SUMMARY

1. INTRODUCTION

101 Background of Study: Upon request of the Government of Indonesia, the Government of Japan had decided to conduct the Study on Flood Control and Water Management in Limboto-Bolango-Bone Basin (the Study). Japan International Cooperation Agency (JICA), who is responsible for implementation of the technical cooperation of the Government of Japan, entrusted the Study work to the joint venture of NIKKEN Consultants, Inc. and Nippon Koei Co., Ltd. (the Study Team). The Study was carried out for about 19 months from June 2001 to December 2002.

102 Objective of Study: The objectives of the Study are (1) to formulate a master plan of sustainable flood control and water management plan in Limboto-Bolango-Bone basin, (2) to conduct the feasibility study on the priority project(s), and (3) to transfer technology to counterpart personnel in the course of the Study. In the Study, flood control aspects are mainly discussed, and water management plan is studied only in relation with the flood control planning, since the water management master plan has already been established.

103 Study Area: The Study covers the areas in Limboto-Bolango-Bone (LBB) basin in Sulawesi Island. The LBB basin has a total catchment area of about 2700 km^2, consisting of the Lake Limboto basin (890 km^2), the Bolango river basin (490 km^2) and the Bone river basin (1,320 km^2). Administratively the LBB basin extends mostly in the south-eastern part of Gorontalo Province (2,400 km^2) covering 11 Kecamatan and small portion in the south-western part of North Sulawesi Province (300 km^2).

104 The Study: The Study was implemented in two phases, i.e., Phase-1 to formulate Flood Mitigation Master Plan (FM-MP) and select priority project(s), and Phase-2 to conduct Feasibility Study for the selected priority project(s). In the course of the Study, public consultation meetings were held three times in Gorontalo.

2. EXISTING CONDITIONS

201 Topography: The Bone River draining eastern half of the Study Area joins the Bolango River at the southern most of Gorontalo City and finally empties into the Tomini Bay. Basins of the Bolango River and tributaries of Lake Limboto share the western half of the Study Area and transport much sediment to the lower plain areas and finally to Lake Limboto.

202 Geology: Sulawesi appears to be formed by the collisions of two main crustal plates. Geology of the Study Area consists mainly of igneous, volcanic and sedimentary rocks of middle Tertiary to early Quaternary periods. Latest volcanic activities of early Quaternary formed the frame of the present topography in the Study Area. Unconsolidated deposits of gravels and sands are widely distributed in the lowland of the basin.

203 Climate and Monthly Rainfall: The climate of the LBB Basin is generally classified as humid tropical, having a tropical rainy climate with no definite dry period, with a temperature exceeding 18℃ in the coolest month. Rainfall in the Study Area is typical of bimodal peaks. The mean annual rainfall is 1,286 mm/yr at Boidu/ Lomaya weir of the Bolango River ranging from 2,249 mm in 1997 to 471 mm in 1972. Maximum monthly rainfall at Jalaludin appears in May (165 mm) with a secondary

peak in November (138 mm). The dry month with monthly rainfall less than 100 mm extends from July to October. February is also a dry month. The monthly runoff distribution is almost similar to the rainfall distribution with peaks occurring in May/June with a secondary peak in January.

204 Lake Limboto Basin: The Lake Limboto basin has a total basin area of 890 km^2 located in the western half of the LBB basin. Its major tributaries are the Biyonga River (66 km^2), the Meluopo River (27 km^2), the Marisa River (64 km^2), and the Alo-Pohu River (466 km^2) consisting of the Alo River (342 km^2) and Pohu River (124 km^2).

205 Bone-Bolango River Basin: The Bone River originates at the eastern mountain of the LBB basin. The Bone River, passing the Alale weir (1,060 km^2) at the outlet of the mountainous basin, runs further toward west in the south of Gorontalo City and joins the Tamalate and Bolango rivers. At its confluence with the Bolango River, the Bone River changes direction southwards and finally discharges into the Tomini Bay. Basin area of the Bone River is 1,320 km^2 at river mouth. Total basin area including the Bolango River basin amounts to 2,700 km^2. The Bolango River, passing through Lomaya weir (388 km^2) at the outlet of the mountainous areas, flows down in the west of Gorontalo City. After joining the Tapodu River, outlet channel of Lake Limboto, it changes the direction toward east and empties into the Bone River at about 1 km upstream from the sea. Basin area is 490 km^2 at Bone confluence. If Lake Limboto basin is included the area amount to 1,380 km^2 in total.

206 Land Use: Land use study by SPOT satellite images, the LBB basin consists of forest land (60%), bush land (10%), farmland (23%), and others (7% in total for grass, settlement and other lands). During the past 10 years, 54 km^2 of bush lands and 21 km^2 of forest lands were converted to farmland.

207 Natural Environment: The geological history of Sulawesi makes the flora and fauna unique with one of the highest levels of species endemism in the world. The plain basin subject to flood mitigation project, however, has already been developed and no precious species are found any more. Organic contamination is progressing in Lake Limboto and lower reaches of the Bolango, Tamalate and Bone rivers.

208 Present Social Conditions: The peoples of the Study Area are originally from the ethnic group of Gorontalo, There are also small villages implanted by government sponsored migrations from Bali and Jawa islands. Indonesian language is widely spoken in Gorontalo Province, but the Gorontalo people speak also their distinct language. Islam is the dominant religion in the area. Muslim is the majority (98.1% of the population) and among the minorities there are Christian (1.6%) and Hindu & Buddhist (0.4%).

209 Administrative Subordinate: The LBB Basin has an area of about 2,700 km^2 in total, in which located are Kabupaten Gorontalo and Kota Gorontalo of Gorontalo Province, and Kabupaten Bolaang-Mongondow of North Sulawesi Province. Most of the developed area of the LBB basin is in the Kabupaten and Kota Gorontalo.

210 Population: According to census data in 2000, population in the LBB Basin was estimated at 445,000. The average growth rate during the 1990's was 1.29% per annum. Kota Gorontalo is the largest town in the basin, and functions as the center of the basin and Gorontalo Province as well. Its census population was 135,000. Urban population in the LBB Basin was estimated at 205,000, comprising 120,000 in Kota Gorontalo and 85,000 in Kabupaten Gorontalo. It accounted for 46% of the basin population.

211 Regional Accounts: Representing regional account of the LBB Basin, per capita gross regional domestic products (GRDP) of Kabupaten Gorontalo and Kota Gorontalo were estimated at Rp.1,160,000 and Rp.2,388,000 (equivalent to US$122 and US$251) respectively in 2000, which are only 18% and 38% of the national average (Rp.6,344,000). The economy of the Kabupaten is said to specialize in agricultural production. On the other hand, the Kota specializes in services in particular.

212 Public Finance: According to the budget base data of the national government, the total amount for the water resources and irrigation sub-sector including flood control rose from Rp.2.0 trillion in 1995/96 to Rp.3.5 trillion in 1999/2000. In North Sulawesi Province, the national government invested Rp.666 billion for development projects in the fiscal year 1999/2000. Of this total, Rp.121 billion (18%) was allotted to public work projects including Rp.46 billion (7%) for water resources development projects. For the recent 4 years, the development expenditure for flood control varied from Rp.3.9 billion to Rp.7.8 billion. As to the LBB basin, it is estimated at around Rp.1.15 to 2.73 billion.

213 Agencies for Water Resources Sector: Ministry of Settlement and Regional Infrastructure is the authority in public work sector. The water resources are administrated in the Directorate General of Water Resources (DGWR) of the Ministry. Dinas PU/Kimpraswil, Dinas PU-Praswil and Dinas PU were established in Province, Kabupaten and Kota Gorontalo, respectively, as their public work agencies. Dinas carries out the water resources administration through its Sub-Dinas. Agencies mentioned above are still in transition stages adjusting toward the decentralization administration and the establishment of new province.

214 PTPA and PPTPA: Water and water resources management at the provincial level are coordinated by Governor, establishing Panitia Tata Pengaturan Air (PTPA: Province Water Resources Management Committee). Coordination at the river-basin level is implemented by Panitia Pelaksana Tata Pengaturan Air (PPTPA: River Basin Water Resources Management Committee). The PPTPA can be established by the Governor. Since Gorontalo is a new province the PTPA is not established yet. The members of the PTPA consist of Vice Governor as chairman, representatives of water related government agencies, university, NGO and other organizations.

215 Progress of Establishment of Gorontalo Province: The establishment of Gorontalo Province was agreed by Central Government with the Law No. 38/2000. The Provincial Governor was appointed by the Central Government. The organization and working order of Gorontalo Province including Dinas were established and the member of Provincial Parliament was formed. New Governor was elected by the Parliament. New setup of the province is progressing and the region seems to be activated rapidly.

216 WATSAL: Coping with financial deficit, the Government of Indonesia prepared a structural adjustment program for the water resources and irrigation sector in 1999. The program was supported by the World Bank with Water Resources Sector Adjustment Loan (WATSAL) financed by Asian Development Bank (ADB) and Japan Bank for International Cooperation (JBIC). The present Study has strong concern with the outcomes of the WATSAL program, because all the activities related to the water resources should follow them. Among others, major concerns of the Study are decentralizing water resources management and establishing integrated water resources organization (Balai PSDA) in the provincial level.

217 Progress of Decentralization System in Water Resources Sector: Administration

system is changing from the centralization to decentralization system. Legislative arrangements for the new system are now carrying out in central government and then in local governments. Under the decentralization system, all the authorities regarding the water resources are transferred to local government (Kabupaten/Kota). In order to cope with new jobs, Kabupaten and Kota Gorontalo established Dinas and Sub-Dinas related to the water resources sector. However, the procurement of qualified staff and capacity building still need time.

3. BASIC STUDIES

301 Field Surveys: For the study on flood mitigation master plan, field surveys and investigations were carried out, for such as topography (including aerial photo), geology, water quality and bottom sediment, riverbed materials, and land use.

302 Runoff/Flood Flow Analyses: In order to simulate flooding and inundation in the Study Area, runoff and flood flow analyses were carried out. Channel model and flood plain model are incorporated in the flood flow model. Flood flows were analyzed for various probable floods.

303 River Channel Study: Based on the latest survey results, channel capacities of the rivers in the western plain area of Lake Limboto are low as a whole, while the Bone and Biyonga rivers have relatively high capacities. According to harmonic analysis of tides, tidal variation in the river mouth of the Bone River is from +0.767 to –0.620 m,MSL. Influence of the tidal variation is limited only up to 2 km from the river mouth, chiefly due to the relatively steep channel slopes of the Bone and Bolango rivers.

304 Sediment Transport Capacity: According to the sediment transport analysis of the existing river, the Biyonga, Meluopo and Alo-Pohu rivers are the main sources of sediment in the Lake Limboto basin, though the share of the Biyonga River is by far much. In the Bone-Bolango river basin, the Bolango River shares 62% of total sediment and the Bone River 38%. The Lake Limboto basin (890 km^2) transports 1.3 times more sediment than that of the Bone-Bolango river basin (1,810 km^2).

305 Sedimentation of Lake Limboto: According to the estimates based on historical data of the lake areas and corresponding maximum water depths from 1952 to 1983 and the sounding survey data in 1996 and 2001, the annual sedimentation rate of Lake Limboto was estimated to be around 1 to 2 MCM/year.

306 Design Water Levels of Lake Limboto: Design water levels of Lake Limboto was studied based on the past water level records, lake water use, topography and land use, and flood water retention, and proposed as (1) lowest lake water level at +4.00 m,MSL for better and stable fish production, and (2) highest lake water level at +5.50 m,MSL; for flood mitigation in lake side areas especially in the western area of the lake.

4. STUDY ON FLOOD MITIGATION MASTER PLAN (FM-MP)

401 Flood and Sediment Disasters: Major areas suffering from flood and sediment disasters in the Study Area are southern part of Gorontalo City, middle reaches of the Bolango River, Limboto and Isimu-Pohu areas, and western area of Lake Limboto. Among these, problems are more serious in the southern part of Gorontalo City near the confluence of the Bolango and Bone rivers.

402 Causes of Flood and Sediment Disasters: Flood and sediment disasters are induced basically by (1) devastation of watershed, (2) concentration of properties on narrow plain, (3) insufficient flood mitigation facilities, and (4) inappropriate land use in flood plain. These problems are associated with financial constraint, shortage of engineers, and lack of comprehensive flood mitigation master plan to direct all the relevant activities.

403 Principles for Planning FM-MP: Flood mitigation master plan (FM-MP) for the LBB basin was studied along the following principles:

1) Objective of Master Plan: The FM-MP aims to direct or guide the flood mitigation activities that will be conducted toward the target year by various agencies and organizations concerned.
2) Scope of Planning: Flood mitigation, in the present study, includes the mitigation of flood damages and sediment induced disasters. The structural measures discussed in the master plan are limited to the primary facilities to mitigate flood and sediment damages of the area.
3) Target Year: In line with the phasing of National Five-Year Plan, target year of the FM-MP was set at the end of Tenth Five-Year Plan in 2019.
4) Design Scale: Facilities for the FM-MP are planned and designed based on 20-year flood.

404 Structural Measures Adopted: Adopting river improvement as a fundamental scheme, other alternative schemes such as floodways, flood control dams, and lake management were studied in comparison. By these measures, effects of flood mitigation will be realized soon, but continuous maintenance activities are required. The following measures were adopted for the FM-MP:

1) **River improvement schemes:** Existing channels of the Bone, Tamalate and Bolango rivers of the Bolango-Bone river system; and the Biyonga, Meluopo, Marisa, Alo-Pohu and Rintenga rivers of the Lake Limboto system are improved so as to have enough capacity to carry flood water of 20 year return period. The river improvement includes the works for channel excavation, dike embankment, bank protection, and drainage sluice across the dike.
2) **Floodway schemes:** Tamalate floodway was proposed to divert all the flood runoff of the upper basin to the Bone River. The lower Tamalate shall serve as a trunk drainage channel of Gorontalo City.
3) **Lake Limboto management scheme:** In order to conserve the flood mitigation function of the lake for the sound development of lake side area and other existing functions of the lake, Lake Limboto management scheme was proposed with (1) construction of lake dikes, (2) Tapodu River improvement with gate, and (3) construction sediment traps.

405 Non-Structural Measures Adopted: Besides the structural measures, (1) watershed management and (2) flood-plain management were also proposed for the FM-MP. The watershed management aims to promote activities undertaken by the relevant agencies and community people for floodwater and sediment retention in the watershed areas. These activities may takes time, but steadily strengthen the basin against flood. The flood-plain management aims to guide and support self-help activities of the community people in the flood-prone areas and reduce substantial damages due to floods.

406 Project Costs: The project cost for structural measures of the FM-MP was estimated at Rp.555.0 billion (US$57.81 million or ¥7,169 million equivalent) in total, consisting of Rp.362.0 billion as direct cost, Rp.66.9 billion as land acquisition and

compensation cost, and Rp.126.2 billion as indirect cost including administration, engineering and physical contingency, at the fixed price as of November 2001 assuming exchange rate of currencies US$1.00 = Rp.9,600 = ¥124.4. Estimated costs by sub-projects are as follows:

Sub-projects	Cost (Rp. billion)
1) Bone River Improvement	75.0
2) Tamalate River Improvement with Floodway	189.5
3) Bolango River Improvement	44.5
4) Biyonga River Improvement	30.2
5) Meluopo River Improvement	15.3
6) Marisa River Improvement	23.7
7) Alo-Pohu River Improvement	109.0
8) Rintenga River Improvemnet	23.9
9) Lake Limboto Management	43.9
Total	555.0

407 Implementation of FM-MP: The FM-MP is proposed to support the socio-economic conditions at the target year 2019. In order to carry out the works effectively in orderly manner toward the target year, stage-wise implementation was proposed as follows:

1) **Preparatory stage** (until end of 2004): Various preparatory works and activities shall be performed for forthcoming full-scale implementation. The works may include feasibility study, fund arrangement, definite plan/detail design, preservation of lands, research and investigation, and coordination with relevant agencies and communities. The non-structural activities such as dissemination activities and community mobilization for watershed and flood plain management shall also be started from this stage.
2) **Intensive implementation stage** (from beginning of 2005 to end of 2009): Actual construction works will start at site. The projects in this stage must be the priority projects which are expected to yield higher outcome. With the intensive implementation, it is expected the flood mitigation activities in the basin will be stimulated and relevant personnel and administration will be trained and adjusted toward effective implementation of the FM-MP.
3) **Sustainable implementation stage** (from beginning of 2010 to end of 2019): The remaining sub-projects will be carried out in sustainable manner in parallel with the watershed management and flood plain management. With completion of these sub-projects, basic flood mitigation facilities in the LBB basin will be enhanced high enough to the 20-year flood.

408 Economic Viability: Flood damage reduction benefit accruing from the implementation of the structural measures was compared with the economic cost to be invested. The analysis endorsed the economic viability of the project under future socio-economic conditions as follows:

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

Note: *: Discounted at 12%

409 Financial Aspects: A study on financial sources based on the past trend of public expenditure of the national government resulted in disclosing financial deficit of the project fund. It is substantial to implement the plan mobilizing communities in

participatory manners from self-support standpoint to cope with flood and sediment disasters. In addition, external inputs are also deemed necessary to activate flood mitigation activities in the basin and to lead economic circle toward upward trend.

410 IEE for Natural and Social Environment: Although the component projects of the FM-MP may bring negative impacts on natural and social environment in a short run, most of such impacts are able to be mitigated by careful design and implementation. On the contrary, the plan is considered to extend favorable impact to natural environment stabilizing the water regime. In terms of social environment, the FM-MP is valid as a whole provided that non-structural and structural measures are implemented in a harmonic and strategic manner.

411 Overall Evaluation: The FM-MP is evaluated economically viable. The plan is evaluated to be valid from the viewpoints of natural and social environment too. 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.

412 Selection of Priority Projects: The following projects were proposed for the intensive implementation as priority projects:

1) River Improvement of the Lower Bone and Lower Bolango rivers
2) Tapodu River Improvement with Tapodu Gate
3) Construction of Tamalate Floodway
4) Sediment Trap Works in Lake Limboto

Implementation of these projects are expected to play vital roles for (1) flood mitigation in urban area of Gorontalo City, (2) water level control of Lake Limboto and the quick drainage of retained water, and (3) alleviation of sedimentation problems of Lake Limboto.

5. FEASIBILITY STUDY FOR PRIORITY PROJECTS

501 Field Survey: Focusing on the priority project sites, field survey were conducted for (1) detailed river survey and topographic mapping and (2) geological investigation. Besides, a study on environmental impact assessment (EIA) for the priority project was carried out in succession to the initial environmental examination (IEE) carried out in the Master Plan study stage.

502 Existing River Facilities: Detailed field survey on the existing river facilities was conducted for the Bolango River from the confluence of the Bone River to the confluence of the Tapodu River. The dike is provided with the Bolango River in the upper suburban area, while in the lower reaches located in Gorontalo City, dikes were not provided. The dike system in the upper reaches may concentrate floodwater to the lower urban area. Implementation of measures in the lower reaches is required soon.

503 Existing Channel Capacity: According to the result of study based on the latest river survey, the Bolango River has capacity of about 100 m^3/s in the lower reaches of the confluence of left and right Bolango rivers. In this stretch, the riverine areas are suffering from floods both from the Bolango and the Bone rivers. The left and right Bolango rivers have capacities of about 75 m^3/s each or 150 m^3/s in total. In the upstream from the divergence of the left and right Bolango, existing channel has capacity of about 200 m^3/s confined by dikes.

504 Control of Bolango Flood by Lake Limboto: In the FM-MP, flood control by Lake Limboto was not incorporated considering the existing sedimentation issues of the lake. The plan, however, was revised considering the difficulty in land acquisition in the lower urban areas and effective usage of the existing facilities. Considering existing channel capacity and minimizing houses to be relocated, design discharge of the Lower Bolango River was decided to be 200 m^3/s based on 20-year flood, and the remaining 550 m^3/s shall be controlled by Lake Limboto. The flood storage calculation confirmed that the lake water level can be kept below +5.50 m,MSL receiving the flood discharge from the Bolango River.

505 Bone-Bolango River Improvement Project: Excavation in the Bone estuary was not planned, since the bed would be buried again soon because of thick sediment cover. Tenda cutoff channel is constructed at the sharp bend near the confluence of the left and right Bolango rivers, to prevent flooding and ensure smooth floodwater passage around the meandering reaches. The right Bolango River is improved as main flood channel by channel excavation and normalization for 125 m^3/s, while the left Bolango River which passes through city center is subject to minor improvement for 75 m^3/s. The Bolango River upstream from the divergence of the left and right Bolango is subject to channel excavation. In the downstream reaches of the divergence dikes are constructed, and in the upstream reaches the existing dikes are strengthened. Bank protection works were planned at the critical banks for the whole reaches.

506 Tapodu River Improvement with Gate: Main function of the Tapodu River is to lead floodwater from the Bolango River, and to drain it quickly after the flood. The Tapodu River is partly improved with new alignment keeping away from the settlement areas. A control gate is constructed across the Tapodu River near the confluence with the Bolango River. The gate has a function mainly to maintain lake water level. Dikes are constructed on both banks of the Tapodu River to protect surrounding lakeside areas from the Bolango floodwater using excavated earth from the channel. As to the lake water level, the influence of the Bolango flood is slight. Lake water level varies mainly due to the runoffs from its own tributary. On the other hand, the Tapodu River improvement contributes much to the lakeside farmlands, lowering the peak water level and shortening the duration of inundation. The existing north and south Tapodu channels will serve for water supply, fish way and drainage in the areas protected by dikes, providing sluice gates at the heads and tails of the channels.

507 Tamalate Floodway: The Tamalate River, which comes from the mountainous basin in the north-east of Gorontalo City, is one of the major causes of inundation of Gorontalo City. The Tamalate floodway aims to divert whole runoff (120 m^3/s) of the upper basin to the Bone River before flowing down to the urban area. The proposed floodway takes route away from settlements and connect two rivers in short distance. The bed slope is 1/1000 which is almost same slope as the upper Tamalate. At the divergence, diversion weir with no operation device is installed. Although the existing Tamalate River is closed for floods at the divergence, a sluice gate is installed for water supply during ordinary time for domestic use and river maintenance.

508 Sediment Trap Works in Lake Limboto: The sediment trap works aims to guide and trap the sediment in the northern part of the lake. The work is proposed as research works to measure lake sedimentation and as test works to develop usage of lake sediment. Realignment of the river mouths of the Biyonga and Alo-Pohu rivers and construction of bamboo-net fence with crest elevation of +4.00 m,MSL are the major project works. As to the usage of lake sediment, reclamation of near-by low-lying lands and exploitation of construction materials could be considered.

509 Non-Structural Approaches: Besides the structural measures mentioned above,

watershed management and flood-plain management shall be implemented in order to materialize invulnerable basin and communities against floods. Activity for the watershed and flood-plain management should be executed constantly and continuously as a routine activity for flood mitigation, not as a project. The activities including were scheduled to start from the preparatory stage. It would be practical to start the activities in some selected villages as pilot areas in the first year, and then expand the areas and activity gradually. It is also advisable to conduct the activities in collaboration with the community-based NGOs acting among the community people and the government agencies.

1) **Watershed Management:** Sedimentation problem of Lake Limboto is serious and watershed management is indispensable. The agencies in charge of flood mitigation should encourage (1) construction of sediment control facilities, and (2) afforestation and land use regulation, in collaboration with the relevant agencies and communities. For this purpose, (3) dissemination activities should be conducted as well.
2) **Flood-Plain Management:** This program aims to complement vulnerability of the local communities in the flood-prone area. For this purpose, local community organization should be first established as a basis of flood mitigation activities in the community. Then, the local coping measures such as (1) flood proofing; (2) flood forecasting, warning and evacuation, (3) flood fighting, and (4) community-based flood mitigation measures should be carried out. The agencies in charge of flood mitigation should guide and promote these self-help activities by the community people, so that they can participate in the activities with incentive.

510 Project Implementation: The priority projects shall be implemented during the intensive implementation stage (2005-2009) as follows:

1) Preparatory Period : 2003-2004
2) Land and Compensation : 2004-2008
3) Construction
   - Bone-Bolango River Improvement Project : 2005-2007
   - Tapodu River Improvement Project with Gate : 2005-2007
   - Tamalate Floodway Project : 2007-2009
   - Sediment Trap Works in Lake Limboto : 2005-2006
4) Non-structural Measures : Continuously from 2003

511 Project Cost and Fund Required: The project cost required for the implementation of the structural components of the priority projects was estimated at Rp.143.7 billion (US$14.96 million or ¥1,856 million) in total, consisting of Rp.110.0 billion as direct cost, Rp.3.9 billion as land acquisition and compensation cost and Rp.29.8 billion as indirect cost including administration, engineering and physical contingency, at the fixed price as of November 2001 assuming exchange rate of currencies US$1,00=RP.9,600=¥124.4. The estimated costs by sub-projects are as follows:

Sub-projects	Cost (Rp. billion)
1) Bone-Bolango-Tapodu River Improvement	120.2
2) Tamalate Floodway	20.8
3) Sediment Trap Works in Lake Limboto	2.7
Total	143.7

The fund required for implementation of works was estimated at Rp.179.4 billion (US$18.69 million or ¥2,318 million), considering price contingency until and during the construction period.

512 Economic Evaluation of Priority Project: Bone-Bolango-Tapodu (BBT) River Improvement Project and Tamalate Floodway Project, were subject to economic evaluation. Flood reduction benefit accruing from project implementation was compared with economic values invested. Under the future socio-economic conditions, these projects were evaluated to be viable economically as shown below. Sediment trap works in Lake Limboto are the test woks and were not subject to the economic evaluation. Economic evaluation on the non-structural measures was not made, since they are a part of river management to be performed as routine works of the agencies in charge of flood mitigation.

Indices	BBT R. Imp		Tamalate FW		Whole projects	
	Present	Future	Present	Future	Present	Future
EIRR(%)	8.3	17.0	6.3	16.2	8.1	16.9
B/C*	0.71	1.54	0.55	1.44	0.69	1.53
NPV*	-21.5	39.4	-5.8	5.7	26	44

(Note) *: Social discount rate 12% was applied; NPV: in Rp. billion

The sensitivity analysis confirmed that even for 10% of cost over-run and 10% of benefit-shortage the EIRR was above the social discount rate of 12%.

513 EIA of Priority Project: Study for environmental impact assessment (EIA study) was conducted. Based on the EIA study, environmental management plan and environmental monitoring plan were prepared. The negative impact of the Priority Projects is slight, since the considerations have been given on the identified impacts in the facility plan, and in the environmental management and the monitoring plans. The major impacts identified are public nuisance due to construction and land acquisition. In conclusion, the priority project was evaluated to be valid for natural and social environment. The EIA Evaluation Committee of Gorontalo Province has already issued a written approval on the EIA.

6. CONCLUSION AND RECOMMENDATIONS

601 Conclusion: The Priority Project (the Project) was evaluated to be technically feasible and economically viable. The negative impacts to the environment can be mitigated giving consideration in planning project facilities and environmental management and monitoring plans. The EIA Evaluation Committee of Gorontalo Province has already issued a written approval on the EIA.

602 Recommendations

1) The Project aims to mitigate flood damages in the most important areas of the new-born Gorontalo Province including its capital city. The Project contributes directly to enhance peoples' livelihood in the flood-prone areas. The Project is a core infrastructure to support economic development of the province. In addition, the implementation of the Project is significant to the capacity building of the relevant staff and to the arrangement of the administrative setup as well. Implementation of the Project at an early stage is recommended.

2) Considering the required fund and the budget available currently, assistance and support in and out of the province would be inevitable for the implementation of the Project. It is desirable that Gorontalo Province makes haste the administrative decision toward the implementation the Project in association with Kabupaten Gorontalo and Kota Gorontalo, so as to initiate preparatory actions for funding and

coordination among the agencies concerned.

3) The Bolango River Improvement heavily depends on the storage function of the Lake Limboto, while the lake is now troubled with serious sedimentation primarily caused by deforestation in the watershed area. It is recommended to take actions as early as possible for the watershed management to conduct afforestation and regulation of deforestation, giving considerations on the enhancement of livelihood of resident peoples in watershed area.

4) The Project was evaluated to be valid from natural and social environment aspects. The evaluation is yes, provided that (1) the watershed management would be carried out strictly, and (2) management and monitoring regarding the water environment of Lake Limboto would be conducted appropriately in sustainable manner.

(End of Summary)

THE STUDY ON FLOOD CONTROL AND WATER MANAGEMENT
IN
LIMBOTO-BOLANGO-BONE BASIN

FINAL REPORT
VOLUME-II MAIN REPORT

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GLOSSARY

(ENGLISH ABBREVIATION)

ADB	Badan Pembangunan Asia	Asian Development Bank
ASTM		American Standards for Testing Materials
BCR, B/C	Rasio Harga dan Keuntungan	Benefit Cost Ratio
BOD		Biochemical Oxygen Demand
CEA	Badan Pelaksana Kanada	Canadian Executing Agency
CIDA	Badan Penyandang Dana Kanada	Canadian International Development Agency
COD		Chemical Oxygen Demand
DD, D/D	Disain Teknis/Rencana Teknis	Detailed Design
DGWR	Direktorat Jenderal Sumber Daya Air	Directorate General of Water Resources
DGWRD	Direktorat Jenderal Pengairan	Dir. General of Water Resources Development
DO		Dissolved Oxygen
EIA	Analisa/Penelitian Lingkungan	Environmental Impact Assessment
EIRR	Tingkat Pengembalian Modal Internal Ekonomi	Economic Internal Rate of Return
FAO	Organisasi Pangan Dunia	Food and Agriculture Organization of the United Nations.
FS, F/S	Studi Kelayakan	Feasibility Study
FY	Tahun Anggaran	Fiscal Year
GDP	Produk Domestik Bruto	Gross Domestic Product
GIS	Sistem Informasi Geografi	Geographical Information System
GOI	Pemerintah Indonesia	Government of Indonesia
GPS	Penentuan Posisi Global	Global Positioning System
GRDP	Produk Domestik regional Bruto	Gross Regional Domestic Product
IBRD	Bank Dunia	International Bank for Reconstruction and Development (World Bank)
IEE		Initial Environmental Examination

JBIC		Japan Bank for International Cooperation (Former OECF)
JICA		Japan International Cooperation Agency
LAN	Jaringan Komputer Lokal	Local Area Network (Computer)
MCM	Juta Meter Kubik	Million Cubic Meters
MP, M/P	Rencana Induk	Master Plan
MSL	Tinggi Muka Air Laut Rata-rata	Mean Sea Level
NGO	Lembaga Swadaya Masyarakat	Non-Governmental Organization
NPV	Nilai Sekarang Neto	Net Present Value
O&M	Operasi dan Pemeliharaan	Operations and Maintenance
OECF	Badan Penyandang Dana Jepang	Overseas Economic Cooperation Fund (Japan), Now reorganized JBIC
OJT	Latihan di Lapangan	On-the-Job Training
PCM	Pertemuan Konsultasi Masyarakat	Public Consultation Meeting
R	Sungai	River
S/W		Scope of Works
TIU	Unit Pelaksana Teknis Dinas	Technical Implementation Unit
UNESCO	Badan Pendidikan, Ilmu Pengetahuan dan Kebudayaan, P.B.B	United Nations Educational, Scientific, and Cultural Organization
USAID	Badan Penyandang Dana Amerika Serikat	United States Agency for International Development
VAT		Value Added Tax
WATSAL	Wanita dalam Pembangunan	Water Sector Adjustment Loan
WID	Pengembangan Sumber Daya Air	Women in Development
WUA	Federasi Petani Pemakai Air	Water Users Association

(INDONESIAN ABBREVIATION)

AMDAL	Analisis mengenai Dampak Lingkungan	Environmental Impact Analysis
ANDAL	Analisis Dampak Lingkingan	Environment Impact Statement
APBD	Anggaran Pendapatan dan Belanja Daerah	Regional Income and Expenditure
APBN	Anggaran Pendapatan dan Belanja Nasional	National Income and Expenditure
Ass.	Asisten	Assistant
BAKORNAS PBP	Badan Koordinasi Nasional Penanggulangan Bencana dan Penanganan Pengungsian	National Coordination Board of Disaster and Evacuation
BAPEDAL	Badan Pengendali Dampak Lingkungan	Environmental Impact Management Board
BAPEDALDA	Badan Pengendali Dampak Lingkungan Daerah	Regional Environmental Impact Management Agency
Bappeda	Badan Perencanaan Pembangunan Daerah	Provincial Development Planning Board
Bappenas	Badan Perencanaan Pembangunan National	National Development Planning Board
Binlak	Pembinaan & Pelaksanaan	Construction Management
BMG	Badan Meteorologi dan Geofisika	Meteorological and Geophysical Institute
BPS	Badan Pusat Statistik	National Statistics Office
Bupati	Kepala Daerah Tingkat II/Kabupaten	Head of District (Regency)
CD, Cabdin	Cabang Dinas	Branch of Dinas
DATI I	Daerah Tingkat I	Regional Level I (Province)
DATI II	Daerah Tingkat II	Regional Level II (District)
DI	Daerah Irigasi	Irrigation Schemes
DinasPU, DPU	Dinas Pekerjaan Umum	Public Works Services
DIP	Daftar Isian Proyek	List of Project Budget
DPR	Dewan Perwakilan Rakyat	National Parliament
DPRD	Dewan Perwakilan Rakyat Daerah	Regional Parliament
DPU	Departemen Pekerjaan Umum	Ministry of Public Works

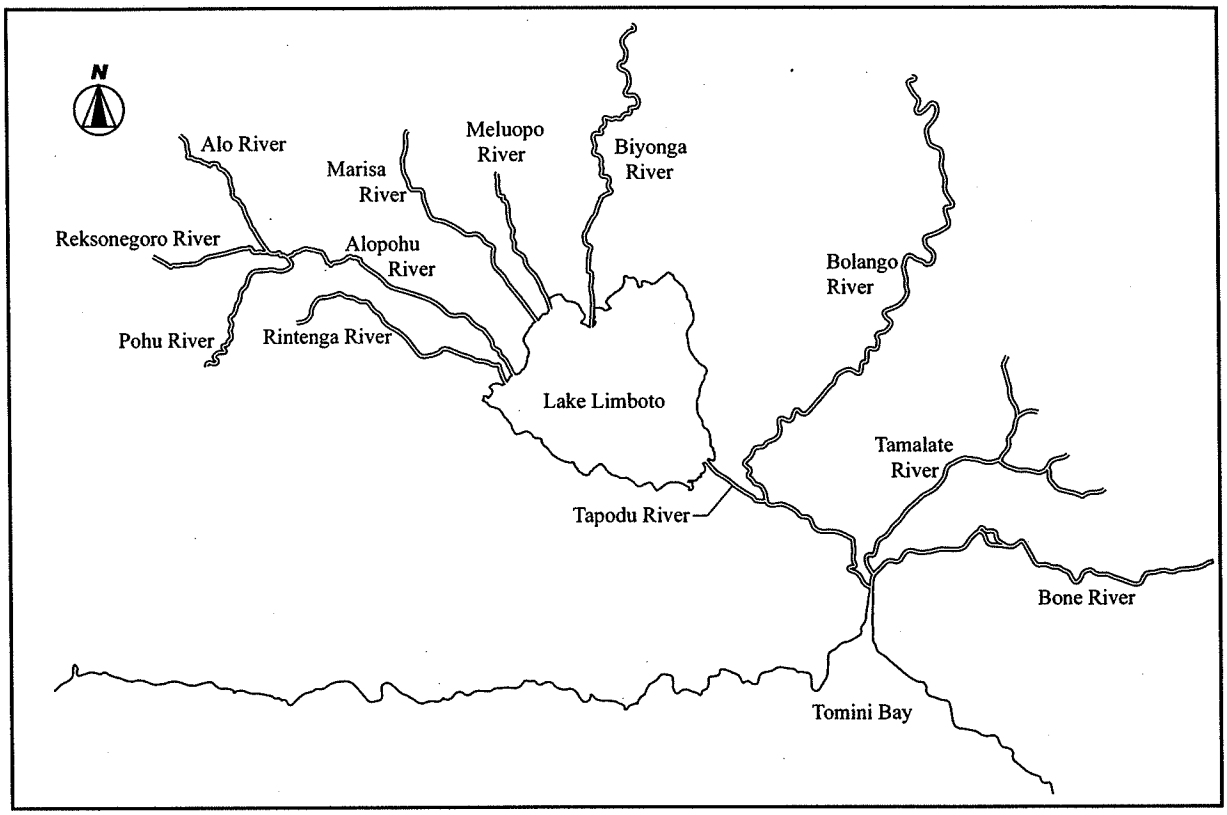
DPUP	Dinas Pekerjaan Umum Propinsi	Provincial Public Works Services
DTP	Dinas Tanaman Pangan	Office of Food Crops
Kanwil	Kantor Wilayah	Regional Office (of a Department)
Kaur	Kepala Urusan	Head of Sub Section
KDH	Kepala Daerah	Head of Regional Government
KDPP	Kepala Daerah Pengamatan Pengairan	Head of Water Resources Sub District
Kepmen	Keputusan Menteri	Minister's Decree
Keppres	Keputusan Presiden	Presidential Decree
KIMPRASWIL	Departemen Permukiman dan Prasarana Wilayah	Ministry of Settlement and Regional Infrastructure (MSRI)
KSDP	Kepala Sub Dinas Pengairan	Head of Provincial Water Resources Service
KTL	Kegiatan Tindak Lanjut	Follow-up Activity
KUD	Koperasi Unit Desa	Village Cooperative Unit
LBB	Limboto-Bolango-Bone	Limboto-Bolango-Bone
LSM	Lembaga Swadaya Masyarakat	Non-Governmental Organization
MONEV	Monitoring & Evaluasi	Monitoring & Evaluation
O&P	Operasi dan Pemeliharaan	Operations and Maintenance
P3A	Perkumpulan Petani Pemakai Air	Water Users' Association (WUA)
P3SU	Proyek Pembinaan Pengairan Sulawesi Utara	North Sulawesi Water Resources Institutional Development Project
PDAM	Perusahaan Daerah Air Minum	Regional Water Company
PDSA	Pengumpulan Data Sumber Air	Water Resources Data Collection
PEMDA	Pemerintah Daerah	Regional Government
PERDA	Peraturan Daerah	Regional Regulation
Pimpro	Pemimpin Proyek	Project Manager
Pinbagpro	Pemimpin Bagian Proyek	Sub Project Manager
PJP	Program Jangka Panjang	Long Term National Dev. Program
PLN	Perusahaan Listrik Negara	State Electricity Company
PPTPA	Panitia Pelaksanaan Tata Pengaturan Air	Basin Water Management Committee

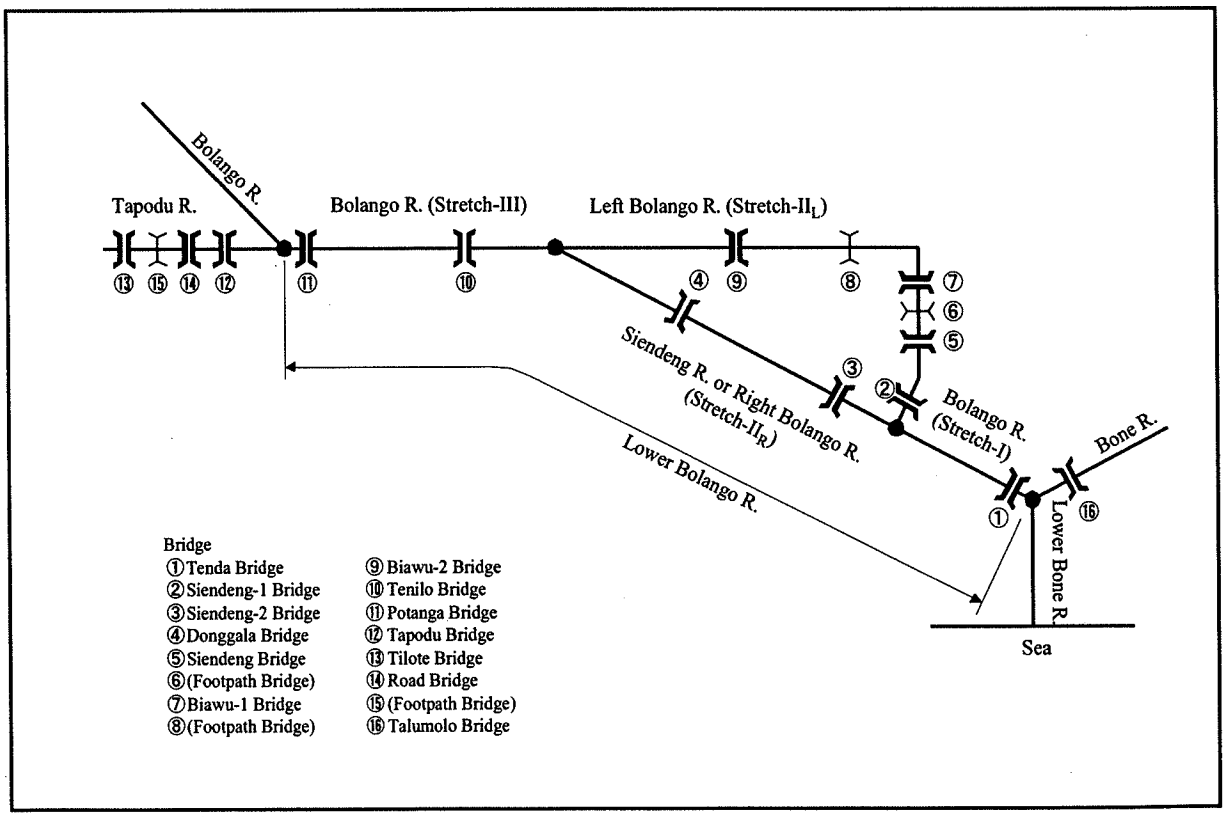
PSDA	Pengamanan Sumber Daya Air	Water Resources Conservation
PTPA	Panitia Tata Pengaturan Air	Provincial Water Resources Committee
PU	Pekerjaan Umum	Public Works
Puslitbang	Pusat Penelitian dan Pengembangan Pengairan PU	Institute of Hydraulic Engineering Center (Bandung)
PWS	Pengembangan Wilayah Sungai	River Basin Development
RKL	Rencana Pengelolaan Lingkungan	Environmental Management Plan
RPL	Rencana Pemantauan Lingkungan	Environmental Monitoring Plan
SATKORLAK PBP	Satuan Koordinasi Pelaksanaan Penanggulangan Bencana dan Penanganan Pengungsian	Implementation Coordination Unit of Disaster Mitigation and Evacuation
SATLAK PBP	Satuan Pelaksanaan Penanggulangan Bencana dan Penanganan Pengungsian	Implementation Unit of Disaster Mitigation and Evacuation
SDA	Sumber Daya Air	Water Resources
Sulut	Sulawesi Utara	North Sulawesi
Tkt. I	Tingkat I	Level I Administration (Province)
Tkt. II	Tingkat II	Level II Administration (Region)
UNSRAT	Universitas Sam Ratulangi	Sam Ratulangi University
UPTD	Unit Pelaksana Teknis Dinas	Technical Implementation Unit

(SOME INDONESIAN WORDS)

Desa	Village (rural area), The Lowest Administrative Unit, Headed by Kepala Desa or Kades who is elected by the residents
Kabupaten, Kab.	Administrative District Headed by Bupati (regency)
Kecamatan, Kec.	Administrative Sub District within the Kabupaten
Kelurahan	Village (urban area), The Lowest Administrative Unit, Headed by Lurah who is Appointed
Kota	Municipality, Administrative District Headed by the Walikotamadya
Kotamadya	Municipality, Administrative District Headed by the Walikotamadya
Propinsi	Province
Ribu	thousand = 1,000
Juta	million = 1,000,000
Milyar	billion =1,000,000,000
Trilyun	trillion = 1,000,000,000,000

NAME OF RIVER





CHAPTER 1. GENERAL

1.1 Introduction

1.1.1 Background of Study

Gorontalo City, located in the lower portion of the Limboto-Bolango-Bone basin is the provincial capital of Gorontalo Province and an economic and trade center of the province connecting with the Central and Southern Sulawesi, Ambon, Jakarta, etc. Gorontalo Province was separated from North Sulawesi as the 32nd province of Indonesia with population of about 800,000 and a total area of 12,215 km^2.

Gorontalo City, Limboto City and areas around Lake Limboto have been suffering from frequent floods, since these areas are located on the flood plain formed by flood flows of the rivers. The flood damages constrain the economic activities of the region. Especially in the southern part of Gorontalo City near the confluence of the Bone and Bolango rivers, flood damages are more serious associated with its low-lying flat topography.

Directorate General of Water Resources of the Indonesian Government (DGWR) has been executing urgent works. The work, however, remains at the level of remedial measures. In the meantime, Water Management Master Plan (WM-MP) for the LBB basin was formulated in December 1999 under the technical assistance of Canadian International Development Agency (CIDA). Since the flood mitigation was not the main objectives of the WM-MP, concrete flood mitigation measures were not discussed.

Considering these situations, the Government of Indonesia requested the Government of Japan to conduct the Study on Flood Control and Water Management in Limboto-Bolango-Bone Basin in the Republic of Indonesia (hereinafter referred to as "the Study"). The Government of Japan had decided to accept the request to conduct the Study in accordance with the relevant laws and regulations in force in Japan. The Preparatory Study Team of Japan International Cooperation Agency (JICA) headed by Mr. K. INOUE visited the site from 31 January to 24 February 2001 to discuss and finalize the scope of work with the authorities concerned of the Government of Indonesia.

JICA, who is responsible for the implementation of the technical cooperation of the

Government of Japan, has entrusted the Study work to the joint venture of NIKKEN Consultants, Inc. and Nippon Koei Co., Ltd. (hereinafter referred to as "the Study Team") in June 2001. The study period is about 19 months from June 2001 until December 2002.

1.1.2 Objective of Study

Objectives of the Study are:

1) to formulate a master plan of sustainable flood control and water management plan in Limboto-Bolango-Bone basin,
2) to conduct the feasibility study on the priority project(s), and
3) to transfer technology to counterpart personnel in the course of the Study.

In the Study, flood control aspects are mainly discussed, and water management plan is studied only in relation with the flood control planning, since the water management master plan has already been formulated.

1.1.3 Study Area

The Study will cover the areas in Limboto-Bolango-Bone (LBB) basin in Sulawesi Island. The LBB basin has a total catchment area of about 2700 km^2, consisting of the Lake Limboto basin (890 km^2), the Bolango river basin (490 km^2) and the Bone river basin (1,320 km^2).

Administratively the LBB basin extends mostly in the south-eastern part of Gorontalo Province (2,400 km^2) covering 11 Kecamatan and small portion in the south-western part of North Sulawesi Province (300 km^2).

1.1.4 Execution of Study

(1) Inception of Study

Inception Report: At the commencement of the Study, the Study Team submitted the Inception Report to the Government of Indonesia and discussed in the Steering Committee organized by Gorontalo Province, North Sulawesi Province and Central Government (Kimpraswil) to decide principal matters for the execution of the Study.

Organization for Study: For the execution of the Study, JICA organized the Study Team and Advisory Committee as shown in Table 1.1.1, while Government of Indonesia organized Steering Committee and Counterpart Staff as shown in Table 1.1.2.

Study Team Office: The Study was carried out on schedule basically in line with the Inception Report. Two offices for the Study Team were prepared in Manado, North Sulawesi Province (Manado Office) and Gorontalo, Gorontalo Province (Gorontalo Office). During the period of Master Plan study, the Study Team mainly stationed in the Manado Office, since most of the data and information required for the formulation of flood mitigation master plan were available in Manado. However, during the Feasibility Study period, the Study Team stationed in the Gorontalo Office mainly, to promote technology transfer to Gorontalo counterparts who would implement the priority flood mitigation projects.

(2) Study Schedule and Progress

Study Schedule: Schedule of the Study and its work flow are shown in Figure 1.1.1. The Study consists of mainly four (4) work divisions and their major work items are as follows:

1) Work Div. A: Preparatory works in Japan to prepare Inception Report;
2) Work Div. B: Works in Indonesia (Phase-I) to conduct data collection, field reconnaissance and basic field survey, to formulate Flood Mitigation Master Plan, and to select priority project(s);
3) Work Div. C: Works in Indonesia (Phase-II) to conduct Feasibility Study for the selected priority project(s); and
4) Work Div. D: Works in Japan to prepare Final Report of the Study.

Progress: The Study was carried out in collaboration with counterpart agencies especially with Dinas PU/Kimpraswil of Gorontalo Province and Dinas Sumber Daya Air of North Sulawesi Province. In the course of the Study, Progress Report, Interim Report and Draft Final Report were prepared. At the important occasions of the Study, Steering Committees were held attended by competent officials in-charge from Gorontalo Province, North Sulawesi Province and Central Government, and interim results of the Study were explained and discussed. Results of these discussions were recorded in the Minutes of Meeting.

1.2 Public Consultation Meeting

(1) Program for Public Consultation Meeting

Background: In order to make the flood mitigation activities sustainable, the plan must meet the actual needs of the community people and acceptable to them. Therefore, involvement of community people is necessary from the project plan stage. The Law No.22/1999 concerning the Regional Government Administration clearly mentions that the regional autonomy is applied to support the involvement of the community people in the social development program of the country. For this purpose, the Government of Indonesia adapts the public consultation procedures as one of the method to get understanding and acceptance of the people on the implementation of the development programs.

In line with this the PCM was also programmed for the present Study. The PCM were held three times in Gorontalo City, inviting relevant local government agencies and representatives of local communities, under the responsibility of counterpart agency. The Study Team assisted the implementation of the PCM in preparation of PCM program, arrangement of discussion data, and advices for technical presentation.

Procedures of Public Consultation: In North Sulawesi, the PCM has been implemented with an assistant of Canadian International Development Agency (CIDA). The procedure used in North Sulawesi was applied in principle to the PCM for the Study (LBB-PCM). The LBB-PCM was implemented mainly in three steps, namely, (1) preparatory works, (2) public consultation meeting (PCM), and (3) following up.

Public Consultation Meeting (PCM): The PCMs were held for one day each time, according to the following agenda in principle:

1) Opening remarks:
2) Presentations: Presentation by Dinas on the main topics of the PCM so as to provide the participants with objectives and basis of discussion.
3) Questions and answers: Questions and answers chaired by a PCM Moderator.
4) Lunch break: Opportunities for interaction and informal discussions
5) Group discussions:
    - Participants are divided into four groups.
    - Each group selects their own spokesperson.

- A facilitator is provided to each group to guide the discussion in orderly manners.
- Discussions on the topics given to each group.

6) Presentation of group findings: Presentation of group findings in plenary session by spokesperson chaired by the PCM Moderator.
7) Closing remarks.

LBB-PCM: The PCMs for the LBB basin were held three times at the important occasions of the Study with different topics as outlined below.

1) **First Public Consultation Meeting:** Held on 23 August 2001 in the inceptive period of the Study, aiming to disseminate program of flood mitigation study and to collect actual flood problems in the areas subject to the Master Plan study, attended by 81 participants.

2) **Second Public Consultation Meeting:** Held on 19 February 2002 upon formulation of the Flood Mitigation Master Plan, aiming to get consent on the Flood Mitigation Master Plan formulated and to collect information on actual flood problems in the areas subject to the Feasibility Study, attended by 100 participants.

3) **Third Public Consultation Meeting:** Held on 17 October 2002 upon completion of the Draft Final Report, aiming to get consent on the result of Feasibility Study and to collect information on the expected problems in implementation period and at operation and maintenance stage, attended by 113 participants.

(2) Proceedings of LBB-PCM

PCM Working Group: The PCM was prepared and held according to the PCM Program proposed by the Study Team in principle, by the PCM Working Group organized by the counterpart staff of North Sulawesi and Gorontalo provinces. In the 1st PCM, North Sulawesi counterparts who ever had experience played an important role in guiding and instructing Gorontalo counterparts. The 2nd and 3rd PCMs were carried out under the initiative of counterparts of Gorontalo Province.

Participants: The following participants were invited from relevant agencies,

organizations and communities:

		1st PCM	2nd PCM	3rd PCM
1) Propinsi Gorontalo	:	8 per.	10 per.	12 per.
2) Kabupaten Gorontalo	:	13 per.	14 per.	13 per.
3) Kota Gorontalo	:	11 per.	12 per.	13 per.
4) Kecamatan	:	10 per.	9 per.	12 per.
5) Desa/Kelurahan	:	30 per.	41 per.	42 per.
6) LSM (NGO)/other organization	:	8 per.	10 per.	13 per.
7) Tokoh Masyarakat (public figures)	:	2 per.	4 per.	8 per.
(Total)		(81 per.)	(100 per.)	(113 per.)

Group Discussion: Group discussions were made on the topics shown in Table 1.2.1 commonly provided by the PCM working Group. Results of discussions on these topics were summarized in Table 1.2.2. Proceedings for respective PCM were prepared in Indonesian language compiling records of activities and discussions.

(3) Some Remarks on LBB-PCM

The PCM procedure is one of the recent attempts to involve community people in the development program. Some remarks on the LBB-PCM are presented below, so that the experience obtained through the LBB-PCM could serve for the PCM to be held in future for other projects.

Outcome of LBB-PCM: As a result of the implementation of the PCM for the Study, the following outcome was acknowledged:

1) The government agencies and communities recognized that the Study Team of JICA was conducting flood mitigation study in collaboration with Indonesian Government agencies concerned.
2) It was confirmed that the communities have great concerns on the flooding problems and they are willing to take coping actions.
3) Judging from the discussions and questions in the PCM, understanding of attendants on the flood mitigation activities was improved more and more including structural and non-structural measures.
4) Discussions in the PCM were very active so that the moderator had to limit the number of speakers. However, the meeting preceded orderly almost on the

program as arranged with good management of the Moderator.

5) Various comments and opinions were expressed and most of them were constructive ones though some of them were those having no concern with the PCM topics. The proposed Flood Mitigation Master Plan and the result of Feasibility Study were supported by the PCM in general.
6) Counterparts of Gorontalo Province have familiarized themselves with the PCM through the experience of three PCMs. A sense of solidarity has been brought up between the counterparts of Gorontalo and North Sulawesi provinces, through the collaborative works for the PCM. For far more importance, staff of Gorontalo Province seems to gain confidence to promote the project.

Objective of PCM: The PCM would be an effective procedure for the communication between the government implementing agency and the related communities and organizations, to make the project fruitful as a whole. However, there is a limitation in time and the number of participants. It is substantial to set the objective clearly and properly. Since the PCM is a procedure for communication, the PCM should have definite objective for the communication. The time and participants should be decided in line with the objective, and the PCM moderator should manage the meeting toward the objective. In the case of LBB-PCM, objective was set at the following points:

1) To get information on actual situation of disasters in the suffering areas and real needs of the community peoples concerned and to enhance common awareness of the disasters taking place in the region.
2) To distribute correct information on the study results in progress and to have comments and opinions to make the plan better for the relevant communities.
3) To improve understanding on flood mitigation of various government agencies and local communities concerned and to mobilize them to the flood mitigation activities.
4) To get general consent of the participants on the plan.

Selection of Participants: Selection of the attendants is one of the most difficult issues for the successful PCM. There is no standard to decide the number of attendants, and their spatial and social distributions for the PCM. Various composition of the participant groups would be possible depending on the objective of the PCM. In the case of LBB-PCM, invited were the leaders and representatives of the interested Desa/Kelurahan, Kecamatan, Kabupaten and Kota; NGOs and public figures; and

relevant provincial government agencies other than the implementing agency; following the practice of the PCMs for Water Management Master Plan held under the assistance of CIDA. As for the number of the participants, the total number of 81 attendants was invited for the 1st PCM and it was increased so as to invite more attendants from local communities (Desa and Kelurahan). Participation of public figures (Tokoh Masyarakat) is also important matters to be considered. The public figure has a leading opinion in the local community.

At the planning stage, the PCM should be the place to confirm whether the proposed plan is acceptable to the relevant communities and the areas. It should not be the place to debate private interests.

Nomination of PCM-Moderator: Discussion should be made freely under the chair of PCM moderator. The nomination of the PCM moderator is an important issue, and the moderator should be selected impartially considering the participants. For the LBB-PCM, the president of the university in Gorontalo was selected as the moderator and he managed the meeting excellently.

1.3 Technology Transfer

Technology transfer to the Indonesian counterparts was carried out through learn-by-doing procedures, technology transfer seminar and technical guidance program for small scale project.

(1) Learn-by-Doing

The Study Team established offices both in Gorontalo and Manado cities. During the period of the Master Plan Study (Work Div. B) the Study Team mainly stayed in the Manado Office, while the Gorontalo Office was used as a principal office during the period of the Feasibility Study (Work Div. C). Meetings with counterpart staff were held biweekly and when occasion called in the course of the Study to discuss current technical topics and administrative problems encountered. For the period the Study Team stationed in Manado office, counterpart staffs of the Gorontalo were invited alternately to Manado to participate in the Study.

(2) Technology Transfer Seminar

In order to disseminate the flood mitigation activities and technology for them, Technology Transfer Seminars were held on 24 September 2001 in Gorontalo with 30 attendants from relevant Dinas of Gorontalo Province, Kota Gorontalo and Kabubaten Gorontalo, and on 26 September in Manado with 20 attendants from Dinas Sumber Daya Air (SDA) of North Sulawesi Province. Following the introductory presentation on the progress of the Study, five topics were presented by two Indonesian experts and three JICA Study Team members, and discussed on them.

(3) Technical Guidance for Urgent Small Scale Project

This program intended to provide counterpart staff of Gorontalo Province with technical guidance on the urgent small scale project which would be implemented by themselves with own budget. Government staffs of Kabupaten and Kota Gorontalo were also invited to the technical guidance meetings. Considering the current situations of the basin and the province, following two projects were selected for technical guidance:

1) Establishment of Hydrological Observation Network
2) Reinforcement of Existing Flood Mitigation Facilities

Establishment of Hydrological Observation Network: Owing to the separation of Gorontalo Province from North Sulawesi Province, hydrological observation network in Gorontalo should be managed and operated by Gorontalo Province. An organization for gauge operation and data process should be established immediately in Gorontalo Province, and capacity building of the staff should be started as soon as possible. Therefore, the technical guidance was made aiming at initiation of transfer of hydrological observation network which has been maintained by North Sulawesi Province, with an assistance of official of North Sulawesi Province.

Reinforcement of Existing Flood Mitigation Facilities: River improvement works have been implemented in and around Gorontalo City for the Bone, Tamalate, Siendeng and Bolango rivers, mainly by the funds from central government. In spite of these efforts, Gorontalo City was suffered from severe flood in May 2002. Monitoring and maintenance of existing flood mitigation facilities are required. Reinforcement of the existing works would be in general easier and economical require less cost, as is said "a stitch in time saves nine". It was also recognized that the staff for those activities are absolutely short in quality and quantity. Therefore, the technical guidance was made, with an assistance of officials of North Sulawesi Province, aiming to provide counterpart staff of Gorontalo Province with a good knowledge and understanding on flood mitigation facilities as a basic tool for construction supervision of river improvement works.

(4) Problems Encountered

As described in the previous sections, the Study Team conducted the technology transfer enthusiastically, keeping in mind the importance of technology transfer especially in newly established Gorontalo Province. Although new province has more needs for capacity building, the new province also has more difficulties for it. Some problems encountered are mentioned below, for more effective technology transfer in future.

Target of Technology Transfer: Since the Project Area is located in Gorontalo Province, the target of the technology transfer should be focused on the counterpart staff of Gorontalo Province. During the period of master plan study, the Study Team stationed in Manado because of the availability of required data and information. In the discussion on the Inception Report, it was disclosed that the Gorontalo Province had

no budget to send counterpart staff to Manado to participate the Study. The technology transfer program was therefore adjusted to have technical meetings in Gorontalo occasionally when expert of the Study Team visited Gorontalo, and to invite the Gorontalo counterpart alternately to Manado. However, the period and number of staff participated in the Study were limited.

Personnel Changes in Dinas: During 19 months of the Study period, Governor of Gorontalo changed from the appointed one to the elected one, and the head of Dinas PU/Kimpraswil also changed. In addition to these changes, the head of Sub-Dinas PSDA (Water Resources Development) changed twice. Because of disorder of staff control due to the changes of high officials of Dinas, counterpart staff of Gorontalo Province could not join the major part of the Study during the period of feasibility study. During the period, technology transfer was made for the Dinas staff of Kabupaten/Kota Gorontalo only.

Routine Works of Counterpart Staff: Besides the problems mentioned above, counterpart staffs were busy at their own routine works, because number of staff were limited in the new province. It is generally difficult to join the Study on a full time basis. Fortunately a counterpart from North Sulawesi Province participated the Study almost full time. He fully understood the process of the flood mitigation study and guided other counterpart staff from Gorontalo Province and staff of Kabupaten/Kota Gorontalo. Even though the routine works are busy, at least one counterpart from Gorontalo Province should have been assigned to the Study on a full time basis.

Local Experts: In the course of the Study, local experts and engineers were employed. They were from university staffs in Manado and Gorontalo and Indonesian consultants. They were enthusiastic and effective to perform the Study. It would be a good opportunity for them to join such an integrated study works. Although they had capability beforehand to a certain level, they could improve their capability through collaborative works with the Study Team. This would enhance the technology level of the country and could be regarded as a type of technology transfer.

Public Consultation: Public consultation meetings (PCM) were held three times in the Study period, and the counterpart staff of Gorontalo Province worked as working group members for the PCM in collaboration with counterpart staff of North Sulawesi and some staff from Kabupaten/Kota Gorontalo. Through the works for the PCM, counterpart staff of Gorontalo Province have familiarized themselves with the PCM

procedure and they seemed to gain confidence to promote the project. This would be real result of learn-by-doing.

Table 1.1.1 ADVISORY COMMITTEE OF JICA AND STUDY TEAM MEMBER

A. ADVISORY COMMITTEE

ASSIGNMENT	NAME
Chairman	Mr. Katsuhiko INOUE
Deputy	Dr. Akira NIWA

B. STUDY TEAM MEMBERS

ASSIGNMENT	NAME
Team Leader / Flood Control Planner	Mr. Noboru JITSUHIRO
Co Team Leader / River Engineer / Flood Analyst	Mr. Hideki ARAKI
Hydrologist	Mr. Masayuki SHIRAISHI
Sediment / GIS Engineer	Mr. Makoto KODAMA
Social Environmentalist	Mr. Kazuchiyo KUSUDA
Natural Environmentalist	Mr. Hitoshi SAKAI
Organization / Management Planner	Mr. SUPARMAN
Geologist / Dam Planner	Mr. Kimihiko KOTOO
Mapping / Topo-Survey Engineer	Mr. Isao IKESHIMA
Structure Design Engineer	Mr. Yukio AZEGAMI
Metal Engineer	Mr. Kenji SETO
Project Economist	Mr. Tatsuo TASHINO
Coordinator	Mr. Hiroaki KONO

Table 1.1.2 STEERING COMMITTEE MEMBER AND COUNTERPART STAFF (1/2)

Steering Committee Member and Coordinator/Supervisor (Master Plan)

No.	Nama	Jabatan/Instansi	Kedudukan
A.	**Tim Pengarah**		
1.	Dr.Ir.Roestam Syarief,MNRM	Direktur PSDA	Ketua merangkap Anggota
2.	Dr. Ir. Nelson Pomalinggo, MTc.	Ketua BAPPEDA, Propinsi Gorontalo	Wakil Ketua I/ merangkap Anggota
3.	Dr.Ir.Lucky Sondakh, M.Ec	Ketua BAPPEDA, Prop. Sulawesi Utara	Wakil Ketua II/ merangkap Anggota
4.	Ir.A.Raymond Kemur, M.Sc	Kasubdit. Perencanaan Wilayah Sungai	Sekretaris merangkap Anggota
5.	JICA Representatives	JICA	Anggota
6.	Ir. Moelyono, MSc.	Kepala Dinas PU / Kimpraswil. Prop. Gorontalo	Anggota
7.	Ir.F.B. Najoan	Kepala Dinas SDA, Propinsi Sulawesi Utara	Anggota
B.	**Tim Koordinator/Supervisi**		
1.	Ir. A. Raymond Kemur, MSc	Kasubdit. Perencanaan Wilayah Sungai	Ketua
2.	Ir. Judi Widagdo, Msi	Kasubdin. Sungai, Rawa dan Pantai Dinas SDA, Prop. Sulawesi Utara	Anggota
3.	Ir. Sugiarto, Dipl. HE	Kasubdin. Pengembangan SDA, Dinas PU/ Kimpraswil Prop. Gorontalo	Anggota
4.	Ir. Bambang Hargono, M.Eng	Kasubdit. Air Baku, Sungai, Waduk dan Danau, Dit. Bintek SDA	Anggota
5.	Ir. Imam Nugroho, Dipl. HE	Kasubdit. Cantek, Dit SDA, Wilayah Timur	Anggota

Counterparting Staff (Master Plan)

No.	Nama	Instansi
1.	Ir. Silvana Pangau	Staf Dinas SDA, Propinsi Sulawesi Utara
2.	Rini Harun, ST, Sp.1	Staf Sub-Dinas PSDA, Dinas PU/Kimpraswil, Propinsi Gorontalo
3.	Dave Muchaimin, ST	Staf Dinas SDA, Propinsi Sulawesi Utara
4.	Ir. Hendrik Wauran	Staf Dinas SDA, Propinsi Sulawesi Utara
5.	J. Toha, ST, Sp.1	Staf Dinas SDA, Propinsi Sulawesi Utara
6.	Haris Jafar, ST	Staf Sub-Dinas PSDA, Dinas PU/Kimpraswil, Propinsi Gorontalo
7.	Fatmawati Dangkua, ST	Staf Sub-Dinas PSDA, Dinas PU/Kimpraswil, Propinsi Gorontalo
8.	Jane Mamoto, ST	Staf Dinas SDA, Propinsi Sulawesi Utara
9.	Ir. Danny Karouw	Staf Dinas SDA, Propinsi Sulawesi Utara
10.	Ir. Jane Wagey, Sp.1	Staf Dinas SDA, Propinsi Sulawesi Utara
11.	Farid Mahmud, ST	Staf Sub-Dinas PSDA, Dinas PU/Kimpraswil, Propinsi Gorontalo

Table 1.1.2 STEERING COMMITTEE MEMBER AND COUNTERPART STAFF (2/2)

Steering Committee Member and Coordinator/Supervisor (Feasibility Study)

No.	Nama	Jabatan/Instansi	Kedudukan
A.	**Tim Pengarah**		
1.	Ir. Adi Sarwoko, Dipl.HE	Direktur PSDA	Ketua merangkap Anggota
2.	Ir. Sudirman Habibie	Ketua BAPPEDA, Propinsi Gorontalo	Wakil Ketua I/ merangkap Anggota
3.	Dr.Ir.Lucky Sondakh, M.Ec	Ketua BAPPEDA, Prop. Sulawesi Utara	Wakil Ketua II/ merangkap Anggota
4.	Ir.A.Raymond Kemur, M.Sc	Kasubdit. Perencanaan Wilayah Sungai	Sekretaris merangkap Anggota
5.	JICA Representatives	JICA	Anggota
6.	Ir. N. Mokoginta, MM	Kepala Dinas PU / Kimpraswil. Prop. Gorontalo	Anggota
7.	Ir.F.B. Najoan	Kepala Dinas SDA, Propinsi Sulawesi Utara	Anggota
B.	**Tim Koordinator/Supervisi**		
1.	Ir. A. Raymond Kemur, MSc	Kasubdit. Perencanaan Wilayah Sungai	Ketua
2.	Ir. Judi Widagdo, Msi	Kasubdin. Sungai, Rawa dan Pantai Dinas SDA, Prop. Sulawesi Utara	Anggota
3.	Ir. B. Sigalingging, MSc	Kasubdin. Pengembangan SDA, Dinas PU/ Kimpraswil Prop. Gorontalo	Anggota
4.	Ir. Bambang Hargono, M.Eng	Kasubdit. Air Baku, Sungai, Waduk dan Danau, Dit. Bintek SDA	Anggota
5.	Ir. Imam Nugroho, Dipl. HE	Kasubdit. Cantek, Dit SDA, Wilayah Timur	Anggota
6.	Ir. Febri Imam Harta, ME	Pemimpin Bagian Proyek PPSPSDA	Anggota

Counterparting Staff (Feasibility Study)

No.	Nama	Instansi
1.	Ir. Silvana Pangau	Staf Dinas SDA, Propinsi Sulawesi Utara
2.	Rini Harun, ST, Sp.1	Staf Sub-Dinas PSDA, Dinas PU/Kimpraswil, Propinsi Gorontalo
3.	Dave Muchaimin, ST	Staf Dinas SDA, Propinsi Sulawesi Utara
4.	Ir. Hendrik Wauran	Staf Dinas SDA, Propinsi Sulawesi Utara
5.	J. Toha, ST, Sp.1	Staf Dinas SDA, Propinsi Sulawesi Utara
6.	Haris Jafar, ST	Staf Sub-Dinas PSDA, Dinas PU/Kimpraswil, Propinsi Gorontalo
7.	Fatmawati Dangkua, ST	Staf Sub-Dinas PSDA, Dinas PU/Kimpraswil, Propinsi Gorontalo
8.	Jane Mamoto, ST	Staf Dinas SDA, Propinsi Sulawesi Utara
9.	Ir. Danny Karouw	Staf Dinas SDA, Propinsi Sulawesi Utara
10.	Ir. Jane Wagey, Sp.1	Staf Dinas SDA, Propinsi Sulawesi Utara
11.	Farid Mahmud, ST	Staf Sub-Dinas PSDA, Dinas PU/Kimpraswil, Propinsi Gorontalo

Tabel 1.2.1 TOPICS FOR GROUP DISCUSSION

	GROUP DISCUSSION TOPICS
1st PCM	1 What kinds of flood and sediment disaster are you suffering from? (bank erosion, inundation, sedimentation, etc) and what do you think are the causes? and what were damage?
	2 How do you think, you / your community / agency can contribute to mitigate the disaster? (contribution of organizations)
	3 In general two types of flood control measures are conceivable i.e. structural and non-structural measures (Structural: Dike/ embankment, normalization, etc. and Non-structural: to formulate Regional Regulation of Lake and River Buffer zone, to change wrong cultivation behavior / activity, etc.). What is your opinion?
	4 What kinds of measure do you think are effective to cope with the disaster you are suffering (possible measure)?
	5 Are you willing to participate to the activities to cope with flood and sedimentation disaster prevention in your community? If you say yes, in what kind (of participation)?
	6 Do you think flood control measure that have been applying recently are conform with the situation / requirement? If you say yes, what is the reason, and if no, what is your opinion (What is your suggestion).
2nd PCM	1 What kinds of structure (from the presentation) will be suitable for this region (mention by priority)
	2 What is the output and benefit from the construction of the structure?
	3 What is the problem that arises before, during and after the construction?
3rd PCM	**Structural Measure (Group A, B, C)**
	1 What is the benefit that you can earn during and after the implementation of the priority projects?
	2 What kind of problem will occur before, during and after the implementation of the project?
	3 What kind of participation you can contribute during and after the implementation of the project?
	4 By your opinion, will this project be beneficial to Kabupaten and Kota Gorontalo?
	Non-Structural Measure (Group D)
	1 What is the benefit of watershed and flood plain management?
	2 What kind of problem will occur during the implementation of watershed and flood plain management?
	3 What kind of participation you can contribute for the implementation of watershed and flood plain management?
	4 By your opinion, will this measure of watershed and flood plain management be beneficial to Kabupaten and Kota Gorontalo?

Table 1.2.2 SUMMARY OF GROUP DISCUSSION (1/3)

1st PCM

No.	DISCUSSION TOPICS	GROUP DISCUSSION			
		BONE	BIYONGA	BOLANGO	ALOPOHU
1.	What kinds of flood and sediment disaster are you suffering from? (bank erosion, inundation, sedimentation, etc) and what do you think are the causes? and what were damage?	- Bank erosion - Inundation (Residence) - Sedimentation	- Flush flood - Inundation(Residence) - Sedimentation - Bank erosion	- Bank erosion - Inundation(Residence) - Sedimentation	- Riverbank erosion - Inundation(Residence) - Sedimentation
	Causes by :	- High rainfall - Mining-sand and coral (Galian C) - Shifting cultivation - Illegal mining (PETI) - Unsuccessful reforestation - HPH-Private Company who have rights for forest exertion / exploitation.	- Deforestation - Shifting cultivation - Mining-sand and coral (Galian C) - Lake water overflow - High rainfall - Unsuccessful reforestation - Broken dike - Illegal wood and rattan exploitation - River and lake sedimentation	- Deforestation - Mining-sand and coral (Galian C) - River flow become narrow - Construction of drainage canal never adjusted to technical procedure (improcedural construction)	- Mining sand and coral (Galian C) - Deforestation - Mislanduse at some slope / shifting cultivation - Bad behavior (always put garbage anywhere)
	Damaged :	- Settlement, plantation, agricultural area, husbandry and fishery - Water resources structure, transportation (structure-infrastructure),etc.	- Land degradation - Irrigation channel - Settlement and agricultural area - Water inundation - Epidemic disease - Degradation of land fertilizing - Change of community behavior and social-economic manner	- Agricultural area - Structure and infrastructure of transportation, education, health, economic, etc. - Residence	- Rice field and road/bridge - Rice field become smaller - Infertile land/soil - Fail / mis-harvesting
2.	How do you think, you / your community / agency can contribute to mitigate the disaster? (contribution of organizations)	*GOVERNMENT - Socialization of regulation - To control illegal mining (PETI) - Law enforcement for destroyer (environm.) *NGO - To motivate the community to be environ aware. *COMMUNITY - To obey the regulation and to protect environmental conservation	*GOVERNMENT - Strictly law enforcement for deforestation, shifting cultivation integrated & continuous - Regreening/reforestation and development of public forest. - Dike construction and normalization - Preparing temporary camp - Establishment of First Aid Center - Sectoral cooperation between related agency *NGO - To motivate the community to be environmental aware - Cooperation between government and related instancies / agency *COMMUNITY - To obey the regulation as a guidance for flood mitigation measure	- Reforestation / regreening of mountainous area, river and lake riparian - To control shifting cultivation - To manage mining activity (sand and coral) in mountain & river	- Extension + reforestation - Training - To form a group of environmental conservation - To propose program / project
3.	In general two types of flood control measures are conceivable i.e. structural and non-structural measures (Structural: Dike/ embankment, normalization, etc. and Non-structural: to formulate Regional Regulation of Lake and River Buffer zone, to change wrong cultivation behavior / activity, etc.). What is your opinion?	*STRUCTURAL - To conduct sustainable structural measure *NON-STRUCTURAL - Formulation of regional regulation of river - To involve and increase community participation and consciousness for flood mitigation measure (all components).	*NON-STRUCTURAL - Extension, train the community - To formulate regional regulation about forest, river and lake buffer zone licensing for any construction - Changing community behavior *STRUCTURAL - Dike construction - River normalization - Reforestation	*STRUCTURAL - Dike construction and normalization *NON-STRUCTURAL - To socialize the regional regulation of river buffer zone - To change/control shifting cultivation behavior of the community	*STRUCTURAL - Dike construction and normalization (Bamboo planted) *NON-STRUCTURAL - To formulate the regional regulation of river buffer zone + to change wrong cultivation behavior / activity (Extension + reforestation)
4.	What kinds of measure do you think are effective to cope with the disaster you are suffering (possible measure)?	- Structural and non-structural measures integrated, synergic and continuous.	- Employing comprehensive flood mitigation measure structural and non-structural from upstream to downstream - Changing community's way of thinking - Reforestation - To formulate regional regulation - Law enforcement	*STRUCTURAL - Construction of reservoir - Construction and improvement of dike - Construction and improvement of drainage canal *NON-STRUCTURAL - To relocate the community / shifting cultivation farmer (local transmigration) - Law enforcement	- Law enforcement - Formulation of regional regulation - Regreening/reforestation with productive plant - Dike construction + normalization - Canal / rill construction - Construction of Reservoir / drainage canal - Terracing
5.	Are you willing to participate to the activities to cope with flood and sedimentation disaster prevention in your community? If you say yes, in what kind (of participation)?	YES - KINDS OF PARTICIPATION : - To give / share opinion-idea, experience and suggestion	YES - KINDS OF PARTICIPATION : - To give / share opinion-idea, assistance, medicine, food, dress, etc.	YES - KINDS OF PARTICIPATION : - To support every effort/action of flood mitigation measure and allow the place for project location - To approach community around the project location	YES - KINDS OF PARTICIPATION : * COMMUNITY - To protect riverbank with vegetative approach - Regreening riverbank with bamboo plant - Do not allow public construction along river basin / riparian - To change bad behavior (put garbage anywhere) * AGENCY - Extension - Proposed program - Selection of construction licensing (IMB) - To formulate lake, river and coastal buffer zone * NGO - To supervise/control every development activity based on each function - Proposed program - To motivate * ACADEMIC - Investigation / research - Proposed program
6.	Do you think flood control measure that have been applying recently are conform with the situation / requirement? If you say yes, what is the reason, and if no, what is your opinion (What is your suggestion).	NO - BECAUSE : - Until now the community still always suffering by flood disaster in every rainy season PROPOSED PROGRAM : - T o improve drainage system - To dredging lake and river Limboto estuary - Construction of Dumbaya Bulan reservoir - Regreening / reforestation - Normalization	NO - BECAUSE : - Lack or less of coordination between related instancies - No regional regulation yet - Unfinished flood mitigation measure and sustainable - Poor sense of belonging to the environment CONCLUSION : - Hope that there is a follow-up action of this meeting - Need same perception about flood mitigation measure	NO - BECAUSE : - Unsuitable planning, low participation of community - Restricted budget allocation PROPOSED PROGRAM : - Dredging at river estuary - Normalization of lake Limboto, Bolango, Bone and Limboto rivers - Regreening - More community participation - Riverbank revetment - To manage the structure along the drainage canal	NO - BECAUSE : - Restricted budget allocation - Lack/less of human resources - Lack/low of community participation - Unawareness of the implemented group to follow the direction / rules - Unfinished formulation of law / regulation of river buffer zone - Sectoral egoism

Table 1.2.2 SUMMARY OF GROUP DISCUSSION (2/3)

2nd PCM

No.	DISCUSSION TOPICS	GROUP DISCUSSION			
		GROUP I	GROUP II	GROUP III	GROUP IV
1.	What kinds of structure (from the presentation) will be suitable for this region (mention by priority)	*Types of Structure :* 1. Bank construction (paving revetment) 2. Dredging of material (sand and pebbles) 3. Construction of dike *Order of Activity (by Priority) :* 1. Bank construction (paving/revetment) of about ± 6.000 m. 2. Dike construction of about ± 10.000 m 3. Material dredging of about ± 500 m 4. Taken away (removing) of material such as sand pebbles in delta (river mouth)	*Types of Structure Suitable :* 1. Canal 2. River Gate *Measure undertaken :* a. Land/canal excavate b. Vegetation of the area around canal as an infiltration area c. Rehabilitation of upper stream d. Installation of an automatic water gate at Tamalate river mouth (if Bone river base higher than Tamalate river)	*Types of Structure :* 1. Topadu river Control Gate 2. Valve gate 3. Dike (concrete/riprap) 4. Bank revetment (gabion)	*Types of Structure* : 1. Removing of Alopohu river channel 2. Widening of river body 3. Construction of sediment trap 4. Parapet dam 5. Controlling dam 6. Gully plat 7. Cut off (normalization) for Alopohu and Biyonga rivers 8. Installation of gabion / riprap 9. Lake widening
2.	What is the output and benefit from the construction of the structure?	*Aims and Benefit :* 1. Bank paving/revetment aims for river normalization to protect riverbank from erosion And the benefit of this structure are : a. For smoothen river water flow b. To prevent watershed widening c. To protect human settlement from flood threaten/ damage 2. Bank construction aims to protect water runoff and benefit for the prevention of flood and bank erosion. 3. Dredging/taken away material in delta aims to smoothing water flow and benefit for the increasing of water volume and capacity	*Aims and Benefit :* The aim and purpose of the development of this structure is for flood controlling and water inundation, and its benefits are : - To create clean and healthy environment - Stable catchment area - To create peaceful/safety (feeling), free from flood threaten	*Aims and Benefit :* 1. To regulate/control in and outflow discharge of Bolango river 2. To regulate/control in and outflow at the time of flood 3. Raising up/to higher land surface 4. To prevent water overflow 5. As inspection road 6. To prevent bank erosion/landslide	*Aims and Benefit :* Non Civil Structure : a. Reforestation of critical land / watershed area b. Terracing for upper stream c. Community empowerment and awareness d. Political will / commitment by the government
3.	What is the problem that arises before, during and after the construction?	*Problem/Constrain That May Be Arise :* 1. Before Construction : - Socialization to the community - Supply of equipment - Hampered/constraint water flow 2. Along Construction : - Land compensation - Location for disposal material/waste - Technique of dredging/ implementation 3. After Construction : - Settlement - Maintenance - Owner	*Problem :* 1. Before / Pre-Construction : - Flood threaten - Land compensation / socialization - Coordination between 2. Along Construction : - Follow up socialization to the people/ community around canal - Preparation of budget for land compensation 3. After/Post – Construction : - Preparation of budget for maintenance - Communities role to protect/maintain the structure developed - Formulation regional regulation on river	*Problems :* 1. Rise up Lake Limboto water level/surface at the time of flood 2. Water inundation locally 3. Water inundation 4. Illegal settlement 5. The difficulties of project 6. Land authorizing complain	*Problem Raised :* a. Before/Pre-Construction - The objection of landowner - Land/plant compensation - Relocation / resettlements - Community preparedness for receiving the project - Budget b. Along the construction - An efficient relocation - Quality of construction - Quality control c. After / Post-Construction - Maintenance - Objection by the community - Regulation of “Galian C” mining - Spatial plan construction

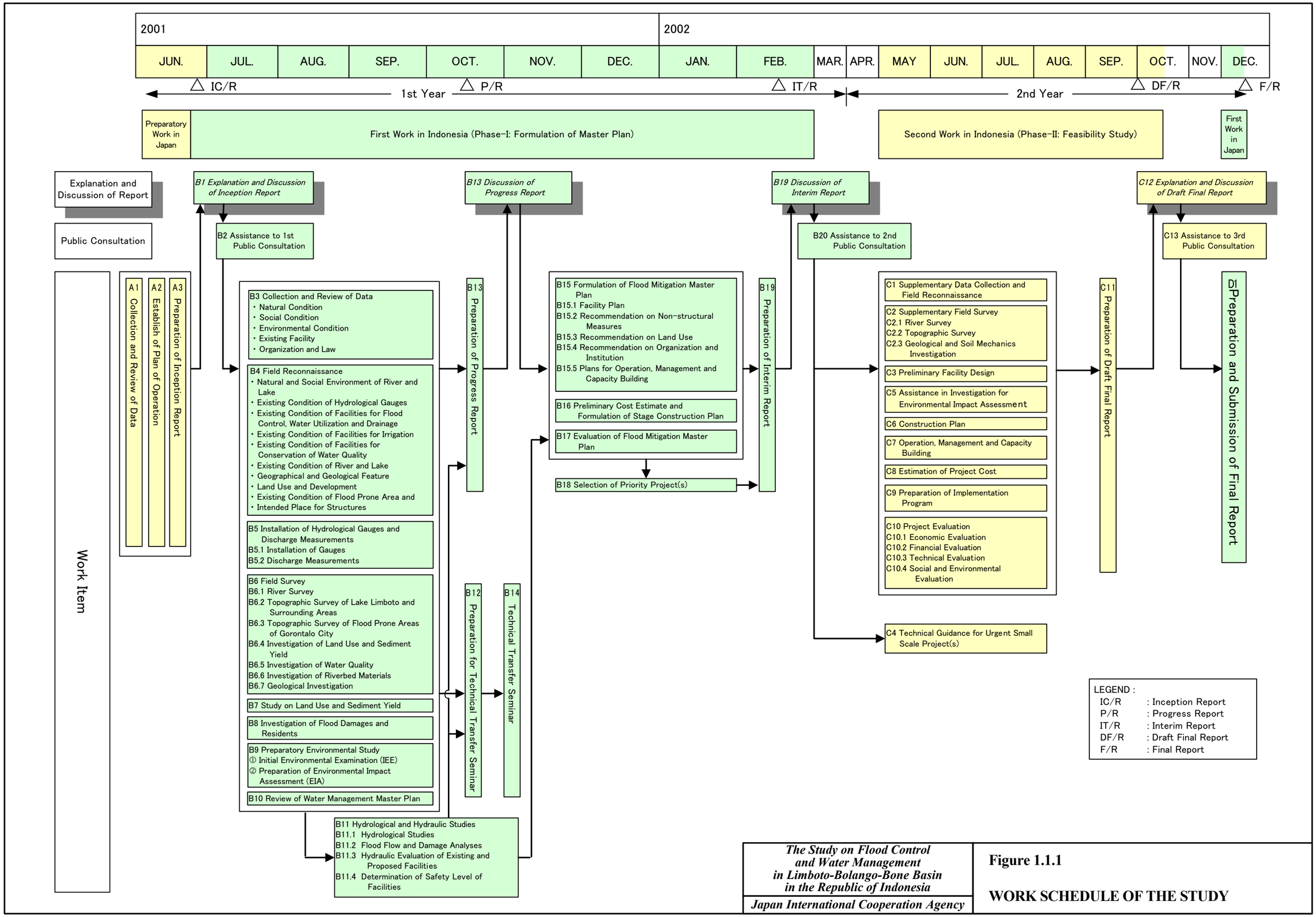
Remarks :

1. *Group I : Improvement of Bone River Downstream*
2. *Group II : Tamalate Floodway and Control Gate*
3. *Group III : Improvement of Topadu and Bolango River with Topadu Control Gate*
4. *Group IV : Realignment of Biyonga and Alopohu River Channel and Sediment Trap*

Table 1.2.2 SUMMARY OF GROUP DISCUSSION (3/3)

3rd PCM

No.	DISCUSSION TOPICS	GROUP DISCUSSION			
		GROUP A **Bone-Bolango River Improvement**	**GROUP B** **Tapodu River Improvement**	**GROUP C** **Tamalate Floodway**	**GROUP D** **Watershed/Flood Plain Management**
1.	(Group A,B,C) What is the benefit that you can earn during and after the implementation of the priority projects? (Group D) What is the benefit of watershed and flood plain management?	PRE-CONSTRUCTION - Application of local labor Technical and non-technical - Increase local people's Income - Support regional government with fund assisting for development POST/AFTER-CONSTRUCTION - Minimized Flood - Decrease phsycological impact to the community for flood occurrences	DURING CONSTRUCTION - Create new employment - Benefit to the mining of sand and gravel (Galian C) for the using of local project material - Create communities' attention / custom in relation with Tapodu River Improvement - Motivate people's of Kabupaten and Kota to mitigate flood POST/AFTER-CONSTRUCTION - Increase people's welfare - Mitigate flood threaten - To control erosion flow/rate - Prevent sedimentation process - Neutralized water discharge	DURING CONSTRUCTION - Application of local labor (Technical and non-technical) - Increase Income of local people, by using local material for project POST/AFTER-CONSTRUCTION - Enough water supply for the surrounding rice field in dry season - Gorontalo city free from flood - Construction and re-construction of 5 bridges will become village transportation - Aesthetics - Decrease social fund aid for the flood victims - Advantage to Desa Poowo and Oluhuta	DURING CONSTRUCTION - Create new employment for local people - Increase Income of local people, by using local material for project POST/AFTER-CONSTRUCTION - To Control Flood - Increase water infiltration - Steady ground water supply - Prevent conflict of interest between agricultural farmers and forestry farmers - Increase animal food stock - Decrease erosion rate - Decrease sedimentation rate - Maintain soil fertile - Decrease flood risk - Conserve living environment - Increase river channel capacity - Tourism object - Smoothing water flow into the sea - Access road for the local people
2.	(Group A,B,C) What kind of problem will occur before, during and after the implementation of the project? (Group D) What kind of problem will occur during the implementation of watershed and flood plain management?	BEFORE/PRE-CONSTRUCTION - Definite fund available - Socialization of project DURING CONSTRUCTION - Land and building acquisition - People's relocation - People's health by the operation of projects equipment, (noisy and air pollution) AFTER/POST CONSTRUCTION - Transfer of technology on flood management - Operation and maintenance costs	BEFORE/PRE-CONSTRUCTION - The adjustment of spatial plan - Land acquisition - Delayed socialization DURING CONSTRUCTION - Weather - Uncertain water discharge fluctuation - Environmental impact (pollution) AFTER/POST CONSTRUCTION - Adjustment of river Management - Ecological Impact to local community - Increasing of Lake Limboto discharge and flow into some rivers as: Meluupo R. Kelurahan Tenilo, Biyonga R. and Alopohu R.	BEFORE/PRE-CONSTRUCTION - Rejection by the agricultural land cultivator and land owners - Incomplete socialization AFTER/POST CONSTRUCTION - Mobilization of project material residue at the location surrounding	BEFORE/PRE-CONSTRUCTION - Land acquisition - Constraint to the activities of some people - Preparation of alternative relocation - Preparation of Alternative Employment for the influenced people (if there any relocation)
3.	(Group A,B,C) What kind of participation you can contribute during and after the implementation of the project? (Group D) What kind of participation you can contribute for the implementation of watershed and flood plain management?	DURING CONSTRUCTION - Support by all stakeholders AFTER/POST CONSTRUCTION - Keep and maintain as well as conserve the project	DURING CONSTRUCTION - Support socialization of the project - Supports material, moral and politic AFTER/POST CONSTRUCTION - Maintain and conserve river environment - Monitoring continuously	DURING CONSTRUCTION - Socialization to the local people - Supports and agree with the implementation of this project AFTER/POST CONSTRUCTION - Keep and maintain the structure - Prohibit any deforestation and shifting cultivation at the upper watershed	DURING CONSTRUCTION - Agree and will support program of watershed and flood plain management - Socialized the importance of management of watershed and flood plain - Praying AFTER/POST CONSTRUCTION - Establish community' monitoring group that will be function to maintain and monitor the watershed and flood plain - Search information and coordinate with related agency voluntarily
4.	(Group A,B,C) By your opinion, will this project be beneficial to Kabupaten and Kota Gorontalo? (Group D) By your opinion, will this measure of watershed and flood plain management be beneficial to Kabupaten and Kota Gorontalo?	YES, BECAUSE: - Mitigate of 20 years flood - Create conducive environment for Kota and Kabupaten community - Decrease number of people suffering flood disease in Kota and Kabupaten - Income sharing between Kabupaten and Kota	YES, BECAUSE: - To regulate / control water flow - To conserve and maintain Tapodu River - Transportation for the transaction of fish production - Stabilizing lake water surface and discharge - Can be developed as tourism object (recreational) - Stabilizing lake water surface and discharge - Can be developed as tourism object	YES, BECAUSE: - Kabupaten and Kota free from flood - Create new employment for local people - Support local people' economic by smoothing good and services flow	YES, BECAUSE: - Decrease flood risk - Create safe feeling to local people especially at rainy season - Benefit for water resources - Increase local people's economic - Maintain and conserve Lake Limboto - Increase regional income - Decrease siltation/aggradations at Gorontalo Port - Support agropolitan and fishery program



The Study on Flood Control and Water Management in Limboto-Bolango-Bone Basin in the Republic of Indonesia

Japan International Cooperation Agency

Figure 1.1.1

WORK SCHEDULE OF THE STUDY

CHAPTER 2 EXISTING CONDITIONS

2.1 Topography and Geology

2.1.1 Topography

Sulawesi Island: Sulawesi Island being entirely occupied by mountainous topography, consists of four narrow branches or arms, separated by deep gulfs and united in a central trunk. The Sulawesi Island is surrounded by deep basins and troughs. The Study Area of the Limboto-Bolango-Bone basin (the LBB basin is located in the central part of north arm (the Minahassa Peninsula) of Sulawesi Island.

Eastern part of the Minahassa Peninsula, trending NE–SW in direction, has active volcanoes extending onto Mindanao of the Philippine archipelago via Sangihe islands. The central and western part of the Minahassa Peninsula has an E-W direction. The width of this section changes from 35km in the central to more than 100km in the western part. The whole of the Minahassa Peninsula is mountainous in general, except for sporadic coastal lands and some part of the area where longitudinal depression stretches. This longitudinal depression is observed also in the Study Area.

Study Area: The Study Area is located in the central part of the Minahassa Peninsula covering a total area of 2,700 km^2 in Limboto-Bolango-Bone basin. Topography of the Study Area is dominantly oriented in the E-W direction. The Study Area consists of east–west oriented mountain ranges in the north and south, and flat plain in between.

The basins of Lake Limboto and the Bolango River are located in the western half of the Study Area and the Bone river basin occupies the eastern half. All rivers drain into the central plain and finally empty into the Tomini Bay at the southern most of Gorontalo city.

The Biyonga, Alo, Molamahu, Pohu and Rintenga rivers are main rivers flowing into Lake Limboto. The Bolango River, joining the Tapodu River (outlet channel of Lake Limboto) in the lower reaches, flows into the Bone River. The Bone river, draining eastern half of the LBB basin, empties into the sea after joining the Bolango River near the mouth. These rivers are dissecting mountains, and transport sediments to the lower plains. The plain area of the LBB basin is narrow, only 20 % of the whole basin area. The topography of the Study Area is shown in Figure 2.1.1.

2.1.2 Geology

Sulawesi Island: Sulawesi appears to be formed by the collisions of two main crustal plates on the surface of the earth. The Australian plate is thrust westwards by sub-crustal magma currents, and it collides with the rigid Asian plate. The collisions were accompanied by considerable crust faulting and rotation of the fragments of the main plates. The Australian plate is being subducted beneath the Asian plate and it causes periodic rifting and separation of the fragments of the plate.

The North Sulawesi together with the South Sulawesi is split along the line of Makassar Strait from Asian plate of eastern Kalimantan due to the said tectonic process during the middle of Tertiary. The oldest pre-Tertiary basement rocks of a complex of metamorphics and ultrabasics are said to be exposed in south-western end of the North Sulawesi. Subsequently early-to-mid Tertiary volcanic rocks inter-bedded with sedimentary rocks are distributed covering the said basement rocks. Granite intrusions occurred in middle and late Tertiary and they are widespread in the North Sulawesi closely associating mineralization.

Sandstones, volcanic conglomerates and thin beds of limestone were formed in late Tertiary. They are mostly observed in the northern part of the North Sulawesi. Volcanic rocks of andesitic and/or dacitic compositions were intruded through the above nebtuibes strata in early Quaternary and they formed the highest mountains in the region.

Relatively less consolidated and gently dipping sedimentary strata called “Celebes Mollasse”, which consists of conglomerates, quartz sandstones, shales, marls, coral limestones are laid down mainly over the early Quaternary volcanics. Limited portion of the strata are observed in exposed state. Recent deposits of sands, gravels and coral reefs are distributed over the said all strata.

Study Area: Geology of the Study Area consists mainly of igneous, volcanic and sedimentary rocks of middle Tertiary to early Quaternary periods.

Volcanic and sedimentary rocks formed prior to igneous intrusion are slightly to highly metamorphosed and the original state of highly metamorphosed rocks are somehow undistinguishable. Some sedimentary rocks are granitized and metamorphosed.

The strata of early to middle Tertiary appear to form the basement rocks in the Study Area. Igneous rocks of granited and granodiarites are distinguishable from the others of the early to middle Tertiary strata, then they are mapped separately in geological map of the Study Area.

The sedimentary rocks of the late Tertiary appear not to exist in the Area, however, existence of crystallized state of limestones may indicates distribution of Tertiary sedimentary rocks prior to the latest volcanic event of early Quaternary. Crystallied state of limestones appears to be formed by the recent hydrothermal activities at the moment.

Latest volcanic activities of early Quaternary formed the frame of the present topography in the Study Area. Andestic and dacitic lavas spreaded in high peaks of the area. Non-welded tuffs are also observed along the right bank of the Bone River.

Unconsolidated deposits of gravels and sands are widely distributed in the lowland of the basin. Talus and terrace deposits are also distributed in scarps of hilly and mountainous areas covering the older formations. Geological map of the Study Area is shown in Figure 2.1.2 for general features and Figure 2.1.3 for schematic geological profile.

2.2 Hydro-Meteorology

Meteo-hydrological features of the LBB basin are outlined here mainly based on the study results of CIDA and partly by the latest data.

2.2.1 Climate

The climate of the Limboto-Bolango-Bone (LBB) basin is generally classified as humid tropical. On the Koppen's classification, the Study area falls into class Af. This climate group is defined as having a tropical rainy climate with no definite dry period, with a temperature exceeding 18℃ in the coolest month.

Figure 2.2.1 shows the monthly average temperature, monthly average relative humidity and monthly rainfall at Jalaludin Airport representing climatic features of the Study Area. The Study Area is equatorial and characterized by high temperature with insignificant seasonal variation (26.3 to 27.0℃), high humidity throughout the year (75.4 to 83.6%) and two main seasonal wind directions with rarely high wind speed. Rainfall in the Study Area is typical of areas close to the equator. The bimodal peak is caused by the double passage of the inter-tropical convergence zone following the overhead passage of the sun.

2.2.2 Rainfall

(1) Mean Annual Rainfall l

The long-term mean annual rainfall (1975-1997) was able to be estimated only at Jalaludin and Biodu stations located in the plain areas of the Study Area.

Rainfall amount at these stations is similar over long periods. The mean annual rainfall is 1,240 mm/yr at Jalaludin Airport in the Lake Limboto basin, while the rainfall at Boidu/Lomaya Weir of the Bolango River is 1,286 mm/yr. At Boidu the maximum annual rainfall was 2,249 mm in 1997 and the minimum 471 mm in 1972.

Though the long-term rainfall data are not available, the annual rainfall in the central portion of the LBB basin (below 100 m, MSL) ranges from less than 1,000 mm to 1,280 mm. The annual rainfall increases to over 1,300 mm on the eastern side of the plain. The annual rainfall may exceed 2,000 mm at the higher elevations in the north and

eastern portions of the LBB basin.

(2) Monthly Variation of Rainfall

Distribution of monthly rainfall at Jalaludin Airport shown in Figure 2.2.1 is typical of areas close to the equator exhibiting a bimodal peak.

Monthly rainfall peaks in May (165 mm) with a secondary peak typically occurring in November (138 mm). The dry season with less than 100 mm of monthly rainfall extends from July to September. February is also a dry month with less than 100 mm rainfall in between the two short wet seasons.

2.2.3 Runoff

(1) Mean Annual Runoff

According to the historical runoff data at six locations, mean annual runoffs in the LBB basin are summarized below:

(Mean Annual Runoff in LBB Basin: 1983-1997)

River	Location	Drainage Area (km^2)	Mean Annual Runoff		
			(mm)	(m^3/s)	($m^3/s/km^2$)
Bone	Alale Weir	1,060	1038	34.9	0.033
Bolango	Lomaya Weir	388	955	11.7	0.030
Biyonga	Huludupitango Weir	57	691	1.24	0.022
Meluopo	Pone Staff Gauge	24	372	0.28	0.012
Molamahu	Molamahu Weir	87	283	0.78	0.009
Pohu	Pohu Weir	134	395	1.68	0.013

Looking into the specific discharges, there is a definite trend of decreasing runoff from eastern basin to western basin, which is similar to the rainfall trend. A trend is also identified that the larger basin yields higher mean annual specific runoff.

(2) Monthly Variation of Runoff

The monthly runoff distributions are shown in Figure 2.2.2 for the Bone River at

Lombongo/Alale Weir and the Bolango River at Boidu Tapa/Lomaya Weir. The monthly runoff distribution is almost similar to the rainfall distribution with peaks occurring in January and in May/June. The highest average annual runoff period is usually from late-May to early-June. Low runoff occurs from August to October with minimums usually occurring in October. A brief low flow period also occurs in late February to early March.

The variation index of the specific monthly runoff height worked out for the Bone River is smaller than that of the Bolango River, though the specific runoff heights for the month of maximum runoff are the same. This may come from better vegetation and larger basin size of the Bone River.

(3) Flood Events

The recent major flooding occurred in 1995 and 1996 in the LBB basin. The instantaneous flood peak of 1,200 m^3/s was recorded in July 1995 at the Pinogu station of the Bone River. At the Lomaya Weir of the Bolango River, two historic flood levels on July 31, 1931 and on February 26, 1971 have been marked on the existing weir. According to these marks flood discharges were preliminarily estimated at 350 m^3/s for 1931-flood and 700 m^3/s for 1971-flood.

2.2.4 Existing Hydro-Meteorological Observatory

(1) Rainfall Observation

Relevant Agencies: The rainfall observation in the LBB basin is operated by the following agencies:

1) BMG: Badan Meteorologi dan Geofisika (Meteorology and Geophysics Board)
2) Bagpro PDSA: Bagian Proyek Pengembangan Data Sumber Air (Water Resources Data Development Project)
3) CDG: Cabang Dinas PU Gorontalo (Publics Works Services, Gorontalo Branch Office)
4) PLN: Perusahaan Listrik Negara (National Electric Power Corporation)

Type of Recording: As of September 2001, there exist at least nineteen (19) rainfall stations that are registered by each organization. The automatic rain gauges (Hellmann

type) were installed at eight (8) rainfall stations. Other stations were equipped with a manual gauge.

Recording Period: In terms of recording period and completeness, there is a high variation among stations. The majority of stations started their observations in 80's or 90's. All but two stations (those operated by BMG or CDG) have a recorded period less than 20 years with some missing periods.

Spatial Distribution: Reflecting on the several geographical constraints in the LBB basin, there are a few rainfall stations situated in the mountainside. No stations are located above an elevation of 500 m. Several of the existing stations, located at the lowland, provide repetitive data due to their close proximity.

Figure 2.2.3 shows the brief location of the rainfall stations ever installed in the LBB basin as of 1999. The location map of rainfall stations in the LBB River basin will precisely be constructed later after collecting the updated information from various related agencies.

Operation and Maintenance: It was acknowledged that three (3) of four automatic rain gauges operated by Bagpro PDSA have not properly been functioned by the broken recorders.

(2) Water Level and Discharge Observation

Relevant Agencies: The river discharge measurement in the LBB basin is performed by the following three agencies:

1) Bagpro PDSA: Bagian Proyek Pengembangan Data Sumber Air (Water Resources Data Development Project)
2) CDG: Cabang Dinas PU Gorontalo (Publics Works Services, Gorontalo Branch Office)
3) PLN: Perusahaan Listrik Negara (National Electric Power Corporation)

Figure 2.2.3 shows the brief location of water level gauging stations ever installed in the LBB basin as of 1999.

Type of Recording: As of September 2001, there exist at least twenty (20) discharge

stations that are registered by each organization. The automatic water level gauges (horizontal A. OTT type X variety or SEBA strip-chart type) were installed at four (4) stations of Bagpro PDSA and at two (2) stations of PLN. Other stations were equipped with only staff gauges.

Recording Periods: In terms of recording period and completeness, there is a high variation among stations. The majority of stations started observation in 90's. All but three stations (those operated by Bagpro PDSA or CDG) have a record period less than 10 years with some missing periods.

Operation and Maintenance: It was acknowledged that three of four automatic water level gauges operated by Bagpro PDSA have been deactivated by severe damage of foundation and recorder caused by the past floods.

(3) Availability of Rainfall and Runoff Data

The extreme lack of data for the flood hydrological study in the LBB basin has already emphasized by the previous studies by CIDA. In addition, the data kept in the Bagpro PDSA, such as database or any other back data collected, processed and analyzed for the previous hydrological studies are unfortunately not fully available for the Study because of software problems of the database (HYMOS) and damages due to November 2000 flood.

Available Data: Availability of daily and hourly rainfall data in the Study Area is shown in Table 2.2.1. Table 2.2.2 shows the daily discharge data collected for the Study. Discharge data available for the Study are very limited. No hourly discharge data are obtained for the Study.

2.3 River Basin and River Channel

2.3.1 River Basin

The Limboto-Bolango-Bone (LBB) basin has a total catchment area of about 2,700 km^2 and is shaped rectangle extending about 100 km from east to west, and about 30 km from north to south. The LBB basin consists of the Lake Limboto basin (890 km^2), the Bolango River basin (490 km^2), and the Bone River basin (1,320 km^2). Overall longitudinal profiles of the Bone River system and the Lake Limboto system are shown in Figures 2.3.1 and 2.3.2.

Administratively the LBB basin is located mostly in the south-eastern part of Gorontalo Province (2,400 km^2) and small portion in the south-western part of North Sulawesi Province (300 km^2). Kabupaten Gorontalo and Kota Gorontalo in Gorontalo Province and Kabupaten Bolaang Mongondow in North Sulawesi Province are related to the basin. The basin and administrative boundaries are shown in Figure 2.3.3.

(1) Lake Limboto Basin

The Lake Limboto basin shares western half of the LBB basin with a total catchment area of about 890 km^2 including the lake area. The major tributaries of the Lake Limboto are the Biyonga River (66 km^2), the Meluopo River (27 km^2) and the Marisa River (64 km^2) from the north, and the Alo-Pohu River, which consists of the Alo River (342 km^2) from the north-west and Pohu River (124 km^2) from the south-west. There are numerous small tributaries from the southern hill. The Lake Limboto has an approximate surface area of 25 km^2 during the dry season and about 50 km^2 during flood.

The headwater elevations of the Lake Limboto basin range from +500 to +800 m, MSL along the coastal divide on the south, +200 to +500 m, MSL along the western basin divide, and +800 to +1,300 m, MSL along the northern divide. In the central portion exists an alluvial plain where Lake Limboto, Limboto city, towns and villages and irrigation areas are located. The elevation of the inland plain ranges from +5 to +25 m, MSL. The combined average basin elevation is less than 150 m, MSL. Tributary basins are all extensively developed with about 66 % of the total area mainly consisting of agricultural land use. Only about 20 % of the basin remain forested.

(2) Bolango River Basin

The Bolango River drains central portion of the LBB basin, originating in the Mt. Lowulowu. It passes through the mountainous areas towards south, joining the Bongo River (81 km^2) and the Mongiilo River (262 km^2) on the left, until it reaches at the Lomaya weir. Basin area of the Bolango River is 388 km^2 at the Lomaya weir. The Bolango River joins the Palanggua River (58 km^2) at the downstream of the Lomaya weir and flows down to the plain land on the northern part of Gorontalo city. Passing on the west of Gorontalo city, it joins the Tapodu River, outlet channel of Lake Limboto, and empties into the Bone River on the south of Gorontalo city. Basin area of the Bolango River is about 490 km^2 in total excluding the Lake Limboto basin.

The maximum elevation is 1,745 m in the eastern headwaters. The inland east-west divide forms the northern headwaters and ranges from 900 m to nearly 1,600 m in elevation. The average basin elevation is approximately 400 m. The lower 33 % of the watershed are developed with dry land, irrigation and urban land use. Approximately 46 % of the basin is forested.

(3) Bone River Basin

The Bone river basin drains the eastern half of the LBB basin. The Moloti River which originates in the Mt. Unggiango and the Bulawa River which originates in the Mt. Sula meet together and become the Bone River in the east of the LBB basin. Passing through the mountainous areas towards the west, the Bone River joins the Bulahu River (73 km^2), the Olama River (73 km^2) and the Bunano River (169 km^2) on the right. After flowing towards the west, it reaches at Alale weir. The total basin area of the Bone River is around 1,060 km^2 at the weir. The Bone River further runs toward the west on the south of Gorontalo city and joins the Tamalate River (70 km^2) and the Bolango River on the right. Just at the downstream of the confluence with the Bolango River, the Bone River changes its direction towards the south, and finally discharges into the Tomini Bay. The total basin area of the Bone River basin is about 1,320 km^2 excluding the Bolango River and Lake Limboto basins.

The average basin elevation is approximately +700 m, MSL with the maximum basin elevation of +1,984 m, MSL at the Mount Matabulawa in the eastern headwaters. The watershed is 90 percent forested and mainly consists of uplands and mountainous terrain. This watershed encompasses a part of Dumoga National Park consisting of

approximately 800 km^2 of protected forest within the Bone River basin.

2.3.2 Principal River Channel Features

River system in the plain area of the LBB basin is shown in Figure 2.3.4. Based on the results of latest river survey conducted by the Study Team, channel characteristics of the major river channels in the Study Area were studied and the results are shown in Table 2.3.1. The channel characteristics include the riverbed slope, river width, mean depth, cross-sectional area, channel slope and existing carrying capacity. They are summarized as follows:

River	River slope	River width (m)	Capacity (m^3/s)
1) Bone River	1/1200	100 to 200	100 to 150
2) Bolango River			
Lower Bone/Bolango River [1)]	1/2600	20 to 30	50 to 100
Middle Reaches [2)]	1/1000	30 to 50	100 to 200
3) Tamalate River	1/3300	11 to 16	6 to 20

Note: 1) River mouth to confluence of Tapodu River, 2) Confluence of Tapodu upstream

2.3.3 Flood and Sediment Disasters

(1) Type of Disaster

Flooding, bank erosion and sediment are the major types of the disaster in the Study Area.

Flooding: Flooding over the riverine lands is the typical disasters observed in the areas along the river course. These flooding occur because of shortage of channel capacity. Poor drainage due to low-lying topography, natural and artificial channel constriction, and backwater from the main river cause the stagnant of flooded water and local storm water bringing about inundation disaster.

Bank erosion: Bank erosions are observed in places of the rivers in the Study Area. Bank protection works were implemented to protect residential areas, trunk roads, etc., although these are implemented as remedial measure with less considerations from basin-wide viewpoint.

Sediment: Devastation of watershed due to illegal logging or shifting cultivation increases sediment yield in the watershed and causes sediment deposits in the river channels, farm lands and lake in the lower reaches. A large part of sediment flows in the Lake Limboto and decrease its storage volume. Consequently a haul of fish in the lake decreases and flood regulation function of the lake lowers.

(2) Inundated Area and Causes

Major inundated areas in the LBB basin are southern part of Gorontalo City, middle reaches of the Bolango River, Limboto City, western part of the Lake Limboto, and Isimu area as shown in Figure 2.3.5. Among these the disasters in the southern part of Gorontalo City are most serious.

Southern Part of Gorontalo City: In the southern part of Gorontalo city, the Bone, the Bolango and the Tamalate rivers join. Water level is raised due to backwater at the confluence of these rivers and inundation occurs frequently. High tide and river mouth sedimentation aggravate the situation.

Middle Reaches of Bolango River: Inundated area extends along the Bolango River from the confluence with the Mongiilo River to the northern part of Gorontalo city. River terrace is formed in this stretch, and flood flow runs along the Bolango River between the river terraces.

Limboto City: Limboto city is inundated by flood water from the Biyonga and Meluopo rivers. The flood flow is interrupted by Gorontalo-Isimu road.

Western Part of Lake Limboto: Western part of the Lake Limboto is inundated due to rising water level of the lake. Inundation in this area lasts for a long time, since the capacity of outlet channel (the Tapodu River) from the lake is small.

Isimu area: Isimu area where the tributaries gather is suffering from inundation due to shortage of carrying capacity of river channel and low-lying topography in the area.

2.4 Natural Environment

2.4.1 Existing Natural Conditions

(1) Flora and Fauna

Geological History: Around 40 million years ago, a northward Australian plate crashed into the Asian plate creating eastern Sulawesi, beginning the fusion between the two around 15 million years ago. Since the two parts of Sulawesi came from different places - Asian origin and Australian origin, they each brought with them a different mix of plants and animals. Sulawesi has one of the highest levels of species endemism in the world. The geological history of Sulawesi makes the flora and fauna of the Sulawesi bio-geographical region unique, and there are many endemic species, though fewer botanical specimens have been collected in Sulawesi than in any other regions in Indonesia.

Endemic and Protected Species: Regarding the protection of endangered and/or vulnerable species, the Indonesian Law (No.5/1990) regarding "Conservation of Biological Resources and Its Ecosystems," designates species needed to be protected (Ref. Table 2.4.1.). According to provincial government officials, four plant species of the designated species are found growing in LBB basin, including Pohon Beringin (*Langusei, Ficus minahasae*), Kayu Hitam (*Diospiros celebica*), Kayu Damar (*Shorea sp.*), and Benuang (*Duabanga moluccaca*). And also, five endemic species of animals, Anoa dataran tinggi (*Buballus depresicornis*), Anoa dataran rendah (*Buballus quarlesi*), Babirusa (*babirussa babirusa*), Kera hitam (*Macaca tongkeana*), and Maleo (*Macrocephalom maleo*), are reported to live in LBB basin. A bird named Maleo (*Macrocephalom maleo*) was formerly widespread in Sulawesi but has disappeared from south of Sulawesi due to habitat loss and is now vulnerable to global extinction.

The Limboto-Bolango-Bone basin (LBB basin), however, is now densely populated and undergoes various activities including agriculture and industry in and around the Lake Limboto, and consequently flora and fauna in it is suffering from human modifications as a whole.

(2) Physical Conditions of Lake Limboto

According to the CIDA Report (Lake Limboto Management Plan Environmental

Screening, 1996), Lake Limboto is currently suffering from sedimentation through rivers and domestic effluent. The inflow rate of suspended loads is assumed to be about 33 mg/l at low flow and up to 1,100 mg/l at high flow. The sources of sediments are coming from the deforested watershed areas and agricultural lands as well as the solid waste, debris, etc. produced from human activities. Sediments are also supplied in the form of bed load during flash floods. In addition to these, there is sedimentation of organic matters produced in the lake, including bacteria, phytoplankton, zooplankton, macrophyte detritus, and faeces from fish and various invertebrates. The thickness of the lake bottom sediments varies throughout the lake, accounting for 3 to 5 m on the east, 5.8 to 6.4 m along the north and west, 8.8 to 10.2 m along the south side, and 12.4 m in the center of the lake. In a eutrophicated lake as Limboto, in-situ sedimentation may account for a significant part of the accretion on the lake bed and result in shallowing over the years.

(3) Water Quality

Results of Investigation: Water quality and bottom-sediment investigations were conducted on the major rivers in LBB basin and in Lake Limboto. The results were summarized as follows:

1) The water quality of the Alo-Pohu, Biyonga, Bolango, Tamalate and Bone rivers as well as Lake Limboto can be evaluated as being polluted by biological pollutants as a whole (Table 2.4.2). Especially, lower Pohu, lower Tamalate and lower Bone river reaches are highly polluted in terms of high concentration of BOD_5, ranging 5.6 to 38.7 mg/l, COD, ranging from 12 to 45 mg/l, and Coliform Bacillus, ranging from <300 to 24,000 MPN/100ml. Turbidity is also high especially on lower reaches of rivers. The Secchi disk reading is usually less than 0.5 m in Lake Limboto, according to the existing data.
2) In spited of the fact mentioned above, water quality of Lake Limboto, whose BOD_5 concentration ranged from 5.6 to 10.3 mg/l, has considered to have improved, when it is compared with the data obtained by CIDA in 1994. This tendency is supported by the Coliform Bacillus of Lake Limboto, ranged from <300 to 2,000 MPN/100ml in 2001, which has improved from the 1994 measurements which ranged from 400 to 46,000 MPN/100ml.
3) The pH value and DO shows that water quality is adequate for aquatic ecology and fisheries. All the measurement results of pH were contained between 7.0 and 8.2. Those of DO ranged from 3.2 to 7.1 mg/l, all of which are consistent

with the water quality criteria of Indonesia.

4) Total Nitrogen (T-N) and Total Phosphorus (T-P) showed that Lake Limboto is under the eutrophic condition. The lake water is evaluated as α-mesosaprobic water judging from the BOD_5 concentration.

5) As for heavy metals, the results indicated that the concentrations of Cadmium (Cd), Total Mercury (T-Hg), Lead (Pb) and Hexavalent Chromium (Cr^{6+}) were lower than the detection limits. However, Selenium (Se), Arsenic (As), Zinc (Zn), Iron (Fe) and Manganese (Mn) were detected, suggesting the effect of some human modification such as industrial activities or mining.

6) The results of bottom-sediment quality test showed that analyzed parameters (heavy metals) were rather low or within Clarke number, which indicates the average concentration in the surface layer of the earth, meaning no contamination with heavy metals. Total Mercury (T-Hg) and Hexavalent Chromium (Cr^{6+}) were lower than their detection limits. However, the measurement results of Selenium (Se) implied the effect of some human activities.

(4) Other Environmental Issues

Water treatment system: Sewage or wastewater treatment system has not been established in the LBB basin. Wastewater from individual house is discharged directly into rivers or other water body, including Limboto Lake. In Kotamadya Gorontalo, the drainage system is developed along roads through which domestic effluent is drained into the rivers. Especially, the Tamalate river is polluted with domestic effluent, because it collects discharges from densely populated areas and the low channel discharge worsens its water quality.

Solid Waste: Regarding solid waste, Kotamadya Gorontalo has a cleaning system. Garbage from individual houses and commercial and industrial enterprises is collected by city service on their request basis. The cleaning activities are carried out from 4:00 to 9:00 in the morning and 16:00 to 18:00 in the evening. According to the city officials, a total of 54 workers (as of August 2001) are allocated in the whole city of Gorontalo. The citizens as well as tourists can receive a benefit from the cleaning system.

The feces collecting system has also been developed in Kotamadya Gorontalo with an assistance of World Bank. Two trucks are now allocated to collect feces from

individual houses on a request basis. The official in charge says that because the collection is charged by Rp.200,000/m^3, only some 20 houses use the collection system a month on the average. The collected faces are separated into solid and liquid, and the solid substances, after dried up, are sold as organic fertilizer to farmers.

Air quality, Noise and Vibration: According to the officials in Kotamadya Gorontalo, there is no data available on air quality, noise pollution or ambient vibration in LBB area.

Land subsidence: According to the PU officials of Gorontalo Province, the issue or problem on land subsidence caused by lowering of groundwater level has not been reported.

2.4.2 Forest Management in Gorontalo

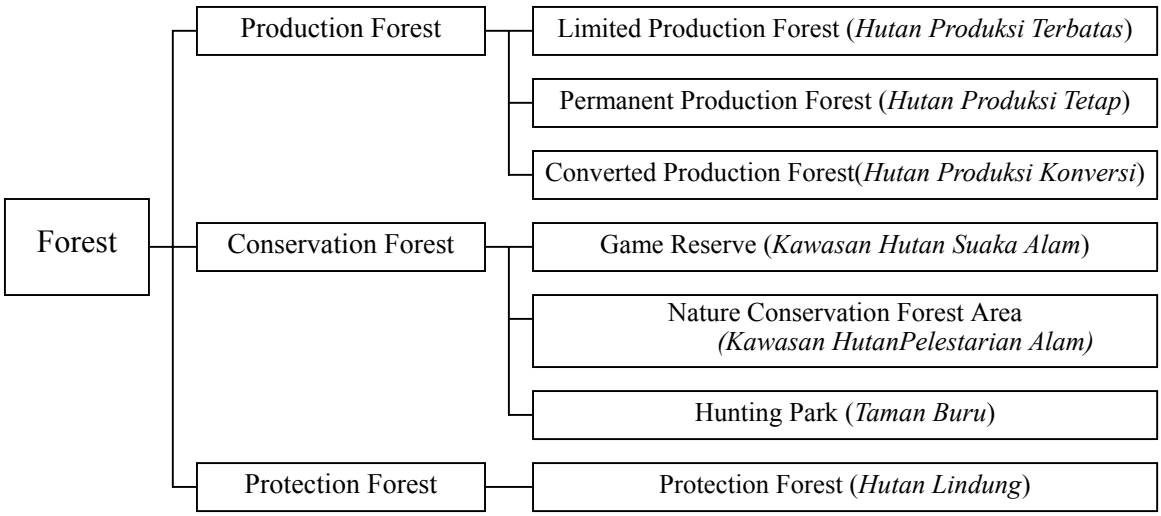
Forest Classification: Forest is classified from the standpoint of ownership rights provided by the New Forest Law (Law No. 41/ 1999) as follows:

1) **State Forest** is a forest in arable land which is not undertaken by authority rights. Customary Forest (*Hutan Adat*) which is located in an *adat* land (traditional jurisdictional area), is also classified into the State Forest.

   The State Forest is further divided into 3 categories in terms of its function defined as follows. Further more, each category is subdivided as illustrated on the figure on the next page:

   - Production Forest is a district of forest that functions mainly to produce forest yield/product.
   - Conservation Forest is a district of forest that has certain characteristics to preserve the diversity of flora and fauna and their ecosystem.
   - Protection Forest is a district of forest that function mainly to protect the life-supporting system in regulating water system, preventing flood, erosion, intrusion of seawater and maintaining soil fertility.

2) **Private Forest** is a forest in arable land which is undertaken by authority rights. All the Private Forest is categorized as Production Forest.



FOREST CLASSIFICATION BY FUNCTION

Conservation Forest and Protection Forest: There are one Game Refuge and one Permanent Nature Conservation Area, which are categorized as Conservation Forest, as listed below while several areas are designated as Protection Forest in the LBB basin as illustrated on Figure 2.4.1. Basically, all the activities of both commercial and domestic are prohibited in the two forest areas. However, some activities done by traditional communities are permitted based on their need, including building houses and planting trees for harvesting and so on.

LIST OF CONSERVATION FOREST IN LBB WATERSHED

Category	Name	Location (Kabupaten)	Area (ha)
Game Refuge	CA. Tangale	Gorontalo	113
Permanent Nature Conservation Area	TN. Bogani Nani Wartabone National Park	Gorontalo and Bolmong	287,115

Source: Report on Data Compilation of Potential Forest Resources of North Sulawesi, Jan. 2000.

Community Forest: Community Forest (*Hutan Kemasyarakatan*, HKM) is a forest developed by government (Decision of Ministry of Forest and Estate Crops No. 677/Kpts-Ⅱ/1998) to improve community participation. The local residents dwelling close to the Community Forest are given common rights to manage and utilize the forest for their livelihood. However, a lot of informal community forests with no permission or approval, are found in upland area of the LBB basin.

Forest Management: The forest in the LBB basin is managed by two levels of local

government: they are Provincial level and Kabupaten level. Each level of government has a forestry service office and formulates program and/or work plan on which forest management activities are to be implemented. Provincial Office (*Dinas Pertanian, Kehutanan dan Perkebunan, Provinsi Gorontalo*) formulated a 5 year (2000-2005) forest management program.

2.4.3 Procedures for Environmental Impact Assessment (EIA)

Environmental Impact Assessment in Indonesia is provided by the Law (No.23/1997) concerning Living Environmental Management and the Governmental Regulation (No. 27/1000) concerning Environmental Impact Assessment and relevant decrees. Procedure for the EIA begins with the public notice of the proposed project and ends at the decision making of project implementation based of the validity of the proposed project (Figure 2.4.2). During the procedure, there are several times of participation opportunities of local residents and stakeholders, by means submission of questions, opinions and/or requests in a form of documents and/or oral through public consultation.

2.5 Social Environment

2.5.1 Present Social Conditions

Peoples: The peoples of the Study Area are mostly from the ethnic group of Gorontalo, however it is known that there are also small village settlements implanted by government sponsored migrations from Bali and Jawa islands (about 35,000 persons in 1999). As a consequence, the Gorontalo Province becomes composed of various peoples from the other areas of Indonesia. Indonesian language is widely spoken in Gorontalo Province like in North Sulawesi, but the Gorontalo people speak also their distinct language. Regarding the religion, Islam is dominant in the area. Muslim is the majority (98.1% of the population) and among the minorities there are Christian (1.6%) and Hindu & Buddhist (0.4%).

Demography and Population: The Study Area in Gorontalo Province has one major urban center, Kota Gorontalo which is made up of three Kecamatan, namely Kota Barat, Kota Utara and Kota Selatan. On the basis of the demographic statistics of BPS of each of the Kecamatan, an aggregated demographic profile is prepared as below.

City (Kota)/ District (Kabupaten)	Area (km^2)	Population (year 2000)	Average pop. Density/ km^2
Whole Area	2,623 (100 %)	495,302 (100%)	154.7
Kota Gorontalo	64.4 (2.5%)	134,937 (27.2%)	2,094.6
Kabupaten Gorontalo	2,558 (97.5%)	360,365 (72.8%)	140.9

Eleven Kecamatan of the study area consist of 204 villages (Desa and Kelurahan) in total.

Education: Education is available up to high school level even in the rural area. Each Kecamatan has at least one high school and more than two junior high schools. Teachers' distribution is different from one Kecamatan to another, but the statistics show that the pupil/teacher ratio is maintained mostly between 12 and 16 pupils per teacher. There are normally more girls than boys in schools at all the educational level and both in Kabupaten and Kota.

Health: A very high number of diarrhea cases were reported at the Kabupaten level in 1999. In Kota Gorontalo, various digestive system disorders were also commonly

observed. In addition, respiratory and eye diseases and skin problem are reported in Kota Gorontalo. There exist various categories of health facilities and their total number for Kota Gorontalo is 187 units and 1,011 for Kabupaten Gorontalo. In terms of personnel, the statistics show a low profile in the region. Only 100 doctors, either general or specialized doctors, are on service for more than 400,000 people in the area.

Social Institutions: Table 2.5.1 summarizes types of existing social institutions at the village level. These institutions are basically established by either government's initiatives or community's own initiatives or with religious background. Although social institutions exist widely in the region, the results of social survey conducted by the present study shows that the residents seem to get a support from their own extended families in the case of flood disaster.

2.5.2 Procedures for Land Acquisition and Compensation

(1) Land Ownership

Land Certificate: BPN (Badan Pertanahan Nasional: National Land Agency, formally called as Agralia till 1988) is the main agency to treat land related issues. The fundamental law regarding land is "Undan Poko Agralia No.5/1960" established in 1960. The BPN is responsible for issuing land certificates in response to the application of land holders. The situation of the issue of land certificate in Kota Gorontalo is presented below.

Land Certificates Issued in Kota Gorontalo (1961-Sept.1997)						
Kecamatan	HM	HGB	P	PL	HGU	Total
Kota Utara	6,664	818	141	-	-	7,623
Kota Barat	3,126	190	109	1	-	3,426
Kota Selatan	9,419	406	422	-	3	10,250
TOTAL	19,209	1,414	672	1	3	21,299

The land certificates seen in the above table are classified according to its utilization and owner: HM (Hak Milik: Private land), HGB (Hak guna bangunam: for government building), P (Hak pakai: only its utilization is permitted), PL (Hak pengelolaan: Public infrastructure such as Sea port) and HGM (Hak guna usaha: only agricultural use is permitted).

Hak Milik Adat: The BPN's map of land property shows most of the land along the principal rivers and outflow of the Lake Limboto is recognized as "Hak milik adat (traditional private property)". But the meaning of "adat (custom, tradition)" seems different from that in Minahasa region, because there should not be "Tanah milik adat (tanah adat: traditional land)" in Gorontalo Province, which is seen only in Minahasa region. Although all the land in Minahasa is considered as "Tanah swapraja" (Tanah Negra: state owned land), people live and cultivate for a long time, often for more than one generation, and the people there come to consider that the land belong to themselves. Since some of the residents in Gorontalo had lived in Minahasa before and called their land as "Tanah adat", they maybe adopted the same term to their using lands in Gorontalo.

(2) Land acquisition

Land Acquisition Options: For the government to acquire the lands which are already occupied and used, there are two alternatives. First, government assists the people to move from the flood prone areas and gives in return compensation in form of money. By doing so, the people will be able to look for new land to build their houses again. Second option is that government provides the people with land of safe area for use. In the second alternative, government is supposed to obtain land by itself and then give to the persons to be moved.

Regulations Concerned: For land acquisition process, two set of regulations below are concerned.

Presidential Decree	Implementation regulation
1. Keppres No.55 / 1993	Peraturan Menteri Negara Agraria/ Kepala BPN No.1 / 1994
2. Keppres No.21 /1993	Peraturan Menteri Negara Agraria/ Kepala BPN No.3 / 1994

(3) Compensation

Compensation is usually provided in the form of land or money and is obligatory especially for formal land owners who already have appropriate land certificates. However, a certain kind of compensation is to be considered for the residents without land certificate who it seems are the majority in the flood prone area of the region according to our observation.

Compensation procedure for the latter case would be complex and need to be carefully elaborated. Formal procedure of land acquisition including compensation payment, which is coordinated and administered by a Land Acquisition Committee, is summarized in Table 2.5.2. The BPN provincial office was established in 2002, which covers the acquisition of the lands extending in both Kabupaten and Kota and in the case of objection on the compensation.

2.6. Socio-Economy

2.6.1 Administration and Demography

Administrative Subordinate: The Republic of Indonesia is administratively divided into 26 propinsi (provinces). The propinsi is divided into 268 kabupaten (regencies) and 73 kota (municipalities). Both the kabupaten and the kota are furthermore divided into 4,049 kecamatan (districts), and the kecamatan into 69,050 desa (villages in rural areas) or kelurahan (township in urban areas), as of the end of 2000. The LBB Basin has an area of about 2,700 km^2 in total, of which 94% is located in Kabupaten Gorontalo, 2% in Kota Gorontalo and 4% in Kabupaten Bolaang-Mongondow (Figure 2.3.3). 3.8% of the administrative territory of Kabupaten Gorontalo is included in the LBB Basin. Most of the developed areas of the Kabpaten Gorontalo are included in the basin. Kota Gorontalo is completely included in the basin.

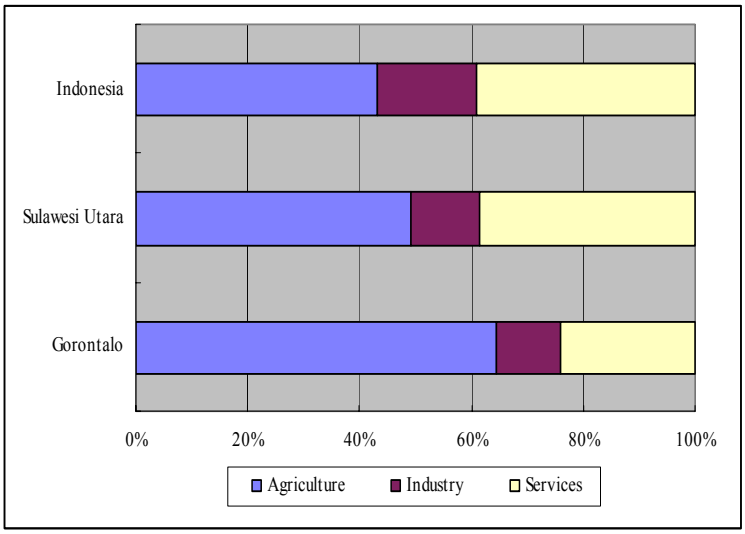
Population: Population in the LBB Basin was estimated at 442,000 or 0.21% of the national population in the census year 2000 as shown in Table 2.6.1. The average growth rate during the 1980's was 1.44% per annum. During the 1990's, it furthermore slowed down to 1.22%. The basin population was summarized as follows:

(Unit: 1000)

Province	Kabupaten/Kota	1980	1990	2000
Gorontalo	Kota Gorontalo	97	121	135
	Kab. Gorontalo	240	268	304
Sulawesi Utara	Bolaang-Mongondow	2	2	3
Total		339	391	442

In the basin, Kota Gorontalo is the largest town in terms of population, and functions as the center of the basin and Propinsi Gorontalo as well. Its census population was 135,000 in 2000. The growth rate during the 1990's was 1.08% per annum on average. An urban population in the LBB Basin was estimated at 205,000 in 2000, comprising 120,000 in Kota Gorontalo and 85,000 in Kabupaten Gorontalo. It accounted for 46% of the basin population. The average family size was 3.9 persons per household in Propinsi Gorontalo in 2000.

Labor Force: In the census year 2000, a population of 15 years old and over in Propinsi Gorontalo was estimated at 448,000, accounting for 66% of the total population (678,000). Of the population of 15 years old and over, it is said that around 65% or 290,000 people participated in labor force market as economically active people. In the labor force market, it was recorded that 265,000 people were employed in Kabupaten Gorontalo in 1999.



Among the major economic sectors, the agriculture sector absorbed 168,000 or 64% of the total employed. 24% was employed in the services sector. The industrial sector absorbed 12% only. This labor structure is quite different from the national one, i.e., 43% in agriculture, 18% in industry and 39% in services, as shown in the figure above. Thus, Propinsi Gorontalo is said to specialize in agricultural production.

2.6.2 Economic Profiles of Study Area

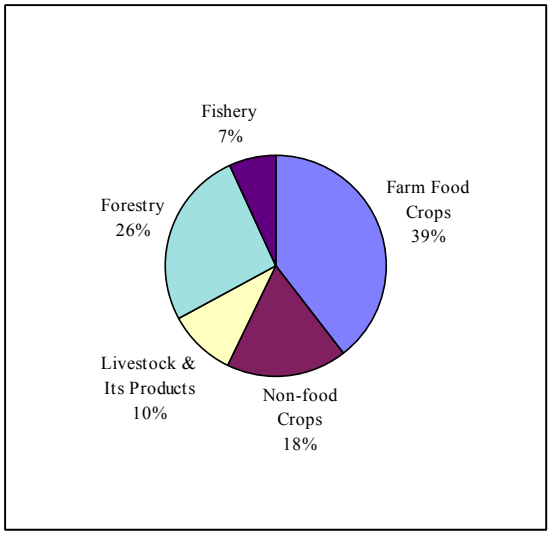
Regional Accounts: Representing regional account of the LBB Basin, historical per capita GRDP were estimated and shown in Table 2.6.2. The per capita gross regional domestic products (GRDP) of Kabupaten Gorontalo and Kota Gorontalo were estimated at Rp.1.16 million and Rp.2.39 million (equivalent to US$122 and US$251) respectively in 2000, which are only 18% and 38% of the national average (Rp.6.34 million) as shown below:

Region	GRDP in 2000 (Rp. Billion)	Per capita GRDP in 2000		Ratio to National GDP per capita (%)
		(Rp.1000)	(US$ Equiv.)	
Kab. Gorontalo	806	1,160	122	18
Kota Gorontalo	322	2,388	251	38
Total	1,128	1,535	162	24
Indonesia	1,290,684	6,344	666	100

The economy of the Kabupaten is said to specialize in agricultural production. On the

other hand, the Kota specializes in services in particular. The national economy performed a steady growth till 1997. In 1998, because of monetary crisis in most of Asian countries, Propinsi Sulawesi Utara and Kabupaten Gorontalo experienced a negative growth of -2.4% and -2.6%, respectively. Kota Gorontalo, however, performed a positive growth of 2.7%. For the year 1999, the national and regional economies were better than those in 1998.

Agriculture Sector: The economy of Kabupaten Gorontalo relies mainly on agriculture, as discussed in the economic structure in regional accounts. Among agriculture sub-sectors, crop production is the leading sub-sector, accounting 57% of the agriculture gross value added (GVA) in the kabupaten in 2000. It comprised 39% of farm food crops and 18% of non-food crops. Production of major crops of Kabupaten Gorontalo is shown in Table 2.6.3. Kabupaten Gorontalo recorded comparatively the large share of coconut, maize and guava in the country in 1999. In addition to these crops, paddy, mango, banana, pineapple and cocoa were popularly produced in the Kabupaten.



Industry Sector: In Gorontalo Province, there were 10,952 industrial establishments in 1996. They are segregated as shown in the table below. The large and medium scale establishments (more than 20 employees) accounted for only 36 establishments or 0.3% of the total establishments. The small (employees between 5 and 19) and home (less than 4 employees) industrial establishments accounted for 8.0% and 91.3%, respectively.

Area	Large & Medium	Small	Home	Total
Kab. Gorontalo/Boalemo	18	698	8,511	9,227
Kota Gorontalo	18	175	1,532	1,725
Total	36	873	10,043	10,952

In addition to manufacturing establishments, there were 1,640 mining and quarrying

establishments, 52 establishments servicing electricity, gas and water supply and 2,912 construction companies in Gorontalo Province in the 1996 census year. The total number of these establishments was 4,604, accounting for 30% of the total establishments (15,556) in the industrial sector. Thus, the manufacturing sub-sector occupied 70% of this sector in 1996.

Services Sector: In Gorontalo Province, there were 41,446 servicing establishments in 1996. They are segregated into four sub-sectors; wholesale and retail, trade, hotel and restaurant; transport and communication; financial institution; and other services. Among these sub-sectors, wholesale and retail trade, hotel and restaurant sub-sector accounted the largest share of 77% of the total establishments. The establishments of trading, hotel and restaurants sub-sector were furthermore classified into three scales based on the number of employees following the same definition as the manufacturing industry. Their percentage distribution was as follows: 0.1% of large and medium scale, 1.3% of small scale and 98.6% of home industry. In this sub-sector, 45,360 workers were employed by these establishments in 1996. Then, an establishment employed 1.4 workers on average.

Area	Large & Medium	Small	Home	Total
Kab. Gorontalo & Boalemo	13	211	24,588	24,812
Kota Gorontalo	22	211	6,965	7,198
Total	35	422	31,553	32,010

According to the handbooks of the Kecamatan related to the flood prone areas, there were around 6,000 establishments of trade, hotel and restaurants sub-sector in their administrative territories.

2.6.3 Public Finance

National Revenue and Expenditure: The total expenditure of the national government has nominally increased from Rp. 79 trillion in 1995/96 to Rp.245 trillion in 1999/2000 as shown in Table 2.6.4. On the other hand, the ratio of this expenditure to GDP has gradually increased from 17% in 1995/96 to 22% in 1999/2000 as shown below.

(Unit: Rp. Trillion)

Item	1995/96	1996/97	1997/98	1998/99	1999/2000
GDP*1	455	532	628	1,002	1,107
Expenditure	79	99	128	216	245
Percentage (%)	17	18	20	23	22

Note: *1 In the case of a fiscal year 1995/96, GDP in 1995 was applied in this table.

According to the budget base of the national government, the total amount for the water resources and irrigation sub-sector including flood control rose from Rp. 2.0 trillion in 1995/96 to Rp. 3.5 trillion in 1999/2000 (Table 2.6.5).

Provincial Revenue and Expenditure: In Sulawesi Utara Province, the national government invested Rp.666 billion for development projects in the fiscal year 1999/2000 as shown in Table 2.6.6. Of this total amount, Rp.121 billion (18%) was allotted to projects of public works, and the water resources development division accounted for Rp.46.3 billion (7%) of the total amount for the public works. Flood control projects accounted for 4.1 billion or (9%) of this total for the water resources development. Expenditures for flood control in Sulawesi Utala Province and those estimated for the LBB basin are shown below.

Expenditure for Flood Control (Unit: Rp.Billion)

Item	1995/96	1996/97	1998/97	1998/99	1999/00
Sulawesi Utara	-	7.8	8.0	3.9	4.1
LBB basin (estimated)	0.81	2.73	1.25	2.21	1.15

2.6.4 External Debt

Balance of Payment: Indonesia has traditionally run a deficit until 1997/1998 but moved toward surplus after 1989/1999 on its current account. The merchandise trade recorded to keep the balance in black for long time. In particular, since the foreign imports abruptly decreased because of economic recession in the domestic market after 1998, trade balance increased drastically after 1998/99. On the other hand, services balance has recorded the high level deficit. As a result, however, the over-all current account balance moved into surplus after 1998/99.

Since consumption and investment in the domestic market went into moderate after 1998, it marked that the savings account exceeded the invested account in the domestic

market. In other word, the domestic market stands in surplus of capital. These excess capitals run out from the country, and the private capital balance dropped into deficit. In recent years, the internal disorder made net capital inflow decrease, so foreign investors decreased capital inflow into the country. However, since official capital balance kept the black after 1998, the over-all capital account balance fluctuated between surplus and deficit.

Foreign Assistance: Table 2.6.7 shows historical changes of official development assistance (ODA) to Indonesia. Gross receipts of ODA from OECD, Arab countries and multilateral agencies aggregated to US$39.30 billion for the recent five years and averaged US$7.86 billion per year between 1995 and 1999. The receipts fluctuate year by year.

An average annual receipt of ODA accounted for approximately 6.3% of GDP in 1999. The percentage of this rate was around 4% until 1997, but it abruptly increase more than 6% after 1998. It would critically be caused by rupiah devaluation. The receipt accounted for 25.9% of an annual expenditure of the central government on average in the same period. For the recent five years, its average rate was around 25%. It ranged from maximum 19.2% in 1996 and minimum 28.7% in 1997 as shown in the table below.

(Unit: US$ billion)

Item	1995	1996	1997	1998	1999
Receipt of ODA	7.89	7.94	7.90	6.63	8.95
GDP	202.13	227.37	215.75	95.45	141.31
Expenditure of Central Government	34.32	41.34	27.52	26.86	34.61
Share of ODA (%)					
To GDP	3.9	3.5	3.7	6.9	6.3
To Expenditure of C. Gov.	23.0	19.2	28.7	24.7	25.9

External Debt and Outstanding: In 1999, the total external debt was US$150 billion, accounting for 106% of GDP (Table 2.6.8). In 1999, the outstanding of long-term debt was US$112 billion. The total debt-service was US$17.8 billion, comprising US$120 billion of principal repayment and US$6.1 billion of interest payment. The table below shows the trend of total debt service between 1995 and 1999.

(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.

The debt-service ratio (DSR), a kind of country risk assessment factors, has been at almost the same condition, i.e., from 30.7% in 1994 to 30.3% in 1999. Thus, the DSR has kept a critical position in terms of external debt problem, because those were always beyond the level of 20%, critical level of DSR.

2.6.5 Socio-Economic Projection

Population Projection: The BPS provides population projections for the country and for its subdivisions down to provincial level during the period 1995 to 2005. In addition, Program Pembangunan Jangka Panjang Tahap ke-II (PJP-II) proposed a population projection in its long-term development program for 25 years from 1995 to 2019.

In this study, the future population was projected as shown in Table 2.6.9 on the basis of the BPS projection and PJP-II. The population projected up to the year 2020 at 5-year intervals is shown below.

(Unit: 1000)

Area	2000	2005	2010	2015	2020
Kab. Gorontalo*1	695	746	794	837	876
Kota Gorontalo	135	142	148	156	158
LBB Basin	442	467	491	512	531

Note: *1 Including Kabupaten Boalemo

GDP and GRDP Projection: The long-term projection of GRDP is indispensable for formulating the future framework of the socio-economic structure in the project area. Official economic projection is proposed in the National Development Plan

(PROPENAS) 2000-2004. After the year 2004, no official projection scenarios are suggested in any of the development plans. Therefore, the GRDP after the year 2004 was estimated, assuming the average growth rate of 5.0 per annum, adjusting it with population growth rate of the respective administrative areas (Table 2.6.9).

GRDPs projected for the areas related to LBB Basin are shown in the table below.

(At 1998 constant prices)

Area	GRDP (Rp. Million)		GRDP per Capita (Rp.1000)	
	2000	2020	2000	2020
Indonesia	1,010,000	2,770,000	4,960	11,260
Kab. Gorontalo	1,030	3,080	1,490	3,520
Kota Gorontalo	290	1,200	2,120	7,540
LBB Basin	740	2,500	1,680	4,720

2.7 Organizations and Institutions

Organizational setup of the government agencies and other organizations are introduced in the following sub-sections based on the latest information as of September 2002, unless otherwise mentioned.

2.7.1 Water Resources Administration

Authority of Central Government: Ministry of Settlement and Regional Infrastructure (KIMPRASWIL) is the authority in public work sector handling spatial management, regional infrastructure, urban and rural, housing and settlement and water resources. The Water Resources are administrated in the Directorate General of Water Resources (DGWR) of KIMPRASWIL. Organizational structures of KIMPRASWIL and DGWR are shown in Figures 2.7.1 and 2.7.2.

Dinas PU/Kimpraswil of Gorontalo Province: Implementation institution (Dinas) in Gorontalo Province was established by the Governor of Gorontalo Decree No. 02/2001 in February 2001. The Decree states the establishment of nine Dinas. In the beginning of the year 2002 these Dinas were reorganized into eleven Dinas by the Provincial Decree. Dinas of Public Work/Settlement and Regional Infrastructure (Dinas PU/Kimpraswil) carries out the Water Resources administration through Sub-Dinas Pengembangan Sumber Daya Air (Sub-Dinas of Water Resources Development). Organization of Dinas PU/Kimpraswil is shown in Figure 2.7.3.

Dinas PU of Kota Gorontalo: Management of water resources matter Kota Gorontalo is done by Dinas Public Works (Dinas PU) through Sub-Dinas of Water Resources (Sub-Dinas Pengairan). Organization of Dinas PU Kota Gorontalo is shown in Figure 2.7.4. For the time being the Irrigation Operation & Maintenance in Kota Gorontalo are still implemented by Sub-Dinas Pengembangan Sumber Daya Air of Gorontalo Province, and the activities of flood control up to the year of 2001 was implemented by Water Resources Management and Flood Control Project (PPSAPB) of North Sulawesi Province, though some part are implemented by Kota Gorontalo using local budget.

Dinas PU-Praswil of Kabupaten Gorontalo: The Water Management in Kabupaten Gorontalo was formerly done by the Branch Office of Public Work in Gorontalo, a branch of Public Work of North Sulawesi Province. The organization and work arrangement of Dinas in Kabupaten Gorontalo are established by Regional Regulation

of Kabupaten Gorontalo No. 43/2000 and Bupati Gorontalo Decision No. 721/2000 for the implementation. The water resources management in Kabupaten Gorontalo is carried out by Dinas Public Works and Regional Infrastructure (Dinas Pekerjaan Umum dan Prasarana Wilayah: Dinas PU-Praswil). Organization of PU-Praswil is shown in Figure 2.7.5. The institution of Kabupaten Gorontalo is still in the transition condition, and the matters of water management such as irrigation operation and maintenance are still being implemented by Sub-Dinas Pengembangan Sumber Daya Air of Gorontalo Province.

Dinas of North Sulawesi Province: The organization of Dinas in the North Sulawesi Province was established by North Sulawesi Regional Regulation (Peraturan Daerah) No. 10/2000. The organization consists of 17 Dinas. The institution related with water resources is Dinas Pengairan (Dinas of Water Resources Development). By the Governor Decree (2001) the name of Dinas Pengairan was changed to Dinas Sumber Daya Air (Dinas SDA).

2.7.2 Coordination Bodies in Water Resources Sector

Panitia Tata Pengaturan Air (PTPA): At the provincial level, water and water resources management are coordinated with other sectors by Governor, establishing Panitia Tata Pengaturan Air (PTPA: Province Water Resources Management Committee) in the sector of water resources. The PTPA is a conference forum for the coordination in water and water resources management at the provincial level. Since Gorontalo is a new province, the PTPA is not yet established, while in North Sulawesi Province PTPA was established by the Governor Decree No. 85/2001. The member of PTPA may consist of Vice Governor as chairman, representatives of water related government agencies, university, NGO and other organizations.

Panitia Pelaksana Tata Pengaturan Air (PPTPA): Coordination in the river basin level can be implemented through Panitia Pelaksana Tata Pengaturan Air (PPTPA: River Basin Water Resources Management Committee). The PPTPA can be established by the Governor. In North Sulawesi Province the PPTPA has been set up in two river basins and the Limboto-Bolango-Bone basin is one of them. Since there is no PTPA in Gorontalo Province, the PPTPA of North Sulawesi Province can function as PTPA of Gorontalo Province. In Kabupaten Gorontalo, a forum for water resources management has been organized by the name of PPTPA Wilayah Sungai Kabupaten Gorontalo and a working team/secretariate has been established by Bupati Decree

No.52/2001.

Water Users Association (WUA): Water Users association in Gorontalo named as Perkumpulan Petani Pemakai Air (P3A) is the farmers' organization which manages irrigation water at a tertiary irrigation network or irrigation network at farmer level. The P3A has function to optimize the use of irrigation water available at tertiary level system for the benefit of the farmers.

Provincial Irrigation Committee: The irrigation committee in North Sulawesi Province was established by Governor Decree No. 157/1989. The functions of Provincial Irrigation Committee are:

1) to assist the Governor in allocation, deciding and giving water for agricultural need and other,
2) to guide Kabupaten Irrigation Committee,
3) to solve problem which can not be solved by Kabupaten Irrigation Committee, and
4) to coordinate with Kabupaten Irrigation Committee periodically and make evaluation.

The Provincial Irrigation Committee is chaired by Governor and representatives of the relevant agencies constitute the members.

Kabupaten/Kota Irrigation Committee: Kabupaten/Kota Irrigation Committee in North Sulawesi Province (including Kabupaten Gorontalo) was established by Governor Decree No. 228/1987. The Irrigation Committee is chaired by Bupati/Walikota and representatives of the relevant organizations constitute the members. Job of the Irrigation Committee is to assist the Bupati/Walikota in allocation of irrigation water for cropping and other.

2.7.3 Progress of Administrative Renovation

(1) Establishment of Gorontalo Province

The establishment of Gorontalo Province was agreed by Central Government with the Law No. 38/2000 pertaining the establishment of Gorontalo Province. The Provincial Governor was initially appointed by the Central Government. The organization and working order of Gorontalo Province, Regional Secretariat and Gorontalo Province Parliament Secretariat have been established by the Governor Decree No. 01/2001, and

the organization and working order of the Dinas in Gorontalo Province have been established by the Governor Decree No. 02/2001. In the year of 2001, the member of the Gorontalo Provincial Parliament has been formed, and in December 2001, the Governor was elected by the Parliament.

Dinas PU/Kimpraswil was established to handle the public works, and Sub-Dinas of Water Resources Development is managing the water resources matters of Gorontalo Province. Although the administrative agencies are organized, they still need reinforcement in the number of staff and the capability.

(2) Water Resources Sector Adjustment

WATSAL: Coping with financial deficit, the Government of Indonesia prepared a structural adjustment program of policy, institutional, regulatory, legal, and organizational reforms in the management of water resources and irrigation sector in 1999. The program was supported by the World Bank with Water Resources Sector Adjustment Loan (WATSAL) financed by Asian Development Bank (ADB) and Japan Bank for International Cooperation (JBIC). The program has four objectives as follows:

1) **Facilitating efficient environmentally and socially sustainable water resources development and management** by improving national policy, institutional, regulatory and decision-support frameworks:
2) **Strengthening of the institutional and regulatory framework** for integrated and equitable river basin management:
3) **Establishing effective regulatory institutions and implementation arrangements** for water pollution abatement and regional water quality management:
4) **Improving the performance and sustainability of irrigation systems** by establishing an institutional framework for transparent and accountable delivery of irrigation services and participatory fiscal support to democratic farmer organizations empowered with governance and financial authority to manage irrigation networks under their control:

Concern of the Study: The WATSAL program is an effort to adjust institutional and regulatory structure through legislative and organizational renovations covering whole water resources issues. The present Study has strong concern with the outcomes of the

WATSAL program, because all the activities related to the water resources should follow them. Among others, major concerns of the Study are decentralizing water resources management and establishing integrated water resources organization in the provincial level. The administration change toward decentralization system is ongoing in the Study Area as described in the following sub-section in line with the WATSAL program. The Technical Implementation Unit called as Balai PDSA, which would be the integrated water resources management unit of the Limboto-Bolango-Bone river basin, is being established over the country as an activity under the WATSAL program.

(3) Decentralization System in Water Resources Sector

There was a change in administration system from the centralization system to decentralization system, mainly by the Law No. 22/1999 pertaining Regional Governance and the Law No. 25/1999 pertaining Fiscal Balance between Central and Regional Government. Having these new paradigms, an activity is being taken recently in the Central Government to replace the Law No. 11/1974 pertaining Water Resources and the Government Regulation No. 22/1982 pertaining Water Management.

The operation of decentralization is progressing gradually stating from preparedness in the Central Government to the local governments step by step. The decentralization in Gorontalo Province seems just started. Under the new decentralization system, all the authorities regarding the water resources are transferred to regional government (Kabupaten/Kota). In order to administrate issues in the water resources sector, Kabupaten/Kota Gorontalo have established Dinas, i.e., Dinas PU Kota Gorontalo and Dinas PU-Praswil Kabupaten Gorontalo. The progress and current issues of the decentralization are described in the paragraphs below.

Fundamental Changes in Administration: This administrative renovation from the centralization system to the decentralization requires fundamental changes of the institutions of the central government, local governments, and local communities as well. For the operation of the decentralization, relevant laws and subsequent regulations must be enacted.

Issuance of Regulations and Decrees: The decentralization policy was announced in 1999. Since then, Central Government devoted to adjustment of relevant regulations and decrees, and as far as the water resources concerned, most of the regulations and decrees were issued in December 2001. Based on the legal frameworks of the Central

Government, regulations and decrees of the provincial and regional governments are now being issued gradually.

Delay of Preparation: Owing to the delay of the announcement of the legal frameworks of the decentralization, it was also delayed to prepare for transfer of authorities from the central and provincial governments to regional governments (Kabupaten/Kota). The Kabupaten/Kota are also not ready to receive the authorities. Gorontalo Province was newly established in 2000 and the Governor had to establish his own administrative institutions first. Provincial government has established Dinas PU/Kimpraswil, and Kabupaten and Kota Gorontalo also have established Dinas PU-Praswil and Dinas PU, respectively for public work services including water resources management. These Dinas, however, are not yet enough to implement the authorities in staff number and their capability, though the preparedness is progressing day by day.

Enpowerment of Local Communities: Under the decentralization administration, the local communities and local organization like Farmer Organization and Water User's Association (WUA) also share important roles in water resources management. Empowerment of local communities with institutional and financial arrangements are necessary, so that they can participate in the water resources management with reasonable contributions.

Balai PSDA: If the transition toward decentralization lasts too long and water management falls in disorder, there would be a possibility of local conflict of interests in the community and territorial ego among the regional governments related to the water resources management. Establishment of Balai PSDA in early stage is expected to direct and mange water resources in LBB basin coordinating the governmental agencies and community organizations.

2.8. Review of Previous Studies and Plans

Various studies and works have been made previously in the LBB basin. These studies are outlined hereunder.

2.8.1 LBB Basin Water Management Master Plan

Limboto-Bolango-Bone Basin Water Management Master Plan (WM-MP) was formulated in March, 1999 by Sub Dinas Pengairan, PU and the Canadian Executing Agency (CEA) through the North Sulawesi Water Resources Institutional Development Project (Proyek Pembinaan Pengairan Sulawesi Utara: P3SU Project:), a project funded by the Canadian International Development Agency (CIDA). The report and the Master Plan are referred to as the CIDA Report and the WM-MP in this report.

Objectives: The WM-MP aims to 1) provide a central planning and coordination instrument for the application of an integrated approach to water management, 2) guide decision makers for the optimal management of the basin in support of the social and economic development, 3) present a group of viable water resources development schemes in support of the National and Provincial plans, and 4) formulate a phased development plan to exploit opportunities for single and multi-purpose water resources projects.

The Plan is addressed to the people of the LBB basin and is intended for the planning agencies and management authorities in the Province of North Sulawesi and the basin.

Studies: Basin-wide studies were undertaken in 1993 and 1994 at the start of the planning process. In 1995/96, a set of water management issues were compiled based on information from initial studies, an analysis of trends, and the outputs of a public consultation meeting.

Plan components addressing the identified issues were prepared. Each component consists of a set of initiatives that are designed to meet the component objective. These components with their respective initiatives make up the WM-MP. National, provincial, and basin level plans were closely studied and referred to at each step of the planning process to ensure that the plan is in keeping with stated Government policy.

Water Management Issues: As a result of studies, the CIDA Report identified nine

major water management issues as follows:

1) Inadequate institutional capacity,
2) Deforestation of Watersheds,
3) Water shortage for irrigation in West Limboto,
4) Flood hazard in Kotamadya Gorontalo and Limboto,
5) Pressure on Lake Limboto,
6) Inadequate exploitation of irrigation infrastructure,
7) Limited access to safe drinking water of the rural population,
8) Unreliable urban water supply systems, and
9) Inadequate sanitation measures.

In order to cope with these issues, six objectives were identified and pursued as the components of the WM-MP.

Component 1: Improve the institutional framework for water management,
Component 2: Protect and conserve the water resources,
Component 3: Improve the use of the Existing water infrastructure
Component 4: Meet water requirement
Component 5: Contribute to meeting energy requirement
Component 6: Reduce urban and agricultural flood damage

A total of 29 initiatives are proposed to attain the component objective. The SDP (Sub Dinas Pengairan) of North Sulawesi Province proposed a five year action plan for Repelita VII from 1999/2000 to 2003/04, and 14 initiative indicated in the said Table were adopted for the five year action plan.

Concerns with the FM-MP: The WM-MP covers widely water management issues including flood and sediment issues in its part. The WM-MP should be observed as a basic plan for the Flood Mitigation Master Plan (FM-MP) under the present study.

Among 6 components of the WM-MP, Component 6 (Reduce Urban Flood Damage) has direct concerns to the FM-MP of the LBB basin. However, there are some other initiatives for other components to be adopted as alternative schemes or to be considered in planning the FM-MP.

Data and studies compiled in the CIDA Report are the invaluable source of basic data

for the study of the FM-MP.

2.8.2 Drainage Master Plan of Gorontalo City

Drainage Master Plan of Gorontalo City (Penyusunan Master Plan Drainase Kota Gorontalo) was prepared in December 2000, for Planning Board (Bappeda)/Kota Gorontalo, by PT. Palma Sejai, Manado. The study was conducted from September to December 2000.

Objective: The study aims to provide clear guidelines to overcome drainage problems of Gorontalo City, its implementation stages, and cost estimate. The scope of the study covers:

1) Preparation such as data collection and problem analysis,
2) Formulation of Drainage Master Plan, and
3) Installation of survey bench marks at 10 places.

Floods in Gorontalo City: Gorontalo City, especially Gorontalo Bawah is suffering from flood every years located in the flood prone area. The repeated floods happen due to the following reasons:

1) Low-lying flat lands almost of sea level;
2) Flood plains at the confluence of the Bone, Bolango and Tamalate rivers;
3) Area influenced by sea tides;
4) Sedimentation and narrow due to sand and others affects toward the Bone, and Bolango and Tamalate rivers; and
5) Lack of systematic overall plan for the drainage system of Gorontalo City.

Division of Drainage Blocks: The urban area of Gorontalo City is divided into four major drainage blocks as follows:

1) Block I: Area located in the north of the Tamarate river bordered by the Primary Bolango canal (Primer Bolango Bagian Kanal).
2) Block II: Area between the Bone and Tamalate rivers
3) Block III: Area consisting of a part of Kelurahan Siendeng and Kelurahan Biawu around the Bolango river.

4) Blook IV: Area consisting of Kelurahans of Talumolo, Leato, Leato Selatan and Botu.

Drainage Master Plan: The drainage master plan proposes the drainage system to cover about 50% of the urban area of Gorontalo City within the time period of 20 years.

Concerns with the FM-MP: The urban area of Gorontalo City is a part of the Study Area of the FM-MP and the drainage system and drained water under the Drainage Master Plan should be taken into account the study for the FM-MP.