP area reflect wider changes which have happened regionally or nationally. These are discussed in more detail in the IEE for the regional study. There has been a revolution in the structure of the navigation sector over the last decade. This has affected both the capacity, costs, numbers and effectiveness of the country boats. As quality boat building wood has become scarce alternative materials have been used, mostly metal and sheeting.

Over 80 percent of traditional boats are estimated to have become mechanised. Mechanisation has allowed country boats to compete with road transport successfully and incomes have begun to rise from a position a decade ago where the sector was severely depressed by the competition from road and rail. This has induced other boatmen to invest and the number of engine boats began to increase dramatically. Again the focus of competition is competing boats and individual incomes have decreased again substantially. This has also coincided with a time when fuel prices have increased significantly.

Local employment in the sector appears to have been relatively unaffected by these developments. No labour displacement or major recruiting was reported due to mechanisation. However, although trip frequency has increased, the volume of trade has not increase at the same rate. So boats cannot utilize their full capacity and time. Displacement of labour from the boat building sector has occurred with the transfer to metal sheeting. Many carpenters have migrated to India or entered the furniture trade.

Water Transport Planning Issues

The following major navigational problems were reported in the GIP area:

Sand coming from the upper basin, together with the river bank erosion, is depositing in the river channels and raising bed levels in parts. Draught has become shallow and hampered navigation. No impacts of the withdrawal of surface and underground water by LLP and STW for irrigation were reported.

Since 1950 many obstructions caused by embankments and unplanned roads has been built. Small tributaries and distributaries, inter-village connections and connections from the main rivers and river ports to the hinterlands floodplains have all been affected. Commercial and domestic operation and social visits are the main activities impacted. Today local boats can only ply in very confined areas during the monsoon. These effects have deprived people of the low cost transportation.

Gaibandha is one of the most important jute growing districts in the region. This study has confirmed that the transportation of jute is not as economic by truck as by boat. Promoting the future of boat access as part of the planning criteria for the GIP could have a significant impact on the economics of jute for both producers and marketeers alike if proper navigation planning were integrated into the engineering designs. The need to consider a range of factors have put this beyond the capabilities and TOR for this study. The basic options for passage and transhipment need careful survey and design. Consultations with local people and commerce is required. Proper surveys of potential dredging routes is also required and the full range of potential linkages in the network of seasonally changing hydrological and marketing conditions.

CHAPTER 5

ENVIRONMENTAL IMPACTS AND BENEFITS

5.1 Methodology

The first phase of regional planning in the NWRS during 1991 allowed the basic scoping and bounding of likely key issues (Important Environmental Component or IEC). Following the rounds of public participation and the range of field surveys, together with the basic configurations of engineering options, those IEC relevant to decision-making for the GIP were refined.

The development profile in section 2 and its corollary in Volume 4 highlight the important resource use and management issues. These are incorporated into the basic matrix for comparative assessment of options against a without project (FWO) situation. Only higher priority issues are indicated. The matrix is shown in Table 5.1.

The configuration of the future with scheme is such that many of the components have been or need to be assessed separately. The final logic of options for the GIP target area itself come down to whether the target areas should be sub-divided into smaller drainage basins or not. Thus, Option 1 is the scheme configured without this sub-division. Option 2 includes the sub-division.

For both options it is assumed that national criteria, relating to flood protection on the major rivers, will decide upon the need to seal the BRE and the TRE. This decision would necessitate the completion of the Ghagot embankments in the Brahmaputra backwater areas and the completion of the new Alai and Manas regulators to prevent flooding from the Brahmaputra entering either the Manas or Alai basins. The "future without" (FWO) scenario would be a "do nothing" on all of these components. The following assesses the individual components.

5.2 Component Impacts

The Major Tactics Selected

a. Sealing the BRE and TRE

The most significant impact will be the reduction in flood damage due to breaches through these existing defense. All the major disbenefits to fish and terrestrial-aquatic relations have already been absorbed in their initial construction period. These losses to the floodplain system are not attributable to this GIP. The GIP strategy will rectify some of these earlier losses through the planned removal of the Manas Regulator (see c. below).

The long-term effectiveness of sealing the TRE will depend upon the future morphological change. If the right bank continues to move to the south-west, then breaches will occur and with increasing frequency. This can be avoided for some considerable period by allowing a large set-back distance between the embankment and the river at the cost of not providing flood protection to a large area of land. This is not a viable option where the Ghagot comes close to the Teesta: it is imperative that the TRE separates the Teesta from the Ghagot. Unfortunately this critical location coincides with one of the unstable reaches.

A similar policy as proposed by FAP1 for the BRE could help protect this and other reaches of the TRE. This would build protection through a series of hard points along the river. If the distance between these points is less than the natural wavelength of the anabranches then the incursions of the anabranches can be controlled. Though erosion may occur between the hard points, deep incursions will not occur.

If spillage from the Teesta into the Ghagot is prevented by the TRE works the results of the MIKE-11 simulations suggest that the dominant discharge will be reduced to approximately 50 m^3/s. In the long-term, the channel would likely reduce significantly in both width and depth and the river course would become much less tortuous. The time for morphological re-adjustment in the Ghagot and Alai Kumari rivers due to sealing of the TRE breaches is likely to be less than 20 years.

b. Compartmentalising Drainage

The results of the modelling and economic analysis show significant benefits accruing to the sub-division of the area into drainage compartments. The context of this must be clearly understood before its apparent advantages are accepted. First, the strategy is based on using existing roads. Thus, many of the costs are treated as sunk costs in the analysis. Second, the scale at which each compartment is being modelled has reached its boundary limits for proper analysis. Thus, the actual conditions and distribution of water within compartments is not well understood or modelled given the local variation in topography and micro-topography and the large degree of landscape alteration which the local communities have already undertaken. Thus, cumulative impacts of many small areas, where impeded drainage or more drought prone areas may occur, is currently undefinable. The benefits or dis-benefits of this, according to the social structure and socio-economic and political organisation within each compartment are also unclear.

The level of analysis which has been applied in this study are reasonable and sustainable given the database and level of analysis. The problems arise because very significant changes in conditions could arise when the analysis is taken to the next scale of detail and particularly where some areas will have to accept heights and duration of water levels that are an increase on those generally experienced under the current regime the current time. The role of public participation as the foundation stone for helping to direct the detailed design stage can be emphasised from the results of the social impact analysis.

c. Removal of the Existing Manas Regulator

All the rounds of public participation and the hydraulic modelling indicate that the removal of this structure will alleviate the dis-benefits of impeded drainage it causes. In practise, its imminent demise from erosion is likely to be the actual cause of its removal. As a result, the recommended approach of not replacing it will improve the overall drainage from the GIP and Ghagot to the Jamuna. There were no grounds established where its future role could be justified. As the structure could pose a physical hazard it would be advisable to plan for its organised demolition and removal.

Its removal will allow pathways to be opened up again for both aquatic organisms and fish, the unrestricted flushing of pollutants away from Gaibandha town, and for seasonal navigation to and from the Jamuna and Ghagot systems, involving inter-regional, intra-regional and local commercial, marketing and domestic networks.

The removal of the Manas regulator is unlikely to have a major morphological impact on the Ghagot river; it will have no impact on the morphology of the Brahmaputra. Removal will allow some flow from the Brahmaputra into the Ghagot river carrying sediment with it for only a short distance. Any

such deposition in the lower Ghagot is likely to be eroded by Ghagot flows into the Brahmaputra over at least 10 months of the year, including the majority of the flood season.

d. Minimising Downstream Impacts

A fundamental criteria applied through the NWRS is to avoid schemes that make people worse off downstream. The confinement of the Ghagot on the left bank, the need to rationalise the flood protection levels in the backwater areas of the Jamuna (once the existing Manas regulator has been removed) and the need to avoid river capture of the Jamuna down the Alai, all require that a regulating structure be sited at the head of the Alai. This effectively is an in-built mitigation component, as well as part of a regional strategy to alleviate flooding in the Alai floodplain by diverting some drainage flows to the Jamuna through the Ghagot.

Options to embank the right bank of the Ghagot were examined to avoid spillage to the right bank floodplains and beels. The model results showed that once the TRE has been effectively sealed the effects of the GIP schemes on the Ghagot river levels are minimal and would not require any mitigation by embanking the right bank. Flood protection measures required for the Ghagot right bank areas thus remain a study in their own right.

The Minor Tactics Selected

a. Construction of a New Regulator at the Confluence of the Manas and Ghagot.

This component showed no positive hydraulic or economic effects during the early analysis within events less than the design criteria laid down for an agricultural area under FAP (1:20 year flood protection). The analysis showed that, in most years, the location of this regulator would actually impede drainage in the same way that the existing Manas regulator does. As a physical obstruction it will also have many basic disbenefits affecting both biological, water quality and navigation systems. On pure technical and economic grounds there was no justification for this additional investment cost.

It has been argued that some local people within the GIP ares might be unhappy to see the existing Manas Regulator removed and then the GIP system left totally open to the potential of flooding from the Brahmaputra. However, the risks of flooding from the Jamuna into the GIP area appear infrequent and not catastrophic (unless the BRE is breached). There has been no public consultations to elicit the community's actual response to this proposal.

The regulator might also be necessary to rationalise the boundary disparities in flood protection in the backwater area influence of the major rivers that have 1:100 year flood protection along their main river frontage. The flood heights associated with the 1:5, 1:20 and 1:100 year flood events indicate that an extreme event near to the design criteria of the BRE would potentially flood areas of Gaibandha town and areas of the Ghagot and Manas Basins. The degree of damage that this flooding would result in is probably far less than the damage from a similar event in the Teesta. Breaches in, or overtopping of the TRE, would create considerable damage to parts of the GIP. In this event the Manas regulator may again be an impediment, rather than an aid to flood relief.

The issue of the degree of protection to be given along the extension of the BRE on both sides of the confluence of the Ghagot and Jamuna is a policy decision based on the switch in boundary conditions required by opening the Jamuna to the Ghagot and its 1:100 year protection level and that of 1:20 year protection for the GIP on its southern side.

b. Extending the Ghagot Left Embankment

The inclusion of this component has been justified partially on the grounds that it logically forms a part of a complete package of engineering structures to control water that is consistent with traditional flood protection interventions. Basic flood protection to the area behind this embankment primarily is achieved through the sealing of the TRE. The beneficial effects of the GLE would be to provide flood protection to a part of the overall GIP area. It again has hidden sunk costs as it will mainly rehabilitate existing roads. The inclusion of these sunk costs would reduce the basic economic benefits in any similar component that had to start from scratch. The construction works, nonetheless, are cheap and will create local employment. The connection of the spills to the important major water body of Bamandanga beel has been built into the embankment alignment. However, this remaining alignment would still leave some other beels and floodplain areas isolated.

5.3 Impact Matrix of the Main Option for GIP

The impact matrix reflects the results of assessing the effects and their spatial and temporal variability within and outside of the GIP target area. These have mainly been derived from model hydrographs (Volume 9) and attempts to map impact zones by highly simplified topography zoning. In general mapping did not prove successful due to the complexities of drainage, topography and existing compartmentalisation from local roads. Figure 5.1 gives an general impression of the area impacted by flood water coming from breaches in the TRE and potentially from the BRE.

The impact matrix could have tried to separate out impacts according to a number of different constructs. The internal GIP target area might have been sub-divided into its component drainage basins, its agro-ecological, or its flood phasing zones. Given the general paucity of reliable local data, the limited resource of the study and the problems of being able to model response and water movements at a detailed level, none of these sub-divisions within the matrix have been attempted as the reliability and usefulness of such an approach would be in question. However, a first stage analysis of overall drainage conditions in each cell is provided in Volume 9.

For the assessment of the outside impact areas these have been defined as follows:

- the charlands and setback land along the Brahmaputra and Teesta rivers to the east and north of the GIP areas respectively.
- the floodplain areas along the right bank of the Ghagot which would be the main additional areas to receive flood protection from the sealing of the TRE.
- the floodplains along the right bank of the Alai given that the left bank is already protected behind the Sonail embankment.

In each case of assessment the most important impact area has been used to reflect the conditions recorded in the matrix.

Figure 5.1

INDICATIVE IMPACT AREA FROM SEALING OF TRE AND BRE

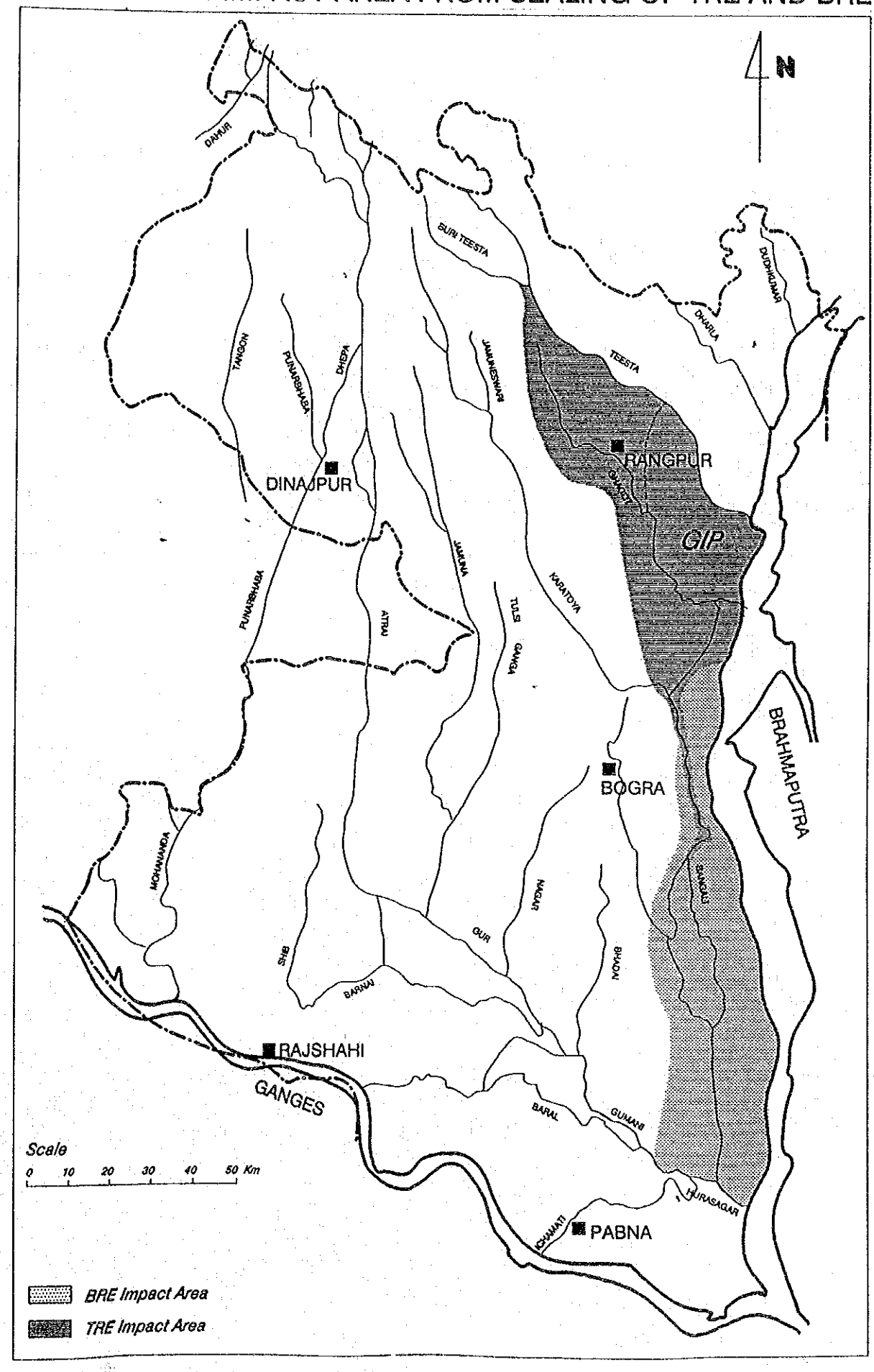


Table 5.1 Assessment of Impacts for GIP

Resource Issue/Important Environmental Component	Option 1				Option 2			
PHYSICAL RESPONSES	INSIDE		OUTSIDE		INSIDE		OUTSIDE	
	FWO	FW	FWO	FW	FWO	FW	FWO	FW
WATER								
- Surface Water								
Peak levels	0	+1	0	+3	0	+4	0	+3
Flood frequency and duration	0	+1	0	+3	0	+4	0	+3
Drainage conditions	0	+1	0	+3	0	+4	0	+3
Morphological change	0	-1	-5	-5	0	0	-5	-5
Quality	0	-3	0	0	0	-4	0	0
- Groundwater, Wetlands and Waterbodies								
Recharge in highland	0	-1	0	-1	0	-1	0	-1
Wetland extent and recharge	0	0	0	-4	0	-2	0	-4
Seasonal availability	0	-1	0	-1	0	-1	0	-1
Quality	0	-1	0	-1	0	-1	0	-1
LAND								
Fertility	0	-2	0	-2	0	-2	0	-2
Physical status	0	-2	0	-2	0	-2	0	-2
Moisture status	0	-2	0	-2	0	-2	0	-2
Erosion or sedimentation	0	+2	0	+2	0	+2	0	+2
Disposal of construction spoil	0	0	0	0	0	0	0	0
BIOLOGICAL RESPONSES								
TERRESTRIAL ECOSYSTEM								
Habitat diversity	0	0	0	0	0	0	0	0
Wildlife habitats	-3	-4	-3	-4	-3	-4	-3	-4
Faunal species diversity	-3	-4	-3	-4	-3	-4	-3	-4
Floral species diversity	-3	-4	-3	-4	-3	-4	-3	-4
Pests and diseases	-3	-4	-3	-4	-3	-4	-3	-4
AQUATIC ECOSYSTEM								
Habitat diversity	-1	-2	-1	-3	-1	-2	-1	-3
Habitats for threatened species	-1	-2	-2	-2	-1	-2	-2	-3
Faunal species diversity	-2	-3	-2	-3	-2	-3	-2	-3
Floral species diversity	-1	-2	-1	-3	-1	-2	-1	-3
Pests and diseases	-2	-3	-2	-3	-2	-3	-2	-3
Wetland functions and productivity	-2	-3	-2	-3	-2	-3	-2	-3

Impact Issue/Important Environmental Component	Option 1				Option 2			
HUMAN RESPONSES	INSIDE		OUTSIDE		INSIDE		OUTSIDE	
	FWO	FW	FWO	FW	FWO	FW	FWO	FW
HAZARD LOSSES								
Normal flood damage	0	+4	0	+4	0	+4	0	+4
Extreme flood damage	-5	-5	-5	-5	-5	-5	-5	-5
Drought losses	0	-1	0	-1	0	-1	0	-1
Liquefaction	-4	-4	-4	-4	-4	-4	-4	-4
SUSTAINABLE RESOURCE USE								
Cropping	-3	-4	-3	-4	-3	-4	-3	-4
Fuel and energy	-4	-4	-4	-4	-4	-4	-4	-4
Common property	-3	-3	-3	-3	-3	-3	-3	-3
Capture fisheries	-2	-4	-2	-4	-2	-4	-2	-4
Culture fisheries	0	+3	0	+3	0	+3	0	+4
Livestock	-2	+1	-2	+2	-2	+1	-2	+2
Traditional medicines	-2	-2	-2	-2	-2	-2	-2	-2
INCOMES AND EMPLOYMENT								
Construction work	0	+2	0	0	0	+3	0	0
Agriculture	0	+4	0	+4	0	+4	0	+4
Fisheries	0	-3	0	-3	0	-3	0	-3
Navigation	0	-1	0	-2	0	-1	0	-2
Landless	0	+2	0	+1	0	+4	0	+2
Equity	0	-1	0	-1	0	-1	0	-1
SOCIAL								
Community and family cohesion	0	+3	0	+3	0	-3	0	+3
Impacts on women	0	+3	0	+3	0	+3	0	+3
Impacts on children	0	+2	0	+2	0	+2	0	+2
Minority groups	0	0	0	0	0	0	0	0
Access to flood survival strategies	-2	+1	-2	-2	-2	+1	-2	+2
Attitudes to flood risks	-3	+4	-3	+4	-3	+4	-3	+4
Land acquisition displacement	0	-2	0	-3	0	-3	0	-3
Settlement patterns	0	0	0	0	0	0	0	0
INSTITUTIONAL								
Public participation	0	+4	0	+4	0	?	0	0
Institutional complexity	0	0	0	0	0	-4	0	0

Impact Issue/Important Environmental Component	Option 1				Option 2			
HUMAN RESPONSES	INSIDE		OUTSIDE		INSIDE		OUTSIDE	
	FWO	FW	FWO	FW	FWO	FW	FWO	FW
NUTRITION AND HEALTH								
Entitlements	-2	-3	-2	-3	-2	-3	-2	-3
Food diversity	-2	-3	-2	-3	-2	-3	-2	-3
Nutritional disorders	-2	-3	-2	-3	-2	-3	-2	-3
Waterborne disease incidence	0	-2	0	-5	0	-5	0	-0
Sewage and sanitary systems	0	-2	0	-2	0	-4	0	-4
CULTURAL								
Cultural diversity	-2	-3	-2	-3	-2	-3	-2	-3
Cultural activities	0	-2	0	-3	0	-2	0	-3
Archaeological, cultural and religious sites	-2	-4	0	0	-2	-4	0	0
INFRASTRUCTURE								
Road network	0	+1	0	0	0	+2	0	0
Navigation Network	0	-1	0	-2	0	-2	0	-2

+1 = Slightly Beneficial, +2 = Somewhat Beneficial, +3 = Beneficial, +4 = Very Beneficial, +5 = Highly Beneficial
0 = No Response, Effect or Trend Detectable,
-1 = Slightly Negative, -2 = Somewhat Negative, -3 = Negative, -4 = Very Negative, -5 = Highly Negative

OPTION 1 = Full FCD without Drainage Cells
OPTION 2 = Full FCD with Drainage Cells

5.4 Impact Quantification and Valuation

Valuation of impacts associated with the project has been fraught with problems making it difficult to quantify or value many. For some issues it is also difficult to be clear whether the actually impact will be positive or negative overall. The problems mainly relate to the desire to keep the impact presentation simple to the reader but in the process subsuming many complexities of the real life situations where different areas and groups in society will be affected differentially or in total contrast.

If these difficulties have been faced in the simple direction of adverse and beneficial impacts this means even more difficult problems face its valuation and the carry-over into the economic analysis. The use of simplistic market cash valuation omits the real cost of sustaining equivalent replacement livelihoods. The use of the discounting rates assumes certain values of time preference. The longer term costs of pollution, resource degradation or exacerbation of the base conditions for malnutrition to be faced by future generations cannot be easily taken into account.

The basic proposals for mitigation programmes inside and outside of the area are an attempt to correctly represent some of these more difficult valuation and development issues. The planning for these is not sufficiently refined in the current study which has been able to confirm the need and identify potential responses. Considerably more survey and planning is now required to follow up. Of great importance is to rationalise the institutional responsibilities for the programmes within

government and more particularly between the various FAP studies, for instance the charland and embankment programme for the Brahmaputra and Teesta.

5.5 Pre Construction Impacts

The current study has introduced the first impacts, particularly through its association with a major national project; already a subject of public debate. The levels of public participation have also made the potential future investments well-known to the local communities. Their effects of this cannot be certain at the current time, but may include impacts on land values and local tactics to dispose of or acquire land in a speculative fashion in advance of these works actually beginning.

The results of this project preparation and impact study have unfortunately been to raise a number of fundamental questions that must be answered before a firm commitment to a particular scheme configuration can be relied on. The remaining impacts in the pre-construction phase will therefore be generally positive in that considerably more time for public participation and monitoring of key data will occur on which more reliable conclusions can be made for the sustainable development of the areas. As the proposed implementation schedule does leave considerable time before works at GIP would be necessary it also means that the likely adverse impacts due to poor preparation of land acquisition and compensation can be more adequately resolved.

5.6 Construction Impacts

Full details of a potential construction programme and methods had not been worked out in detail for GIP by the time of this analysis. The EIA can only suggest potential problems which might indicate changes to the planning approach between now and the completion of the detailed design studies.

By far the most important benefit to be derived from construction will be the potential for generating local employment and Food-for-Work options. This programme can potential bring temporary relief to the condition of many economically and resource poor people.

The most significant adverse effect will be the need for land and the displacement of people. It is estimated that some 15 ha. of land will have to be acquired for GIP. This could involve the displacement of up to 150 people. The socio-economic profiles show intense deprivation already existing. Dispossession can transform access to survival strategy and future opportunities. The resettlement options are negligible. The scheme will have to rely on a sympathetic and well-managed compensation programme. Land acquisition problems have been the responsibility of FAP 15. They concluded that major changes are needed to ensure speedier and more equitable settlement of claims. Without this they are likely to be a major constraint to the implementation of project requiring land acquisition under the FAP. Their conclusions and recommendations must be made integral to the TOR, staffing and work capabilities of the detailed design stage. The phasing of these studies must also be carefully matched to the time by when the land acquisition process must be completed to allow actual construction to begin.

The drain on non-renewable and scarce resources of the construction phase of GIP has not been carried out in detail for each major item. As an indicator of scale the number of bricks consumed has been estimated which will be a drain on national energy resources in the form of fuelwood, coal or gas. The results indicate a consumption of 900 cu.m.of bricks for all works. This would require in the order of 250 tonnes of fuelwood. Disposal of spoil is not regarded as a major issue for further compensation payments.

A number of important sites of cultural and historic significance lie very close site of construction works. Further survey and assessment of the specific mitigation will be required in the detailed design phase.

Without a clear strategy on water management having resulted from the study it is still too early to give details of the actual construction programme and its impacts. These will be very specific to the final programme implemented with respect to the level of technology to be used, the phasing and detailed location of sites. These will have to be finally reviewed at the detailed design stage. The preparation of the engineering programme does indicate the following issues to be considered:

- The need to promote local employment that would benefit the char and embankment dwellers in particular; construction employment being a major positive impact of the project.

- Given the risks of disease transmissions from migration of labour a proper public health and sanitation component to accompany the construction works should be mobilised.

- Construction for site works would affect highly significant local sites of cultural and historic significance. A programme of survey and mitigation are recommended.

- Given the need for skilled supervision and management there will be problems of proper siting, compensation, pollution control and sanitation provisions for the contractors camp and works areas.

- Land acquisition, both for temporary works and permanent structures is relatively small. For the full TRE it totals 167 ha.; the GRE 5 ha.and the sub-division of the GIP area into drainage cells 10 ha. The reasons for the low figures are that existing embankments are being used. Early provisions for survey and preparing compensation payments will be necessary.

- No provisions for temporary access roads or upgrading have yet been made to allow efficient haulage of materials into the work sites. Option 2 for GIP will require 900 cubic metres of bricks to be moved from suitable brick fields. Haulage along the roads within the area will create additional traffic hazards.

- Conforming to existing employment and safety legislation will be written in the conditions of contract. This would also attach specific aims to target employment for women or landless people through LCSs.

5.7 Post-Construction Impacts

Principal Negative Impacts

The main negative impacts for both options are in declining order of priority:

1. The increased risks of loss of life and additional damage if the BRE or TRE were breached or the system fails.

2. The increased risk of the spread of malaria and cholera has been particularly flagged for Option 2. The expansion of surface irrigated agriculture from the Teesta barrage to the west of the GIP, the known incidence of both disease and vectors in the GIP areas and the likely increase in all year standing water which drainage sub-division of the area could induce are strong risk indicators that cannot be ignored at this stage. Whereas many of these areas might previously have seasonally dried out and inhibit mosquito habitats this may not occur particularly if boro irrigation increases. In addition the reduction in the level of surface flooding will likely induce more areas where stagnant water which previously would have flowed and been flushed. The increase in stagnant water could significantly promote both malaria, cholera and diarrhoea. The degree to which these will become increased problems depends upon the new micro-regimes of water flow and the overriding criteria and priorities used for water management. As these have not been established the probability of these events occurring cannot be determined. Further surveys and integration of health criteria into the detailed design and operational phase are recommended.

3. Both options will undermine further the ability of the capture fisheries systems to be maintained and loss of nutritional diversity and livelihood.

4. Both options will enhance further the final stage of habitat loss for an already thoroughly degraded environment of natural flora and fauna.

5. Both options would provide protection and encourage the continued development of farming systems which are probably unsustainable in the long term.

6. Both options would result in new areas where deterioration in water quality is likely to occur as a result of impeded drainage behind embankments, by the faster draining from higher lands where standing pools occur or by distributing drainage waters more widely as will be the case with Option 2. The effect will mainly come as a result of the construction of the TRE which will reduce the flow and flushing effect of Teesta waters through the project area.

It is likely that Option 1 will not have a significant context of inducing public cuts. This is mainly because the sealing of the TRE will significantly reduce levels in the Ghagot and the embankment of the left bank of the Ghagot has no noticeable confining effect for people on the left bank. The main problems could come from people within the set back areas on the TRE and BRE. Experience to date shows that public cutting on these major embankments is not a usual strategy given the scale of water flows and pressures in the major rivers. People are usually more resigned to their fate of loosing their land to the main rivers and simply retreat to the embankments for refuge in the flood or else migrate elsewhere in search of a new livelihood. What cannot be clarified at this stage is the risk involved in Option 2. Here the closing of the smaller overland drainage paths will lead to differential water levels either side of these embankments.Whether these will be significant enough to induce public cutting will be a major part of the future monitoring and detailed design studies. This factor cannot be modeled at the present time as it exceeds the presents scale boundaries and design features of MIKE 11. In view of the over-riding importance of this one issues for the sustainability and integrity of the basic tactics this has been noted as a negative impact of note for Option 2.

Other impacts will be of less importance and would include a further reduction in the possibilities for navigation inside the GIP area; an effect that would be more noticeable with Option 2. The levels of nutrition and nutritional disorders could be expected to get marginally worse overall by the disruption of the capture fisheries and vulnerability of those who will be adversely impacted. Other groups will benefit from the increased protection, production and employment generated.

The bacterial quality of many surface water supplies is unsatisfactory, and is a major cause of diarrhoeal disease outbreaks. Without adequate sanitation development, this situation cannot be expected to improve. No significant levels of any common toxins were detected in the study surveys, but they are reported to be locally significant near industrial units in Gaibandha and Rangpur. The chemical standards set for drinking water are in some cases irrelevant and would preclude every tubewell source tested, despite their being generally the best quality water available in the Region. FCD interventions are unlikely to have any significant effect on surface water oxygenation, since reducing current flows permits the development of phytoplankton, which form an alternative source of supply for aquatic organisms.

Reviews of soil surveys undertaken in the GIP areas indicate that there are no major problems to be expected as a result of the project directly. No salinity problem from soil or groundwater exist. Increased soil water levels in the highlands may inhibit the ability of many trees to absorb nutrients, a process promoted by the fungae-tree association. FCD interventions which reduce the water table in highland areas, therefore, have the potential to improve the nutrition of trees, which provide the most important ranges of natural resources for rural people. FCD potentially affect soil biology by altering the balance between processes which alternate through the annual inundation cycle. The present semi-natural system relies considerably on aquatic components. FCD interventions, which cause an increase in the length of time that the soils remain unsaturated each year, will certainly cause a reduction in nitrogen fixation. This represents a major cost to the agricultural sector, since this nitrogen is another of the 'free goods' of the floodplain, which will need to be replaced by traded goods if the natural cycle is disturbed.

The key problems noted for the area include the role of medicinal plants, the encouragement of food diversity and community based programmes to ensure that habitats suitable for the spread of malaria are minimised.

The embankments serve as important linear habitats and are major dispersal corridors for many species, some of which may be reservoirs of infection of diseases which affect humans. They are also important as dispersal routes for the agents of some contagious human and animal diseases. They provide shelter - often the only shelter - amongst the open and generally treeless fields of the floodland for the wild birds which feed on insects which may at times become crop pests.

The importance of the beels does not lie in their conventional role as wetland reserves for wildfowl, but as dry-season refuges for the floodland fish. The preservation of the fish stocks, which should be a matter of international concern, demands that the present network of beels and river channels should be maintained and the fish sheltering in them protected by sound and effective management policies, to ensure that their access to their essential energy source, the floodland, is continued. In FCD terms, this means that compartmentalisation centred on the major beel complexes, but allowing some access to the river channels as well, is the correct approach to the management of the fish stocks of the Region.

There are already significant problems with the supply of fodder, fuelwood and household energy. This will continue to deteriorate in even without the projects as the rice based systems and population pressure continue to intensify. The impact of the two options will accelerate this process to some extent through secondary effects. However, as all natural tree cover and seasonal grasslands have been removed already it is village grove resources, crop residues, the multiple use crops and the margins of beels and waysides which are of concern for detailed planning.

The present shortage and poor quality of draught animals in the study area is a constraint to the development of irrigated agriculture. The intensification of resource use associated with both options

will make the situation more difficult. Small power tillers are being adopted by larger farmers and those with the necessary resources and this trend can be expected to continue in the absence of any change to the general thrust of intensive rice-based commercial farming systems.

Principal Beneficial Impacts

The benefits are the flood protection afforded by the sealing of the BRE and TRE. These benefits are enhanced by the tactic of Option 2 which diverts drainage waters that would adversely accumulate at the Manas - Ghagot - Brahmaputra confluences. These have benefits for both peak levels, and for flood frequency and duration in most areas. There are a small number of drainage cells close to the regulators where impeded drainage conditions will likely occur and where these areas will be worse of in the future than they are now or in a future without project scenario. The trade off indicated by the model is deemed worthwhile from a hydraulic and equity viewpoint.

Flood protection interventions may potentially encourage the preservation of the floral and animal diversity in the highlands by reducing a high watertable in the flood season. This will enhance the growth of the trees which form the dominant group in the highland habitats, and so improve the resource availability of those species which rely on them.

The resulting agricultural benefits of savings in crop damage and cropping pattern improvements will both improve agricultural incomes and employment possibilities for seasonal labourers. Those people who will control the resources of the beels and borrow areas selected for improvement will be significant benefited through the increased fish production that is expected. The issue of commercial and influential people controlling access to these resources is a matter of operational concern if this mitigation is to truly be a targeted tactic to mitigate those specific communities who would suffer as a result of the project's adverse impacts on capture fisheries.

The increased employment generated through the construction works and increased agricultural output would benefit both landless, resource poor and the women and children, This will directly satisfy one of the most over-riding priorities expressed in the rounds of public participation which is to create employment. In providing these additional resources and the protection from damage from floods many people's access to survival strategies during floods with be improved. Unfortunately this effect will be mostly temporary as the construction period is finite (followed by maintenance contracts) and the agricultural effects are purely seasonal.

There will be a considerable improvement in the deterioration in social cohesion which has arisen as a result of the breaches in the TRE and BRE. This will be further seen in the case of the Alai regulator which help solve the problem of inequity that annually lead to the public cutting of the Sonail embankment. The attitudes to flood risks will therefore be considerable improved and this reflected clearly in all the rounds of public participation in the area.

Minor positive impacts will include the improved status of road networks.

5.8 Effects in Other Areas

The inclusion of the sealing of the TRE in the project proposals for GIP complicate the clear analysis of impacts of the independent GIP works on areas outside. At its simplest levels the options for GIP of sub-dividing the GIP area or not are not expected to have any influence at all on areas outside of the GIP target area.

The impacts of sealing the BRE and TRE, backwater embankments on the Ghagot and the Alai regulator do have significant impacts outside of the GIP area. To aid the impact analysis of these a separate impact matrix has been drawn up for the TRE project as part of the regional sub-projects. This is dealt with in Volume 4. The issues of the maintenance of the BRE protection levels, the resulting protection for Gaibandha town and the flood control provided by the regulator on the Alai are all beyond the scope of impact assessment aimed at the target area of the GIP and are not dealt with here.

5.9 Selection Between Options

The impacts analysis would show that Option 1 is likely to be the more benign strategy to adopt for the GIP area. All the negative impacts of this option are reproduced for Option 2 but are magnified in a number of important areas these being:

- the potential for public cutting
- the greater likely potential for the spread of water-related disease
- the fact that this option did not go through rounds of public participation

This conclusion has to be weighed against the major improvement in the equity of spread of flood water in the system overall which can only be achieved through the strategy of Option 2. Herein also lie the major economic benefits of investment which cannot be achieved to the same extent if Option 1 were selected. As the economic and equity potential of Option 2 is significantly greater this has been the main option to take through as the best option for future study. However, great priority must be placed upon being able to resolve the likelihood of differential water levels between drainage cells before this option should be decided on as the actual feasible option for investment. Similarly, whichever option is finally selected a proper survey tied to design and detailed mitigation planning must be carried out on the risks and management of the water-related diseases.

The study therefore concludes that sufficient flexibility must be maintained through to detailed design to allow future changes in design and selection of tactics. This must be adequately represented in the TOR. Also, the future phasing of surveys, studies and design must be carried out in such a fashion as to ensure that the correct information is available and phased to allow proper design and decision making to occur.

5.10 Selected Development and Planning Issues

The following sub-sections provided some selected data pertinent to particular aspects of major impacts. It provides some of the insights arrived at from the field surveys.

5.10.1 Impacts on Sites of Cultural and Historic Interest

A comparison of the proposed location and type of engineering works and the location of identified sites was carried out. This identified that there will be 5 sites of class 1 significance that could be directly affected by construction works. The number which may be affected by changes in water levels cannot be determined based on current information. The indications of the model results would be that while water levels could increase at their peak in some compartments the amount of rise will probably not be significant to the sites on the ground. More detailed survey would be required of these selected sites in the detailed design phase. Table 5.2 list the sites and assesses the impacts.

Table 5.2 Impact of Construction on Cultural Heritage Sites

Sl. No.	Name of the Monuments	Distance to Nearest Works	Impact Rating
1.	Mithapukur Mosque	NA	3
2.	Chandipur Mosque	< 100m	1
3.	Dariapur Mosque	< 100m	1
4.	Bamondanga Temple	< 50m	1
5.	Naldanga Temple	< 100m	1
6.	Pirgacha Temple	750m	3
7.	Sadra Temple	300m	3
8.	Temple	150m	2
9.	Temple	NA	3
10.	Temple	NA	3
11.	Temple	NA	3
12.	Bamondanga Z Palace	< 25m	1
13.	Naldanga Z. Palace	< 100m	1
14.	Pirgacha Z. Palace	750m	3
15.	Itakumari Z. Palace	150m	2
16.	Rasulpur Z Palace	NA	3
17.	Begum Rokeya's Palace	NA	3
18.	Hindu crematory	NA	3
19.	Hindu crematory	NA	3
20.	Hindu crematory	NA	3
21.	Hindu crematory	NA	3
22.	Hindu crematory	NA	3

Impact rating: 1 = Highly Significant
2 = Significant
3 = Not So Significant

NA = Site outside Project Boundary

5.10.2 Public Health and Nutrition Impacts

Overall, the studies undertaken for the GIP found that the status of health and nutritional condition of children had improved in the polder village compared to those on the riverside. The embankments have brought some semblance of reduced risk and normality to the life of the inhabitants living within

the polders. The production of crops and vegetables had become easier and this had played a significant role in creating employment. These improvements had also given encouragement for local communities to become more aware of health and nutritional issues. However, the existence of unplanned embankments gave rise to internal flash flooding and impeded drainage the effects of which were sometimes even of greater severity than had existed before.

The current compartmentalisation component of the GIP proposals is likely to lead to some improvements in general health and vector conditions in some areas and to a deterioration in others, both within compartments and across compartments. This system cannot be sufficiently modelled to lead to any precise prediction. It can be clearly concluded that public health and disease vector management programmes and criteria must become a foundation stone of the detailed design stage and more particularly during the operational phase.

The most significant risk will be the spread of malaria and water-borne disease associated with localised impeded drainage and changing habitats in various compartments. The second greatest risk is how to mitigate for the additional communities and people who will be made worse off as a result of the works in an area which already records one of the worst poverty and malnutrition situations in the country. The third major risk will be from a continuing loss of access to floral diversity due to mono-cropping in the agricultural areas and inadequate support for medicinal flora by any agency. The proper integration of all inter-sectorial activities in a coordinated plan for the GIP appears to be a necessity that needs to be reflected at the detailed design stage. Closer liaison and involvement of the NGOs and local communities will also benefit a coordinated approach.The proper mitigation is to ensure proper provisions of safe drinking water and sanitation with special planning and resourcing disaster preparedness.

Though floods are a regular feature of the area no systematic flood preparedness measures are undertaken either by the NGOs or the Government agencies in the GIP area. As a result, by the time preparations to deliver services are completed, the disease outbreaks have already taken their toll and sometimes reach epidemic proportions.

5.10.3 Navigation

No integral planning of navigation requirement accompanied the planning until very late in the designs when the first survey results and preliminary economic calculations identified the potential benefits which could accrue. In practise the provision of locks and passage through control structures can only be theoretical until detailed local research is carried out. This is primarily because there is considerable use of the floodplains by a whole category of boats smaller than that which is being considered at present. This must be an important component of any TOR for future studies.

Even if major navigation routes are maintained, closure of minor passages by embankments, drains or by reduced water levels is likely to have a significant effect on poorer people who depend on these routes. There remains a basic trade off between reducing flood levels in the monsoon and the requirements of the country boat sector. Many of the proposals would either change the available landscape of water over which small boats could ply or else change the timing of the floods so that important seasonal marketing and social needs would be disrupted.

The main drainage networks being considered could provide new seasonal navigation opportunities. Access to these from the hinterland streams along their routes would need detailed planning to provide for adequate landing stages and locks. Details on minimum navigation standards for channel and locks design will need to be obtained from BIWTA for future planning purposes.

Major areas will inevitably remain inaccessible during the monsoon. Changing flow regimes will affect the sedimentation patterns. The water which remains will be critical for the movement of people and goods. The modelling tools cannot answer these basic questions. Changes in the technology of country boats may also be affecting the erosion and sedimentation patterns. This would also have to become a design factor which might require changes to the vegetation management on embankments. This has social implications and stresses the need for public participation in these designs and their management. Such approaches are increasingly commonplace in the designs and management for waterways throughout Europe.

How much navigation by mechanized country boats could be benefitted or disadvantaged is difficult to assess without more field research and better data. Dredging schemes to straighten and deepen an interior waterway to improve drainage, rather than navigation, might result in a higher velocity and a more "efficient" river to remove floods but, could result in a drying of the channel earlier in the season than would otherwise be the case. The same drain, as part of an overall water control and management system, might be operated to maintain water levels later into the dry season to advantage navigation and irrigation. If the channel were deepened sufficiently to lower the regional water table so that the drainage ran all the year round, this could result in the tributaries, beels, and khals drying out altogether earlier in the dry season. This would result in mixed effects on navigability and irrigation.

These types of operating criteria have not been examined at this level of study. They are clearly a very real set of actual problems and trade-offs which must be addressed at the detailed design stage.

5.10.4 Sustainability

The assessment of sustainability in the matrix show only small effects of either option. Captured fisheries will further decline and to some extent would be mitigated for by a cultured fisheries and beel improvement programme. However, when set in a context of on-going trends there are indications of cumulative impacts arising from the process of agricultural and resource tenure commercialisation. These trends indicate problems of inappropriate resource management to ensure the long term sustainability of the system as it is currently being developed and encouraged.

Two conclusions are reached from the study:

- flood alleviation is a necessary, but not sufficient, strategic investment to achieve sustainable development.

- traditional FCD flood alleviation technologies and operational designs developed to advantage a rice based rural economy (independent of other development objectives) imposes unnecessary disbenefits for such important areas as health and equity. Many of these could be avoided if flood control designs were to serve a wider set of beneficiaries and address a broader set of development objectives.

Final policy and investment decisions on how to achieve sustainable development and improve the quality of life may require that flood alleviation tactics be adjusted to allow them to be more complementary with tactics required in other sectors. This may involve either reconsideration of the technologies selected for flood alleviation or the institutional mechanisms developed for how water is controlled and managed.

The current impact assessment can only allude to some of these issues by regarding them as dis-benefits. What it is not possible to show is the full potential advantages of a fully integrated approach to the management of natural resources, human development and water in all its forms. Put simply floods are pre-determined to be a cause of hardship and dis-benefit and thus its advantageous roles cannot be appreciated as they have not been planned for.

CHAPTER 6

RISKS AND HAZARD ANALYSIS

6.1 Introduction

The following considers a range of factors which imply either risk or uncertainty towards the continuation of planning or investment in the project. The review covers many of the items which otherwise would appear in an assessment of cumulative impacts. The major risks to project investments in the GIP will come from a number of sources. Many of these would be cumulative impacts that are externalities but, nevertheless, are likely to affect the long-term sustainability of the plans. Some issues are discussed further Volumes 7, 10 and 12. Volume 4 reviews in greater detail the possible hazards and risks in the region which would impact on the proposed scheme. These include natural phenomena and human-induced problems, both of which need to be considered in the investment decisions, engineering design and priorities of resource allocation for the basic scheme, flood proofing and for disaster preparedness. These risks include system failure caused by poor construction or maintenance, seismic activity, extreme flooding and major morphological changes through sedimentation, erosion or changing river courses due to a morphological response to the FCD interventions. All these risks would directly impinge on the safety and socio-economic livelihoods amongst communities that are already severely at risk from economic deprivation, poor health and malnutrition. Any additional strains induced by the project could lead to further marginalising the vulnerable households.

Risk is inherent in the planning and operation of any dams, which is what embankments in Bangladesh effectively are. Their associated risk and hazards are becoming standard components of project assessment to assist the appreciation of policy makers. An embankment building programme is by nature a long term strategy and thus must be maintained with integrity if the strategy is to make sense. The experience in Bangladesh is one where integrity of embankments is the exception, rather than the rule. The costs of maintenance are high and the costs of poor maintenance, in terms of damage from breaches, even higher. The decision to embank can only be justified when conventional hydraulic and economic analysis is supplemented by risk and hazard analysis. Currently this is nowhere being done within the FAP analysis and a system of accountability associated with the designs and decision making should be built into the system, as it is for international dams.

Risk and uncertainty are largely inextricable. Risk usually refers to events which can be assigned statistical probabilities and to chance events; some of which may have predictable recurrence intervals. Uncertainty in the context of this planning study might be taken to refer to the lack of relevant scientific data; the use of flawed data (constantly changing datum levels in the modelling is a typical example); the dearth of environmental modelling or simulation tools; and the present crude understanding of complex ecological processes.

This impact assessment can offers little quantitative guidance to decision-makers and suffer similarly with respect to the assessment of risks and hazards. It is the level of uncertainty inherent in the project planning which severely limits defensible quantification. In one area of seismic analysis and risks of liquefaction was the impact assessment able to summon a more scientific approach. The details of this are given in Volume 7 and are also discussed below.

Table 6.1 summarises some of the likely risks and looks at their implications for planning.

Table 6.1 Risk and Hazard Assessment

Issue	Potentially Severe Local Damage	Planning Assumptions or Configuration Potentially Deficient	Potentially Irreversible Changes
Physical Risks			
Seismic and tectonic events	X	X	X
Mass wasting in the upper catchment	X	x	x
River capture in the upstream catchment		x	X
Extreme climatic events in the upstream catchment	X		X
Coincident high floods in different rivers	X		X
Global warming, climatic change and rising sea levels			X
Delays or ineffectiveness of Brahmaputra river training programmes	X	X	X
Biological Risks			
Continued collapse in the floodplain fisheries	X		X
Under-valuation of loss of species and habitats	x	x	X
Under-valuation of cumulative impacts due to changes to wetland functions and processes	x	X	
Under-valuation of the background linkages between FCD, public health and nutrition	X	X	X
Economic Risks			
Inappropriate signals indicated by discounting or discount rate used	x	x	
Inappropriate signals sent by lack of inter-sectorial investment appraisal to resolving development problems	x	x	
Inappropriate signals sent by utilising sunk cost infrastructure	x	x	
Human Risks			
Public cuts	X	X	
Cumulative impacts associated with loss of social cohesion	X	x	X
Cumulative impacts due to untargeted tactics to reduce inequalities	x	x	X
Cumulative impacts due to untargeted tactics to maintain nutritional entitlements	X	x	
Cumulative impacts due to untargeted strategy to diversify natural resource base and products	x	x	
Lack of adequate O & M	x	x	

X = Severe x = Less Severe

6.2 Physical Risks and Hazards

The main effects in this category include many items commonly grouped under the heading of climate change. The type of conditions which would affect the base analysis would be associated with climatic change. Three conditions of change have to be noted:

- Above average events which exceed the design criteria, but do not lead to structural damage.
- Extreme and catastrophic events that will need emergency measures and consideration of both structural and non-structural contingency plans.
- Changing global climate patterns that will affect the base conditions of the existing situation on which the design criteria for projects have been designed.

These, and coincident events which exceed the design criteria, would compromise the sustainability of the engineering structures and lead to damage within and outside of the protected areas. This would significantly increase the costs for maintenance and rehabilitation beyond those assumed in standard project analysis. The principles of persistence and discontinuity (well-known natural phenomena used in chaos theory) imply that in an economic sensitivity analysis of extreme events, the system would have to be failed more than that suggested by the return period, as a grouping of these events results from the persistence principle.

In most areas of climate analysis there is insufficient data or other evidence from which reliable forecasts of future conditions may be made. The hydraulic modelling studies and the overall approach of the study should provide reasonable guidance for potential development over the immediate planning horizon. Debate and speculation about changes in the longer term will continue and research efforts in this direction will also intensify. The factors to be considered are numerous, and their future changes so uncertain, that any attempt to quantify the likely effects on the region would be at best extremely tenuous. The most realistic approach to assessing potential long-term effects would probably be a sensitivity study. The areas under which climate change might be considered include:

- rise in sea level:
- changes in rainfall:
- temperature change:
- carbon dioxide and radiation changes

There are a number of hazards where analysis of their implications should take place. None are easy to evaluate mathematically. Earthquakes, for example, may or may not be predictably distributable on a recurring interval scale. Their intensity of destruction may also be related more to their coincidence with other events, such as the coincidence with the monsoon and flood peaks, coincidence with high rainfall years or coincidence with mass wasting events and other morphological threshold events, either upstream or within the delta.

Seismic activity through tectonic sources can come from two sources. First, related to the subduction and subsidence of the Bengal Basin. Rates of subsidence here are locally variable and range between 1.5-21 mm per year due to a combination of physical consolidation of alluvial sediments under their own weight. This in turn can trigger minor earthquakes with low energy releases. Second, there are major tectonic movements. Bangladesh is located on the northern edge of the Indian Plate whose subduction has contributed to the development of the Himalayan mountain belt. Relatively high

displacement is caused by the Indian Plate underthrusting the largely stable Asian Plate. This is a potential source of catastrophic energy release through earthquakes.

A continuing and regular sequence of earthquakes is apparent in this geographical zone and has been analysed in detail in Volume 7 Geotechnical Investigations. The probability and intensity of seismic events declines moving across the country from north-east to south-west. The NWR lies mostly in the area of medium risk of seismic vulnerability, but the whole of the northern reaches including the GIP area lie in the area of highest risk. The description given in the District Gazetteers are a salutary reminder of the events around Gaibandha in the earthquake of 1897.

> "It commenced at 5-15 pm on the 12th June and the shocks lasted for five minutes. It was heralded by a loud rumbling noise from the east, (there) followed instantly yawning fissures, east to west in direction, from which torrents of sand and water poured over the surrounding country. The same phenomena was observed in rivers, tanks and wells. In many places there were explosions leaving cavities in the ground 4 to 5 feet in diameter, from which there was a similar discharge of sand and water. A great shrinkage of water and accession of sand in khals, canals, streams, tanks and wells was observed immediately after the earthquake. Large tracts of land were covered with a thick layer of sand, causing much damage to standing crops and rendering many lands uncultivable. The earthquake wrecked or damaged most of the public and private masonry buildings, the railways, all sources of water supply and almost all roads and bridges. ..The loss of life was small for an earthquake of such intensity and was confined mostly to Rangpur town. This was due to the fact that the entire population lived in thatched bamboo houses (at) that time. .. The earthquake made many changes in the drainage of the country. The beds of many stream and rivers were upheaved and also contracted by slippage of their banks. Some of them, the Gorai Nadi, the Bamni Nadi, the Buri Teesta, the Sarai, the Manas, the Nahalia and the Akhira Nadi were rendered useless as drainage channels. Both the Tista and Ghagot rivers were reported to have suddenly become fordable in places. The latter river, an important drainage channel in the district was, since 1897, a shallow sluggish stream with a weak current and a tendency to silt and be choked with aquatic vegetation.
>
> Upheaval in some places was attended by subsidence in others. On the whole the effect of the earthquake was to raise the general level of the district. The conversion of considerable arable areas, particularly in the Gaibandha sub-division, into uncultivable marshes and swamps, would seem to indicate the contrary. This is accounted for by the fact that, in the process of the upheaval, the country had, in places, assumed a cup-shaped formation, allowing little or no outlet for accumulated rainfall. The Ghagot Manas canal constructed in 1907 has drained some of these swamps and restored them to agricultural industry."

Studies by Rajshahi University indicate that there is a 96% probability of a high magnitude event occurring in Bangladesh every 25 years. The general return period of a earthquake of magnitude 7 was 63 years and of magnitude 6 was 10 years. These events are thus directly relevant to the immediate medium time scale of planning.

Investigations on liquefaction of delta deposits have confirmed that events exceeding only 5 on the Richter scale and with sufficient duration can induce liquefaction on embankment foundation materials where relative density of materials is less than 85%. The risks of liquefaction are therefore real hazards that cannot be ignored in the planning, assessment and contingency arrangements of flood protection schemes. The risks vary according to distance of the epicentre, project location, soil type, engineering design criteria and the construction method and quality of work. Local embankment materials are at particular risk from liquefaction as evidenced by the geological surveys of the FAP

2 and FAP 3.1 study. The construction materials are largely unconsolidated, sandy-silt materials of low cohesive strength and would be subject to liquefaction failure in the next high-energy seismic event. Even if such an event occurred during the dry season, the direct effects of embankment failures might only be minor, but the integrity of the system would have failed for the following season unless a widespread programme of immediate rehabilitation could be mounted. If the rivers were high, the outcome could be catastrophic with considerable loss of life and property over and above that which would have occurred without the embankments.

The statistical analysis of ground acceleration and return periods indicate that events of high risk are extremely unlikely to affect the economic rational and criteria for engineering design (the 1:100 year return period for a ground acceleration of 0.11g). Therefore, no counter-measures for structure and embankments have been deemed necessary for basic engineering design. However, given the general features of energy build up in tectonic processes associated with tectonic movement, the actual occurrence of an event above 5 on the Richter scale in the medium-term future can be regarded as extremely likely.

To actually find out the implications for the GIP's main embankments on the Teesta, Brahmaputra and Ghagot, the seismic and liquefaction model results were combined in the geotechnical studies to assess which areas of the surveyed soils which would liquefy under a statistical extreme event. This showed that total liquefaction of embankments would not occur. However, liquefaction would occur in those areas where unsuitable foundation materials occur. This would create major breaches in embankments that, initially, would lead to high rates of localised damage if the events coincided with the monsoon river flow period.

Figure 6.1 shows the high risk areas associated with the GIP Teesta right embankment. The methodology applied suggests that it is possibly to identify to the areas of risk. Two options for mitigation are possible:

1. To always undertake adequate surveys and laboratory analysis of foundation materials to avoid the localised use of unreliable materials or,

2. To prepare early warning systems and disaster contingency planning for areas considered to be of risk.

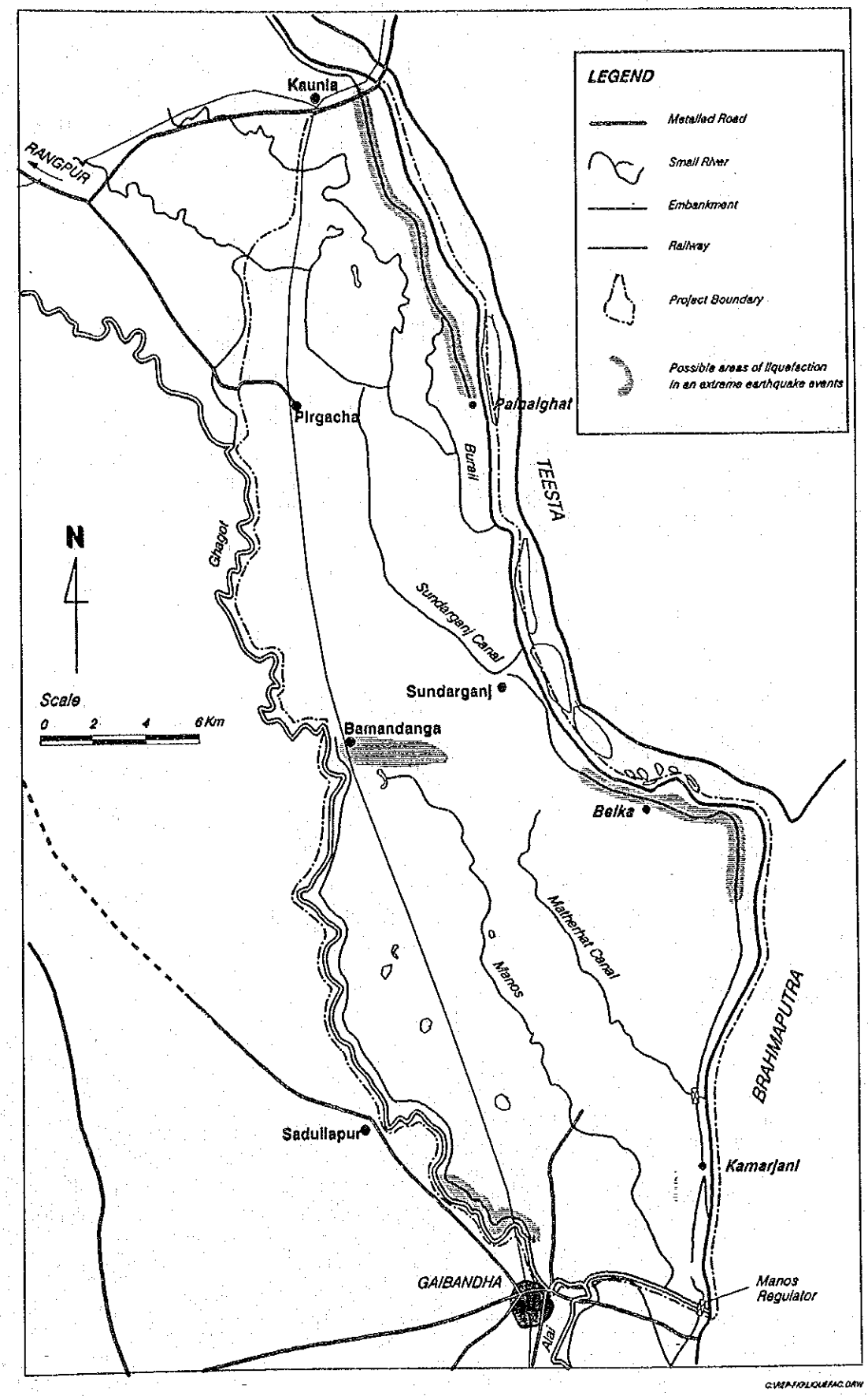
The first options implies considerably more survey and design work than is usually the case in Bangladesh and would result in higher construction costs for haulage of suitable materials to sites where high risk materials were otherwise to be used. The second option implies accepting the potential risk but also actually preparing for the event. As this event will occur a hazard response through organised relief programmes and rehabilitation works will be required.

The information presented in Figure 6.1 would be the first stage in preparing a disaster preparedness programme. Similarly, the nodal points in the system of the Teesta indicate where changing courses are most likely also indicate sensitive node in the system. The assessment opens up ideas for other options for planning. These might be to ensure a strict quality control over the use of embankment materials in weak sections or to reduce the standards overall so that compete slumping occurred to disperse the flood water more quickly over a wider area.

A proper safety and hazards analysis being carried through for a contingency plan of disaster preparedness and response should be a minimum requirement for any CFD scheme. The major embankments (as dams) should meet international standards, at least to assess and plan for the risks and hazards where loss of life can be expected. This study has been insufficiently resourced to

Figure 6.1

POSSIBLE AREAS OF LIQUEFACTION IN AN EXTREME EARTHQUAKE EVENT



undertake any detailed planning of these factors. These should be considered at the next level of investigations.

6.3 Resource and Habitat Alterations

The conditions of habitat alteration of significance to the project would be those leading to a cumulatively faster rate of morphological change and, thus, increase in the likelihood of rivers changing their course. The pattern of upstream catchment habitat alteration is not sufficiently well known or understood to make clear predictions as to the likely effects on the Brahmaputra or Teesta. Other features related to mass wasting or seismic events appear to be of far greater significance.

It is clear that Bangladesh and the regions around are going through a phase of major landscape, floral and faunal alteration with a great loss in genetic diversity and a restructuring of the food chain linkages. Ultimately the main looser is mankind. The implications involve loss of survival strategies, livelihoods, traditional medicines and the quality of life to highlight a few issues. The GIP area has already gone through the worst of this degradation and will suffer as much as anywhere else. Yet the proposed project will effectively continue to degrade the remaining aquatic resources systems, particulary minor fish species to the point that a critical collapse may soon be reached. Proposals to revive a caring approach to environmental management where local people are assisted and empowered to regain control over their future diversity of resources has been proposed. The basis of this conforms to the national environmental policy of May 1992, the thrust of the National Conservation Strategy (draft 1991) and the World Conservation Strategy (IUCN 1991)

6.4 Socio-economic Risks and Hazards

The traditional farming systems are based around risk minimisation strategies. The intensification of agriculture and uptake of irrigated HYVs leads to specialisation, indebtedness, shifting in the access to resources and a greater dependence on external factors. Thus, while the overall increase in productivity and seasonal employment may appear to show overall gains, the real situation of continued marginalisation and entitlements to food and resources may get worse for more amongst the resource poor. For instance, increased seasonal employment is unlikely to provide better nutrition throughout the year.

Options for integrated resource management have been offered in this study as a future direction to be taken up for detailed planning.

The most significant feature that will affect conditions in the project will be the status and displacement of people caused by the continued westward movement of the Brahmaputra or the south westward movement of the Teesta.

Within the GIP area river erosion from the two main rivers was a major issue. It is noteworthy that the development throughout the region of roads and railways have effectively compartmentalised the whole region. The GIP has the same configuration with the scale running from national to town to village to household sized roads and raising transport paths. Virtually none of these are considered to be appropriately designed to pass the river and rainfall waters that build up in the system. Even if one section were improved this would lead a greater quantity passing on down the chain into a system within Bangladesh that is always effectively constrained in the flood season by sea level and the flows in the main rivers. It is thus logical that flood storage throughout the system is the only way that an equity or improvement is likely.

Upstream the Brahmaputra has been embanked for a considerable numbers of years which in itself has contributed to the additional flooding and passing of sediments into Bangladesh. A similar scenario is seen on the Teesta. In the case of every embankment there is a response from the river system of changing water levels through confinement, changing morphology and the reactions of the people who live either side of them. Each additional project adds to these effects. Given that there is as yet little rational inter-state planning or even inter-regional planning under FAP, there should and are serious questions being raised on the sense of the potential massive expenditures and human effort that these undertakings imply when it is not clear what they achieve overall in terms of safety, flood control or reduction in damage. The GIP is just one project that will potentially formalise the cutting of natural drainage paths within the area and again rehabilitate the previous attempts to control the Teesta and Brahmaputra. The response of these massive rivers is very likely to be the same as its recent history, leading to another succession of breaches and retirements and changing river courses that have been indicated by the morphological assessment to be within the period of economic planning time frame.

CHAPTER 7

ENVIRONMENTAL MANAGEMENT PLANNING

7.1 Legislation

The chief sources of the national environmental policy are the Environment Policy and Implementation Programme (MOEF, 9 May, 1992) and the Fourth Five Year Plan, 1990-1995. The base objectives are to:

(a) To conserve and develop the environment to maintain and improve the ecological balance;

(b) To protect the country from natural hazards;

(c) To identify and control activities leading to pollution and degradation of the environment;

(d) To ensure environmentally sound development in all sectors;

(e) To ensure environmentally sustainable, long-term development of national resources;

These aims have been translated into more detailed priority objectives for different sectors. Those specifically relating to CFD planning are:

(a) Environmentally sound and sustainable development and management of water development, drainage and irrigation projects involving both surface and ground water;

(b) Maintaining the inland waters free from pollution

(c) Undertaking EIAs of water development and management projects

(d) Removal of the adverse environmental effects of previous water resources management and flood control projects.

(e) Adoption and extension of environmentally and ecologically sound land use practices and conservation of soil fertility; prevention of land erosion and strengthening of the land reclamation programm; prevention of soil salinity and alkalinity.

(f) Forestry conservation and afforestation to maintain ecological balance; conservation of wildlife and biodiversity

(g) Conservation and development of the national wetlands and the migratory bird sanctuaries.

(h) Protection, conservation and development of fish habitat

(i) Re-evaluation of past FCD/I projects causing adverse effects on fisheries resources.

7.2 Pre-Construction Surveys, Assessments and Policy

Future surveys are required to establish the soundness of compartmentalising drainage in the GIP area and what the criteria for environmental management would be. This will include a full health survey of vectors and water-related diseases. Moving to a proper water management strategy will require considerable more work on public participation to establish the role of local communities and their responsibilities in organising and managing the water and drainage systems. Strategic decisions have to be made on the role of proper water management before details on other mitigations could be given. These will be subject that will have to be dealt with in the detailed design phase. This suggests that flexibility in financing provisions should be allowed for.

The detailed design studies should include an on-going impact assessment process to both review the findings of the study, adapt the assessment to changing policy, conditions or designs finally selected and to help prepare the contract documents and conditions for environmental protection.

7.3 Construction Management

Mitigation for construction impacts will mainly be achieved through contractual conditions and supervision during the construction programme. The specifications need to be drawn up with the direct involvement of the impact assessor and environmental team during the detailed design stage. These conditions should not just be the responsibility of the engineers who may be unaware of the specific requirements of particular project components and operations.

The key requirements that have been identified so far include:

- Conditions on the contracts and checks to ensure that use of timber in brickfields supplying the project complies with government restrictions and will not add to the over-exploitation of village groves.

- Pre-selection of construction methods based on maximising local employment generation.

- Detailed designs of borrow areas and excavation works that will a. minimise the impact zone of temporary disturbance to habitats through turbidity changes or decline in water quality. b. minimise the degree of conformity of excavated landforms and channel or beel cross sections and bank characteristics to maintain a diversity of habitats. c. maximise the re-instatement of impacted areas to ensure a rapid regeneration of productive uses in agricultural, fisheries or wayside habitats.

- Proper lead in time for surveys and compensation arrangements for people to be displaced by project works together with proper follow up monitoring to ensure that negative impacts are minimised.

7.4 Mitigation Measures

7.4.1 Fisheries Mitigation

The main mitigation for fisheries has been to ensure that Bamandanga beel remains attached to the river flooding from the Ghagot. Thus, the river embankment is retired around the beel. No other

beels have been treated in this way, primarily because the system has been approached as one of flood protection and not water management. With this view of the water planning it has not been possible to examine the other alternatives for fisheries development or mitigation. Had the main benefit for project to be justified on diverse fisheries, and not maximum rice output, another system or configuration of water control would almost certainly have resulted. These options would have considered maintaining and enhancing the linkages between a range of seasonal aquatic habitats which only occur by default under the current approach.

The immediate and natural enhancement of river fisheries in the Ghagot through the non-replacement of the existing Manos regulator will be costless. It will also be responded to by local fishermen and communities without any assistance. Within the wider context of drawing the local communities into taking up more coordinated involvement in environmental management initiatives the planning of the Ghagot role in fisheries and its management will be important. This again should form a component of the detailed design phase planning.

The main mitigations as specified in Volume 12 are still in outline and potentially suggest an unimaginative approach to managing fish habitats and species. The mitigation responds to the new fisheries management policy, and a still uncertain agreement between BWDB, DOF and local people that permanent water bodies will not be drained as in the past. The perspective is one of a "need to comply". However, GOB national policy is quite clear on the objectives to protect and enhance the management of these important wetland and waterbody areas and should be squarely addressed.

Five beels and a section of the Matherhat canal have been identified for the improvement of capture fisheries. Due to the impacts on the right bank of the Ghagot and in the Alai floodplains improvement to four beels external to the GIP area have also been recommended. The programme will also include the renovation and redesign of 200 ha. of borrow pits within the GIP area which, through poor design, have left these areas abandoned and unproductive. As currently specified the approach would take the form of "excavation of silted up areas" with the involvement of the BWDB, DOF and NGOs; the latter to mobilise fishing communities into groups. The approach to modifying water regulating structures awaits the research conclusions of FAP 17 and their advise on management approaches for the river. In the meantime the GIP suggestions are for a "token" provision pending these results. If the whole of the fisheries management is to be dependent on FAP 17 research outcomes the phasing of the future studies should take this into account. The current proposals would seem to allow for this.

The next phase of planning must elucidate the details for each waterbody and its inter-connections to the surrounding seasonal habitats in khals, river and floodplain. The designs should be worked out primarily by a fisheries ecologist, together with the local fishermen and a public health ecologist. An engineer, well-versed in environmental management, would also be required to assess the implications for system planning and operations and to ensure that the specification of contracts, designs and conditions clearly. Only this background is likely to lead to an approach which appreciates fully the need for a diversity of habitats to maintain and enhance species diversity, and thus productivity of the system overall.

At present, there is little experience of this form of environmental design and management in the fishery and engineering institutions within Bangladesh. A further part of the EMP would be to fund international training of BWDB and DOF staff in this evolving field of engineering and to use sites at Gaibandha or in the Lower Atrai as training sites.

To be sure of deriving the greatest gains in productivity this approach would probably conclude it wise to maintain some areas were beels have become silted up as suitable habitats for other forms of habitat development and management that would benefit fish productivity. This sub-area might

spearheaded by a vegetation management strategy using both terrestrial and aquatic flora to create suitable habitats.

A far greater problem is that of the social management of these mitigatory resources to address the wider development problems of poor nutrition and disappearing access to common property resources. This also has to address the needs of professional fishing households and also the occasional fishing households or individuals who catch fish for direct consumption. It would seem certain that a revision of the existing leasing systems and giving major resources for maintaining floodplain and paddy fisheries would be the only way forward to resolving some of the issues.

Social and cultural programmes to help formalise the inter-relationship between fishermen and rice farmers would assist. All this requires data on the changed hydrological regime at the macro and micro level. The macro implications have been provided by this study. The micro implications go beyond the scale of the current model to assess. Neither is it clear that the MIKE 11 model would be the most suitable mathematical construct for the next level of detailed planning where water management becomes the rationale. This aspect must be carefully reviewed ad clarified before the technical and modelling assumptions of the detailed design phase are decided upon.

7.4.2 Flora and Fauna Management

The GIP area has already been so severely impacted by human exploitation that there appears little that can be done for protection of flora and fauna in the area as part of the logic of protected area networks or genetic conservation in concerned. However, along the riverine zones of the Brahmaputra, Teesta and Ghagot threatened bird species were seen. Thus, these areas would likely come under the regional planning approach discussed in Volume 4.

While the losses of natural flora and fauna have been great within the GIP area this does not mean that the future environmental management planning and community responsibility in this could not regain an element of regeneration of habitat and species diversity; albeit in a different form from that which existed naturally. The discussion above of the fisheries approach is an indication of a future direction. No such programmes will have any validity unless they form part of the perceived needs of the local communities and that they are willing to take responsibility for the programme. Similarly, in such a resource poor and economic deprived area the programme would also have little validity unless there is an honest and motivated commitment from the government and the donors to join in partnership with local communities and give them the access to scientific research and financial and material resources that they lack. Unless this is the approach adopted all the rhetorical platitudes of planners will have no basis in action and results on the ground.

7.4.3 Fuelwood and Fodder Production

Some replacement provision of fuelwood could be carried out by the development of community forestry as part of a strategy of multi-purpose use of embankments. Selecting appropriate species needs to focus on maximum utility to the communities (i.e. shade, fruit, craft, fuelwood, forage, building and tools) but will also not damage embankment. The indigenous species which traditionally occupied the niche of the river levees would clearly be the most suitable species in the first instance.

The shortage and poor quality of draught animals is a constraint to the development of agriculture. The intensification of rice based farming will only make the problem worse. Mitigation here can only result from a fundamental change in the farming and resource tenure systems and as part of a wider

commitment to achieving improved environmental management. The prevalence of inter-changeable small engines for both irrigation and boat power indicates that mechanisation could be a sustainable complementary approach for those that can afford it.

7.4.4 Soil Resource Management

The main mitigation for any adverse effects on soil structure are a monitoring programme incorporating community feedback networks and more resources for agricultural extension systems that can promote IPM and better ecological management of organic matter in the farming systems. The ability to achieve results is intimately linked to the outcomes of efforts to promote crop diversification and alleviate the crisis in homestead fuel and energy sources.

7.4.5 Mitigation for Cultural Heritage

Bangladesh has a rich cultural heritage. During the two thousand or more years of its chequered history, many dynasties kings, sultans and zaminders have ruled the country. The desolated ruins of the magnificent cities and monuments, still visible in many places throughout the country, are reminders of those days and history. Proper assistance to preserve these archaeological sites is needed and has recently been given Presidential support. To preserve and research these sites helps safeguard history and the reconstruction of the past in a more authentic way. Much evidence is still hidden under the ground of these sites awaiting proper archaeological surveys and excavation.

All special sites should be kept free from flood water by erecting walls around the entire site as a secondary measures to the major embankments on the major rivers. Adequate resources are needed to allow proper renovation of priority sites under expert guidance. Site protection will only be brought about by employing local guards and by raising local awareness of the importance of their own heritage. Proper government involvement and legislation is needed with sufficient resources to implement them.

7.4.6 Health Mitigation

a. Disease and Vector Controls

Integrated biological and environmental control programmes have proved themselves worldwide to be particularly cost effective. This require the authorities to fully mobilise and involve local communities to remove or purposively manage habitats suitable for vector breeding (i.e. small ponds, tanks and borrow pits), encouraging drainage and water flows in areas where stagnant pools could otherwise develop, cleaning ditches and introducing inedible and edible larvivorous fish into the remaining permanent water bodies, ponds and troughs.

b. Tube Wells

To make safe drinking water available and accessible to the flood risk population more DPHE tube wells should be sanctioned for the Gaibandha area. The scattered community over a large area and the problems of movement during floods means that the population eligibility for DPHE tube wells should be reduced to a maximum of 50 persons per tubewell. The problems of installation and operation mean that a physical count survey is needed in the next phase of planning to determine the real tube well use rate in all the riverine thanas of the region.

The sociological studies (Volume 11) have clearly identified the need for programmes to be carried out for the embankment and char dwellers as a matter of priority. These communities are directly affected by FAP programmes and thus should be dealt with rationally for the GIP as part of the on-going phased needs of the area.

Installation of tube wells above flood water levels in the low lying, embankment and char areas; the repairing of the non-functioning tube wells; and the intensive training of community volunteers on their maintenance, should be undertaken as a matter of routine flood preparedness.

c. Latrines

DHPE needs to increase their capacity for producing and installing hygienic latrines. Local NGOs, like GUK, USS, FATEMA and other social groups in the Fulchari, Sundarganj and Shaghata areas, should be involved for social mobilization, raising health awareness and the production and sale promotion of such latrines. Similar programmes should also be undertaken in other riverine Upazilas in collaboration with local NGOs of the area.

d. Iodized Salt and Lipoidal Injection

Even though there is no direct connection between FCD and goitre problems the need to distribute iodized salt should be considered as an integral part of any major scheme such as the GIP in a coordinated way. Iodised salt can made available through, private business sectors, NGOs and local government authorities in the northern areas of the region, including the Gaibandha project area. Government health and family planning field workers, school teachers, and NGO workers should incorporate iodine deficiency problem awareness messages in their health and functional education programmes. Government and NGO health services should run routine iodine supplementation programmes in specially high risk areas in the form of lipoidal injections.

e. Vitamin A: Capsule (VAC) Distribution

Vitamin A deficiencies are directly linked to FCD projects and must therefore be seen as of high priority in the programmes of mitigation. Government and NGO health services should give increased importance to Vitamin A capsule distribution programme especially in the riverine Upazilas. They should be distributed to children routinely, during flood and at times of diarrhoeal episodes.

7.4.7 Mitigation for Navigation

The GIP sub-division into smaller more numerous drainage cells would improve a considerable network of existing roads. It is unclear as to whether the proposed closures would seriously affect local navigation. The main mitigation for the GIP is to ensure that a detailed navigation plan, based on rationalising marketing and cargo outlet for a least cost approach is carried out as a central guiding feature to the final designs. This plan is likely to affect the main regulator outlets to the Teesta and Brahmaputra and enhancing the new seasonal navigation possibilities through the Ghagot to Gaibandha and Rangpur. These needs for local internal networks for fishing and domestic users must also be given due consideration in these studies.

The compartmentalised option should also review the types of vehicles that will need to pass on these enhanced embankment such that they can serve the proper needs of different sizes of vehicle for different purposes. This again will require some review of marketing, commerce and public transport systems.

The Ghagot business centres have supplies of cargo to maintain the demand for about 500 different types of boat. Dredging would be required to ensure the durability of navigation and extend the navigation season by three months. This would also stimulate navigation demands for up to 100 boats along the river Manos.

The Sorai canal is very narrow, but a very important canal in the GIP area. It also has almost silted up and converted to what are now some of the best jute and paddy growing areas. To dredge this channel would involve some loss of jute and paddy production along the canal alignment. If excavated it is estimated that some 50 boats could be engaged in cargo carrying. Similar works on the Sundorganj canal, which is now blocked by the groyne, could provide opportunities for up to 50 boats. Similarly, the Nurail canal and some other minor canal might support a further 100 boats.

The potential benefits are summarised in Table 7.1. Additional benefits may also accrue to the existing local fishing fleet.

Table 7.1 Potential Navigation Income and Employment Benefits

River/Canal	No. of Boats	Rate of Employment	Total Nos Employed	Monthly Income Tk.	Total Income Tk.	Total Cargo maund
Ghagot	500	3	1,500	900	1,350,000	1,200,000 - 1,500,000
Manos	100	3	300	900	270,000	200,000
Sarai	50	3	150	900	135,000	150,000
Burail	50	3	150	900	135,000	150,000

The solutions that can be proposed for the GIP are very preliminary and would require further detailed study. Based on the survey and views of the local people the suggestions for improvement include:

1. Develop Main Drainage or Sluice Gates as Transhipment Points

The main drainage nodes should be provided with transit facilities to allow loading and unloading of incoming and outgoing cargo.

2. River Dredging

The estimated length of river requiring dredging is given in Table 7.2 below. The Burail canal is not considered significant as it is very susceptible to erosion.

Table 7.2 Estimates of Dredging Programme for GIP

River/Canal	Dredging		Length Approximate
	From	To	
Ghagot river	R. Brahmaputra	End of Project	35 Km.
Manos river	R. Brahmaputra	Bamandanga	20-25 Km.
Sarail canal	R. Brahmaputra	End	12-15 Km.
Sundarganj canal	Sundarganj	Pirpacha	8-10 Km.

3. Redesign of Sluice Gates

The gates of the Manos regulator are well known to be too narrow. Wider gates designed for passage of boats would assist the stimulation of the water transport sector, promote cheaper transport and allow better control over drainage. Wherever present or planned sluice gate can be replace by lock gates their size must accord to the size of boats likely to pass. The following are suggested criteria.

Large boats: Length x breadth x draft = 50'x15'x3.5'

Small boats: " x " x " = 20'x5'x1.5'

7.5 Disaster Preparedness and Response

Coordination of projects in the NWR and other regions will be required, to know in advance how best to fail the system safely and which areas would be used for storage and which would be protected. These requirements should be built into detailed planning of the projects it effects as well as the training of staff, preparation of manuals, provision of communications equipment, public participation and warning systems.

All the projects in the plan are built to a variously set design criteria. In view of the complexity and range of hazard risk that exist, full contingency planning and resourcing should accompany the feasibility and detailed design of future projects. Under international criteria relating to dam construction (which is effectively what the major embankments are) all such designs would normally have to conform to the most stringent technical and quality control standards and plan a full disaster preparedness strategy. This aspect may require more detailed consideration in future planning for Gaibandha and other regional sub-projects.

A number of recommendations have been made in this study. These can be summarised as follows:

- Financing and planning of flood proofing measures are required with or without any of the interventions proposed in this plan. This is because the risks of exceeding the design criteria involve many hazards that could obviously occur in the economic lifetime of the projects. As the basic strategy will not be abandoned at the end of this economic life these risk become certain hazards if the long term planning period is adopted. For engineering planning the most significant works will be the survey and proofing of all vulnerable public infrastructure, facilities, services and

communications to ensure that these continue to function during and after a disaster event.

- The most significant hazards will involve events associated with or occurring coincidentally with the monsoon season. Full disaster preparedness will depend to a large extent upon the navigation services, resources, facilities and planning that has been considered in future planning. River ambulances and emergency supply boats can play a dual role in monsoonal development activities and disaster response. This will require the prior coordination of response primarily from local communities, local government, the health services, the NGOs, national coordinating bodies and the international community.

- Prior programmes to ensure the improvement of the basic conditions for clean water, latrines, food storage and improved sanitation, particularly for char and embankment dwellers would reduce the risks of disease and their current susceptibility to post disaster problems.

- Targeting of development resources, agricultural planning and water management into addressing the issues of malnutrition would improve the resilience of those most at risk to withstand the post disaster problems and contribute more productively in development. The use of extended berms on embankments both for ensuring flood refuges and areas for agro-forestry and vegetable production have already been under research in Bangladesh and these results must taken account of.

- Mobilising public participation and support for a partnership between local communities, government and donors in planning and effecting flood action plans and disaster response would resolve many contradictions of interest and ensure better management and caretaking of the infrastructural base for flood control. The role of and liaison with local women's committee is seen as central to community issues for flood preparedness.

7.5.1 Flood Proofing Unprotected Land

The areas which would remain unprotected all the time are the attached and island chars and setback land along the Brahmaputra and Teesta. The whole area countryside of the embankments would require flood proofing to mitigate against the events which exceed the design criteria of the system or system failure due to other reasons (such as poor quality of construction or maintenance).

How the external flood proofing costs are allocated between regions or projects is not of concern to this discussion. These mitigation costs probable should be paid for out of the benefits achieved in the adjacent protected areas. In the case of the GIP the method of analysis used in the study assumes the existing BRE and TRE as sunk costs. The associated disbenefits and mitigations for the chars are also assumed to have "sunk". Clearly this is a socially unacceptable approach. It also masks the real costs of long term development of the GIP areas.

The NGO experiences suggest that few individual houses would be flood proofed. Most people would rely upon seeking refuge on the nearest higher ground and onto the embankments. Data collection and flood proofing for the Brahmaputra charlands is been tackled in greater detail by FAP 3.1 and 16. Reference should be made to these studies to rationalise an approach and avoid duplication of activities.

7.5.2 Health Planning

The need for a public health intervention plan applies for all the thanas of the GIP area and in other riverine thanas of the region detailing all emergency activities. The plans should include a list of resources which are to be mobilized and estimates of logistic support needs. The plan should integrate inputs from NGOs, cooperative groups and local social organizations. Advance mobilization of the required resources, materials, logistics and training of field workers and community volunteers must be ensured.

a. Flood Shelters

Prior identification of available premises as prospective flood shelters is required with provisions for adequate, functioning tube wells and latrines and proper sanitation. Advance agreement and management responsibility must be established in the plan.

b. Buffer Medicine Stock for Flood Emergency

The thana health authorities should strictly maintain the buffer medicine stock for flood emergencies. Items used or outdated should be replaced immediately. Adequate essential drugs, dressing articles (i.e gauge, bandage and cholera fluids) must be included in the stock list.

c. Equipment for Field Medical Camps

Thana health authorities should be well equipped for setting up field camps with necessary materials and medical equipments.

d. Contingency for River Transport

The thana health authority there should have contingency fund earmarked for hiring river transport for the quick and efficient mobility of medical teams and supplies during the flood months.

e. Coordination of NGO Activities

To achieve optimum utilization of voluntary services, ensuring proper coverage and avoiding duplication of services, a mechanism for the coordination of NGO activities should be established.

f. Health Nutrition Awareness Programme

Given the present poor health and nutritional status in the flood affected area and the future risks involved, mass health and nutrition awareness programme should be launched in all the thanas of the Gaibandha project area and in all other riverine thanas of the region. Efforts should be made to reach the remotest population in chars. The programme should lay emphasis on the following:

- Water, sanitation, iodine and vitamin "A" deficiencies
- Food preservation and supplementary feeding for the lean season
- Treatment of diarrhoea
- Promotion of cultivation of winter vegetable and medicinal plants
- Chlorination of ponds and water reservoirs after floods
- Spraying waterlogged ditches