B6. PROJECT EVALUATION

B6.1 Procedures for Evaluation

In the previous chapters, the flood mitigation master plan (FM-MP) for the LBB basin was discussed and formulated mainly from technical point of view, seeking for the optimum technical solution of basin's flood and sediment issues. The FM-MP is then subject to the examination from the following aspects:

1) Economic viability
2) Financial aspects
3) Initial environmental examination

The economic viability of the master plan will be evaluated in the process of cost-benefit analysis. Flood damage reduction benefit accruing from the implementation of the plan will be compared with the economic cost to be invested. The discussions on the financial aspects are made mainly on the financial sources. Past trend of public financing to flood control sector will be reviewed. The initial environmental examination (IEE) will be conducted chiefly for the screening of natural and social environmental components that may be affected by the implementation of the plan.

B6.2 Economic Evaluation

The economic evaluation is to examine the proposed project from the economic point of view, testing the viability of social investment in the national economy. The evaluation is conducted in accordance with the conventional methodology that is commonly applied in the evaluation of development programs in Indonesia with finance from the World Bank, Asian Development Bank and other international agencies concerned with technical and economic cooperation. The methodology suggests that the project evaluation has two steps for quantifying evaluation factors in general. Firstly, the project costs and benefits are identified and quantified in monetary terms, which arise from implementation of the proposed projects. Then, they are compared and condensed into evaluation factors. This procedure is illustrated in Figure B6.2.1.

B6.2.1 Project Benefits

(1) Structure of Project Benefits

Flood control benefit is generally defined as the reduction of potential flood damage attributed to designed works. The reduction is obtained as the difference of the flood damages estimated under with- and without- project conditions. For estimation of the benefit, thus, it is the first step to identify and to quantify potential flood damages in flood prone areas under without-project condition.

In June 1999, Ministry of Land, Infrastructure and Transport (MLIT) of the Japanese government revised "Manual for Economic Study on Flood Control Project". The previous manual was published in April 1970. The basic methodology of damage estimation is not different from the previous manual, although some items are broken down more deeply than those in the previous one. The components of flood damages in the new manual are listed in Table B6.2.1.

The flood damage is generally classified into two categories, i.e., direct damage and indirect damage. The direct damage is furthermore classified into two damages: damage to human lives and damage to general assets. The damage to general assets is composed of (1) damage to assets such as buildings, equipment, furniture, movables, and inventory stock, (2) damage to agricultural production in crop fields and inland fishery, and (3) damage to infrastructures including road, bridge, railway, river facilities, water supply, sewerage, electric power, city gas supply, telecommunication, irrigation, etc.

The indirect damage comprises the following three components: (1) damages to daily activities during flooding period such as usual business activities and household tasks, (2) damages to supporting systems after flood, and (3) damages of mental influence to people affected by flood. The first damages above consist of (a) damages to household economy, i.e., daily housekeeping and community activities, (b) damages to industrial production and business activities, and (c) damages to public services' stoppage or decrease. The second damages manifest themselves after flood inundation. In a damaged house, its family has to clean and to repair the house and furniture damaged by flood. In industrial establishments, they also clean and repair their building, equipment and furniture damaged. The government expends for extra public services for communities and people affected. Traffic systems cannot function well due to disruption of the systems. The third damages are mental blow to people in flooded areas. The people suffer metal shock from flood emergence during and after flood menace. These damages may differ with conditions of casualties.

In addition to these damages, a flood control project will make the people in the areas protected by the project enjoy its sophisticated environment. This improvement of spatial environment fosters land's appreciation. Furthermore, an investment to flood control project will give incentive to related economic sectors. Thus, the project reinvigorates the regional economy. These effects also are considered as indirect benefits.

Yet, this current study adopts the following damage components for project benefits taking account of the reports of flood control in Indonesia and data availability. They are (1) direct damages, (2) infrastructure damages and (3) indirect damages. The estimation procedures are discussed in the following sections.

(a) Direct Damage

The components of direct damage in this study are selected taking inventory of existing facilities and data availability into consideration. They are as follows.

1) Residential building
2) Manufacturing establishment
3) Wholesale and retail trading establishment
4) Educational facility
5) Medical facility
6) Crop production (paddy, maize and vegetable)
7) Fishpond production

In terms of building property such as residence and industrial facilities, flood damage is calculated with the following formula in general: [unit property value] x [damage rate]. In a more palpable form, the direct damages to buildings, their durable assets and inventory stocks are calculated as follows.

Distribution of damageable assets is worked out in the form of grid information. A mesh block is 250 m interval squares. The inventory of damageable assets in every square is read or estimated on the basis of 1:10,000 topographic maps made in this study, the 1:50,000 existing topographic maps, administrative boundary maps, in addition to socio-economic data and information given through the surveys to agencies concerned.

$$DD = \sum_{k=1}^{n} \{ \sum_{i} (Vh_i \bullet R_b + Vm_i \bullet R_m) + \sum_{j} (Vb_j \bullet R_b + Va_j \bullet R_a + Vs_j \bullet R_s) \}$$

Where,

DD	:	Flood damage
Vh	:	Value of housing unit
Vm	:	Value of household effects
Vb	:	Value of industrial buildings listed above such as factories, stores, schools and hospitals
Va	:	Value of depreciable assets such as equipment and machinery in the respective buildings listed above
Vs	:	Value of inventory stocks such as raw materials, products and semi-products in the respective buildings listed above
R_b	:	Damage rate of buildings
R_m	:	Damage rate of residential indoor movables
R_a	:	Damage rate of depreciable assets
R_s	:	Damage rate of inventory stocks
i	:	Number of houses in a mesh block
j	:	Number of industrial buildings in a mesh block
n	:	Total number of mesh blocks in flood prone areas

Although average values of the respective facilities will be discussed in the following section B6.2.1(3), their values in economic terms were shown in Table B6.2.2. The rates of flood damage to the respective facilities are proportionate with inundation depth. These rates are also tabulated in Table B6.2.3. The rates are based on the new manual named "Manual for Economic Study on Flood Control" published by MLIT of the Japanese Government.

(b) Infrastructure Damage

Infrastructure damage has rarely been recorded, although it is occasionally larger than the damage to building properties and agricultural production. There is no standard information regarding infrastructure damages. In the Japanese manual mentioned in the previous section, the infrastructure damage rates are set as follows. It is recommended in the manual that these rates be modified taking into consideration of the regional situation.

(Unit: %)

Facility	Road	Bridge	Sewerage	Urban facilities	Public utilities	Crop lands	Irrigation facilities	Total
Damage rates	61.6	3.7	0.4	0.2	8.6	29.1	65.8	169.4

Note: These rates were calculated as an average of the actual flood damage records in Japan during nine years from 1987 to 1996.

The ratio of infrastructure damage to that of direct damages is estimated at the range of 30% in the report of "Ciliwung-Cisadane River Flood Control Project". This rate seems to be quite small as compared with the rates in the table above. Although the rate of 30% looks much more conservative than the rates in the table above, it might be reasonable taking into consideration of the regional conditions of the study area. Accordingly, the damage rate of infrastructures is set as 30% of the direct damages in this study.

(c) Indirect Damage

The following components of indirect damage are selected taking account of data availability.

(a) Residence, cleaning away materials damaged after inundation
(b) Business losses of private business establishments
(c) Other indirect damages

After flood, a family has to clean rooms and furniture damaged by flood and to repair things damaged. These activities are done by members of the household in general. Thus, these activities are considered as loss of housekeeping, so their labor cost is estimated as a part of flood damages. Its amount is estimated as a product of daily household income multiplying the number of days spent. The number of days is enumerated in Table B6.2.3.

After flood, a damaged business establishment is closed to clean, fix and repair its workspace, furniture and equipment damaged by flood, and to clean away inventory stocks damaged. Even after these activities, its business stagnates for a few days until returning to its former normal state. These losses are considered as business losses. The loss days are proportionate to inundation depth. Its amount is estimated as a product of daily value added of the business establishment multiplying the number of days closed and stagnated. The number of these days is enumerated in Table B6.2.3.

Furthermore, indirect losses included the following activities in general.

(a) Emergency activities: Emergency activities such as evacuation and relief of flood victims are brought about during flooding period and just after the disaster. These activities are usually executed by the public sector or by social welfare bodies.

(b) Medical care and cure for victims suffering from waterborne diseases due to flood inundation: Even after flood disaster, some victims could suffer from waterborne diseases, since the circumstance of flood prone areas is vulnerable against public hygiene. Then, medical activities are indispensable for these victims.

(c) Prevention activities against crimes: Crimes such as stealing and pilfering in the confusion at the scene of the flood should be prevented in addition to evacuation and relief activities.

In cities, particularly, the other indirect damages could be sufficient to require inclusion in the flood damage computation. Although the actual computation of the other indirect damages above was not undertaken, it is presumed to be 10% of the direct damage.

(2) Distribution of Damageable Assets

The maximum potential flood area, i.e., the target area for the current study, is demarcated by the project team, on the basis of the hydrologic analysis. The potential flood areas are estimated at approximately 78 km^2 in the LBB Basin, which occupies around 3% of the catchment's area (2,700 km^2).

Distribution of damageable assets is worked out on the basis of desa or kelurahan information. The inventory of damageable assets in every desa or kelurahan is given or estimated on the basis of the following data and information: results of population and housing census, results of establishments' survey of the respective economic sub-sectors, land use maps, topographic maps, administrative boundary map, and socio-economic data and information given through interview survey.

As regard housing units, the distribution was figured out through the following procedure. Housing units were counted through the maps of a scale of 1:10,000 topographic maps, made in this JICA study based on aero-photos taken also in this study.

In outside areas of the 1:10,000 topographic maps, housing units were assumed to be distributed equally all over the built-up areas in 1:50,000 topographic maps in desa or kelurahan territory. The number of housing units is assumed to be the same as the number of households. The number of existing housing units in flood prone areas is calculated as a product of (i) housing unit density in built-up areas and (ii) areas categorized as built-up in the respective desa or kelurahan, administrative areas of which are completely included in the flood prone areas. Through this estimation procedure, the number of residential buildings in the potential flood area was counted at around 52,000 units in total, as shown in Table B6.2.4.

In the administrative areas of the kecamatan related to the flood prone areas, there were 6,700 manufacturing establishments in the year 2000. The number of existing establishments was provided as desa or kelurahan information that was reported in the "Kecamatan Dalam Angka 2000 (Handbooks of Kecamatan in Figure)" by PBS. 4,400 establishments were identified in the flood prone areas through the same procedure as mentioned above. In the same manner, the number of major facilities in the potential flood area was enumerated as follows: trading, hotel and restaurant establishments of 4,700 units, education facilities of 450 units and medical facilities of 280 units.

The distribution of crop cultivation lands was figured out on the basis of 1:10,000 topographic maps and, of 1:50,000 topographic maps for outside area of the 1:10,000 maps. In urban areas, most of these lands are being transferred to residential lands because the urbanization has made serious inroads into the farmlands. The crop cultivation lands still exist, but these lands in the urban areas are limited. At present, they were enumerated as follows: 5,300 ha of irrigated fields and 600 ha of rainfed fields particularly in the urban areas.

The table below shows the distribution of aforesaid facilities and croplands in the potential flood areas for 5-year, for 20-year and for 50-year return periods. Details of the distribution are tabulated in Table B6.2.15. This table summarized the total inventory of the respective facilities in the potential flood area.

Item	2-year return period	20-year return period	50-year return period
Inundation area (km^2)	33	70	80
Population (1000)	12	86	110
Housing units	3,040	22,070	28,200
Manufacturing	172	1,780	2,290
Trading, hotel & restaurant	200	2,030	2,700
Educational facility	20	170	220
Medical facility	18	100	130
Agricultural lands (ha)	1,662	3,513	3,963
Irrigated fields	1,440	3,120	3,550
Rainfed fields	200	370	390
Fishpond	22	23	23

(3) Unit Value of Damageable Assets

(a) Housing Units

Housing unit is classified into three types, as mentioned in Section A6.2.3. According to Table B6.2.5, meanwhile, tax revenues of Gorontalo Tax Office through real property tax to buildings were Rp.388 million in Kota Gorontalo and Rp.139 million in Kabupaten Gorontalo in 2000. In the same year, tax payers of real property tax imposed on buildings were counted as 18,300 in Kota Gorontalo and 12,500 in Kabupaten Gorontalo, including some entrepreneurs as well as house owners. It is said that house owners occupy more than 95% of the total number of tax payers. Then, the tax information was presumed that the all taxes were collected from houses only. As a result, an average tax amounts of building were calculated as Rp.21,150 per unit in Kota Gorontalo and Rp.11,140 in Kabupaten Gorontalo.

A tax amount is calculated through the following formula, under the property tax law.

Property Tax = (Assessed Value of Property) · (Tax Rate (0.5%))

Assessed Value = (Market Value of Property) · (Taxable Rate (20%))

Then, a market value is estimated through the following formula.

Market Value = (Property Tax Amount) / (Tax Rate) / (Taxable Rate)

Applying the formula above, the average market value of housing unit is calculated as Rp.21.2 million in Kota Gorontalo and Rp.11.1 million in Kabupaten Gorontalo in 2000.

Yet, non-permanent houses are exempted from taxation of real property tax. A unit construction cost of non-permanent house is estimated around a half of that of permanent and semi-permanent houses, referring to the recent regulation of the government SE No. 181/D.VI/01/1999. Non-permanent houses are mostly constructed in rural areas, on the basis of the reconnaissance survey in the flood prone areas. According to Table B6.2.5, an average floor area of rural house was around two-third of that of urban house. Accordingly, a market value of non-permanent house is estimated at one-third of that of permanent and semi-permanent houses, i.e., (1/2) x (2/3). Thus, the average market value of non-permanent house is estimated as Rp.7.1 million in Kota Gorontalo and Rp.3.7 million in Kabupaten Gorontalo.

According to Table B6.2.6, there were 20,179 houses in Kota Gorontalo and 48,313 houses in kecamatan related to the flood prone areas in Kabupaten Gorontalo. These houses are segregated into taxation objects (permanent and semi-permanent houses) and tax-exempt articles (non-permanent houses). Their average values are estimated as Rp.17.9 million in Kota Gorontalo and Rp.7.7 million in Kabupaten Gorontalo as weighted average, as shown in the table below.

	Kota Gorontalo		Kabupaten Gorontalo	
Item	Permanent & semi-permanent	Non-permanent	Permanent & semi-permanent	Non-permanent
Value (Rp. million)	21.2	7.1	11.1	3.7
Existing number	15,101	4,761	26,209	22,104
Weighted average (Rp. million)	17.9		7.7	

In terms of household effects, their average value was estimated on the basis of the durable assets holdings in the report of the population census 1990, named as "Penduduk Sulawesi Utara, Hasil Sensus Penduduk 1990 Seri: S2.22, September 1992, BPS". The results of durable assets holdings are tabulated in Table A6.2.5. Since there is no information of values regarding assets holdings in the census, their value was valuated as the new products of those durable goods are purchased at present situation. These estimates were re-evaluated taking account of depreciation. In this study, the present value was assumed as a half of the new products' value. The procedure of these estimated is tabulated in Table B6.2.7. The results of household assets holdings were as follows: Rp.11.6 million in Kota Gorontalo and Rp.3.6 million in Kabupaten Gorontalo. In addition, a family has movable stock such as food and cloths for their daily life. They are estimated as Rp.371,000 in urban areas and Rp.272,000 in rural areas in the 1999 survey year, as mentioned in Section A6.4.4. They are re-evaluated as Rp.460,000 in urban areas and Rp.337,000 in rural areas, applying CPI index of 1.24 between 1999 and November 2001. Accordingly, household effects of an average family were calculated at Rp.12.1 million in Kota Gorontalo and Rp.3.9 million in Kabupaten Gorontalo in financial terms.

Land Value in Urban Areas

According to Table B6.2.5, tax revenues of Gorontalo Tax Office through real property tax to land were Rp.580 million in Kota Gorontalo and Rp.291 million in Kabupaten Gorontalo in 2000. In the same year, tax payers of real property tax imposed on lands were counted as 34,400 in Kota Gorontalo and 41,800 in Kabupaten Gorontalo. As mentioned in housing unit section above, it is said that house owners occupy more than 95% of the total number of tax payers. Then, the tax information was presumed that the all taxes were collected from houses only. As a result, an average tax amounts of land were calculated as Rp.16,900 per unit in Kota Gorontalo and Rp.7,000 in Kabupaten Gorontalo.

A tax amount is calculated through the following formula, under the property tax law.

Property Tax = (Assessed Value of Property) · (Tax Rate (0.5%))

Assessed Value = (Market Value of Property) · (Taxable Rate (20%))

Then, a market value is estimated through the following formula.

Market Value = (Property Tax Amount) / (Tax Rate) / (Taxable Rate)

Applying the formula above, the average market value of land unit is calculated as Rp.20,000/m^2 in Kota Gorontalo and Rp.2,000/m^2 in Kabupaten Gorontalo in 1999.

(b) Manufacturing Industry

Asset holdings of large and medium scale manufacturing establishments were already discussed in Section A6.4.2. The values of these assets were analyzed in the survey of establishment. The detail figures are enumerated in Table A6.4.6. Based on these figures in the table, damageable assets of manufacturing establishments as of the 2000 census year were re-evaluated by means of applying price deflator 1.20 between 2000 and November 2001 as follows: Rp.63.2 million of building, Rp.152.9 million of equipment and Rp.97.0 million of inventory stock on average for large and medium scale establishments. In the same manner, an average of VA was re-evaluated at Rp.956.3 million per annum.

In terms of small and home industry, there is no information of management. As shown in Table A6.4.6, average assets holdings per worker of large and medium scale industry were estimated as Rp.1.1 million of building, Rp.2.7 million of equipment and Rp.9.1 inventory stock in 2000. On the other hand, the average number of workers in small scale and home industry was considered as 2 persons only, referring to Table A6.4.4. Then, applying these basic figures and the price deflator, the assets holdings of small scale and home manufacturing establishments were estimated as Rp. 2.9 million of building, Rp.6.4 million of equipment and Rp.21.8 inventory stock on average in 2001.

On the basis of the figures above, the damageable assets of manufacturing establishments as of 2001 were estimated as follows in the form of weighted averages: Rp.2.8 million of building, Rp.6.9 million of equipment and Rp.23.6 million of inventory stock on average of entire establishment. In the same procedure, the average VA per establishment was re-evaluated at Rp.12.1 million.

(Unit: Rp. million)

	Item	Large & medium	Small & home*1	Entire establishments
1.	Ratio of establishment	0.3%	99.7%	100.0%
2.	Building	63.2	2.9	3.1
3.	Equipment	152.9	6.9	7.4
4.	Inventory stock	97.0	23.6	25.2
5.	Total	313.1	33.4	35.7
	Value added (per year)	1,043.3	8.8	12.1

Note: *1 Re-evaluated applying the price deflator of 1.30 to Rp.6.7 million in Table A6.4.4.

(c) Services Industry

<u>Trade, Hotel and Restaurant Facilities</u>

In the services sector, the trading, hotel and restaurants sub-sector accounted for 32,010 or the largest share of 77% of the total establishments (41,446) in Propinsi Gorontalo in 1996, as discussed in Section A6.4.3. An establishment employed 1.4 workers on average.

In 1996, GRDPs of Kabupaten Gorontalo and Kota Gorontalo were Rp.515 billion and Rp.191 billion at current prices respectively, as shown in Table A6.3.2. VAs of trading, hotel and restaurant sub-sector was Rp.40 billion and Rp.59 billion, respectively. In 1996, thus, an average value added per an establishment was estimated at Rp.3.09 million.

Regarding trading, hotel and restaurant sub-sector, management indices are not available like manufacturing sub-sector mentioned in the previous section. This sub-sector’s indices, i.e., asset holding ratios of damageable assets’ values to an average VA, were as follows: 34% for building, 84% for durable assets such as furniture and showcases, and 37% for inventory stock such as merchandises and their stock. Since their average VA was Rp.3.09 million in 1996, their damageable assets were calculated as Rp.1.05 million of building, Rp.2.60 million of durable assets and Rp.1.14 million of inventory stocks.

In 2001, these damageable assets were revaluated at Rp.2.10 million of building, Rp.5.20 million of durable assets and Rp.2.28 million of inventory stocks. Their average VA was re-evaluated at Rp.6.80 million in 2001. Incidentally, 2001 values were calculated applying a price index of 2.20 between 1996 and 2001. The consumer price index (CPI) was 2.80 during the same period, according to the official CPI data. On the other hand, the wholesale price index (WPI) was 1.63 for the same period. The index applied 2.20 was set referring these indices.

Educational Facilities

There were 996 schools in Kota Gorontalo and Kabupaten Gorontalo in 2000, as shown in Table A6.5.1. Since the total enrollments of these schools were 136,200 students, the average number of students per school was calculated at 135 students. In Indonesia, the number of students per class is set as 40 students, so there were at least four classes for a school on average.

According to Dinas Pend dan Olahraga, Propinsi Gorontalo (Education and Culture Office, Gorontalo Province), a typical four-class school is constructed at a total cost of Rp.879 million at 2001 prices. It includes four classes, one library, one office for five teachers, one room for head office and two toilets.

Regarding school furniture and fixtures for this school, they are estimated at Rp.258 million in total. They are composed as follows: Rp.43 million for furniture in four classes, Rp.10 million of fixtures for five teachers, Rp.195 million for equipment for language laboratory, and Rp.10 million for fixtures for library.

Taking into account of depreciation, the present value of these facilities is assumed to be as a half of the costs of brand-new facilities. Thus, the present values are re-evaluated as Rp.440 million for school buildings and Rp.129 million for durable assets such as furniture and fixtures at 2001 market values.

Medical Facilities

In Kota Gorontalo and Kabupaten Gorontalo, there were 447 medical facilities in 2000, as shown in Table A6.5.2. The most populous medical facilities in these areas are health centers. They counted 164 facilities, comprising 23 public health centers and 141 semi-public ones. The hospitals counted six facilities only in Kota Gorontalo.

According to Dinas Kesehatan dan Kesejahteraan Sosial, Pemerintah Propinsi Gorontalo (Health and Social Welfare Department, Provincial Government of Gorontalo), a new health center is set up at a total cost of Rp.173.5 million for public health center and Rp.60.5 million for semi-public health center at 2001 prices. The average unit cost is broken down into building, furniture and medical tools, as shown in the table below.

(Unit: Rp. Million)

	Item	Public health center	Semi-public health center	Entire Facilities
1.	Number of centers	23	141	164
2.	Building	50.0	35.0	37.1
3.	Furniture	87.0	15.5	25.5
4.	Medical tools	26.5	10.0	12.3
	Total	163.5	60.5	74.9

Note: Figures above were modified on the basis of the estimates by Health and Social Welfare Department of Gorontalo Provincial Government.

Taking into account of depreciation, the present value of these facilities is assumed to be as a half of the costs of brand-new facilities. Thus, the present values are re-evaluated as Rp.18.6 million for building, Rp.18.9 million for durable assets comprising Rp.12.8 million of furniture, and Rp.6.1 million of medical tools at 2001 market values. In addition, public health centers are re-supplied medicines of Rp.200 million in total. These medicines are considered as a part of inventory stocks, so an average value of inventory stocks is assumed as Rp.2.0 million in every health center.

There are many kinds of medical facilities as shown in Table A6.5.2. Health centers occupy the largest share among medical facilities. In this study, thus, the damageable values above were applied to flood damage estimation.

(d) Agricultural Production

<u>Crop Production</u>

As major crops in the project areas were discussed in Section A6.4.1, the LBB Basin was specialized for production of paddy in addition to maize, and a few kinds of vegetables. In this current study, paddy, maize and soybean were selected as representative crops since their production values were prominent in the region. In the potential flood area, there are approximately 3,900 ha of crop cultivation area. Of this total area, 3,500 ha were irrigated and only 400 ha were rainfed.

The degree of crop damage varies from month to month, depending on the cropping stage and timing of flood occurrence. Therefore, the annual average damageable value of crop per hectare is estimated as an aggregate of expected net income and accumulated expenditure for production until the time when flood occurs. In that case, flood frequency and planted areas cultivated in each month have to be taken into account as well. It is expressed by the following formula:

$$DV = \sum_{i=Jan.}^{Dec.} CA_i \bullet FF_i \bullet (AC_i \bullet PC_i + NI)$$

where;

DV : damageable value (Rp./ha)

CA : cultivated area (%)

FF : flood frequency (%)

AC : accumulated cost (%)

PC : production cost (Rp./ha)

NI : net income (Rp./ha)

Production cost (PC) of paddy, maize and soybeans is tabulated in Table B6.2.10. Paddy production was estimated as Rp.3.25 million per ha for irrigated field and

Rp.2.38 million per ha for non-irrigated filed. Maize and soybean production costs were estimated at Rp.2.56 million per ha and Rp.2.70 million per ha, respectively. They were estimated at market prices.

Gross income is a product of farm gate price and crop production. Farm gate price of major crops was listed in Table B6.2.8. The table shows the trend of farm gate prices for the latest three years. The average farm gate prices were calculated at Rp.1,400/kg of paddy, Rp.1,500/kg of maize and Rp.4,750/kg of soybean. On the other hand, the farm gate prices of tradable crops were estimated at Rp.1.80 million/ton (Rp.1,800/kg) of paddy and Rp.1.60 million/ton (Rp.1,600/kg) in international prices, as shown in Table B6.2.9. In economic evaluation, these international prices are applied as economic value. In terms of soybean, however, its economic value was converted from Rp.4.75 million per ton at market prices to economic price of Rp.4.28 million per ton applying standard conversion factor of 0.90. The conversion factor is discussed later. Hereinafter, agricultural production is analyzed in economic terms.

A yield of paddy was set as 5.0 tons per ha for irrigated field, referring to the present cultivation condition in Gorontalo. This yield was assumed to be improved to 6.0 tons per ha in the future. The yield of soybean and maize was assumed to keep at 1.3 tons per ha and 3.0 ton per ha respectively, even in the future.

Net income (*NI*) is estimated gross income minus production cost. Thus, the net income from irrigated field cultivating paddy and from rainfed field cultivating maize and soybean during a year was estimated Rp.12.1 million per ha and Rp.5.6 million per ha at economic value, respectively. The net income from irrigated field of paddy in the future was estimated at Rp.15.7 million per ha. They are calculated in Tables B6.2.11 to B6.2.13. The damageable values were Rp.6.0 million per ha for irrigated field; Rp.3.2 million per ha for rainfed field. The damageable value in irrigated field was estimated Rp.7.4 million per ha in the future.

<u>Fishpond Production</u>

Fresh water fishpond has generally three crops a year. However, it does not have any distinct crop season like crop production. Thus, damageable value is set as the same value of gross income, i.e., production cost and expected value added. Thus, a damageable value is Rp.25 million per ha at financial terms, as discussed in Section A6.4.1(2). It was converted to Rp.22.5 million per ha at economic terms applying the conversion factor.

(4) Estimation of Annual Benefit

The annual damage is calculated applying the following formula, on the basis of the flood damages for the respective probable rainfalls or discharges.

$$B = \sum_{i=1}^{n} \frac{1}{2}\left[D(Q_{i-1}) + D(Q_i)\right] \bullet \left[P(Q_{i-1}) - P(Q_i)\right]$$

Where,	B	:	Annual average benefit
	$D(Q_{i-1}), D(Q_i)$	:	Flood damage caused by the floods with Q_{i-1} and Q_i discharges, respectively
	$P(Q_{i-1}), P(Q_i)$	:	Probabilities of occurrence of Q_{i-1} and Q_i discharges, respectively
	n	:	Number of flood applied

The annual average benefit is defined as the reduction of probable damage under with- and without-project conditions. The project was proposed as flood control scheme for 20-year probable rainfall.

B6.2.2 Basic Conditions for Economic Evaluation

(1) Conversion Factors and Elements for Real Economic Values

(a) Transfer Payments

Market values are usually distorted by transfer payments such as taxes and subsidies. These transfer payments are transferred to the government which acts on behalf of the society. Then, they should not be treated as cost. These have to be eliminated from the market values of cost and benefit as a whole. In Indonesia, the taxes concerning to the construction works are enumerated as follows: the value added tax (VAT), excise tax, income tax, customs duties, real property tax, tax on aggregate such as sand and gravel, various local taxes, etc.

(b) Conversion Factors

In the current master plan, composite costs and benefits estimated at market prices are converted to economic costs applying a standard conversion factor (SCF). It is clearly impracticable to trace procurement sources for all the detailed components. Thus, taking this situation into consideration and referring to Table B6.2.14, the economic costs are assumed to be 90% of the market values.

(c) Land Value

Market price of land has its peculiar characteristics as compared with other commodities, especially in urban areas. Land price should be evaluated on the basis of productivity of the land for productive plots such as crop cultivation, and balance of supply and demand for non-productive land such as residential plots. In this study, land acquisition takes place in urban area, crop land, and grass areas. In terms of crop cultivation land, its land value is evaluated on the basis of productivity, i.e., production of paddy for the project life of the proposed projects. In urban area, the market value of land is assumed that it reflects opportunity cost in the market. Thus, the economic value is estimated as a product of the market value of land and the SCF. Other areas are considered as no values from the economic point of view, because they are considered to be simply diverted to other land utilization from the original usage.

(2) Construction Schedule and Evaluation Period

(a)	Base Year	Beginning of 2004 for detailed design and land acquisition
(b)	Construction Period	The years from 2005 to 2019 for construction of major works corresponding to three terms of five-year development plans
(c)	Disbursement Schedule	Disbursed in accordance with construction schedule during the construction period above
(d)	Economic Life	50 years after the completion of the project
(e)	Evaluation Period	65 years including preparatory works such as detailed design and construction period, and economic life of the project scheme (2004 - 2069)
(f)	Timing of Benefits Accruing	In proportion to the progress of the construction works for river improvement scheme. In terms of the flood control gate, after the completion.
(g)	Social Discount Rate	12% per annum (Referring to the “Guidelines for the Economic Analysis of On-going Projects in PIADP” supported by World Bank)

(3) Future Damageable Assets

Socio-economic conditions in Gorontalo will be improved in accordance with the growth of regional economy. Those in the LBB Basin will also be improved in the future. Then, the damageable assets could increase along with the growth of socio-economic conditions. Thus, the flood mitigation benefit would increase, and it could be estimated on the basis of socio-economic projection. They are based on population increase, improvement of people's living standard, growth of economic activity in various industries and expansion of infrastructures in the basin as well as agricultural production based on improvement cultivation technology.

In terms of residential units, the number of units in the respective desa or kelurahan was assumed to increase in proportion to population growth (household growth). Their damageable value was assumed to increase in proportion to GRDP per capita in the LBB Basin. Incidentally, GRDP in 2020 in the basin was estimated as 3.17 times of that in 2001 as projected in Section A6.8.2. Accordingly, their assets will increase in proportion to GRDP growth (3.17 times of the present values), as a result. Incidentally, 3.17 times are the results of both growth factors, i.e., increasing of both population and value of asset holdings for individual residential houses.

In terms of industrial establishments such as manufacturing, trading and others, the increment of their assets holdings was assumed to increase in proportion to the GRDP growth. The increment is also revealed by means of an increase of the number of establishments and the growth of their production. In the basin, the increment of these phenomena was assumed to be absorbed in the same desa or kelurahan. Thus, their assets will increase in proportion to GRDP growth (3.17 times of the present values), as well. Incidentally, 3.17 times are the results of both growth factors, i.e., increasing of both the number of facilities and value of assts inventory for individual facilities.

Paddy production in irrigated fields was assumed to increase its yield from 5.0 ton/ha to 6.0 ton/ha by the target year 2020. Rainfed crop production, however, was assumed to keep the same yield even in the future. In the same manner, fishpond production was assumed to maintain the same production yield as done in the basin.

B6.2.3 Economic Benefit

Flood control benefit is defined as the damage reduction by the proposed project. The benefit consists of direct damages, infrastructure damage and indirect damage, as discussed in Section B6.2.1

The direct damages are estimated as a product of the number of facilities inundated by flood in affected areas, a damageable value of inundated property and a damage rate in accordance with inundation depth. The number of facilities inundated was counted in Section B6.2.1(2). The information of existing facilities was as of the year 2000. In this analysis, however, these existing numbers are regarded as the same even in the year 2001. The inundation depth in the area was identified by the hydrologic analysis. The financial values of the respective facilities were also discussed in Section B6.2.1(3).

These financial values are converted into real economic values applying a conversion factor, as discussed in the previous section. The SCF was applied to convert for all benefits items in this current study. As a result, the economic values of damageable assets are calculated for the respective facilities. The economic damageable values are tabulated in Table B6.2.2. The values of buildings and agricultural production fields in economic terms are summarized as follows.

Damageable property	Unit	Present	2020*1
Housing unit			
Kota	Rp. million/unit	16.1	43.1
Kabupaten	Rp. million/unit	6.9	22.0
Manufacturing	Rp. million/unit	2.5	7.5
Trading	Rp. million/unit	0.9	5.1
Education facility	Rp. million/unit	396.0	1,059.3
Medical facility	Rp. million/unit	16.7	44.8
Irrigated paddy production	Rp. million/unit	6.0	7.4
Rainfed crop production	Rp. million/unit	3.2	3.2
Fishpond production	Rp. million/unit	22.5	22.5

Note: *1 The number of facilities was assumed to increase 1.19 times of the present number in 2020.

The direct damages of the respective facilities by return period were estimated applying the unit damageable values above and damage rates in Table B6.2.3. As mentioned in Section B6.2.1(1)b, the infrastructure damage was calculated as 30% of the total value of the direct damage. In addition, the indirect damages were estimated in the procedure discussed in Section B6.2.1(1)c. Finally, the entire damages are calculated for the respective return period of flood. The flood damages by return period under without-project condition were enumerated in Table B6.2.15.

The average annual benefit is estimated through the formula discussed in Section B6.2.1(4). The project was proposed as flood control scheme for 20-year probable rainfall. The annual benefit of the proposed flood control plan in the LBB Basin was estimated as follows. The annual benefit was calculated at Rp.36.3 billion.

Return period	Flood damage (Rp. billion)			Average (Rp. billion)	Expectation	Benefit (Rp. billion)
	W/O Project	W/ Project	Reduction			
	-	-	D(Qi)	1/2(D(Qi-1)-D(Qi))	P(Qi-1)-P(Qi)	-
				10.3	0.500	5.2
2-year	20.7	0	20.7			
				42.2	0.300	12.7
5-year	63.7	0	63.7			
				88.5	0.100	8.9
10-year	113.4	0	113.4			
				141.9	0.050	7.1
20-year	170.4	0	170.4			
				85.2	0.030	2.6
50-year	250.2	250.2	0			
				Total Annual Benefit (B):		**36.3**

The flood damages under the future socio-economic conditions are calculated in the same manner as done in those under present conditions above. The results are shown in Table B6.2.16. Through the same procedure using these estimates of flood damages, the annual benefits are calculated at Rp.101.3 billion under future conditions. The annual benefit of the proposed plan was summarized as follows.

Socio-economic condition	Annual benefit (Rp. billion)
1. Under present condition	36.3
2. Under future condition	101.3

As mentioned in Section B6.2.2(1), crop lands acquired for setting up the project facilities are evaluated on the basis of productivity. These lands are evaluated as negative benefit for the projects. Since a net income of irrigated field was estimated at Rp.12.1 million per ha per annum as shown in Table B6.2.11, the negative benefit from crop lands acquired was reckon up every year for the project life, i.e., 50 years. Since a half of rural areas acquired are still assumed to be cultivated, the negative benefit was estimated at Rp.4.55 billion per annum in total, when the whole crop lands were taken over. In the future, the net income was revaluated at Rp.15.7 million per ha as shown in Table B6.2.13. The negative benefit under the future socio-economic conditions was estimated at Rp.5.90 billion in total.

B6.2.4 Economic Cost

The construction cost consists of the following major items. The construction costs are segregated into the following cots items.

(1) Direct construction cost;
(2) Compensation cost;
(3) Administration cost;
(4) Engineering service cost; and
(5) Physical contingency cost

The economic cost of the proposed master plan was calculated from the corresponding financial cost applying the conversion factor of 0.9. They are summarized as follows.

(Unit: Rp. billion)

Objective project	Financial Cost	Economic Cost
1. Direct Construction Cost	362.0	325.8
2. Compensation	66.9	39.9
3. Government Administration	21.4	16.3
4. Engineering Services	54.3	48.9
5. Physical Contingency	50.5	43.1
Total	555.0	474.0

In terms of the compensation items, the land acquisition cost is converted through the two ways i.e., agricultural land and residential land in urban areas. The procedure of valuation of these lands was mentioned in Section B6.2.2(1). Since agricultural lands were evaluated as negative benefit for the evaluation period, their values in the financial cost item were excluded in the economic cost items.

As a result, the entire economic cost is calculated as Rp.474.0 billion. Since the financial total cost is Rp.555.0 billion, the economic construction cost corresponds to 85% of the financial costs. The construction cost is disbursed in compliance with the construction schedule. The disbursement schedule of economic costs is tabulated in Table B6.2.17 and B6.2.18.

In addition, the operation and maintenance (O&M) cost is annually required during the economic life of the proposed project. The O&M cost is assumed to be approximately

0.5% of the total direct construction cost of river improvement schemes. It was estimated at Rp.1.63 billion in economic terms, after the completion of the proposed master plan project.

B6.2.5 Result of Economic Evaluation

In this section, the proposed project is examined from the economic point of view. The economic benefits were expected to accrue in conformity to the schedule. For river improvement scheme, the benefit is assumed to generate in proportion to progress of the construction works, because even a part of river improvement works can give its effects to the target areas. The benefit under future condition was also calculated in Section B6.2.3.

The economic evaluation indices are calculated applying the present economic benefits and costs estimated in the respective sections. The annual stream of benefit and cost under present socio-economic conditions is tabulated in Table B6.2.17. The economic internal rate of return (EIRR) of the project is estimated to be 6.0%. This rate is lower than the social discount rate of 12%. Accordingly, the proposed project is not viable at present from the economic point of view. Incidentally, the cost-benefit ratio (B/C) is 0.51 and net present value (NPV) is estimated at Rp.-99 billion discounted at 12%.

Yet, these indices are recalculated in the same manner applying the future economic benefits as the case of "under the future socio-economic conditions". The expected benefits in the year 2020 were estimated at Rp.101.3 billion per year in Section B6.2.3. Once this benefit is applied for the economic evaluation, the EIRR is calculated at 14.7%. This rate is higher than the social discount rate of 12%. In this case, thus, the proposed project is viable from the economic point of view. In other words, the proposed project should be implemented from this time forth taking consideration of the future viability of the project. Other indices of economic evaluation are shown in the table below.

Item	EIRR (%)	B/C*1	NPV*1 (Rp. Billion)
Under present conditions	6.0	0.51	-99
Under future conditions	14.7	1.28	57

Note: *1 Discounted at 12%

B6.3 Financial Aspect

(1) Basic Stance of Financial Evaluation

From the financial point of view, a flood control project is different from general public and private undertaking. No business income directly accrues from its undertaking. Although its economic benefits are expected as discussed in the previous chapter, the benefits do not bring about revenue in the undertaker of the project. In other words, the benefits were estimated as reduction of social losses listed in Table B6.2.1. Accordingly, it is purposeless to analyze its profitability and liquidity of the project. This section, thus, deals with whether or not the project costs are available from the public finance of the national government. Furthermore, the financial constraints that the national government has for investment onto flood control projects are discussed taking account of present financial situation. They comprise the burden of external debts and outstanding, financial sources and limit of investment

(2) Public Finance for Flood Control

The financial requirement of the proposed master plan was estimated at Rp.555 billion at 2001 market prices. This amount has to be procured between 2004 and 2019, as explained in the previous section.

The total capital investment for flood control schemes by the national government was expected to be Rp.10 billion in the year 2004, after 2005 around Rp.38.5 billion every year until 2019. The accumulation of the annual capital investment was estimated at Rp555 billion for 16 years from 2004 through 2019. As mentioned in Section A6.8.3, 0.0037% of the national development expenditure was spent for Propinsi Gorontalo, in particular for the LBB Basin, on the basis of the past trend. Then, the expected investment accumulated to the year 2019 was estimated at Rp.71 billion at 1998 constant prices for Propinsi Gorontalo, if the rate was applied to the estimation. That amount was re-evaluated at Rp.96 billion at 2001 prices, applying a price index of 1.36. This was around 17% of the financial requirement for the proposed master plan.

The table below shows the investment expected for Propinsi Gorontalo by the national government between 2004 and 2019, taking consideration of socio-economic indices. According to the population ratio, it was 0.41% or Rp.16 billion. In the case of land area, it was 0.63% or Rp.25 billion. In the case of G(R)DP, it was 0.09% or Rp.4

billion. These figures are less than the expected expenditure (Rp.96 billion) for flood control. Accordingly, the budget expected by 2019 from the viewpoint of financial trend would rather be considered as Rp.96 billion. Thus, it is said that the national government has appropriated the considerable budget of flood control to Propinsi Gorontalo, as compared with socio-economic indices above.

Item	Figures		Percentage share (%)	Amount (Rp. billion)
	Indonesia	Propinsi Gorontalo		
1. Total expenditure (2005-2019)*1	-	-	-	1,916,500
1) Expenditure to flood control*2				3,830
2. Indices				
1) Financial trend				
· Expenditure trend ('95-'99*3)			1.85*4	71
2) Socio-economic features				
· Population (2000 census)	203×10^6	830×10^3	0.41	16
· Land area	$1{,}923 \times 10^3$ km^2	12.2×10^3 km^2	0.63	25
· G(R)DP (2000)	Rp.$1{,}291 \times 10^{12}$	Rp.$1{,}128 \times 10^9$	0.09	4

Note: *1 Total accumulation of development expenditure between 2005 and 2019 at 1998 constant prices.
*2 Assumed that 0.2% of the total development expenditure was appropriated to flood control schemes, referring to the past trend.
*3 Data in '97 were missing because of data availability.
*4 Rp.71 billion came from the discussion in Section A6.8.3 and was quoted from Table A6.8.2. It accounted for 1.85% of the national development expenditure (Rp.3,830 billion at 1998 constant prices) for flood control schemes by the year 2019.

(3) Status of Foreign Aid and Public Debt

Total debt stocks of Indonesia aggregated to US$150 billion as of the end of 1999. This debt accounted for 106% of GDP in 1999. Of this total, US$120 billion or 80% was procured as long-term debt, mostly for capital investment. Due to this outstanding of external debt, the total debt service aggregated to US$17.8 billion in 1999. Then, the debt-service ratio (DSR), a kind of country risk assessment factors, was 30.3%. This rate has been almost at the same condition, i.e., from 30.7% in 1994 to 30.3% in 1999, as shown in the table below. The DSR has kept a critical position for these years, because those were always beyond the level of 20%, critical level of DSR. Thus, Indonesia is already below difficult position to increase degree of dependence on loan.

(Unit: US$ billion)

Item	1995	1996	1997	1998	1999
Debt outstanding of long-term debt	98.4	96.7	100.3	121.7	119.8
Total debt service	16.4	21.5	19.7	18.3	17.8
Principal repayment	10.2	14.9	13.0	11.2	11.7
Interest payment	6.2	6.6	6.7	7.1	6.1
Exports of goods and services	54.9	58.8	65.8	57.7	58.8
Debt service ratio (DSR)*1	29.9	36.6	30.0	31.7	30.3

Note: *1 A ratio of total debt service over exports of goods and services.

(4) Overcoming Financial Constraints

According to the past trend of the public expenditure for flood control projects, the national government could appropriate Rp.96 billion for Propinsi Gorontalo between 2005 and 2019. Even if the national government allots its flood control budgets, the capital requirement will still be more than 83% lacking.

Accordingly, the governments concerned should make efforts to materialize the following, taking account of the financial conditions reflecting the national and international circumstances.

(1) To increase capital investment for flood control in the national budget
(2) To procure loans of low interest and long-term payment period
(3) To procure grant sources
(4) To formulate construction consortium by stakeholders

Especially in the intensive implementation stage, the external financial sources mentioned about are important to activate basin’s flood mitigation activities under such conditions that the local financial source due to decentralization process is not fully established.

In the sustainable implementation stage, the governments concerned will be able to appropriate their budgets for the flood control schemes proposed in the master plan in accordance with their financial capability. It is essential to execute the flood mitigation works continuously step by step using the budget as available, since the flood mitigation effects would be in hand in proportion to the input even though the progress of works is behind the initial schedule.

It would be still difficult with their own budget to implement the whole schemes by the end of tenth five-year development plan. In order to catch up with the schedule, the governments should search for the financial sources as in the intensive implementation stage, taking account of national and international circumstances.

B6.4 Social Aspect

(1) Creation of Job Opportunity and Activation of Regional Economy

The implementation of the proposed project creates opportunities of temporal jobs during the construction period. These temporal workers and some construction materials will be supplied from inside and outside of the basin. Moreover, the supporting services and other materials for these construction works are produced in the province and its surroundings. These supporting business results in creating job opportunity and it will contribute to activation of the regional economy.

(2) Enhancement of Land Use and Encouragement of Economic Activity

There are many areas depressed economically and environmentally in the LBB Basin. Some of these urban areas have been washed out for long time. Without the proposed flood control projects, people in these flood prone areas would be discouraged to expand their business in their territories. Then, they might not utilize their land more effectively than the present utilization, in spite of limited urbanized lands in Kota Gorontalo and even in Kabupaten Gorontalo. On the other hand, once the proposed projects were implemented in these areas, these lands could be utilized more effectively for economic activities because of no more flood disasters.

These visible benefits were already quantified as tangible benefits in the economic evaluation. People in the flood prone areas in particular were depressed by these disasters and got disincentive on their mental motivation as well as on their economic activities. The proposed projects would give them incentives to encourage their business development and more effective use of their spatial territory. These activities might stimulate regional economy within the basin.

(3) Improvement of Social Amenity and Public Hygiene

People living in the LBB Basin have experienced habitual floods in the past. It is clear that the people in the flood prone areas tremble with flood menace, whoever had fear experiences in the floods. Besides, the people exposed themselves to danger of serious public hygiene after the flood disaster.

Due to the implementation of the proposed flood control plan in this study, the riverine people in the LBB Basin would be able to be relieved from menace of floods. This would result in the emergence and subsequent pervasion of positive mental climate among inhabitants in the basin. They could enjoy their living conditions and industrial activities with little worries about flood and sedimentation disasters.

B6.5 Initial Environmental Examination (IEE)

(1) Project Description

The candidate projects adopted in the Master Plan are listed in Table B6.5.1 including their sizes and components. They are composed of five schemes: 1) River improvement schemes, 2) Floodway scheme, 3) Lake Limboto management schemes, 4) Watershed management schemes, and 5) Flood plain management schemes. The components of these schemes and overview of environmental impacts are as follows:

River Improvement Schemes: River improvement schemes consist of the following components:

1) Alo and Pohu river improvement, including Rintenga, Marisa and Meluopo rivers improvement as well as Alo-Pohu diversion channel,
2) Biyonga river improvement, including Biyonga diversion channel,
3) Bolango river improvement,
4) Bone river improvement,
5) Tamalate river improvement, and
6) Tapodu river improvement.

These river improvement schemes include such activities as dike construction, bank protection and channel normalization work. The channel normalization work is to be undertaken by means of smoothing channel alignment, widening and deepening channel section, and normalizing channel section by means of dredging. These activities will accompany physical and structural modifications in and around river channels, which may cause impacts on natural environment in the river channels and social environment along them.

Floodway Scheme (Tamalate Floodway): Tamalate floodway scheme includes such activities as constructions of flood diversion channel by means of excavation work and a weir set up by which runoff discharge is diverted and controlled. These activities will accompany physical and structural modification, which may cause impacts on both natural and social environment in and around the newly constructed floodway as well as on natural environment in the existing rivers.

Lake Limboto Management Schemes: Lake Limboto management schemes consist of the following components:

1) Tapodu gate (Hydraulic control gate),
2) Ring dike, and
3) Sediment trap.

The construction of the hydraulic gate at the outlet of Lake Limboto (on the Tapodu river) may cause impacts on water regime of the lake and aquatic ecology in it, and on social environment of surrounding area in terms of settlements and fisheries.

Watershed Management Schemes: Watershed management schemes consist of the following components:

1) Erosion control facilities,
2) Afforestation in the upstream areas and land use control, and
3) Publicity activities.

These components relate to natural environment in the LBB basin, especially on forest functions, as well as on social environment in terms of awareness building on the forest functions, especially its water retention capability.

Flood Plain Management Schemes: Flood plain management schemes consist of the following components:

1) Community mobilization,
2) Local coping measures, and
3) Community-based sustainable measures.

These components are intended to organize flood fighting activities and systems at the community level, and promote them, aiming at strengthening local people's preparedness or coping capacity for the mitigation of flood damage in a sustainable manner. These are more related to social environment rather than natural environment.

(2) Methodology of Examination

Natural Environmental Component to be Examined: The impacts on natural environment were examined for the following environmental components:

<u>Natural environmental components:</u>

- Topography (including sedimentation),
- Soil erosion,
- Groundwater,
- Water regime (river flow regime and lake water level),
- Flora and fauna (terrestrial and aquatic ecology, but not including sea ecology),
- Protected area,
- Meteorology, and
- Landscape.

<u>Physical environmental components:</u>

- Air quality,
- Water quality,
- Soil contamination,
- Noise and vibration,
- Land subsidence, and
- Odor.

Social Environmental Component to be Examined: The impacts on social environment were examined in term of the following components:

- Resettlement of the residents,
- Livelihood (Access to open water),
- Economic activities,
- Local opposition,
- Access to public and cultural/religious facilities and traffic,
- Community split,

- Historical and cultural heritage,
- Waste, and
- Disaster.

Access to open water of the rivers and the lake is included as a component, because the life of people in the region is highly related to such water resource in terms of daily life for washing clothes, bathing and a privy.

Impact Magnitude: Evaluation of impacts on each environmental component was conducted comprehensively, considering the following criteria:

- Positive or negative,
- Nature of impact such as reversibility, possibility to avoid and duration,
- Spatial extent of the impact, and
- Population of affected people or wild life.

The impact magnitude was judged by orderly scale giving five grades as follows:

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

The impact evaluation was not undertaken on the basis of any single evaluation criterion mentioned above, but was done in a comprehensive manner taking into account all the criteria, and consequently concluded in view of environmental validity, provided that the itemized mitigation measures are properly taken.

(3) Conceivable Impacts and Possible Mitigation/Enhancement Measures

Natural Environment: Conceivable impacts of candidate projects in the Master Plan on natural environment are summarized in Table B6.5.2. The relationship between impact activities/programs and environmental components are shown in Table B6.5.3, with giving the magnitude of the conceivable impacts.

Basically, the candidate projects are not such that generate toxic or hazardous substances, nor that involve dangerous structures, but that improve the river environment in terms of reducing flood risks. Accordingly, the project cannot act as a source of public pollution or danger. Looking carefully into the candidate projects, however, each activity involved in the schemes may cause the impacts on both physical and ecological environment. The possible mitigation/enhancement measures for each impact are summarized in Table B6.5.4.

Social Environment: Conceivable impacts of candidate projects in the Master Plan on social environment are summarized in Table B6.5.5. The relationship of impact activities/programs with social environmental components is shown in Table B6.5.6.

In general, the structural measures listed in the Master Plan consist of various construction works. And the lands along the target rivers are to be occupied by the projects and therefore land acquisition is necessary. In this section, land acquisition and eventual relocation of people or various facilities and its repercussions were examined in addition to other impacts on social environment. Land acquisition causes an impact mainly at the pre-construction stage of the projects and the other impacts can occur at all the project stages (pre-construction, construction and operation and maintenance). The possible mitigation/enhancement measures for each conceivable impact are summarized in Table B6.5.7.

(4) Project Evaluation from Environmental Viewpoint

Initial environmental examination (IEE) was conducted by project scheme included in the Master Plan. The conceivable impacts were described by environmental component so far. The project evaluation, as a conclusion of the IEE, is summarized as follows:

Natural Environment

No major negative impacts on natural environment will be brought about by the implementation of the Master Plan, except for some physical impacts such as air pollution, water pollution (turbid water flow) and noise and vibration. These negative impacts will be caused by the construction works, especially made by construction machinery and transportation vehicles. Therefore, these impacts will be confined within construction stage. Among all the construction sites, these negative impacts would be significant only at the lower Biyonga, the lower Bolango and the lower Tamalate river reaches because these areas are densely populated.

The other negative impacts, minor or negligible, include habitat disturbance of aquatic ecology in rivers, topographic modification and consequent negative impacts such as change of groundwater level and the ground stability near the excavated area.

Positive impacts, on the other hand, include reduction of soil erosion at river bank and upland areas, reduction of sedimentation in Lake Limboto, improvement of groundwater retention in forest lands, reduction of flood peaks, stability of water level of Lake Limboto, habitat creation and landscape improvement by restoration of forests.

Most of these positive impacts are not limited during a certain period, but will last for a long time during operation and maintenance stage. Among those positive impacts, reduction of sedimentation and stability of water level in Lake Limboto are major ones. In addition, watershed management schemes will bring about several major positive impacts such as reduction of soil erosion and stability of water regime if candidate projects in the scheme are properly and successfully undertaken.

As a conclusion, the candidate projects in the Master Plan are considered not to bring about serious negative impacts. Most of the negative impacts are minor or negligible judging from its duration and area to be affected. On the contrary, the candidate projects would bring about many positive impacts. Stability of water regime in Lake Limboto will be effective not only on aquatic ecology but also for fishery in the lake. Thus, the Master Plan candidate projects are considered to be valid from the view point of natural environment.

Social Environment

Possible negative impacts would occur from early pre-construction stage throughout operation and maintenance stage. The most significant one is various disturbance of people's daily life brought about by resettlement. The relocation of public service and religious facilities and the release of land rights of farming lands would be needed as well. These events occur especially at pre-construction stage. The magnitude of such impacts depends partly on the size of facilities concerned and partly on the population density of affected areas.

Another negative impact is access limitation to local resources such as river/lake waters and existing traffic with the opposite riverside. Such access is essential in people's daily life and flood control structures such as dike can be a disturbance. The disappearance of traffic between the riversides could cause a split of community along rivers.

In respect to positive impacts, temporary job would be available at the local level during construction. The positive impacts by the non-structural measures of the Master Plan can be sustainable and beneficial to local residents in the long term, although they require long-term and continuous efforts and commitment to attain the goals.

But, the most important positive impact is, of course, the reduction of flood risks especially in highly populated areas at the lower reaches of treated rivers, once the Master Plan is properly and successfully implemented. Free from fear or insecurity in livelihood, the people as well as the local government including various agencies, will be able to make use of their resources in terms of money, time and efforts for individual and regional development. Other positive impacts such as traffic improvement along the ring dike, better collaboration among agencies can be supportive factors to such development.

To conclude, although the candidate projects of the Master Plan may bring negative impacts on social environment in a short run, most of such impacts can be mitigated by various means. For example, the significance of impacts caused by resettlement can be reduced and minimized by carefully designing the magnitude of constructing facilities so as to affect minimal residents at project sites. The Master Plan as a whole can also bring long-term solutions vis-a-vis flood disaster. In particular, non-structural measures would strengthen local people's preparedness or coping capacity in terms of flood problem. Provided that non-structural and structural measures are implemented in a harmonic and strategic manner, the candidate projects of the Master Plan are valid as a whole in terms of social environment in the long term.

B6.6 Overall Evaluation

Economic Evaluation: The economic internal rate of return (EIRR) of the FM-MP was estimated to be 13.2% under future conditions and was evaluated economically viable exceeding the social discount rate of 12%, though the EIRR under the present conditions was worked out to be 5%.

Financial Aspects: A study on financial sources based on the past trend of public expenditure of the national government resulted in disclosing financial constraints of Gorontalo Province. It is substantial to implement the plan mobilizing communities in participatory manners from self-support standpoint as basic activities to cope with flood and sediment disaster. In addition, external inputs are also deemed necessary to activate flood mitigation activities, and to change past trend of economic circle of the region.

Social Aspects: In addition to the benefit accruing from the reduction of flood damages, the implementation of the FM-MP is expected to bring about the following favorable social effects:

1) Creation of job opportunity and activation of regional economy,
2) Enhancement of land use and encouragement of economic activity, and
3) Improvement of social amenity and public hygiene.

IEE for Natural Environment: The result of initial environmental examination clarified that the FM-MP will not bring about serious negative impact to natural environment of the basin, except for some physical impacts during the construction works mostly by construction equipment. On the contrary, the plan is considered to extend favorable impact to natural environment stabilizing water regime in Lake Limboto.

IEE for Social Environment: Although the candidate projects of the Master Plan may bring negative impacts on social environment in a short run, most of such impacts will be able to be mitigated by carefully designing and implementation. The FM-MP as a whole can bring long-term solutions for flood disaster. Provided that non-structural and structural measures are implemented in a harmonic and strategic manner, the candidate projects of the FM-MP are valid as a whole in terms of social environment in the long term.

Recommendation: The proposed flood mitigation master plan (FM-MP) is evaluated economically viable. The plan will bring about less negative natural and social environmental impacts. The FM-MP is evaluated to be valid from the view points of natural and social environment. The basin is suffering from frequent flood disasters constraining sound economic activities and people's livelihood. Implementation of the FM-MP in early stage is recommended.

Table B6.2.1 BENEFITS OF FLOOD MITIGATION PROJECT

Category of Damageable Assets and Activities					Damages Mitigated by FC Project
Benefits of Flood Mitigation	Direct Damages	Effects of Mitigating Damages to General Assets	Damages to General Assets	Building Unit	Damage to residential and business's buildings due to inundation
				Household Effects	Furniture and movables such as automobile, electric appliances
				Depreciable Assets of Business Establishments	Damage to depreciable assets of business establishments except their sites and buildings
				Inventory Stocks of Business Establishments	Damage to inventory stocks of business establishments due to inundation
				Depreciable Assets for Farming and Fishery	Damage to depreciable assets of farming or fishery in farmers or business establishments except their sites and buildings
				Inventory Stocks for Farming and Fishery	Damage to inventory stocks of farming or fishery in farmers or business establishments except their sites and buildings
			Damages to Agricultural Production		Damage to crop and fishery production
			Damages to Infrastructures	Road, Bridge, Railway, River Facility, Sewerage, Water Supply, Electric Power, Gas, Telephone, Park, Irrigation, etc.	Damage to infrastructures supporting livelihood, business activities and farming production
		Effects of Mitigating Damage to Human Lives			Damage to living space, causing casualties
	Indirect Damages	Effects of Mitigating Damages to Daily Activities	Damage to Daily Maintenance and Business Activities	Household Economy	Damage to daily housekeeping tasks and community activities due to inundation
				Industrial Production	Stoppage or decrease of business and production activities due to inundation
				Public Services	Stoppage or decrease of public services
		Effects of Mitigating Damages after Flood	Expenses for State of Emergency	Household Economy	After inundation, cleaning and repairing houses damaged by flood, and extra expenses for state of emergency
				Industrial Production	After inundation, cleaning and repairing buildings damaged by flood, and extra expenses for state of emergency
				Government's Activities	Expenses for emergency activities to casualties in addition to the works above
			Damage due to Traffic Disruption	Road, Railway, Port, Airport, etc.	Disruption of traffic systems such as road network, railway, etc., spreading to surrounding areas
			Damage due to Disruption of Lifeline Services	Water Supply, Electric Power, Gas, Telephone, etc.	Disruption of public utility services such as water supply, electricity, gas, etc., spreading to surrounding areas
			Damage due to Stoppage and Decrease of Daily Activities		Decrease of production due to lack of raw and semi finished materials, Stoppage of public services such as medical and utilities, spreading to surrounding areas
		Effects of Mitigating Mental Influence	Influence due to Damages Above		Mental influence due to damages to general assets, business losses, casualties, aftereffects, and influence over surrounding areas
Benefit from Sophisticated Environment					Land appreciation owing to improvement of flood control

Table B6.2.2 ECONOMIC VALUE OF DAMAGEABLE ASSETS

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

Note: *1 VA is calculated based on actual business days of 250 days.
*2 In residence, the daily amount for cleaning damaged house is equivalent to daily income of an average fami
*3 The daily cost to clean, fix and repair its rooms, furniture and equipment damaged by flood was assumed as the same as services establishment.

Table B6.2.3 DAMAGE RATE

(1) Direct Damage

Item		Inundation Depth					
		Below Floor Level	Over Floor Level				
			Less than 0.5 m	0.5-0.99 m	1.0-1.99 m	2.0-2.99 m	More than 3.0 m
1.	Building						
	(a) Building*1	0	0.092	0.119	0.266	0.380	0.834
2.	Residence						
	(a) Household Effects	0	0.145	0.326	0.508	0.928	0.991
3.	Industrial, Educational and Medical Facilities						
	(a) Depreciable Assets	-	0.232	0.453	0.789	0.966	0.995
	(b) Inventory Stock	-	0.128	0.267	0.586	0.897	0.982

4.	Crop Production	Water Depth (m)	Inundation Time (days)			
			1 to2	3 to 4	5 to 6	More Than 7
	(a) Lowland Crop	Less than 0.5	0.21	0.30	0.36	0.50
		0.5 to 0.99	0.24	0.44	0.50	0.71
		More than 1	0.37	0.54	0.64	0.74
	(b) Upland Crop	Less than 0.5	0.27	0.42	0.54	0.67
		0.5 to 0.99	0.35	0.48	0.67	0.74
		More than 1	0.51	0.67	0.81	0.91

Note: *1 In case of residence, a floor level is 20cm higher than the ground level.
However, a floor level of business establishments is the same as the ground level.

(2) Indirect Damage

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

Source: Manual for Economic Study on Flood Control, 1999, Ministry of Land, Infrastructure and Transport in Japan
Note: *1 Damages of (b) were not applied to educational and medical facilities.

Table B6.2.4 INVENTORY OF ASSETS IN FLOOD PRONE AREAS IN LBB BASIN

Kabupaten / Kecamatan	Agricultural Land (ha)			Residential Building		Facilities				
	Irrigated Field	Rainfed Field	Inland Fishpond	Number of Households	Number of Houses	Manufacturing Establishment	Trading Establishment	Educational Facility	Medical Facility	Others Facility
Inventory of Existing Facilities in Administrative Areas (Kotamadya and Kecamatans Related to Flood Prone Areas										
1. Kota Gorontalo	1,042	1,033	0	34,619	20,179	2,401	3,591	205	153	1,158
(1) Kota Barat	124	522	0	7,212	4,520	551	458	40	44	66
(2) Kota Utara	808	361	0	10,999	6,591	787	516	47	63	125
(3) Kota Selatan	110	150	0	16,408	9,068	1,063	2,617	118	50	967
2. Kabupaten Gorontalo	7,083	506	0	68,884	48,313	4,304	2,455	423	225	1,417
(1) Batudaa	1,936	344	-	15,417	9,602	989	310	90	61	257
(2) Tibawa	896	51	0	13,919	8,969	430	581	75	34	305
(3) Limboto	2,178	38	-	15,291	11,274	113	483	101	41	299
(4) Telaga	891	0	-	14,865	10,729	1,080	665	97	52	325
(5) Kabila	1,182	73	-	9,392	7,739	1,692	416	60	37	231
Total	8,124	1,539	0	103,503	68,492	6,705	6,046	628	378	2,575
Inventory of Existing Facilities in Flood Prone Areas					*1					
1. Kota Gorontalo	805	25	1	31,132	31,132	2,139	3,286	169	127	-
(1) Kota Barat	159	3	1	6,603	6,603	465	371	23	32	-
(2) Kota Utara	399	22	0	9,453	9,453	641	494	29	63	-
(3) Kota Selatan	246	0	0	15,076	15,076	1,034	2,421	117	32	-
2. Kabupaten Gorontalo	4,448	555	30	20,939	20,939	2,236	1,391	285	150	-
(1) Batudaa	1,450	265	9	4,884	4,884	941	242	84	42	-
(2) Tibawa	214	0	0	1,101	1,101	22	78	15	7	-
(3) Limboto	1,929	93	9	7,277	7,277	92	468	95	37	-
(4) Telaga	719	197	12	5,616	5,616	685	434	68	50	-
(5) Kabila	135	0	0	2,061	2,061	496	169	23	14	-
Total	5,252	580	32	52,071	52,071	4,375	4,677	454	277	-

Source: Handbooks of Respective Kota and Kecamatan, 2000 or 1999
Note: *1 Assumed as the number of houses are equal to the number of households.

Table B6.2.5 TAX REVENUE THROUGH REAL PROPERTY TAX IN KOTA GORONTALO AND KABUPATEN GORONTALO: 2000

Item	Land				Building			
	Class	Total Area (ha)	Tax (1000 Rp.)	Number of Tax Payers	Class	Total Area (ha)	Tax (1000 Rp.)	Number of Tax Payers
1. Kota Gorontalo	A25	15.81	39,390	446	B18	0.01	152	1
	A26	12.90	24,646	361	A02	0.62	5,937	24
	A27	6.11	9,275	141	A03	0.71	5,797	17
	A28	15.34	18,926	264	A04	1.45	11,770	27
	A29	24.86	24,002	468	A05	3.67	21,452	94
	A30	39.36	29,896	493	A06	3.98	19,595	125
	A31	75.06	48,676	1,404	A07	13.03	53,756	586
	A32	94.30	41,112	2,500	A08	5.57	18,326	378
	A33	141.45	46,247	2,783	A09	27.40	76,254	2,493
	A34	217.05	51,687	4,478	A10	6.85	35,879	827
	A35	276.00	50,921	4,430	A11	43.81	79,810	5,057
	A36	616.23	80,453	6,306	A12	2.32	3,130	381
	A37	740.91	70,991	6,068	A13	36.96	44,101	5,431
	A38	579.69	40,408	3,883	A14	0.88	646	96
	A39	47.21	2,399	310	A15	7.60	6,650	1,141
	A40	14.22	498	57	A16	2.62	2,721	619
					A17	2.97	1,220	596
					A18	0.67	327	160
					A19	0.81	316	251
					A20	0.01	16	35
Total		2,916.50	579,525	34,392		161.94	387,854	18,339
Average of Tax per Payer (Rp			16,851				21,149	
Average of Tax per m2 (Rp.)			20				240	
2. Kabupaten Gorontalo	A33	9.49	3,417	143	A01	0.13	1,550	2
	A34	4.66	989	68	A02	0.04	480	10
	A35	31.85	6,079	474	A03	0.01	42	1
	A36	88.36	11,653	1,175	A04	0.50	955	18
	A37	229.75	19,788	2,361	A05	0.16	938	6
	A38	332.40	22,244	2,928	A06	0.87	4,331	40
	A39	764.94	34,578	4,612	A07	3.29	14,045	240
	A40	1,034.60	32,177	5,287	A08	1.03	4,778	96
	A41	1,738.37	40,567	6,334	A09	10.47	30,733	1,116
	A42	3,969.68	64,000	8,697	A10	3.53	9,673	480
	A43	3,021.88	35,776	6,037	A11	14.71	28,211	2,074
	A44	1,491.40	13,595	2,428	A12	4.50	6,971	611
	A45	639.13	4,019	912	A13	13.77	16,451	2,216
	A46	195.89	1,837	375	A14	7.82	5,211	1,187
					A15	16.83	9,187	2,353
					A16	5.46	2,064	816
					A17	5.82	2,018	845
					A18	1.19	514	166
					A19	1.83	636	142
					A20	0.95	258	64
Total		13,552.40	290,719	41,831		92.91	139,049	12,483
Average of Tax per Payer (Rp			6,950				11,139	
Average of Tax per m2 (Rp.)			2				150	

Source: Gorontalo Regional Taxation Office, Regional Office XIII

Table B6.2.6 HOUSEHOLDS AND HOUSES IN KOTA AND KECAMATAN RELATED TO FLOOD PRONE AREAS IN LBB BASIN

Kabupaten Kecamatan	Number of Housholds	Number of Houses			
		Total	Permanent	Semi-permanent	Non-permanent
1. Kota Gorontalo	34,619	20,179	6,317	9,101	4,761
(1) Kota Barat	7,212	4,520	3,129	-	1,391
(2) Kota Utara	10,999	6,591	1,435	3,697	1,459
(3) Kota Selatan	16,408	9,068	1,753	5,404	1,911
2. Kabupaten Gorontalo	68,884	48,313	26,209	-	22,104
(1) Batudaa	15,417	9,602	3,694	-	5,908
(2) Tibawa	13,919	8,969	6,554	-	2,415
(3) Limboto	15,291	11,274	4,855	-	6,419
(4) Telaga	14,865	10,729	5,295	-	5,434
(5) Kabila	9,392	7,739	5,811	-	1,928
Total	103,503	68,492	32,526	9,101	26,865

Source Handbooks of the Kecamantan and Kota listed in the table in 2000 (Kecamatan) or 1999 (Kota)

Table B6.2.7 ESTIMATED AVERAGE VALUE OF HOUSEHOLD EFFECTS: 2001

Items of Household Effects	Number of Households Holding Durable Assets Listed*1			Value of New Materials			Average Value in Actuality*3
	Urban	Rural	Total	Unit Value*2 (Rp.1000)	Total Value (Rp. Million)	Average Value (Rp.1000)	(Rp. Million)
Kota Gorontalo							
1. Total Number of Households	20,098	5,476	25,574				
2. Durable Assets							
(1) Sideboard	14,750	2,971	17,721	750	13,291		
(2) Stove	11,384	2,260	13,644	750	10,233		
(3) Bicycle	7,830	1,848	9,678	1,000	9,678		
(4) Radio-Cassette	10,597	2,036	12,633	1,500	18,950		
(5) TV Set	8,877	1,147	10,024	3,500	35,084		
(6) Motor Cycle	4,472	508	4,980	50,000	249,000		
(7) Car/Motor Boat	952	85	1,037	250,000	259,250		
Total					595,485	23,285	**11.6**
Kabupaten Gorontalo							
1. Total Number of Households	4,992	119,150	124,142				
2. Durable Assets							
(1) Sideboard	3,323	51,095	54,418	750	40,814		
(2) Stove	1,988	20,527	22,515	750	16,886		
(3) Bicycle	2,430	28,703	31,133	1,000	31,133		
(4) Radio-Cassette	2,520	32,350	34,870	1,500	52,305		
(5) TV Set	1,342	7,643	8,985	3,500	31,448		
(6) Motor Cycle	733	6,710	7,443	50,000	372,150		
(7) Car/Motor Boat	252	1,108	1,360	250,000	340,000		
Total					884,735	7,127	**3.6**

Source: Penduduk Sulawesi Utara, Hasil Sensus Penduduk 1990 Seri: S2.22, September 1992, BPS

Note: *1 The number of households was quoted from the source above.

*2 Average market value in 2001

*3 Assumed as a half of new materials taking depreciation into consideration.

Table B6.2.8 FARMGATE PRICES OF AGRICULTURAL COMMODITIES: 1998-2001

(Unit: Rp.)

Commodity	Unit	1998	1999	2000	2001												
					Jan.	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
Farmgate Price																	
1. Paddy	Kg	1,200	1,300	1,350	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	**1,400**
2. Maize	Kg	900	1,200	1,400	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	**1,500**
3. Soybean	Kg	3,500	4,200	4,500	4,750	4,750	4,750	4,750	4,750	4,750	4,750	4,750	4,750	4,750	4,750	4,750	**4,750**
Wholesale Price																	
1. Paddy	Kg	1,350	1,400	1,400	1,450	1,450	1,450	1,450	1,450	1,450	1,450	1,450	1,450	1,450	1,450	1,450	1,450
2. Maize	Kg	1,200	1,500	1,700	1,700	1,700	1,700	1,700	1,700	1,700	1,700	1,700	1,700	1,700	1,700	1,700	1,700
3. Soybean	Kg	4,000	4,500	5,000	4,750	4,750	5,250	5,250	5,000	5,500	5,500	5,500	5,500	5,500	5,500	5,500	5,292
Retail Price																	
1. Paddy	Kg	1,400	1,500	1,550	1,500	1,500	1,600	1,600	1,600	1,600	1,600	1,600	1,650	1,650	1,650	1,650	1,600
2. Maize	Kg	1,350	1,600	1,800	1,850	1,850	1,900	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	1,967
3. Soybean	Kg	4,750	5,000	5,000	5,000	5,000	6,000	6,000	6,000	5,500	6,000	5,500	6,000	6,000	6,500	6,500	5,833

Source: Agriculture Department, Provincial Government of Gorontalo

Table B6.2.9 ECONOMIC PRICE FOR AGRICULTURAL PRODUCTS AT 2001 CONSTANT PRICES

I. Paddy

	Item	Unit	Import Parity Price
1.	Export Price, Thai 5% Broken, FOB Bangkok *1	US$/ton	299
2.	Ocean Freight and Insurance	US$/ton	40
3.	Grade Differential (25-35% broken) *2	US$/ton	60
4.	CIF Manila Price	US$/ton	279
5.	Converted to Rupiah *3	Rp.1000/ton	2,677
6.	Costs of Port Charge, Handing and Warehousing *4	Rp.1000/ton	54
7.	Importer's Margin *5	Rp.1000/ton	134
8.	Ex-warehouse Price	Rp.1000/ton	2,865
9.	Transportation Cost to Selling Center *6	Rp.1000/ton	29
10.	Trader's Margin *7	Rp.1000/ton	57
11.	Wholesale Price of Rice in Manado	Rp.1000/ton	2,951
12.	Transportation Cost (Manado - Basin) *8	Rp.1000/ton	43
13.	Ex-mill Rice Price	Rp.1000/ton	2,908
14.	Milling Cost *9	Rp.1000/ton	200
15.	Value of By-products *10	Rp.1000/ton	112
16.	Value of Pre-million	Rp.1000/ton	2,820
17.	Paddy Equivalent Price *11	Rp.1000/ton	1,833
18.	Costs of Procurement, Transportation and Handling *12	Rp.1000/ton	15
19.	Farmgate Price of Paddy	Rp.1000/ton	1,818
	Farmgate Price of Paddy (Round Off Figure)	Rp.1000/ton	1,800

Source: 1987 Master Plan

Note:
*1 Global Commodity Markets, A Comprehensive Review and Price Forecast, April 2000, World Bank
*2 15% lower than 5% broken rice of Thailand, because of rice quality.
*3 Applied an exchange rate of Rp.9,600 per US$.
*4 2% of rice price imported.
*5 5% of rice price imported.
*6 1% of ex-warehouse price.
*7 2% of ex-warehouse price.
*8 400km x Rp.120/ton/km x 0.9 (SCF) = Rp43,200/ton
*9 Applied Rp.10,000/50kg of milling cost.
*10 Applied Rp.112,000/(ton of rice).
*11 Million rate is estimated at 65%.
*12 Rp.750/50kg of paddy including handling charges.

II. Maize

	Item	Unit	Import Parity Price
1.	Export Price, No.2 Yellow, FOB US Gulf Ports *1	US$/ton	126
2.	Ocean Freight and Insurance	US$/ton	26
4.	CIF Manila Price	US$/ton	152
5.	Converted to Philippines Pesos *3	Rp.1000/ton	1,462
6.	Costs of Port Charge, Handing and Warehousing *4	Rp.1000/ton	29
7.	Importer's Margin *5	Rp.1000/ton	73
8.	Ex-warehouse Price	Rp.1000/ton	1,565
9.	Transportation Cost to Selling Center *6	Rp.1000/ton	16
10.	Trader's Margin *7	Rp.1000/ton	31
11.	Wholesale Price of Rice in Manila	Rp.1000/ton	1,612
12.	Transportation Cost (Manado - Basin) *8	Rp.1000/ton	43
17.	Wholesale Price of Corn at Basin Market	Rp.1000/ton	1,568
18.	Costs of Procurement, Transportation and Handling *9	Rp.1000/ton	15
19.	Farmgate Price of Paddy	Rp.1000/ton	1,553
	Farmgate Price of Paddy (Round Off Figure)	Rp.1000/ton	1,600

Source: 1987 Master Plan

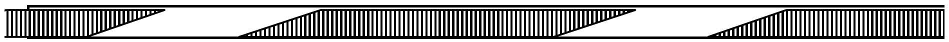
Note:
*1 Global Commodity Markets, A Comprehensive Review and Price Forecast, April 2000, World Bank
*2 15% lower than 5% broken rice of Thailand, because of rice quality.
*3 Applied an exchange rate of Rp.9,600 per US$.
*4 2% of rice price imported.
*5 5% of rice price imported.
*6 1% of ex-warehouse price.
*7 2% of ex-warehouse price.
*8 400km x Rp.120/ton/km x 0.9 (SCF) = Rp43,200/ton
*9 Rp.750/50kg of maize including handling charges.

Table B6.2.10 PRODUCTION COST OF MAJOR CROPS AT MARKET PRICES: 2001

Cost Item	Paddy		Maize	Soybean	Chili
	Irrigated	Rainfed*1			
I. **Production Cost in 2000/2001 (Rp.1000 per ha)**					
1. Seeds/Planting Materials	120.0	120.0	105.0	300.0	262.5
2. Fertilizers	592.5	252.2	467.5	405.0	890.0
Urea	312.5	132.8	187.5	125.0	312.5
TSP	175.0	75.3	175.0	175.0	262.5
KCI	105.0	44.1	105.0	105.0	315.0
3. Agro-chemicals	290.0	70.0	140.0	140.0	140.0
Pesticide	140.0	70.0	140.0	140.0	140.0
Herbicide	150.0	-	-	-	-
4. Animal and Machine	425.0	455.4	250.0	250.0	250.0
5. Hired Labor	1,725.0	1,377.6	1,500.0	1,500.0	2,000.0
6. Others	100.0	100.0	100.0	100.0	250.0
7. Total	3,252.5	2,375.1	2,562.5	2,695.0	3,792.5
II. **Unit Production**					
1. Yield per Hectare (tons)	5.0	2.7	3.0	1.3	5.0
2. Cost per Ton (Rp.1000)	650.5	879.7	854.2	2,073.1	758.5

Source: Agriculture Department, Provincial Government of Gorontalo
Note: :1Modified the costs of production in irrigated fields.

Table B6.2.11 AVERAGE DAMAGEABLE VALUE OF PADDY PRODUCTION IN IRRIGATED FIELD

Item		Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
(1) Crop Calendar													
(2) Planted Area (%)	1st Crop	100	50							50	50	100	100
	2nd Crop			50	50	100	100	100	50				
(3) Accumulated Cost (%)	1st Crop	80	95	50						3	13	35	60
	2nd Crop			3	13	35	60	80	95	50			
(4) Flood Frequency *1(%)		8.1	6.7	8.2	9.3	13.3	9.5	7.9	4.2	4.3	8.3	11.1	9.2
(5) Damageable Value *2 (Rp.1000/ha)	1st Crop	682	297	0	0	0	0	0	0	132	267	788	720
	2nd Crop	0	0	252	299	944	744	665	186	0	0	0	0

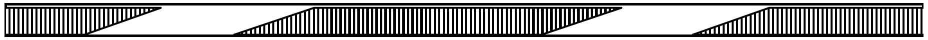
Economic Terms

	1st Crop	2nd Crop	Total/Average
(6) Yield (ton/ha)	5.0	5.0	5.0
(7) Economic Farmgate Price (Rp.1000/ton)	1,800	1,800	1,800
(8) Gross Income (Rp.1000/ha)	9,000	9,000	18,000
(9) Production Cost (Rp.1000/ha)	2,927	2,927	5,855
(10) Net Income (Rp.1000/ha)	6,073	6,073	12,146
(11) Damageable Value (Rp.1000/ha)	3,090	2,886	5,975 (= 6,000)

Source: (1) Quarterly Review of Commodity Market, Fourth Quarter 2000, World Bank
(2) LBB Basin, Water Management Master Plan, Vol.II Annexes, March 1999, CIDA
(3) SCF is assumed to be 0.90.

Note: *1 Based on monthly distribution of rainfall (1997-1993)
2 (2)(4)*{(3)*(9)+(10)}

Table B6.2.12 AVERAGE DAMAGEABLE VALUE OF CROP PRODUCTION IN RAINFED FIELD

Item		Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
(1) Crop Calendar													
(2) Planted Area (%)	1st Crop	100	50							50	50	100	100
	2nd Crop			50	50	100	100	100	50				
(3) Accumulated Cost (%)	1st Crop	80	95	50						3	13	35	60
	2nd Crop			3	13	35	60	80	95	50			
(4) Flood Frequency *1(%)		8.1	6.7	8.2	9.3	13.3	9.5	7.9	4.2	4.3	8.3	11.1	9.2
(5) Damageable Value *2 (Rp.1000/ha)	1st Crop	411	182	0	0	0	0	0	0	69	143	443	423
	2nd Crop	0	0	105	129	439	368	343	98	0	0	0	0

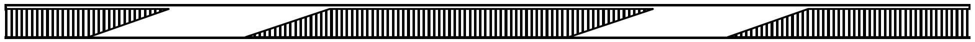
Economic Terms

	1st Crop (Maize)	2nd Crop (Soybean)	Total/Average
(6) Yield (ton/ha)	3.0	1.3	-
(7) Economic Farmgate Price (Rp.1000/ton)	1,600	4,280	-
(8) Gross Income (Rp.1000/ha)	4,800	5,564	10,364
(9) Production Cost (Rp.1000/ha)	2,306	2,426	4,732
(10) Net Income (Rp.1000/ha)	2,494	3,139	5,632
(11) Damageable Value (Rp.1000/ha)	1,482	1,671	3,153 (= 3,200)

Source: (1) Quarterly Review of Commodity Market, Fourth Quarter 2000, World Bank
(2) LBB Basin, Water Management Master Plan, Vol.II Annexes, March 1999, CIDA
(3) SCF is assumed to be 0.90.

Note: *1 Based on monthly distribution of rainfall (1997-1993)
2 (2)(4)*{(3)*(9)+(10)}

Table B6.2.13 AVERAGE DAMAGEABLE VALUE OF PADDY PRODUCTION IN IRRIGATED FIELD IN FUTURE

	Item		Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
(1)	Crop Calendar													
(2)	Planted Area (%)	1st Crop	100	50							50	50	100	100
		2nd Crop			50	50	100	100	100	50				
(3)	Accumulated Cost (%)	1st Crop	80	95	50						3	13	35	60
		2nd Crop			3	13	35	60	80	95	50			
(4)	Flood Frequency *1(%)		8.1	6.7	8.2	9.3	13.3	9.5	7.9	4.2	4.3	8.3	11.1	9.2
(5)	Damageable Value *2 (Rp.1000/ha)	1st Crop	827	357	0	0	0	0	0	0	171	342	988	886
		2nd Crop	0	0	326	383	1,183	915	807	224	0	0	0	0

Economic Terms

	Item	1st Crop	2nd Crop	Total/Average
(6)	Yield (ton/ha)	6.0	6.0	6.0
(7)	Economic Farmgate Price (Rp.1000/ton)	1,800	1,800	1,800
(8)	Gross Income (Rp.1000/ha)	10,800	10,800	21,600
(9)	Production Cost (Rp.1000/ha)	2,927	2,927	5,855
(10)	Net Income (Rp.1000/ha)	7,873	7,873	15,746
(11)	Damageable Value (Rp.1000/ha)	3,838	3,570	7,408 (= 7,400)

Source: (1) Quarterly Review of Commodity Market, Fourth Quarter 2000, World Bank
(2) LBB Basin, Water Management Master Plan, Vol.II Annexes, March 1999, CIDA
(3) SCF is assumed to be 0.90.

Note: *1 Based on monthly distribution of rainfall (1997-1993)
2 (2)(4)*{(3)*(9)+(10)}

Table B6.2.14 STANDARD CONVERSION FACTOR

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

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

Not *1 Conversion Factor = (6)/(7)
*2 International Financial Statistics, IMF

Table B6.2.15 DAMAGEABLE PROPERTY AND FLOOD DAMAGE UNDER PRESENT SOCIO-ECONOMIC CONDITIONS

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

Table B6.2.16 DAMAGEABLE PROPERTY AND FLOOD DAMAGE UNDER FUTURE SOCIO-ECONOMIC CONDITIONS

Item			Return Period (Year)				
			2	5	10	20	50
I.	Affected Population and Area						
	1	Affected Population (1000)	14	48	80	102	131
	2	Area Inundated (km^2)	33	51	62	70	80
II.	Inundated Property						
	1	Buildings (Nos)	4,086	14,134	24,078	31,044	39,812
	a.	Housing Units	3,603	12,335	20,467	26,197	33,470
	b.	Manufacturing	204	763	1,616	2,117	2,721
	c.	Trading	234	887	1,746	2,403	3,210
	d.	Educational	24	85	148	204	262
	e.	Medical	21	64	101	122	150
	2	Agricultural Land (ha)	1,659	2,587	3,118	3,509	3,958
	a.	Irrigated Field	1,437	2,289	2,770	3,121	3,549
	b.	Rainfed Field	200	276	324	365	386
	c.	Fishpond	22	22	23	23	23
III.	Estimated Value of Damaged Property (Rp. Million in Economic Terms)						
	1.	Direct Damage	45,207	160,835	298,190	457,257	681,624
	(1)	Facilities	28,302	113,865	217,579	338,233	509,377
	a.	Housing Units	15,387	64,293	122,316	195,052	292,608
	b.	Manufacturing	3,996	15,119	32,866	48,348	72,536
	c.	Trading	1,249	5,094	10,356	16,511	26,405
	f.	Education	5,054	19,557	33,741	51,468	77,651
	g.	Health	463	1,540	2,424	2,991	4,049
	h.	Other Facilities	2,152	8,262	15,877	23,864	36,128
	(2)	Agricultural Production	6,473	9,854	11,798	13,503	14,949
	a.	Irrigated Field	5,668	8,878	10,727	12,295	13,684
	b.	Rainfed Field	312	483	549	686	743
	c.	Fishpond	493	493	522	522	522
	(3)	Infrastructure	10,432	37,116	68,813	105,521	157,298
	2.	Indirect Damage	5,132	18,346	34,298	52,410	77,984
	(1)	Household	288	1,027	1,910	2,995	4,469
	(2)	Business Losses	324	1,236	2,569	3,689	5,353
	(3)	Other Damages	4,521	16,083	29,819	45,726	68,162
	3.	Total	50,339	179,181	332,488	509,667	759,609
IV.	Annual Benefit under Present Conditions (Rp. Million in Economic Terms)						
						101,295	

Table B6.2.17 ECONOMIC COSTS AND BENEFITS STREAM OF PROPOSED PROJECT UNDER PRESENT SOCIO-ECONOMIC CONDITIONS

(Unit: Rp. Billion)

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

B/C: 0.51 NPV: -98.7 Rp. Billion EIRR: 6.0%

Table B6.2.18 ECONOMIC COSTS AND BENEFITS STREAM OF PROPOSED PROJECT UNDER FUTURE SOCIO-ECONOMIC CONDITIONS

(Unit: Rp. Billion)

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

B/C: 1.28 NPV: 56.7 Rp. Billion EIRR: 14.7%

Table B6.5.1 DESCRIPTIONS OF CANDIDATE PROJECTS IN FM-MP

a. Structural Measures

Impact Activities/Programs	Length	Components/Interventions	Structure/Basic size	Remarks
1.River Improvement Schemes				
(1) Alo-Pohu river improvement (2) Biyonga river improvement (3) Bolango river improvement	9.0 km 8.3 km 16.0 km	Dike construction	Structure: Earth dike - Height: Depends on elevation above Mean Sea Level (MSL), - Width: 3 or 4 m, Free board: 0.6 m, 0.8 m or 1.0 m, Slope: 1:2.0	Including the following: - Rintenga river improvement: 7.0km - Marisa river improvement: 5.3km
(4) Bone river improvement	14.7 km	Bank protection	Wetrubble masonry	- Meluopo river improvement: 4.1km
(5) Tamalate river improvement (6) Tapodu river improvement	6.9 km 1.5 km	Channel normalization (straightening)	Only on Tapodu river, Length change: from 488m to 303 m	- Alo-Pohu diversion channel: 3.8 km - Biyonga diversion channel: 2.0 km
2.Floodway Scheme				
Tamalate floodway	1.5 km	Channel construction	Width of channel: 40 m, Depth: approx. 5 m below ground level	Including Tamalate weir
3. Lake Limboto management schemes				
(1) Tapodu gate		Slide type gate (2 gates)	Height of gate: 3.6 m, Width of gate: 12.0 m Maintenance water level of Lake Limboto: Max.: +5.5 m (MSL), Min.: +4.0 m (MSL)	
(2) Lake dike - East Lake Dike - West Lake Dike	Total : 12.9 km 7.6 km 5.3 km	Earth dike	Height: + 6.5 m (MSL), Approx. 2 m above ground level Width (Top): 6.0 m, (Bottom): More than 18 m, Free board 1.0 m Slope: 1:3.0	
(3) Sediment Trap - East Trap - West Trap	Total : 4.0 km 2.2 km 1.8 km	Trap net installation	Bamboo net	

b. Non-structural Measures

Impact Activities/Programs	Components/Interventions
4 .Watershed Management Schemes	
(1) Erosion control facilities	Construction of check dam, revetment works along river banks and hill slops, protection of small-scale channels.
(2) Afforestation and land use control	Afforestation and reforestation by promoting farm trees and shrub planting, planting of fodder grasses, conservation of wild medical herbs, etc.
(3) Publicity activities	Activities to inform and disseminate the watershed management by mass media for such as planting trees, fund raising activities, organizing and inviting tree-planting volunteer groups, etc.
5.Flood Plain Management Schemes	
(1) Community mobilization	Training for community leaders and creation of organizational bases at the community.
(2) Local coping measures	-Flood proofing by agricultural adjustment, strengthening building, etc. so as to reduce the risks of damage. -Establishmment of flood forecasting, warning and informing and evacuation systems -Flood fighting activities by community group to cope with attacking flood.
(3) Community-based sustainable measures	Promotion of such activities as community forest development, local bank protection works, access improvements, bed material collection, operation and maintenance of flood control structures and land use management.

Table B6.5.2 CONCEIVABLE IMPACTS OF CANDIDATE PROJECTS ON NATURAL ENVIRONMENT (1/2)

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

Table B6.5.2 CONCEIVABLE IMPACTS OF CANDIDATE PROJECTS ON NATURAL ENVIRONMENT (2/2)

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

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

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

Table B6.5.3 IMPACT MATRIX ON NATURAL ENVIRONMENT COMPONENTS

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

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

Table B6.5.4 CONCEIVABLE IMPACTS OF CANDIDATE PROJECTS ON NATURAL ENVIRONMENT AND MITIGATION／ENHANCEMENT MEASURES (1/2)

Environmental Components	*Conceivable Impacts*	*Mitigation/ Enhancement Measures*	*Impact Occurrence Stage*＊		
			P	***C***	***O/M***
Topography including Sedimentation	• Modification of topography (Tamalate floodway and dikes) by means of excavation and embankment. (-1) • Instability of ground along Tamalate floodway (-1) • Oppressive feeling near the dike (-1)	• Consideration of design, structure and materials of floodway and dikes. • Planting on dikes.	-	○	○
	• Reduction of sedimentation in the center of Lake Limboto (+2)	• Regular maintenance of sediment trap. • Dredging of sediment load when filled in the trap. • Assurance of restoration of devastated forest.	-	-	○
Soil Erosion	• Reduction of soil erosion at river banks (+1)	• Consideration of design for bank protection	-	-	○
	• Reduction of soil erosion in forest lands (+2)	• Implementation of effective afforestation and assurance of conservation of existing forest	-	-	○
Groundwater	• Lowering of groundwater along Tamalate floodway (-0)	• Adoption of proper excavation method during construction stage. • Consideration of route of floodway.	-	○	○
	• Improvement of water retention of uplands (+1)	• Adoption of effective restoration method of devastated forest lands. • Increase of project area for forest restoration.	-	-	○
Water Regime	• Reduction of flood peak and mitigation of flood risks (+2) • Stability of water level of Lake Limboto (+2)	• Consideration and analysis of water regime control at Tapodu gate • Consideration of effective design of river improvement • Adoption of effective restoration method of devastated forest lands.	-	-	○
Terrestrial Flora and Fauna	• Formation of forest area (Afforestation) (+1)	• Adoption of indigenous tree species for afforestation. • Adoption of effective restoration method of devastated forest lands.	-	-	○
	• Habitat creation by afforestation. (+1)	• Adoption of effective restoration method of devastated forest lands.	-	-	○

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

Table B6.5.4 CONCEIVABLE IMPACTS OF CANDIDATE PROJECTS ON NATURAL ENVIRONMENT AND MITIGATION／ENHANCEMENT MEASURES (2/2)

Environmental Components	*Conceivable Impacts*	*Mitigation/ Enhancement Measures*	*Impact Occurrence Stage*＊		
			P	***C***	***O/M***
Aquatic Ecology	• Habitat disturbance by turbid water flow caused by river improvement works and by construction of dikes and sediment traps. (-1)	• Consideration of timing of improvement works (e.g. avoiding rainy day). • Placement of sandbags for prevention of turbid flow generation.	-	○	-
	• Disconnection of ecological connectivity (lateral and longitudinal) (-1)	• Adoption of environmentally friendly design to produce habitat diversity (e.g. avoiding the construction of continuous concrete wall). • Equipment of bio-path (fishway) at weir	-	-	○
	• Stability of aquatic ecology in Lake Limboto (+2)	• Consideration and analysis of water regime control at Tapodu gate.	-	-	○
Protected Area	• No significant impacts.	-	-	-	-
Landscape	• Creation of new landscape. (±)	• Consideration of the design of river improvement, ring dikes and sediment traps, etc.	-	-	○
Air Quality	• Air pollution caused by heavy construction machinery and transportation vehicles. (-1)	• Keeping construction machinery and transportation vehicles in good condition. • Keeping traffic rules and regulations. • Consideration of transportation routes.	-	○	-
Water Quality	• Turbid water flow from construction sites.(-1)	• Consideration of timing of improvement works (e.g. avoiding rainy day). • Placement of sandbags for prevention of turbid flow generation.	-	○	-
	• Water pollution in Bone river through Tamalate floodway. (-1)	• Awareness building of protection of river improvement, e.g. stopping of garbage dumping in river channel.	-	-	○
Noise and Vibration	• Noise caused by heavy construction machinery and transportation vehicles. (-1)	• Establishment of preventive wall if necessary.	-	○	-
Soil contamination	• Soil contamination through dumping or usage of excavated soil, i.e. Tamalate floodway. (-0)	• Examination of excavated soil if necessary.	-	○	○
Land subsidence	• Land subsidence along Tamalate floodway through lowering of groundwater level. (-1)	• Adoption of proper excavation method during construction stage.	-	○	-

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

Table B6.5.5 CONCEIVABLE IMPACTS OF CANDIDATE PROJECTS ON SOCIAL ENVIRONMENT (1/3)

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

Table B6.5.5 CONCEIVABLE IMPACTS OF CANDIDATE PROJECTS ON SOCIAL ENVIRONMENT (2/3)

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

Table B6.5.5 CONCEIVABLE IMPACTS OF CANDIDATE PROJECTS ON SOCIAL ENVIRONMENT (3/3)

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

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

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

Table B6.5.6 IMPACT MATRIX ON SOCIAL ENVIRONMENT COMPONENTS

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

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

Table B6.5.7 CONCEIVABLE IMPACTS OF CANDIDATE PROJECTS ON SOCIAL ENVIRONMENT AND MITIGATION / ENHANCEMENT MEASURES

Environmental Components	*Conceivable Impacts*	*Mitigation/ Enhancement Measures*	*Impact Occurrence Stage**		
			P	***C***	***O/M***
Relocation of residence	• Opposition of local residents and conflict between local community and the government (-2)	• Proper application of government regulations for land acquisition • Consideration of cultural/ religious features • Appropriate communication between population and the government, for example, by organizing regular public meetings • Disclosure of relevant information on the project	○	○	-
	• Interruption of ongoing economic activities, such as rice culture and fishing (-2)	• Compensation in form of an equivalent land for the same activity or money • Careful selection of construction sites • Helping the person affected to find the same or equivalent occupation in the resettled place • Priority to employ the person affected as a worker in the project	○	○	-
	• Loss of land rights (-2)	• Compensation	○	-	-
	• Loss of person's properties (farming lands, houses) (-2)	• Appropriate compensation	○	-	-
	• Possible outbreak of health problem because of new living environment (-2)	• Careful selection of new settlement location	○	○	○
Livelihood	• Limitation of access to river/lake waters (-2)	• Consideration of dike design (for example constructing stairs and setting discharge duct)	-	○	○
Community split	• Interruption of existing traffic between riversides (±0)	• Construction of bridges or special crossing places	-	○	○
Disaster risks	• Mitigation of flood damage (+1)	• Enhancement of collaboration with other governmental agencies such as Forestry office and community organizations	-	-	○
	• Reduction of flood risks (+2)	• Enhancement of collaboration with other governmental agencies such as Forestry office and community organizations • Proper maintenance of the facilities	-	-	○
	• New flood risks along newly constructed dikes (±0)	• Consideration of dike design and its location	-	-	○
Public services & facilities/ Transportation	• Relocation of facilities (±0)	• Construction of new equivalent facilities and/or enhancement of existing facilities nearby	○	○	○
	• Difficult access to existing cultural facilities such as mosque, and to public facilities such as school and medical centre (-1)	• Consideration to easy access, for example, by constructing a bridge	○	○	○
	• Disturbance to actual traffic (-1)	• Provision of (temporary) alternative traffic way	○	○	-
	• Creation of new traffic (+1)	• Proper maintenance of dike roads	-	-	○
	• New settlement on sediment trap sites (±0)	• Limitation of access to the sites	-	-	○

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

Table B6.2.1 BENEFITS OF FLOOD MITIGATION PROJECT

Category of Damageable Assets and Activities					Damages Mitigated by FC Project
Benefits of Flood Mitigation	Direct Damages	Effects of Mitigating Damages to General Assets	Damages to General Assets	Building Unit	Damage to residential and business's buildings due to inundation
				Household Effects	Furniture and movables such as automobile, electric appliances
				Depreciable Assets of Business Establishments	Damage to depreciable assets of business establishments except their sites and buildings
				Inventory Stocks of Business Establishments	Damage to inventory stocks of business establishments due to inundation
				Depreciable Assets for Farming and Fishery	Damage to depreciable assets of farming or fishery in farmers or business establishments except their sites and buildings
				Inventory Stocks for Farming and Fishery	Damage to inventory stocks of farming or fishery in farmers or business establishments except their sites and buildings
			Damages to Agricultural Production		Damage to crop and fishery production
			Damages to Infrastructures	Road, Bridge, Railway, River Facility, Sewerage, Water Supply, Electric Power, Gas, Telephone, Park, Irrigation, etc.	Damage to infrastructures supporting livelihood, business activities and farming production
		Effects of Mitigating Damage to Human Lives			Damage to living space, causing casualties
	Indirect Damages	Effects of Mitigating Damages to Daily Activities	Damage to Daily Maintenance and Business Activities	Household Economy	Damage to daily housekeeping tasks and community activities due to inundation
				Industrial Production	Stoppage or decrease of business and production activities due to inundation
				Public Services	Stoppage or decrease of public services
		Effects of Mitigating Damages after Flood	Expenses for State of Emergency	Household Economy	After inundation, cleaning and repairing houses damaged by flood, and extra expenses for state of emergency
				Industrial Production	After inundation, cleaning and repairing buildings damaged by flood, and extra expenses for state of emergency
				Government's Activities	Expenses for emergency activities to casualties in addition to the works above
			Damage due to Traffic Disruption	Road, Railway, Port, Airport, etc.	Disruption of traffic systems such as road network, railway, etc., spreading to surrounding areas
			Damage due to Disruption of Lifeline Services	Water Supply, Electric Power, Gas, Telephone, etc.	Disruption of public utility services such as water supply, electricity, gas, etc., spreading to surrounding areas
			Damage due to Stoppage and Decrease of Daily Activities		Decrease of production due to lack of raw and semi finished materials, Stoppage of public services such as medical and utilities, spreading to surrounding areas
		Effects of Mitigating Mental Influence	Influence due to Damages Above		Mental influence due to damages to general assets, business losses, casualties, aftereffects, and influence over surrounding areas
Benefit from Sophisticated Environment					Land appreciation owing to improvement of flood control