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MINISTRY OF WATER RESOURCES

BANGLADESH WATER DEVELOPMENT BOARD

MEGHNA ESTUARY STUDY

TECHNICAL NOTE MES-013

ASSESSMENT OF SEDIMENTATION FIELDS

August 1998

DHV CONSULTANTS BV

in association with

KAMPSAX INTERNATIONAL
DANISH HYDRAULIC INSTITUTE

DEVELOPMENT DESIGN CONSULTANTS
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Technical Note on:

SEDIMENTATION FIELDS

Dhaka, June 1998
Project Name : Meghna Estuary Study (MES)
Location : Meghna Estuary, along southern coast Noakhali, Hatia and Bhola
Key words : Sedimentation fields, acceleration of sedimentation
Design and cost estimates, economic feasibilty

MEGHNA ESTUARY STUDY - FAP 5B
IMPLEMENTATION OF SMALL SCALE INTERVENTION

Construction of Sedimentation Trial Fields: Technical Report

MEGHNA ESTUARY STUDY - FAP 5B
IMPLEMENTATION OF SMALL SCALE INTERVENTION

Construction of Sedimentation Trial Fields

1. Introduction

a) Background

Reclamation of land is a major component for the development of coastal and estuarine areas. It involves the measures to induce land accretion process. When there is a land mass in the process of natural formation, any small intervention may enhance sediment settlement contributing to raising a larger area of land for reclamation in shorter time.

Construction of sedimentation field is a trial process to induce settlement of silt where there is already a natural process of accretion taking place. Reclamation and development of land mass thus formed will depend on cost involved in the construction of groynes, their maintenance, rate of formation, time taken for formation of land at a desired level and expected benefits accrued out of this to establish economic viability of such intervention.

Under Land Reclamation project(LRP), BWDB carried out a test series on groynes construction starting June 1979 for taking up a large scale test with sedimentation field for accretion trials. The location of the first test was Kumira Ferry Ghat about 30 km from the Chittagong City. The second site for test groyne was at North Kattuli about 13 km from Chittagong City.

BWDB under LRP carried out full scale accretion trial by constructing sedimentation trial fields at two places along Chittagong Coast. The one at North Kattuli about 13 km from Chittagong was completed in December 1980 and the other at Shitakunda about 23 km from Chittagong was completed in March 1981.

Though the sedimentation field trials could not produce the desired results but evaluation of those trials provided information, conclusions and guidelines for future research and implementation.

b) Small Scale Intervention: Accretion Trial

Terms of Reference, Article 5 describes in detail the activities to be performed to realize the required outputs. One of tasks under the TOR for the study (TOR 5.3.9) requires the consultant to develop appropriate measures to accelerate accretion by means of low cost approach using indigenous materials and labour intensive method. It also envisages selecting of small works using local technologies, labour and construction materials which can be rapidly implemented. The consultant will locate and design such works and monitor their effectiveness.

The construction will be the responsibility of BWDB with advice from the consultant (TOR 5.3.10).

As per provision contained in the TOR, upon review of different reports and documents prepared and published by LRP, and discussion with BWDB and other concerned offices, the consultant has located three areas for accretion trial, prepared the outline design,work

specifications, bill of quantities and cost estimates for the construction of sedimentation trial fields.

2. Key assumptions

Economic evaluation to judge cost-effectiveness of construction of sedimentation fields is based on certain assumptions. The key assumptions concerning the sequence of land accretion and use are presented below.

- For the areas south of Bhola the new land reaching a level of +0.7 m PWD will be suitable for planting mangroves and will take about 6 to 8 years to attain the level without project intervention.

  The accretion level in this area will not attain +1.5 m PWD and above without project intervention to make it suitable for agriculture.

  With project condition, the land level will attain a level of above 1.5 m PWD and will be suitable for agriculture by about 8 years.

- For the areas south of Noakhali coast and Hatia island the new land reaching a level of +1.5 m PWD will be suitable for planting mangroves and will take about 4 to 8 years to attain this level without intervention.

  With intervention the land level in these areas will reach +1.5 m PWD in about 4 years time to make it suitable for mangrove plantation. The new land will attain a level of +2.2 m PWD and above within 4 to 8 years and thus make the areas suitable for agriculture.

- it is assumed that all newly accreted land will be first planted in mangroves. Without project situation, mangrove forest will continue on new land as it is practiced now. Under project situation, mangrove forest after a rotation period of 15 years may be cleared for agriculture and other uses.

3. Location of Trials

For selection of trial location several tours and recconnaissance were made around the costal areas of Noakhali and Feni. Different Chars and islands in the estuary areas were also visited by ANWESHA. On the basis of field reconnaissance and consideration of other aspects and in-house discussions among the consultants' team members three tentative potential accretion areas have been selected as suitable for construction of sedimentation trial fields as part of small scale intervention.

i) to the east of Char Lakshmi opposite Urir Char
ii) to the south-east coast of Hatia island opposite Damar Char
iii) to the south-east of Bhola island opposite Char Kukri Mukri

Engineering surveys of the trial areas have not yet been taken up. The present estimates have been based on the type design and experience of spot visits and reconnaissance of the selected locations. It is expected that the present estimate both bill of quantities and abstract of cost should not be much off-the mark.

Locations for construction of sedimentation trial fields have been selected based on field verification and review of various reports, publications, latest maps and satellite imageries. Final locations will be selected after further field visits to the areas and detailed engineering surveys. This will be done after the accretion trial proposed herein are finally accepted and considered for approval. Proposed locations for accretion trials are shown in figure 1.

4. Design, Estimating

Past LRP experiences on design and planning of the sediment accretion trial fields as has been laid down in the various reports and publications have been studied and reviewed while working out the present design.

LRP Technical Report No.8, sedimentation fields: LAND RECLAMATION PROJECT, January 1992, Fig-II: Final design of brush wood groyne; and section 4 of LRP report No. 23, June 1985 : Evaluation of Accretion Trials (sedimentation fields) along the Chittaong Coast in Bangladesh and the report on a study by A.E.R Backer have been given particular consideration in planning and designing the trial fields with certain modifications to suit local requirements.

Available estimates, drawings and some estimates prepared by Survey and Study Division (SSD) Chittagong in connection with the construction and repair of sedimentation field at Kattuli, Chittagong were collected and consulted in preparing the design and estimates. Item framing and unit rates have been mainly based on the schedule of rates (effective from 1st day of July, 1995) of Feni O & M Circle and Bhola O & M Circle with certain modifications in item descriptions and unit rates to suit the requirements. Most of the items in the estimate have come out to be non-scheduled items.

Each sedimentation trial field proposed for implementation will comprise three Compartments measuring 240m x 120m each constructed side by side separated and surrounded by bamboo groynes filled in with brushwood to make it permeable and to allow dissipating of energy and for reducing the possibility of local scour.

In the present design and estimate, few changes have been suggested to adapt to the requirements based on previous experience on stability of sedimentation field. These are summarized below.

- Brush wood bundle in place of Kancha reeds have been provided as the later when put in bundles in water for some days, shrink and lose their permeability which may induce local scour leading to collapse of the structure.

- In fixing the bamboo walling with the piled bamboo pins nylon ropes have been kept as alternative to Gazal(big nail) subject to the decision of the Engineer in charge. If necessary he can also decide to use Gazal and nylon rope in the alternative rows or both Gazal and nylon rope in all rows.

5. Technical Specifications

The Bamboo pins should be straight and thick walled made of ripe bamboo plants. Their top ends should be cut just above a knot and the bottom end should be sharpened from just below a knot about 60^0 from the plane of the knot.

Piles should remain vertical after driving and care should be taken so that the top knots of the pins are not broken or split apart.

All steel, ropes, threads, G.I.wires etc used as fixing and binding materials should be well soaked or painted by coal tar paint both before and after fixing in place.

Bags should be soaked and dried in coal tar paint before filling in by brick bats and should be sewed properly by nylon thread after being filled in and before laying in place

6. Estimated Cost for Construction of Sedimentation Field

i) Char Lakshmi, Noakhali

Area(ha)		9	
Estimated Cost(Tk)		1,642,000	
Estimated Cost(US$)@Tk.46 per US$		35,696	
Estimated Cost per Hectare(US$)		3,966	
SAY		4,000	
First Year	Construction Year		4000
Second Year	O&M Cost per Hectare 20%of Estimated Cost		800
Third Year	O&M Cost per Hectare 10% of Estimated Cost		400
Fourth Year	O&M Cost per Hectare 10% of Estimated Cost		400
Total Estimated Cost per Hectare(US$)			5,600

ii) South East of Hatia Island

Area(ha)		9	
Estimated Cost(Tk)		1,642,000	
Estimated Cost(US$)@Tk.46 per US$		35,696	
Estimated Cost per Hectare(US$)		3,966	
SAY		4,000	
First Year	Construction Year		4,000
Second Year	O&M Cost per Hectare 20%of Estimated Cost		800
Third Year	O&M Cost per Hectare 10% of Estimated Cost		400
Fourth Year	O&M Cost per Hectare 10% of Estimated Cost		400
Total Estimated Cost per Hectare(US$)			5,600
Add Extra for Carrying 25% and for Labour 10% of the Total Estimated Cost			1,960
Total Estimated Cost per Hectare(US$) in Four Years			7,560
SAY			**8,600**

iii) South East of Bhola

Area(ha)		9
Estimated Cost(Tk)		1,749,000
Estimated Cost(US$)@Tk.46 per US$		38,022
Estimated Cost per Hectare(US$)		4,225
SAY		4,300
First Year	Construction Year	4,300
Second Year	O&M Cost per Hectare 20%of Estimated Cost	860
Third Year	O&M Cost per Hectare 10% of Estimated Cost	430
Fourth Year	O&M Cost per Hectare 10% of Estimated Cost	430
Total Estimated Cost per Hectare(US$)		6,020
Add L.S. Extra 10% of the Total Estimated Cost for Carrying and Labour		602
Total Estimated Cost per Hectare(US$) in Four Years		6,622
SAY		**6,700**

7 Economic Assessment

7.1 Project Cost

Economic assessment for sedimentation trial fields at the three proposed locations have been made for each of the trial fields.

Capital cost for the proposed interventions would include the costs of construction of groynes and other works at the sedimentation fields and costs of land development when forested land will be cleared for agriculture after a rotation period of 15 years. Land development cost includes the costs of poldering and construction of necessary water management structures.

A summary of capital costs for the three sedimentation trial fields are presented below.

Table 7.1: Cost Estimates for Trial Fields and Land Development (Financial prices)

Trial Field	Trial Field cost (Tk`000)	Per ha Land Development cost (Tk`000)
S-E of Bhola	1749	30
S-E of Hatia	1642	38
Char Lakshmi	1642	38

7.2 Project Benefits

The benefits due the project interventions will accrue from the expansion of production in agriculture, fisheries and forestry. A number of potential benefits, both quantifiable and non-quantifiable, have not been quantified because necessary data are not available to make such estimates. The potential benefits/ disbenefits that are in principle quantifiable, but have not been quantified include potential benefits from improved transportation within the project area and the impacts of the construction of groynes on marine fisheries that are likely to be mildly negative.

7.3 EIRR and NPV

The economic viability of project interventions has been judged by estimation of EIRR and NPV. A summary of analytical results are presented in Table. 7.2 below. (The calculations are shown in annex-D, Table D.5, D.6 and D.7).

Table 7.2: EIRR and NPV for Sedimentation Trial Fields

Trial Field	EIRR (%)	NPV (Tk million)
S-E of Bhola	-0.91	-1.73
S-E of Hatia	-1.55	-1.65
Char Lakshmi	-1.55	-1.65

7.4 Conclusions and Recommendations

The EIRR and NPV for the proposed interventions at three different locations are all negative. Therefore, the proposed interventions are not economically feasible and not recommended for implementation.

ANNEX A.1

Detailed Estimate (Bill of Quantities) for construction of Sedimentation Field for the purpose of Accretion Trial in Char Lakshmi, Noakhali

All in MKS Unit

Sl	Items	No.	Length	Width	Height	Quantity	Total	Unit
1.	Supplying, Sizing and placing of thick walled Barak bamboo pins and stays in position, average 8.0 cm dia and above in size and 3.70 m to 4 m in length etc. complete as per specification, drawing and direction of Engineer in charge							
	Groyne no							
	1	882						
	5	882						
	7	882						
	3	800						
	8	800						
	2	1600						
	4	1600						
	6	1600					9046	nos.
2	Labour Charge for driving average 8.0 cm and above dia thick walled Barak bamboo pins, by hammer or monkey-hammer, 2.2 m to 2.4 m drive as per specification, drawing and direction of Engineer in charge							
	a) In dry land	5046	2.5			12615	12615	m
	b) In water including necessary staging etc. as required.	4000	2.5			10000	10000	m
3.	Supplying, Sizing and fitting in position 8.0 cm and above dia in size full barak bamboo walling pieces with 200 mm long gazali or 12 mm dia Nylon rope two fold winding with bamboo poles including supply of all materials as per specification, drawing and direction of Engineer in charge.							
	a) Longitudinal walling	2	1320			2640		
	b) Cross ties	1516	0.5			758	3398	m

Sl	Items		No.	Length	Width	Height	Quantity	Total	Unit
4.	supplying of brush wood compacted in bundle not more than 200 mm dia (or as directed by the Engineer in charge)and approximately 180 cm in length tied securely with coir string and dumping the same in position etc complete with supply of all materials and as per specification, drawing and direction of the Engineer in charge								
	Groyne no								
		1	1	120	0.22	2.5	66		
		3	1	120	0.22	2.5	66		
		5	1	120	0.22	2.5	66		
		7	1	120	0.22	2.5	66		
		8	1	120	0.22	2.5	66		
		2	1	240	0.22	2.5	132		
		4	1	240	0.22	2.5	132		
		6	1	240	0.22	2.5	132	726	cum
5.	Earthwork in excavation in trenches in all kinds of soil including levelling,dressing, placing and removal of soil to a safe distance with all leads and lifts as per specification, drawing and direction of the engineer in charge.								
	Groyne no								
		1	1	120	0.22	0.9	24		
		3	1	120	0.22	0.9	24		
		5	1	120	0.22	0.9	24		
		7	1	120	0.22	0.9	24		
		8	1	120	0.22	0.9	24		
		2	1	240	0.22	0.9	48		
		4	1	240	0.22	0.9	48		
		6	1	240	0.22	0.9	48	264	cum
6.	Earth work in fill by manual labour in all kinds of soil in putting up back support of the country side of groynes in 1:4 slope with all leads and lifts and throwing the earth in 225mm in layer breaking clods, rough dressing, bailing out water etc. complete as per specification, drawing and direction of engineer in charge								
	Groyne no								
		1	1	120	2	1	240		
		3	1	120	2	1	240		
		5	1	120	2	1	240		
		7	1	120	2	1	240		
		8	1	120	2	1	240		
		2	1	240	2	1	480		
		4	1	240	2	1	480		
		6	1	240	2	1	480	2640	cum

ANNEX A.1

Sl	Items		No.	Length	Width	Height	Quantity	Total	Unit
7.	Supplying and laying in position over the back support earthwork of the groynes 50 kg capacity polytheline bags filled up with average 75 mm downgraded brick bats including sewing the bags with nylon thread and tieing the bags by 3 mm dia G.I. wire with piled bamboo pins including supply of all necessary materials as per specification, drawing and direction of Engineer in charge.								
	Groyne no.								
		1	2.25	120			270		
		3	2.25	120			270		
		5	2.25	120			270		
		7	2.25	120			270		
		8	2.25	120			270		
		2	2.25	240			540		
		4	2.25	240			540		
		6	2.25	240			540	2970	nos.
8.	Supplying Nylon rope of 12 mm dia, tripple fold tieing of piled bamboo pins of each row at the level of bamboo walling								-
			3007	2			6014	6014	m

Abstract of Cost (cost estimate) for Construction of sedimentation Field for the purpose of Accretion Trial in Char Lakshmi, Noakhali

Amount in Tk

Sl	Item	Quantity	Unit	Rate	Amount	Total Amount
1.	Supplying, Sizing and placing of thick walled Barak bamboo pins and stays in position, average 8.0 cm dia and above in size and 3.70 m to 4 m in length etc. complete as per specification, drawing and direction of Engineer in Charge	9046 nos.	% no	6578	595045.88	
2.	Labour Charge for driving average 8.0 cm and above dia thick walled Barak bamboo pins by hammer or monkey hammer 2.2 m to 2.4 m drive as per specification, drawing and direction of Engineer in charge					
	a) In dry land	12615 m	% m	2128	268447.2	
	b) In water including necessary staging etc. as required	10000 m	% m	1273	127300	
3.	Supplying, Sizing and fitting in position 8.0 cm and above dia in size full barak bamboo walling pieces with 200 mm gazali or 12 mm dia Nylon rope four fold winding with bamboo poles including supply of all materials as per specification, drawing and direction of Engineer in charge	3398 m	% m	4934	167657.32	
4.	Supplying of brush wood compacted in bundle not more than 200 mm dia (or as directed by the engineer in charge) and approximately 180 cm in length tied securely with coir string and dumping the same in position etc. complete with supply of all materials and as per specification, drawing and direction of the Engineer in charge.	726 cum	cum	111	80586	
5.	Earthwork in excavation in trenches in all kinds of soil including, levelling dressing, placing and removal of soils to a safe distance with all leads and lifts as per specification, drawing and direction of Engineer in charge.	264 cum	%cum	2817	7436.88	

Sl	Item	Quantity	Unit	Rate	Amount	Total Amount
6.	Earthwork by manual labour in all kinds of soils in putting up back support of the country side of groynes in 1:4 slope with all leads and lifts and throwing the earth in 225 mm layer breaking clods, rough dressing, bailing out water etc. complete as per specification, drawing and direction of Engineer in charge.	2640 cum	cum	25	66000	
7.	Supplying and laying in position over the back support earthwork of the groynes 50 kg capacity polytheline bags filled up with average 75mm down graded brick bats including sewing the bags with Nylon thread and tieing the bags by 3 mm dia G.I. wire with piled bamboo pins including supply of all necessary materials as per specification, drawing and direction of Engr. in charge	2970 nos.	each	58	172260	
8.	Supplying Nylon rope of 12 mm dia, tripple fold tieing of piled bamboo pins of each row at the level of bamboo walling	6014 m	m	13	78182	

						1562915.28
		Add conti	ingency 5% o		e Total	78145.764
						1641061.044
		SAY				1642000

Total Cost computation for Four Years

Area (ha)	9
Estimated Cost (Tk)	1642000
Estimated Cost (US$) @ Tk. 46 per US$	35696
Estimated Cost per Hectare (US$)	4131
SAY	4200

First year	Construction year	4200
Second year	O&M Cost per hectare, 20% of Estimated Cost	840
Third year	O&M Cost per hectare, 10% of Estimated Cost	420
Fourth year	O&M Cost per hectare, 10% of Estimated Cost	420
Total Estimated Cost per Hectare (US$) in Four Years		**5880**
SAY		**5900**

Detailed Estimate (Bill of Quantities) for construction of Sedimentation Field for the purpose of Accretion Trial in south east of Hatia Island

All in MKS Unit

Sl	Items	No.	Length	Width	Height	Quantity	Total	Unit
1.	Supplying, Sizing and placing of thick walled Barak bamboo pins and stays in position, average 8.0 cm dia and above in size and 3.70 m to 4 m in length etc. complete as per specification, drawing and direction of Engineer in charge							
	Groyne no							
	1	882						
	5	882						
	7	882						
	3	800						
	8	800						
	2	1600						
	4	1600						
	6	1600					9046	nos.
2.	Labour Charge for driving average 8.0 cm and above dia thick walled Barak bamboo pins, by hammer or monkey-hammer, 2.2 m to 2.4 m drive as per specification, drawing and direction of Engineer in charge						-	
	a) In dry land	5046	2.5			12615	12615	m
	b) In water including necessary staging etc. as required.	4000	2.5			10000	10000	m
3.	Supplying, Sizing and fitting in position 8.0 cm and above dia in size full barak bamboo walling pieces with 200 mm long gazali or 12 mm dia Nylone rope two fold winding with bamboo poles including supply of all materials as per specification, drawing and direction of Engineer in charge							
	a) Longitudinal walling	2	1320			2640		
	b) Cross ties	1516	0.5			758	3398	m

Sl	Items	No.	Length	Width	Height	Quantity	Total	Unit
4.	Supplying of brush wood compacted in bundle not more than 200 mm dia (or as directed by the Engineer in charge)and approximately 180 cm in length tied securely with coir string or Nylone rope and dumping the same in position etc complete with supply of all materials and as per specification, drawing and direction of the Engineer in charge							
	Groyne no							
		1	1	120	0.22	2.5	66	
		3	1	120	0.22	2.5	66	
		5	1	120	0.22	2.5	66	
		7	1	120	0.22	2.5	66	
		8	1	120	0.22	2.5	66	
		2	1	240	0.22	2.5	132	
		4	1	240	0.22	2.5	132	
		6	1	240	0.22	2.5	132	726 cum
5.	Earthwork in excavation in trenches in all kinds of soil including levelling,dressing, placing and removal of soil to a safe distance with all leads and lifts as per specification, drawing and direction of the engineer in charge.							
	Groyne no							
		1	1	120	0.22	0.9	24	
		3	1	120	0.22	0.9	24	
		5	1	120	0.22	0.9	24	
		7	1	120	0.22	0.9	24	
		8	1	120	0.22	0.9	24	
		2	1	240	0.22	0.9	48	
		4	1	240	0.22	0.9	48	
		6	1	240	0.22	0.9	48	264 cum
6.	Earthwork in fill by manual labour in all kinds of soil in putting up back support of the country side of groynes in 1:4 slope with all leads and lifts and throwing the earth in 225 mm layer breaking clods, rough dressing, bailing out water etc. complete as per specification, drawing and direction of engineer in charge							
	Groyne no							
		1	1	120	2	1	240	
		3	1	120	2	1	240	
		5	1	120	2	1	240	
		7	1	120	2	1	240	
		8	1	120	2	1	240	
		2	1	240	2	1	480	
		4	1	240	2	1	480	
		6	1	240	2	1	480	2640 cum

Sl	Items	No.	Length	Width	Height	Quantity	Total	Unit
7.	Supplying and laying in position over the back support earthwork of the groynes 50 kg capacity polytheline bags filled up with average 75 mm drowngraded brick bats including sewing the bags with nylon thread and tying the bags by 3 mm dia G.I. wire with piled bamboo pins including supply of all necessary materials as per specification, drawing and direction of Engineer in charge.							
	Groyne no							
	1	2.25	120			270		
	3	2.25	120			270		
	5	2.25	120			270		
	7	2.25	120			270		
	8	2.25	120			270		
	2	2.25	240			540		
	4	2.25	240			540		
	6	2.25	240			540	2970	nos.
8.	Supplying Nylone rope of 12 mm dia and tying tripple fold of piled bamboo pins of each row at the level of bamboo walling as per specification, drawing and direction of engineer in charge	3007	2			6014	6014	m

Abstract of Cost (cost estimate) for Construction of sedimentation Field for the purpose of Accretion Trial in south east of Hatia Island

Amount in Tk

Sl	Item	Quantity	Unit	Rate	Amount	Total Amount
1.	Supplying, Sizing and placing of thick walled Barak bamboo pins and stays in position, average 8.0 cm dia and above in size and 3.70 m to 4 m in length etc. complete as per specification, drawing and direction of Engineer in Charge	9046.0 nos	% no	6578.0	595045.9	
2.	Labour Charge for driving average 8.0 cm and above dia thick walled Barak bamboo pins by hammer or monkey hammer, 2.2 m to 2.4 m drive as per specification, drawing and direction of Engineer in charge					
	a) In dry land	12615.0 m	% m	2128.0	268447.2	
	b) In water including necessary staging etc. as required	10000.0 m	% m	1273.0	127300.0	
3.	Supplying, Sizing and fitting in position 8.0 cm and above dia in size full barak bamboo walling pieces with 200 mm long gazali or 12 mm dia Nylone rope two fold winding with bamboo poles including supply of all materials as per specification, drawing and direction of Engineer in charge	3398.0 m	% m	4934.0	167657.3	
4.	Supplying of brush wood compacted in bundle not more than 200 mm dia (or as directed by the engineer in charge) and approximately 180 cm in length tied securely with coir string or Nylone rope and dumping the same in position etc. complete with supply of all materials and as per specification, drawing and direction of the Engineer in charge.	726.0 cum	cum	111.0	80586.0	
5.	Earthwork in excavation in trenches in all kinds of soil including, levelling dressing, placing and removal of soil to a safe distance with all leads and lifts as per specification, drawing and direction of Engineer in charge.	264.0 cum	%cum	2817.0	7436.9	

Sl	Item	Quantity	Unit	Rate	Amount	Total Amount
6.	Earthwork in fill by manual labour in all kinds of soil in putting up back support of the country side of groynes in 1:4 slope with all leads and lifts and throwing the earth in 225 mm layer breaking clods, rough dressing, bailing out water etc. complete as per specification, drawing and direction of Engineer in charge.	2640.0 cum	cum	25.0	66000.0	
7.	Supplying and laying in position over the back support earthwork of the groynes 50 kg capacity polytheline bags filled up with average 75mm down graded brick bats including sewing the bags with Nylon thread and tying the bags by 3 mm dia G.I. wire with piled bamboo pins including supply of all necessary materials as per specification, drawing and direction of Engr. in charge	2970.0 nos	each	58.0	172260.0	
8.	Supplying Nylone rope of 12 mm dia and tying tripple fold of piled bamboo pins of each row at the level of bamboo walling as per specification, drawing and direction of engineer in charge	6014.0 m	m	13.0	78182.0	
						1562915.3
		Add Contingency 5% of Tot			Total	78145.8
						1641061.0
		SAY				1642000.0

Total Cost Computation for Four Years

Area (ha)	9
Estimated Cost (Tk)	1642000
Estimated Cost (US$) @Tk.46 per US$	35696
Estimated Cost per Hectare (US$)	4131
SAY	4200

First year	Construction Year	4200
Second year	O&M Cost per hectare 20% of Estimated Cost	840
Third year	O&M Cost per hectare,10% of Estimated Cost	420
Forth year	O&M Cost per hectare, 10% of estimated Cost	420
Estimated Cost per Hectare(US$) in Four Years		**5880**
Add Extra for Carrying 25% and for Labour 10% of the Total estimated Cost		2058
Total Estimated Cost per Hectare(US$) in Four Years		**7938**
SAY		**8000**

Detailed Estimate (Bill of Quantities) for construction of Sedimentation Field for the purpose of Accretion Trial in south east of Bhola

All in MKS Unit

Sl	Items	No.	Length	Width	Height	Quantity	Total	Unit
1.	Supplying, Sizing and placing of thick walled Barak bamboo pins and stays in position, average 8.0 cm dia and above in size and 3.70 m to 4 m in length etc. complete as per specification, drawing and direction of Engineer in charge							
	Groyne no							
	1	882						
	5	882						
	7	882						
	3	800						
	8	800						
	2	1600						
	4	1600						
	6	1600					9046	nos.
2.	Labour Charge for driving average 8.0 cm and above dia thick walled Barak bamboo pins, by hammer or monkey-hammer, 2.2 m to 2.4 m drive as per specification, drawing and direction of Engineer in charge							
	a) In dry land	5046	2.5			12615	12615	m
	b) In water including necessary staging etc. as required.	4000	2.5			10000	10000	m
3.	Supplying, Sizing and fitting in position 8.0 cm and above dia in size full barak bamboo walling pieces with 200 mm long gazali or 12 mm dia Nylone rope two fold winding with bamboo poles including supply of all materials as per specification, drawing and direction of Engineer in charge							
	a) Longitudinal walling	2	1320			2640		
	b) Cross ties	1516	0.5			758	3398	m

ANNEX C.1

Sl	Items	No.	Length	Width	Height	Quantity	Total	Unit
4.	Supplying of brush wood compacted in bundle not more than 200 mm dia (or as directed by the Engineer in charge)and approximately 180 cm in length tied securely with coir string or Nylone rope and dumping the same in position etc complete with supply of all materials and as per specification, drawing and direction of the Engineer in charge							
	Groyne no							
	1	1	120	0.22	2.5	66		
	3	1	120	0.22	2.5	66		
	5	1	120	0.22	2.5	66		
	7	1	120	0.22	2.5	66		
	8	1	120	0.22	2.5	66		
	2	1	240	0.22	2.5	132		
	4	1	240	0.22	2.5	132		
	6	1	240	0.22	2.5	132	726	cum
5.	Earthwork in excavation in trenches in all kinds of soil including levelling,dressing, placing and removal of soil to a safe distance with all leads and lifts as per specification, drawing and direction of the engineer in charge.							
	Groyne no							
	1	1	120	0.22	0.9	24		
	3	1	120	0.22	0.9	24		
	5	1	120	0.22	0.9	24		
	7	1	120	0.22	0.9	24		
	8	1	120	0.22	0.9	24		
	2	1	240	0.22	0.9	48		
	4	1	240	0.22	0.9	48		
	6	1	240	0.22	0.9	48	264	cum
6.	Earthwork in fill by manual labour in all kinds of soil in putting up back support of the country side of groynes in 1:4 slope with all leads and lifts and throwing the earth 225mm layer breaking clods, rough dressing, bailing out water etc. complete as per specification, drawing and direction of engineer in charge							
	Groyne no							
	1	1	120	2	1	240		
	3	1	120	2	1	240		
	5	1	120	2	1	240		
	7	1	120	2	1	240		
	8	1	120	2	1	240		
	2	1	240	2	1	480		
	4	1	240	2	1	480		
	6	1	240	2	1	480	2640	cum

ANNEX C.1

Sl	Items	No.	Length	Width	Height	Quantity	Total	Unit
7.	Supplying and laying in position over the back support earthwork of the groynes 50 kg capacity polytheline bags filled up with average 75 mm drowngraded brick bats including sewing the bags with nylon thread and tying the bags by 3 mm dia G.I. wire with piled bamboo pins including supply of all necessary materials as per specification, drawing and direction of Engineer in charge.							
	Groyne no							
	1	2.25	120			270		
	3	2.25	120			270		
	5	2.25	120			270		
	7	2.25	120			270		
	8	2.25	120			270		
	2	2.25	240			540		
	4	2.25	240			540		
	6	2.25	240			540	2970	nos.
8.	Supplying Nylone rope of 12 mm dia and tying tripple fold of piled bamboo pins of each row at the level of bamboo walling as per specification, drawing and direction of engineer in charge	3007	2			6014	6014	m

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Abstract of Cost(cost estimate) for Construction of Sedimentation Field for the purpose of Accretion Trial in south east of Bhola

Amount in Tk.

Sl	Item	Quantity	Unit	Rate	Amount	Total Amount
1.	Supplying, Sizing and placing of thick walled Barak bamboo pins and stays in position, average 8.0 cm dia and above in size and 3.70 m to 4 m in length etc. complete as per specification, drawing and direction of Engineer in Charge	9046.0 nos	% no	7846.0	709749.2	
2.	Labour Charge for driving average 8.0 cm and above dia thick walled Barak bamboo pins by hammer or monkey hammer, 2.2 m to 2.4 m drive as per specification, drawing and direction of Engineer in charge					
	a) In dry land	12615.0 m	% m	1915.0	241577.3	
	b) In water including necessary staging etc. as required	10000.0 m	% m	1151.0	115100.0	
3.	Supplying, Sizing and fitting in position 8.0 cm and above dia in size full barak bamboo walling pieces with 200 mm long gazali or 12 mm dia Nylon rope two fold winding with bamboo poles including supply of all materials as per specification, drawing and direction of Engineer in charge	3398.0 m	% m	5306.0	180297.9	
4.	Supplying of brush wood compacted in bundle not more than 200 mm dia (or as directed by the engineer in charge) and approximately 180 cm in length tied securely with coir string or Nylon rope and dumping the same in position etc. complete with supply of all materials and as per specification, drawing and direction of the Engineer in charge.	726.0 cum	cum	138.0	100188.0	
5.	Earthwork in excavation in trenches in all kinds of soil including, levelling dressing, placing and removal of soil to a safe distance with all leads and lifts as per specification, drawing and direction of Engineer in charge.	264.0 cum	%cum	2559.0	6755.8	

Sl	Item	Quantity	Unit	Rate	Amount	Total Amount
6.	Earthwork in fill by manual labour in all kinds of soil in putting up back support of the country side of groynes in 1:4 slope with all leads and lifts and throwing the earth in 225 mm layer breaking clods, rough dressing, bailing out water etc. complete as per specification, drawing and direction of Engineer in charge.	2640.0 cum	cum	23.0	60720.0	
7.	Supplying and laying in position over the back support earthwork of the groynes 50 kg capacity polytheline bags filled up with average 75mm down graded brick bats including sewing the bags with Nylon thread and tying the bags by 3 mm dia G.I. wire with piled bamboo pins including supply of all necessary materials as per specification, drawing and direction of Engr. in charge	2970.0 nos	each	58.0	172260.0	
8.	Supplying Nylon rope of 12 mm dia and tying tripple fold of piled bamboo pins of each row at the level of bamboo walling as per specification, drawing and direction of engineer in charge	6014.0 m	m	13.0	78182.0	
				-	----------	
						1664830.1
		Add Contingency 5% of Tot			total	83241.5

						1748071.6
		SAY				1749000.0

Total cost Computation for Four Years

Area (ha)		9
Estimated Cost (Tk)		1749000
Estimated Cost (US$)@Tk.46 per US$		38022
Estimated Cost per Hectare(US$)		4401
SAY		4400
First year	Construction year	4400
Second year	O&M Cost per hectare,20% of Estimated Cost	880
Third year	O&M Cost per hectare,10% of Estimated Cost	440
Fourth year	O&M Cost per hectare, 10% of Estimated Cost	440
Estimated Cost per Hectare(US$)in Four Years		**6160**
Add L.S Extra 10% of the Total Estimated Cost for Carrying and Labour		616
Total Estimated Cost per Hectare(US$) in Four Years		**6776**
SAY		**6800**

ANNEX - D

Economic analysis for the Sedimentation Trial Fields along the coasts of Bhola, Hatia and Char Lakshmi.

1 Key Assumptions for Economic Analysis

The project life for economic analysis is 40 years. The discount rate is 12%.

A standard conversion factor of 0.902 is used to convert financial to economic prices, except for agricultural labour. For agricultural labour, a conversion factor of 0.85 has been used in line with other recent studies.

2 Project Costs

2.1 Capital costs

Cost estimate for construction of sedimentation trial fields are based on technical considerations for each of the trial fields. Details are furnished in annex - A,B and C.

Economic costs for construction of sedimentation trial fields are Tk 1.58 million for Bhola location and Tk 1.48 million for both Hatia and Char Lakshmi locations. Cost of land development for Bhola location is based on development cost of newly accreted land estimated for Char Montaz- Kukri Mukri development Project (MES feasibility study,1998) at Tk 30 thousand per ha (financial prices). Cost of land development for Hatia and Char Lakshmi locations are based on per ha development cost of newly accreted land estimated at TK 38.5 thousand (financial prices) under Nijhum Dwip Integrated Development Project (MES feasibility study,1998).

2.2 O&M costs

Maintenance needs would be heavy for three years after construction of trial fields. Maintenance costs have been set at 20% of initial investment cost of construction of trial fields for the second year and at 10% of investment cost for the third and fourth year. Maintenance cost of embankment and water management structure under land development programme is assumed to be 2% of investment cost of the item.

3. Project Benefits

The benefits quantified for the analysis are:

- agricultural production on newly accreted land
- fish pond production
- forest products from thinning and harvesting of mature forests

An important feature of any intervention for the accretion of new land in the Meghna Estuary is that there is a long gap between the investment in infrastructure and accrual of benefits from such investments. Estimation of benefits are based on the assumptions made in MES study.

Agriculture: Agricultural benefits arise from the increase in crop yields and cropping intensity. It is assumed that crop yields would start at 50% of the target level and slowly increase over time. Rabi crop areas would gradually increase as desalinization process continues.

Cropping patterns on new land in trial field areas with and without intervention are given in Table D.1.

Table D.1 : Cropping Patterns for Sedimentation Trial Fields.

Future Without Project			
Crops	year 9	Year 16	Year 20
T.Aman	0.75	0.85	1
Pulses (Khesari)	0	0.15	0.2
G. Nut	0	0.05	0.05
Chilli (Dried)	0	0.05	0.05
Total	0.75	1.1	1.3

Future with Project			
Crops	Year 5	Year 10	Year 16
LT Aman	0.75	1	0.8
HYV Aman	0	0	0.2
Ground Nut	0	0.1	0.2
Pulses	0.15	0.16	0.25
Sweet Potato	0	0.05	0.1
Chilli Dried)	0	0.04	0.05
Total	0.9	1.35	1.6

Notes:

a) Cropping intensities will increase from 75% to 135% in future without project situation.

b) Cropping intensities will increase from 95% to 160% with project situation.

c) With project situation, land available for agriculture in the project area is estimated at 75% of gross land accreted. The proportion not included covers homestead areas, khals, drainage canals, embankments, protective forests, etc.

d) Under future without project situation, land available for agriculture is estimated at 20% of gross accreted land.

e) At the trial field south east of Bhola, without intervention, no land will accrete to +1.2 m PWD or above level required for agriculture.

f) The above assumptions are based on MES Feasibility Study on Nijhum Dwip Integrated Development Project, April, 1998 and Feasibility Study on Char Montaz-Kukri Mukri development Project, May, 1998.

Total crop income based on net crop income per ha under different cropping patterns are considered in the analysis. Per ha. net crop income of different crops with and without project intervention are given in table D.2.

Table D.2 : Net Crop Income per Ha.(Tk.)

Crops	Future Without Project		Future With Project	
	Fin. Price	Eco. Price	Fin. Price	Eco. Price
LT Aman	3112	3592	6941	7540
HYV Aman			6514	7137
Ground Nut	12293	11191	17300	16332
Sweet Potato	1294	1770	5861	6040
Pulses	1440	1403	3718	3448
Chilli(dried)	14534	13484	22627	20874

Fisheries: It is assumed that 2.5% of gross new agricultural land would be converted to ponds. Fisheries benefits include only production from new fish ponds. Net return from fish culture (1ha. pond) is presented in table D.3.

Table D.3 : Net Revenue of Fish Culture (1 ha. pond - future situation)

(Cost/Revenue-Tk.)

Item	Financial	Economic
Total costs	32371	29068
Yield	80000	72160
Revenue	47629	43092

Forestry: Forestry activities considered in the analysis are self-financing type. In other words, forest planting and maintenance would be financed from revenues from the clearing of mature forests after a rotation period of 15 years. Only the net benefit are taken into the analysis. Net revenue of mangrove forest per hectare are presented in table D.4.

Table D.4 : Net Revenue of Mangrove Forest (1ha) by Different Operations (Tk.)

Item	Plantation		Thinning		Harvesting	
	Fin. Price	Eco. Price	Fin. Price	Eco. Price	Fin. Price	Eco. Price
Total costs	14125	12322	4830	4273	108220	92154
Yield	0	0	6300	5683	200550	180896
Net Revenue	-14125	-12322	1470	1410	92330	88742

Source: Feasibility study on Nijhum Dwip Development Project, April,1998, MES .

Notes

a) Without Project, 75% of new land accreting to +0.7m PWD (south of Bhola) and +1.2m PWD (South of Hatia and Char Lakshmi) may be planted in mangroves. Remaining land may be used for grazing of livestock and other purposes.

b) Forest plantation starts at year 9 without project situation and year 5 with project situation.

c) Thinning of mangrove forest may be done at year 9 and harvesting at year16.

Salvage Value: A portion of the bamboo pins and other materials may be retrieved at the third and fourth year of the project intervention. So 20% of cost of bamboos has been set as salvage value.

4 Prices

Financial and economic import parity price have been estimated for rice, TSP and potash and export parity prices for urea. These prices are based on World Bank price projections for 2010. For the economic prices transport, handling, processing, marketing and distribution costs are adjusted by the standard conversion factor.

Prices of other outputs are based on national farm gate prices, averaged for the four most recently available years.

For fisheries and forestry, market prices collected in the study area have been used.

5 EIRR and NPV

The EIRR and the NPV has been estimated for each of the three proposed intervention areas. The analytical results are presented below.

S-E Bhola: The EIRR is (-) 0.91% and the NPV is Tk (-)1.73 million. The calculation is shown in Table D.5.

S-E Hatia: The EIRR is (-) 1.55% and the NPV is Tk (-) 1.65 million. The calculation is shown in Table D.6.

Char Lakshmi : The EIRR is (-) 1.55% and the NPV is Tk (-) 1.65 million. The calculation is shown in Table D.7.

Negative results rule out the need for sensitivity analysis.

6. Conclusions and Recommendations

None of the proposed interventions is economically feasible and therefore not recommended for implementation.

Table D.5 : Estimation of EIRR and NPV of Sedimentation Trial at South East of Bhola.

(Thousand Tk.)

Year	Project costs F1		Forestry benefits		Agricultural benefits		Acquacultural benefits		Total benefits		Net benefit	Net Revenue
	Investment	O&M	Future Without Project	Future with Project F1	Future Without Project	Future with Project F1	Future Without Project	Future with Project F1	Future Without Project	Future with Project F1	F1- F0	F1
1	1578								0	0	0	-1578
2		315.6							0	0	0	-315.6
3		157.8		64 s					0	64	64	-93.8
4		157.8		64 s					0	64	64	-93.8
5				-110.9					0	-110.9	-110.9	-110.9
6									0	0	0	0
7									0	0	0	0
8									0	0	0	0
9			-83.17						-83.17	0	83.17	83.17
10									0	0	0	0
11									0	0	0	0
12									0	0	0	0
13				12.7					0	12.7	12.7	12.7
14									0	0	0	0
15									0	0	0	0
16									0	0	0	0
17			9.52						9.52	0	-9.52	-9.52
18									0	0	0	0
19									0	0	0	0
20				789.7					0	789.7	789.7	789.7
21	170.48					23.32			0	23.32	23.32	-147.16
22		3.41				27.2		6.46	0	33.66	33.66	30.25
23		3.41				33.04		6.46	0	39.5	39.5	36.09
24		3.41				34.98		6.46	0	41.44	41.44	38.03
25		3.41	239.6			38.87		6.46	239.6	45.33	-194.27	-197.68
26		3.41				42.75		6.46	0	49.21	49.21	45.8
27		3.41				42.75		6.46	0	49.21	49.21	45.8
28		3.41				46.64		6.46	0	53.1	53.1	49.69
29		3.41				46.64		6.46	0	53.1	53.1	49.69
30		3.41				68.42		6.46	0	74.88	74.88	71.47
31						68.42		6.46	0	74.88	74.88	74.88
32						68.42		6.46	0	74.88	74.88	74.88
33						68.42		6.46	0	74.88	74.88	74.88
34						68.42		6.46	0	74.88	74.88	74.88
35						68.42		6.46	0	74.88	74.88	74.88
36						83.37		6.46	0	89.83	89.83	89.83
37						83.37		6.46	0	89.83	89.83	89.83
38						83.37		6.46	0	89.83	89.83	89.83
39						83.37		6.46	0	89.83	89.83	89.83
40						83.37		6.46	0	89.83	89.83	89.83

Notes:

1/ F0= Future without project intervention; F1= Future with project intervention.

2/ S= It denotes salvage value of bamboo pins and materials used in the sedimentation field.

EIRR(%) -0.91

NPV(MnTk) -1.73

Table D.6 : Estimation of EIRR and NPV of Sedimentation Trial at South East of Hatia.

(Thousand Tk.)

Year	Project costs F1		Forestry benefits		Agricultural benefits		Acquacultural benefits		Total benefits		Net benefit	Net Revenue
	Investment	O&M	Future Without Project	Future with Project F1	Future Without Project	Future with Project F1	Future Without Project	Future with Project F1	Future Without Project	Future with Project F1	F1- F0	F1
1	1481								0	0	0	-1481
2		296.2							0	0	0	-296.2
3		148.1		53.64 s					0	53.64	53.64	-94.46
4		148.1		53.64 s					0	53.64	53.64	-94.46
5				-110.9					0	-110.9	-110.9	-110.9
6									0	0	0	0
7									0	0	0	0
8									0	0	0	0
9			-83.17		4.85				-78.32	0	78.32	78.32
10					4.85				4.85	0	-4.85	-4.85
11					4.85				4.85	0	-4.85	-4.85
12					4.85				4.85	0	-4.85	-4.85
13				12.7	4.85				4.85	12.7	7.85	7.85
14					4.85				4.85	0	-4.85	-4.85
15					4.85				4.85	0	-4.85	-4.85
16					8.09				8.09	0	-8.09	-8.09
17			9.52		8.09				17.61	0	-17.61	-17.61
18					8.09				8.09	0	-8.09	-8.09
19					8.09				8.09	0	-8.09	-8.09
20				789.7	9.17				9.17	789.7	780.53	780.53
21	218.78				9.17	23.32			9.17	23.32	14.15	-204.63
22		4.37			9.17	27.2		6.46	9.17	33.66	24.49	20.12
23		4.37			9.17	33.04		6.46	9.17	39.5	30.33	25.96
24		4.37			9.17	34.98		6.46	9.17	41.44	32.27	27.9
25		4.37	239.6		9.17	38.87		6.46	248.77	45.33	-203.44	-207.81
26		4.37			9.17	42.75		6.46	9.17	49.21	40.04	35.67
27		4.37			9.17	42.75		6.46	9.17	49.21	40.04	35.67
28		4.37			9.17	46.64		6.46	9.17	53.1	43.93	39.56
29		4.37			9.17	46.64		6.46	9.17	53.1	43.93	39.56
30		4.37			9.17	68.42		6.46	9.17	74.88	65.71	61.34
31		4.37			9.17	68.42		6.46	9.17	74.88	65.71	61.34
32		4.37			9.17	68.42		6.46	9.17	74.88	65.71	61.34
33		4.37			9.17	68.42		6.46	9.17	74.88	65.71	61.34
34		4.37			9.17	68.42		6.46	9.17	74.88	65.71	61.34
35		4.37			9.17	68.42		6.46	9.17	74.88	65.71	61.34
36		4.37			9.17	83.37		6.46	9.17	89.83	80.66	76.29
37		4.37			9.17	83.37		6.46	9.17	89.83	80.66	76.29
38		4.37			9.17	83.37		6.46	9.17	89.83	80.66	76.29
39		4.37			9.17	83.37		6.46	9.17	89.83	80.66	76.29
40		4.37			9.17	83.37		6.46	9.17	89.83	80.66	76.29

Notes:

1/ F0= Future without project intervention; F1= Future with project intervention.

2/ S= It denotes salvage value of bamboo pins and materials used in the sedimentation field.

EIRR(%)	-1.55
NPV(MnTk)	-1.65

Table D.7 : Estimation of EIRR and NPV of Sedimentation Trial at Char Lakshmi, Noakhali.

(Thousand Tk.)

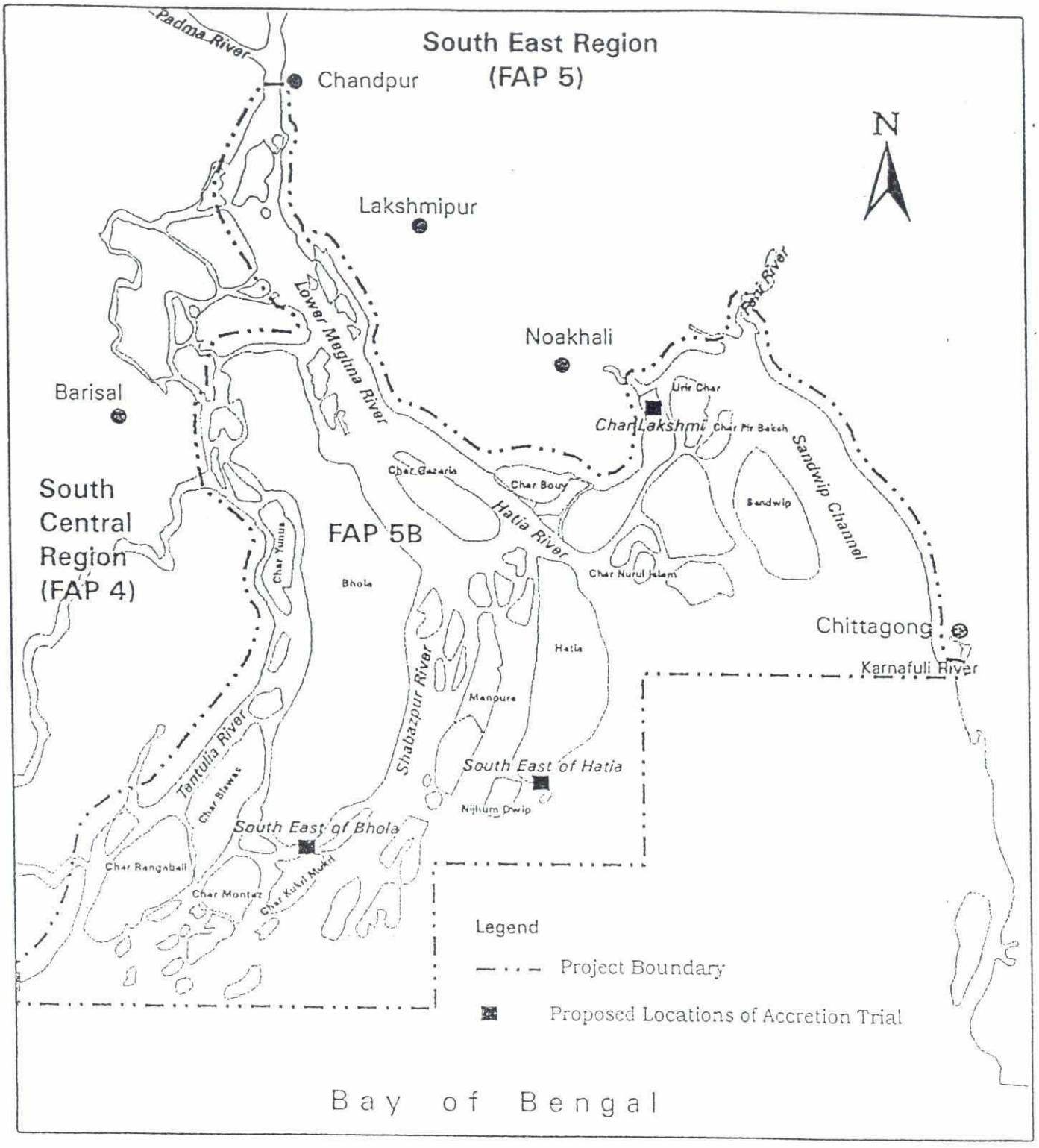
Year	Project costs F1		Forestry benefits		Agricultural benefits		Acquacultural benefits		Total benefits		Net benefit	Net Revenue
	Investment	O&M	Future Without Project	Future with Project F1	Future Without Project	Future with Project F1	Future Without Project	Future with Project F1	Future Without Project	Future with Project F1	F1- F0	F1
1	1481								0	0	0	-1481
2		296.2							0	0	0	-296.2
3		148.1		53.64 s					0	53.64	53.64	-94.46
4		148.1		53.64 s					0	53.64	53.64	-94.46
5				-110.9					0	-110.9	-110.9	-110.9
6									0	0	0	0
7									0	0	0	0
8									0	0	0	0
9			-83.17		4.85				-78.32	0	78.32	78.32
10					4.85				4.85	0	-4.85	-4.85
11					4.85				4.85	0	-4.85	-4.85
12					4.85				4.85	0	-4.85	-4.85
13				12.7	4.85				4.85	12.7	7.85	7.85
14					4.85				4.85	0	-4.85	-4.85
15					4.85				4.85	0	-4.85	-4.85
16					8.09				8.09	0	-8.09	-8.09
17			9.52		8.09				17.61	0	-17.61	-17.61
18					8.09				8.09	0	-8.09	-8.09
19					8.09				8.09	0	-8.09	-8.09
20				789.7	9.17				9.17	789.7	780.53	780.53
21	218.78				9.17	23.32			9.17	23.32	14.15	-204.63
22		4.37			9.17	27.2		6.46	9.17	33.66	24.49	20.12
23		4.37			9.17	33.04		6.46	9.17	39.5	30.33	25.96
24		4.37			9.17	34.98		6.46	9.17	41.44	32.27	27.9
25		4.37	239.6		9.17	38.87		6.46	248.77	45.33	-203.44	-207.81
26		4.37			9.17	42.75		6.46	9.17	49.21	40.04	35.67
27		4.37			9.17	42.75		6.46	9.17	49.21	40.04	35.67
28		4.37			9.17	46.64		6.46	9.17	53.1	43.93	39.56
29		4.37			9.17	46.64		6.46	9.17	53.1	43.93	39.56
30		4.37			9.17	68.42		6.46	9.17	74.88	65.71	61.34
31		4.37			9.17	68.42		6.46	9.17	74.88	65.71	61.34
32		4.37			9.17	68.42		6.46	9.17	74.88	65.71	61.34
33		4.37			9.17	68.42		6.46	9.17	74.88	65.71	61.34
34		4.37			9.17	68.42		6.46	9.17	74.88	65.71	61.34
35		4.37			9.17	68.42		6.46	9.17	74.88	65.71	61.34
36		4.37			9.17	83.37		6.46	9.17	89.83	80.66	76.29
37		4.37			9.17	83.37		6.46	9.17	89.83	80.66	76.29
38		4.37			9.17	83.37		6.46	9.17	89.83	80.66	76.29
39		4.37			9.17	83.37		6.46	9.17	89.83	80.66	76.29
40		4.37			9.17	83.37		6.46	9.17	89.83	80.66	76.29

Notes:

1/ F0= Future without project intervention; F1= Future with project intervention.

2/ S= It denotes salvage value of bamboo pins and materials used in the sedimentation field.

EIRR(%)	-1.55
NPV(MnTk)	-1.65

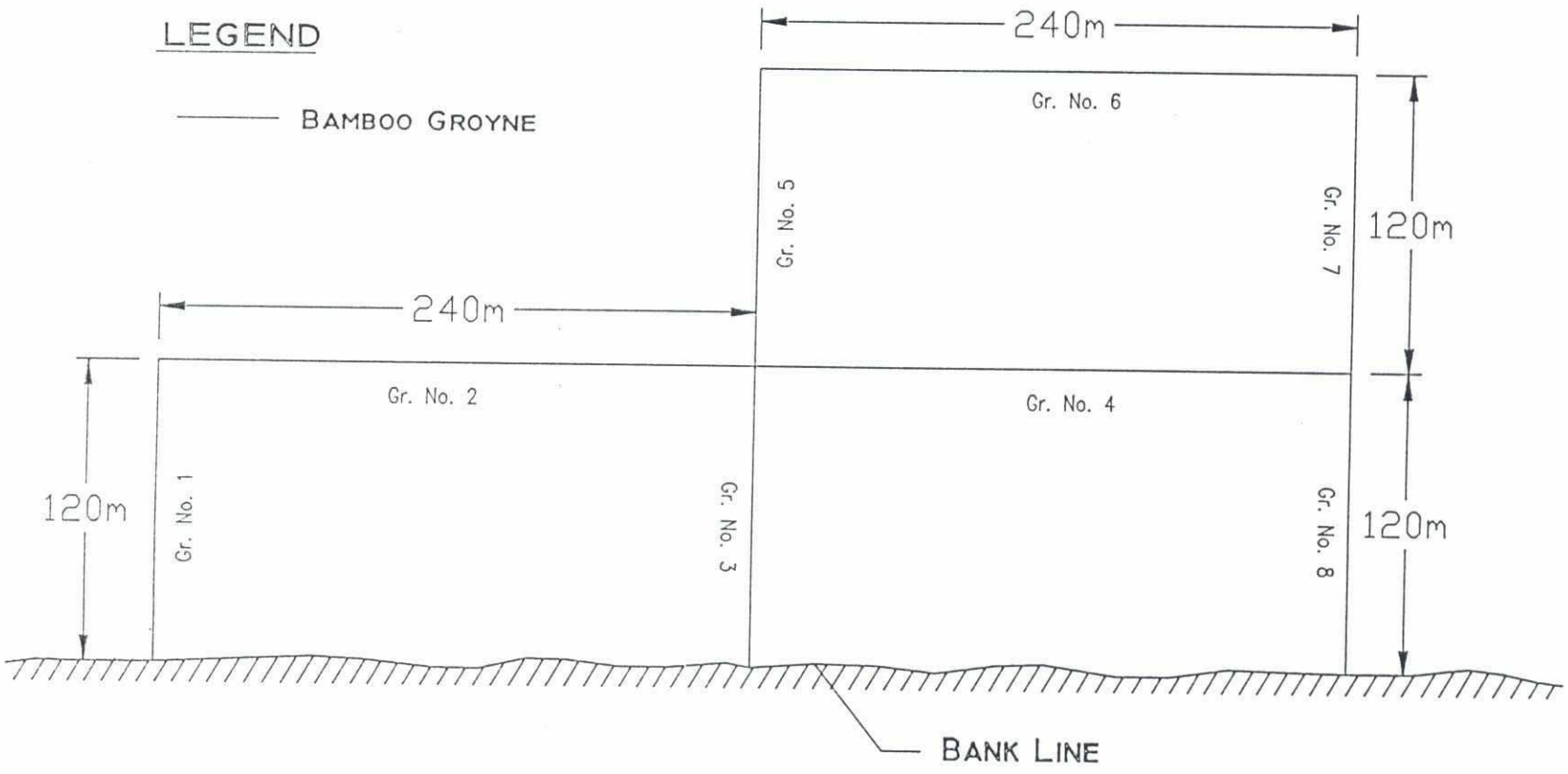


Location Map of Accretion Trials
MEGHNA ESTUARY STUDY (MES)

DHV Consultants BV

Figure 1

SCALE 1:1,000,000



PLAN FOR SEDIMENTATION TRIAL FIELD

NOT TO SCALE

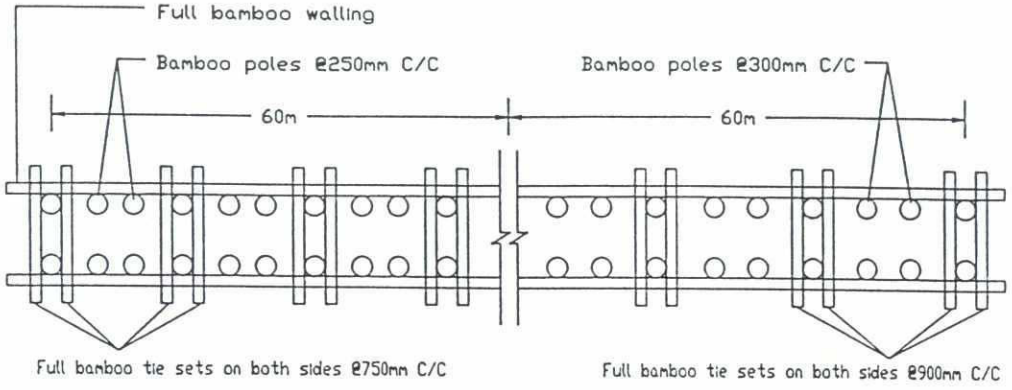
FIGURE 2

DATE: 14-08-96

MEGHNA ESTUARY STUDY (MES)

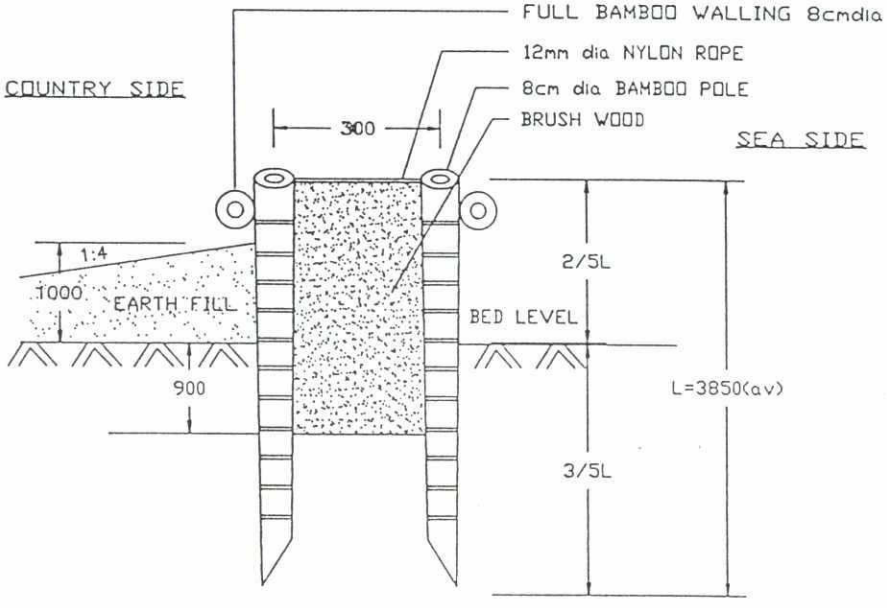
DHV CONSULTANTS BV

CIVIL ENGINEERING AND RECLAMATION SECTION



PLAN FOR 120m BAMBOO GROYNE

(NOT TO SCALE)



SECTION OF BAMBOO GROYNE

(NOT TO SCALE)

DIMENTIONS ARE IN MILLIMETRE

MEGHNA ESTUARY STUDY (MES) DHV CONSULTANTS BV	CIVIL ENGINEERING AND RECLAMATION SECTION	
	FIGURE 3	DATE: 14-08-96