Table 3.1 Estimated Half Monthly Discharge at Proposed Embung Site

Embung Matasio

Unit : 1000 m3

	Jan.		Feb.		Mar.		Apr.		May		Jun.		Jul		Aug		Sep.		Oct.		Nov.		Dec.		Annual
	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	
1931	368.00	368.00	0.00	0.00	240.00	240.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	35.00	35.00	93.00	93.00	1,472.00
1932	194.00	194.00	89.00	89.00	90.00	90.00	0.00	0.00	0.00	0.00	41.00	41.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	151.00	151.00	1,130.00
1933	70.00	70.00	203.00	203.00	309.00	309.00	0.00	0.00	0.00	0.00	42.00	42.00	0.00	0.00	35.00	35.00	0.00	0.00	0.00	0.00	51.00	51.00	365.00	365.00	2,150.00
1934	147.00	147.00	236.00	236.00	262.00	262.00	55.00	55.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	82.00	82.00	66.00	66.00	1,696.00
1935	298.00	298.00	152.00	152.00	325.00	325.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	34.00	34.00	95.00	95.00	1,808.00
1936	242.00	242.00	249.00	249.00	96.00	96.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	177.00	177.00	1,528.00
1937	113.00	113.00	184.00	184.00	302.00	302.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	101.00	101.00	1,400.00
1938	234.00	234.00	173.00	173.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	41.00	41.00	0.00	0.00	0.00	0.00	0.00	0.00	58.00	58.00	152.00	152.00	1,316.00
1939	335.00	335.00	359.00	359.00	278.00	278.00	0.00	0.00	370.00	370.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	74.00	74.00	91.00	91.00	3,014.00
1940	158.00	158.00	135.00	135.00	246.00	246.00	93.00	93.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	35.00	35.00	128.00	128.00	1,590.00
Average	215.90	215.90	178.00	178.00	214.80	214.80	14.80	14.80	37.00	37.00	8.30	8.30	4.10	4.10	3.50	3.50	0.00	0.00	0.00	0.00	36.90	36.90	141.90	141.90	1,710.40

Table 3.2 Estimated Flood Discherge

Matasio Scheme

Characteristics of the catchment area								
Catchment Area	(km2)	5.00						
Eelevation at Dam Site (1)	(m)	24						
Maximum elevation in the catchment area (2)	(m)	65						
Height (3)=(2)-(1)	(h)	41						
Length of Catchment Area (l)	(m)	6,000						
Flow velocity	W2 (km/hr)	3.62						
Time of concentration	T2 (hrs)	1.66						
Estimate of the Design Flood Discherge								
Return Period	(years)	2	5	10	20	50	100	200
Rainfall	(mm/day)	115	136	149	160	175	185	195
Rainfall intensity within the time of concentration	(mm)	18	22	24	25	28	29	31
Designed Flood	(m3/s)	20	24	26	28	31	33	34
Specific Discharge	(m3/s/km2)	4	5	5	6	6	7	7

To estimate design rainfall, the Log Pearson III method is adopted.
The rational method is adopted for estimation of the design flood discharge.
C = 0.8 is used to estimate designed flood discharge by the rational method.

Table 3.3 Result of Water Quality Test

Matasio Scheme

DESCRIPTION	UNIT	1 Upstream of proposed embung	2 Embung Site	3 Embung Site	4 downstream of proposed embung	Max. Limit of B Class by GR. NO. 20/1990
I. PHYSICS						
1 Temperature	C	28.50	28.50	27.50	25.00	Normal water temperature
2 Dissolved solid matter	mg/liter	436.00	1120.00	1103.00	1787.00	1000
3 Electric Conductivety	umhos/cm	593.00	1523.00	1500.00	2440.00	-
II. CHEMISTRY						
a. Unorganic chemistry						
1 Mercury	mg/liter	0.00	0.00	0.00	0.00	0.001
2 Ammonia	mg/liter	0.00	0.12	0.13	0.13	0.5
3 Arsenic	mg/liter	-	-	-	-	0.05
4 Barium	mg/liter	-	-	-	-	5
5 Ferro	mg/liter	0.00	0.11	0.60	0.19	1
6 Fluoride	mg/liter	0.90	1.00	1.00	1.00	1.5
7 Cadmium	mg/liter	0.00	0.00	0.00	0.00	0.005
8 Chloride	mg/liter	85.20	341.00	348.00	546.00	600
9 Chronium, valense-6	mg/liter	0.00	0.00	0.00	0.00	0.05
10 Manganese	mg/liter	0.00	0.00	0.00	0.00	0.5
11 Nitrate, N	mg/liter	0.90	0.00	0.00	0.00	10
12 Nitric, N	mg/liter	0.00	0.00	0.00	0.00	1
13 Dissolved Oxygen	mg/liter	6.80	0.17	0.17	2.93	*
14 pH	-	6.70	8.20	8.20	7.70	5-9
15 Selenium	mg/liter	-	-	-	-	0.01
16 Zinc	mg/liter	0.00	0.00	0.00	0.00	5
17 Cyanide	mg/liter	0.00	0.00	0.00	0.00	0.1
18 Sulphate	mg/liter	20.00	160.00	171.00	308.00	400
19 Sulfide, H2S	mg/liter	0.00	0.00	0.00	0.00	0.1
20 Copper	mg/liter	0.00	0.00	0.00	0.00	1
21 Lead	mg/liter	0.00	0.00	0.00	0.00	0.1
b. Organic Chemistry						
1 Aldrin and Dieldrin	mg/liter	0.00	0.00	0.00	0.00	0.017
2 Chlordane	mg/liter	0.00	0.00	0.00	0.00	0.003
3 DDT	mg/liter	0.00	0.00	0.00	0.00	0.042
4 Endrine	mg/liter	0.00	0.00	0.00	0.00	0.001
5 Fenol	mg/liter	0.00	0.00	0.00	0.00	0.001
6 Heptachlor and Heptachlor Epoxide	mg/liter	-	-	-	-	0.018
7 Carbon Cloroform Ekiract	mg/liter	-	-	-	-	0.5
8 Lindane	mg/liter	0.00	0.00	0.00	0.00	0.056
9 Methoxychlor	mg/liter	-	-	-	-	0.035
10 Oil and Fat	mg/liter	0.00	0.00	0.00	0.00	Nil
11 Organofosphate and Carbomate	mg/liter	0.00	0.00	0.00	0.00	0.1
12 PCB	mg/liter	-	-	-	-	Nil
13 Senyawa atife biru (Sulfaktan)	mg/liter	0.00	0.00	0.00	0.00	0.5
14 Toxaphene	mg/liter	0.00	0.00	0.00	0.00	0.005
III MICRO BIOLOGY						
1 Coliform tinja	per 100 ml	14,000	18,000	18,000	22,000	2,000
2 Total Coliform	per 100 ml		24,000	24,000	28,000	10,000

NOTE:
* = The water level shall be more than or equal to 6.
mg = miligram
ml = Milimeter
Bq = Bequerel

Heavy metals are classified into dissolved matter.

Source : JICA's Water Quality Test

Table 5.1 Design Value of Embankment Materials

Matasio Scheme

Item		Unit	Design Value
Natural Water Content	(NWC)	%	25.9
Bulk Density	(γ d max)	g/cm3	1.796
Maximum Dry Density	(γ t)	g/cm3	1.60
Saturated Density	(σ sat)	g/cm3	1.944
Optimum Moisture Content	(Wopt)	%	22
Specific Gravity	(Gs)	-	2.55
Liquid Limit	(LL)	%	61.7
Plastic Limit	(PL)	%	22.8
Plastic Index	(PI)	%	38.9
Shrinkage Limit	-	%	21.0
Angle of Internal Friction	(ϕ)	°	24.0
Cohesion (UU/CU)	(C)	kg/cm2	1.1
Permeability	(K)	cm/sec	2.05E-06
Classification of Soil	-	-	CH

Table 6.1 Summary of Construction Equipment

Matasio Scheme

No.	Equipment	Capacity	Munimum Number
1	Bulldozer	21 ton	2
2	Wheel loder	1.2 m3	1
3	Backhoe	1.2 m3	2
4	Backhoe	0.6 m3	3
5	Dump Truck	11 ton	12
6	Dump Truck	7 ton	3
7	Type roller	10 ton	1
8	Motor grader	3.7 m	1
9	Water Tanker(Sprinkler)	6 kl	1
10	Leg drill	2.8 m3/min	2
11	Sinker	3.3 m3/min	2
12	Air compressor	14 m3/min	1
13	Batching plant	0.75 m3	1
14	Agitator (Trunk mixer)	3.0 m3	2
15	Concrete bucket	1.0 m3	2
16	Concrete vibrator	-	3
17	Truck crane	20 ton	1
18	Water pump	3,7 kw	2
19	Welder	300 A	2
20	Diesel generator	80 KVA	2
21	Truck	7 ton	4
22	Truck with crane	6 ton	1
23	Pickup car	-	4
24	Jeep	-	4
25	Concrete pump	20 m3/hr	1

Table 7.1 Summary of Project Cost

Scheme : MATASIO

Item	Amount (Rp. million)
I. Direct Construction Cost	
1.1 Preparatory Works	150
1.2 Embung Construction	
1) Main dam	1,171
2) Spillway	997
3) Intake, outlet & diversion channel	164
4) Seepage protection works	0
5) Miscellaneous	233
Sub-total of 1.2	2,565
1.3 Domestic Water Supply	
1) Pipe line	81
2) Division boxes	53
3) Miscellaneous	13
Sub-total of 1.3	147
1.4 Embung Operation and Maitenace Road	82
1.5 Irrigation Facilities	210
Sub-toal of I.	3,154
II. Administration Cost	158
III. Engineering Services	473
Sub-total of I, II & III	3,785
IV. Physical Contingency	568
Sub-total of I, II, II, & IV	4,353
V. Contract Tax	420
VI. Land Aquisition Cost	16
Sub-total I, II, III, IV, V & VI	4,788
VII. Price Contingency	479
GRAND TOTAL	5,267

Table 7.2 Direct Construction Cost (1/3)

Scheme : MATASIO

Item	Unit	Unit Price Rp.	Quantity	Total 1000 Rp.
I. Embung				
1. Main Dam				
1.1 Earth/stone works				
1) Clearing	m2	400	16,000	6,400
2) Excavation	m3	5,500	16,000	88,000
3) Embankment	m3	8,000	110,000	880,000
4) Rip-rap protection	m3	15,000	6,000	90,000
1.2 Other miscellaneous works				106,440
Sub-total of 1.				1,170,840
2. Spillway				
2.1 Earth works				
1) Clearing	m2	400	8,000	3,200
2) Excavation	m3	5,500	37,000	203,500
3) Backfill	m3	5,200	4,000	20,800
2.2 Concrete works				
1) Concrete - A	m3	250,000	300	75,000
2) Concrete - B	m3	170,000	2,200	374,000
3) Reinforcement bar	ton	1,500,000	43	64,500
4) Form	m2	15,000	11,000	165,000
2.3 Other miscellaneous works	L.S			90,600
Sub-total of 2.				996,600
3. Intake, Outlet & Diversion Channel				
3.1 Earth works				
1) Clearing	m2	400		0
2) Excavation	m3	5,500	2,400	13,200
3) Backfill	m3	15,000		0
3.2 Concrete works				
1) Concrete - A	m3	250,000		0
2) Concrete - B	m3	170,000	800	136,000
3) Reinforcement bar	ton	1,500,000		0
4) Form	m2	15,000		0
3.3 Other miscellaneous works	L.S			14,920
Sub-total of 3.				164,120
4. Seepage Protection Works				
4.1 Earth works				
1) Clearing	m2	400		0
2) Earth blanket works	m3	8,000		0
4.2 Concrete lining works	m2	170,000		0
Sub-total of 4.				0
5. Miscellaneous & Others				233,156
Total of I.				2,564,716

Table 7.2 Direct Construction Cost (2/3)

Scheme : MATASIO

Item	Unit	Unit Price Rp.	Quantity	Total 1000 Rp.
II. Domestic Water Supply				
1. Pipe line				
1.1 Earth works				
1) Clearing	m2	400	8,900	3,560
2) Excavation	m3	5,000	1,450	7,250
3) Backfill	m3	5,200	1,430	7,436
1.2 Pipe line setting works				
1) Dia 40 mm	m	5,300		0
2) Dia 50 mm	m	7,400		0
3) Dia 65 mm	m	9,200	350	3,220
5) Dia 75 mm	m	13,300	4,090	54,397
6) Dia. 400 mm	m	218,000		0
1.3 Pipe line related structures				
1) Check valve	nos.	624,000	5	3,120
2) Air valve	nos.	506,000	1	506
3) Drainage valve	nos.	1,036,000	1	1,036
Sub-total of 1.				80,525
2. Division Boxes				
1) Division box for inhabitants	nos.	6,990,000	6	41,940
2) Division box for livestock	nos.	1,130,000	10	11,300
Sub-total of 2.				53,240
3. Miscellaneous & Others	L.S			13,377
Total of II.				147,142
III. Embung Operation and Maintenance Road				
1. Road Works				
1.1 Earth works				
1) Clearing	m2	400	15,400	6,160
2) Excavation	m3	5,000		0
3) Embankment	m3	6,300	100	630
4) Pavement (lime stone)	m3	15,000	2,940	44,100
2. Related structures				
2.1 Cross drain	nos.	4,700,000	5	23,500
3. Miscellaneous and others	L.S			7,439
Total of III				81,829

Table 7.2 Direct Construction Cost (3/3)

Scheme : MATASIO

Item	Unit	Unit Price Rp.	Quantity	Total 1000 Rp.
IV. Irrigation Facilities				
1. Canal works				
1.1 Earth works				
1) Clearing	m2	400	10,000	4,000
2) Excavation	m3	5,000	4,400	22,000
3) Embankment	m3	6,300	1,800	11,340
1.2 Concrete works				
1) Concrete - A	m3	250,000	310	77,500
2) Concrete - B	m3	170,000	45	7,650
3) Reinforcement bar	ton	1,500,000	9	13,500
4) Form	m2	15,000	2,400	36,000
2. Related structures				
2.1 Irrigation inlet box	nos.	1,600,000	1	1,600
2.2 Aqueduct	nos.	2,750,000	1	2,750
2.3 Cross drain	nos.	4,700,000	3	14,100
2.4 Irrigation division box	nos.	600,000	1	600
3. Rehabilitation of existing canal				
3.1 Weir rehabilitation	L.S			
3.2 Canal rehabilitation	L.S			
4. Miscellaneous & Others	L.S			19,104
Total - IV				210,144
GRAND TOTAL				3,003,831

Table 8.1 Price Structures for Paddy in NTT
(June 1994 price level)

	Item	Import Parity			Export Parity		
		Operation	US$/ton	Rp./kg	Operation	US$/ton	Rp./kg
1	Export price of Thai 5% broken, FOB Bangkok 1)		283			283	
2	Quality adjusment 2)	x 0.9	255		x 0.9	255	
3	Shipping and insurance cost	+	35		+	0	
4	Import price, bagged milled rice, CIF Surabaya	=	290		=	255	
5	Convert to Rupiah	x 2,117		613.3	x 2,090		539.2
6	Port handling, storage and losses 3)	+		25.0	-		25.0
7	Handling and transportation cost to Kupang	+		50.0	-		50.0
8	Ex-wholesaler	=		688.3	=		464.2
9	Conversion to price of dried paddy 4)	x 0.65		447.4	x 0.65		301.7
10	Milling charge 5)	-		12.0	-		12.0
11	Handling and transportation cost to farm gate 6)	-		30.0	-		30.0
12	*Economic farm gate price of dried paddy*	=		405.4	=		259.7
		≠		(405)	≠		(260)
	Average farm gate price of Import-Export parity			333 Rp./kg			

Note: 1) Based on "Quarterly Review of Commodity Markets, IBRD Third Quarter 1993" with 1990 constant prices *infrated* to 1994 prices using factor of 1.1085 based on MUV index.
2) 90% of world price.
3) Includes port costs, transport to warehouse, spraying and fumigation, unloading, warehouse rents, losses at unloading and at the warehouse.
4) Standard coversion rate at DOLOG
5) Net of value of by-products at includes milling/storage losses.
6) Includes 1% losses.

Table 8.2 Price Structures for Palawija Crops in NTT (June 1994 price level)

	Item	Operation	US$/ton	Rp./kg
Maize				
1	Export price, FOB US Gulf port 1)		116	
2	Freight and insurance	+	35	
3	Import price, maize, CIF Surabaya	=	151	
4	Convert to Rupiah	x 2,117		319.7
5	Port handling and storage	+		29.2
6	Internal transportation cost (Surabaya-Kupang)	+		50.0
7	Ex-wholesaler (Kupang)	=		398.9
8	Handling and transportation cost to project site	-		30.0
9	Local transport and handling losses	-		5.0
10	Economic farm gate price of maize	=		363.9
		≠		(364)
Mungbean				
1	Import price, CIF Jakarta 2)		427	
2	Convert to Rupiah	x 2,117		904.0
3	Port handling and storage	+		40.7
4	Transport to wholesaler (Jakarta)	+		5.0
5	Ex-wholesaler (Kupang)	=		949.7
6	Internal transportation cost (Jakarta-Kupang)	-		50.0
7	Handling and transportation cost to project site	-		30.0
8	Local transport and handling losses	-		5.0
9	Economic farm gate price of mungbean	=		914.7
		≠		(915)

Note: 1) Based on "Quarterly Review of Commodity Markets, IBRD Third Quarter1993"
2) Estimated on the basis of CIF Jakarta prices for last 5 years.

Table 8.3 Price Structures for Fertilizer in NTT (June 1994 price level)

Item	Operation	US$/ton	Rp./kg
Urea			
Export price FOB Europe, bagged 1)		160	
Transport premium	+	15	
FOB Palembang	=	175	
Conversion to Rupiah	x 2,117		370.5
Cost of shipping to Surabaya	+		8.0
Port handling charges	+		19.3
Handling and transportation cost to project area	+		65.0
Economic cost of bagged urea at farm gate	=		462.8
	≠		(463)
TSP			
Export price, FOB US Gulf, bulk 1)		139	
Shipping and insurance cost to Surabaya	+	65	
Import price CIF Surabaya	=	204	
Conversion to Rupiah	x 2,117		431.9
Port handling charges	+		19.3
Bagging cost	+		15.0
Handling and transportation cost to project area	+		65.0
Economic cost of bagged TSP at farm gate	=		531.2
	≠		(531)
Potassium Chloride (KCl)			
Export price, FOB, Vancouver, bulk 1)		119	
Shipping and insurance cost to Surabaya	+	65	
Import price CIF Surabaya	=	184	
Conversion to Rupiah	x 2,117		389.5
Port handling charges	+		19.3
Bagging cost	+		15.0
Handling and transportation cost to project area	+		65.0
Economic cost of bagged TSP at farm gate	=		488.8
	≠		(489)

Note: 1) Based on "Quarterly Review of Commodity Markets, IBRD Third Quarter1993" with 1990 constant prices infrated to 1994 prices using factor of 1.1085 based on MUV index.

Table 8.4 Economic Crop Budget per Ha
(June 1994 price level)

Matasio Scheme

Item		Unit	Unit Value	Without Project				With Project	
				Rainfed Paddy		Maize		Irrigated Paddy	
			(Rp.)	Q'ty	Amount	Q'ty	Amount	Q'ty	Amount
Gross Production Value									
Paddy		kg	333	2,250	749,250	0	0	4,500	1,498,500
Maize		kg	364	0	0	2,000	728,000	0	0
Production Cost									
Seed									
Paddy	Certified	kg	537	0	0	0	0	25	13,425
	Own	kg	333	60	19,980	0	0	0	0
Maize	Certified	kg	533	0	0	0	0	0	0
	Own	kg	364	0	0	25	9,100	0	0
Fertilizer									
Urea		kg	463	120	55,560	30	13,890	250	115,750
TSP		kg	531	60	31,860	0	0	100	53,100
KCl		kg	489	0	0	0	0	50	24,450
Agro-chemicals		liter	10,000	0.8	8,000	0.5	5,000	3.0	30,000
Rodenticide		kg	5,500	0.0	0	0.0	0	1.0	5,500
Labor									
Family		md	1,500	80	120,000	65	97,500	180	270,000
Hired		md	2,000	10	20,000	0	0	10	20,000
Draft Animal		ad	5,000	40	200,000	40	200,000	40	200,000
Tractor		ha	200,000	0	0	0	0	0	0
Miscellaneous (10% of above)					45,540		32,549		73,223
Total production cost					500,940		358,039		805,448
Net Production Value					248,310		369,961		693,053

Table 8.5 Calculation of Economic Net Production Value (June 1994 price level)

Item	Tasiepah Embung	Benkoko Embung	Matasio Embung
A Harvested Area (ha)			
1. With Project			
a. Paddy	160	35	75
b. Mungbean	160	35	0
c. Red Onion	0	70	0
2. Without Project			
a. Paddy	73	35	60
b. Maize	87	0	3
B Unit Net Production Value (Rp./ha)			
1. With Project			
a. Paddy	607,854	607,854	693,053
b. Mungbean	466,741	375,241	0
c. Red Onion	0	1,670,950	0
2. Without Project			
a. Paddy	117,164	18,555	248,310
b. Maize	280,661	0	369,961
C Net Production Value (Rp.1,000)			
1. With Project			
a. Paddy	97,257	21,275	51,979
b. Mungbean	74,679	13,133	0
c. Red Onion	0	116,967	0
Sub-total for C1	171,935	151,375	51,979
2. Without Project			
a. Paddy	8,553	649	14,899
b. Maize	24,418	0	1,110
Sub-total for C2	32,970	649	16,008
D Incremental Amount (Rp. 1,000)	138,965	150,725	35,970

Table 8.6 Summary of Economic Costs and Benefits for Economic Evaluation (June 1994 price level)

(Unit : Rp. million)

Item	Tasiepah Embung	Benkoko Embung	Matasio Embung	Total
1. Cost Allocation (Financial Cost)				
1.1 Investment Cost	22,688	9,526	5,267	37,481
(a) Domestic and Livestock Water Supply	12,906	4,255	3,897	21,058
(b) Irrigation Water Supply	8,848	4,879	1,153	14,880
1.2 Administrative Cost born from Counter Budget	934	392	217	1,543
2. Economic Investment Cost for Irrigation				
1.1 Direct construction cost				
(a) Embung	3,013	2,110	361	5,484
(b) Irrigation Water Distribution System	908	53	149	1,110
Sub-total	3,921	2,163	510	6,594
1.2 Engineering services	745	411	97	1,253
1.3 Physical contingency	700	386	91	1,177
Total investment cost	5,366	2,960	698	9,024
1.5 Annual disbursement				
1st Year	285	158	44	487
2nd Year	1,591	2,802	654	5,047
3rd Year	3,490	0	0	3,490
4th Year	0	0	0	0
5th Year	0	0	0	0
3. Annual O&M cost				
3.1 Embung, intake and pipe (0.5% 0f 1.1)	20	11	3	33
4. Economic irrigation benefit				
4.1 Annual net production value (see Table 8-5)				
(a) With project net benefit	171.9	151.4	52.0	375.3
(b) Without project net benefit	33.0	0.6	16.0	49.6
4.2 Incremental net benefit (= a - b)	138.9	150.8	36.0	325.7
5. Negtive benefit	0	0	0	0

Table 8.7 Economic Costs and Benefits Flow (Matasio Embung Development Project)

EIRR = -0.1 %

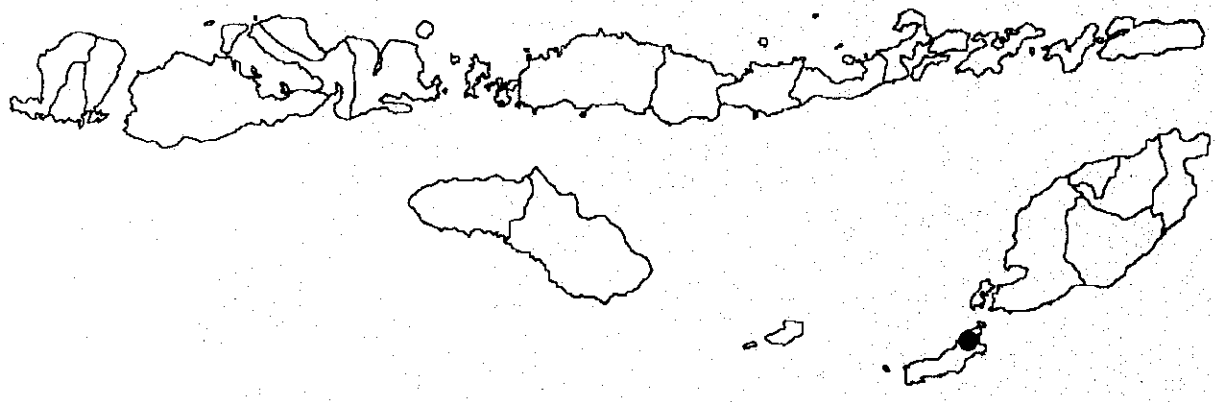
Year	Cost				Benefit			Increment
	Capital	Replace	O&M	Total	Irrigation	Negative	Total	
1.	44	0	0	44	0	0	0	-44
2.	654	0	0	654	0	0	0	-654
3.	0	0	0	0	0	0	0	0
4.	0	0	3	3	22	0	22	19
5.	0	0	3	3	25	0	25	22
6.	0	0	3	3	29	0	29	26
7.	0	0	3	3	32	0	32	29
8.	0	0	3	3	36	0	36	33
9.	0	0	3	3	36	0	36	33
10.	0	0	3	3	36	0	36	33
11.	0	0	3	3	36	0	36	33
12.	0	0	3	3	36	0	36	33
13.	0	0	3	3	36	0	36	33
14.	0	0	3	3	36	0	36	33
15.	0	0	3	3	36	0	36	33
16.	0	0	3	3	36	0	36	33
17.	0	0	3	3	36	0	36	33
18.	0	0	3	3	36	0	36	33
19.	0	0	3	3	36	0	36	33
20.	0	0	3	3	36	0	36	33
21.	0	0	3	3	36	0	36	33
22.	0	0	3	3	36	0	36	33
23.	0	0	3	3	36	0	36	33
24.	0	0	3	3	36	0	36	33
25.	0	0	3	3	36	0	36	33

Note: June1994 price level

The Study on The Embung Development Project in East Nusa Tenggara and West Nusa Tenggara

Feasibility Study on Matasio Embung Development Project

Figures



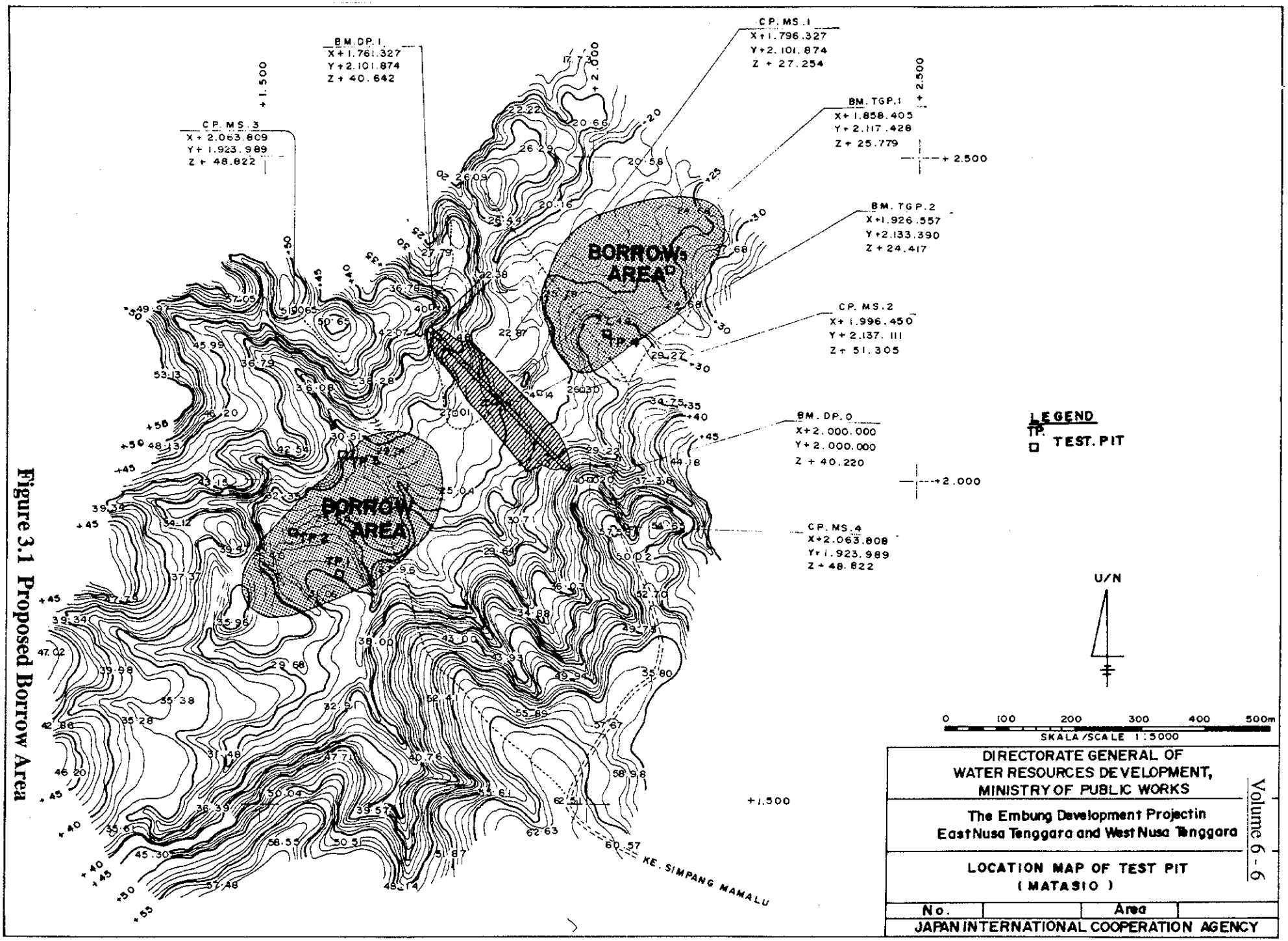
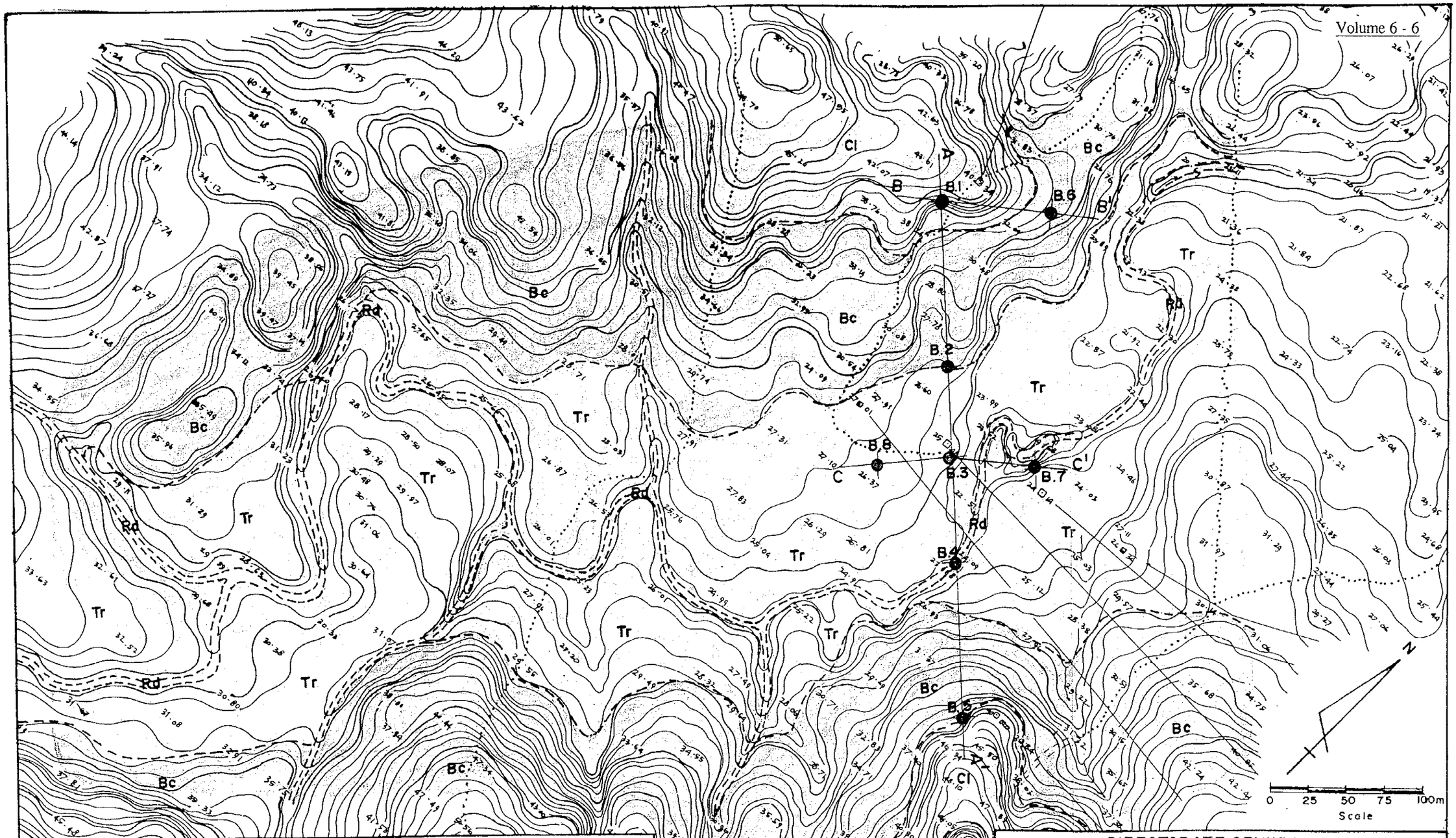


Figure 3.1 Proposed Borrow Area



LEGEND

Rd	River deposits
Tr	Terrace deposits
Cl	Coral limestone : Coralline limestone
Bc	Claystone : Bobonaro complex

Geological boundary

Bore Hole

Geological profile line

DIRECTORATE GENERAL OF
WATER RESOURCES DEVELOPMENT,
MINISTRY OF PUBLIC WORKS

The Embung Development Project in
East Nusa Tenggara and West Nusa Tenggara

GEOLOGICAL MAP OF MATASIO SITE

No.		Area	

JAPAN INTERNATIONAL COOPERATION AGENCY

Figure 3.2 Geological Map and Profile (1/2)

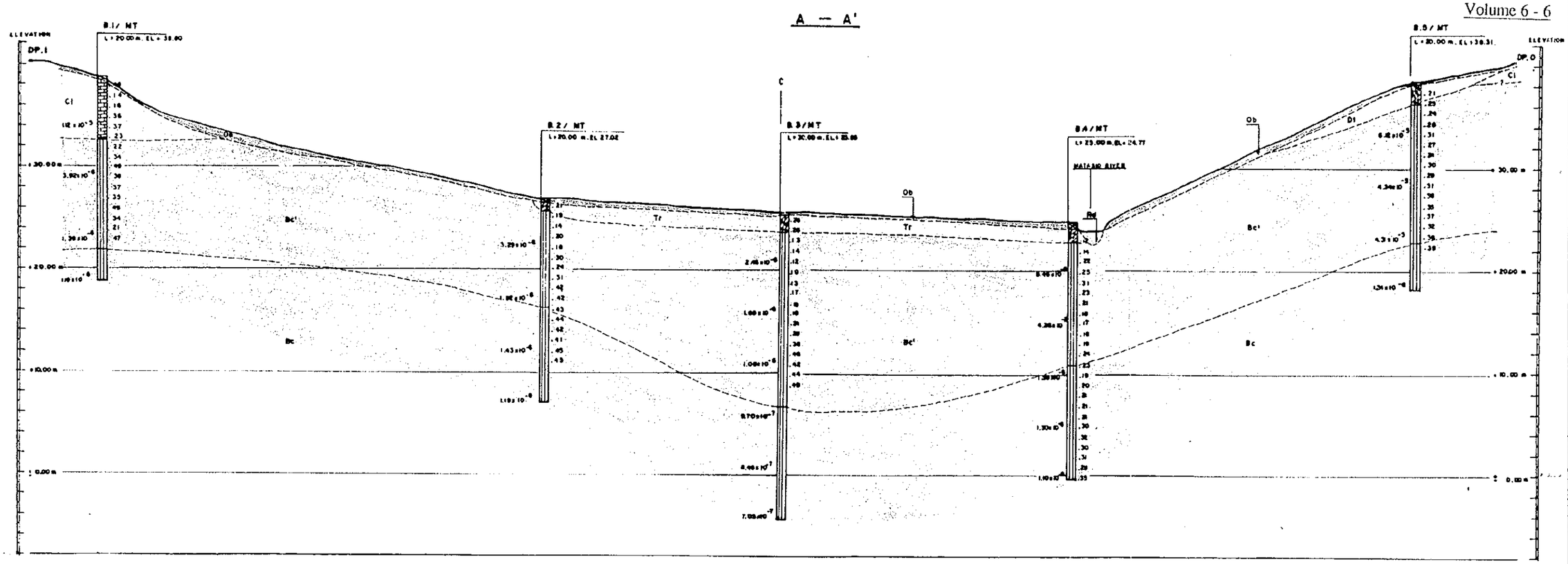


Figure 3.3 Geological Map and Profile (2/2)

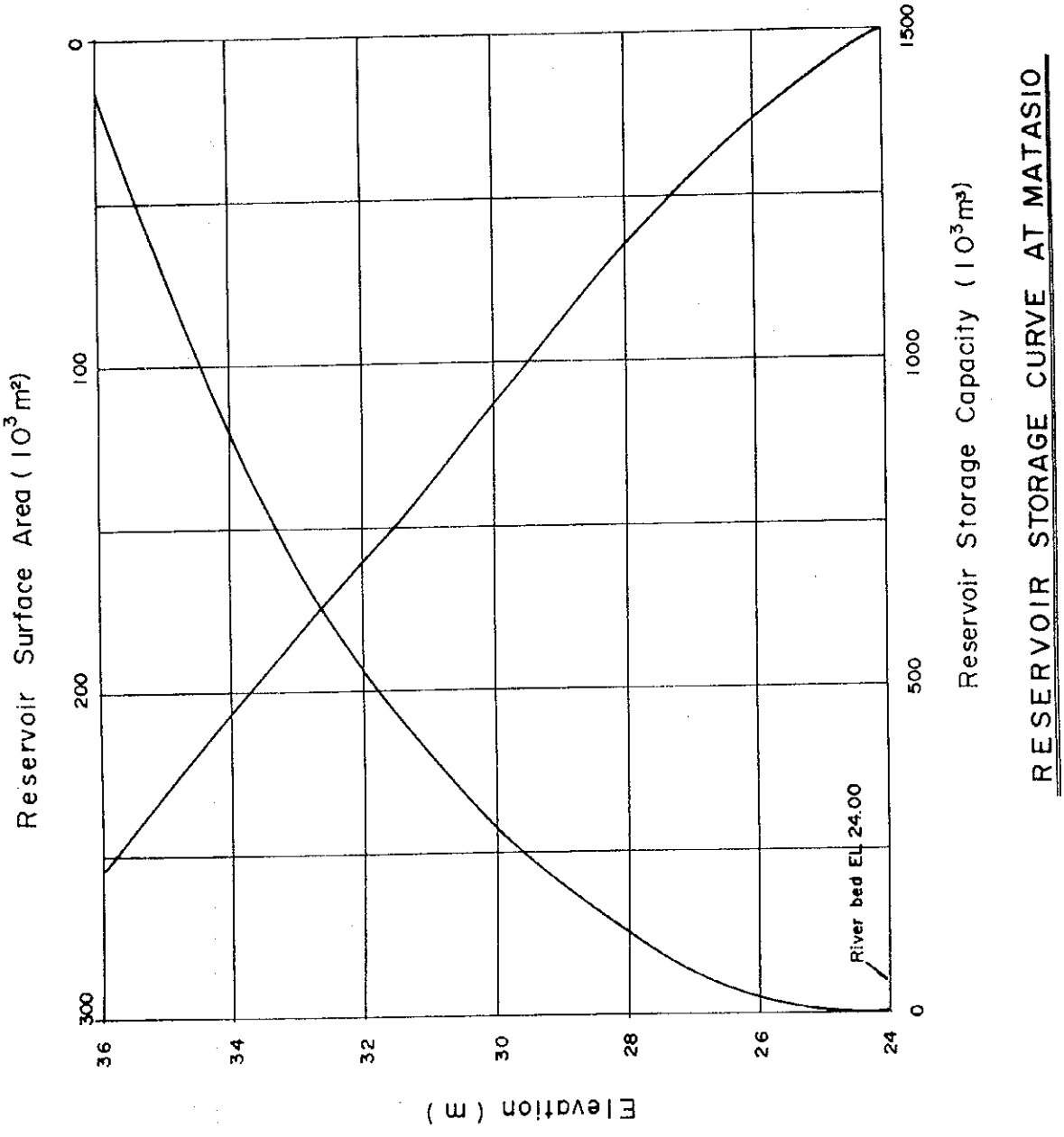


Figure 4.1 Reservoir Storage Curve

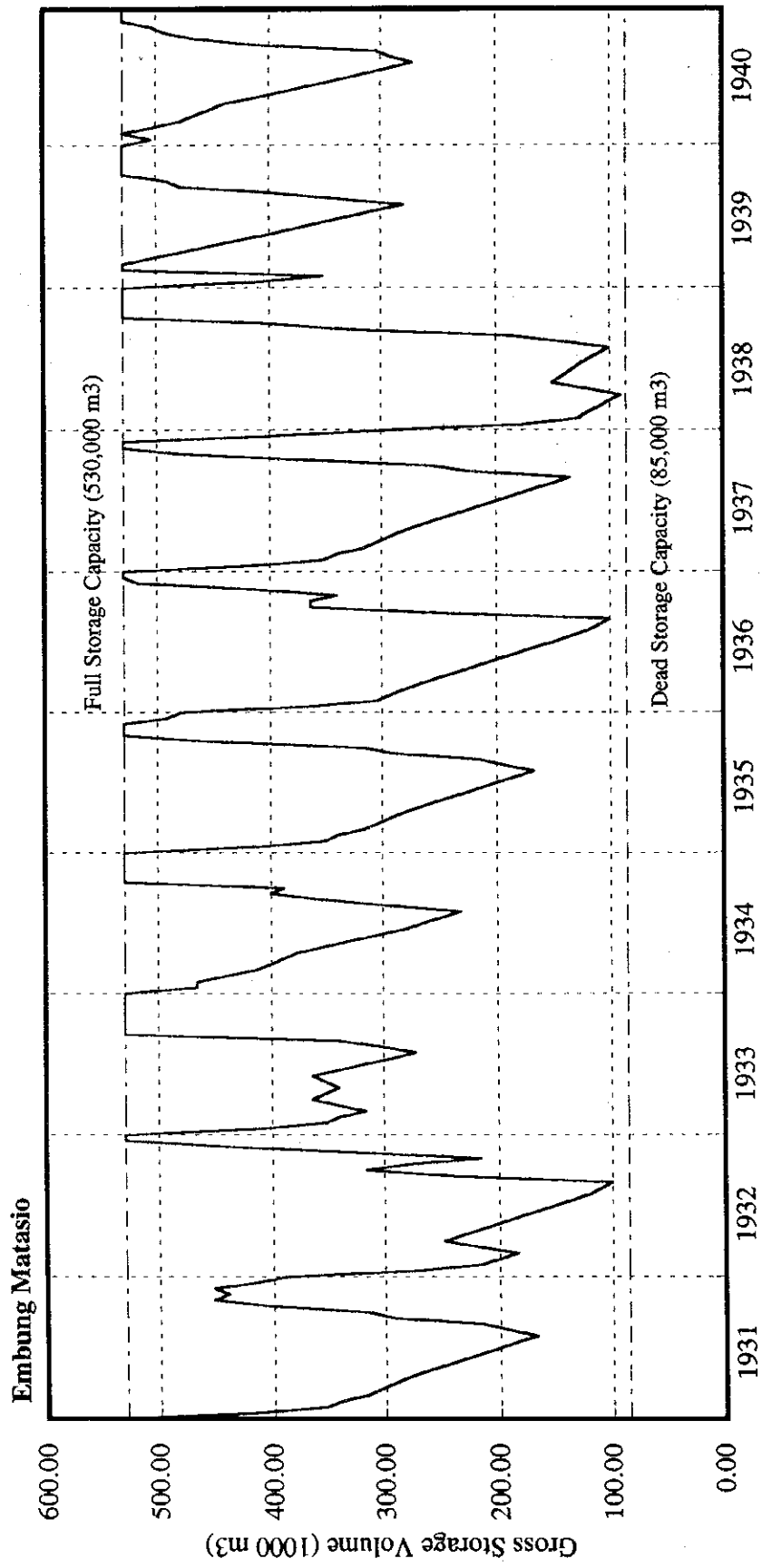


Figure 4.2 Result of Reservoir Operation

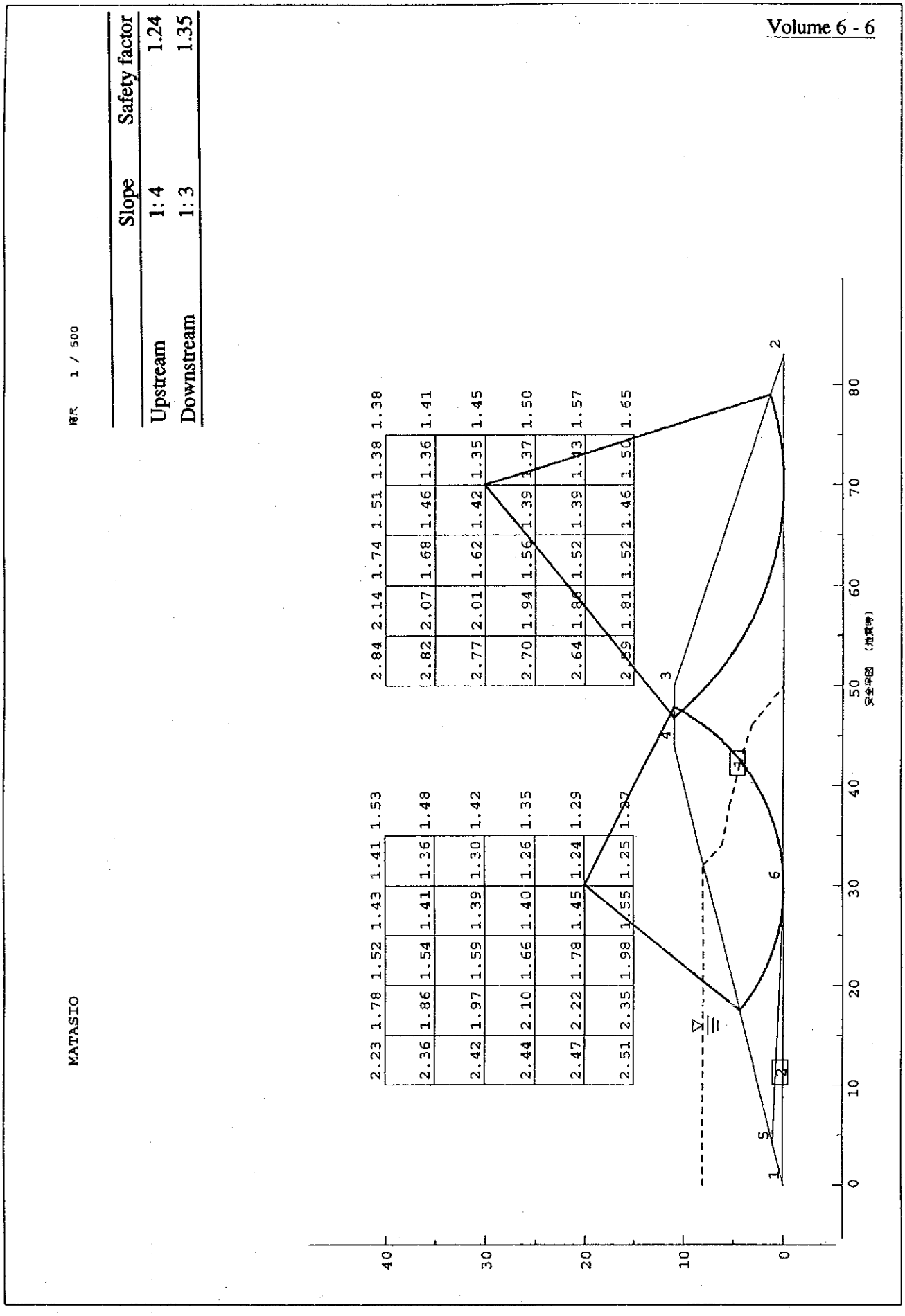


Figure 5.1 Stability Analysis

Matasio Scheme

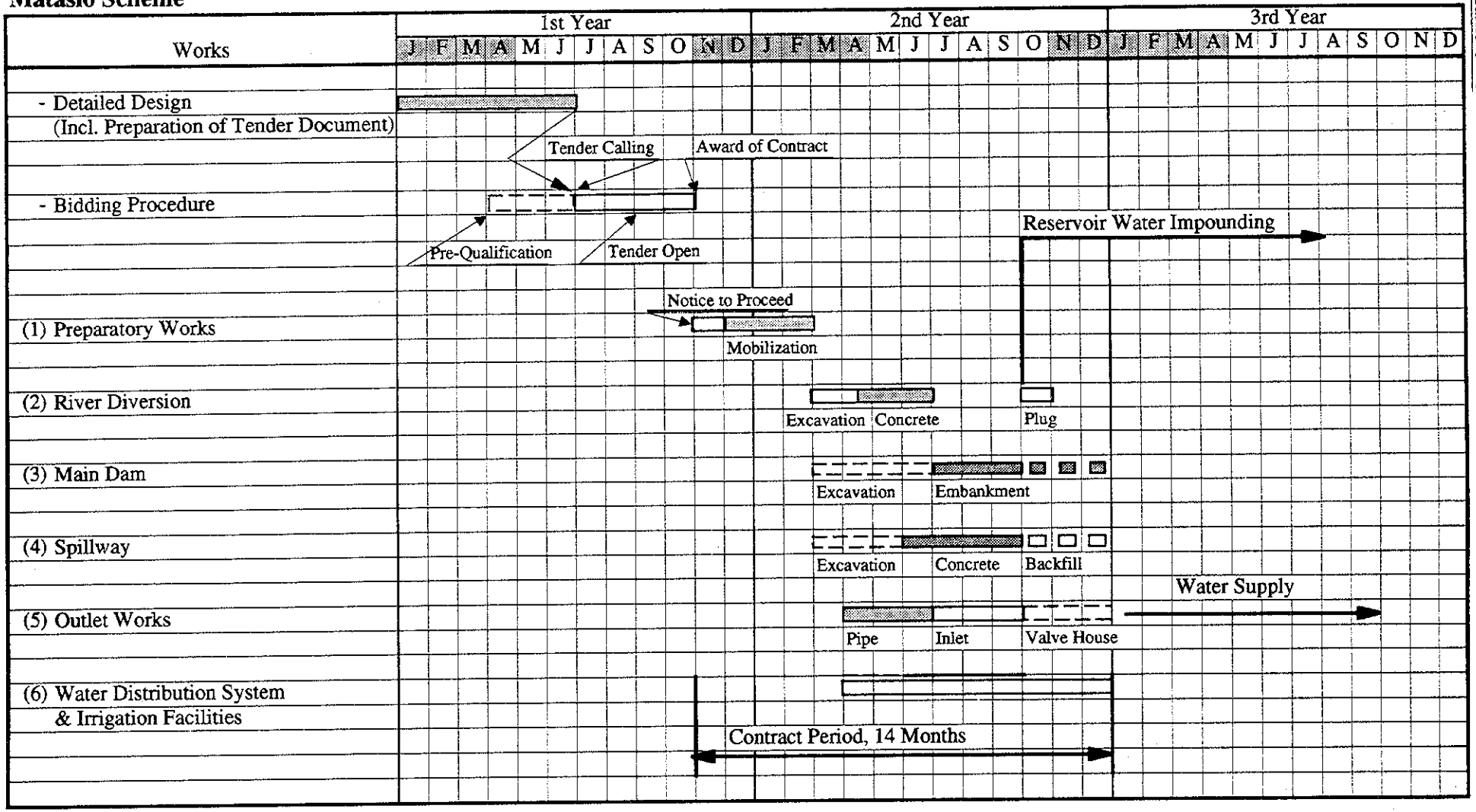
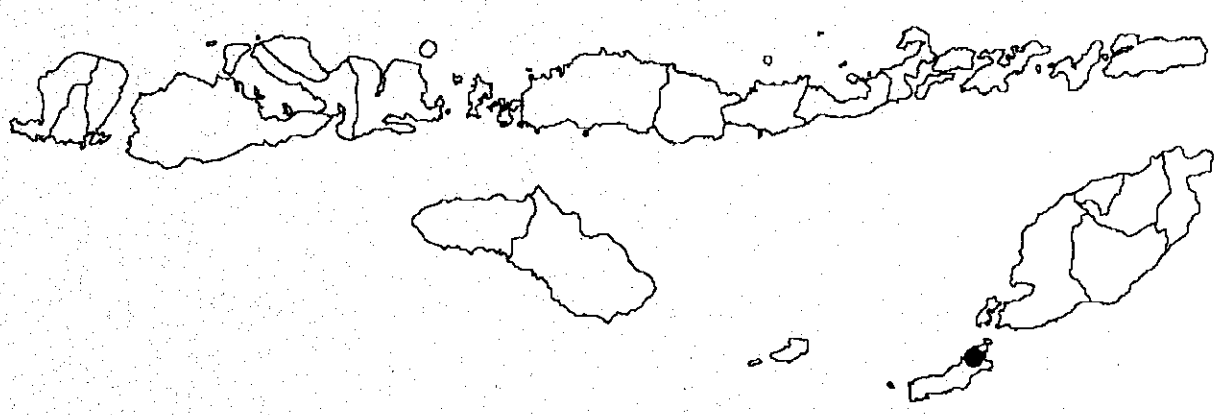


Figure 6.1 Construction Time Schedule

The Study on The Embung Development Project in East Nusa Tenggara and West Nusa Tenggara

Feasibility Study on Matasio Embung Development Project

Attachments



Irrigation Water Requirement

Irrigation water demand is estimated at unit irrigation area of one hectare in semi-monthly base in order to consider the optimization of development scale and the water resource allocation plan, and to decide the basic dimensions of the Embung for the Tasiepah scheme. First, proposed cropping pattern for this scheme is made taking into considerations of existing cropped area and cropping pattern of the Embung's beneficially area. Second, water demand calculations per hectare are made based on the established cropping patterns and climatic conditions of this scheme. Water demand is estimated by the following formula :

Irrigation Water Demand = (Etc + IR + RW + P - ER) / IE x A

Where,
Etc = crop consumptive use = Eto x kc
Eto = evapotranspiration
kc = crop coefficient
IR = land preparation water (for paddy)
RW = layer replacement water (for paddy)
P = percolation loss (for paddy)
ER = effective rainfall
IE = irrigation efficiency
A = irrigation area

(1) Crop consumptive use (Etc)

The crop consumptive use is calculated as

Etc = kc x Eto

Where,
Etc : crop consumptive use (mm/day)
Eto : evapotranspiration (mm/day)
kc : crop coefficient

The crop coefficients for paddy and beans given by FAO and Irrigation Design Standard, KP -01 by PU, DGWRD are used for the calculations as shown below :

Crop coefficient (Kc)

Month	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0
Paddy	1.10	1.10	1.05	1.05	0.95	0.00		
Upland Paddy	1.10	1.10	1.10	1.10	1.10	1.05	0.95	0.00
Beans	0.50	0.75	1.00	1.00	0.82	0.23		
Red onion	0.50	0.60	0.95	0.75				
Leaf vegetable	0.50	0.70	0.95	0.90				
Maize	0.50	0.59	0.96	1.05	1.02	0.95	0.60	

Source : FAO and KP-01

(2) Evapotranspiration (Eto)

Evapotranspiration can be estimated by some empirical equations using meteorological data. Major calculation methods are introduced by FAO Irrigation and Drainage Paper No.24, " Crop Water Requirement " which is quoted in the Design Criteria KP-01 by PU, DGWRD. Monthly evapotranspirations are computed in this study by using the Modified Penman method introduced in the above.

(3) Land preparation water requirement (IR)

Land preparation water requirements for paddy include a pre-saturation amount to increase moisture in the dry field to a workable condition, and water to compensate for evaporation and percolation loss during the period of land preparation. The land preparation period is assumed to be 30 days. Initial application depth for land preparation of paddy fields is taken at 250 mm, including presaturation of the soil, pudding of soil, and water requirements for nurseries.

For the calculation of the irrigation requirements during land preparation, Van de Goor and Zijlstra's formula as described in Irrigation Design Standard (KP-01) is used.

(4) Percolation (P)

Deep percolation is the water that flows through the soils occupied by the root system of the crop to underlying soils, and is therefore unavailable to the crops. Infiltration is the entry of water into the soils and is purely a surface phenomenon. The loss of water to deep percolation can be controlled by whatever is effective in limiting permeability or infiltration. Deep percolation is continuing use of water in producing paddy rice. Percolation occurs from paddy production areas due to the continuous free water surface maintained for most of the production period. This value will vary depending on the permeability, and in some cases the infiltration rates of the soil used for rice production. Percolation rate to estimate the irrigation demand in this scheme is assumed to be 2 mm/day over the rice producing area referring to the Irrigation Design Standard (KP-01).

Upland crops are not subject to submergence during production where any submergence, even for short term periods, may have a detrimental effect in crop production. Therefore, percolation is a field loss and is treated as a reduction in field application efficiencies.

(5) Water layer replacement (RW)

Twice water layer replacements, each of 50 mm at about 1 month and 2 months after transplanting, are considered according to the Irrigation Design Standards (KP-01). The normally flooded field is drawn down at these times in order to apply fertilizer and to carry out weeding operations. The water layer must then be replaced an allowance of 50 mm in the above periods. This allowance is not required for upland crops.

(6) Effective rainfall (ER)

Rains which fall directly on the irrigated area reduce the amount of supplemental water needed to meet the total water requirements. Only a portion of the total rainfall is effective in meeting crop requirements since some of it runs off the cultivated area and some percolates beyond the crop root zone. Estimation of effective rainfall for paddy rice irrigation is adopted at 70 % of once in 5 years rainfall and as for upland crops irrigation is adopted the USDA-SCS method as recommended in KP-01.

(7) Irrigation diversion requirement

Irrigation diversion requirements are calculated by considering the irrigation efficiency which is divided into following two components. :

a) a conveyance efficiency which account for losses from the main and secondary canal system.

b) a farm efficiency which account for losses from the tertiary canal system and the farm field irrigation application activities.

In this study, the following irrigation efficiencies for paddy and upland crops are adopted taking the information in the Irrigation Design Standard (KP-01), DGWRD into considerations.

Irrigation Efficiency

Canal	Irrigation Efficiency	
	Paddy	Upland crops
Main canal system	90 %	90 %
Secondary canal system	80 %	80 %
Tertiary system / Application efficiency	90 %	70 %
Over all	64.8 %	50.4 %

Source : Irrigation Design Standards, KP-01, DGWRD

Irrigation efficiencies of 65 % for paddy and 50 % for upland crops are applied.

Attachment - 2

Result of Soil Laboratory Test in Matasio

Bor.No. (Depth)	Formation Classification	Unified Soil Content(%)	Water (g/cm3)	Unit Weight	Specific Gravity
B1(15.0m)	Bobonaro claystone	MH	8.8	-	2.59
B2(3.0m)	Bobonaro claystone	CH	6.8	-	2.6
B3(7.0m)	Bobonaro claystone	CH	8.4	-	2.53
B4(3.0m)	Bobonaro claystone	CL	7.8	-	2.71
B4(13.0m)	Bobonaro claystone	CH	9.3	-	2.52
B5(7.0m)	Bobonaro claystone	CH	23.1	-	2.55
B5(12.0m)	Bobonaro claystone	CL	14.8	-	2.54
B6(3.0m)	Bobonaro claystone	CL	23.9	-	2.64
B7(3.0m)	Bobonaro claystone	CH	20.7	-	2.68
B8(7.0m)	Bobonaro claystone	CH	20.5	1.95	2.56

Result of Rock Test in Matasio

Sample	Formation	Unit Weight (g/cm3)	Specific Gravity	Unconfined Compression (kg/cm3)
B1(14.0m)	Bobonaro claystone	2.2	2.7	3.21
B5(15.0m)	Bobonaro claystone	2.31	2.67	28.78

Attachment-3

SUMMARY OF LABORATORY TEST

PROJECT : Embung Matasio
LOCATION OF PROJECT : Ds. Oesuti, Kec. Rote Timur
DISTRICT : Kupang
PROVINCE : Nusa Tenggara Timur
DATE : Jun-94

			TP.1	TP.2	TP.3	TP.4	TP.5	Average
Depth of Sample		m						
Water Content	(Wn)	%	20.27	20.54	25.64	34.48	28.49	25.88
Unit Weight	(γ w)	g/cm3						
Maximum Dry Density	(γ d max)	g/cm3	1.750	1.650	1.700	1.430	1.465	1.60
Optimum Moisture Content	(Wopt)	%	16.82	19.20	16.10	29.45	28.35	21.98
Specific Gravity	(Gs)	-	2.61	2.51	2.54	2.54	2.56	2.55
Liquid Limit	(LL)	%	45.25	62.80	62.85	70.10	67.65	61.73
Plastic Limit	(PL)	%	15.45	20.36	24.63	30.42	23.30	22.83
Plastic Index	(PI)	%	29.80	42.44	38.22	39.68	44.35	38.90
Shrinkage Limit	-	%	9.54	26.58	16.32	27.44	24.89	20.95
Angle of Internal Friction	(ϕ)	°	17	37	31	19	24	25.60
Cohesion (UU/CU)	(C)	kg/cm2	0.400	0.775	0.800	1.100	0.595	0.73
Permeability	(K)	cm/sec	2.13E-06	2.15E-06	1.70E-06	1.87E-06	2.39E-06	
Passing of # 200 Sieve	-	%	32.08	84.21	81.40	94.41	96.94	
Clasification of Soil			CH	CH	CH	CH	CH	

1. Physical Environmental Impacts

Place I : Catchment area
Place II : Embung and reservoir area planned
Place III : River and riverbed
Place IV : Riverside
Place V : Beneficial area
Place VI : Downstream area other than beneficial area

Embung Site: 1: T101 : Bimoku
2: T102 : Oeltua
3: T103 : Tasiepah
4: T108 : Benkoko
5: T109 : Oebuain
6: RO13: Matasio

Positive Impact with Project

Negative Impact with Project

Environmental component	Environmental Issue	Actual or Potential	Places Environmental Issues Occur I II III IV V VI	Evaluation is available or not available	Actual and Potential Aspect	Actual and Potential Impact of Aspect	Places Environmental Impact Occur I II III IV V VI	Embung Site 1 2 3 4 5 6	Mitigatory Measures
LAND	Land use	Actual	I	not available					
		Potential	I	not available					
	Soil erosion	Actual	I	not available					
		Potential	I	not available					
	Soil fertility	Actual	I	not available					
		Potential	I	not available					
	Soil contamination	Actual	I	not available					
		Potential	I	not available					
WATER	River hydrology	Actual	III	available	· Flush floods in short duration are observed during the wet season	· no impact		1 2	
		Actual	III	available	· -ditto-	· It causes scour and erosion of river bed	III	5	
		Potential	III	available	· River run-off is reduced by storage function of the reservoir	· no impact		1 2 5	
		Actual	III	available	· River flow discharge rapidly increase during the wet season	· It causes scour and erosion of riverbed · Sedimentation and erosion of riverbed induce reduction of flow area of the river	III	3	
		Actual	III	available	· -ditto-	· It causes scour and erosion of riverbed	III	4 6	
		Potential	III	available	· River run-off is reduced by storage function of the reservoir	· -ditto-	III	3 4 6	

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Negative Impact with Project

Environmental component	Environmental Issue	Actual or Potential	Places Environmental Issues Occur I II III IV V VI	Evaluation is available or not available	Actual and Potential Aspect	Actual and Potential Impact of Aspect	Places Environmental Impact Occur I II III IV V VI	Embung Site 1 2 3 4 5 6	Mitigatory Measures
	River morphology	Actual	IV	available	· River section is stable because it composed of lime stone	· no impact		1 2	
		Potential	IV	available	· not applicable	· no impact		1 2	
		Actual	IV	available	· Erosion and collapse of river banks caused by floods and excess grazing are observed	· Sedimentation in the river reduces flow area of the river	III	3 5 6	
		Potential	IV	available	· Grazing is slightly controlled by means of the water supply for livestock	Decrease of sedimentation is expected	III	3 5 6	
		Actual	IV	available	· Erosion and slope collapse are not observed owing to the slope protection by dense vegetation along the river	· no impact		4	
		Potential	IV	available	· no applicable	· no impact		4	
	Flooding	Actual	III	IV available	· Overflow from river banks is not observed during floods	· no impact		1	
		Actual	III	IV available	· Intensive flow induces flood occurrence during the wet season.	· no impact		2 4	
		Actual	III	IV available	· Intensive flow induces flood occurrence during the wet season	· Erosion along the river banks is accelerated by floods	III	3 5 6	
		Potential	III	IV available	· Flood discharge is not reduced because the dam has not flood control purpose	· no impact		1 2 3 4 5 6	

Place I : Catchment area
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Positive Impact with Project

Negative Impact with Project

Environmental component	Environmental Issue	Actual or Potential	Places Environmental Issues Occur I II III IV V VI	Evaluation is available or not available	Actual and Potential Aspect	Actual and Potential Impact of Aspect	Places Environmental Impact Occur I II III IV V VI	Embung Site 1 2 3 4 5 6	Mitigatory Measures
	Surface water availability	Actual	V	available	· Surface water is utilized in the wet season	· Surface water is utilized for livestock during the wet season	V	1	
		Potential	V	available	· Surface water is stored in the reservoir during the wet season	· Stored water is utilized as a water source for domestic water supply	V	1	
		Actual	V	available	· Surface water is utilized in the wet season	· Surface water is utilized for livestock during the wet season	V	2	
		Actual	V	available	· -ditto-	· Surface water is utilized for livestock during the wet season	V	5	
		Potential	V	available	· Surface water is stored in the reservoir during the wet season	· Stored water is constantly utilized for the uses of domestic water and livestock	V	2 5	
		Actual	V	available	· Surface water is utilized throughout the year	· Stored water is utilized as a water source for domestic water supply throughout the year · Stored water is supplementarily utilized for irrigation purpose during the wet season	V	3	
		Actual	V	available	· Surface water is utilized in the wet season	· Stored water is supplementarily utilized for irrigation purpose during the wet season	V	4	
		Actual	V	available	· -ditto-	· Stored water is supplementarily utilized for irrigation purpose during the wet season	V	6	
		Potential	V	available	· Surface water is stored in the reservoir	· Stored water is utilized as a water source for domestic water supply throughout the year · Stored water is supplementarily utilized for irrigation purpose	V	3 4 6	
	Surface water quality	Actual	III	not available					
		Potential	III	not available					
	Groundwater levels	Actual	V	not available					
		Potential	V	not available					
	Groundwater quality	Actual	V	not available					
		Potential	V	not available					

Place I : Catchment area
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Positive Impact with Project

Negative Impact with Project

Environmental component	Environmental Issue	Actual or Potential	Places Environmental Issues Occur I II III IV V VI	Evaluation is available or not available	Actual and Potential Aspect	Actual and Potential Impact of Aspect	Places Environmental Impact Occur I II III IV V VI	Embung Site 1 2 3 4 5 6	Mitigatory Measures
ATMOSPHERE	Dust, Odor, Noise	Actual	II	available	–	–			
		Potential	II	available	· Air contamination is generated by the construction works in the vicinity area	· Inhabitants and livestock in the vicinity area are affected by air contamination	V	1 2 3 4 5 6	· Proper supervisory works, e.g. education of laborer, construction schedule, safety control shall be performed.

2. Biotic Environmental Impacts

Place I : Catchment area
Place II : Embung and reservoir area planned
Place III : River and riverbed
Place IV : Riverside
Place V : Beneficial area
Place VI : Downstream area other than beneficial area

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Positive Impact with Project

Negative Impact with Project

Environmental component	Environmental Issue	Actual or Potential	Places Environmental Issues Occur I II III IV V VI	Evaluation is available or not available	Actual and Potential Aspect	Actual and Potential Impact of Aspect	Places Environmental Impact Occur I II III IV V VI	Embung Site 1 2 3 4 5 6	Mitigatory Measures
FAUNA	FAUNA	Actual	II	available	· There is not any inhabitant and its migration	· no impact		1 2 3 4 5 6	
		Potential	II	available	· not applicable	· no impact		1 2 3 4 5 6	
FLORA	Forests/trees	Actual	II	available	· There exist savanna and evergreen trees	· Logging by inhabitants is observed	II	1 2 3 4 5 6	
		Potential	II	available	· Logging in the reservoir area caused by dam construction is required	· Limitation of logging area by dam construction accelerate logging activities in the catchment area of the	I	1 2 3 4 5 6	· Vegetations in the catchment area should be protected by means of artificial remedy

3. Human Environmental Impacts

Place I : Catchment area
Place II : Embung and reservoir area planned
Place III : River and riverbed
Place IV : Riverside
Place V : Beneficial area
Place VI : Downstream area other than beneficial area

Embung Site: 1: T101 : Bimoku
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4: T108 : Benkoko
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Positive Impact with Project

Negative Impact with Project

Environmental component	Environmental Issue	Actual or Potential	Places Environmental Issues Occur I	II	III	IV	V	VI	Evaluation is available or not available	Actual and Potential Aspect	Actual and Potential Impact of Aspect	Places Environmental Impact Occur I	II	III	IV	V	VI	Embung Site 1	2	3	4	5	6	Mitigatory Measures
SOCIAL	Human carrying capacity	Actual					V		available	· Human carrying capacity, which is attributed to low farm productivity due to unstable irrigation during the wet season, is still in low level	· Low employment opportunity in the dry season accelerate outflow of labor force from rural area to urban area · Low economic growth is not afford to satisfy the social demand derived from constant population growth					V			3	4			
		Potential					V		available	· Increase of human carrying capacity is expected by means of the provision of sufficient irrigation water supply in the wet/dry seasons	· Control of labor force outflow · Proper economic growth contributes to the social demand derived from constant population growth					V			3	4			
		Actual					V		available	· Human carrying capacity, which is attributed to low farm productivity due to unstable irrigation during the wet season, is still in low level	· Low economic growth is not afford to satisfy the social demand derived from constant population growth					V						6	
		Potential					V		available	· Increase of human carrying capacity is expected by means of the provision of sufficient irrigation water supply in the wet/dry seasons	· Proper economic growth contributes to the social demand derived from constant population growth											6	
	Settlement	Actual					V		available	· Settlement is not recommended to avoid conflict among indigenous social communities	· no impact						1	2	3	4	5	6	
		Potential					V		available	· Settlement is not composed of the project components	· no impact						1	2	3	4	5	6	
	Resettlement	Actual							available	—	—						1	2	3	4	5	6	
		Potential		II					available	· Involuntary resettlement is not applicable because any residence does not exist there	· not applicable						1	2	3	4	5	6	

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Positive Impact with Project

Negative Impact with Project

Environmental component	Environmental Issue	Actual or Potential	Places Environmental Issues Occur I II III IV V VI	Evaluation is available or not available	Actual and Potential Aspect	Actual and Potential Impact of Aspect	Places Environmental Impact Occur I II III IV V VI	Embung Site 1 2 3 4 5 6	Mitigatory Measures
	Population growth	Actual	V	available	· Population is growing as same rate as nation's average	· Increase of water demand due to population growth causes the shortage of the water supply in coming year	V	1 2 5 6	
		Actual	V	available	· Twice of rapid annual population increase were observed due to implementation of irrigation project in latest 5 years	· Rapid increase of population causes the shortage of domestic water supply	V	3	
		Potential	V	available	· Constant population growth is maintained due to stable domestic water supply and medical and sanitary improvement of living condition	· Sufficient domestic water supply in proportion to the population growth is inevitable to maintain rural living condition in view points of health and sanitation	V	1 2 3 5 6	
		Actual	V	available	· Rapid annual population decreases caused by starvation from drought, and increases by implementation of irrigation project were observed due to in latest 5 years	· Decrease of population was occurred · Deterioration of a sense of social cohesion in their communities	V	4	
		Potential	V	available	· Improvement of living condition is attained through stable farm activities	· Mitigate a decrease of population · Retrieve a sense of social cohesion in their communities	V	4	
	Demographic structure	Actual	V	available	· Poor employment opportunity induces seasonal laborer movement to the urban area	· no impact	V	1	
		Potential	V	available	· not applicable	· no impact	V	1	
		Actual	V	available	· Composition of population ranges in national average by age and sex	· no impact		2 6	
		Potential	V	available	· not applicable	· no impact		2 6	
		Actual	V	available	· Young generation is likely to outflow to urban area	· no impact	V	3 4 5	
		Potential	V	available	· Labor force requirement due to increase of employment opportunity slightly reduces an outflow of young generation to the urban area	· no impact	V	3 4 5	

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	Social equity	Actual	V	available	· Indigenous practice regarding domestic water utilization, such as water right and distribution methods might incur inconvenience among them	· Restriction of water use might confuse their general concept on water use especially in the dry season	V	1 2 3 4 5 6	
		Potential	V	available	· Social equity regarding water utilization is realized through unification of water distribution system	· Achievement of effective water distribution system is acceptable for inhabitants and it improves social cohesion among them	V	1 2 3 4 5 6	
	Health	Actual	V	available	· Lacking of acknowledge about disease prevention, i.e. excretion in the field is social problem in the health and sanitary points of view	· It causes prevailing oral contagious and rising of waterborne intestinal disease among infant	V	1 2 3 4 5 6	
		Potential	V	available	· Prevention of disease infection is expected by means of stable domestic water supply	· Decrease of contagious disease and infant mortality rate are expected	V	1 2 3 4 5 6	

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HUMAN USE	Cultivation	Actual	V	available	· Insufficient irrigation water, poor maintenance of irrigation facilities and water distribution management cause low productivity and cultivated area	· Unstable farm management causes low farm income, investment and increase unemployment rate	V	3 4 6	
		Potential	V	available	· High farm productivity and increase of cultivated area are attained by adequate irrigation water supply	· High farm income, investment and employment opportunity are realized by improvement of irrigation system	V	3 4 6	
	Livestock	Actual	V	available	· Surface water is used for livestock during the wet season · Ground water or spring yield are used in the dry season	· Shortage of domestic water is occurred in the dry season · Women are compelled to heavy duties, such as water conveyance	V	2	
		Actual	V	available	· Ground water and spring yield are available during the wet season · Ground water is principally utilized in the dry season	· -ditto-	V	4	
		Actual	V	available	· Spring yield is available	· -ditto-	V	6	
		Potential	V	available	· It is possible to supply stable water for livestock · Effective water distribution system is planned	· Water supply quantity for livestock is kept · Heavy duties of women, e.g. water conveyance, is mitigated	V	2 4 6	
		Actual	V	available	· Majority of water supply for livestock uses surface water throughout the year, the rest uses ground water	· Insufficiency of water supply for livestock is occurred during the dry season due to a shortage of surface flow · Over grazing induces erosion and slope collapse at the riverside	IV V	3 5	
		Potential	V	available	· Stable water supply is required · Effective water distribution system is required	· Water supply quantity for livestock is kept · Restriction of grazing in the river to control riverside erosion	IV V	3 5	
	Fisheries	Actual	IV	available	· Fisheries activities are not conducted at downstream of reservoir and at a mouth of river	· no impact		1 2 3 4 5 6	
		Potential	IV	available	· no impact	· no impact		1 2 3 4 5 6	
	Afforestation	Actual	I	available	· Reforestation project is not implemented · Logging is conducted to maintain inhabitants' daily life	· Deterioration of recharge of ground water is observed in the reservoir catchment area · Logging accelerate soil erosion	I	1 2 3 4 5 6	
		Potential	I	available	· Limitation of logging area contributes excess logging in the reservoir catchment area	· Excess logging accelerate soil erosion and results in deterioration of ground water recharge capacity and increase of inflow of sediment into the reservoir	I II III IV	1 2 3 4 5 6	· Increase of recharge capacity of ground water and effect of erosion control are expected by reforestation in the catchment area

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	Domestic water supply	Actual	V	available	· Ground water is utilized for the domestic water supply · Private shallow wells are not useful during the dry season because of the decline of water level Public deep wells are useful during the dry season	· Shortage of domestic water supply is observed · Women are compelled to water conveyance	V	1	
		Potential	V	available	· Stable and sufficient domestic water supply shall be attained · Improvement of water system, e.g. distribution tank construction is planned	· Shortage of domestic water supply is reduced at a part of area · Heavy duties of women are mitigated	V	1	
		Actual	V	available	· Ground water or spring yield are available for the domestic water supply · Spring yield is perennially available in the case that well water is dried up in the dry season	· Shortage of domestic water supply is observed · Women are compelled to water conveyance	V	2	
		Actual	V	available	· Ground water or river water are available for the domestic water supply · Water shortage is occurred during the dry season	· -ditto-	V	3 5	
		Actual	V	available	· Ground water (including by pump lifting) and spring yield transmitted by pipeline are available for domestic water supply	· -ditto-	V	4	
		Actual	V	available	· Spring yield and ground water by pump lifting are used for domestic water supply · Shortage of water supply is occurred in a part of service area in the dry season in both water sources	· -ditto-	V	6	
		Potential	V	available	· Reliable water sources and distribution system are to be facilitated · Water distribution plan shall be established to attain stable water distribution	· Shortage of domestic water supply is reduced at a part of area · Heavy duties of women are mitigated	V	2 3 4 5 6	

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ECONOMIC	Income	Actual	V	available	· Farm income by single cropping in the wet season remains farmers in low income level	· Increase of farm productivity is not expected owing to the deficiency of investment (farm inputs)	V	3 6	
		Actual	V	available	· Increase of disposable income is not expected owing to a low productivity	· Increase of farm productivity is not expected owing to insufficiency of disposable income	V	4	
		Potential	V	available	· Slightly increase of farm income with improvement of farm productivity is expected by means of stable irrigation water supply	· Increase of investment incentive and improvement of living standard are expected with increase of farm income	V	3 4 6	
	Employment	Actual	V	available	· Employment opportunity remains in a low level due to a stagnation of agro-economy	· Outflow of labor force is incurred due to low employment opportunity in the rural area	V	3 4	
		Potential	V	available	· Increase of farm income with improvement of farm productivity is expected by means of stable irrigation water supply	· Outflow of labor force is controlled	V	3 4	
		Actual	V	available	· Employment opportunity remains in a low level because cultivation in the dry season is not enforced	· It causes unemployment	V	6	
		Potential	V	available	· Employment opportunity is created by activation of farming practice with irrigation water supply	· It affects decrease of unemployment	V	6	

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CULTURAL	Historic/ archaeological sites	Actual	II	available	· Historic/archaeological remains and cultural assets do not exist	· no impact		1 2 3 4 5 6	
		Potential	II	available	· not applicable	· no impact		1 2 3 4 5 6	
	Lifestyle (quality of life)	Actual	V	available	· Women are imposed in heavy duties, e.g. water conveyance	· Physical disorder is observed in women	V	1	
		Potential	V	available	· Alleviation of women's heavy duties by means of stable supply of domestic water, etc.	· Release women from physical disorder	V	1	
		Actual	V	available	· Women are imposed in heavy duties, e.g. water conveyance for domestic use	· Physical disorder is observed in women · Indifference on education	V	2 5	
		Potential	V	available	· Alleviation of women's heavy duties by means of stable supply of domestic water, etc.	· Release women from physical disorder · Interest and spreading in education	V	2 5	
		Actual	V	available	· Women are imposed in heavy duties, e.g. water conveyance for domestic use · Living condition is still in low level	· Physical disorder is observed in women · Living condition is subjected to being distracted by natural disasters	V	3 4 6	
		Potential	V	available	· Alleviation of women's heavy duties by means of stable supply of domestic water, etc. · Living condition is upgraded by increase of farm income and employment opportunities	· Release women from physical disorder · Interest and spreading in education · Inhabitants live in affluent circumstances	V	3 4 6