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MEGHNA ESTUARY STUDY

DRAFT DEVELOPMENT PLAN

VOLUME 2 : PART 2
INITIAL ENVIRONMENTAL EXAMINATION
HAIMCHAR EROSION CONTROL PROJECT

FAP-5B
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September 1998

DHV CONSULTANTS BV

in association with

KAMPSAX INTERNATIONAL
DANISH HYDRAULIC INSTITUTE

DEVELOPMENT DESIGN CONSULTANTS
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DRAFT DEVELOPMENT PLAN

VOLUME 2 : PART 2
INITIAL ENVIRONMENTAL EXAMINATION
HAIMCHAR EROSION CONTROL PROJECT

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September 1998

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ACRONYMS, ABBREVIATIONS AND GLOSSARY

The spelling of Bangla words is not standardised, with frequent differences between vowel use. The following use the standard set by ISPAN in their reports based upon the work of a professional editor with a large international academic publishing house.

ADB	-	Asian Development Bank
AFPM	-	Active Flood Plain Management
ARTI	-	Acute Respiratory Tract Infection
BBS	-	Bangladesh Bureau of Statistics
BIWTA	-	Bangladesh Inland Water Transport Authority
BWDB	-	Bangladesh Water Development Board
CERP	-	Coastal Embankment Rehabilitation Project
char	-	Bangla word for accreted land
CIP	-	Chandpur Irrigation Project
Danida	-	Danish Government aid agency
DoE	-	Department of Environment (of the Government of Bangladesh)
EGIS	-	Environment and GIS Support Programme for the Water Sector, successors to ISPAN FAP 16/19 funded by the Netherlands Government
EIA	-	Environmental Impact Assessment
EMP	-	Environmental Management Plan
FAP	-	Flood Action Plan
FCD/I	-	Flood Control, drainage and Irrigation
FPCO	-	Flood Plan Co-ordination Organisation (of the Ministry of Water Resources) now incorporated into WARPO
FRSS	-	Fisheries Resource Statistical Survey (of the Department of Fisheries)
ghat	-	Ferry landing stage (Bangla)
GIS	-	Geographical Information System
GPA	-	Guidelines for Project Assessment
ha	-	hectare
ICDDR,B	-	International Centre for Diarrhoeal Disease Research, Bangladesh
IEC's	-	Important Environmental Components
IEE	-	Initial Environmental Examination
ISPAN	-	Irrigation Support Programme for Asia and the Near East, funded by USAID and responsible for the Environmental and GIS components of FAP. Now succeeded by EGIS.
km	-	kilometre
LGED	-	Local Government Engineering Department
LRP	-	Land Reclamation Project
m	-	metre
Mauza	-	A Bangla word for the smallest government administration area corresponding to a village revenue unit.
MES	-	Meghna Estuary Study
MOEF	-	Ministry of Environment and Forest
MWR	-	Ministry of Water Resources
NCS	-	National Conservation Strategy
NEMAP	-	National Environmental Management and Action Plan
NGO	-	Non-Government Organisation
NWMP	-	National Water Management Plan
SRP	-	Systems Rehabilitation Project
SWMC	-	Surface Water Modelling Centre, previously FAP 25
Thana	-	Government administration unit between a Union and Zila, has been known in the past as an Upazila (Bangla word)
Union	-	Government administration unit between a Mauza and a Thana. The lowest level from which representatives are elected.
WARPO	-	Water Resources Planning Organisation of the Ministry of Water Resources

SUMMARY, CONCLUSIONS, RECOMMENDATIONS AND FUTURE ENVIRONMENTAL WORK PROGRAMME

SUMMARY

Aims and objective of the environmental assessment

The aim of the environmental assessment is to ensure environmentally sound project planning and implementation. Under the Department of the Environment Guidelines for EIA of August 1997, the proposed full project is likely to be classified under Category D (red) under Section 66, although this is not clear cut situation.

The trial for the Haimchar Erosion Control Project intervention commenced in early 1998 and has been in place during the monsoon season of 1998. An environmental scoping of the proposed trial was carried out and concluded that there were no environmental obstacles to going ahead with it, as the aim was preserve the present situation by attempting to reduce river bank erosion. The environmental scoping exercise was then extended to an Initial Environmental Examination (IEE) for the full proposed intervention. Construction of the remaining part of the intervention is planned to follow after the end of 1998 monsoon and cyclone risk period. The present document is an IEE carried out for this proposed intervention.

Proposed intervention

An outline of the proposed intervention is given in Section 2 of the IEE. As stated above, the trial for the full intervention has already be put in place and is shown in Figure V.11b. The aim is to use geotextile spurs and screens to divert river flow away from the bank to reduce erosion and possibly to promote sedimentation. The Pilot Schemes comprise 9 spurs and 345 screens in two locations. The full proposed intervention would add a further 34 spurs and 1,140 screens and is shown in Figure V.11a. A significant factor is that erection of the spurs and screens can be carried out from a barge and no major land acquisition is needed as the spurs and screens are located in the river channel and under water.

Baseline conditions and future trends

An environmental baseline description is given in Section 3 of the IEE, working systematically from the natural environment to the human using the order given in the WARPO EIA Manual. The most significant issue in the area is river bank erosion which, as well as land loss (and resulting impoverishment), causes flooding of homesteads and agricultural land from the main river in peak flow times during the monsoon in places where the embankment has been eroded away and not retired. Past erosion rates have been mapped for 1957, 1973 and 1996 and are shown in Figure V.8. Predicted future erosion rates have been calculated and using the best present knowledge, bank lines for the years 2010 and 2025 have been plotted. The areas of land inside these areas have been quantified in Table V.2.

A key issue is that human population densities are very high (well over 1,000 people per km^2) in the areas adjacent to the erosion areas (see Figure V.10), as displaced households are forced to re-locate on the Chandpur Irrigation Project (CIP) embankment. It has been estimated that the likely population in the area of predicted erosion by the year 2025 will be 18,000 households (roughly 100,000 people) over an area of 4,700 ha.

A needs assessment was carried out and the results are given in Table V.1. It was found that control of river bank erosion was considered the greatest priority in all social groups in the project area. There should thus be little difficulty in obtaining the No Objection Certificate from the Local Authority that is required under the recent EIA Guideline before a proposed project can be approved.

Scoping of important environmental components

A scoping exercise was carried out to identify Important Environmental Components (IEC's) and is outlined in Section 5. The IEC's were identified both on a technical basis and using the findings of the needs assessment. The components were put into a matrix , which is given as Figure V.12, for impact analysis. A time limit of 25 years was used for the analysis which compares a with project situation to a future without project situation based upon a present day zero baseline. The likely geographical limits of impacts were identified and external impacts and constraints are discussed in Section 7.

As the primary objective of the intervention is preservation of the current situation, the future with project situation is similar to the present situation. The major exception to this are additional indirect positive impacts created because residents have the confidence to invest more in the area as the flood risk is reduced, due to the fact that the existing embankment is less likely to be eroded. Thus the future without intervention situation is in decline for most components, whilst the with intervention situation keeps things at their present condition and in some cases improves it.

Identified positive impacts

The main identified positive impacts are:

- reduction in erosion
- promotion of accretion
- reduction in river flooding risk

Identified negative impacts

The main identified negative impacts are:

- disruption to navigation landing sites on the river bank due to possible induced accretion
- possible erosion of some island chars
- minor direct construction impacts.

Mitigation of negative impacts

It should be possible to mitigate for any disruption to navigation by constructing boat centres in appropriate places. Monitoring of the island chars will be needed to identify if any induced erosion occurs, so that appropriate action can be planned and implemented. Construction monitoring should be carried out so that any significant direct construction impacts can be identified and appropriate action taken. A checklist has been prepared for consideration at construction time.

Residual negative impacts

The only significant residual negative impact is possible induced erosion of mid river char land. however discussion with the people having land rights in the area has indicated that they recognise that prevention of main river bank erosion is of a much higher priority than preserving unstable newly accreted island chars.

Environmental risk assessment

Due to the fact that the proposed intervention uses technology that is new to Bangladesh, it is considered imperative to retire the existing embankment as a matter of great urgency, irrespective of the proposed erosion control intervention. Such a step will also act as a contingency if the intervention were to prove unsuccessful. In addition it is considered wise to carry out a flood proofing programme for those households in the area that was behind the old embankment but will now be on the unembanked side of the retired embankment.

Environmental monitoring

There will be a need to regularly monitor erosion and accretion patterns in the area using time series satellite imagery, supported by ground truthing. Such work will indicate the effectiveness of the intervention and also any induced impacts on navigation and particularly induced erosion to the mid-channel island chars.

CONCLUSIONS

The main conclusion of the environmental assessment is that an Initial Environmental Examination is sufficient for the project and falls within the requirements of the Department of Environment EIA Guidelines. A full EIA with quantification and valuation is not required. It is apparent that the benefits of successful implementation far outweigh the potential negative impacts, all but one of which can be mitigated for at an acceptable cost, should they occur. It should be remembered that the primary aim of the intervention is to preserve the present situation.

The main potential negative impact is possible induced erosion to the large island char in the main river channel. However, even the people with land rights in this area agree that preventing erosion on the mainland is of a much higher priority.

RECOMMENDATIONS

The recommendation from the environmental analysis is for the intervention to go ahead as soon as possible. The initial trial of the vanes and screens has commenced and is due to be monitored once the 1998 monsoon water levels have fallen.

However due to the fact that the existing embankment is under immediate threat of erosion it is considered imperative that it be retired to the predicted 10 year erosion line, preferably by upgrading an existing road alignment, so as to minimise the negative impacts of land acquisition. In addition a programme of homestead flood proofing should be instigated in the areas on the non-embanked side of all retired embankments.

The main mitigation measure that could be required is to construct two boat centres for navigation, assuming that the Pilot Schemes are successful and any resulting accretion creates problems with boat access to the eroded end of the embankments which act as ghats and fish markets.

A monitoring programme for identifying and quantifying induced erosion and accretion patterns needs to be established using time series satellite imagery in a similar manner to that used for analysing historical erosion patterns for the present studies. The analysis should include the large emerging char in the main river channel.

A construction impact monitoring and management programme should be implemented using the checklist attached as Appendix E.

FUTURE ENVIRONMENTAL WORK PROGRAMME

It is proposed that the recommendations given above would be implemented as part of the on-going project activities. The monitoring programme for erosion and accretion patterns is a continuation of the existing studies and would be used to observe the effectiveness of the intervention and identify the need for mitigation measures, particularly the provision of boat centres for waterborne navigation. The monitoring will also indicate if induced erosion to the large island char is taking place, prevention of which is not possible but consideration may need to be given to the resettlement and livelihood needs of people seasonally resident there. The management of any direct construction impacts should be implemented as part of normal engineering supervision using the checklist given in Appendix E.

1 PROJECT SETTING

1.1 Background

The Haimchar Erosion Control Project is one of the three selected priority projects of the Meghna Estuary Study (MES) to be taken to Feasibility Study. The location of the area within the MES area is shown in Figure V.1 and a map of the project area is given as Figure V.2. The previous Land Reclamation Project (LRP) identified a major constraint to addressing the two major issues in the area, namely erosion and land accretion, in that traditional engineering techniques were prohibitively expensive. The MES has thus identified and is now testing new techniques for erosion control and accretion promotion using geotextile materials. For erosion control works the methods include suspending geotextile spurs vertically under water, a technique that is new to Bangladesh. The project at Haimchar is being used as a trial for these new techniques. Some of the geotextile components were put in place just prior to the 1998 monsoon, with the aim of monitoring their effectiveness during the monsoon period. Depending upon the results of the trial, then the complete intervention could be considered for construction starting after the monsoon and cyclone seasons, around November 1998. An environmental scoping for the use of geotextile screens for erosion control trial was undertaken as part of the environmental component of the MES in 1997. The conclusion from this assessment was that there were no major environmental objections that could prevent such trials from going ahead.

1.2 Aims and objectives of environmental assessment

The aim of the environmental assessment component of the MES and associated Feasibility Studies is to ensure that environmentally sound project planning and implementation takes place. Environmental assessment covers both the natural and human environment, their interaction and how this relationship is changed as a result of any proposed intervention. Environmental assessment aims to identify, and if possible and necessary, quantify and value predicted impacts of any proposed intervention, both positive and negative. As part of the philosophy of environmentally sound and sustainable development all negative impacts are to be identified and if possible avoided, minimised and/or economically mitigated for. The costs of mitigation are to be included in the economic and financial assessment of the proposed intervention. The overall aim is that no person is to be made worse off as a result of the intervention, although in the context of the population densities and social complexity of Bangladesh this is normally hard to achieve. A more realistic aim is to ensure that, at the minimum, the predicted positive impacts far outweigh the negative ones.

1.3 Legislative framework for EIA in Bangladesh

The Terms of Reference for the MES state that the environmental assessment procedures to be followed for the study are those given in the FPCO/WARPO EIA Guidelines (Ref: FPCO, 1992). These Environmental Impact Assessment (EIA) Guidelines follow the spirit of World Bank Operational Directive 4:01 (Ref: World Bank, 1991) which has become the international standard for such work. There is also a manual for EIA for the water sector in Bangladesh that was produced by ISPAN (Ref: ISPAN 1995a) as part of the Flood Action Plan (FAP), which supports the EIA Guidelines.

The recently enacted Environmental Conservation Rules of Bangladesh (Ref: Abdus, 1998, Chapter III of which contains a translation into English of the Rules which were published in Bangla in the Government Gazette of August 1997), contain the Ministry of Environment and Forest legal procedures for EIA as allowed under the Environmental Conservation Act of 1995. The Act delegates the Department of Environment as the responsible body for enforcing EIA. The overall policy objectives for environmental management in Bangladesh were contained in the National Conservation Strategy (NCS) and these were formulated into an implementation strategy as part of the National Environmental Management Action Plan (NEMAP). The Environmental Rules give the criteria for grading different types of proposed interventions by likely severity of impact and the steps required for the granting of Environmental Clearance Certificates.

Figure V.1: Project Location Map

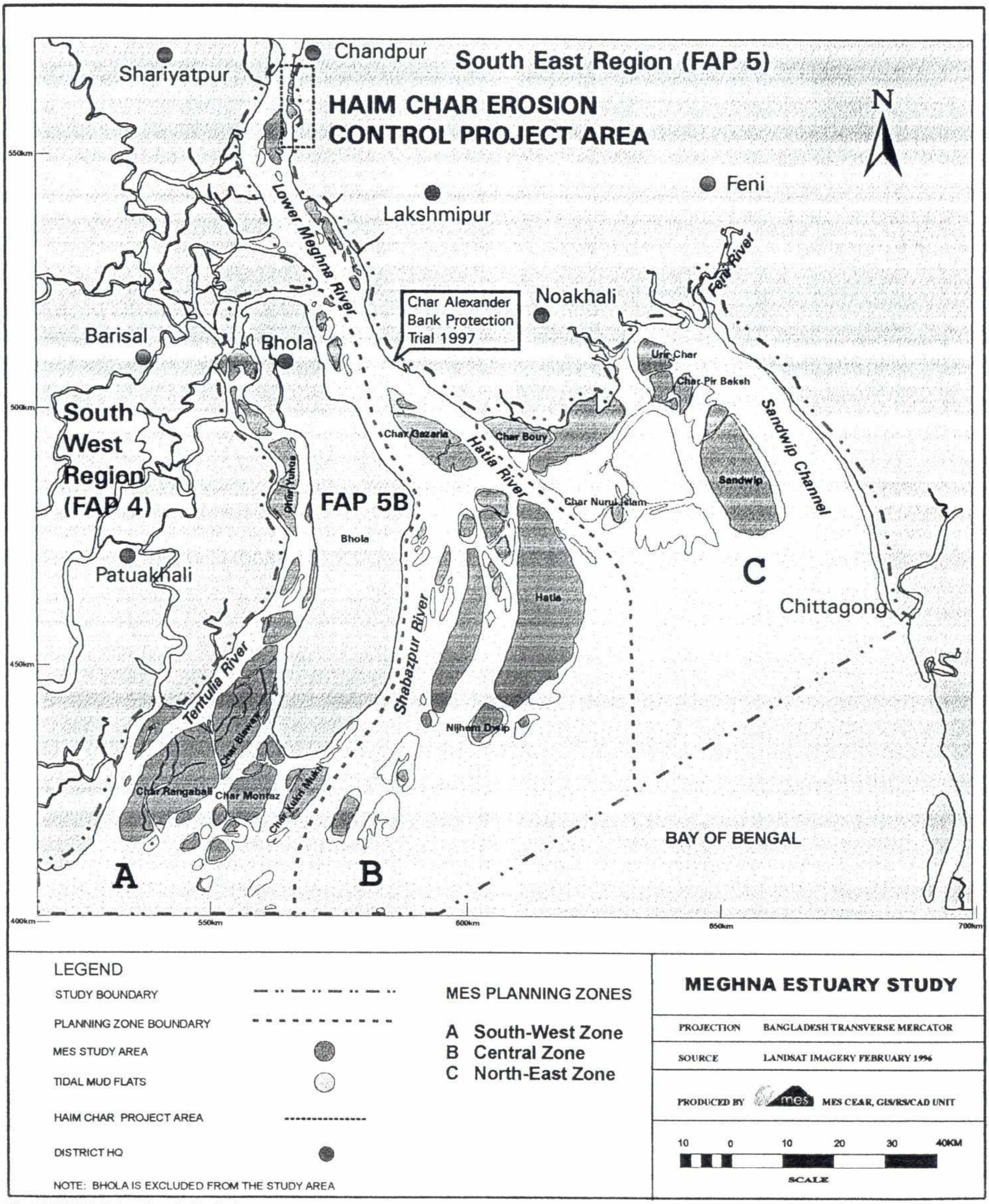

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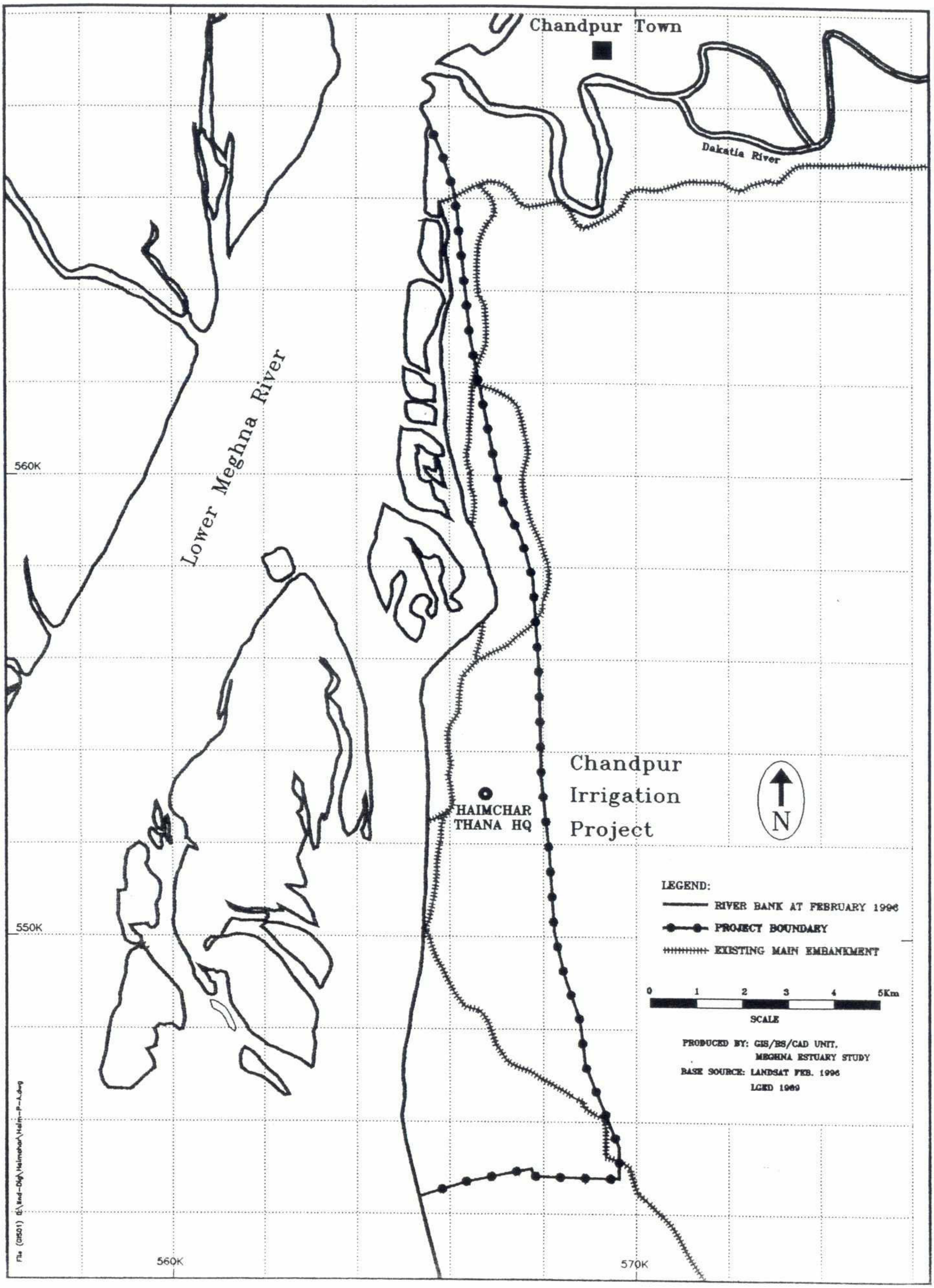
Figure V.2: Project Area Map



The DoE procedures have recently been outlined in more detail in the DoE EIA Guidelines for Industries (Ref: Department of the Environment dated June 1997) which, despite its title, covers water sector interventions, including flood control embankments, polders and dikes, water supply and sanitation programmes, as well as roads and bridges.

Under the Environmental Rules it is not absolutely clear which category the proposed Haimchar intervention would fall under, as apart from the fact that the legislation has been primarily drawn up for dealing with the construction of new industrial operations, the four part classification by severity puts all water related interventions in the most severe class with the one exception of water treatment plants which manage to appear in two classes. Within the most severe Class D (Red), Section 66 includes all flood control embankments, polders and dikes (sic), both their construction, reconstruction and extension. There is no specific section within which the proposed intervention of erosion control using submerged geotextile spurs obviously fits. The situation is further complicated by the fact that the primary aim of the proposed intervention at Haimchar is to retain the present situation by preventing future bank erosion. That is the intervention is specifically designed to produce no environmental changes over the current situation.

The implications of how the Haimchar project would be classified are of great importance when it comes to deciding which EIA legal procedures should be followed. A further complication is that the trial was planned before the legislation was enacted and has been part implemented without following the legal procedures which are now in place but untested. The two most sensitive EIA classes, Category Amber (Orange in one translation) B and Category Red both first require an Initial Environmental Examination (IEE) to be carried out. Then, depending upon the evaluation of the DoE, it may be necessary to carry out a full EIA for the Red Category, even before an Environmental Site Clearance Certificate can be granted. A No Objection Certificate from the Local Authority is also required before a full Environmental Clearance Certificate can be granted by the DoE and this lasts a year and has to be renewed annually.

In view of the uncertainty that the recent legislation has created, it has been decided to carry out an IEE for the proposed intervention, which will be submitted for review by BWDB and WARPO and then subsequently passed on to the DoE, as required in the legislation. Depending upon the conclusions of the DoE, then an Environmental Site Clearance Certificate my be granted. However before a full Environmental Clearance Certificate could be issued a No Objection Certificate would be needed from the Local Authority. The needs assessment carried out by the MES in the Haimchar project area indicates that granting of a No Objection Certificate should not be a major problem as the proposed intervention was overwhelmingly rated the top priority by all social groups in the area.

Potential donors other than the World Bank also have their own EIA Guidelines, but by following the FPCO/WARPO Guidelines it is normally the case that most donor requirements will be satisfied. The Asian Development Bank (ADB) Guidelines (Ref: Asian Development Bank, June 1991 and November 1991) are arranged by the sectoral nature of the proposed intervention and this can cause great confusion when an intervention cuts across different sectors. The European Commission have their own Directive, DG VIII, (Ref: European Commission, 1995?) and the EC's Country Office in Dhaka have put out their own notes for EIA (Ref: European Commission, Dhaka, June 1996). It is assumed that by following the FPCO Guidelines as far as is practical and appropriate then the environmental assessment will be considered adequate by the two donor governments of the MES.

This IEE report has been drawn up to be a self standing document to allow for external review by other Government Departments and potential donors, without having to extensively refer to the main Feasibility Study report. A summary of the IEE has been abstracted and presented as Section 7 of the main Haimchar Feasibility Report.

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1.4 Methodology for IEE

As stated above, the IEE follows the methodology outlined in the WARPO EIA Guidelines (Ref: FPCO, October 1992) and the ISPAN EIA Manual (ISPAN, April 1995a). The experiences of other studies in preparing EIA documentation for the water sector have also been reviewed.

The IEE includes impact identification and any necessary mitigation requirements for predicted negative impacts, but stops short of quantification and valuation as the conclusions, even by that stage of the analysis, were overwhelming that the central aim of the proposed intervention is to keep things as they are at the present. Put bluntly the intervention aims to prevent the negative impacts of on-going erosion and for this reason it is considered that an IEE is perfectly adequate and a full EIA is not required. The benefit analysis of the proposed intervention given in the Haimchar Feasibility Study looks at the losses that will occur if the proposed project is not implemented or fails to be effective. The results of the IEE can be fed into a multi-criteria analysis following the format of the Guidelines for Project Assessment (GPA - Ref: FPCO, May 1992, modified with a new Annex 1 in March 1994). The GPA methodology relies heavily upon agricultural benefits to justify interventions. As the aim of the proposed intervention is to reduce erosion to agricultural land the methodology of the GPA is considered appropriate.

1.5 Scope, resources and limitations of the IEE

The original Terms of Reference for the MES were drawn up in 1992 before most of the procedures and EIA guidelines for the FAP were in place. The inadequate discipline cover and restricted man months for international specialists were noted in the Inception Report (Ref: DHV consultants BV et al, April 1996) and proposals made to address this to some degree by providing inputs from specialists in forestry, fisheries and livestock. However there was no provision for a full time international Deputy Team Leader position with specific responsibility for non-engineering issues, a post which has been found desirable on most integrated regional studies for the water sector in Bangladesh. The result is that some difficulty was experienced in maintaining continuity of supervision of the work.

The non-engineering components of the MES were only fully mobilised by the beginning of March 1997, and even then the fisheries and forestry international specialists could not be started, as formal approval of the Inception Report (Ref: DHV Consultants BV et al, April 1996) and the revised Terms of Reference had still not been given over one year after submission. There was discipline cover with local specialists in broad environmental issues, soil and land resources, agriculture, forestry, fisheries, socio-economics, participation, economics and general rural development. In addition the work on coastal morphology (specifically erosion prediction), climatology, bathymetry, remote sensing and GIS was fed into the environmental assessment component. However the international staffing inputs of these components were not continuous and ensuring adequate supervision and co-ordination was at times problematic.

It is now generally accepted in Bangladesh that any primary data collection for environmental assessment normally requires a set of seasonal data to be collected over a 12 month period, particularly for issues concerning the natural environment. However due to the nature of the proposed intervention at Haimchar this was not a constraint, as the initial environmental scoping showed that the main requirement was for quantification and valuation of existing physical infrastructure that would be lost to erosion. The most important data set underpinning the whole environmental analysis is the delineation of predicted erosion extents by the years 2010 and 2025 shown in Figure V.11 and Table V.2.

1.6 Interface with other study components

An inter-disciplinary approach was followed for the non engineering components of the study, covering the subject areas indicated above. A logical framework analysis was also developed for the overall MES which demonstrated what data was needed at which stage to allow rational decision taking for the planning process. The environmental assessment work was carried out as a component within the overall framework of the MES. For the Haimchar IEE all work was carried out in a fully integrated manner with staff jointly visiting the field for data collection.

1.7 Layout and format of the IEE report

The layout of the report follows the contents list in Chapter 6 of the EIA Manual (Ref: ISPAN April 1995a), as far as is possible and sensible for an IEE in a coastal area.

1.8 Acknowledgements

During the course of the work many people have been consulted at all levels of society, in Dhaka, at Regional, thana and union level and also on the site. In addition a large body of knowledge was already held by staff working on the study due to their previous activities on similar studies in the country, particularly those in coastal areas and under the FAP. A listing of contacts and liaisons is given in Appendix D.

2. THE PROPOSED INTERVENTION

2.1 Regional planning framework

The MES area forms a sixth regional study started under the Flood Action Plan, but has been assigned the number 5B. The MES area interfaces with the South West Regional Study (FAP 4) and the South East Regional Study (originally FAP 5, now reassigned 5A), the boundaries of which are shown in Figure V.1.

The overall aim of the MES is to draw up a 25 year phased land and water development programme for the area based upon an understanding of the present environmental conditions, likely future trends and identification of environmental constraints to development. The work already carried out for the MES clearly demonstrates that erosion and accretion patterns are the two most significant variables determining the availability and human use of the resources in the MES area. The mapping of erosion and accretion trends carried out by the MES, using time series satellite imagery for the last 23 years in six year increments, has allowed those areas of continuous erosion and continuous accretion to be identified. The mapping forms a major source of information for identifying appropriate potential intervention types and locations.

The analysis of the erosion and accretion mapping indicates that the Haimchar area is one of the most consistent areas of continual erosion in the last 23 years. The defined extent of the Haimchar Project area is shown in Figure V.2, the eastern boundary having being delineated by the predicted erosion limit of the bank line in the year 2025.

2.2 Previous studies

River bank protection and erosion studies have been carried out for other programmes in the water sector in Bangladesh, particularly under the Flood Action Plan. These studies and trials include FAP 21/22 at Bahadurabad ghat on the Jamuna (Ref: Rhein-Ruhr et al, June 1993), the Brahmaputra Right Embankment at Sariakandi under FAP 1 (Ref: Halcrow, July 1992) and Meghna River Bank Protection under FAP 9b which included Chandpur town and Haimchar. The FAP 9b work also included a preliminary environmental scoping exercise. The conclusion of the Haimchar work under FAP 9b was that the intervention cost would be high and the economic internal rate of return was very low at around 3 per cent (Ref: Haskoning, 1992). In addition the issues surrounding the revetment of coastal embankments were studied as part of FAP 7 (CERP) and the environmental issues connected with construction of such embankments were studied by the environmental component (Ref: Bird, October 1993).

The results of these studies have indicated that the technical feasibility of such works can be problematic and the capital costs are very high, unjustifiably so for just preventing erosion of agricultural land. The aim of the proposed works at Haimchar is to test new, less costly techniques using geotextiles, which if successful could allow cost effective bank protection measures to be undertaken in Bangladesh.

The Haimchar project area lies within the area of the Chandpur Irrigation Project (CIP) which became fully operational in 1979. An assessment of the effectiveness of the CIP was carried out in 1990 (Ref: Thompson, 1990) and in addition the Systems Rehabilitation Project (SRP) carried out an assessment of CIP during the mid 1990's. As part of the SRP assessment the Surface Water Modelling Centre (SWMC) produced a detailed hydro-dynamic model of the CIP area to identify shortcomings in the hydrological design of CIP, particularly flooding inside the constructed embankments caused by inappropriate design and poor water management. The model was used as a tool by the SRP to draw up criteria for operation of the CIP, particularly taking into consideration local people's experiences. Evaluation of similar Flood Control, Drainage and Irrigation projects (FCD/I) was undertaken under FAP 12/13, although this did not actually include the CIP. The broad conclusions of Thompson's work on the CIP were that, whilst the actual economic rate of return achieved by the project was significantly lower than that predicted (5 per cent) and for which the economic calculations were carried out for, overall the project was beneficial. There were significant losses of flood plain fisheries caused by the construction of embankments which prevented migration, but significant aquaculture had also been developed inside the embankment, often using the borrow pits created by the construction of the embankments.

It is significant to note that in the 1988 floods the CIP embankment did not fail (probably because it had been retired early enough), unlike that at Meghna Donagoda where embankment failure resulted in longer flooding than if there had been no embankment.

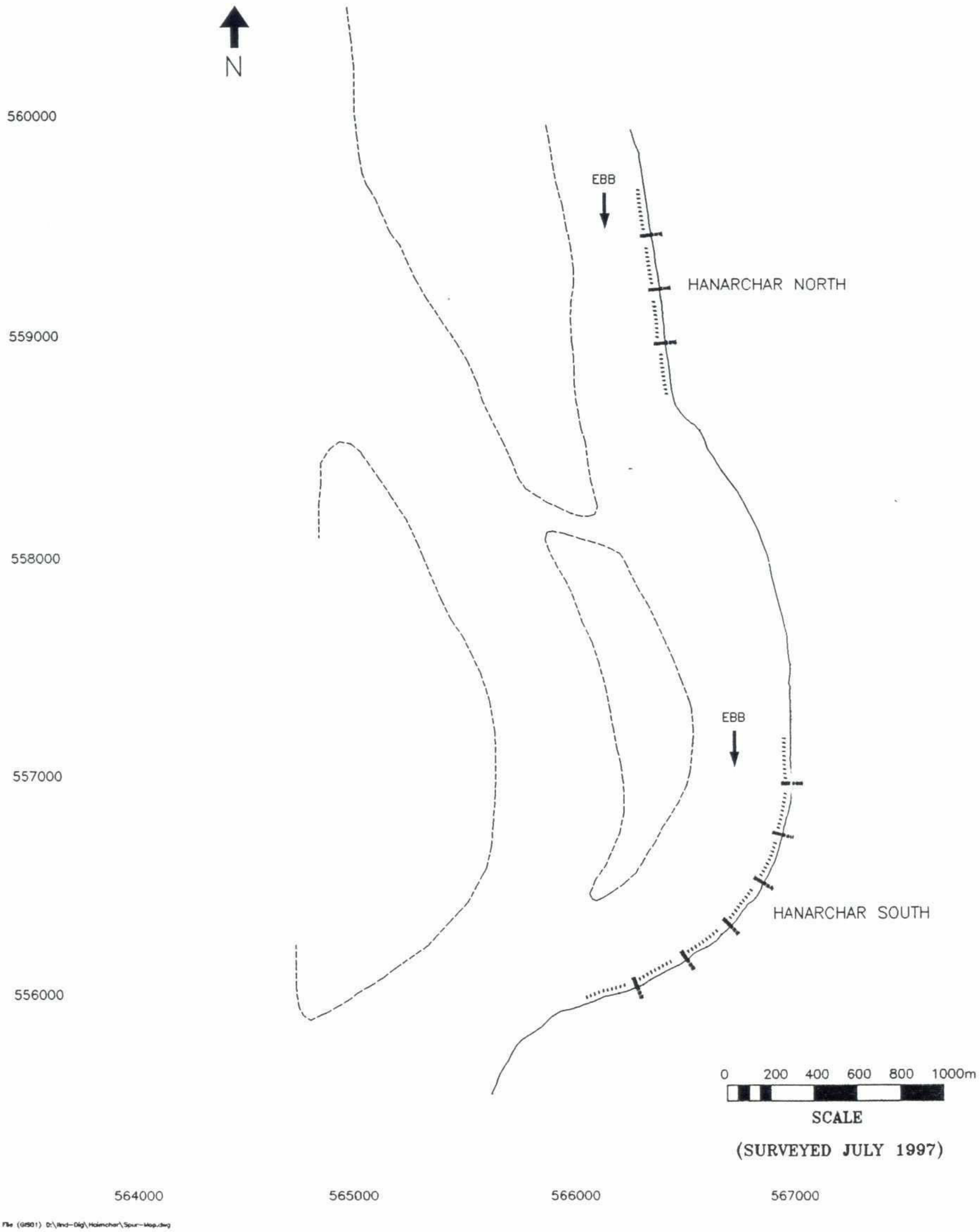
2.3 Trial interventions and pilot schemes

Within the framework of the MES, trial interventions and Pilot Schemes are to be identified and tested, alongside the drawing up a 25 year phased development programme for the area and identifying three Feasibility Studies and three Pre-Feasibility Studies. The Haimchar Erosion Control Project has been selected as one of the three Feasibility Studies, the area falling within one of the MES Planning Units (number B4) selected for commencement of interventions within the planning period year zero to five.

An initial trial of the geotextile techniques for bank protection and erosion control works was carried out in the 1997 monsoon at a location further downstream of Haimchar, on the left bank of the Lower Meghna at Char Alexander (see Figure V.1). Unfortunately the trial at Char Alexander failed so an alternative Pilot Scheme with different conditions was identified at Haimchar. The situation at Haimchar is different than Char Alexander in that at Haimchar a string of island chars is developing, both close to the river bank and further into the main river channel.

The Pilot Scheme at Haimchar commenced with the placement of some geotextile spurs and screens after the cyclone risk time of April and prior to the start of the 1998 monsoon season as shown in Figure V.11b. An initial environmental scoping of the proposed technique was undertaken in early 1997 and concluded that, as the aim was to preserve the present situation, there were no significant negative environmental impacts that would undermine the validity of the trial.

Figure V.4: As constructed Pilot Project



2.4 Alternatives

As discussed above, various studies have looked at the possibilities for bank protection in Bangladesh, both on inland rivers and the coast. The overall conclusions were that costs are often very high and difficult to justify, especially for areas which are just agricultural land. The alternative scenario in such situations is to accept that such erosion will occur and plan an organised "phased retreat" from the area to be eroded, including the provision of replacement public infrastructure. In conditions like Haimchar such a programme would include the retirement of flood embankments and the flood proofing of homesteads that subsequently found themselves to be on the river side of the retired embankment. Such a policy has been covered in the broad category of "erosion management" for the MES when looking at overall intervention possibilities. An environmental scoping of such an intervention has already been carried out and is presented in the MES Interim Development Plan (Ref: DHV, December 1997).

The other alternative scenario is for government to do nothing at all about bank erosion, expecting local people to provide their own responses to such conditions. People's responses include such measures as moving their homesteads to safer locations (normally adjacent remaining embankments) and finding replacement economic livelihoods for those that may have been lost. The comparative environmental analysis carried out for the Haimchar IEE compares the successful outcome of the proposed intervention with the future do nothing situation.

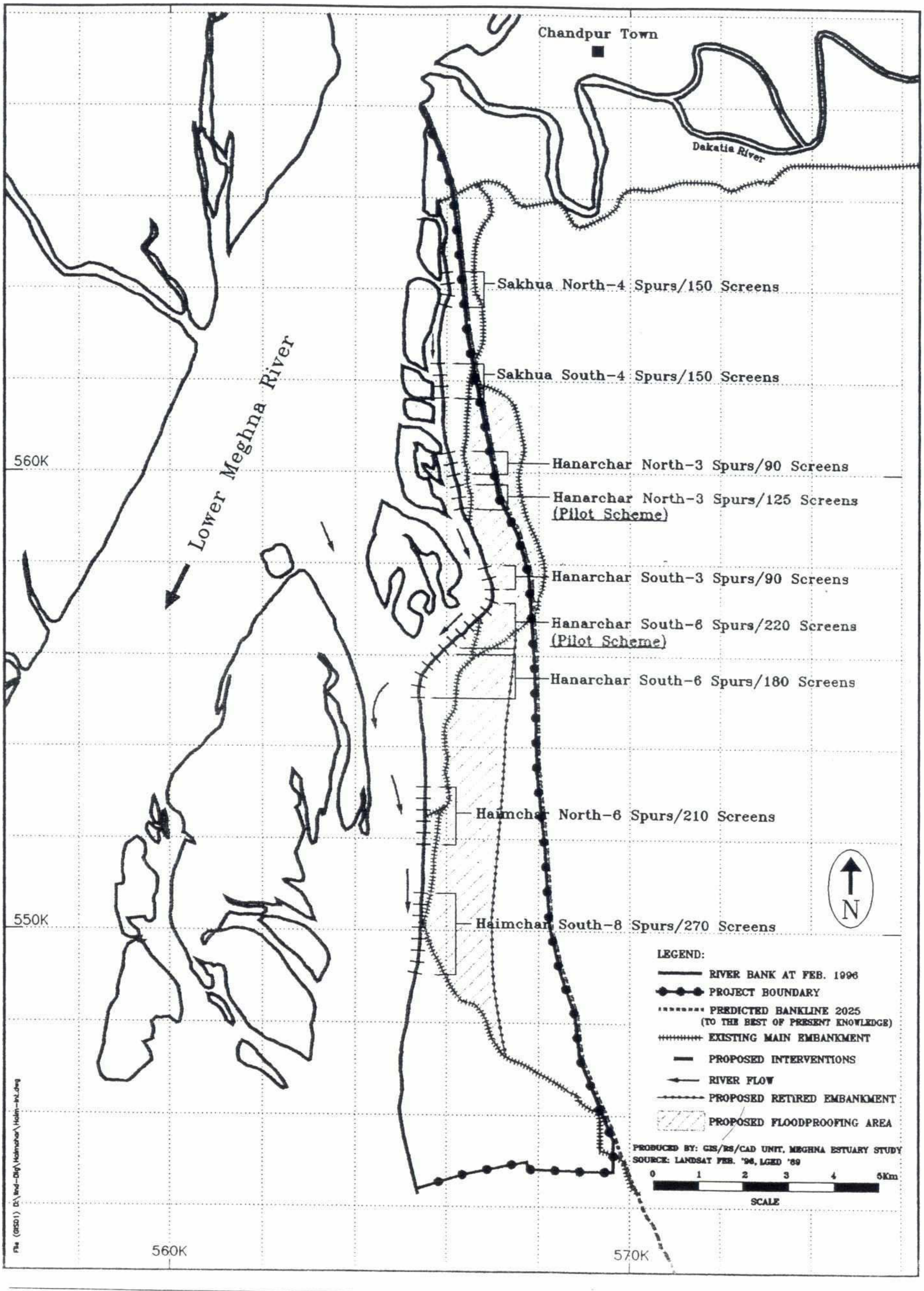
Due to the fact that the proposed intervention is a trial of new technology never used in Bangladesh before, it is considered imperative that a least risk strategy is followed. There is no guarantee that the trial will be successful so it is imperative that the BWDB continue with their planned embankment retirement programme, irrespective of the Haimchar intervention. Specifically the present embankment needs to be retired as a matter of great urgency to the alignment of the predicted 2010 year erosion line. In order to minimise the potential land acquisition, compensation and resettlement requirements and costs it is best to try and upgrade an existing road alignment roughly at the 2010 predicted erosion location. Such measures would achieve such risk minimisation in the most cost effective manner.

2.5 The proposed intervention

As part of the scoping exercise carried out in the project area, and also for the IEE, a needs assessment was carried out amongst local people to establish what were their development priorities. The needs assessment data was collected from 112 people, split by different social groups, including women as a separate group. The results of the needs assessment are given in Table V.1. The conclusion is that the control of main river bank erosion was the highest priority need for all social groups within the project area, even those with land that had already been eroded away and the re-emergence of which may be prevented by erosion control measures. The second highest priority was for the accretion of more land followed by provision of sanitation, health, water supply and education facilities. The risks posed by rainfall flooding, salinity intrusion and cyclones were not considered great and, unsurprisingly, measures to deal with such situations were rated a low priority by local people. There were no significant differences between social groups.

The nature and location of the proposed intervention is given in Figure V.11, which also defines the project area by the predicted limit of erosion in the year 2025 assuming no intervention. In addition the project area has been sub-divided into the land predicted to be eroded by the year 2010. The predicted 2025 erosion line also constitutes the eastern boundary of the defined impact area from which benefits are likely to obtained, due to the fact that a successful intervention will prevent loss of land and immovable assets up to this point, along with a reduction in subsequent livelihood loss. For impact analysis the western boundary of the potential impact area includes the island chars in the main river channel.

Figure V.3: Proposed Interventions



The aim of the intervention is to prevent future river bank erosion by using submersed geotextile spurs and bottom screens to divert river flow away from the existing bank and also to promote land accretion by trapping sediment. The advantage of this technique is that it is far less costly than traditional revetment works, erection can be carried out from a barge and it requires no major land acquisition as the spurs are anchored in the edge of the channel and are always under water. The full proposed intervention comprises 43 spurs and 1,485 screens of which the trial comprises 9 spurs and 345 screens in two locations (see Figure V.11a and Figure V.11b).

Due to the fact that the existing embankment is under immediate erosion threat at Haimchar, it is considered imperative that it be retired to the 2010 predicted erosion line. Such a step is considered necessary, irrespective of the fact that if the proposed intervention were immediately successful then the retired embankment may be redundant. A prudent approach needs to be observed, bearing in mind that the proposed technique has never been used before in Bangladesh. In order to minimise the land acquisition, compensation and resettlement requirements of embankment retirement, consideration should be given to upgrading the existing road alignment east of the predicted alignment as an embankment. In addition those areas which were previously on the landward side of the existing embankment but will be on the river side of the retired embankment should be considered for homestead flood proofing along with all other homesteads which lie on the river side of the present embankment.

3. DESCRIPTION OF THE EXISTING ENVIRONMENT

Baseline data collection for both the natural and human environment has been carried out for the Haimchar project area to allow identification of the existing environmental constraints and also likely future trends. This baseline data also provides the framework for identification of likely Important Environmental Components (IEC's). In addition the likely impacts of the proposed intervention, both positive and negative, can be identified and the data used to assess their importance and, if necessary, quantify and value them.

3.1 Natural physical environment

3.1.1 Topography and bathymetry

The best available base maps for the area are the LGED 1:50 000 maps, derived from SPOT satellite imagery, and Landsat imagery of February 1996, as the latter gives the latest bank line locations. However these data sources do not have topographic information on them and the best available level information is from the Survey of Bangladesh and BWDB carried out for the Chandpur Irrigation Project. A digital elevation model was developed by the SWMC for the SRP hydro-dynamic modelling of the CIP. The 1:10 000 Finmap topographic maps of the coastal area of Bangladesh do not cover as far north as the Haimchar area.

The Rennall's map of 1776 covers the Haimchar area and Chandpur town is clearly marked on it. At that time there was a large island char due west of Chandpur and the river was split into two channels. For 10 km south of Chandpur the bank line would seem to have been roughly where it is now, but south of this 10 km point the river was much further east of its present location. However the 1914/6 map from the government gazetteer, shown in Figure V.5, shows that for 22 km south of Chandpur there was land up to 8 km west of its 1996 location, most of which looks to have been densely settled.

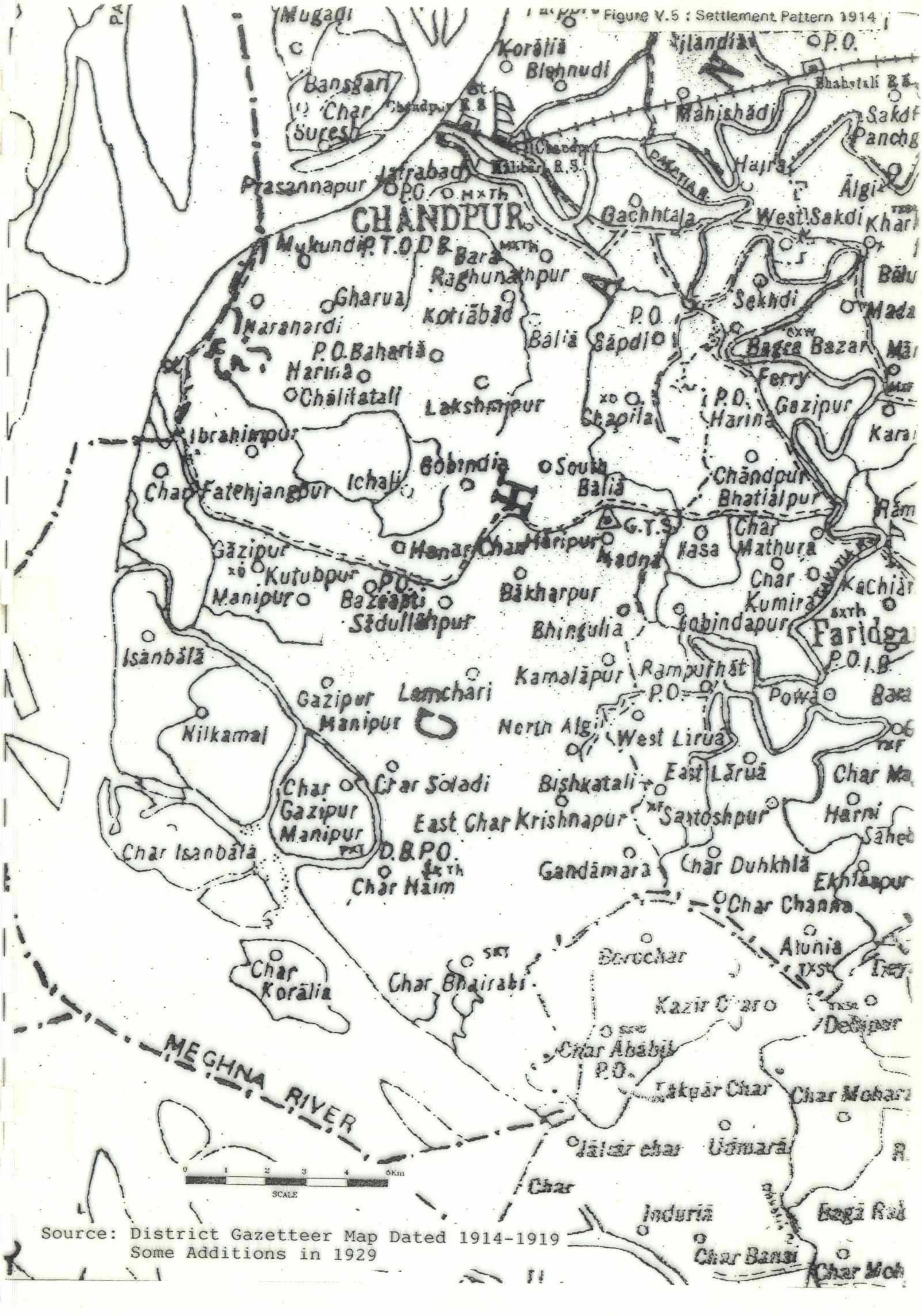
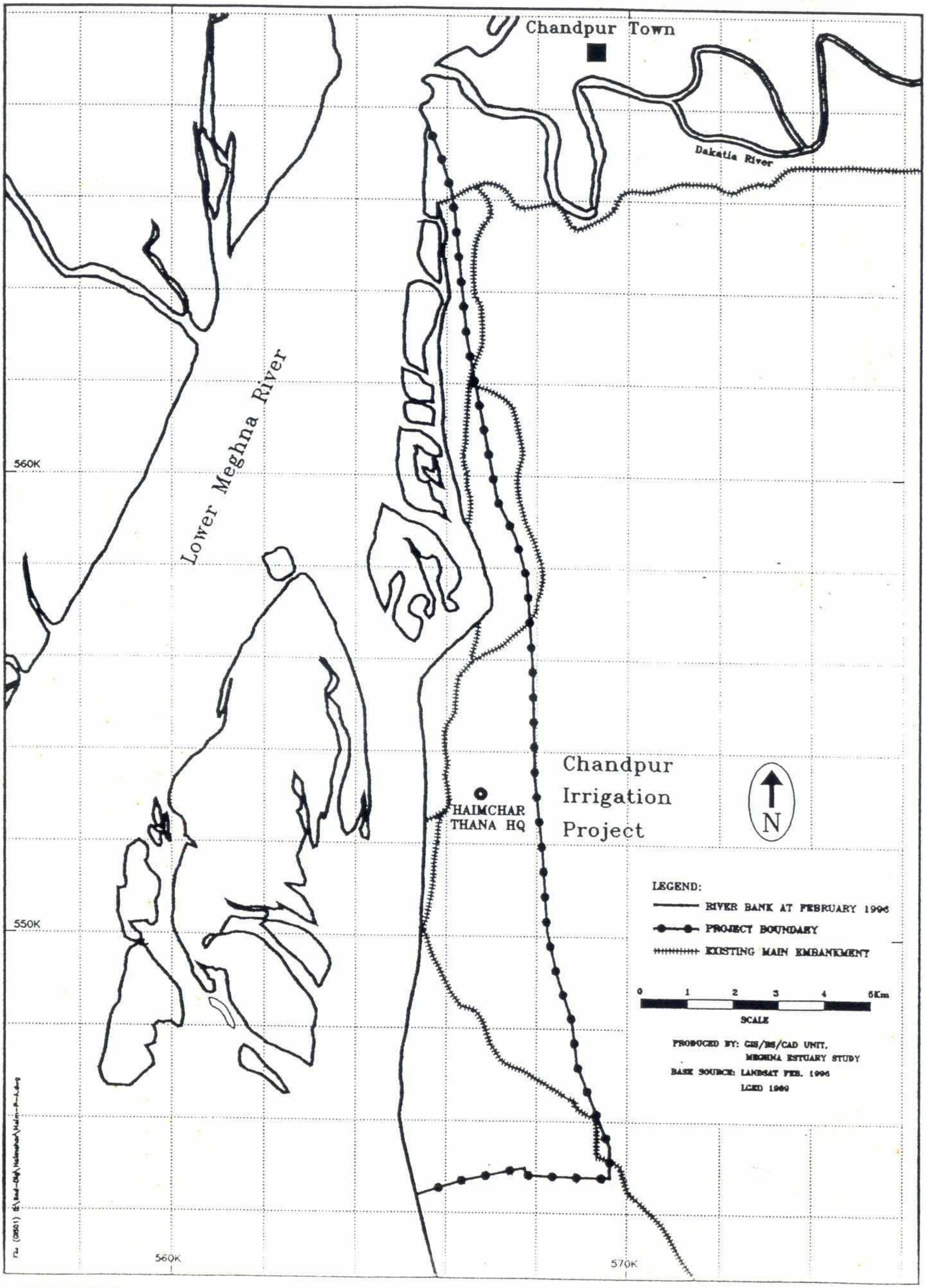


Figure V.5 : Settlement Pattern 1914

Source: District Gazetteer Map Dated 1914-1919
Some Additions in 1929


Chandpur Town
Dakatia River
Lower Meghna River
560K
550K
560K
570K
Chandpur
Irrigation
Project
N
HAIMCHAR
THANA HQ
LEGEND:
RIVER BANK AT FEBRUARY 1996
PROJECT BOUNDARY
EXISTING MAIN EMBANKMENT
0 1 2 3 4 5Km
SCALE
PRODUCED BY: GIS/RS/CAD UNIT,
MEGHNA ESTUARY STUDY
BASE SOURCE: LANDSAT FEB. 1996
LGED

3.1.2 Climate

The mean climatic norms for the area between 1962 and 1989, are shown in Figure V.6. The broad conclusions are that rainfall is significantly less in Chandpur (about 2100 mm per year) than in the true coastal areas such as Hatia and Noakhali, where the mean annual rainfall is in the region of 3600 mm per year. However the most important rainfall parameter with reference to flooding of agricultural land in the area is peak daily rainfall. Analysis from other parts of Bangladesh indicates that even in areas with similar annual rainfall to Chandpur, daily rainfall peaks can be as high as 250 mm and periods of three or four days with 150 mm rainfall a day are quite common. In such conditions the effectiveness of local rainfall run-off drainage is critical in preventing serious localised flooding, especially inside embanked areas. The Chandpur area does not normally experience significant effects from cyclones as it lies quite far inland. However the 1960 cyclone track was south to north straight up the Meghna river system and the severe 1970 cyclone passed west to east some 30 km south of the project area. Analysis of the cyclone simulation modelling indicates that in the 1970 cyclone Chandpur would seem to have been the point at which the tidal surge was held back by the flow of the river system.

3.1.3 Surface water hydrology

The most significant factor effecting water levels in the Meghna river at Chandpur are the peak monsoon season flows from the upstream river system, which can last for up to three months from early July to early October each year. The daily water levels for 1995 (considered to be a particularly wet year) are given in Figure V.7. The effect of both daily and lunar tidal cycles can be seen, but this is over-ridden by the seasonal variation in river levels brought about by the monsoon rainfall in the upper catchments of the Brahmaputra, Ganges and Meghna systems. Figure V.7 also clearly shows the effect of a cyclone surge in mid May 1995, a relatively late time for such an occurrence. "Normal" tidal range is about 1 metres but if a cyclone surge occurs at high tide during a spring tide and during the monsoon peak then the effect can be very significant, causing water levels to be some 5 or 6 metres higher than "normal" low flow conditions.

Surface water quality

As the project area lies a long way inland there are no significant surface water salinity problems. Since 1991 the Department of Environment have been regularly monitoring water quality in the Meghna at Chandpur, however the results are not as yet published. The Noakhali North Drainage and Irrigation Feasibility Study (Ref: Sir M MacDonald and Partners Ltd, October 1993), carried out as part of the South East Regional Study (FAP 5), also did water quality sampling in both the wet and dry season in the Meghna river west of Chandpur and 20 km upstream of Chandpur in the Dakatia river. The conclusions were that in November 1992 the Meghna river had significantly lower nitrate levels but higher phosphate levels than the ponds, Khals and floodplains on land. At this time there were also very high silica levels in the Meghna (a function of the Brahmaputra/Jamuna suspended sediment), but low levels of sodium chloride. Faecal coliform levels in the Meghna during November 1992 were high, like most open water in Bangladesh, but not as high as on the Dakatia river. For the dry season (February/March 1993) the nitrate levels in the Meghna river were higher than in the wet season. During the dry season EC levels were lower in the Meghna than on inland sites but silica levels were higher, but not as high as the wet season conditions in the main Meghna. Faecal coliform levels in the Meghna were even higher than during the wet season, probably because there are less dilution and dispersion effects due to lower flows.

Sedimentation, erosion and accretion

Erosion and accretion are the most important factors in the project area. Sedimentation levels in the river system are variable over time as the characteristics of the three main feeder rivers are very different. The highest sediment levels are in the Jamuna river, although the material is not fertile (Ref: ISPAN, June 1995). A time series analysis of satellite imagery has been carried out for the period 1973 to 1996 to map land extents. The conclusions are that the Haimchar main river bank has been under constant erosion during that time. Figure V.8 extends the bank line erosion analysis back to 1957 and Figure V.5 shows the alignment of the river bank in 1914 with the 1996 alignment superimposed on it.

Figure V.6 : Climatic Norms at Hatia 1962-1989

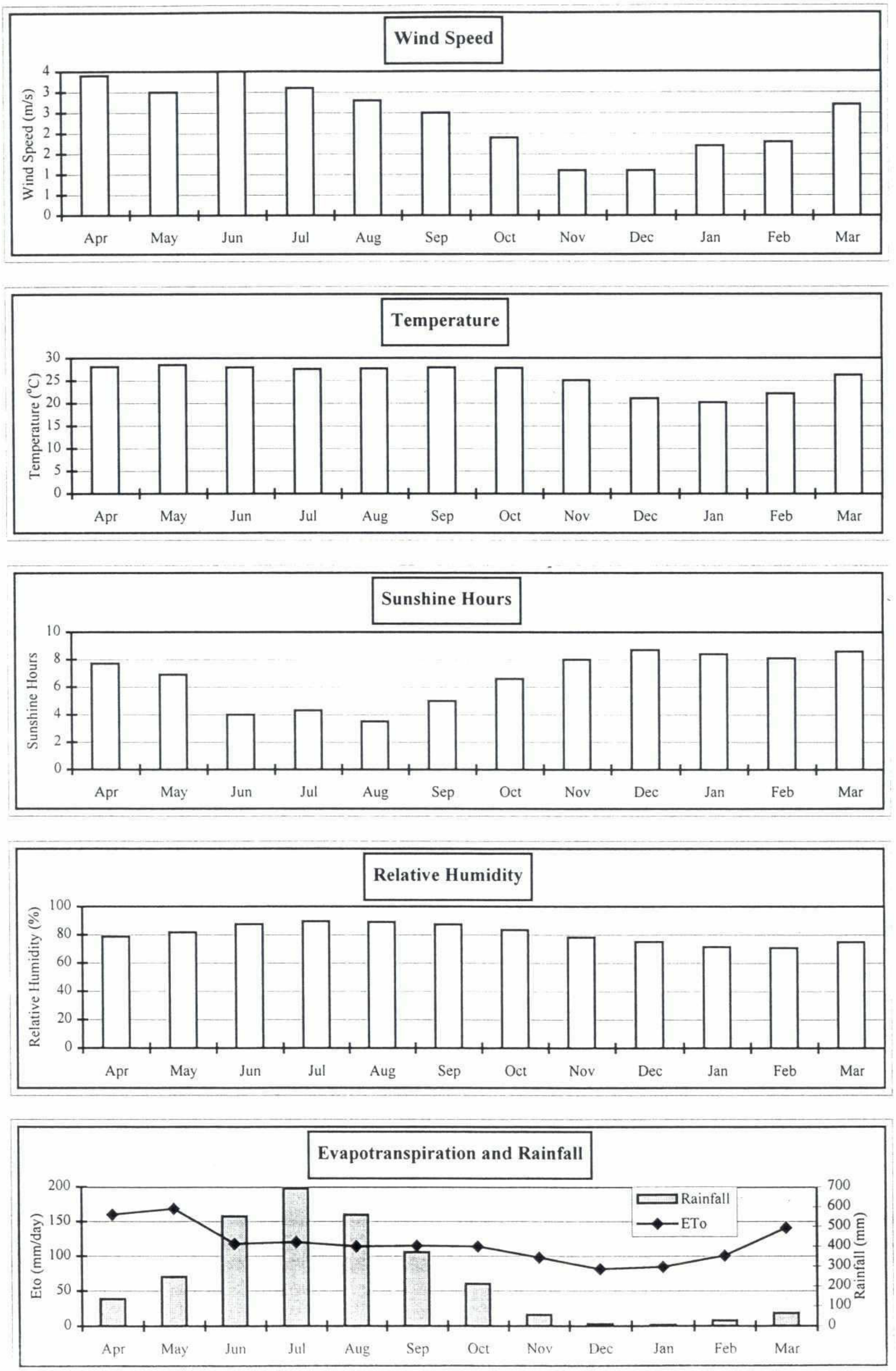


Figure V.7 :Water levels at Chandpur 1995

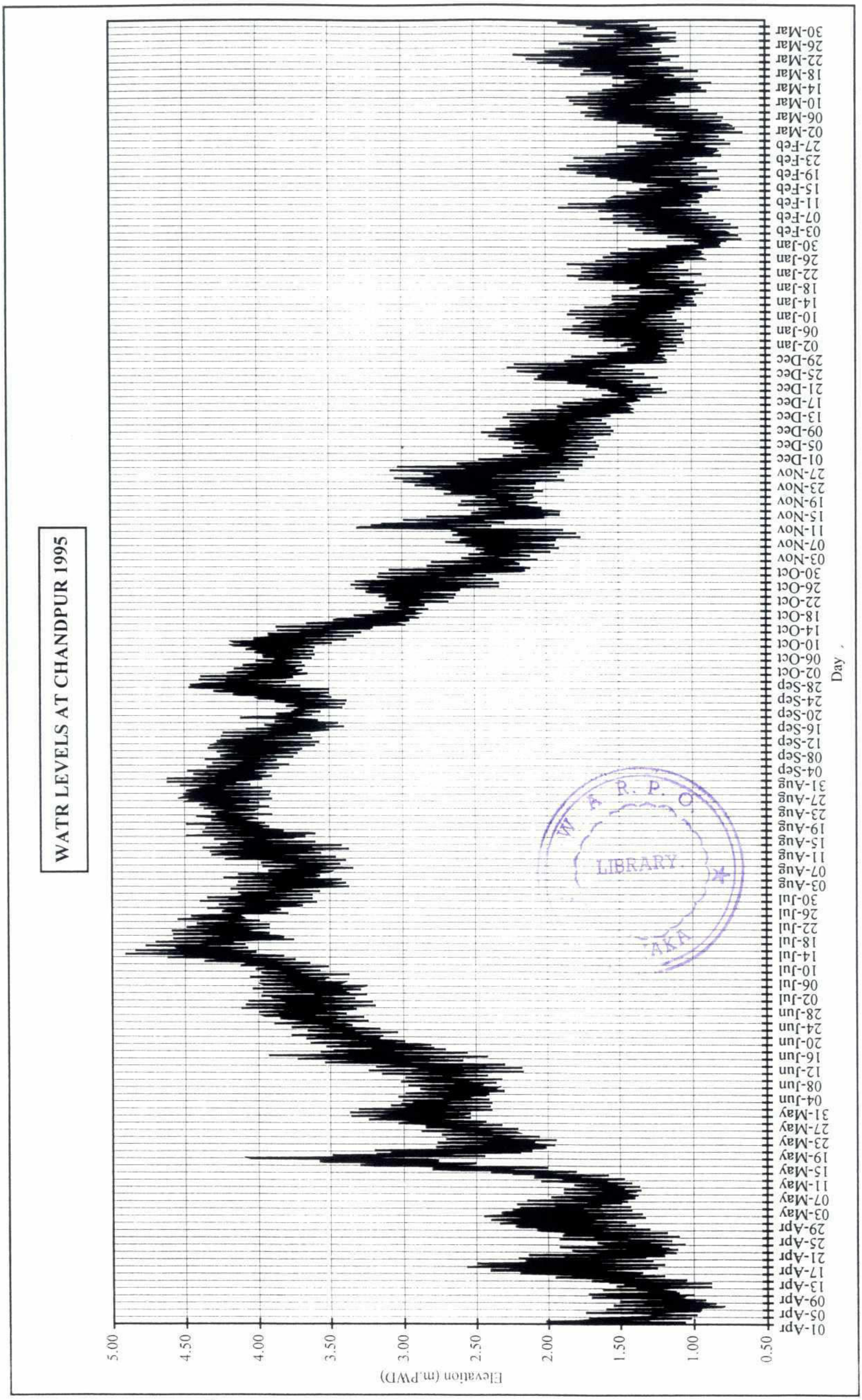


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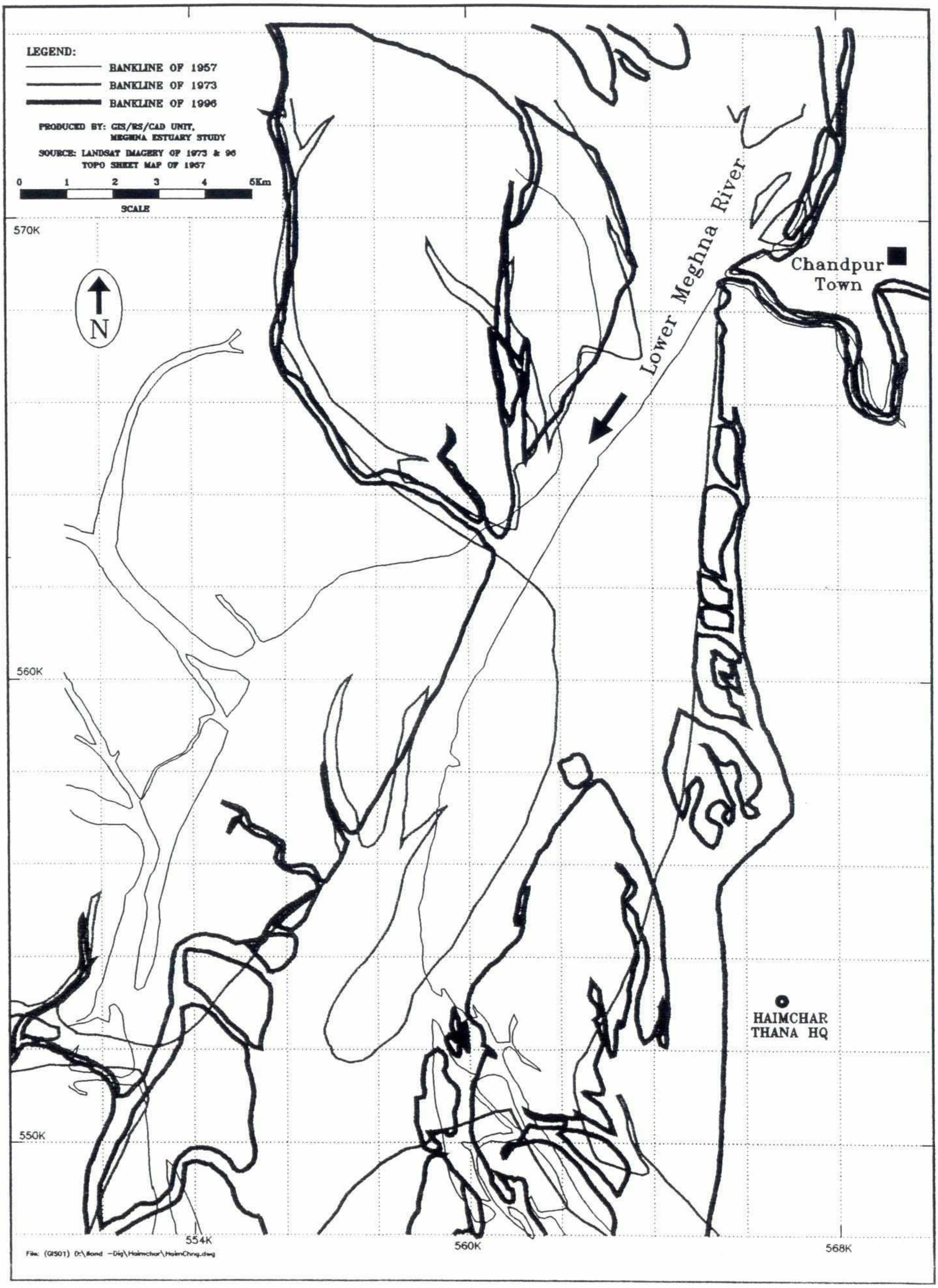
Figure V.8: River Bankline Change Map 1957–1996



The nature of the bank erosion can be seen in Plates 1 to 6. It can be seen that there are land areas now on the western side of the main river channel that in 1914 lay on the eastern side. However the Rennall's map of 1776 indicates that the left bank of the Meghna was in approximately in the same place as it is now for the reach 10 km downstream of Chandpur. Without maps of the intervening years it is difficult to make any interpretation except to say that the western part of the project area has probably accreted since 1776 and is now being rapidly eroded.

A significant recent trend is that a string of accreted islands is emerging off the river bank. The proposed intervention aims to control erosion by promoting this natural trend. The nature of the newly accreted land can be seen in Plates 7 and 8. In general these areas are low, have poor quality soil with high infiltration rates that can only be cultivated in the dry season and then using dry-land farming techniques. Many people who have long standing land rights in these areas occupy them seasonally and there is extensive use made of them for livestock grazing.

The broad prediction of erosion and accretion trends for the MES area has been made for the year 2025. The prediction is for main bank erosion to continue at the recent past rate. For the detailed Haimchar project area predicted bank lines have been given for 2025 (this line defines the eastern project area boundary) and an intermediate line for the year 2010. The predicted eroded areas are given in Table V.2:.

Table V.2 : Land erosion rates with and without the proposed intervention (ha)

Embankment Section by Change N-S	1996 - 2010 Outside Embankment	1996 - 2010 Inside Embankment	2011 - 2024 Outside Embankment	2011 - 2024 Inside Embankment	1996 - 2024 TOTALS
0 - 9km	261	0	467	0	728
Erosion per year	18.6	0	33.4	0	
9 - 21km	1381	571	378	1642	3972
Erosion per year	98.6	40.8	27.0	117.3	
TOTAL	1642	571	845	1642	4700

Source: MES Hydromorphological Studies, 1998

3.1.4 Ground water hydrology

All "safe" drinking water (defined as piped or hand pumped) in the Haimchar project area has to be obtained from groundwater, which bearing in mind the high levels of faecal pollution found in surface water is a benefit despite the natural arsenic pollution problem. The primary source of reliable groundwater is the second (middle) aquifer at a depth between 13 to 80 metres. There would appear to be good annual recharge. The Department of Public Health Engineering (DPHE) are the government institution responsible for such works and their monitoring has shown that there are problems with high iron, chloride and natural arsenic levels. Three iron removal plants were installed in Chandpur town to try and address the high iron content problem. The on-going studies into high arsenic levels in groundwater sources in Bangladesh have identified the Chandpur area as being a major concentration of cases. The pollution appears to be a natural occurrence due to the nature of the geological formation, made worse by rapid pumped extraction. The next step in the arsenic studies is to identify cost effective methods of reducing the arsenic levels. Clinical studies are also on-going to see the degree to which human health has been irreversibly harmed. Initial findings indicate high levels of skin disorders and cancers.

An important consideration is that the water source for nearly all irrigation in the area is from surface sources (by retaining monsoon flooding in drainage systems) and very little from groundwater. In the light of the arsenic problem that would seem to be very fortunate, although the reason for using surface water is probably the higher cost of pumped extraction from groundwater.

3.1.5 Land resources

The past and future predicted patterns of erosion and accretion have been discussed in Section 3.1.3 above. The implications for land resources are that relatively long established land (up to 200 years old) is being eroded away and is being replaced in time by newly emergent shallow char lands which have considerably less agricultural potential and are liable to seasonal flooding. The other major issue is that the main sediment source is the Jamuna/Brahmaputra river system and studies have shown that the sediment is not fertile (Ref: ISPAN, June 1995). Unlike most of the MES coastal areas there would appear to be no major soil salinity problem in the area, either from capillary rise in the dry season or from high river water inflow in the monsoon season in areas where the embankment has been broken by erosion.

3.2 Natural biological environment

3.2.1 Flora

A significant conclusion from similar studies in Bangladesh is that the main flora bio-diversity lies in areas of homestead vegetation. This has been confirmed by the work carried out on the nearby Noakhali North Drainage and irrigation Feasibility Study (Ref: Sir M MacDonald and Partners, October 1993). The most dense areas of such vegetation lie on embankments or raised areas where people have had their homes for a considerable length of time, are not prone to annual flooding and have planted economic trees. The areas where people displaced by erosion have (illegally) relocated on to the CIP embankment often have extensive planted vegetation and hence richer flora resources. However as there is a lack of fuel sources and population densities are high in some of these embankment areas, cutting of biomass for domestic fuel does take place. The cutting is especially a problem in areas with low levels of livestock ownership, as less animal dung is available for use as fuel, and also places with a large number of households with no agricultural land and hence no access to crop residuals for fuel or fodder.

3.2.2 Fauna

There would appear to be no threatened terrestrial fauna species in the project area. Gangetic Dolphins which are listed internationally as threatened, are however found in the Meghna river system. The biggest threat to dolphins is human persecution for medicinal use, not loss or change of habitat. Evidence from the Noakhali North Irrigation and Drainage Feasibility Study (Ref: Sir M MacDonald and Partners, October 1993), showed that fauna levels and bio-diversity are likely to be greater in raised homestead vegetation areas than in seasonally flooded lands. However some of the fauna may be pests (e.g. rats) and annual flooding which may have controlled their numbers in the past has been reduced by construction of embankments, resulting in an increase in peat numbers. There is anecdotal evidence that this is the case in the project area due to the construction of the CIP embankment.

3.2.3 Fish

By far the greater part of the project area is embanked and the construction of these embankments has prevented the recruitment of migratory species into any seasonally flooded areas and rivers inside the embanked area. For this reason there are unlikely to be any significant floodplain fish habitats in the project area. However Chandpur District has one of the highest catch per unit area ratios for river fisheries in the country (Ref: FRSS fisheries catch data). This may well be because inshore marine fish caught outside the area are landed at the main riverbank markets. The Meghna river is also very narrow at this point and is a very important fish migration route, so catch levels could be high, although there is likely to be significant over fishing and in the medium term fish resources are likely to decline significantly.

3.2.4 Ecologically sensitive areas

There would appear to be no major ecologically sensitive areas in the project area, although the newly emergent mud flats can provide habitats for wading birds and certain species of fish.

3.3 Natural hazards

3.3.1 Cyclones

As stated in Section 3.1.3 above the effects of cyclones in the project area are limited when compared to downstream coastal areas of the MES area. However the timing of cyclones in relation to both the daily and lunar tidal cycles, as well as the overriding effect of monsoon flooding river levels, means that in extreme conditions the effect of a cyclone can be an increase in water levels of 5 metres over the "normal". Figure V.7 clearly shows the effect of a cyclone on 19th May 1995. The track of the cyclone is also crucial in determining its effect. The highest risk area in terms of landfall site of the track in Bangladesh is the coast between Feni and Chittagong. However the 1970 cyclone track was inland from the coast and roughly parallel to it, passing through Noakhali District. Analysis of the simulation model of the 1970 cyclone shows that the project area lies at the interface of the cyclone surge and the effect of the upstream inflow from the three main river systems. The 1960 cyclone was unusual in that the track went south to north up the Meghna river. There is no simulation modelling available of this, but the cyclone shelter project have concluded that in such conditions the storm surge levels are likely to be higher the further inland the surge encroaches. The implication of this is that embankment freeboard levels have to be higher the further inland you go. The other effect of cyclones is to cause significant wind damage, which when combined with the extensive use of corrugated iron as a roofing material leads to very serious human casualties.

3.3.2 Main river flooding

The construction of the CIP embankment and its timely retirement appears to have been effective in preventing flooding of the embanked area from the river system, despite the significant range of peak water levels (see Figure V.7). The risk created to the embankment by main river bank erosion is severe and can be seen in Plates 1 to 6.

3.3.3 Saline water intrusion

There is no problem with intrusion of saline water from the river system as the embankment is effective and even in the dry season salinity levels in the Meghna river are not high. There are localised areas where pools of water that are not connected to the drainage system evaporate out in the dry season and salinity levels increase but not to a problematic level.

3.3.4 Monsoon rainfall flooding

In the early days of the CIP there were significant problems with rainfall flooding inside the embankment (Ref: Thompson, 1990), as natural drainage was impeded. Recent work by the SRP, combined with the SWMC hydrological modelling of the area, appears to have been successful in improving the operation of the drainage system. In addition, local people stated that if flooding were to occur there is now a rapid response system in place where they can immediately approach the authorities responsible for operating the system with a request to increase the opening of drainage structure gates and this is normally granted.

3.3.5 Main river bank erosion

Erosion of the main Meghna River Bank has created the greatest persistent risk to human livelihood in the area, having implications for failure of the flood protection embankments and causing widespread impoverishment. The human implications of bank erosion are discussed in Section 3.6.3 below. Attempts to control wave erosion have been made at Haimchar (see Plate 12), but these are unlikely to be effective at preventing main bank erosion, even in the short term. The erosion of the flood protection embankments makes it imperative that they are always retired in a timely manner as shown in Plate 11. In addition consideration should be given to flood proofing the homesteads that after retirement of the embankment find themselves now prone to main river flooding. The problem with such a flood proofing strategy is that the homesteads are likely to be eroded in the near future and it is thus difficult to cost justify.

3.3.6 Seismic activity

Whilst the project area lies in the medium seismic risk Zone II (Ref: Geological Survey of Bangladesh, 1979), the gradient to the highest risk Zone I area eastwards is steep and the Tripura hills 80 km to the east have been the epicentres of many earthquakes. Seismic events in Bangladesh are relatively infrequent but historically have been severe. The 1897 event caused widespread damage to all structures constructed of rigid materials (Ref: Government of the People's Republic of Bangladesh, 1977), due to differential settlement brought about by liquefaction. Another serious consideration is that the most serious earthquakes appear to occur during the monsoon season when the river systems are full and hence the implications of embankment failure are very serious indeed. The orientation of embankments to the shock wave and the nature of their construction is critical in determining how well they would survive a seismic event. A localised failure in an embankment can often be far more dangerous than simultaneous failure of a long reach, as it causes a sudden concentrated flood.

3.4 Socio-economic environment

3.4.1 Administration

The administration units in the project area are mapped in Figure V.9. The project area covers two Districts, although the piece in Lakshmipur is small and lies in the south of the area. The project area includes parts of three thanas and ten unions, covering all or parts of 22 mauzas. The BBS census data for 1981 and 1991 covering seven critical parameters is given in Tables 1 and 2. The rates of change between the two dates have been calculated and mapped down to mauza level and used to gain an understanding of past and likely future trends. Selected socio-economic data is listed in Table V.5 which is taken from the sample agricultural and socio-economic survey carried out in the field as part of the MES. The physical infrastructure in the project area has been enumerated and is listed in Table V.6.

3.4.2 Demography

The basic BBS demographic data (Ref: BBS, 1985 and 1992/95) for the area, down to mauza level for both 1981 and 1991, are given in Table V.3 and the location of the mauzas are shown in Figure V.9. The human population trends over the ten year period clearly show the effects of river bank erosion, with people being displaced and forced to crowd into the remaining part of their mauza or on a nearby embankment. The overall annual mean change in human population between 1981 and 1991 was +1.57 per cent, way below the national average, even for rural areas of the country. However the variation in rate between mauzas is dramatic, part of the change being due to natural increase (bearing in mind increased life expectancy and reduced infant mortality over the period), and the rest because of migration. All the mauzas suffering major erosion show reductions in population, the most extreme being a fall of 18 per cent, while the greatest population increase is 5 per cent, which occurs in the adjacent stable land where those displaced by erosion crowd on the embankment.

The predicted 1996 population numbers have been calculated by extrapolating the 1981 to 1991 rate. The land areas for each mauza for 1996 have been measured from the satellite imagery of that time and the population densities calculated. The calculated density of human population for 1996 is presented in mapped form as Figure V.10. The conclusions are that the mean density of 2314 people per km^2 is significantly higher than the national rural average. However the areas of severe erosion have exceedingly high densities (theoretically over 10,000 k^{m2}, but this assumes that people leave the mauza at the past linear rate), whereas in the stable land away from the river bank densities are between 936 and 1,234/km^2. In the whole of Haimchar Thana the 1991 density was calculated by BBS to be 649/km^2. However cross checks with measurement from satellite imagery have shown that the published BBS areas in coastal locations are often over measured (presumably because they include large areas of water) resulting in artificially low population densities.

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Table V.3 : BBS Demographic data 1981 and 1991 by Mauza

No	District	Thana	Union	Mauza	BBS Code	LGED Code	Total Mauza human population 1981	Total Mauza human population 1991	Annual population Change 81-91	Total Mauza estiamted human population 1996	Mauza land area 1996 ha	Population density 1996 per km2	Area of Mauza in 2025 erosion	Estimated 1996 population in 2025 area	Total Mauza households 1981	Mean hh size 1981	Total Mauza households 1991	Mean hh size 1991	% change in mean hh size 81-91
1	Chandpur	Chandpur S	Shakua	Lakshipur	132290624	116	7312	10250	3.44	12136	462	2627	81	2128	1323	5.53	1819	5.63	2
2	Chandpur	Chandpur S	Shakua	Baharia	132290047	117	3744	2898	-2.53	2550	18	14165	15	2125	811	4.62	530	5.47	18
3	Chandpur	Chandpur S	Ibrahimpur	Sakhua	132263920	118	2607	1878	-3.23	1594	53	3007	26	782	467	5.58	360	5.22	-7
4	Chandpur	Chandpur S	Hanar Char	Gobindia	132258423	166	6267	9229	3.95	11200	225	4978	203	10105	1042	6.01	1657	5.57	-7
5	Chandpur	Chandpur S	Chandra	Bakharpur	132254063	168	7356	10013	3.13	11682	466	2507	171	4287	1521	4.84	1862	5.38	11
6	Chandpur	Chandpur S	Chandra	Dakshin Balia	132254322	167	4965	7444	4.13	9115	411	2218	14	310	988	5.03	1387	5.37	7
7	Chandpur	Haim Char	Gazipur	Baziepti	134759002	161	6068	5442	-1.08	5154	37	13929	37	5154	1500	4.05	977	5.57	38
8	Chandpur	Haim Char	U. Algi Durgapur	Chhota Lakshipur	134711040	157	2083	2902	3.37	3425	133	2575	48	1236	366	5.69	537	5.40	-5
9	Chandpur	Haim Char	U. Algi Durgapur	Lamchari	134711072	160	1598	2206	3.28	2592	61	4249	61	2592	280	5.71	400	5.52	-3
10	Chandpur	Haim Char	U. Algi Durgapur	Mazampur	134711075	158	1335	2089	4.58	2613	110	2376	105	2494	268	4.98	354	5.90	18
11	Chandpur	Haim Char	U. Algi Durgapur	Nayani Lakshipur	134711087	170	3251	4180	2.55	4740	221	2145	148	3174	550	5.91	751	5.57	-6
12	Chandpur	Haim Char	D. Algi Durgapur	Char Bhanga	134723010	151	4260	5611	2.79	6440	522	1234	435	5366	774	5.50	942	5.96	8
13	Chandpur	Haim Char	D. Algi Durgapur	Char Poramukhi	134723035	152	1631	2232	3.19	2611	279	936	15	140	340	4.80	362	6.17	29
14	Chandpur	Haim Char	D. Algi Durgapur	Pach. Char Krishnapur	134723090	159	6454	9611	4.06	11728	456	2572	456	11728	928	6.95	1635	5.88	-15
15	Chandpur	Haim Char	D. Algi Durgapur	Pur. Char Krishnapur	134723092	154	1751	2320	2.85	2670	252	1060	48	509	298	5.88	398	5.83	-1
16	Chandpur	Haim Char	Char Bhairabi	Char Bhairabi	134735007	349	17599	28737	5.03	36721	1679	2187	1679	36721	3409	5.16	5461	5.26	2
17	Chandpur	Haim Char	Haim Char	Haim Char	134747017	348	11199	1520	-18.10	560	4	14000	4	560	2196	5.10	295	5.15	1
18	Chandpur	Haim Char	Haim Char	Charpakshidia	134747032	371	NA	NA	0.00	0	22	0	22	0	0	0.00	0	0.00	0
19	Chandpur	Haim Char	Haim Char	Char Koralia	134747030	347	NA	NA	0.00	0	65	0	65	0	0	0.00	0	0.00	0
20	Chandpur	Haim Char	Nilkamal	Char Saladi	134771037	150	7652	7593	-0.08	7564	150	5042	150	7564	1655	4.62	1379	5.51	19
21	Chandpur	Haim Char	Nilkamal	Gazipur Manipur	134771055	143	2415	573	-13.40	279	38	734	38	279	514	4.70	113	5.07	8
22	Lakshmipur	Raipur	Char Ababil	Char Ababil	515823162	1	12737	14524	1.32	15509	857	1810	430	7782	2653	4.80	2969	4.89	2
TOTAL							112284	131252	1.57	150883	6521	2314	4251	98360	21883	5.13	24188	5.43	6
										141906				105036					
										2.83									

Source: BBS 1985 and 1992

ESTIMATED HH IN 2025 AREA = 18114
GROSS MESUREMENT OF 2025 AREA IS 2.1% GREATER THAN ITS PARTS
2025 AREA FROM MASTER MAP IS 4689HA, 10.3 % GREATER THAN THE PARTS

Notes:
1. Order and spelling are according to 1991 BBS Census
2. NA indicates that no population figures are given in the BBS census data, this is likely to be zero as the Mauzas have eroded away
3. 1996 land area is the actual land area in the Mauza as shown on the satellite image of February 1996
4. The population densities for 1996 assume that erosion displacees remain in their Mauza, in reality a minority leave the area completely and those who remain move east to the nearest embankment

\HCTAB1.WK4 Alan Bird 20th June 1998

Table : V.4 : BBS Key data 1981 and 1991 by Mauza

No	District	Thana	Union	Mauza	BBS code	LGED code	%hh owning ag land 1981	% DU owning land 1991	Change in % land owning 1981-1991	% Pop age 10-29 in Cultiv 1981	% Pop Over 10 in ag 1991	Change in % Pop in ag 1981-1991	Literacy rage (7 yrs) 1981	Literacy rage (7 yrs) 1991	Change in literacy 1981-1991	% hh with pot water 1981	% DU safe drinking water 1991	Change in safe water 1981-1991	%DU with sanitation 1991
1	Chandpur	Chandpur S	Shakua	Lakshipur	1.32E+08	116	42	35	-7	13	15	2	18	30	12	25	61	36	1
2	Chandpur	Chandpur S	Shakua	Baharia	1.32E+08	117	30	21	-9	16	6	-10	14	16	2	9	63	54	1
3	Chandpur	Chandpur S	Ibrahimpur	Sakhua	1.32E+08	118	22	9	-13	8	8	0	12	20	8	26	21	-5	3
4	Chandpur	Chandpur S	Hanar Char	Gobindia	1.32E+08	166	52	30	-22	16	16	0	23	23	0	40	42	2	1
5	Chandpur	Chandpur S	Chandra	Bakharpur	1.32E+08	168	74	53	-21	18	16	-2	23	36	13	24	56	32	4
6	Chandpur	Chandpur S	Chandra	Dakshin Balia	1.32E+08	167	75	61	-14	19	18	-1	23	31	8	20	65	45	3
7	Chandpur	Haim Char	Gazipur	Baziepti	1.35E+08	161	63	32	-31	20	15	-5	20	18	-2	22	51	29	4
8	Chandpur	Haim Char	U. Algi Durgapur	Chhota Lakshipur	1.35E+08	157	77	70	-7	21	25	4	13	14	1	13	20	7	0
9	Chandpur	Haim Char	U. Algi Durgapur	Lamchari	1.35E+08	160	54	36	-18	19	11	-8	11	32	21	19	57	38	2
10	Chandpur	Haim Char	U. Algi Durgapur	Mazampur	1.35E+08	158	68	60	-8	22	20	-2	16	27	11	15	13	-2	9
11	Chandpur	Haim Char	U. Algi Durgapur	Nayani Lakshipur	1.35E+08	170	77	60	-17	17	15	-2	19	31	12	15	39	24	3
12	Chandpur	Haim Char	D. Algi Durgapur	Char Bhanga	1.35E+08	151	88	70	-18	7	22	15	16	26	10	40	62	22	2
13	Chandpur	Haim Char	D. Algi Durgapur	Char Poramukhi	1.35E+08	152	85	71	-14	21	20	-1	20	34	14	30	48	18	2
14	Chandpur	Haim Char	D. Algi Durgapur	Pach. Char Krishnapur	1.35E+08	159	68	47	-21	23	18	-5	18	29	11	16	66	50	3
15	Chandpur	Haim Char	D. Algi Durgapur	Pur. Char Krishnapur	1.35E+08	154	78	56	-22	23	20	-3	22	30	8	15	44	29	8
16	Chandpur	Haim Char	Char Bhairabi	Char Bhairabi	1.35E+08	349	62	49	-13	18	15	-3	15	24	9	74	82	8	3
17	Chandpur	Haim Char	Haim Char	Haim Char	1.35E+08	348	40	15	-25	7	4	-3	18	39	21	54	92	38	13
18	Chandpur	Haim Char	Haim Char	Charpakshidia	1.35E+08	371	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
19	Chandpur	Haim Char	Haim Char	Char Koralia	1.35E+08	347	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
20	Chandpur	Haim Char	Nilkamal	Char Saladi	1.35E+08	150	54	28	-26	17	12	-5	19	35	16	41	56	15	12
21	Chandpur	Haim Char	Nilkamal	Gazipur Manipur	1.35E+08	143	54	58	4	19	16	-3	17	24	7	10	55	45	0
22	Lakshmipur	Raipur	Char Ababil	Char Ababil	5.16E+08	1	52	47	-5	20	13	-7	11	22	11	78	54	-24	3
TOTAL							58	46	-12	17	16	-1	17	27	10	42	60	18	4

Source: BBS 1985 and 1992

NOTES:
1. Order and spelling are according to 1991 BBS Census
2. NA indicates that no population figures are given in the BBS census data, this is likely to be zero as the Mauzas have eroded away
3. The data are for the whole Mauza, not just the piece which falls within the 2025 erosion line

\HCTAB2.WK4 Alan Bird 20th June 1998

02

Selected Socio-Economic Survey outputs for Haimchar

Table V.5a: Population Characteristics

Population Characteristics	
Total households surveyed	37
Total population	236
Economic active population	92
Average size of households	6.38
Economic dependency ratio	156.52

Table V.5b: Sex distribution of the sample households

Age	**Male**		**Female**	
	Nos.	**(%)**	**Nos.**	**(%)**
<5	5	2%	10	4%
5-14	29	12%	44	19%
15-24	32	14%	20	8%
25-34	21	9%	11	5%
35-44	14	6%	15	6%
45-54	9	4%	8	3%
55>	14	6%	4	2%
Total	124	53%	112	47%
Sex Ratio	111			

Sex ratio = Males against per 100 females

Table V.5c: Literacy rate of the household members

Literacy Status	**Male**		**Female**	
	Nos.	**(%)**	**Nos.**	**(%)**
Can't read or write	27	11%	44	19%
Can read but not write	3	1%	3	1%
Can read or write but no schooling	11	5%	7	3%
Primary	36	15%	34	14%
Secondary	21	9%	16	7%
SSC and above	26	11%	8	3%
Total	124	53%	112	47%

Table V.5d: Main occupation of the households heads

Occupation	Nos.	(%)
Agriculture	15	41%
Agricultural labor	2	5%
Business	6	16%
Fishing	2	5%
Boat Labor	5	14%
Others	7	19%
Total	37	100%

Table V.5e: Main occupation of the household mamebers

Occupation	Male		Female	
	Nos.	(%)	Nos.	(%)
Agriculture	6	3.0%	0	0.0%
Agricultural labour	1	0.5%	1	0.5%
Business	9	4.5%	0	0.0%
Fishing	4	2.0%	0	0.0%
Boatman	4	2.0%	0	0.0%
Service	0	0.0%	0	0.0%
Student	32	16.1%	34	17.1%
Housewife	0	0.0%	35	17.6%
Dependent	17	8.5%	39	19.6%
Others	14	7.0%	3	1.5%
Total	87	44%	112	56%

Table V.5f: Secondary occupation of households heads

Occupation	Nos.	(%)
Agriculture	6	16%
Agricultural labour	1	3%
Absentee land owner	0	0%
Business	3	8%
Fishing	2	5%
Boatman	0	0%
Service	0	0%
Others	0	0%
No secondary occupation	25	68%
Total	37	100%

Source : MES Field Survey 1998

Table V.6 : Listing of physical infrastructure within the project area

Table V.6a : Embankment

	Location Name Thana/Uioan	Category Original	Category Replace /New	Length Km	Year of Construc-tion	Cost per Km	Present condition Good	Present condition Partially damage	Present condition Badly damaged
A.	**CHANDPUR SADAR**								
	1. Sakhua	Y	-	2.50	1976-77	215,000	Y	-	-
	2. Hanar Char	-	Y	1.50	1976-77	3,446,000	Y	-	-
	3. Chandra	-	Y	5.00	1976-77	3,446,000	Y	-	-
B.	**HAIM CHAR**								
	1. Haim Char	-	Y	2.00	1976-77	3,446,000	Y	-	-
	2. Nil Kamal	-	-	-	-	-	-	-	-
	3. Char Bhairabi	Y	-	4.00	1976-77	215,000	-	Y	-
	4. Uttar Algi Durgapur	-	Y	2.50	1976-77	3,446,000	Y	-	-
	5. Dakshin Algi Durgapur	-	Y	3.50	1976-77	3,446,000	Y	-	-
	6. Gazipur	-	-	-	-	-	-	-	-
C.	**RAIPUR**								
	1. Char Ababil								
	Total			21.00					

Source: Field Survey MES January, 1998.

Table V.6b : Water Management Structures

	Location Name Thana/Uioan	Type	No.	Size feet	Year of Const.	Cost Per Unit	Irrigation canal Length	Irrigation canal Width	Irrigation canal Yr of cons.	Irrigation canal Cost/ Km
A.	**CHANDPUR SADAR**									
	1. Sakhua	1 vent	1	5/6	1984	6,640,000	-	-	-	-
	2. Hanar Char	-	-	-	-	-	-	-	-	-
	3. Chandra	1 vent	1	5/6	1995-96	3,800,000	-	-	-	-
B.	**HAIM CHAR**									
	1. Haim Char	-	-	-	-	-	-	-	-	-
	2. Nil Kamal	-	-	-	-	-	-	-	-	-
	3. Char Bhairabi	1 vent	1	5/6	1983	1,569,000	-	-	-	-
	4. Uttar Algi Durgapur	-	-	-	-	-	-	-	-	-
	5. Dakshin Algi Durgapur	-	-	-	-	-	-	-	-	-
	6. Gazipur	-	-	-	-	-	-	-	-	-
C.	**RAIPUR**									
	1. Char Ababil	-	-	-	-	-	-	-	-	-
	Total		3							

Source: Field Survey MES January, 1998.

Table V.6c : Bridges and Culverts

	Location Name Thana/Uioan	Number	Total span (m)	Condition (Span/m) Good	Condition (Span/m) Poor	Condition (Span/m) Damaged
A.	**CHANDPUR SADAR**					
	1. Sakhua	-	-	-		
	2. Hanar Char	23	30.53	30.53		
	3. Chandra	-	-	-		
B.	**HAIM CHAR**					
	1. Haim Char	-	-	-		
	2. Nil Kamal	-	-	-		
	3. Char Bhairabi	7	20	10		10.00
	4. Uttar Algi Durgapur	6	19.5	9.5		10.00
	5. Dakshin Algi Durgapur	7	19.5	12		7.50
	6. Gazipur	-	-	-		
C.	**RAIPUR**					
	1. Char Ababil	2	6	3		3.00
	Total	45	95.53	65.03		

Source: Inventory of Rural Infrastructures; Infrastructure Maintained System 1997 LGED.
Note: Average cost per meter of road structure is Tk. 1,25,000, LGED Design Section.

Table V.6d : Road

	Location Name Thana/Uioan	FR - A				FR - B				Village Road			
		Length Km	Cost per Km	Yr. of const.	Status *	Length Km	Cost per Km	Yr. of const.	Status *	Length Km	Cost per Km	Yr. of const.	Status *
A.	CHANDPUR SADAR												
	1. Sakhua	0.50	2,000,000	1992-97	2	-	-	-	-	2	70000	1990-97	2
	2. Hanar Char	0.50	2,000,000	1994-97	2	-	-	-	-	9.2	70000	1990-95	2
	3. Chandra		2,000,000	1992-97	2	-	-	-	-	2.45	70000	1990-97	2
B.	HAIM CHAR					-							
	1. Haim Char	2.00	500,000	1992	2	-	-	-	-	-	-	-	-
	2. Nil Kamal	1.20	500,000	1992	2	-	-	-	-	1.25	100000	1985-90	2
	3. Char Bhairabi	5.00	500,000	1976-92	2	-	-	-	-	21.65	95000	1975-90	2
	4. Uttar Algi Durgapur	4.00	500,000	1992	2	3.50	200,000	1988	2	4.75	90000	1975-90	2
	5. Dakshin Algi Durgapur	-	-	-	-	2.50	200,000	1988	2	8.19	90000	1975-90	2
	6. Gazipur	-	-	-	-	-	-	-	-	-	-	-	-
C.	RAIPUR												
	1. Char Ababil	3.00	350,000	1976-77	2					7	80000	1975-92	2
	Total	16.20				6.00				56.49			

Source: Inventory of Rural Infrastructures, Infrastructure Maintenance System, 1997; LGED.

Note: Existing CIP embankment in the project are used as feeder road - A.

Excepting 0.50 Km in Sakhua Union, these are not standaradized as per FRA specification

* Status
1 = Good
2 = Partially damaged
3 = Badly damaged

Table V.6e : Thana and Union Headquarters

	Location Name Thana/Uioan	Union Head quarter area			Buildings / Structure				
		Area (Sq. m)	Length (m)	Width (m)	Type	Number	Size (max.)	Yr. of cons.	Average Cost
A.	CHANDPUR SADAR								
	1. Sakhua	252	18	14	Tin shed	1	13.5 x 6	1920	1,500
*	2. Hanar Char	-	-	-	-	-	-	-	-
	3. Chandra	208	16	13	Building	1	16 x 13	1985	340,000
B.	HAIM CHAR								
	1. Haim Char	288	18	16	Building	1	16 x 13	1993-94	640,000
	2. Nil Kamal	300	20	15	Tin shed	1	13 x 6	1992	95,000
	3. Char Bhairabi	300	20	15	Building	1	16 x 13	1992-93	640,000
	4. Uttar Algi Durgapur	375	25	15	Building	1	16 x 13	1988-89	640,000
*	5. Dakshin Algi Durgapur	-	-	-	-	-	-	-	-
**	6. Gazipur	-	-	-	-	-	-	-	-
C.	RAIPUR								
	1. Char Ababil								
	Total	1723	117	88		6			
	Haim Char Thana	3800	76	50	Tin shed	6	36 x 7	1989	600,000

Source: Field Survey MES, January, 1998.

Note: * = Hanar char and Dakshin Algi Durgapur UP have no office building. They use one room belonging to Union health sub-centre.
** = Gazipur UP runs office in Chairman's residence.

Table V.6f : Telephone Line

	Location Name Thana/Uioan	Length Km	No of Pole/Km	Year of Const.	Cost per Km	Catagory
A.	CHANDPUR SADAR					
	1. Sakhua	3	24	1985	96200	P.C.O
	2. Hanar Char	10	24	1985	96200	P.C.O
	3. Chandra	-	-	-	-	-
B.	HAIM CHAR					
	1. Haim Char (a)	16	24	1985	167692	P.C.O and trunk
	2. Nil Kamal	-	-	-	-	-
	3. Char Bhairabi	4	24	1985	96200	P.C.O
	4. Uttar Algi Durgapur	2	24	1985	96200	P.C.O
	5. Dakshin Algi Durgapur	2	24	1985	96200	P.C.O
	6. Gazipur	-	-	-	-	-
C.	RAIPUR					
	1. Char Ababil	-	-	-	-	-
	Total	37	144			

Source: Field Survey, MES January, 1998.

Note:

(a) = Telephone line recorded in the TT registers have been shifted to Nilkamal and Dakshin Algi Durgapur Union

Table V.6g : Transmission Lines

	Location Name Thana/Uioan	Length Km	No of Pole/Km	Year of Const.	Cost per Km	Catagory
A.	CHANDPUR SADAR	59	14	1982-97	500000	11 KV
		200	23	1982-97	350000	0.4 KV
	1. Sakhua	-	-	-	-	-
	2. Hanar Char	-	-	-	-	-
	3. Chandra	-	-	-	-	-
B.	HAIM CHAR	17	14	1982-97	500000	11 KV
		67	23	1982-97	350000	0.4 KV
	1. Haim Char	-	-	-	-	-
	2. Nil Kamal	-	-	-	-	-
	3. Char Bhairabi	-	-	-	-	-
	4. Uttar Algi Durgapur	-	-	-	-	-
	5. Dakshin Algi Durgapur	-	-	-	-	-
	6. Gazipur	-	-	-	-	-
C.	RAIPUR	14	14		500000	11 KV
		31	23	1982-97	350000	0.4 KV
	1. Char Ababil	-	-	-	-	-
	Total	388	111			

Source: Field Survey, MES January, 1998.

Note: Unionwise distribution of transmission lines is not available.

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Figure V.9: Administration Boundaries and Mauza Locations.

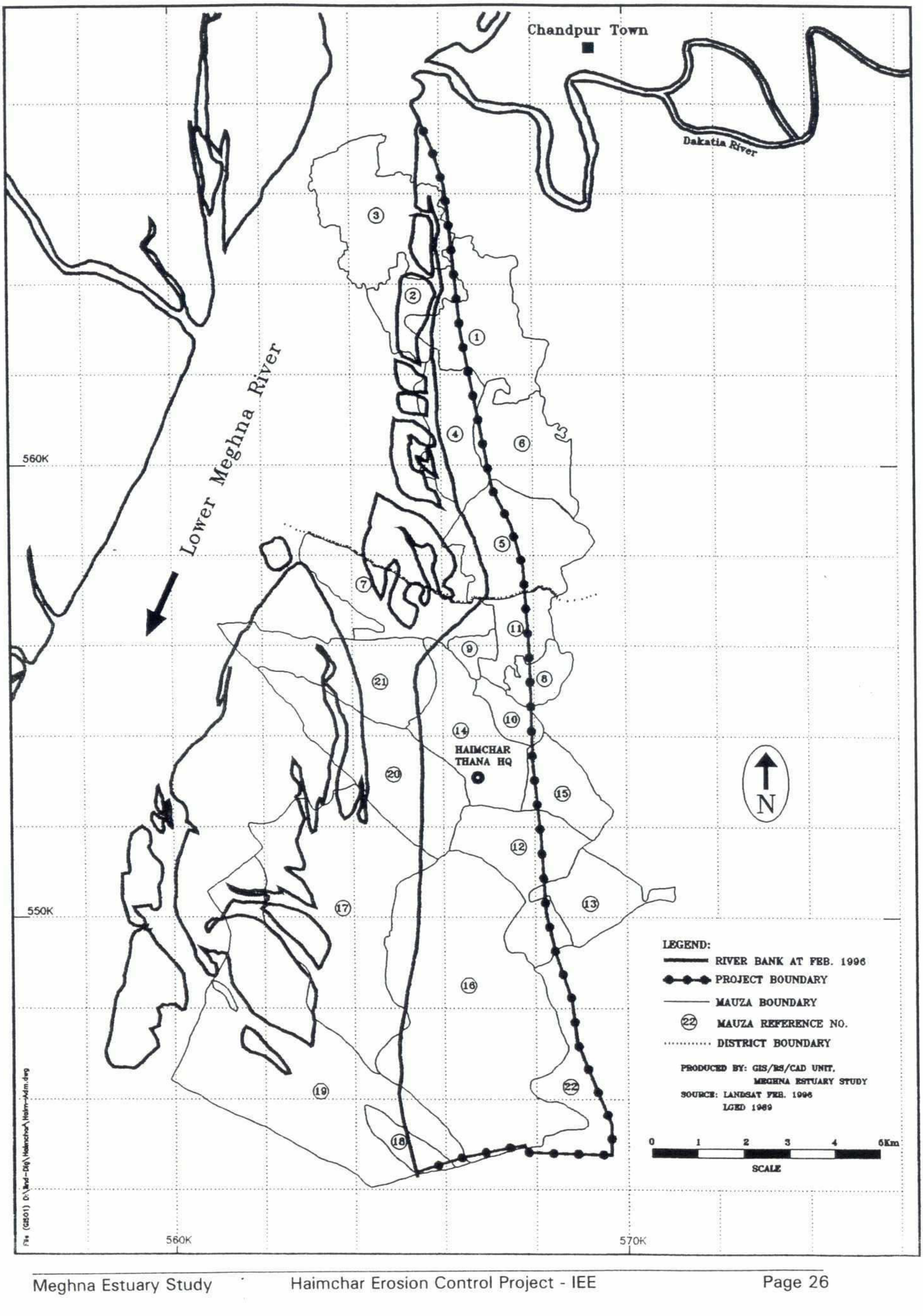
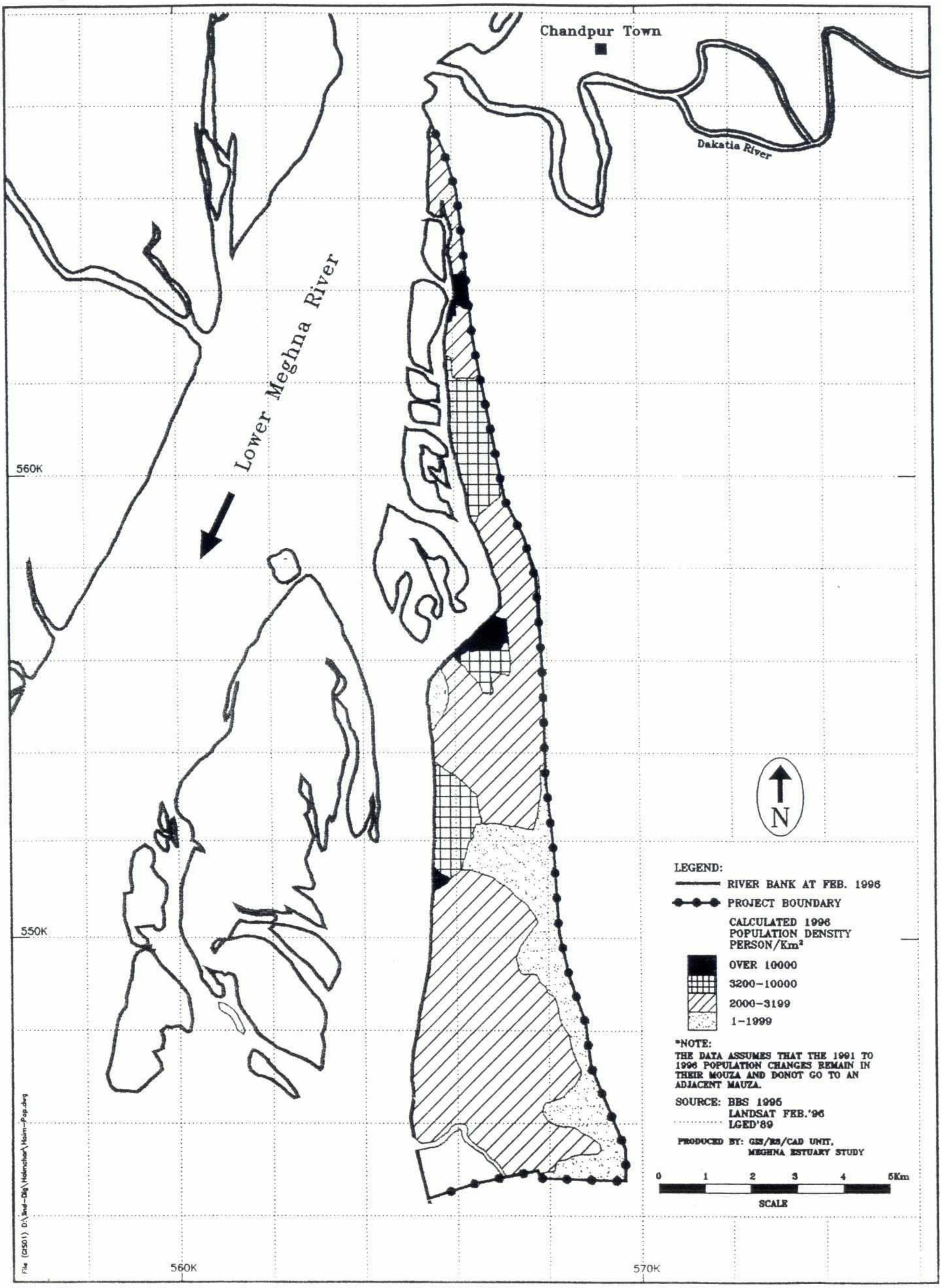


Figure V.10: Calculated Human Population Density 1996



Household size

From the BBS data the overall mean 1991 household size was 5.43, but with significant variations across the project area. The largest households are found in the mauzas not subject to erosion, with the notable exception of the very South East corner. It may be the case that households of erosion displacees fragment as members leave to seek alternative economic activities outside the mauza. It is common for the male head of an erosion displaced household to work away from the area leaving a de facto female headed household. However the overall trend in mean household size between 1981 and 1991 is a rise of 6 per cent, contrary to both the national and regional trend which shows a significant fall. The greatest increases in household size occur in stable mainland (perhaps as a result of erosion displaced relatives moving into the area) and also in the three mauzas which have experienced the heaviest erosion but still retain the remnants of relocated service centre provision, namely, Shakua, Haimchar and Gazipur Union headquarters

3.4.3 Settlement pattern and history

The settlement pattern of 1914 can be seen in Figure V.5 and it must be remembered that the area to the west of the 1996 bank line has accreted at some time between 1776 and 1914 and then subsequently eroded. An indication of the present general settlement pattern can be seen from the homestead vegetation visible in red on the 1996 satellite imagery of the area. The density of human population in 1996 is shown in Figure V.10. In addition the LGED map (see Figure V.10) gives the locations of the main service centres.

There is considerable settlement of erosion displacees on the Chandpur Irrigation Project embankment, in places two or three households deep on the landward side (see Plate 13) and also on the river side (see Plate 14), despite the risk of annual inundation. Due to the unplanned nature of the settlement there are problems of water supply and sanitation provision, as well as the fact that in some places the embankment crest has been damaged making it difficult for vehicles to pass. There are also a significant number of households who, due to erosion of the embankment, now find themselves on the river side of the retired embankment and prone to annual damaging floods to their homesteads and agricultural land, sometimes for periods of up to three months a year. For example on Plate 11 the area to the left of the embankment is prone to annual flooding as the embankment has been retired.

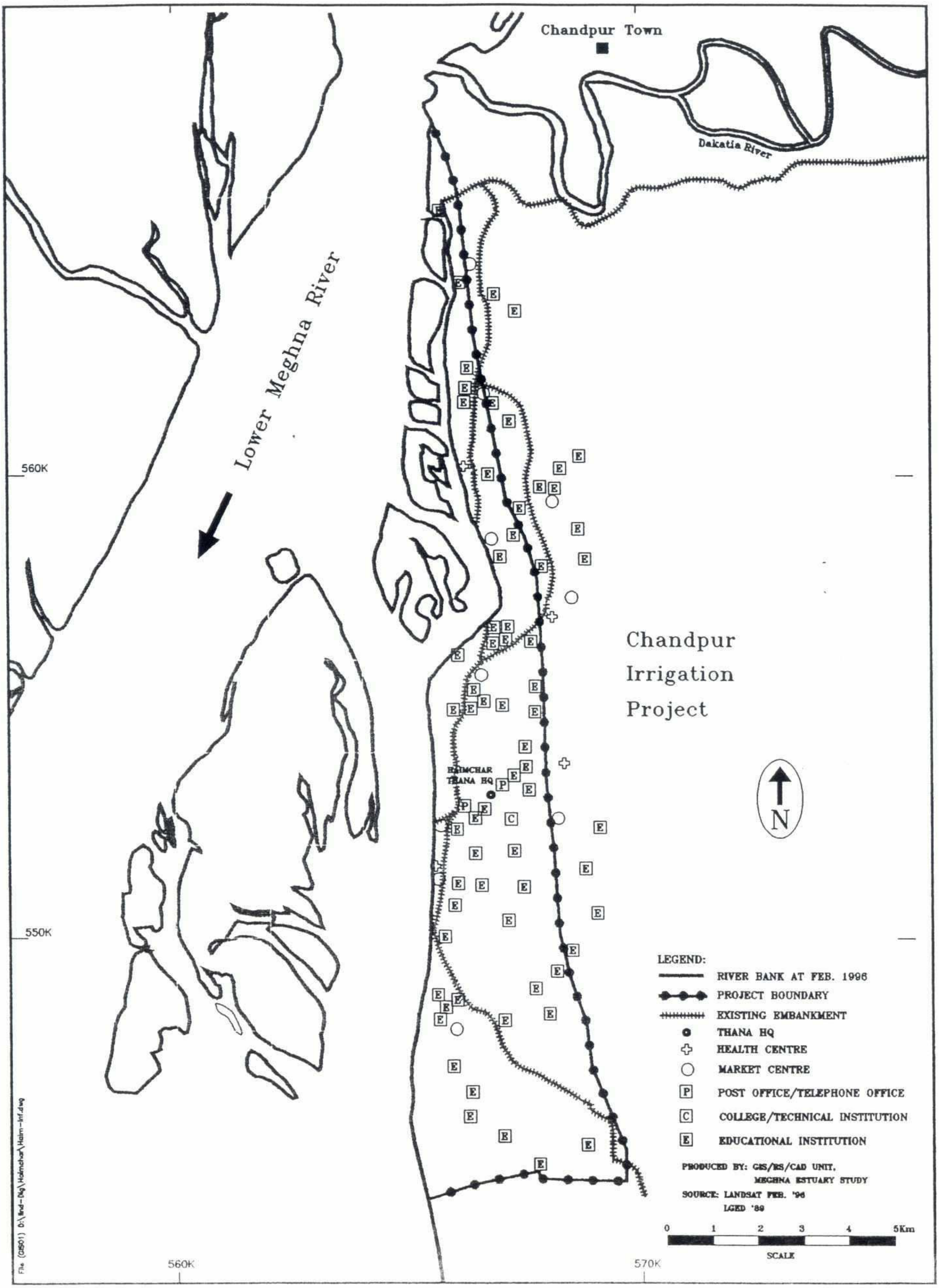
Agricultural land tenure

From the key BBS socio-economic for 1981 and 1991 given in Table V.4 it can be seen that 46 per cent of households in the project area owned agricultural land in 1991. However there is considerable variation, with the highest levels of 70 per cent being found in stable mainland away from the river bank and the lowest (less than 35 per cent) in the mauzas which suffer erosion. The overall trend in household agricultural land holding is a fall of 12 per cent in the 1981-1991 period. Whilst the direction of the trend is consistent with both the national and regional picture, the size of the fall is very high. As should be expected, the greatest falls are in the erosion prone areas, but there are also significant falls well inland. Indications are that when people lose their land to erosion the majority do not continue to pay land tax and consider it lost. This situation is unlike the Jamuna river erosion victims where most continue to pay their land tax in order to assert their title to the land. However those people living in the project area who have lost land but then seen it re-emerging in the offshore islands have attempted to reassert their rights on it, often by seasonal occupation.

Land values

Traded land values in the Haimchar area show that the rates for unembanked land are significantly lower than embanked land, mainly due to the perceived risk of erosion. Recent traded prices were found to be Tk 74,000 per ha outside the embankment and Tk 600,000 per ha inside the embankment. For other water sector studies in Bangladesh land values have also been estimated by calculating the value of agricultural produce per hectare per year. In the Jamalpur area it was found that traded land values were equivalent to 13 years gross agricultural production value per ha (Tk 32,000/ha per year) which was 30 years net value of production.

Figure V.11: LGED Infrastructure Map



Land valuation for the Jamuna bridge also used land valuation based on net returns from agriculture as a cross check to land values based upon declared land tax valuations (these are notoriously under-declared). The net value of production at Haimchar was found to be Tk 14,000 per hectare per year, making traded land values only just over five years net production outside the embankment but 42 times inside the embankment. This indicates the severity of the erosion and local people's perception of it.

3.4.4 Women's issues

The needs assessment carried out for the project area indicated that women's primary concern, like all other social groups, was control of erosion. This would seem to confirm that the erosion issue is perceived to be by far the most over-riding problem in the area. However the responses from women also showed very little differences in other priorities for development when compared to other social groups. Part of the problem may be that there was no differentiation between the responses of erosion displaces and non erosion displacees. From informal discussions amongst erosion displacees it would appear that the number of de facto women headed households is quite high, a similar situation to that found in the erosion prone areas of the Jamuna river. This situation arises when the male head of the household is forced to work away from the area and send money back. It is difficult to gain an accurate picture of how many of these households have been "abandoned" by the household head, the best measure is to record how often money has been remitted and how much and when did the male household head last visit. These types of questions are obviously very sensitive and tactful detailed questioning is required, often using women enumerators, to get a true measure of the situation. Time and resources did not permit this to be carried out for the project area. However the ISPAN char land studies (FAP 16, Ref: ISPAN, 1995d, 1995e and 1995f) carried out such detailed studies in the islands at the Meghna confluence, just upstream of the project area.

3.4.5 Drinking water availability

Table V.4 gives the BBS data for provision of drinking water by mauza for the project area in 1981 and 1991. The overall level of provision of safe drinking water in 1991 was 60 per cent of all households, the lowest rates being further inland where the population is more dispersed. Between 1981 and 1991 the provision of safe drinking water increased by 18 per cent, the greatest rises being in those mauzas with concentrated urbanised centres and the lowest rises in inland areas. The main source of "safe" drinking is groundwater from the middle aquifer at 13 metres to 80 metres depth. However recent data from DPHE indicates that the area south of Chandpur has some of the highest incidences of natural arsenic content in the country. There is an on-going high priority study addressing this issue, including the development of appropriate village level cost effective techniques for treatment. Despite the apparent seriousness of the arsenic problem (clinical data collected by ICDDRB indicates severe cases of skin diseases and cancer probably an accumulation of 15 years exposure), there is no doubt that the increased water supply provision has dramatically reduced levels of severe diarrhoeal disease, many of which were previously fatal. However without the development of sealed pit latrines that can withstand annual inundation, further reductions in diarrhoeal disease may be difficult to achieve.

3.4.6 Human health and sanitation

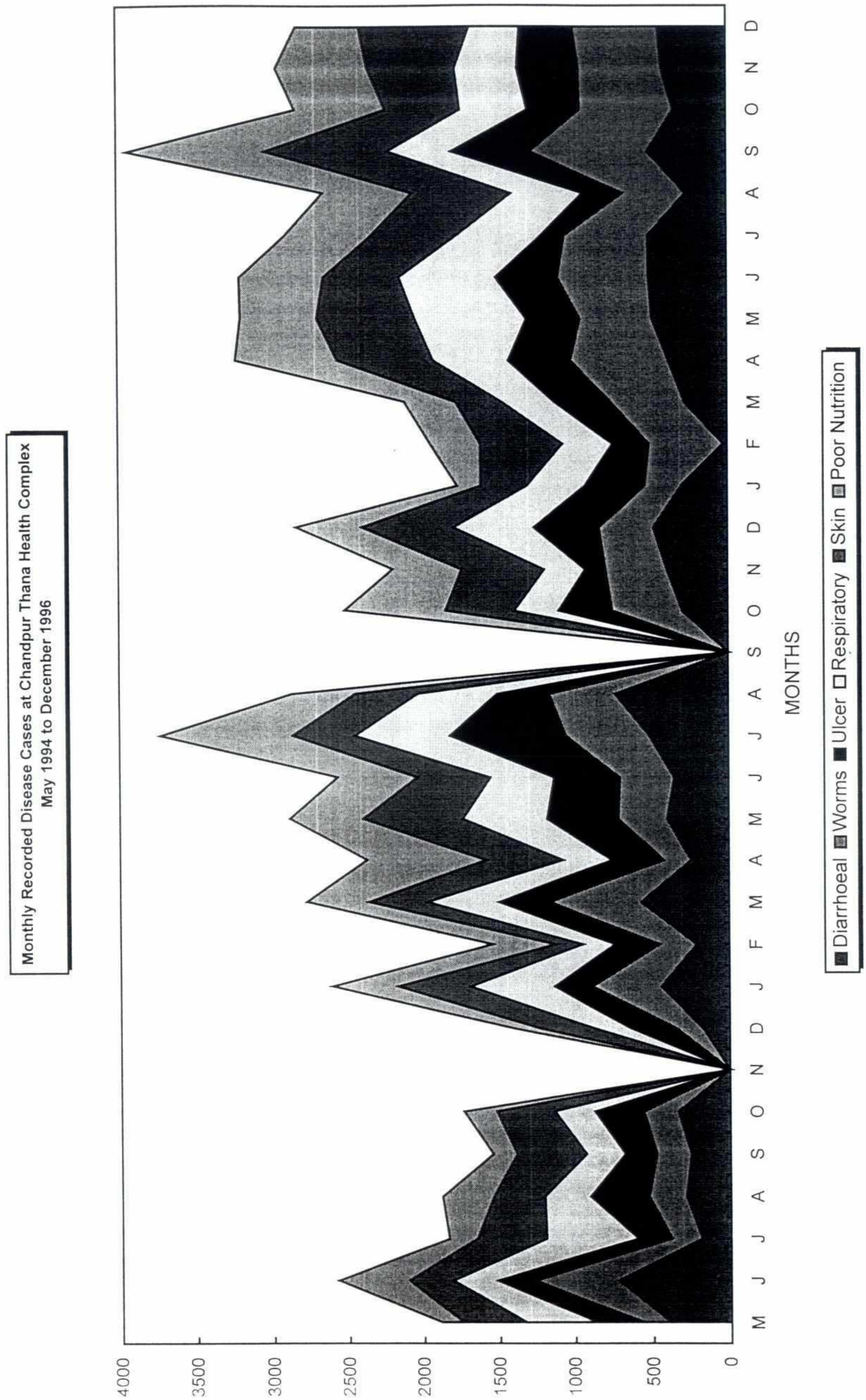
The monthly recorded disease data from Chandpur Thana Health Centre for the period between May 1994 and December 1996 is given in Table V.7 and illustrated in Figure V.12. The catchment area of the Health Centre is likely to reflect the urban characteristics of Chandpur town rather than the actual project area. However it is a useful guide as to conditions in the general area. The data show that of the water related illnesses, skin disease is the most significant health problem for which people in the area seek help. The highest incidences occur from April to December, some probably due to wading in water during flood times but other incidences could be related to wading in irrigated paddy fields during the dry season and bathing in polluted ponds. The second most significant water related disease is acute respiratory tract infection (ARTI) which normally peaks in May to July, the onset of the monsoon. Diarrhoeal disease patterns would appear to be highest between June and September, during the flood season, indicating that the reason is likely to be poor access to safe drinking water during flood times.

Table V.7 : Reported disease incedence data for Chandpur Thana health centre 1994-1996

Thana	Year	Month	Diarr	Worms	Peptic ulcer	Arti	Skin disease	Poor nutrition	Anemia	Astma	Eye disease	Ear disease	Dental disease	OBS & Gyne
CHANDPUR	1994	May	392	172	290	470	417	145	196	160	35	93	389	195
CHANDPUR	1994	June	725	540	250	295	293	472	420	60	56	98	383	66
CHANDPUR	1994	July	189	194	216	590	462	183	408	90	42	89	770	45
CHANDPUR	1994	August	288	242	371	300	340	338	427	115	51	189	635	158
CHANDPUR	1994	September	255	223	200	247	460	158	288	96	76	196	585	101
CHANDPUR	1994	October	338	221	311	262	386	216	302	84	64	89	535	142
CHANDPUR	1994	November												
CHANDPUR	1994	December	175	173	294	227	361	180	316	123	88	178	611	46
TOTAL 1994			2362	1765	1932	2391	2719	1692	2357	728	412	932	3908	753
MONTHLY MEAN 1994 (Pro Rata)			337	252	276	342	388	242	337	104	59	133	558	108
CHANDPUR	1995	January	445	438	246	556	481	441	366	60	76	120	703	118
CHANDPUR	1995	February	213	242	283	204	180	419	397	98	90	133	563	18
CHANDPUR	1995	March	571	585	339	471	390	416	345	61	99	182	633	102
CHANDPUR	1995	April	248	177	329	316	511	790	529	179	165	188	819	340
CHANDPUR	1995	May	402	312	461	557	662	488	646	92	237	387	710	162
CHANDPUR	1995	June	355	348	425	421	482	534	555	75	39	271	833	130
CHANDPUR	1995	July	515	534	766	631	414	871	469	211	179	238	835	444
CHANDPUR	1995	August	732	426	348	519	419	421	165	23	66	145	966	137
CHANDPUR	1995	September												
CHANDPUR	1995	October	297	451	346	293	453	675	546	15	209	288	908	93
CHANDPUR	1995	November	398	392	129	269	545	457	1062	258	451	317	712	129
CHANDPUR	1995	December	485	346	425	531	608	441	375	97	140	466	710	179
TOTAL 1995			4661	4251	4097	4768	5145	5953	5455	1169	1751	2735	8392	1852
MONTHLY MEAN 1995 (Pro Rata)			424	386	372	433	468	541	496	106	159	249	763	168
CHANDPUR	1996	January	303	236	381	382	303	155	224	120	124	266	612	125
CHANDPUR	1996	February	26	486	231	321	543	331	408		270	132	437	72
CHANDPUR	1996	March	279	475	364	345	304	340	457	65	119	130	728	160
CHANDPUR	1996	April	384	628	410	493	638	670	709	193	319	181	728	76
CHANDPUR	1996	May	490	460	351	733	653	503	579	47	604	793	116	
CHANDPUR	1996	June	511	585	409	633	505	552	243	274	246	257	878	
CHANDPUR	1996	July	515	536	153	556	561	575	431	305	351	242	1072	131
CHANDPUR	1996	August	270	405	256	471	651	593	701	457	347	286	980	419
CHANDPUR	1996	September	518	757	516	423	813	911	1103	405	550	488	982	325
CHANDPUR	1996	October	348	601	341	444	493	601	514	200	499	208	744	147
CHANDPUR	1996	November	425	530	402	411	576	608	808	371	646	523	894	70
CHANDPUR	1996	December	447	548	345	331	729	418	499	175	418		737	76
TOTAL 1996			4516	6247	4159	5543	6769	6257	6676	2612	4493	3506	8908	1601
MONTHLY MEAN 1996 (Pro Rata)			376	521	347	462	564	521	556	218	374	319	742	160
GRAND TOTAL			11539	12263	10188	12702	14633	13902	14488	4509	6656	7173	21208	4206
ANNUAL MEAN 1994/1996 (Pro Rata)			4616	4905	4075	5081	5853	5561	5795	1804	2662	2869	8483	1682
SUMMARY														
MONTHLY MEAN 1994 (Pro Rata)			337	252	276	342	388	242	337	104	59	133	558	108
MONTHLY MEAN 1995 (Pro Rata)			424	386	372	433	468	541	496	106	159	249	763	168
MONTHLY MEAN 1996 (Pro Rata)			376	521	347	462	564	521	556	218	374	319	742	160
MONTLY MEAN 1994/1996 (Pro Rata)			385	409	340	423	488	463	483	155	222	247	707	150

Source: Compiled from disease profile data from Chandpur Thana Health Complex, 1997

Figure V.12 : Monthly recorded disease cases for Chandpur 1994-1996



The Union Health Centre building at Haimchar which has been under severe threat of bank edge erosion as it lay on the river side of the retired embankment (as shown in Plate 10), was washed away in July 1998.

Sanitation

The 1991 BBS data for sanitation provision is given by mauza in Table V.4. The levels of sanitation provision in the area are very low indeed at around 4 per cent of households in 1991. This is especially serious when considering the high population densities in the area and is a major reason for ill health. DPHE has a sanitation programme based in Chandpur town but this appears to have made little impact on the surrounding rural area so far.

There have been cholera outbreaks in Noakhali District in the recent past. The last major one in the mid 1990's killed a lot of children and there is now an international effort to try and tackle this issue centred at ICDDR,B and their Matlab control site which lies just north of Chandpur.

3.4.7 Human nutrition

The Chandpur Thana Health Centre data indicates a significant number of people have been seeking treatment for poor nutrition. It is likely that many of these are erosion displacees who have lost their immovable assets and suffered significant livelihood loss and impoverishment. Put bluntly the low levels of nutrition are probably a function of poverty, as despite the fact that the fish production figures for the area are the highest in the country, it is likely that these are just landed in the area and then transported to large urban markets.

3.4.8 Education

The number and location of schools in the project area is given in Figure V.10 and a detailed listing in Table V.6. Provision of Primary schooling is significantly better than secondary. The BBS literacy data for 1981 and 1991 are given in Table V.4. The mean literacy rate for the area was 27 per cent in 1991 (lower than the figure for the whole country) with significant variations, the highest rates being in the more densely populated mauzas where distance to education provision is shorter. There was an overall increase in literacy rates of 10 per cent between 1981 and 1991, but this is very uneven across the area. Some of the highest increases in literacy are in the erosion prone areas where access to provision is presumably easier in areas of concentrated population. This is one of the few benefits of erosion displacement in that it can make service provision easier.

3.4.9 Landscape aesthetics, cultural and archaeological sites

Due to erosion the land to the west of the present river bank in the project area has experienced significant losses of both private and government buildings. However the area is shown as being in the river on the 1776 Rennall's map and presumably it accreted after this time, the 1914 map (Figure V.5) showing it as land. For this reason there would appear to be no significant old archaeological or cultural sites in the area. The aim of the intervention is to stop erosion and as such helps to prevent loss of existing infrastructure in the project area.

3.4.10 Environmentally sensitive areas

There would appear to be no environmentally sensitive areas within the project area and newly accreted lands to the west have been discussed in Section 3.2.4 above.

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3.5 Economic development

3.5.1 Common resource rights

Fish

The availability of "free good" fish has been significantly reduced in recent years as more erosion displacees are forced into fishing as a livelihood. Such a situation has resulted in professional fishing households finding it harder to make a living.

Fuelwood

There is a severe lack of common good fuel wood as population densities increase due to erosion induced land loss and there is very little common land. The result of such a situation is that other sources of fuel have to be used, particularly animal dung, and any fuelwood that is available is sold for relatively high prices.

Grazing

Because of the high intensity of use of land, made significantly higher due to land loss from erosion, public grazing land is virtually non existent. The result of this is that most animals are stall fed on fodder from crop residuals. However those households which do not own land or are erosion victims have no easy access to fodder and this is reflected in the lower per capita livestock holdings of such households.

3.5.2 Agriculture

The number and proportion of households in the project area having agriculture as their primary economic activity is given by mauza in Table V.4 for both 1981 and 1991. The proportion of the population having agriculture as their main economic activity in 1991 is greatest inland and lowest in the erosion prone parts of the project area. During the period 1981 to 1991 there was an overall fall in the proportion of households having agriculture as their main economic activity with significantly higher rates in the erosion prone areas.

Agricultural production data per household for the project area is given in Table V.8. It can be seen that households owning no cultivated land actually work larger areas of land than those owning marginal holdings. Such a situation is probably a result of erosion displacees renting land to continue farming. Table V.8 also shows that the marginal group of farmers produce the greatest production per hectare than other land owning groups. However care has to be taken in analysing the data as the sample size was relatively small. The overall mean net return per hectare for the area has been calculated at Tk 14,000 per year.

3.5.3 Forestry

There is no formal forestry in the area at all as the pressure on land is so great due to erosion. The main source of income from trees is the utilisation of homestead vegetation at the household level. there is very little "free good" forestry resources.

3.5.4 Livestock

From the agricultural and socio-economic survey it was found that livestock holding levels were relatively low, probably due to the difficulty in finding grazing and fodder. The levels of livestock holding were found to be lower amongst landless households than those owning land.

Table V.8 : Agricultural Production Data

Land holding category	Mean gross cultivated area per farm hh (ha)	Mean net cropped area per farm hh (ha)	Mean crop production per farm hh (Kg)	Mean production consumed per farm hh (Kg)	Mean production sold out per farm hh (Kg)	Mean farm income per hh (Tk.)
Landless	0.43	0.93	1040	840 (81%)	200	1067
Marginal	0.26	0.55	682	539 (79%)	142	1655
Small	0.43	0.9	1016	694 (68%)	322	2513
Medium	1.19	2.12	2497	1147 (46%)	1350	8463
Total	0.52	1.03	1202	749 (62%)	453	3252

Source: MES field survey January 1998, sample size 32 farming hh

Note: Land holding size is area of agricultural land owned by each farm hh grouped in to UNDP classification.
Land areas included worked land not owned by the farming hh cropped area includes multiple cropping of the same land.

3.5.5 Fishing

The Chandpur area records one of the highest landed catch per unit area amounts in Bangladesh according to the recent FRSS data. However it is likely to be the case that the large quantities of fish landed are just transhipped to urban markets. These fish are also likely to be caught outside of the project area by professional fishermen who do not come from Chandpur. In the Haimchar project area it was found that some 5 per cent of households are primarily dependant upon fishing for their livelihood and a further 5 per cent were catching fish for sale to supplement their primary occupation. However there are also many poor households, particularly erosion displacees, who catch fish as and when they can for direct consumption. This latter trend has been increasing and is a factor in the reduction of average catch weights. The data for aquaculture is given in Table V.9. From this data it can be seen that the number of ponds inside the embankment is much greater than outside and the yields are also higher.

Table V.9 : Fishing production data

Table V.9a : Pond fisheries in Haimchar

POND CATEGORY	NUMBER OF PONDS	TOTAL PRODUCTION (ha)	PRODUCTION RATE (est) (kg/ha)	PROPORTION OF TOTAL PRODUCTION (%)
Cultured Pond	788	97	800	69
Culturable Pond	894	114	300	31
Derelict Pond	9	1	50	0
TOTAL	1691	213	1150	100

Source: MES Survey, Union Councils, 1998

Table V.9b : Fish ponds inside and outside the existing CIP embankment

POND CATEGORY	INSIDE EMBANKMENT		OUTSIDE EMBANKMENT	
	AREA (ha)	PRODUCTION (mt/yr)	AREA (ha)	PRODUCTION (mt/yr)
Cultured Pond	67.8	54.2	29.6	23.7
Culturable Pond	79.5	23.9	34.8	10.4
Derelict Pond	0.9	0.1	0.4	0
TOTAL	148.2	78.2	64.8	34.1

Source: MES Consultant's estimate based on Thana Fisheries Office Data

3.5.6 Rural energy

As stated above there is very little available fuelwood in the area and many households are forced to use animal dung as domestic fuel. The alternative of using rice straw is also problematic as it is the main source of animal fodder and is in short supply. There is even a shortage of animal dung in some locations, particularly in those areas of highly concentrated populations such as erosion displace communities. The Haimchar project area would appear to have one of the most severe rural energy problems in the country.

3.5.7 Wage paid employment

Table V.5 indicates that at least 35 per cent of household heads are dependant upon wage paid labour for their livelihood, including wage paid agricultural labour (5 per cent), fishing labour (5 per cent), boat labour (14 per cent) and people in business (16 per cent). In addition a significant proportion of the 19 per cent in the other category could be wage paid. Landless erosion victims are more dependant on wage paid labour than households owning agricultural land.

3.5.8 Industry

There is very little significant industry in the area, although processing of agricultural produce is carried out. There is also some fish drying and significant fish marketing, although the latter employs very few people directly.

3.5.9 Access and transport

The location of existing LGED infrastructure is given in Figure V.10, embankments being the main access roads, the lengths and details of these being given in Table V.6a. Listings of road infrastructure are given in Tables 9c and 9d. The biggest problem is the disruption to the road network created by erosion of the embankments which then have to be retired, creating a disjointed and convoluted network.

3.6 Social risks and hazards

The human implications of both natural events (see Section 3.3 for an outline of these) and also man made conditions are dealt with below by category:

3.6.1 Storms and cyclones

Cyclones are the primary cause of direct hazard death in Bangladesh, often made worse by the secondary impacts of disease. There have been severe cyclonic storms in the Study Area in 1893, 1895, 1960, 1961 and 1970. The cyclone of 1970 was the most severe in Bangladesh this century and killed up to 275,000 people. However the track was south-west to north- east across the Meghna Estuary and centred south of Lakshmipur and avoided directly hitting the project area. The biggest cyclone problems for the project area occurred in 1960 when two cyclones only 21 days apart caused a total of 11,000 deaths in the country. Both of the 1960 tracks were south to north up the Meghna river directly across the project area. Fortunately the intensity was not as great as 1970 or the death toll would have been much higher.

3.6.2 Floods

Significant floods have been recorded in the area during 1784, 1853, 1870, 1905, 1954 and 1970. The 1905 floods were due to local rainfall rather than flooding from the Meghna river. The 1970 floods were particularly bad in the Chandpur area as river levels were high. However the CIP embankment has been built since this time which reduces the risk of flooding from the river in the embanked part of the project area. There is thus no significant problem with flooding from the Meghna if the embankment holds. The erosion of the embankment is thus a serious increase in risk to the livelihoods of local people. However the embankment has in the past impeded local rainfall drainage out of the area but this has recently been addressed by improving the drainage system under the Systems Rehabilitation Project, making use of the tidal range to drain the area at low tide. Flooding itself does not kill many people but is highly disruptive and impoverishes them, many malnourished and vulnerable, particularly to waterborne disease.

3.6.3 River bank erosion

River bank erosion has been a continual problem in the project area since at least 1914, as explained in Section 3.3.5 above. Plates 1 to 6 show the effects of erosion, particularly on the CIP embankment, which needs constant retirement to remain intact and achieve its function of preventing flooding from the Meghna river. It has proven very difficult to accurately estimate numbers of erosion displacees in the Haimchar area as this changes so rapidly, however the population densities of over 10,000/km2 for rural mauzas adjacent to the main erosion locations (see Figure V.10) are a reflection of the problem. Many of the erosion displacees relocate to live on the landward side of the embankment (see plate 14) and in some places the houses are three

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deep as shown in Plate 13. Plate 9 shows a family in the process of packing up their belongings to move and Plate 15 the remains of houses on the bank edge immediately after removal.

3.6.4 Earthquakes

The area is subject to infrequent but severe earthquakes as outlined in Section 3.3.6 above. The last severe earthquake in the area was on 12th June 1897 during which most buildings built of rigid materials were seriously damaged. The human casualties were relatively few as most buildings were then of lightweight construction. However if such an event were to happen today it is likely that the casualties would be much higher. Another important aspect is that the most severe earthquakes have occurred during the monsoon period when the river systems are full. The failure of embankments during this time due to earthquakes would be likely to have serious consequences for local people.

3.6.5 Famine

There were famines in the area during, 1866, 1943 and 1970/71. The 1943 Bengal famine was mainly due to food grains being diverted to the war effort against the Japanese, where as the 1970 famine was due to the effects of the 1970 cyclone and later compounded by the war with Pakistan.

3.6.6 Disease

The main disease threat to humans are diarrhoeal diseases brought about by high faecal pollution levels in surface water due to lack of sanitation provision compounded by high population densities. These have been discussed in Section 3.4.6 above and numbers of cases are shown in Table V.7.

3.6.7 Pollution

There is little industrial pollution in the area, the main problems are high faecal pollution levels in surface water and natural arsenic pollution in the second depth groundwater aquifer. Recent studies have shown that the Chandpur area has some of the highest incidence of natural arsenic contamination in the country.

3.6.8 Social instability

The disruption caused by river bank erosion is a major factor in causing social instability as households are forced to relocate, and in some cases split, in order to find a replacement economic livelihood.

3.6.9 Economic instability

River bank erosion creates economic instability due to the disruption it causes which necessitates the relocation of people and construction of replacement infrastructure. There is also an underlying uncertainty in erosion prone areas which discourages longer term investment in economic activities which can not easily be relocated.

3.7 Conclusions

The most important environmental factor affecting the area is river bank erosion, which as well as direct land loss (and resulting impoverishment), causes flooding of homesteads and agricultural land from the main river. Such flooding occurs in peak flow times during the monsoon season in places where the embankment has been eroded away and not retired or in those areas which now find themselves on the river side of the retired embankment. The past bank lines for 1957, 1973 and 1996 are shown in Figure V.7 and the predicted future bank lines for 2010 and 2025 in Figure V.11. The predicted erosion rates are given in Table V.2. The proposed intervention aims to address the issue of bank erosion.

4. PROJECT SCOPING AND PUBLIC CONSULTATION

4.1 Local people

As stated in Section 2.5 above a needs assessment has been carried out in the area in which 112 people were interviewed and results are given in Table V.1. The overwhelming response was that river bank erosion was the most pressing problem in the area and requires appropriate action. The response was universal across different social groups (including women) and throughout the project area.

4.2 Government officials and elected representatives

Meetings were held with local government officials and elected representatives as part of the data collection work for the Project. A list of the people contacted is given in Appendix D. There was widespread support for any measure which would address the problem of bank erosion. The biggest problem is likely to be unrealistically high expectations of how successful the intervention will be. It is imperative that the work is considered as a trial which has a risk of failure. Due to the risk of failure of such trials it is thus imperative that the programme for retiring the CIP embankment should be continued, not stopped, because of the project.

4.3 NGO's

There are surprisingly few NGO's working in the Study Area, considering that there is significant hardship amongst erosion displacees. The only one that could be found was Jubo Shangho (a youth organisation) which has operations in Maliar Hat and Mullah Kandi. As part of the SRP works in rehabilitating the CIP embankment, local users groups were established to carry out the works, often using erosion displacees living on the embankment. However it has apparently proved difficult to continue the momentum of this now that the rehabilitation has been completed and project based funding has ended.

4.4 Other projects and studies

Section 2.2 above has outlined previous studies undertaken in the area. These are briefly summarised below:

4.4.1 FAP 9b

The conclusion of the Haimchar work under FAP 9b was that the intervention cost would be high and the economic internal rate of return was very low at around 3 per cent (Ref: Haskoning, 1992). As a result the project was not implemented. The present proposed project attempts to tackle this problem by using more cost effective intervention techniques.

4.4.2 Chandpur Irrigation Project and Systems Rehabilitation Project

The Haimchar project area lies within the area of the Chandpur Irrigation Project (CIP) which became fully operational in 1979. An assessment of the effectiveness of the CIP was carried out in 1990 (Ref: Thompson, 1990) and in addition the Systems Rehabilitation Project (SRP) carried out an assessment of CIP during the mid 1990's. As part of the SRP assessment the Surface Water Modelling Centre (SWMC) produced a detailed hydro-dynamic model of the CIP area to identify shortcomings in the hydrological design of CIP, particularly flooding inside the constructed embankments caused by inappropriate design and poor water management. The model was used as a tool by the SRP to draw up criteria for operation of the CIP, particularly taking into consideration local people's experiences. The broad conclusions of Thompson's work on the CIP were that, whilst the actual economic rate of return achieved by the project was significantly lower than that predicted (5 per cent) and for which the economic calculations were carried out for, overall the project was beneficial. There were significant losses of flood plain fisheries caused by the construction of embankments which prevented migration, but significant aquaculture had

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also been developed inside the embankment, often using the borrow pits created by the construction of the embankments.

It is significant to note that in the 1988 floods the CIP embankment did not fail (probably because it had been retired early enough), unlike that at Meghna Donagoda where embankment failure resulted in longer flooding than if there had been no embankment.

4.4.3 FAP 12/13 FCDI review

Evaluation of similar Flood Control, Drainage and Irrigation projects (FCD/I) similar to Chandpur Irrigation Project, was undertaken under FAP 12/13. In all 13 case examples were evaluated, including the Meghna Donagoda Project but not the CIP. The conclusions were that in over half of the cases the economic implications of negative environmental impacts (especially flood plain fish loss) were so great as to negate the predicted benefits.

4.4.4 South East Regional Study (FAP 5)

As part of the FAP 5 South East Regional Study (Ref: Sir M MacDonald and Partners, August 1993), within which the Haimchar project area falls, a Feasibility Study was carried out for a drainage and irrigation project in Noakhali North (Ref: Sir M MacDonald and Partners, October 1993). The conclusions of this work were that the drainage improvement intervention was high desirable and cost effective as it addressed the problems created by the construction of the coastal cross dams in the 1960's which impeded drainage over a large area and has resulted in the loss of one seasons cropping. However no donor has as yet come forward to take the proposed project further.

4.4.5 Coastal Embankment Rehabilitation Project (FAP 7)

The issues surrounding the revetment of coastal embankments were studied as part of FAP 7 (CERP) and the environmental issues connected with construction of such embankments were studied by the environmental component (Ref: Bird, October 1993). The conclusion was that overall such interventions are highly desirable but care is needed in their implementation to minimise negative impacts and maximise the positive ones by appropriate management. The environmental work carried out for the FAP 21/22 Bank Protection and Active Flood Plain Management (AFPM) Project was also reviewed.

4.4.6 Conclusions

The results of the above and other studies have indicated that the technical feasibility of bank protection works can be problematic and the capital costs are high, often unjustifiably so for just preventing erosion of agricultural land. However the social benefits of such works can be very high and politically easy to justify as part of a multi-criteria analysis. The aim of the proposed works at Haimchar is to test new, less costly techniques using geotextiles, which if successful could allow cost effective bank protection measures to be undertaken in Bangladesh.

4.5 Project planning response to consultation

The results of the needs assessment given in Table V.1 provide the basis for a Public Response Document which is often required as part of an environmental assessment. Overall there was overwhelming support for the proposed intervention. However the recently passed DoE Environmental Rules require that a No Objection Certificate be given by the Local Authority and submitted to the DoE with the IEE document before a Site Clearance Certificate can be granted. As these procedures are new and untried and date from after the project was proposed, the next stage forward is unclear. However there should be no problems in obtaining such support from the Local Authority for such work.

5. ENVIRONMENTAL SCOPING AND BOUNDING

5.1 Environmental scoping

5.1.1 Technical scoping exercise

An environmental scoping exercise was carried out using the field data from the needs assessment, and also amongst the study team, to identify the Important Environmental Components (IEC's). The basis for selection of the IEC's was the master environmental checklist compiled for all work in the MES as outlined in the MES Interim Development Plan, (Ref: DHV, 1997, the environmental assessment matrix given in Figures 8.1 and 8.2 gives the full listing of the checklist). The master list was adapted for local conditions at Haimchar and the main environmental constraints to development, identified from the conclusions of the baseline environmental description in Section 3.7 above, were borne in mind. The resulting matrix of Important Environmental Components (IEC's) is given as Figure V.13, with the second column identifying the priority issues on technical grounds.

5.1.2 Local people's priority issues

Column three of the matrix shown in Figure V.13 gives local people's priority issues based upon the results of the needs assessment discussed in Section 4.1 above. The overwhelming conclusion was that river bank erosion is the most pressing problem in the area and requires appropriate action.

5.2 Identification of likely important environmental components

The identified IEC's for Haimchar are listed systematically in the left hand column of the scoping matrix given as Figure V.12. The second column shows those issues considered to be important by the study team and the third column those identified by local people. The rating has fixed the present situation at zero for all issues to allow a comparative assessment to be carried out. Ratings have been made as to the future situation both without and with a successful proposed intervention.

The matrix indicates the likely direction and degree of induced change as a result of the proposed interventions. The rating has fixed the present situation at zero for all issues to allow a comparative assessment to be carried out for the future situation at year 2025, the time period for which the erosion prediction data is available. It should also be the case that by this time most impacts will be apparent. Three scenarios have been assessed:

- "do nothing" future without project situation
- implementation of the project assuming that it is successful in year 5
- the difference that a successfully implemented project will make over the future without project situation.

The matrix has been used as the basis for impact analysis for the IEE in Section 6.

5.3 Bounding of possible impact areas

The delineation of likely environmental impacts created by the proposed interventions, (known by the term "bounding" in the FPCO/WARPO EIA Guidelines and Manual), has been made based upon the outputs of the erosion model and delineated in Figure V.3 and possible induced erosion to accreted char land.

Any possible impacts and constraints outside these areas are considered to be external issues and are dealt with as a separate item in the analysis in Section 7.

Figure V.13 : Important environmental components matrix

IMPORTANT ENVIRONMENTAL COMPONENTS	Technical Priority	Local Priority	NOW	Future Without Sucessful Intervention	Future With Sucessful Intervention	Difference Due to Intervention	Future With Project With Mitigation	Residual Impact
NATURAL ENVIRONMENT								
Natural Physical Environment								
Climate								
Cyclones			0	0	0	0	0	0
Hydrology								
Surface Water:								
Quantity:								
River Flooding	*	*	0	-	+	+ +	+	+ +
Erosion	*	*	0	-	+	+ +	+	+ +
Accretion		*	0	-	+	+ +	+	+ +
Land								
Soil								
Erosion	*	*	0	-	+	+ +	+	+ +
Natural Risks and Hazards								
Storms/Cyclones			0	0	0	0	0	0
Flood			0	-	+	+ +	+	+ +
HUMAN ENVIRONMENT								
Social Environment								
Human Population	*		0	- -	-	+	-	+
Settlement Pattern and History	*		0	-	0	+	0	+
Land Holding and Tenure	*		0	-	0	+	0	+
Sanitation			0	0	0	0	0	0
Health								
Waterborne Disease			0	-	-	0	-	0
Cultural Sites			0	-	0	+	0	+
Economic Environment								
Agriculture	*		0	-	+	+ +	+	+ +
Homestead Production			0	-	+	+ +	+	+ +
Fisheries - Aquaculture			0	-	+	+ +	+	+ +
Industry			0	-	0	+	0	+
Infrastructure								
Roads and Embankments	*	*	0	-	0	+	0	+
Navigation		*	0	+	-	- -	-	-
Telecommunications			0	-	0	+	0	+
Social Risk and Hazards								
Storms and Cyclones	*		0	-	0	+	0	+
Floods	*		0	-	0	+	0	+
Erosion	*		0	-	0	+	0	+
Disease			0	-	0	+	0	0
EXTERNAL ISSUES								
Upstream Constraints and Impacts			0	+/-	+/-	0	+/-	0
Downstream Constraints and Impacts	*		0	+/-	+/-	+/-	+/-	+/-?
DIRECT CONSTRUCTION IMPACTS								
Land Acquisition			0	0	+	+	+	+
Compensation			0	0	0	0	0	0
Resettlement			0	-	+	+	+	+
Construction Management			0	0	-	-	0/+	0/+

Source: Meghna Estuary Study, 1998

RATING OF IMPACTS:

+ + Significant Positive Trend
+ Positive Trend
0 Present Baseline Condition
- Negative Trend
- - Significant Negative Trend

NOTES:

1. Intervention is erosion control and accretion promotion
2. Mitigation Required: Boat Centres and Construction Management
3. Contingency of Multi-Purpose Embankment Construction and Flood Proofing should still be considered
4. Increased positive impacts could come with formalised Resettlement Strategy on newly accreted land
5. Need to monitor Erosion/ Accretion and Construction Impacts

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6. ENVIRONMENTAL IMPACT ASSESSMENT

6.1 Assessment methodology

The impact assessment methodology has followed that outlined in the WARPO EIA Guidelines and manual to identify possible impacts, a comparative matrix having been used to do this. The matrix is given in Figure V.13 and allows the significant impacts (both positive and negative) of the proposed intervention to be identified. The analysis has been carried out using a comparison to a without project situation 25 years after construction. The analysis allows the impacts of the project to be separated from future trends that would occur irrespective of the intervention. The need for mitigation can also be identified and its effectiveness can be assessed. The final column allows the overall residual impacts to be seen. Of concern are those residual impacts which are negative, i.e. those impacts for which mitigation is either impossible or unable to prevent the post project situation being worse off than that before it, brought about as a result of the intervention.

6.2 Assessment by important environmental component

The results of the impact assessment are given below split firstly between positive impact and negative impact. The direction of the impact is viewed from the perspective of long term sustainable human use of resources. As the primary objective of the intervention is preservation of the current situation, the future with project situation is similar to the present situation. The major exception to this are additional indirect positive impacts created because residents have the confidence to invest more in the area as the flood risk is reduced, due to the fact that the existing embankment is less likely to be eroded. Thus the future without intervention situation is in decline for most components, whilst the with intervention situation keeps things at their present condition and in some cases improves it. The overall differences due to the intervention are given in column seven of the matrix.

6.3 Identified positive impacts

The primary positive impacts of the proposed intervention stem from preservation of the present situation by preventing bank erosion and some further benefits can be derived from promotion of additional accretion. In addition the risk of main river flooding is likely to be reduced as the CIP embankment will be under less erosion threat.

6.3.1 Reduction in erosion

The aim of the intervention is to reduce the present rate of erosion. The predicted benefits of this include:

- preventing the loss of immovable assets and public infrastructure and the need for constant replacement
- preventing the need for human relocation
- reducing levels of uncertainty, both economic and social, which will allow economic activity, in particular agriculture, homestead production and aquaculture, to develop without fear of loss and disruption.

6.3.2 Promotion of accretion

It is predicted that some accretion may occur adjacent to some of the existing islands close to the river bank. It is not yet possible to estimate the location and quantity of this possible accretion, but the project monitoring programme aims to collect this data as a matter of course. Whilst there are obvious benefits in promoting the development of new land, the economic use of this new resource is often marginal and long term. The land levels of newly accreted land are likely to remain low and it takes a considerable length of time for them to accrete above annual normal peak flood level. The recolonisation of these areas is normally of a seasonal nature and the predominant economic activity is animal grazing and some dry season farming, based around dry-land farming systems. A serious constraint is that soils are light and do not retain moisture as well as being low in organic matter.

6.3.3 Reduction in river flooding risk

A major benefit of reducing bank edge erosion is lessening the risk of erosion damage to the CIP embankment, and hence also the risk of river flooding in the embanked area. This is particularly important as when such an embankment fails it is often more difficult to drain the area behind it than if there were no embankment at all.

6.4 Identified negative impacts

6.4.1 Navigation

The main negative impact that could be created by successful intervention is likely to be on waterborne navigation. Successful promotion of sedimentation will prevent boats from entering the present ghats which are primarily located at the ends of eroded embankments, where the excavated borrow pit come drain and irrigation storage area creates a very good safe haven for boats and direct interchange with the road network.

6.4.2 Induced erosion to adjacent island chars

There is also a risk that prevention of erosion of the main river bank could cause erosion of some of the larger islands in the river channel, particularly the newly accreted char west of Haimchar. Discussion with people who have reclaimed their land rights on this island has indicated that even in their view, preservation of the main land is a higher priority than avoiding erosion of the island chars. The island char is of poor productivity being mainly used for seasonal grazing land.

6.4.3 Direct construction impacts

There are also likely to be some minor direct construction impacts, however as most erection will take place from specially adapted barges in the water, such impacts are likely to be significantly less than land based work. There is no requirement for significant land acquisition, compensation and resettlement.

6.5 Impact matrix, quantification and valuation

The results of the analysis are summarised in Figure V.13 and it can be clearly seen that there are no significant negative impacts that undermine the viability of the proposed intervention. As a result it was decided that a full EIA with quantification and valuation is not required. The quantification exercise that has been carried out is for benefit analysis and estimates the value of resources that would be saved from erosion if the intervention were successful. This forms the basis for the economic analysis for the proposed project.

7. EXTERNAL AND CUMULATIVE IMPACTS

7.1 Upstream constraints and impacts

There would appear to be no impacts created by the proposed intervention which will affect areas upstream. There are however proposed or recently constructed projects which may impose some changed conditions upon the proposed project. The main issue is the degree to which velocities and sediment levels in the river would change and the effects that would occur in the Meghna downstream of Chandpur. Specific projects are discussed below:

Jamuna multipurpose bridge

The construction of the Jamuna bridge has resulted in the peak flow width of the Jamuna river being restricted to 4.5 km width instead of 12 km. From the experience of the first two years flood conditions it would appear that the main effect has been to increase velocities through the restricted width rather than raise peak flood levels upstream of the bridge. The unknown factor is how much more sediment is likely to be put into transport and for how far downstream of the bridge. It would seem unlikely that there would be any significant impact downstream of the confluence with the Padma near Aricha, although the results of monitoring would need to be studied to verify this.

Ganges barrage and Gorai dredging

The proposed construction of a barrage across the Ganges just downstream of the Gorai intake would also be likely to affect the velocity and sediment load in the Meghna at Chandpur. In addition the objective of diverting water into a newly dredged Gorai system during low flow conditions may also cause changes in water volumes, flow velocities and sediment concentrations. Changes in the velocity of the Meghna may alter the effectiveness of the proposed Haimchar intervention, as could reductions in sediment amounts. Any EIA for these proposed projects should take this into account.

Other possible upstream interventions include a barrage on the Brahmaputra and development on the feeder rivers in Nepal, China and India. Only an integrated basin planning approach will be able to manage these issues in an environmentally sound and sustainable manner.

7.2 Downstream constraints and impacts

The one main possible downstream impact is that by affecting current patterns it may be that the island chars in the main river channel could experience reductions in sedimentation or even erosion. However this issue has been raised with people having land rights on the islands and there is a consensus view that prevention of mainland erosion is of far greater importance than possible loss of newly accreted islands that have low economic productivity.

7.3 Climate change and sea level rise

The scenario for sea level change in the Meghna estuary area is for a rise of 0.27 metres by the year 2030 (Ref: Bangladesh Unnayan Parishad, 1993). For offshore islands the recent natural rates of accretion are faster and higher than this. However the design of any proposed embankments, including the retired embankment at Haimchar, should take the predicted changes in sea level into account, although compared to the requirement to cope with cyclone surges, the added height needed is comparatively small.

7.4 Cumulative impacts

It is considered that there will be no significant cumulative impacts as a result of implementing the full intervention at Haimchar. Even if the technology used were proven to be successful and it was then used more widely across the MES area, the fact this it aims to preserve the present situation means there are unlikely to be significant cumulative impacts except to reduce the overall levels of bank erosion.

8. ENVIRONMENTAL MANAGEMENT

8.1 Mitigation measures

Due to the nature of the proposed intervention there are very few negative impacts and hence little need for mitigation measures. If found necessary, then any induced disruption to waterborne navigation can be mitigated for by the construction of carefully located boat centres as recommended and costed in the BIWTA study (Ref: BIWTA, 1994).

The predicted effects of environmental mitigation programmes can be seen in Figure V.12 by deducting column six from column eight.

8.2 Environmental enhancements

The scope for environmental enhancement is to ensure that the construction process is reviewed so that appropriate construction management techniques can be incorporated which minimise any negative impacts and maximise the positive ones, particularly the availability of temporary wage paid employment on the construction works.

8.3 Compensation measures

There is no major requirement for compensation measures as there is no major land acquisition required for the construction of the intervention as it lies in the river channel or in the case of the cross dams, the short pieces linking them to the road lie on existing roads or within the existing land take of drains. The only compensation measure that may be required is for navigation as outlined in Section 8.1 above.

8.4 Environmental risk and contingency planning

As stated in Section 7.2 above, it is considered imperative to retire the existing embankment as a matter of great urgency, irrespective of the proposed erosion control intervention. Such a step will also act as a contingency if the intervention were to prove unsuccessful, bearing in mind that such technology has not be used before in Bangladesh.

8.5 Environmental monitoring requirements

There will be a need to regularly monitor erosion and accretion patterns in the area using time series satellite imagery. Such work will indicate the effectiveness of the intervention and also any induced impacts on navigation and particularly induced erosion to the mid-channel island chars.

An environmental monitoring programme for construction operations will also need to be set in place so that potential problems can be identified in advance and steps taken to avoid or minimise negative impacts. A master checklist for such work has been prepared and is given as Annex E. With care a well implemented construction management plan can provide additional benefits.

8.6 Quantified and costed EMP

It is not considered necessary to have a quantified and costed environmental management plan as the main requirement for monitoring erosion and accretion will be incorporated into the technical assistance for the project as it is an intrinsic part of the monitoring and evaluation of the performance of the project.

8.7 Institutional management of the EMP

The monitoring programme is an intrinsic part of the project implementation process. The review of the construction programme to ensure that environmental issues are adequately addressed in the implementation of the works would be part of the technical assistance programme for the on-going MES work. Institutionally this should eventually be carried out by the environmental planning cell being established at WARPO under the National Water Management Plan, along with a coastal zone planning capability.

8.8 Residual impacts

The possible residual environmental impacts can be seen in the last column of the matrix. The only negative residual impact is likely to be induced erosion of the mid-river char land. There is nothing that can realistically be done to prevent this erosion, if it should occur, and the overwhelming feeling of local people is that it is a small and justifiable price to pay for prevention of main river bank erosion. Consideration could be given as to appropriate measures for resettlement and reduction in livelihood loss for the people who are seasonally resident and use the area.

9. CONCLUSIONS, RECOMMENDATIONS, FUTURE WORK PROGRAMME

9.1 Conclusions

The main conclusion of the environmental assessment is that an Initial Environmental Examination is sufficient for the project and falls within the requirements of the Department of Environment EIA Guidelines. A full EIA with quantification and valuation is not required. It is apparent that the benefits of successful implementation far outweigh the potential negative impacts, all but one of which can be mitigated for at an acceptable cost, should they occur. It should be remembered that the primary aim of the intervention is to preserve the present situation.

The main potential negative impact is possible induced erosion to the large island char in the main river channel. However, even the people with land rights in this area agree that preventing erosion on the mainland is of a much higher priority.

9.2 Recommendations

The recommendation from the environmental analysis is for the intervention to go ahead as soon as possible. The initial trial of the vanes and screens has commenced and is due to be monitored once the 1998 monsoon water levels have fallen.

However due to the fact that the existing embankment is under immediate threat of erosion it is considered imperative that it be retired to the predicted 10 year erosion line, preferably by upgrading an existing road alignment, so as to minimise the negative impacts of land acquisition. In addition a programme of homestead flood proofing should be instigated in the areas on the non-embanked side of all retired embankments.

The main mitigation measure that could be required is to construct two boat centres for navigation, assuming that the trail is successful and any resulting accretion creates problems with boat access to the eroded end of the embankments which act as Ghats and fish markets.

A monitoring programme for identifying and quantifying induced erosion and accretion patterns needs to be established using time series satellite imagery in a similar manner to that used for analysing historical erosion patterns for the present studies. The analysis should include the large emerging char in the main river channel.

A construction impact monitoring and management programme should be implemented using the checklist attached as Appendix E.

9.3 Future environmental work programme

It is proposed that the recommendations given above would be implemented as part of the on-going project activities. The monitoring programme for erosion and accretion patterns is a continuation of the existing studies and would be used to observe the effectiveness of the intervention and identify the need for mitigation measures, particularly the provision of boat centres for waterborne navigation. The monitoring will also indicate if induced erosion to the large island char is taking place, prevention of which is not possible but consideration may need to be given to the resettlement and livelihood needs of people seasonally resident there. The management of any direct construction impacts should be implemented as part of normal engineering supervision using the checklist given in Appendix E.

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APPENDICES

LIST OF PHOTOGRAPHIC PLATES IN

APPENDIX 1

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Plate 1: Bank erosion Hanar Char, looking north, eroded end of CIP embankment, March 1998.

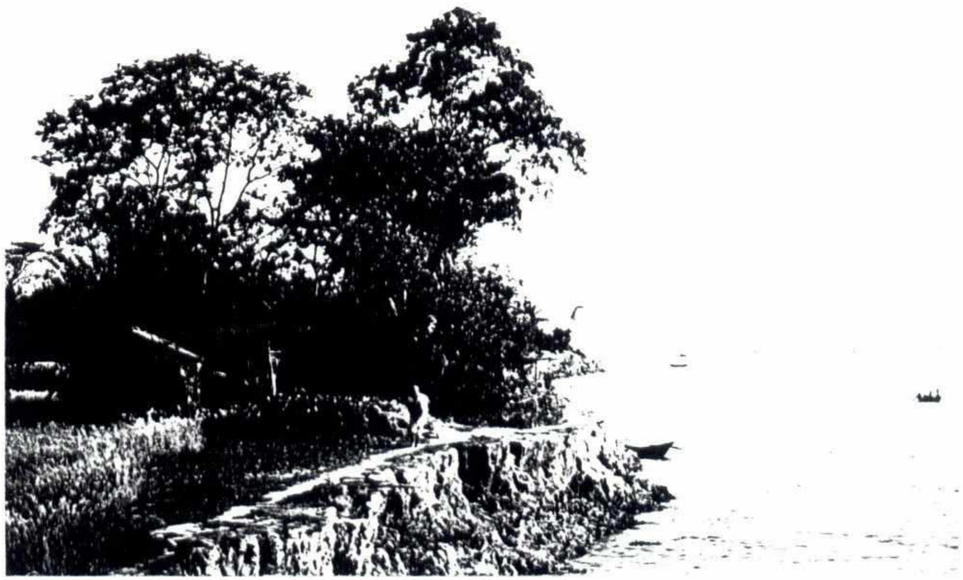

Plate 2: Bank erosion Hanar Char, looking south, March 1998.

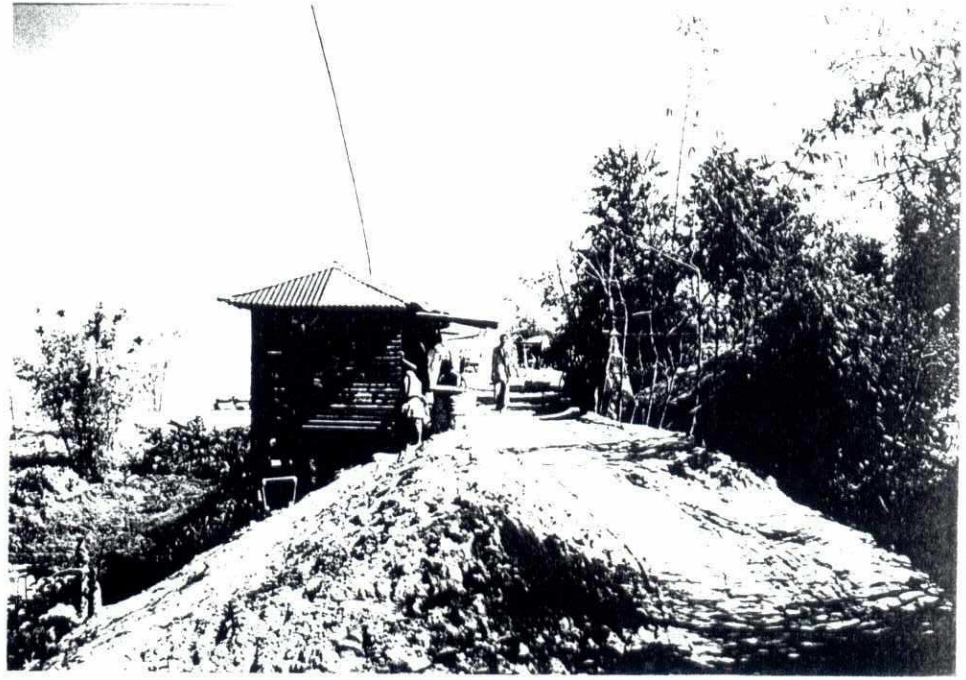

Plate 3: End of the CIP embankment, Gazipur Union, looking north, March 1998.

Plate 4: Bank erosion at Gazipur looking northwards to eroded end of CIP embankment, March 1998.

Plate 5: Bank erosion, Char Saladi Mauza (north Haim Char), looking south, March 1998.

Plate 6: Bank erosion, Char Saladi Mauza (north Haim Char), looking north, March 1998.

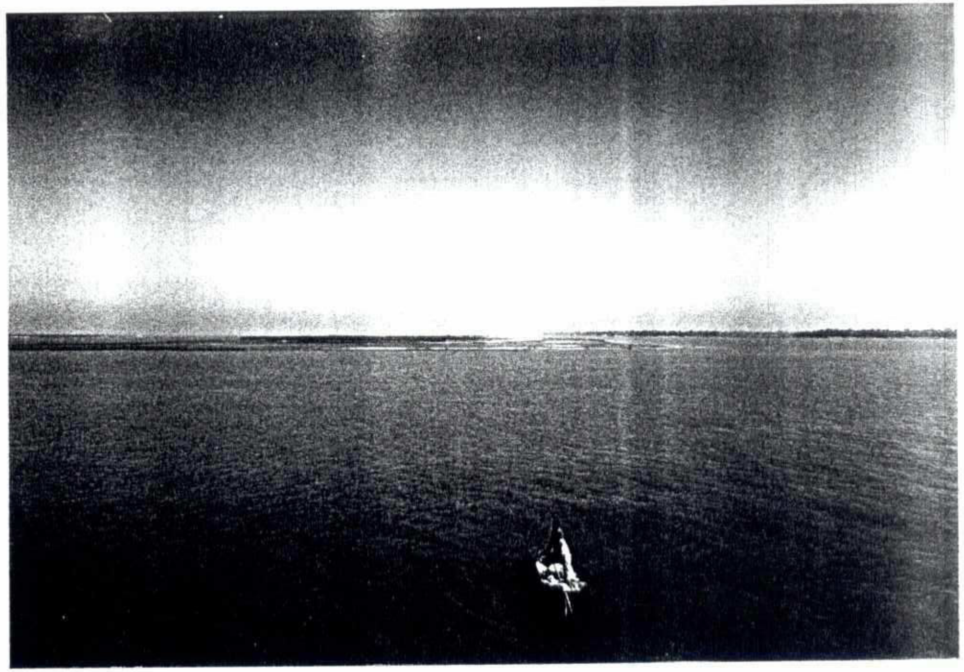

Plate 7: Newly accreted Char lands west of Gizipur, looking west, March 1998.

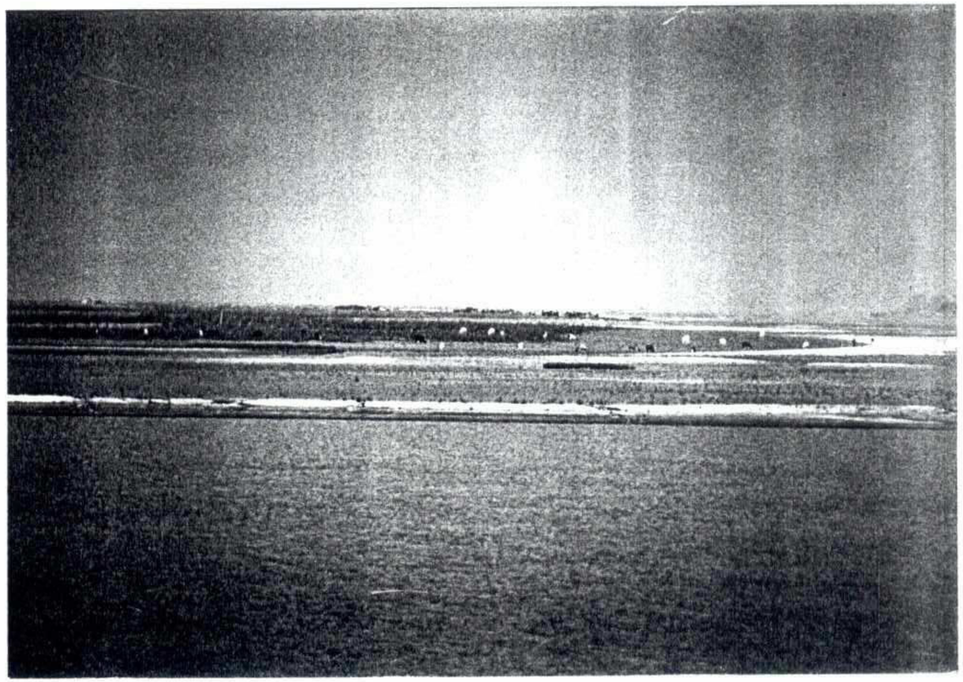

Plate 8: Large accreted Char land (Nilkamal Union), south west of Gazipur, used for grazing land, looking south west, March 1998

Plate 9: Erosion displaced household at Hanar Char packing up their belongings to move away, March 1998.

Plate 10: Union Health Centre, Hanar Char, March 1998 now lost to the river

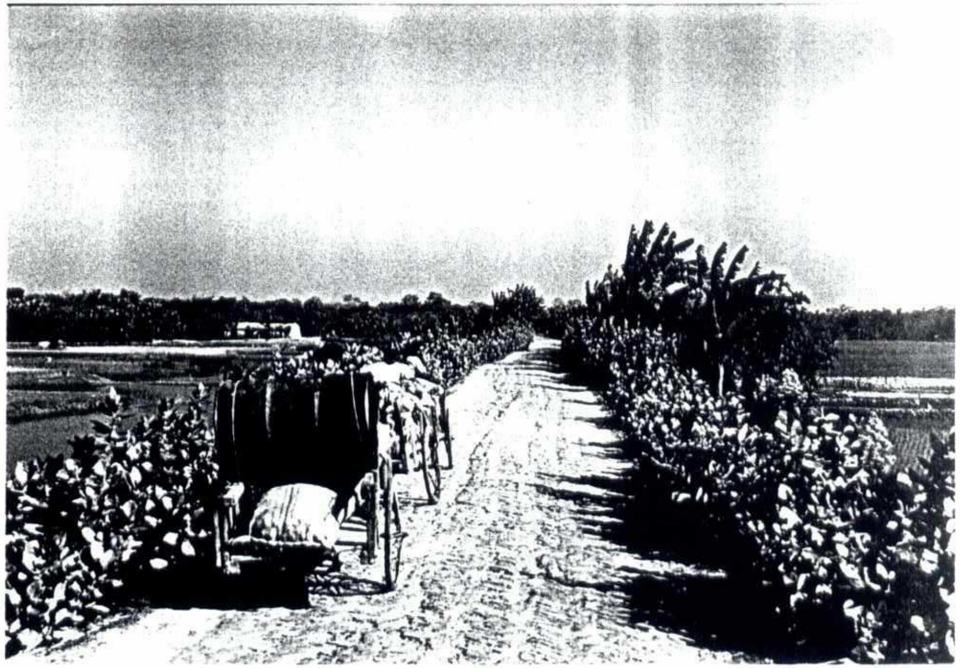

Plate 11: Retired CIP western embankment at Chandra Union, looking north, area to west requires flood-proofing, March 1998.

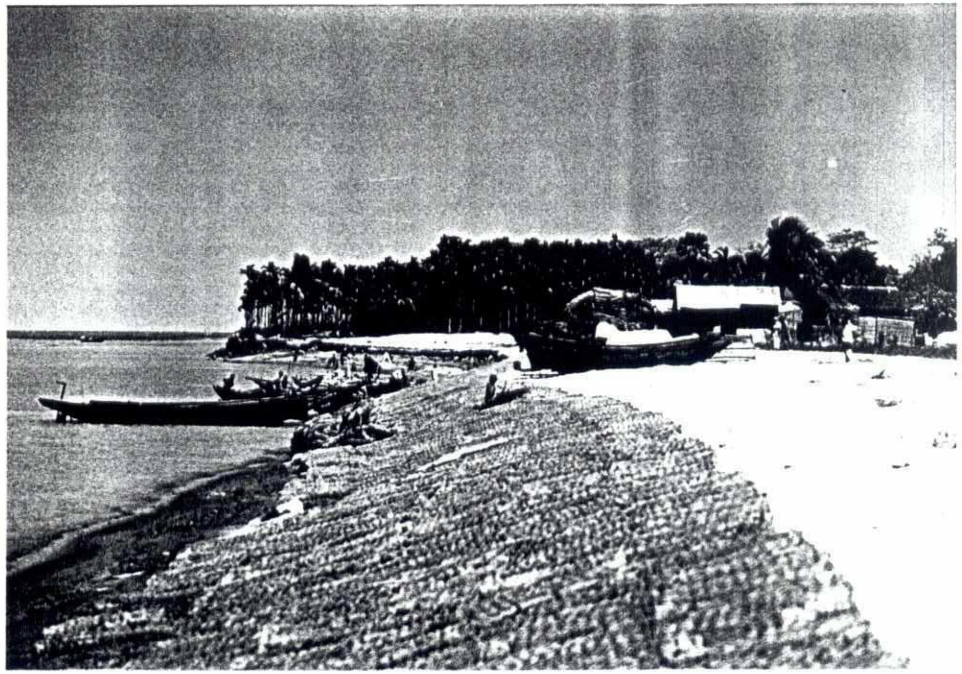

Plate 12: BWDB works for wave protection, Haim Char south, looking north, March 1998.

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Plate 13: Erosion displaced households on the landward berm of the CIP embankment at Hanar Char, looking north east, March 1998.

Plate 14: Erosion displaced households on CIP embankment, Char Bhairabi, note damage to embankment, looking south, March 1998.

Plate 15: Bank erosion, Char Saladi Mauza (north Haim Char), abandoned house plinths and latrine, looking south, March 1998.

ENVIRONMENTAL CONTACTS AND LIAISON

Considerable liaison with other studies, projects and organisations has taken place during the course of the MES and also prior to this by study staff working on related programmes. The following people and organisations have been contacted with specific reference to environmental aspects in the Study Area:

Char Development and Settlement Project (CDSP) Mission
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Habibur Rahman, Social Worker, Char Hare, Hatia

Ministry of Establishment
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DPHE, Noakhali
Abdul Hafiz, Executive Engineer
Monu Miah, Head Assistant
Rafique, Sub-Assistant Engineer

Ministry of Water Resources
Water Resources Planning Organisation
Mohammed Shahjahan, Economist

Bangladesh Water Development Board (BWDB), Hatia
Mohammad Ali, SDE, Hatia

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Tim Martin, GIS Project Advisor
Ian Tod, ex Team Leader FAP 23, Flood Proofing
Paul Thompson, ex Team Leader, FAP 16 Meghna Charland Inventory

Land Reclamation Project
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Char Development and Settlement Project
Arend van Riessen, Team Leader
A K Biswas, Administrative Officer

Cyclone Protection Project/CERP I
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Ron Bastin, Social Development Advisor

Coastal Embankment Rehabilitation Project (CERPII)
Peter Diack, Engineer

Cyclone Shelter Project
Martin Gillham, Team Leader
James Goodman, Engineer
Linda Thorn, Social Planner

FAP 5 South East Regional Study
Patricia Almada-Villela, Ecologist and Fisheries Specialist

FAP 4 South West Regional Study
Malcolm Wallace

South West Area Water Resources Development Project
Frank Cooper, Senior Design Engineer

Systems Rehabilitation Project (SRP)
Robert West, Training Specialist
Jennifer Duyne, Socio-economic Advisor/Participation Specialist
Frank Cooper, Senior Engineer
Syed Latif, Environmentalist

Jamalpur Project Refinement Study (FAP 3.1)
Chris Swayne, Team Leader
S Hussain, Agro-Economist
K Mitra, Sociologist/Participation Specialist

FAP 20 Compartmentalisation Pilot Programme (CPP)
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FAP 6 North East Regional Study
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National Minor Irrigation Development Project (NMIDP)
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Jaco Mebius, Environmental Monitoring Component

Nine Towns Water Supply and Sanitation Project
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Department of Roads and Highways, Noakhali
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Bashir Ahmed, Oskhali Inspection Bungalow, Hatia

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Parvin Sultana, former Resettlement Specialist
Paul Thompson, former Resettlement Specialist

Inland Water Transport III Environmental Component
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Mustafa Zaman Mallick

Bangladesh Bureau of Statistics
Ataul Haque, Director General

Bangladesh Standards and Testing Institution, Dhaka
Anwar Hossain, Deputy Director

Soil Resources Development Institute
Mustafizur Rahman, Director
S.M.Shaheed, Ex Director
Abdul Wadud, Chief Scientific Officer
Majibur Rahman, Senior Scientific Officer
Mainuddin Ahmed, Senior Scientific Officer

International Centre for Diarrhoeal Disease Research,Bangladesh
Md.Sirajul Islam, Scientist and Head Environmental Microbiology Laboratory
Md Jahangir Alam, Senior Research Officer

International Union for the Conservation of Nature and Natural Resources (IUCN)
Nargis Banu Joardar, Ecologist

International Center for Living Aquatic Resources Management (ICLARM)
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Bangladesh University of Engineering and Technology (BUET)
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Dhaka University
Nazrul Islam, Professor of Botany

Jahangirnagar University
Anwarul Islam, Professor of Zoology

Bangladesh Agricultural University, Mymensingh
Dr M Shahisul Haque, Professor, Department of Food Technology and Rural Industries

Bangladesh National Herbarium
Dr Matiur Rahman, Director
Dr Salar Khan, Advisor
Md Oliur Rahman, Research Officer

Norwegian Embassy
Ryder Kvam, Country Boats Improvement Project

IFADEP
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Parvin Sultana, Evaluation Specialist

CARE
Andrew Sayles, Co-ordinator IFFD Project
Kevin Fitzcharies, Training Co-ordinator IFFD
Ian Tod, Flood Proofing Specialist

CONCERN
John Kilkenny, Country Director
Pradip Sanyal, Programme Manager
Donna Mooney, Technical Support Officer, Environmental Health

International Federation of Red Cross and Red Crescent Societies
Bob Storey, DPP Development Delegate

Centre for Women and Child Development
Azam Ali, Public Health Specialist
Afsana Wahab, Women and Child Development Specialist

CAPRe (Research Foundation assessing NGO Performance)
Jorge Barenstein

Bangladesh Centre for Advanced Studies (BCAS)
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Environmental Quality Laboratory (EQUAL)
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Alam, Laboratory Chief

Coastal Area Resource Development and Management Association (CARDMA)
Hasna Moudud

BIRTAN, Noakhali
Golam Kibria, Accountant
Abu Taher, Field Assistant

Dwip Unnayan Songstha (Hatia based NGO)
Matt Griffiths
Md. Rafiq Alam

Individuals:
Don Brown, formerly Team Leader for FAP 3
Mike Dapplyn, formerly Team Leader for FAP 12
Parvin Saltana, formerly Co-Team Leader for FAP 12
Paul Thompson, formerly Team Leader for FAP 13

ELECTED REPRESENTATIVES:
Abul Kalam, Chairman, Jahajmara Union Parishad, Jahajmara, Hatia
Jamal Uddin Mohammad, Union Parishad Member, Jahajmara, Hatia
Mohiuddin Mohammad, Union Parishad Member, Jahajmara, Hatia
Khabirul Haq Belal, Union Parishad Member, Jahajmara, Hatia
Abul Kalam Azad, Union Parishad Member, Char Macpherson Mauza, Jahajmara Union, Hatia
Abdul Jalil, Union Parishad Member, Char Hare Mauza, Jahajmara Union, Hatia

CONSTRUCTION IMPACT CHECKLIST FOR EMBANKMENT WORKS IN BANGLADESH

This checklist was drawn-up following an environmental audit of the Coastal Embankment Rehabilitation Project whilst it was under construction in September 1993. It can easily be adapted for other locations and types of construction programmes in Bangladesh.

1. Background Information:

Phase Number:
Section Name:
Construction Contract No
Name of Main Contractor:

2. Nature of the Works:

Total Length of Embankment in Contract:
Length to be Re-sectioned:
Length to be Retired:
Length to be Revetment:

Numbers of Households to be Resettled on each:

Number of Structures to be Built/Rebuilt:

3. Details of the Contract:

Total Contract Duration and Times:

Work Programme/Phasing: (mark locations up on map), Phased/Staggered?

Critical Programme Operations:
- Priority Works
- Seasonal Constraints (include monsoon flood risk)

Land Access Needs - areas and phasing:
- Degree of Simultaneous Working

Nature and Degree of Supervising Engineers Control over the Contractor:

Existing Health and Safety Legislation:
- Adequate? Appropriate? Enforceable? Enforced?

4. Construction Operations:

Land Access requirements/arrangements to site:
- for site investigations
- construction
  - mobilisation date
  - permanent works
  - temporary works (e.g.borrow areas, workshop areas)
- Negotiation/leasing Arrangements for Land:
- Specific Difficulties Incurred:

Excavation/Stripping:
- Depths and areas:
- Plant/Techniques Used

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- Manual Labour
- Bulldozer/Scraper
- Plough

- Tree/Scrub Removal: (problems with Forestry Department Cover?)

Fill:
- Materials
- Quantities
- Sources

Structures:
- Types
- Sizes
- Materials Required

Construction Technology:
- Labour Intensive, Mechanised or both

5. Construction Labour:

Maximum Number of Labourers to be Employed:
Skills Required:
Source of Labour:
Living Accommodation Arrangements:
Water Supply and Sanitation Arrangements:
Labour Health Checks:
- Infectious/transmitted diseases

Electricity Supply:
- Generators or mains?

Accident Emergency Facilities:
- First Aid Facilities
- Radio/Telephone Contact
- Emergency Medical Arrangements

6. Construction Plant and Machinery:

Types and Numbers of Plant to be used for what operations:
- Excavation - Excavators, Bulldozers, Scrapers, Tractors, Ploughs
- Fill Placement - Trucks, Tippers, Front-end Loaders, Graders
- Fill Compaction - Water Bowsers, Rollers
- Other Materials Transportation - Trucks, tippers, Low Loaders
- Materials Crushing Plants
- Concrete Batching Plants and Mixers
- Cranes
- Dewatering Pumps

Experience and Skills of operators:
Driver Training and Safety Awareness:
Workshops - Central Provision and/or Field Sites
Fabrication Yards - Location/Access, Materials, Equipment
Workshop, Stores and Fabrication Yards
- Pollution and Material Storage Hazards

Laboratories - locations, machinery, chemical storage/handling

7. Construction Materials and Sources:

Transportation Issues: volumes, distance, type of transport,
- Road -tipper trucks, size/volumes, routes, speeds, road access, bridge weight loadings, loading and unloading requirements
- Rail
- Boat

Fill Materials: -Specification, suitable sources
- Embankments -borrow pit strategy, locations, depths, extents, land acquisition and compensation arrangements, permanent or temporary acquisition? reinstatement? reuse as aquaculture ponds?
- General Principals- all fill as far as possible from river side of embankment, distances, routes

Protection/Pitching:
- stone, sources, crushing and grading, where and how?
- concrete, what aggregate to be used? Where mixed/batched?
- aggregate, sources, types, sizes, volumes. Where Crushed
- gravel/shingle, sources, transport, handling, washing, grading, stockpiling
- sand, sources, handling, stockpiling, drying
- cement, sources, handling, bulk or bagged? silos?
- brick requirement- minimise as much as possible, problem of fuel wood requirement of this, however labour requirements for hand crushing have overall social and economic benefits

Geo-textiles: Use of local materials, imported geo-textiles now officially banned

Steel: Quality and Quantity Requirements, Types- Plate, bars etc
Sources, Transport/Handling, Fabrication, Erection

Formwork - materials used, reusable? Standard sizes

Gates - Fabrication/Erection- practices and procedures

8. Other Issues:

- Noise and dust pollution. Siting of crushing plants, prevailing wind direction, generator siting and operation
- Days and hours of work, night-time work, Friday work.
- Disturbance to residents
- Disruption of existing communications routes
- Demolition of old structures
- Reinstatement/Turfing after construction
- Dredging will require special consideration

9. Open Comments:

Supervising Engineers:

Contractors:

Local People:

10. Summary of Main Issues: