APPENDIX-XII

Economic Evaluation

THE STUDY ON SABO AND FLOOD CONTROL
FOR WESTERN RIVER BASINS OF MOUNT PINATUBO
IN THE REPUBLIC OF THE PHILIPPINES

FINAL REPORT

SUPPORTING REPORT

APPENDIX XII ECONOMIC EVALUATION

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CHAPTER 1 CRITERIA, ASSUMPTIONS AND METHODOLOGY

1.1 Definition of Project Benefit

The benefit to be obtained by implementing the Project is defined as the reduction of direct and indirect damage resulting from flood and mudflow. The probable direct damage has been estimated under without project conditions at the end of 2001. Probable indirect damage has also been described and estimated under without project conditions in 2002.

The damage expected to occur under with-project conditions is assumed to be zero under a design flood of a 20-year return period or less. Therefore the project benefit is equivalent to the probable damage to be caused by flood and mudflow of a 20-year return period or less.

Project benefits and costs, estimated in financial terms, have been converted to economic values by applying conversion factors.

1.2 Direct Damage

1.2.1 Methodology

In estimating the value of damageable properties in the probable inundation area, a Barangay Database was established in the GIS (Geophysical Information System). All the data needed for estimating damage including the area, farmland, population, number of households, number of buildings and infrastructure such as roads and bridges, and irrigation canals of each barangay were input into this database.

The probable inundation areas were specified for the three river basins from a hydrological simulation study for return periods of 2, 5, 10, 20, 50 and 100 years.

Damage curves were generated for major types of property such as residential buildings, non-residential buildings, fields for paddy, and infrastructure including roads and bridges. Damage curves were generated for the hazards of flooding, sediment and lahar, indicating the depth of each hazard. The damage curves established in the JICA East Pinatubo River Basin Study[1] undertaken in 1996 were referred to in generating these curves. Figure 1.2.1 shows the damage curves developed in the JICA East Pinatubo Study.

Of the three damage curves, for flooding, sediment and lahar, the damage curves for lahar were applied for the evaluation based on the actual observations of damage at the damage prone areas in the Sto. Tomas and Bucao Rivers.

Figure 1.2.2 shows photographs of the flooding area due to the breach of the left dike at the downstream portion of the Sto. Tomas River, which occurred on 23 July 2002. Since the entire stretch of the river bed is much higher in elevation than the land protected by the dike, after the dike breached a considerable amount of lahar deposits from within the river area was spread over the prone area through flooding. After the flood had receded from the prone area, lahar of more than 1 meter depth remained over the entire flooded area. All the houses needed reconstruction and the damaged farm lands and fishponds can no longer be used without excavation.

The probable inundation areas and damage curves were then combined and overlaid on to the Barangay

[1] The Study on Flood and Mudflow Control for Sacobia-Bamban/Abacan River Draining from Mt. Pinatubo 1996, funded by JICA.

Database to generate percentage damage figures for each barangay for each property type and were aggregated by municipality.

The unit value of each type of damageable property was either derived from information obtained during the study or taken from the above East Pinatubo River Basin Study and then adjusted by the actual or projected changes in market prices. The choice was made by assessing the relative reliability of the two sets of data.

The method of identifying and estimating damageable unit values is explained in the following paragraphs.

1.2.2 Buildings

Individual building types could not be identified from the inundation study. Thus the distribution of building types and values were built into the unit value to be applied. The inundation of one building was assumed to be the partial inundation of residential buildings and the identified types of non-residential buildings.

Currently, the distribution of residential and non-residential buildings in building numbers with average unit value (or average floor area from which average unit value can be calculated) is not known. Therefore, some broad assumptions have had to be made.

First, it is assumed that the number of residential buildings in the 7 municipalities where inundation may occur[2] equals the number of households, which is 42,661[3]. Second, that the number of public buildings is equal to 1% of residential buildings which equals 427, or about 430 buildings. Third, it is assumed that the number of commercial, industrial and other non-residential buildings is calculated to be 1,363. This comprises totals for the 7 municipalities[4] as follows:

- Up to 1983, establishments for:
  - Trading = 772,
  - Services = 244,
  - Financing, insurance, real estate and business service = 46 (estimated from partial data),
  - Electricity, gas and water services = 4,
- Up to 1993, establishments for:
  - Manufacturing = 196,
- From about 1980 to 1995, additional establishments in:
  - Industry and services sectors = 63

The total for the above sectors to mid-1990s equals 1,325. Growth since the mid-1990s is assumed to be equal to the annual growth of 0.4% from 1980 to 1995, which gives a 2002 total of 1,363 establishments. Unfortunately, this total does not take into account those establishments not registered with the Department of Trade and Industry (DTI), which may be a significant but unavoidable omission.

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[2] Botolan, Cabangan, Castillejos, San Antonio, San Felipe, San Marcelino, San Narciso.
[3] From the 2000 Census of Population and Households.
[4] Data from DTI, Zambales Provincial Office, Iba. Information extracted from IEE Report for Sabo and Flood Control Project in Major Three Western River Basins of Mount Pinatubo prepared by JBJ Consulting Inc. dated 31 July 2002. The JBJ survey was conducted on 8 municipalities, the 7 considered here plus Iba, the provincial capital.

From this preliminary assessment, we can conclude that in the seven municipalities:

- Total number of buildings = 44,454 of which
  - 42,661 are residential buildings (96.0% of total)
  - 430 are public buildings, and (1.0% of total)
  - 1,363 are industrial, commercial or services buildings (3.0% of total).

The next step is to obtain unit values for these three categories of building.

(1) Initial Attempt to Value all Buildings

From the Provincial Assessor's Office, two years of all new building assessments for all eight municipalities were obtained; these are said to be mainly residential and include some improvements. Results are given in Table 1.2.1.

Compared with the value computations for residential property (see (b) below), these values seem low. This may be due to lower value improvements and few larger buildings during the 2-year period.

Other relevant information supplied by the Provincial Assessor included:

- Market values are about 40% above the assessed values for residential and commercial buildings;
- No depreciation is applied to new buildings (e.g. the above assessments). But for older buildings the average depreciation would be in the range 32% to 40%;
- Commercial land has the highest premium over assessed value: e.g. up to P800/m^2 assessed value could go as high as P3,000 to P4,000/m^2;
- Schools are not assessed as they are tax exempt
- Lists of assessed values are increased by around 40% every 3 to 5 years (should be 3 years).

(2) Residential Buildings

From the JBJ HH survey of types of housing and house areas[5], and the Provincial Assessor's assessed values for various types of property based on values per square meter (see Table 1.2.2), the following was produced:

i) Weighted assessed unit value per dwelling of P4,805/m^2 (see Table 1.2.3 for derivation);

ii) Average floor area (as reported by survey respondents) of 56.9m^2 (see Table 1.2.4 for derivation);

iii) Therefore, the assessed value of an average residential property = P4,805*56.9 = P273,405;

iv) Therefore, the average residential property market value = P273,405*1.4 = P382,767;

v) If iii) is depreciated by the average 36%[6], the depreciated assessed value of an average residential property = P273,405*.64 = P174,979;

vi) If iv) is depreciated by the average 36%, the depreciated market value of an average residential property = P382,767*.64 = P244,971.

This average assessed figure of P273,405 is far greater than most of the Total Assessed Value (TAV)/building figures in Table 1.2.1 which are said to include some commercial property. The

[5] Information extracted from IEE Report for Sabo and Flood Control Project in Major Three Western River Basins of Mount Pinatubo prepared by JBJ Consulting Inc. dated 31 July 2002. The JBJ survey was conducted on 8 municipalities, the 7 considered here plus Iba, the provincial capital.

[6] From Provincial Assessor's Office

TAV/building figures were therefore ignored for developing unit value information.

The East Pinatubo Study[7] gave a 50% depreciated value of P51,000 equivalent to a gross value of P102,000 in 1995. If this is increased by the estimated rate of inflation since 1995 (about 53% in Region 3) the gross value becomes P156,060.

(3) Non-residential Buildings

The unit value for a non-residential building depends on the average floor area, the unit value/m^2 and the application of a mark-up estimated to be about 40% to reach the market value. To date, separate floor areas for public and other non-residential buildings could not be obtained. For buildings of classes (8) to (17) of average type IIA (see Table 1.2.2), which is close to the residential average determined by survey, the average assessed value would be P3,774/m^2 increased by 40% to a market value of P5,284/m^2. Applying this figure to an estimated average floor area of 200m^2 gave a unit value of P1,056,800 for all non-residential property. This figure is just under three times the unit value for residential property.

The value applied for economic valuation is therefore P676,352/building taking into account the depreciation of 36% as follows:

P1,056,800*(1-0.36) = P676,352.

In the East Pinatubo Study, a non-residential building was valued at P265,000 after 50% depreciation which equals P530,000 gross in 1995. Current value would therefore be about 530,000*1.53 = P810,900. This value is about 5 times the East Pinatubo gross residential value of P156,060 in (b) above.

(4) Household effects

From the HH survey of household appliances ownership, and the study estimate of new prices (see Table 1.2.5), the un-depreciated value was found to be P40,652/household.

The East Pinatubo Study valued household effects in 1995 at P14,000/building after 50% depreciation which equals P28,000 gross. Therefore the estimated present gross value would be 1.53*28,000 = P42,840.

(5) Inventory and equipment for non-residential buildings

No information was obtained through this study.

The East Pinatubo Study valued in 1995, after 50% depreciation, inventory and equipment for non-residential buildings at P143,000/building. If grossed up and increased for inflation, the resultant value would be P437,580/building.

1.2.3 Agricultural Crops and Livestock

Unit prices applied were based on farm prices in Zambales Province. These were compared with values from the East Pinatubo Study after adjustment to allow for the interval between the date of that study and the present one. Livestock damage was estimated by applying an average livestock value per household to damaged buildings.

[7] The Study on Flood and Mudflow Control for Sacobia-Bamban/Abacan River Draining from Mt. Pinatubo – funded by JICA and undertaken by Nippon Koei Co., Ltd. in association with CTI Engineering Co., Ltd.

(1) Paddy

The average farm price for paddy from January to June 2002 was calculated by the study team to be P9.78 Pesos/kg[8]. The average yield of paddy per hectare in Region 3 for 2000 was 3.56 tons/ha[9]. From these figures, the average farm price per hectare for damageable paddy crop was assumed to be 9.78*1,000*3.56 which equals P34,817/ha.

The East Pinatubo Study gave a value per hectare in 1995 of P12,650 which, after increasing for an estimated 15% increase in paddy prices since 1995, increases to P14,548/ha. The reason for the large difference in the two estimated prices is not known.

(2) Livestock

From the JBJ HH survey of 274 households[10], no data specific to types of livestock could be derived. However, an inspection revealed the following approximate valuation of livestock for responding households based on owner information. It was assumed that non-respondents have no livestock:

Livestock Valuation per Household from Owner Survey

Municipality	Value per HH owning l/stock (1,000 pesos)	Percentage of HH owning livestock (plus total HH in sample)	Average value per total HH (1,000 pesos)
Botolan	8	63 (40)	5.0
Cabangan	35	85 (40)	29.8
Castillejos	30	88 (34)	26.4
San Antonio	15	70 (40)	10.5
San Felipe	20	35 (40)	7.0
San Marcelino	20	70 (40)	14.0
San Narciso	15	75 (40)	11.3
TOTAL	4,000*	(274)	14.6

Note: *Total value of all livestock declared in survey

From this table, the average value of livestock for every household – assumed to be equivalent to a residential building – in the seven municipalities would be P14,600 per household.

1.2.4 Infrastructure

(1) Roads and Bridges

Unit values provided by DPWH for constructing national and local roads and bridges appear in the table below[11].

[8] Sources of data were (1) Farm Prices Provincial Validation for Q1 2002, and (2) Farm Prices Survey Provincial Summary for April to June 2002; both documents issued by Bureau of Agricultural Statistics, Region 3.
[9] 2001 Philippine Statistical Yearbook
[10] 274 households in the 7 municipalities that are subject to inundation.
[11] This construction cost increase of up to 22% per annum seems at variance with the low annual WPI for construction materials in Metro Manila of about 2.6%

Average Unit Cost for Road & Bridge Construction (Pesos/meter)

Category/ Level of improvement	Year 2002	2003
National Roads		
Rural Roads		
Concrete	9,500	10,000
Asphalt	6,400	6,700
Gravel	4,100	4,300
Urban Roads		
Concrete	11,600	12,200
Asphalt	8,700	9,200
Local Roads		
2-Lane Roads		
PCC	8,280	
Asphalt	5,980	
Gravel	3,640	
National Bridges		
Permanent Construction		
Steel	410,000	431,000
Pre-stressed concrete girder	330,000	348,000
Reinforced concrete deck girder		
Reinforced concrete box culvert		
Flyover		
Temporary Construction		
Bailey (with permanent structure)	170,000	180,300
Timber	150,000	160,400
Footbridge (suspended)	13,000	14,000
Local Bridges (2-Lane)		
Reinforced concrete deck girder	190,000	
Pre-stressed concrete girder	280,000	

Source: DPWH

Additional values are available for the improvement of national roads only.

However, in this study, the following unit values (which are usually less than 50% of DPWH new construction costs, and in the case of bridges, much less) are applied referring to the East Pinatubo Study. This is because flood damage is considered to be partial only:

Road

National Road: P2,940/l.m. **[[E Pinatubo +68%]]**

Other Roads: P2,353/l.m. **[[E Pinatubo +68%]]**

Bridge

National Bridge P100,800/l.m. **[[E Pinatubo +68%]]**

Other Bridges P84,000/l.m. **[[E Pinatubo +68%]]**

(2) Irrigation System

As the study team did not access any separate data, that of the East Pinatubo Study is given. The cost, increased by the rate of CP inflation (53%) since 1995, is P979/meter.

1.2.5 Summary of Direct Benefits

The following table summarizes the value of direct damage for the base year of 2002:

Summary of Direct Damage Values (Pesos)

Direct Damage	Value	
1 Buildings		
1.1 Residential	244,971	/ house
1.2 Non-residential	676,352	/ building
1.3 Household effects	40,652	/ house
1.4 Inventory and equipment (non-residential)	437,580	/ building
2 Agricultural crops and livestock		
2.1 Paddy	34,817	/ ha
2.2 Livestock	14,600	/ household
3 Infrastructure		
3.1 National roads	2,940	/ l.m.
3.2 Other roads	2,353	/ l.m.
3.3 National bridges	100,800	/ l.m.
3.4 Other bridges	84,000	/ l.m.
3.5 Irrigation facilities	979	/ l.m.

1.3 Indirect Damage

In this study, indirect damage refers to secondary damage and cost resulting from flood and mudflow, such as:

- additional transport cost incurred because of long detours due to existing bridge and road closures,
- loss of product (output) due to the interruption of economic activity,
- the cost of evacuating people, and
- cleaning up buildings after the event.

1.3.1 Additional Transportation Cost

The probable additional cost of transportation due to forced detours caused by flooding of roads and bridges was computed for bridges and roads separately. This was done using the distance, duration and frequency of the detour, and from vehicle operating cost. The following information was needed for the computation of this cost:

i) Alternative routes which would be used for the closure of each major bridge and road, for each origin-destination journey. This calculation did not have to include the probability of certain routes being impassable (or preferable) during particular times of the year. The distance, average duration and frequency[12] of each detour was also needed;

ii) The average number of each major type of vehicle making each origin-destination journey during the base year of 2002[13];

iii) The operating cost of each major type of vehicle;

The value of drivers' and passengers' time was not considered in this computation.

[12] The number of days per year when the detour is needed.

[13] No specific increase of vehicles has been included in the projection of indirect benefits to 2033, although the study team have forecast traffic volumes to increase by an average of more than 5% per annum until 2017. However, a real increase (+2%) of R3 GRDP has been applied to all damageable assets and indirect benefits (see section 1.5 of this chapter).

For this study, two main detours were proposed to bypass inundations between San Marcelino and Iba, causing either bridge failure or road closure. For traffic traveling from Olongapo to Iba, the detour would have to pass through San Fernando, Tarlac and Lingayen and would involve an additional distance of 279 km. For travel between San Fernando and Iba, the detour would also pass through Tarlac and Lingayen, the additional distance being 145 km.

Traffic volumes for four types of vehicle were measured at five locations between San Marcelino and Iba. The AADT[14] was projected (at about 5.4% per annum for all vehicles) for each vehicle type to 2017 at each of the three bridges.

Two sets of additional transportation costs were calculated: 1) for failure of each of the three bridges over the Sto. Tomas, Maloma and Bucao rivers, and 2) for additional inundation by flood and mudflow from the three rivers, rendering the road between San Marcelino impassable to traffic.

Other assumptions were made in the computation, including:

- 70% of traffic travels from Olangapo to Iba, the rest from San Fernando to Iba;
- Vehicle operating costs in pesos/km were obtained from a DPWH Feasibility Study undertaken in 2002 as follows: car/pickup = 6.262, jeepney = 5.804, bus = 19.036, and truck = 14.921;
- Bucao and Maloma Bridges would break under floods of more than 20-year return period; Maculcol Bridge over the Sto. Tomas River under floods of more than 10-year return period;
- In the case of bridge failure, a temporary steel bridge would be constructed over a period of 10.5 months including 4 months for material procurement.
- Some cancellation of journeys, especially on the longer detour from Olangapo to Iba.

From the calculations shown in Tables 1.3.1 and 1.3.2, the most probable additional annual transportation costs due to failure of bridges over the three rivers are:

- P176.8 million (Bucao); P41.6 million (Maloma); P218.3 million (Sto. Tomas); totaling some P436.7 million.

From the calculations shown in Tables 19.1.7 and 19.1.10, the most probable additional annual transportation costs due to road inundation by flood/mudflow from the three rivers (occurring before or after the above damaged bridges are repaired) are:

- P10.6 million (Bucao); P5.1 million (Maloma); P9.5 million (Sto. Tomas); totaling some P25.2 million.

1.3.2 Loss of Non-agricultural Production

The loss of production through interruption of economic activity caused by flood and mudflow was estimated from the per capita non-agricultural Region 3 GRDP multiplied by the number of people affected in urban areas. The information needed for this purpose includes:

- Non-agricultural GRDP for Region 3 at constant price for base year 2002;
- Total and urban population for Zambales Province and Region 3 for base year 2004;
- Duration of interruption of economic activities for each of the three rivers in the study area;
- Most probable number of households affected at different levels of inundation for a 20-year return period or less.

[14] Annual Average Daily Traffic.

Loss of production in the agricultural sector was not considered as this was already included in the loss of agricultural crops calculation.

Tables 1.3.5 and 1.3.6 show, respectively, the calculations used to derive the non-agricultural GRDP loss for the three rivers, and the base data used. The resulting non-agricultural GRDP losses, projected for the base year 2004, are:

- P2.60 million (Sto. Tomas); P0.10 million (Maloma); P0.93 million (Bucao); totaling some P3.63 million.

1.3.3 Evacuation Cost

Evacuation cost to be incurred through flood and mudflow depends on the number of households, the period of evacuation and the unit evacuation cost. The information used included:

- Unit cost for evacuation of one household, assumed to be P330 per week15;
- The number of households from a count of heavily damaged buildings. This information was assumed to be the most probable number of buildings inundated under a 20-year return flood;
- The evacuation period was assumed to be one week. The East Pinatubo Study used 10 weeks for a lahar event, and one week for a flood event.
- The calculation of most probable annual cost is shown in Table 1.3.7 with results as follows:
- P106,500 (Sto. Tomas); P31,500 (Bucao); P2,500 (Maloma); totaling P140,500.

1.3.4 Emergency Cleaning Cost

Emergency cleaning cost is the cost needed to clean up damage from flood and lahar. This cost is estimated from the product of the period expended, unit cost and the number of buildings cleaned. The expended periods for various levels of inundation are taken from Japanese Government data[16] and are shown in Table 1.3.8 along with other assumptions and calculations. Unit cleaning cost is assumed to be 230 pesos per day[17]. The number of buildings cleaned is equal to the number inundated to a depth of 50 cms or more multiplied by the estimated probability of inundation.

The most probable annual costs from Table 1.3.8 are:

- P1.43 million (Sto. Tomas); P0.12 million (Maloma); P1.06 million (Bucao); totaling P2.60 million.

1.3.5 Development Benefit and Value of Damageable Assets

In this study, the specific computation of development benefit arising from the increased value of land and other assets and the use of such land for investment projects has not been undertaken. Instead, a broader and probably more conservative approach has been adopted.

Socio-economic conditions in the study area and even the flood prone areas will be improved in line with the real growth of the regional economy. In this case, damageable assets would increase in real value along with the growth of socio-economic conditions. Therefore, the flood mitigation benefit

[15] Based on a similar cost of P216 per week in 1995 from the East Pinatubo Mud & Flood Control Study, plus 53% from the increase in CPI to 2002.
[16] Manual for Economic Study on Flood Control, 1999, Ministry of Land, Infrastructure and Transport, Japan
[17] Derived from 150 pesos per day used in the East Pinatubo Study in 1995 plus 53% from the increase in CPI to 2002.

would increase, and could be estimated using a regional socio-economic projection. Such a projection would be based on population increase, improvement of people's living standard, and real growth of economic activity in the various sectors.

It is proposed that real growth of regional GDP projected to 2020[18] should be used in the computation of direct and indirect benefits to be used in the economic evaluation of the project and specifically for deriving the EIRR. A conservative increase of +2.0% has been adopted, based on an extension of the NEDA Medium Term Development Plan 2001 to 2004.

1.3.6 Indirect Benefit in Aggregate

The following table summarizes the most probable annual indirect benefits for the base year 2002 discussed above.

Summary of Annual Indirect Benefits

(Unit: Million Pesos)

Benefit	Bucao	Maloma	Sto Tomas	Total
Additional transportation cost	176.8 (bridge) 10.6 (road flood)	41.6 (bridge) 5.1 (road flood)	218.3 (bridge) 9.5 (road flood)	436.7 (bridge) 25.2 (road flood)
Non-agricultural production loss	0.9	0.1	2.6	3.63
Evacuation cost	0.0	0.0	0.1	0.1
Cleaning cost	1.1	0.1	1.4	2.6

1.4 Conversion Factors for Real Economic Values

1.4.1 Transfer Payments

Market values are usually distorted by transfer payments such as taxes and subsidies. These payments are transferred to the government which acts on behalf of society. Therefore they should not be treated as costs and should be eliminated from the market values of both costs and benefits. In the Philippines, the taxes applied to construction work are as follows: value added tax (VAT), excise tax, income tax, customs duties, tax on sand, gravel and quarry resources, various local taxes, etc. The overall tax rates on major materials and services are shown in Table 1.4.1.

1.4.2 Shadow Wage Rates

Wages of skilled workers are considered to reflect an opportunity cost of labor, because these workers are not generally in surplus. Therefore, the shadow wage rate of skilled workers is assumed to be equal to the actual wage rate. On the other hand, unskilled workers are generally in excess. For this reason the shadow wage rate of unskilled workers is assumed to be 0.6 of actual wage rates.

1.4.3 Shadow Foreign Exchange Rates

It is understood that there are some distortions in the present foreign exchange rate due to balance of payments imbalance and protection structures in the country. In this study, the shadow exchange rate is assumed at 1.2 of the prevailing exchange rate, as recommended in "ICC Project Evaluation Procedures

[18] As adopted in the Lower Cagayan Flood Control Study Final Report dated February 2002.

and Guidelines" by NEDA. This rate is applied to imported materials and services. The import portions of major construction materials are enumerated in Table 1.4.2.

1.4.4 Conversion Factors

The material costs were nominally segregated into the following proportion of foreign and local portions, using NEDA information.

Item	Local Portion	Foreign Portion
1. Materials		
Cement	0.3	0.7
Aggregate (Coarse and Fine)	0.6	0.4
Steel	0.2	0.8
Fuel and Lubricant	0.3	0.7
Lumber	0.6	0.4
2. Machinery and Equipment Rental	0.3	0.7
3. Labor	1.0	0.0
4 Administration Cost	1.0	0.0
5. Engineering Cost	0.1	0.9

To convert financial market value to real economic value, conversion factors are set up in respect of the elements discussed in paragraphs 1.4.1 to 1.4.3 above. Taking account of the foreign and local composition, the conversion factors corresponding to the above cost categories were summarized as follows. The details of the factors were broken down in Table 1.4.1 to 1.4.3.

Item	Local/Foreign Separate Estimate		Local/Foreign Combined Estimate
	Local Portion*1	Foreign Portion	
1. Materials			
Cement	0.51	1.06	0.89
Aggregate (Coarse and Fine)	0.68	1.04	0.83
Steel	0.23	1.06	0.90
Fuel and Lubricant	0.38	1.06	0.85
Lumber	0.79	1.01	0.88
Others	0.72	1.05	0.88
2. Machinery and Equipment Rental	0.27	1.13	0.87
3. Labor			
Skilled	0.93	-	0.93
Unskilled	0.60	-	0.60
4. Indirect Costs			
Overhead, contingencies and miscellaneous (OCM)	0.86	-	0.86
Profit	0.65	-	0.65
Value Added Tax*2	0.00	-	0.00
5. Government Expenditure*3	0.95	-	0.95
6. Engineering Service*4	-	1.22	1.10
7. Standard Conversion Factor	-	-	0.85

Note: *1 Including all taxes national and local in the Philippines
*2 Imposed on item numbers of (2) and (3) only in this form.
*3. For engineering and administrative overhead

*4 Detailed design and supervising services by foreign consultants

All market values not included in the above table are converted to economic costs by applying a standard conversion factor (SCF) of 0.85. Thus these economic values are assumed to be 85% of the financial values.

1.4.5 Economic Costs

The construction costs estimated in Section 10.3 were based on market prices, that is are financial costs. For the derivation of economic rates of return these costs must be converted to economic costs. For the conversion of financial costs, direct construction costs have been divided into machinery and equipment rental, materials (with some subdivision of materials), labor (skilled and unskilled), and indirect costs (VAT, overheads). Conversion factors for deriving economic costs were discussed in Sections 1.4.1 to 1.4.4 above.

The results of the conversion are given in detail in Table 1.4.4 and are summarized in the table below.

Project Economic and Financial Costs (Million Pesos)

Sub-project	Equipment	Labor	Material	Overhead*[1]	Total*[2]
Financial Cost					
Dike Construction	189.97	66.65	296.57	137.45	690.62
Diversion Channel	5.76	4.35	29.58	8.99	48.68
Maintenance Road	0.93	0.22	1.08	0.56	2.79
Bucao Bridge	71.80	61.13	136.56	71.60	341.09
TOTAL	268.46	132.34	463.78	218.59	1,083.18
Economic Cost					
Dike Construction	165.28	50.69	258.00	95.60	569.56
Diversion Channel	5.01	3.27	25.77	6.81	40.86
Maintenance Road	0.81	0.16	0.94	0.38	2.30
Bucao Bridge	62.47	50.68	120.58	50.62	284.34
TOTAL	233.56	104.80	405.29	153.40	897.00

Notes: *[1] Including VAT. *[2] Totals may not equal sum of constituent figures due to rounding.

The overall economic cost is calculated at 82.8% of the financial cost for the structural measures on the Bucao River. Accordingly, 82.8% of economic conversion factor was applied for the economic evaluation for the structural measures.

Based on the above, the economic costs for the structural measures are estimated as follows:

Estimated Economic Cost for Structural Measures

(Unit: 1,000 Pesos)

No.	Item	Bucao River	Sto.Tomas River	Remarks
1	Civil Work	1,034,500	1,192,128	
2	Land Acquisition & Compensation	44,878	37,988	
3	Administration	31,035	35,764	
4	Engineering Services	165,520	190,741	
5	Sub Total (1 to 4)	1,275,933	1,456,622	
6	Physical contingency	152,546	178,147	
7	Base Cost (5+6)	1,428,479	1,634,750	
8	Economic Conversion Factor	82.8%	82.8%	
9	Economic Cost (8 x 0.828)	1,182,780	1,353,573 (1,624,229)*1	*1) Including economic cost for Maculcol Bridge

Notes: Land acquisition and compensation cost were included in economic cost based on the comments from NEDA.

1.4.6 Economic Benefits

In accordance with the discussion in Sections 1.4.1 to 1.4.4 above, direct and indirect financial benefits are converted to economic benefits by applying the conversion factor of 85%; that is, economic benefits are 85% of financial benefits.

1.4.7 Economic Evaluation

The proposed flood/mudflow control measures for the Bucao and Sto. Tomas Rivers will be implemented to prevent flooding and mudflow spreading to the flood/mudflow prone areas and also to improve the safety conditions along the National Highway No.7. All the bridges across the rivers need to be re-constructed, together with the proposed dike raising or river widening. Accordingly, the cost of re-construction of the Bucao and Maculcol Bridges was included in the cost of structural measures for flood and mudflow control. It is noted that the re-construction of the Maculcol Bridge across the Sto. Tomas River was not selected as priority project, as the project have been committed by the Government of Philippines for implementation, which is only for economic evaluation.

The calculation sheets of economic internal rate of return are shown in Tables 1.4.4 and 1.4.5 and are given as follows:

Summary of the Results of the Economic Evaluation for Structural Measures

River	Structural Measure	Project Cost (Million Pesos)	EIRR
Bucao	Dike Raising / Strengthening including re-construction of Bucao Bridge	1,678 (Equivalent to US$ 33.2 million)	16.6%
Sto. Tomas	Dike Raising / Strengthening	1,960 (Equivalent to US$ 38.5 million)	27.0%

For the Bucao River, it is evaluated that the proposed flood/mudflow control works including re-construction Bucao Bridge is feasible in the economic viewpoint. The IRR is estimated at 16.6%, which is beyond the NEDA's criteria of 15%. In this case, bridge component is the most beneficial aspect, which provides high value of indirect benefit of the project. If the bridge component is removed

from the project, the IRR for the Bucao River Flood/Mudflow Control drops to 11.1%.

For the Sto. Tomas River, the proposed flood/mudflow control measure is highly feasible with 27% of economic internal rate of return. The damage prone area was reasonably wide and more than 5,000 HH will be protected against further mudflow damages.

1.5 Economic Evaluation for Non-Structural Measures and Community Disaster Prevention Plans

The results of the economic evaluation of the proposed non structural measures and community disaster prevention plans are summarized as follows:

Economic Evaluation for Non-Structural Measures and Community Disaster Prevention Plans

Proposed Projects	Project Cost (Million Pesos)	EIRR
GSM telemetry warning and improvement of evacuation system (including monitoring system of Maraunot Notch)	82 (Equivalent to US$ 1.6 million)	N.A.
Community-Based Forest Management (for Pilot Scheme of 2,200 ha)	76 (Equivalent to US$ 1.5 million)	21.5%
Agriculture Development on Lahar Area (for Pilot Scheme of 20 ha)	19 (Equivalent to US$ 0.38 million)	9.8%
Community Road Rehabilitation Project (Priority Scheme for Route-A1:16km)	189 (Equivalent to US$ 3.7 million)	2.1%
Establishment of Aeta Assistance Station (Pilot Scheme for FOCUS Project)	15 (Equivalent to US$ 0.30 million)	N.A.

For the GSM telemetry warning and evacuation system, the objective of the project is to secure human life against the further disasters. Since the project objective is to mitigate the damage of human life, it is rather difficult to quantify the benefit as monetary values. According to the JICA's Manual for Economic Evaluation for Flood Control and Sabo Project, it is suggested that the effect to mitigate the damage to human life should not be counted as the benefit because of the following reasons:

1) To prevent human life from the disaster is one of important objectives of flood control and sabo project. However, evaluation for the mitigation effect on human life as monetary value is generally not an acceptable approach,
2) The number of death due to disaster is much dependent on the natural and social factors, and it is difficult to estimate the number of death persons with /without the project.

Considering the above, the economic benefit for warning and evacuation system is not counted in the feasibility study, and the warning and evacuation system is defined as the basic human needs particularly for such areas as severe disasters were experienced.

For the community based forest management project, the following three kind of economic benefit are taken into account:

1) Stumpage value for controlled tree cutting,
2) Sales of agro-forestry produce,
3) Prevention of sediment yield in the watershed.

The unit value of the benefit is as follows:

Unit Value for Community Based Forest Management Project

1	Stumpage value	P11,194/ha /year
2	Sales of agro-forestry produce	P36,226/ ha / year
3	Prevention of sediment yield	P2,086 /ha/year

Table 1.5.1 shows the calculation sheet for EIRR estimation, in which the EIRR is estimated at 21.5%. Accordingly, Community Based Forest Management Program is judged as feasible in terms of economic aspect.

For the lahar agricultural development as a livelihood program, the sales of agriculture produce are considered as the project benefit. Since the pilot project areas are defined as the downstream area of the Bucao and the Sto. Tomas Rivers, cash crops such as onion and sweet potato are assumed to be planted. The required land development, soil improvement and river training activities are taken into account the cost for the project. Based on this, the EIRR is estimated at 9.8% as summarized below and shown in Table 1.5.2.

Summary of Cost / Benefit, Economic Evaluation

No.	Location	Barangay	Area (ha)	Project Cost (million Pesos)	Annual Benefit (million Pesos)	EIRR	Cropping Pattern (Assumed)
1	Bucao-d/s-2 (L)	San Juan	120	105.8	81.3	11.6%	Sweet potato
2	Sto. Tomas, middle (L)	San Rafael	250	220.5	253.9	16.9%	Onion
3	Pilot Scheme of 1&2		20	17.6	16.9	14.3%	

For community road development on the Bucao River basin, time saving for traveling is considered as the benefit. In the Upper Bucao River basin, the estimated population is about 11,000 people, which is considered as to receive the direct benefits. The average time saving by community road development is assumed 3 hours, as they have so far no access road and they usually travel by carabao cart or by foot along the lahar buried river channel. The EIRR is then calculated at 2.1% as shown in Table 1.5.3, which is evaluated as non-feasible in terms of economic viewpoint.

For establishment of Aeta Assistance Station, the cost for further study and pilot scheme is considered. No economic return is so far considered as the project aims to preserve the tradition and culture of Aeta People, originated in Mount Pinatubo area.

1.6 Overall Project Evaluation

Based on the economic evaluation and poverty reduction analysis, it is understood that the even though the economic viability is rather low, some projects, such as community road rehabilitation, and establishment of Aeta Assistance Station, are quire important in the view of comprehensive development viewpoint. In addition, since the economic viable projects are generally located in the downstream reach of the river basin, the projects might be realized only at the downstream area if only respective economic evaluation is focused to judge the projects. This might result in selective investment only for the areas where the relatively high level of economy is observed, and then the economic gap would be expanded within the same river basin.

In natural basin-wide viewpoints also, the river basin activities should cover the whole basin, from the upstream to downstream, watershed and flood plane, mountain and fan formed area, and so on. All the area in one river basin is strongly linked in various natural and social aspects, and the activities

particularly in the upstream area might seriously affect to the downstream area.

In the views of basin-wide, regional equity, and poverty reduction, it is important to conduct comprehensive approach for the project evaluation.

Table 1.6.1 shows the results of overall economic evaluation of the selected priority projects. It was revealed that even some priority projects are not economically feasible, such as Warning and Evacuation System, Monitoring System for Maraunot Notch, Agriculture Development on Lahar Area, Community Road Rehabilitation Project, and Aeta Assistance Station, the overall EIRR for integrated projects are revealed economically feasible with the EIRR of 20.0%, and the integrated project implementation can be justified also in the economic viewpoints as well as in the view of basin-wide natural and social importance.

Tables

Table 1.2.1 Assessed Values of New Constructed Buildings and Taxable Improvements

Municipality	Total Assessed Value (P'000)				Number of buildings				TAV/building (P'000)			
	7-12/00 (1)	1-6/01 (2)	7-12/01 (3)	1-6/02 (4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Botolan	664.7	350.8	556.2	433.7	4	12	9	6	**166.2**	**29.2**	**61.8**	**72.3**
Cabangan	246.0	4,013.5	465.8	490.4	6	7	3	7	**41.0**	**573.4**	**155.3**	**70.1**
Castillejos	1,852.3	1,267.6	2,442.7	799.8	14	9	16	14	**132.3**	**140.8**	**152.7**	**57.1**
Iba	2,283.9	323.2	3,754.5	4,459.0	20	4	40	32	**114.2**	**80.8**	**93.9**	**202.7**
San Antonio	1,431.7	602.0	1,147.1	1,319.2	19	12	16	12	**75.4**	**50.2**	**71.7**	**109.9**
San Felipe	3,174.3	1,419.1	1,797.7	1,895.3	11	13	10	12	**288.6**	**109.2**	**179.8**	**157.9**
San Marcelino	54.8	184.7	1,120.2	1,447.4	3	3	9	5	**18.3**	**61.6**	**124.5**	**289.5**
San Narciso	1,384.1	1,006.7	749.3	1,798.4	18	8	6	5	**76.9**	**125.8**	**124.9**	**359.7**
TOTALS	**11,091.6**	**9,167.6**	**12,033.4**	**12,643.2**	**160**	**68**	**109**	**93**	**116.8**	**134.8**	**110.4**	**135.9**

Source: Zambales Provincial Assessor's Office, Iba

Table 1.2.2 Schedule of Unit Values for Buildings: 1999

(Pesos per square meter)

TYPE	(1) One family Dwelling	(2) Two-family Dwelling (3) Multiple Dwelling	(4) Accessories or Row house	(5) Apartment (6) Boarding House (7) Lodging House Hotel	(8) Accessory Building a. Garage b. Quarters c. Guard House d. Laundry House, etc.	(9) School Building	(10) Condominium/ Hotel/ Bank/ Hospital/ Office	(11) Theater Church Assembly House
IA	7,370	7,040	6,220	6,220	-	6,340	7,810	7,910
IB	6,530	6,430	5,780	5,780	-	5,940	6,530	6,450
IIA	5,040	4,970	4,560	4,560	4,800	4,960	5,600	5,160
IIB	4,570	4,340	3,870	3,870	3,010	4,500	5,040	4,730
IIC	4,370	4,240	3,790	3,790	2,630	4,240	4,610	4,440
IIIA	3,700	3,140	3,020	3,020	2,070	3,310	3,940	3,770
IIIB	3,160	2,810	2,680	2,680	1,820	3,030	3,390	3,250
IIIC	2,890	2,330	2,190	2,190	1,530	2,560	3,240	3,030
IIID	2,530	2,040	1,580	1,580	1,250	-	2,730	2,800
IV	1,700	-	-	-	-	-	-	-

TYPE	(12) Factory Warehouse Industrial Plant/Storage	(13) Market/ Shopping Center	(14) Gymnasium Coliseum	(15) Recreation a. Bowling lane b. Clubhouse	(16) Saw Hills and Lumber shed	(17) Gasoline Station	(18) Swimming Pool and Bath House	(19) Piggery and Poultry House
IS	7,280	-	-	-	-	-	4,640 : 6,980	-
IA	4,340	6,170	5,460	5,570	-	5,380	-	-
IB	4,000	5,430	4,850	5,100	-	4,740	-	-
IIA	2,770	3,690	3,470	4,000	-	3,290	-	-
IIB	2,520	3,280	3,090	3,710	-	2,790	-	-
IIC	2,160	3,040	2,790	3,010	2,040	2,410	-	-
IIIA	1,480	2,810	1,970	2,390	1,880	-	-	1,550
IIIB	1,300	2,520	1,660	2,150	1,610	-	-	1,420
IIIC	1,060	2,130	1,510	1,530	1,450	-	-	1,330
IIID	-	1,800	700	1,160	1,250	-	-	1,070

Source: Zambales Provincial Assessor's Office, Iba

Table 1.2.3 Results of Household Survey: Housing Condition (Responses & Weighted Values)

Type of Building	Botolan	Cabangan	Castillejos	San Antonio	San Felipe	San Marcelino	San Narciso	Totals	% Total Responding	Average Assessed Value* (Pesos/m^2)	Weighted Value/m^2 by Type
1) Type 1 – Steel and concrete	27	4	18	31	21	18	11	130	49	6,950	3,406
2) Type 2 – Bricks, stone and steel	2	3	3	3	-	-	8	19	7	4,660	326
3) Type 3 – Wood and asbestos	-	-	-	1	1	-	7	9	3	3,070	92
4) Type 4 - Cogon, nipa	9	5	6	3	4	11	10	48	18	1,700	306
5) Others – Wood and concrete	2	28	2	2	10	11	3	58	22	3,070	675
6) No response	-	-	5	-	4	-	1	10	-	-	-
TOTALS	40	40	34	40	40	40	40	274	99	-	4,805

Notes:

1. Average assessed value was obtained by grouping building types from the Schedule of Unit Values for Buildings (1999).
2. Survey data was extracted from IEE Report for Sabo and Flood Control Project in Major Three Western River Basins of Mount Pinatubo prepared by JBJ Consulting Inc. dated 31 July 2002.

Table 1.2.4 Results of Household Survey: Floor Areas (Responses and Weighted Averages)

Floor Area	Botolan	Cabangan	Castillejos	San Antonio	San Felipe	San Marcelino	San Narciso	Totals	% Total Responding	Weighted Average Floor Area
Below 50m^2 (45m^2)	27	24	18	11	33	35	32	180	68	30.6
50-100m^2 (75m^2)	12	14	14	20	2	3	6	71	27	20.3
More than 100m^2 (100m^2)	1	2	1	9	-	1	-	14	6	6.0
No reponse	-	-	1	-	5	1	2	9	-	-
TOTALS	40	40	34	40	40	40	40	274	101	56.9

Notes:

1. Assumed average floor areas are stated in brackets for each survey category.
2. Survey data was extracted from IEE Report for Sabo and Flood Control Project in Major Three Western River Basins of Mount Pinatubo prepared by JBJ Consulting Inc. dated 31 July 2002.

Table 1.2.5 Results of Household Survey: Ownership of Household Effects (Responses & Weighted Cost)

Household Effects	Botolan	Cabangan	Castillejos	San Antonio	San Felipe	San Marcelino	San Narcisco	Totals	% Total Responding	Estimated Cost (Pesos)	Weighted Cost (Pesos)
Refrigerator	10	19	16	30	16	8	23	122	45	7,500	3,375
Electric Range	4	7	4	6	1	-	2	24	9	12,000	1,080
Stereo	15	19	13	24	5	7	28	111	41	11,000	4,510
TV set	31	27	27	39	30	22	32	208	76	8,000	6,080
Radio	34	33	25	34	28	24	34	212	77	5,000	3,850
Electric fan	12	19	7	20	12	13	17	100	36	1,500	540
Washing machine	3	4	10	5	1	1	-	24	9	6,000	540
Flat iron	1	-	-	5	2	1	-	9	3	650	20
Computer	-	1	1	-	2	-	-	4	1	40,000	400
VCD/VHS player	-	-	3	-	1	6	-	10	4	5,000	200
Rice cooker	1	2	-	-	-	-	-	3	1	1,300	13
Air conditioner	-	1	-	-	-	-	-	1	0.4	11,000	44
Carpets, curtains, fittings*										20,000	20,000
Total households owning items	111	132	106	163	98	82	136	828			
Total households in survey	40	40	34	40	40	40	40	274	-	-	40,652

Notes:

1. Average assessed value was obtained by grouping building types from the Schedule of Unit Values for Buildings (1999).
2. *Estimated outside the survey.
3. Survey data was extracted from IEE Report for Sabo and Flood Control Project in Major Three Western River Basins of Mount Pinatubo prepared by JBJ Consulting Inc. dated 31 July 2002.

Table 1.3.1 Calculation of Average Annual Detour Days for Bridge Damage

Bucao River Basin

Return Period (years)	Average Annual Probability of Exceedance for Return Period	Average Annual Events within interval	Detour days up to Indicated Return Period (days)	Average Detour days (days)	Average Annual Detour days (Days)	Average Annual Detour days up to Indicated R.P. (Days)
2	0.50		0.0			0.0
		0.30		0.0	0.0	
5	0.20		0.0			0.0
		0.10		142.5	14.3	
10	0.10		285.0			14.3
		0.05		285.0	14.3	
20	0.05		285.0			28.5
		0.03		285.0	8.6	
50	0.02		285.0			37.1
		0.01		285.0	2.9	
100	0.01		285.0			39.9

Maloma River Basin

Return Period (years)	Average Annual Probability of Exceedance for Return Period	Average Annual Events within interval	Detour days up to Indicated Return Period (days)	Average Detour days (days)	Average Annual Detour days (Days)	Average Annual Detour days up to Indicated R.P. (Days)
2	0.50		0.0			0.0
		0.30		0.0	0.0	
5	0.20		0.0			0.0
		0.10		0.0	0.0	
10	0.10		0.0			0.0
		0.05		90.0	4.5	
20	0.05		180.0			4.5
		0.03		180.0	5.4	
50	0.02		180.0			9.9
		0.01		180.0	1.8	
100	0.01		180.0			11.7

Sto. Tomas River Basin

Return Period (years)	Average Annual Probability of Exceedance for Return Period	Average Annual Events within interval	Detour days up to Indicated Return Period (days)	Average Detour days (days)	Average Annual Detour days (Days)	Average Annual Detour days up to Indicated R.P. (Days)
2	0.50		0.0			0.0
		0.30		0.0	0.0	
5	0.20		0.0			0.0
		0.10		157.5	15.8	
10	0.10		315.0			15.8
		0.05		315.0	15.8	
20	0.05		315.0			31.5
		0.03		315.0	9.5	
50	0.02		315.0			41.0
		0.01		315.0	3.2	
100	0.01		315.0			44.1

Table 1.3.2 Estimation of Additional Transportation Cost for the Bucao Bridge Damage (1/3)

1 Traffic Volume at Bucao Bridge — Unit:AADT

Year	Car/P-up	Jeepney	Bus	Truck	Total
2002	2,022	175	412	412	3,021
2007	2,790	199	468	510	3,967
2017	5,312	251	590	781	6,934

*Source: JICA Study Team

2 Detour Distance

30% of traffic is cosidered from San Fernando to IBA

70% of traffic is considered from Olongapo to IBA — Unit:km

San Fernando - IBA	30% (Assumed)				Total	Additional Distance
W/Bridge	SF-OLG	OLG-IBA				
	67	77			144	**145**
W/o Brg.	SF-TLC	TLC-LGY	LGY-IBA			
	58	83	148		289	
Olongapo - IBA - Lingayen	70% (Assumed)				**Total**	
W/Bridge	OLG-IBA					
	77				77	**279**
W/o Brg.	OLG-SF	SF-TLC	TLC-LGY	LGY-IBA		
	67	58	83	148	356	

3 Detour Cost — Unit:Peso/km

Car/P-up	Jeepney	Bus	Truck
6.262	5.804	19.036	14.921

*Source: DPWH, PMO-FS

* Price Level:Apr.2002

* Road Condition: Paved road, Fair condition

4 Number of Detour Days

Existing flow capacity of Bucao River at Bucao Bridge is less than 20-year probable flood.

The bridge is considered to break by those flood more than 20-year probability.

Construction period of temporary steel bridge is estimated at 10.5 months including the material procument of 4 months.

	2-Year	5-Year	10-Year	20-Year	50-Year	100-Year	Annual
Bridge Break	0	0	285	285	285	285	
Probability	0.5	0.2	0.1	0.05	0.02	0.01	
Days	0	0	28.5	14.25	5.7	2.85	
Accum.Days		0	28.5	42.75	48.45	51.3	
Av.prob within intervals	0.30	0.10	0.05	0.03	0.01		
Av.detour days within intervals	0.0	142.5	285.0	285.0	285.0		
Av.annual detour days	0.0	14.3	14.3	8.6	2.9		
Accum.av.annual detour days		0.0	14.3	28.5	37.1	39.9	37.1

5 Annual Detour Cost

1) SF-TLC-LGY-IBA		Car/P-up	Jeepney	Bus	Truck	Total
	Total AADT	2,022	175	412	412	3,021
	% of traffic	30%	0%	30%	30%	
	AADT from SF	606.6	0	123.6	123.6	854
	% of cancel	20%	50%	10%	20%	
	Actual AADT	485.28	0	111.24	98.88	695
	Unit rate	6.262	5.804	19.036	14.921	
	Distance	145	145	145	145	
	Detour days	37.1	37.1	37.1	37.1	
	Amount	16,325,319	0	11,376,087	7,926,156	35,627,561
2) OLG-SF-TLC-□LGY - IBA		**Car/P-up**	**Jeepney**	**Bus**	**Truck**	**Total**
	Total AADT	2,022	175	412	412	3,021
	% of traffic	70%	100%	70%	70%	
	AADT fr. OLG	1415.4	175	288.4	288.4	2,167
	% of cancel	30%	100%	20%	30%	
	Actual AADT	990.78	0	230.72	201.88	1,423
	Unit rate	6.262	5.804	19.036	14.921	
	Distance	279	279	279	279	
	Detour days	37.1	37.1	37.1	37.1	
	Amount	64,133,170	0	45,399,739	31,137,493	140,670,402

6 Additional Damage cost due to repair of abutment

Total cost	Life time	Discount rate	Conv.Rate	Annual cost
5,000,000	50	10%	0.091619	458,095

*Right abutment of the bridge is seriously damaged and the bridge will be easily broken without repair of abutment

7 TOTAL Annual Damages — **176,756,058**

Table 1.3.2 Estimation of Additional Transportation Cost for the Maloma Bridge Damage (2/3)

1. Traffic Volume at Maloma Bridge Unit:AADT

	Year	Car/P-up	Jeepney	Bus	Truck	Total
Maloma	2002	1,905	144	401	394	2,844
	2007	2,628	164	457	488	3,737
	2017	5,004	206	576	750	6,536

*Source: JICA Study Team

2. Detour Distance
30% of traffic is cosidered from San Fernando to IBA
70% of traffic is considered from Olongapo to IBA Unit:km

San Fernando - IBA	30% (Assumed)				Total	Additional Distance
W/Bridge	SF-OLG	OLG-IBA				
	67	77			144	**145**
W/o Brg.	SF-TLC	TLC-LGY	LGY-IBA			
	58	83	148		289	
Olongapo - IBA - Lingayen	70%	(Assumed)				
W/Bridge	OLG-IBA					
	77				77	**279**
W/o Brg.	OLG-SF	SF-TLC	TLC-LGY	LGY-IBA		
	67	58	83	148	356	

3. Detour Cost Unit:Peso/km

Car/P-up	Jeepney	Bus	Truck
6.262	5.804	19.036	14.921

*Source: DPWH, PMO-FS
* Price Level:Apr.2002
* Road Condition: Paved road, Fair condition

4. Number of Detour Days
Existing flow capacity of Maloma River at Maloma Bridge is less than 10-year probable flood.
The bridge is considered to break by those flood more than 20-year probability.
Construction period of temporary steel bridge is estimated at 6 months including the material procument of 4 months.

	2-Year	5-Year	10-Year	20-Year	50-Year	100-Year	Annual
Bridge Break	0	0	0	180	180	180	
Probability	0.5	0.2	0.1	0.05	0.02	0.01	
Days	0	0	0	9	3.6	1.8	
Accum.Days	0	0	0	9	12.6	14.4	
Av.prob within intervals	0.30	0.10	0.05	0.03	0.01		
Av.detour days within intervals	0.0	0.0	90.0	180.0	180.0		
Av.annual detour days	0	0	4.5	5.4	1.8		
Accum.av.annual detour days		0	0	4.5	9.9	11.7	9.9

5. Annual Detour Cost

		Car/P-up	Jeepney	Bus	Truck	Total
1) SF-TLC-LGY -IBA	Total AADT	1,905	144	401	394	2,844
	% of traffic	30%	0%	30%	30%	
	AADT from SF	571.5	0	120.3	118.2	810
	% of cancel	20%	50%	10%	20%	
	Actual AADT	457.2	0	108.27	94.56	660
	Unit rate	6.262	5.804	19.036	14.921	
	Distance	145	145	145	145	
	Detour days	9.9	9.9	9.9	9.9	
	Amount	4,109,817	0	2,958,605	2,025,390	9,093,812
		Car/P-up	Jeepney	Bus	Truck	Total
2) OLG-SF-TLC - LGY - IBA	Total AADT	1,905	144	401	394	2,844
	% of traffic	70%	100%	70%	70%	
	AADT fr. OLG	1333.5	144	280.7	275.8	2,034
	% of cancel	40%	100%	20%	40%	
	Actual AADT	800.1	0	224.56	165.48	1,190
	Unit rate	6.262	5.804	19.036	14.921	
	Distance	279	279	279	279	
	Detour days	9.9	9.9	9.9	9.9	
	Amount	13,838,746	0	11,807,216	6,819,976	32,465,937

6. TOTAL Annual Damages **41,559,749**

Table 1.3.2 Estimation of Additional Transportation Cost for the Maculcol Bridge Damage (3/3)

1. Traffic Volume at Maculcol Bridge Unit:AADT

	Year	Car/P-up	Jeepney	Bus	Truck	Total
Sto.Tomas	2002	2,367	99	555	447	3,468
	2007	3,266	113	630	554	4,563
	2017	6,217	142	794	849	8,002

*Source: JICA Study Team

2. Detour Distance
30% of traffic is cosidered from San Fernando to IBA
70% of traffic is considered from Olongapo to IBA Unit:km

San Fernando - IBA	30% (Assumed)				Total	Additional Distance
W/Bridge	SF-OLG	OLG-IBA				
	67	77			144	**145**
W/o Brg.	SF-TLC	TLC-LGY	LGY-IBA			
	58	83	148		289	
Olongapo - IBA - Lingayen	70% (Assumed)					
W/Bridge	OLG-IBA					
	77				77	**279**
W/o Brg.	OLG-SF	SF-TLC	TLC-LGY	LGY-IBA		
	67	58	83	148	356	

3. Detour Cost Unit:Peso/km

Car/P-up	Jeepney	Bus	Truck
6.262	5.804	19.036	14.921

*Source: DPWH, PMO-FS

* Price Level:Apr.2002

* Road Condition: Paved road, Fair condition

4 Number of Detour Days
Existing flow capacity of Sto.Tomas River at Maculcol Bridge is less than 2-year probable flood.
The bridge is considered to break by those flood more than 10-year probability.
Construction period of temporary steel bridge is estimated at 10.5 months including the material procument of 4 months.

	2-Year	5-Year	10-Year	20-Year	50-Year	100-Year	Annual
Bridge Break	0	0	315	315	315	315	
Probability	0.5	0.2	0.1	0.05	0.02	0.01	
Days	0	0	31.5	15.75	6.3	3.15	
Accum.Days		0	31.5	47.25	53.55	56.7	
Av.prob within intervals	0.3	0.1	0.05	0.03	0.01		
Av.detour days within intervals	0.0	157.5	315.0	315.0	315.0		
Av.annual detour days	0.0	15.8	15.8	9.5	3.2		
Accum.av.annual detour days		0.0	15.8	31.5	41.0	44.1	41.0

5. Annual Detour Cost

		Car/P-up	Jeepney	Bus	Truck	Total
1) SF-TLC-LGY-IBA	Total AADT	2,367	99	555	447	3,468
	% of traffic	30%	0%	30%	30%	
	AADT from SF	710.1	0	166.5	134.1	1,011
	% of cancel	20%	50%	10%	20%	
	Actual AADT	568.08	0	149.85	107.28	825
	Unit rate	6.262	5.804	19.036	14.921	
	Distance	145	145	145	145	
	Detour days	41.0	41.0	41.0	41.0	
	Amount	21,122,459	0	16,937,697	9,504,704	47,564,860
		Car/P-up	Jeepney	Bus	Truck	Total
2) OLG-SF-TLC-LGY-IBA	Total AADT	2,367	99	555	447	3,468
	% of traffic	70%	100%	70%	70%	
	AADT fr. OLG	1656.9	99	388.5	312.9	2,457
	% of cancel	40%	100%	20%	40%	
	Actual AADT	994.14	0	310.8	187.74	1,493
	Unit rate	6.262	5.804	19.036	14.921	
	Distance	279	279	279	279	
	Detour days	41.0	41.0	41.0	41.0	
	Amount	71,124,417	0	67,595,038	32,004,633	170,724,088

6. TOTAL Annual Damages **218,288,948**

Table 1.3.3 Calculation of Average Annual Detour Days due to Road Inundation by Flood/Mudflow

Bucao River Basin

Return Period (years)	Average Annual Probability of Exceedance for Return Period	Average Annual Events within interval	Detour days up to Indicated Return Period (days)	Average Detour days (days)	Average Annual Detour days (Days)	Average Annual Detour days up to Indicated R.P. (Days)
2	0.50		4.0			0.0
		0.30		4.5	1.4	
5	0.20		5.0			1.4
		0.10		5.5	0.6	
10	0.10		6.0			1.9
		0.05		6.5	0.3	
20	0.05		7.0			2.2
		0.03		7.5	0.2	
50	0.02		8.0			2.5
		0.01		8.5	0.1	
100	0.01		9.0			2.5

Maloma River Basin

Return Period (years)	Average Annual Probability of Exceedance for Return Period	Average Annual Events within interval	Detour days up to Indicated Return Period (days)	Average Detour days (days)	Average Annual Detour days (Days)	Average Annual Detour days up to Indicated R.P. (Days)
2	0.50		2.0			0.0
		0.30		2.5	0.8	
5	0.20		3.0			0.8
		0.10		3.0	0.3	
10	0.10		3.0			1.1
		0.05		3.5	0.2	
20	0.05		4.0			1.2
		0.03		4.5	0.1	
50	0.02		5.0			1.4
		0.01		5.0	0.1	
100	0.01		5.0			1.4

Sto. Tomas River Basin

Return Period (years)	Average Annual Probability of Exceedance for Return Period	Average Annual Events within interval	Detour days up to Indicated Return Period (days)	Average Detour days (days)	Average Annual Detour days (Days)	Average Annual Detour days up to Indicated R.P. (Days)
2	0.50		3.0			0.0
		0.30		3.5	1.1	
5	0.20		4.0			1.1
		0.10		4.5	0.5	
10	0.10		5.0			1.5
		0.05		5.5	0.3	
20	0.05		6.0			1.8
		0.03		6.5	0.2	
50	0.02		7.0			2.0
		0.01		7.5	0.1	
100	0.01		8.0			2.0

Table 1.3.4 Estimation of Additional Transportation Cost for the Bucao River Flood/Mudflow on Road (1/3)

1. Traffic Volume at Bucao Bridge — Unit:AADT

Year	Car/P-up	Jeepney	Bus	Truck	Total
2002	2,022	175	412	412	3,021
2007	2,790	199	468	510	3,967
2017	5,312	251	590	781	6,934

*Source: JICA Study Team

2. Detour Distance

30% of traffic is cosidered from San Fernando to IBA — Unit:km

70% of traffic is considered from Olongapo to IBA

San Fernando - IBA	30%	(Assumed)		Total	Additional Distance
W/Bridge	SF-OLG	OLG-IBA			
67	77			144	**145**
W/o Brg.	SF-TLC	TLC-LGY	LGY-IBA		
58	83	148		289	
Olongapo - IBA - Lingayen	70%	(Assumed)			
W/Bridge	OLG-IBA				
77				77	**279**
W/o Brg.	OLG-SF	SF-TLC	TLC-LGY	LGY-IBA	
67	58	83	148	356	

3. Detour Cost — Unit:Peso/km

Car/P-up	Jeepney	Bus	Truck
6.262	5.804	19.036	14.921

*Source: DPWH, PMO-FS

* Price Level:Apr.2002

* Road Condition: Paved road, Fair condition

4. Number of Detour Days

The detour day due to break of existing dike was considered as indirect damage

As the lahar deposition is expected on the road, cleaning period is added to the days of inundation

Cleaning days of road is considered 2-days after the flood

	2-Year	5-Year	10-Year	20-Year	50-Year	100-Year	Annual
Road Inundation	4	5	6	7	8	9	
Probability	0.5	0.2	0.1	0.05	0.02	0.01	
Days	2	1	0.6	0.35	0.16	0.09	
Accum.Days		3	3.6	3.95	4.11	4.2	
Av.prob within intervals	0.3	0.1	0.05	0.03	0.01		
Av.detour days within intervals	4.5	5.5	6.5	7.5	8.5		
Av.annual detour days	1.4	0.6	0.3	0.2	0.1		
Accum.av.annual detour days		1.4	1.9	2.2	2.5	2.5	2.2

5. Annual Detour Cost

		Car/P-up	Jeepney	Bus	Truck	Total
1) SF-TLC-LGY-IBA	Total AADT	2,022	175	412	412	3,021
	% of traffic	30%	0%	30%	30%	
	AADT from SF	606.6	0	123.6	123.6	854
	% of cancel	20%	50%	10%	20%	
	Actual AADT	485.28	0	111.24	98.88	695
	Unit rate	6.262	5.804	19.036	14.921	
	Distance	145	145	145	145	
	Detour days	2.2	2.2	2.2	2.2	
	Amount	980,400	0	683,179	475,997	2,139,577

		Car/P-up	Jeepney	Bus	Truck	Total
2) OLG-SF-TLC-LG -IBA	Total AADT	2,022	175	412	412	3,021
	% of traffic	70%	100%	70%	70%	
	AADT fr. OLG	1415.4	175	288.4	288.4	2,167
	% of cancel	30%	100%	20%	30%	
	Actual AADT	990.78	0	230.72	201.88	1,423
	Unit rate	6.262	5.804	19.036	14.921	
	Distance	279	279	279	279	
	Detour days	2.2	2.2	2.2	2.2	
	Amount	3,851,452	0	2,726,435	1,869,930	8,447,818

6. TOTAL Annual Damages **10,587,395**

Table 13.4 Estimation of Additional Transportation Cost for the Maloma River Flood/Mudflow on Road (2/3)

1. Traffic Volume at Maloma Bridge — Unit:AADT

	Year	Car/P-up	Jeepney	Bus	Truck	Total
Maloma	2002	1,905	144	401	394	2,844
	2007	2,628	164	457	488	3,737
	2017	5,004	206	576	750	6,536

*Source: JICA Study Team

2. Detour Distance
30% of traffic is cosidered from San Fernando to IBA
70% of traffic is considered from Olongapo to IBA

Unit:km

San Fernando - IBA		30%(Assumed)			Total	Additional Distance
W/Bridge	SF-OLG	OLG-IBA				
	67	77			144	**145**
W/o Brg.	SF-TLC	TLC-LGY	LGY-IBA			
	58	83	148		289	
Olongapo - IBA - Lingayen		70%(Assumed)				
W/Bridge	OLG-IBA					
	77				77	**279**
W/o Brg.	OLG-SF	SF-TLC	TLC-LGY	LGY-IBA		
	67	58	83	148	356	

3. Detour Cost — Unit:Peso/km

Car/P-up	Jeepney	Bus	Truck
6.262	5.804	19.036	14.921

*Source: DPWH, PMO-FS
* Price Level:Apr.2002
* Road Condition: Paved road, Fair condition

4. Number of Detour Days
The detour day due to break of existing dike was considered as indirect damage

Cleaning days of road is considered 1-day after the flood

	2-Year	5-Year	10-Year	20-Year	50-Year	100-Year	Annual
Road Inundation	2	3	3	4	5	5	
Probability	0.5	0.2	0.1	0.05	0.02	0.01	
Days	1	0.6	0.3	0.2	0.1	0.05	
Accum.Days	1	1.6	1.9	2.1	2.2	2.25	
Av.prob within intervals	0.3	0.1	0.05	0.03	0.01		
Av.detour days within intervals	2.5	3.0	3.5	4.5	5.0		
Av.annual detour days	0.8	0.3	0.2	0.1	0.1		
Accum.av.annual detour days		0.8	1.1	1.2	1.4	1.4	1.2

5. Annual Detour Cost

		Car/P-up	Jeepney	Bus	Truck	Total
1) SF-TLC-LGY-IBA	Total AADT	1,905	144	401	394	2,844
	% of traffic	30%	0%	30%	30%	
	AADT from SF	571.5	0	120.3	118.2	810
	% of cancel	20%	50%	10%	20%	
	Actual AADT	457.2	0	108.27	94.56	660
	Unit rate	6.262	5.804	19.036	14.921	
	Distance	145	145	145	145	
	Detour days	1.2	1.2	1.2	1.2	
	Amount	508,538	0	366,090	250,616	1,125,244

		Car/P-up	Jeepney	Bus	Truck	Total
2)OLG-SF-TLC-LGY-IBA	Total AADT	1,905	144	401	394	2,844
	% of traffic	70%	100%	70%	70%	
	AADT fr. OLG	1333.5	144	280.7	275.8	2,034
	% of cancel	40%	100%	20%	40%	
	Actual AADT	800.1	0	224.56	165.48	1,190
	Unit rate	6.262	5.804	19.036	14.921	
	Distance	279	279	279	279	
	Detour days	1.2	1.2	1.2	1.2	
	Amount	1,712,370	0	1,460,994	843,886	4,017,250

6. TOTAL Annual Damages **5,142,494**

Table 1.3.4 Estimation of Additional Transportation Cost for the Sto. Tomas River Flood/Mudflow on Road (3/3)

1. Traffic Volume at Maculcol Bridge — Unit:AADT

	Year	Car/P-up	Jeepney	Bus	Truck	Total
Sto.Tomas	2002	2,367	99	555	447	3,468
	2007	3,266	113	630	554	4,563
	2017	6,217	142	794	849	8,002

*Source: JICA Study Team

2. Detour Distance
30% of traffic is cosidered from San Fernando to IBA
70% of traffic is considered from Olongapo to IBA — Unit:km

San Fernando - IBA	30%(Assumed)				Total	Additional Distance
W/Bridge	SF-OLG	OLG-IBA				
	67	77			144	**145**
W/o Brg.	SF-TLC	TLC-LGY	LGY-IBA			
	58	83	148		289	
Olongapo - IBA - Lingayen			70%	(Assumed)		
W/Bridge	OLG-IBA					
	77				77	**279**
W/o Brg.	OLG-SF	SF-TLC	TLC-LGY	LGY-IBA		
	67	58	83	148	356	

3. Detour Cost — Unit:Peso/km

Car/P-up	Jeepney	Bus	Truck
6.262	5.804	19.036	14.921

*Source: DPWH, PMO-FS
* Price Level:Apr.2002
* Road Condition: Paved road, Fair condition

4. Number of Detour Days
The detour day due to break of existing dike was considered as indirect damage
As the lahar deposition is expected on the road, cleaning period is added to the days of inundation
Cleaning days of road is considered 2-days after the flood

	2-Year	5-Year	10-Year	20-Year	50-Year	100-Year	Annual
Road Inundation	3	4	5	6	7	8	
Probability	0.5	0.2	0.1	0.05	0.02	0.01	
Days	1.5	0.8	0.5	0.3	0.14	0.08	
Accum.Days	1.5	2.3	2.8	3.1	3.24	3.32	
Av.prob within intervals	0.3	0.1	0.05	0.03	0.01		
Av.detour days within intervals	3.5	4.5	5.5	6.5	7.5		
Av.annual detour days	1.1	0.5	0.3	0.2	0.1		
Accum.av.annual detour days		1.1	1.5	1.8	2.0	2.0	1.8

5. Annual Detour Cost

		Car/P-up	Jeepney	Bus	Truck	Total
1) SF-TLC-LGY-IBA	Total AADT	2,367	99	555	447	3,468
	% of traffic	30%	0%	30%	30%	
	AADT from SF	710.1	0	166.5	134.1	1,011
	% of cancel	20%	50%	10%	20%	
	Actual AADT	568.08	0	149.85	107.28	825
	Unit rate	6.262	5.804	19.036	14.921	
	Distance	145	145	145	145	
	Detour days	1.8	1.8	1.8	1.8	
	Amount	915,564	0	734,174	411,987	2,061,725

		Car/P-up	Jeepney	Bus	Truck	Total
2) OLG-SF-TLC-LGY-IBA	Total AADT	2,367	99	555	447	3,468
	% of traffic	70%	100%	70%	70%	
	AADT fr. OLG	1656.9	99	388.5	312.9	2,457
	% of cancel	40%	100%	20%	40%	
	Actual AADT	994.14	0	310.8	187.74	1,493
	Unit rate	6.262	5.804	19.036	14.921	
	Distance	279	279	279	279	
	Detour days	1.8	1.8	1.8	1.8	
	Amount	3,082,927	0	2,929,944	1,387,258	7,400,128

6. TOTAL Annual Damages **9,461,853**

Table 1.3.5 Loss of Non-agricultural Production from Flood and Lahar

Sto.Tomas River

Number of House

Depth(m)			2Year	5Year	10Year	20Year	30Year	50Year	100Year
0.05	~	0.10	1305	1445	1496	1412	1409	1424	1537
0.10	~	0.20	984	1483	1647	1914	1912	1895	1954
0.20	~	0.30	713	784	873	980	1137	1263	1365
0.30	~	0.50	455	805	1100	1278	1343	1405	1598
0.50	~	0.75	211	313	351	462	572	773	925
0.75	~	1.00	65	120	165	238	279	292	375
1.00	~	1.50	26	70	100	122	140	198	262
1.50	~	3.00	23	25	29	37	39	45	61
3.00	~	10.00	0	0	1	1	1	1	2
Total			3782	5045	5762	6444	6832	7296	8079
Effective total houses			3782	1263	717	682	ignore values for return periods of > 20 years		
Probability of event in one year			0.5	0.2	0.1	0.05			
Most probable houses affected per year			1891	253	72	34			

Total most probable houses affected per year	2,249
Total most probable urban houses affected per year	1,350
Number of adults affected (3.04 adults per HH in Region 3 in 2000) per year	4,103
Number of days per year for average flood/lahar event (see Table 19.1.12 for notes on calculation)	4.74
Number of productive days lost in 2004 (base year)	19,448
Non-agricultural GRDP per adult per day in Region 3 in 2000 = P199billion/(4.965 millionx365)	109.81
Total non-agricultural GRDP lost in 2004 = 32,413 x 109.81 x 1.05^4 (million pesos)	2.60

Maloma River

Number of House

Depth(m)			2Year	5Year	10Year	20Year	30Year	50Year	100Year
0.05	~	0.10	14	6	2	3	8	63	43
0.10	~	0.20	12	9	10	4	3	38	73
0.20	~	0.30	32	20	9	8	5	2	25
0.30	~	0.50	38	54	52	41	38	22	7
0.50	~	0.75	21	33	46	49	53	63	57
0.75	~	1.00	8	13	15	27	29	37	41
1.00	~	1.50	3	8	15	20	23	21	35
1.50	~	3.00	0	1	1	2	2	7	11
3.00	~	10.00	0	0	0	0	0	0	0
Total			128	144	150	154	161	253	292
Effective total houses			128	16	6	4	Ignore values for return periods of > 20 years		
Probability of event in one year			0.5	0.2	0.1	0.05			
Most probable houses affected per year			64	3	1	0			

Total most probable houses affected per year	68
Total most probable urban houses affected per year	41
Number of adults affected (3.04 adults per HH in Region 3 in 2000) per year	124
Number of days per year for average flood/lahar event (see Table 19.1.12 for notes on calculation)	6.18
Number of productive days lost in 2004 (base year)	767
Non-agricultural GRDP per adult per day in Region 3 in 2000 = P199billion/(4.965 millionx365)	109.81
Total non-agricultural GRDP lost in 2004 = 1,278 x 109.81 x 1.05^4 (million pesos)	0.10

Bucao River

Number of House

Depth(m)			2Year	5Year	10Year	20Year	30Year	50Year	100Year
0.05	~	0.10	130	163	154	291	244	241	271
0.10	~	0.20	303	297	295	332	441	489	450
0.20	~	0.30	250	224	244	253	245	269	395
0.30	~	0.50	346	392	406	457	473	471	467
0.50	~	0.75	126	176	233	258	302	355	394
0.75	~	1.00	48	100	96	106	112	121	150
1.00	~	1.50	43	59	99	135	147	165	184
1.50	~	3.00	30	49	64	76	74	74	89
3.00	~	10.00	0	0	0	0	2	6	6
Total			1276	1460	1591	1908	2040	2191	2406
Effective total houses			1276	184	131	317	Ignore values for return periods of > 20 years		
Probability of event in one year			0.5	0.2	0.1	0.05			
Most probable houses affected per year			638	37	13	16			

Total most probable houses affected per year	704
Total most probable urban houses affected per year	422
Number of adults affected (3.04 adults per HH in Region 3 in 2000) per year	1,284
Number of days per year for average flood/lahar event (see Table 19.1.12 for notes on calculation)	5.41
Number of productive days lost in 2004 (base year)	6,944
Non-agricultural GRDP per adult per day in Region 3 in 2000 = P199billion/(4.965 millionx365)	109.81
Total non-agricultural GRDP lost in 2004 = 1,278 x 109.81 x 1.05^4 (million pesos)	0.93

Total for Three Rivers

Gross total houses	5186	6649	7503	8506	9033	9740	10777	
Effective total houses	5186	1463	854	1003	Ignore values for return periods of > 20 years			
Probability of event in one year	0.5	0.2	0.1	0.05				
Most probable houses affected per year	2593	293	85	50				

Total most probable houses per year	3,021
Total most probable urban houses affected per year	2,266
Number of adults affected (3.04 adults per HH in Region 3 in 2000) per year	6,888
Number of days per year for average flood/lahar event	not computed
Number of productive days lost in 2004 (base year)	27,159
Non-agricultural GRDP per adult per day in Region 3 in 2000 = P199billion/(4.965 millionx365)	109.81
Total non-agricultural GRDP lost in 2004 = 93,069 x 109.81 x 1.05^4 (million pesos)	3.63

Table 1.3.6 Base Data for Estimate of GRDP Loss Caused by Flood and Lahar

Population

Adult population in Region 3 in 2000	4,965,000
Number of households in Region 3 in 2000	1,632,047
Number of adults per household	3.04

GRDP Loss

Non-agricultural GRDP in Region 3 at current prices in 2000 (million pesos)	199,025
Growth in non-agricultural GRDP in Region 3 (per cent per annum)*	5.00
Projected growth in population in Zambales (rough estimate based on national projection to 2004*	
and past Zambales rates since 1980) (per cent per annum)	2.00

Loss of GRDP caused by interruption of economic activities
= number of affected population x urban/rural ratio x daily per capita non-agricultural GRDP x days (see below)
Urban:rural population ratio:
1990 Region 3 urban population = 3.73m; total population = 6.20m Therefore Zambales urban/rural ratio ~ 60/40

Data specific to Sto.Tomas River
Assumed duration of interruption of economic activities (days per year)** 4.74

Data specific to Maloma River
Assumed duration of interruption of economic activities (days per year)*** 6.18

Data specific to Bucao River
Assumed duration of interruption of economic activities (days per year)**** 5.41

Notes:
1 *Average growth rate for Region 3 (1999 to 2004) plus national population growth rates extracted from Philippine Medium Term Development Plan (1999-2004)
2. Calculation of productive days lost is based on standard Japanese statistics as follows:

Days/depth (cms)	4.4/50	6.3/50-99	10.3/100-199	16.8/200-299	22.6/300	
For the following frequencies for 20-year return flood:						
Sto. Tomas River**						
- houses inundated to depth indicated/total houses inundated to any depth:						
	5584/6444	700/6444	159/6444	-	1//6444	
Therefore most probable days lost for each inundation depth =						Total
	3.80	0.68	0.25	-	0.00	4.74
Maloma River***						
- houses inundated to depth indicated/total houses inundated to any depth:						
	56/154	76/154	22/154	-	0//154	
Therefore most probable days lost for each inundation depth =						Total
	1.60	3.11	1.47	-	0.00	6.18
Bucao River****						
- houses inundated to depth indicated/total houses inundated to any depth:						
	1333/1908	364/1908	211/1908	-	0//1908	
Therefore most probable days lost for each inundation depth =						Total
	3.07	1.20	1.14	-	0.00	5.41

Table 1.3.7 Evacuation Cost from Flood and Lahar

Sto.Tomas River

Number of House

Depth(m)			2Year	5Year	10Year	20Year	30Year	50Year	100Year
0.05	～	0.10	1305	1445	1496	1412	1409	1424	1537
0.10	～	0.20	984	1483	1647	1914	1912	1895	1954
0.20	～	0.30	713	784	873	980	1137	1263	1365
0.30	～	0.50	455	805	1100	1278	1343	1405	1598
0.50	～	0.75	211	313	351	462	572	773	925
0.75	～	1.00	65	120	165	238	279	292	375
1.00	～	1.50	26	70	100	122	140	198	262
1.50	～	3.00	23	25	29	37	39	45	61
3.00	～	10.00	0	0	1	1	1	1	2
Total			3782	5045	5762	6444	6832	7296	8079
Effective total houses			3782	1263	717	682	ignore values for return periods of > 20 years		
Probability of event in one year			0.5	0.2	0.1	0.05			

Households affected by 20-year flood	6444
Most probable number of households	322.2
Evacuation period (weeks) per flood event	1.0
Total evacuation weeks	322.2
Weekly cost per household (216 pesos + 53% cost inflation increase):	330.48
STO. TOMAS RIVER COST PER YEAR	106,481

Maloma River

Number of House

Depth(m)			2Year	5Year	10Year	20Year	30Year	50Year	100Year
0.05	～	0.10	14	6	2	3	8	63	43
0.10	～	0.20	12	9	10	4	3	38	73
0.20	～	0.30	32	20	9	8	5	2	25
0.30	～	0.50	38	54	52	41	38	22	7
0.50	～	0.75	21	33	46	49	53	63	57
0.75	～	1.00	8	13	15	27	29	37	41
1.00	～	1.50	3	8	15	20	23	21	35
1.50	～	3.00	0	1	1	2	2	7	11
3.00	～	10.00	0	0	0	0	0	0	0
Total			128	144	150	154	161	253	292
Effective total houses			128	16	6	4	ignore values for return periods of > 20 years		
Probability of event in one year			0.5	0.2	0.1	0.05			

Households affected by 20-year flood	154
Most probable number of households	7.7
Evacuation period (weeks)	1.0
Total evacuation weeks	7.7
Weekly cost per household (216 pesos + 53% cost inflation increase):	330.48
MALOMA RIVER COST PER YEAR	2,545

Bucao River

Number of House

Depth(m)			2Year	5Year	10Year	20Year	30Year	50Year	100Year
0.05	～	0.10	130	163	154	291	244	241	271
0.10	～	0.20	303	297	295	332	441	489	450
0.20	～	0.30	250	224	244	253	245	269	395
0.30	～	0.50	346	392	406	457	473	471	467
0.50	～	0.75	126	176	233	258	302	355	394
0.75	～	1.00	48	100	96	106	112	121	150
1.00	～	1.50	43	59	99	135	147	165	184
1.50	～	3.00	30	49	64	76	74	74	89
3.00	～	10.00	0	0	0	0	2	6	6
Total			1276	1460	1591	1908	2040	2191	2406
Effective total houses			1276	184	131	317	ignore values for return periods of > 20 years		
Probability of event in one year			0.5	0.2	0.1	0.05			

Households affected by 20-year flood	1908
Most probable number of households	95.4
Evacuation period (weeks)	1.0
Total evacuation weeks	95.4
Weekly cost per household (216 pesos + 53% cost inflation increase):	330.48
BUCAO RIVER COST PER YEAR	31,528

Total for Three Rivers

Households affected by 20-year flood	8506
Probability of event in one year	0.05
Most probable houses affected per year	425
Total evacuation weeks	425.3
TOTAL RIVERS COST PER YEAR (PESOS)	140,553

Table 1.3.8 Cleanup Cost from Flood and Lahar (1/2)

Sto. Tomas River

Number of House

Depth(m)	2Year	5Year	10Year	20Year	30Year	50Year	100Year
0.05 ～ 0.10	1305	1445	1496	1412	1409	1424	1537
0.10 ～ 0.20	984	1483	1647	1914	1912	1895	1954
0.20 ～ 0.30	713	784	873	980	1137	1263	1365
0.30 ～ 0.50	455	805	1100	1278	1343	1405	1598
0.50 ～ 0.75	211	313	351	462	572	773	925
0.75 ～ 1.00	65	120	165	238	279	292	375
1.00 ～ 1.50	26	70	100	122	140	198	262
1.50 ～ 3.00	23	25	29	37	39	45	61
3.00 ～ 10.00	0	0	1	1	1	1	2
Total	3782	5045	5762	6444	6832	7296	8079
Effective total houses	3782	1263	717	682	ignore values for return periods of > 20 years		
Probability of event in one year	0.5	0.2	0.1	0.05		Totals	
to 0.50	455	805	1100	1278			
Effective total houses	455	350	295	178			
Most probable houses per year	228	70	30	9			
Cleaning days per house	7.5	7.5	7.5	7.5			
Total cleaning days needed	1,706	525	221	67		2,519	
0.50 to 1.00							
Effective total houses	276	157	83	184			
Most probable houses per year	138	31.4	8.3	9.2			
Cleaning days per house	13.3	13.3	13.3	13.3			
Total cleaning days needed	1,835	418	110	122		2,486	
1.00 to 2.00							
Effective total houses	26	44	30	22			
Most probable houses per year	13	9	3	1			
Cleaning days per house	26.1	26.1	26.1	26.1			
Total cleaning days needed	339	230	78	29		676	
2.00 to 3.00							
Effective total houses	23	2	5	8			
Most probable houses per year	12	0	1	0			
Cleaning days per house	42.4	42.4	42.4	42.4			
Total cleaning days needed	488	17	21	17		543	
STO TOMAS CLEANING DAYS						6,224	
STO TOMAS CLEANING COST (days*(150+53%))						1,428,346	

Maloma River

Number of House

Depth(m)	2Year	5Year	10Year	20Year	30Year	50Year	100Year
0.05 ～ 0.10	14	6	2	3	8	63	43
0.10 ～ 0.20	12	9	10	4	3	38	73
0.20 ～ 0.30	32	20	9	8	5	2	25
0.30 ～ 0.50	38	54	52	41	38	22	7
0.50 ～ 0.75	21	33	46	49	53	63	57
0.75 ～ 1.00	8	13	15	27	29	37	41
1.00 ～ 1.50	3	8	15	20	23	21	35
1.50 ～ 3.00	0	1	1	2	2	7	11
3.00 ～ 10.00	0	0	0	0	0	0	0
Total	128	144	150	154	161	253	292
Effective total houses	128	16	6	4	Ignore values for return periods of > 20 years		
Probability of event in one year	0.5	0.2	0.1	0.05			
	64	3	1	0			
to 0.50							
Effective total houses	38	16	-2	-11			
Most probable houses per year	19	3	0	-1			
Cleaning days per house	7.5	7.5	7.5	7.5			
Total cleaning days needed	143	24	0	0		167	
0.50 to 1.00							
Effective total houses	29	17	15	15			
Most probable houses per year	14.5	3	2	1			
Cleaning days per house	13.3	13.3	13.3	13.3			
Total cleaning days needed	193	45	20	10		268	
1.00 to 2.00							
Effective total houses	3	5	7	5			
Most probable houses per year	2	1	1	0			
Cleaning days per house	26.1	26.1	26.1	26.1			
Total cleaning days needed	39	26	18	7		90	
2.00 to 3.00							
Effective total houses	0	1	1	2			
Most probable houses per year	0	0	0	0			
Cleaning days per house	42.4	42.4	42.4	42.4			
Total cleaning days needed	0	8	4	4		17	
MALOMA CLEANING DAYS						504	
MALOMA CLEANING COST (days*(150+53%))						115,737	

Table 1.3.8 Cleanup Cost from Flood and Lahar (2/2)

Bucao River

Number of House

Depth(m)	2Year	5Year	10Year	20Year	30Year	50Year	100Year
0.05 ～ 0.10	130	163	154	291	244	241	271
0.10 ～ 0.20	303	297	295	332	441	489	450
0.20 ～ 0.30	250	224	244	253	245	269	395
0.30 ～ 0.50	346	392	406	457	473	471	467
0.50 ～ 0.75	126	176	233	258	302	355	394
0.75 ～ 1.00	48	100	96	106	112	121	150
1.00 ～ 1.50	43	59	99	135	147	165	184
1.50 ～ 3.00	30	49	64	76	74	74	89
3.00 ～ 10.00	0	0	0	0	2	6	6
Total	1276	1460	1591	1908	2040	2191	2406
Effective total houses	1276	184	131	317	Ignore values for return periods of > 20 years		
Probability of event in one year	0.5	0.2	0.1	0.05			

to 0.50						
Effective total houses	346	46	14	51		
Most probable houses per year	173	9	1	3		
Cleaning days per house	7.5	7.5	7.5	7.5		
Total cleaning days needed	1298	69	11	19		1,396
0.50 to 1.00						
Effective total houses	174	102	53	35		
Most probable houses per year	87	20	5	2		
Cleaning days per house	13.3	13.3	13.3	13.3		
Total cleaning days needed	1157	271	70	23		1,522
1.00 to 2.00						
Effective total houses	43	16	40	36		
Most probable houses per year	22	3	4	2		
Cleaning days per house	26.1	26.1	26.1	26.1		
Total cleaning days needed	561	84	104	47		796
2.00 to 3.00						
Effective total houses	30	19	15	12		
Most probable houses per year	15	4	2	1		
Cleaning days per house	42.4	42.4	42.4	42.4		
Total cleaning days needed	636	161	64	25		886
BUCAO CLEANING DAYS						4,601
BUCAO CLEANING COST (days*(150+53%))						1,055,819

Total for Three Rivers

Gross total houses	5186	6649	7503	8506	9033	9740	10777
Effective total houses	5186	1463	854	1003	Ignore values for return periods of > 20 years		
Probability of event in one year	0.5	0.2	0.1	0.05			
Most probable houses affected per year	2593	293	85	50			
Total most probable houses per year						3,021	
TOTAL CLEANING DAYS						11,329	
TOTAL CLEANING COST (PESOS)						2,599,902	

Table 1.4.1 Percentage of Taxation to Estimated Market Values of Local and Foreign Currency Portions

Item	Tax Rates of Construction Materials and Services on Estimated Market Values						
	National Taxation				Local Taxation		Imposed on Total Value of Local & Foreign Portions (g)
	Imposed on Both Local & Imported Goods			Imposed Only Imported Goods			
	Value Added Tax (a)	Excise Tax (b)	Income Tax (c)	Customs Duties (d)	Tax on Sand, Gravel & Quarry Resources (e)	Other Taxes*10 (f)	
1. Materials							
a. Cement	9.09% *1	1.82% *4	1.13% *8	1.87% *13	-	0.94%	14.8%
b. Aggregate (Coarse & Fine)	9.09% *1	1.82% *4	2.86% *8	0.81% *13	3.00% *5	1.40%	19.0%
c. Steel	9.09% *1	1.82% *6	1.57% *8	2.23% *13	-	0.60%	15.3%
d. Fuel & Lubricant	9.09% *1	4.81% *7	1.00% *8	3.45% *14	-	0.39%	18.7%
e. Lumber	9.09% *1	-	2.24% *8	0.12% *13	-	0.90%	12.3%
f. Others	9.09% *1	-	2.49% *8	1.16% *13	-	1.33%	14.1%
2. Machinery and Equipment Rental	- *16	-	1.62% *8	19.60% *15	-	0.72%	21.9%
3. Labor							
a. Skilled Workers	- *16	-	7.00% *9	-	-	-	7.0%
b. Unskilled Workers	- *16	-	-	-	-	-	0.0%
4. Indirect Costs							
a. OCM*3	9.09% *1	-	1.82%	-	-	2.73% *11	13.6%
b. Profit	-	-	35.00%	-	-	-	35.0%
c. VAT*2	100.0% *2	-	-	-	-	-	100.0%
5. Government Expenditure							
a. Engineering & Adm. Overhea	-	-	5.00% *11	-	-	-	5.0%
6. Engineering Service	9.09% *1	-	0.91% *12	-	-	-	10.0%

Source: The Fundamentals of Taxation, 1993 Edition, October 1996, REX Book Store
The National Internal Revenue Code of the Philippines Annotated, 1997 Revised Edition, National Book Store

Note: *1 Value Added Tax: 10% of sales or appropriated amount
*2 The tax is imposed on (4) machinery and equipment rental and (5) labor costs, which are eliminated from market value completely.
*3 Overhead, contingencies and miscellaneous expenses
*4 The tax was assumed to account for 2% of purchased amount excluding VAT, according to page 1046 and 1049 of the reference T44.
*5 4 pesos per 1 cu.m. of aggregate consumed including local government charge, or 3.3% of purchased value excluding VAT
*6 The tax was assumed to account for 2% of purchased amount excluding VAT, according to page 1047 of the reference T44.
*7 8.5 pesos per 1 liter of diesel fuel oil consumed, and 0.45 pesos of excise tax per liter.
*8 Compensation of workers comes from II-2 of Table.8-2 and profit (included in operating surplus) of manufacturer from II-3 of Table.8.1.2.
Income tax on workers was assumed at 10% of the compensation and income tax on manufacturer at 35% of the profit which accounts for 1/10 of operating surplus.
*9 7% of a total wage including basic salary and fringe benefits was assumed as average annual income tax.
*10 Including (1) real property tax, (2) professional tax, (3) business taxes, (4) license fee, etc.
5% of operation surplus was assumed to be paid for other local taxes, which comes from II-3 of Table.8.1.2.
*11 5% of overhead expenses, accounting for 60% of OCM, was assumed to be allocated as the taxes.
*12 10% of local personnel expenses, accounting for 10% of the total expenditure, was assumed to be paid for income tax.
*13 10% of imported CIF value, which comes from II-1 of Table.8.1.2, was assumed to be imposed as customs duties and charges.
*14 19.8% (P1.63/liter (Customs Duty) to P8.50/liter of Diesel) of imported CIF value, which comes from II-1 of Table.8.1.3, was assumed to be imposed as customs duties and charges.
*15 3% of imported CIF value of backhoe and truck-crane and 30% of dump-truck were assumed to be imposed as customs duties and charges.
*16 VAT is appropriated in the item 4-c as ultimate payment, so the VAT figure is not indicated here.

Table 1.4.2 Cost Composition of Construction Materials: 1994

(Unit: Million Pesos)

Description	Commodity							
	035 Stone Quarrying & Sand Pits	093 Misc. Wood, Cork & Cane Products	112 Lubticants & Misc. Products of Petroleum	121 Cement Manufacturing	130 Structural Metal Products	142 Non-Electrical Machinery	153 Motor Vehicles	TID Total Intermediate Demand
	Aggregate	Lumber	Fuel/Lubricant	Cement	Steel Bar	Machinery & Equipment		Others
I. Composition of Material Cost								
1. Domestic Intermediate Inputs	1,581	789	2,519	7,623	2,525	1,165	8,996	1,171,380
2. Imports	475	17	833	3,252	1,351	932	41,696	413,960
3. Compensation of employees	1,102	236	333	828	698	692	3,869	555,784
4. Depreciation	540	25	158	874	210	142	644	153,537
5. Indirect Taxes Less Subsidies	154	21	134	312	63	45	661	95,402
6. Operating Surplus	1,643	263	365	3,258	726	910	4,854	945,565
7. Gross Value Added*1	3,439	545	990	5,273	1,697	1,789	10,027	1,750,288
8. Total Primary Inputs*2	3,914	562	1,823	8,525	3,048	2,721	51,723	2,164,248
9. Total Inputs*3	5,494	1,351	4,343	16,147	5,574	3,886	60,719	3,335,628
10. Total Inputs w/o ITS*4	5,341	1,331	4,209	15,835	5,511	3,841	60,058	3,240,226
II. Share of Component								
1. Imports to Total Inputs w/o ITS	8.9%	1.3%	19.8%	20.5%	24.5%	24.3%	69.4%	12.8%
2. Compensation to Total Inputs w/o ITS	20.6%	17.8%	7.9%	5.2%	12.7%	18.0%	6.4%	17.2%
3. Operating Surplus to Total Inputs w/o ITS	30.8%	19.7%	8.7%	20.6%	13.2%	23.7%	8.1%	29.2%
cf. Indirect Taxes Less Subsidies to Total Inputs	2.8%	1.5%	3.1%	1.9%	1.1%	1.2%	1.1%	2.9%

Source: 1994 Input-Output Table at Current Producers' Prices [229 x 229 Commodity x Commodity Use Matrix (Domestic/Non-competitive)], NSCB

Note: *1 (3)+(4)+(5)+(6)
*2 (2)+(7)
*3 (1)+(8)
*4 Total Inputs without Indirect Taxes Less Subsidies: (9)-(5)

Table 1.4.3 Conversion Factors from Financial Market Cost to Real Economic Cost

Item	Local/Foreign Currency Composition Appropriated for Project Cost Estimation*1		Tax Portion Against Total Market Cost*2	Shadow Wage Rate *3	Foreign Portion		Conversion Factors for Estimated Financial Costs of Local/Foreign Portions		Conversion Factors for Benefit Estimation
	Local	Foreign			Import Share to Total*4	Shadow Exchange Rate*3	Local	Foreign	
1. Materials									
a. Cement	30%	70%	15%	100%	21%	120%	0.51	1.06	0.89
b. Aggregate (Coarse & Fine)	60%	40%	19%	100%	9%	120%	0.68	1.04	0.83
c. Steel	20%	80%	15%	100%	25%	120%	0.23	1.06	0.90
d. Fuel & Lubricant	30%	70%	19%	100%	20%	120%	0.38	1.06	0.85
e. Lumber	60%	40%	12%	100%	1%	120%	0.79	1.01	0.88
f. Others	50%	50%	14%	100%	13%	120%	0.72	1.05	0.88
2. Machinery and Equipment Rental	30%	70%	22%	100%	47%	120%	0.27	1.13	0.87
3. Labor									
a. Skilled Workers	100%	0%	7%	100%	-	-	0.93	-	0.93
b. Unskilled Workers	100%	0%	0%	60%	-	-	0.60	-	0.60
4. Indirect Costs									
a. OCM*3	100%	0%	14%	100%	-	-	0.86	-	0.86
b. Profit	100%	0%	35%	100%	-	-	0.65	-	0.65
c. VAT*2	100%	0%	100%	100%	-	-	0.00	-	0.00
5. Government Expenditure									
a. Engineering & Administrative Overhead	100%	0%	5%	100%	-	-	0.95	-	0.95
6. Engineering Service	10%	90%	10%	100%	100% *5	120%	0.00	1.22	1.10

Source: ICC Project Evaluation Procedures and Guidelines, NEDA

Note: *1 Composition figures come from NEDA information.
*2 Refer to Column (g) of Table.1.4.1.
*3 Refer to the above source.
*4 The total figures do not include indirect taxes. Imported portion comes from II-1 of Table.1.4.2.
*5 Engineering service is supplied by a foreign consultant firm.

Table 1.4.4 Economic Evaluation for Bucao River Flood/Mudflow Control Project (including re-construction of Bucao Bridge)

(Unit : million Peso)

No.	Year	COST			BENEFIT			
		Initial	O&M	Total	Direct	Indirect	Total	B - C
1	2004			0.00				0.00
2	2005	82.79		82.79				-82.79
3	2006	165.59		165.59				-165.59
4	2007	295.70		295.70				-295.70
5	2008	224.73		224.73			0.00	-224.73
6	2009	224.73		224.73			0.00	-224.73
7	2010	189.24		189.24			0.00	-189.24
8	2011		17.74	17.74	131.63	152.03	283.66	265.92
9	2012		17.74	17.74	131.63	152.03	283.66	265.92
10	2013		17.74	17.74	131.63	152.03	283.66	265.92
11	2014		17.74	17.74	131.63	152.03	283.66	265.92
12	2015		17.74	17.74	131.63	152.03	283.66	265.92
13	2016		17.74	17.74	131.63	152.03	283.66	265.92
14	2017		17.74	17.74	131.63	152.03	283.66	265.92
15	2018		17.74	17.74	131.63	152.03	283.66	265.92
16	2019		17.74	17.74	131.63	152.03	283.66	265.92
17	2020		17.74	17.74	131.63	152.03	283.66	265.92
18	2021		17.74	17.74	131.63	152.03	283.66	265.92
19	2022		17.74	17.74	131.63	152.03	283.66	265.92
20	2023		17.74	17.74	131.63	152.03	283.66	265.92
21	2024		17.74	17.74	131.63	152.03	283.66	265.92
22	2025		17.74	17.74	131.63	152.03	283.66	265.92
23	2026		17.74	17.74	131.63	152.03	283.66	265.92
24	2027		17.74	17.74	131.63	152.03	283.66	265.92
25	2028		17.74	17.74	131.63	152.03	283.66	265.92
26	2029		17.74	17.74	131.63	152.03	283.66	265.92
27	2030		17.74	17.74	131.63	152.03	283.66	265.92
28	2031		17.74	17.74	131.63	152.03	283.66	265.92
29	2032		17.74	17.74	131.63	152.03	283.66	265.92
30	2033		17.74	17.74	131.63	152.03	283.66	265.92
31	2034		17.74	17.74	131.63	152.03	283.66	265.92
32	2035		17.74	17.74	131.63	152.03	283.66	265.92
33	2036		17.74	17.74	131.63	152.03	283.66	265.92
34	2037		17.74	17.74	131.63	152.03	283.66	265.92
35	2038		17.74	17.74	131.63	152.03	283.66	265.92
36	2039		17.74	17.74	131.63	152.03	283.66	265.92
37	2040		17.74	17.74	131.63	152.03	283.66	265.92
TOTAL		1,182.78	408.06	1,590.84	3,027.47	3,496.71	6,524.19	4,933.35
							EIRR =	15.7%
							NPV(12%)	270

Table 1.4.5 Economic Evaluation for the Sto.Tomas Flood/Mudflow Control Works (cost for Maculcol Bridge is added)

(Unit : million Peso)

No.	Year	COST			BENEFIT			
		Initial	O&M	Total	Direct	Indirect	Total	B - C
1	2004			0.00				0.00
2	2005			0.00				0.00
3	2006	64.97		64.97				-64.97
4	2007	341.09		341.09				-341.09
5	2008	438.54		438.54			0.00	-438.54
6	2009	454.78		454.78			0.00	-454.78
7	2010	324.85		324.85			0.00	-324.85
8	2011		24.36	24.36	479.43	189.04	668.47	644.11
9	2012		24.36	24.36	479.43	189.04	668.47	644.11
10	2013		24.36	24.36	479.43	189.04	668.47	644.11
11	2014		24.36	24.36	479.43	189.04	668.47	644.11
12	2015		24.36	24.36	479.43	189.04	668.47	644.11
13	2016		24.36	24.36	479.43	189.04	668.47	644.11
14	2017		24.36	24.36	479.43	189.04	668.47	644.11
15	2018		24.36	24.36	479.43	189.04	668.47	644.11
16	2019		24.36	24.36	479.43	189.04	668.47	644.11
17	2020		24.36	24.36	479.43	189.04	668.47	644.11
18	2021		24.36	24.36	479.43	189.04	668.47	644.11
19	2022		24.36	24.36	479.43	189.04	668.47	644.11
20	2023		24.36	24.36	479.43	189.04	668.47	644.11
21	2024		24.36	24.36	479.43	189.04	668.47	644.11
22	2025		24.36	24.36	479.43	189.04	668.47	644.11
23	2026		24.36	24.36	479.43	189.04	668.47	644.11
24	2027		24.36	24.36	479.43	189.04	668.47	644.11
25	2028		24.36	24.36	479.43	189.04	668.47	644.11
26	2029		24.36	24.36	479.43	189.04	668.47	644.11
27	2030		24.36	24.36	479.43	189.04	668.47	644.11
28	2031		24.36	24.36	479.43	189.04	668.47	644.11
29	2032		24.36	24.36	479.43	189.04	668.47	644.11
30	2033		24.36	24.36	479.43	189.04	668.47	644.11
31	2034		24.36	24.36	479.43	189.04	668.47	644.11
32	2035		24.36	24.36	479.43	189.04	668.47	644.11
33	2036		24.36	24.36	479.43	189.04	668.47	644.11
34	2037		24.36	24.36	479.43	189.04	668.47	644.11
35	2038		24.36	24.36	479.43	189.04	668.47	644.11
36	2039		24.36	24.36	479.43	189.04	668.47	644.11
37	2040		24.36	24.36	479.43	189.04	668.47	644.11
TOTAL		1,624.23	560.36	2,184.59	11,026.87	4,347.92	15,374.79	13,190.20
							EIRR =	26.3%
							NPV(12%)	1,458

Notes: Cost for Maculcol bridge: 327 million Pesos is added to the Project Cost.

Table 1.5.1 Economic Evaluation on CBFM Program for Community Based Disaster Prevention Activities (For Pilot Scheme Development of 2,200ha)

Year	Cost			Benefit					B-C
	Re-forestation		Agro-forestry	Stumpage of Tree-Plantation	Agro-forestry			Sediment Reduction	
	Initial Development Cost	Replacement Cost			Mango	Cashew	Corn		
				1,837	147	110	110		
	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0
1	20.795	0.000	5.851	0.000	-0.712	-0.577	0.000	0.000	-27.935
2	14.972	0.000	3.069	0.000	-0.451	-0.381	0.201	0.000	-18.672
3	6.779	0.000	1.690	0.000	-0.451	-0.647	0.402	0.000	-9.165
4	3.498	0.000	1.037	0.000	-0.392	-0.410	0.634	0.000	-4.702
5		0.000		0.000	-0.399	-0.140	0.866	0.000	0.326
6		0.000		0.000	-0.593	0.263	0.866	0.000	0.536
7		0.000		0.000	-0.546	0.605	0.866	0.000	0.925
8		0.000		0.000	-0.467	0.853	0.866	0.000	1.252
9		0.000		43.774	0.153	1.172	0.866	0.000	45.965
10		20.795		43.774	1.446	1.542	0.866	4.600	31.432
11		14.972		43.774	4.637	1.911	0.866	4.600	40.816
12		6.779		43.774	9.143	2.247	0.866	4.600	53.852
13		3.498		43.774	13.546	2.496	0.866	4.600	61.783
14		0.000		0.000	17.260	2.496	0.866	4.600	25.221
15		0.000		0.000	21.858	2.496	0.866	4.600	29.819
16		0.000		0.000	23.230	2.496	0.866	4.600	31.192
17		0.000		0.000	24.751	2.496	0.866	4.600	32.713
18		0.000		43.774	26.541	2.496	0.866	4.600	78.276
19		20.795		43.774	28.216	2.496	0.866	4.600	59.156
20		14.972		43.774	29.493	2.496	0.866	4.600	66.257
21		6.779		43.774	29.463	2.496	0.866	4.600	74.420
22		3.498		43.774	29.036	2.496	0.866	4.600	77.273
23		0.000		0.000	28.976	2.496	0.866	4.600	36.937
24		0.000		0.000	28.976	2.496	0.866	4.600	36.937
25		0.000		0.000	28.976	2.496	0.866	4.600	36.937
26		0.000		0.000	28.946	2.496	0.866	4.600	36.907
NPV (15%)	20.50	7.48	5.21	35.22	14.63	1.90	2.25	4.52	25.31
EIRR									**21.5%**

Table 1.5.2 Economic Evaluation for Agriculture Development on Lahar Area
(For Pilot Development Area : Full Development Scheme)

Area-4 : Bucao, Downstream, Right Side at River Area (Barangay San Juan)

Development Area: 120 ha

EIRR	**11.6%**								
98968383.36	2613600	823680	1580832	1884960	105871455.4	33741	156240	122499	
						120	120		

Year	Cost						Benefit (Sweet Potato)			B-C
	River training	Land develop	Soil improve	Fertilizer	Water supply	Total	Expenses	Revenue	Net Income	
						0			0	0
						0			0	0
2004	40,577,037					40,577,037			0	-40,577,037
2005	40,577,037	2,143,152	337,709	648,141	772,834	44,478,873			0	-44,478,873
2006			337,709	648,141	772,834	1,758,684			0	-1,758,684
2007							3,441,582	15,936,480	12,494,898	12,494,898
2008							3,441,582	15,936,480	12,494,898	12,494,898
2009							3,441,582	15,936,480	12,494,898	12,494,898
2010							3,441,582	15,936,480	12,494,898	12,494,898
2011							3,441,582	15,936,480	12,494,898	12,494,898
2012							3,441,582	15,936,480	12,494,898	12,494,898
2013							3,441,582	15,936,480	12,494,898	12,494,898
2014							3,441,582	15,936,480	12,494,898	12,494,898
2015							3,441,582	15,936,480	12,494,898	12,494,898
2016							3,441,582	15,936,480	12,494,898	12,494,898
2017							3,441,582	15,936,480	12,494,898	12,494,898
2018							3,441,582	15,936,480	12,494,898	12,494,898
2019							3,441,582	15,936,480	12,494,898	12,494,898
2020							3,441,582	15,936,480	12,494,898	12,494,898
2021							3,441,582	15,936,480	12,494,898	12,494,898
2022							3,441,582	15,936,480	12,494,898	12,494,898
2023							3,441,582	15,936,480	12,494,898	12,494,898
2024							3,441,582	15,936,480	12,494,898	12,494,898
2025							3,441,582	15,936,480	12,494,898	12,494,898
2026							3,441,582	15,936,480	12,494,898	12,494,898
2027							3,441,582	15,936,480	12,494,898	12,494,898
2028							3,441,582	15,936,480	12,494,898	12,494,898
2029							3,441,582	15,936,480	12,494,898	12,494,898
2030							3,441,582	15,936,480	12,494,898	12,494,898
2031							3,441,582	15,936,480	12,494,898	12,494,898
2032							3,441,582	15,936,480	12,494,898	12,494,898
2033							3,441,582	15,936,480	12,494,898	12,494,898
NPV (15%)						52,985,377			40,156,410	-12,828,967

Area-7 : Sto-Tomas, Middle stream, Left Side (Barangay San Rafael)

Development Area: 250 ha

EIRR	**16.9%**								
206184132	5445000	1716000	3293400	3927000	220565532	79056	262500	183444	
						250	250		

Year	Cost						Benefit (Onion)			B-C
	River training	Land develop	Soil improve	Fertilizer	Water supply	Total	Expenses	Revenue	Net Income	
						0			0	0
						0			0	0
2004	84,535,494					84,535,494			0	-84,535,494
2005	84,535,494	4,464,900	703,560	1,350,294	1,610,070	92,664,318			0	-92,664,318
2006			703,560	1,350,294	1,610,070	3,663,924			0	-3,663,924
2007							16,799,400	55,781,250	38,981,850	38,981,850
2008							16,799,400	55,781,250	38,981,850	38,981,850
2009							16,799,400	55,781,250	38,981,850	38,981,850
2010							16,799,400	55,781,250	38,981,850	38,981,850
2011							16,799,400	55,781,250	38,981,850	38,981,850
2012							16,799,400	55,781,250	38,981,850	38,981,850
2013							16,799,400	55,781,250	38,981,850	38,981,850
2014							16,799,400	55,781,250	38,981,850	38,981,850
2015							16,799,400	55,781,250	38,981,850	38,981,850
2016							16,799,400	55,781,250	38,981,850	38,981,850
2017							16,799,400	55,781,250	38,981,850	38,981,850
2018							16,799,400	55,781,250	38,981,850	38,981,850
2019							16,799,400	55,781,250	38,981,850	38,981,850
2020							16,799,400	55,781,250	38,981,850	38,981,850
2021							16,799,400	55,781,250	38,981,850	38,981,850
2022							16,799,400	55,781,250	38,981,850	38,981,850
2023							16,799,400	55,781,250	38,981,850	38,981,850
2024							16,799,400	55,781,250	38,981,850	38,981,850
2025							16,799,400	55,781,250	38,981,850	38,981,850
2026							16,799,400	55,781,250	38,981,850	38,981,850
2027							16,799,400	55,781,250	38,981,850	38,981,850
2028							16,799,400	55,781,250	38,981,850	38,981,850
2029							16,799,400	55,781,250	38,981,850	38,981,850
2030							16,799,400	55,781,250	38,981,850	38,981,850
2031							16,799,400	55,781,250	38,981,850	38,981,850
2032							16,799,400	55,781,250	38,981,850	38,981,850
2033							16,799,400	55,781,250	38,981,850	38,981,850
NPV (15%)						110,386,202			125,280,826	14,894,624

Table 1.5.3 Economic Evaluation for Community Road Rehabilitation (For Priority Scheme: Route-A1:16km)

Benefit Estimation:

1	Beneficial Population:	11,000	persons
2	Saving Travel Time by Community Road:Route-A1:	3	hours
3	GRDP per capita for Region III (as of 2002):	30,784	Peso/year
4	Hourly value of time saving:	10.54	Peso/capita/hour
5	Assumed travel opportunity per person:	12	Trip/year
6	Total time saving by community road Route-A	792,000	hours/year
7	Annual value for time saving:	8,349,633	Pesos/year

Cost Estimation:

1	Project Cost for Route-A1:	189	million Pesos
2	Economic Cost for Route-A1:	161	million Pesos

(Unit : million Peso)

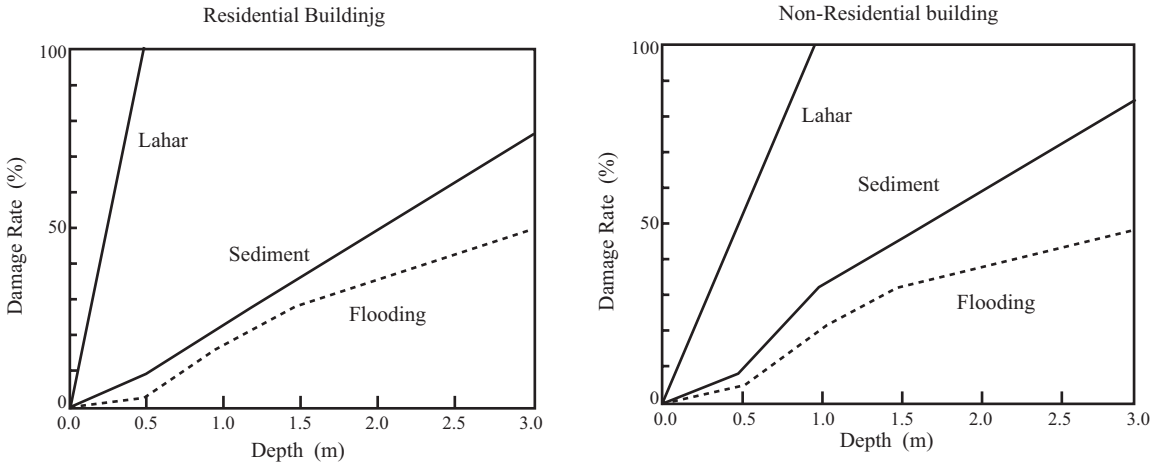
No.	Year	COST			BENEFIT			
		Initial	O&M	Total	Direct	Indirect	Total	B - C
1	2004	32.20		32.20				-32.20
2	2005	48.30		48.30				-48.30
3	2006	48.30		48.30				-48.30
4	2007	32.20		32.20				-32.20
5	2008		0.81	0.81	8.35	0.00	8.35	7.54
6	2009		0.81	0.81	8.35	0.00	8.35	7.54
7	2010		0.81	0.81	8.35	0.00	8.35	7.54
8	2011		0.81	0.81	8.35	0.00	8.35	7.54
9	2012		0.81	0.81	8.35	0.00	8.35	7.54
10	2013		0.81	0.81	8.35	0.00	8.35	7.54
11	2014		0.81	0.81	8.35	0.00	8.35	7.54
12	2015		0.81	0.81	8.35	0.00	8.35	7.54
13	2016		0.81	0.81	8.35	0.00	8.35	7.54
14	2017		0.81	0.81	8.35	0.00	8.35	7.54
15	2018		0.81	0.81	8.35	0.00	8.35	7.54
16	2019		0.81	0.81	8.35	0.00	8.35	7.54
17	2020		0.81	0.81	8.35	0.00	8.35	7.54
18	2021		0.81	0.81	8.35	0.00	8.35	7.54
19	2022		0.81	0.81	8.35	0.00	8.35	7.54
20	2023		0.81	0.81	8.35	0.00	8.35	7.54
21	2024		0.81	0.81	8.35	0.00	8.35	7.54
22	2025		0.81	0.81	8.35	0.00	8.35	7.54
23	2026		0.81	0.81	8.35	0.00	8.35	7.54
24	2027		0.81	0.81	8.35	0.00	8.35	7.54
25	2028		0.81	0.81	8.35	0.00	8.35	7.54
26	2029		0.81	0.81	8.35	0.00	8.35	7.54
27	2030		0.81	0.81	8.35	0.00	8.35	7.54
28	2031		0.81	0.81	8.35	0.00	8.35	7.54
29	2032		0.81	0.81	8.35	0.00	8.35	7.54
30	2033		0.81	0.81	8.35	0.00	8.35	7.54
31	2034		0.81	0.81	8.35	0.00	8.35	7.54
32	2035		0.81	0.81	8.35	0.00	8.35	7.54
33	2036		0.81	0.81	8.35	0.00	8.35	7.54
34	2037		0.81	0.81	8.35	0.00	8.35	7.54
TOTAL		161.00	20.93	181.93	217.07	0.00	217.07	35.14
							EIRR =	2.1%
							NPV(12%)	-83

Table 1.6.1 Overall Economic Evaluation for Basin-wide Integrated Disaster Prevention Activities

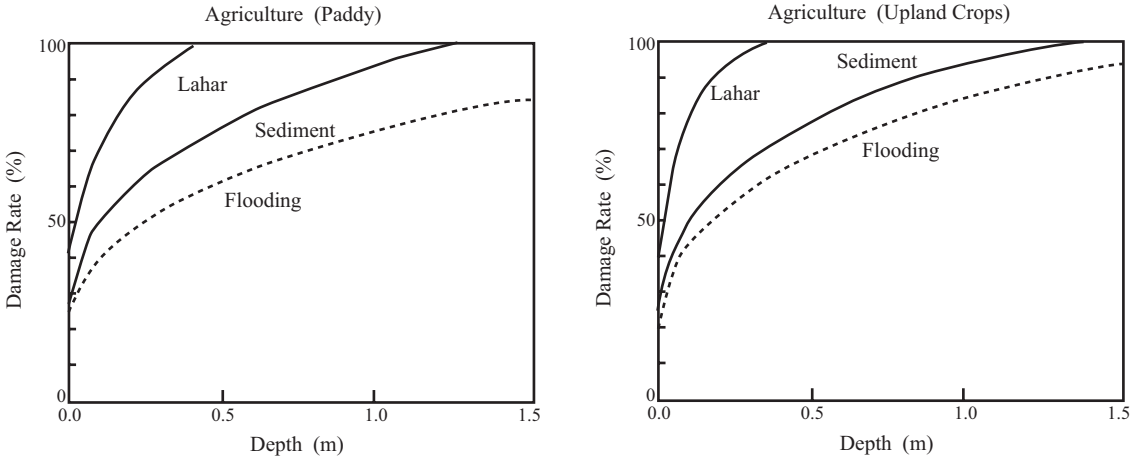
No.	Year	Structural Measures						Non-Structural Measures						Community Based Disaster Prevention Measures										BASIN-WIDE INTEGRATED DISASTER PREVENTION		
		Bucao River with Bridge			Sto. Tomas River w/Bridge			Warning & Evacuation			Hydro/Sediment/Water Quality Monitoring			Community Road			Lahar Agriculture (Pilot)			CBFM (Pilot)			AETAS (Pilot)			
Activities		Bucao Downstream			Sto.Tomas Downstream			Whole Study Area			Whole Study Area			Bucao			Bucao/Sto.Tomas Downstream			Bucao/Sto.Tomas Upstream			Bucao/Sto.Tomas Upstream			Whole Basin & Communities
Beneficial Area		Bucao Downstream			Sto.Tomas Downstream			Downstream Flood Prone Area			Downstream Flood Prone Area			Bucao			Bucao/Sto.Tomas Downstream			Bucao/Sto.Tomas Upstream			Bucao/Sto.Tomas Upstream			Whole Basin & Communities
Implementation		MPE-PMO / DPWH			MPE-PMO / DPWH			PDCC / Zambales			MPE-PMO / DPWH			Zambales / District Office-DPWH			Zambales / DA-Region III			Zambales / DENR-Region III			Zambales / NGO			
Financial Arrange		GOP w/Foreign Assistance			GOP w/Foreign Assistance			Provincial / LGU			GOP			GOP / Provincial Government			GOP w/Foreign Assistance			GOP / Provincial Government			Grant Aid / NGO			
		Cost	Benefit	B-C	Cost	Benefit	B-C	Cost	Benefit	B-C	Cost	Benefit	B-C	Cost	Benefit	B-C	Cost	Benefit	B-C	Cost	Benefit	B-C	Cost	Benefit	B-C	Cost	Benefit	B-C
1	2004	0.0	0.0	0.0	0.0	0.0	0.0	2.0		-2.0	1.0		-1.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5		-2.5	5.5	0.0	-5.5
2	2005	82.8	0.0	-82.8	0.0	0.0	0.0	2.0		-2.0	1.0		-1.0	32.2		-32.2	0.0	0.0	0.0	0.0	0.0	0.0	2.5		-2.5	120.5	0.0	-120.5
3	2006	165.6	0.0	-165.6	65.0	0.0	-65.0	2.0		-2.0	1.0		-1.0	48.3		-48.3	0.0	0.0	0.0	0.0	0.0	0.0	2.5		-2.5	284.4	0.0	-284.4
4	2007	295.7	0.0	-295.7	341.1	0.0	-341.1	27.3		-27.3	1.0		-1.0	48.3		-48.3	6.7	0.0	-6.7	26.6	-1.3	-27.9	2.5		-2.5	749.3	-1.3	-750.6
5	2008	224.7	0.0	-224.7	438.5	0.0	-438.5	27.3		-27.3	1.0		-1.0	32.2		-32.2	6.7	0.0	-6.7	18.0	-0.6	-18.7	2.5		-2.5	751.1	-0.6	-751.7
6	2009	224.7	0.0	-224.7	454.8	0.0	-454.8	27.3		-27.3	1.0		-1.0	0.8	8.4	7.5	1.9	0.0	-1.9	8.5	-0.7	-9.2	2.5		-2.5	721.5	7.7	-713.9
7	2010	189.2	0.0	-189.2	324.9	0.0	-324.9	2.0		-2.0	1.0		-1.0	0.8	8.4	7.5	1.9	0.0	-1.9	4.5	-0.2	-4.7			0.0	524.4	8.2	-516.2
8	2011	17.7	283.7	265.9	24.4	668.5	644.1	2.0		-2.0	1.0		-1.0	0.8	8.4	7.5	1.9	0.0	-1.9	0.0	0.3	0.3			0.0	47.8	960.8	913.0
9	2012	17.7	283.7	265.9	24.4	668.5	644.1	2.0		-2.0	1.0		-1.0	0.8	8.4	7.5		2.6	2.6	0.0	0.5	0.5			0.0	45.9	963.6	917.7
10	2013	17.7	283.7	265.9	24.4	668.5	644.1	2.0		-2.0	1.0		-1.0	0.8	8.4	7.5		2.6	2.6	0.0	0.9	0.9			0.0	45.9	964.0	918.1
11	2014	17.7	283.7	265.9	24.4	668.5	644.1	2.0		-2.0	1.0		-1.0	0.8	8.4	7.5		2.6	2.6	0.0	1.3	1.3			0.0	45.9	964.3	918.4
12	2015	17.7	283.7	265.9	24.4	668.5	644.1	2.0		-2.0	1.0		-1.0	0.8	8.4	7.5		2.6	2.6	0.0	45.1	45.1			0.0	45.9	1,008.2	962.3
13	2016	17.7	283.7	265.9	24.4	668.5	644.1	2.0		-2.0	1.0		-1.0	0.8	8.4	7.5		2.6	2.6	20.8	52.2	31.4			0.0	66.7	1,015.3	948.6
14	2017	17.7	283.7	265.9	24.4	668.5	644.1	2.0		-2.0	1.0		-1.0	0.8	8.4	7.5		2.6	2.6	15.0	55.8	40.8			0.0	60.9	1,018.9	958.0
15	2018	17.7	283.7	265.9	24.4	668.5	644.1	2.0		-2.0	1.0		-1.0	0.8	8.4	7.5		2.6	2.6	6.8	60.6	53.9			0.0	52.7	1,023.7	971.0
16	2019	17.7	283.7	265.9	24.4	668.5	644.1	2.0		-2.0	1.0		-1.0	0.8	8.4	7.5		2.6	2.6	3.5	65.3	61.8			0.0	49.4	1,028.4	979.0
17	2020	17.7	283.7	265.9	24.4	668.5	644.1	2.0		-2.0	1.0		-1.0	0.8	8.4	7.5		2.6	2.6	0.0	25.2	25.2			0.0	45.9	988.3	942.4
18	2021	17.7	283.7	265.9	24.4	668.5	644.1	2.0		-2.0	1.0		-1.0	0.8	8.4	7.5		2.6	2.6	0.0	29.8	29.8			0.0	45.9	992.9	947.0
19	2022	17.7	283.7	265.9	24.4	668.5	644.1	2.0		-2.0	1.0		-1.0	0.8	8.4	7.5		2.6	2.6	0.0	31.2	31.2			0.0	45.9	994.3	948.4
20	2023	17.7	283.7	265.9	24.4	668.5	644.1	2.0		-2.0	1.0		-1.0	0.8	8.4	7.5		2.6	2.6	0.0	32.7	32.7			0.0	45.9	995.8	949.9
21	2024	17.7	283.7	265.9	24.4	668.5	644.1	2.0		-2.0	1.0		-1.0	0.8	8.4	7.5		2.6	2.6	0.0	78.3	78.3			0.0	45.9	1,041.4	995.4
22	2025	17.7	283.7	265.9	24.4	668.5	644.1	2.0		-2.0	1.0		-1.0	0.8	8.4	7.5		2.6	2.6	20.8	80.0	59.2			0.0	66.7	1,043.0	976.3
23	2026	17.7	283.7	265.9	24.4	668.5	644.1	2.0		-2.0	1.0		-1.0	0.8	8.4	7.5		2.6	2.6	15.0	81.2	66.3			0.0	60.9	1,044.3	983.4
24	2027	17.7	283.7	265.9	24.4	668.5	644.1	2.0		-2.0	1.0		-1.0	0.8	8.4	7.5		2.6	2.6	6.8	81.2	74.4			0.0	52.7	1,044.3	991.6
25	2028	17.7	283.7	265.9	24.4	668.5	644.1	2.0		-2.0	1.0		-1.0	0.8	8.4	7.5		2.6	2.6	3.5	80.8	77.3			0.0	49.4	1,043.9	994.4
26	2029	17.7	283.7	265.9	24.4	668.5	644.1	2.0		-2.0	1.0		-1.0	0.8	8.4	7.5		2.6	2.6	0.0	36.9	36.9			0.0	45.9	1,000.0	954.1
27	2030	17.7	283.7	265.9	24.4	668.5	644.1	2.0		-2.0	1.0		-1.0	0.8	8.4	7.5		2.6	2.6	0.0	36.9	36.9			0.0	45.9	1,000.0	954.1
28	2031	17.7	283.7	265.9	24.4	668.5	644.1	2.0		-2.0	1.0		-1.0	0.8	8.4	7.5		2.6	2.6	0.0	36.9	36.9			0.0	45.9	1,000.0	954.1
29	2032	17.7	283.7	265.9	24.4	668.5	644.1	2.0		-2.0	1.0		-1.0	0.8	8.4	7.5		2.6	2.6	0.0	36.9	36.9			0.0	45.9	1,000.0	954.1
30	2033	17.7	283.7	265.9	24.4	668.5	644.1	2.0		-2.0	1.0		-1.0	0.8	8.4	7.5		2.6	2.6	0.0	36.9	36.9			0.0	45.9	1,000.0	954.1
31	2034	17.7	283.7	265.9	24.4	668.5	644.1	2.0		-2.0	1.0		-1.0	0.8	8.4	7.5		2.6	2.6							45.9	963.1	917.2
32	2035	17.7	283.7	265.9	24.4	668.5	644.1	2.0		-2.0	1.0		-1.0	0.8	8.4	7.5		2.6	2.6							45.9	963.1	917.2
33	2036	17.7	283.7	265.9	24.4	668.5	644.1	2.0		-2.0	1.0		-1.0	0.8	8.4	7.5		2.6	2.6							45.9	963.1	917.2
34	2037	17.7	283.7	265.9	24.4	668.5	644.1	2.0		-2.0	1.0		-1.0	0.8	8.4	7.5		2.6	2.6							45.9	963.1	917.2
35	2038	17.7	283.7	265.9	24.4	668.5	644.1	2.0		-2.0	1.0		-1.0	0.8	8.4	7.5		2.6	2.6							45.9	963.1	917.2
36	2039	17.7	283.7	265.9	24.4	668.5	644.1	2.0		-2.0	1.0		-1.0					2.6	2.6							45.1	954.7	909.6
37	2040	17.7	283.7	265.9	24.4	668.5	644.1	2.0		-2.0	1.0		-1.0					2.6	2.6							45.1	954.7	909.6
38	2041																	2.6	2.6							0.0	2.6	2.6
39	2042																									0.0	0.0	0.0
40	2043																									0.0	0.0	0.0
41	2044																									0.0	0.0	0.0
42	2045																									0.0	0.0	0.0
43	2046																									0.0	0.0	0.0
44	2047																									0.0	0.0	0.0
45	2048																									0.0	0.0	0.0
46	2049																									0.0	0.0	0.0
47	2050																									0.0	0.0	0.0
48	2051																									0.0	0.0	0.0
49	2052																									0.0	0.0	0.0
50	2053																									0.0	0.0	0.0
NPV (15%)		664.4	700.2	35.8	834.6	1,650.0	815.4	51.2	0.0	-51.2	6.6	0.0	-6.6	102.4	54.8	-75.1	9.4	5.6	-3.8	38.2	67.7	29.5	9.5	0.0	-9.5	1,716.3	2,450.8	734.5
EIRR				**15.7%**			**26.3%**			Un-countable			Un-countable			**2.1%**			**9.8%**			**21.5%**			Un-countable			**20.0%**

Figures

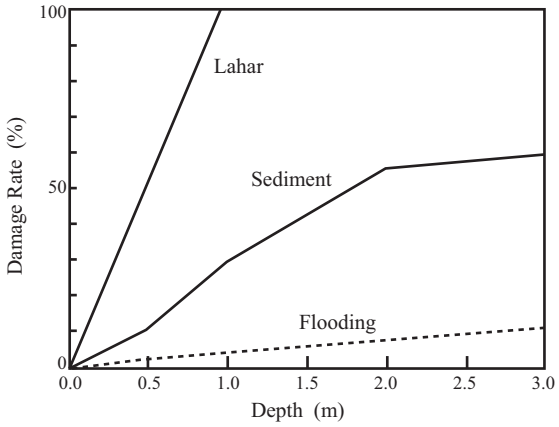
Building



Agriculture



Infrastructure



THE GOVERNMENT OF THE PHILIPPINES
THE DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS

The Study on Sabo and Flood Control for Western River Basins of Mount Pinatubo in the Republic of the Philippines

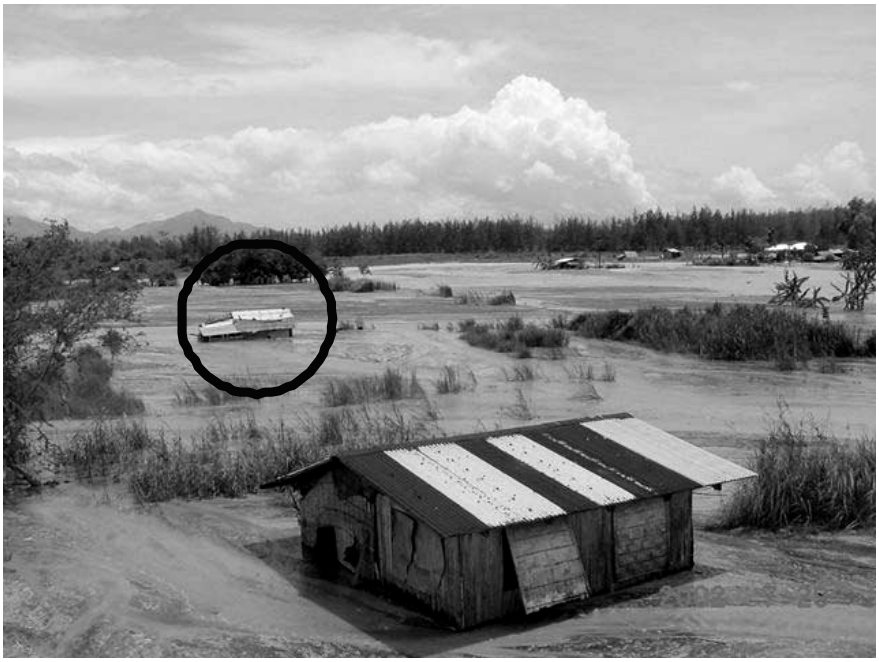
JAPAN INTERNATIONAL COOPERATION AGENCY

Figure 1.2.1

Damage Curves for Properties

A. During Flood

B. After Flood



Inundated area / building were fully buried by sediment more than 1 m depth.
House and farm land are no longer available after flood

c THE GOVERNMENT OF THE PHILIPPINES THE DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS	**Figure 1.2.2**
The Study on Sabo and Flood Control for Western River Basins of Mount Pinatubo in the Republic of the Philippines	**Actual Flood Damage Condition due to Dike Breach in July 2002 in Sto.Tomas River**
JAPAN INTERNATIONAL COOPERATION AGENCY	