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INCEPTION REPORT

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CONTENTS OF THE INCEPTION REPORT

ANNEX 05

WATER MANAGEMENT AND DRAINAGE

TABLE OF CONTENTS ANNEX 05

1 INTRODUCTION

In general, agriculture in the coastal area is less developed compared to other parts of Bangladesh. Agriculture in the coastal area is characterised by lower cropping intensities, lower yields and little crop diversification.

Salinity, drainage congestion and poor water management are among the important factors that contribute to unfavourable agricultural conditions in the coastal area. A brief description of drainage, salinity and water management problems is given hereafter and where possible directions for improvements are suggested.

Finally a brief overview is presented of water management aspects during the process of formation and development of new land as it happens so far in the estuary.

2 INTERNAL DRAINAGE

2.1 Floods and Drainage in Coastal Lands

Unprotected lands located in the estuary are frequently flooded by tidal floods carrying saline water as well as fresh water floods caused by high rainfall. Both happen mainly during the monsoon. Such lands are drained by a natural network of branched channels (khals) capable to convey large volumes of excess fresh and saline surface water back to surrounding open waters in a fairly short period of time.

In the case of lands protected by embankments, only rainfall remains as a source of floods. Harmful floods occur when excess rainfall can not be evacuated in time due to an inadequate drainage system. Poor functioning surface drainage systems have resulted in drainage congestion and water logging due to a low permeability of subsoils. Water logging is an unfavourable condition for standing crops, even in the case of rice.

Severe drainage congestion and water logging problems have been observed by LRP in accreted coastal lands south of Noakhali. This area is characterised by a slow but on-going accretion of land. In accreting areas, drainage problems are further aggravated by sedimentation of an inland arterial drainage system, prior to the construction of embankments, as well as sedimentation of natural drainage outfalls. An example of sedimentation of a drainage outfall is the large Noakhali Khal of the South Sudharam area, south of Noakhali.

2.2 Causes of Internal Drainage Problems

Inadequate drainage scheme in coastal areas seems to be the result of an insufficient drainage density and overall drainage capacity in combination with a poor operation of drainage sluices. LRP found in South Sudharam that drainage problems do start after the construction of embankments and sluices, despite that this stopped rapid sedimentation of the drains.

After the construction of embankments and main sluices, it is assumed that the existing natural drainage network consisting of branched khals provides sufficient drainage capacity for the polder. Little is known whether this is indeed the case. Drainage sluices are costly and not all khals with a connection to open water have been provided with a drainage sluice, which means that some have been blocked by protection embankments.

However, it is more likely that the gradual deterioration of the drainage condition is much more the result of a gradual development of a physical infrastructure inside the polder. A development which had become possible after construction of protection embankments.

Such infrastructure, notably those of roads and footpaths interfere with the existing drainage network. Observations of SRP, EIP and LRP in existing polders show a) rural roads and foot paths with insufficient culvert capacity, b) the use of crossdams in stead of bridges, notably for road construction under food for work schemes c) fishing methods practised in main drains which obstruct a free flow of water d) drainage sluices with too large catchment areas as a result of a changed drainage pattern and e) poor operation of drainage sluices.

2.3 Adaptation to or Improvement of Drainage Conditions

Solving the problem of drainage congestion can be approached in basically two ways. One way is to promote adaptation to existing unfavourable drainage conditions, and the other way is to try to reduce drainage congestion and water logging through improvement of the surface drainage system. Since it will require considerable investments and time to improve existing drainage schemes, the potential of both ways needs to be examined.

Flooding due to excessive rainfall has a negative impact on crop production. The extent of crop damage depends on adaptations made by farmers to reduce the risk of partial or complete crop failure. According to LRP, farmers in areas prone to flooding are well aware of the need for adaptation and have taken risk-reducing measures.

Techniques already practised by rice growing farmers are, a) replanting of Aman rice in case of flooding during early growth stages (using an excess of plants from seedbeds), b) the use of long stem Aman rice varieties with a higher tolerance for larger water depths and c) the cultivation of Aus in the pre-Kharif season or irrigated Boro rice in the dry Rabi season in deep depressions which are flooded during the monsoon and where even long stem Aman can no longer be cultivated (Begumganj depression).

Since the present agricultural production in coastal areas is most probably well adapted to local conditions one may expect a rather limited scope for further improvement. However, if higher agricultural production levels are desired by farmers as well as by the Government, gradual improvement of existing drainage schemes in coastal areas is the only option left.

2.4 Drainage Criteria and Requirements

Criteria for development of drainage schemes are hardly specified. Also CDSP found it extremely difficult to trace criteria for design discharges, drainage density and layout of a drainage network presently used by BWDB.

In the case of SRP, Polder 55/1, the only known criterion was an overall design discharge of 40 mm/day defined in the late sixties for the Coastal Embankment Project by Leedshill - De Leuw. Experiences of SRP show that this will be even more difficult in the case of drainage criteria used by LGED, responsible for the provision of bridges and culverts in rural roads. Such criteria were not known to BWDB, and vice versa.

A critical factor in establishing surface water drainage criteria are the agricultural requirements, especially those for the main crop, Aman rice. LRP studies for Char Baggar Dona defined that a drainage capacity of 123 mm/day is required in that case. However, a capacity of 40 mm/day, restricting yield reduction to a maximum of 50% once in five years, and in line with the BWDB criteria for coastal areas, was considered more realistic seen. The main reason for this were the expected costs required to improve drainage schemes beyond this criterion.

LRP found that in the case of South Sudharam area that this drainage criterion of 40 mm/day was far from fulfilled. Based on findings of SRP, EIP and LRP, similar conditions can be found in many other polders of the coastal area.

Therefore, a first step in these polders will be to bring the drainage capacity back to its original design discharge of 40 mm/day. In most cases such a step does not involve costly modification of existing drainage sluices.

As far as the density of drains and layout of drains is concerned, some recommendations have been made by LRP. Similar to the system applied in the LRP pilot polder, the proposed drainage system consist of primary drains, main natural khals, with a spacing of 2000 to 3000 meters, supplemented by a system of secondary drains, minor khals, with a spacing of around 1000 to 2000 meters. These secondary drains convey excess water from blocks of 30 to 40 ha. Small tertiary drains need to be constructed to allow all the plots access to the drainage system.

2.5 Improvements of the Drainage System

It is the question whether the focus of present studies should be on elaborating more detailed design criteria for discharge, density and layout of drainage systems. First of all, costs of improvements need to be kept as low as possible and secondly, much may be gained in existing polders by removing obvious bottlenecks in the present drainage schemes through co-ordination between BWDB and agencies such as LGED, MOF and last but not least by involving Water Users Organisations in planning, construction and O&M of drainage systems.

The same holds for future priority project areas of MES and most probably as well for new polders. The layout of the primary and secondary drainage system will, by and large, be defined by a natural khal system that follows natural depressions, which are formed during the accretion phase. According to LRP, accretions that have reached HWL still require 10 to 15 years more to reach a level that allows for reclamation. By then, the land will be fully used by temporary or more permanent settlers for grazing and Aman cultivation. After construction of a protecting embankment and drainage sluices, the capacity and density of a primary and to some extent a secondary drainage network may be checked and where required slightly modified.
Further, improvements may not be justified since agricultural production in newly reclaimed land is low due to an initial high salinity level.

As salinity levels reduce over the years, new investments in further improving the surface drainage network are justified, especially when cultivation of HYV Aman and Rabi crops becomes a real possibility. Much will depend on the need felt by farmers on whose land new drains need to be excavated. In line with the guidelines for people participation, farmers should be involved in planning, construction and maintenance of such drains.

In short, possible measurements which may improve drainage systems of polders are in principle, a) modification and re-excavation of the present main drainage system consisting of primary and secondary khals in close co-operation with LGED and MOF, b) promotion among farmers of tertiary drains to increase the density of the existing drainage network in line with findings of LRP and c) if necessary, modification of existing sluices with too large catchment areas. The institutional framework required for such improvements will be discussed later under water management.

3 SALINITY

3.1 Existing Situation

A second agricultural constraint in the coastal area, besides drainage congestion, is salinity. The first, but in most cases the only crop grown, in the coastal area is Aman rice. Aman is grown during the monsoon, the Kharif season. High soil salinity levels prevent most farmers from introducing crops in the Rabi and pre-Kharif seasons.

According to LRP it takes at least 4 to 5 years after the construction of embankments before salinity levels are sufficiently reduced to allow other crops than low yielding saline tolerant Aman varieties. Desalinisation of newly accreted land is a natural, but slow process.

Soil salinity levels differ much throughout the year. During the monsoon, July to October, top soils are slightly saline when abundant rainfall dilutes salts of the upper soil layer. After the rains, from November onwards, salinity increases again, reaching a peak in March and April. By then, soils are strongly affected by salinity in the dry season.

Field research in the pilot polder of LRP revealed that during the monsoon significant desalinisation takes place when excess rainfall can percolate through the saline subsoil. By this leaching process salts are washed down till they reach a deep groundwater flow in more sandy layers starting at 3 to 5 meters below groundlevel. A deep groundwater drainage flow in the period of July to November, draining a total of 500 to 1000 mm was found to be the main agent for desalinisation.

This desalinisation effect is nearly neutralised by a resalinisation of the topsoil, caused by a capillary rise of still saline subsoil groundwater. This process starts in November, when evaporation losses exceed rainfall. LRP found in the pilot polder that topsoils and subsoils of accreted land to a depth of 3 meters below groundlevel consist of layers of very fine sandy loam, silty loam and silty clay loam. These medium textured soils posses strong capillary characteristics. According to LRP this explains the sharp and deep fall of the water table shortly after the monsoon, upto 5 meters deep, even below the average drainage level estimated around 2 to 3 meters deep during the months of December till May.

For farmers such soils mean two things. Considerable soil moisture will be available for the cultivation of Rabi crops, even if the water table is at a depth of 2 to 3 meters. At the other hand, the capillary rise of water will also bring up salts from the subsoil, which accumulate in the topsoil and damage standing crops. Therefore introduction of Rabi crops will become possible when mid-monsoon salinity levels drop below EC_e values of 5 to 10 mS/cm and pre-monsoon levels stay below 15 mS/cm.

3.2 Desalinisation

The general principle of reclaiming saline soils comprises the following sequence,
- Prevention of further salinisation or resalinisation,
- Leaching of salts,
- Replacement of exchangeable sodium by exchangeable calcium.

Natural desalinisation of land starts during accretion and mid-monsoon EC_e values may be lowered by 50 percent, from 30 to 40 mS/cm to levels as low as 15 to 20 mS/cm. These lower salinity levels allow the cultivation of salt tolerant, but low yielding, Aman varieties during the monsoon. In the final stages of accretion land level will approach high water levels (HWL). Flooding with saline water occurs less frequent and mainly during the monsoon when the tides are higher.

Prevention of resalinisation through tidal floods of saline water is realised after the construction of flood protection embankments and sluices. Further desalinisation depends on the existence of a deep drainage flow that can remove salts from the subsoils and reduce resalinisation of the topsoil in the dry season. Although resalinisation is accelerated by the construction of embankments and sluices, such protection will also stop further accretion and thus further rising of land levels. It may be expected that high land levels favour deep drainage since in most cases water levels of the Bay of Bengal form the ultimate drainage base.

Measurements to further accelerate the desalination process studied by LRP are,

- Flushing of plots,
- Levelling and bunding,
- Construction of minor drains,
- Re-excavation of main drains, khals,

Desalinisation of the top soil by flushing techniques , as practised by some farmers, should be considered only an additional measure with a limited effect.

Adequate levelling and bunding favours ponding of fresh rain water may increase the percentage of rainfall that percolates through the subsoil. The cultivation of wet rice, using salt tolerant Aman varieties, favours desalinisation.

Minor drains and field drains with a depth of 1 to 2 meters will improve the drainage of polder lands, and for example be able to meet drainage requirements of Rabi crops allowing a favourable early start. Such drains are very useful to improve surface drainage conditions. Due to low transmissivity of subsoil layers, subsurface drainage is of less importance and these drains are not deep and large enough to contribute to deep drainage, the main factor in desalinisation.

Re-excavation of main khals will lower the base level for drainage. Deep drainage and thus leaching of salts is expected to be stimulated by re-excavation of khals forming the main drainage system.

Irrigation will reduce the capillary rise and thus resalinisation. However the main problem is the availability of fresh water during the dry season stored in the ground or in surface water bodies. Flushing in of fresh water is an option. However, during the dry season the volume of fresh water conveyed by the Meghna reduces considerable and water in the Bay of Bengal is more saline. Experiences in SRP show that the situation may still be favourable in the north west corner of the estuary, along the Tetulia river. In the case of Polder 55/1, the period of saline water, more than 1.5 to 2 mS/cm, in rivers surrounding the polder is limited to March and April only. Since large khals exist inside the polder, fresh water may be flushed in, stored and used for irrigation.

4 WATER MANAGEMENT

4.1 Land and Water Use

The two most important forms of land and water use are agriculture and fisheries. The scope for agriculture is much enlarged by the construction of protecting embankments and sluices, whereas the traditional form of fisheries is often negatively influenced by empolderment.

Before empolderment the unprotected charland is used for grazing and later on for the cultivation of salt-tolerant Aman rice varieties during the monsoon. After the construction of a protection embankment and drainage sluices, the cultivation of salt-tolerant Aman varieties continues till the soil salinity level is low enough to allow other high yielding Aman varieties. LRP found that such soil salinity levels may be reached 4 to 5 years after the construction of embankments and sluices. Besides lower salinity levels, these short stem varieties require a more strict water control. Too high water levels during the initial stage of the crop may reduce yields considerably. Sluices with a lifetime of approximately 20 years should therefore take into account the drainage requirements of future crops, such as high yielding Aman varieties. A drainage module of 40 mm/day, as mentioned earlier in this annex, seems to be acceptable in this case allowing a probability of flooding of once in five years.

Besides high yielding Aman varieties during the Kharif season (July-October), a second crop in the Rabi season (November-February) will become possible as salinity levels go down. Salt tolerant Rabi crops are Khesari and linseed. More profitable Rabi crops such as potato, wheat and improved pulses and oil crops require lower salinity levels and supplementary irrigation. Apart from salinity, drainage plays also an important role. The timely cultivation of Rabi crops depends to a large extent on an adequate drainage of the plots. A late start results in yield losses due to drought and resalinisation. Capillary resalinisation starts in December and becomes more pronounced in February and March.

A third crop, in coastal areas is Aus rice. This crop is grown in the pre-Kharif season (March-July).Traditionally Aus is a rainfed crop grown in depressions where excess rain water from fairly unreliable pre-Kharif rains can accumulate. However, timely cultivation of Aus rice at a larger scale requires supplementary irrigation. Especially in the month of April and May a considerable supply of fresh water is needed. Since fresh shallow groundwater is not available, in the coastal area, water supply has to come from available fresh surface water using small Low Lift Pumps. The latter may be an option in the Tetulia river for chars between Bhola and the western coast line and boundary of the MES project area. HYV Boro rice cultivation (January-April) is not very popular in the coastal area. Salinity, but also the full irrigation requirements as well as a need for costly inputs such as fertiliser may be reasons that Boro is less grown in this part of Bangladesh.
Fish forms an important source of protein in coastal areas. The construction of protection embankments and sluices prevent tidal flooding as well as fish fry from entering ponds and the natural drainage system. If no mitigating measures are taken, this situation will greatly reduce the catch of fish for protected lands. Solutions for this problem are less known and most probably have to be found in promotion of improved fish cultivation in appropriate ponds. Borrow pits, used for road and embankment construction, if properly sized, may be used for improved fish cultivation.

4.2 Internal Embankments, Roads and Drains

The layout road and drain or khal embankments inside new empoldered land should take into account a number of aspects such as,

- The existing infrastructure of the old land as well as the future requirements. This refers in particular to,

  - Drainage of the old polder. New polders should not impede the drainage of old poldersand the drainage system of the new polder should be integrated with the existing drainage pattern of adjacent lands.

  - Incorporation of fresh water sources for irrigation where possible.

  - Integration of management of the new polder with existing management structures for the older polders.

  - Connection with the existing road infrastructure.

- Transport requirements such as the transport of agricultural inputs and outputs and access to local markets. Not only roads but also possibilities to use the main khals as waterways should be explored. For example, the use of waterways was an important issue stressed by farmers of Polder 55/1 (SRP). Unpaved rural roads are in most cases the only available roads. The means of transport, especially on chars, are limited to motorbikes, bicycles and rickshaws. During the monsoon such roads are hardly used by for rickshaws and transport of goods becomes virtually to a standstill. An internal network of main drains may be used by small country boats.
  The cost of a few rural bridges may be much lower than providing a hard surface for a number of roads.

- Topography and hydrological boundaries. Embankment may be required for drains crossing depressions and or drains that are used for flushing in fresh water for storage.

- Need for secondary protection by interior embankments (see also civil engineering).

4.3 Hydrological and Administrative Boundaries

Administrative boundaries rarely coincide with hydrological boundaries. Both are important for water management and both may change, especially in a dynamic environment such as the Meghna estuary. Hydrological units are defined by topography and physical infrastructure such as roads, waterways and secondary protection embankments. Hydrological boundaries are important for water management because,

- Participation in O&M and Command Area Development (CAD) of local water users has become a vital factor in future water management. Participation requires organisation of water users and organisation of water users is possible when a common water management interest exists. In a drainage or irrigation unit a common interest to solve a common problem can be expected. Farmers should be able to take responsibility for hydrological units, also named tertiary units.

- For larger hydrological units, such as entire polders, water management will be the responsibility of both BWDB and water users organisations. Jurisdiction boundaries of BWDB coincide with hydrological units but not necessarily with administrative boundaries. In most cases they differ. For this reason, co-ordination between BWDB and other departments at thana and district level may not be adequate.

- In the case of considerable new land, it will be an advantages to use hydrological boundaries to define BWDB as well as administrative boundaries. New polders, larger than 2,000 ha where the creation of an Union Parishad is justified is an example where hydrological boundaries can coincide with administrative boundaries.

4.4 Irrigation

As discussed earlier, irrigation water may play an important role in reducing resalinisation of the top soil during the dry season which starts in November. However, the scope for irrigation in the estuary is rather bleak.

In general traditional Rabi crops require little or no irrigation. However, some promising new and improved Rabi crops like potatoes, wheat and mustard and pulse varieties do benefit from supplementary irrigation. Besides, improved Aman rice crops cultivated in the foregoing Kharif season may suffer from dry-spells. Monsoon rainfall may diminish earlier than expected in October and November. One to two additional irrigation gift may prevent considerable yield losses. If little fresh water is available, irrigation may be limited to vegetable growing on and near to the homestead.

In principle two options for irrigation exist,

- Use of groundwater
- Use of surface water stored inside or supplied from outside the polder

The use of groundwater is in most cases very limited. The shallow groundwater is of recent marine origin and is saline.
Even if deep fresh water aquifers are found, most probably over 200 to 300 meters deep, exploitation will be far too costly. Moreover, recharge rates of such deep layer are low for any substantial irrigation. There is little potential for improvement since the area is low and the sea so near. Groundwater may become an option in the older coastal lands but is very unlikely in the southern, younger polders and chars located in the estuary. If fresh water lenses do exist in shallow or deeper layers, they should be preserved for drinking water.

As far as surface water is concerned, gravity flows should be excluded. Seen the topography this would require costly upper reach reservoirs and canal irrigation systems. Another possibility is tidal gravity irrigation with fresh water from surrounding tidal rivers Such options are rare, but may exist in the upper reach of the Tetulia channel.
In the eastern side of the estuary fresh water supply may come from northern upstream intakes in the Megna, such as the Rahmatkhali regulator or from the Dakatia via the Little Feni river. So far investigations in this direction provide little hope. Land levels of recent accretions adjacent to old land are high and bringing in fresh water in these areas from the northern lower areas would require one to two lifts before pumping with a LLP can be done by the farmer.

The storage of fresh surface water bodies in polders may be considered for further studies. The natural internal drainage system as well as eventual ring drains excavated for embankment construction may store considerable amounts of fresh water at the end of the monsoon. In most cases irrigation will be limited to plots adjacent to drains. However, if the drainage network is extensive and irrigation is limited to supplementary irrigation to Aman, if necessary, and to some Rabi crops in January and February, more plots may benefit from supplementary. At the same time it will help to keep salinity levels low. A far better scope for irrigation in the dry season may exist in the upper part of the Tetulia Channel where drainage sluices can flush fresh water from surrounding rivers inside the drainage system of polders, when salinity levels in these rivers are below 1.5 mS/cm. Farmers will use small LLP of 0.5 cusec (14 l/s) or even smaller capacities, to irrigate their lands taking water from field ditches which serve as irrigation canals as well. Small seasonal field canals are used to further distribute the water to the different plots. Although irrigation is still rather limited in coastal areas, small, less costly LLP technology may become readily available and popular on local markets.

4.5 Improvement of Operation & Maintenance (O&M)

BWDB is the main agency responsible for O&M in FCD/I projects in Bangladesh, besides planning, design and supervision of implementation. In the case of small FCD/I projects the responsibility may be with or shared with the LGED. Other agencies concerned with O&M are the Department of Fisheries, Department of Forestry, NGOs and to a lesser extent the Department of Agricultural Extension.

Co-ordination between BWDB and Departments at Thana and District level is weak since BWDB is a semi-Governmental institute with a rather independent status and boundaries of jurisdiction, which do not coincide with those of the Local Administration.

So far O&M implemented by BWDB has been far from adequate. Also the operation and maintenance of LRP polders needs to be strengthened. CDSP found that an operation plan for sluices of the Bagar Donna Polders is still missing. Sluice operators are often found absent. Fishermen operate sluice gates for fishing purposes, which does not necessarily coincide with a need for drainage. When water is flushed in is also not clear. Nevertheless. flushing of water inside the polder at the end of the monsoon when water salinity levels outside the polder are still low can create possibilities for irrigation in the Rabi season.

Recent projects and studies such as SRP and FAP-13 stress the importance of improved O&M and CAD (Command Area Development) to ensure the sustainability of FCD/I projects. There is a growing belief that a change of the present institutional framework of O&M forms a prerequisite to ensure adequate O&M.

Changes are focused on,

- Re-orientation of BWDB. At present BWDB is an agency oriented towards the planning, design and implementation of new FCD/I projects rather than Rehabilitation, O&M and On-Farm Development of a growing number existing FCD/I projects. Such a change in tasks will require a change in human resources and a review of the BWDB training and staff development programmes.

- Peoples' Participation. Water users like farmers and fishermen need to be involved in water management planning and implementation at the various hydrological levels of FCD/I projects. Water users' organisations will be responsible for the planning and implementation of O&M in the smallest hydrological units and participate in the same for larger units such as polders. At the same time water users will contribute to O&M costs through the introduction of tailored cost recovery programmes.

  Experiences of BWDB projects such as GK, LRP, CDSP, DDP, EIP, CPP and particularly SRP will be extremely important in establishing an institutional framework for water management in newly created polders.

4.6 From accretion to development

The process of accretion to settlement may be subdivided in an accretion phase, a reclamation phase and a development phase. Settlement is a process which starts together with accretion and continues throughout the phases of reclamation and development. Drainage and salinity aspects are important in the first two phases while water management aspects are stressed in the development and settlement phase.

Phase 1, *Accretion, 10-15 years or more*

Grass is observed when accretion levels raise beyond MWL. As accretion continues to HWL Uri

grass will gradually be replaced by other grasses and reeds. Grass and reed stimulate accretion of finer soil materials improving the top layer of the char. At this stage the land is used as grazing land for buffaloes and bullocks.

After land has accreted near to HHWL, crop cultivation starts on the still unprotected land. The first farmers may settle, albeit on a seasonal basis. The first crop will be Aman rice, cultivated during the monsoon. The Aman variety used is salt-tolerant and yields seems to be low, not more than 500 kg/ha.

According the LRP feasibility study of the Sandwip Crossdam it is expected that if land has accreted to a high water level (HWL), it still will take 10 to 15 years before it has reached the highest high water level (HHWL). This may not necessarily be true for other locations in the estuary. A high land level close to HHWL has the following advantages,

- Empolderment of land at HHWL will improve deep drainage, the major agent of desalinisation. For the Sandwip crossdam area mid-monsoon salinity levels, expressed in EC_e values, are expected to fall from 30-40 mS/cm at HWL to less than 15-20 mS/cm around HHWL.
- Costly options such as pumping stations can be avoided. However, interior drains not protected against floods are subject to sedimentation , especially in rapid accreting areas. Re-excavation may be required after empoldering.
- A high land level will reduce the height and thus cost of sea embankments, also since such an embankment will be less exposed to waves.
- The topsoil of accreting land may change with the height of the accretion. In general, more fertile loamy soils are formed in the last stage of the accretion process.

A disadvantage may be that land at HHWL may be occupied for more then 10 to 20 years by cattle herdsmen and farmers, represented or not represented by local landlords, who have claimed since long parts of the new land.

As temporary settlement takes place an first claims for the land are made at this stage, an unambiguous policies and implementation of policies regarding settlement is required. Seen the experiences of LRP, an appropriate policy and proper implementation should be a prerequisite for protection works and complementary development works to further upgrade an internal drainage system.

Phase 2, Land Protection, 1-3 years

To stop resalinisation of the soils by tidal floods, protection of new land against tidal surges and intrusion of saline water is needed. Primary protection works consist of sea embankments, foreshore protection and the construction of drainage sluices and eventual additional works to assure a stable outfall.

Secondary protection works may consist for example of smaller internal embankments for road construction, embankments along drains and compartment embankments to separate lower and higher areas. The layout of secondary protection works such as embankments will have an impact on the drainage pattern, catchment areas of sluices as well as the hydrological units for which water user organisations may be organised.

Aspects which may require further attention are,

- Creation of a sequence of polders in rapid accreting areas which will reduce functional life of costly sluices. Search for low-cost designs and or removable and reusable parts.
- Creation of side-way main drainage points to open water at stable locations where no or few accretion and erosion takes place to avoid the construction of sluices facing accreting foreland.
- Danger of settlement of old land adjacent to new land or drainage of lower old land adjacent to new land (Muhuri accretion)

- Low-cost approved designs (DDP/LRP designs) and labour intensive construction methods.
- Layout of the main drainage system by dividing of the polder into hydrological units by secondary embankments. Also the creation of storage for excess rain water, to be used eventually for irrigation should be looked into.
- Integration of the main drainage and road plans.
- Construction of cyclone shelters.
- Non-structural protection (early warning, disaster preparedness and management).
- Mitigating negative environmental impacts related to fisheries.

Phase 3, Development

Implementation of a settlement policy should be finalised at this stage. Further development of an drainage and eventually irrigation system requires the participation of water users. Although not complete, a number of considerations are discussed briefly here after.

a) Agricultural Aspects

In the beginning, when local varieties Aman are grown as the only crop, drainage requirements may be moderate since agriculture is limited due to still high salinity levels. The emphasis may be on adaptation to an existing situation such as the promotion of improved salt tolerant and deep water tolerant rice varieties.

The moment that a start can be made with a gradual introduction of new crops will require further improvement of the drainage scheme. The introduction of higher yielding improved Aman and Aus rice varieties in the Kharif and pre-Kharif season can only be successful if high flood levels that submerges the short stem rice varieties for more than 24 hours can be prevented. Farmers will need more control over water levels in their plots. Not only because crops demand such a situation, also agricultural practices such as the application of costly fertiliser. This is hardly effective in water levels more than one foot.

Crop diversification in the Rabi season with crops such as khesari, lentils, mustard, chillies and later on potato, wheat, maize and vegetables require proper drainage in December to start these crops in time. Also protection against flooding in March is necessary. Such flooding can happen due to early storm rains, improper sluice operation or Aus cultivating farmers who need standing water n their fields.

b) Fisheries Development

Protection works may imply that traditional fish catch will reduce and new fishery techniques will be introduced to maintain fish catch at a sufficient level among the population involved in fisheries. Water requirements of fish ponds connected to the drainage system need to be taken into account.

c) Rural Development and Institutional Aspects

Settlement policies and institutional interventions to ensure co-ordination of development activities such as agricultural, fishery, forestry, transport and land allocation activities will have an impact on water management, especially in developing an institutional framework for water management. The creation of an institutional framework for water management as envisaged by SRP may not be the most appropriate form of organisation in this stage of development. Organisation of land and water users in multi-purpose groups and committees rather than single-purpose water management groups may be recommended since peoples' participation is sought in not only in the water sector but in others as well.

Later on such groups may evolve into single-purpose O&M groups. However, if water management is a core activity and remains an important function in the future, organisation criteria such as hydrological boundaries should play an important role.

The approach started by LRP, to organise settlers in multi-purpose cooperatives seems not to have worked. Cooperatives proved to be effective in organising landless to pursue land settlement issues. However, once their lease of land issue was arranged most members seemed to lost their interest. At present no single-purpose water management organisation does exist in the Baggar Dona polder. CDSP has taken up activities to organise Water Users Groups at a lower level and to link these with former multi-purpose growth centre organisations, now called sub-polder committees (SPC). Since the later are not based on hydrological boundaries, it may have implications for the WUGs as well. Whether such boundaries are a must remain to be seen. So far experiences with WUG organised along hydrological boundaries in flood protection and drainage projects are limited to recently started projects such as SRP and CPP.

The experience of CDSP may be a unique one, linked with the historical presence of former multi-purpose growth centres or cooperatives and therefore less relevant for MES. However, particularly in the early stages of development, multi-purpose committees may have their advantages to ensure peoples participation in more aspects than O&M only.

5 DETAILED WORKPLAN APRIL 1996 - MARCH 1997

5.1 Collect existing data of the study area

- Collection of meteorological data

  Inventory of meteorological stations that are relevant for the project area. Those stations may also be located outside the project area! The data mentioned below should be considered a maximum.

  Location, of meteorological stations, owner, name and identification number, longitude, latitude and altitude, indicated on a base map

  Rainfall, daily rainfall data in mm/day
  Analysis: Rainfall depth frequency curves for 1, 2, 3, 4, 5 and 6 days of rainfall for once in 2, 4 and 5 years curve for a few characteristic locations in the estuary..

  Pan-evapotranspiration, daily E_{pan} in mm/day

  Temperature, daily air temperature, max. min. and mean in °C

  Relative humidity, daily (RH), in %

  Wind speed, daily preferably at a height of 2 meter in m/s

  Sunshine, daily bright sunshine in hrs
  Analysis: Calculation of potential evapotranspiration according modified Penman formula. Comparison with pan evapotranspiration.

- Collection of soil data

  Soil texture and profile, of topsoil and subsoil unto rootzone and unto a depth of max. 5 meters
  Analysis: Comparison of various locations in the estuary with soils of LRP pilot polder.

  Soil physical definitions, such as soil porosity, pF values
  Analysis: Comparison of various locations in the estuary with soils of LRP pilot polder.

- Collection of water salinity data

  Salinity, in mS/cm (or mmho/cm) at 25 °C, for as much as possible locations and years. Sometimes only the months of February till June are given (saline period).
  Analysis: Monthly salinity contour lines in the estuary with values from 1000 mS/cm to say 6000 mS/cm with 500 mS/cm interval in the lower range and 1000 mS/cm in the higher range.

- Collection of soil salinity data

  Soil salinity and alkalinity. Electric conductivity of saturated soil extract, EC_e , and if available CEC, ESP for sample areas.
  Analysis: Comparison with soil data of LRP polder

- Collection of data on land and water use

  History of land accretion.
  a) Base map of estuary with indication of age of the land, based on interpretation of satellite images. Categories: Before 1970, 1970-1975, 1975-1980, 1980-1985, 1985-1990, 1990-1995.
  b) Base map of visited areas with these categories.

  History of Aman and Rabi/Aus cropping.
  a) Base map indicating the cultivated area during the monsoon (Aman), during Rabi and pre-Kharif (Aus) for the entire estuary and for the same time intervals as for accretion.
  b) Base map of visited areas with the same information as well as the present (95/96) cropping pattern.

  Crop suitability assessment. Derived from AEZ database. Presentation on base map of estuary for Monsoon crops (Aman), Rabi crops and pre-Kharif crop such as Aus.

  Land suitability assessment. Derived from AEZ database. Presentation on base map of estuary.

  History of natural vegetation. For example of mangrove, grass and reeds. Base map with this information for areas visited including present situation.

  Water use. For visited areas an overview of water use such as domestic, fishery and agriculture. In the case of agricultural use, the emphasis is on irrigation (how many hectares irrigated for which crops). Source of water: All rain water or is water also flushed in, when?

- Inventory of BWDB O&M

  Levels and jurisdiction. Present zone, circle, division and sub-division boundaries. These should be presented on a base map of the estuary (indicate boundaries and headquarters) and in an up-to-date organisation chart.

  Staffing. Listing for O&M divisions and sub-divisions only of staff positions and number of staff for each position.

  Establishment. BWDB general (O&M, Mechanical etc.), available compounds with buildings (offices, houses, guesthouses and workshops), transport situation (motorbikes, jeep/cars, launches, speedboats).

  ADP. Annual development Plans. Copies of 95/96 ADPs for areas located inside estuary. Analysis: Inventory of works and budgets (Taka and if under FFW metric tons) which are considered maintenance works of protection, drainage and irrigation infrastructure of BWDB. In case of time constraints, limit this to the areas visited (South Bhola, Hatia etc.).
  - List it per polder / sub-division / division for the categories preventive or routine maintenance and periodic maintenance (for definition see page 43/44, SRP technical report 33). Note: so, excluding all new construction and rehabilitation programs and emergency works.
  - Indicate percentage of planned maintenance works done in this year.
  - Indicate use of EMGs, LCSs or other, where landless or destitute women are involved.

- Establish and maintain a (GIS) data base for collected data

  Data collected for the entire project area, but also from field surveys conducted in selected areas need to be stored properly. Where possible, data will be stored in computerised data bases. Where appropriate, data bases are linked to a GIS for geographical presentations of stored and processed data.

5.2 Review of relevant water management and drainage projects and studies

- Inventory of relevant projects and studies

The following completed project and studies are considered relevant,

- LRP, Land Reclamation Project
- FAP 4, South West Regional Study
- FAP 5, South East Regional Study
- FAP 7, Cyclone Protection Project II
- FAP 13, O&M study

as well as the following on-going projects and studies,

- FAP 5A, CDSP, Char Development and Settlement Project
- FAP 20, CPP, Compartmentalisation Pilot Project
- SRP, Systems Rehabilitation Projects

The review is focused on an analysis of existing drainage, irrigation, salinity and water management problems and the identification of possible solutions. A first description of problems and directions for solutions has been mentioned in the inception report. New problems or modification of identified problems and solutions may be required as insight and knowledge will improve on water management and drainage issues relevant to the Meghna Estuary.
Remark: Try to build a problem tree where applicable.

- Listing of all relevant publications of these projects.

  A separate file exists with listings of relevant documents

- Acquisition of most relevant publications.

  Coordinate this activity with librarian.

  Preparation of document notes

  On relevant findings related to drainage, irrigation, salinity and water management for each consulted project document.

- First field visits of selected projects

- Visit of CDSP.

  BWDB O&M Division, Noakhali. Polder development and settlement is nearly completed in two polders, Baggar Dona I and II, and on-going in two new polders, Char Majid and Char Batir Tek.

- Visit of CPP.

  BWDB O&M Division, Tangail. Development of open systems aiming at flood control.

20

- Visit of SRP.

  Concepts on improved O&M and On-Farm Development have been developed for BWDB and tested in the field. Relevant area to visit, Polder 55/1, BWDB O&M Division Patuakhali.

  The objective of the study is to make a first assessment of drainage, irrigation and water management issues in the context of these projects. Findings will be mentioned in field visit notes.

- Preparation of Technical Notes on Relevant Project and Study Findings

  The Technical Notes should focused on an elaboration of problems and possible solutions for internal drainage, irrigation, salinity and water management. Remark: Project descriptions should be kept to a bare minimum!!

  These Technical Notes will contain the findings based on , notes of consulted project documents and notes on field visits (use notes made under 2.1.2.1 and 2).

- Field surveys of protected and unprotected areas

- Design and preparation of field investigations and studies

- Listing and study of relevant documents on areas to be visited

  These areas are,
  - South Hatia and Nijhum Dwip
  - Char Urir and Char Bhuiyan
  - South Bhola Chars, among others Char Kukri Mukri

- Preparation of pre-visit notes

  Notes are prepared on most relevant findings found in documents related to internal drainage, salinity and water management of documents about areas to be visited.

- Implementation of field investigations and studies to assess the existing situation

- Assess previous and planned drainage and water management interventions

  In case of a protected area describe the history of the water system and other relevant infrastructure such as roads. What was there before, what was constructed when etc.

  Try to assess the development of drainage, salinity and water management in the past. Make use of the problem tree technique (What causes drainage problems, maintenance problems etc., and put these causes in a logical order, down to the institutional and planning level).

  In case drainage, irrigation or salinity problems are obvious, make an assessment of the internal drainage network, embankments, structures, roads, footpaths, crossdams and other relevant features. Use the 1:10,000 photomozaic of Finmap for the visited area. This will help in preparing a map showing main features of the visited area. If necessary survey the area with investigators who try through interview to define the areas with severe, moderate and light drainage and salinity problems.

  Try to identify main hydrological units, separated by main roads and or main internal khals.

Add additional relevant information on soil textures and profiles of top and sub soils. Locations of accretion and erosion. Opinions of local agencies and the local population.

Meetings and interviews during the field visits

a. Visits of local agencies

BWDB

O&M Circles, Divisions and sub-divisions within MES area.

- Interventions in the past, new projects, rehabilitation and O&M plans, establishment, ADPs (see data collection).
- Drainage and salinity problems observed in their area (discussion on intensity and location of the problems, possible causes and solutions. Make a problem tree.

TNO, Thana Nirbahi Officer

- Local development plans, use/lease of water bodies.

Union Parishad

- Local development plans.

DAE

- Information on land use, cropping patterns and extension messages for each season.

SRDI

- Soil information

BRRI and BARI

- Research topics and findings for rice and non-rice crops in coastal areas in relation to drainage and salinity problems.

LGED

- Present and future road plan and situation. Design criteria for culverts and bridges.

Fisheries

- Information on fisheries in the area.
- Fish catch before and after empolderment.
- Fishery programmes of MoF in the area and others such as NGOs.
- Existing fisheries in khals and around sluices.

DPHE

- Groundwater situation. Free groundwater table depth during dry season (lowest).
- Fresh/drinking water availability, quantity indication and depth of borings.

NGOs

- Related projects and relevant activities.

b. Consultation of local population

Basically through structured interviews. Individual interview of local representatives and individual farmers and group interview of farmers in areas affected by drainage, salinity and or water management problems.

- Emphasis is on land and water use, domestic use, use for fisheries and use for agriculture.

- Topics are drainage (culverts, bridges), irrigation (availability of fresh water), salinity, maintenance of BWDB infrastructure, crops cultivated in various seasons, restrictions in cultivation due to water management and salinity problems(?), water levels in khals (existing versus desired levels).
- What should be in an O&M plan according the farmers?

- Preparation of Technical Notes on findings of field investigations

Of great importance is reporting of observations and survey findings. Presentation of processed data should be as accessible as possible. Presentation in maps are preferred whenever possible. Graphs and tables can further illustrate the text of technical notes.

A structured table of contents need to be developed for the survey reports

Data Collection MES

Type of data and unit	Possible sources of data	Remarks	MES specialist involved	Storage
Water salinity [mmho/cm, mS/cm]	Existing: •LRP •BWDB •Other New: •SSD •MES/Anwesha	•Data for Monsoon (Jul-Nov)and Dry season (Nov- Jun) required on monthly basis, if possible for various years, especially peak months March - May. •List of stations/studies and data in tables. •Entire MES area is relevant. •Water salinity of interior water bodies such as khals and ponds in protected areas can be checked as well.	Hydraulic engineer Water management	GIS Data base Documents
Soil Salinity [EC_e]	Existing: •SRDI •SSD •Other New: •MES survey	•Data for Monsoon and Dry season required on monthly basis. •List of stations/studies and data tables •Entire MES area relevant •Specific survey for priority projects for more detail may be required.	Water management Agronomist	GIS Data base Documents
Soils	Existing: •SRDI New: •MES survey	•Classification of soils within MES area. •Soil texture and profile descriptions of top soil 0-0.3 m and subsoil 0.3 - 2.0 m is also of interest and to know whether significant differences exist inside the estuary. •In priority project areas some measurements (auger) may be useful to confirm an overall picture (combined wit soil salinity measurements).	Water management Agronomist Civil engineer	GIS
Rainfall [mm/day]	Existing: BWDB Hydrology department (annual publications)	List of rainfall stations and data. Minimum 10 years, maximum 20 years daily rainfall data required for May-October. Most important July-September.	Water management	GIS Data base Documents
Cropped Area	Existing: •Aerial photographs •Satellite images •Land use maps (SPARRSO) •DAE statistic (handle with care!!) New: MES survey	Historical information (maximum 20 years ago) of how many years areas are cropped (and salinity problems are of interest) •Seasons of interest: a)Kharif (best period for inventory: Aug-Oct) b)Rabi (best period for inventory: Jan-Feb) c)Pre-Kharif (best period for inventory: May-Jun) •Historical and latest situation for entire MES area. •For existing situation in priority areas a survey is required specifying also a cropping pattern (crops and intensity).	Agronomist Water management	GIS Data base tables and graphs.

Type of data and unit	Possible sources of data	Remarks	MES specialist involved	Storage
Water Levels [m, PWD]	Existing: LRP/SSD •BITWA New: •MES survey (Master Plan)/SSD	•If possible monthly average HHWL, HWL, MWL and LWLs. •Of interest is the period July-September when drainage problems may occur for drainage sluices due to high water levels. •Entire year is of interest for Mid-North Tetulia area in relation to flushing sweet water from surrounding rivers into polders in the pre- and post-monsoon period and dry-season.	Hydraulic engineer Morphologist	GIS
Land Levels [m, PWD]	Existing: •SOB maps •BWDB maps	•Important to connect WLs with LLs and to evaluate drainage and eventual gravity irrigation potentials. •For priority projects, more detailed levels are required for hydrological units.	Hydraulic engineer Morphologist	GIS
Dating accretion and erosion	Existing: •Satellite images •Aerial photographs	•For priority projects only. •Historical sequences of accretion and erosion is of interest (a.o. to identify age of land and link it with salinity and land use).	GIS and remote sensing	GIS
Drainage Systems and Physical Infrastructure	Existing: •Aerial photographs •SOB and BWDB maps. New: •MES surveys	•Required for priority projects only. •Main and secondary drainage khals can be indicated as well as embankments, sluices and main roads. •More detail in sample areas of priority projects can be provided as example. Here also tertiary drains, bridges, culverts, crossdams and footpaths can be indicated based on field visits. Important also is to indicate future plans of LGED, TNO and Union Parishads. Finally potential hydrological units can be identified based on the above information (need to be confirmed by population).	Civil engineer Water management	GIS
Institutional Infrastructure	Existing: •LGED Maps •BWDB Maps New: •Contacts with representatives of organisations	•For MES area: Administrative boundaries and BWDB O&M subdivision, division and circle boundaries, headquarters. •For priority projects: (see rural development specialists)	Water management	GIS Organisation charts

6 PROJECT IMPLEMENTATION PLAN

6.1 Introduction

During project implementation the emphasis will be on a further elaboration of three key-problems, drainage, salinity and water management. During the first project year, the emphasis will be on the collection and selection of relevant data, study and visits of previous and on-going projects and specially field visits of potential areas in the estuary.

6.2 Collection and selection of existing data of the study area

The first component of the workplan is the collection and selection of existing and relevant technical and institutional data. These data are considered relevant for an assessment of the existing situation and are not collected by other studies of MES. These technical data are related to drainage and salinity, whereas institutional data are related to BWDB. As much as possible, data will be stored and processed in a computerised database and presented geographically by the use of a GIS to facilitate assessment of the existing situation. The obtained information will be used later in the formulation of strategies, development of models and the preparation of a development plan.

An inventory will be made of existing meteorological stations in and near to the project area. Data will be collected, selected, stored and if required processed. Relevant meteorological data are daily rainfall, wind speed, temperature, sunshine hours, relative humidity and evapotranspiration. Soil data such as profile descriptions, texture and measured salinity will be useful and can be compared with data found by LRP. The collection of water salinity data for the estuary are important as well. Salinity of open waters in the estuary varies over the year and form place to place. For example water salinity levels outside polders will also influence options for the operation of sluices, such as flushing in water for irrigation during the dry season. Water levels in the estuary and land levels of chars and islands are required to review the scope for drainage and flushing in of water.

Besides more technical data, institutional data about BWDB are of interest to assess the status of water management, including O&M, in the project area. These data are the organisation chart of BWDB for the estuary, presence of O&M staff and facilities, O&M training, O&M budgets in the previous years. An assessment of the existing situation will also include applied O&M plans and on-going O&M programmes of BWDB O&M divisions and sub-divisions.

6.3 Review of relevant water management and drainage projects and studies

A second component consist of a review of water management and drainage projects and studies. So far identified relevant projects which have been completed are, first of all LRP, Land Reclamation Project, FAP 4, South West Regional Study, FAP 5, South East Regional Study, FAP 7, Cyclone Protection Project II, and FAP 13, the Operation and Maintenance Study.

Important still on-going projects are, CDSP, Char Development and Settlement Project, CPP, Compartmentalisation Pilot Project also known as FAP 20 and SRP, Systems Rehabilitation Project.

6.4 Field investigations and studies of protected and unprotected areas

The third component of the workplan is related to visits of the MES area and in particular those areas which can be considered at this stage potential areas for early implementation.

These areas are the chars south of Bhola, South Hatia and Nijum Dwip and accreting chars near to the Noakhali main land such as Urir Char and Char Bhuiyan, areas which also are covered by detailed morphological measurements and hydraulic modelling.

Field investigations on drainage, salinity and water management will be carried out in at least three study areas of the estuary. Participation of the local population and local agencies in assessment of problems and formulation of eventual solutions will play an important role during these investigations. Participation will be realised through individual interviews, group interviews and informal and formal meetings with local agencies such as BWDB, LGED, MoF, MoL, DAE and coordinating and planning organisations such as the Union Parishad and the Thana Co-ordination Committee.

6.5 Assessment of strategies and development models for protected areas

The information obtained through analysis of collected data, studies of previous projects and visits of the project area will be used in the formulation of alternative strategies for development of water management in protected areas, with emphasis on adequate drainage and desalinisation. Strategies will be based on findings from the water management and drainage study and the outcome of other MES studies such as rural development, reclamation and civil engineering.

6.6 The Development Plan and priority projects and programmes

Assessment of priority projects and programmes will be done in line with guidelines developed under FAP. Participation of water users will play a vital role in improving water management of FCD projects such as coastal polders. Participation of affected population in and outside project areas and local organisations such as Union Parishads and the Thana administration headed by the TNO will take place in participatory and rapid rural appraisals. Pre-project meetings will be held in line with the People's Participation Act, as approved and adopted by BWDB.

The approach adopted for the Development Plan will be multi-disciplinary, which means that that water management and drainage will be studied in relation with other aspects such as civil engineering, agriculture, fisheries, institutional aspects, environmental aspects and socio-economic aspects.

ANNEX 06

RURAL DEVELOPMENT

TABLE OF CONTENTS ANNEX 06

1 INTRODUCTION

1.1 Definition of Rural Development under MES

The Meghna Estuary Study, (MES) is basically designed as a hydrological, morphological and engineering study. The rural development parameters are not clearly defined in the description of the assignment. It is, however, evident and also explicitly stated that these parameters shall be considered. The rural development potentialities shall be important for determining the overall feasibility of technical interventions aiming at land protection and accretion in the study area.

The major part of the study area is presently under water - and will probably also be that in the future. The entire MES deals with identification of options for land protection and land reclamation, and the options that can be translated into feasible project interventions may eventually be implemented. The rural development planning, of which the first element is concerned with land distribution and settlement, therefore come into the picture after the technical aspects have been studied and feasible options found.

Rural development strategies and project interventions do not have to await availability of new char land. New islands at different stages of development can already be found in the area, and optimal rural development strategies for the benefit of these islands shall be further refined. Parallel with that, strategies and models for rural development should be ready for new land accretions if they are found adequate for settlement and development.

Char land is not a new phenomenon in Bangladesh. It has existed for long and extensive experience from rural development in these areas do therefore exist and can be utilized. Further experience in the same field is presently being produced, e.g. through implementation of Char Development and Settlement Project (CDSP) (under Ministry of Water Resources, Minisry of Local Government, Rural Development & Cooperatives and Ministry of Land) and the Adarsha Gram Project (AG) (under Ministry of Land). Both projects deal with settlement and development on char and khas land.

It shall be the task of the rural development section of the MES to follow such activities closely in order to extract experience and develop further improved models for settlement and rural development. In addition a socio-economic sample survey will be conducted in the area in order to get first hand and fully up to date information. This survey is outlined in Annex 10 of this Inception Report.

1.2 Composition of this Annex

The present annex is structured in the way that chapter 2 provides the background for the rural development study and chapter 3 provides a description in the logical framework format. As it is believed that land distribution and settlement on char khas land is one of the most important and difficult issues to implement successfully this aspect is discussed in further detail in chapter 4. Chapter 5 gives the overview of aspects to be studied in relation to the entire rural development process, based on general experience with rural development in Bangladesh and some initial knowledge of the preconditions in the study area. In this context a discussion of the potentialities of the institutional facilitators of rural development is included, i.e. local level government institutions and to a smaller extent NGOs: Chapter 4 and 5 are meant to give the first direction of the studies to be carried out under MES over the project period.

The final aim of MES is to present a development plan for the study area including proposals for specific project interventions. Chapter 6 outlines the approach of this planning process and identifies steps and methodologies. Chapter 7 is the implementation schedule of MES as far as rural development studies and planning are concerned.

2 BACKGROUND

The development objectives of the MES is defined as "increased physical and social security for the population in the coastal areas and on the islands". The physical security is related to protection against the natural phenomena such as normal as well as extreme tidal fluctuations and also cyclones which occur now and then in the climatic and aqua-geographic context of Bangladesh. The physical security also relates to the soil as a productive factor where salinity is a basic problem in the southern char areas and reclaimed land generally.

The social security is in the present context defined as the security after the physical protection has been created, or design of the social security in such a way that it reduces or eliminates the effect of the natural forces. Both aspects are important though the former shall be dealt with in most detail in the present study. In this way social security means the potential for people to settle on a plot and create a living on the reclaimed land without being threatened by severe poverty, non-access to employment opportunities and non-access to social facilities.

This is not unknown problems in rural Bangladesh in general, however, the severity of the problems seems to be accentuated with increasing remoteness of the localities, e.g. char areas in general. A large part of the present project area expected to be char island, where the accessibility can be foreseen as a major difficulty.

The project area includes the islands of Sandwip and Hatya which are old settled areas although both the islands are experiencing erosion and accretion. A number of smaller islands of more recent origin exists as well and some of them are spontaneously settled without legally endorsed land allocation. Such islands are found between Sandwip and the Noakhali mainland, between Sandwip and Hatya and south of Hatya and Bhola. Bhola itself is not included in the study area.

3 PROJECT DESCRIPTION - LOGICAL FRAMEWORK

3.1 Objectives of Meghna Estuary Study, Rural Development.

The third item of the project objectives of the MES pays special attention to the rural development aspects. It reads as follows: "Priority projects and programmes for flood protection, agricultural and socio-economic development prepared for early implementation". Below is given a further elaboration of the objective related to rural development. Khas land allocation and settlement is considered the first step in the rural development process.

A. Establish development potentialities and strategies as well as constraints and propose interventions for rural development of the area.

B. Identify the role of institutions that will be instrumental in the rural development process.

3.2 Output

Below are listed the specific outputs which are supposed to contribute to fulfilment of the objectives listed as A and B above.

A.1 Updated data base for the project areas on rural development aspects.

A.2 Strategies for short and long term rural development in the project area.

A.3 Assessment of the experience from implementation of CDSP, Adarsha Gram, and possibly other projects.

A.4 Proposal for realistic and tested methodologies for land allocation and rural development on reclaimed land.

A.5 Proposal for a range of interventions to facilitate sustainable rural development in the area.

A.6 Proposals for small scale interventions/priority projects for immediate implementation, e.g. under MES funding.

B.1 Identification of Government institutions that will be instrumental in the rural development process, including the role and expected capacity of the institutions.

B.2 Assessment of the institutional experience from other projects, e.g. CDSP and Adarsha gram.

B.3 Recommendation for institutional arrangements..

B.4 Recommendations for NGO involvement.

3.3 Activities

The activities under this component of the project can be summarized as follows:

* Collection of socio-economic and general rural development data about the present situation, partly from existing documentation and partly through the survey outlined in annex 10.

* Close liaison with CDSP and to some extend Adarsha Gram Project.

* Liaison with government institutions which are involved in settlement and rural development.

* Preparation of inputs for Development Plan.

4 THE SETTLEMENT PROCESS ON KHAS LAND

4.1 The Context for Settlement

One should think that development of new accreted land presents an opportunity to make ideal designs and promote ideal processes in respect of land distribution and promoting rural development and land use.

It may, however, not be that simple, socio-economic development is a multidimensional and complex process where a number of social and economic determinants are involved and interrelated which make the ideal planning and in particular implementation extremely difficult. Thus before thinking of this ideal situation, it is important to understand the administrative routine, including the obstacles that often appear during implementation of the routines. It is equally important to have a clear understanding of the local social and economic structures, including the intermingling if different interests which constitutes the local power structures.

These aspects are thus given particular emphasis in the present study although it is unlikely that much new information will appear - the subjects have been studied extensively on several occasions by foreign consultant as well as by Bangladeshi scholars and consultants. The specific aim in the present context is to arrive at a precise description of the situation in the char areas of the meghna estuaries - being it mainland or islands.

4.2 Land Allocation Institutions

Land distribution and allocation is under the authority of Ministry of Land (MoL) and implemented through the Deputy Commissioner (DC) of the districts, the actual officer being in charge of daily work is the Additional DC Revenue (ADC Revenue). Each thana has a Thana Revenue Officer (TRO) and an Assistant Commissioner Land (AC Land) who is responsible at thana level under supervision of the Thana Nirbahi Officer (TNO). In the MoL the Directorate of Land Records and Survey (DLRS) is the key institution for supervising the surveying and keeping the land ownership records, which includes the publication of the land ownerships being registered (khatian).

Until recently DLRS has hardly had the capacity to deal with the large workload it is entrusted with, which has meant that regular surveying has only taken place with a 30 - 35 years interval; it is the policy to re-survey all part of the country every 10 years, due to buying and selling of land, inheritance of land and sub-division of plots. Increased capacity to manage and update the records of rights by the help of modern computer technology has been needed for long. An ADB financed project to upgrade DLRS' technical and records management capacity has started implementation recently, and the results of that are likely to have some extent of positive impact on the institutional performance on at district and thana level.

4.3 Land Allocation Procedures

The procedure of land allocation is unreasonably long and time consuming and often with many obstacles. Before any reclaimed land can be declared as khas land it has to be surveyed by the DLRS, this is called the *Diary Survey*. Survey capacity has as mentioned above been one of the constraints faced. Subsequent to surveying the land is allocated to Government Revenue Department, that is represented at the district level by the ADC Revenue.

The actual occupants or the potential settlers selected by the thana committee can on own initiative apply to the AC Land for legal documents in their favour.

At this stage the settler can get a temporary user right of the particular plot for a year, the issued document is the Duplicate Carbon Receipt (DCR) for which the legal registration costs are fixed at Tk. 300. The settler can then apply for permanent rights of the plot, through a prolonged procedure. It includes hearings by a committee comprising the TNO, Tashildar, AC Land, the Union Parishad Chairman and possibly others as well. If they find the applicant acceptable they make a positive recommendation to the DC through appropriate channels. He will make his own examination, call for interviews, etc., and if he approves the application it is passed on to the Office of the District Registrar for signing of the deed of registration, i.e. *the Kabuliat*. The application - now the kabuliat - can then go to DLRS for publication as the *Khatian*. Once the khatian is published the settler has the legal right to the land with issuing of a title deed.

During this long process, and even with publication of the khatian, people who are unsatisfied or other people who make claims on the same plot may challenge the decision; this can be the beginning of a long court case which can defer final issuing of the title deed for a long time. Years may pass by from the first application for land ownership to the final title deed is issued.

It can thus safely be stated that settlement itself is the first major problem to face in the process of rural development, including socio-economic development. There is ample documentation that settlement on khas land is a very difficult process to address in a controlled manner if the rules and regulations issued by the government are to be followed. A thorough study of the issue was for instance made under the "Feasibility Study on the Sandwip Cross-Dam development Scheme" in 1986 - 87 just to mention one study within the geographical area of the MES. This discussion was carried on in the GoB's response to the study, and in 1988 a Review Panel was commissioned by the Dutch Government to assess the reporting of the feasibility study. This illustrates the importance given to the issue by GoB as well as donors.

Many other studies and reports have confirmed the findings presented in the Sandwip study report, and although the focus on settlement on khas land has been sharpened since 1986 - 87 it is still to be considered a major issue which remains largely unsolved.

Ongoing projects dealing with settlement on - and rural development on - khas land exists, e.g. the Char Development and Settlement Project (CDSP) and the Adarsha Gram project under the Ministry of Land with financial support from the EU. The experience from both shall be followed closely, and both are facing some degree of difficulties in final processing of the khatians.

Whether it is acceptable that the formalization of the land distribution issues are lagging significantly behind the prescribed and technically possible time schedule can not entirely be answered from a technical point of view. It seems, however, relevant to flag some concern when it is seen that increasing income, due to costly rural development interventions, is to a large extent being transferred out of the areas, i.e. from the intended beneficiaries to the still dominating land lords. This can for obvious reasons not be totally avoided in the present socio-cultural setting in rural Bangladesh, where feudal structures and patron-client relations still are dominating features. However, with legal and formalized ownership to land the beneficiaries will - other things being equal - stand a better chance of keeping a larger part of their produced revenue, even if the latter is only of marginal magnitude.

4.4 Settlement Strategy

The problem which has been faced by all khas land settlement schemes so far - including the reclaimed char areas - is that *the land has already been occupied at the time the settlement scheme has come to the point of implementation*. The actual settlers - in fact illegal settlers - are usually from the very poor strata of society but the de facto control of the areas is in the hand of people from the local power elite, which is often a mix of the local political and economic power.

Absentee land lords living in Dhaka or other big cities are also seen as holding power over large areas of land. This situation is what makes it difficult to undertake a planned settlement afterwards, and the land owner elite seems to constitute an social force strong enough to resist establishment of an efficient and transparent land allocation and formalization system.

The actual and illegal settlers do not have title deed to their plots, and they have often paid a high price to the land lord for the plot. Due to their non-formalized settlement situation their legal position is weak.

The MES project area consists of different types of land in respect of settlement and legal status of settlement although the major part of the area is still covered by water. There are two major islands which have been inhabited over a long time, Sandwip and Hatya, they are believed to have been surveyed and the land has been recorded according to ownership.

Investigations of the MES will provide more information on the issue. A number of smaller islands which have appeared recently or during recent years may in some cases already be inhabited and the settlements and ownership are believed not to be formalized through the proper authorities. Other islands are not yet permanently inhabited but may as a beginning have seasonal settlement of fishermen, others are not settled at all. Just off the shore south of the ferry ghat to Hatya such not yet inhabited island can be spotted during March 1996, and it seems ready for habitation anytime. However, most of the MES area is still under water, but due to dynamic situation new char will appear and others will disappear, and some areas will appear and be stabilized if it is decided to construct dams or other accretion promoting interventions.

The situation is thus anticipated to continue with creation of new khas land and subsequent illegal settlement. An essential part of the strategy formulation process shall be to assess if there would be any way to improve on the efficiency of the land allocation and settlement process. It should in this context be considered if the present institutional process is adequate or adjustments could be made. It should also be considered once again if the proposal made by the Sandwip Feasibility Study Team of establishing a special development authority for new char areas development - including land surveying and distribution - is feasible. Care should be taken in suggesting new ad hoc institutions to fulfil functions which other institutions are supposed to undertake, in this case Ministry of Land and specific local institutions.

The socio-economic survey outlined in annex 9 shall pay special attention to the issue is land distribution and the processing of application for title deed. Qualitative as well as quantitative date shall be acquired in this respect from the field investigations.

The issue of scattered settlement versus clustered settlement will also be investigated. The approach of the CDSP project mainly scattered settlement with allocation of about 2 acres land agricultural land while the Adarsha Gram Project is focusing on clustered settlement (Adarsha Gram = model village) allocating homesteads of about 8 decimals and with access to some village agricultural land. The appropriate strategy may include both approaches, in combination or depending on whether it is main land char or island char. It can be commented that scattered settlement seems to be preferred in respect of small scale farming and in some cases for privacy reasons. Clustered settlements is seen to strengthen the settlers in relations to pressure from the local power elite, and it seems to be a proper settlement form if wage income possibilities can be identified.

5 THE RURAL DEVELOPMENT PROCESSES

5.1 Conditions for Rural Development

Assuming the settlement issue on the actual new reclaimed char land has been overcome - or in parallel with the settlement process - the rural development process has to be embarked upon. It must also be assumed at this stage, that it has been possible to create the necessary physical protection from regular flooding and also to the extent possible from the cyclones that appear now and then in unprotected areas with disastrous consequences. The necessary physical protection is not something absolute but what ever has been agreed by the GoB being as acceptable.

The planned rural development process shall have as its goal to create a local environment which is conducive for creation of sustainable living conditions for the settlers. It means basically that habitation, income possibilities and services shall be available and be free of strong influence of local elites and power structures. these are often mostly oriented at domination of the people and keeping them only at survival level, not leaving room for much development perspective. It is known and well documented that the local power structures have a strong influence in the often remote char areas, and evidently not less if it is char islands to where communication is difficult and the isolation relatively high.

The power structures are an integrated part of the local societies and can not easily be eliminated, but organization and development activities have to be designed in such a way that the local population get most possible benefit. Similarly design of activities should be made in a realistic way in the sense that the local elite and power structures should accept the activities and not counteract strongly. By its very nature this development process can not be fast, and the design of possible interventions has to accept that, otherwise inputs may be wasted.

It underlines the need for prioritization of the possible interventions that could be relevant. Obviously there are both political and technical aspects of this issue, and the technical aspects may be dealt with effectively while the political ones are far more complicated. It seems to be the experience that the only effective way of dealing with the political problems is through a strong government commitment to implement and facilitate agreed interventions. As discussed in chapter 4 this has to be the case with MoL concerning land allocation and settlement, and for other rural development institutions as well as discussed under item 5.3.

To some extend technical improvements may have a positive impact on political problems as well, e.g. if procedures of beneficiary selection or the land registration process could be made a little more transparent - which is obviously not in the interest of the ruling power elite.

5.2 Strategy and Priority Setting

A key question to be asked is if land distribution and processing of title deeds should be done in parallel with substantial inputs for accelerated rural development or it should be done in sequential order awaiting finalization of the land distribution process. Both CDSP and Adarsha Gram projects are doing the two things simultaneously. That will be the first strategic question to deal with.

Keeping in mind the basic aims of rural development in char areas, i.e. improved physical and social living conditions and as much as possible free of external domination, some form of organization of the settlers seems to become crucial. Already the chosen settlement form, scattered or clustered, constitutes differences in respect of both income possibilities and resistance from domination.

In order to enhance the developmental potential of the new settlements, it seems at this point clear that some form of local organization is strongly called for. This is indeed the case not only for new char settlers but is acknowledged as important for enhancing the process of poverty alleviation in rural Bangladesh in general. Whether this organization should take the form of formal cooperative, e.g. BRDB's BSS/MBSS cooperatives, or 'informal' groups organized by NGOs may be a matter of discussion during the strategy development. There is, though, ample documentation that many NGOs have been quite successful in organizing the landless in groups for income generation and wider human and socio-economic empowerment. This being said without ignoring the weaknesses of the operations of the NGOs, being less experienced in char areas than in rural Bangladesh in general.

A most crucial thing for the settlers is that they have access to income earning activities, either through agriculture and fishery or non-agricultural/fishery activities. At the outset there are no activities at all in new char areas, thus naturally agriculture, livestock and fishery will be playing an important role. With soil salinity problems and possibly other soil deficiencies it is likely to take some years to develop agriculture to a point where yield reaches an expected level, and even in that case 2 acres (the size prescribed by MoL for khas land settlers) will normally not be sufficient to sustain a household. The household deficit has consequently to be supplied in other ways which may be fishery or other non-farm activities. The latter are not easily available in new char areas, and support to establishment of new income generating activities should thus be given high rating.

For both agriculture and non-agricultural activities the question of access to credit becomes critical. The informal credit sources are available but with high interest rates and with a high rate of dependency on the loan provider. The informal credit is likely to persist for some time, but reduced dependence on only this source would ease the overall rate of dependency. This is considered an essential strategic issue.

Easy access to health and education facilities will normally not exist in new char areas and can thus pose a serious constraint for the population. Social infrastructure must thus have high priority on the planning agenda. In realization of the government departments' difficulties in reaching out to peripheral areas it is often seen that NGOs have played an important role for health and sanitation as well as awareness raising about good health and sanitation practices.

NGOs are also seen to be facilitators for adult education, and some NGOs have established local informal primary education, often the first three grades, and Bangladesh Rural Advancement Committee (BRAC) has established informal education almost on a nation wide scale. This is a clear indication of the insufficient out-reach of the government system, at least in the more remote and less-easy accessible rural areas.

Considering the overall need for rural development interventions in newly reclaimed char areas one could easily come to the conclusion that a large number of different activities would be required. It should, however, be seen as a strategic matter whether a large variety of interventions are desirable or fewer key interventions are to prefer.

Obviously the institutional difficulties are essential, and the experience with integrated rural development projects executed by government is somehow mixed and certainly not in all cases worth replication. Some NGOs seem to have been more successful with multi-sectoral activities in specific geographical areas, although the level of ambition and scale has been more modest than in for instance the case of the Danida supported Noakhali Rural Development Project (NRDP), which was completed in 1992 after 14 years of implementation. CDSP has also a wide range of activities on its agenda although not comparable with NRDP, and the experience from CDSP shall be followed closely also in this respect. The experience from the last couple of decades' development work in Bangladesh seems to indicate that institutional arrangements should be kept as straightforward as possible.

5.3 Sectoral and Institutional Assessment

Some of the most important institutions in relation to rural development shall be discussed below, in most cases sectorally oriented institutions. institutions of importance for morphological, hydraulical and water management aspects in relation to MES are dealt with in other sections of the present report.

The planned socio-economic survey as well as experience from other projects will indicate how far the government institutions have been able to reach people living in the MES geographical area including the mainland char areas of Noakhali district., i.e. char areas, with various social, economic and technical services. That information is going to be important parameters in the rural development planning process starting in the II phase of MES.

Local Government and administration:

The union is the lowest level of administration in Bangladesh and the lowest level with an elected forum of local representatives, the Union Parishad. However, the administrative capacity at union level is very limited and most administrative routines and decisions remains at thana level for the time being. The union chairman and other parishad members are members of some committees which are of importance for the local population and the rural development process in the areas, e.g. the committee for selection of landless people eligible for settlement on khas land and the Thana Development Coordination Committèe.

At thana level the administration is headed by a Thana Nirbahi Officer (TNO), who is coordinating all development activities at thana level, including the departmental ones mentioned above. There is no elected forum (no parishad) at thana level, the role is administrative and coordinating. The Thana Coordination Committee is the overall coordinating body, the members are departmental heads, union chairmen and others. All the thana officers are the ones involved in development and administration at local level, e.g. provision of social services, local infrastructure development and maintenance, and also land distribution issues. Although the departments in Dhaka are technically responsible and provide the funding the actual execution depends to a large extent on the local staff.

The district (or zila) is overlooking the activities of the thanas, headed by the Deputy Commissioner (DC). Direct implementation of projects, programmes as well as the Annual Development Plan (ADP) is taking place at thana level, however, the DC and his staff has the overall supervising and monitoring role. In a number of cases the departments of ministries at district level has technical expertise to assist the thana officers.

The funding for implementation of the ADP as well as projects and programmes comes from the various ministries and the decision making regarding the funding of activities is not the local authorities. The exception is a few small projects funded by revenue surplus from the thana and union.

The district, thana and union administrations belong under the Ministry of Local Government, Rural Development & Cooperatives while the departments at all these levels report back to their line ministries.

Due to the remoteness and difficult accessibility to char areas, in particular the islands, one could speculate on the possibility of thana administrations or union parishads being given special development authority in these areas, even with a strengthened staff position and enhanced funding for development activities. Sandwip and Hatya are defined as thanas while some of the smaller, but habitated, islands do not have any independent administrative status, e.g. as unions. It needs further investigation to determine the feasiblity of such institutional options.

Organization and credit:

Lack of access to credit is in many cases seen to be a constraining factor for growth of the various sectors of the rural economy, e.g. for improved productivity in crop production, improved livestock, higher yields of fish ponds or gear for off shore fishery, a range of non-farm activities, etc.

The general picture is that the poorer sections of the population are facing severe difficulties in getting access to institutional credit if they do not possess sufficient collateral, and for instance marginal farmers with 1.5 - 2.0 or less acres of land can hardly get this access. Those with less or no land will then be equally or worse off, and their chance to obtain credit is only through the informal credit market, i.e. the local high interest charging money lenders (mahajans), which could also be the supplier of inputs or the market channel for any marketable produce. It might well be the land lord who are also in de facto control of the land where the loanee is settled.

The institutional credit is provided by the private and nationalized commercial banks which have the above mentioned conditions for credit provision. Credit through the farmer cooperatives, KSS under BRDB, has also shown to be accessible only for the larger and already well established farmers. The rural poor cooperatives under BRDB, i.e. the BSS/MBSS, should be targeted towards the smaller farmers and even landless households. Information on this branch of BRDB shall be sought during implementation of the MES.

Even if poor people has not themselves identified a need for credit it can be an empowering factor for them if they receive small amounts of credit and invest in income generating activities. This is more to be considered as a survival strategy than a growth strategy, and many NGOs and some government projects have implemented such credit programmes, often supplemented by a number of other activities such as awareness raising and socio-economic support activities. Grameen Bank is such a credit institution, however, basically without the social support activities. Several NGOs are presently working in the coastal areas around the MES area.

Agriculture:

Agricultural extension is the responsibility of Directorate of Agricultural Extension (DAE) under Ministry of Agriculture. DAE has a nation wide set-up in all district and thana headquarters, at thana level staffed by a Thana Agricultural Officer with a small staff of agricultural officers including a subject matter officer; the agricultural extension workers - Block Supervisors (BS) are operating from the TAO's office. The TAO can get further technical support on specific issues from the Subject Matter Specialists, who are working under the Deputy Director of Agriculture (DDA), head of the agricultural department at districts level. A major constraint for efficient work of the agricultural extension system has been the lack of transport for the BSs, which has not least affected the inputs given in remote areas as for instance the chars. At least the legally settled population of the char areas have in most cases only small agricultural plots, and the experience is clearly that this category of farmers have received very little attention from agricultural extension system of DAE.

Homestead gardening is not part of the extension services although it could be relevant for the char settlers. Production of vegetables for home consumption and even for cash sale is an obvious expenditure saving or income earning activity, and it has positive nutritional implications as well.

Fisheries:

Department of Fisheries (DoF) under the Ministry of Fisheries and Livestock (MoFL) is responsible for all marine and inland fishery extension service in Bangladesh. DoF has office set-up in all districts and thanas, and the thana staff comprises in principle one Thana Fishery Officer (TFO) and two field assistants.

Just as the DAE extension staff often have been lacking transport to get out to the farmers the DoF extension staff have faced a similar problem.

A number of donor funded projects have been implemented in limited areas of Bangladesh and under various conditions, and research has been conducted as well on the subject of fish cultivation under different conditions. This is all going to be useful information for development of a rural development strategy for the existing and new char areas. The research and donor funded projects have made new information available which can possibly increase fishery as a potential production and income earning activity in char areas.

Infrastructure:

Local Government Engineering Department (LGED), is responsible for the rural roads network and infrastructure for local markets and hats. Minor irrigation constructions and hardware for water supply and sanitation is also under this department. Each district and thana have an LGED office with engineering capacity.

Social services:

Primary education is monitored by the Thana Education Officer (TEO) who is supervising the entire software part of the primary education. Construction and maintenance of buildings is the responsibility of LGED. Primary education has been short of funds for a long time and the primary education system is not in a good shape at the moment although it has gained more political attention lately.

The poor performance of the public primary education system is one of the main reasons for the seemingly success of the NGO lead non-formal education programmes.

The Thana Health Administrator (THA) is overlooking the general health situation in the areas and reports on outbreak of diseases. The THO is also in charge of the family planning programmes.

6 DEVELOPMENT PLANNING

6.1 Background for Planning Process

The background for the planning, strategy setting and priority making will be created basically during phase I (see figure 6.1), i.e. during the first year of the project implementation period. This background will in respect of rural development planning consist of:

1 Location of new emerging char land within the MES area.

2 The physical security of specific char areas - or char areas under creation - in terms of durability of the land accretion, protection against tides and floods has to be established. This information is expected to be available from other sections of the MES projects.

3 Gather experience from other projects dealing with settlement and rural development, especially on khas land in char areas. Two important projects in this respect are the EU funded Adarsha Gram Project and in particular the Dutch funded CDSP. A close liaison with CDSP shall be established for gaining maximum experience regarding settlement and rural development in the MES char and khas land areas. The CDSP can be considered as a pilot project for MES in this respect.

4 Assessment of the outreach of the local government administration for provision of social, economic and physical services to settlers. This information will partly arrive from experience from CDSP and partly from the socio-economic survey to be conducted under phase I. It shall include an assessment of the experience of working with NGOs in respect of service delivery to settlers. Chapter 4 and 5 above provide a first rather general description of the role of some of these institutions and their short-comings as well.

5 Socio-economic survey of samples of existing charland settlements in the MES area. It will primarily be a household survey with a combination of fully structured interviews and less structured, but more in-depth interviews of households and village groups. This exercise is described in more details in annex 9.

In addition to the above subjects it is expected that a global view of the area can be obtained from remote sensing and GIS operations, this is a technique available within the project. This shall in particular provide information on availability of land, a rough idea about existing settlements and infrastructure, and ideas about which land is cultivated and which is not.

6.2 Strategies for Settlement and Rural Development

Settlement is the first crucial issue to deal with in the rural development process as described in chapter 4 above. Different approaches have been applied in projects, within the rules and regulations given by Ministry of Land. Especially the strategy for a quick and smooth administration of the settlement by the local authorities should be in focus, with emphasis on provision of final title deed to land as fast as possible.

Also the question of when the surveying, mapping and land allocation takes place should be looked into. So far, khas land has usually be allocated when it was already illegally settled which makes the legal settlement process much more difficult. It has thus to be investigated how early in the char formation process land can be surveyed for mapping and formally taken over by ADC Revenue for distribution to landless families.

The question of selection of settlers is another issue to be looked into given that it is government policy that khas land shall be allocated to poor landless families. Are the present thana based selection committees the most proper instruments for selection of beneficiaries according to the given criteria.

Once the settlement issues are dealt with properly, the rural development aspects will be in focus, and it is already from the beginning clear that these aspects are in many ways different from the "old" inland aspects. The rural development process is discussed in chapter 5, and the most adequate strategies for development of char areas have to be outlined and developed. It seems evident that issues relating to agriculture and homestead development will be in focus, however, together with discussion of adequate strategies for provision of basic service facilities. Altogether, it should be a matter of providing the settlers with such living conditions - or creating the basis for people themselves to produce such living conditions - that can be considered as a relatively fair alternative to settling in other areas of Bangladesh.

In the outlining of strategies the role of the various institutions are not least important, it is the specific institutions which can (and should) enhance a positive and progressive development, however, the same institutions can also be the major constraints and bottlenecks for the process. Before suggesting any strategies it is of utmost importance to have consulted with all the relevant authorities, and in fact the strategies should be made in close cooperation with relevant departments and local authorities. In order to ensure that especially local authorities get an opportunity to comment on the strategies and suggest changes a interim phase of 6 - 8 months is allocated for that purpose, i.e. in between the presentation of the interim plan and preparation of the draft plan. This phase is described under item 6.4 below.

6.3 Development Planning & Formulation of Projects

Whereas the master plan - which is one of the outputs to be prepared by the MES - outlines the long term physical potentials and constraints, the development plan will outline the aspirations and potentialities of the population within the given physical framework. The development plan produced by MES will include both physical reclamation and protection aspects as well as rural development aspects. Only the latter is dealt with in the present annex.

From the settlement and rural development point of view key elements are envisaged to be interventions to streamline and fasten the land allocation process as well as the beneficiary selection process. This has strong institutional linkages involving Ministry of Land, DC with AC Land and ADC Revenue, and the TNO with other thana staff. As the development plan is foreseen to include a portfolio of relevant projects, it is not unlikely that some of the proposed projects relate to land distribution and settlement.

The rural development process as a whole will be outlined in the development plan for the MES area, and the particular sectoral development shall be discussed and outlined. It should be anticipated that sectors as agriculture, livestock, open water fishery and aquaculture will play a dominant role, however, in a more long term perspective non-farm and non-fishery related activities may as well be of great importance. Basically is it a matter of establishing the foundation for economic activities which are sufficient for creation of necessary income for establishing the proper living conditions for the settled population.

A portfolio of rural development projects will be suggested as far as a need is identified and the proper institutional arrangements can be found. The proposals shall be prioritized, some will be presented in outline, others will be developed to feasibility study and appraisal level and some of them shall be recommended for early implementation.

As mentioned under item 6.2 a draft development plan will be prepared during the period March -June 1997, and during the following period until February 1998 the plan and the proposed projects shall be appraised in cooperation with the government departments, the thana and district authorities. During this period new data and information will continuously be available and the proposals and the plan shall be updated accordingly.

6.4 Feasibility Studies

In connection with preparation of the development plan - as well as before and after - a number of feasibility assessments shall be undertaken, not only for settlement and rural development projects but for major project options in relation to land reclamation and physical protection. Such interventions require proper feasibility studies, and it will be important to identify and quantify costs and benefits of socio-economic and human development nature in addition to the economic, financial and technical parameters of cost and benefit.

Once the feasibility study methodology has been decided and actual subjects for study has been defined - probably during first quarter 1997 - the specific data input can be specified. It is likely that socio-economic data from specific areas may be required in this context and 2 - 3 small surveys can be conducted in response to need, and manpower has been allocated accordingly. The survey methodology is expected to be adapted versions of the Rapid rural Appraisal technique.

6.5 Local Level Appraisal of Strategies and Projects

In between the interim and the draft development plan an appraisal process shall be conducted for strategy, plan and project proposals. The appraisal process shall be undertaken in cooperation with departmental staff at central level as well as at district and thana level, and if possible at union level also. In cases where NGOs are involved they have to participate as well.

The procedure shall roughly be as follows:

a. Presentation and initial discussion. Depending on the proposal it shall be decided how much time shall be allocated at central departmental level and how much at local level. On land issues, for instance, it should be considered very important to have thorough discussions with Ministry of Land to reach the fullest extent of commitment and cooperation. Sufficient time shall be spent at district and thana level to make a full presentation of the proposals and have initial discussions. DC, TNO and relevant departmental officers shall be consulted. The concerned union chairmen should also be approached at some stage in the process, however, they may be involved through the Thana Coordination Committee meetings.

b. Time to respond. Officers at all levels should be given about one month to consider the proposals and give their comments.

c. At round of final discussions shall be held with the same departments and local level institutions as under item a. Their final response shall be discussed and a prioritization of the possible project proposals shall be made. New proposals may also be presented by the concerned authorities. If deemed appropriate for facilitation of the communication process workshops may be conducted.

   Appraisal of the projects in cooperation with the intended beneficiaries seems more difficult as there are no established procedures to follow and no institutions to approach at that level. It is anticipated that RRP/PRA techniques can be applied for this purpose, mostly applied at village level or a sub-group of the most interested villagers. If

cooperatives or informal groups are in existence they could be the focus of communication as well. The approach and methodology for this shall be further developed during the third or fourth quarter of 1997, and the actual field work shall be conducted during fourth quarter of 1997 and first quarter of 1998.

The whole planning and implementation process is summarized in figure 6.1 below

Fig. 6.1

MES - RURAL DEVELOPMENT
Planning and Implementation Process

PHASE I

Necessary background for strategy and project formulation process:

Experience from other projects, espc. CDSP & Adarsha Gram, as well as other documentation material from studies and projects	Physical security of specified char areas in respect of flooding and cyclones	Location of potential new char land within MES area (accretion areas)	Socio-economic survey of samples of existing char land settlements	Outreach and capacity of local government system for provision of social, economic and physical services to settlers

Information and Data to be collected and assessed by MES/Rural Development
DURATION: February 1996 - April 1997

PHASE II

Initial formulation of strategies and interventions

1. Strategy for rural development
2. Identify possible interventions
3. Select priority projects
4. Select early implementation projects
5. Prepare Interim Development Plan

The initial planing process should be performed by
MES in consultation with relevant Government Departments and NGOs
DURATION: March 1997 - June 1997

PHASE III

Appraisal of strategies and proposed interventions through consultations with Government Departments and with institutions and population at local level

Discussions and consultations with relevant Gov. Departments.

Discussions and consultations with Union Parashads and Thana administrations.

Discussions and consultations with local & national NGOs

Consultations with local population through RRA methodology

DURATION: June 1997 - February 1998

PHASE IV

Preparation of final draft strategies and plans

1. Strategy for rural development
2. final outline of interventions
3. Select specific priority projects
4. Select specific early implementation projects
5. Prepare Development Plan

DURATION: February 1998 - April 1998

PHASE V

Government approval of Strategies and plans

DURATION: July 1998 - August 1998

PHASE VI

GoB and NGOs (i.e. in case of national NGOs) look for funding with subsequent implementation of interventions

DURATION: From July 1998
(MES project completed)

ANNEX 07

AGRICULTURAL ASPECTS

TABLE OF CONTENTS ANNEX 07

1 GENERAL

Agricultural production systems, particularly the crop production systems, are highly complex and diverse and are influenced largely by physical, biological, climatological and socio-economic factors. Land, soil, hydrological and agroclimatic parameters are the basic components of the coastal ecosystem and crop production system is largely dependent on the quality and limitation of these resources.

Salinity problem recently received very important attention due to increased demand for growing more food to feed the booming population of the country and it has become imperative to explore the potentials of these land. The project / sub project area is dominated by medium high land (F_1), followed by medium lowland (F_2) and highland (F_0), (Report-2, Agro-Ecological Regions of Bangladesh / BARC / UNDP / FAO - 1988). This area includes tidal and estuarine floodplains of Ganges, Muhuri and Meghna rivers. Mainly three categories of salinity exist in this area (S_1 to S_3 - Salinity Problems and Crop Intensification in the Coastal Regional of Bangladesh / BARC - 1990). The highest area is under S_2 followed by S_1 and S_3 categories.

2 SOILS

In the project area, 5 (five) Agro-Ecological Regions (AER) and 7 (Seven) general soil types occur. Among the AER regions, Young Meghna Estuarine Floodplain (AER-18) is dominant. Others are Ganges Tidal Floodplain (AER-13), Lower Meghna River Floodplain (AER-17), Old Meghna Estuarine Floodplain (AER-19) and Chittagong Coastal Plain (AER-23). Seven main general soil types are : Calcareous Alluvium, Noncalcareous Alluvium, Calcareous Grey Floodplain Soils, Noncalcareous Grey Floodplain Soils, Calcareous Dark Grey Floodplain Soils, Noncalcareous Dark Grey Floodplain Soils and Acid Sulphate Soils. The dominant soil textural classes that occur in the project area are silt loam to silty clay loam. Most of the soils are moderate to strong alkaline (6.0-8.4) and the pH values of the surface soil are lower than the subsoil,. The organic matter content of the most of the soils ranges from less than 1% to 1.5%.

3 PRESENT AGRICULTURAL LAND USE

In the project area mainly in saline soils, rice, sugarcane, pulses, oil seeds vegetables etc. are grown but their contributions to cropping intensity vary greatly with different AER. In salt affected highland t. aman (L) is dominant, whereas, in the same type of land t. aman (HYV) is the major crop in Chittagong region. In medium lowland region broadcast aman is domenant whereas in Chittagong area broadcast aus is the dominant crop in lowland region.

During Kharif - II (July-Oct) t. aman (L) is grown extensively in the coastal saline project area with normal yield between 1.5t to 2.5t per/ha. T. aman-fallow is the most dominant cropping pattern in Barisal and Patuakhali regions. In Noakhali, Laxmipur and Chittagong coastal area, the main pattern is aus-t. aman. Winter crops such as wheat. potato cowpea, vegetables etc. which cover small area in northern part of the project area with t. aman (L)-winter crops cropping pattern. Adoption of HYV rice cultivar varied considerably in different regions of the project. A substantial coverage of HYV rice in highland and medium highland during both aus and aman season found in poldered area like Bhola, Sandwip, Polders-58/1-58/3, Hizla embankment (North and South) and polder-55/1 etc., where flooding depth is Fo-F1 (0.0m to 0.9m). This category of land is suitable for minimum two rice crop where quality irrigation water is available in dry season.

4 OBJECTIVES OF AGRICULTURAL SURVEY

The main objective of agricultural survey is to accelerate agricultural development through flood protection/saline water intrusion, drainage improvement and creating facilities for optimum irrigation in dry season and supplementary irrigation in wet season. These will raise the standard of living; particularly farmers and landless masses. The untimate outcome of this survey would be to formulate comprehensive CEP/FCD/FCDI projects on the basis of technical and socio-economic guide lines. The objective may be fulfilled by the following ways:

- Provision for flood / saline water intrusion control, drainage improvement and increased irrigation facilities by making embankment and constructing adequate infrastructure, which will reduce crop damage, properties, human sufferings and augmented agricultural productivity and accelerate other economic activities.

5 IDENTIFICATION OF SURVEY AREAS

The survey area of the project generally consists of:

- Poldered area with some agricultural and infrastructural development.
- Unpoldered area or charlands (unsubmerged by high tide, without any development).
- Mud land (submerged by high tide, less scope for development)

The above survey area should be visited thoroughly through a series of reconnaissance field visits by different categories of Experts collect different types of data for screening identifying and selecting of the sub-projects for pre or post-project feasibility study. After selecting the sub-projects, they should be phased on the basis of priority and for immediate implementation.

6 DATA COLLECTION

The data of agro-socio-economic aspects comprise all relevant issues to determine the present condition in the project area and their potential for future development. These issues include soils, cropping pattern, cultivation practices, input uses, cost of cultivation, yield and production of crops, assessment of crop constraints and damages by different means, income level of various groups of project beneficiaries, demographic characteristics, land tenurial system, land holding size, land fragmentation, agricultural credit and marketing, livestock and fisheries resources, local institutions serving, their effectiveness. Data for the above issues may be collected from two types of sources.

- Primary sources
- Secondary sources.

Primary sources data will be collected through a previously selected questionnaire and checklist. For quantitative and qualitative data collection both types of systems are needed. The checklist will be filled in through RRA / group discussion and the questionnaires will be filled in through previous selected households. RRA/group discussion have many advantages. It is participatory in nature. As there is access to a large body of knowledge, a volume of information can be obtained quickly. At the same time, through mutual checking and cross checking by different kinds of knowledgeable individuals, the group can provide a consensus or fairly representative picture of the existing situation .

Secondary sources data will be collected from local BWDB amd BBS, respective TAO, TLO, TFO, TEO, TE, TSO, LGED, BRDB, BADC, NGO etc. and Union Parishad offices through a separate checklist to supplement and compare with primary data for report preparation.

7 METHODOLOGY FOR AGRO-SOCIO-ECONOMIC SURVEY

This survey designed to conduct the pre or post-feasibility study in order to formulate an appropriate project plan for flood/saline water intrusion control, drainage and irrigation to suit hydrological, sociological and environmental condition keeping in view to the agricultural, fisheries and socio-economic development in the project area.

A set of questionnaires carefully designed to collect primary data on agro-socio-economic aspects of the project through household survey. The questionnaires pretested and based on the findings of pretesting, necessary modifications made. If necessary, the questionnaires will be redesigned during field survey stage.

Field survey through RRA/group discussion will be conducted through field visits, spot verifications and exchange of views with target beneficiary groups at union and village level. The group will consist of respondents from Union Parishad (Chairman / Members), available social elites, village leaders; large, medium, small, marginal and landless farmers, cattle / poultry rearers, landless women, etc. All concerned officials of government support agencies at Zila/Thana/Union level and NGOs concerned will be within these groups.

A detailed household survey will be conducted in the representative villages within the project. In selecting the sample households a two-stage stratified random sampling technique will be applied. In the first stage, the whole listed villages in the project area will be stratified according to the level of land elevation and 10% villages will be selected purposively on the basis of the highest number to lowest number of households in each category of land.

In the second stage, 1% households from each sample village will be selected at random for detailed investigation. This selection will be made after making a complete listing of all households collected from Union Parishad. This will cover all groups (large, medium, small, marginal and landless) of farmers in the village.

8 IDENTIFICATION OF MAJOR AGRICULTURAL CONSTRAINTS

The agricultural development within this saline regions is constrained by various physical, chemical and social factors. In general the major factors that impedes development are identified after reviewing of different related literatures and reports.

- Soil salinity is the most dominant limiting factor in the region, especially during dry season. It affects certain crops at different levels of soil salinity, which reduces yield. A substantial charland is tidally affected by saline water, appropriate management practice for crop production in this area is not available.

- Fertility status of most saline soils ranges from low to very low in respect to organic matter content, nitrogen, phosphorus and micronutrients like zinc and copper. The crop yields obtained in these soil are also low.

- Scarcity of quality irrigation water during dry season limits cultivation of boro rice and rabi crops, and aus cultivation during kharif-I season.

- High year to year variability of rainfall, uncertain dates of onset and recession of seasonal floods and risk of drought restrict cultivation of aus and aman rice. Uncertain rainfall delays sowing/transplanting and flood damages aus and aman crops. Heavy monsoon rainfall causes delay in transplanting of aman and sometimes flash floods washes away the standing crop.

- Narrow technological and germplasm bases for salt tolerant crops limit crop choices. on the other hand, due to extensive cultivation of a particular cultivar of crop year after year makes the crop susceptible to pests and disease attack. Pests and diseases like hispa, leaf-hopper and tungro virus are prevalent in the region and extensive damage is caused by these almost every year.

- In the coastal saline belt the winter season is very short, therefore, timely sowing/planting of rabi crops is essential but this is restricted by late harvest of aman rice.

- A considerable area of the project is within the polders of different types. Soil salinity levels has not decreased considerably within the poldered area. Polder management like maintenance of sluice gates, water height in different times of the year is not maintained matching with the present time agronomic development for the cultivation of modern cultivars. The seriously constrained the adoption of HYV aman and HYV aus in these area.

- The texture of most of the saline soils varies from silty clay to clay. Land preparation becomes very difficult as the soil dries out, deep and wide cracks develop and the surface soil becomes very hard.

- Perennial water-logging due to inadequate drainage and faulty operation of sluice-gate facilities and embankment erosion restricts potential land use of the lowlands within the poldered areas. In these areas unauthorized digging of channels for intake of saline water for shrimp culture by shrimp farmers also creates many social conflicts.

- Lack of appropriate extension programmes for diffusion of modern technologies. Extension personal trained in saline soil management is also inadequate. These lackings retarded adoption of HYV technologies.

- Big land ownerships and unfavorable and tenural system, and dominance of absentee farmers discourages adoption of modern technologies.

- Difficult communication and remote marketing facilities also retard agricultural development of the region.

9 PLANNING STUDIES FOR AGRICULTURAL DEVELOPMENT

A meticulous planning is the prime requirement to carry out any kind of pre or post feasibility study. The general requirement for the agricultural study would include:

- digitization of contour map of the project area for drawing area elevation curve to be used in determing flooding depth/land type

- determination of types and capacity of the proposed interventions and hydraulic design criteria to suit agricultural requirement.

- provide a comparison between present agriculture and production levels with future potential of agriculture and production levels. The results of the studies will be used to assess the economic feasibility of the project.

a) Inputs required for the assessment are :

  - existing information available from relevant institutions.

- the questionnaires/RRA/checklist for conducting household survey/ group discussions at the union/village level.
- the secondary checklist (institutional survey for the project).
- review and compilation of available soil/landuse information from SRDI/BARC.
- opinions of other Specialists, local authorities and concerned BWDB officials.
- the flood depths for present situation from (area-elevation curve) and projected situation after implementation.

b) The data collected from the field surveys will be reviewed. The Agronomist will analyze the secondary data for the project. The following information will be obtained from the primary data base :

- land ownership summary
- irrigated area summary
- cultivated area, crop yields summary
- crop damage and total harvested area summary
- livestock and draft power summary etc.

c) The present agricultural situation in the project will be assessed. The cultivated areas and present cropping patterns in the project will be identified by an assessment of:

- the soil type and fertility status.
- land use according to present anticipated flooding/drainage levels.
- present cropping patterns and related farming practices.
- present cost of cultivation.
- present levels of crop damage.
- present livestock and draft power availability.
- present use of irrigation and methods of water application.
- present availability of extension services.
- present average yield per hectare and production levels.
- present use of fertilizer and pesticide.

d) The results of the analysis of the field surveys and existing information will be used to:

- establish the agricultural and land use alternatives for the area taking into account the present irrigation and drainage conditions and the technical/economic feasibility of improved flood control/drainage.

- help to formulate irrigation and drainage requirements on the basis of these land use alternatives and the prevailing soil and climatic conditions.

- help to assess the anticipated benefits from the improved irrigation and drainage needed explicitly for economic evaluations.

e) The future potential agriculture and production levels, after proposed flood control and drainage works implementation, will be assessed based on a projected cropping pattern. The alternative cropping pattern will be based on opportunities that may be created to convert to different crops and improved varieties.

f) The predominant cropping will be correlated with land type (inundation category). The assessment of the change of cropping pattern will be related to the improvement in land drainage and flood control. The predicted future cropping pattern will only change where there is a reduction in inundation depth between certain elevations for a sufficient period of time.

g) The present livestock situation will be assessed. The consequences of agricultural changes on livestock production on the one hand and the dependence of the future agriculture on draft power and manure availability on the other, should be established.

h) Where the new cropping pattern requires an increase in irrigation facilities to match the potential increase in area of crop production, this cost will be prepared by the engineering team and taken into account in the economic evaluation.

i) Envisaged constraints to the potential future agricultural system will be identified and summarized in the study report.

ANNEX 08

ENVIRONMENTAL ASPECTS

TABLE OF CONTENTS ANNEX 08

1 INTRODUCTION

Development aims at the betterment of the quality of life, and sustainable development is development that lasts beyond the present generation. Indeed, development activities and sound environmental management are complementary aspects of the same agenda. Development will be short lived without adequate environmental protection measures; and without development, environmental protection will fail.

Most development activities, especially those involving structural interventions, produce impacts on or changes in the state of the natural environment. Some of these are positive, but some may be negative. Hence, an adequate attention is essential at the planning stage of a development initiative for the identification of the net gains from an investment and the potential impacts on the environment. It would allow the planners to assess environmental protection and mitigation measures as well as to estimate the tradeoffs in striking a balance between development and the environment.

Environmental Impact Assessment (EIA, or simply EA) is a tool for identifying project impacts on the environment and suggesting measures for damage limitation as well as environmental enhancement. EIA is not intended to slow down or prevent development, rather it should make development sustainable by ensuring that development plans are implemented in an environmentally sound manner. This is especially true in water projects involving complex hydromorphic regimes, and it has been fully recognized in the FAP that EIA should form an integral component of their current and future studies / projects.

2 RATIONALE AND SCOPE FOR EIA IN THE MES

The logical bases for carrying out EIA in the Meghna Estuary Study (MES) are examined below with reference to the project objectives and their environmental implications.

2.1 Project Objectives

The project area of the MES extends from Lower Meghna river, below Chandpur town, to the Bay of Bengal. The eastern boundary follows the left bank of the Lower Meghna and the Chittagong coastline upto the Karnafuli mouth, while the western boundary is marked by the right banks of the Lower Meghna and Tetulia rivers, all offshore islands and chars within this perimeter are included in the project area, although Bhola is outside the MES considerations.

The area is subject to fluvial processes and tides, and is characterized by complex hydraulic and morphological conditions. Available historical data indicate that the forces responsible for erosion in one place and accretion or siltation in another place are in some sort of an equilibrium. Hence, any net gain in land in the estuarine islands and coastal areas can only be achieved through physical interventions to protect the naturally accreted land and accelerate the process of accretion.

The immediate objectives of the study are : a) enhancement of the knowledge base of estuarine behavior; b) identification of appropriate land reclamation methods; and c) preparation of priority projects / programmes for early implementation. The objectives are to be addressed through four interconnected activities.

1 Surveys and studies of estuarine dynamics, which would yield an understanding of natural processes of erosion and accretion and impacts of human interventions, and identify potentials for land reclamation including the possibility of shortening the coastline of Bangladesh along the estuary.

2 A phased long term Master Plan for land reclamation and estuary control. The first step in the master planning process will be to develop a Reference Plan, which will provide guidance to the preparation of the Master Plan.

3 A comprehensive Land and Water Use Development Plan for flood protection and improved internal water management of the coastal islands.

4 Priority project and programme formulation involving small scale interventions and feasibility studies of priority projects.

2.2 Environmental Implications

The project objectives and activities have been summarized above in order to underscore the significance of the environmental issues involved in the various stages of studies and planning. The MES aims at planning for a variety of intervention in the Meghna estuary ranging from small scale efforts of land reclamation to ambitious schemes of shortening the coastline through constructing enclosure dams. All such interventions are expected to impact on the environment at micro - meso - and macro levels. Hence, an examination of these environmental impacts becomes an integral component of the MES. Major interventions which may be proposed in the phased Master Plan have to be studied carefully for their potential benefits and disbenefits vis-a-vis the environment. Likewise, in the preparation of the Development Plan, assessment of environmental impacts of protection, reclamation and non-structural measures will be required. Smallscale interventions in localized area and priority projects for early implementation are also to be assessed for their effects on the environment.

In view of the dynamic nature of the Meghna estuary environment and the vulnerability of human occupance in the offshore islands, it is also necessary to make a comprehensive assessment of the existing environmental assets and liabilities of the project area. It will help in the evaluation of the magnitude and significance of the impacts on them from proposed or planned interventions. The major components of the environment, which will be examined for potential impacts, are a) physico-chemical; b) ecological; and c) human. The environmental parameters in each component and specific impact issues will be identified by the environmentalists in the MES team through literature review, discussions and reconnaissance visits to the project area.

3 EIA INPUTS INTO THE MES

According to the Terms of Reference, the outputs from the various activities of the MES will be presented through a series of reports. These reports will include EIA components dealing with proposed plans, projects and programmes.

Environmental Impact Assessment (EIA) will be carried out at two levels depending upon whether the planning process is at pre-feasibility or feasibility level. Pre-feasibility level EIA will address project environment linkages in broad terms, and will be reported in the Initial Environmental Evaluation (IEE). On the other hand, feasibility level EIA will be more detailed in scope, includes an Environmental Management Plan, and will be presented in the Environmental Impact Assessment Report (EIAR).

EIA components will form parts of the various reports (as specified in the TOR) according to the following schedule:

- Interim Master Plan Report : IEE (Month 15)
- Draft Master Plan Report : IEE (Month 30)
- Interim Development Plan Report : IEE (Month 17)
- Draft Development Plan Report : IEE (Month 30)
- Draft Project / Programme Preparation Report : EIAR (Month 28)
- Feasibility Report on Reassessment of Nijhum Dwip Reclamation : EIAR (Month 24)

4 STUDY APPROACH AND ACTIVITIES

4.1 Activity Schedule :

a) Literature review : Month 11 (Sept 96)

- Review of guidelines / strategies for EIA used by the GOB, the World Bank, ADB, EU, LGED and NGOs.

- Review of the relevant LRP reports and data.

- Review of the various documents of the FAP components (listed in Sec 3.3 of the TOR), and liaise with FAP activities.

b) Reconnaissance field visit : Month 12 (Oct 96)

- One or more reconnaissance field visits will be undertaken with a view to :

  (a) collecting information on baseline environmental conditions;

  (b) selecting sample sites for detailed field investigations; and

  (c) identifying major environmental parameters and impact issues through a scoping process (in accordance with the EIA Manual of FAP).

c) Formulation of a Field Plan : Month 13 (Nov 96).

- Following the reconnaissance visit/s, the plan for field investigations will be firmed up. It will include:

(a) the identification and selection of major environmental parameters and specific impact issues which are relevant to the MES;

(b) formulation of a Rapid Rural Appraisal (RRA) approach for IEE and more detailed investigation for EIAR; and

(c) incorporating information and other inputs from such consultants in the MES as morphologist, economist, rural development specialist, agronomist and remote sensing specialist.

d) Field Investigation : Months 14-15 (Dec 96 - Jan 97), Months 25-26 (Nov-Dec 97)

- It is proposed that the EIA field investigations will be done through RRA techniques involving semi-structured interviews and consultation with key informants, direct observations including sketch maps and transect walks, and checklists of environmental impact issues.

- The actual sample sites for field investigation will be selected during the reconnaissance visit. However, based on the map study of the MES project area, the following five sites are tentatively chosen for field data collection.

1 Manpura;
2 North Hatiya;
3 South Hatiya or Nijhum Dwip;
4 North Sandwip ;
5 South Sandwip.

e) Report preparation : Months 15-17 (Feb-Mar 97);
Month 24 (Oct 97); and
Months 27-30 (Jan-Apr 98).

4.2 Impact Assessment Methodology

During and after the reconnaissance visits to the project area, and through the scoping process (mentioned above), the major environmental parameters / components and specific impact issues will be identified for evaluation. Project-on-environment impact assessment consists of predicting the degree and direction of change in an environmental component due to a specified set of project activities. For each impact issue, its significance, magnitude, duration, multiplier effects and reversibility will be considered.

Impacts on the environment will be categorized as a) positive or negative; and b) short or long-term impacts, and will be assessed under a comparative approach of "with" and "without" project scenarios. Impacts will be rated or quantified by using a numeric rating scale (recommenced in the FAP Manual for EIA). For IEE (pre-feasibility level), a seven - point rating scale will be used: 1, 2 or 3 for positive impacts, 0 for no impact, -1, -2 or -3 for negative impacts; the numerals 0, 1, 2, and 3 corresponding to "none," "low," "moderate" and "high" in qualitative terms.

For EIAR (feasibility level) which requires more detailed impact analysis - a 21-point rating scale will be used: e.g., 1 to 10 for positive impacts, 0 for no impact, and -1 to -10 for negative impacts. The impacts of each project intervention on the identified environmental components will be presented in the form of a matrix - where the columns showings environmental components and the rows showing project activities will indicate their respective linkages in the matrix cells by means of a positive or negative number.

It is proposed that an attempt will be made to assign "weigthage" to environmental components in terms of their relative significance in the project area by using numerical scores like 1, 2 and 3. This assigned score for an environmental component can then be multiplied by its impact score (on the 21 - point scale) to yield a total impact rating (which can be entered into the matrix cell). It is granted that weighting of environmental components is a highly judgmental procedure. For the EIA in the MES, weighting will be done through an in-house exercise by involving the MES team of consultants, and obtaining their views and opinions on the significance of identified environmental components. This will allow the environmental specialists to avoid subjective judgement and inconsistency.

4.3 Public Consultation

An effective participation of the public is the key for success of programmes of water management, and the lack of local participation has often resulted in ineffective programmes. A major element in environmental assessment of the MES will be public consultation in the project area because it is essential to learn about the people's perceptions of the local environment and of the impact of proposed project activities. People's perception can be valuable in understanding the level of public support the project will get, and what participatory strategies might be required for the project's planning, design, implementation, operation and maintenance.

In the project area, public consultation exercise will be undertaken through informal interviews of the residents, in-depth interviews of key informants and local leaders, and focus group interviews of the local stakeholders. In this exercise, special attention will be given to such groups as landless, small farmers, new settlers, fishermen, and women. The aim will be to learn from them as to how they perceive the existing environmental situation, recent trends or changes, the resultant problems, and to collect their indigenous knowledge, their views and ideas for solution, and information on their needs and aspirations.

5 SUPPORT STAFF

The objectives of the MES do involve actions that are expected to produce changes in the aquatic habitat of the project area. In specific terms, the sector that is likely to be affected is fishery. The environmental assessment task, therefore, requires an examination of the project's impact on fishery and fishermen.

It is proposed that the EIA team should include a fishery expert for this job. The input from the fishery expert will be needed in two discontinuous periods; a total of 4 person-months: 2 months during the Phase I of EIA (Months 11-17), and 2 months in Phase II (Months 24-30).

In order to assist in field investigations, 2 field investigators will be appointed for 2 months in Phase I and 2 months in Phase II (i.e., a total of 8 person-months are to be earmarked for the field investigators). They should be college graduates in social science, and they would participate in RRA and public consultation exercises.

6 SUMMARY OF WORK PLAN

a)	Literature review and discussions	: Month 11 (Sept 96)
b)	Reconnaissance field visits	: Month 12 (Oct 96)
c)	Formulation of a Field Plan	: Month 13 (Nov 96)
d)	Field investigations	: Months 14-15 (Dec 96-Jan 97), Months 25-26 (Nov-Dec 97)
e)	Report preparation	: Months 15-17 (Jan-Mar 97) Month 24 (Oct 97) Months 27-30 (Jan-Apr 98)

ANNEX 09

SOCIO-ECONOMIC ASPECTS

TABLE OF CONTENTS ANNEX 09

1 INTRODUCTION

Meghna Estuary Study has been launched with the assistance from Netherlands & Denmark. MES studies and proposes plans and interventions based on feasibility investegations with the purpose of ultimately settling the landless population in the region. The project has an important rural development component which demands carrying out a systematic program of socio-economic surveys in order to build up a reliable data base. This will help enhancing the optimum exploration of the potentials of the area in terms of land reclamation and landuse, and socio-economic activities of the people.

To obtain information about the trends of the rural development situation especially socio-economic situation in the project area, a survey will be conducted in the area to have back-ground knowledge of the existing situation of the rural community in the Char lands of Meghna estuary.

2 OBJECTIVES OF THE SOCIO-ECONOMIC SURVEY

The survey has the following objectives :

- to contribute to establish background data for the rural development planning (ref. annex on rural development) for the char settlers in the project area.
- to help identifying a realistic approach to the planning process in the project area.
- to identify needs, formulate ideas and propose activities in the rural development planning for the benefit of the settlers.
- to develop an understanding of gender issues and women's participation in the planning and development process of the char land.

3 SURVEY AREA

Four survey areas have been indentified : Char Majid, Urir Char, Nijum Dwip & Char Kashem. In selecting the survey areas, it is proposed that geographical representation may be considered.

Identification of survey area :

a) Area 1 : Char Majid is situated in Noakhali mainland and purposively selected to represent mainland char settlement already under CDSP. For comparative analysis with off-shore sample Chars, Area 1 survey will contribute to make comparison meaningful.

b) Area 2 : Urir Char : Urir Char is situated in south east of the region. It is almost exclusively settled by landless from Sandwip under the patronage of the power holder from Sandwip while landless from Noakhali mainland have been denied permission to settle.

c) Area 3 : Nijhum Dwip is situated in the mid situation of the region. This island is illegally inhabited by the people with the help of Musclemen while the island is not frequently approached by the administration. If its present socio-economic status is evaluated recommendations for better approach for development will be feasible.

d) Char Kasem : Char Kasem is situated in the south of Bhola. It has been considered for its relevance in some aspects particularly the landless settlement and the impact of the same on society and culture in the region.

4 METHODOLOGY

The socio-economic survey may be conceived as to cover three aspects of the project (1) economic viability (2) social desirability and (3) strategy for development. In order to answer these questions, both quantitative and qualitative information will be sought by data collection and presention by analysis of data. While having the data profile for the present situation, it will in some cases be possible to have access to short term time series of data, either through comparison with existing data or simply by including questions about the situation of to-day, 6 months ago or one year ago in the survey questionnaire. This can provide an indication of the trend of the present development and also help planning in future.

Data sources are as follows :

4.1 Household Survey

Survey with pre-designed questionnaire will be administered in the study area to obtain mainly quantitative information. This is a background socio-economic survey.

For the household survey the following procedures will be followed :

All Mauzas in the selected study area will be listed by reviewing existing data (BBS small area atlases, 1991 census data and Thanas maps). This will be followed by physical identification in the field. From this a list of all the villages in the study area will be made.

A sample of villages in the listed Mauzas will be purposively selected to get better representation of easily approachable villages. The sampling frame will be prepared by listing the households in the sample villages while random sampling method will be followed to ensure represenTa-tion of the population. The unit of analysis will be the household heads who will be selected by the procedure of systematic sampling i.e. every Kth individual in the list will be selected after random selection of the first sample.

As the households in the char areas are found to have homogenous characteristics to a significant extent (maximum landless and a few marginalized farmers) the minimum standard error in the population is estimated. In view of this 600 samples may be sufficient for representation of the population in all the four survey areas. The distribution of the samples among the off-shore and on-shore chars will be made proportion to the number of households residing in the respective study areas. Field investigators will collect the information from heads of selected households through a questionnaire that will be tested at field level.

Despite good training and strict supervision, there may be some interviewers who may not do their jobs sincerely. As such, the possibility of completing questionnaires without actual interviewing respondents cannot be ruled out. Interviewing is a hard job and an interviewer may sometime be tempted to fill out a questionnaire all by himself or herself rather than by actually conducting the interview. Thus we propose to keep strict quality control checks on the work of the interviewing team. Proposed quality control checks shall be carried out through field checking. Field checking is designed to physically verify in the field whether the interviewers completed questionnaires by visiting the right households and by interviewing the right respondents in the households, field checking shall be undertaken in both 'presence' and 'absence' of the interviewing team. For the purpose of field checking, Research Associate will visit study team in the field to supervise their work.

4.2 Secondary Sources :

Information will be collected from secondary sources, particularly from BBS, BWDB, FAP-4 and CDSP.

- BBS for geo code maps and populations statistics of the region
- BWDB for relevent data on socio-economics of the polder areas in the southern Bay to act as reference
- FAP - 4 for data on existing infrastructure in the southern region
- CDSP for the char development data it is at present working with in the extreme accreted and settled areas of Noakhali mainland
- Adarsha Gram for having information about distribution of khas land

4.3 In-depth Investigation :

Qualitative information will mainly be obtained through in-depth investigation. The members of the study team will obtain information through long visit to the field, observations, informal interviews and group discussions with cross-section of the population. Groups in this case are defined by criteria of land ownership and occupation.

Group discussions are widely used to obtain information about peoples perceptions, attitudes and behaviour. When utilised as a systematic and conscious qualitative research method with a definite goal, it can yield a considerable amount of information and create a widespread awareness of development possibilities amongst the target population. It is often advisable to hold these amongst specific target groups avoid dominance of one over another or issues of specific concern of one group being neglected in favour of those of a more powerful for influential one. This is particularly a problem in a country like Bangladesh where there is considerable social diversification. These can be held amongst groups of similar socio-economic level, occupation, age group and gender.

There will be flexibility rather than rigidity in the group discussion method in obtaining relevant information. Discussion in group rather than with indivudual will produce far greater analytic insight than individual close type question answer formulation. Group discusstion requires good facilitation skill to enable cross section of local pepople in participatory discussion. Analysis by them is shared with investigators and information stays with the people who generate it and they also get enlightened about the proposed projèct. Indepth investegation will provide qualitative data on people's persepective on the project and also potential obstacles that may be created by the intervention.

In holding group discussions, no formally structured questionnaires are used, however, a check-list of issues or guidelines is held in mind or noted so that possible issues are not inadvertently omitted and respondents minds can be opened to a full range of potential issues. It does however require highly skilled animators who whilst not influencing discussion can guide it to address all possible issues and by tactful questioning can recognise and raise issue that would have otherwise have been omitted.

5 SURVEY INDICATORS

A detail household survey will be conducted on the following indicators

5.1 Household Survey, Fully Structured Interviews.

Main group of indicators

I Population Profile

* No of household members (m/f), age, marital status, literacy
* Occupation of household members
* Household stratification based on land actually available (as owner, leasee, share cropper)
* Part of cluster settlement or single settlement
* Household settled at present location (when, why, from where)
* Are any household members away due to permanent or seasonal migration

II Land Ownership and Land Access Profile

* Legal and official ownership to homestead or land (single ownership, husband, wife)
* Application for ownership to khas land in process, since when and now at what stage
* Loss or gain of land, why and when
* Lease of homestead and/or land, from who, lease conditions (share cropping)
* Settled without permission from authorities, how, when,

III Income and Sources of Income

* Farm income, crop/livestock (items, cash sale)
* Subsistance production at farm/homestead (kg/no/item)
* Open water fishery and/or pond/aquaculture, cash sale
* Open water fishery and/or pond/aquaculture, self consumption
* Non-fishery/farm self-employment, activity, single or more persons activity, cash income
* Labourer, cash and/or kind income, seasonal or permanent
* Income transfer from migrant labour, from where, how much, seasonal or full time

IV Service Provision and - Accessibility

* Children attending primary school
* Hospital or health centre needed, disease or incident, how often over past year
* Hospital or health centre visited, how often last year
* Family planning information received, what, when, from who
* Productive services: agric or fishery extention, how and how often
* Service received from NGO, type of service, why and when

V Credit and Indebtedness

* Credit taken during last year, amount, source, conditions
* Use of credit, productive, consumption, other
* Need for credit at the moment, for what, preferred source & why
* Total debt at the moment and one year ago, by source
* Seasonal needs for credit, purpose, availability and source

VI Assets other than land

* Domestic house or other similar structures
* Bicycle or other means of transport
* Productive equipment of any sort, type, value
* Other household belongings
* Livestock and/or poultry
* Stock of any produce

VII Coping capacity during crisis

* Type of crisis experienced (natural, health, death)
* What additional resources were needed, cash funds, advisory services, technical expertise, etc.
* How were additional resources secured
* Reduced living standard as result of crisis
* Increased indebtedness after crisis
* Relocation or resettlement due to crisis

5.2 Indepth Interview

I Power Structure & Power relationship :

* Formal (Union Parishad)
* Informal (village elder, teacher, Imam etc.)
* Mix formal & informal power

II Patron and Client relationship :

* Power faction in the villages and distribution of privileges among the clients clinging to faction leader
* Dependency on patron

III Social Conflict :

* Legal protection against encroachment of individual rights
* Settlement medium of conflict

IV People's Perception about cross dam, land reclamation & poldering

V Gender Issues

* Economic situation of women
* Role of women in development
* Women awareness and their participation in the project
* Domestic violence and reprssion on women

90

6 STAFFING FOR SOCIO-ECONOMIC SURVEY

Personnel	No of Person	Duration month
Research Associate	1	12
Research Associate	1	5
Investigator	10	3
Data analyst	1	2
Coders	2	1

ANNEX 10

ECONOMIC ASPECTS

TABLE OF CONTENTS ANNEX 10

1 BACKGROUND AND PURPOSE

This work plan is to be viewed as a management tool - for the Team Leader and for the MES economists themselves - to organize the implementation of the economic activities or tasks on an efficient and co-ordinated basis. It is a clear delineation and scheduling of the substantive works required to transform inputs (resources) into outputs (results) and includes milestones or indicators of progress in the delivery of outputs, thereby permitting monitoring and measurement.

The overall objective of the activities of the MES economists is according to the TOR to provide sound operational models and skills to undertake preparation for early implementation of priority projects and programmes for flood protection, agriculture and socio-economic development.

As such, the MES economists will be working with:

- identification and selection of projects for inclusion in a phased Development Plan for the study area,
- perform pre-feasibility level analysis on selected projects for the Development Plan,
- select from the Development Plan priority projects,
- perform feasibility level analysis on priority projects, and
- prepare the priority projects for immediate implementation.

2 STATEMENT OF OUTPUTS

A pre-condition for effective work planning is the existence of output statements which, individually, are sufficiently described and, collectively can reasonably be expected to result in achievement of the economists objectives.

The outputs for the MES economists are as per TOR the following:

1. A phased land and water use Development Plan (pre-feasibility level) including:

- strategies for progressive implementation (the micro and macro economic aspects),
- portfolio of projects for implementation in the short and medium term (pre-feasibility assessment performed), and
- identified priority projects for early implementation.

2. Priority projects prepared at feasibility level and in a format for immediate implementation.

In addition to the above mentioned outputs the MES economists have found it appropriate to include the following MES related economic outputs.

3. Operative Screening Models - project selection criteria for MES will be identified and structured for both the identification and the feasibility phases of the study.

4. Project Assessment Models - the models will be explicit on the analytical steps to take and what level of information is required in order to perform the pre-feasibility analysis, the feasibility analysis, and the project preparation activities. One computer model - Lotus 123 version 5 - will be developed for carrying out the project economic and financial assessment,

5. A Meghna Estuary Study Project Assessment Guideline - The MES economists will on the basis of the above mentioned activities built a set of guidelines designed specially for the Meghna Study.

The MES Guidelines will be linked to the overall FAP water management strategic planning exercise. The MES economist will updated, methodologically expanded and finally calibrate the FPCO Guidelines to the needs of MES. The MES economists will include a set of guidelines for technical and socio-economic input data reporting. It is essential for the efficient use of resources that the data reported has a high degree of reliability, relevance and validity in relation to the multi-criteria assessment methodology to be used.

6. Trained counterparts in economic project planning and evaluation methodology - micro and macro level.

3 DESCRIPTION OF THE WORK TO BE PERFORMED - THE PROCESS

The process will be based on the following work-method:

- The Need for guidelines to bind the study together - at the macro and the micro level,
- Study the existing FPCO and other relevant Guidelines,
- Observations on methodological shortcomings and issues needing clarification made and avenues for solving the outstanding issues identified,
- Lessons to be learned from other assessment and evaluation exercises - exchange of views and experiences with FPCO economists and policy makers and colleagues on other FAP projects,
- Proposals made by the economists on MES methodology for impact data reporting,
- Proposals discussed and finalized together with the MES technical experts,
- Proposals discussed with FAP colleagues and BWDB,
- Preparation of MES assessment methodology and MES Project Assessment Guidelines,
- Discussion of MES Project Assessment Guidelines with BWDB,
- Finalization of the MES Project Assessment Guidelines.
- Conduct workshop.

4 DESCRIPTION OF THE WORK TO BE PERFORMED-DETAILED WORK PROGRAMME

The issues to be addressed under each output are listed below. The activities will be guided by the list but not necessarily limited by it.

- Study the FPCO and other Guidelines as well as other FAP projects and make observations on methodological shortcomings and issues needing clarification.

- Contact and discuss with FPCO economists and policy makers and colleagues on other FAP projects experiences - positive and negative - with the use of the FPCO Guidelines for project assessments for micro and macro planning purposes.

- Develop operative screening models for identification and screening of water management projects - for Development Plan Projects, Priority Projects and Small Scale Interventions (?)).

- Prepare proposals for impact data reporting. The proposal to be discussed with FAP colleagues, BWDB and MES specialists before finalization.

- Develop the project assessment models - the models will be explicit on the analytical steps to take and what level of information is required in order to perform the pre-feasibility analysis, the feasibility analysis, and the project preparation activities. Among other things the following specific activities will be undertaken:

- develop consistent models for evaluation of benefits and costs for project assessment - pre-feasibility as well as feasibility - including economic, financial, social, institutional and environmental evaluation,

- develop one computer model - Lotus 123 version 5 - for carrying out the project economic and financial assessment. The model will - as a minimum - be based on the following sheets:

  - Summary Project Evaluation Sheet,
  - A variable data input Sheet,
  - Benefit Sheet, and
  - Cost Sheets.

- Develop a format for presenting the Multi-Criteria Analysis making it possible for decision-makers to choose between alternative possible resource strategies and investments,

- Assess and rank alternative project proposals in terms of their scoring under the multi-criteria assessment,

- Update the FPCO Guideline information, such as:
  - conversion factors
  - prices on project inputs and outputs - ref. World Bank commodity price projections
  - CIF and FOB prices
  - Inflation and foreign exchange rates.

- Prepare the Meghna Estuary Study Project Assessment Guideline - The MES economists will on the basis of the above mentioned activities built a set of guidelines designed specially for the Meghna Study.

- Prepare and conduct workshop on economic project planning and evaluation methodology (micro and macro level)

Based on the above "preparatory activities" the efforts can be concentrated on:

- Preparation of the Development Plan at pre-feasibility level including:

  - strategies for progressive implementation (the micro and macro economic aspects),
  - portfolio of projects for implementation in the short and medium term (pre-feasibility assessment performed), and
  - identified priority projects for early implementation.

- Preparation of the priority projects at feasibility level in a format that will allow GOB to invite donor assistance for immediate implementation.

5 MANPOWER INPUTS AND TIMING

The economists have been programmed in the Interim Inception Report to undertake their part of the overall project assignment in three phases as follows:

Phase I	:	February to April 1996	-	3 months
Phase II	:	Oct. 1996 - Feb. 1997	-	5 months
Phase III	:	July 1997 - June 1998	-	12 months
Total	:		-	20 months

The total use of man-months has been distributed as follows:

Local inputs 20 months
Expat.inputs 8 months.

The work programme for the three phases has been proposed as follows:

Phase I Feb. - April 1996

- Update and methodologically expand the FPCO Guidelines for Project Assessment
- Lay foundation for presenting a guideline designed specially for the Meghna Estuary Study
- Prepare draft guidelines for technical and socio-economic input data reporting
- Design draft computer model for project economic and financial evaluation
- Prepare a draft standard format for reporting evaluation results based on the multi-criteria analysis

Phase II Oct. 1996 - Feb. 1997

- Finalize the evaluation guideline for the Meghna Study
- Finalize guidelines for technical input data reporting
- Finalize the computer model for project economic and financial evaluation
- Test the balance between the model and the actual reports from the field
- Finalize the model for reporting evaluation results based on the multi-criteria analysis

Phase III July 1997 - June 1998

- Provide inputs in undertaking a master socio-economic survey as basis for master plan preparation
- Evaluation of Master Plan projects
- Evaluation of Priority Projects
- Training in economic project planning and evaluation methodology - micro and macro level
- Conduct workshop.

The input of the expatriate economist has to be adjusted according to the workload of the economists at the given. It is suggested that the remaining (after phase I) expatriate input be shared on an equal basis between the last two phases and that the inputs will be given under split missions as and when required by the project at the time.

ANNEX 11

REMOTE SENSING

TABLE OF CONTENTS ANNEX 11

1 INTRODUCTION

The Meghna Estuary Study is mainly set up for hydrological, morphological and engineering purposes. For a sound understanding of the processes and the potential for land reclamation the project activities require large amounts of different types of data. The Meghna estuary is a rapidly changing delta area. As a result of these rapid changes and related inaccessiblity in the area, good maps and data are limited.
Besides the more traditional ground (and water) surveys (described in Annex 02: Surveys and Investigation) in this project the use of Remote Sensing techniques and tools for data gathering is required. Additionally, the data that is procured for the project will be processed and analysed using a PC GIS/RS workstation. Specific hardware and software are purchased for this project. This annex gives a detailed description of the remote sensing activities and GIS activities in the Meghna Estuary Study. Futhermore it discusses the activities, the techniques and the anticipated products as well as the workplan.

2 BACKGROUND

Remote Sensing techniques make it possible to obtain information on objects and characteristics on the earth surface without being in direct contact with them. Thus, remote sensing can give information on an area to be studied before any field work is done. Especially when large areas are to be studied the reduction of the amount of fieldwork can be considerable. Traditionally, aerial photography is the most commonly used technique, but more recently other forms of remote sensing, notably satellite imagery, have become available. These images are relatively inexpensive and provide a great deal of information.

Starting with the Landsat MSS-images (Multi-Spectral Scanner images, resolution of ground details 80x80 meters) in 1973, enhanced sensors became available. At present, the most sophisticated satellite sensors are Landsat TM (Thematic Mapper, resolution of ground details approximately 30x30 meter) and SPOT panchromatic (ground resolution 10x10 meter).

In general, two types of satellite image products can be obtained: the black and white or color prints or photomaps, and the digital information on computer tape. Both the products have their own use with specific advantages and disadvantages. The photomaps are readily available for further visual interpretation, and with most of the photos the user does not have to worry about georeferencing and geocorrecting the photo. However, interpretation can only be done visually, while image enhancement and automatic image classification are only possible with digital images on computer tape.

Several studies have been executed to define the applicability of Remote Sensing techniques for the water sector in Bangladesh. The reports of these studies start to appear from around 1975 onward. The use of Remote Sensing in the water sector can be divided into two major groups of applications. The first group is the classification of landuse and cropping patterns, and the second group is the applications for coast line and river bank development.

SPARRSO and ERIM (Environmental Research Institute of Michigan) conducted a study in 1981 using Landsat Digital Data for measuring the land accretion in the Coastal Zone of Bangladesh. Their main objectives were:

1 to determine whether a net gain or loss of land occured along the coastline of Bangladesh between 1972 and 1979;

2 to provide some insight into the nature of the interrelationship between the processes of accretion, erosion and sediment transport in the Meghna estuary that are responsible for the changes observed;

3 to predict, on basis of the observations, where new land formation is likely in future

4 to determine the needed steps to accelerate the process of land formation.

In the above mentioned study it is concluded that it was feasible in 1981 to monitor and measure changes in the Meghna delta since 1973. Present day remote sensing technique provides frequent images for recording temporal and spatial changes. The high resolution and spatial characteristics of the modern sensors provide a more detailed insight and overview for the Meghna estuary.

3 REMOTE SENSING AND GIS TASK DESCRIPTION

3.1 Objectives

The following are objectives of the remote sensing and the GIS task:

A To provide necessary data for the preparation of the plans, which should be based on the situation and dynamics occuring in the area;

B To provide coastline data and bathymetric data for an enhanced understanding of the spatial and temporal pattern of erosion and sedimentation;

C To provide a tool for monitoring the physical and human environment, as an autonomous process or a reaction to structural and non-structural interventions in the project area.

3.2 Results

The output of the Remote Sensing/GIS component is listed below:

A.1 Basemap (photomap) and digital data of the project area
A.2 Basemap (schematised) of the project area

B.1 Maps and digital data on Coastline development (longterm: 1777 - present)
B.2 Maps and digital data on Coastline development (midterm: 1973 - present)
B.3 Interpretation of Landsat and SPOT images to assist in this study of morphological characteristics
B.4 Maps and digital Jata on bathymetric development of areas of interest (midterm: 1978 - present)
B.5 ArcView Viewer application for coastline and bathymetry dynamics

C.1 Training and coaching

The anticipated results are described in more detail

A.1 Basemap (photomap) and digital data of the project area

A set of very recent Landsat Remote Sensing images (recording data february 09, 1996 and february 18, 1996) of the project area has been procured as part of the project. EGIS will do the processing and geocorrection of these images and maps of 1:1.000.000, 1:250.000 and 1:50.000 will be created from it. An overview of the area will be given in the maps 1:1.000.000 and 1:250.000, while for the areas of special interest 1:50.000 scale maps will be provided. These maps provide detailed information on land use and settlement patterns and can be used to (visually) identify areas of erosion and sedimentation.

A.2 Basemap (schematised) of the Meghna Estuary project area

A paper map is developed from the 1:250.000 DHS map (SPARRSO,1988). This map is compiled from several sources, which are listed below:

- hydrological features: Landsat TM image 1988;
- international, district, upazilla boundary: Survey of Bangladesh;
- union boundaries: Bangladesh Bureau of Statistics;
- roads: Roads and Highway Department.

This map will be copied several times and be used as a sketch map for planning and inventory purposes.

A digital version of the base map will be developed using available data from the Bangladesh National Level GIS database (FAP19, 1995) and additional data from paper maps. This Bangladesh National Level GIS database contains a collection of digitized maps at scales ranging from 1:250.000 to 1:63.360. Registered members will be provided digital copies of the requested data and supporting documents. The databank is open to legitimate users of GIS and spatial data subject to approval of FPCO/WARPO.

This map will be made available as soon as the digitizing and GIS software is installed.

The Bangladesh National level GIS database contains the following ArcInfo coverages usefull in the MES project:

1 Administrative boundaries

Administrative boundaries for thanas, districts, and the national boundary of Bangladesh are included in this theme. The thana and district polygons are linked with BBS census data. Thana headquarters are in a separate coverage.

2 Infrastructure

The road and railway networks which make up this coverage were derived from the UNDP-FAO AEZ maps. The road network is not highly detailed and is intended for national or regional use only. It contains only major roads, such as national highways and primary, or type A, feeder roads. Embankments are not included in this coverage.

3 Hydrography

FAP-19 developed a semi-detailed rivers coverage based on SPOT multispectral satellite images. The data was digitized as line (narrow rivers) and polygons (wide rivers, beels, chars, land masses).

4 Soils

The soils coverage is converted from a digitized soils association map of 17 1:250.000 scale AEZ maps. These maps were originally digitized in SPANS, the GIS system used at AST. A relational database containing additional soil related information, including AEZ-zone, soil phase, land type, texture, effective soil depth, soil moisture, drainage, salinity status and others, is linked to the polygon data.

5 Topography

A medium resolution DEM (Digital Elevation Model) (500 x 500 meter) for the entire area of Bangladesh has been produced. This map is not an ArcInfo vector coverage, but a Erdas raster file.

6 Water resources monitoring system

This is a coverage which shows the exact location of river water level and discharge gauging stations as well as rainfall monitoring stations for all of Bangladesh.

Attention should be paid to the fact that information gathered by other groups in the project might very well be used for integration into the mapping system. Especially usefull may be the integration of socio-economic data gathered by the economists and agricultural data as collected by the agricultural engineers. The requirements of the agricultural groups include maps on soil types, soil salinity,

B.1 Maps and digital data on Coastline development (longterm: 1777 - present)

For evaluating the coastline development and coastline dynamics, an analysis can be made of several historical maps. The first one is the Rennell map published in 1794. The second map relevant to this study is the Wilcox map, published in 1840, additional maps from 1942 and a present-day maps. A good inventory of the availability of historic maps will be made during the project.

The maps have to be georeferenced so that they all have a known coordinate system and projection. From all these maps the coastlines will be digitized, and transformed to BTM-projection. Combined, these digitized coastlines are used to analyze long term coastal development. It seems justified to produce these maps on a scale of 1:1.000.000 (and may be 1:250.000), and not on a 1:50.000 because otherwise we cannot see the difference between mapping inaccuracies and coastal dynamics.

B.2 Maps and digital data on Coastline development (midterm: 1973 - present)

This is essentially a dynamic view of the area: what is happening where, and can we identify possible causes of the phenomena. To do this, we need a multitemporal approach, meaning we need Remote Sensing images of the study area reflecting the situation at several moments in time. Each individual image gives a static overview of the situation at that moment, and when digitized the GIS can be used to produce a stack of images which together reveal the dynamics of the system.

Detailed mapping (1:250.000 and 1:50.000) of the dynamics of the coastline can be obtained by using SPOT satellite images (black and white-prints) of 1989 (available through FPCO, LGED and SPARRSO), which are already geocorrected. Also available is the coastline from the 1996 Landsat TM image. The coastline digitized from these images can be directly overlayed showing changes from 1989 to 1996.

A longer period can be analysed using older images as well. From 1973 onward, a set of satellite black and white imagery prints is available through SPARRSO. Full sets of black and white prints are available for:
1973, 1974, 1975, 1976, 1977, 1978, 1979, 1980, 1981, 1982, 1983, 1984, 1985, 1986, 1987, 1988, 1989, 1990, 1991, 1992.

These images are not geocorrected. However, they can be geocorrected photographically at SPARRSO. For one description of the coastline, four images have to be processed and mosaiced.

Good candidates for our study are the images of 1973 (136/44: feb 24; 136/45: dec 27, 1972; 137/44: feb 02; 137/45: feb 02), 1984 (136/44: apr 13; 136/45: apr 13; 137/44: mar 14; 137/45: mar 14) and 1992 (Landsat TM 136/44: feb 7; 136/45: feb 7; 137/44 apr 2; 137/45 apr 2).

From the 1980 images a water bodies map for the Fisheries Resources Survey has been prepared (1:50.000). Bankline and coasts are clearly shown on these maps.

B.3 Interpretation of Landsat and SPOT images to assist in this study of morphological characteristics

The SPOT 1989 and Landsat 1996 images covering the total MES study area show a lot of detail on morphological characteristics. A good inventory of what exactly can be extracted from the images is not yet made. Part of the study is to make this inventory. A first impression of morphological characteristics that can be interpreted from the images reveal that we have a chance of finding the following classes by visual interpretation:

- natural vegetation;
- cultivated areas;
- intertidal zones;
- bare soils;
- sandbars and mudflats;
- afforestation; and
- newly formed islands.

One selected sheet of the SPOT images will be interpreted according to the above mentioned classification scheme. The same area from the Landsat 1996 will be visually interpreted and the results of both classification operations will be transferred to GIS. The classified maps are subsequently analyzed for changes between successive maps. This results in maps showing what part of the land has been stable (no change), what part was shifted from land to water (erosion), what part was shifted from water to land (accretion) and did any changes occur from bare soil to vegetation (may be an indicator for settlement).

After this exercise proves to be satisfactory, the operation can be performed for the total area (scale 1:250.000). For selected study areas more detailed maps could be produced (scale 1:50.000).

B.4 Maps and digital data on bathymetric development of areas of interest (midterm:1978 - present)

GIS as instrumentation can be a handy and powerful tool for morphological analysis and interpretation of the bathymetric data. Sounding maps have been prepared in the study area on 'regular' basis since the early 80's. These soundings have provided the basic data for geomorphological research. The morphological development of the areas of interest (intertidal areas, islands, tidal channels) during the last decades can be examined quantitatively from digitized bathymetric maps.
At the present state most of the bathymetric data which where collected during LRP aren't available in digitized form
These bathymetric maps will be digitized during MES partly (based upon priority) or fully as the time permits.

B.5 ArcView Viewer application for coastline and bathemetry dynamics

In the project ArcView 2.0 will be used for the computer display of the digital maps. ArcView is used as the main GIS/RS engine for data analysis, visulatisation and map production. ArcView is used to program a user-defined application and a graphical user-interface for the spatial database. The ArcView application is the main result of the RS/GIS group. It can be used for browsing the database, analysing the erosion-sedimentation patterns in the project area and create user-defined maps.

ArcView enables the visualisation of both vector and raster data. The major source of raster data will be the digital 1996 TM image, processed at EGIS. The major source of vector data will be digitizing of the coastline maps, of the BW Remote Sensing images and of the visual interpretation of the Remote Sensing images. The important maps that can be visualised using the ArcView engine are:

- Basemap visualisation;
- RS image visualisation; and
- Coastline development visualisation.
- Bathymetric development visualisation

Three types of applications and mapscales can be defined:

1 General overview (1:1.000.000 mapscale):

- Basemaps; and
- Longterm coastline development from 1777 onwards.

2 Project area overview (1:250.000 mapscale):

- Basemaps;
- Longterm coastline developments from 1777 onwards;
- Midterm coastline developments from 1973 onwards; and
- Morphological characteristics such as intertidal area, mangroves etc

3 Detailed overview of predefined areas (1:50.000 mapscale):

- Basemaps;
- Midterm coastline development (especially 1989 and 1996 situation); and
- Morphological characteristics.

A prototype of the viewer should be able to display the 1996 Landsat TM-image, and the coastlines digitized from the sources that are available. This prototype should show a background with the Landsat TM 1996 image, and on top of that lines of different colors with coastlines of different situations and colored polygons for erosion/accretion. Later extentions might include the full set of data collected from EGIS Bangladesh National database and other sources.

C.1 Training and coaching

Part of the objectives of the MES project includes training and coaching of the staff involved in the MES study as well as the staff of the concerned institutes . The transfer of GIS and RS technology needs to be based on a firm technical knowledge, adequate training, thorough understanding of the required inputs for the project and the acquisition of the necessary tools and infrastructure. During the project, these prerequisites should be kept in mind, to ensure a smooth and proper transfer of knowledge and technology.

A more formal prerequisite is that the software to be used in the project is utilized to its full extent. Although we can not provide training for all aspects of ArcInfo and ArcView, ample time is allocated for training the GIS operators in these complicated programs.

3.3 Activities

The activities needed to produce the anticipated output are listed:

A.1 Basemap (photomap) and digital data of the project area
A.1.1 Data collection
A.1.2 Data preparation
A.1.3 Digitizing and GIS management
A.1.4 Producing output

A.2 Basemap (schematised) of the project area
A.2.1 Data collection
A.2.2 Data preparation
A.2.3 Digitizing and GIS management
A.2.4 Producing output

B.1 Maps and digital data on Coastline development (longterm: 1777 - present)
B.1.1 Inventory of available data sources
B.1.2 Data collection
B.1.3 Data preparation
B.1.4 Digitizing and GIS management
B.1.5 Producing output

B.2 Maps and digital data on Coastline development (short term: 1973 - present)
B.2.1 Inventory of available data sources
B.2.2 Data collection
B.2.3 Data preparation
B.2.4 Digitizing and GIS management
B.2.5 Producing output

B.3 Interpretation of Landsat and SPOT images to assist in this study of morphological characteristics.
B.3.1 Preprocessing of Landsat TM 1996 images
B.3.2 Procurement of SPOT 1989 images
B.3.3 Selection of appropriate area to do test interpretation (in accordance with the views of the rest of the team)
B.3.4 Visual interpretation of selected areas
B.3.5 Digitizing results of B.3.4 and producing output maps
B.3.6 (If appropriate) Selection of other areas to be interpreted
B.3.7 (If appropriate) Visual interpretation of other areas
B.3.8 (If appropriate) Digitizing results of B.3.7

B.4 Maps and digital data on bathymetric development of areas of interest (midterm: 1978 - present)
B.4.1 Inventory of available data sources
B.4.2 Data collection
B.4.3 Data preparation
B.4.4 Digitizing and GIS management
B.4.5 Producing output

B.5 ArcView Viewer application for coastline and bathymetric dynamics
B.5.1 Development of prototype
B.5.2 Development of application

C.1 Training and coaching
C.1.1 Inhouse training in ArcInfo and ArcView

4 HARDWARE AND SOFTWARE

4.1 Inhouse infrastructure

The software to be used in this project consists of the following:
- PCArcInfo
- ArcView 2
- ILWIS

ArcInfo is used as the main platform for data management and digitizing. ArcView is the platform for producing maps and outputs. ILWIS is used as a platform to handle and manipulate the Remote Sensing images.

To hardware to be procured for the project consists of:
- Pentium PC 1GB Hard Disk, 16 MB RAM
- Digitizer A1
- Color printer A3

4.2 Infrastructure at SWMC

contact person	:	Emaduddin Ahmad, Mr Sayeed
telephone	:	884590
staff	:	Mrs. Nasreen Mohal, Mr Deedar
equipment	:	ArcInfo + ArcGrid Workstation PCArcInfo Printer/Plotter/Digitizer
previous experience	:	Linking Mike-11 to ArcInfo Flood depth duration modelling Tidal and coastal hydraulics
possible tasks	:	General support for GIS related work Support for linking model results to GIS

4.3 Infrastructure at EGIS

The image processing of the Landsat TM 1996 image is executed by EGIS.

contact person	:	Timothy Martin
telephone	:	881570
equipment	:	ERDAS IMAGINE PC based ArcInfo Unix Workstation Idrisi, Idrisi for Windows, PC based Digitizing, printing and plotting facilities
Tasks	:	- georeferencing the image (make sure a known and correct coordinate system is attached to the image, so that we can correspond locations in the field to locations in the image); - enhancing the image (contrast stretching etc); - printing of the image.

5 WORK PLAN

Table A11.1 shows the tasks and the persons assigned to the tasks.
JAB stands for Mr. M.A. Jabbar, MAF stands for Mr. Mahfuzur Rahman Chowdhury, AHMED stands for Mr. Saifuddin Ahmed (morphologist),WD stands for Mr. Willem van Deursen.

References

SPARRSO and ERIM, 1981. Measument of land accretion in the coastal zone of Bangladesh by analysis of landsat digital data. Final Report.

FAP19,1995. Bangladesh National Level GIS database, May 1995.

Item	Activity	Start Date	End Date
1.	(JAB) Assessment of RS requirements by having group discussions with different sectors.	25-1-1996	29-2-1996
2.	(JAB) Collection of information from different institutions regarding maps and RS data.	15-2-1996	15-3-1996
3.	(JAB) Collection of reports and RS data from different institutions	15-2-1996	31-5-1996
3.1	(JAB) Procurement of Landsat TM image of 1996	15-2-1996	15-3-1996
3.2	(JAB) Procurement of soil reports and maps from SRDI	1-3-1996	15-4-1996
3.3	(JAB) Procurement of Landsat MSS data	15-3-1996	31-3-1996
3.4	(JAB) Procurement 1:250.000 DHS map	15-3-1996	31-3-1996
3.5	JAB) Procurement Thana and District maps from LGED	1-3-1996	21-3-1996
3.6	(JAB) Procurement of SPOT bw prints	1-4-1996	31-5-1996
3.7	(JAB) Procurement of 1:50.000 scale Fisheries Resources Survey System maps	15-4-1996	30-4-1996
4.	(JAB) Inventory of historic maps and topo sheets	1-2-1996	30-4-1996
5.	(JAB/MAF) Interpretation of Remote Sensing data and preparation of shoreline/bankline GIS maps using inhouse GIS facilities	1-4-1996	31-10-1996
5.1	(JAB) Preparation of shoreline/bankline maps from Rennells map of 1779 and Landsat map of 1984 at 1:1.000.000 scale	1-4-1996	15-4-1996
5.2	(JAB) Preparation of shoreline/bankline map from Landsat MSS data of 1972-1973 at 1:250.000 scale	15-4-1996	31-5-1996
5.3	(JAB/MAF) Preparation of GIS map 1:250.000 from 5.2	1-5-1996	31-5-1996
5.4	(JAB/MAF) Preparation of GIS map from 1:50.000 scale Fisheries Resources Survey System maps at 1:250.000 scale	1-5-1996	31-5-1996
5.5	(JAB/MAF) Preparation of shoreline/bankline map from Landsat 1984 data at 1:250.000 scale	1-6-1996	30-6-1996
5.6	(JAB/MAF) Preparation of GIS map from SPOT 1989 images from National GIS database at 1:250.000 scale	1-7-1996	31-8-1996
5.7	(JAB/MAF) Preparation of shoreline/bankline map from Landsat TM data of 1992 at 1:250.000 scale	1-8-1996	31-8-1996
5.8	(MAF) Create ArcView application for showing coastline coverages of 1973-1980-1984-1989-1992-1996 images	1-4-1996	31-10-1996

Table A11.1 Work plan remote sensing

Item	Activity	Start Date	End Date
6.	(MAF/AHMED) Digitizing of bathymetric maps of areas of interest	1-4-1996	31-8-1996
7.	(JAB/MAF) Visual interpretation of one of the SPOT images of 1989/1990 to assist in this study of morphological characteristics.	1-7-1996	30-8--1996
8.	(JAB/MAF) Preparation of basemap items from BWDB maps showing polders, embankments sluices etc.	1-9-1996	30-10-1996
9.	(JAB) Coordination of processing of Landsat TM image of 1996 through EGIS	15-3-1996	15-5-1996
9.1	(JAB) Coordination of mosaiced image to be presented in the Inception Report	15-3-1996	30-3-1996
9.2	(JAB) Coordination of preparation of 1:250.000/1:500.000 scale prints of MES project area on A3 or A2 size paper	15-3-1996	15-5-1996
9.3	(JAB) Coordination of preparatiuon of 1:50.000 maps of detailed study areas	1-4-1996	1-9-1996
9.4	(JAB) Coordination of preparation of shoreline/bankline map from 1996 Landsat TM image at 1:250.000 scale	15-5-1996	15-7-1996
9.5	(JAB) Coordination of preparation of shoreline/bankline map from 1996 Landsat TM image at 1:50.000 scale	1-4-1996	1-9-1996
10.	(JAB/MAF) Preparation of reports and final GIS maps	1-10-1996	24-1-1996
11.	(MAF) Training in ArcInfo and ArcView	1-5-1996	1-7-1996
12.	(MAF) Development of ArcView application	1-7-1996	31-12-1996
12.1	(MAF) Development of prototype application	1-7-1996	1-10-1996
12.2	(MAF) Development of application	1-10-1996	31-12-1996
13.	(MAF) Digitizing the maps for coastline development prepared under 5	1-5-1996	1-10-1996
14.	(WD) Foreign consultant visits to Bangladesh		
14.1	(WD) First visit	21-2-1996	21-3-1996
14.2	(WD) Second visit	1-8-1996	30-9-1996
14.3	(WD) Third visit	1-3-1996	30-3-1996

Table A11.1 Work plan remote sensing (cont.)

ANNEX 12

INSTITUTIONAL DEVELOPMENT

TABLE OF CONTENTS ANNEX 12

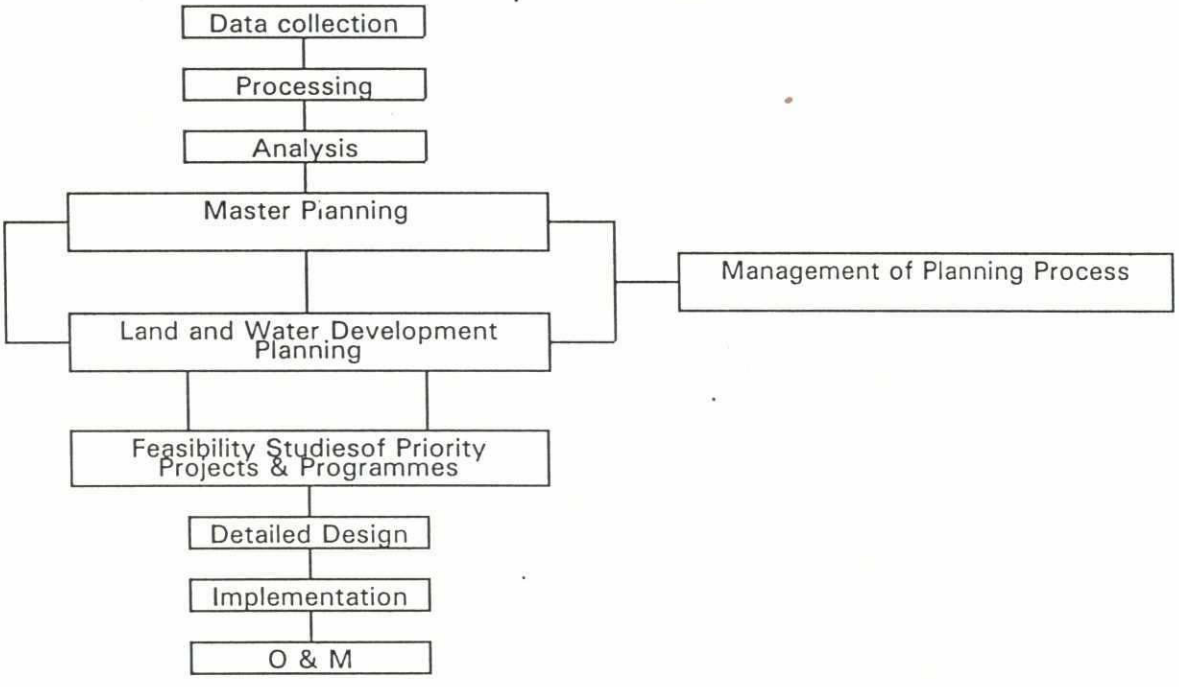
1 OBJECTIVE OF INSTITUTIONAL DEVELOPMENT IN MES

1.1 Project goals and objectives

The long term objective of MES is to increase physical safety and to promote sustainable development in the Meghna Estuary. This translates to the following measurable short-term objectives:

- to increase the operational knowledge of the hydro/morphological processes of the River Meghna;
- to increase the institutional capacity to retain and update that knowledge;
- to develop appropriate approaches for rapid and low-cost land reclamation.

Main objective of the institutional development component of the project is to identify conditions conducive to sustainability and continuation of project activities. The institution development component will pursue its objectives in relation to the complete land and water development process within the existing institutional and policy framework:



MES will be involved through the stage of identifying and conducting feasibility studies on priority projects. Implementation and O&M of proposed (small-scale or larger) interventions will be done by the relevant organizations (BWDB, LGED, or local groups and organizations).

1.2 Scope of institution development in MES

While the long-term beneficiaries are of course the population in the coastal areas, the more concrete beneficiaries of MES institutional development are:

- the BWDB (SSD) or some other organization(s) to be entrusted with data collection and processing (short term);
- the BWDB as the organization responsible for project planning (short term);
- the WARPO, as the organization in charge of macro planning of water resources development and flood protection (medium to long term).

The project documents mention institutional development for people's participation. In this regard, one should be aware of the fact that MES is principally a planning project whose main objective is to establish the macro planning process in the GoB institutional framework, with special emphasis on re-activating in a sustainable manner the supporting activity of data collection and processing. People's participation becomes relevant in micro planning. MES will be involved in micro planning only to the point of feasibility studies for priority projects and programs. Therefore, institutional development for people's participation in MES cannot refer to grassroots development of beneficiary organizations. Rather, in MES it implies identifying institutional needs for implementation of the priority projects and programs within the overall objective of shifting the burden of especially O&M from central GoB organizations to the local level. On this subject, MES will defer to CDSP and determine whether this sister project's approaches (to be) developed in this regard can be utilized. To the extent that the institutional requirements for MES interventions go beyond the scale of CDSP's approaches, MES will identify the relevant needs for development in follow-on projects.

The division of responsibilities for institutional development between MES and CDSP can further be rationalized by distinguishing technical and non-technical components that need institutionalization when it comes to actual settlement of newly developed land. The institutionalization of technical arrangements for internal water management on the new land and the coastal islands, i.e. arrangements for real-time management of the physical infrastructure in conjunction with agencies such as R&H, BIWTA, etc. is to be formulated by MES. Conversely, the institutionalization of non-technical arrangements for development of people's participation in conjunction with (development of) local government capability will be formulated by CDSP.

The principal activities of MES will concentrate on measuring, studying, and macro planning in the water sector. As stated in the invitation to prepare a proposal for the Meghna Estuary Study the project's objective is to develop appropriate approaches for rapid and low-cost land reclamation, i.e. the focus is more on the process than on specific outputs. In this connection, the project will pay attention to creating a conducive environment for micro-level interventions, but in general such interventions will have to be planned and executed through participative approaches at the field level. Whether it will be possible to undertake significant (planning for) infrastructure projects within the master plan will depend on technical, financial, economic, and institutional feasibility. The MES will undertake feasibility studies for priority projects and programs. It is quite possible that the MES will determine that only limited measures should be taken to help people adjust/accommodate to the existing situation.

2 INSTITUTIONAL SETTING

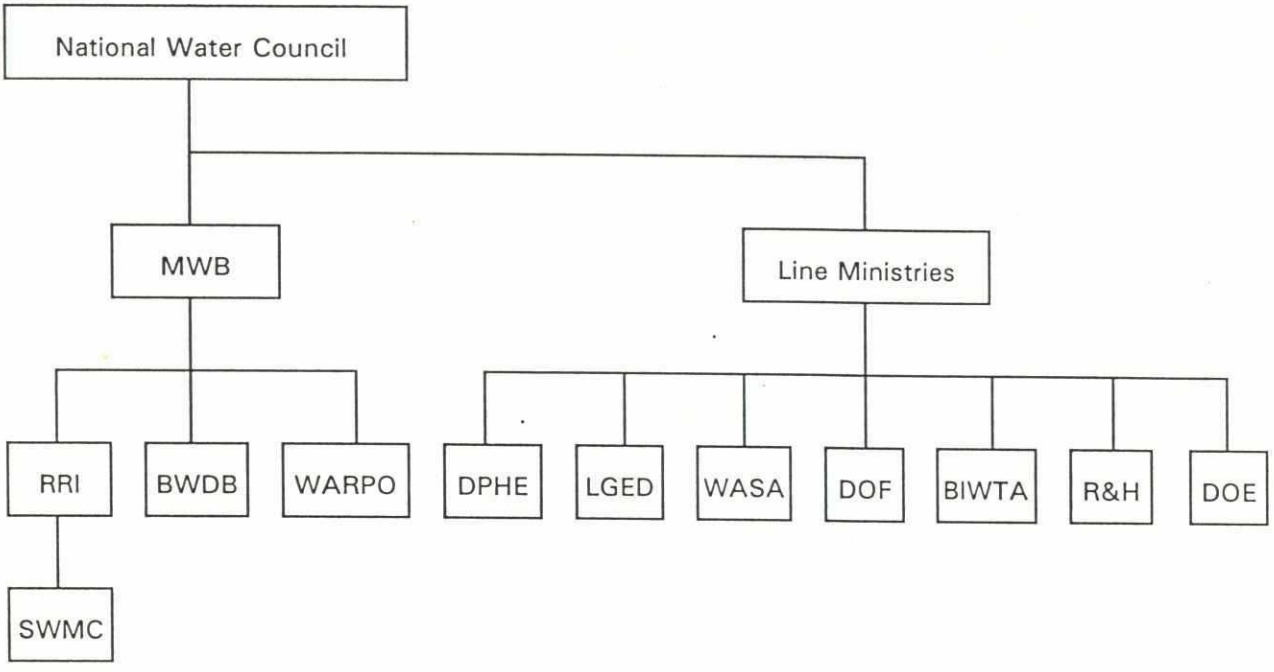
2.1 GoB Water and flood management strategy

The FAP Conference of December 1995 discussed *inter alia* institutional development in the water sector. It established that the GoB has formulated a Water and Flood Management Strategy calling for:

- addressing the long-term needs of sector management;
- undertaking integrated land and water use planning;
- achieving inter-sectoral balance;
- managing cross-border flows;
- basin-wide water resources development (Surface Water and Groundwater);
- balance between physical infrastructural and non-physical infrastructural approaches;
- setting environmental priorities;
- developing appropriate institutions.

2.2 Existing institutions and related problems

The Water Resources Planning Organization (WARPO) has recently been merged with the Flood Plan Coordination Organization (FPCO), and is now identified as the locus of responsibility for macro planning. BWDB, LGED and organizations in water-related sectors are responsible for micro planning (project planning), implementation, and O&M. This has resulted in some streamlining of the institutional framework in the water sector. Nevertheless, there are still many different organizations operating in the sector.



In this setting, as presented to the FAP Conference, a number of institutional problems are recognized regarding the principal functions in the water management process, from policy formulation through planning, implementation, and O&M:

- lack of effective coordination of conflicting inter-sectoral activities at top levels of government - the Cabinet-level National Water Council has no effective down-the-line organization to feed it with input based on a holistic analysis of water issues. Although WARPO has the mandate for national policy and strategy development this has yet to come off the ground;
- lack of a national plan identifying public and private responsibilities in the water sector - WARPO's role of central body for water policy and planning has yet to become strongly established;
- lack of inter-sectoral coordination in water projects - no mechanisms for integrating planning, even in the Planning Commission;
- lack of adequate consideration of environmental aspects in water projects - due to disintegrated planning processes and lack of knowledge of environmental impacts;
- lack of people's support of water projects due to excessive centralized planning without adequate local inputs and participation;
- lack of adequate support and funding for maintenance of water structures, caused by lack of skills in grass-roots institution building for public support;
- dearth of private investment in the water sector.

As the primary objective of institutional development in MES is to formulate arrangements to sustain the project activities, a number of the above observations are relevant to MES. This is particularly true for the observations on the role and position of WARPO and BWDB, not only as they relate to planning as such but also specifically regarding data collection and processing in support of the planning process. A number of different agencies are involved. Within the project's immediate "technical range", the most important organizations are:

- BWDB/SSD in Chittagong for data collection;
- BIWTA for data collection
- BWDB/LAED for data processing (acting only as a "user" of the information; the actual processing is done by the SWMC which resorts administratively under the RRI but is operated as a project organization);
- BWDB/LAED for planning and prioritizing of actual land development and protection projects including developing arrangements for people's participation;
- WARPO for macro planning of the estuary area.

A number of other organizations impact on the project's activities as well, particularly as they are related to different aspects of master planning and development planning. These organizations are:

- LGRD&C (because of its involvement in CDSP);
- LGED (develop small-scale infrastructure for rural water resources development, including developing arrangements for people's participation.);
- Roads and Highways (road/highway development has a major physical impact on water management);
- BIWTA (concerned with infrastructure and procedures for availability and navigability of inland waterways);
- Ministry of Agriculture (concerned with rain-fed and groundwater irrigation, i.e. important aspects of integrated water management);
- Department of Fisheries (concerned with aquaculture, access to open water for fishery on the river and at sea);
- DPHE (concerned with developing resources for domestic water supply);
- Ministry of Land (owns new land and is involved in land allocation, land acquisition for infrastructure projects, and land reform);
- Departments of Environment and Forestry (concerned with capability of the land for water retention);
- Department of Education, Department of Relief

With so many institutions involved, coordination becomes a major challenge. From a management perspective, it would be best to have as much of the responsibility for the different steps in the process in as few as possible hands. Of particular relevance to MES are the following key institutional needs presented to the conference:

- providing specific mandates for execution, monitoring, and data collection organizations for implementation of the National Water Plan in collaboration with other agencies;
- providing specific levels of interaction between major water and water-related agencies for planning and coordination of water programs and schemes.

2.3 Existing proposals for change

While the Water and Flood Management Strategy is reportedly basically agreed upon, its full implementation has yet to materialize. As such, the strategy was found to have a well-defined goal, but related, measurable objectives have not yet been specified. These objectives would provide a framework for sectoral planning. There are three main participants involved in water resources development and planning:

- Government : - to control overall exploitation and management of the resources for the benefit of society (mainly through laws and regulations);
  - to undertake investment projects of a public good nature;
  - to fill in the gaps caused by market failure;
- Non-Government Entities : to develop and manage resources for their members' benefit (within government-set boundaries);
- Private sector : parallel to NGEs except for scale and a profitability motive.

A number of options and recommendations for institutional restructuring were presented to the conference:

- strengthening the national water policy framework by providing proper support to the NWC through WARPO;
- strengthening national water planning and programming by augmentation of WARPO to have as major functions:
  - planning national, regional, and basin programs with overall assessment of water supply and demand in the country;
  - management of overall water resources through inter-sectoral coordination (macro-management);
  - monitoring, evaluation, and data collection (retain GIS, SWMC, EIA, and integrate data from different sub-sectors in a central data collection unit);
  - regulations;
- focusing government organizations on the legitimate role of the public sector institutions in the water sector, i.e. the creation of infrastructure.

Non-government organizations (including groups of individuals) would interact with the system at various levels for planning, scheme development, and implementation.
In line with these recommendations, it was proposed to formally create WARPO as responsible for sector strategy formulation, long-term planning, intersectoral coordination, and regulation of water use activities. As a complement, it was proposed to update the mission/goal for BWDB "to provide large-scale engineering support for implementation of the national water sector strategy and plan for flood control, drainage, and irrigation and real-time management of water resources in accordance with NWP and WARPO guidelines". BWDB would pursue this by:

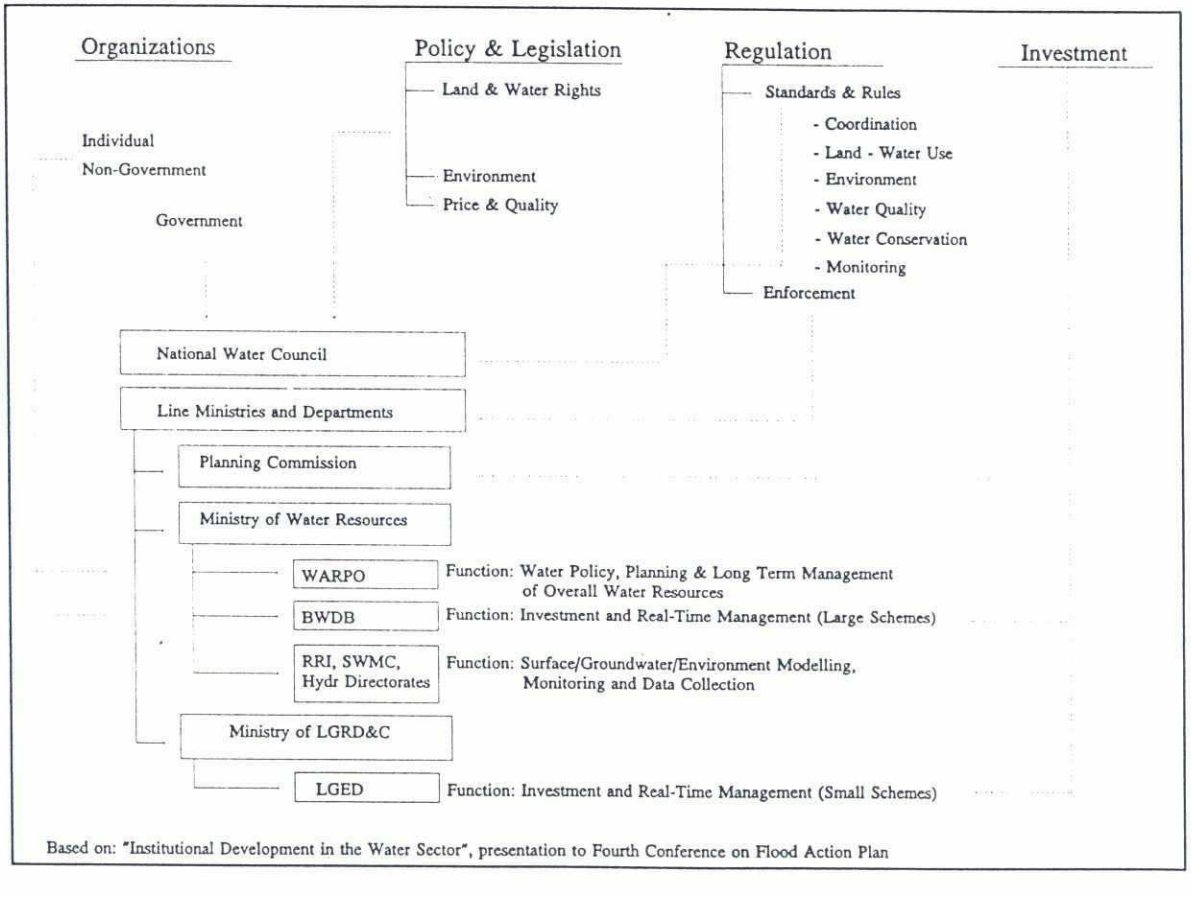
- creating infrastructure (project planning, construction, O&M);
- developing beneficiaries' capability to implement minor water control structures and do O&M of facilities;
- carrying out major water development and management functions requiring heavy engineering equipment and skills;
- monitoring and regulation of water regime.

Of particular relevance for MES is a proposal for the strengthening of the national water resource data collection and processing system. Under the proposal, the data management process is to be consolidated and systematized by merging activities, building synergy between units, and ensuring availability of information to all users. The proposal is to:

- merge RRI, SWMC, and the Hydrology Directorates of the BWDB (Water Investigation Directorate, Surface Water Hydrology Directorate, Groundwater Investigation Circle, Groundwater Data Processing and Research Circle), along with GIS, into a non-profit corporation under the Companies Act with specific provisions allowing for compensation schemes outside GOB rules and flexibility in hiring and firing, etc.;

- integrate EIA into WARPO, where environmental studies will be an integral part of water planning and evaluation in related sectors.

The proposed institutional set-up would be as follows:



Based on: "Institutional Development in the Water Sector", presentation to Fourth Conference on Flood Action Plan

3 ASPECTS OF INSTITUTION DEVELOPMENT IN MES

3.1 Awareness of overall institutional change

Recognizing that these proposals have not yet been formally accepted, but also the reality that BWDB has already been instructed to focus on micro planning (leaving macro planning to WARPO), the institutionalization of the MES activities must be formulated in such a way as to neither prescribe nor frustrate (transition to) this proposed set-up. In this context, the project must establish contact with organizations dealing with these matters today, while keeping an open mind towards possible alternative arrangements providing better guarantees for continuation of the activities on a high level of quality.

This means that particular attention will be paid to placing the modelling function with SWMC and perhaps, in order to better be able to control the data processing and analysis process, shifting the responsibility for data collection there as well. As regards planning, MES data and information would be used for macro as well micro planning. Therefore, for planning purposes possibilities must be investigated to connect with WARPO (e.g. establishing some link with the World Bank-funded institutional development in support of establishing WARPO in its new role), BWDB, and LGED.

3.2 Project "ownership"

On balance, MES is oriented toward macro-level planning, with a clear link to project planning. This means that counterparts for the project are in different organizations, WARPO and BWDB. This is especially relevant for transfer of knowledge on the planning methodologies and management of the planning process to be established by the project, as this will require availability of considerable numbers of qualified staff.
Arrangements must be made with both WARPO and the BWDB in this regard, and also to support the project in more general terms. In this respect the question arises whether WARPO feels sufficient "ownership" of the project to make this type of contribution despite the fact that the counterpart budget is entirely controlled by BWDB/LAED.

3.3 Privatization/sustainability

In looking to establish sustainable arrangements for the various activities it is likely that benefit can be reaped from streamlining of procedures. This would indicate a preference for concentration of a significant part if not all of the process (from data collection to analysis) in the hands of just one organization. Failing that, at least procedures must be streamlined and task and responsibility allocations must be simplified.

The ultimate objective would be to have clear accountability for the entire process. Part of the search for this type of solution should be directed at sub-contracting to private sector companies. In looking for modalities to create sustainability of the data collection and modelling function, private sector alternatives will be considered. Such alternatives may be more promising because, compared to government organizations these may:

- have more secure budgets for operational activities;
- be less bureaucratic and therefore more flexible in their operations;
- be better able to retain and motivate staff with attractive salary and benefit packages;
- be less susceptible to unplanned lateral moves of just-trained employees.

3.4 Ultimate usefulness of MES outputs

All planning for flood protection and land development will come to naught unless there are clear arrangements for coastal zone management at different levels. This includes the legal framework and the responsibility for real-time management of the plan area (deciding who can undertake what type of intervention in what location).

In line with the proposal for institutional change discussed at the FAP Conference, this would be probably the responsibility of the BWDB. However, this role has not heretofore been performed by any GoB organization, at least not comprehensively. In any event, it would be new to BWDB, which has been more accustomed to being the intervenor in - rather than the manager - of plan areas.

Development of an organization for coastal zone management is not an objective of MES. However, in developing the master planning process the project will highlight requirements in this regard (since they relate directly to plan implementation) and will be ready to support development of required capabilities in BWDB when requested and to the extent possible within the MES budget and work schedule.

4 INSTITUTIONAL DEVELOPMENT TASKS FOR MES

4.1 Assessment of SSD Chittagong

To get the MES activities underway, the immediate need for the project is to re-activate the data collection and processing activity and to formulate arrangements to sustain data collection and processing upon completion of the project.

Regarding the continuation of these activities, it is important to point out that the TOR require a special Report on Institutional Strengthening of the BWDB Surveys and Studies Division in Chittagong, containing an assessment of the available capabilities regarding hydrographic surveying of coastal waters.

The report is required after 12 months with proposals for optimum institutional arrangements to continue routine surveys and studies after MES, including required facilities, equipment, staffing, initial investment required, and annual recurrent costs). However, in the specified TOR it is also mentioned that BWDB should have its own institute to independently undertake studies, collect data, and update the gathered information before the end of the project.

The required strengthening of SSD would appear to upstage (at least part of) developing optimal institutional solutions, for from the desire for an independent institute it appears that "optimal" is not necessarily felt to be in SSD. It is necessary to clarify this issue before embarking on activities that may subsequently prove to be in vain. Whatever route is taken, it is important to realize that equipment and skill are not the only important parameters for success; an appropriate mandate is at least as important.

4.2 Institutionalizing the planning process

The survey and studies activity feeds into a planning process. The technical objective of the project is to establish a process for master planning (identifying potentials for development of new land); the institutional development activity of the project will in large part deal with formulating arrangements to manage the master plan upon completion of the project, i.e. establishing master planning as a continual, long-term activity in or under an organization with a proper mandate, equipment, and skills (the new WARPO).

In this connection, the project will pay specific attention to the relationship between BWDB and WARPO in the planning process, and coordination with other FAP studies with particular emphasis on the monitoring function.

The project will also establish the process for land and water development planning by developing models for the development and settlement of new land from the perspective of flood protection and internal water management. The TOR require that these models be described at the pre-feasibility level in the Development Plan Report and include institutional recommendations.

This process needs to be permanently institutionalized as well. It appears that this will be more complicated, as this activity exists on the interface between macro planning (WARPO) and micro planning (BWDB), where more organizations are involved. Furthermore, there is also the interface between policy development and technical planning on the one hand, and budgeting for actual development projects on the other. On this latter interface there will also be involvement of the Planning Commission, whose role is to establish multi-sector investment priorities and to recommend allocation of resources.

Finally, especially in providing a framework for high-priority projects and small-scale interventions through the Master Plan and the Land and Water Development Plan, the project will have to establish relationships with other organizations such as the MoL and LGRD&C (particularly in relation to the organizations involved in CDSP).

5 ACTIVITIES TO BE UNDERTAKEN

5.1 Methodology

Basic methodology for institutional development activities is similar to that for the MES as a whole:

- description of institutional arrangements at different levels;
- analysis of past performance;
- specification of objectives and criteria for development;
- projection of possible bottlenecks;
- identification of on-going plans and projects with impact on institutionalization of MES activities;
- specification and analysis of costs where applicable;
- evaluation of alternatives.

202

5.2 First year

First year - assessment and proposals for SSD activities

A stated before, the immediate concern of MES is to re-activate the data collection and processing activities in support of planning. The operational responsibility for data collection lies with the Surveys and Studies Division (SSD) in Chittagong. For the duration of the project, MES will essentially control the data collection process. MES will also control data processing and analysis.

Data are sent to SWMC, which develops an overall model for the MES plan area and local models to study specific intervention alternatives in more detail. The MES institutional development component will assess the possibilities for sustaining these activities, taking into account the need for operational budgets, flexibility of operations, and the links between the data collection and processing/analysis to better manage the overall process.

In accordance with the TOR, the possibility of strengthening SSD will be investigated first. However, suitable alternatives will be investigated as well. Institutional assessments will be made of the relevant organizations to determine their relative strengths and weaknesses in terms of meeting the needs in respect of budget, flexibility, and process management.

This will be done by conducting interviews in the organizations concerned, using checklists to be developed in the project based on existing samples. A major concern in this regard will be the fact that a number of data collection and processing related activities, now established in different organizations, need their future secured after the conclusion of FAP. MES proposals will take into account the need for streamlining of procedures, effectiveness of the activities, and efficiency of operations.

5.3 Throughout project

Throughout: WARPO/BWDB
- **master planning and LWU planning process**
- **manpower development (on-the-job and formal training)**

WARPO is at least set to go for the next two years as it is covered by a TAPP which describes it as the center of action for planning. Institutional development will be funded with $10.0 mln World Bank support. If possible, MES will coordinate with this effort by identifying links and potential overlaps and gaps between the MES activities and the overall development of WARPO functions. MES would then play a supporting role in implementation of this development, by providing specific skills on (management of) macro and master planning.

A major effort will be made to transfer knowledge on the entire planning process and its management to counterpart staff of BWDB and WARPO. Ideally, this should be done through on-the-job training. It cannot be stressed too much that it is not just transfer of knowledge about a process that is important, but the internalization of the process itself. This will only succeed if counterpart staff are made available on a long-term and if possible full-time basis to actually participate in the activities of the project. Should this be agreed, the interventions aimed at changing the way the organization works may not continue to be seen as some outside consultant's or donor's ideas.

In cases where BWDB/WARPO staff would need more general instruction on new concepts and approaches regarding planning and management of planning, on-the-job training would be supplemented by courses in relevant organizations and training abroad.

However, formal training should only be done if there is a guarantee that the trainee remains in the project organization or its successor for at least five years. Due to the intersectoral nature of the development activities, staff from related organizations such as DOE, BIWTA, LGED, etc. would be included in the courses as well (as far as resources allow).

The institutional development component of MES will assist in making a systematic training needs assessment of counterpart staff. The assessment will cover formal (classroom) and non-formal (workshop, etc.) training and involve the subjects that need to be covered and how many trainees will be targeted. Next, a training program will be developed regarding the timing and location of training on the different subjects. The program will also include induction training to acquaint staff more generally with the nature and objectives of the project.

Development of the training program will take place as soon as possible, i.e. after counterpart staff have been assigned and needs have been identified. As the project continues, it is likely that new training needs will be revealed and/or new staff will join the project or present themselves from related organizations. Hence, the training program to be developed during the first stage may well be amended later on.

5.4 Second half of projects

Second half of project: - **priority programs and projects**
- **small-scale interventions**

As the potentials for development become more clear in the master planning part of MES, the project will become able to identify priority projects and programs for land development and land protection as required in the TOR. The availability of institutional provisions for implementation and management will be one of the criteria for assigning priority to these projects. The institutional development component of MES will take inventory of such arrangements where they exist, to assess whether the contemplated projects can in fact be implemented and sustained. This will particularly relate to the technical aspects of water management in the newly developed or protected areas.

As the priority programs and projects will not be implemented by MES, MES activities will not involve extensive development of (new approaches to) people's participation in the project area. Rather, MES will work with CDSP to determine whether its approaches are relevant for more general application in (master) planning of development, and specifically for the MES priority plans and projects. Where changes are needed, these would be discussed with CDSP and included in the TOR for implementation of the priority projects and programs, to be carried out after conclusion of MES.

Improvements to existing arrangements may be proposed for the purposes of planning, i.e. the actual and potential role of institutions relevant for physical development will be identified, with special attention to the legal framework. However, actual institutional development in MES will focus on sustaining the activities for (management of) planning for land and water development upon completion of the project (i.e. at the WARPO and BWDB level). MES will not actually undertake institutional development of other organizations other than by promoting needed changes to the authorities concerned and determining whether and when these changes are likely to be implemented.

Where priority projects and programs exceed the scale of CDSP, the project may suggest establishment of a special authority for development of the infrastructure and real-time management of the project area during an initial subsequent period, possibly through (rearrangement of) BWDB. In this case, MES would describe the role and position of the authority and its major functions. It would not actually embark on the institutional change itself, whether within BWDB or by creation of some new organization.

ANNEX 13

CONSULTANCY SERVICES

TABLE OF CONTENTS ANNEX 13

ACTIVITY - TASK ALLOCATION SCHEDULE

1. TEAM LEADER & CO-TEAM LEADER:

The Team Leader is the over all incharge of the team of consultants, other staff and paraphernalia and all activities pertaining to the physical implementation and preparation of programs, plans and reports of the project, including field studies. His particular responsibilities include:

- Review and assessing of report, data,instruments,equipment, facilities and staff in LRP.
- Establishing coordination links with the client and determination of the roles of other inter-linked FAP programs, their objectives and outputs, with respect to MES.
- Preparation of Project Implementation Plan and Inception Report.
- Surveying of various conditions on the coastal islands to establish extent and causes of flooding and erosion and assessment of requirements for protection and development.
- Establishing an appropriate data base and management system for data processing, analysis and storage.
- Locating the areas for small scale interventions and preparations of outline design and cost estimates. Monitoring of the effectiveness of implemented small scale interventions.
- Preparation of report on the feasibility of reclamation along Nijhum Dwip.
- Providing support to CDSP for preparation of a feasibility study for the Muhuri accretion.
- Assessing country's available capability for coastal water survey and preparation of report with proposals including institutional arrangements, equipment and staffing.
- preparation of technical reports and working papers on special aspects of the surveys and studies.
- Preparation of a report with proposals for the continuation of the surveys and studies in phase 2.
- Preparation of a phased long-term plan, including environmental impact of the main phases of the plan.
- Preparation and submission of the Interim and the Draft Master Plan and finalization and submission of the Master Plan after review by the client and other concerning authorities.
- Preparation of Phased Development Plan with identification of projects and preliminary allocation of priorities.
- Making recommendations for Priority Projects and Programs.
- Preparation and submission of Interim and Draft Development Plan and submission of the final Development Plan after review by the client and concerning authorities.
- Recommending early stage projects with draft project formulations and terms of reference.
- Preparation and submission of the draft and the final Project/Program Preparation Reports with draft Concept Papers and Project Programs.
- The Co-Team Leader is responsible for assisting and necessarily advising the Team Leader in programming, planning, coordination, preparation of reports and plans and all the functions related to implementation of the project, including field studies.

2. HYDRAULIC ENGINEER (Estuary)

- Review and assess reports, data, instruments, equipment, facilities and staff in LRP.
- Examine & assess on-going and pipe line studies, projects and other activities; advise necessary support to CDSP for feasibility study for Muhuri accretion.
- Survey conditions on the coastal islands to establish the extent and causes of flooding and erosion in the area.
- Re-assess the feasibility of reclaiming land along Nijum Dwip and prepare report.
- Collect data and carry out surveys to establish the existing state of development of estuarine islands.
- Assist in simulating the hydraulic and morphological processess and predicting the effects of interventions, with the existing one-dimensional model and also in developmening two-dimensional models for specific detail studies.
- Develop and assess alternative strategies for flood/cyclone protection, options for primary and secondary protection.
- Carry out project preparation at full feasibility level and programme preparation in accordance with Guidelines.
- Assist in developing appropriate measures to accelerate accretion and reduce erosion in the estuary; locate areas for small scale interventions, outline their designs & cost estimates.
- Assist in preparation of Inception Reports, technical reports, working papers, phased long-term plan, Master plans, development Plans and determination of Priority Projects & Programmes.

3. HYDRAULIC ENGINEER (Reclamation) AND CIVIL ENGINEER

- Review and assess reports, data, instruments, equipment, facilities and staff in LRP.
- Examine and assess on-going and pipeline studies, projects and other activities; advise necessary support to CDSP for feasibility study for Muhuri accretion.
- Survey conditions on the coastal islands to establish extent and causes of flooding and coastal erosion in the area.
- Assist in developing appropriate measures to accelerate accretion and reduce erosion in the estuary; in locating the areas for small scale interventions and preparing outline designs and cost estimates.
- Monitor the effectiveness of implemented small scale interventions.
- Re-assess the feasibility of reclaiming land along Nijhum Dwip and coordinate in preparing report on it.
- Assist in preparation of technical reports and working papers on special aspects of the surveys and studies and a phased long-term plan, including environmental impact of the main phases of the plan.
- Collect data and carry out surveys to establish the existing state of development on the estuarine islands.
- Assess alternative strategies for flood/cyclone protection, reclamation and the development of the protected areas.
- Develop and assess options for primary and secondary protection and reclamation in protected areas.
- Develop and assess options for non-structural systems.
- Initiate preparation of priority projects and programmes.
- Carry out project preparation at full feasibility level in accordance with Guidelines.
- Assist in preparation of Inception Report, Progress Reports, Master Plans & Development Plans.

4. MORPHOLOGIST

- Review and assess reports, data, instruments, equipment, facilities and examine and assess no-going and pipeline studies, projects and other studies.
- Prepare a Project Implementation Plan for the inception Report.
- Survey conditions on the coastal islands to establish extent and causes of flooding and coastal erosion in the area.
- Establish an appropriate data base and management system for data processing, analysis and storage.
- Assess the morphological changes in the estuary and identity areas of apparent rapid siltation & erosion; locate areas for small scale interventions; prepare outlines of designs and cost estimates; suggest measures for accelerating accretion & reducing erosions in the estuary.
- Re-assess the feasibility of reclaiming land along Nijhum Dwip and prepare report; advise necessary support to CDSP for feasibility study of Muhuri accretion.
- Assist in simulation of the hydraulic and morphologic processes with the existing one -dimensional model and prediction of effects of interventions; also in developing two-dimensional models for specific detail studies.
- Prepare technical reports and working papers on special aspects of the surveys & studies and assist in preparation of phased long-term plan including environmental impact of its main phases.
- Collect data and carry out surveys to determine the existing state of development on the estuarine islands.
- Assess alternative strategies for flood/cyclone protection and for reclamation and development of protected areas.
- Assess options for primary & Secondary protection & reclamation
- Assist in preparation of reports and plans of the project.

5. CHIEF HYDROGRAPHER

- Review and assess reports, data, instruments, equipment, facilities and staff in LRP.
- Prepare a Project Implementation Plan for the Inception Report.
- Survey conditions on the coastal islands to establish the extent and causes of flooding and coastal erosion in the area.
- Set-up and maintain a network of Bench Marks & Water Level Gauges, including determination of zero levels.
- Observe and record as well as collet tidal water levels and store these data in a data base for easy access.
- Carry out velocity, discharge, salinity and sediment measurements at appropriate locations; measure wave characteristics.
- Carry out bathymetric surveys as agreed by BWDB.
- Carry out water sampling to monitor the sediment concentration, salinity as well as water quality.
- Establish an appropriate data base and management system for data processing, analysis and storage.
- Make an assessment of the available capabilities in the country with respect to hydrographic surveys in the costal waters.
- Prepare a report with proposals for optimum institutional arrangements, equipment and staffing for continuation of future routine surveys & studies.
- Prepare technical reports and working papers on special aspects of the surveys and studies.
- Prepare a report with proposals for the continuation of the surveys and studies in phase 2.
- Collect data and carry out surveys to establish the existing state of development on the estuarine islands.
- Assist in preparation of Master Plans, Development plans and Priority Project Programmes.

6. ECONOMIST

- Review and assess reports, data, instruments, equipment, facilities and staff in LRP.
- Examine and assess on-going and pipeline studies, projects and other activities.
- Assist in preparation of Project Implementation Plan (to be included in the inception Report).
- Make economic evaluation of cost estimates of small scale interventions.
- Re-assess the economic feasibility of reclaiming land along Nijum Dwip and prepare report.
- Provide support to the CDSP for preparation of a feasibility study for the Muhuri accretion with study and analysis of social, economic and financial aspects.
- Assist in preparation of a phased long term plan, including environmental impact of the main phases of the plan.
- Collect data and carry out economic surveys to establish the existing state of development on the estuarine islands.
- Assist in preparation of Interim & Draft Master Plan for physical development of the estuary and preparation of phased Development Plan with identification of projects and preliminary allocation of priorities with provisional assessment of economic & financial viability.
- Assist in making recommendations for priority projects and programmes justifying economic viability.
- Assist in preparation of Interim & Draft Development Plan.
- Coordinate in making recommendations for early stage projects with draft project formulations and terms of reference.
- Assist in Project/Programme preparation at full feasibility level in accordance with Guidelines for Project Assessment.

7. WATER MANAGEMENT/DRAINAGE ENGINEER

- Review and assess reports, data, instruments, equipment, facilities and staff in LRP.
- Examine and assess on-going and pipeline studies, projects and other activities.
- Assist in preparation of the Project Implementation Plan for Inception Report.
- Establish an appropriate data base and management system for data processing, analysis and storage.
- Provide support to CSDP for preparation of a feasibility study for the Muhuri accretion.
- Prepare technical reports and working papers on special aspects of the surveys and studies.
- Assist in preparation of phased long-term plan, including environmental impact of the main phases of the plan.
- Collect data and carry out surveys to establish the existing state of development on the estuarine islands laying importance to water and land management (drainage & reclamation)
- Assess alternative strategies for reclamation and development of protected areas
- Develop and assess options for non-structural systems.
- Prepare a phased development plan with identification of projects and preliminary allocation of priorities.
- Assist in preparation of the Interim & the Draft Development Plans and Interim & Draft Master Plans.
- Initiate preparation of priority projects and programmes
- Carry out programme preparation in accordance with the Guidelines for Project Assessment.
- Prepare and submit draft Project/Programme Preparation Reports.

8. RURAL DEVELOPMENT SPECIALIST

- Review and assess reports, data, instruments, equipment, facilities and staff in LRP.
- Examine and assess on-going and pipeline studies, projects and other activities
- Prepare a Project Implementation Plan for inclusion in the inception Report.
- Establish an appropriate data base and management system for data processing, analysis and storage.
- Assist in re-assessment of the feasibility of reclaiming and developing land along Nijhum Dwip with the input of selection procedures in allocation of land covering socio-economic and environmental dimensions.
- Assist in providing of support to CSDP for preparation of a feasibility study for the Muhuri accretion.
- Prepare a phased long-term plan, including environmental impact of the main phases of the plan.
- Collect data and carry out surveys to establish the existing state of development on the estuarine islands.
- Assess alternative strategies for development of protected areas.
- Develop and assess options for non-structural systems.
- Prepare a phased development plan with identification of projects and preliminary allocation of priorities.
- Assist in preparation of the Interim and the Draft Development Plans.
- Initiate preparation of priority projects and programmes.
- Carry out project preparation at full feasibility level in accordance with Guidelines for Project Assessment.
- Assist in Preparation of Interim & Draft Master Plans.
- Prepare Draft Project/Programme Preparation Reports.

9. ENVIRONMENTALIST

- Review and assess reports, data, instruments, equipment, facilities and staff in LRP.
- Re-assess the feasibility of reclaiming land along Nijhum Dwip addressing socio-economic & environmental dimensions.
- Provide support to CSDP for preparation of a feasibility study for the Muhuri accretion
- Prepare a phased long-term plan, including environmental impact of the main phases of the plan
- Assist in preparation of the Interim & the Draft Master Plan for the development of the physical development of the estuary.
- Collect data and carry out surveys to establish the existing state of development on the estuarine islands.
- Develop and assess options for development of protected areas.
- Develop and assess options for non-structural systems.
- Prepare a phased development plan with identification of projects and preliminary allocation of priorities.
- Make recommendations for priority projects and programmes.
- Assist in preparation of the Interim and Draft Development Plan.
- Carry out project preparation at full feasibility level in accordance with Guidelines for Project Assessment.
- Prepare draft Project/Programme Preparation Reports.

220

10. AGRONOMIST

- Review and assess reports, data, instruments, equipment, facilities and staff in LRP.
- Re-assess the feasibility of reclaiming land along Nijhum Dwip and prepare report on agronomic aspect.
- Provide support to CDSP for preparation of a feasibility study for the Muhuri accretion, on agronomic aspect.
- Prepare a phased long-term plan, including environmental impact of the main phases of the plan.
- Assist in preparation of Interim and Draft Master Plan for the physical development of the estuary.
- Collect data and carry out surveys to establish the existing state of development on the estuarine islands in respect of geomorphology & soils, agriculture and afforestation.
- Assess alternative strategies for development of protected areas with emphasis to agronomic aspect.
- Develop and assess options for development of protected areas.
- Develop and assess options for non-structural systems.
  Prepare a phased development plan with identification of projects and preliminary allocation of priorities.
- Assist in preparation of Interim and Draft Development Plans.
- Carry out project preparation at full feasibility level in accordance with Guidelines for Project Assessment.
- Prepare and submit draft Project/Programme Preparation Reports.

11. MODELLING SPECIALIST

- Review and assess reports, data, instruments, equipment, facilities and staff in LRP.
- Simulate the hydraulic and morphologic processes with the existing one-dimensional model.
- Predict the effects of interventions with the existing one-dimensional model.
- Develop two-dimensional models as may be required for specific detailed studies.
- Carry out project preparation at full feasibility level in accordance with Guidelines for Project Assessment.
- Assist in preparation of Draft Project/Programme Preparation Reports.

12. INSTITUTIONAL SPECIALIST

- Review and assess reports, data, instruments, equipment, facilities and staff in LRP.
- Examine and assess on-going and pipeline studies, projects and other activities.
- Re-assess the feasibility of reclaiming land along Nijhum Dwip in respect of institutional arrangements.
- Establish institutional setting for support to CDSP for preparation of a feasibility study for the Muhuri accretion.
- Prepare technical reports and working papers over institutional frame work of the surveys and studies.
- Assist in preparation of Interim & Draft Master Plan for the physical development of the estuary.
- Collect data and carry out surveys to establish the existing state of development on the estuarine islands.
- Carry out project preparation at full feasibility level in accordance with Guidelines for Project Assessment.
- Assist in preparation of Draft Project/Programme Preparation Reports.

13. REMOTE SENSING SPECIALIST

- Review and assess reports, data, instruments, equipment, facilities and staff in LRP.
- Examine and assess on-going and pipeline studies, projects and other activities.
- Survey conditions on the coastal islands to establish extent and flooding and erosion using satellite data.
- Establish an appropriate data base and management system for data processing, analysis and storage
- Collect data and carry out surveys to establish the existing state of development on the estuarine islands with the help of R.S data.
- Assist in preparation of the Interim and Draft Development Plans and Master Plans.

14. SPECIAL ADVISER 1

- Review and assess reports, data, instruments, equipment, facilities and staff in LRP.
- Prepare a Project Implementation Plan (to be included in the Inception Report.
- Prepare the Interim Development Plan.

15. SPECIAL ADVISER 2

- Prepare a phased long term plan, including environmental impact of the main phases of the plan.
- Prepare Interim Master Plan for the physical development of the estuary.
- Prepare the Draft Master Plan report for the development of the physical development of the estuary.
- Assess alternative strategies for reclamation and development of protected areas.
- Develop and assess options for reclamation and development of protected areas
- Prepare a phased development plan with identification of projects and preliminary allocation of priorities
- Prepare the Interim Development Plan.

16. INSTRUMENT SPECIALIST

- Review and assess reports, data, instruments, equipment, facilities in LRP.
- Advise on efficiency of modern equipment & instruments used in surveys.
- Install equipment of surveys and measurements.

ANNEX 14

BUDGET PLAN

TABLE OF CONTENTS ANNEX 14

BUDGET PLAN MEGHNA ESTUARY STUDY (COSTS IN NGL)

DGIS code	Description	1995											
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
300	Contract staff	0	0	0	0	0	0	0	0	0	0	77418	137497
400	Purchase/Investments	0	0	0	0	0	0	0	0	0	0	0	5000
500	Operational costs	0	0	0	0	0	0	0	0	0	0	4000	11850
600	Training and courses	0	0	0	0	0	0	0	0	0	0	0	0
800	Contingencies												
	Total	0	0	0	0	0	0	0	0	0	0	81418	154347

BUDGET PLAN MEGHNA ESTUARY STUDY (COSTS IN NGL)

DGIS code	Description	1996											
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
300	Contract staff	103399	267755	252564	144162	217558	197223	119958	94600	108168	82086	220668	234636
400	Purchase/Investments	2000	1000	340000	310000	358000	100000	0	0	20000	0	0	0
500	Operational costs	11850	26850	29850	13850	51850	38850	29850	28850	28850	54850	28850	28850
600	Training and courses	0	0	0	0	0	0	0	0	40000	0	0	0
800	Contingencies												
	Total	117249	295605	622414	468012	627408	336073	149808	123450	197018	136936	249518	263486

BUDGET PLAN MEGHNA ESTUARY STUDY (COSTS IN NGL)

DGIS code	Description	1997 JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
300	Contract staff	154001	184213	215905	377351	416471	281784	99511	122746	83898	85428	116785	174708
400	Purchase/Investments	10000	0	0	0	0	0	0	0	0	0	0	0
500	Operational costs	28850	28850	28850	23850	18850	18850	28850	28850	23850	18850	28850	28850
600	Training and courses	0	40000	0	0	30000	0	5000	5000	40000	0	0	0
800	Contingencies												
.	Total	192851	253063	244755	401201	465321	300634	133361	156596	147748	104278	145635	203558

BUDGET PLAN MEGHNA ESTUARY STUDY (COSTS IN NGL)

DGIS code	Description	1998											
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
300	Contract staff	136822	155279	239625	336831	403969	325808	103664	29018	44442	0	0	0
400	Purchase/Investments	0	0	0	0	0	0	0	0	0	0	0	0
500	Operational costs	28850	48850	28850	33850	18850	19850	18850	18850	11850	0	0	0
600	Training and courses	0	40000	0	0	5000	5000	0	0	0	0	0	0
800	Contingencies												
	Total	165672	244129	268475	370681	427819	350658	122514	47868	56292	0	0	0

BUDGET PLAN MEGHNA ESTUARY STUDY (COSTS IN THOUSAND NGL)

DGIS code	Description	YEAR							TOTAL PROJECT
		1995/II	1996/I	1996/II	1997/I	1997/II	1998/I	1998/II	
300	Contract staff	214.9	1,182.7	860.1	1,629.7	683.1	1,598.3	177.1	6,346.0
400	Purchase/Investments	5.0	1,111.0	20.0	10.0	0.0	0.0	0.0	1,146.0
500	Operational costs	15.9	173.1	200.1	148.1	158.1	179.1	49.6	923.9
600	Training and courses	0.0	0.0	40.0	70.0	50.0	50.0	0.0	210.0
800	Contingencies	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Total	235.8	2,466.8	1,120.2	1,857.8	891.2	1,827.4	226.7	8,625.9

ANNEX 15

LIST OF REPORTS

MES LIBRARY INVENTORY (LIST OF DOCUMENTS/ BOOKS/ REPORTS)

As on : 17/4/1996

PR = Progress Report , FS = Feasibility Study , TR = Technical Report , MR = Miscellaneous Report , ER = Evalution Report , IR = Inception Report , PP = Proposal , MP = Master Plan , DP = Developme
MI = Mission Report , TO = Tor , HB = Hand Book, MOA = Ministry of Agriculture

Sl.	Title	Agency or Project	Date	No. of copies	Cat.	Key word 1	Key word 2	Key word 3
1	A cross dam in the coastal region of Bangladesh : Geotechnical and Hydrodynamic Design Considerations. by Muhammed Humayun Kabir, Muhammed Monowar Hossain. Presented at the 30th Annual converntion of the institution of Engineers,	BUAT	Mar-86	1	AR			
2	Action Plan for Phase - III, 1990-95	LRP	Jun-90	1	PL			
3	Administering Credit Programme through NGO, An Analysis of Credit Programme in Chair Bagadona, 1990-91 Aman Season	LRP	Feb-91	1	TR			
4	Amtali Closure, Early Implementation Projects on flood control and irrigation in Bangladesh. Study of Methods for closing tidal channels , sixth interim report	IEP	Jul-82	1	TR			
5	An Interim Presemtation on Dranage study of south Sundharam Upazilla, Noakhali , D.K. Barua	BUET	Aug-87	1	AR			
6	An Interim presentation on drainage study of south Sudharam Upazilla, Noakhali, August 87, by Dilip K. Barua	LRP	Aug-87	1	TR			
7	An Introduction to reference Naterials on Remote sensing (FAO)	FAO		1	AR			
8	Annex V -VI . Volume -4	UNDP	Aug-93					
9	Area Development in Char Baggar Dona and Overview of the Pilot Polder Scheme	LRP	Mar-90	1	TR			
10	Bangladesh Estuary control (A programme of delta development) Report of an Identification Mission. 5-26 October 1976	NEDECO	Oct-76	2	MI			
11	Bangladesh Flood Action Plan . Guidelines for Environmental Impact Assessment .	ISPAN	May-92					
12	Bangladesh landreclamation Project Sandwop cross -dam. Geulsluiting, grondemchanische en	dss		1	AR			
13	Bangladesh Space Research and Remote sensing Organization	SPARRSO			AR			
14	Bangladesh Tide Tables	BIWTA	Jan-90	1	MR			
15	Bangladesh Tide Tables	BIWTA	Jan-89	1	MR			
16	Bangladesh Tide Tables	BIWTA	Jan-88	1	MR			
17	Bangladesh Tide Tables	BIWTA	Jan-91	1	MR			
18	Bangladesh Tide Tables 1977 Part II	BIWTA	Jan-77	1	MR			
19	Bangladesh Tide Tables 1979 Part II	BIWTA	Jan-79	1	MR			
20	Bangladesh Tide Tables 1980 Part II	BIWTA	Jan-80	1	MR			
21	Bangladesh Tide Tables 1981 Part II	BIWTA	Jan-81	1	MR			
22	Bangladesh Tide Tables 1982 Part II	BIWTA	Jan-82	1	MR			
23	Bangladesh Tide Tables 1985 Part II	BIWTA	Jan-85	1	MR			
24	Bangladesh Tide Tables 1975	BIWTA	Jan-75	1	MR			
25	Bangladesh Tide Tables 1976 Part I	BIWTA	Jan-76	1	MR			
26	Bangladesh Tide Tables 1986 Part II	BIWTA	Jan-86	1	MR			
27	Bangladesh Tide Tables Ports 1974	BIWTA	Jan-74	1	MR			
28	Bangladesh Tide Tables, 1984 Part II	BIWTA	Jan-84	1	MR			
29	Bangladesh Tide Tables, 1988	BIWTA	Jan-88	1	MR			
30	Bangladesh Tide Tables, 1989	BIWTA	Jan-89	1	MR			

Sl.	Title	Agency or Project	Date	No. of copies	Cat.	Key word 1	Key word 2	Key word 3
31	Bangladesh Tide Tables, 1990	BIWTA	Jan-90	2	MR			
32	Bangladesh Tide Tables, 1991	BIWTA	Jan-91	2	MR			
33	Bangladesh Training Program in the Processing of Landsat Digital Data for land Accretion, Boro rice Inventory and Forestry Applications. Bangladesh Landsat Programme	LRP	Aug-79	1	AR			
34	Base Map Analysis of Coastal Changes, using Aerial Photography. by Craig H. Everts and Deborah C. Wilson, Technical papar no. 81-4 (U.S. Army, Corps of Engineers)	LRP	Nov-81	1	AR			
35	Bedykmeem in Bangladesh over be maatschappelyke Potemtie van Cultuur Techmiek, Kees Blok	LRP						
36	Bhola irrigation scheme, Bangladesh An assessment of salinity intrustion and abstraction	HRSW	Oct-81	1	AR			
37	Biomass assessment in third world villages via a systems methodology by M. Slesser, C.W.	US	Jun-81	1	AR			
38	Brief on Land Reclamation Project	LRP	Jun-91	1	MR			
39	Cartography from remote sensing data	VISP	Jun-79	1	AR			
40	Ceodetic Control in Bangladesh	LRP						
41	Chapter 12 The Use of Satellites in hydrometry	LRP		1				
42	Char Development & Settlement Project .	LRP	Nov-94					
43	Charcteristic Morphological Relationship for tide dominated Channels of the Meghna Estuary,	LRP	Nov-86	1	TR			
44	Closing tidal basins, draft lecture notes j.c. huis in's veld	DTU		1	AR			
45	Cloud Formations seen satellite	LRP		1	AR			
46	Coastal Engineering Glossary and Conversion Factors	DUT		1	AR			
47	Coastal Engineering , An Introduction to Ocean Engineering , Kiyoshi Horikawa , University			1	AR			
48	Coastal Engineering Volume I, Intrduction	DUT		1	AR			
49	Coastal Engineering Volume II, Harbor and Beach Problems	DUT		2	AR			
50	Coastal Engineering Volume III, Breakwater Design	DUT		1	AR			
51	Coastal Erosion West-Africa, Inventory of coastal problems based on Nedeco's project experience in the region, Report prepared for UNESCO WACAF/3Project	nedeco	Mar-84	1	AR			
52	Comments of the final report of the feasibility study on Sandwip cross dam development scheme	IWDFC	Oct-87	1	MI			
53	Comments on the draft final report of the feasibility study on Sandwip cross dam development scheme, June 1986	LRP	Nov-86	1	MI			
54	Compartmentalization Pilot Project Techni. Note 95 / 07 . Govt . of the People Republic of		Dec-95					
55	Comprehensive Report (Draft) on Research and Pilot Polder Activities	LRP	Feb-89	1	TR			
56	Computation of Tidal discharge by the velocity area method. Engr. D.K. Barua, Paper	LRP	Jan-85	1	AR			
57	Computation of Flow Distribution in an Estuary, a cass study for the eastern of Bangladesh , F.G.Koch, Paper presented at the 29the convention of the Instituion of Engineers,	LRP	Jan-85	1	AR			
58	Contract Agreement Topographic Survey Work	SRP	Nov-92	1	TR			
59	Credit Operation Plan M. R. # 7	CDSP	Dec-94					
60	Cyclone Protection Project II . FAP 7 Volume - 3	FAP	May-92					
61	Cyclone Protection Project II . FAP 7 Appendix -A	FAP	May-92					
62	Cyclone Protection Project II .FAP 7 Appendix E Socio -Economics	BWDB	May-92					
63	Cyclone Protection Project II . FAP 7 Appendix I Feasibility Study on Petenga Project.	BWDB	May-92					
64	Cyclone Katry at landfall	UNDP		1	TR			
65	Cyclone Protection Project II . FAP 7 Feasibility & Design Studies Volume 1	FAP	May-92					

Sl.	Title	Agency or Project	Date	No. of copies	Cat.	Key word 1	Key word 2	Key word 3
66	Cyclone Protection Project II . FAP 7 Appendix F . Operation & Maintenance .	BWDB	May-92					
67	Cyclone Protection Project II . FAP 7 Appendix J Fisheries .	BWDB	May-92					
68	Cyclone Protection Project II . FAP 7 Volume 2 Annexes I -XI ,XIII	BWDB	May-92					
69	Cyclone Protection Project II . FAP 7Appendix G . Cyclone Early Warning System .	BWDB	May-92					
70	Cyclone Protection Project II .FAP 7 Appendix B . Field Surves & Soil Investigations .	BWDB	May-92					
71	Cyclone Protection Project II .FAP 7 Appendix D Agriculture .	BWDB	May-92					
72	Delft Hydraulics Final Report .	LRP	Aug-91					
73	Design of a Monitoring System	LRP	Oct-88	1	PL			
74	Draft Tentative Plan for upgrading of production and equipment of the Survey and Study	SSD	90-95	1	PL			
75	Drainage study of Noakhali : hydro-morphological investigations and solution options, (Dilip	LRP	Dec-87	1	TR			
76	Drainage Study of Polder 59 / 3C . Noakhali . Prefeasibility Report	LRP	Sep-89					
77	Drainage Study of Southern Sudharam Upaziala, Noakhali	LRP	Mar-87	1	TR			
78	Drainage Study of Southern Sudharam Upazila, Noakhali, Pre-feasibility Report, Annex - A (draft)	LRP	Feb-88	1				
79	Drainage Study of Southern Sudharam Upazila, Noakhali, Pre-feasibility Report, Main Report (draft)	LRP	Feb-88	1				
80	Effect of Daria Nadi Closure (An Accretion Trial Test) A.T.M.Khorshed Alam .	LRP	Apr-89					
81	Embankment Maintenance Groups A Comprehensive Assessment of their Technical, Econo,ic, Social and Institutional Implications TR-43 (Draft)	SRP	Apr-94	1	TR			
82	Environmental Aspects M.R. # 5 .	CDSP	Dec-94					
83	Erosion Hazards & Accretion Prospects in the Lower Meghna Estuary. D.K.Barua &F.G.Koch.	LRP	Mar-85					
84	Estuary Control (A programme of delta development) . .	ITAD	Oct-79	1	MR	. .		
85	Estuary Information System, Hydraulic and morphological conditions in the southeastern estuary	LEP	Mar-90	1	PL			
86	Evaluation	LRP	Nov Dec 82	1	MI			
87	Evaluation Mission	LRP/DDP	May-89	1	MI			
88	FAP 12 Volume 1 Main Report	FAP	Feb-92					
89	FAP 15 Land Acquisition & Resettlement Study . Final Report .	FAP	Nov-92					
90	FAP 21 / 22 . Final Report COMPLETE SET OF TABLES OF CONTENT							
91	FAP 16 Manual for Environmental Impact Assessment	FAP	Apr-95					
92	FAP 17 Fisheries Studies & Pilot Project (Main Volume.)	FAP	Jul-95					
93	FAP 4 Final Report Volume 3, Morphological Studies	DHIE	Aug-93	1	AR			
94	FAP 4 Final Report Volume 5, Hydrology, Hydrogeology and RAOM	DHIE	Aug-93	1	AR			
95	FAP 5 Sough East Region Water Resources Development Progremme BGD/86/037 Regional Plan Report, volume 1 , Part 1 - Existing Situation		Aug-93	1				
96	FAP 5 South East Region Water Resources Development Programme BGD/86/037 Regional Plan Report, volume 4 Annex V Hydrogeology Annex VI Hydrology and Water Modelling		Aug-93	1				
97	FAP 5 South East Region Water Resources Development Progremme BG/86/037 Regional Plan Report, volume 2 , Part 2 - The Regional Water Plan		Aug-93	1				
98	FAP-13 Operation and Maintenance Study, Final Report, Vol.-2, Case Studies	FPCO	Mar-92	1	TR			

Sl.	Title	Agency or Project	Date	No. of copies	Cat.	Key word 1	Key word 2	Key word 3
99	FAP-18 : Report on Topographic Mapping	FPCO	Sep-85	1	TR			
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101	FAP-24 Library Inventory	FAP-24	Jan-94	1				
102	Feasibility Report , South Hatia Island Embankment Project	OXFAM	Nov-86	1	AR			
103	Feasibility Study on constructior of a Cross dam between Sandwip island and Noakhali mainland , Progress Note on the Design of the Closure Dams	LRP	Feb-86	1				
104	Feasibility Study and Proposal for Nijhum Dwip cross-dam, Planning & Monitoring cell office	LRP	Apr-89	1	FS			
105	Feasibility Study and Proposal for South Hatia Cross-dam, Planning & Monitoring Cell Office	LRP	Feb-89	1	FS			
106	Feasibility study on construction of a cross-dam between sandwip islan and Noakhali	LRP	Jun-85	1	FS			
107	Feasibility study on construction of a cross-dam between Sandwip islan and Noakhali mainland, Draft Proposal	LRP	Jul-84	1	FS			
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109	Feasibility study on construction of a cross-dam between sandwip island and Noakhali	LRP	Mar-85	1	FS			
110	Feasibility study on construction of a crossdam between sandwip island and Noakhali mainland, Draft Proposal	LRP	Jul-84	1	FS			
111	Feasibility Study on construction of a Sandwip-Noakhali cross-dam in Bangladesh , results of revised Nethflow computations (Modification of draft report of January 1986)	LRP	Jan-86	1	FS			
112	Feasibility Study on construction of a Sandwip-Noakhali cross-dam in Bangladesh , results of	LRP	Jan-86	1	FS			
113	Feasibility Study on construction of a Sandwip-Noakhali cross-dam in Bangladesh , results of	LRP	Jan-86	1	FS			
114	Feasibility Study on Construction of Cross-dam between sandwip island and Noakhali Mainaland , Progress Report	LRP	Jan-86	1	FS			
115	Feasibility Study on construction of Cross-dam, between Sandwip Island and Noakhali Mainland beta Noakhali and Sandwip	LRP	Jan-87	1	FS			
116	Feasibility Study on Sandwip-Noakhali cross-dam, Economic and social studies	LRP	Dec-85	1	FS			
117	Feasibility Study on south Hatia cross-dam, Environmental report, Dr. A. Atiq Rahman , Dr. Saleemul huq	LRP	Jun-90	1	FS			
118	Feasibility study on south Hatia cross-dams	LRP	Dec-90	1	FS			
119	Feasibility study on south Hatia Cross-dams	LRP	Apr-90	1	AR			
120	Feasibility Study on the Sandwip Cross-dam development Scheme, Executive Summary, Final	LRP	Mar-87	1	FS			
121	Feasibility Study on the Sandwip Cross-dam Development Scheme, Vol - II, Final Report.	LRP	Mar-87	1	FS			
122	Feasibility Study on the Sandwip Cross-dam Development Scheme, Vol. - I, mani Report,	LRP	Mar-87	1	FS			
123	Feasibility Study on the Sandwip Cross-dam Development Scheme, Vol. -III, Final Report	LRP	Mar-87	1	FS			
124	Feasibility Study on the Sandwip Cross-dam Deveopmnet Scheme, Vol -IV, Final Report	LRP	Mar-87	1	FS			
125	Feasibility study Sandwip cross-dam, Stability of clay-filled gunny bags Report on	DHL	Dec-85	1				
126	Feasibility Study South Hatia Cross-dam	LRP	Feb-90	1	FS			
127	Feni River Closure dam (Part of Muhuri irrigation project), Final Design Report	BWDB	Sep-83	1	AR			
128	Field Measurements and remote sensing in the estuaries for engineering development, by	LRP	Nov-86	1	AR			
129	Firsh Version of Comments . 23 Nov. '86	LRP	Nov-86					
130	Flood Plan coordination Organisation. Ministry of Irrigation, Water Development &Flood Contr. Bangladesh Flood.Action Plan FAP 13 Volume -1 .	FAP						

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131	Foundation Design of small Hydraulic Structures. Prepared for : Workshop on Small Scale Water Control Structure Sept. 12-19,1982. Prepared by : Mr. Anwar Hossain Bhuiyan M.	BWDB	Sep-82	1	AR			
132	Four LRP Technical Papers	LRP	85-86	1	TR			
133	Gender Assessment Study / Women in Development. M. R. # 8	CDSP	Oct -94					
134	Geodetic Control in Bangladesh	DDP		1	TR			
135	Geographical location of heat sources and sinks, Lecture II	LRP		1	AR			
136	Geology of Bangladesh F.H.Khan							
137	Ground Water in the Coastal Zone and offshore islands of Bangladesh, BWDB water supply paper 416	BWDB	Oct-79	1	AR			
138	Guidelines For Execution of Estuarine Surveys .	MES	Fab -96					
139	How The Design Turns out in Reality. Harriet Wansink Frank Van Bussel. Noakhali Dec 90.		Dec-90					
140	Hydraulic studies for the desing of closure gaps, ir. R.A.H. Thabet, waterloopkunding	LRP	Mar-81	1	MR			
141	Hydrographic Surveys & Hydraulic Models For Land Development Planning in Estuaries (A Case Study for the Eastern Estuary of Bangladesh) F.G.Koch .	LRP						
142	Hydrographic Survey (Data Collecetion and Processing)	LRP		1	MR			
143	Hydrology and Accretion in the area of Char Batir Tek, Martin Bos, Practice Report,	LRP	Jul-86	1	TR			
144	Impeded drainage and water management problems of polders in the South-West Delta of	IHE	Nov-90	1	AR			
145	Improved O & M in water Management Proejcts TR-33 (Final)	SRP	Oct-94	1	TR			
146	Inception Report '87 Drainage Study of South Sudharam Upazilla , Noakhali .	LRP	87					
147	Inception Report on Hatia-Nijhum Dwip Cross Dam	LRP	Oct-87	1				
148	Inception Report, Char development and settlement project (Annexes Draft)		Mar-95	1	IR			
149	Inception Report, Char development and settlement project (Main Report Draft)		Mar-95	1	IR			
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153	Inlet Current Measured with Seasat-1, synthetic Aperture Radar	LRP	Oct-80	1	AR			
154	Institutional Affairs M.R. # 9	CDSP	Jan-94					
155	Integrated Water Management Planning for FCD schemes TR-47 (Final)	SRP	Feb-95	1	TR			
156	Interim Inception Report	MES	Dec-95	1	IR			
157	Interim Report	LRP	Jan-81	1	MR			
158	Inventory of Available Data and Information		May-91	1	MR			
159	Kitchen Gardening and other Activities with Women in Char Baggar Dona	LRP	Feb-90	1	TR			
160	Land And Water Engineering . M.R. # 12 .	CDSP	Oct-95					
161	Land & Soil Resource Utilization Index, Babuganj Thana, Barisal	SRDI	Mar-89	1				
162	Land & Soil Resource Utilization Index, Barisal Shadar Thana, Barisal	SRDI	Aug-89	1				
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170	Land Development in the Ganges -Brahmaputra Estuary in Bangladesh .	LRP						
171	Land Distribution . M. R. # 6	CDSP	Dec-94					
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173	Land Reclamation and Estuary Control in Bangladesh. Proforma for survey of development project	DDP	Dec-77	1	MR			
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176	Land Reclamation on CharBaggarDona. Report on a field visit to the Land Recla. Proj.J	LRP	Apr-84					
177	Land sat Data Users Hand Books, Revised Edition	US GS		1	AR			
178	Landreclamation project Sandwip cross-dam , Geulsluiting, grondmechanische en	dses		1	TR			
179	Landreclamation Project Sandwip cross-dam, Risk analysis, first stage	dses	Jan-85	1	AR			
180	Livestock 1988 -90 . Reports . T. R. # 58 B	LRP	Jul-91					
181	Livestock Component Final Report Live Stock T. R. # 58 A	LRP	Jul-91					
182	Liviling with Cyclones	LRP	Jun-91	1	MR			
183	Manpura - Goalia Cross-dam, Areport on Reconnaissance Survey, By Mohiuddin Ahmed	LRP	Mar-87	1	AR			
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188	Medium and long term planning, Mission report Rob Koudstaal	LRP	Oct-Nov-89	1				
189	Medium/ Long Term Planning Programme	LRP	88	1	PL			
190	Mission Report on Hydrology . In the Burri Teesta . Irrigation Project & the Muhuri Irrigation Project . T.R. # 20 (Draft)	SRP	Mar-92					
191	Muhuri Accpetion Reconnaissance / Identifioation Study, Land Reclamation Project , Executive Engineer Planning & Monitoring Cell fstuarine Survey, BWDB, Dhaka	BWDB	Jun-90	1	AR			
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195	Nijhum Dwip & Damarchar Cross-dam , Land Reclamation Project Tender Docuemnts , Tour report of Mr. G. Te Slaa	LRP	Mar-90	1				
196	Nijhum Dwip / Sough Hatia cross dam, Construction aspects	LRP	May-88					
197	Nijhum dwip cross-dam and south Hatia development, Workplan and cost estimate for a	LRP	Nov-89	1	PL			
198	Nijhum Dwip Hatia Cross - dam A report on reconnaissance survey, Mohiuddin Ahmed	LRP	Mar-87	1				
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200	Nijhumdwip Cross-dam & South Hatia Development Workplan and cost Estimate '89/90	LRP	Nov-89	1	PL			
201	Nijhumdwip Crossdam Feasibility Study, Results of surveys and hydraulic/morphological	LRP	Aug-88	1	FS			
202	Noakhali Khal Discharge Survey and study division, LRP Technical Note	LRP	Nov-83	1				
203	Note on Transfer of Datum	LRP	Apr-85	1	TR			
204	Notes on Economical Aspects, Monitoring, Muhuri Siltation Area. Mission Report#3	CDSP	Dec-94					

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209	Pilot Polder on Char Baggar Dona Plan for the Development of Integrated Farming	Frands Dol.	Dec-87	1	TR			
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211	Plan of Operations, 87-90	LRP	Mar-89	1	PL			
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217	Pre-feasibility report, Annex -A , agricultural and socio-economic investigation (Draft)	LRP	Feb-88	1	FS			
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219	Preliminary Plan of Operations, July 90- June 95	DDP	Nov-89	1	PL			
220	Preliminary Report on Remgati boyer Char Cross-dam, by Abdul Khaleque & ATM Khorshd Alam (Draft, 17.9.87)	IWDFC	Sep-86	1				
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223	Productive Development Plan TR # 1 Final Draft Mujibul Huq	CDSP	Jan-94					
224	Progress Report , 21 July-Dec. '86	LRP	Apr-87	1	PR			
225	Progress Report, 20, April-June '86	LRP	Oct-86	1	PR			
226	Progress Report, 23, July-Dec. '88	LRP	Apr-88	1	PR			
227	Progress Report, 24, Jan. - June '88	LRP	Oct-88	1	PR			
228	Progress Report, 25, July-Dec. '88	LRP	Jun-89	1	PR			
229	Progress Report, 26, Jan. - June '89	LRP	Sep-89	1	PR			
230	Progress Report, 28, Jan. - June '90	LRP	Nov-90	1	PR			
231	Progress Report, 29, July - Dec. '90	LRP	Mar-91	1	PR			
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233	Project Summary	LRP	Feb-86	1	MR			
234	Proposal for Char Majid Polder Development Scheme (Draft, 17.9.87)	LRP	Sep-87	1	PP			
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250	Report on Activities 1986 Edition , Special topic , remote Sensing			1	AR			
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253	Report on Hydrographic Surveys erosion Hatiya North	LRP	Jun-87	1	TR			
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261	Review and Comments on teh draft final report of the feasibility study on sandwip cross-dam development scheme	BWDB	Sep-86	1	AR			
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270	Sandwip cross-dam Hydraulic conditions closure gaps, Report on computations	LRP	Oct-85	1	TR			
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275	Sedimentation Engineering, Vito A. Vanoni, Dditor, Prepared by the asac task committee for	VAVE	77	1	AR			
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337	TR-30, Medium and Long Term Planning for Estuary Development	LRP	Jan-87	1	TR			
338	TR-31, Agriculture Research Annual Report 1985/86	LRP	Jun-88	2	TR			
339	TR-32, Plan for the Development of Integrated Farming, Char Baggar Dona	LRP/DDP	Dec-88	2	TR			
340	TR-33, Improved O & M in water managerment projects, BWDB systems rehabilitation project	SRP	Oct-94	1	TR			
341	TR-4, Technical Factors	LRP	Apr-82	1	TR			
342	TR-42, Review of the Hydraulic Design of Drainage Sluices	LRP	Dec-89	2	TR			
343	TR-43, Embankment maintenance groups, A comprehensive assessment of their Technical, Economic, Social and Institutional Implications	SRP	Apr-94	1	TR			
344	TR-44, by Els Ensink	LRP	Jul-91	1	TR			
345	TR-46, Use of Satellite Image for Water Sector Project,	LRP	Jan-91	2	TR			
346	TR-47, Feasibility Study on Hatia Cross-dam, Environmental Report, by Dr. A. Atiq Rahman &	LRP	Jun-90	2	TR			

Sl.	Title	Agency or Project	Date	No. of copies	Cat.	Key word 1	Key word 2	Key word 3
347	TR-5, Social Factors	LRP	Jan-82	1	TR			
348	TR-54, Land to the Landless, A Reference Book on Allocation Khas Land	LRP	Feb-91	1	TR			
349	TR-55, A Decade of Social Change, Socio-Economic Survey in Char Baggardona	LRP	May-91	1	TR			
350	TR-56, Earthwork by Direct Labour Engagement	LRP	Jul-91	1	TR			
351	TR-58B, Livestock Component , Livestock 1988-90	LRP	Jul-91	1	TR			
352	TR-6, Research Plot Activities 1980/81	LRP	Jun-82	1	TR			
353	TR-7, Sediment Concentrations and Salinities, Between Bhola islan and Chittagong Coast,	LRP	May-82	1	TR			
354	TR-8, Sed Imentation Fields	LRP	Jan-82	1	TR			
355	TR-9, Bathymetric Maps and Tracings of Aerial Photographs, Between Bhola Island and	LRP	Apr-82	1	TR			
356	TR-S1, Feasibility study on construction of a cross-dam between Sandwip Island and	LRP	Oct-84	1	TR			
357	TR-S2, Fesibility Study on Construction of a cross-dam between Sandwip island and Noakhali	LRP	May-85	1	TR			
358	Traditional, Land - Grabbing & Settlement Patterns in the South Eastern Delta	LRP	Apr-88					
359	Turbidity of coastal water determined from Landsat. Aranuvachapun, S. LeBLOND, P.H.	LRP		1	MR			
360	Um-Qasr River 1 , Siltation study, report on investitation	DHL	Feb-81	1	MR			
361	Use of landsat data to improve the water budget computation in lake okeechobee, Florida			1	AR			
362	Van Zee Tot Land, Buitendijkse mariene gronden, hun opbouw bedijking en ontginning door	LRP	May-85	1				
363	Visit to delft laboratory,Holand, to study the possible effect of proposed Sandwip dross-dam, Draft Report	BWDB		1	AR			
364	Voordelta Morphological Study .Schematization of the natural Condition in Multi.							
365	Water Supply & Sanitation Programme Formulation M.R. # 15	CDSP	Feb-96					
366	wendy, manual , version 2.10	dh	Aug-90	1	AR			

260