

*The Study on Comprehensive Disaster Prevention
around Mayon Volcano*

SUPPORTING REPORT (1)

(Part I: Master Plan)

XI : Cost Estimate

SUPPORTING REPORT (1) - XI
COST ESTIMATE

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SUPPORTING REPORT (1) - XI
COST ESTIMATE

1. INTRODUCTION

1.1 Mud and Debris Flow Control

The facility proposed for each alternative plan is composed of consolidation dam, spur dike and training dike. The main features and work items of each facility are as follows:

(1) Consolidation dam

Main structure : All CSG (Cemented Sand and Gravel)
Work items : Excavation works, Concrete works, Concrete facing works, CSG works

(2) Spur Dike

1) Type A

Main structure : All CSG
Work items : Excavation works, Concrete facing works, Boulder facing works, CSG works, Gabion mattress works

2) Type B

Main structure : Combined with CSG and Embankment
Work items : Excavation works, Boulder facing works, CSG works, Embankment works, Gabion mattress works

3) Type C

Main structure : All Embankment
Work items : Excavation works, Boulder facing works, Embankment works, Gabion mattress works

4) Type D (Combined type with existing dike)

Main structure : All Embankment
Work items : Boulder facing works, Embankment works

(3) Training Dike

Main structure : All CSG
Work items : Excavation works, Concrete facing works, Boulder facing CSG works

1.2 River Improvement

The main work items are as follows:

- (1) Channel excavation works for widening the river channel
- (2) Embankment works for the dike
- (3) Revetment works for protection of the riverside slope

1.3 Urban Drainage in Legazpi City

The drainage plan proposed for Legazpi city is composed of improvement of urban drainage system, enlargement of flow capacity, pump drainage and retention pond. The main work items are as follows:

- (1) River improvement such as channel excavation, embankment, and riprapping works for main river channels (Tibu and Macabalo rivers)
- (2) Installation of pumping station
- (3) Installation of floodgate
- (4) Installation of retention pond

1.4 Forecasting, Warning and Evacuation

The proposed facilities for the main components of the selected plan are as follows:

- (1) Monitoring of volcanic eruption
- (2) Monitoring of flood and mud flow
- (3) Warning system
- (4) Repeater station
- (5) Inter-agency network
- (6) Evacuation center
- (7) Emergency shelter
- (8) Live stock sanctuary

1.5 Relocation and Resettlement

The relocation and resettlement plan covers two cases of the resettlement, which are required for 1) the people residing in 6km radius and 2) the people to be resettled due to implementation of the sabo project. On the other hand, the relocation and resettlement plan consists of residential development, industrial development and agricultural development. The work items of each development plan are as follows:

- (1) Residential development works
 - Land development including house lot area and the other communal area
 - Core house construction

- (2) Industrial development works
 - Land development including service industry
 - Building construction and installation of indoor movables
- (3) Agricultural development works
 - Farm land trust management system (No need of land development cost)
 - Need for annual land use fee

1.6 Institutional and Supporting Services Strengthening

The institutional and supporting programs identified at the respective administrative levels are as follows:

- (1) At the central and regional level
 - 1) Strengthening of the national and regional disaster management system
- (2) At the provincial level
 - 1) Consolidation of the provincial disaster management system
 - 2) Province-wide socio-economic development and monitoring
- (3) At the community (city/municipality) level
 - 1) Community-based disaster management strengthening
 - 2) Livelihood development projects & programs
 - On-farm and marine production enhancement
 - Agro-industry and manufacturing development
 - Tourism promotion
 - Institutional and supporting system strengthening
 - Farm land trust management

2. CONSTRUCTION PLANNING

2.1 Construction Method

Conventional and common construction methods will be introduced to each of the project works. Employment of human power will be incorporated as much as possible in the project works. The standard construction methods are as follows:

- (1) CSG method for consolidation dam, spur dike and training dike of sabo facility

Major features of the CSG method are as follows:

- 1) It is possible to use natural materials around dam/river sites effectively.
- 2) Because CSG has greater strength than fill materials, it allows construction of structures with steeper slopes and less volume.

- 3) This construction method is almost the same as that for embankment dike/dams, and structures can be completed faster than conventional embankment type structures.

The procedure of the CSG method is as follows:

- 1) The riverbed gravel and excavated materials locally available are mixed with cement by a backhoe at the site.
- 2) The cemented sand and gravel is transported and dumped at placement points by a dump truck.
- 3) The material is spread at a thickness of 25cm per layer at a time by a bulldozer. After two layers (1 lift = approx. 50cm) are spread, the material is compacted with a vibratory roller. The horizontal joints between the lifts are not processed.

(2) Earthworks

Excavation works will be carried out by a combination of a backhoe for excavation/loading, a bulldozer for collecting/spreading, a wheel loader for loading and a dump truck for hauling to specific sites. Embankment works including spreading and compacting for dike, road and land development will be done mainly by heavy equipment such as bulldozer, tire roller, and vibrating roller.

(3) Concrete works

Ready mixed concrete will be used for consolidation dam, weir, pumping station and building works. The ready mixed concrete will be conveyed by agitator truck from concrete production plant to the work sites. If necessary, a concrete production plant will be installed at the site. The placement into the structure will be carried out with a concrete bucket and wheel crane.

(4) Stone works

Boulder facing/grouted riprap for slope protection works will be constructed manually using a portable concrete mixer, truck crane, and backhoe. Gabion works also will be carried out manually with assistance of a truck crane.

2.2 Construction Materials

Major construction materials are sand, gravel, boulder, mountain soils, cement and reinforcing bar. Stone and soil materials are available in and around construction

sites, while cement and reinforcement materials will be obtained from Legazpi City or Metro Manila on a commercial basis.

3. COST ESTIMATE

3.1 Basic Conditions and Assumptions

Project cost comprises 1) Construction cost, 2) Government administration cost, 3) Engineering services cost, 4) Land acquisition cost, 5) Physical contingency, and 6) Price contingency. The conditions and assumptions for the project cost estimate in the Master Plan are as follows:

- (1) Project cost is estimated at the price level as of July 1999.
- (2) Exchange rates used in the cost estimate are as follows:
US\$ 1.0 = PHP 38.2 = ¥122.4
- (3) Construction cost is composed of two parts, 1) the direct cost consisting of the labor cost, material cost, and equipment expenses, 2) the indirect cost consisting of overhead expenses, unforeseen contingencies, miscellaneous expenses, and contractor's profit, pursuant to the Department Order (DPWH) No.30.
- (4) The unit price estimating method is applied to the estimate of construction cost.
- (5) Government administration cost for detailed design and supervision is estimated at a percentage of the total construction cost.
- (6) The engineering services cost for detailed design and supervision is estimated at a percentage of the total construction cost.
- (7) Physical contingency is estimated at 10% of the total of construction cost, government administration cost, engineering services cost, and land acquisition cost.
- (8) Price contingency is calculated based on the escalation rate of 7.85% per annum and the Implementation Schedule of the Master Plan Projects and Programs.
- (9) Value Added Tax (VAT) is not included in the cost estimate.

3.2 Unit Price

- (1) Labor and construction material costs

Labor cost which include all fringe benefits and construction material cost are based on the data collected by Region V, DPWH. The labor cost and construction material cost are listed in Table XI 3.1 and XI 3.2 respectively.

(2) Unit price for each work item

The unit price for each work item is determined by referring to the unit price obtained from DPWH and the recent bidding data of similar projects in the Philippines.

3.3 Structural Countermeasure Projects

(1) Sabo facility construction

In the process of formulating the master plan, various type and size of facility were identified in this study. The unit cost per meter of each facility for each alternative plan is shown in Table XI 3.3, together with the unit price for each work item. For each river system proposed in the Master Plan, the project cost except price contingency is estimated in Table XI 3.4.

Meanwhile, annual operation and maintenance cost after completion of the project is estimated as follows:

- 1) For the ordinary works, it is assumed to be 0.5% of the total construction cost.
- 2) For the dredging works, it is estimated as shown below.

Name of Project	Annual Dredging Volume (m ³ /year)	Unit Price (PHP/m ³)	Annual Dredging Cost (PHP)
Yawa River System	23,600	90	2,124,000
Quinali (A) System	79,600	90	7,164,000
San Vicente River	16,200	90	1,458,000
Padang River	5,300	90	477,000
Basud River	4,300	90	387,000

(2) River improvement

The project cost except price contingency for each alternative plan is estimated in Table XI 3.5. Among each alternative plan, the project for Yawa river improvement is selected as component of the Master Plan. For annual maintenance and operation cost, it is assumed to be 0.5% of the total construction cost.

(3) Urban drainage

The Legazpi city urban drainage project is selected as component of the Master Plan. The breakdown of construction cost is estimated in Table XI 3.6. The project cost except price contingency is estimated in Table XI 3.7. For annual maintenance and operation cost, it is assumed to be 0.5% of the total construction cost.

(4) Forecasting, warning and evacuation

The prices for the forecasting and warning equipment are estimated at the total of the CIF price at Manila, inland transportation charge and installation cost. The basic software required for the equipment is included in the said equipment price, while the application software required for the system of analysis is estimated separately. The project cost except price contingency is estimated in Table XI 3.8. For annual maintenance and operation cost, it is assumed to be 7% of the total construction cost.

(5) Resettlement site development

The project cost except price contingency consisting of the residential development cost and industrial development cost is estimated in Table XI 3.9.

Meanwhile, annual maintenance and operation cost is estimated as follows:

- 1) For the ordinary works, it is assumed to be 0.5% of the total construction cost.
- 2) For the land use fee for farm land trust management, it is estimated on the basis of the unit price of 37,071PHP/year/ha.

3.4 Institutional and Supporting Services Strengthening Programs

The engineering service cost is estimated based on the assumed man-months for each expert required and miscellaneous cost such as transportation fee, personnel expenditure, report binding and office running cost. The project cost except price contingency for each program is estimated in Table XI 3.10.

3.5 Project Cost of the Master Plan Projects and Programs

The project cost including price contingency is summarized in Table XI 3.11. Annual operation and maintenance costs for the structural countermeasure projects are estimated in Table XI 3.12.

3.6 Project Cost of the Priority Projects and Programs

The priority projects and programs comprises 1) Yawa river system sabo project, 2) Legazpi city urban drainage project, 3) Resettlement site development project, 4) Forecasting, warning and evacuation project, and 5) Institutional and supporting services strengthening programs. For the resettlement site development, the cost is estimated as shown in Table XI 3.13, since the

component of this project is reorganized compared to the relocation and resettlement project proposed in the master plan.

The project cost for implementation of the priority projects and programs is summarized in Table XI 3.14.

Table XI 3.1 Labor Cost

Item	Unit	Unit Cost (PHP)
Foreman	man-day	350
Mason	man-day	250
Steel Worker	man-day	250
Form worker	man-day	250
Concrete Worker	man-day	250
Carpenter	man-day	250
Skilled Labor	man-day	250
Common Labor	man-day	150
Equipment Operator	man-day	350
Driver	man-day	350

Table XI 3.2 Construction Material Cost

Material	Unit	Unit Cost (PHP)
Portland Cement (40kg)	bag	125
Reinforced Bar	kg	19
Crushed Gravel	cu.m	450
Boulder	cu.m	400
Sand	cu.m	300
Aggregates for Subbase	cu.m	250
Mountain Soil	cu.m	200
Concrete Class A	cu.m	5,775
Concrete Class B	cu.m	3,200
Gasoline	lit.	11.75
Light Oil	lit.	9

Table XI 3.3 Unit Cost per Meter of Sabo Facility

Name of Facility	Year	Effective height	Height	Width of Crown	Concrete (m ³)		Concrete Facing (m ³)	Boulder Facing (m ³)	Cemented Sand and Gravel (m ³)	Embankment (m ³)	Excavation (m ³)	Gabion (m ³)	Unit Price per m (PHP)
					2,500	400							
Consolidation Dam Overflow Portion	1/50	5.0	7.0	5.0	17.4	2,500	33.9	2,000	103.5	200	120	1,500	181,014
	1/20	4.0	6.0	5.0	15.4	2,500	30.1	2,000	77.5	200	120	1,500	155,142
	1/10	3.0	5.0	5.0	13.4	2,500	26.0	2,000	49.0	200	120	1,500	126,308
Consolidation Dam None-overflow Portion	1/50	5.0	7.0	5.0		2,500	28.4	2,000	179.2	200	120	1,500	153,216
	1/20	4.0	6.0	5.0		2,500	25.7	2,000	144.7	200	120	1,500	131,682
	1/10	3.0	5.0	5.0		2,500	21.9	2,000	106.5	200	120	1,500	104,190
Low Consolidation Dam	1/50	1.5	4.0	6.0		2,500	2.5	2,000	34.4	200	120	1,500	37,810
	1/20	1.5	4.0	6.0		2,500	2.5	2,000	34.4	200	120	1,500	37,810
	1/10	1.5	4.0	6.0		2,500	2.5	2,000	34.4	200	120	1,500	37,810
Ground Sill	1/50	0.0	3.0	4.0		2,500	11.4	2,000	11.4	200	120	1,500	37,884
	1/20	0.0	3.0	4.0		2,500	11.4	2,000	11.4	200	120	1,500	37,884
	1/10	0.0	3.0	4.0		2,500	11.4	2,000	11.4	200	120	1,500	37,884
Spur Dike type(A)	1/50	6.0	8.0	6.0		2,500	7.4	2,000	84.3	200	120	1,500	73,512
	1/20	5.0	7.0	6.0		2,500	6.6	2,000	65.0	200	120	1,500	61,960
	1/10	4.0	6.0	6.0		2,500	4.7	2,000	48.2	200	120	1,500	48,458
Spur Dike type(B)	1/50	6.0	7.5	6.0		2,500		2,000	50.4	200	120	1,500	62,052
	1/20	5.0	6.5	6.0		2,500		2,000	39.8	200	120	1,500	51,640
	1/10	4.0	5.5	6.0		2,500		2,000	30.4	200	120	1,500	42,020
Spur Dike type(C)	1/50	6.0	7.5	6.0		2,500		2,000	7.2	200	120	1,500	55,880
	1/20	5.0	6.5	6.0		2,500		2,000	6.3	200	120	1,500	46,740
	1/10	4.0	5.5	6.0		2,500		2,000	5.4	200	120	1,500	38,400
Spur Dike type(D)	1/50	3.0	7.0	6.0		2,500		2,000	3.2	200	120	1,500	28,960
	1/20	2.0	6.0	6.0		2,500		2,000	2.3	200	120	1,500	21,040
	1/10	1.0	5.0	6.0		2,500		2,000	1.3	200	120	1,500	13,540
Training Dike	1/50	3.0	5.0	3.0		2,500	1.0	2,000	7.8	200	120	1,500	36,660
	1/20	2.5	4.5	3.0		2,500	1.0	2,000	7.0	200	120	1,500	32,212
	1/10	2.0	4.0	3.0		2,500	1.0	2,000	6.2	200	120	1,500	27,964

Table XI 3.4 Project Cost for Sabo Facility (1/3)

Yawa River System Sabo Project

Work Item	Description	Unit	Quantity	Unit Price (PHP)	Amount (PHP)
A. Construction cost					
(1) Preparatory works	5% of (2)	L.S.			43,421,900
(2) Construction					
1) Cosolidation Dam	Overflow Portion	m	130	155,142	20,168,460
2) Cosolidation Dam	Non-overflow Portion	m	970	131,682	127,731,540
3) Spur Dike	Type-A	m	1,900	61,960	117,724,000
4) Spur Dike	Type-B	m	5,100	51,640	263,364,000
5) Spur Dike	Type-C	m	600	46,740	28,044,000
6) Training Dike	Type-A	m	5,100	61,060	311,406,000
(3) Miscellaneous works	10% of (2)	L.S.			86,843,800
Total of A					998,703,700
B. Administration cost	5% of A	L.S.			49,935,185
C. Engineering services cost	10% of A	L.S.			99,870,370
D. Land acquisition cost		L.S.			341,521,600
E. Physical contingency	10% of (A+B+C+D)	L.S.			149,003,086
Grand Total					1,639,033,941

Quinali (A) River System Sabo Project

Work Item	Description	Unit	Quantity	Unit Price (PHP)	Amount (PHP)
A. Construction cost					
(1) Preparatory works	5% of (2)	L.S.			32,758,965
(2) Construction					
1) Cosolidation Dam	Overflow Portion	m	140	155,142	21,719,880
2) Cosolidation Dam	Non-overflow Portion	m	310	131,682	40,821,420
3) Low Cosolidation Dam		m	900	37,810	34,029,000
4) Spur Dike	Type-A	m	2,200	61,960	136,312,000
5) Spur Dike	Type-B	m	2,750	51,640	142,010,000
6) Spur Dike	Type-C	m	1,050	46,740	49,077,000
7) Spur Dike	Type-D	m	1,700	21,040	35,768,000
8) Training Dike	Type-B	m	2,100	64,640	135,744,000
9) Training Dike	Type-C	m	950	62,840	59,698,000
(3) Miscellaneous works	10% of (2)	L.S.			65,517,930
Total of A					753,456,195
B. Administration cost	5% of A	L.S.			37,672,810
C. Engineering services cost	10% of A	L.S.			75,345,620
D. Land acquisition cost		L.S.			10,000,000
E. Physical contingency	10% of (A+B+C+D)	L.S.			87,647,462
Grand Total					964,122,087

Table XI 3.4 Project Cost for Sabo Facility (2/3)

Buang River System Sabo Project

Work Item	Description	Unit	Quantity	Unit Price (PHP)	Amount (PHP)
A. Construction cost					
(1) Preparatory works	5% of (2)	L.S.			2,969,300
(2) Construction					
1) Spur Dike	Type-B	m	1,150	51,640	59,386,000
(3) Miscellaneous works	10% of (2)	L.S.			5,938,600
Total of A					68,293,900
B. Administration cost	5% of A	L.S.			3,414,695
C. Engineering services cost	10% of A	L.S.			6,829,390
D. Land acquisition cost		L.S.			924,600
E. Physical contingency	10% of (A+B+C+D)	L.S.			7,946,259
Grand Total					87,408,844

San Vicente River System Sabo Project

Work Item	Description	Unit	Quantity	Unit Price (PHP)	Amount (PHP)
A. Construction cost					
(1) Preparatory works	5% of (2)	L.S.			18,826,260
(2) Construction					
1) Cosolidation Dam	Overflow Portion	m	400	155,142	62,056,800
2) Cosolidation Dam	Non-overflow Portion	m	200	131,682	26,336,400
3) Spur Dike	Type-A	m	2,400	61,960	148,704,000
4) Spur Dike	Type-B	m	2,700	51,640	139,428,000
(3) Miscellaneous works	10% of (2)	L.S.			37,652,520
Total of A					433,003,980
B. Administration cost	5% of A	L.S.			21,650,199
C. Engineering services cost	10% of A	L.S.			43,300,398
D. Land acquisition cost		L.S.			28,836,480
E. Physical contingency	10% of (A+B+C+D)	L.S.			52,679,106
Grand Total					579,470,163

Table XI 3.4 Project Cost for Sabo Facility (3/3)

Padang River System Sabo Project

Work Item	Description	Unit	Quantity	Unit Price (PHP)	Amount (PHP)
A. Construction cost					
(1) Preparatory works	5% of (2)	L.S.			16,149,385
(2) Construction					
1) Cosolidation Dam	Overflow Portion	m	50	155,142	7,757,100
2) Cosolidation Dam	Non-overflow Portion	m	300	131,682	39,504,600
3) Spur Dike	Type-A	m	3,950	61,960	244,742,000
4) Spur Dike	Type-B	m	600	51,640	30,984,000
(3) Miscellaneous works	10% of (2)	L.S.			32,298,770
Total of A					371,435,855
B. Administration cost	5% of A	L.S.			18,571,793
C. Engineering services cost	10% of A	L.S.			37,143,586
D. Land acquisition cost		L.S.			86,400,000
E. Physical contingency	10% of (A+B+C+D)	L.S.			51,355,123
Grand Total					564,906,357

Basud River System Sabo Project

Work Item	Description	Unit	Quantity	Unit Price (PHP)	Amount (PHP)
A. Construction cost					
(1) Preparatory works	5% of (2)	L.S.			11,457,735
(2) Construction					
1) Cosolidation Dam	Overflow Portion	m	100	155,142	15,514,200
2) Cosolidation Dam	Non-overflow Portion	m	250	131,682	32,920,500
3) Low Cosolidation Dam		m	2,500	61,960	154,900,000
4) Spur Dike	Type-A	m	500	51,640	25,820,000
(3) Miscellaneous works	10% of (2)	L.S.			22,915,470
Total of A					263,527,905
B. Administration cost	5% of A	L.S.			13,176,395
C. Engineering services cost	10% of A	L.S.			26,352,791
D. Land acquisition cost		L.S.			19,200,000
E. Physical contingency	10% of (A+B+C+D)	L.S.			32,225,709
Grand Total					354,482,800

Bulawan River System Sabo Project

Work Item	Description	Unit	Quantity	Unit Price (PHP)	Amount (PHP)
A. Construction cost					
(1) Preparatory works	5% of (2)	L.S.			10,613,550
(2) Construction					
1) Spur Dike	Type-B	m	1,350	51,640	69,714,000
2) Spur Dike	Type-C	m	3,050	46,740	142,557,000
(3) Miscellaneous works	10% of (2)	L.S.			21,227,100
Total of A					244,111,650
B. Administration cost	5% of A	L.S.			12,205,583
C. Engineering services cost	10% of A	L.S.			24,411,165
D. Land acquisition cost		L.S.			20,736,000
E. Physical contingency	10% of (A+B+C+D)	L.S.			30,146,440
Grand Total					331,610,837

Table XI 3.5 Project Cost for River Improvement

Alternative Plan : 10-year flood

Work Item	Description	Unit	Quantity	Unit Price (PHP)	Amount (PHP)
A. Construction cost					
(1) Preparatory works	5% of (2)	L.S.			101,632,200
(2) Dike construction					
1) San Vicente river	H = 2.7m, both sides (Q10)	m	4,000	43,000	172,000,000
2) Quinali(B)river	H = 4.8m, both sides (Q10)	m	4,050	83,000	336,150,000
	H = 4.4m, both sides (Q10)	m	7,050	77,000	542,850,000
	H = 3.4m, both sides (Q10)	m	150	64,000	9,600,000
3) Nassisi river	H = 4.7m, both sides (Q10)	m	600	82,000	49,200,000
	H = 3.8m, both sides (Q10)	m	7,033	68,000	478,244,000
4) Ogsong river	H = 4.5m, both sides (Q10)	m	5,700	78,000	444,600,000
(3) Miscellaneous works	10% of (2)	L.S.			203,264,400
Total of A					2,337,540,600
B. Administration cost	5% of A	L.S.			116,877,030
C. Engineering services cost	10% of A	L.S.			233,754,060
D. Land acquisition cost		L.S.			154,540,000
E. Physical contingency	10% of (A+B+C+D)	L.S.			284,271,169
Grand Total					3,126,982,859

Alternative Plan : 20-year flood

Work Item	Description	Unit	Quantity	Unit Price (PHP)	Amount (PHP)
A. Construction cost					
(1) Preparatory works	5% of (2)	L.S.			117,738,800
(2) Dike construction					
1) Yawa river	H = 5.6m, both sides (Q20)	m	2,000	96,000	192,000,000
2) San Vicente river	H = 2.8m, both sides (Q20)	m	4,000	46,000	184,000,000
3) Quinali(B)river	H = 5.2m, both sides (Q20)	m	4,050	90,000	364,500,000
	H = 4.7m, both sides (Q20)	m	7,050	82,000	578,100,000
	H = 3.6m, both sides (Q20)	m	150	68,000	10,200,000
4) Nassisi river	H = 5.0m, both sides (Q20)	m	600	87,000	52,200,000
	H = 4.0m, both sides (Q20)	m	7,033	72,000	506,376,000
5) Ogsong river	H = 4.7m, both sides (Q20)	m	5,700	82,000	467,400,000
(3) Miscellaneous works	10% of (2)	L.S.			235,477,600
Total of A					2,707,992,400
B. Administration cost	5% of A	L.S.			135,399,620
C. Engineering services cost	10% of A	L.S.			270,799,240
D. Land acquisition cost		L.S.			170,220,000
E. Physical contingency	10% of (A+B+C+D)	L.S.			328,441,126
Grand Total					3,612,852,386

Table XI 3.6 Breakdown of Construction Cost for Legazpi City Urban Drainage Project

Work Item	Description	Unit	Quantity	Unit Price (PHP)	Amount (PHP)
1. Preparatory Works	5% of 2				14,551,931
2. Construction Works					
(1) Macabalo River					
1) River Improvement					
Excavation		m ³	36,400	120	4,368,000
Embankment		m ³	4,840	200	968,000
Riprapping		m ²	23,750	330	7,837,500
2) Pump Drainage					
Embankment		m ³	16,000	200	3,200,000
Reinforced concrete		m ³	6,700	5,000	33,500,000
RC pile		m	3,900	1,600	6,240,000
Horizontal shaft pump, Q=3.0m ³ /s		set	2	7,200,000	14,400,000
Horizontal shaft pump, Q=2.0m ³ /s		set	2	4,800,000	9,600,000
Diesel engine, 325ps - 1,000rpm		set	4	6,000,000	24,000,000
Mechanical rake		set	1	20,000,000	20,000,000
Electrical facilities for auxiliary		L.S.	1		4,200,000
Diesel engine for auxiliary equipment		set	2	1,500,000	3,000,000
Auxiliary pump and auxiliary facilities		L.S.	1		1,750,000
Cable and miscellaneous materials		L.S.	1		2,800,000
Control panel		set	1	2,000,000	2,000,000
Day oil tank, 2.0 ton		ton	2.0	250,000	500,000
Track crane, 20 ton class		set	1	5,100,000	5,100,000
Flood Gate		set	5	4,809,000	24,045,000
3) Retention Pond					
Excavation		m ³	434,413	120	52,129,560
Embankment		m ³	5,127	200	1,025,400
Riprapping		m ²	3,198	330	1,055,340
Subtotal (1)					221,718,800
(2) Tibu River					
1) River Improvement					
Excavation		m ³	1,503	120	180,360
Embankment		m ³	437	200	87,400
Riprapping		m ²	9,178	330	3,028,740
2) Pump Drainage					
Embankment		m ³	4,600	200	920,000
Reinforced concrete		m ³	3,200	5,000	16,000,000
RC pile		m	560	1,600	896,000
Submersible pump, Q=0.5m ³ /s		set	2	750,000	1,500,000
Mechanical rake		set	1	15,200,000	15,200,000
Low-tension distribution panel		set	3	840,000	2,520,000
Auxiliary pump and auxiliary facilities		L.S.	1		300,000
Cable and miscellaneous materials		L.S.	1		1,500,000
Diesel generator, 250kVA		set	1	3,200,000	3,200,000
Control panel		set	1	1,800,000	1,800,000
Day oil tank, 1.5 ton		ton	1.5	250,000	375,000
Track crane, 20 ton class		set	1	5,100,000	5,100,000
Flood Gate		set	3	5,006,000	15,018,000
3) Retention Pond					
Excavation		m ³	13,576	120	1,629,120
Embankment		m ³	161	200	32,200
Riprapping		m ²	100	330	33,000
Subtotal (2)					69,319,820
Total (1+2)					291,038,620
3. Miscellaneous Works	10% of 2				29,103,862
Total Construction Cost					334,694,413

Table XI 3.7 Project Cost for Legazpi City Urban Drainage Project

Work Item	Description	Unit	Quantity	Unit Price (PHP)	Amount (PHP)
A. Construction cost		L.S.			334,694,413
B. Administration cost	5% of A	L.S.			16,734,721
C. Engineering services cost	10% of A	L.S.			33,469,441
D. Land acquisition cost		L.S.			15,651,361
E. Physical contingency	10% of (A+B+C+D)	L.S.			40,054,994
Grand Total					440,604,930

Table XI 3.8 Project Cost for Forecasting, Warning and Evacuation

Work Item	Unit	Amount (Million PHP)
A. Construction cost		
(1) Monitoring system of volcanic eruption		
1) Seismograph system	L.S.	8.0
2) GPS system	L.S.	10.0
3) Gas collector facility	L.S.	4.0
4) Analysis software	L.S.	15.0
Subtotal of (1)		37.0
(2) Monitoring system of flood and mud flow		
1) Rainfall gauge	L.S.	51.5
2) Water level gauge	L.S.	11.5
3) Telemeter	L.S.	15.3
4) data Processing	L.S.	0.7
5) Power supply	L.S.	15.0
6) Analysis software	L.S.	26.0
Subtotal of (2)		120.0
(3) Warning system		
1) Siren station and control system	L.S.	54.0
2) Power supply	L.S.	4.0
3) Cellular phone	L.S.	1.3
Subtotal of (3)		59.3
(4) Repeater station system		
1) Repeater station	L.S.	6.0
2) Power supply	L.S.	1.3
Subtotal of (4)		7.3
(5) Inter agency disaster mitigation network		
1) Server and cable	L.S.	12.0
2) Hard disk	L.S.	2.3
3) Other required equipment	L.S.	2.3
4) Software	L.S.	10.7
Subtotal of (5)		27.3
(6) Evacuation center		
1) Extension of evacuation center	L.S.	901.0
2) Installation of water supply facility	L.S.	2.3
3) Installation of toilet facility	L.S.	3.7
Subtotal of (6)		907.0
(7) Emergency shelter		
1) Shelter	L.S.	7.0
2) Supplementary facility	L.S.	2.7
Subtotal of (7)		9.7
(8) Live stock sanctuary		
1) Shelter	L.S.	7.0
2) Supplementary facility	L.S.	0.3
Subtotal of (8)		7.3
Total of A		1174.9
B. Administration cost (10% of A)	L.S.	117.5
C. Engineering services cost (15% of A)	L.S.	176.2
D. Physical contingency (10% of (A+B+C))	L.S.	146.9
Grand Total		1615.5

Table XI 3.9 Project Cost for Relocation and Resettlement

Work Item	Description	Unit	Quantity	Unit Price (Million PHP)	Amount (Million PHP)
A. Construction cost					
A-1: Resettlement for people residing in 6km radius					
(1) Residential development					
1) Camalig Municipality		House	135	0.2	27.0
(2) Industrial development					
1) Camalig Municipality		ha	3.9	3.3	12.9
2) Legazpi Municipality		ha	1.4	3.3	4.6
3) Malilipot Municipality		ha	4.2	3.3	13.9
4) Tabaco Municipality		ha	2.9	3.3	9.6
A-2: Resettlement for people due to implementation of the sabo project					
(1) Residential development					
1) Yawa river system		House	65	0.2	13.0
2) Quinali (A) river		House	21	0.2	4.2
3) Buang river		House	5	0.2	1.0
4) San vicente river		House	8	0.2	1.6
5) Padange river		House	38	0.2	7.6
(2) Industrial development					
1) Yawa river system		ha	1.8	3.3	5.9
2) Quinali (A) river		ha	0.6	3.3	2.0
3) Buang river		ha	0.1	3.3	0.3
4) San vicente river		ha	0.2	3.3	0.7
5) Padange river		ha	1.0	3.3	3.3
Total of A					107.6
B. Administration cost	5% of A	L.S.			5.4
C. Engineering services cost	10% of A	L.S.			10.8
D. Physical contingency	10% of (A+B+C)	L.S.			12.4
Grand Total					136.1

Note: Land acquisition cost is included in the above A. Construction cost.

Table XI 3.10 Project Cost for Institutional and Supporting Services Strengthening (1/3)

NP-1 : Strengthening of the National and Regional Disaster Management System

Work Item	Description	Unit	Quantity	Unit Price (PHP)	Amount (PHP)
A. Engineering services cost					
(1) International Expert	Institutional strengthening	M/M	18	850,000	15,300,000
(2) Miscellaneous cost	20% of (1)	L.S.			3,060,000
Total of A					18,360,000
B. Administration cost	10% of A	L.S.			1,836,000
C. Physical contingency	10% of (A+B)	L.S.			2,019,600
Grand Total					22,215,600

PP-1 : Consolidation of the Provincial Disaster Management System

Work Item	Description	Unit	Quantity	Unit Price (PHP)	Amount (PHP)
A. Engineering services cost					
(1) Local Expert	FFW&Evacuation Expert	M/M	12	20,000	240,000
(2) Local Expert	Institutional strengthening	M/M	26	20,000	520,000
(3) Miscellaneous cost	20% of ((1)+(2))	L.S.			152,000
Total of A					912,000
B. Administration cost	10% of A	L.S.			91,200
C. Physical contingency	10% of (A+B)	L.S.			100,320
Grand Total					1,103,520

Table XI 3.10 Project Cost for Institutional and Supporting Services Strengthening (2/3)

PP-2 : Province-wide Socio-economic Development and Monitoring

Work Item	Description	Unit	Quantity	Unit Price (PHP)	Amount (PHP)
A. Engineering services cost					
(1) Local Expert	Social Investment Fund	M/M	26	20,000	520,000
(2) Local Expert	TLRC	M/M	26	20,000	520,000
(3) Local Expert	Tourism	M/M	26	20,000	520,000
(4) Miscellaneous cost	20% of ((1)+(2)+(3))	L.S.			312,000
Total of A					1,872,000
B. Administration cost	10% of A	L.S.			187,200
C. Physical contingency	10% of (A+B)	L.S.			205,920
Grand Total					2,265,120

CP-1 : Community-based Disaster Management Strengthening

Work Item	Description	Unit	Quantity	Unit Price (PHP)	Amount (PHP)
A. Engineering services cost					
(1) International Expert	Volunteer	M/M	24	230,000	5,520,000
(2) Local Expert		M/M	20	20,000	400,000
(3) Miscellaneous cost	20% of ((1)+(2))	L.S.			1,184,000
Total of A					7,104,000
B. Administration cost	10% of A	L.S.			710,400
C. Physical contingency	10% of (A+B)	L.S.			781,440
Grand Total					8,595,840

Table XI 3.10 Project Cost for Institutional and Supporting Services Strengthening (3/3)

CP-2 : Livelihood Development and Supporting Projects and Programs

Work Item	Description	Unit	Quantity	Unit Price (PHP)	Amount (PHP)
A. Engineering services cost					
A-1: On farm and marine production enhancement					
(1) International Expert	Volunteer	M/M	24	230,000	5,520,000
(2) Local Expert		M/M	20	20,000	400,000
(3) Miscellaneous cost	20% of ((1)+(2))	L.S.			1,184,000
A-2: Agro-industry & manufacturing development					
(1) International Expert	Volunteer	M/M	24	230,000	5,520,000
(2) Local Expert		M/M	20	20,000	400,000
(3) Miscellaneous cost	20% of ((1)+(2))	L.S.			1,184,000
A-3: Tourism promotion					
(1) International Expert	Volunteer	M/M	24	230,000	5,520,000
(2) Local Expert		M/M	20	20,000	400,000
(3) Miscellaneous cost	20% of ((1)+(2))	L.S.			1,184,000
A-4: Institutional & supporting system strengthening					
(1) International Expert	Volunteer	M/M	24	230,000	5,520,000
(2) Local Expert		M/M	20	20,000	400,000
(3) Miscellaneous cost	20% of ((1)+(2))	L.S.			1,184,000
A-5: Farm land trust management					
(1) International Expert	Volunteer	M/M	24	230,000	5,520,000
(2) Local Expert		M/M	20	20,000	400,000
(3) Miscellaneous cost	20% of ((1)+(2))	L.S.			1,184,000
Total of A					35,520,000
B. Administration cost	10% of A	L.S.			3,552,000
C. Physical contingency	10% of (A+B)	L.S.			3,907,200
Grand Total					42,979,200

Table XI 3.11 Summary of Project Cost Proposed in the Master Plan (1/3)

Code No.	Description	Amount (Million PHP)
<i>Sabo Facility Construction</i>		
SF-1	Yawa River System Sabo Project	
A.	Construction cost	998.7
B.	Government administration cost	49.9
C.	Engineering services cost	99.9
D.	Land acquisition cost	341.5
E.	Physical contingency	149.0
	Total of (A - E)	1,639.0
F.	Price contingency	705.5
	Total of (A - F)	2,344.5
SF-2	Quinali (A) River System Sabo Project	
A.	Construction cost	753.5
B.	Government administration cost	37.7
C.	Engineering services cost	75.3
D.	Land acquisition cost	10.0
E.	Physical contingency	87.6
	Total of (A - E)	964.1
F.	Price contingency	948.7
	Total of (A - F)	1,912.8
SF-3	Buang River System Sabo Project	
A.	Construction cost	68.3
B.	Government administration cost	3.4
C.	Engineering services cost	6.8
D.	Land acquisition cost	0.9
E.	Physical contingency	7.9
	Total of (A - E)	87.3
F.	Price contingency	161.8
	Total of (A - F)	249.1
SF-4	San Vicente River System Sabo Project	
A.	Construction cost	433.0
B.	Government administration cost	21.7
C.	Engineering services cost	43.3
D.	Land acquisition cost	28.8
E.	Physical contingency	52.7
	Total of (A - E)	579.5
F.	Price contingency	879.9
	Total of (A - F)	1,459.4
SF-5	Padang River System Sabo Project	
A.	Construction cost	371.4
B.	Government administration cost	18.6
C.	Engineering services cost	37.1
D.	Land acquisition cost	86.4
E.	Physical contingency	51.4
	Total of (A - E)	564.9
F.	Price contingency	395.5
	Total of (A - F)	960.4

Table XI 3.11 Summary of Project Cost Proposed in the Master Plan (2/3)

Code No.	Description	Amount (Million PHP)
SF-6	Basud River System Sabo Project	
A.	Construction cost	263.5
B.	Government administration cost	13.2
C.	Engineering services cost	26.4
D.	Land acquisition cost	19.2
E.	Physical contingency	32.2
	Total of (A - E)	354.5
F.	Price contingency	230.4
	Total of (A - F)	584.9
SF-7	Bulawan River System Sabo Project	
A.	Construction cost	244.1
B.	Government administration cost	12.2
C.	Engineering services cost	24.4
D.	Land acquisition cost	20.7
E.	Physical contingency	30.1
	Total of (A - E)	331.5
F.	Price contingency	437.7
	Total of (A - F)	769.2
<i>River Improvement</i>		
RI-1	Yawa River Improvement	
A.	Construction cost	220.8
B.	Government administration cost	11.0
C.	Engineering services cost	22.1
D.	Land acquisition cost	15.7
E.	Physical contingency	27.0
	Total of (A - E)	296.6
F.	Price contingency	212.6
	Total of (A - F)	509.2
<i>Urban Drainage</i>		
UD-1	Legazpi City Urban Drainage Project	
A.	Construction cost	334.7
B.	Government administration cost	16.7
C.	Engineering services cost	33.5
D.	Land acquisition cost	15.7
E.	Physical contingency	40.1
	Total of (A - E)	440.7
F.	Price contingency	203.0
	Total of (A - F)	643.7
<i>Forecasting, Warning and Evacuation</i>		
FW-1	Strengthening of the Forecasting, Warning and Evacuation System	
A.	Construction cost	1,174.9
B.	Government administration cost	117.5
C.	Engineering services cost	176.2
D.	Physical contingency	146.9
	Total of (A - D)	1,615.5
E.	Price contingency	2,124.7
	Total of (A - E)	3,740.2

Table XI 3.11 Summary of Project Cost Proposed in the Master Plan (3/3)

Code No.	Description	Amount (Million PHP)
<i>Relocation/ Resettlement</i>		
RR-1	Relocation and Resettlement Projects	
A.	Construction cost	107.5
B.	Government administration cost	5.4
C.	Engineering services cost	10.8
D.	Physical contingency	12.4
	Total of (A - D)	136.1
E.	Price contingency	50.5
	Total of (A - E)	186.6
<i>Institutional and Supporting Services Strengthening</i>		
NP-1	Strengthening of the National and Regional Disaster Management System	
A.	Engineering services cost	18.4
B.	Government administration cost	1.8
C.	Physical contingency	2.0
	Total of (A - C)	22.2
D.	Price contingency	31.7
	Total of (A - D)	53.9
PP-1	Consolidation of the Provincial Disaster Management System	
A.	Engineering services cost	0.9
B.	Government administration cost	0.1
C.	Physical contingency	0.1
	Total of (A - C)	1.1
D.	Price contingency	1.1
	Total of (A - D)	2.2
PP-2	Province-wide Socio-economic Development and Monitoring	
A.	Engineering services cost	1.9
B.	Government administration cost	0.2
C.	Physical contingency	0.2
	Total of (A - C)	2.3
D.	Price contingency	3.3
	Total of (A - D)	5.6
CP-1	Community-based Disaster Management Strengthening	
A.	Engineering services cost	7.1
B.	Government administration cost	0.7
C.	Physical contingency	0.8
	Total of (A - C)	8.6
D.	Price contingency	2.7
	Total of (A - D)	11.3
CP-2	Livelihood Development and Supporting Projects and Programs	
A.	Engineering services cost	35.5
B.	Government administration cost	3.6
C.	Physical contingency	3.9
	Total of (A - C)	43.0
D.	Price contingency	11.6
	Total of (A - D)	54.6

Table XI 3.12 Annual O&M Cost (1/2)

Code No.	Description	Unit	Quantity	Unit Price (PHP)	Amount (Million PHP)
<i>Sabo Facility Construction</i>					
SF-1	Yawa River System Sabo Project				
(1)	Annual cost (0.5% of construction cost)	L.S.			5.0
(2)	Annual dredging cost	m3	23,600	90	2.1
	Total				7.1
SF-2	Quinali (A) River System Sabo Project				
(1)	Annual cost (0.5% of construction cost)	L.S.			3.8
(2)	Annual dredging cost	m3	79,600	90	7.2
	Total				11.0
SF-3	Buang River System Sabo Project				
(1)	Annual cost (0.5% of construction cost)	L.S.			0.3
	Total				0.3
SF-4	San Vicente River System Sabo Project				
(1)	Annual cost (0.5% of construction cost)	L.S.			2.2
(2)	Annual dredging cost	m3	16,200	90	1.5
	Total				3.7
SF-5	Padang River System Sabo Project				
(1)	Annual cost (0.5% of construction cost)	L.S.			1.9
(2)	Annual dredging cost	m3	5,300	90	0.5
	Total				2.4
SF-6	Basud River System Sabo Project				
(1)	Annual cost (0.5% of construction cost)	L.S.			1.3
(2)	Annual dredging cost	m3	4,300	90	0.4
	Total				1.7
SF-7	Bulawan River System Sabo Project				
(1)	Annual cost (0.5% of construction cost)	L.S.			1.2
	Total				1.2
<i>River Improvement</i>					
RI-1	Yawa River Improvement				
(1)	Annual cost (0.5% of construction cost)	L.S.			1.1
	Total				1.1
<i>Urban Drainage</i>					
UD-1	Legazpi City Urban Drainage Project				
(1)	Annual cost (0.5% of construction cost)	L.S.			1.7
	Total				1.7

Table XI 3.12 Annual O&M Cost (2/2)

Code No.	Description	Unit	Quantity	Unit Price (PHP)	Amount (Million PHP)
<i>Forecasting, Warning and Evacuation</i>					
FW-1	Strengthening of the Forecasting, Warning and Evacuation System				
(1)	Annual cost (7% of construction cost)	L.S.			82.2
	Total				82.2
<i>Relocation/ Resettlement</i>					
RR-1	Relocation and Resettlement Projects				
(1)	Annual cost (0.5% of construction cost)	L.S.			0.5
(2)	Land use fee for agriculture				
	1) Resettlement for people residing in 6km				
	- Camalig Municipality	ha	27.0	37,071	1.0
	- Legazpi Municipality	ha	16.5	37,071	0.6
	- Malilipot Municipality	ha	29.7	37,071	1.1
	- Tabaco Municipality	ha	18.9	37,071	0.7
	2) Resettlement for people due to implementation of the sabo project				
	- Yawa river system	ha	19.5	37,071	0.7
	- Quinali (A) river	ha	6.3	37,071	0.2
	- Buang river	ha	1.5	37,071	0.1
	- San vicente river	ha	2.4	37,071	0.1
	- Padange river	ha	11.4	37,071	0.4
	Total				5.4

Table XI 3.13 Project Cost for Resettlement Site Development Project

Work Item	Description	Unit	Quantity	Unit Price (Million PHP)	Amount (Million PHP)
A. Construction cost					
(1) Residential development					
1) Yawa river system		House	65	0.2	13.0
(2) Industrial development					
1) Yawa river system		ha	1.8	3.3	5.9
2) Banquerohan existing resettlement		ha	8.6	3.3	28.4
3) Anislag existing		ha	16.9	3.3	55.8
Total of A					103.1
B. Administration cost	5% of A	L.S.			5.2
C. Engineering services cost	10% of A	L.S.			10.3
D. Physical contingency	10% of (A+B+C)	L.S.			11.9
Grand Total					130.5

Table XI 3.14 Summary of Project Cost for the Priority Projects (1/2)

Code No.	Description	Amount (Million PHP)
<i>Sabo Facility Construction</i>		
SF-1	Yawa River System Sabo Project	
A.	Construction cost	998.7
B.	Government administration cost	49.9
C.	Engineering services cost	99.9
D.	Land acquisition cost	341.5
E.	Physical contingency	149.0
	Total of (A - E)	1,639.0
F.	Price contingency	705.5
	Total of (A - F)	2,344.5
<i>Urban Drainage</i>		
UD-1	Legazpi City Urban Drainage Project	
A.	Construction cost	334.7
B.	Government administration cost	16.7
C.	Engineering services cost	33.5
D.	Land acquisition cost	15.7
E.	Physical contingency	40.1
	Total of (A - E)	440.7
F.	Price contingency	203.0
	Total of (A - F)	643.7
<i>Forecasting, Warning and Evacuation</i>		
FW-1	Strengthening of the Forecasting, Warning and Evacuation System	
A.	Construction cost	494.5
B.	Government administration cost	49.5
C.	Engineering services cost	74.1
D.	Physical contingency	61.8
	Total of (A - D)	679.9
E.	Price contingency	266.4
	Total of (A - E)	946.3
<i>Resettlement Site Development</i>		
RS-1	Resettlement Site Development Project	
A.	Construction cost	103.1
B.	Government administration cost	5.2
C.	Engineering services cost	10.3
D.	Physical contingency	11.9
	Total of (A - D)	130.5
E.	Price contingency	48.5
	Total of (A - E)	179.0

Table XI 3.14 Summary of Project Cost for the Priority Projects (2/2)

Code No.	Description	Amount (Million PHP)
<i>Institutional and Supporting Services Strengthening</i>		
NP-1	Strengthening of the National and Regional Disaster Management System	
A.	Engineering services cost	6.1
B.	Government administration cost	0.6
C.	Physical contingency	0.7
	Total of (A - C)	7.4
D.	Price contingency	1.2
	Total of (A - D)	8.6
PP-1	Consolidation of the Provincial Disaster Management System	
A.	Engineering services cost	0.5
B.	Government administration cost	0.1
C.	Physical contingency	0.1
	Total of (A - C)	0.7
D.	Price contingency	0.2
	Total of (A - D)	0.9
PP-2	Province-wide Socio-economic Development and Monitoring	
A.	Engineering services cost	0.7
B.	Government administration cost	0.1
C.	Physical contingency	0.1
	Total of (A - C)	0.9
D.	Price contingency	0.3
	Total of (A - D)	1.2
CP-1	Community-based Disaster Management Strengthening	
A.	Engineering services cost	6.7
B.	Government administration cost	0.7
C.	Physical contingency	0.7
	Total of (A - C)	8.1
D.	Price contingency	1.7
	Total of (A - D)	9.8
CP-2	Livelihood Development and Supporting Projects and Programs	
A.	Engineering services cost	33.6
B.	Government administration cost	3.4
C.	Physical contingency	3.7
	Total of (A - C)	40.7
D.	Price contingency	8.6
	Total of (A - D)	49.3