

**Table4.1.1 NATIONAL DEVELOPMENT FRAMEWORKS****Second Long-Term National Development Program (PJP-II: 1994 – 2019)**

Indicator	1993	Five-year planning period				
		Sixth '95-'99	Seventh '00-'04	Eighth '05-'09	Ninth '10-'14	Tenth '15-'19
Population						
National population (10 <sup>6</sup> ) *1	189.1	204.4	219.4	233.6	246.5	258.1
Average growth rate (%)	1.66	1.51	1.37	1.20	1.01	0.88
Birthrate (per 1000)	24.5	22.6	20.9	19.0	17.2	16.1
Mortality (per 1000)	7.9	7.5	7.2	7.1	7.1	7.4
Labor force	78.8	91.4	105.2	119.7	132.9	147.9
GDP						
GDP Growth (%)*2	6.6	6.2	6.6	7.1	7.8	8.7
GDP per Capita						
(Rp.1000)*3	1,188	1,487	1,908	5,525	3,483	5,046
(US\$)	676	775	995	1,317	1,816	2,631

(Note) \*1: The total population at the end of the planning period

\*2: Average rate for the respective five-year planning periods

\*3: At the 1989 constant prices

**National Development Program (PROPENAS: 2000 – 2004)**

Indicator	1999	Projection				
		2000	2001	2002	2003	2004
Economic growth (%)	0.3	4.0-5.0	4.5-5.5	5.0-6.0	6.0-7.0	6.0-7.0
GDP per capita						
Nominal (US\$)	691	760	912	1,011	1,196	1,312
Real (Rp.1000) *1	4,785	4,929	5,111	5,328	5,583	5,873
State budget balance/GDP (%)	-3.9	-3.4	-3.7	-2.2	-0.7	1.5
GDP growth (%)						
Agriculture	2.1	1.4	2.5	2.5	2.7	2.9
Manufacturing	2.6	4.8	6.4	7.3	8.4	9.2
Non-oil & natural gas	2.2	5.5	6.9	7.9	9.2	10.0
Others	-1.2	5.3	5.5	6.0	6.2	6.4

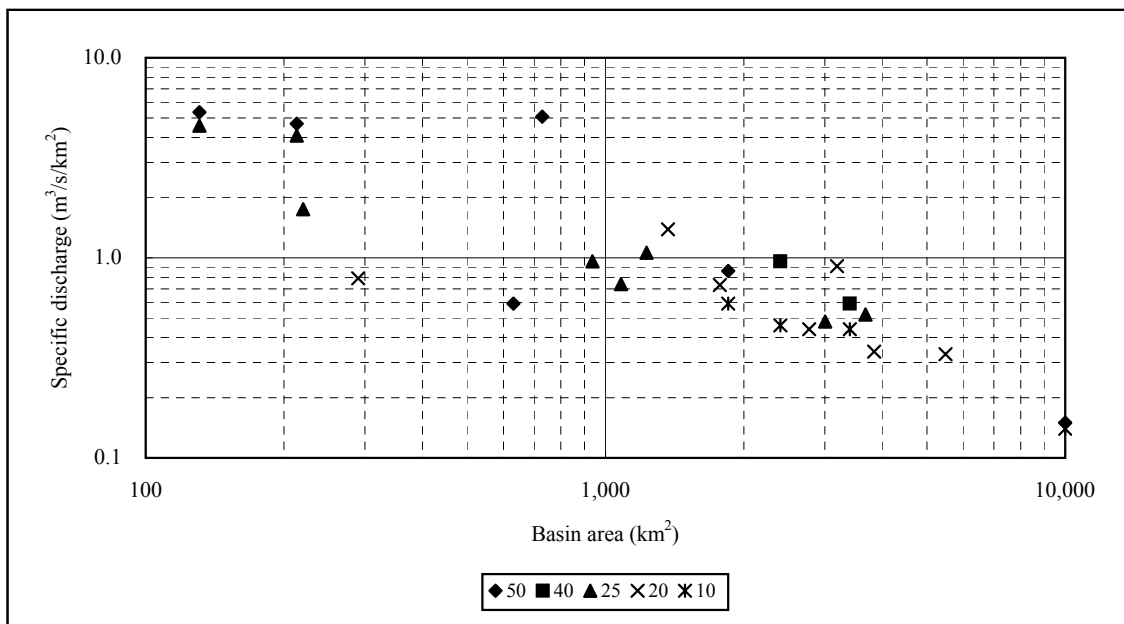
(Note) \*1: At 1998 constant prices

**Table 4.1.2 DESIGN SCALE AND DISCHARGE OF RIVERS IN INDONESIA**

No.	Name of River	Province	Chatchment Area (km <sup>2</sup> )	Design Flood (m <sup>3</sup> /s)	Specific Discharge (m <sup>3</sup> /s/km <sup>2</sup> )	Return Period (year)	Remarks
1	Brantas	East Java	10,000	1,500	0.15	50	*2
2	Ciujung	North Banten	1,850	1,600	0.86	50	*2
3	Jenebarang	South Sulawesi	729	3,700	5.08	50	
4	Surabaya	East Java	631	370	0.59	50	
5	Kuranji	West Sumatra	213	1,000	4.69	50	*2
6	Air Dingin	West Sumatra	131	700	5.34	50	*2
7	Solo	Central/East Java	3,400	2,000	0.59	40	*2
8	Madium	East Java	2,400	2,300	0.96	40	*2
9	Citanduy	West Java	3,680	1,900	0.52	25	
10	Cimanuk	West Java	3,006	1,440	0.48	25	
11	Pemali	Central Java	1,228	1,300	1.06	25	
12	Ular	North Sumatra	1,080	800	0.74	25	
13	Serang	Central Java	937	900	0.96	25	
14	Cipanas	West Java	220	385	1.75	25	
15	Kuranji	West Sumatra	213	870	4.08	25	*1
16	Air Dingin	West Sumatra	131	600	4.58	25	*1
17	Arakundo	Ache	5,495	1,800	0.33	20	
18	Wampu	North Sumatra	3,840	1,320	0.34	20	
19	Walarue	South Sulawesi	3,190	2,900	0.91	20	
20	Bah Bolon	North Sumatra	2,776	1,220	0.44	20	
21	Kring Ache	Ache	1,775	1,300	0.73	20	
22	Biba	South Sulawesi	1,368	1,900	1.39	20	
23	Marmoyo	East Java	290	230	0.79	20	
24	Brantas	East Java	10,000	1,350	0.14	10	*1
25	Solo	Central/East Java	3,400	1,500	0.44	10	*1
26	Madium	East Java	2,400	1,100	0.46	10	*1
27	Ciujung	North Banten	1,850	1,100	0.59	10	*1

Note \* 1 : For short-term or urgent plan

\* 2 : For long-term plan



**Table 4.1.3 RECOMMENDED DESIGN SCALE IN INDONESIA**

Conveyance System	Project type (for river flood control project) and total population (for drainage system)	Initial phase	Final phase
River	Emergency project	5	10
	New project	10	25
	Updating project		
	- for rural and/or urban with P < 2,000,000	25	50
	- for urban with P > 2,000,000	25	100
Primary drainage system (catchment area > 500 ha)	Rural	2	5
	Urban P < 500,000	5	10
	Urban 500,000 < P < 2,000,000	5	15
	Urban P > 2,000,000	10	25
Secondary drainage system (catchment area > 500 ha)	Rural	1	2
	Urban P < 500,000	2	5
	Urban 500,000 < P < 2,000,000	2	5
	Urban P > 2,000,000	5	10
Secondary drainage system (catchment area < 500 ha)	Rural and urban	1	2

Notes:

1. Higher design flood standard should be applied if an economic analysis indicates that it is desirable, or if flooding is a significant risk to human life.
2. P = Total urban population
3. Emergency Project: Emergency projects are developed without preliminary engineering and economic feasibility studies at sites where flooding is excessive and flooding problems present a significant risk to human life.
4. New Project: New project include flood control projects where no previous flood control projects have been developed or where Emergency Projects have been developed.
5. Updating Project: Updating projects include rehabilitation projects and improvements to existing projects. Most river basin development projects are considered to be updating projects

Source: "Recommended Minimum Return Period of Design Flood" in Flood Control Manual, Volume II, Guidelines for Planning and Survey (DGWRD, June 1993)

**Table 4.2.1 COMPARISON OF ALTERNATIVES: TAMALATE FLOODWAY SCHEME**

<b>Descriptions</b>	<b>Alternative   Ch  </b> (Tamalate River improvement)	<b>Alternative   Fw+Ch  </b> (Tamalate Floodway) Construction of Floodway(1.5km) + improvement of existing channel
<b>SCHEME DESCRIPTION</b>	Improvement of existing channel	Improvement of existing channel
<b>TECHNICAL ASPECT</b>		
- Major quantity of work	- New channel: None - Excavation: 686,000 m <sup>3</sup> - Embankment: 63,300 m <sup>3</sup> - Concrete: None - Dam: None Works in populated urban area	- New channel: 1.5 km - Excavation: 340,000 m <sup>3</sup> - Embankment: 62,000 m <sup>3</sup> - Concrete: 5,000 m <sup>3</sup> - Dam: None Works in farm lands
- Difficulty in work	2 (0.30)	0 (0)
<b>FINANCIAL ASPECT</b>		
- Project cost	Rp 35.8 billion	Rp 29.2 billion
- Maintenance cost		
- Ranking (Wf=0.40)	2 (0.80)	0 (0)
<b>ECONOMIC ASPECT</b>		
- Project effects	- Same as other scheme	- Same as other scheme
- Other positive/negative effects	- None	- None
- Ranking (Wf=0.15)	1 (0.15)	1 (0.15)
<b>SOCIAL ASPECT</b>		
- Relocation of houses	Medium	Medium
- Land acquisition	43 ha	33 ha
- Ranking (Wf=0.15)	1 (0.15)	1 (0.15)
<b>ENVIRONMENTAL ASPECT</b>		
- Negative impact	Public pollution along lower Tamalate	Water pollution and sedimentation in Bone
- Positive impact	Reduction of bank erosion in lower Tamalate	Reduction of bank erosion in lower Tamalate
- Ranking (Wf=0.15)	2 (0.30)	0 (0)
<b>OVERALL EVALUATION</b>		
- Summary of ranking	1.70	0.30
- Special remarks		Lower cost and firm effects
- Evaluation	Not selected	<b>SELECTED</b>

(Remarks) Wt: Weight for overall evaluation 0: Advantageous/better, 1: Moderate/no difference, 2: Disadvantageous/worse

**Table 4.2.2 COMPARISON OF ALTERNATIVES: BOLANGO-LIMBOTO FLOODWAY SCHEME**

Descriptions	Alternative   Ch   (Bolango River improvement)	Alternative   Fw+Ch   (Bolango - Limboto Floodway) Contraction of Floodway(6.3km) + improvement of existing channel
<b>SCHEME DESCRIPTION</b>	Improvement of existing channel	Contraction of Floodway(6.3km) + improvement of existing channel
<b>TECHNICAL ASPECT</b> - Major quantity of work  - Difficulty in work - Ranking (Wt=0.15)	- New channel: None - Excavation: 1,560,000 m <sup>3</sup> - Embankment: 600,000 m <sup>3</sup> - Concrete: None - Dam: None Works in populated urban area 2 (0.30)	- New channel: None - Excavation: 2,900,000 m <sup>3</sup> - Embankment: 170,000 m <sup>3</sup> - Concrete: 15,000 m <sup>3</sup> - Dam: None Works in farm lands 0 (0)
<b>FINANCIAL ASPECT</b> - Project cost - Maintenance cost - Ranking (Wt=0.40)	Rp 107.7 billion  0 (0)	Rp 126.9 billion  2 (0.80)
<b>ECONOMIC ASPECT</b> - Project effects - Other positive/negative effects - Ranking (Wt=0.15)	- Same as other scheme - None  1 (0.15)	- Same as other scheme - None  1 (0.15)
<b>SOCIAL ASPECT</b> - Relocation of houses - Land acquisition - Ranking (Wt=0.15)	Medium 301 ha  2 (0.30)	Medium 108 ha  0 (0)
<b>ENVIRONMENTAL ASPECT</b> - Negative impact - Positive impact - Ranking (Wt=0.15)	Public pollution along lower Bolango Reduction of bank erosion in lower Bolango 1 (0.15) 0.90	Sedimentation in Lake Limboto Reduction of bank erosion in lower Bolango 2 (0.30)
<b>OVERALL EVALUATION</b> - Summary of ranking - Special remarks - Evaluation	Lower cost and less sediment and environmental problems <b>SELECTED</b>	1.25  Not selected

(Remarks) Wt: Weight for overall evaluation 0: Advantageous/better, 1: Moderate/no difference, 2: Disadvantageous/worse

**Table 4.2.3 COMPARISON OF ALTERNATIVES: TOHETI-DEHUA DAM SCHEME**

<b>Descriptions</b>	<b>Alternative [ Ch ]</b> (Bolango River improvement)	<b>Alternative [ Dm+Ch ]</b> (Toheti-Dehua Dam)
<b>SCHEME DESCRIPTION</b>	Improvement of existing channel	Construction of Dam + improvement of existing channel
<b>TECHNICAL ASPECT</b> - Major quantity of work	- New channel: None - Excavation: 1,560,000 m <sup>3</sup> - Embankment: 600,000 m <sup>3</sup> - Concrete: None - Dam: None Traditional earth work 0 (0)	- New channel: None - Excavation: 1,560,000 m <sup>3</sup> - Embankment: 420,000 m <sup>3</sup> - Concrete: None - Dam: 1 nos Dam need sophisticated technology 2 (0.30)
- Difficulty in work - Ranking (Wt=0.15)		
<b>FINANCIAL ASPECT</b>		
- Project cost	Rp 107.7 billion	Rp 198.5 billion
- Maintenance cost		
- Ranking (Wt=0.40)	0 (0)	2 (0.80)
<b>ECONOMIC ASPECT</b>		
- Project effects	- Same as other scheme	- Same as other scheme
- Other positive/negative effects	- None	- None
- Ranking (Wt=0.15)	1 (0.15)	1 (0.15)
<b>SOCIAL ASPECT</b>		
- Relocation of houses	Medium 301 ha	Medium 492 ha
- Land acquisition		
- Ranking (Wt=0.15)	1 (0.15)	2 (0.30)
<b>ENVIRONMENTAL ASPECT</b>		
- Negative impact	Public pollution along lower Bolango	Negative impacts on flora and fauna
- Positive impact	Reduction of bank erosion in lower Bolango	Not identified
- Ranking (Wt=0.15)	1 (0.15)	2 (0.30)
<b>OVERALL EVALUATION</b>		
- Summary of ranking	0.45	1.85
- Special remarks	Lower cost and immediate effects	
- Evaluation	<b>SELECTED</b>	Not selected

(Remarks) Wt: Weight for overall evaluation 0: Advantageous/better, 1: Moderate/no difference, 2: Disadvantageous/worse

**Table 4.2.4 COMPARISON OF ALTERNATIVES: KAYU-MERAH DAM SCHEME**

<b>Descriptions</b>	<b>Alternative [ Ch ] (Biyonga River improvement)</b>	<b>Alternative [ Dm+Ch ] (Kayu-Merah Dam)</b>
<b>SCHEME DESCRIPTION</b>	Improvement of existing channel	Construction of Dam + improvement of existing channel
<b>TECHNICAL ASPECT</b> - Major quantity of work	- New channel: None - Excavation: 85,000 m <sup>3</sup> - Embankment: 110,000 m <sup>3</sup> - Concrete: None - Dam: None Traditional earth work	- New channel: None - Excavation: None - Embankment: 26,000 m <sup>3</sup> - Concrete: None - Dam: 1 nos Dam needs sophisticated technology
- Difficulty in work - Ranking (Wt=0.15)	0 (0)	2 (0.30)
<b>FINANCIAL ASPECT</b>		
- Project cost	Rp 19.7 billion	Rp 47.3 billion
- Maintenance cost - Ranking (Wt=0.40)	0 (0)	2 (0.80)
<b>ECONOMIC ASPECT</b>		
- Project effects	- Same as other scheme	- Same as other scheme
- Other positive/negative effects - Ranking (Wt=0.15)	- None 1 (0.15)	- None 1 (0.15)
<b>SOCIAL ASPECT</b>		
- Relocation of houses - Land acquisition - Ranking (Wt=0.15)	Medium 31 ha 1 (0.15)	Medium 29 ha 1 (0.15)
<b>ENVIRONMENTAL ASPECT</b>		
- Negative impact - Positive impact - Ranking (Wt=0.15)	Public pollution along lower Biyonga Reduction of bank erosion in lower Biyonga 1 (0.15)	Impacts on both terrestrial and aquatic ecology Not identified 2 (0.30)
<b>OVERALL EVALUATION</b>		
- Summary of ranking - Special remarks - Evaluation	0.45 Lower cost and immediate effects <b>SELECTED</b>	1.70 Not selected

(Remarks) Wt: Weight for overall evaluation 0: Advantageous/better, 1: Moderate/no difference, 2: Disadvantageous/worse

**Table 4.3.1 SUMMARY OF PROJECT COST FOR FM-MP**

No	Work Item	Unit	Unit Price (Rp.)	FM-MP for LBB Basin (Grand Total)	
				Q'ty	Amount (Rp.million)
<b>1</b>	<b>Direct Cost</b>			<b>0</b>	<b>361,974</b>
	11. Earth Works				
	111. Excavation work	m <sup>3</sup>	15,000	4,303,000	64,545
	112. Embankment work	m <sup>3</sup>	28,000	2,085,000	58,380
	113. Sediment trap work	m	265,000	4,000	1,060
	114. Sodding work	m <sup>2</sup>	20,000	86,000	1,720
	12. Structural Work				
	121. Concrete work	m <sup>3</sup>	550,000	8,000	4,400
	122. Wet masonry work	m <sup>3</sup>	220,000	611,000	134,420
	123. Drainage sluice work				
	- DS type-1 (1m x 1m)	pcs	45,000,000	33	1,485
	- DS type-2 (3m x 3m)	pcs	350,000,000	1	350
	124. Metal Works	m <sup>2</sup>	130,000,000	86	11,180
	125. Bridge work				
	- Br. type-1 (w = 4.0 m)	m	17,000,000	1,670	28,390
	- Br. type-2 (w = 7.0 m)	m	35,000,000	1,300	45,500
	13. Miscellaneous work	l.s.		0	10,544
<b>2</b>	<b>Land Acquisition</b>			<b>0</b>	<b>66,853</b>
	21. Residential Land	m <sup>2</sup>	20,000	2,219,000	44,380
	22. Agricultural Land	m <sup>2</sup>	3,000	7,491,000	22,473
<b>3</b>	<b>Indirect Costs</b>				<b>126,198</b>
	31. Administration Cost	l.s.	-		21,442
	32. Eng. Services Cost	l.s.	-		54,297
	33. Physical Contingency	l.s.	-		50,459
<b>GRAND TOTAL</b>					
			<b>(Rp.million)</b>		<b>555,025</b>
			<b>(US\$ million eq.)</b>		<b>57.814</b>
			<b>(Yen million eq.)</b>		<b>7,169.1</b>

(Note) FM-MP: Proposed flood mitigation master plan



**Table 4.3.2 PROJECT COSTS OF SUB-PROJECTS FOR FM-MP (1/4)**

No	Work Item	Unit	Unit Price (Rp.)	Lower Bone River Improvement		Middle Bone River Improvement		Bone River Improvement (Total)		Lower Tamalate River Improvement		Tamalate Floodway		Tamalate River Improvement (Total)	
				Q'ty	Amount (Rp.million)	Q'ty	Amount (Rp.million)	Q'ty	Amount (Rp.million)	Q'ty	Amount (Rp.million)	Q'ty	Amount (Rp.million)	Q'ty	Amount (Rp.million)
<b>1</b>	<b>Direct Cost</b>			<b>5,933</b>	<b>42,018</b>	<b>0</b>	<b>47,951</b>	<b>0</b>	<b>15,621</b>	<b>13,565</b>	<b>0</b>	<b>29,186</b>			
	I1. Earth Works														
	I11. Excavation work	m <sup>3</sup>	15,000	0	0	0	0	0	0	0	0	0	0	0	
	I12. Embankment work	m <sup>3</sup>	28,000	2,240	12,684	533,000	14,924	62,000	1,736	0	0	0	0	0	
	I13. Sediment trap work	m	265,000	0	0	0	0	0	0	0	0	0	0	0	
	I14. Sodding work	m <sup>2</sup>	20,000	0	0	0	0	0	0	0	0	0	0	0	
	I2. Structural Work														
	I21. Concrete work	m <sup>3</sup>	550,000	0	0	0	0	0	0	0	0	0	0	0	
	I22. Wet masonry work	m <sup>3</sup>	220,000	3,520	19,360	104,000	22,880	32,000	7,040	2,750	5,000	2,750	5,000	2,750	
	I23. Drainage sluice work														
	- DS type-1 (1m x 1m)	pcs	45,000,000	0	0	0	0	12	540	90	2	90	14	630	
	- DS type-2 (3m x 3m)	pcs	350,000,000	0	0	0	0	0	0	0	0	0	0	0	
	I24. Metal Works	m <sup>2</sup>	130,000,000	0	0	0	0	0	0	0	0	0	0	0	
	I25. Bridge work														
	- Br. type-1 (w= 4.0 m)	m	17,000,000	0	0	0	0	200	3,400	1,360	80	1,360	280	4,760	
	- Br. type-2 (w= 7.0 m)	m	35,000,000	0	8,750	250	8,750	40	1,400	1,400	40	1,400	80	2,800	
	I3. Miscellaneous work	l.s.		173	1,224	0	1,397	0	455	395	0	850	0	850	
<b>2</b>	<b>Land Acquisition</b>			<b>0</b>	<b>10,170</b>	<b>0</b>	<b>10,170</b>	<b>0</b>	<b>0</b>	<b>5,200</b>	<b>0</b>	<b>5,200</b>	<b>0</b>	<b>5,200</b>	
	21. Residential Land	m <sup>2</sup>	20,000	0	0	0	0	0	0	5,200,000	260,000	5,200	260,000	5,200	
	22. Agricultural Land	m <sup>2</sup>	3,000	0	10,170	3,390,000	10,170	0	0	0	0	0	0	0	
<b>3</b>	<b>Indirect Costs</b>			<b>1,899</b>	<b>15,022</b>	<b>0</b>	<b>16,921</b>	<b>0</b>	<b>4,999</b>	<b>5,147</b>	<b>0</b>	<b>10,146</b>	<b>0</b>	<b>10,146</b>	
	31. Administration Cost	l.s.	-	297	2,609	0	2,906	0	781	938	0	1,719	0	1,719	
	32. Eng. Services Cost	l.s.	-	890	6,303	0	7,193	0	2,343	2,035	0	4,378	0	4,378	
	33. Physical Contingency	l.s.	-	712	6,110	0	6,822	0	1,875	2,174	0	4,049	0	4,049	
<b>GRAND TOTAL</b>					<b>67,210</b>		<b>75,042</b>		<b>20,620</b>	<b>23,912</b>		<b>44,532</b>		<b>44,532</b>	
					<b>7,832</b>		<b>7,817</b>		<b>2,148</b>	<b>2,491</b>		<b>4,639</b>		<b>4,639</b>	
					<b>101.2</b>		<b>969.3</b>		<b>266.4</b>	<b>308.9</b>		<b>575.3</b>		<b>575.3</b>	

**Table 4.3.2 PROJECT COSTS OF SUB-PROJECTS FOR FM-MP (2/4)**

No	Work Item	Unit	Unit Price (Rp.)	Lower Bolango River Improvement		Middle Bolango River Improvement		Bolango River Improvement (Total)		Biyonga River Improvement		Realignment of Biyonga R. w/ E. Sediment Trap		Biyonga River Improvement (Total)	
				Q'ty	Amount (Rp.million)	Q'ty	Amount (Rp.million)	Q'ty	Amount (Rp.million)	Q'ty	Amount (Rp.million)	Q'ty	Amount (Rp.million)	Q'ty	Amount (Rp.million)
<b>1</b>	<b>Direct Cost</b>			<b>52,791</b>	<b>54,870</b>	<b>0</b>	<b>107,661</b>	<b>0</b>	<b>10,849</b>	<b>10,058</b>	<b>0</b>	<b>20,907</b>			
	I1. Earth Works														
	I11. Excavation work	m <sup>3</sup>	15,000	763,000	11,955	1,560,000	23,400	51,000	765	510	85,000	1,275			
	I12. Embankment work	m <sup>3</sup>	28,000	188,000	11,536	600,000	16,800	66,000	1,848	1,232	110,000	3,080			
	I13. Sediment trap work	m	265,000	0	0	0	0	0	0	583	2,200	583			
	I14. Sodding work	m <sup>2</sup>	20,000	0	0	0	0	0	0	600	30,000	600			
	I2. Structural Work														
	I21. Concrete work	m <sup>3</sup>	550,000	0	0	0	0	0	0	0	0	0			
	I22. Wet masonry work	m <sup>3</sup>	220,000	88,200	19,404	20,196	39,600	36,000	7,920	5,280	60,000	13,200			
	I23. Drainage sluice work														
	- DS type-1 (1m x 1m)	pcs	45,000,000	2	90	135	5	225	0	0	0	0			
	- DS type-2 (3m x 3m)	pcs	350,000,000	1	350	0	350	0	0	0	0	0			
	I24. Metal Works	m <sup>2</sup>	130,000,000	0	0	0	0	0	0	0	0	0			
	I25. Bridge work														
	- Br. type-1 (w= 4.0 m)	m	17,000,000	0	0	0	0	0	0	510	30	510			
	- Br. type-2 (w= 7.0 m)	m	35,000,000	420	14,700	9,450	24,150	690	0	1,050	30	1,050			
	I3. Miscellaneous work	l.s.		1,538	1,598	0	3,136	0	316	293	0	609			
<b>2</b>	<b>Land Acquisition</b>			<b>18,800</b>	<b>22,207</b>	<b>0</b>	<b>41,007</b>	<b>0</b>	<b>1,974</b>	<b>282</b>	<b>0</b>	<b>2,256</b>			
	21. Residential Land	m <sup>2</sup>	20,000	940,000	18,800	1,881,000	37,620	78,000	1,560	0	78,000	1,560			
	22. Agricultural Land	m <sup>2</sup>	3,000	0	3,387	1,129,000	3,387	138,000	414	282	232,000	696			
<b>3</b>	<b>Indirect Costs</b>			<b>19,808</b>	<b>21,001</b>	<b>0</b>	<b>40,809</b>	<b>0</b>	<b>3,777</b>	<b>3,263</b>	<b>0</b>	<b>7,040</b>			
	31. Administration Cost	l.s.	-	3,580	3,854	0	7,434	0	641	517	0	1,158			
	32. Eng. Services Cost	l.s.	-	7,919	8,231	0	16,150	0	1,627	1,509	0	3,136			
	33. Physical Contingency	l.s.	-	8,309	8,916	0	17,225	0	1,509	1,237	0	2,746			
	<b>GRAND TOTAL</b>			<b>91,399</b>	<b>98,078</b>		<b>189,477</b>		<b>16,600</b>	<b>13,603</b>		<b>30,203</b>			
			(Rp.million)												
			(US\$ million eq.)	<b>9,521</b>	<b>10,216</b>		<b>19,737</b>		<b>1,729</b>	<b>1,417</b>		<b>3,146</b>			
			(Yen million eq.)	<b>1,180.6</b>	<b>1,266.8</b>		<b>2,447.4</b>		<b>214.4</b>	<b>175.7</b>		<b>390.1</b>			

**Table 4.3.2 PROJECT COSTS OF SUB-PROJECTS FOR FM-MP (3/4)**

No	Work Item	Unit	Unit Price (Rp.)	Meluopo River Improvement		Marisa River Improvement		Alo-Pohu River Improvement		Realigning of Alo-Pohu R. w/ W. Sediment Trap		Alo-Pohu River Improvement (Total)		Rintenga River Improvement	
				Q'ty	Amount (Rp.million)	Q'ty	Amount (Rp.million)	Q'ty	Amount (Rp.million)	Q'ty	Amount (Rp.million)	Q'ty	Amount (Rp.million)	Q'ty	Amount (Rp.million)
<b>1</b>	<b>Direct Cost</b>			<b>11,134</b>		<b>17,154</b>		<b>50,707</b>		<b>27,063</b>		<b>77,770</b>		<b>17,160</b>	
	I1. Earth Works														
	I11. Excavation work	m <sup>3</sup>	15,000	18,000	270	260,000	3,900	900,000	700,000	10,500	1,600,000	24,000	290,000	4,350	
	I12. Embankment work	m <sup>3</sup>	28,000	50,000	1,400	58,000	1,624	110,000	71,000	1,988	181,000	5,068	50,000	1,400	
	I13. Sediment trap work	m	265,000		0	0	0	0	1,800	477	1,800	477	0	0	
	I14. Sodding work	m <sup>2</sup>	20,000		0	0	0	0	13,000	260	13,000	260	0	0	
	I2. Structural Work														
	I21. Concrete work	m <sup>3</sup>	550,000		0	0	0	0	0	0	0	0	0	0	
	I22. Wet masonry work	m <sup>3</sup>	220,000	23,000	5,060	39,000	8,580	70,000	40,000	8,800	110,000	24,200	38,000	8,360	
	I23. Drainage sluice work														
	- DS type-1 (1m x 1m)	pcs	45,000,000		0	0	0	0	0	0	0	0	0	0	
	- DS type-2 (3m x 3m)	pcs	350,000,000		0	0	0	0	0	0	0	0	0	0	
	I24. Metal Works	m <sup>2</sup>	130,000,000		0	0	0	0	0	0	0	0	0	0	
	I25. Bridge work														
	- Br. type-1 (w= 4.0 m)	m	17,000,000	240	4,080	150	2,550	500	8,500	250	4,250	750	150	2,550	
	- Br. type-2 (w= 7.0 m)	m	35,000,000		0	0	0	250	8,750	0	0	8,750	0	0	
	I3. Miscellaneous work	l.s.			324		500		1,477		788			500	
<b>2</b>	<b>Land Acquisition</b>				<b>510</b>		<b>900</b>		<b>4,290</b>		<b>1,230</b>		<b>5,520</b>	<b>1,050</b>	
	21. Residential Land	m <sup>2</sup>	20,000	0	0	0	0	0	0	0	0	0	0	0	
	22. Agricultural Land	m <sup>2</sup>	3,000	170,000	510	300,000	900	1,430,000	4,290	1,230	1,840,000	5,520	350,000	1,050	
<b>3</b>	<b>Indirect Costs</b>				<b>3,642</b>		<b>5,629</b>		<b>16,891</b>		<b>8,851</b>		<b>25,742</b>	<b>5,655</b>	
	31. Administration Cost	l.s.	-		582		903		2,750		1,415		4,165	911	
	32. Eng. Services Cost	l.s.	-		1,670		2,573		7,606		4,059		11,665	2,574	
	33. Physical Contingency	l.s.	-		1,390		2,153		6,535		3,377		9,912	2,170	
<b>GRAND TOTAL</b>					<b>15,286</b>		<b>23,683</b>		<b>71,888</b>		<b>37,144</b>		<b>109,032</b>		<b>23,865</b>
					<b>1,592</b>		<b>2,467</b>		<b>7,488</b>		<b>3,869</b>		<b>11,357</b>		<b>2,486</b>
					<b>197.4</b>		<b>305.9</b>		<b>928.5</b>		<b>479.8</b>		<b>1,408.3</b>		<b>308.3</b>

**Table 4.3.2 PROJECT COSTS OF SUB-PROJECTS FOR FM-MP (4/4)**

No	Work Item	Unit	Unit Price (Rp.)	Tapodu R. Improvement with Tapodu Gate		East Lake Dike		West Lake Dike		Lake Limboto Management (Total)	
				Q'ty	Amount (Rp.million)	Q'ty	Amount (Rp.million)	Q'ty	Amount (Rp.million)	Q'ty	Amount (Rp.million)
<b>1</b>	<b>Direct Cost</b>				<b>17,086</b>	<b>9,507</b>	<b>6,458</b>	<b>0</b>	<b>33,051</b>		
	11. Earth Works										
	111. Excavation work	m <sup>3</sup>	15,000		0	90,000	1,350	60,000	900	150,000	2,250
	112. Embankment work	m <sup>3</sup>	28,000	21,000	588	250,000	7,000	170,000	4,760	441,000	12,348
	113. Sediment trap work	m	265,000		0		0		0	0	0
	114. Sodding work	m <sup>2</sup>	20,000		0	26,000	520	17,000	340	43,000	860
	12. Structural Work				0		0		0	0	0
	121. Concrete work	m <sup>3</sup>	550,000	3,000	1,650		0		0	3,000	1,650
	122. Wet masonry work	m <sup>3</sup>	220,000	9,000	1,980		0		0	9,000	1,980
	123. Drainage sluice work										
	- DS type-1 (1m x 1m)	pcs	45,000,000		0	8	360	6	270	14	630
	- DS type-2 (3m x 3m)	pcs	350,000,000		0		0		0	0	0
	124. Metal Works	m <sup>2</sup>	130,000,000	86	11,180		0		0	86	11,180
	125. Bridge work										
	- Br. type-1 (w = 4.0 m)	m	17,000,000	70	1,190		0		0	70	1,190
	- Br. type-2 (w = 7.0 m)	m	35,000,000		0		0		0	0	0
	13. Miscellaneous work	l.s.			498		277		188		963
<b>2</b>	<b>Land Acquisition</b>				<b>240</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>240</b>	
	21. Residential Land	m <sup>2</sup>	20,000	0	0	0	0	0	0	0	0
	22. Agricultural Land	m <sup>2</sup>	3,000	80,000	240	0	0	0	0	80,000	240
<b>3</b>	<b>Indirect Costs</b>				<b>5,505</b>	<b>3,042</b>	<b>2,067</b>	<b>0</b>	<b>10,614</b>		
	31. Administration Cost	l.s.	-		866	475	323				1,664
	32. Eng. Services Cost	l.s.	-		2,563	1,426	969				4,958
	33. Physical Contingency	l.s.	-		2,076	1,141	775				3,992
<b>GRAND TOTAL</b>											
										(Rp.million)	<b>43,905</b>
										(US\$ million eq.)	<b>4,573</b>
										(Y/en million eq.)	<b>567.1</b>

**Table 4.4.1 AUTHORITIES OF PROVINCE UNDER DECONCENTRATION**

No.	Authority	Form of Authority		
		Formulation	Implementation	Evaluation
1	Deconcentrated Authorities	-	✓	✓
1.1	National Planning & Dev. Control	-	✓	✓
1.2	Financial Balance	-	✓	✓
1.3	State Administration System & Economic Inst.	-	✓	✓
1.4	Human Resources Building & Efficiency	-	✓	✓
1.5	Eff. Natural Resources Strategic & High Technology	-	✓	✓
1.6	Conservation	-	✓	✓
1.7	Standardization	-	✓	✓
2	Authority Done by Province for Kabupaten/Kota	✓	✓	✓
2.1	Public Works	✓	✓	✓
2.2	Healthy	✓	✓	✓
2.3	Education & Culture	✓	✓	✓
2.4	Agriculture	✓	✓	✓
2.5	Communication	✓	✓	✓
2.6	Trade and Industry	✓	✓	✓
2.7	Capital investment	✓	✓	✓
2.8	Environment	✓	✓	✓
2.9	Land Affairs	✓	✓	✓
2.10	Cooperation	✓	✓	✓
2.11	Human Power	✓	✓	✓

*Source: Profile of Province Gorontalo from Law No. 22/1999 and Gov. Regulation No. 25/2000.*

**Table 4.4.2 JOB SHARING IN FLOOD MITIGATION AUTHORITY  
(RIVER BASIN LOCATED INTER-KABUPATEN/KOTA)**

No.	Related Institution	Initiative			Planning			Actuating			Budgeting			Control		
		Before Decent.	Now	Under Decent.	Before Decent.	Now	Under Decent.	Before Decent.	Now	Under Decent.	Before Decent.	Now	Under Decent.	Before Decent.	Now	Under Decent.
1	MASTER PLAN															
	- Central	-	-	-	-	√ <sup>②</sup>	-	√	√ <sup>①</sup>	√	-	√ <sup>③</sup>	√ <sup>③</sup>	√ <sup>③</sup>	-	-
	- Province - Kabupaten/Kota	√ -	√ √	√ √	√ -	√ -	√ √	- -	√ -	√ -	√ -	√ -	√ -	- -	- -	√ -
2	CONSTRUCTION															
	- Central	-	-	-	-	-	-	-	√ <sup>②</sup>	-	√ <sup>②</sup>	√ <sup>③</sup>	√ <sup>③</sup>	√ <sup>③</sup>	√ <sup>③</sup>	√ <sup>③</sup>
	- Province - Kabupaten/Kota	√ -	√ √	√ √	√ -	√ -	√ <sup>④</sup> √ <sup>④</sup>	√ √	√ -	√ -	√ <sup>④</sup> √ <sup>④</sup>	√ <sup>①</sup> √	√ <sup>①</sup> √	√ -	√ -	√ √
3	REHABILITATION															
	- Central	-	-	-	-	-	-	-	-	-	-	√ <sup>②</sup>	√ <sup>②</sup>	√ <sup>③</sup>	√ <sup>③</sup>	√ <sup>③</sup>
	- Province - Kabupaten/Kota	√ -	√ √	√ √	√ -	√ -	√ √	√ -	√ -	√ <sup>①</sup> √	√ -	√ <sup>①</sup> √	√ -	√ -	√ -	√ √
4	OPERATION															
	- Central	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	- Province - Kabupaten/Kota	√ -	√ √	√ √	√ -	√ -	√ √	√ -	√ -	√ -	√ -	√ -	√ -	√ -	√ -	√ √
5	MAINTENANCE															
	- Central	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	- Province - Kabupaten/Kota	√ -	√ √	√ √	√ -	√ -	√ √	√ -	√ -	√ -	√ -	√ -	√ -	√ -	√ -	√ √

Note :

① In condition if Kabupaten is not capable yet.

② In condition if Province is not capable yet.

③ In condition budgeting by Central

④ Small Scale Structure

Decent. : Decentralization

**Table 4.5.1 ECONOMIC VALUE OF DAMAGEABLE ASSETS**

Asset	Damageable Value				
	Building (Rp. Million)	Durable Assets Rp. Million)	H. Effects/ Stock Rp. Million)	Value Added*1 (Rp./day)	Crop Production Rp.1000/ha)
1. Residence					
(a) Kota Areas	16.1	-	10.9	5,440 *2	
(b) Kabupaten Areas	6.9	-	3.5	3,660 *2	
2. Industrial, Educational and Medical Facilities					
(a) Manufacturing	2.8	6.7	22.7	43,600	
(b) Wholesale & Retail Trade	1.9	4.7	2.1	24,500	
(c) Education	396.0	116.1	-	24,500 *3	
(d) Health & Social Work	16.7	17.0	1.8	24,500 *3	
3. Crop Production					
(a) Irrigated Fields					6,000
(b) Rainfed Field					3,200
(c) Irrigated Fields in Future					7,400
4. Fishpond Production					
(a) Fishpond					22,500

Note: \*1 VA is calculated based on actual business days of 250 days.

\*2 In residence, the daily amount for cleaning damaged house is equivalent to daily income of an average famil

\*3 The daily cost to clean, fix and repair its rooms, furniture and equipment damaged by flood was assumed as the same as services establishment.

**Table 4.5.2 DAMAGE RATE**

**(1) Direct Damage**

Item	Inundation Depth					
	Below Floor Level	Over Floor Level				More than 3.0 m
		Less than 0.5 m	0.5-0.99 m	1.0-1.99 m	2.0-2.99 m	
1. Building						
(a) Building*1	0	0.092	0.119	0.266	0.380	0.834
2. Residence						
(a) Household Effects	0	0.145	0.326	0.508	0.928	0.991
3. Industrial, Educational and Medical Facilities						
(a) Depreciable Assets	-	0.232	0.453	0.789	0.966	0.995
(b) Inventory Stock	-	0.128	0.267	0.586	0.897	0.982
4. Crop Production						
	Water Depth (m)	Inundation Time (days)				
		1 to2	3 to 4	5 to 6	More Than 7	
(a) Lowland Crop	Less than 0.5	0.21	0.30	0.36	0.50	
	0.5 to 0.99	0.24	0.44	0.50	0.71	
	More than 1	0.37	0.54	0.64	0.74	
(b) Upland Crop	Less than 0.5	0.27	0.42	0.54	0.67	
	0.5 to 0.99	0.35	0.48	0.67	0.74	
	More than 1	0.51	0.67	0.81	0.91	

Note: \*1 In case of residence, a floor level is 20cm higher than the ground level.

However, a floor level of business establishments is the same as the ground level.

**(2) Indirect Damage**

Item	Inundation Depth					
	Below Floor Level	Over Floor Level				More than 3.0 m
		Less than 0.5 m	0.5-0.99 m	1.0-1.99 m	2.0-2.99 m	
1. Residence						
(a) Works for Cleaning (days)		7.5	13.3	26.1	42.4	50.1
2. Industrial, Educational and Medical Facilities*1						
(a) Stoppage of Business (days)		4.4	6.3	10.3	16.8	22.6
(b) Stagnant Days of Business after Stoppage		2.2	3.15	5.15	8.4	11.3
Total		6.6	9.45	15.45	25.2	33.9

Source: Manual for Economic Study on Flood Control, 1999, Ministry of Land, Infrastructure and Transport in Japan

**Table 4.5.3 STANDARD CONVERSION FACTOR**

Item	1994	1995	1996	1997	1998	1999	Average
A. Import (CIF) in US \$Million	31,984	40,629	42,929	41,680	27,337	24,003	34,760
B. Export (FOB) in US\$ Million	40,053	45,418	49,815	53,444	48,848	48,665	47,707
1. Import (CIF) in Rp. Billion	69,110	91,358	100,551	121,263	273,741	188,551	140,762
2. Export (FOB) in Rp. Billion	86,547	102,127	116,681	155,489	489,140	382,276	222,044
3. Import Tax in Rp. Billion	3,900	3,029	2,579	2,999	2,218	3,748	3,079
4. Export Tax in Rp. Billion	131	186	81	129	4,582	835	991
5. Subsidies for Foreign Trade	-	-	-	-	-	-	-
6. Total of (1) & (2)	155,657	193,485	217,233	276,752	762,881	570,827	362,806
7. (1)+(2)+(3)-(4)+(5)	159,426	196,328	219,731	279,622	760,517	573,740	364,894
8. Conversion Factor*1	0.98	0.99	0.99	0.99	1.00	0.99	0.99
9. Standard Conversion Factor Considering VAT							<b>0.90</b>
10. Average Exchange Rate (Rp./US\$)*2	2,160.8	2,248.6	2,342.3	2,909.4	10,013.6	7,855.2	-

Source: Statistik Indonesia 2000 (Statistical Yearbook of Indonesia), June 2001, BPS  
International Financial Statistics, November 2001, IMF

Note: \*1 Conversion Factor = (6)/(7)

\*2 International Financial Statistics, IMF



**Table 4.5.4 FLOOD DAMAGE UNDER  
PRESENT SOCIO-ECONOMIC CONDITIONS**

Item	Return Period ( Year )				
	2	5	10	20	50
I. Affected Population and Area					
1 Affected Population (1000)	12	41	67	86	110
2 Area Inundated (km <sup>2</sup> )	33	51	62	70	80
II. Inundated Property					
1 Buildings (Nos)	3,443	11,910	20,289	26,158	33,546
a. Housing Units	3,036	10,394	17,246	22,074	28,202
b. Manufacturing	172	643	1,362	1,784	2,292
c. Trading	197	747	1,471	2,025	2,705
d. Educational	20	72	125	172	221
e. Medical	18	54	85	103	126
2 Agricultural Land (ha)	1,659	2,587	3,118	3,509	3,958
a. Irrigated Field	1,437	2,289	2,770	3,121	3,549
b. Rainfed Field	200	276	324	365	386
c. Fishpond	22	22	23	23	23
III. Estimated Value of Damaged Property (Rp. Million in Economic Terms)					
1. Direct Damage	18,610	57,252	101,794	153,030	224,649
(1) Facilities	8,915	35,866	68,534	106,539	160,447
a. Housing Units	4,847	20,251	38,528	61,439	92,167
b. Manufacturing	1,259	4,762	10,352	15,229	22,848
c. Trading	393	1,605	3,262	5,201	8,317
f. Education	1,592	6,160	10,628	16,212	24,459
g. Health	146	485	763	942	1,275
h. Other Facilities	678	2,602	5,001	7,517	11,380
(2) Agricultural Production	5,400	8,174	9,768	11,177	12,360
a. Irrigated Field	4,595	7,198	8,697	9,969	11,095
b. Rainfed Field	312	483	549	686	743
c. Fishpond	493	493	522	522	522
(3) Infrastructure	4,295	13,212	23,491	35,315	51,842
2. Indirect Damage	2,054	6,438	11,590	17,408	25,557
(1) Household	91	323	601	943	1,406
(2) Business Losses	102	389	809	1,162	1,686
(3) Other Damages	1,861	5,725	10,179	15,303	22,465
3. Total	20,663	63,690	113,383	170,438	250,207
IV. Annual Benefit under Present Conditions (Rp. Million in Economic Terms)				36,325	

**Table 4.5.5 COSTS AND BENEFITS STREAM UNDER  
PRESENT SOCIO-ECONOMIC CONDITIONS**

		(Unit: Rp. Billion)						
		Cost			Benefit			Balance
		Construciton	O/M	Total	F/C Benefit	Negative	Total	
1	2004	7.4		7.4		0.3	-0.3	-7.7
2	2005	31.3		31.3		0.6	-0.6	-31.9
3	2006	31.3	0.1	31.4	2.4	0.9	1.5	-29.9
4	2007	31.3	0.2	31.5	4.8	1.2	3.6	-27.9
5	2008	31.3	0.3	31.6	7.3	1.5	5.7	-25.9
6	2009	31.3	0.4	31.7	9.7	1.8	7.9	-23.9
7	2010	31.3	0.5	31.8	12.1	2.1	10.0	-21.9
8	2011	31.3	0.7	32.0	14.5	2.4	12.1	-19.8
9	2012	31.3	0.8	32.1	17.0	2.7	14.2	-17.8
10	2013	31.3	0.9	32.2	19.4	3.0	16.3	-15.8
11	2014	31.3	1.0	32.3	21.8	3.3	18.5	-13.8
12	2015	31.3	1.1	32.4	24.2	3.6	20.6	-11.8
13	2016	31.3	1.2	32.5	26.6	3.9	22.7	-9.8
14	2017	31.3	1.3	32.6	29.1	4.2	24.8	-7.8
15	2018	31.3	1.4	32.7	31.5	4.5	26.9	-5.8
16	2019	28.4	1.5	29.9	33.9	4.5	29.4	-0.5
17	2020		1.6	1.6	36.3	4.5	31.8	30.1
18	2021		1.6	1.6	36.3	4.5	31.8	30.1
19	2022		1.6	1.6	36.3	4.5	31.8	30.1
20	2023		1.6	1.6	36.3	4.5	31.8	30.1
21	2024		1.6	1.6	36.3	4.5	31.8	30.1
22	2025		1.6	1.6	36.3	4.5	31.8	30.1
23	2026		1.6	1.6	36.3	4.5	31.8	30.1
24	2027		1.6	1.6	36.3	4.5	31.8	30.1
25	2028		1.6	1.6	36.3	4.5	31.8	30.1
26	2029		1.6	1.6	36.3	4.5	31.8	30.1
27	2030		1.6	1.6	36.3	4.5	31.8	30.1
28	2031		1.6	1.6	36.3	4.5	31.8	30.1
29	2032		1.6	1.6	36.3	4.5	31.8	30.1
30	2033		1.6	1.6	36.3	4.5	31.8	30.1
::	::		::	::	::	::	::	::
46	2049		1.6	1.6	36.3	4.5	31.8	30.1
47	2050		1.6	1.6	36.3	4.5	31.8	30.1
48	2051		1.6	1.6	36.3	4.5	31.8	30.1
49	2052		1.6	1.6	36.3	4.5	31.8	30.1
50	2053		1.6	1.6	36.3	4.5	31.8	30.1
51	2054		1.6	1.6	36.3	4.5	31.8	30.1
52	2055		1.6	1.6	36.3	4.5	31.8	30.1
53	2056		1.6	1.6	36.3	4.5	31.8	30.1
54	2057		1.6	1.6	36.3	4.5	31.8	30.1
55	2058		1.6	1.6	36.3	4.5	31.8	30.1
56	2059		1.6	1.6	36.3	4.5	31.8	30.1
57	2060		1.6	1.6	36.3	4.5	31.8	30.1
58	2061		1.6	1.6	36.3	4.5	31.8	30.1
59	2062		1.6	1.6	36.3	4.5	31.8	30.1
60	2063		1.6	1.6	36.3	4.5	31.8	30.1
61	2064		1.6	1.6	36.3	4.5	31.8	30.1
62	2065		1.6	1.6	36.3	4.5	31.8	30.1
63	2066		1.6	1.6	36.3	4.5	31.8	30.1
64	2067		1.6	1.6	36.3	4.5	31.8	30.1
65	2068		1.6	1.6	36.3	4.5	31.8	30.1
66	2069		1.6	1.6	36.3	4.5	31.8	30.1
B/C: 0.51			NPV:	-98.7 Rp. Billion		EIRR: 6.0%		

**Table 4.5.6 COSTS AND BENEFITS STREAM UNDER  
FUTURE SOCIO-ECONOMIC CONDITIONS**

		(Unit: Rp. Billion)						
		Cost			Benefit			Balance
		Construciton	O/M	Total	F/C Benefit	Negative	Total	
1	2004	7.4		7.4		0.3	-0.3	-7.7
2	2005	31.3		31.3		0.6	-0.6	-31.9
3	2006	31.3	0.1	31.4	3.2	1.0	2.2	-29.2
4	2007	31.3	0.2	31.5	6.7	1.3	5.4	-26.1
5	2008	31.3	0.3	31.6	10.6	1.7	8.9	-22.7
6	2009	31.3	0.4	31.7	14.9	2.0	12.9	-18.8
7	2010	31.3	0.5	31.8	19.7	2.4	17.3	-14.6
8	2011	31.3	0.7	32.0	24.9	2.8	22.1	-9.8
9	2012	31.3	0.8	32.1	30.7	3.2	27.5	-4.5
10	2013	31.3	0.9	32.2	37.0	3.6	33.5	1.3
11	2014	31.3	1.0	32.3	44.0	4.0	40.0	7.7
12	2015	31.3	1.1	32.4	51.6	4.4	47.2	14.8
13	2016	31.3	1.2	32.5	59.9	4.8	55.0	22.5
14	2017	31.3	1.3	32.6	68.9	5.3	63.6	31.0
15	2018	31.3	1.4	32.7	78.8	5.7	73.1	40.4
16	2019	28.4	1.5	29.9	89.6	5.8	83.8	53.9
17	2020		1.6	1.6	101.3	5.9	95.4	93.8
18	2021		1.6	1.6	101.3	5.9	95.4	93.8
19	2022		1.6	1.6	101.3	5.9	95.4	93.8
20	2023		1.6	1.6	101.3	5.9	95.4	93.8
21	2024		1.6	1.6	101.3	5.9	95.4	93.8
22	2025		1.6	1.6	101.3	5.9	95.4	93.8
23	2026		1.6	1.6	101.3	5.9	95.4	93.8
24	2027		1.6	1.6	101.3	5.9	95.4	93.8
25	2028		1.6	1.6	101.3	5.9	95.4	93.8
26	2029		1.6	1.6	101.3	5.9	95.4	93.8
27	2030		1.6	1.6	101.3	5.9	95.4	93.8
28	2031		1.6	1.6	101.3	5.9	95.4	93.8
29	2032		1.6	1.6	101.3	5.9	95.4	93.8
30	2033		1.6	1.6	101.3	5.9	95.4	93.8
::	::		::	::	::	::	::	::
46	2049		1.6	1.6	101.3	5.9	95.4	93.8
47	2050		1.6	1.6	101.3	5.9	95.4	93.8
48	2051		1.6	1.6	101.3	5.9	95.4	93.8
49	2052		1.6	1.6	101.3	5.9	95.4	93.8
50	2053		1.6	1.6	101.3	5.9	95.4	93.8
51	2054		1.6	1.6	101.3	5.9	95.4	93.8
52	2055		1.6	1.6	101.3	5.9	95.4	93.8
53	2056		1.6	1.6	101.3	5.9	95.4	93.8
54	2057		1.6	1.6	101.3	5.9	95.4	93.8
55	2058		1.6	1.6	101.3	5.9	95.4	93.8
56	2059		1.6	1.6	101.3	5.9	95.4	93.8
57	2060		1.6	1.6	101.3	5.9	95.4	93.8
58	2061		1.6	1.6	101.3	5.9	95.4	93.8
59	2062		1.6	1.6	101.3	5.9	95.4	93.8
60	2063		1.6	1.6	101.3	5.9	95.4	93.8
61	2064		1.6	1.6	101.3	5.9	95.4	93.8
62	2065		1.6	1.6	101.3	5.9	95.4	93.8
63	2066		1.6	1.6	101.3	5.9	95.4	93.8
64	2067		1.6	1.6	101.3	5.9	95.4	93.8
65	2068		1.6	1.6	101.3	5.9	95.4	93.8
66	2069		1.6	1.6	101.3	5.9	95.4	93.8
B/C: 1.28		NPV:		56.7 Rp. Billion	EIRR: 14.7%			

**Table 4.5.7 CONCEIVABLE IMPACTS  
ON NATURAL ENVIRONMENT (1/2)**

<b>Impact Activities/Program Stages*</b>	<b>Conceivable Impacts</b>	<b>Impact ** Magnitude</b>
<b>1. River Improvement Schemes</b>		
(1) Alo and Pohnu river improvement	P No-significant impacts	-
	Air pollution from construction machinery and transportation vehicles	(-1)
	C Turbid water flow from construction site to lower reach	(-1)
	Noise from construction machinery and transportation vehicles	(-0)
	Mitigation of river bank erosion	(+2)
	O/M Habitat disturbance of aquatic fauna	(-1)
	Decrease of flood frequency and lessen wetness along river	(-1)
Landscape change of Alo and Pohnu river	±	
(2) Biyonga river improvement	P No-significant impacts	-
	Air pollution from construction machinery and transportation vehicles	(-2)
	C Turbid water flow from construction site to lower reach	(-1)
	Noise from construction machinery and transportation vehicles	(-2)
	Mitigation of river bank erosion	(+1)
	O/M Habitat disturbance of aquatic fauna	(-1)
	Landscape change of Biyonga river	±
(3) Bolango river improvement	P No-significant impacts	-
	Air pollution from construction machinery and transportation vehicles	(-2)
	C Turbid water flow from construction site to lower reach	(-1)
	Noise from construction machinery and transportation vehicles	(-2)
	Mitigation of river bank erosion	(+1)
	O/M Habitat disturbance of aquatic fauna	(-1)
	Landscape change of Bolango river	±
(4) Bone river improvement	P No-significant impacts	-
	Air pollution from construction machinery and transportation vehicles	(-1)
	C Turbid water flow from construction site to lower reach	(-1)
	Noise from construction machinery and transportation vehicles	(-1)
	Mitigation of river bank erosion	(+1)
	O/M Habitat disturbance of aquatic fauna	(-1)
	Landscape change of Bone river	±
(5) Tamalate river improvement	P No-significant impacts	-
	Air pollution from construction machinery and transportation vehicles	(-2)
	C Turbid water flow from construction site to lower reach	(-1)
	Noise from construction machinery and transportation vehicles	(-2)
	Mitigation of river bank erosion	(+1)
	O/M Landscape change of Tamalate river	±
	(6) Tapodu river improvement	P No-significant impacts
Air pollution from construction machinery and transportation vehicles		(-1)
C Turbid water flow from construction site to lower reach		(-1)
Noise from construction machinery and transportation vehicles		(-1)
Mitigation of river bank erosion		(+1)
O/M Habitat disturbance of aquatic flora and fauna		(-1)
Landscape change of Tapodu river		±
<b>2. Floodway Scheme</b>		
Tamalate floodway	P No-significant impacts	-
	Air pollution from construction machinery and transportation vehicles	(-1)
	Turbid water flow from construction site	(-1)
	C Noise from construction machinery and transportation vehicles	(-1)
	Dumping/Usage of excavated soil	(-0)
	Topographic modification and change of ground stability	(-1)
	Lowering of groundwater level	(-1)
	Acceleration of sedimentation in Bone river at the mouth of floodway	(-1)
	O/M Change of runoff discharge of Tamalate river in downstream	(+1)
	Water pollution in Bone River	(-1)
	Creation of new landscape	±

**Table 4.5.7 CONCEIVABLE IMPACTS  
ON NATURAL ENVIRONMENT (2/2)**

<b>Impact Activities/Program Stages*</b>	<b>Conceivable Impacts</b>	<b>Impact ** Magnitude</b>
<b>3. Lake Limboto management schemes</b>		
(1) Tapodu gate (Hydraulic control gate)	P No-significant impacts	-
	Air pollution form construction machinery and transportation vehicles	(-1)
	C Turbid water flow from construction site to lower reach	(-1)
	Noise form construction machinery and transportation vehicles	(-1)
	Raising of groundwater level around Lake Limboto	(-0)
	Change of water regime of Lake Limboto	(+2)
	O/M Water Quality improvement in dry seasons	(+1)
	Disconnection of longitudinal connectivity	(-2)
	Restraint of growth of aquatic grasses	(+1)
	Stability of habitat environment for aquatic ecology	(+2)
(2) Ring dike	P No-significant impacts	-
	Air pollution form construction machinery and transportation vehicles	(-1)
	C Turbid water occurrence near construction site	(-1)
	Noise form construction machinery and transportation vehicles	(-1)
	Change of water regime (draw-down zone) of Lake Limboto	(+1)
	O/M Disconnection of lateral connectivity with surrounding areas	(-1)
	Landscape change of Lake Limboto	(-1)
(2) Sediment trap	P No-significant impacts	-
	Air pollution form construction machinery and transportation vehicles	(-1)
	C Turbid water occurrence near construction site	(-1)
	Noise form construction machinery and transportation vehicles	(-0)
	Reduction of sedimentation in the center of Lake Limboto	(+2)
	O/M Disconnection of lateral connectivity by sedimentation deposit	(-1)
Landscape change of Lake Limboto	(-0)	
<b>4. Watershed Management Schemes</b>		
(1) Erosion control facilities	Stability of upland slope areas	(+2)
	Reduction of soil erosion	(+1)
	Contribution to reduction of sedimentation	(+2)
	Landscape improvement	(+1)
(2) Afforestation and land use control	Prevention of reduction of water retention capacity	(+2)
	Mitigation of exhaustion of groundwater	(+1)
	Creation and conservation of flora	(+1)
	Creation and conservation of habitat	(+1)
	Prevention of soil erosion	(+2)
	Landscape improvement	(+1)
(3) Publicity activities	Contribution to project promotion for watershed management	(+1)
	Awareness building of local people and stake holders	(+1)
<b>5. Flood Plain Management Schemes</b>		
(1) Community mobilization	-	-
(2) Land coping measures	Contribution to reduction of soil erosion	(+1)
	Contribution to creation to habitat	(+1)
(3) Community-based sustainable measures	Contribution to reduction of soil erosion	(+1)
	Contribution to creation to habitat	(+1)

\* P: Pre-construction stage, C: Construction stage, O/M: Operation and Maintenance stage

\*\* (+2) Major positive impact, (+1) Minor positive impact, (-1) Minor negative impact, (-2) Major negative impact),  
(±0) Negligible impact, ± Whether positive or negative depends on design of structures

**Table 4.5.8 IMPACT MATRIX ON NATURAL ENVIRONMENT**

Project	Impact Activities/ Programs	Topography including Sedimentation	Soil Erosion	Groundwater	Water Regime	Flora & Fauna	Protected Area	Meteorology	Landscape	Air Quality	Water Quality	Soil Contamination	Noise and Vibration	Land Subsidence	Odor
River Improvement Schemes	1) Alo and Pohnu river improvement		(+1)			(-1)			±	(-1)	(-1)		(-0)		
	2) Biyonga river improvement		(+1)			(-1)			±	(-1)	(-1)		(-2)		
	3) Bolango river improvement		(+1)			(-1)			±	(-1)	(-1)		(-2)		
	4) Bone river improvement		(+1)			(-1)			±	(-1)	(-1)		(-1)		
	5) Tamalate river improvement		(+1)			(±0)			±	(-1)	(-1)		(-2)		
	6) Tapodu river improvement		(+1)			(-1)			±	(-1)	(-1)		(-1)		
Floodway Scheme	Tamalate floodway	(-1)		(-1)	(+1)	±			±	(-1)	(-1)	(-0)	(-1)	(-1)	
Lake Limboto Management Schemes	1) Tapodu gate			(-0)	(+2)	(+2)				(-1)	(-1)		(-1)		
	2) Ring dike	(-1)			(+1)	(-1)			±	(-1)	(-1)		(-1)		
	3) Sediment trap	(+2)				(-1)			(-0)	(-1)	(-1)		(-0)		
Watershed Management Schemes	1) Erosion control facilities	(+2)	(+2)						(+1)						
	2) Afforestation and land use control	(+1)	(+2)	(+1)	(+2)	(+1)			(+1)						
	3) Publicity activities		(+1)		(+1)										
Flood Plain Management Schemes	1) Community mobilization														
	2) Local coping measures		(+1)			(+1)									
	3) Community-based sustainable measures		(+1)			(+1)									

Note: (+2): Major positive impact, (+1): Minor positive impact, (-2): Major negative impact, (-1): Minor negative impact, (± 0): Negligible impact, ±: Whether positive or negative depends on design of structures.

**Table 4.5.9 CONCEIVABLE IMPACTS ON SOCIAL ENVIRONMENT (1/3)**

Impact Activities/Programs	Stage *	Conceivable Impacts (on the community and population there)	Impact ** Magnitude
<b>I. River Improvement Schemes</b>			
(1) Alo and Pohnu river improvement	P	Land acquisition for the construction work and resettlement of the	(-1)
		Disturbance to ongoing economic activities (fishing, agriculture, etc.)	(-2)
		Opposition of local population/Conflict between population and	(-2)
	C	Temporary job creation at the local level	(+1)
		Disturbance to ongoing economic activities (fishing, agriculture, etc.)	(-2)
		Interference with movement of boats and other transportation means	(-1)
		Influx of people as construction workers	±
	O/M	Reduction of flood risks	(+2)
		Community split by constructed dike	(-1)
		Difficult access to public services (school, health post, etc.)	±
		Degradation of living environment by dumping domestic waste	(-1)
		Increase of stability of riverbank communities	(+2)
		Difficult access to open water	(-1)
		Additional population growth as a consequence of influx of workers	±
(2) Biyonga river improvement	P	Land acquisition for the construction work and resettlement of the	(-1)
		Disturbance to ongoing economic activities (fishing, agriculture, etc.)	(-2)
		Opposition of local population/Conflict between population and	(-2)
	C	Temporary job creation at the local level	(+1)
		Disturbance to ongoing economic activities (fishing, agriculture, etc.)	(-2)
		Interference with movement of boats and other transportation means	(-1)
		Influx of people as construction workers	±
	O/M	Reduction of flood risks	(+2)
		Community split by constructed dike	(-1)
		Difficult access to public services (school, health post, etc.)	±
		Degradation of living environment by dumping domestic waste	(-1)
		Increase of stability of riverbank communities	(+2)
		Difficult access to open water	(-1)
		Additional population growth as a consequence of influx of workers	±
(3) Bolango river improvement	P	Land acquisition for the construction work and resettlement of the	(-1)
		Disturbance to ongoing economic activities (fishing, agriculture, etc.)	(-2)
		Opposition of local population/Conflict between population and	(-2)
	C	Temporary job creation at the local level	(+1)
		Disturbance to ongoing economic activities (fishing, agriculture, etc.)	(-2)
		Interference with movement of boats and other transportation means	(-1)
		Influx of people as construction workers	±
	O/M	Reduction of flood risks	(+2)
		Community split by constructed dike	(-1)
		Difficult access to public services (school, health post, etc.)	±
		Degradation of living environment by dumping domestic waste	(-1)
		Increase of stability of riverbank communities	(+2)
		Difficult access to open water	(-1)
		Additional population growth as a consequence of influx of workers	±
(4) Bone river improvement	P	Land acquisition for the construction work and resettlement of the	(-1)
		Disturbance to ongoing economic activities (fishing, agriculture, etc.)	(-2)
		Opposition of local population/Conflict between population and	(-2)
	C	Temporary job creation at the local level	(+1)
		Disturbance to ongoing economic activities (fishing, agriculture, etc.)	(-2)
		Interference with movement of boats and other transportation means	(-1)
		Influx of people as construction workers	±
	O/M	Reduction of flood risks	(+2)
		Community split by constructed dike	(-1)
		Difficult access to public services (school, health post, etc.)	±
		Degradation of living environment by dumping domestic waste	(-1)
		Increase of stability of riverbank communities	(+2)
		Difficult access to open water	(-1)
		Additional population growth as a consequence of influx of workers	±
(5) Tamalate river improvement	P	Land acquisition for the construction work and resettlement of the	(-1)
		Disturbance to ongoing economic activities (fishing, agriculture, etc.)	(-2)
		Opposition of local population/Conflict between population and	(-2)

**Table 4.5.9 CONCEIVABLE IMPACTS ON SOCIAL ENVIRONMENT (2/3)**

<b>Impact Activities/Programs</b>	<b>Stage *</b>	<b>Conceivable Impacts (on the community and population there)</b>	<b>Impact ** Magnitude</b>	
(5) Tamalate river improvement (cont.)	C	Temporary job creation at the local level	(+1)	
		Disturbance to ongoing economic activities (fishing, agriculture, etc.)	(-2)	
		Interference with movement of boats and other transportation means	(-1)	
		Influx of people as construction workers	±	
	O/M	Reduction of flood risks	(+2)	
		Community split by constructed dike	(-1)	
		Difficult access to public services (school, health post, etc.)	±	
		Degradation of living environment by dumping domestic waste	(-1)	
		Increase of stability of riverbank communities	(+2)	
		Difficult access to open water	(-1)	
		Additional population growth as a consequence of influx of workers	±	
	(6) Tapodu river improvement	P	Relocation of cultural and public service facilities	(-2)
			Land acquisition for the construction work and resettlement of the	(-2)
Disturbance to ongoing economic activities (fishing, agriculture, etc.)			(-2)	
Opposition of local population/Conflict between population and			(-2)	
C		Temporary job creation at the local level	(+1)	
		Disturbance to ongoing economic activities (fishing, agriculture, etc.)	(-2)	
		Interference with movement of boats and other transportation means	(-1)	
		Influx of people as construction workers	±	
O/M		Reduction of flood risks	(+2)	
		Community split by constructed dike	(-1)	
		Difficult access to public services (school, health post, etc.)	±	
		Degradation of living environment by dumping domestic waste	(-1)	
		Increase of stability of riverbank communities	(+2)	
	Difficult access to open water	(-1)		
	Additional population growth as a consequence of influx of workers	±		
<b>2. Floodway Schemes</b>				
(1) Tamalate floodway	P	minimal conflict with existing farming	(±0)	
		Relocation of cultural and public service facilities	(-2)	
		Land acquisition for the construction work and resettlement of the	(-2)	
		Disturbance to ongoing economic activities (fishing, agriculture, etc.)	(-2)	
		Opposition of local population / Conflict between local population &	(-2)	
	C	Temporary job creation at the local level	(+1)	
		Disturbance to ongoing economic activities (fishing, agriculture, etc.)	(-2)	
		Interference with movement of boats and other river transportation means	(-1)	
		Influx of people as construction workers	±	
	O/M	Reduction of flood risks	(+2)	
		Community split by constructed facilities	(-1)	
		Difficult access to public services (school, health post, etc.)	±	
		Degradation of living environment by dumping domestic waste	(-1)	
		Increase of stability of riverbank communities	(+2)	
		Additional population growth as a consequence of influx of workers	±	
		Decrease health problem having been caused by flood	(+1)	
	Degradation of living environment along Tamalate down-stream with	(-1)		
Supply of water for livestock, gardening, and local production increase	(+1)			
<b>3. Lake Limboto Management Schemes</b>				
(1) Hydraulic control gate	P	Land acquisition for the construction work and resettlement of the	(-2)	
		Disturbance to ongoing economic activities (fishing, agriculture, etc.)	(-2)	
	C	Temporary job creation at the local level	(+1)	
		Disturbance to ongoing economic activities (fishing, agriculture, etc.)	(-2)	
		Interference with movement of boats and other transportation means	(-1)	
		Influx of people as construction workers	±	
	O/M	Possible degradation of well water by retaining lake water	±	
		Reduction of flood risks	(+2)	
	(2) Ring dike	P	Land acquisition for the construction work and resettlement of the	(-1)
		C	Disturbance to ongoing economic activities (fishing, agriculture, etc.)	(-2)
O/M		Easy move of population along the dike road	±	
		Creation of new transportation network using dike road	(+1)	
		Physical community split by dike	(-1)	
		Reduction of flood risks	(+2)	



**Table 4.5.9 CONCEIVABLE IMPACTS ON SOCIAL ENVIRONMENT (3/3)**

<b>Impact Activities/Programs</b>	<b>Stage *</b>	<b>Conceivable Impacts (on the community and population there)</b>	<b>Impact ** Magnitude</b>
(3) Sediment trap	P	Land occupation for construction material	(±0)
	C	Disturbance to ongoing economic activities (fishing, agriculture, etc.)	(-1)
	O/M	Reduction of flood risks	(+2)
		Possible new settlement on accreted land	±
<b>4. Watershed Management Schemes</b>			
(1) Erosion control		Temporary job creation	(+1)
		Disturbance to ongoing economic activities (agriculture, plantation, etc.)	(-2)
		Reduction of flood risks and landslides	(+2)
(2) Afforestation and land use control		Opposition of local population, including illegal loggers	(-1)
		Enhancement of collaboration with Forestry Office and others	(+1)
		Reduction of flood risks and landslides	(+2)
		Improvement of agricultural practices and increase of agricultural	(+2)
		Harassment by corrupted local government officials	(-2)
(3) Publicity activities		Better understanding on forestry functions	(+2)
		Better collaboration among agencies	(+2)
		Reduction of flood risks	(+2)
<b>5. Flood Plain Management Schemes</b>			
(1) Community		Strengthening of community organizations	(+1)
		Mitigation of flood damage at the community level	(+1)
(2) Local coping measures		Mitigation of flood damage at the community level	(+1)
		Enhancement of local preparedness vis-a-vis flood disaster	(+2)
		Decrease health problem having been caused by flood	(+1)
		Improvement of agricultural practices and increase of agricultural	(+2)
(3) Community-based sustainable measures		Opposition of local population/Conflict between population and	(-2)
		Mitigation of flood damage	(+1)
		Enhancement of organizational capacity of community	(+2)
	Enhancement of the preparedness of community vis-a-vis flood	(+2)	

\* P: Pre-construction stage, C: Construction stage, O/M: Operation and Maintenance stage

\*\* (+2) Major positive impact, (+1) Minor positive impact, (-1) Minor negative impact, (-2) Major negative impact,

(±0) Negligible impact, ± Whether positive or negative depends on design of structures

**Table 4.5.10 IMPACT MATRIX ON SOCIAL ENVIRONMENT**

Project	Impact Activities/ Programs	Resettlement	Livelihood	Economic Activity	Local population's opposition	Traffic & Public Facilities	Community Split	Historical & Cultural Heritage	Access to water	Public Health & Sanitary	Waste	Disaster
River Improvement Schemes	1) Alo and Pohnu river improvement	(-1)	(±0)	±	(-1)	±	±		(-1)			(+2)
	2) Biyonga river improvement	(-2)	(±0)	±	(-1)	±	±		(-1)			(+2)
	3) Bolango river improvement	(-2)	(±0)	±	(-1)	±	±		(-1)			(+2)
	4) Bone river improvement	(-2)	(±0)	±	(-1)	±	±		(-1)			(+2)
	5) Tamalate river improvement	(-2)	(±0)	±	(-1)	±	±		(-1)	(-1)	(-1)	(+2)
	6) Tapodu river improvement	(-2)	(±0)	±	(-2)	(-1)	±		(-1)			(+2)
Floodway Scheme	1) Tamalate floodway	(-2)	(±0)	±	(-1)	±	±			(-1)	(-1)	(+2)
Lake Limboto Management Schemes	1) Tapodu gate	(-2)	(±0)	±	(-1)	±	±		(-1)			(+2)
	2) Ring dike	(-2)	(±0)	±	(-1)	±	±		(-1)			(+2)
	3) Sedimentation deposit	(-1)	(±0)	±	±	±	±		(-1)	(-1)	(-1)	(+2)
Watershed Management Schemes	1) Erosion Control Facilities	(±0)	(±0)	±	(±0)							(+2)
	2) Afforestation and land use control	(-1)		±	(-1)							(+2)
	3) Publicity Activities			±								(+2)
Flood Plain Management Schemes	1) Community mobilization						(+2)					(+1)
	2) Local coping measures		(+1)	(+1)			(+2)					(+2)
	3) Community-based sustainable measures		(+1)	(+1)		(+1)	(+2)					(+2)

Note: (+2): Major positive impact, (+1): Minor positive impact, (-2): Major negative impact, (-1): Minor negative impact, (± 0): Negligible impact, ± : Whether positive or negative depends on design of structures.

**Table 4.5.11 MITIGATION / ENHANCEMENT MEASURES FOR NATURAL ENVIRONMENT (1/2)**

<i>Environmental Components</i>	<i>Conceivable Impacts</i>	<i>Mitigation/ Enhancement Measures</i>	<i>Impact Occurrence Stage *</i>		
			<i>P</i>	<i>C</i>	<i>O/M</i>
<i>Topography including Sedimentation</i>	<ul style="list-style-type: none"> <li>• Modification of topography (Tamalate floodway and dikes) by means of excavation and embankment. (-1)</li> <li>• Instability of ground along Tamalate floodway (-1)</li> <li>• Oppressive feeling near the dike (-1)</li> </ul>	<ul style="list-style-type: none"> <li>• Consideration of design, structure and materials of floodway and dikes.</li> <li>• Planting on dikes.</li> </ul>			
	<ul style="list-style-type: none"> <li>• Reduction of sedimentation in the center of Lake Limboto (+2)</li> </ul>		<ul style="list-style-type: none"> <li>• Regular maintenance of sediment trap.</li> <li>• Dredging of sediment load when filled in the trap.</li> <li>• Assurance of restoration of devastated forest.</li> </ul>		
<i>Soil Erosion</i>	<ul style="list-style-type: none"> <li>• Reduction of soil erosion at river banks (+1)</li> </ul>	<ul style="list-style-type: none"> <li>• Consideration of design for bank protection</li> <li>• Implementation of effective afforestation and assurance of conservation of existing forest</li> </ul>			
	<ul style="list-style-type: none"> <li>• Reduction of soil erosion in forest lands (+2)</li> </ul>		<ul style="list-style-type: none"> <li>• Adoption of proper excavation method during construction stage.</li> <li>• Consideration of route of floodway.</li> </ul>		
<i>Groundwater</i>	<ul style="list-style-type: none"> <li>• Lowering of groundwater along Tamalate floodway (-0)</li> </ul>	<ul style="list-style-type: none"> <li>• Adoption of effective restoration method of devastated forest lands.</li> <li>• Increase of project area for forest restoration.</li> </ul>			
	<ul style="list-style-type: none"> <li>• Improvement of water retention of uplands (+1)</li> </ul>		<ul style="list-style-type: none"> <li>• Consideration and analysis of water regime control at Topadu gate</li> <li>• Consideration of effective design of river improvement</li> <li>• Adoption of effective restoration method of devastated forest lands.</li> </ul>		
<i>Water Regime</i>	<ul style="list-style-type: none"> <li>• Reduction of flood peak and mitigation of flood risks (+2)</li> <li>• Stability of water level of Lake Limboto (+2)</li> </ul>	<ul style="list-style-type: none"> <li>• Adoption of indigenous tree species for afforestation.</li> <li>• Adoption of effective restoration method of devastated forest lands.</li> </ul>			
	<ul style="list-style-type: none"> <li>• Formation of forest area (Afforestation) (+1)</li> </ul>		<ul style="list-style-type: none"> <li>• Adoption of effective restoration method of devastated forest lands.</li> </ul>		
<i>Terrestrial Flora and Fauna</i>	<ul style="list-style-type: none"> <li>• Habitat creation by afforestation. (+1)</li> </ul>	<ul style="list-style-type: none"> <li>• Adoption of effective restoration method of devastated forest lands.</li> </ul>			

\* *P*: Pre-construction Stage, *C*: Construction Stage, *O/M*: Operation and Maintenance Stage

**Table 4.5.11 MITIGATION / ENHANCEMENT MEASURES FOR NATURAL ENVIRONMENT (2/2)**

<i>Environmental Components</i>	<i>Conceivable Impacts</i>	<i>Mitigation/ Enhancement Measures</i>	<i>Impact Occurrence Stage *</i>		
			<i>P</i>	<i>C</i>	<i>O/M</i>
<i>Aquatic Ecology</i>	<ul style="list-style-type: none"> <li>Habitat disturbance by turbid water flow caused by river improvement works and by construction of dikes and sediment traps. (-1)</li> </ul>	<ul style="list-style-type: none"> <li>Consideration of timing of improvement works (e.g. avoiding rainy day).</li> <li>Placement of sandbags for prevention of turbid flow generation.</li> </ul>			
	<ul style="list-style-type: none"> <li>Disconnection of ecological connectivity (lateral and longitudinal) (-1)</li> </ul>	<ul style="list-style-type: none"> <li>Adoption of environmentally friendly design to produce habitat diversity (e.g. avoiding the construction of continuous concrete wall).</li> <li>Equipment of bio-path (fishway) at weir</li> </ul>			
	<ul style="list-style-type: none"> <li>Stability of aquatic ecology in Lake Limboto (+2)</li> </ul>	<ul style="list-style-type: none"> <li>Consideration and analysis of water regime control at Topadu gate.</li> </ul>			
	<ul style="list-style-type: none"> <li>No significant impacts.</li> </ul>				
<i>Protected Area</i>	<ul style="list-style-type: none"> <li>Creation of new landscape. (±)</li> </ul>	<ul style="list-style-type: none"> <li>Consideration of the design of river improvement, ring dikes and sediment traps, etc.</li> </ul>			
<i>Air Quality</i>	<ul style="list-style-type: none"> <li>Air pollution caused by heavy construction machinery and transportation vehicles. (-1)</li> </ul>	<ul style="list-style-type: none"> <li>Keeping construction machinery and transportation vehicles in good condition.</li> <li>Keeping traffic rules and regulations.</li> <li>Consideration of transportation routes.</li> </ul>			
	<ul style="list-style-type: none"> <li>Turbid water flow from construction sites.(-1)</li> </ul>	<ul style="list-style-type: none"> <li>Consideration of timing of improvement works (e.g. avoiding rainy day).</li> <li>Placement of sandbags for prevention of turbid flow generation.</li> </ul>			
<i>Water Quality</i>	<ul style="list-style-type: none"> <li>Water pollution in Bone river through Tamalate floodway. (-1)</li> </ul>	<ul style="list-style-type: none"> <li>Awareness building of protection of river improvement, e.g. stopping of garbage dumping in river channel.</li> </ul>			
	<ul style="list-style-type: none"> <li>Noise caused by heavy construction machinery and transportation vehicles. (-1)</li> </ul>	<ul style="list-style-type: none"> <li>Establishment of preventive wall if necessary.</li> </ul>			
<i>Soil contamination</i>	<ul style="list-style-type: none"> <li>Soil contamination through dumping or usage of excavated soil, i.e. Tamalate floodway. (-0)</li> </ul>	<ul style="list-style-type: none"> <li>Examination of excavated soil if necessary.</li> </ul>			
	<ul style="list-style-type: none"> <li>Land subsidence along Tamalate floodway through lowering of groundwater level. (-1)</li> </ul>	<ul style="list-style-type: none"> <li>Adoption of proper excavation method during construction stage.</li> </ul>			

**\* P:** Pre-construction Stage, **C:** Construction Stage, **O/M:** Operation and Maintenance Stage

**Table 4.5.12 MITIGATION / ENHANCEMENT MEASURES FOR SOCIAL ENVIRONMENT**

<i>Environmental Components</i>	<i>Conceivable Impacts</i>	<i>Mitigation/ Enhancement Measures</i>	<i>Impact Occurrence Stage*</i>		
			<i>P</i>	<i>C</i>	<i>O/M</i>
<i>Relocation of residence</i>	<ul style="list-style-type: none"> <li>• Opposition of local residents and conflict between local community and the government (-2)</li> <li>• Interruption of ongoing economic activities, such as rice culture and fishing (-2)</li> <li>• Loss of land rights (-2)</li> <li>• Loss of person's properties (farming lands, houses) (-2)</li> <li>• Possible outbreak of health problem because of new living environment (-2)</li> <li>• Limitation of access to river/lake waters (-2)</li> <li>• Interruption of existing traffic between riversides (±0)</li> <li>• Mitigation of flood damage (+1)</li> <li>• Reduction of flood risks (+2)</li> <li>• New flood risks along newly constructed dikes (±0)</li> <li>• Relocation of facilities (±0)</li> </ul>	<ul style="list-style-type: none"> <li>• Proper application of government regulations for land acquisition</li> <li>• Consideration of cultural/ religious features</li> <li>• Appropriate communication between population and the government, for example, by organizing regular public meetings</li> <li>• Disclosure of relevant information on the project</li> </ul>	○	○	-
		<ul style="list-style-type: none"> <li>• Compensation in form of an equivalent land for the same activity or money</li> <li>• Careful selection of construction sites</li> <li>• Helping the person affected to find the same or equivalent occupation in the resettled place</li> <li>• Priority to employ the person affected as a worker in the project</li> <li>• Compensation</li> <li>• Appropriate compensation</li> <li>• Careful selection of new settlement location</li> </ul>	○	○	-
		<ul style="list-style-type: none"> <li>• Consideration of dike design (for example constructing stairs and setting discharge duct)</li> <li>• Construction of bridges or special crossing places</li> <li>• Enhancement of collaboration with other governmental agencies such as Forestry office and community organizations</li> <li>• Enhancement of collaboration with other governmental agencies such as Forestry office and community organizations</li> <li>• Proper maintenance of the facilities</li> <li>• Consideration of dike design and its location</li> <li>• Construction of new equivalent facilities and/or enhancement of existing facilities nearby</li> <li>• Consideration to easy access, for example, by constructing a bridge</li> <li>• Provision of (temporary) alternative traffic way</li> <li>• Proper maintenance of dike roads</li> <li>• Limitation of access to the sites</li> </ul>	○	○	-
		○	-	○	
		○	-	○	
		○	-	○	
		○	-	○	
		○	-	○	
		○	-	○	
		○	-	○	
○	-	○			
<i>Disaster risks</i>	<ul style="list-style-type: none"> <li>• Difficult access to existing cultural facilities such as mosque, and to public facilities such as school and medical centre (-1)</li> <li>• Disturbance to actual traffic (-1)</li> <li>• Creation of new traffic (+1)</li> <li>• New settlement on sediment trap sites (±0)</li> </ul>	○	○	-	
		○	○	-	
<i>Public services &amp; facilities/ Transportation</i>	<ul style="list-style-type: none"> <li>• New settlement on sediment trap sites (±0)</li> </ul>	○	○	-	
		○	○	-	

\* *P*: Pre-construction Stage, *C*: Construction Stage, *O/M*: Operation and Maintenance Stage

**Table 4.6.1 SELECTION OF PRIORITY PROJECTS**

Work code	Description of Sub-Project	Parameters for evaluation										Overall evaluation
		① Urgency of implementation (Damage)		② Importance of protected area (Properties)		③ Site in critical condition (Facilities)		④ Favorable social impact (Benefishery)		⑤ Engineering sequence (Work order)		
<b>BOLANGO-BONE RIVER SYSTEM</b>												
BNI	<b>Lower Bone River Improvement:</b> This channel functions as the outlet of the whole LBB basin.	Frequent flooding in Gorontalo City	1	City center of Gorontalo	1	Sedimentation at river mouth. River bank relatively high	1	Port area and residents of Gorontalo City	1	No condition	1	<b>5</b>
BNm	<b>Middle Bone River Improvement:</b> The channel has relatively high capacity. Flooding and sediment problems are not currently serious.		0	Suburbs	0	Relatively high channel capacity	0	Settlements and farmlands along the river	1	No condition	1	2
TMI	<b>Lower Tamalate River Improvement:</b> Construction of Tamalate floodway will enhance the safety level of lower Tamalate markedly high. The lower Tamalate should be improved as a trunk drainage channel.	Safety to be enhanced by work TF	0	City center of Gorontalo	1	Flood wall installed already	0	Offices and residents of Gorontalo City	1	After the work TF	0	2
TF	<b>Tamalate Floodway:</b> The new floodway diverts flood water to the Bone river so as to protect Gorontalo City from flood inundation of the Tamalate. The function is definite.	Frequent flooding in Gorontalo City	1	City center of Gorontalo	1	Flood runoff from mountain basin enters directly to city center	1	Offices and residents of Gorontalo City	1	No condition	1	<b>5</b>
BLI	<b>Lower Bolango River Improvement:</b> This is an only channel to drain flood water of the middle Bolango River and Lake Limboto as well. Existing channel capacity is low. The river improvement will mitigate the flood inundation in the urban areas of Gorontalo.	Long lasting and frequent flooding in Gorontalo City	1	City center of Gorontalo	1	No continuous dike except upper portion	1	Offices and residents of Gorontalo City	1	No condition	1	<b>5</b>
BLm	<b>Middle Bolango River Improvement:</b> Improvement of this river should follow the improvement of the lower Bolango River. Existing channel capacity is relatively high provided by dikes.		0	Suburbs	0	Earth dike and bank protection installed already	0	Settlements along the river	1	After the work BLI	0	1
<b>LAKE LIMBOTO SYSTEM</b>												
BY	<b>Biyonga River Improvement:</b> The river has relatively high channel capacity provided with natural retardation areas in the upstream basin.	Flooding in Limboto town	1	Town center of Limboto	1	Relatively high channel capacity	0	Residents of Limboto town and farmlands	1	No condition	1	4
ML	<b>Meluopo River Improvement:</b> The beneficiary areas of this improvement are mainly farmlands.		0	farmlands	0	No major facilities	1	farmlands	0	No condition	1	2
MR	<b>Maris River Improvement:</b> The beneficiary areas of this improvement are mainly farmlands.		0	farmlands	0	No major facilities	1	farmlands	0	No condition	1	2
AP	<b>Alo-Pohu River Improvement:</b> The beneficiary areas of this improvement are mainly farmlands.	Long lasting and frequent flooding in farmland	1	farmlands	0	Channel excavated with low dikes	0	farmlands	0	No condition	1	2
RT	<b>Rintenga River Improvement:</b> The beneficiary areas of this improvement are mainly farmlands.		0	farmlands	0	No major facilities	1	farmlands	0	No condition	1	2
TP	<b>Tapodu River Improvement with Tapodu Gate:</b> The river and gate play crucial roles for the drainage and management of lake water level.	Long lasting and frequent flooding in Gorontalo city	1	Lower Bolango R. and City of Gorontalo	1	No major facilities	1	Settlement and farmlands	1	No condition	1	<b>5</b>
LD	<b>Lake Dike:</b> The beneficiary areas of the dike works are mainly farmlands in buffer zone of the lake.	Long lasting flooding mainly in farmland	0	farmlands	0	No major facilities	1	Lake side farmland and settlements	1	No condition	1	3
ST	<b>Sediment Trap Works in Lake Limboto</b>	Research/test works	1	Flood control Lake	1	Severe sedimentation	1	Whole area of lower Bolango R. incl. Gorontalo city	1	No condition	1	<b>5</b>

(Notes) Mark "1" for higher priority and "0" for not so high priority