No.

THE STUDY ON
CAPACITY DEVELOPMENT FOR JENEBERANG RIVER BASIN MANAGEMENT
IN
THE REPUBLIC OF INDONESIA

FINAL REPORT

VOLUME II
MAIN REPORT

March 2005

Japan International Cooperation Agency

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PREFACE

In response to a request from the Government of the Republic of Indonesia, the Government of Japan decided to conduct the Study on Capacity Development for Jeneberang River Basin Management in the Republic of Indonesia and entrusted the Study to the Japan International Cooperation Agency (JICA).

JICA selected a study team consisting of Nippon Koei, Co., LTD. and CTI Engineering International Co., Ltd. The team was headed by Mr. Michito Kato and was dispatched to Indonesia three times between January 2004 and January 2005. In addition, JICA set up an advisory committee headed by Dr. Takeyoshi Sadahiro, Japan Water Agency (JWA), for the period between January 2004 and and March 2005.

The team held discussions with the officials concerned of the Government of the Republic of Indonesia and conducted field surveys and studies in the study area. Upon returning to Japan, the team conducted further studies and prepared this final report.

I hope that this report will contribute to the capacity development of the river basin management activities in the Jeneberang River basin and also to the enhancement of friendly relations between our two countries.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of Indonesia for the close cooperation they extended to the Study.

March 2005

Mr. Etsuo Kitahara
Vice-President
Japan International Cooperation Agency

March 2005

Mr. Etsuo Kitahara
Vice-President
Japan International Cooperation Agency (JICA)
Tokyo, Japan

Letter of Transmittal

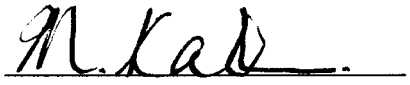
It is with great pleasure that we submit herewith the Final Report of the "Study on Capacity Development for Jeneberang River Basin Management in the Republic of Indonesia".

The main objectives of the Study were threefold: (i) assistance in establishment of a new Public Corporation (PJT Jeneberang) to be responsible for river basin management, (ii) preparation of a river basin management plan incorporating plans for O&M of infrastructures, and (iii) preparation of a capacity development plan. Phase I of the Study examined the present conditions of the basin and its management. Subsequently, in Phase II, a plan was formulated in line with the above-stated objectives. The Final Report presents the outcomes from these Phase I and Phase II studies.

We hope that this Final Report will assist capacity development for river basin management in the Jeneberang River basin. We believe that the success of the proposed capacity development programs would assure further improvements in river basin management activities in the long term and thus would contribute to the improved social welfare and living environments of people in the basin.

We wish to express our sincere gratitude to the personnel concerned of your Agency for the guidance and support given throughout the Study period. Our deep gratitude is also expressed to the Directorate General of Water Resources of the Ministry of Public Works (acted as Counterpart Agency) and other concerned authorities of the Government of the Republic of Indonesia, JICA Indonesia Office, and the Embassy of Japan in Indonesia for their close cooperation and assistance extended during the course of the Study.

Very truly yours,



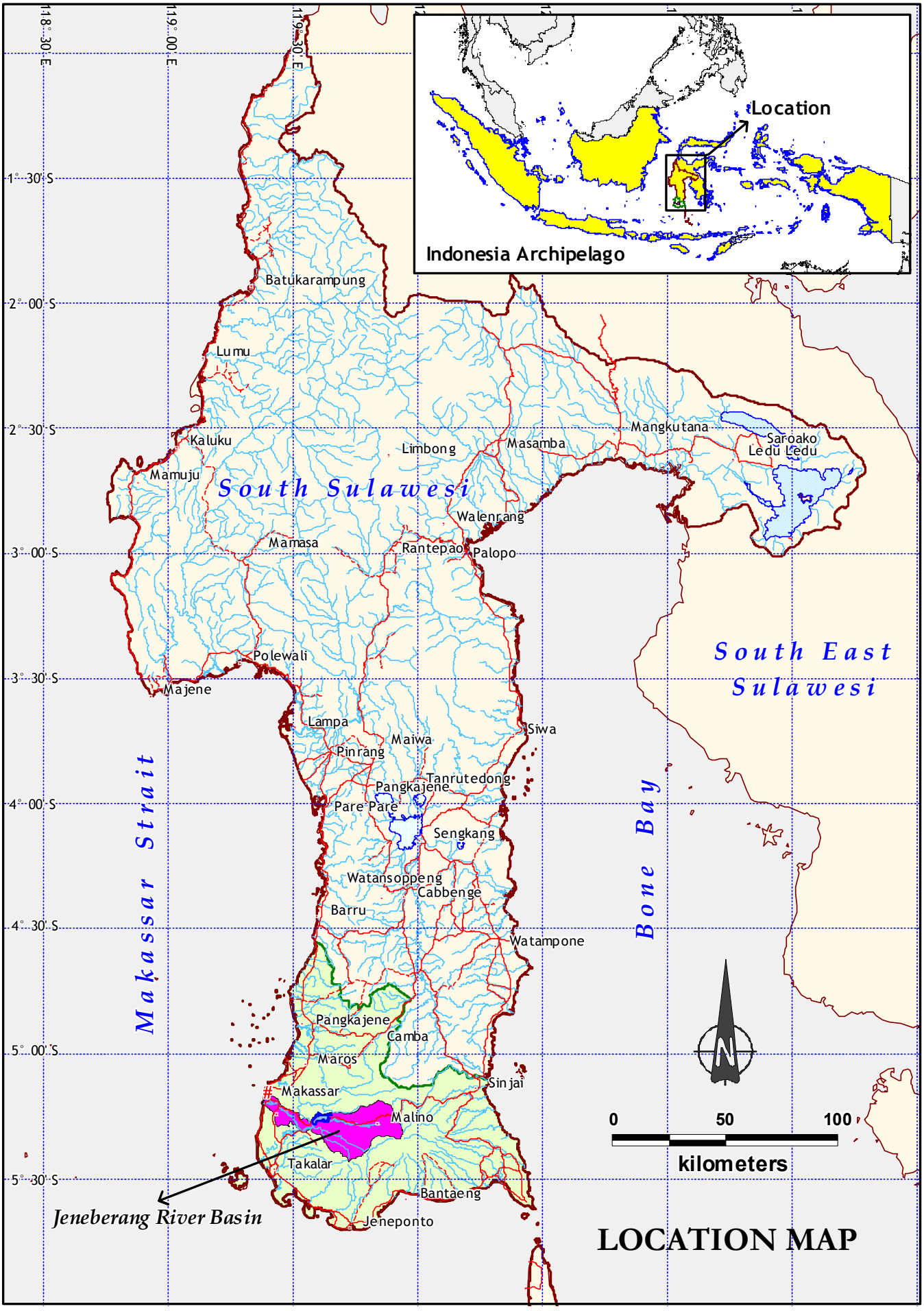
Michito Kato
Team Leader
The Study on Capacity Development for Jeneberang River Basin Management in the Republic of Indonesia

Composition of Final Report

Volume I	**Executive Summary**
Volume II	**Main Report**
Volume III-1	**Supporting Report 1**
Volume III-2	**Supporting Report 2**
Volume IV-1	**Data Book 1-Guidelines and Manuals**
Volume IV-2	**Data Book 2-Data**

Cost Estimate : October 2004 Price

Exchange Rate: **IDR 1,000 = JPY 11.92 = USD 0.1094**
JPY 100 = IDR 8,387 = USD 0.9174
USD 1 = JPT 109.0 = IDR 9,142
(Bank Indonesia, October 2004 average TT selling rate)


Location
Indonesia Archipelago
118° 30' E
119° 00' E
119° 30' E
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Batukarampung
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Mamuju
Limbong
Masamba
Mangkutana
Saroako
Ledu Ledu
South Sulawesi
Walenrang
Mamasa
Rantepao
Palopo
Polewali
Majene
South East Sulawesi
Lampa
Siwa
Maiwa
Pinrang
Tanrutedong
Pangkajene
Pare Pare
Sengkang
Watansoppeng
Cabbenge
Barru
Watampone
Makassar Strait
Bone Bay
Pangkajene
Camba
Maros
Sinjai
Makassar
Malino
Takalar
Bantaeng
Jeneponto
Jeneberang River Basin
N
0
50
100
kilometers
LOCATION MAP

Summary

SUMMARY OF MAIN REPORT

Introduction (Chapter 1)

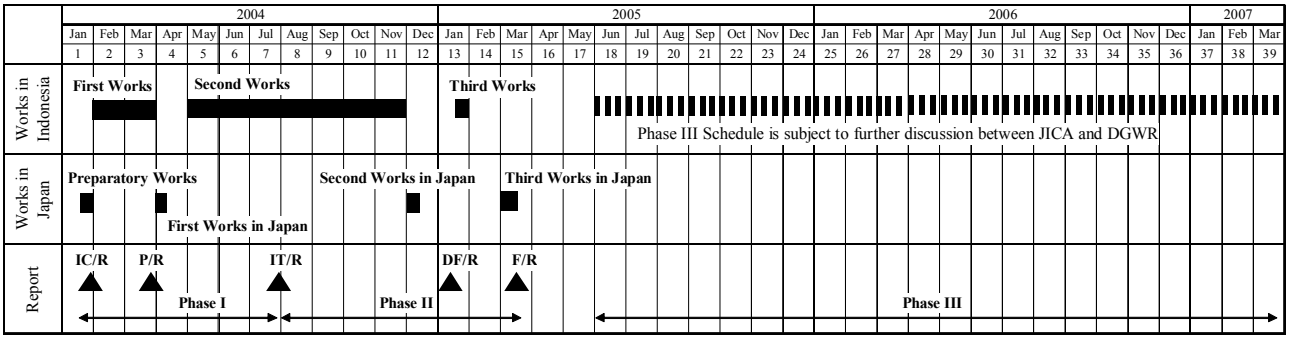
Objective of the Study

1. The objectives of the Study described in the Scope of Work are as follows:
   (1) To assist in the establishment of Jeneberang Public Corporation
   (2) To assist the Jeneberang Public Corporation in capacity development in the following aspects: (i) administration, (ii) financial arrangement, (iii) river basin management, and (iv) human resources development
   (3) To formulate the operation and maintenance plan of river facilities

   The Scope of Work of the Study is described in the Appendix attached to this Report.

Overall Schedule of the Study

2. Total duration of the Study was originally scheduled to be 39 months starting in January 2004 and ending in February 2007. This Report is submitted as the product at the end of the Phase II study in March 2005. Owing to delays in the establishment of Jeneberang Public Corporation, it is now foreseen that Phase III could not commence as originally scheduled and will have to be reprogrammed. Revised program of Phase III will be subject to further discussion between JICA and DGWR.



Overall Schedule of the Study

Socio-Economy of the Study Area (Chapter 2)

Population and GRDP

3. The population of the study area totaled around 1.9 million in 2002 and has grown at a relatively high ratio (1.4 % per annum). Kota (City) Makassar accounts for almost 60 % (1.1 million) of the total population of the Study area. Average annual GRDP growth rates of South Sulawesi province and the Study area have been 4.3 and 6.0 %, respectively, in real terms between 1998 and 2002, achieving a growth trend in per-capita GRDP (3.1 % and 4.4 %, respectively) in the same period. These indices show a growing trend of economy in the province as well as Study area.

Population and GRDP in South Sulawesi and Study Area

Description		1998	2000	2001	2002	Average Growth Rate
Population:	South Sulawesi	7,624,525	7,801,678	-	7,960,991	1.09 %
	Makassar	1,067,757	1,100,019	-	1,127,785	1.40 %
	Study Area Total	1,786,276	1,842,611	-	1,888,779	1.41 %
GRDP: (Rp.million)	South Sulawesi	9,366,229	10,101,948	10,603,661	11,092,996	4.3 %
	Makassar	2,212,970	2,589,535	2,704,974	n.a	6.9 %
	Study Area Total	2,914,515	3,327,499	3,475,227	n.a	6.0 %
Per-capita GRDP: (Rp.)	South Sulawesi	1,228,434	1,294,843	1,343,632	1,389,587	3.1 %
	Makassar	2,074,484	2,354,082	2,392,969	n.a	4.9 %
	Study Area Total	1,631,615	1,805,861	1,857,301	n.a	4.4 %

4. The agricultural sector is the mainstay of the economy in South Sulawesi, accounting for 37.5 % (in 2002) of the total GRDP. This, however, declined from 45.8 % (in 1998) due to the shift to a service-oriented economy. The Study area will further shift to a service-oriented economy and gradual industrialization in the future.

Physical Features of Jeneberang River Basin (Chapter 3)

Administrative Boundaries of River Basin

5. Jeneberang River basin (catchment area: 762 km^2) is administratively divided into Kabupaten (District) Gowa, Kabupaten Takalar and Makassar City as shown in Figure 3.6 of the main text. Among others, Kabupaten Gowa occupies 95.9 % (730 km^2) of the river basin including the whole catchment of Bili-Bili Dam. The share of the river basin by Kabupaten Takalar and Makassar City is extremely small; 1.2 % (9.5 km^2) and 2.9 % (22.5 km^2), respectively.

6. An irrigation area of about 7,400 ha in Kabupaten Takalar receives its irrigation water supply from the Jeneberang River. Makassar City also relies for the majority of its municipal water supply on the Jeneberang River. Thus, both Kabupaten Takalar and Makassar City are the major water users of Jeneberang River, although topographically they do not represent a substantial share of the basin. Kabupaten Gowa is also the beneficiary of Jeneberang water resources, taking water for the PDAM water supply system and also for an irrigation area of about 16,200 ha.

Particular Issues on Use of River

7. Sand mining and riverbed degradation: Sand mining is now undertaken intensively along the downstream reaches of Jeneberang River. The annual mining volume in the past five years (1995 to 2001) is 1,749 thousand m^3/year, of which 75 % (or 1,316 thousand m^3/year) is from reaches downstream of Bili-Bili dam. This latter mining volume is more than two times the annual sediment runoff volume of the basin. The excess of sand mining over natural sediment runoff volume has been further aggravated by trapping of sediment runoff by Bili-Bili Dam reservoir following its completion in 1999. As a result, serious river channel erosion as well as damage to river infrastructure has occurred along downstream reaches of Jeneberang River. The riverbed level has dropped by 5.2 m at Sungguminasa Bridge and 8.1 m at Kampili Weir during a period of 22 years from 1979 to 2001.

8. Sediment yield due to Mt. Bawakaraeng collapse: Jeneberang River has another particular issue affecting sediment runoff. This has occurred due to recent large-scale collapses of the quay on the caldera of Mt. Bawakaraeng. The collapse occurred on 26 March 2004 and it is now producing a tremendous volume of sediment runoff. The "JICA Sabo Urgent Investigation Team" estimated the volume of these collapses to be about 235 million m^3 in total, of which about 27 million m^3 is expected to accumulate in Bili-Bili Dam reservoir in the next five years. This sediment accumulation corresponds to about 90 % of the dead storage capacity of Bili-Bili Dam reservoir.

Irrigation Development in the Basin (Chapter 4)

Bili-Bili Irrigation Project

9. The area of Bili-Bili irrigation project lies in the downstream basin of the Jeneberang River, and administratively belongs to the two Kabupatens of Takalar and Gowa, and Makassar city. The Bili-Bili irrigation project comprise three irrigation schemes, namely Bili-Bili, Bissua and Kampili, which cover a total area of 23,660 ha. The location of the irrigation schemes is shown in Figure 4.2 of the main text.

O&M Cost and Irrigation Service Fee (ISF)

10. The O&M cost of irrigation facilities has been updated by the Bili-Bili irrigation project office. The preliminary total annual O&M cost is estimated to be about Rp. 7.2 billion, excluding salaries for state-employees (PNS) at the Kabupaten level. If this amount is to be collected in the form of an Irrigation Service Fee (ISF), the ISF rate adopted for the Bili-Bili irrigation project would be approximately Rp. 304,000/ha/year, covering O&M of the weir/intake and primary and secondary systems (but not including O&M cost of Bili-Bili Dam).

11. The new Public Corporation will manage weir/intake facilities. The O&M cost for weirs/intakes corresponds to about ten percent (10 %). Consequently, it is recommended that some ten percent (10 %) of IFS actually collected by the Corporation be shared, on a premise that ISF will be collected in the future.

Financial Sharing of Irrigation Sector to River Basin Management

12. The irrigation sector is the largest water user, accounting for about 78 % of total water demand (irrigation and municipal water without hydropower) from the Jeneberang river, or about 35 % (382 MCM) of average annual runoff (1,100 MCM) at the Bili-Bili dam site. The irrigation sector should bear an equitable portion of water resources O&M costs accordingly.

13. Present Government Regulation No.77/2001 on Irrigation admits collecting ISF from irrigation beneficiaries (farmers) to cover irrigation O&M cost. Recently, however, a revised concept of O&M of irrigation was introduced in the New Water Resources Law No.7/2004, this being enacted in March 2004. The New Water Law set forth the principles of irrigation O&M and water management fees as follows:

    - The operation and maintenance of primary and secondary irrigation systems shall be under the authority and responsibility of the Government and the regional governments, according to

their authorities (Article 64 (6))

- Due to the limited ability of farmers using water, the use of water for people's agricultural activities is free from the obligation to pay water resources management services, except those for the tertiary system (Elucidation Para.I.12)

14. Considering the above concepts, this Study takes account of the following principles: (i) irrigation O&M cost shall be paid principally by farmers (as beneficiaries) based on the beneficiary-to-pay principle; however, (ii) on account of farmers' limited ability to pay, the government shoulders the obligation of paying the O&M cost. This government obligation should also be applied to the O&M service cost incurred by the public corporation.

15. The O&M service fee to be paid by the government to the corporation shall include the O&M cost of the irrigation weir and intake stated in Para.10 above, and also the allocated portion of the O&M cost of Bili-Bili dam/reservoir.

Water Supply Development in the Basin (Chapter 5)

Present Water Use in Water Supply Sector

16. At present, the following utilities abstract water from the Jeneberang River for the purpose of municipal and industrial water supply: (i) PDAM Makassar, (ii) PDAM Gowa, and (iii) industries represented by a sugar factory in Kabupaten Takalar. Of these utilities, the largest water user of the Jeneberang River is the PDAM Makassar, which supplies water for most parts of Makassar City. Of the total water production capacity of 2,340 l/s, some1,250 l/s or about 53 % is obtained from the Jeneberang River with the rest from the Maros River. Water supply for the service area of PDAM Gowa, representing 290 l/s in total production capacity, is wholly dependent on the water resources of the Jeneberang River.

17. In addition to the aforesaid municipal uses of water from the Jeneberang River, JRBDP releases water of the Long Storage to the Jongaya canal in Makassar City during the dry season in order to dilute the polluted canal water and flush contained pollutants when poor smells spread along the canal.

Water Demand Projection

18. Water demand for the Makassar City was projected in four studies conducted recently (2000-2003). This Study considered that the latest projection by PDAM would represent a most probable projection. Water demand (at the water treatment plant) in 2020 is projected to increase from the present 2,340 l/s to 4,400 l/s or 139 MCM[1] per year. Water demand of PDAM Gowa is projected to grow from the present 190 l/s (present actual water supply) to 810 l/s in 2020.[2] Since there is no alternative water source, all future demand growth will be met from the Jeneberang River.

[1] MCM: million cubic meter

[2] Main Report on Consulting Services for Comprehensive Water Management Study for Maros-Jeneponto River Basin, November 2001, CTI Engineering International Co., Ltd.

Hydrology and Water Balance Study (Chapter 6)

Rainfall Analysis

19. The mean basin rainfall was estimated using the Thiessen method based on the 5-day rainfall data gauged at nine stations for a 30-year period from 1972 to 2001. As a result, it was determined that Jeneberang River basin receives an annual average basin rainfall of 3,830 mm/year with large variations from 2,450 mm/year (lower reaches) to 5,300 mm/year (upper mountainous area).

Runoff Analysis

20. The long-term basin runoff discharge was simulated through application of a Tank Model Method using the above 5-day basin rainfall for a 30-year period from 1972 to 2001. As a result of simulations, it is estimated that the annual runoff discharge from the upper reaches of Bili-Bili Dam catchment (384.4 km^2) is about 1,100 MCM on average, which is equivalent to about three times the effective storage capacity of Bili-Bili Dam (346 MCM). Adding the annual runoff of 570 MCM from Jenelata River basin (226.3 km^2), the annual runoff discharge of Jeneberang River basin is estimated to be about 1,670 MCM per year.

Simulation of Water Supply-Demand Balance

21. As a result of a water supply-demand simulation, it was identified that the three years of 1972, 1982 and 1997 among the simulated 30 years were drought years, during which Bili-Bili dam reservoir could not meet the present water demand. Thus, it is concluded that the supply capacity of Jeneberang River could meet the present water demand with a probable 10-year return period (= three simulated drought years divided by 30 years of simulation period).

22. The water balance simulation was also made on the premise of the future incremental municipal water demand added to the present whole water demand. As a result, it was estimated that the frequency of drought years would increase from 1 in 10 years at present to 1 in 5 years in 2018 and 1 in 3.8 years in 2019-2020.

River and Infrastructure Management Plan (Chapter 7)

Present River Management and Issues in Jeneberang River Basin

23. Existing River Infrastructures: A variety of river infrastructures exist in Jeneberang River basin as shown in Table 7.1 and Figures 7.1 and 7.2 of the main text. Among these, the major structures used for water supply and distribution are represented by Bili-Bili Multipurpose Dam, Rubber Dam, Long Storage and three irrigation weirs, namely Bili-Bili, Bissua and Kampili weirs. There also exist a variety of riparian structures and urban drainage facilities for flood mitigation along the lower Jeneberang River and seven sand pocket dams/sabo dams[3] in the upper reaches of Bili-Bili dam catchment, which function to minimize sediment inflow into Bili-Bili dam reservoir.

24. Water Quantity Management: An updated review under this Study revealed the present water demand

[3] One sabo dam, Sabo Dam No.4 located at uppermost reach, was abandoned due to excessive damage due to floods and debris flow from Bawakaraeng area

of Bili-Bili dam reservoir is about 490 million m^3/year, and Bili-Bili dam reservoir could meet full supply for the present water demand against a 10-year drought as simulated above (ref. Para.21 above). Thus, Jeneberang River still provides a sufficient water capacity, and has never experienced any serious drought since Bili-Bili dam commenced reservoir operations in 2000. This has led to a less strict and consistent water quantity management program to date. However, the water supply-demand balance will become tighter after feeding of water to irrigation schemes commenced in November 2004.

25. Flood Management: The low-lying flood plain areas spread out in the densely populated areas of Makassar and Sungguminasa City downstream of Sungguminasa Bridge. The river flow capacity strengthened by the existing river dikes, together with the flood control effect by Bili-Bili dam reservoir, currently protect these flood plain areas against a design flood with a 50-year return period. Due to this level of flood control, no serious flood damage has occurred since completion of Bili-Bili dam in 1999. However, no countermeasures exist against floods of a greater return period than 50 years. In order to minimize disastrous flood damage, including the death of people during more extraordinary floods, it is necessary to formulate an emergency flood warning, fighting and evacuation system.

26. Management of River Administration Area: The relevant government and provincial regulations prescribe that a water body (such as river, lake and dam reservoir) and its adjacent river corridor be categorized as the river area[4]. Presently, JRBDP and Dinas PSDA are the principal administrative agencies for the water body as well as the river corridor. However, regular inspection in the area is rarely implemented, and as a result illegal activities such as sand mining without permit licenses and construction of houses in the river corridor often occur along Jeneberang River.

27. Operation and Maintenance (O&M) of River Infrastructure: JRBDP has undertaken a substantial part of O&M works for river infrastructure in Jeneberang River. The annual budget of JRBDP in 2004 was Rp. 88 billion, of which 89 % was allocated to water resources development projects. Thus, the present works by JRBDP are oriented to development rather than O&M. The budget allotted to O&M works was Rp. 1,329 million (about 4.7 % of total annual budget) in 2003 and Rp. 954 million (about 1.1 %) in 2004. Of the total O&M cost, that for Bili-Bili dam accounted for about 65 % of the total O&M in 2003 and 84 % in 2004. In contrast to Bili-Bili dam, however, the sand pocket dam/sabo dams and riparian structures such as river revetment, groin and groundsill are likely to have received little notable O&M work.

Proposed Water Quantity Management Plan

28. Water Allocation Plan: As described above, a shortage in water supply from the Jeneberang River would occur during a 5-year drought year from 2018 onwards due to increments in the municipal water demand. Hence, in order to protect reliability of water supply for present water use and to establish more effective and fair rules over water allocation, the licensing of water use permits should be strictly implemented to comply with the present regulations.[5]

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[4] River utilization area + river control area (see Chapter 7 for the definition)

[5] MPW is now studying to introduce water use right (WUR) system in place of or as a supplement to the present water use permit system.

29. Reliable Water Supply: Of the total water use, irrigation water use accounts for the largest share of about 78.0 %, followed by 12.3 % for municipal water use, 6.4 % for river maintenance flow, and 3.2 % for the sugar factory in Takalar Regency. The existing river infrastructures should ensure a reliable water supply up to allowable drought levels: (a) 5-year drought for irrigation use and (b) 10-year drought for other water uses.

30. Monitoring of River Flow and Water Use: In order to ensure the obligation for reliable water supply, the Public Corporation is required to precisely monitor the seasonal variations of both river flow and requirements of water users. Such monitoring works will become more crucial, especially upon completion of the on-going Bili-Bili irrigation project in November 2004. From these viewpoints, monitoring of the following river flows and water intake discharges is proposed: (1) inflow/outflow of dam reservoir, (2) unregulated flow discharge from Jenelata River, (3) river flow discharge below the major water intake points, and (4) water abstraction volume at all intake points. Of these monitoring points, items (1) to (3) should be monitored by the Public Corporation, and item (4) by the water users under supervision of the Public Corporation.

31. Proposed Procedures of Water Distribution: In order to achieve a sustainable water distribution throughout the year, the Public Corporation should prepare a draft of the semi-annual water allocation plan at the end of each rainy and dry season. The draft of the plan should stipulate the updated water users and the seasonal variations of their water abstraction volumes for the next six months. Based on the semi-annual water allocation plan, the Public Corporation should further formulate the daily operation plan for water distribution at the end of the dry season. The Public Corporation is further required to collect the half-monthly water requirement from all water users.

Proposed Drought Management Plan

32. Should Bili-Bili dam unconditionally release its storage water in accordance with the downstream water requirement, the available water supply of the reservoir will possibly reduce to zero during drought years. This would cause a sudden and drastic reduction in water supply, even for drinking water. In order to avoid such unfavorable conditions, a drought management plan together with detailed methodologies on reservoir operation is proposed (refer to Chapter 7 of the main text). The principles and/or contents of proposed drought management are as follows:

    (1) The priority for water supply during drought years should be given to municipal water supply and river maintenance flow.
    (2) The present Reservoir Operation Curve (RC), which was established in 1993, should be revised as proposed in Figure 7.8 of the main text.
    (3) Reservoir operations in drought years should be based on the stepwise procedures as proposed in Section 7.4.4 of the main text.

Proposed Flood Management Plan

33. Plan for Flood Warning, Evacuation and Fighting System: In order to cope with floods of an extraordinary scale, which exceeds the design level of the existing flood control facilities (i.e., 50-year return period flood), the following flood warning, evacuation and fighting system are proposed:

(1) Setup of Flood Warning Levels:

The warning levels are classified into: (i) Step 1 for Standby, (ii) Step 2 for Warning, and (iii) Step 3 for Evacuation/Flood Fighting. These would be based on the discharge/water level gauged by the four principal telemetry stations as shown in Section 7.5.1 of the main text.

(2) Required Work Activities at Each Flood Warning Level:

The Public Corporation would place its flood-warning center at the existing Monitoring Office for Bili-Bili Dam in Makassar City. The Operations Director of Public Corporation should be stationed there during a flood and make all critical determinations and issuances for flood warning, evacuation and fighting. The secondary center would be placed at the Dam Control Office at Bili-Bili dam site. Its functions would be to undertake the necessary flood control operation of gate facilities at Bili-Bili Dam. The Public Corporation should undertake the activities as described in Section 7.5.1 of the main text.

34. Development and Dissemination of Flood Risk Map: A flood risk map should be produced and disseminated to make residents aware of the extent of the potential flood inundation area and available evacuation routes during a flood. A potential flood inundation area was estimated as the basis of the flood risk map in this Study, as shown in Figure 7.11 of the main text. The estimated area extends over about 58.5 km^2, spreading over a substantial part of Makassar and Sungguminasa City on the left bank of the Jeneberang River. Locations of evacuation centers as well as evacuation routes should in the future be designated by the relevant local government agencies based on the base flood risk map. The flood risk map prepared should be disseminated to the public through a bulletin, information boards and other available information tools.

Proposed Management Plan of River Area

35. Land Use Control in River Area: In order to sustain the appropriate controls within the river area, the Public Corporation should undertake the following activities:

(1) Development of Inventory of River Area

In order to facilitate management of the river area, the Public Corporation should develop an inventory of river stretches and river corridors in its river area. The inventory should contain information on land ownership, classification of land use type, and sand mining activity, if any, together with evaluation on whether or not the activity could cause danger to the levee.

(2) Land Use Control in River Utilization Area[6]

The river utilization area is herein defined as part of the river area, covering the water body and its adjacent river corridor, with land acquisition being undertaken by the river administrator. The allowable land use in this river control area should be limited to those related to public interest such as river-parks and public grounds. Moreover, structures in the river corridor should be limited to those that would not hamper flood flows and/or riparian structures such as water level gauging stations and drainage sluices, which must be constructed within the river corridor.

[6] Refer to Chapter 7 for further detail of definitions

(3) Land Use Control in River Control Area[6]

The river control area is defined as part of the river area but is limited to the river corridor, where land acquisition has not been executed by the river administrator. The land of this river corridor is privately owned, and therefore, the Public Corporation can hardly implement any land control authority over it. Nevertheless, the Public Corporation should monitor the progress of land exploitation in the river corridor, and control any excessive exploitation whenever it is judged to cause significant effects on river morphology, river flow conditions, and/or the river environment.

(4) Land Use Control in Circumference of Bili-Bili Dam Reservoir

Any removal of grass and logging activities in the circumference area around the dam reservoir should be subject to approval of the Public Corporation. Construction of structures, except those for the public interests such as roads and riparian structures, should also be prohibited in the area.

36. Control of Sand-mining: The following measures should be taken in order to prevent the current progressive and serious degradation of the downstream riverbed below Bili-Bili dam due to excessive sand mining activities:

(1) Stop any renewal of mining licenses for the downstream channel below Bili-Bili dam;
(2) Promote potential sand mining sites located upstream of the reservoir area and sand pocket dams Nos.1 to 4 (refer to Figure 7.2);
(3) Carry out a river channel survey at the end of every rainy season and clarify the tendencies of riverbed degradation at each of the major river structures based on the results of the river channel survey;
(4) Estimate sediment deposition on the riverbeds at each of the major river structures after stopping of mining license renewals;
(5) Estimate the allowable sand mining volume and available mining sites on the downstream reaches of Jeneberang River based on the results of clarification on the above; and
(6) Carry out river patrols to control illegal sand mining activities.

37. Control of Sediment Runoff from Collapse of Mt. Bawakaraeng: As described above, the recent collapse of Mt. Bawakaraeng is now producing a huge volume of sediment runoff. In order to reduce the sediment accumulation in the reservoir and to prevent the outflow of water impounded in the natural ponds at the caldera of Mt. Bawakaraeng, JRBDP is going to implement the urgent countermeasures outlined below. The Public Corporation should collaborate on project implementation with JRBDP.

Proposed Operation and Maintenance (O&M) Plan of River Infrastructure

38. Objective River Infrastructure for O&M by Public Corporation: Among the river infrastructure currently managed by JRBDP, those other than urban drainage facilities are indispensable for consistent water quantity management and flood mitigation for a wide range of beneficiaries. On the other hand, the urban drainage facilities contribute only to beneficiaries of Makassar City, and their functions are less related to consistent river management. The Public Corporation should undertake O&M for all river infrastructures other than urban drainage facilities. O&M for the urban drainage facilities should be handed over by JRBDP directly to Makassar City.

39. Expansion Program of O&M by Public Corporation: Due to limited potential human resources and budgetary constraints over the initial operation period, it is deemed to be difficult for the Public Corporation to initially undertake O&M of all river infrastructure. The following expansion program of O&M is proposed in due consideration of the potential revenue source for Public Corporation:

Proposed Expansion Program of O&M by Public Corporation

Stage	Objective River Infrastructure of O&M by Public Corporation
Initial stage in 2007 and 2008	- Bili-Bili Dam and its associated Raw Water Transmission Main (RWTM); - Rubber Dam and Long Storage; - Three irrigation weirs of Bili-Bili, Bissua, and Kampili.
Succeeding stage from 2009 onwards	- Four sand pocket dams and three sabo dams (other than Sabo Dam No.4, which was seriously damaged and abandoned) in upper reaches of Bili-Bili dam reservoir, and - Riparian structures such as embankment, revetment, groin, and groundsill, and sluices along the downstream reach of Jeneberang River from the river mouth to the Sungguminasa Bridge.

40. Development of Inventory and Location Map of Water Resources Facilities: In order to achieve effective inspection and maintenance, inventories of all major river infrastructure in Jeneberang river basin should be developed and updated. It should contain the following information:

(1) A unique identity number (ID) and name of each infrastructure,

(2) Location of infrastructure and name of river where infrastructure is located; and

(3) Structural size, type and quantities of the river infrastructure.

Location maps of river infrastructure from the river mouth to Sungguminasa were initially developed in this Study as shown in Figure 7.13 of the main text.

41. Maintenance Plan: The maintenance works are broadly classified into the following three categories:

(1) Preventative Maintenance: This aims at keeping the original design function of river infrastructure through the following three activities: (i) routine maintenance, (ii) periodic maintenance, and (iii) minor repair work, which includes works of a small-scale necessary for restoration of a facility.

(2) Corrective Maintenance: This aims at more substantial repair/replacement works than Preventative Maintenance to restore a facility, which has considerably reduced its function from the original design due to age of facilities and/or destructive damage.

(3) Emergency Maintenance: This is executed against imminent failure of infrastructure due to extensive disasters such as floods, landslides and earthquakes.

Both corrective and emergency maintenance require huge implementation costs within a rather short period, and the budgetary arrangement for them is deemed to be far beyond the capacity of Public Corporation. Moreover, corrective and emergency maintenance is oriented to replacement of the assets (river infrastructure). Such replacement is deemed to be within the responsibility of JRBDP as the owner of the assets, and not the Public Corporation as their operator. From these viewpoints, the Public Corporation should concentrate on Preventative Maintenance. The standard maintenance works were described in Volume IV-1: “Guidelines and Manuals”.

42. Operation Plan: The operation procedures for all objective river infrastructure are described in the existing O&M manuals and are currently applied by JRBDP. The list of available O&M manuals is shown in Table 7.4 of the main text. All O&M manuals other than those for irrigation intake facilities were prepared from 1994 to 2001, but no updating on their contents has been made. The necessary revisions and updating of the contents of the existing manuals were made in this Study and its results are compiled in Volume IV-1: "Guidelines and Manuals".

43. Required Rehabilitation Works for Existing River Infrastructure: There exist a number of river infrastructures that have been seriously damaged and remain without any rehabilitation and/or replacement. JRBDP would be required as the present possessor of the facilities to repair and/or replace them before hand-over of O&M works of the structures to Public Corporation. The major required rehabilitation works together with their rehabilitation costs are summarized below:

Required Rehabilitation Works for Existing River Infrastructure

Objective Facilities	Required Rehabilitation Cost (Rp. million)
Telemetry gauging system for monitoring and operation for Bili-Bili Dam, including revision of software system	703.8
Flow meter placed at inlet of RWTM	7.5
Eleven drainage gates along the downstream reaches of Jeneberang River	1,250.0
Total	1,961.3

Note: Excluding repairs of Rubber Dam, Groundsill No.2 and Sand Pocket No.4: the former 2 are under repair and the latter 1 is scheduled to be repaired by JRBDP

Required Cost for O&M of River Infrastructure and River Management

44. The O&M cost of river infrastructure and the relevant river basin management work by Public Corporation was estimated at Rp. 4,054 million (on a direct cost basis, excluding indirect costs). This corresponds to about three times the actual budget currently disbursed by JRBDP.

Summary of Cost for O&M of River Infrastructures and Cost for River Management *

(Unit: Rp. million)

Item	Facility/management Field	2007-2008**	From 2009 onward
O&M of River Infrastructures	Bili-Bili Dam/RWTM	933	996
	Irrigation Intake Weir	566	593
	Rubber Dam/Long Storage	353	437
	Riparian Structure	0	428
	Sand Pocket Dam and Sabo Dam	0	468
	Sub-total	1,852	2,917
River Management	Water Quantity management	188	259
	Flood Management	229	278
	Drought Management	227	267
	River Conservation Management	209	334
	Sub-total	854	1,137
Total		2,706	4,054

* The above cost represents direct cost of O&M works, not including indirect expenditures such as indirect personnel cost and general expenses

** In accordance with the proposed expansion program of O&M as described above, Public Corporation would not undertake O&M for the sand pocket dam/sabo dam and riparian structures during the first operation period from 2007 to 2008.

Water Quality and Watershed Conservation (Chapter 8)

Water Quality Management

45. Water Quality of Jeneberang River: Figure 8.1 of the main text shows the seasonal variation of representative water quality parameters of the Jeneberang River (data before the Bawakaraeng land collapse). The Figure shows that, although the extent is not severe, the observed BOD values (3 to 6 mg/l) do not meet the requirement for the standard of Class-I water[7], that is water classified as acceptable as a raw water source for drinking water supply (BOD value to be less than 2 mg/l). The observed COD values (9 to 11 mg/l) are also at a marginal level to meet the Class I water standard (to be less than 10 mg/l). The river water quality seems to be deteriorating. The recent Bawakaraeng land collapse has seriously increased both turbidity and suspended solids content. The detail is contained in Chapter 8.

46. Present Water Quality Monitoring Activity: There are several agencies conducting water quality monitoring on the rivers in the Province including Jeneberang River. They are Bapedalda, Dinas PSDA, JRBDP, PDAM Makassar (at their water treatment plants) and PLN (at Bili-Bili hydropower site). Reviewing the present water quality monitoring activities, the Study noted that due improvement would be required with regard to the following aspects:

    (a) Present water quality monitoring is mostly on an ad-hoc and intermittent basis, with no predetermined integrated monitoring program coordinated among the agencies concerned. The observed data are not properly reported to Bapedalda.
    (b) There is no coordinated data management system at present. The data are filed in different ways (hard copy or computerized files) by each agency.
    (c) Bapedalda has commenced monitoring of effluent discharges (presently at 16 identified factories), but has not fully launched the implementation of controls on inadequate effluent disposals (such as instruction of corrective measures, fines and sanctions), although some effort is being made.

    As the leading agency for water quality conservation and management, Bapedalda shall take the initiative for improving the above aspects in coordination with the concerned agencies.

47. Water Quality Testing Laboratory: At present, there are four laboratories operating in Makassar. They are laboratories operated by: (i) Provincial Industry Service, (ii) Provincial Health Service, (iii) Bapedalda, and (iv) University of Hasanuddin. All laboratories have the capability of conducting standard items of water quality testing. The Study assumes that new Public Corporation can use these laboratories for outsourcing on a contract basis and hence will not need to have its own laboratory for a certain period. Nevertheless, there will be an option to have an own laboratory in the future depending on the increase of work volume.

48. Proposed Role of Corporation: As one of the elements for proper water resource management and as required in the relevant regulations, the new Public Corporation shall participate in water quality monitoring and pollution control activities through cooperation with concerned agencies, among others Bapaedalda. Like the case of PJT I and PJT II, the role and responsibility of the Public

[7] Raw Water Quality Standard of Government Regulation No.82/2001

Corporation include: (i) river water quality monitoring, (ii) wastewater pollution control and (iii) data management. The detailed activities of (i) and (ii) are listed in Table S-2 attached to this Summary. The estimated cost of the above services is about Rp. 366 million annually on a direct cost basis.

49. River Water Quality Monitoring Plan: Main objectives of river water quality monitoring are focused on identifying any potential problems before they arise. The monitoring will focus mainly on the following six aspects:

(a) Adequacy of water quality for use as a source of drinking water supply
(b) Hazardous industrial effluent inflow into the river in the lower reach
(c) Effect of use of fertilizers for upstream agriculture
(d) Eutrophication of Bili-Bili reservoir water, particularly potential pollution due to fish-cage aquaculture
(e) Excessive sediment runoff from Mt. Bawakaraeng area
(f) Excessive aggravation of water quality in canals of Makassar City

Eight (8) locations are selected for monitoring of the river water quality as shown in Figure 8.4 of the main text. Of those, water quality monitoring in the drainage canal of Makassar City shall eventually be carried out by the Cipta Karya of Makassar City in the future.

50. Financial Source: Water quality monitoring is a service essential for public health and environmental conservation, but no revenue income is expected for the Corporation. Thus, the expenditure incurred by the Corporation shall be borne by the Government under a concept of public service obligation (PSO). Existing regulations (Government Regulation No.6/1981) stipulates that polluters shall pay a fee to the river management body to compensate for having caused contamination of water. A new decree shall be legislated, either by MPW or regional government, to authorize the Corporation to collect the effluent discharge fee in the Jeneberang river basin.[8]

Watershed Conservation

51. Need for Forest Conservation: The most prominent issue regarding watershed conservation is the decreasing trend in forest area. According to a CEPI-PPLH UNHAS study in 2001, forest area has decreased from 25,845 ha in 1987 to 17,250 ha in 1996, about 33 % during a 10-year period. In particular, horticultural farming practices and tourism activities in the upstream area have generated the change in land coverage pattern from forest area to horticulture cultivation, tourism infrastructure and supporting facilities. The reduction of forests in the upstream area is not only causing impacts on the forest ecosystem but also generating further effects on the hydrological regime such as increases in the max.-min. discharge ratio, prolonged drought duration, increased sediment yield, and so on.

52. Main Focuses from Aspect of River Basin Management: From the aspect of river basin management by new Public Corporation, the main interests will be placed on the following:

(a) Reduction of sediment yield from the upper basin
(b) Conservation of water resources by increasing water holding capacity in the upper basin
(c) Conservation of natural environments in the river course

[8] A decree similar to Kimpraswil Decree No.342/KPTS/M/2002 issued for PJT I to authorize PJT I to collect and receive fees including effluent discharge fee

(d) Conservation of fishery resources, particularly in the Bili-Bili reservoir

Of the above, item (a) - reduction of sediment yield, will need the utmost attention and active participation by the Corporation.

53. Measures for Reducing Sediment Yield: There are various types of measures, both structural and non-structural, to reduce sediment yield. Among others, the following may be the main activities:

(a) Reforestation

(b) Forest Management by means of economic incentive measures; such as: (i) exploitation of existing pine forests by planting coffee, (ii) conversion of public forest to horticulture plantation with appropriate care and techniques, and (iii) intensification of greenbelt functions along rivers and around reservoirs by planting multipurpose trees

(c) Improvement of land use practices by means of bench terracing, embankments following contour line, planting along the contour lines, and combinations of embankments and terracing.

(d) Structural Measures; such as check dams, sand pockets, gully protection, channel consolidation work, and various types of hillside erosion control works (e.g. planting work, lateral drains, fence work, slope greening work, etc.).

54. Watershed Management by Public Corporation: It is understood that the leading role for watershed conservation is taken by Dinas Forestry in the field of forest conservation and by Dinas Plantation / Dinas Agriculture in the field of land use practice in cultivation areas. Hence, the main role of Public Corporation will be the participation (on a collaborative concept) in those watershed conservation activities. The proposed activities cover technical and funding assistance for: (i) reforestation and forest management, (ii) improvement of land use practices, (iii) structural measures for sediment yield reduction, (iv) river environment conservation, and (v) fishery resources conservation. The detailed items are shown in Table S-2 attached to this Summary.

55. Service Schedule and Cost Estimate: Provision of these services will be a burden to the Corporation during the initial phase of operation since no direct revenue is expected from them. It is proposed that the Corporation would commence these services only after it has consolidated firm revenue income; say commencing the services from the 3rd year after operation. The estimated cost of the above services is about Rp. 285 million annually on a direct cost basis.

Legal and Institutional Framework (Chapter 9)

Existing Legislation

56. The new Water Law No. 7/2004 has introduced major changes to water resources management (WRM) legislation, e.g. new (or enhanced) paradigms such as regional autonomy, decentralization and state revenue sharing, a National Water Resources Council, stakeholder participation in policy-making, private sector involvement in water resources development and management, and

empowerment of farmers. Nine[9] of the 35 WRM Government Regulations (GR) needed under the law are in various stages of completion. On one hand, Ministry of Public Works (MPW) contemplates establishing a new Pubic Corporation for the Jeneberang river basin based on present laws and regulations. The revision of the GRs is therefore not necessarily a prerequisite for the establishment of the Corporation.

Legislation Needed for the Establishment and Operation of the New Corporation

57. As described in Para.83 below, the new Public Corporation in the Jeneberang River basin (called 'PJT Jeneberang' hereinafter) will be established as the extension of the working area of existing PJT I[10]. In this case, seven items of national legislation will be needed to establish PJT Jeneberang: a Presidential Decree (PD), a GR and five ministerial decrees. At regional level, four provincial regulations, 8 governor decrees, at least two heads of Dinas decrees, several joint decrees and cooperation agreements with Kabupaten / Kota are the main legal products to be drafted, stakeholder consulted, approved, socialized and enacted. They are listed in Section 9.3.1 of the main text.

58. The scheduling of these activities suggests that PJT Jeneberang cannot be established before January 2006, and is unlikely to begin formal operations before January 2007. This is because of the time needed to: (i) enact provincial regulations / decrees, (ii) budget for the cost of processing the legal products required, and (iii) prepare PJT Jeneberang's staff, premises, O&M and financial resources for full short-term O&M operation. A projected legislation schedule is shown in Table 9.1 of the main text. A key deadline is issuance of the PD on PJT Jeneberang before the end of March 2005.

Organization Structure and Interagency Arrangements

59. PJT Jeneberang will be an Operations Directorate within PJT I's organization (Figure 9.3 of main text). The Operations Director will manage two water service divisions[11], a Technical Bureau and Administration and Finance Bureau, with technical assistance from the PJT I parent units. An estimated staff of 76 persons is intended as a future steady state level (in the 5th year after operation, say) to allow all assets controlled by PJT Jeneberang to be operated and maintained sustainably and efficiently. In due course, a division should be set up to develop revenue from non-water businesses. The proposed organization chart is shown in Figures 9.4 of the main text.

60. Start-up staff levels will be much reduced (at 45 persons[12]), partly for financial reasons (costs should be minimal until adequate revenue is assured) and partly because any newly established organization must begin with a reduced functionality. The proposed organization at the start-up stage is shown in Figure 9.5 of the main text.

61. The South Sulawesi (SS) Dinas PSDA will regulate PJT Jeneberang's WRM activities on behalf of the SS Governor, while Balai PSDA will undertake its mandate in those rivers not selected for PJT J. Other provincial Dinas, such as Mining, Forestry and Fisheries, will perform the same role within their sectors. Coordination of WRM and stakeholder participation will be accomplished by the fully

[9] GRs on irrigation, rivers, WRM, financial management of WR, WQM, ground water, WRM corporatization, PJT I & PJT II.
[10] Perum Jasa Tirta I in the Brantas and Bengawan Solo basins
[11] WS Division I will cover Bili Bili Dam / reservoir & upstream Jeneberang and Jenelata; WS Division II will cover middle Jeneberang with three weirs and lower Jeneberang.
[12] For 2007.

functioning provincial PTPA and Jeneberang PPTPA.

Administrative and Financial Management (Chapter 10)

Administrative Management

62. Work Plans: One of the principal requirements from an administrative management aspect is the proper preparation and implementation of a work and budgetary plan. PJT Jeneberang will be required to fulfill the following requirements in the relevant regulations: (i) formulation of a long-term plan (RJP), (ii) formulation of an annual plan (RKAP), and (iii) implementation of the work plans.

63. Corporate Monitoring and Review: Corporate monitoring and review by management is an important activity to ensure sound corporate management and to efficiently achieve the planning targets of river basin management, including customer satisfaction. The management review should be regarded as one of the main responsibilities of top management and be documented for accountability to the supervising authorities as well as stakeholders.

64. Internal Auditing: The internal audit chiefly addresses financial and operational aspects. During the audit inspection, the head of respective sections concerned should fully collaborate with the PJT I head office's inspector to become acquainted with the outcomes from the inspection. The inspection should be used as a good opportunity of learning the know-how and experience accumulated in PJT I.

65. Public Relations: One of the tasks assigned to a public relations coordinator of PJT Jeneberang will be to educate and promote the responsibilities of the stakeholders. This will be attainable through: (i) disseminating information of the Corporation's activities to stakeholders and (ii) calling for stakeholder involvement in the river basin management activities. It is proposed to identify and monitor stakeholders' opinions through the following measures:

    a) Distributing questionnaires and making surveys, for example using the PRA (participatory rural appraisal) method
    b) Focus group discussion
    c) Providing a complaint box and setting "complaint day" to listen and process the aspirations of the customers and other stakeholders.

    One of the public relations programs is financial and technical support to small and medium-sized enterprises (SMEs) and cooperatives (referred to as PUKK) in the basin. This is conducted as a mandatory program appointed to all state-owned enterprises (SOE) in Indonesia. Financial contribution consists of loan provision at low interest rate and grant provision to individual SMEs and cooperatives wishing to apply for such assistance. A similar activity is scheduled in the PJT Jeneberang from the beginning year.

66. Customer Management: Customers of the corporation will be beneficiaries of water resources management; they are PDAM, PLN, industries, plantations, farmers, fisheries and the public. In order to maintain good collaboration with the customers, customer satisfaction will be monitored once a year through a questionnaire to stakeholders asking about customer satisfaction on water quantity, water quality and services provided by the PJT Jeneberang. The results of evaluation shall

be reported to each business division and bureau.

67. Stakeholder Participation: It was identified in the workshops conducted during the Study that communities in the upper-stream and middle-stream areas still have arguments and questions about the benefits they have gained from the Bili-Bili reservoir development and could gain from subsequent river basin management. Some tend to believe they are victims of development activities rather than beneficiaries. The management of PJT Jeneberang should provide appropriate responses to these questions including donation of a part of the corporation's profits to enhance economic activities in the upper-stream and middle-stream areas.

68. Authority to be Delegated: PJT Jeneberang shall be afforded a reasonable level of authority and power in its operation by PJT I head office. In monetary terms, the amount of authorization assigned to the Operations Director of PJT Jeneberang will be up to Rp. 50 million and the maximum amount of advance payment up to Rp. 15 million. These will be a sufficient authority for PJT Jeneberang to realize self-governance, efficient and timely decision-making, and involvement of stakeholders' interests.

Financial Management

69. Funding Plan of Paid in Capital: Basic sources of capital to establish a corporation, to start operation and to sustain growth are equity (owner's capital), debt (borrowed capital), retained earnings and contributed capital (grant). For PJT Jeneberang, capital investment will be made as follows:

    (a) Assets of JRBDP will be transferred to the PJT Jeneberang as owned assets, the value of which is calculated at about Rp. 3.4 billion. This is a capital investment in kind.

    (b) Fresh money is required for initial operation, which will be about Rp.6.0 billion in total to cover initial mobilization costs and start-up working capital. The Government shall afford a grant or an interest-free loan to PJT I so that PJT I could provide this financing for the PJT Jeneberang.

70. Funding Plan of Working Capital: Working capital should be sourced from revenue of fees for raw water supply and other river basin management services. Additional revenue generated from non-water services[13] (or business) may help realizing more adequate water resource management in the basin. The Study assumes that the government will subsidize part of the working capital for which collection of fees are not possible under the principle of 'public service obligation (PSO)' for the corporation's services for irrigation water supply, water quality monitoring, etc.

71. Cash flow: Liquidity is the life-blood of the corporation and lack of cash will force the corporation out of business. The corporation shall ensure a constant income of revenue to generate cash flow for running the operation.

72. Accounting Policy: Law No.13/1998 prescribes the public corporation to comply with the financial accounting standard set forth in the Law. PJT I sets forth its accounting policy in the Director's decree KP 001/KPTS/2000, which conforms to MSRI Minister Decree No. 49/KPTS/M/2000 and a financial accounting standard issued by Indonesian Accountant Association in 1999. Accounting is

[13] Non-water services mean the services other than raw water supply, including corporation's business activities such as tourism development, land lease, fishery business, sand mining business, etc.

practiced based on the accrual basis. PJT Jeneberang should follow the accounting policy set forth by PJT I.

73. Budget Control: Budget control shall be exercised by checking the current financial status and projecting the future financial condition in comparison with the predetermined budgetary plan. PJT I is conducting budget planning and control through cash flow reviews on a weekly basis and budget allocation reviews on a monthly basis for the succeeding quarterly period. A similar exercise shall also be undertaken in PJT Jeneberang.

74. Accounting System: Since PJT Jeneberang will become a work unit under PJT I, it shall use the same accounting system as currently used by PJT I. A computerized system, called ASGL (Accounting System General Ledger), was developed by PJT I in 1990. The system is running parallel with manual bookkeeping so that reconciliation may be made at key points such as the daily journal, accounts receivable/payable and cash flow. The ASGL for the PJT Jeneberang was prepared under this Study with the assistance of PJT I.

Human Resources Development Plan (Chapter 11)

Recruitment of Staff

75. Within the PJT I, the process for assessing staff and arranging staff training appears to be systematic and may be effective. However, in setting up PJT Bengawan Solo, PJT I management was not always able to select the staff preferred. Partly for this reason, capacity development there proved arduous and demanding, e.g. in terms of PJT I management time. This should not be repeated in Jeneberang: only staff of appropriate age, caliber, motivation, qualifications and experience should be appointed, at every level.

HRD Framework Proposed for PJT Jeneberang

76. A statement of human resources development (HRD) policy for PJT Jeneberang will be needed. This will include statements on:

(i) Corporate commitment to continuous development of staff;

(ii) Self-development as a responsibility of every member of staff;

(iii) Corporate commitment to staff appraisal, to recognize and reward improved performance, and to use enhanced skills operationally.

HRD should be central to PJT Jeneberang's development especially in the early years. Training is directly linked to organizational development, promotion and career structure, succession planning, job evaluation and salary structure.

77. Off-the-job or classroom training in-house should be undertaken to ensure the use of techniques to motivate trainees, reinforce learning, and give feedback to trainees on their performance. On-the-job training (OJT) can be handled in several ways. The "on-the-job presentation" is more suitable when only a few employees are involved and tasks are relatively simple; employees can practice immediately in the trainer's presence and this promotes feedback and discussion. Programmed instruction replaces a "live" trainer with a written set of instructions, programs and information

modules. The trainee then works through the written material.

78. Trainers may be full time professionals or capable line managers or other staff co-opted for the course or program. Supervisors and managers, even if not undertaking training themselves, must be involved in tasks such as staff TNA (training needs assessment), assisting with course selection and design, employee motivation and encouragement, evaluating results of training, and counseling. This implies that supervisors and managers should themselves be trained in these skills.

Manuals and Guidelines for HRM

79. Existing manuals and guidelines used by PJT I will be applied to human resources management (HRM) of PJT Jeneberang. In PJT I, most organizational and HRM systems and procedures are documented in decrees, instructions, procedure statements and guidelines. The documented procedures (ISO and non-ISO) available in PJT I are sufficiently detailed to act as training aids, as long as they are implemented with competent trainers in the early stages of PJT Jeneberang's start-up.

80. Ten major organizational and HRM procedures[14] will be progressively transferred to PJT Jeneberang during the last 6 months of 2006 and in the first year after the start of operations at the beginning of 2007.

Establishment and Operation Plan of PJT Jeneberang (Chapter 12)

Roles and Responsibilities of PJT Jeneberang

81. Roles and Responsibilities: Based on the proposed scope of services to be provided by PJT Jeneberang as presented in Chapters 7 to 11 of the main text, the duties and functions of PJT Jeneberang are summarized in Table 12.1. In principle, PJT Jeneberang will act in the basin as 'operator or service provider'. The PJT Jeneberang will expand its activities in three phases: (i) Start-up Phase (2 years), (ii) Development Phase (3 years) and (iii) Expansion Phase (10-15 years). The period of (i) and (ii), 5 years in total, is regarded as the 'mid-term plan period'. The principal operational framework of PJT Jeneberang is summarized in Table S-1 attached to this Summary.

82. River Basin Management Services: As detailed in Chapters 7 and 8, the PJT Jeneberang will provide various services related to river basin management and infrastructure O&M. The principal items are described in Table 12.2 of the main text and summarized in Table S-2 attached to this Summary.

Proposed Plan for Establishment and Operation of PJT Jeneberang

83. Organizational Form of PJT Jeneberang: Ministry of Public Works (MPW, former Kimpraswil) has studied three options regarding the organizational form of corporations to be newly established, including PJT Jeneberang. The three options studied were:
    - Option I: Corporations will be established under two main corporations (PJT I for eastern regions and PJT II for western regions)
    - Option II: Corporations will be established under three main corporations (PJT I, PJT II and new PJT III in central Jawa)

[14] Refer to Section 11.5.1 of Main Report for items of procedures

- Option III: Establishment of a National Corporation

MPW finally selected to adopt Option II as of November 2004, where the PJT Jeneberang is established as an extension of the working area of PJT I at the start-up stage, while allowing for the possibility of future reform to an independent public corporation, either state-owned (BUMN) or province-owned (BUMD).

84. Schedule towards the Establishment and Operation of PJT Jeneberang: Taking account of time requirements for legislation and various agreements among stakeholders (refer to Para.58), the Study Team tentatively defined an anticipated schedule towards the establishment and commencement of operations of the Corporation, as shown in Figure 12.1 of the main text. The schedule assumes the following milestone achievements:

- Establishment of Corporation: Towards the end of 2005
- Completion of all required legislation: Towards the end of 2006
- Commencement of operations: Early 2007

85. Mobilization of PJT I Jeneberang will be commenced in 2006 after it is legally established. The activities include: (a) office se-up, (b) assignment of key staff, (c) assistance in regional legislation and socialization, (d) preparation of detailed annual work plan and budget plan, (e) finalization of corporate management system, and (f) procurement of initial O&M operation resources. Funding for these activities, roughly estimated at Rp. 4.8 billion, would be procured from a grant fund or from an interest-free loan made available by the Government. Figure 12.1 shows a time schedule of these activities.

86. Operational Program: In 2007, PJT Jeneberang will commence the operation. In the first two years (2007-2008), priority of PJT Jneneberang's operation will be given to water quantity management and O&M of major infrastructure. PJT Jeneberang will expand the activities to gradually cover other service areas, such as water quality management, flood and drought management, river area management, and watershed conservation, towards 2009, as shown in Figure 12.1.

Financing Source for PJT Jeneberang Operation

87. Revenue from Service Fees and Non-water Business: Of the proposed services, the items producing revenue are envisaged to be fees from raw water supply, water use for hydropower generation, and several other fee items (e.g. service fee for effluent discharge monitoring, C-class mining and land use in river utilization area[15]). The fees are contributed by respective beneficiaries based on beneficiary-to-pay and/or polluters-to-pay principles. PJT Jeneberang will also pursue development of its own businesses. The conceivable revenue items are listed in Table 12.3.

88. Funding Support by the Government will be needed for the following services provided by the PJT Jeneberang:

(1) O&M for irrigation intake weirs; cost of which would be borne by the government based on the concept of government obligation for irrigation O&M as set forth in New Water Law

[15] Refer to Chapter 7 for the definition of river utilization area

No.7/2004 (refer to Para.14).

(2) Technical services required for supporting public welfare and livelihood (e.g. water quality monitoring, flood and drought management, watershed conservation, etc.), the cost of which should be supported by the government under the concept of PSO.

Corporate Financial Plan

89. Water Fee Rates Alternatives: The study examined the following three alternative scenarios of water fee rate setting:

Case-1: Beneficiary-to-pay Principle

Case-2: Corporation to be financially self-reliant within five years

Case-3: Affordability-to-pay Principle

Water fee rates estimated for the respective cases are summarized in the Table below.

Water Fee Rate assumed in Alternative Cases (at 2004 price)

Customer	Unit	Case-1	Case-2	Case-3
PLN	Rp/kWh	17	14	25
PDAM	Rp/m^3	**59**	**47**	40
Industry	Rp/m^3	66	66	80

Note: Rates shown in bold letters seem to exceed or are very close to the limit of affordability-to-pay of average households. See Para.91 below.

90. Profit-Loss Calculation: Financial projections were made by preparing a profit and loss statement to the year 2020 for the three alternative cases. The results are detailed in Tables 12.7 to 12.9 and summarized below.

Profit-Loss before Tax for the Three Alternative Cases

(Unit Rp. Million)

Alternative Case	Mid-term Plan Period					2015	2020
	2007	2008	2009	2010	2011		
Case-1	616	1,231	488	487	825	3,133	4,749
Case-2	-215	383	-205	-216	59	2,126	3,446
Case-3	211	797	196	172	403	2,293	3,392

91. Household's affordability to pay of raw water fee must be taken into consideration in proposing a raw water fee rate. In Makassar, average monthly household expenditure is estimated as Rp. 1,210 thousand at 2004 price level. If the affordability-to-pay of average households for piped water supply is assumed to be 3.0 % of monthly expenditure, the tolerable amount of household payment for piped water is calculated as Rp. 36,300. This corresponds to Rp. 1,370/m^3 in terms of water tariff based on the average household's consumption of 26.5 m^3/month. Since the present average water tariff is already as high as Rp. 1,279/m^3, the households seem to have no sufficient extra capacity to accept the increase of water tariff. The maximum rate of raw water fee affordable as an additional charge to the recipients would be around Rp. 46/m^3, which is derived from the difference between Rp. 1,370/m^3 and Rp. 1,279/m^3 stated above and further in consideration of an unaccounted-for water ratio of 0.5 (i.e., (1,370-1,279) x 0.5 = 46).

92. Selection of Alternative Fee Scenario: Overall, this Study recommends that the raw water fee rates

proposed in Alternative Case-3 seems to be the most practical fee rate scenario in consideration chiefly of affordability-to-pay by municipal water supply recipients. The proposed rates are the rates effected in PJT I service area in East Jawa and, in this context, would be most explanatory to the customers (PDAM and PLN).

93. Issues Involved in Alternative Case-3: Case-3 assures a financially sound operation as far as profit-loss projection indicates (Para.90 above). However, this is based on a premise that the government would make funding support under the principle of PSO, including the O&M cost of the irrigation intake weir. In case the government does not fulfill this obligation, the financial performance of the PJT Jeneberang will be much worse as summarized in the Table below.

Profit-Loss before Tax for the Cases of 'With and Without PSO Support' from the Government

Case	Mid-term Plan Period					2015	2020
	2007	2008	2009	2010	2011		
Case-3 with PSO	211	797	196	172	403	2,293	3,392
Case-3 without PSO	- 1,700	- 1,333	- 2,371	- 2,517	- 2,407	- 517	581

The above Table shows that PSO support from the government is very essential for the PJT Jeneberang's sound financial operation. Under the case of 'Without PSO', loss-making operation will continue for 11 years towards 2017.

Five-Year (Mid-term) Financial Operation Plan

94. Profit-Loss Projection at Current Prices: Five-year financial projection was made for Case-3 above based on current prices, assuming a price inflation rate of 7.36 % per annum. Further sensitivity testing was carried out by assuming the following variations:

- Sensitivity 1: Water revenue collectable is limited to 75 % in the first year, but will increase in stages to 100 % in the fifth year
- Sensitivity 2: Water revenue collectable is limited to 50 % in the first year, but will increase in stages to 100 % in the fifth year, and
- Sensitivity 3: No payment of PSO for irrigation O&M and other public services

The results of profit-loss calculation are shown in the Table below.

Profit-Loss Projection for 5-Year Period based on Current Price (Case-3)

(Unit: Rp.million)

Year	2007	2008	2009	2010	2011	Total
Base case	299	1,141	416	558	1,007	3,421
Sensitivity 1	-1,074	18	-401	113	1,007	-337
Sensitivity 2	-2,447	-1,105	-1,217	-332	1,007	-4,095
Sensitivity 3 *	-2,065	-1,688	-3,245	-3,559	-3,613	-14,170

Note: Equivalent to 'Case-3 without PSO' in Para.93 above, but calculated on current price basis taking account of price escalation

The Table above indicates that any level of reduction of revenues is very sensitive for the operation of the PJT Jeneberang.

95. Fund Requirement: The Corporation will require an initial working capital of Rp. 4.8 billion in 2006

for the initial organizational setup of the PJT Jeneberang. Further, working funds are needed for starting the operation in 2007 to pay wages and other expenses amounting to at least Rp.1.2 billion, which represents the shortage of the running fund for the initial 2-month period in 2007. The Government shall consider providing assistance in this funding operation, either by grant or interest-free loan. This study assumed that the running fund would be procured by an interest-free loan from the Government with a repayment period of seven years including a grace period of two years.

96. Evaluation of Major Financial Ratios: Financial ratios were calculated and evaluated according to the Decree of MSOE No.100/MBU/2002. The results are shown in Table 12.8 of the main text. Under the condition that initial working capital is provided by loan (or interoffice account from PJT I if capable) and the government PSO support for irrigation and other public services, the financial condition of the PJT Jeneberang is assessed as "healthy" for the first three years and will become "very healthy" in the 4^{th} and 5^{th} years.

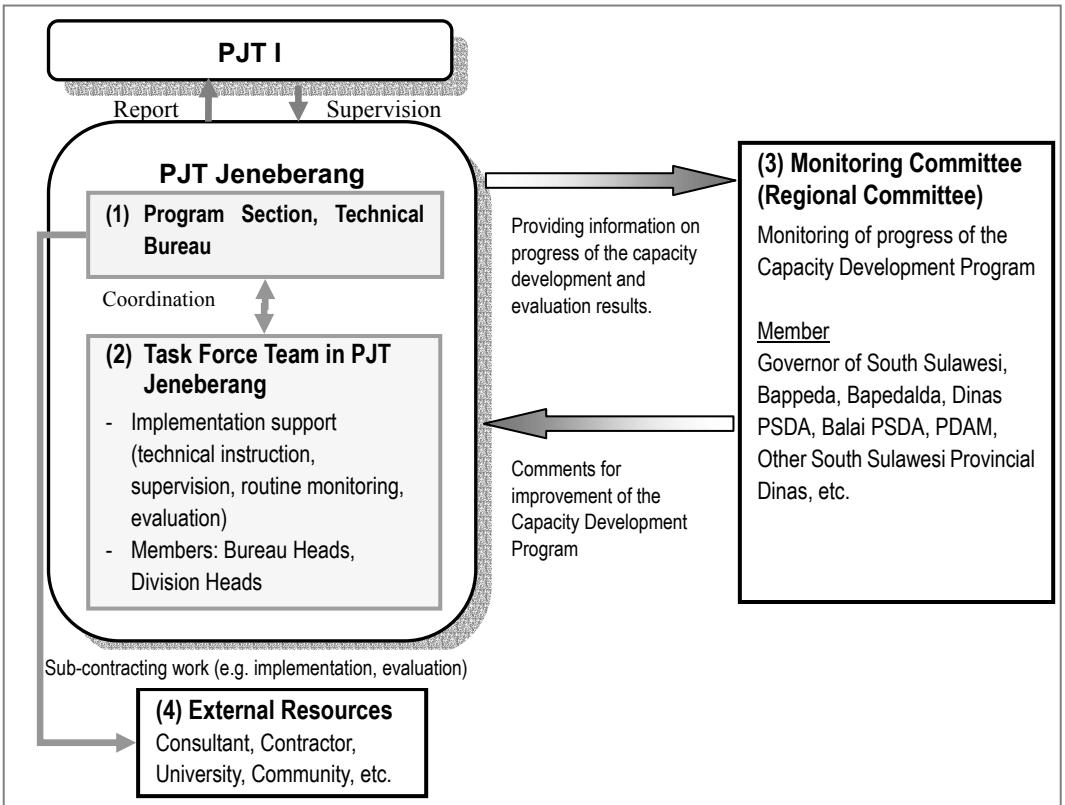
Capacity Development Program (Chapter 13)

Capacity Development Program

97. Capacity development is composed of four components: namely 1) facility management/river basin management, 2) institutional and organizational management, 3) financial management, and 4) human resources development. In total, 27 programs were proposed as shown in Table S-3 attached to this Summary. The detail of the proposed programs is presented in the profile sheets contained in Supporting Report N.

Implementation Organization for the Capacity Development Program

98. Implementation: Several groups within the PJT Jeneberang are involved in the implementation and monitoring of the Capacity Development Program. The Program Section in the Technical Bureau of PJT Jeneberang takes sole responsibility for implementation supported by a Task Force Team composed of Bureau Heads and Division Heads. A Monitoring Committee, composed of stakeholders, is responsible to monitor the implementation and provide advice if necessary. The implementation structure is shown below.



Implementation and Monitoring Organizations

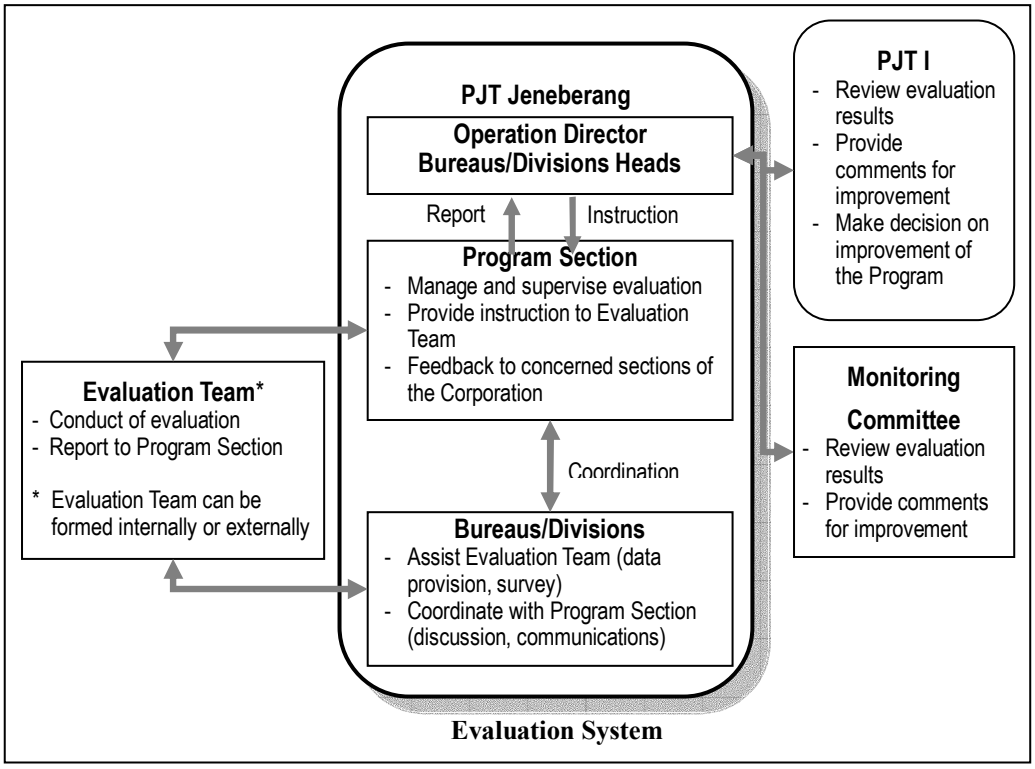
Monitoring and Evaluation of the Capacity Development Program

99. Monitoring shall be conducted internally, and all sections of PJT Jeneberang should be involved. The table below shows monitoring activities and responsible sections in PJT Jeneberang.

Monitoring and Responsible Section

Sections in PJT Jeneberang	Responsibilities
Bureau Heads (Technical Bureau & Administration & Finance Bureau) of PJT Jeneberang	・ Decision making and feedback ・ Modification of the program (if necessary) ・ Report to PJT I head office
Program Section, Technical Bureau of PJT Jeneberang	・ Aggregation of monitoring information ・ Reporting to Bureau Heads/Division Heads ・ Modification of the program (if necessary)
Each Section responsible for implementation of Capacity Development Program	・ Record keeping of the Capacity Development Program ・ Information collection (monitoring indicators)

100. Evaluation: Unlike monitoring, which is conducted internally, evaluation may involve several organizations. The concept of the evaluation system is shown below.



Implementation Schedule

101. The Capacity Development Program is planned to be implemented intensively for three years after establishment of PJT Jeneberang, starting in 2006 and being completed in 2008. Some activities will continue until the end of mid-term plan period (2011). The proposed implementation schedule is shown in Figure 13.2 of the main text.

Further Programs (Chapter 14)

Actions Toward the Establishment and Operation of PJT Jeneberang

102. Approaching the establishment and commencing operation of the new PJT Jeneberang, there are a number of actions to be taken by the relevant organizations. Details of such actions are described in Chapters 7 to 12 of the main text. Major points are summarized in Table 14.1. In order not to delay the commencement of operation of PJT Jeneberang, the agencies responsible for respective actions shall accomplish the necessary activities within the prescribed period.

Phase III Program

103. After the commencement of operation of PJT Jeneberang, the Study will commence activities for Phase III (monitoring & evaluation of capacity development activities). Since it is foreseen that PJT Jeneberang will commence the operation in 2007, Phase III has to start in 2007. This will involve a deferral of 2 years from the originally contemplated schedule. To avoid this, an alternative schedule is under discussion between JICA and DGWR.

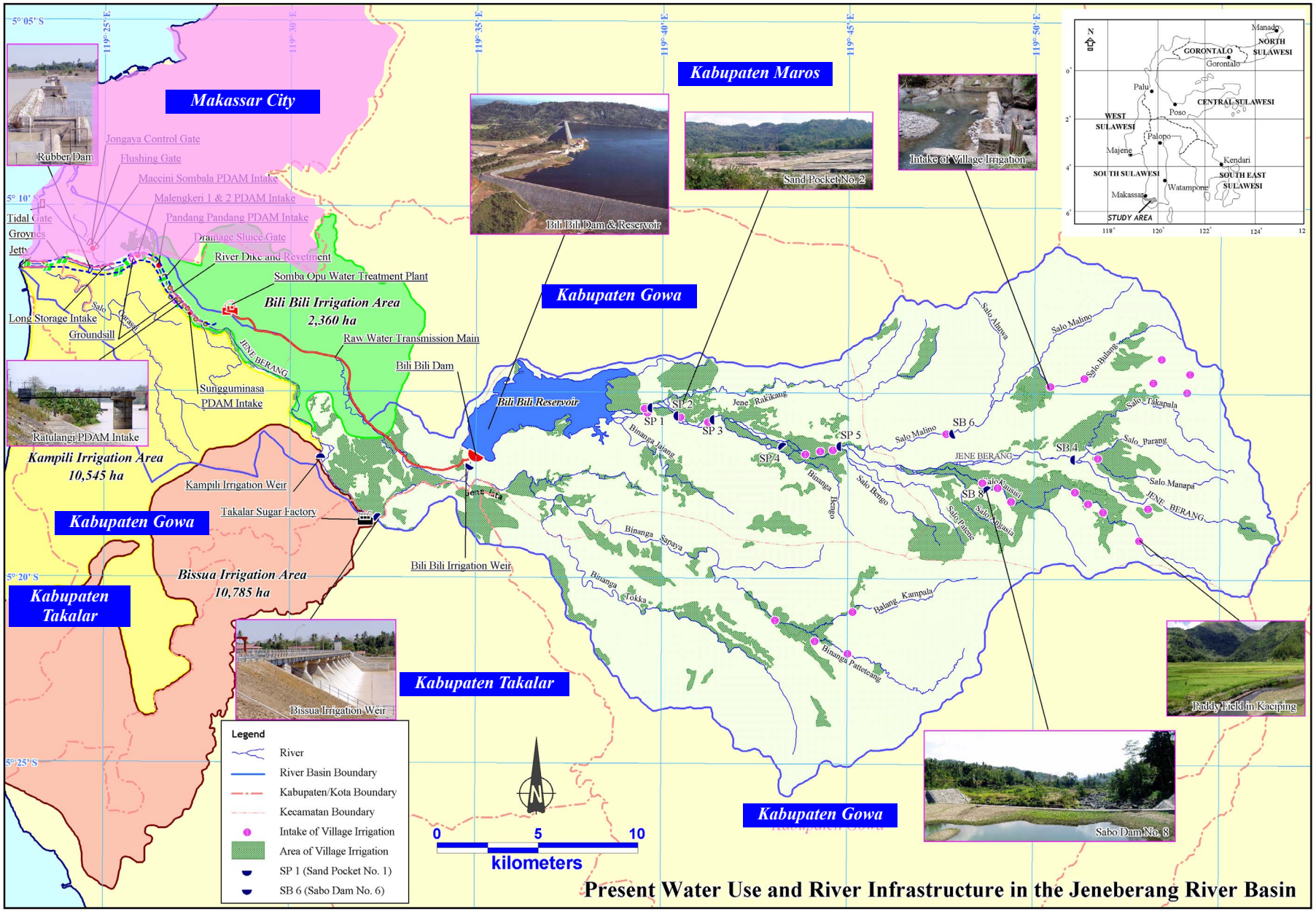

Makassar City
Kabupaten Maros
Kabupaten Gowa
Kabupaten Takalar
Kabupaten Gowa
Kabupaten Takalar
Kabupaten Gowa
Rubber Dam
Jongaya Control Gate
Flushing Gate
Maccini Sombala PDAM Intake
Malengkeri 1 & 2 PDAM Intake
Pandang Pandang PDAM Intake
Drainage Sluice Gate
River Dike and Revetment
Somba Opu Water Treatment Plant
Bili Bili Irrigation Area
2,360 ha
Raw Water Transmission Main
Bili Bili Dam
Bili Bili Reservoir
Long Storage Intake
Groundsill
Sungguminasa
PDAM Intake
Ratulangi PDAM Intake
Kampili Irrigation Area
10,545 ha
Kampili Irrigation Weir
Takalar Sugar Factory
Bissua Irrigation Area
10,785 ha
Bili Bili Irrigation Weir
Bissua Irrigation Weir
Bili Bili Dam & Reservoir
Sand Pocket No. 2
Intake of Village Irrigation
Paddy Field in Kaciping
Sabo Dam No. 8
SP 1
SP 2
SP 3
SP 4
SP 5
SB 4
SB 6
SB 8
Legend
River
River Basin Boundary
Kabupaten/Kota Boundary
Kecamatan Boundary
Intake of Village Irrigation
Area of Village Irrigation
SP 1 (Sand Pocket No. 1)
SB 6 (Sabo Dam No. 6)
0
5
10
kilometers
STUDY AREA
Present Water Use and River Infrastructure in the Jeneberang River Basin

Table S-1 Corporation Establishment and Operation Plan – Summary Table

Item		Description	Anticipated Schedule
Establishment of PJT Jeneberang:			
1	Organizational form of setup	➢ As extension of working area of PJT I, subject to final decision by MPW with agreement of regional governments	By March 2005
2	Legislation	(1) Legislate new Keppres for inclusion of Jeneberang basin as additional working area of PJT I (by MPW) (2) Legislation of 6 central level regulations/decrees for enabling establishment/operation of PJT J (by MPW, etc) (3) Legislation of at least 12 regulations/decrees at regional level for enabling operation of PJT J, plus various agreements among stakeholders (by Dinas PSDA/ PJT J)	By March 2005 By March 2006 By Dec. 2006
3	Budgetary arrangement	➢ Budget for legislation work at regional level (by MPW) ➢ Initial fund for organizational setup of PJT J (by MPW/PJT J) ➢ Funding of working capital for operation in the first year (by PJT J)	By Sept. 2005 By Dec.2005 By Dec. 2006
4	Schedule of establishment and operation	➢ With the completion of legislation of (1) above, PJT J can commence the organizational setup from the beginning of 2006 ➢ With completion of legislation and agreements in (2) and (3) above, PJT J can commence the operation in the beginning of 2007	Beginning 2006 Beginning 2007
Operational Framework:			
5	Assets to be transferred	➢ Managed assets: All infrastructures situated on the rivers to be managed by PJT J, including 17 major facilities (see Table 9.2 of Main Text) ➢ Owned Assets: Lands, buildings, and other fixed/movable assets transferred from state assets (those presently managed by JRBDP)	2007-2009 By Dec. 2005
6	Classification of river basin	➢ Regarded as 'strategic river basin' under jurisdiction of State (after enactment of Keppres on Strategic RB), or trans-Kabupaten river basin under jurisdiction of Province (before enactment of Strategic RB)	
7	Rivers to be managed by PJT J	➢ Jeneberang main stream (1st Order River) + 3 selected 2nd order rivers and 1 selected 3rd order river (out of 1-main stream, 14 - 2nd order rivers and 14 - 3rd order rivers), covering about 65% length of the whole river system (see Table 9.2 of Main Text)	
8	River administrator	➢ Provincial Governor delegated by Minister of Public Works. River Administrator will be the final decision maker including issuance of water use permits and other permits/licenses	
9	Regulator at technical level	➢ Dinas PSDA for river and water management ➢ Bapedalda for water quality and river environmental conservation ➢ Dinas Forestry Services for watershed conservation ➢ Dinas Mining Services for river sand mining and groundwater use	
10	Operator / service provider for O&M of infrastructure	➢ PJT J will manage rivers listed in 7. above and related infrastructure ➢ Balai PSDA / Dinas PSDA Kabupaten Gowa for infrastructure on other 2nd & 3rd order rivers, assisted by PJT J ➢ Cipta Karya of Kota Makassar for city drainage canals and Pampang drainage pump station/retention basin, assisted by PJT J ➢ Balai PSDA for trans-Kabupaten irrigation canals, and Dinas PSDA Kabupaten for in-Kabupaten canals, including water allocation management in irrigation areas ➢ As water users, PLN will operate Bili-Bili power plant, PDAM and other water users operate water supply intakes owned by them	
11	Major rehabilitation work	➢ To be undertaken by JRBDP or Dinas PSDA Province/Kabupaten depending on type of project	
12	Coordinator	➢ PPTPA supported by PTPA, which will assess and coordinate the issues arising in connection with water use and conservation, acting also as an advisor to the river administrator	
Financial Operation:			
13	Revenue source	➢ Raw water supply fee from PDAM, PLN, industries, plantation and fishpond ➢ Support from government under concept of PSO for irrigation intake O&M and other non-revenue generating public services ➢ Income from non-water business such as tourism, sand mining, fishery, etc.	
14	Financial operation	➢ PJT J can earn profit from the 1st year of operation, but on a basis of 'with PSO support' from the government. In case of 'without PSO support', PJT J will be in loss-making operation toward 2020 ➢ Revenue and operation cost at the end of mid-term plan period (2011) are Rp.8.0 billion and Rp.7.6 billion with a profit of Rp.0.4 billion before tax (at 2004 constant price, the case of 'with PSO support')	

Note: MPW: Ministry of Public Works, JRBDP: Jeneberang River Basin Development Project, PJT I: Perum Jasa Tirta I, PJT J: PJT Jeneberang, Keppres: Presidential Decree, RB: River basin

Table S-2 Proposed River Basin Management Plan – Summary Table (1/2)

	Service	Proposed River Basin Management Plan (Main Items only)
1.	**Water Quantity Management**	(1) Complete registration of existing water use (489.3 million m^3/year in total) as officially admitted water permit holders (2) Ensure reliable water supply to water users against the following drought levels: (i) drought of 5-year return period for irrigation use, (ii) drought of 10-year return period for all water requirements other than irrigation use (3) Update continuously the inventory of water use permits (also water use rights in the future) (4) Monitor river flow discharge at eight critical points and the water abstraction volume at six principal river intake points (5) Continue to update the H-Q rating curves at the proposed river flow monitoring points. (6) Establish and operate definitive procedures of daily water distribution with referring to the procedures proposed in the Study.
2.	**Drought Management**	(1) Priority of water supply should be given to the water requirement of municipal water and river maintenance flow in the drought year. (2) Elaborate on a continuous basis the reservoir operation curve incorporating the experience accumulated in various type of drought years (3) Operate the reservoir, if drought occurs, in accordance with stepwise procedures proposed in the Study.
3.	**Flood Management**	(1) Enhance flood evacuation and fighting system in cooperation with SATLAK PB which involves Mayor of Makassar City, the commander of regional military administrative unit, the head of provincial police and the relevant local communities. (2) Develop and disseminate flood risk map, which shows the location of the flood evacuation centers and the evacuation routes (3) Enhance the system for the post-flood technical/financial support from the central government through coordination by the Governor of South Sulawesi, who is the member of BOKORNAS PB
4.	**River Area Management**	(1) Update the inventory of land ownership, classification of land use and other relevant information in the river area (2) Any land use in the high water channel of the river area should be subject to approval of the PJT Jeneberang (3) Monitor and control the excessive land exploitation in the private land located within the boundary of the river area (4) Any logging activities, construction activities and land exploitation around circumference of Bili-Bili dam reservoir specified as the administration area should be subject to approval of the PJT Jeneberang (5) Any renewal of mining license in the lower reaches of Bili-Bili dam should be frozen. (6) Promote the mining activities at the potential mining sites proposed in the upper reaches of Bili-Bili dam (7) Monitor the tendency of degradation of riverbed through river channel survey at every end of rainy season. (8) Monitor the sediment runoff from Mt. Bawakaraeng to facilitate the implementation of the urgent countermeasures by JRBDP.
5.	**Water Quality Management and pollution Control**	(1) Water quality monitoring shall include the following tasks: ➢ Conduct river water quality monitoring at 8 proposed locations ➢ Release river maintenance discharge as required for maintaining the river water quality ➢ Report the results of monitoring and recommend corrective measures to Bapedalda through Dinas PSDA ➢ Assist Bapedalda in formulating and conducting an integrated water quality monitoring activity in the basin

Table S-2 Proposed River Basin Management Plan – Summary Table (2/2)

	Service	Proposed River Basin Management Plan (Main Items only)
		(2) Wastewater Pollution Management shall include the following services: ➢ Monitor periodically effluent quality at pollutant sources in addition to factories' 3- monthly reporting currently in practice ➢ Identify pollutant sources as a part of river patrol ➢ Report the results of data analysis and recommend corrective measures to Bapedalda through Dinas PSDA ➢ Submit technical recommendation regarding the issuance of effluent discharge permits on demand of Bapedalda ➢ Assist Bapedalda in formulating and conducting an integrated water pollution control activity in the basin
6.	**Watershed Management**	PJT Jeneberang will contribute to this sector by providing the following services (1) Reforestation and Forest Management: (a) Donation of seeds and seedlings to Dinas Forestry and communities, and (b) Provision of technical recommendation regarding priority area of reforestation / forest management (2) Improvement of Land Use Practices: (a) Donation of fund for land use practice improvement work, and (b) Provision of technical recommendation regarding priority area of land use practice improvement (3) Structural Measures for Sediment Yield Reduction: (a) Donation of fund for sediment yield control work, and (b) Planning, design and construction supervision service of structural works in assisting Dinas of local government (4) River Environment Conservation: (a) Periodical inspection of condition of river course to identify any adverse issues as part of river patrol, (b) Implementation of corrective measures as required as part of river channel maintenance work (5) Fishery Resources Conservation: (a) Monitoring of fish culture activities in the Bili-Bili reservoir so that over-development of fish-cage aquaculture should not occur, and (b) Reporting to local government (Dinas Fishery) regarding condition and recommendation of corrective measures
7.	**O&M of River Infrastructures**	(1) Undertake O&M for all of the river infrastructures currently managed by JRBDP other than urban drainage facilities. (2) The inventory and location map of the river infrastructures should continue to be updated in accordance with the latest information. (3) Among the above objective river infrastructures, PJT Jeneberang will firstly undertake O&M of those for water resources/distribution as represented by Bili-Bili Dam, 3 irrigation intakes, rubber dam and long storage facilities (4) Expand the O&M works to those for the flood control facilities (e.g. levees), Sabo and sand pocket dams and other riparian structures after 2009 onward, (5) JRBDP should rehabilitate the damages of the eleven drainage sluice gates along the lower Jeneberang River, the telemetry system and a flow meter at the Raw Water Transmission Main before handover of the O&M works to the PJT Jeneberang (6) Undertake the preventative maintenance works, while JRBDP should be responsible for the corrective and emergency maintenance which are oriented to replacement of the river infrastructures due to superannuation of the facilities and/or destructive damages by the extensive scales of natural disasters. (7) O&M manuals should continue to be updated in accordance with the latest information.

Note: SATLAK PB: Regional Implementation Unit for Disaster Management, BOKORNAS PB: National Coordination Board of Disaster Management

Table S-3 Proposed Capacity Development Program – Summary Table (1/2)

No.	Subject	Objective of Capacity Development	Target Group	Schedule		
				'06	'07	'08
(1) Facility Management						
(1)-1-1	Development of inventory of land use status in river area	➢ To identify the outward bound of river area to be managed by PJT Jeneberang ➢ To identify the updated land use states in the river area	TB WS I WS II			●
(1)-1-2	Development of inventory of facilities relevant to river management	➢ To identify the updated states of facilities relevant to river management	TB WS I WS II	●	●	
(1)-1-3	Hydrological data collection and analysis	➢ To improve knowledge of PJT Jeneberang on hydrological data collection and analysis ➢ To improve accuracy of hydrological gauging data as the base for operation of the facilities	WS I		●	
(1)-2-1	O&M of Bili-Bili Dam and Raw Water Transmission Main (RWTM)	➢ To improve the knowledge of PJT Jeneberang on the relevant operation and maintenance works and to improve the conditions of facilities.	WS I	●	●	
(1)-2-2	Maintenance system for electrical equipment in Bili-Bili Dam	➢ To achieve the conduct of proper maintenance work for electrical equipment in Bili-Bili dam on a continuous basis.	WS I		●	●
(1)-2-3	O&M for hydromechanical facility (Bili-Bili Dam site)	➢ To establish a long-term maintenance plan and to conduct proper O&M for hydromechanical facility at Bili-Bili dam site.	WS I		●	●
(1)-2-4	O&M for hydromechanical facility (drainage gates at Jeneberang river)	➢ To establish a long-term maintenance plan and to conduct proper O&M for hydromechanical facility for drainage gate.	WS II		●	●
(1)-2-5	O&M of the existing 11 drainage gates along lower Jeneberang River	➢ To improve the knowledge of PJT Jeneberang on the relevant operation and maintenance works ➢ To improve the knowledge of the local residents as the gatekeepers regarding the relevant operation and maintenance works	WS II TB	●	●	
(1)-2-6	O&M of Rubber Dam and Long Storage	➢ To improve the knowledge of PJT Jeneberang on the relevant operation and maintenance works. ➢ To improve the knowledge of the local resident as the gatekeepers regarding the relevant operation and maintenance works.	WS II	●	●	
(1)-2-7	O&M of irrigation weirs	➢ To improve the knowledge of PJT Jeneberang on the relevant operation and maintenance works	WS II	●	●	
(2) River Basin Management						
(2)-1-1	Flood plain management	➢ To establish the effective flood plain management system. ➢ To improve the knowledge of PJT Jeneberang on flood plain management.	TB AB WS II	2009 onward		
(2)-1-2	Flood warning, fighting and evacuation	➢ To establish the flood warning, fighting and evacuation system ➢ To improve the knowledge of PJT Jeneberang on flood warning, fighting and evacuation system	TB AB WS I WSII	2009 onward		
(2)-2	Water quantity management	➢ To establish the water quantity management system for accomplishing reliable water supply. ➢ To improve knowledge of PJT Jeneberang on water quantity management system.	TB AB WS I WSII	●	●	
(2)-3	Drought management	➢ To establish the drought management system ➢ To improve the knowledge of PJT Jeneberang on	TB AB	2009 onward		

Table S-3 Proposed Capacity Development Program – Summary Table (2/2)

No.	Subject	Objective of Capacity Development	Target Group	Schedule		
				'06	'07	'08
		drought management system	WS I WSII	2009 onward		
(2)-4	Implementation of watershed management services	➢ To accomplish the conduct of services relevant to watershed conservation and management. ➢ To acquaint with the basic know-how of providing the services.	TB WS II			
(2)-5-1	Water quality monitoring (WQM)	➢ To accomplish the conduct of WQM work on a continuous basis.	TB		●	●
(2)-5-2	Water pollution monitoring (WPM)	➢ To accomplish the conduct of WPM work on a continuous basis	TB		●	●
(3) Institutional Management / Human Resources Management						
(3)-1	Laws and regulations in the water sector	➢ To familiarize PJT Jeneberang management with the relevant (i) national laws, regulations and decrees, (ii) regional regulations, decrees, (iii) PJT I Directors' Decrees.	M All BD	●		
(3)-2	Organizational structuring & staffing, and HRA	➢ To educate selected senior personnel and those responsible in organizational structuring, job analysis, staff planning and budgeting, and personnel administration so that the staff can execute jobs properly.	All BD	●	●	
(3)-3	Human resources development (HRD)	➢ To educate the HR Section and PJT Jeneberang managers in the basic skills, procedure and documentation of HRD.	M All BD	●	●	
(3)-4	Strengthening of public relations capability	➢ To strengthen operation capability by establishing public relations system and skills development aiming at customer satisfaction and stakeholder participation.	All BD		●	
(4) Administration Management						
(4)-1	Business planning skill training	➢ To familiarize with the basic skills, procedure, know-how and documentation of business planning, and to be able to elaborate planning document and business proposal.	M All BD	●	●	
(4)-2	Quality management system training	➢ To learn about Quality Management System (QMS) – quality policy and goals, work procedure and instruction, and document control – and acquire capability of preparing the certificate acquisition process through actual operation.	M All BD	●	●	
(4)-3	Corporate management capacity development	➢ To establish management base of PJT Jeneberang with business mind.	M All BD	●	●	
(5) Financial Management						
(5)-1	Financial administration capacity development	➢ To strengthen capacity of financial administration system and its operation by establishing the system and skill development.	M All BD	●	●	
(5)-2	Corporate accounting by ASGL (Accounting System General Ledger)	➢ To develop skills for corporate accounting specialized in water resources management using ASGL.	AB	●	●	
(5)-3	Revenue collection	➢ To establish and strengthen revenue collection procedure of the services provided by PJT Jeneberang.	AB WS II		●	

Note: M: Management, All BD: All Bureau and Divisions, TB: Technical Bureau, AB: Administration & Finance Bureau, WS I: Work Service Division I. WS II: Work Service Division II

THE STUDY ON
CAPACITY DEVELOPMENT FOR
JENEBERANG RIVER BASIN MANAGEMENT
IN
THE REPUBLIC OF INDONESIA

FINAL REPORT

Volume II Main Report

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ABBREVIATIONS (1/5)

ABBREVIATION	BAHASA INDONESIA	ENGLISH
ADB	Bank Pembangunan Asia	Asian Development Bank
Amdal	Analisa Mengenai Dampak Lingkungan	Environmental Impact Assessment (EIA)
Andal	Analisa Dampak Lingkungan	Environmental Impact Analysis
APBD	Anggaran Pendapatan dan Belanja Daerah	Regional Government Revenue and Expenditure Budget (Province/Regency Budget)
APBN	Anggaran Pendapatan dan Belanja Negara	Central Government Revenue and Expenditure Budget (National Budget)
ASA	Air dan Sumber-sumber Air	Water and Water Resources
ASGL	Sistem Akuntasi Buku Besar	Accounting System General Ledger
Askes	Asuransi Kesehatan	Health Insurance
AWLR	Alat Pencatat Tinggi Muka Air Otomatis	Automatic Water Lever Recorder
Bakornas PB	Badan Kordinasi Nasional-Penanggulangan Bencana	National Coordination Board for Disaster Managemenet
Balai PSDA	Unit Pelakasana Teknis Dinas Balai Pengelolaan	Provincial River Basin Management Unit
Bapedal	Badan Pengendalian Dampak Lingkungan	Environmental Impact Management Agency
Bappeda	Badan Perencanaan Pembangunan Daerah	Regional Development Planning Agency
Bapedalda	Badan Pengendalian Dampak Lingkungan Daerah	Provincial Environmental Impact Agency
Bappenas	Badan Perencanaan Pembangunan Nasional	National Development Planning Agency
Bili-Bili HEPP	Pembangkit Listrik Tenaga Air Bili-bili	Bili-Bili Hydro Electric Power Plant
BKPMM	Badan Kerjasama Pengembangan Metropolitan Mamminasata	Mamminasata Metropolitan Development Cooperation Board
BLK	Balai Latihan Kerja	Government Work Training Office
BMG	Badan Meterologi dan Geofisika	Meterology and Geophysics Agency
BOD	Kandungan Oksigen dari Bahan Biologi dan Kimia	Biological Oxygen Demand
BOD	Direksi	Board of Directors
BODD	Surat Keputusan Direksi	Board of Directors Decree
BPDAS	Balai Pengelolaan Daerah Aliran Sungai	Watershed Management Office (under National Ministry of Forestry; formerly Land Rehabilitation and Soil Conservation Office, Balai RLKT)
BPK	Badan Pemeriksa Keuangan	Government Audit Agency
BPKP	Badan Pemeriksa Keuangan dan Pembangunan	Finance and Development Control Agency
BPP	Balai Penyuluhan Pertanian	Agricultural Extension Office
BPTH	Balai Pembenihan Tanaman Hutan	Forest Tree Seedling Office
BPS	Biro Pusat Statistik	Central Bureau of Statistics
BUMD	Badan Usaha Milik Daerah	Regional Government-owned Corporation
BUMN	Badan Usaha Milik Nasional	State-owned Corporation
BWRM	Pengelolaan Sumber Daya Air DAS	Basin Water Resources Management
CDP	Rencana Pengembangan Kapasitas	Capacity Development Plan
CDMP	Rencana Pengelolaan dan Pengembangan Menyeluruh	Comprehensive Development and Management Plan
CEPI	Kerjasama Program Lingkungan di Indonesia -	Collaborative Environmental Program in Indonesia
CES/PPLH-UNHAS	Pusat Penelitian Lingkungan Hidup - Universitas HasanuddinPusat Studi Lingkungan - Universitas Hasanuddin (PSL-UNHAS)	Center of Environmental Studies-Hasanuddin University
CG	Pemerintah Pusat	Central Government
CP	Periode Penagihan	Collection Periods
COD	Kandungan Oksigen dari Bahan Kimia	Chemical Oxygen Demand
CSSP	Standar Kompetensi Posisi Struktural	Competence Standard for Structural Position
DAK	Dana Alokasi Khusus	Special Allocations Fund
Danrem	Komandan Resort Militer	Commander of Regional Military Administrative Unit
DASK	Dokumen Anggaran Satuan Kerja	Work Unit Budget Document
DAU	Dana Alokasi Umum	General Allocations Fund
DFWL	Muka Air Banjir Rencana	Design Flood Water Level
DG	Direktorat Jenderal	Directorate General
DGWR	Direktorat Jenderal Sumber Daya Air	Directorate General of Water Resources
DIK	Daftar Isian Kegiatan	Activities Implementation Plan
DIP	Daftar Isian Proyek	Project Implementation Plan
DIP	Daftar Isian Proyek	Project Budget Allocation
DO	Oksigen Terlarut	Dissolved Oxygen
DOMC	Direktorat Kota Metropolitan	Directorate of Metropolitan City
DPR	Dewan Perwakilan Rakyat	House of Representatives
DPRD	Dewan Perwakilan Rakyat Daerah	Regional House of Representatives

ABBREVIATIONS (2/5)

ABBREVIATION	BAHASA INDONESIA	ENGLISH
DPSDA	Dinas Pengelolaan Sumber Daya Air	Provincial Water Resources Services (PWRS)
DPS	Daerah Pengaliran Sungai	Watershed
DWRS	Dinas PSDA Kabupaten	District Water Resources Services
EC	Komisi Eropa	Europian Commission
FAO	Organisasi Pertanian dan Pangan PBB	United Nations Food and Agriculture Organization
FFWS	Sistem Peringatan dan Peramalan Banjir	Flood Forecasting and Warning System
FIK-ORNOP/LSM	Forum Informasi Komunikasi-Organisasi Non Profit/ Lembaga Swadaya Masyarakat	Communication & Information Forum - Non-Profit Organizations/Non-Governmental Organizations
FMISP	Proyek Sistem Irigasi Dikelola Petani	Farmer Managed Irrigation System Project
FRAP	Perencanaan Pemulihan Keuangan	Financial Recovery Action Plan
F/S	Studi Kelayakan	Feasibility Study
FY	Tahun Anggaran	Fiscal Year
GBHN	Garis Garis Besar Haluan Negara	Broad Outlines of the Nation's Direction
GDP	Produk Domestik Bruto	Gross Domestic Product
GIS	Sistem Informasi Geografik	Geographic Information System
GMTDC	PT. Gowa Makassar Tourism Development (GMTD)	Gowa Makassar Tourism Development Corporation
GNRHL	Gerakan Nasional Rehabilitasi Hutan dan Lahan	National Campaign for Land and Forest Rehabilitation
GOI	Pemerintahan Republik Indonesia	Government of Indonesia
GR	Peraturan Pemerintah (PP)	Government Regulation (GR)
GRDP	Produk Domestik Bruto Daerah	Gross Regional Domestic Product
GWUA	Perkumpulan Pemakai Air Tanah	Ground Water Users Association
HEPP	Pembangkit Listrik Tenaga Air	Hydro Electric Power Plant
HO	Kantor Pusat	Head Office
HR	Sumber Daya Manusia	Human Resources
HRA	Administrasi Sumber Daya Manusia	Human Resources Administration
HRD	Pengembangan Sumber Daya Manusia	Human Resources Development
HRM	Pengelolaan Sumber Daya Manusia	Human Resource Management
HWL	Tinggi Muka Air	High Water Level
IKMN	Inventarisasi Kekayaan Milik Negara	National Treasury Inventory System
ORARI	Organisasi Radio Amatir Indonesia	Indonesian Amateur Radio Organization
IMT	Penyerahan Pengelolaan Irigasi	Irrigation Management Transfer
Inpres	Instruksi Presiden	Presidential Instruction
Inhutani	PT. Industri Kehutanan dan Pertanian	Government-owned Forestry and Agricultural Industry Company
IOMP	Kebijakan Pengoperasian dan Pemeliharaan Irigasi	Irrigation O&M Policy
IP3A	Induk P3A	Main Water Users Association (at primary irrigation system level)
IPAIR	Iuran Pelayanan Air Irigasi	Irrigation Service Fee (ISF)
IPABP	Iuran Penggunaan Air Bawah Permukaan	Underground Water Use Fee
IPAP	Iuran Penggunaan Air Permukaan	Surface Water Use Fee
IPLC	Iuran Pembuangan Limbah Cair	Liquid Waste Disposal Fee
IPEP	Iuran Pembiayaan Eksplotasi dan Pemeliharaan	Fee for Financing Exploitation and Maintenance
IR	Komponen dari Kajian Khusus WATSAL yg bertujuan untuk peningkatan pengelolaan irigasi	A component of WATSAL Special Study aiming at improvement of irrigation management
ISF	Iuran Pelayanan Air Irigasi (IPAIR)	Irrigation Service Fee
ISO	Pengoperasian Standar International	International Standard Operation
IWIRIP	Proyek Pelaksanaan Pembaharuan Irigasi & Sumber Daya Air Indonesia	Indonesian Water Resources & Irrigation Reform Implementation Project
IWRM	Pengelolaan Sumber Daya Air Terpadu	Integrated Water Resources Management
Jamsostek	Jaminan Sosial Tenaga Kerja	Labor Social Insurance
JBIC	Bank Jepang untuk Kerjasama Internasional	Japan Bank for International Cooperation
JBIC-SAPS	Bank Jepang untuk Kerjasama Internasional - Bantuan Khusus untuk Keberlanjutan Proyek	Japan Bank for International Cooperation - Special Assistance for Project Sustainability
JDESs	Uraian Tugas dan Persyaratan Pegawai	Job Descriptions and Employee Specifications
JICA	Badan Kerjasama Internasional Jepang	Japan International Cooperation Agency
JIWMP	Proyek Pengembangan Irigasi dan Pengelolaan Sumber Daya Air di Jawa	Java Irrigation Improvement and Water Resources Management Project
JRB	Wilayah Sungai Jeneberang	Jeneberang River Basin
JSUIT	Tim Investigasi Khusus JICA Sabo	JICA Sabo Urgent Investigation Team
Kapolda	Kepala Polisi Daerah	Head of the Provincial Police

ABBREVIATIONS (3/5)

ABBREVIATION	BAHASA INDONESIA	ENGLISH
Kapolwil	Kepala Polisi Wilayah	Head of the Regional Police
Kepmen	Keputusan Menteri	Ministerial Decree
Keppres	Keputusan Presiden	Presidential Decree
KIMA	Kawasan Industri Makassar	Makassar Industrial Zone
Kimpraswil	Departemen Pemukiman dan Prasarana Wilayah	Ministry of Settlement and Regional Infrastructure
KPH	Kelompok Pengaman Hutan	Forest Protector Group
KPSA	Kelompok Pelestari Sumber Daya Alam	Natural Resources Conservation Group
KSM	Kelompok Sosial Masyarakat	Social Community Group
KT	Kelompok Tani	Farmer's Group
KTH	Kelompok Tani Hutan	Forest Farmers Group
KTP	Kelompok Tani Penghijauan	Reforestation Farmers Group
KUD	Koperasi Unit Desa	Village Unit Cooperatives
LAN	Lembaga Administrasi Negara	State Administration Institute
LHP	Laporan Hasil Penelitian	Report on Research Result
LKMD	Lembaga Ketahanan Masyarakat Desa	Village Social Activities Group
LWL	Muka Air Rendah	Low Water Level
MCM	Juta m3	Million Cubic Meter
M&E	Pemantauan & Evaluasi	Monitoring & Evaluation
Menko-Ekuin	Menteri Koordinator Ekonomi, Keuangan dan Industri	Coordinating Minister for Economy, Finance and Industry
Meneg LH	Menteri Negrara Lingkungan Hidup	State Minister of Environment
MoHA	Departemen Dalam Negeri	Ministry of Home Affairs
MEI	Laporan Monitoring, Evaluasi dan Implementasi	Monitoring, Evaluation and Implementations
MENR	Departemen Energi dan Sumber Daya Alam	Ministry of Energy and Natural Resources
MoA	Departemen Pertanian	Ministry of Agriculture
MoF	Departemen Keuangan	Ministry of Finance
MoU	Nota Kesepakatan	Memorandum of Understanding
MPW	Departemen Pekerjaan Umum	Ministry of Public Works
MSOE	Departemen BUMN	Ministry of Stated-Owned Enterprises
MSRI	Departemen Permukiman dan Prasarana Wilayah (Kimpraswil)	Ministry of Settlement and Regional Infrastructure
NDF	Dana Pembangunan Nasional	National Development Fund
N-1	Suatu komponen WATSAL Studi Khusus tentang peningkatan kerangka kelembagaan nasional	A component of WATSAL Special Study aiming at improvement of national institutional framework
N-2	Suatu komponen WATSAL Studi Khusus tentang peningkatan pengelolaan wilayah sungai	A component of WATSAL Special Study aiming at improvement of river basin management
N-3	Suatu komponen Watsal Studi Khusus mengenai pengelolaan kualitas air	A component of WATSAL Special Study aiming at water quality management
NGO	Lembaga Swadaya Masyarakat (LSM)	Non-Government Organization
NTU	Satuan Turbiditas Nephlometrik	Nephlometric Turbidity Unit
NWL	Muka Air Normal	Normal Water Level
NWRC	Dewan Sumber Daya Air Nasional	National Water Resources Council
NWRP	Kebijakan Sumber Daya Air Nasional	National Water Resources Policy
O&M	Operasi & Pemeliharaan (O&P)	Operation & Maintenance
OECD	Organisasi Kerjasama Ekonomi & Pembangunan	Organization for Economic Co-operation & Development
OECF	Pendanaan Kerjasama Ekonomi Luar Negeri Jepang	Overseas Economic Cooperation Fund of Japan
OJT Training	Pelatihan Kerja di Tempat	On the Job Training
P.T.	Perseroan Terbatas	Limited Liabilities Corporation
PAB	Penyediaan Air Baku	Raw Water Supply (RWS)
PABJ	Penyediaan Air Baku Jeneberang	Jeneberang Raw Water Supply
PAD	Pendapatan Asli Daerah	Regional Government Revenue
Pangdam	Panglima Daerah Militer	Territorial Military Commander
PBB	Pajak Bumi dan Bangunan	Land and Building Tax
PBPP	Pengendalian Banjir dan Pengamanan Pantai	Flood Control and Coastal Protection
PCM	Manajemen Siklus Proyek	Project Cycle Management
PDAM	Perusahaan Daerah Air Minum	Regional Drinking Water Supply Company
PDM	Matriks Disain Proyek	Project Design Matrix
Perda	Peraturan Daerah	Regional Regulation (RR)
Permen	Peraturan Menteri	Ministerial Regulation
Perum	Perusahaan Umum	Public Corporation

ABBREVIATIONS (4/5)

ABBREVIATION	BAHASA INDONESIA	ENGLISH
Persero	Perusahaan Perseroan	Copartnership / Shareholding Corporation
PGPNS	Peraturan Gaji Pegawai Negeri Sipil	Government Employee Salary Rule
PHU	Unit Hydrologi Propinsi	Provincial Hydrology Unit
PIPWSJ	Proyek Induk Pengembangan Wilayah Sungai Jeneberang	Jeneberang River Basin Development Project (JRBDP)
PIRASS	Proyek Irigasi dan Rawa Andalan Sulawesi Selatan	South Sulawesi Major Swamp and Irrigation Project
PISP	Proyek Irigasi Partisipatif	Participatory Irrigation Sector Project
PJT	Perum Jasa Tirta	Jasa Tirta Public Corporation
PKK	Pendidikan Keterampilan Keluarga	Skills Training for Housewifes
PKPI	Pembaharuan Kebijakan Pengelolaan Irigasi	Irrigation Management Policy Reform (IMPR)
PKPT	Program Kerja Pengawasan Tahunan	Work Program for Annual Inspection (Audit)
PLN	Perusahaan Listrik Negara	State Electricity Company
PLTA	Pembangkit Listrik Tenaga Air	Hydro Electric Power Plant
PNS	Pegawai Negeri Sipil	Government Employees
PO	Rencana Pengoperasian	Plan of Operation
POJ	Perum Otorita Jatiluhur	Jatiluhur Authority Public Corporation
Pokja	Kelompok Kerja	Working Group
POWAA	Pola Operasi Waduk & Alokasi Air	Semiannual Water Allocation Plan
PP	Perencanaan Partisipatif	Participatory Plan
PPAP	Pajak Pengambilan Air Permukaan	Surface Water Use Tax
PPABP	Pajak Pengambilan Air Bawah Permukaan	Underground Water Use Tax
PPh	Pajak Penghasilan	Income Tax
PPL	Penyuluh Pertanian Lapangan	Field Extension Workers
PPSA	Pengembangan dan Pengelolaan Sumber Air	Water Resources Development and Management
PPSAJ	Pengembangan & Pengelolaan Sumber Air Jeneberang	Jeneberang Water Resources Development and Management
PTPA	Panitia Tata Pengaturan Air	Provincial Water Resources Coordination Committee(PWRC)
PPTPA	Panitia Pelaksana Tata Pengaturan Air	River Basin Water Resources Coordination Committee (RBWRC)
PRA	Identifikasi Desa secara Partisipatif	Participatory Rural Appraisal
Prokasih	Program Kali Bersih	Clean River Campaign Program
Propeda	Program Pembangunan Daerah	Regional Development Program
Propenas	Program Pembangunan Nasional	National Development Program
PSB	Petunjuk Siaga Bajir	Flood Alert Manual
PSO	Kewajiban Pelayanan Umum (KPU)	Public Service Obligation
PSP	Partisipasi Pihak Swasta	Private Sector Participation
PUKK	Pembinaan Usaha Kecil dan Koperasi	Small Business and Cooperative Guidance
PWRC	Panitia Pelaksana Tata Pengaturan Air (PPTA)	Provincial Water Resource Coordination Committee
QMS	Sistem Pengelolaan Mutu	Quality Management System
RBPC	Badan (Perum) Pengelola Wilayah Sungai	River Basin Public Corporation
RBM	Pengelolaan Wilayah Sungai	River Basin Management
RBMC	Korporasi Pengelola Wilayah Sungai	River Basin Management Corporation
RBWRC	Panitia Pelaksana Tata Pengaturan Air (PPTPA)	River Basin Water Resources Coordination Committee
RD	Rapat Direksi	Board of Director's Meeting
Repetada	Rencana Pembangunan Tahunan Daerah	Regional Annual Development Plan
RC	Kurva Dasar Pengoperasian Waduk	Reservoir Operation Curve
RJP	Rencana Jangka Panjang	Long Term Plan
Renstra	Rencana Strategis	Strategic Plan
RIM	Pengelolaan Prasarana Wilayah	River Infrastructure Management
RKAP	Rencana Kerja Anggaran Perusahaan	Corporate Work Plan Budget
RKM	Rapat Koordinasi Manajemen	Management Coordination Meeting
RKOP	Rencana Kerja Operasional Perusahaan	Corporate Work Plan Operations
RKU	Rapat Koordinasi Unit	Unit Coordination Meeting
RLKT	Rehabilitasi Lahan dan Konservasi Tanah	Land Rehabilitation and Soil Conservation
RMCD	Proyek Pengembangan Kapasitas Pemantauan Daerah	Regional Monitoring Capcity Development Project
ROE	Laba atas Modal Sendiri	Return on Equity
ROI	Laba atas Investasi	Return on Investment
RPH	Polisi Hutan	Forest Ranger Resort
RTM-P	Rapat Tinjauan Managemen - Pusat	Central Management Evaluation Meeting

ABBREVIATIONS (5/5)

ABBREVIATION	BAHASA INDONESIA	ENGLISH
RTM-U	Rapat Tinjauan Management - Unit	Unit Management Evaluation Meeting
RWL	Muka Air Waduk	Reservoir Water Level
RWTM	Pipa Transmisi Utama Air Baku	Raw Water Transmission Main
Satlak-PB	Satuan Pelaksana-Penanggulangan Bencana	Implementation Unit for Disaster Management (District Level)
Satkorlak	Satuan Coordinator Pelaksana	Implementation Coordination Unit (Province Level)
SDA	Sumber Daya Air	Water Resources
SEC	Komisi Pertukaran Sekuriti	Security Exchange Commission
SKI	Surat Ketetapan Iuran	Fee Enactment
SMEs	Usaha Kecil Menengah (UKM)	Small and Medium Size Enterprises
SMSOE	Menteri Negara BUMN	State Minister of State-Owned Enterprises
SOE	Badan Usaha Milik Negara (BUMN)	State-Owned Enterprises
SP3AP	Surat Penetapan Pengambilan dan Penggunanan Air Permukaan	Surface Water Abstraction and Utilization Enactment
SPI	Satuan Pengawas Internal	Internal Control Unit
SPK	Surat Perjanjian Kerja	Work Agreement Letter
SPTP	Surat Perintah Tugas Pemeriksaan	Inspection Letter
SS	South Sulawesi	Sulawesi Selatan
SS	Padatan Tersuspensi	Suspended Solid
SuSENas	Survey Sosial Ekonomi Nasional	National Socio-Economic Survey
SWL	Muka Air Tambahan	Surcharge Water Level
SWOT Analysis	Analisa Kekuatan, Kelemahan, Peluang dan Ancaman	Strength, Weakness, Opportunity and Threat Analysis
SWS	Satuan Wilayah Sungai	River Basin Unit
TA	Bantuan Tekhnis	Technical Assistance
TATO	Perputaran Total Aset	Total Asset Turn Over
T-C	Total Bakteri Coli	Total Coliforms
TDS	Total Padatan Terlarut	Total Dissolved Solid
TET	Tim Evaluasi Tarif	Tariff Evaluation Team
TIU	Unit Pelaksana Teknis	Technical Implementation Unit
TNA	Pelatihan Analisa Kebutuhan	Training Needs Analysis
TSS	Total Padatan Tersuspensi	Total Suspended Solid
ToR	Kerangka Acuan	Term of Reference
UFW	Air yang hilang	Unaccounted-for Water
UKL/UPL	Upaya Kelola Lingkungan / Upaya Pemantau Lingkungan	Environmental Management Effort / Environmental Monitoring Effort
UNWB	Unit Usaha Non-Air	Non-Water Business Unit
UPTD/Balai PSDA	Unit Pelaksana Teknis Daerah/Balai PSDA	Local Technical Implementation Unit/Balai PSDA
WATSAL	Penyesuaian Pinjaman Sektor Sumber Daya Air	Water Resources Sector Adjustment Loan
WATSAP	Program Penyesuaian Sektor Air	Water Sector Adjustment Programme
WB	Bank Dunia	World Bank
WiD	Wanita dalam Pembangunan	Women in Development
WISMP	Proyek Pengelolaan Sektor Irigasi dan Sumber Air	Water Resources and Irrigation Sector Management Program
WMO	Badan Meteorologi Dunia	World Meteorogical Organization (WMO)
WPM	Pemantauan Pencemaran Air	Water Pollution Monitoring
WQM	Pemantauan Kualitas Air	Water Quality Monitoring
WRM	Pengelolaan Sumber Daya Air (PSDA)	Water Resource Management
WS	Wilayah Sungai	River Basin (RB)
WTP	Instalasi Pengelolaan Air (IPA)	Water Treatment Plant
WUA	Perkumpulan Petani Pemakai Air (P3A)	Water User Association
WUAF	Gabungan Perkumpulan Petani Pemakai Air (GP3A)	Water User Association Federation
WUR	Hak Guna Air	Water Use Right

CHAPTER 1

INTRODUCTION

1.1 Background Information

1.1.1 Necessity of River Basin Management

With a strategy of expanding the nation's economic development and improving people's welfare, the Government of Indonesia has implemented a number of water resources development projects, such as irrigation, flood mitigation, hydropower generation, watershed conservation projects and others, over the country for the last several decades. This attempt has brought about the present country's prosperity represented by a remarkable increase in gross domestic product, a great improvement in food self-sufficiency and a notable upgrading of people's living standards. On the other hand, however, little attention has been given to proper operation and maintenance (O&M) of the completed water resource facilities, due mainly to insufficient O&M budgets available to the Government.

The Government has launched the reform of the water resources sector in recent years in which the importance of proper river basin management, including the O&M of facilities, is recognized as a priority policy. The Government pursues the attainment of integrated river basin management for all river basins in the country, setting in place a policy of 'one river basin, one management'.

The necessity of proper river basin management can be expressed in the following four points:

- Water resources are a valuable social/economic good essential for the welfare of the public, but are of limited availability, especially in the dry seasons. They should be utilized most efficiently and effectively through proper water resources management under the rules of integrated river basin management.
- The completed water resources facilities and river facilities are the nation's valuable assets. Their service lives must be prolonged as much as possible by providing proper care for operation, maintenance and rehabilitation.
- Proper river basin management is requisite for enhancing people's daily lives and regional economic activities.
- Proper river basin management is also requisite for maintaining and upgrading the basin's natural environments including water quality conservation, ecological protection and watershed conservation.

1.1.2 River Basin Management by a Public Corporation

River basin management must be consistent with Government policies on good governance, decentralization, community participation and long-term sustainability as emphasized in the draft National Water Resources Policy. There is a need to establish a capable river basin

management organization, which could manage the basin with strategies in line with the policies stated above.

An approach to attaining such a strategic river basin management is to entrust the work to a Public Corporation fully supported and empowered by central and regional governments and communities in the basin. There are already two success examples of existing Public Corporations; Jasa Tirta I in the Brantas and Bengawan Solo River basins and Jasa Tirta II in the Citarum River basin. They have been in operation for more than a decade after corporatization and are showing fair degrees of success in their river basin management.

Unlike the government agency, Public Corporation is entitled to recover the O&M costs from water users and generate other income sources, thus contributing to reducing the budgetary burden on central and regional governments.

With these advantages in mind, the Government contemplates establishing a new public corporation, referred to as the Jeneberang River Basin Management Corporation, responsible for river basin management of the Jeneberang River.

1.1.3 Technical Cooperation Program by JICA

The Government of the Republic of Indonesia (hereinafter referred to as "the GOI") requested the Government of Japan (hereinafter referred to as "the GOJ") to conduct a study on the establishment and capacity development of a new public corporation to be formulated in the Jeneberang river basin.

In response to the request of the GOI, the GOJ decided to conduct the 'Study on Capacity Development for Jeneberang River Basin Management in the Republic of Indonesia' (hereinafter referred to as "the Study") in accordance with the relevant laws and regulations in force in Japan.

Japan International Cooperation Agency (hereinafter referred to as "JICA"), the official agency responsible for the implementation of the technical cooperation programs of the Government of Japan, dispatched the Preparatory Study Team to Indonesia in August 2003 to discuss the scope of works and other study requirements. The scope of works agreed between DGWR and JICA Preparatory Study Team on August 27, 2003 is contained in Appendix attached to this report, together with the Minutes of Meeting.

In accordance with the agreed Scope of Work, JICA dispatched the study team to Indonesia at the end of January 2004 to commence the study activities. Since then, the study team conducted investigations and studies in Indonesia until the end of November 2004, and has further finalized the study outputs in Japan/Indonesia towards March 2005.

1.2 Objective of the Study

The objectives of the Study are described in the Scope of Work as follows: (see Appendix for detail)

(1) To assist in the establishment of a Jeneberang Public Corporation

(2) To assist the Jeneberang Public Corporation in capacity development in the following aspects:
- Administration,
- Financial arrangement,
- River basin management, and
- Human resources development

(3) To formulate the operation and maintenance plan of river facilities

Before the establishment of the Corporation, assistance from the Study will be addressed to the Jeneberang River Basin Development Project (JRBDP). In the Study, assistance to the Provincial River Basin Management Unit (Balai PSDA) will also be taken into account for matters related to their roles in river basin management activities for the Jeneberang River.

1.3 Study Area

The study area covers the whole Jeneberang River basin (approximately 762 km^2 in area) and, in addition, the potential service areas where any revenues and other income sources are expected for the new Jeneberang Public Corporation (e.g. municipal water supply area, irrigation area, flood mitigation area, etc).

The Jeneberang River basin is located administratively in two Kabupaten (District) and one Kota (City), namely Kabupaten Gowa, Kabupaten Takalar and Kota Makassar. It spreads over seven Kecamatan (Sub-district) in Kabupaten Gowa, one Kecamatan in Kabupaten Talalar and three Kecamatan in Kota Makassar (see Chapter 2 and 3 for detail). The service area includes the almost entire area of Makassar urban area and Bili Bili-Bissua-Kampili irrigation scheme areas in Kabupaten Gowa and Takalar.

The location of the Study area is shown in the Location Map attached at the beginning of this report.

1.4 Scope of the Study

The Scope of Work describes that the Study will be carried out in three phases, Phase I to Phase III. The scope of studies in the respective phases is summarized as follows:

Phase I: Basic Study/Analysis and Assessment of River Basin Management Plan (end January – July 2004)

1. Collection and analysis of existing data and information
2. Review and assessment of the existing related development plans, policies, guidelines and manuals
3. Review and assessment of donor activities in the water resources sector in Indonesia (case study on capacity building and financial condition improvement)

4. Review and assessment of the river basin management in Indonesia (including Brantas River basin and Citarum River basin)
5. Assessment of the river basin management plan for the operation and maintenance plan

Phase II: Formulation of Capacity Development Plan (August 2004 - March 2005)

1. Development of the organizational framework
2. Formulation of the operation and maintenance plan of river facilities
3. Development of strategies and plans for securing revenue
4. Formulation of the administrative and financial management plans
5. Formulation of the human resources development plan

Phase III: Monitoring and Capacity Development (Scheduled for April 2005 onwards)

1. Monitoring and evaluation of the progress of capacity development of Jeneberang Public Corporation
2. Review and improvement of capacity development plan
3. Enhancement of capacity development based on the results of monitoring and evaluation

1.5 Counterpart Agency

On the part of the Government of Indonesia, the Ministry of Settlement and Regional Infrastructure (hereinafter referred to as "MSRI" or "Kimpraswil") represented by the Directorate-General of Water Resources (hereinafter referred to as "DGWR") shall act as the executing agency for the Study and also act as a coordinating body in relation to other relevant government and non-governmental organizations concerned with the smooth implementation of the Study. The MSRI was reformed to the Ministry of Public Works (hereinafter referred to as "MPW" or "DPU") in October 2004.

At the river basin level, the Jeneberang River Basin Development Project Office (JRBDP or PIPWS Jeneberang) is the counterpart agency cooperating with the Study. The Study is also supported by Provincial Water Resources Services (Dinas PSDA) of South Sulawesi Province.

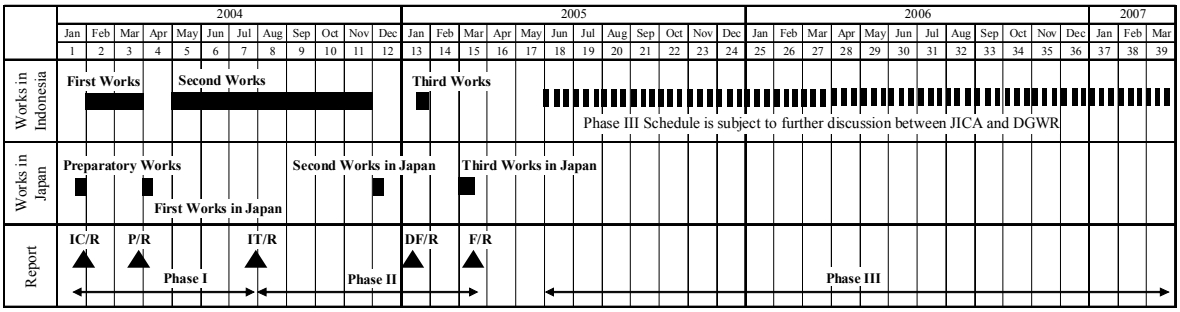
JRBDP has assigned a counterpart team to provide cooperation and assistance at working level. The team consists of five personnel; (i) chief counterpart/water resources engineer, (ii) O&M expert, (iii) institutional expert, (iv) legal expert, and (v) accountant.

1.6 Steering and Regional Committees

To proceed with the Study effectively and smoothly, a Steering Committee and Regional Committee were organized in Jakarta and Makassar, respectively. The Steering Committee, composed of central government agencies concerned with the Study, has supervised the overall activities of the Study. The Regional Committee, composed of regional government agencies, has monitored the progress, discussed the issues and supported the Study. The member list of the Committees is contained in Appendix.

1.7 Overall Schedule of the Study

Total duration of the Study has been scheduled as 39 months starting in January 2004 and ending in February 2007. Owing to delays in the establishment of Jeneberang Public Corporation, however, it is now foreseen that Phase III f the Study could not commence as originally scheduled and will have to be reprogrammed. Revised program of Phase III will be subject to further discussion between JICA and DGWR.



Overall Schedule of the Study

1.8 Final Report

This Final Report (F/R in above figure) is hereby submitted as a final product of Phase I and Phase II studies conducted to date since the beginning of the study.

The Report presents among others: (i) proposed formation of a new public corporation, (ii) proposed capacity development of the corporation, and (iii) proposed operation and maintenance plan of river infrastructure, in conformity with the objectives of the Study.

Final Report consists of the following six (6) volumes:

Volume I	Executive Summary
Volume II	Main Report (this volume)
Volume III-1	Supporting Report 1
Volume III-2	Supporting Report 2
Volume IV-1	Data Book 1 - Guidelines and Manuals
Volume IV-2	Data Book 2 – Data

The Report was explained and discussed at the Steering Committee meeting and Regional Committee meeting held in the middle of January 2005. The Report was hereby finalized towards March 2005 after incorporating the comments expressed at the Committee meetings.

CHAPTER 2

SOCIO-ECONOMY OF THE STUDY AREA

2.1 Socio-economic Profile of the Study Area

The Jeneberang River basin is located in the province of South Sulawesi and extends over three districts, namely Makassar City (Kota), Takalar District (Kabupaten) and Gowa District. Both Takalar and Gowa Districts will benefit from new irrigated abstraction from the river basin. Makassar City also receives water for municipal and industrial use from the river basin.

Makassar City, as a capital of the province, leads the manufacturing, commercial, and service activities of the province. As an economic presence, Gowa and Takalar District are less significant, and are dependent on agriculture and labor-intensive industries.

2.1.1 Population

(1) Population of the Study Area

The population of South Sulawesi Province totaled approximately 8 million in 2002. Both population growth (1.1 % per annum) and density (127.7 persons per km^2) of the province are close to the national average and have shown rather modest trends in recent years. The population trend of the Study area is presented in Table 2.1.

Population of the Study area was around 1.9 million in 2002 and has grown at a rather higher ratio (1.4 %), reflecting a continuous influx of people into Makassar and development of residential estates in Gowa. Makassar City accounts for almost 60 % (1.1 million) of the total population of the Study area, and is an exception in the province. It is more urbanized with a high density of 6,416 persons per km^2. Accordingly, the Study covers a relatively dense area (719.4 persons per km^2).

Table 2.2 shows that the average household size in the Study area has declined (from 4.6 persons per family in 2000 to 4.3 in 2002) as a positive result of the family planning program. The sub-districts (Kecamatan), with average household sizes of over 5.0, are a minority in the Study area, revealing the gradual shift to urbanization and a 'nuclear' household.

2.1.2 Economic Performance

(1) Gross Regional Domestic Product (GRDP)

The economic crisis in 1998 hit the economy of South Sulawesi Province and brought about a contraction of 5.3 % compared to a growth of 4.3% in the previous year (both in real-terms). However, the provincial economy immediately recovered owing to a revitalization of export-oriented industries (as a result of currency depreciation), and has maintained steady growth since.

Table 2.3 presents GRDP trend in the province and Study area in recent years. Average annual GRDP growth rates of South Sulawesi Province and the Study area have been 4.3 % and 6.0 % between 1998 and 2002, respectively, in real terms. As a result growth trends in per-capita GRDP of 3.1 % and 4.4 % have been achieved over the same periods.

Also, in every district in the Study area, both GRDP and per-capita income have grown steadily after the economic crisis. Makassar City has achieved the higher annual GRDP growth rate of 6.9 %. Economic activities in the Study area have been largely concentrated in Makassar (almost 78 % of the total GRDP).

(2) Structure of Regional Economy

In the South Sulawesi Province, the agricultural sector (food crop production sub-sector) is the mainstay of the economy, accounting for 37.5 % (in 2002) of the total GRDP. This figure has, however, been declining from 45.8 % (in 1998) due to the shift to a service-oriented economy. From Table 2.4, notable features of the economic structure of the province are summarized as follows:

- Manufacturing industry accounts for a small segment (11.4 % of the total GRDP in 2002) in the economy, and the process of industrialization has been slow. Among the manufacturing industries, agro-processing, wooden-products and cement / quarrying have a dominant share.
- Service-related industry (trading) has expanded steadily, benefiting from sophisticated access infrastructure such as sea / air ports in Makassar.
- Only Makassar shows features of urbanization, explained by the higher contribution of manufacturing and service industries. Other districts in the Study Area have almost the same industrial structure as a rural economy.

It is assumed that the Study area will shift further to a service-oriented economy and gradual industrialization in the future, taking into account the past trend in economic structure.

(3) Employment

As presented in Table 2.5, the sector that absorbs the workforce is mostly agriculture (57.9 % of the total workforce in 2002) in South Sulawesi, showing the feature of an agriculture-based economy. In the Study area and Makassar, however, the major sector is trading, accounting for 28.7 % of total workforce of the Study area and 37.1 % of Makassar, respectively. The agricultural workforce is more dominant in other districts such as Gowa, Takalar and Maros.

(4) International Trade

The value of total commodity export from South Sulawesi Province amounted to US$ 744 million in 2001, with records indicating a steady growth from US$ 598 million in 1998. This growth trend has been largely explained by the currency devaluation at the time of economic crisis. Main export commodities have been nickel (43.6 % of the total value in 2001), cacao (24.4 %) and shrimp (12.7 %). The value of total imports has faced a sharp decline as a result of the adverse impact of the economic crisis. Exports have dropped from US$ 330 million in 1998 to US$ 206 million in 2001. The major import commodity is machinery, from Singapore and China.

(5) Investments

Foreign and domestic investment in South Sulawesi Province was severely affected by the economic crisis, but has recovered in recent years. In 2002, the number of approved domestic investment projects only amounted to 15, and the value of investment was Rp. 146,059 million. Domestic investment has been mainly directed to the manufacturing industry and transportation sectors. The number of foreign direct investment projects had reached 16 projects by 2002, amounting to US$ 382.9 million. Foreign investment mostly occurs in manufacturing and service industries.

(6) Prices

Inflation in the Study area occurs at a rather high rate (much lower, however, than compared to other Eastern Indonesian cities), reflecting the recent growth of economic activities and resultant increase in demand. The past trend (Table 2.6) has been rather fluctuating, but indicates an average rate of escalation of 7.36 % per annum (eliminating the effect of the economic crisis).

2.1.3 Profile of Economic Sector

(1) Agriculture and Fisheries

The agricultural sector still remains as the mainstay. Paddy production is the most important crop. Paddy from the province accounts for almost 75 % (3,728 thousand tons in 2002) of the total production in the entire Sulawesi Island, although the area of paddy field (822.6 thousand ha in 2002) has been declining since 1999 (902.3 thousand ha), partly due to a declining trend of paddy price. Table 2.7 shows that such a declining trend in paddy field has also been true for the Study area.

Other important basic staples in terms of production volume include maize, casaba, and sweet potato. Food crop production is a significant activity in Gowa District, accounting for almost 43 % of the total district GDP. Plantation crop production is also active, and represented by sugar cane, tall coconut, coconut palm, cocoa, and cacao in terms of volume of production. However, the Study area has a relatively smaller presence in the plantation crop production of the province.

Marine and blackish water fisheries are another major activity in the Study area, particularly in Takalar District. The fishery sub-sector accounts for 21 % of the total district GRDP.

(2) Mining and Quarrying

In South Sulawesi, mining and quarrying has not been a negligible sector. The most intensive production takes place for limestone, which is utilized by the domestic cement industry. Nickel production has an export value, and has become one of the major economic drivers in the province. In the Study area, limestone mining, clay extraction for brick and ceramic production, and sand mining for construction material are activities of importance. As indicated in Table 2.8, such exploitation has also been encouraged by an increase in construction material prices in recent years.

(3) Manufacturing Industry

The manufacturing industry itself has been on an expansionary trend, however, the extent of its contribution to the entire economy of the province has been stagnant since the economic crisis. This trend is also true for urban and industrialized districts such as Makassar. The manufacturing sector is expected to act as a main driver of the regional economy for local governments, considering its industrial linkage with related industries and services.

In South Sulawesi Province, approximately 53 % of total GRDP by manufacturing industry of the province was generated by Makassar in 2001. Accordingly, the manufacturing industry of Makassar is more dominant among the Study area, accounting for some 90 %. Among the manufacturing sub-sectors, three, namely agro-processing, wooden and cement products, have a dominant share.

The number of large and medium industrial establishments in the Study area totaled 46 and 131 units, respectively, as of 2002. Most of these industrial establishments are located in Makassar City. The dominant types of industry are agro-processing and wooden product manufacturing.

The largest sub-sector in terms of gross output value has been cement production, followed by agro-processing and wooden products. The value of gross output of these major sub-sectors accounts for almost 94 % of the total manufacturing sector.

(4) Service Industry

Service industry shares approximately 43 % of the total GRDP of the province. The GRDP share of the service sector in Makassar City has risen to 71 %, reflecting its feature of urbanization. On the other hand, the share of other districts in the Study area (Gowa and Takalar) remains relatively lower (around 41 %). It is a distinctive feature common to the Study area that public administration activity accounts for a large share (almost a third of the service industry in Gowa and Takalar).

Growth of the construction sub-sector peaked in 2000 and has shifted to a gradually declining trend. The construction sector, however, still holds an expectation of growth, powered by real estate development. Trading has been rapidly growing since 2000, accounting for around 15 % of

the total GRDP of the province in 2002. In the Study area, trading is also concentrated in Makassar City.

Tourism sub-sector

One of the potential sub-sectors is a tourism-related industry in the Study area, considering the cultural and scenic resources such as historical sites in Gowa, Malino highlands, water falls, Bili-Bili reservoir and coastal area. Malino highland has already obtained business-oriented attention from the tourism industry.

Looking at the present economic performance of hotel and recreational business, however, it is judged as being rather insignificant. The share of hotel and recreational business only accounts for 0.3 % of the total GRDP of the province and even less in the case of the Study area. The number of guests for accommodation in the province increased from 1,214 per day on average in 1999 to 2,740 in 2003. Among this, foreign guests were around 10 %. Out of 8,000 rooms available in the province, around 3,800 rooms are located in the Study area.

2.1.4 Social Aspects

(1) Human Development

Major human development indicators in the South Sulawesi Province have improved in the past years, as indicated in Table 2.9. Of importance is life expectancy, which increased from 63.7 in 1996 to 71.0 in 2001 as a provincial average. Education-related indicators such as literacy ratio and average schooling period have also favorably improved.

Table 2.10 explains educational attainment performance as of 2002. In the province, around 28.6 % of the total population over 10 years-old have not joined any formal education, and only 14.3 % have finished senior high school. This figure is largely improved in Makassar. Only 13.3 % of the over 10 year-old population have not attended school, and as many as 31.3 % of the population have finished senior high school. In other districts of the Study area, a similar performance regarding educational attainment to the provincial average is observed.

(2) Basic Infrastructure

Diffusion ratio of piped-water and electricity varies among the districts in the Study area. As shown in Table 2.11, compared to electricity supply (62.2 % in 2002), piped-water supply (23.5 % in 2002) has not been widely diffused among the households of the entire Study area. One of the major reasons is an availability of alternative sources of water such as ground water and vender's supply.

It is also estimated that Makassar City holds the highest diffusion ratio for both water (36.7 %) and power (70.5 %) among the Study area, reflecting the higher household income. Piped water supply has been particularly low in the districts of Gowa, Takalar and Maros.

(3) Household Expenditure

Basic human needs such as education, health, water and electricity will be met in accordance with the rise in household income and resultant expenditure level. According to a socio-economic survey (SUSENAS) 2002 and Table 2.12, the largest per-capita expenditure class observed in Makassar is in the range of Rp.200,000 - 300,000, and Rp.100,000 - 150,000 in Gowa and Takalar Districts.

These figures are then translated to monthly household expenditures of Rp.840,000 - 1,260,000 (for Makassar) and Rp.430,000 - 630,000 (for others), based on the average household size. In Makassar, more than a quarter of the total households in the entire Study area belong to the indicated expenditure class. In Gowa and Takalar Districts, as many as around 37 – 50 % of the population belongs to the largest expenditure class.

(4) Poverty

Table 2.13 reports that the number of poor households amounts to 234,554 units, although the definition of "poor" is not explained. Based on this figure, the poverty ratio for the entire households is estimated to be approximately 12.8 % in the province. Poverty ratio of the Study area (i.e. Makassar, Gowa and Takalar) is also estimated to be 9.8%, but presents an insignificant gap in the ratio between the urban (Makassar 9.6 %) and rural (Gowa 9.7 % and Takalar 11.1 %) districts.

The BPS also indicates the necessary expenditure to satisfy the minimum food and living essentials for each district as Rp. 117,000 per capita / month in Makassar and Rp. 87,000 in Gowa. Population with per-capita expenditure below these lines is classified as poor. The monthly per-capita expenditure class shown in Table 2.12 also gives similar poverty ratios if those poverty lines are applied. It is then inferred that the poor households can afford a monthly expenditure of no more than around Rp. 420,000 in urban areas or Rp. 380,000 in rural areas.

2.1.5 Socio-economic Activity Related to River Basin Management

(1) Sub-districts (Kecamatans) in the river basin

Sub-districts (Kecamatans), which belong to the Jeneberang River basin, are outlined as follows. Demographic information at sub-district level[1] reveals the density gap, which accounts for the difference in degree of urbanization (urban, semi-urban and rural).

(Urban sub-district)

Sub-district	District	Location in river basin	Density (/km^2)	Large and medium manufacturing units
Mariso	Makassar	Downstream	29,276	3
Mamajang	Makassar	Downstream	27,238	2

[1] Official information / data on economic performance and structure at Kecamatan level are not available.

(Semi-urban sub-district)

Tamalate	Makassar	Downstream	7,322	4
Somba Opu	Gowa	Downstream	3,101	14
Pallangga	Gowa	Downstream	1,418	3
Bajeng	Gowa	Downstream	894	1

(Rural sub-district)

Bontomarannu	Gowa	Midstream	314	1
Polombangkeng Utara	Takalar	Midstream	190	1
Parangloe	Gowa	Upper to mid stream	83	1
Bungaya	Gowa	Upstream	93	-
Tinggimoncong	Gowa	Upstream	117	3

Source: BPS, Kabupatens in Figure 2002, except industrial units of Pallanga, Tinggimoncong sub-districts (from BAPEDALDA)

An agglomeration of industrial units is largely seen in Makassar City but outside of the river basin area. In the semi-urban sub-districts of downstream areas such as Tamalate, Somba Opu and Pallangga, there are some scattered factories.

(2) Upstream area

Kecamatan Tinggi Moncong is located in the upstream area, and this sub-district has a large paddy field area, and public and industrial forest areas. This is also a large producer of vegetable crops compared to the other basin sub-districts. Horticulture in this sub-district has grown during the 1990s. Commodities grown include potato, cabbage, leek, tomato, broad bean and peas. Horticulture farming in the upstream areas has raised living standards of local people.

Compared to paddy and dry field farming, horticulture farming is more intensive. Application of a hydrological system (modification of dike embankment according to rainfall condition) and crop shifting system (based on market demand), and usage of extensive fertilizers and pesticides have been observed in this area. Industrial forest which supplies firewood and other wood products has also been developed.

This sub-district is also well known as a tourism area, represented by Malino highland. Income generation opportunities have been abundant either through working for hotels and other types of accommodation or sales of vegetables.

A change of land use pattern has been obvious in the upstream areas. There is an observed tendency for forest conversion into horticulture farming and settlements in the form of resort facility construction. An intensive forest conversion in the upstream area generates adverse impacts on a watershed basis and soil erosion.

(3) Midstream area

Sub-districts in the midstream area of the river basin earn income mainly from the primary industries such as paddy farming, horticulture crop farming, forestry, C-class mining and some

agro-processing industries. Bili-Bili reservoir recently opened new income generation opportunities through floating net cage farming and food stalls.

PT. INHUTANI (government-owned industrial forestry company) also provides a new field of job opportunities for farm workers, and allows local farmers to cultivate alley crops around the main crop. However, incomes generated from those new efforts are still considered as small.

Being based on primary industries, this area also faces forest conversion into commercial usage and over application of fertilizers and pesticides as in the upstream area. Furthermore, an issue of river bed erosion and effluent discharge from agro-processing industry has been apparent in this area.

(4) Downstream area

Reflecting high population density and some industrial concentration, sub-districts in this area hold more assets to be protected from threats of flood, and can be given priority for river improvement and other flood mitigation works. In the downstream area, a variety of livelihoods are seen including service industries, construction, sand mining, fisheries and tourism, showing the urban characteristics and generating the higher clean water demand compared to the other basin areas.

Furthermore, on the right side of the river mouth, urbanization and landscaping (namely Tanjung Bunga Development) have been occurring, converting the existing swamp area into a commercial complex and large-scale housing estates, together with infrastructure development.

On the other hand, those areas may generate much higher risks of effluent and waste discharge. Along the river line, there are many cases of non-permitted land usage observed even in the river area. Intensive monitoring and control on waste discharge and land usage around this area are imperative. Excessive extraction of ground water also needs to be curved by charging reasonable incentives to users.

Sand mining is conducted mainly around the rubber dam and at the left side of the Jeneberang River mouth, bringing about severe river bed erosion. The number of active miners has decreased due to tighter control by the local government, and mining activity in the lower reach is presently limited to traditional mining.

(5) Issues and conflicts related to river basin management

As mentioned above, there are some issues related to river basin management triggered by socio-economic activities. Although generating favorable socio-economic progress, development around the river basin also brings about issues that require adequate consideration by the authority or administrator. Some of these issues can also be considered as conflicts that have been generated between the up and downstream regions of the basin. Major conflicts are summarized as follows:

- Clear water provision for municipal requirement needs to be further challenged, since the raw

water may be increasingly polluted by over usage of fertilizers and pesticides in the upstream area.

- Forest conversion into commercial usage will further increase pressure on a watershed basis and soil conservation, resulting in increasing sediment flows into the reservoir and earlier loss of reservoir function.

2.2 Regional Development

2.2.1 Regional Development Strategy and Plan by Provincial Level

Based on the rule of regional autonomy, district governments have been empowered to play a major role in their regional development planning. The provincial development strategy and plan have been set as a sort of guidance paper, which each district authority is expected to refer to for their planning of regional development and sector programs.

The Provincial Government of South Sulawesi presently prioritizes the following development program areas as the target to be addressed by district governments under its Strategic Plan (RENSTRA) and Five-year (2001-2005) Socio-Economic Development Program (PROPEDA). An implementation of the program is then to be authorized through an Annual Implementation Program (REPETADA).

A. Improvement of Quality of Life for Population
Priority Area of Program and Activity
1. Promotion of Quality, Relevant and Equal Education
2. Comprehensive Religious Development
3. Improvement of Health and Nutrient Services
4. Enhancement of Cultural and Art Activities
5. Employment Development
Supporting Area of Program and Activity
1. Population Control / Family Planning
2. Improvement of Social Welfare
3. Construction of Sports Facility
4. Women Empowerment
5. Promotion of Young Fellowship

B. Strengthening of Regional Economic Resilience
Priority Area of Program and Activity
1. Product Competitiveness Raising
2. Stabilization of Economic Democracy (Equal access to business information and financial resource)
3. Assurance of Regional Food Security
4. Strengthening of Regional Economic Structure
5. Reinforcement of Economic Integration of Sulawesi Island
6. Sustainable Natural and Marine Resources Management
Supporting Area of Program and Activity
1. Management of Water Resource and Transportation Infrastructure, Improvement of Regional Infrastructure, and Development of Communication Infrastructure
2. Facilitation and Management of Inter-district Issues

C. Improvement of Environmental Quality
Priority Area of Program and Activity
1. Management of Regional Legislative System
2. Strengthening of Law Enforcement and Society Order
Supporting Area of Program and Activity
1. Promotion of Access to Information by Population

D. Empowerment of Government Institution
Priority Area of Program and Activity
1. Empowerment of Government Institution
2. Empowerment of Social (political, economic, cultural and educational) Institution
Supporting Area of Program and Activity
1. Promotion of Policy Study and Research
2. Capacity Building of Development Planning

2.2.2 Regional Development Strategy and Plan by District Level

Each district belonging to the Study area also prepares PROPEDA and REPETADA annually as a specific program document. Major issues, development strategy and potentials recognized in the latest available documents by each district government are summarized as follows:

Makassar City (PROPEDA 2001-2005)

Key Issues for regional development	- Quality of urban facility and utility is not property maintained - Capacity development of human resources for urban development and management is not optimized - Market for manufacturing industry is stagnant - Women's participation in socio-economic activity is still weak - Unemployment rate is still high
Key Strategy	- Capacity development for urban development and management - Promotion of market-oriented economic development and local resource utilization - Improvement of accessibility to housing and basic infrastructure - Improvement of social welfare and promotion of community participation
Major Potential	- Marine resource - Large population, and superiority of the geographical location in Eastern Indonesia

Gowa District (RENSTRA / PROPEDA 2001-2005)

Key Issues for regional development	- Economic base of community / people is weak - Natural resource management is not optimized - Government role is not well institutionalized or weak - Living standard of community is low
Key Strategy	- Empowerment of economic base and improvement of investment condition - Improvement of natural resource utilization and management - Improvement of human resource quality through overriding budget allocation for education and capacity building - Strengthening the institution and role of government - Improvement of living standard of community
Major Potential	- Abundant natural resources such as water and suitable land for agriculture - Tourism and cultural resources - Strategic geographical location

Takalar District (RENSTRA 2000-2004)

Key Issues for regional development	- Productivity in agricultural sector is still low - Community still depends on small-scale agriculture and handicraft industry - Income distribution is not evenly made, ratio of poverty is high - Human resource quality and technological level are still low

	- Agro-business and industry are not well run
Key Strategy	- Improvement of human resource - Empowerment of general public and its institutions through increasing community participation - Improvement of accessibility to infrastructure and other public facilities to stimulate investment and business activities - Inter-connection of intelligence in the region
Major Potential	- Availability of basic and social infrastructure - Geographic location as supporting area for Makassar - Marine resource and human resource for fishery - Wide range of agricultural products and land - Tourism and maritime spots

What is frequently emphasized throughout the regional development documents is a necessity for i) proper utilization and management of natural resources, ii) strengthening the growth basis for the major economic sectors (i.e. agriculture, agro-related and manufacturing industries), and iii) capacity building for public administration services. Potential resources hold less variety among the district governments and are limited to marine and tourism resources, and a wide range of agricultural products.

2.2.3 Integrated Spatial Plan in the Study Area

(1) *Mamminasata* Metropolitan Spatial Plan

Makassar City and its surrounding districts of Maros (some parts only), Gowa (only Sungguminasa part), and Takalar were designated as a metropolitan area known as *Mamminasata*[2]. Badan Kerjasama Pengembangan Metropolitan *Mamminasata* (BKPMM) was officially legislated by regional regulation and established as an independent board with a government structure.

In 2003, BKPMM prepared *Mamminasata* Metropolitan Spatial Plan (2003-2012), which was also legislated by the regional regulation. The plan is designed to inhibit a rapid urbanization and over-density in Makassar and deal with urban management difficulties faced by each district government. This spatial plan includes the guidance document for planning, land use concept, and the mid-term infrastructure proposals (2004-2008).

The mid-term infrastructure program covers the sectors of water resource management, water supply, waste management, road, electricity, transportation (air, sea, railway), telecommunication, tourism, industry, and trade center. Of those water and related sectors, the projects that have implications to the Jeneberang River basin management are identified as follows:

Sector	Program	Volume	Agency	Cost (million)
Water resource management	Physical environmental management	-	District gov. PSDA	Rp. 400
Waste water management	Construction of (communal) septic tank	100 units	District gov. DINAS Spatial Plan	Rp. 2,400

[2] *Mamminasata* area covers the western and upper-middle parts of the Jeneberang River basin.

Sector	Program	Volume	Agency	Cost (million)
	Construction of waste water treatment plant	4 units	ditto	Rp. 6,050
	Construction of feces waste treatment plant	4 units	ditto	Rp. 10,500
Municipal water supply	(Makassar)			
	Somba Opu WTP improvement	1,000 l/s	Dir. of Metropolitan City (DOMC)	Rp. 75,400
	Raw water transmission installation	11,000 m	ditto	Rp. 77,000
	PVC pipe installation	41,000 m	DOMC, DINAS Spatial Plan, City gov.	Rp. 3,240
	(Sungguminasa)			
	Centrifugal pump (50 l/s, h-60 m)	2 units	DOMC	Rp. 500
	PVC pipe installation		DOMC, District gov.	Rp. 6,140
Industrial Development	Study / Planning for Industrial Center Development		DINAS Spatial Plan DINAS Industry District gov.,	Only study budget
	Land acquisition		BKPMM Private investor	Rp. 1,000

Most water resource management projects are planned for other river basins. An industrial center plan and water supply capacity enhancements in Makassar and Sungguminasa will increase raw water demand from Bili-Bili reservoir (not quantitatively estimated for industrial center). Furthermore, waste water and feces treatment plants are identified to deal with chaotic effluent discharges in Makassar and the downstream reaches of the river basin. An implementation of the plan and its supporting projects need to be also listed in the budget plan of the responsible central departments or provincial / district governments.

(2) Major Development Activity in the Study and *Mamminasata* Area

A distinctive issue for the development activity in the Study and *Mamminasata* area has been a recent change in land use pattern, as a result of a rapid conversion of agricultural into residential-commercial areas in Makassar and surrounds. Effective regulations and mechanisms have not yet been practiced.

Some real estate and related development is proceeding or planned in the Study area. Around the lower Jeneberang River basin, a large-scale residential and commercial complex development has been promoted by Gowa-Makassar Tourism Development Corporation (GMTDC).

2.2.4 Existing Priority Program for Water Resource Sector

As documented in the above spatial plan, the following have been prioritized as supporting programs in water resource related sectors, upon the agreement of the regional governments concerned.

Sub-sector	Activity	Location	Term
Water Resources / Irrigation	Study - F/S on Tallo River Water Resources Utilization - F/S on Maros River Water Resources Utilization - M/P of Water Transportation System and Recreational Facilities in Tallo River, Sal Pampang - F/S on Water Transportation System and Recreational Facilities in Pamukullu River and Pappa Construction - Installation of Raw Water Transmission Mains and Distribution of Clean Water (with discharge rate of 2,000 liter / sec from Bili-Bili - Construction of Pamukullu Irrigation System - Construction of Bontosunggu Dam - Construction of Pamukullu Dam - Construction of Water Transportation System and Recreational Facilities in Tallo River, Sal Pam Pang	Makassar, Gowa Maros Makassar, Gowa Takalar Makassar Maros Maros Takalar Makassar, Gowa, Maros	Short-term Short-term Mid-term Long-term Short- and mid-term Mid- and long-term Not-specified Not-specified
Flood Control / Drainage	Study - Master Plan on Flood Control and Drainage of Makassar Construction - Opening of Daya Primary Drainage Line (Makassar and Bone Tanjora) - Opening of Batangase, Tomalia, and Other Primary Drainage Line - Construction of Secondary and Tertiary Drainage in Area V (Daya and its vicinity) - Opening of Garassi River Line - Construction of Primary Daya Drainage Line (Makassar and Bone Tanjora) - Tallo River Flood Control Construction - Construction of Primary Drainage in Batangase, Tomalia, and others - Construction of Bontosunggu Dam	Makassar, Gowa, Maros Makassar Maros Makassar S. Minasa Makassar, Maros Makassar, Maros Maros Maros	Short-term Short-term Short-term Not-specified Mid-term Mid-term Long-term Not-specified

However, most of the above supporting programs have not identified the source of funding, and the demarcation among the central, provincial and district governments has not yet been clarified nor coordinated in the planning document.

2.3 Community Organizations and Activities

Community organization in general in the Study area can be categorized into: i) common public organizations and ii) Non-Government Organizations (NGO). Common public organizations are usually religion and profession-based, or based on women and youth groups. Many could trace their roots to government-initiated programs and were linked to governmental organizations of the New Order era.

Non-government organizations were initially known for their advocating roles, especially to channel suppressed voices of the people during the New Order administration. The economic crisis during 1997-1998 stimulated a growth of community service-oriented NGOs.

2.3.1 Community Organizations in Makassar

Makassar City, as the capital of South Sulawesi, is host to a gargantuan amount of NGOs. The very first local NGOs were born in the mid-80s and their ranks swelled to a peak in 1996-1998, stimulated by conditions for endorsements by the financial donors for an increased involvement of NGOs in absorbing aids more effectively.

In 2000, South Sulawesi-based NGOs annexed themselves into one associative forum group. At its birth, it registered 41 members. A standardization in 2003 led to the abolishment of some members. At present, the forum consists of 38 members. Another 100 or so are in the pipeline, waiting for admittance into the forum. Their scopes of activity usually revolve around legal aid, community development, human resources development, environment and rural economy development.

2.3.2 Community Organizations in Gowa

Gowa District Government has registered 104 common public organizations and 53 NGOs including 13 women organizations. The most common public organizations in Gowa are those with primary activities to serve the members internally. More than 30 % are religion-based and some 21 % are youth groups.

NGOs provide services to the society, presenting them with opportunities to work with other institutions and organizations, which enhances their credibility as a worth partner. NGOs contribute to those sectors not covered by the common public organizations such as environment and community development. So far their activities have mostly focused on ombudsman and community work through participation in several government-initiated programs.

2.3.3 Community Organizations in Takalar

There are about 28 active NGOs, and the District Takalar is currently working with them through the provision of 20 field officers to support community groups (KSM) at the village level. Activity of NGOs in Takalar commenced recently. Influenced by some foreign aid programs, NGOs have been formed one by one to fulfill the basic needs of the community. Compared to other districts, the District Government of Takalar allocates more funding and takes more initiatives to collaborate with NGOs in supporting community groups.

Table 2.1-a Population Trend of the Study Area

	1998	2000	2002	Average growth rate	Population density -02 (persons/ha)
South Sulawesi	7,624,525	7,801,678	7,960,991	1.09 %	127.7
Makassar	1,066,757	1,100,019	1,127,785	1.40 %	6,416.3
Gowa	494,725	512,876	528,313	1.66 %	280.5
Takalar	224,794	229,718	232,681	0.87 %	410.7
Study area total	1,786,276	1,842,611	1,888,779	1.41 %	719.4
Maros	265,283	272,116	278,833	1.25 %	172.2

Source : BPS, South Sulawesi in Figures 2002

Table 2.1-b Population by Kecamatan of the Study Area

Makassar	2000	2002	Household size -02
- Mariso	51,419	53,282	4.6
- Mamajang	59,689	61,286	4.3
- Tamalate	130,777	133,119	4.2
- Rappocini	128,637	128,855	4.3
- Makassar	80,593	84,104	4.6
- Ujung Pandang	27,254	29,889	5.0
- Wajo	34,833	35,402	4.6
- Bontoala	57,406	59,549	4.8
- Ujung Tanah	44,373	46,129	5.1
- Tallo	116,633	120,786	4.5
- Panakkukang	124,861	129,651	4.1
- Manggala	77,443	81,102	4.4
- Biringkanaya	96,057	100,018	4.0
- Tamalanrea	82,641	85,140	3.0

Gowa	2000	2002	Household size -02
- Bontonompo	58,319	60,038	4.5
- Bajeng	68,693	70,763	4.4
- Pallangga	66,491	68,493	4.6
- Barombong	26,003	26,787	4.7
- Somba Opu	84,566	87,115	4.8
- Bontomarannu	41,973	43,241	4.5
- Parangloe	25,151	25,907	4.0
- Tinggimoncong	31,414	32,364	4.9
- Tombolo Pao	22,106	22,791	5.1
- Bungaya	28,610	29,475	3.9
- Tompobulu	27,890	28,721	4.2
- Biringbulu	31,660	32,618	3.3

Takalar	2000	2002	Household size -02
- Mangarabombang	32,613	33,563	4.4
- Mappakasunggu	25,118	25,430	4.7
- Polombangkeng S.	23,124	23,471	4.0
- Polombangkeng U.	38,939	40,338	3.8
- Galesong S.	43,410	44,479	4.6
- Galesong U.	38,614	39,319	4.4
- Pattalassang	28,345	28,967	4.5

Maros	2000	2002	Household size -02
- Mandai	25,659	26,054	n.a
- Moncongloe	9,335	9,483	n.a
- Maros Baru	20,750	21,629	n.a
- Lau	20,755	21,104	n.a
- Turikale	34,146	35,210	n.a
- Marusu	21,050	21,718	n.a
- Bontoa	23,999	23,877	n.a
- Bantimurung	26,513	27,030	n.a
- Simbang	19,701	20,013	n.a
- Tanralili	21,419	21,462	n.a
- Tompobulu	11,905	12,120	n.a
- Camba	13,337	13,551	n.a
- Cenrana	12,988	13,242	n.a
- Mallawa	10,559	10,703	n.a

Source : BPS, Makassar, Gowa, Takalar, Maros in Figures 2002

Note : Shaded Kecamatans belong to the Jeneberang River basin area.

Note : Total population for each district (Kabupaten or Kota) in Table 2.1-b does not coincide with the figure in Table 2.1-a, due to difference in data source (i.e. BPS by Kabupaten and BPS Province).

Table 2.2 Average Household Size in the Study Area

	2000	Number of Household	2002	Number of Household
South Sulawesi	4.4	1,760,024	4.3	1,830,336
Makassar	4.6	237,084	4.2	270,509
Gowa	4.4	116,803	4.4	119,894
Takalar	4.5	50,796	4.3	54,495
Study area total	4.6	404,683	4.3	444,898
Maros	4.6	59,472	4.5	61,856

Source : BPS, South Sulawesi, Makassar, Gowa, Takalar, Maros in Figures 2001 and 2002

Table 2.3 GRDP Trend of the Study Area (in 1993 constant price)

			1998	2000	2001	2002	Average annual growth rate (real)
South Sulawesi	GRDP	Rp. mil	9,366,229	10,101,948	10,603,661	11,092,996	4.3 %
	Per-capita	Rp.	1,228,434	1,294,843	1,343,632	1,389,587	3.1 %
Makassar	GRDP	Rp. mil	2,212,970	2,589,535	2,704,974	n.a	6.9 %
	Per-capita	Rp.	2,074,484	2,354,082	2,392,969	n.a	4.9 %
Gowa	GRDP	Rp. mil	487,879	508,704	531,557	n.a	4.4 %
	Per-capita	Rp.	974,199	911,865	1,017,361	n.a	2.6 %
Takalar	GRDP	Rp. mil	213,666	229,260	238,696	248,631	3.9 %
	Per-capita	Rp.	916,627	998,007	1,028,075	1,070,862	4.0 %
Study area total	GRDP	Rp. mil	2,914,515	3,327,499	3,475,227	n.a	6.0 %
	Per-capita	Rp.	1,631,615	1,805,861	1,857,301	n.a	4.4 %
Maros	GRDP	Rp. mil	314,804	329,579	340,875	n.a	2.7 %
	Per-capita	Rp.	1,192,368	1,233,043	1,258,806	n.a	1.8 %

Source : BPS, GRDP in South Sulawesi and South Sulawesi, Makassar, Gowa, Takalar, Maros in Figures 1999-2002
Note : Per-capita GRDP is partly calculated by the Study team.

Table 2.4 Sector Contribution to GRDP in the Study Area (%, in 2002 current price)

	South Sulawesi		Makassar	Gowa	Takalar	Maros
	1998	2002	2001	2001	2002	2001
1. Agriculture	45.8	37.5	2.3	45.3	48.8	69.0
(Farm crops)	(35.8)	(27.7)	n.a	(43.0)	(25.3)	(39.7)
(Fishery)	(8.2)	(8.5)	n.a	(0.4)	(21.0)	(26.6)
2. Mining & Quarrying	6.0	7.7	0.02	7.5	0.7	1.3
(non-oil / gas)	(4.5)	(6.4)	n.a	n.a	(0.7)	(1.3)
3. Manufacturing industry	11.2	11.4	26.7	5.7	9.3	1.5
(Food, beverage, tobacco)	(5.9)	(6.4)	n.a	n.a	n.a	n.a
(Wood products)	(1.8)	(1.5)	n.a	n.a	n.a	n.a
(Cement / Quarrying)	(2.6)	(2.7)	n.a	n.a	n.a	n.a
4. Public Utility Industry	0.9	1.1	2.7	1.8	0.9	0.7
5. Construction	4.4	4.0	8.0	3.3	4.9	1.2
6. Trading, Hotel, Restaurant	13.2	16.5	27.4	10.5	9.3	6.6
(Wholesale / Retail)	(12.0)	(15.1)	n.a	(9.3)	(8.7)	(5.9)
(Hotel)	(0.2)	(0.2)	n.a	(0.2)	(0.0)	(0.02)
7. Transportation & Communication	5.8	7.0	12.9	4.7	4.0	7.0
8. Financing Services	3.9	3.6	5.1	3.7	6.2	2.6
9. Other Services inc. public admin.	8.6	10.9	14.9	17.6	15.9	10.2
(Entertainment / Recreation)	(0.1)	(0.1)	n.a	(0.01)	(0.01)	(0.03)

Source : BPS, GRDP in South Sulawesi and South Sulawesi, Makassar, Gowa, Takalar, Maros in Figures 2002

Note : Per-capita GRDP is partly calculated by the Study team.

Table 2.5 Workforce Distribution by Sector in 2002 in Percentage

	South Sulawesi	Makassar	Gowa	Takalar	Study area total	Maros
Agriculture	57.9	1.5	44.3	58.1	22.2	49.2
Mining and Quarrying	0.4	0.6	0.1	0.2	0.4	-
Manufacturing	5.6	11.6	6.4	8.5	9.7	5.2
Public Utilities	0.3	1.4	0.3	0.1	0.9	-
Construction	3.0	8.3	8.2	5.1	7.8	6.0
Trade, Hotels and Restaurant	15.6	37.1	18.7	16.4	28.7	17.9
Transportation and Communication	5.0	10.8	6.6	5.5	8.8	7.8
Finance, Insurance and Real Estate	0.4	1.6	0.9	-	1.2	0.2
Public Administration and Others	11.7	26.6	14.4	6.2	20.0	13.7

Source : BPS, South Sulawesi in Figure 2002

Table 2.6 Average Inflation Trend in Kota Makassar

	1996	1997	1998	1999	2000	2001	2002	Term average*
General to commodities	4.56 %	8.20 %	67.89 %	1.64 %	9.73 %	11.77 %	8.25 %	7.36 %

Source: BPS, South Sulawesi in Figure, 2002

Note : Term average is derived by excluding the figure in 1998 to better represent the likely trend, since this period was faced by the economic crisis.

Table 2.7 Paddy Field (wet and dry) and Production Trend

	Area (ha)		Production (thousand ton)	
	1999	2002	1999	2002
South Sulawesi	902,286	822,586	3,870.0	3,728.0
Makassar	4,139	2,172	19.5	11.0
Gowa	45,953	45,241	205.9	232.0
Takalar	23,857	21,409	124.0	118.3
Study area total	73,949	68,822	349.4	361.3
Maros	39,757	41,257	218.6	223.9

Source : BPS, South Sulawesi, Makassar, Gowa, Takalar and Maros in Figure, 2002

Table 2.8 Average Wholesale Prices of Sand and Gravel Products in South Sulawesi

	Unit	1999	2002	2003	2004
Sand	Rp. / m^3	26,000	-	40,500	41,667
Gravel	Rp. / m^3	39,700	59,584	87,500	92,000
River stone	Rp. / m^3	-	47,500	51,200	52,755

Source: BPS South Sulawesi in Figure 2002, Makassar Revenue Office for 2003-04

Table 2.9 Selected Human Development Indicators

	Unit	1996	2001	Ratio of improvement
Life Expectancy	Years	63.7	71.0	12.7 %
Average Schooling Period	Years	5.6	6.8	21.4 %
Literacy Ratio	%	77.7	82.8	6.7 %

Source: BAPPEDA I South Sulawesi

Table 2.10 Percentage of Population over 10 Years-old by Educational Attainment in 2002

	Never / not yet attended school	Primary School	Junior High School	Senior High School	University
South Sulawesi	28.6	31.8	16.5	14.3	2.6
Makassar	13.3	18.3	19.1	31.3	7.6
Gowa	30.3	27.5	17.7	14.5	2.4
Takalar	36.9	30.6	15.5	10.6	1.3
Maros	35.8	31.3	14.2	12.9	1.6

Source: BPS, South Sulawesi in Figure, 2002

Table 2.11 Diffusion Ratio of Domestic Piped-water / Electricity in 2002

	No. of Domestic Customer (piped-water)	No. of Domestic Customer (electricity)	No. of Household (reported)	Diffusion Ratio (piped water)	Diffusion Ratio (electricity)
Makassar	99,324	190,749	270,509	36.7 %	70.5 %
Gowa	3,870	72,032	119,894	3.2 %	60.1 %
Takalar	1,401	13,816	54,495	2.6 %	25.4 %
Study area total	104,595	276,597	444,898	23.5 %	62.2 %
Maros	3,710	n.a	61,856	6.0 %	n.a

Source: BPS, South Sulawesi, Gowa, Takalar and Maros in Figure, 2002

Note : Diffusion ratio is not officially announced, therefore calculated by the Study team based upon household number.

Table 2.12 Monthly Per-capita Expenditure Class in 2002 (percentage)

Expenditure Class (Rp.)	Less 60,000	60,000 -79,999	80,000 -99,999	100,000 -149,999	150,000 -199,999	200,000 -299,999	More 300,000
South Sulawesi	1.03	4.88	10.98	36.76	22.01	16.42	7.92
Makassar	0.10	2.25	5.10	16.70	21.70	28.87	25.28
Gowa	1.93	7.61	17.21	37.46	17.80	13.52	4.47
Takalar	-	1.89	13.40	49.29	25.12	8.87	1.44
Study area total	0.62	3.73	9.58	26.66	21.02	22.01	16.39
Maros	0.13	2.00	10.24	47.20	23.26	11.82	5.34

Source: BPS, Socio-economic Survey (SUSENAS) South Sulawesi, 2003

Table 2.13 Number of Poor Household in 2002

	South Sulawesi	Makassar	Gowa	Takalar	Study area total	Maros
Poor household	234,554	26,080	11,629	6,034	43,743	3,076
Total household	1,830,336	270,509	119,894	54,495	444,898	61,856
Poverty ratio	12.8 %	9.6 %	9.7 %	11.1 %	9.8 %	5.0 %
Poverty line (per capita / month)	Rp. 101,292	Rp. 117,071	Rp. 87,117	Rp. 88,255	n.a.	Rp. 97,973

Source: BPS, South Sulawesi for the number of poor and total household. Poverty line is derived from BPS, National Poverty Survey, 2003

CHAPTER 3

PHYSICAL FEATURES OF JENEBERANG RIVER BASIN

3.1 Geography and Present Land Use in Jeneberang River Basin

Jeneberang River originates from Mt. Bawakaraeng (EL. 2,830 m) running westward before finally discharging into Makassar Strait. The overall extent of the river basin and channel length of the main stream are about 762 km^2 and 85.5 km, respectively. There are fourteen first order tributaries (or second order rivers), which join or branch off from the mainstream as listed below (refer to Figures 3.1 and 3.2).

First Order Tributaries of Jeneberang River

	Name of Tributary	Channel Length (km)	Catchment Area (km^2)
1	Long Storage*	15.8	5.3
2	Garassi	16.5	42.3
3	Salo Tebeatu	6.6	6.2
4	Bantimurung	11.9	14.6
5	Jenelata	38.5	232.7**
6	Jene Bontomalangngrere	7.9	8.8
7	Binanga Jajang	9.7	22.4
8	Jene Rakikang	19.2	41.2
9	Binanga Bengo	6.6	14.2
10	Salo Bengo	8.5	22.6
11	Salo Malino	18.7	85.9
12	Angasia	5.6	5.4
13	Salo Kauusik	18.9	37.5
14	Takapala	11.5	37.5

*: The channel branches off from the main stream.
**: The catchment area of Jenelata includes the second order tributary (or third order river), Binanga Tokka (77.5 km^2).

The principal tributary, Jenelata, has a catchment area of 233 km^2 and joins the main stream about 29.4 km upstream from the river mouth. Bili-Bili Multipurpose Dam, the major water resources development facility is located on the main stream of Jeneberang River just upstream from the confluence with the Jenelata River. It has a gross storage capacity of 375 million m^3 and catchment area of 384.4 km^2.

The lower reaches below the confluence of the Jeneberang and Jenelata Rivers are the extremely flat alluvium plains, which were formed by lateral erosion of the river. In contrast, the upper reaches above this confluence are mountainous/hilly areas with rather steep ground slopes of about 15 % (refer to Figure 3.3). These mountainous/hilly areas form the foothills of Mt. Bawakaraeng and Mt. Lompobatang, which have calderas of about 3 to 5 km in diameter reflecting the notable volcanic geological features. Due to the steep ground slope and volcanic geology, the upper reaches of the Jeneberang River tend to produce large quantities of sediment and debris runoff.

Due to these contrasting geographies, the Jeneberang River as well as its tributaries tend to have a gentle channel slope in the lower reaches and steep slope in the upper reaches (refer to Figure 3.4). Along the main stream of Jeneberang River the lower 20 km reach has a gentle channel slope of about 1/2,400, while the upper channel has a steeper channel slope of about 1/600 below Bili-Bili dam and more than 1/300 above the dam. Of the first tributaries, those in the upper mountainous area such as Salo Takapla, Salo Keoenisik and Salo Malino also have very steep channel slopes ranging from 1/40 to 1/100. Conversely, those in the middle and lower reaches of Jeneberang River, such as Garassi and Salo Tebeatu, have relatively gentle channel slopes of less than 1/500.

The above two contrasting geographies also lead to quite different patterns of land use in the reaches up- and downstream of the confluence of the Jeneberang and Jenelata rivers. Paddy fields are the principal land use in the lower reaches of the Jeneberang River, while more than 80 % of the upper reaches remains as non-cropping area, as listed below (refer to Figure 3.5).

Land Use in the Jeneberang River Basin

(Unit: ha)

Classification of Land Use	Lower Reaches from Confluence of Jenelata		Upper Reaches from Confluence of Jenelata		Basin Total	
Forest Area	1,716	(11.7 %)	32,929	(53.4 %)	34,646	(45.3 %)
Grass Land	2,668	(18.1 %)	18,193	(29.5 %)	20,861	(27.3 %)
Mixed Estate Crop Field	3,284	(22.3 %)	2,280	(3.7 %)	5,564	(7.3 %)
Paddy Field	6,035	(41.0 %)	3,892	(6.3 %)	9,927	(13.0 %)
Dry Crop Field	548	(3.7 %)	3,227	(5.2 %)	3,775	(4.9 %)
Dam Reservoir Area	0	(0.0 %)	1,170	(1.9 %)	1,170	(1.5 %)
Urban Area	465	(3.2 %)	0	(0.0 %)	465	(0.6 %)
Total	14,716	(100.0 %)	61,691	(100.0 %)	76,408	(100.0 %)

Source: Department of Forestry Service, South Sulawesi Province.

3.2 Administrative Boundaries in the Jeneberang River Basin

The Jeneberang river basin is divided administratively into Kabupaten Gowa, Kabupaten Takalar and Makassar City in South Sulawesi Province. The proportion of the river basin by each Kabupaten and City are as below (refer to Figure 3.6):

(1) 730.0 km^2 (95.9 % of the basin) in Kabupaten Gowa;

(2) 9.5 km^2 (1.2 % of the basin) in Kabupaten Takalar; and

(3) 22.5 km^2 (2.9 % of the basin) in Makassar City.

As listed above, the substantial part of the river basin is within Kabupaten Gowa, while Kabupaten Takalar and Makassar City account for extremely small proportions of the overall area. Thus, almost all the river basin apparently belongs to Kabupaten Gowa. The entire extent of Bili-Bili Dam reservoir and its catchment area also falls within this Kabupaten. Nevertheless, an extensive irrigation area of about 7,400 ha in Kabupaten Takalar receives its irrigation water supply from the Jeneberang River. Makassar City also relies on the Jeneberang River as the source for a major part of its municipal water requirement. Thus, both Kabupaten Takalar and Makassar

City are major users of water from the Jeneberang River, although topographically they do not represent a substantial share of the basin.

The river basin is further divided into eleven Kechamatans. Of these, three are in Makassar City, one is in Takalar Regency and seven are in Gowa Regency (refer to Table 3.1 and Figure 3.6):

Kechamatans overlapping with Jeneberang River Basin

Name of City or Kabupaten	Kechamatans
Makassar City	1. Mariso
	2. Tamalate
	3. Mamajang
Kabupaten Takalar	4. Polombankeng Utra
Kabupaten Gowa	5. Bajeng
	6. Bontomarannu
	7. Bungaya
	8. Palangga
	9. Prangloe
	10. Somba Opu
	11. Tinggimoncong

3.3 Serious Degradation of Riverbed of Lower Jeneberang River

There are several sand mining sites along Jeneberang River, as shown in Table 3.2 and Figure 3.7. The annual average sediment runoff volume from the Jeneberang River basin before 2004 (i.e., before the recent major collapse of Mt. Bawakaraeng) was estimated to be 890 thousand m^3/year. This is divided into 690 thousand m^3/year from the upper reaches of Bili-Bili Dam and 200 thousand m^3/year from the Jenelata River basin, as listed below.

Annual Average Sediment Runoff Volume in Jeneberang River Basin before Collapse of Mt. Bawakaraeng

Watershed	Catchment Area (km^2)	Annual Sediment Run-off Volume (m^3/year/km^2)	(10^3m^3/year)
Upper Reaches of Bili-Bili Dam*	384.4	1,800	690
Jenelata River Basin**	226.3	890	200
Total	610.7	1,460	890

Source: * Supporting Report Vol. IV Sediment an Erosion Control, 1994
** Detailed Design for Jeneberang River Improvement Works

On the other hand, the annual average sand mining abstraction from the Jeneberang River from 1995 to 2001 was recorded as 1,749 thousand m^3/year. Of this volume some 1,316 thousand m^3/year was mined downstream of Bili-Bili dam and 433 thousand m^3/year from upstream of the dam as listed below.

Annual Volume of Sand Mining from the Jeneberang River

(unit: thousand m^3/year)

River Stretch	'95/'96	'96/'97	'97/'98	'98/'99	'99/'00	'00/'01	Ave.
1. Downstream of Bili-Bili Dam	**1,537**	**1,787**	**1,790**	**1,476**	**703**	**604**	**1,316**
(1) Estuary–Sungguminasa Br.	88	451	348	285	290	286	291
(2). Sungguminasa Br.-Kampili Weir	1,301	906	1,026	843	88	42	701
(3). Kampili Weir-Bili-Bili Dam	148	430	416	348	325	276	324
2. Upstream of Bili-Bili Dam	**177**	**475**	**701**	**301**	**585**	**360**	**433**
Total	**1,714**	**2,262**	**2,491**	**1,777**	**1,288**	**964**	**1,749**

Source: Annual Monitoring Report 1995/1996-1999/2000, "Environmental Management and Monitoring (EMM), The Bili-Bili Multipurpose Dam Project (Phase II")

As listed above, the annual average sand mining abstraction is more than twice the annual sediment runoff volume from the basin. Moreover, the mining volume only represents the figure registered in the license list by Gowa Dinas Mining & Energy. Other non-licensed mining activities also exist therefore the actual difference between the mining volume and sediment runoff will be larger than those estimates based on the license record. Moreover, after completion of Bili-Bili dam reservoir in 1999, a substantial part of the sediment runoff volume from the upper reaches of the dam will have been trapped in the reservoir. This will have further aggravated the excess of sand mining over sediment runoff volume from the upper reaches.

As a result, serious river channel erosion has occurred downstream of Jeneberang River. Serious damage to existing river infrastructures can therefore be attributed to this river erosion (refer to Chapter 7). The riverbed elevation dropped by 5.2 m at Sungguminasa Bridge and 8.1 m at Kampili Weir during the 22 year period from 1979 to 2001 as listed below (refer to Figure 3.8):

River Bed Elevation of Jeneberang River

Location	Distance from River Mouth (km)	River Bed Elevation (EL. m)			Reduction in River Bed from 1979 to 2001 (m)
		1979*	1983*	2001**	
River Mouth	0.0	-2.3	-1.9	-5.6	3.3
Sungguminasa Bridge	9.6	+4.2	+0.3	-1.0	5.2
Kampili Weir	21.0	+16.5	+16.5	+8.4	8.1

Source: * Annual Monitoring Report 1999/2000, "Environmental Management and Monitoring (EMM), The Bili-Bili Multipurpose Dam Project (Phase II")
** Results of river channel survey by JRBDP

3.4 Gigantic-scale Collapse of Quay in Caldera of Mt. Bawakaraeng

On 26 March 2004, a gigantic collapse of a quay occurred in the caldera of Mt. Bawakaraeng (EL. 2,870 m), which is located at the upstream end of the Jeneberang River basin approximately 40 km upstream of Bili-Bili dam reservoir. The collapse brought about a tremendous volume of sediment runoff downstream and caused disastrous damage including the death of ten people, twenty-two people missing, and evacuation of 6,333 people.

In accordance with a request by MSRI (the present Ministry of Public Works), JICA dispatched a survey team, "JICA Sabo Urgent Investigation Team" (hereinafter referred to as "JSUIT") in June

2004, to clarify the mechanism of collapse and necessary countermeasures against possible disasters due to the collapse.

According to the field investigation by the JSUIT, two collapses occurred and the volume of sediment runoff was estimated to be about 235 million m^3 in total. Of the total volume, about 14 million m^3 had already been eroded and transported as sediment runoff to the downstream reaches of Jeneberang River over the three-month period from the time of collapse in March until the end of the last rainy season in May 2004. JSUIT further suggested that judging from the conditions experienced in previous similar collapse events, the sediment runoff would peak in the following year (i.e., 2005) and its runoff volume would be about twice that currently observed. Thereafter, sediment volume would exponentially reduce and subside within five years of the collapse. Taking into account these conditions, JSUIT estimated the sediment runoff and deposited volumes due to the collapse of Mt. Bawakaraeng as listed below:

Sediment Runoff and Deposited Volumes Caused by Collapse of Mt. Bawakaraeng

Year of Rainy Season (Nov. to May)	Annual Runoff	1st Annual Deposit on River Bed	2nd Movement of Sediment from River Bed	Annual Inflow to Dam Reservoir	Annual Deposit in Dam Reservoir
	Mil. m^3/year	Mil. m^3/year	Mil. m^3/year	Mil. m^3/year	Mil. m^3/year
Up to Present	14.00 *1	8.70 *4	0.00 *6	5.30 *7	2.65 *8
2004/2005	28.00 *2	17.00 *5	5.00 *6	16.00 *7	8.00 *8
2005/2006	17.00 *3	11.00 *5	5.00 *6	11.00 *7	5.50 *8
2006/2007	10.00 *3	6.00 *5	5.00 *6	9.00 *7	4.50 *8
2007/2008	6.00 *3	4.00 *5	5.00 *6	7.00 *7	3.50 *8
2008/2009	3.00 *3	2.00 *5	5.00 *6	6.00 *7	3.00 *8
	78.00	48.70	25.00	54.30	27.15

Note: *1 Estimated through field reconnaissance
*2: Assumed as the volume to date of 8.7 million m^3 (for 3 months since collapse) x 2 (for an entire rainy season of 6 months)
*3. Assumed to exponentially decrease from the annual volume of 28 million m^3 in 2005/2006
*4: Estimated through field reconnaissance (Sediment deposit length of 29km x Average sediment depth of 1m)
*5: {Sediment Deposit to Date (8.7 mil.m^3)}/{Sediment Runoff to Date (14mil.m^3)} = 0.62. The annual sediment deposit from 2004/2005 onward is assumed to be annual sediment runoff x 0.62
*6: Estimated by "Brown-Formula"
*7: Estimated as the Volume (="Annual Runoff" - "Annual Deposit on River Bed" + "2nd Movement of Sediment from River Bed")
*8: Assumed as 50% of the accumulated annual inflow volume to Bili-Bili dam reservoir
Source: "Recommendation on Urgent Measures Plan against the Gigantic Collapse of Mt. Bawakaraeng in Indonesia, June 20th - 29th, 2004"by JICA Sabo Urgent Investigation Team.

As estimated above, the collapse of Mt. Bawakaraeng would produce a sediment runoff volume of about 78 million m^3 in total over the next five years (= a period starting from the occurrence of collapse until the subsidence of runoff). Of this total sediment runoff volume, 54.30 million m^3 is expected to flow into Bili-Bili dam reservoir and half (i.e., 27.15 million m^3) would accumulate in the reservoir.

Bili-Bili dam reservoir has a dead storage capacity of 29 million m^3. This dead storage capacity was designed to accommodate the sediment deposit for a period of 50 years, but the above sediment deposit due to the collapse of Mt. Bawakaraeng would account for about 90 % of the dead storage capacity within five years.

Another critical issue is also associated with the several natural ponds in the caldera of Mt. Bawakaraeng. Should these ponds break out, a tremendous volume of impounded water would flow down with debris causing intensive damage to the residents and houses in the lower reaches below the pond.

3.5 Existing Use of River Water and River Channel

3.5.1 Use of River Water

The river water is currently used as the water source for municipal water use, irrigation water use, and other various water demands. The present major water users such as the PDAM, large irrigation schemes of Bili-Bili, Bissua, and Kampili, and the Takalar Sugar Factory have been substantially registered for customary water users and their full supply is promised through reservoir operation of Bili-Bili dam. Details of these major water users are described in Chapter 7.

In addition to these major water users there are, however, several minor ones. Details of the latter have never been known, and therefore a survey of them was undertaken during this Study. Based on the results, it was clarified that users could be classified into: (1) small irrigation schemes, (2) factories/commercial shops, and (3) fishponds. Among others, the small irrigation schemes called "the village irrigation" are dotted in the upper reaches of Jeneberang River and its tributary, Jenelata River. Those confirmed through this Study (refer to Figure 3.9) included:

Village Irrigation Preliminarily Confirmed in the Study

No	Name of Irrigation Scheme	Name of Village	Name of River	Area (ha)
V1	Tanralili	Lengkesek/Manimbahoi	Kunisi	360.25
V2	Kaciping	Manimbahoi	Kunisi	226.00
V3	Kalolo	Manimbahoi	Kunisi	305.00
V4	Bontote'ne	Buluttana	BL.Manappa	105.00
V5	Takapala	Buluttana	Takapala	175.00
V6	Batulapisi	Malino	Bongko	105.00
V7	Tujuang	Malino	Bongko	74.00
V8	Karangpuang	Malino	Karangpuang	70.00
V9	Lembangbata	Gantarang	BL.Bulang	155.00
V10	Lambangmanai	Gantarang	BL.Bulang	232.00
V11	Je'ne Kampala	Sapaya	Tattumbu	50.00
V12	Tallanggatarang	Sapaya	Nyulu	50.50
V13	Leang Panyikiang	Sapaya	Danggang	58.00
V14	Manggunturu	Bonto Manai	Manggunturu	55.00
		Total		2020.75

It was also confirmed in a survey under the Study that there are nine factories/commercial shops, which abstract water from the Jeneberang River and/or release its effluent into the River (refer to Table 3.3). Among them, three factories abstract water from the Jeneberang River at rates of 40

and 200 m^3/day, respectively. Another six factories do not directly abstract water from the Jeneberang River, but their effluent is discharged to the River.[1]

3.5.2 Land Use along River Channel

As described in Chapter 7, the river and its adjacent river corridor is designated as the river administration area. All development and/or utilization of water and land resources within the river administration area should be under the jurisdiction of the river management body. The outer boundaries of the river corridor are assumed as:

(1) 3 m from the edge of the existing river dike from the river mouth up to Sungguminasa Bridge located 9.5 km upstream of the river mouth, and

(2) 100 m from the existing natural riverbank upstream from Sungguminasa Bridge up to Bili-Bili Dam.

The present state of land use within the above river administration area from the river mouth up to Bili-Bili Dam were initially estimated based on the Ortho-photo Maps developed under the "Bili-Bili Irrigation Project" in 2000. As a result, it was clarified that a considerable part of the river control area is occupied by settlement areas and agricultural cropping land as outlined below (refer to Tables 3.4 and 3.5).

Share of Settlement Area and Agricultural Cropping Area in the Designated River Control Area

River Stretch		Settlement Area	Agricultural Cropping Area	Total
(1) Left bank along the dike section	Inside of Dike	38.5%	43.5%	82.0%
	Outside of Dike	0.0%	26.2%	26.2%
(2) Right bank along the river dike section	Inside of Dike	6.2%	20.1%	26.3%
	Outside of Dike	58.3%	9.6%	67.9%
(3) Left bank along the non-dike section		9.1%	60.7%	69.8%
(4) Left bank along the non-dike section		8.1%	41.9%	50.0%

Particular attention in the above list is given to the settlement area inside the dike (i.e., the area of the flood high water channels), which is exposed to a high risk of flood damage. The settlement areas inside the dike are concentrated on the following sections:

(1) The stretch along the right bank 2 to 3 km upstream of river mouth (just downstream of Rubber Dam); and

(2) The stretch along the left bank 5 to 6 km upstream of river mouth (adjacent to the existing groundsill).

[1] It is interpreted that these nine factories are part of factories identified by Bapedalda (see Supporting Report F)

3.6 Existing Use of Ground Water

The low-lying area in the lower reaches of Jeneberang River is formed by river alluvium sediment, beach sediment and swamp, which contains rather abundant shallow groundwater. This is conveyed through the sediment rock layer of the Camba Formation from the mountainous area to the flat plain area. The upland area in the basin also contains a plentiful and good quality groundwater supply in its thick sand-gravel layers of the Quaternary deposits.

Due to the above basin conditions, shallow wells less than 10 m in depth are extensively exploited by the individual households, especially in the lowland area. The exploited shallow well is the indispensable water source for household use in the non-PDAM service area. At the same time, a large proportion of the population, even in the PDAM service area, also use private wells for secondary water uses such as washing and bathing. According to the results of the previous Study, of the total annual consumption for household use, about 70% is met from groundwater sources as listed below:

Annual Water Consumption of PDAM System for Household Use

(Unit: Thousand m^3/year)

Classification of Water Use		Makassar	Gowa	Total	
1.	Use of water supplied from PDAM system	16,239	348	16,587	(31.5 %)
2.	Use of groundwater				
	(1) Use of households served by PDAM supply	2,716	81	2,797	
	(2) Use of household not served by PDAM supply	22,469	10,839	33,308	
	Sub-total of 2	25,185	10,920	36,105	(68.5%)
	Total of 1 and 2	41,424	11,268	52,692	(100.0%)

Source: Consulting Engineering Services for Comprehensive Water Management Plan Study for Maros-Jeneponto River Basin

The deep wells about 50 to 250 m in depth are also exploited, especially for irrigation use in paddy field that is not within the technical irrigation system of Kampili, Bissua and Bili-Bili. Some 90 deep well units exist for the upland irrigation area of 972 ha. The groundwater is lifted by pump under operation and management of each water user's association. There are also 40 locations of spring water in Kabupaten Gowa. Most spring water has been exploited as a clean water source for the surrounding houses. A large discharge spring is on the Lompobatang volcanic lock, where some 75 liter/sec discharges.

Table 3.1 Area of Kecamatan in Each of Sub-River Basin

(unit: km^2)

Regency / Kechamatan / Name of River	Gowa							Takalar	Makassar			Total
	Bajeng	Bontomarannu	Bungaya	Palangga	Parangloe	Somba Opu	Tinggimoncong	Polombangkeng Utara	Mamajang	Mariso	Tamalate	
Jeneberang	0.19	22.60		26.53	60.85	9.01	47.44	6.48	1.18	0.36	16.14	190.78
Garassi	9.88			27.64							4.79	42.31
Salo Tebebatu				6.22								6.22
Bantimurung		14.58										14.58
Jenelata			199.69		29.94		0.04	3.01				232.68
Jene Bontomalangngrere					8.78							8.78
Binanga Jajang					22.43							22.43
Jene Rakikang					19.29		21.96					41.25
Binanga Bengo			0.24		13.98							14.22
Salo Bengo			0.62		11.77		10.16					22.55
Salo Malino					0.55		85.34					85.89
Angasia			0.15				5.19					5.34
Salo Keoenisik			0.84				36.65					37.49
Takapala							37.46					37.46
Total	10.07	37.18	201.54	60.39	167.59	9.01	244.24	9.49	1.18	0.36	20.93	761.98
	(1.3%)	(4.9%)	(26.4%)	(7.9%)	(22.0%)	(1.2%)	(32.1%)	(1.2%)	(0.2%)	(0.0%)	(2.7%)	100.0%

Table 3.2 Inventory of Mining Sites as of 2004

No	Location	Objectives of Mining	Mining Equipment	Estimated Mining Volume (m^3/day)	Name of Mining Firm
S 1	Kec.Barombong Desa Bayang	Sand	Pump and Excavator	80	Wirabuana CV.Ansar
S 2	Kec.Tamalate/Bayang Bayang Caddi	Sand	Traditional by Boat	40	
S 3	Kec.Tamalate/Bayang	Sand	Traditional by Boat	60	Dg.Nuntung,DgMambang,Dg,lalo
S 4	Kec.Sombaopu	Sand	Traditional by Boat	12	Dg.Nuntung,DgMambang,Dg,lalo
S 5	Parangtambung/Malengkeri	Sand	Traditional by Boat	40	Dg.Naba,Dg Tayang, Dg.Tawang, Dg.Gasing,Dg.Nai.
S 6	Parangtambung	Sand	Pump	16	H.Tampak CV.Buana Jaya
S 7	Desa Balang-Balang Kec.Botomaranu	Sand	Pump	32	DG.Kio, Kamaruddin
S 8	Desa Borongloe	Sand	Pump	48	Dg.tata,Dg Bahar
S 9	Desa Songkolok	Stone, Sand, Gravel	Excavator	40	Kamaruddin
S 10	Desa Songkolok	Stone, Sand, Gravel	Excavator	200	H.Awing.
S 11	Desa Pattiro	Sand	Pump	40	Dg.Basir
S 12	Desa Pattiro	Sand	Pump	40	Ir.Amir
S 13	Desa Patiro	Sand	Pump	16	Dg.Mansur
S 14	Desa Songkolok	Sand	Pump	28	Tayyep
S 15	Desa Songkolok	Sand	Pump	28	Dg.Paik
S 16	Desa Songkolok	Sand	Pump	24	Dg.Liwung
S 17	Lebong/Parangloe, Sand Pocket 4	Sand	Excavator	Unknown	Perusda Kab.Gowa
	Total			744	

Note: The above mining sites are only those, which the Study Team could confirm through the field reconnaissance.

Table 3.3 Inventory of Factories Related to Jeneberang River

No	Location	Name of Factory	Kind & Production	Source of Water Supply	Abstraction Vol.
F1	Tanjung Bunga	Pt.GMDT	Property	PDAM/Deep Well	N/A
F2	Jl.Pelita Raya, Desa Bontoala, Kec.Pallangga	UD.Cahaya Indra Mulia	Ice Factory	Jeneberang River	N/A
F3	Jl.Pallangga Raya 8, Gowa	UD.Tulungagung	Roof tile factory	Deep Well	5 m^3/day
F4	Jl.Raya Palangga, Gowa	UD.Adinata	Taste & Saus Factory	Deep Well	2 m^3/day
F5	Jl. Raya Pallangga, Gowa	UD.Cahaya Terbit	Fry oil Factory	PDAM	5 m^3/day
F6	Jl.Kacong Dg.La'lang, Gowa	UD.Kian Jaya	Drinking Factory	PDAM/Deep Well	5 m^3/day
F7	Jl.Kacong Dg.La'lang, Gowa	CV.DHT	Syrup Drinking	PDAM	5 m^3/day
F8	Jl.Poros Malino Km.22 Gowa	PT.Ketelindo Tulus, Sejahtera	Tapioca flour Factory	Jeneberang River	200 m^3/day
F9	Desa Bontoramba, Kec.Pallangga	PT.Uma Pelita Abadi	Tapioca flour Factory	Jeneberang River	40 m^3/day

Note: N/A- Information not available

Table 3.4 Land Use in River Administration Area along River Dike Section (1/2)

Left Bank from River Mouth to Sungguminasa Bridge

Inside of Dike			
No.	Distance (m)	Length (m)	Land Use Type
1	0-1072	1072	Water Body
2	1072-1500	428	Bare Land
3	1500-2127	627	Paddy Field
4	2127-2298	171	Bare Land
5	2298-2848	550	Settlement
6	2848-3792	944	Paddy Field
7	3792-3878	86	Settlement
8	3878-4595	717	Paddy Field
9	4595-5421	826	Settlement
10	5421-5698	277	Paddy Field
11	5698-5820	122	Settlement
12	5820-6255	435	Estate Crop Field
13	6255-6990	735	Settlement
14	6990-7479	489	Estate Crop Field
15	7479-7554	75	Settlement
16	7554-7931	377	Paddy Field
17	7931-8473	542	Settlement
18	8473-8545	72	Paddy Field
19	8545-8609	64	Settlement
20	8609-8704	95	Paddy Field
21	8704-9272	568	Settlement

Total	Water Body	1,072	(11.6%)
	Bare Land	599	(6.5%)
	Paddy Field	3,109	(33.5%)
	Settlement	3,568	(38.5%)
	Estate Crop Field	924	(10.0%)
	Bush	-	(0.0%)
	Dry Farm Land	-	(0.0%)
	Grass Land	-	(0.0%)
	Forest Area	-	(0.0%)
	Scrub Land	-	(0.0%)
	Grand Total	9,272	(100.0%)

Outside of Dike			
No.	Distance (m)	Length (m)	Land Use Type
1	0-3160	3,160	Bare Land
2	3160-3327	167	Rubber Dam
3	3327-4958	1,631	Bush
4	4958-5041	83	Dry Land Farm
5	5041-5420	379	Bush
6	5420-5792	372	Dry Land Farm
7	5792-5888	96	Bush
8	5888-6086	198	Dry Land Farm
9	6086-6350	264	Bush
10	6350-7066	716	Dry Land Farm
11	7066-7319	253	Bush/Bare Land
12	7319-7584	265	Dry Land Farm
13	7584-7851	267	Bush/Bare Land
14	7851-8223	383	Dry Land Farm
15	8223-9028	794	Bush/Bare Land
16	9028-9272	244	Dry Land Farm

Total	Water Body	-	(0.0%)
	Bare Land	3,160	(34.1%)
	Paddy Field	167	(1.8%)
	Settlement	-	(0.0%)
	Estate Crop Field	-	(0.0%)
	Bush	3,684	(39.7%)
	Dry Farm Land	2,261	(24.4%)
	Grass Land	-	(0.0%)
	Forest Area	-	(0.0%)
	Scrub Land	-	(0.0%)
	Grand Total	9,272	(100.0%)

Note:

Water Body	Area that covered by water e.g. river, canal
Bare Land	Empty Area from plants or artificial activities e.g. river deposit bar
Paddy Field	Area that planted by paddy
Settlement	Housing Area and it surrounding, including front yard, back yard, plantation between houses
Estate Crop Field	Area that dominated by estate trees, usually around settlement
Bush	Area that dominated by bushes
Dry Farm Land	Farm area that dominated by dry farm e.g. non-irrigated agricultural field, sugar cane field, corn field, etc.
Grass Land	Area that dominated by grass for livestock's
Forest Area	Area that dominated by forest trees, commonly in hilly or mountainous area
Scrub Land	Area that dominated by scrubs plants

Table 3.4 Land Use in River Administration Area along River Dike Section (2/2)

Right Bank from River Mouth to Sungguminasa Bridge

Inside of Dike			
No.	Distance (m)	Length (m)	Land Use Type
1	0-1045	1045	Bare Land, Bush
2	1045-1976	931	Bush, Bare Land
3	1976-2000	24	Settlement
4	2000-3427	1427	Bush, Bare Land
5	3427-3440	13	Settlement
6	3440-3752	312	Bush
7	3752-4573	821	Bare Land, Bush
8	4573-5118	545	Bush, Bare Land
9	5118-5526	408	Estate Crop Field
10	5526-5624	98	Bush
11	5624-5745	121	Settlement
12	5745-6023	278	Bush
13	6023-6426	403	Settlement
14	6426-6759	333	Bush
15	6759-6871	112	Water Pond
16	6871-7188	317	Bush
17	7188-8402	1214	Dry Farm Land
18	8402-10040	1638	Bush, Bare Land
19	10040-10460	420	Dry Farm Land
20	10460-10670	210	Bare Land, Bush
21	10670-11020	350	Dry Farm Land
22	11020-11510	490	Bush
23	11510-11680	170	Settlement
24	11680-11880	200	Bare Land, Bush

Total			
	Water Body	112	(0.9%)
	Bare Land	2,276	(19.2%)
	Paddy Field	-	(0.0%)
	Settlement	731	(6.2%)
	Estate Crop Field	408	(3.4%)
	Bush	6,369	(53.6%)
	Dry Farm Land	1,984	(16.7%)
	Grass Land	-	(0.0%)
	Forest Area	-	(0.0%)
	Scrub Land	-	(0.0%)
	Grand Total	11,880	(100.0%)

Outside of Dike			
No.	Distance (m)	Length (m)	Land Use Type
1	0-342	342	Bush, Bare Land
2	342-770	428	Dry Farm Land
3	770-912	142	Bush
4	912-1145	233	Water Body
5	1145-1287	142	Bush
6	1287-1532	245	Dry Farm Land
7	1532-1813	281	Bush
8	1813-1989	176	Paddy Field
9	1989-2134	145	Settlement
10	2134-2539	405	Paddy Field
11	2539-2984	445	Settlement
12	2984-3167	183	Paddy Field
13	3167-3426	259	Grass Land
14	3426-3440	14	Rubber Dam
15	3440-4456	1016	Bush
16	4456-10190	5734	Settlement
17	10190-10290	100	Paddy Field
18	10290-10670	380	Settlement
19	10670-11020	350	Paddy Field
20	11020-11290	270	Estate Crop Field
21	11290-11510	220	Settlement
22	11510-11680	170	Paddy Field
23	11680-11880	200	Dry Farm Land

Total			
	Water Body	233	(2.0%)
	Bare Land	-	(0.0%)
	Paddy Field	1,398	(11.8%)
	Settlement	6,924	(58.3%)
	Estate Crop Field	270	(2.3%)
	Bush	1,923	(16.2%)
	Dry Farm Land	873	(7.3%)
	Grass Land	259	(2.2%)
	Forest Area	-	(0.0%)
	Scrub Land	-	(0.0%)
	Grand Total	11,880	(100.0%)

Note:

Water Body	Area that covered by water e.g. river, canal
Bare Land	Empty Area from plants or artificial activities e.g. river deposit bar
Paddy Field	Area that planted by paddy
Settlement	Housing Area and it surrounding, including front yard, back yard, plantation between houses
Estate Crop Field	Area that dominated by estate trees, usually around settlement
Bush	Area that dominated by bushes
Dry Farm Land	Farm area that dominated by dry farm e.g. Non-irrigated agricultural field, sugar cane field, corn field, etc.
Grass Land	Area that dominated by grass for livestock's
Forest Area	Area that dominated by forest trees, commonly in hilly or mountainous area
Scrub Land	Area that dominated by scrubs plants

Table 3.5 Land Use in River Administration Area along Non-dike River Dike Section (1/2)

Left Bank from Sungguminasa Bridge to Bili-Bili Dam

No.	Distance (m)	Length (m)	Area (ha)	Land Use Type
1 -1	9270-10490	1220	12.85	Settlement
1 -2			0.14	Paddy Field
2 -1	10490-11240	750	2.92	Bare Land
2 -2			4.19	Settlement
2 -3			0.65	Paddy Field
3 -1	11240-11430	1190	13.32	Paddy Field
3 -2			1.76	Settlement
4 -1	11430-13470	1040	6.15	Bare Land
4 -2			3.68	Dry Land Farm
4 -3			1.21	Paddy Field
4 -4			0.09	Estate Crop Field
5 -1	13470-15560	2090	10.14	Dry Land Farm
5 -2			8.46	Estate Crop Field
5 -3			2.02	Paddy Field
6 -1	15560-16220	660	3.02	Bare Land
6 -2			0.85	Dry Land Farm
6 -3			2.91	Paddy Field
7 -1	16220-16490	270	2.39	Paddy Field
7 -2			0.70	Estate Crop Field
7 -3			0.07	Settlement
8 -1	16490-17760	1270	7.11	Bare Land
8 -2			6.03	Paddy Field
8 -3			1.44	Dry Land Farm
8 -4			2.29	Estate Crop Field
9 -1	17760-17880	120	0.67	Estate Crop Field
9 -2			0.48	Paddy Field
9 -3			0.02	Bare Land
10 -1	17880-18860	980	2.95	Bare Land
10 -2			8.52	Estate Crop Field
10 -3			0.02	Settlement
11 -1	18860-18920	60	0.58	Estate Crop Field
11 -2			0.04	Dry Land Farm
12 -1	18920-19060	140	1.28	Dry Land Farm
12 -2			0.01	Estate Crop Field
13 -1	19060-19660	600	4.50	Bare Land
13 -2			2.32	Dry Land Farm
13 -3			0.08	Water Body
13 -3			1.33	Estate Crop Field
14 -1	19660-19970	310	2.66	Estate Crop Field
14 -2			0.34	Water Body
14 -3			1.29	Paddy Field
15 -1	19970-20150	180	1.88	Paddy Field
16 -1	20150-20830	680	3.56	Bare Land
16 -2			0.61	Estate Crop Field
16 -3			1.01	Paddy Field
16 -4			1.90	Dry Land Farm
17 -1	20830-20940	110	1.19	Dry Land Farm
17 -2			0.05	Water Body
18 -1	20940-23740	2800	6.84	Bare Land
18 -2			17.86	Dry Land Farm
18 -3			1.50	Estate Crop Field
18 -4			3.50	Paddy Field
19 -1	23740-23910	170	1.87	Paddy Field
20 -1	23910-24900	990	7.03	Bare Land
20 -2			4.32	Estate Crop Field
20 -3			1.74	Dry Land Farm
20 -4			0.73	Paddy Field
20 -5			1.10	Forest Area
20 -6			0.02	Scrub Land
21 -1	24900-25330	430	3.50	Dry Land Farm
21 -2			0.87	Forest Area
22 -1	25330-27340	2010	6.30	Bare Land
22 -2			9.36	Dry Land Farm
22 -3			5.25	Grass Land
22 -4			1.04	Scrub Land
23 -1	27340-27450	110	0.46	Scrub Land
23 -2			0.82	Grass Land
24 -1	27450-29110	1660	11.97	Bare Land
24 -2			1.57	Dry Land Farm
24 -3			0.05	Grass Land
24 -4			0.13	Scrub Land
24 -5			3.60	Estate Crop Field
24 -6			0.01	Paddy Field
24 -7			0.57	Settlement
25 -1	29110-30110	1180	11.44	Estate Crop Field
25 -2			2.22	Settlement
25 -3			1.83	Paddy Field

Total	Water Body	-	0.47	0.2%
	Bare Land	13,440	62.37	26.1%
	Paddy Field	1,810	41.27	17.3%
	Settlement	1,220	21.68	9.1%
	Estate Crop Field	1,670	46.78	19.6%
	Bush	-	-	0.0%
	Dry Farm Land	2,770	56.87	23.8%
	Grass Land	-	6.12	2.6%
	Forest Area	-	1.97	0.8%
	Scrub Land	110	1.65	0.7%
	Grand Total	21,020	239.18	100.0%

Note:

Water Body	Area that covered by water e.g. river, canal
Bare Land	Empty Area from plants or artificial activities e.g. river deposit bar
Paddy Field	Area that planted by paddy
Settlement	Housing Area and it surrounding, including front yard, back yard, plantation between houses
Estate Crop Field	Area that dominated by estate trees, usually around settlement
Bush	Area that dominated by bushes
Dry Farm Land	Farm area that dominated by dry farm e.g. non-irrigated agricultural field, sugar cane field, corn field, etc.
Grass Land	Area that dominated by grass for livestock's
Forest Area	Area that dominated by forest trees, commonly in hilly or mountainous area
Scrub Land	Area that dominated by scrubs plants

Table 3.5 Land Use in River Administration Area along Non-dike River Dike Section (2/2)

Right Bank from Sungguminasa Bridge to Bili-Bili Dam

No.	Distance (m)	Length (m)	Area (ha)	Land Use Type
1 -1	11440-11700	260	1.49	Bare Land
1 -2			1.09	Settlement
2 -1	11700-11880	180	1.58	Bare Land
2 -2			0.08	Settlement
3 -1	11880-12110	230	2.33	Paddy Field
3 -2			0.10	Bare Land
4 -1	12110-12390	280	3.18	Bare Land
4 -2			0.28	Paddy Field
5 -1	12390-12480	90	0.89	Paddy Field
5 -2			0.23	Bare Land
6 -1	12480-13140	660	5.44	Bare Land
6 -2			1.86	Paddy Field
7 -1	13140-13500	360	2.60	Paddy Field
7 -2			1.05	Estate Crop Field
8 -1	13500-14310	810	7.08	Estate Crop Field
8 -2			1.12	Paddy Field
8 -3			0.23	Settlement
8 -4			0.01	Dry Land Farm
9 -1	14310-15930	1620	12.79	Dry Land Farm
9 -2			3.61	Settlement
9 -3			0.09	Water Body
10 -1	15930-16430	500	5.23	Settlement
11 -1	16430-16820	390	2.23	Dry Land Farm
11 -2			0.63	Settlement
11 -3			0.59	Paddy Field
11 -4			0.49	Estate Crop Field
12 -1	16820-16890	70	0.45	Paddy Field
12 -2			0.38	Estate Crop Field
13 -1	16890-17640	750	2.31	Bare Land
13 -2			4.33	Estate Crop Field
13 -3			1.36	Paddy Field
13 -4			0.66	Settlement
14 -1	17640-18210	570	5.42	Paddy Field
14 -2			0.77	Estate Crop Field
14 -3			0.01	Bare Land
15 -1	18210-18380	170	1.41	Dry Land Farm
15 -2			0.52	Paddy Field
15 -3			0.01	Bare Land
16 -1	18380-18920	540	6.90	Bare Land
16 -2			0.77	Dry Land Farm
16 -3			0.10	Estate Crop Field
17 -1	18920-19250	330	2.50	Dry Land Farm
17 -2			0.38	Paddy Field
17 -3			0.52	Estate Crop Field
18 -1	19250-19350	100	0.87	Estate Crop Field
18 -2			0.09	Dry Land Farm
18 -3			0.01	Paddy Field
19 -1	19350-20430	1080	4.03	Bare Land
19 -2			5.54	Settlement
19 -3			2.76	Estate Crop Field
19 -4			0.47	Paddy Field
20 -1	20430-20600	170	0.41	Estate Crop Field
20 -2			1.32	Dry Land Farm
20 -3			0.01	Paddy Field
21 -1	20600-20900	300	1.65	Dry Land Farm
21 -2			1.27	Estate Crop Field
21 -3			0.08	Settlement
22 -1	20900-21020	120	1.29	Estate Crop Field
22 -2			0.06	Settlement
23 -1	21020-21080	60	0.21	Paddy Field
23 -2			0.94	Estate Crop Field
24 -1	21080-21300	220	1.43	Estate Crop Field
24 -2			1.11	Paddy Field
25 -1	21300-21580	280	3.14	Paddy Field
25 -2			0.03	Estate Crop Field
26 -1			1.08	Paddy Field
26 -1	21580-21730	150	0.49	Estate Crop Field
27 -1	21730-21820	90	1.20	Paddy Field
27 -2			0.02	Estate Crop Field
28 -1	21820-22260	440	4.38	Dry Land Farm
28 -2			0.04	Paddy Field
29 -1	22260-22490	1230	1.23	Estate Crop Field
29 -2			1.16	Dry Land Farm
30 -1	22490-23730	240	5.30	Bare Land
30 -2			5.77	Dry Land Farm
30 -3			1.27	Estate Crop Field
30 -4			0.52	Water Body
31 -1	23730-23910	180	1.72	Dry Land Farm
31 -2			0.10	Paddy Field
32 -1	23910-24370	460	5.22	Paddy Field
33 -1	24730-25380	1010	7.93	Bare Land
33 -2			2.57	Dry Land Farm
33 -3			0.31	Paddy Field
34 -1	25380-25570	190	1.39	Dry Land Farm
35 -1	25570-26160	590	6.78	Bare Land
35 -2			0.94	Estate Crop Field
35 -3			0.87	Dry Land Farm
36 -1	26160-27050	890	1.24	Grass Land
36 -2			0.31	Bare Land
37 -1	27050-27210	160	3.91	Bare Land
37 -2			3.30	Grass Land
37 -3			0.90	Estate Crop Field
37 -4			0.02	Dry Land Farm
38 -1	27210-27450	240	0.59	Estate Crop Field
38 -2			0.78	Dry Land Farm
38 -3			0.45	Paddy Field
39 -1	27450-27530	80	0.26	Bare Land
39 -2			1.42	Dry Land Farm
39 -3			0.87	Paddy Field
39 -4			0.03	Estate Crop Field
40 -1	24530-30450	2920	0.16	Estate Crop Field
40 -2			0.62	Paddy Field
40 -3			0.09	Scrub Land
41 -1	30450-30760	310	21.77	Bare Land
41 -2			6.65	Estate Crop Field
41 -3			1.14	Scrub Land
41 -4			0.21	Paddy Field
41 -5			2.05	Dry Land Farm
41 -6			0.33	Grass Land
41 -7			0.62	Settlement
42 -1	30760-31520	760	2.99	Scrub Land
42 -2			56.27	Bili-Bili Dam Comple
42 -3			0.05	Scrub Land
43 -1	31520-32110	590	4.44	Settlement
43 -2			1.57	Paddy Field
43 -3			0.10	Bili-Bili Dam Comple

Total	Water Body	-	0.61	0.2%
	Bare Land	6,140	127.91	46.5%
	Paddy Field	2,210	34.42	12.5%
	Settlement	1,090	22.27	8.1%
	Estate Crop Field	5,960	36	13.1%
	Bush	-	0	0.0%
	Dry Farm Land	3,620	44.9	16.3%
	Grass Land	890	4.87	1.8%
	Forest Area	-	0	0.0%
	Scrub Land	760	4.27	1.6%
	Grand Total	20,670	275.25	100.0%

Water Body	Area that covered by water e.g. river, canal
Bare Land	Empty Area from plants or artificial activities e.g. river deposit bar
Paddy Field	Area that planted by paddy
Settlement	Housing Area and it surrounding, including front yard, back yard, plantation between houses
Estate Crop Field	Area that dominated by estate trees, usually around settlement
Bush	Area that dominated by bushes
Dry Farm Land	Farm area that dominated by dry farm e.g. non-irrigated agricultural field, sugar cane field, corn field, etc.
Grass Land	Area that dominated by grass for livestock's
Forest Area	Area that dominated by forest trees, commonly in hilly or mountainous area
Scrub Land	Area that dominated by scrubs plants

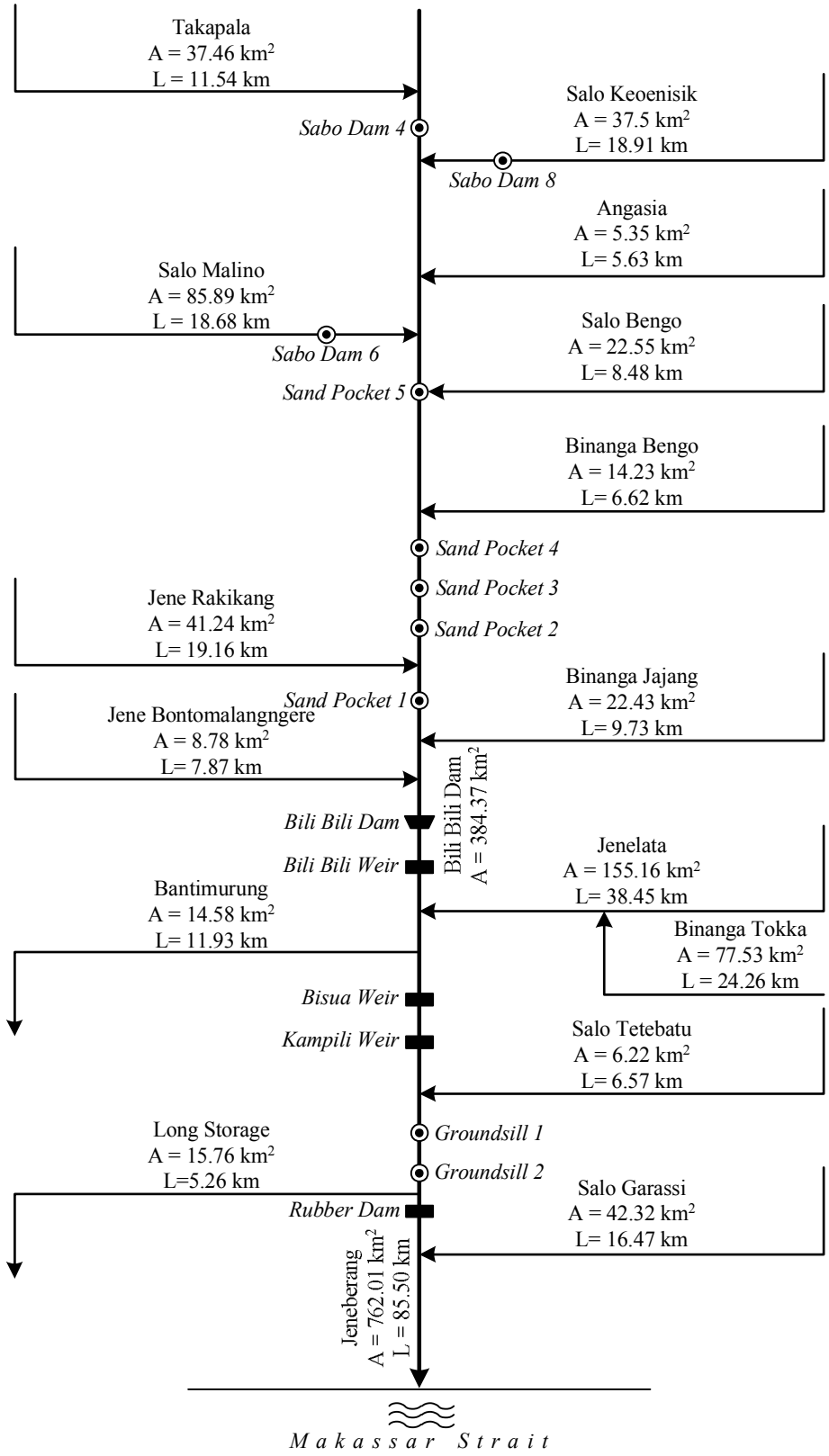


Figure 3.1 River Flow System of Jeneberang River Basin

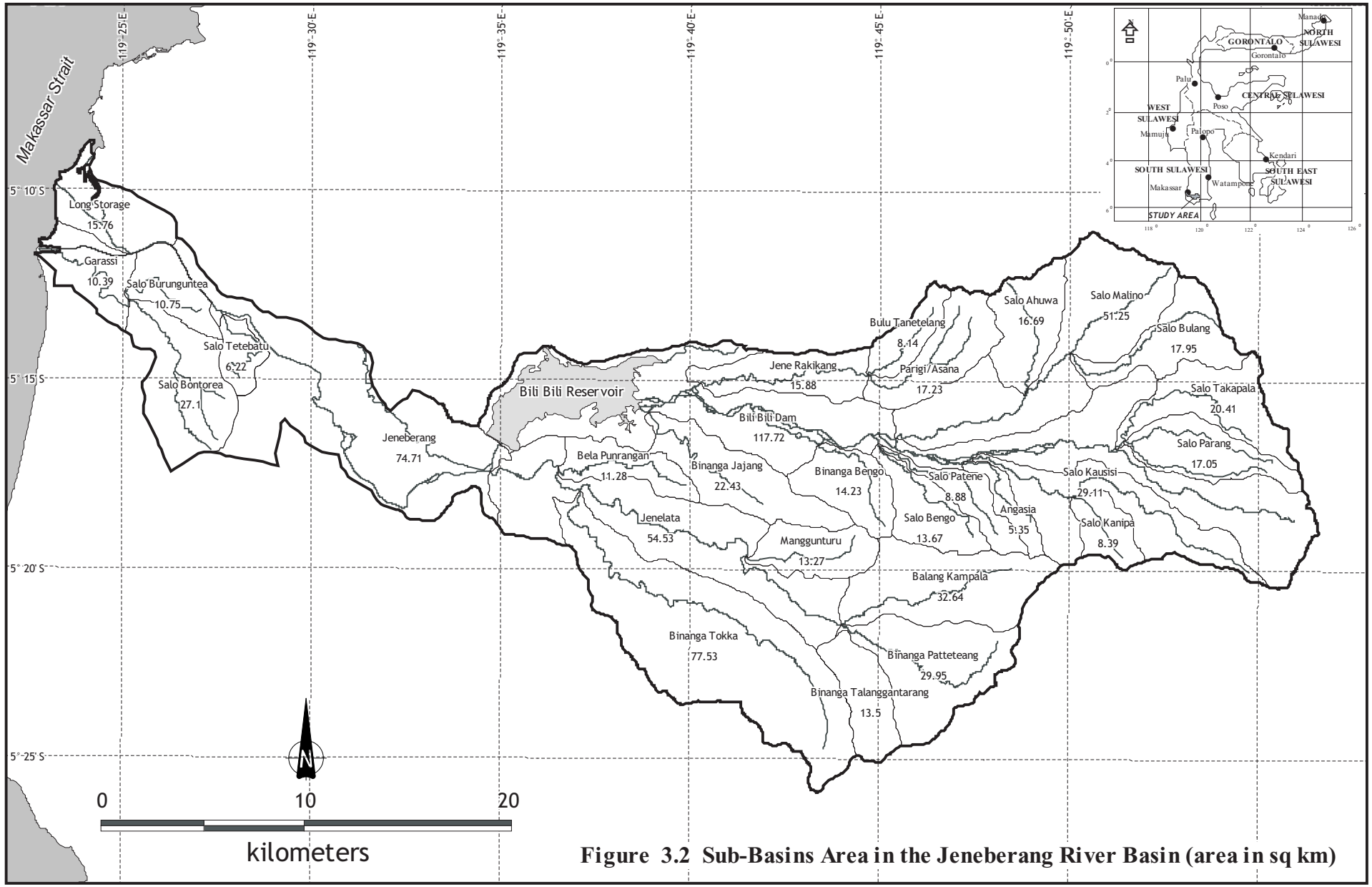


Figure 3.2 Sub-Basins Area in the Jeneberang River Basin (area in sq km)

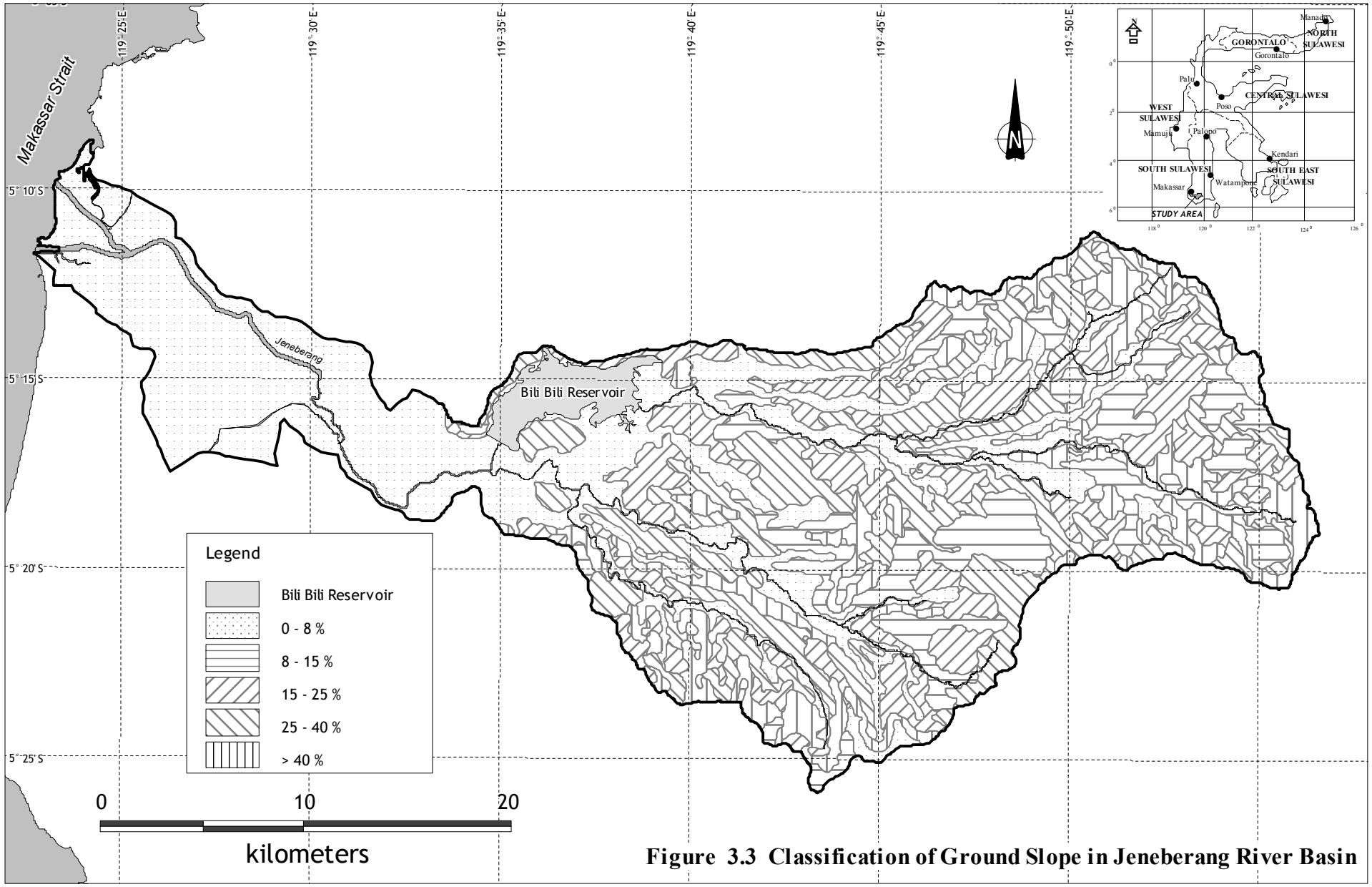


Figure 3.3 Classification of Ground Slope in Jeneberang River Basin

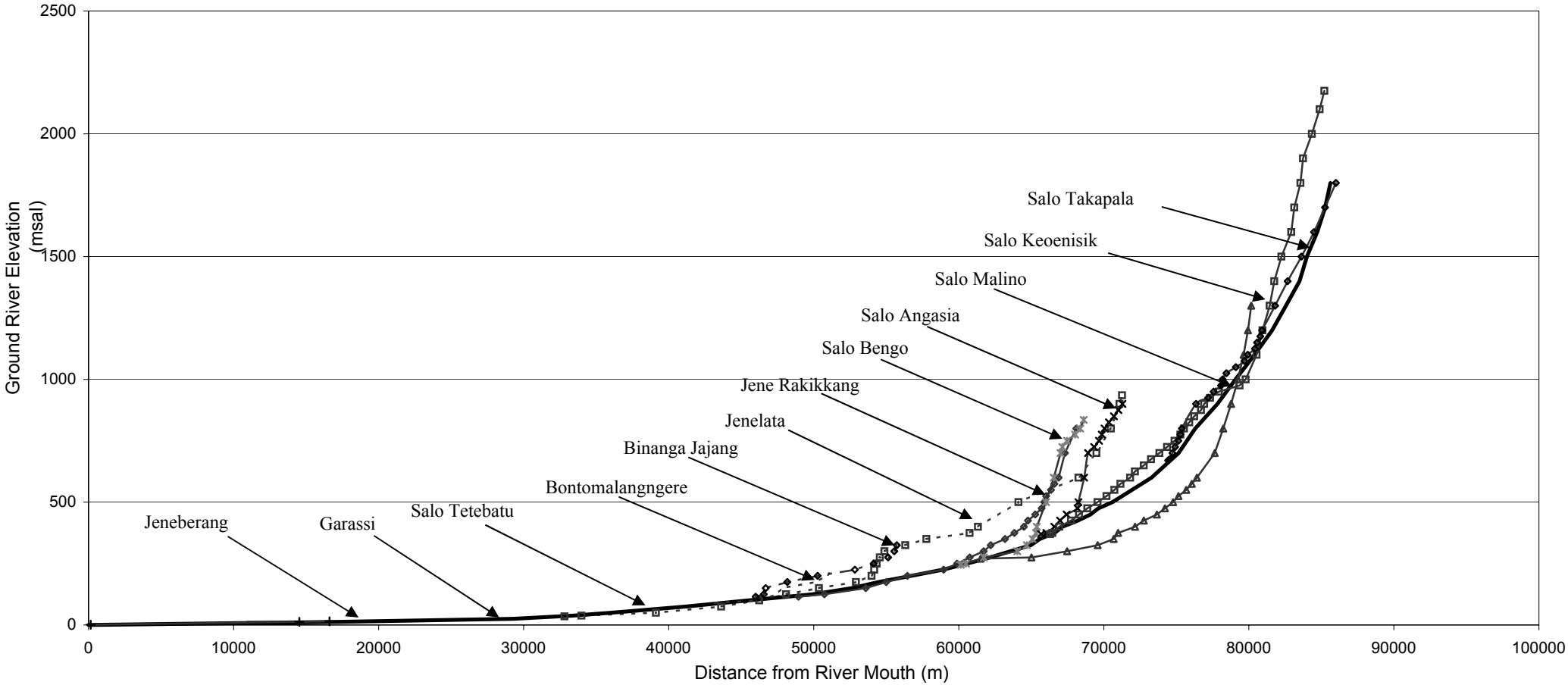
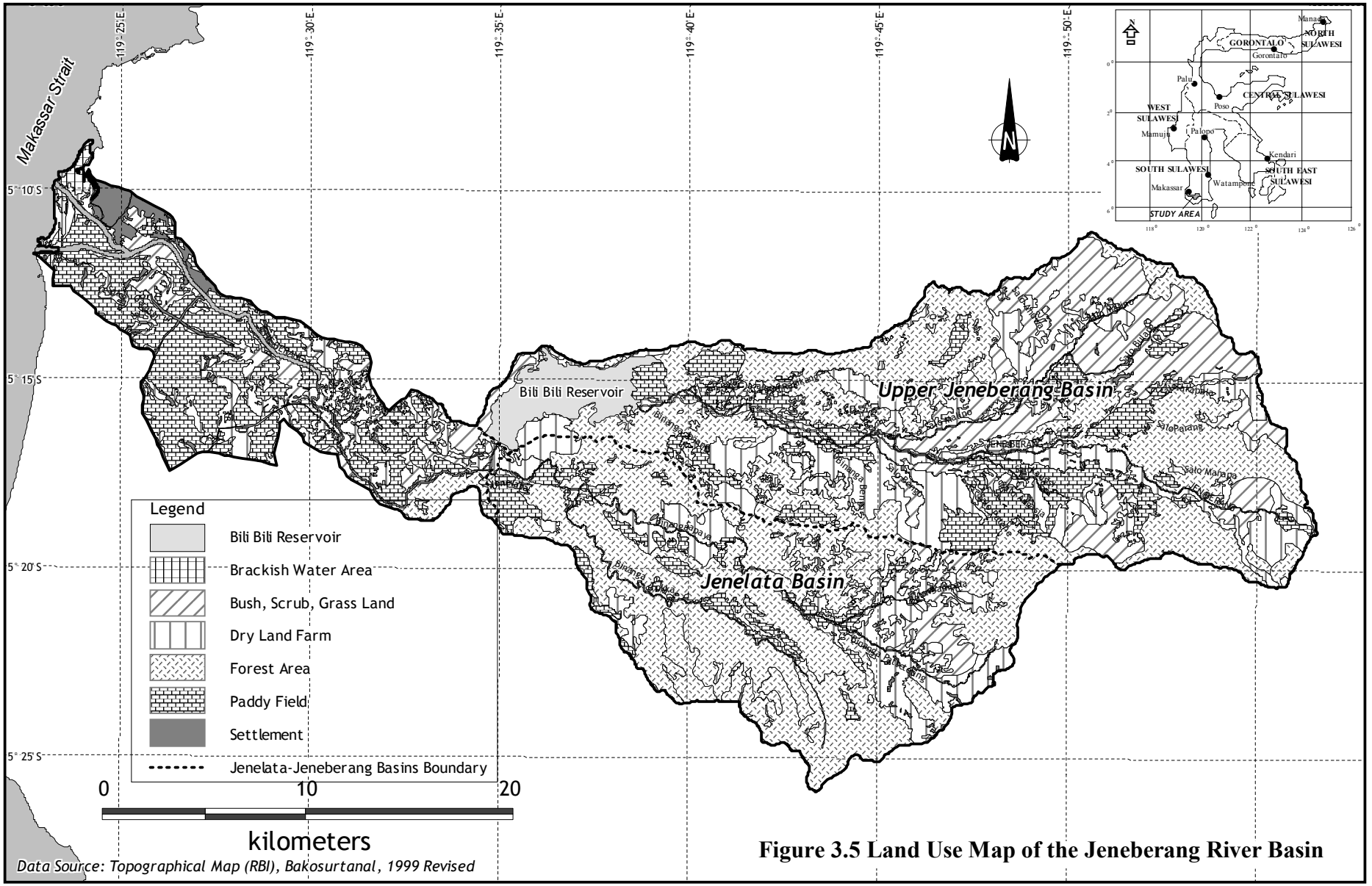


Figure 3.4 Channel Slope of Jeneberang River and Tributaries



Data Source: Topographical Map (RBI), Bakosurtanal, 1999 Revised

Figure 3.5 Land Use Map of the Jeneberang River Basin

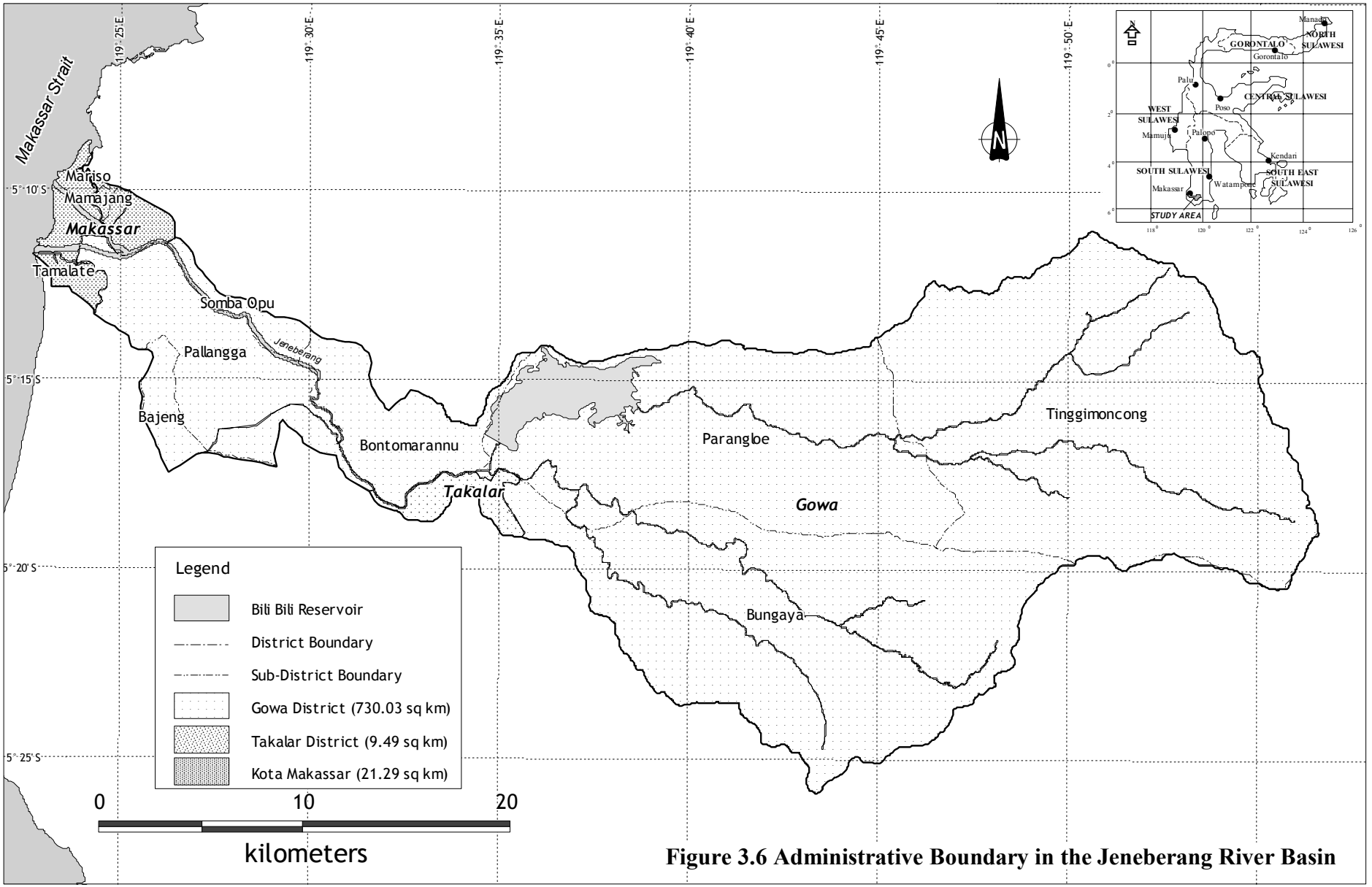


Figure 3.6 Administrative Boundary in the Jeneberang River Basin

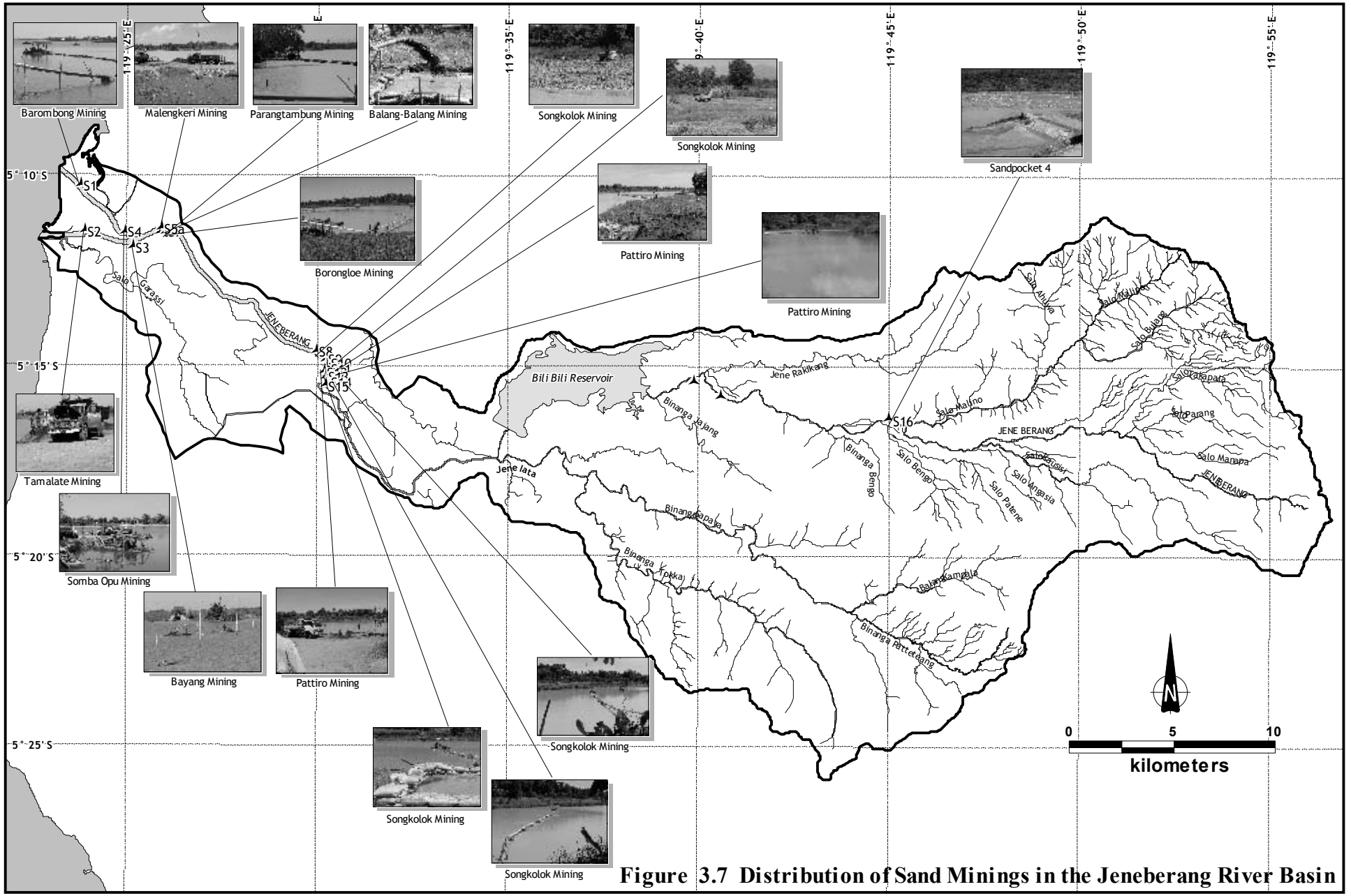


Figure 3.7 Distribution of Sand Minings in the Jeneberang River Basin

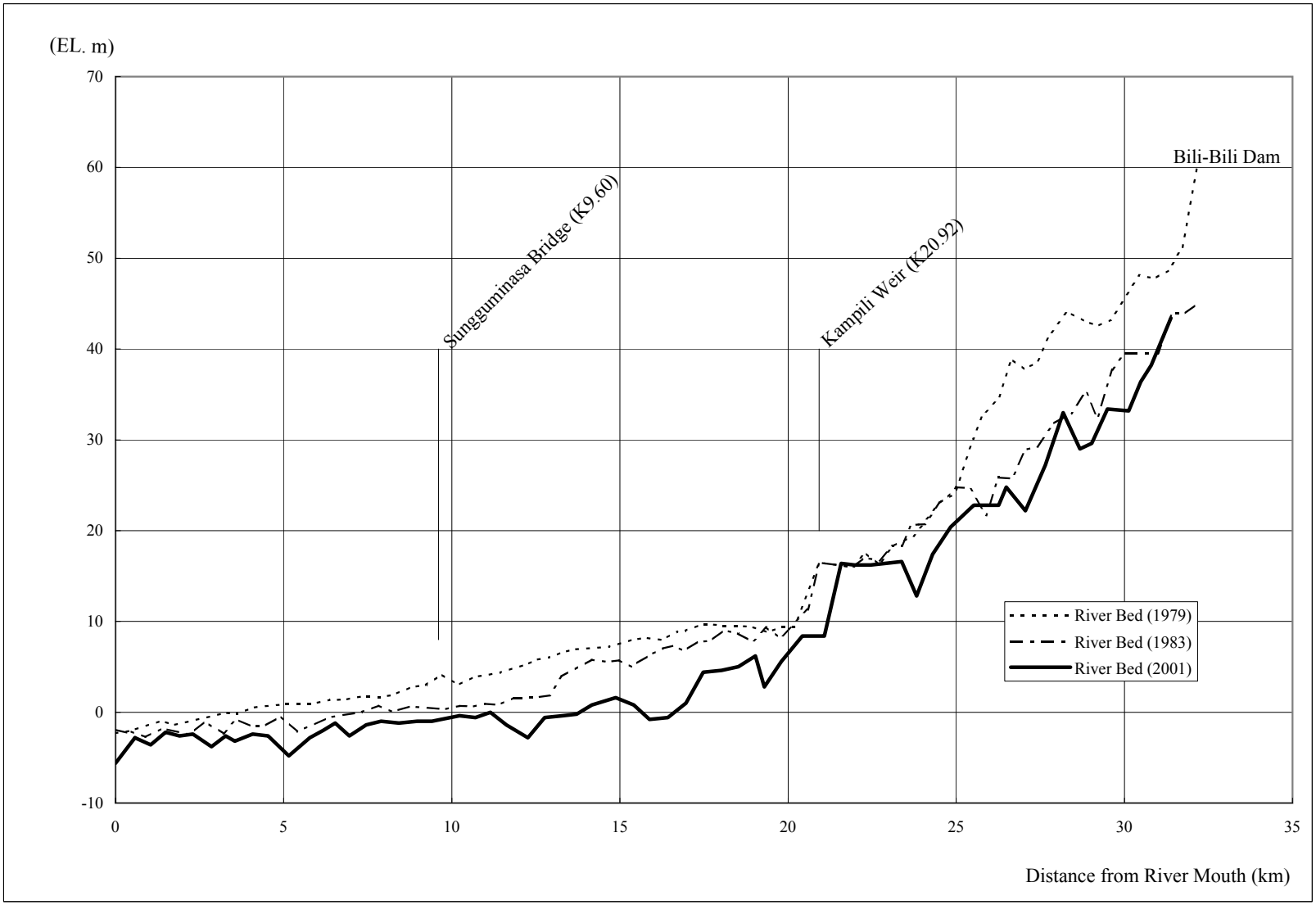


Figure 3.8 Change of River Bed of Jeneberang River

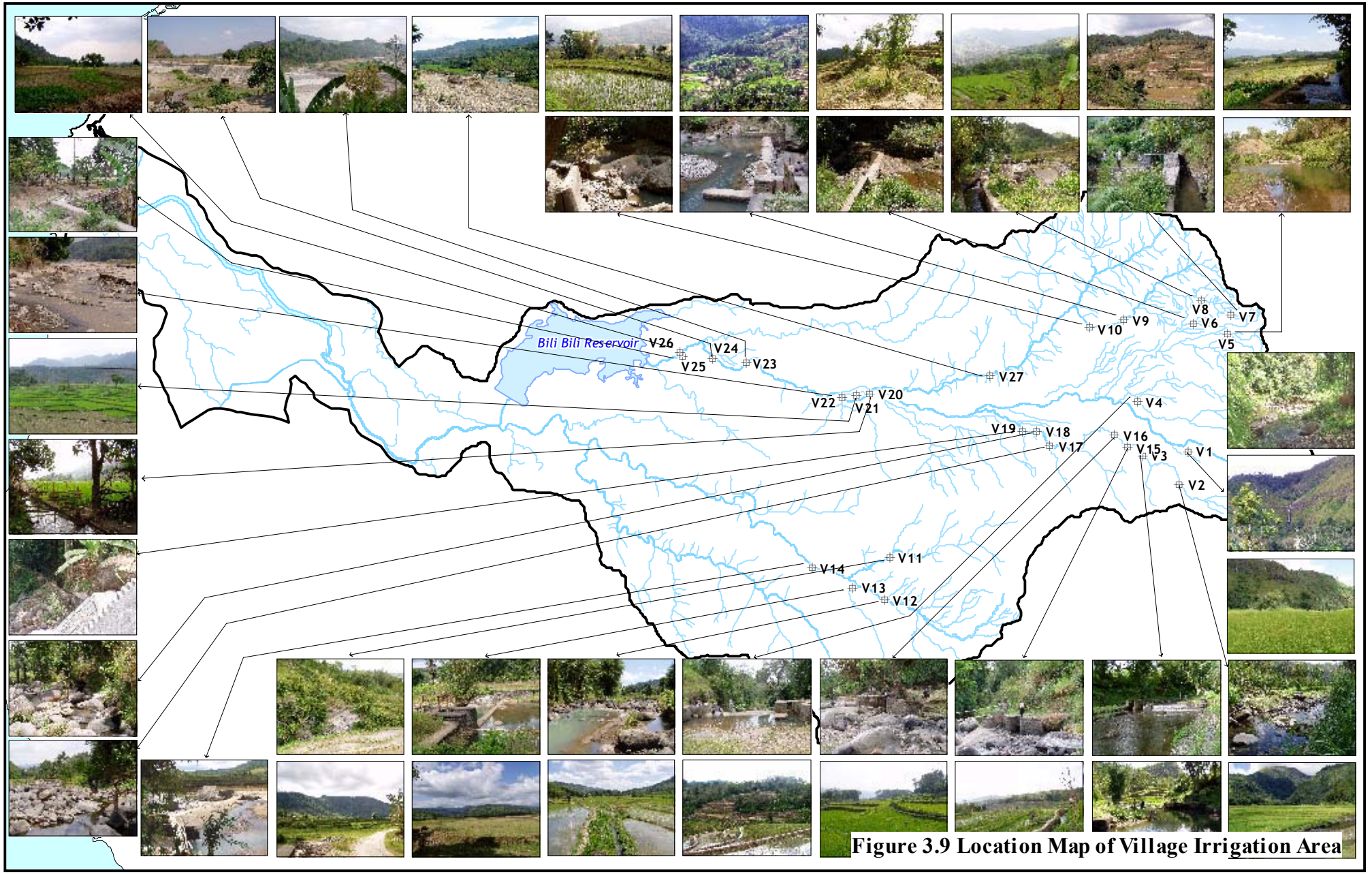


Figure 3.9 Location Map of Village Irrigation Area

CHAPTER 4

IRRIGATION DEVELOPMENT IN THE BASIN

4.1 Overview of National Irrigation Sector Policy

The irrigated area in Indonesia was increased by about 1.1 million ha over the 23-year period from 1976 (3.9 million ha) to 1999 (5.0 million ha) to ensure self-sufficiency in rice production. However, the current trade liberalization based on the new agriculture development policy for 2000-2004 is forcing farmers to face serious price competition between local and imported rice. Under such circumstances, the public focus on food policy seems to be shifting to stable food supply rather than food self-sufficiency. Consequently, the role of the irrigation sector will have to be tailored to support the new food policy.

The development and ongoing operation and maintenance (O&M) of irrigation systems have been shouldered by a significant number of public investments. In 1987, the Government attempted to introduce an irrigation service fee (ISF) and the transfer of those irrigation systems of less than 500 ha to water users associations (WUA). ISF was intended to cover the full O&M expenditure of public irrigation systems. However, the ISF collection remained at a low level and the system turnover was achieved at an unexpectedly gradual pace. Consequently, O&M and rehabilitation continued to be primarily the Government's responsibility.

With the national political reform that took place in 1998, the Government issued a new national water resources policy (NWRP) with the support of the World Bank and ADB. In April 1999, the Government launched a participatory irrigation development and management policy through the issue of a decree on irrigation management policy reform (IMPR). The IMPR directed: (i) redefinition of tasks and responsibilities for irrigation management institutions, (ii) empowerment of WUAs, (iii) irrigation management transfer (IMT), (iv) restructuring finances for irrigation management, and (v) sustainable management of irrigation. The principle of IMPR was legitimized in Government Regulation No.77, December 2001 (PP77/2001). In addition, the execution of irrigation management was transferred to Kabupaten governments under the decentralization policy, in such a way that assets and staff were transferred to the Kabupatens in most irrigation systems.

The new Water Law was enacted on March 18, 2004. It openly encourages stakeholders to participate in all steps of water resources development and management from the preparation of strategic policy and plan to the design, construction, operation and maintenance, and in-stream water quality monitoring works. The main principles of the irrigation management policy provided in the new water law are as follows:

- Development/construction and operation and management of irrigation schemes are

responsibilities of the Government and the Regional Governments and these activities will be implemented with participation of WUAs; and

- Funding for construction and operation and maintenance of tertiary irrigation systems is the responsibility of farmers and the community, while the government will provide financial assistance if required.
- The government is responsible for management of irrigation area
  - (i) District/City government to manage irrigation areas of less than 1,000 ha (small irrigation areas) located in a single district/city
  - (ii) Provincial government to manage irrigation areas of 1,000 to 3,000 ha (medium-sized irrigation areas) or a small irrigation area located across districts/cities
  - (iii) Central government to manage irrigation areas larger than 3,000 ha (large irrigation areas) or a medium-sized irrigation area located across provinces, in nationally strategic irrigation areas, and across countries.

With enactment of the new Water Law, the Government is revising the controversial Government Regulation No.77/2001 on Irrigation that was intended to transfer the management of primary and secondary irrigation systems to WUAs.

4.2 Overview of Irrigation and Irrigation Management in South Sulawesi Province

4.2.1 Agriculture and Irrigation

The South Sulawesi Province has been recognized as one of the most important granaries in Indonesia, particularly for supplying paddy and other food crops for other provinces in the Sulawesi region. The number of farm households in the province in 2001 is estimated at about 1,140,000, which accounts for about 64% of the total households of about 1,795,000.[1] The primary farming activity of the farm households in the province is food crops production followed by estate crops production. Food crops farmers represent some 82% of the total farmers. The current land holding status in the province is assessed at 1.28 ha/household, of which paddy field occupies about 0.55 ha or 43%. Households with less than 0.5 ha accounts for 29%, and the remaining 71% have farm sizes larger than 0.5 ha.

The largest farm land category in the province is paddy fields, which occupy 629,000 ha or about 32% of the total farm land of 1,970,000 ha. Paddy production is the largest food crops agriculture sub-sector, representing 68% of the total harvested area with food crops (not including vegetables) in 2001. The major food crops produced in the province in 2001 were 4.2 million tons of paddy and 0.88 million tons of maize, respectively.

[1] The latest agriculture census in the province was made in 1993, and the current conditions of agriculture and agro-economy as of 2001 is estimated based on the 1993 agriculture census.

The existing potential irrigation areas in South Sulawesi Province are estimated at 503,748 ha, consisting of 320,907 ha under 250 government-developed irrigation schemes and 182,841 ha under 1,287 village irrigation schemes. The government-developed irrigation schemes consist of 57 technical irrigation schemes with potential irrigation areas of 237,657 ha, 132 semi-technical irrigation schemes with potential irrigation areas of 72,981 ha and 61 simple irrigation schemes having potential areas of 10,269 ha. There are 63 large-scale irrigation schemes each of which has a potential irrigation area of more than 500 ha. These schemes cover 260,173 ha or 81% of the potential irrigation area of government developed irrigation schemes.

4.2.2 Agriculture Support and Institutions

The government agricultural support systems in the province include the Food & Horticulture Crops Agriculture Services Office, Estate Crops Services Office, Livestock Services Office and Food Security Agency. A number of farmers' organizations involved in agricultural activities have been formed in the province. Among these, the major one is the Farmers' Group (Kelompok Tani/KT), of which only 20 % of KTs are active and advanced and the remaining KTs are merely dormant organizations. The activities of KTs are generally limited to technical issues such as scheduling of farming operations; their economic activities such as group purchasing and marketing are seldom practiced. General problems encountered by KTs are: (i) limited group funds, (ii) not well organized as a group, and (iii) limited economic activities as a group.

Some 442 Village Unit Cooperatives (KUD) exist in the province with activities varying from dormant status to actively operated status. The main activities of KUDs are distribution of farm inputs, procurement of paddy, rice milling, supply of daily commodities, and deposit and credit services.

The numbers of Rural Extension Centers (Balai Penyuluhan Pertanian/BPP) and Field Extension Workers (Penyuluhan Pertanian Lapangan/PPL) deployed in the province in 2001 were 201 and 2,111, respectively.

4.2.3 Irrigation Management and Water Users Associations

In South Sulawesi, the water resources and irrigation sector is administered by Dinas PSDA Province (Provincial Water Resources Services/PWRS). Under the Head of Dinas PSDA, Sub-divisions are set up to handle technical and administrative matters with Regional Technical Implementation Units (Balai PSDA/UPTD) established as branch offices to conduct water resources management and coordinate with district/municipal governments. At district/municipal level, Dinas PSDA Kabupaten (District Water Resources Services/DWRS) and its branch offices are responsible for implementing irrigation management, providing services to the existing WUA and promoting new WUA establishment. Regarding staff availability, the vacancy rate is approximately 50%.

The WUA establishment target set up by PWRS South Sulawesi is 3,302 for 250

government-developed irrigation schemes and 1,149 for 1,287 village irrigation schemes. To date, 2,224 WUAs have been established in government-developed irrigation schemes. Because of slow progress of legal registration in local courts of justice, only 119 WUAs have until now been legitimized.

4.3 Irrigation Schemes in the Jeneberang River Basin

4.3.1 Historical Background of Irrigation Schemes in the Jeneberang River Basin

A vast low-lying area in the lower Jeneberang river basin is known as a granary of Sulawesi Island. It has, however, suffered from repeated flood mainly from the Jeneberang River during the wet season. The paddy-based agriculture in the area has also faced shortages in irrigation water in the dry season and limitations due to aged infrastructure (built in 1930's). In addition, Makassar city has had critical problems both in the domestic and industrial water supplies. To mitigate flood problems and develop water resources both for agriculture and urban development, the Government launched an integrated water resources development project for Jeneberang River in 1979.

The Government of Japan has to date been providing technical and financial assistance through JICA and OECF (JBIC). The JICA carried out a two-phased study for Jeneberang river flood control and water resources development in 1979 and 1981, the 1981 feasibility study to formulate the irrigation schemes in the basin, and also the construction of Bili-Bili multipurpose dam. The multi-purpose Jeneberang river basin development project has been implemented with the financial assistance of OECF since 1983. The Bili-Bili multipurpose dam was constructed from 1986 to 1997, followed by construction and rehabilitation of Bili- Bili irrigation project. The latter consisted of three schemes, namely Bili-Bili (existing), Bissua (new) and Kampili (existing), and was undertaken from 1998 to 2004.

4.3.2 Agriculture and Agro-economic Development Plan

The areas of Bili-Bili irrigation project lie on the downstream reaches of the Jeneberang River, and administratively belong to the two Kabupatens of Takalar and Gowa, and Makassar city. The Bili-Bili irrigation project is composed of three irrigation schemes; Bili–Bili, Bissua and Kampili. The gross and net irrigation service areas of the three schemes are 45,500 ha and 23,663 ha, respectively[2], as classified below.

[2] There are inconsistencies in figures of irrigation area (ha) throughout this chapter, because there are differences in irrigation development area between planned and actual. These figures are at present being confirmed based on the tertiary developments by the Bili-Bili irrigation project office.

Gross area and irrigation service area (Unit : ha)

Scheme	Gross area	Irrigation service area
Bili-Bili (existing)	7,050	2,360
Bissua (existing and new)	20,000	10,758
Kampili (existing)	18,450	10,545
Total	45,500	23,663

Note: A part of old Kampili scheme (17,480 ha) is divided into two sub-systems by water intake alteration; one (6,935 ha) is merged with the new Bissua scheme, and the other (10,545 ha) remains under the existing Kampili weir.

Source : (i) Final Design Report on Detail Design and Construction Supervision of Bili-Bili Irrigation Project, December 1999, and (ii) Operation and Maintenance Manual (2nd Draft) Detail Design and Construction Supervision of Bili-Bili Irrigation Project, November 2003.

The average net farm size in the proposed Bili-Bili irrigation project area was estimated at 0.8 ha[3]. This comprised 0.6 ha of paddy field and 0.2 ha of upland field. Most farmland is owned by owner-farmers. The owner-farmer ratio was estimated to average 88 % in 1993, varying from 91 % in Gowa to 73 % in Makassar.

The cropping pattern applied to the overall Bili-Bili irrigation project is three irrigated crops a year. These comprise two paddy crops of wet and dry (200 %) and partly the palawija crops (40 %). The palawija crops are mixed with soybeans (15 %), mungbeans (10 %), groundnuts (8 %) and maize (7 %). The proposed cropping pattern is shown in Figure 4.1. The anticipated yields of paddy were estimated to be 5.5 tons/ha of wet season paddy and 6.0 tons/ha of dry paddy. The gross return and net benefit after deducting production costs and not considering family labor cost were assessed to be about Rp. 13.2 million/ha (US$ 1,833/ha equiv.).

4.3.3 Water Requirement and Water Balance

The irrigation water requirement was computed by FAO's empirical method on a half-month period basis for the 26 year period from 1972 to 1997. The maximum net field requirement for the 26 year period was calculated at 1.08 lit/sec/ha on paddy field. The designed net field requirement was set at 1.17 lit/sec/ha taking the prevailing planning standard. The overall irrigation efficiency is estimated at 68.85 % from the head intake down to the tertiary level. The design unit discharge at the head gate is set at 1.65 lit/sec/ha.

The diversion water requirements at the respective headgates of Bili-Bili, Bissua and Kampili diversion dam are computed for the 26 year period as shown below.

Diversion Discharge at Weir's Headgate (m^3/sec) for 1972 to 1997

Bili-Bili (2,360 ha)		Bissua (10,760 ha)		Kampili (10,540 ha)		Average total volume (MCM)
Max.	Ave. Max.	Max.	Ave. Max.	Max.	Ave. Max.	
3.70	2.17	16.88	9.90	16.53	9.70	407.06

MCM : million cubic meter

[3] The figures of land holding sizes mentioned here are based on the planning and design of the Bili-Bili irrigation project in 1999. The facts imply that the actual sizes are smaller than these figures. This will be clarified and confirmed by the on-going tertiary development works carried out by the Bili-Bili irrigation project office.

Source : Final Design Report on Detail Design and construction Supervision of Bili-Bili Irrigation Project, December 1999

With the above computed irrigation demands on a field water requirement basis, the water balance simulation gave a result as summarized below that the failure in full supply of irrigation water took place five times for the 26-year period, thus the proposed cropping pattern and intensity matched the project concept of ensuring 80% assurance. It should be noted that almost a full double-cropping of paddy except two years was ensured.

Result of water balance simulation (1972-1997)

Order	Year	Area irrigated (%)			Cropping intensity (%)
		Wet paddy	Dry paddy	Palawija	
1	1972	100	79	0	179
2	1983	100	98	0	198
3	1997	100	100	4	204
4	1982	100	100	17	217
5	1992	100	100	35	235
6	1976	100	100	40	240
7-26	Years rest	100	100	more 40	240

Source : Final Design Report on Detail Design and Construction Supervision of Bili-Bili Irrigation Project, December 1999

Note: The above water balance analysis was reviewed in this Study incorporating the latest 4-year data of 1998-2001. The result is shown in Chapter 5.

4.3.4 Major Features of Bili-Bili Irrigation Project

The service area of Bili-Bili irrigation project is 23,660 ha, originally intended in the development plan, under the three irrigation sub-systems (schemes). Irrigation water is taken at three weirs on the main stream of Jeneberang river and supplied to the respective schemes through the respectively independent irrigation networks. A general layout of the irrigation schemes and its irrigation diagram are shown in Figures 4.2 and 4.3, respectively. The features of three irrigation schemes are presented below.

Main features of Bili-Bili irrigation project

Description	Bili-Bili irrigation scheme		Bissua irrigation scheme		Kampili irrigation scheme	
1. Irrigation area	2,360 ha		10,760 ha		10,540 ha	
2. Primary canal						
- Head discharge	3.9 m^3/sec		19.7 m^3/sec		17.4 m^3/sec	
- Nos. of canal	2		2		1	
- Total length	9.4 km		23.7 km		13.5 km	
3. Secondary canal						
- Discharge	1.3-0.02 m^3/sec		2.4-0.1 m^3/sec		2.4-0.2 m^3/sec	
- Nos. of canal	5		28		5	
- Total length	18.6 km		27.2 km		75.4 km	
4. Related structures	New	Rehab.	New	Rehab.	New	Rehab.
- Weir	-	5	1	-	-	1
- Division str.	3	-	12	-	-	15
- Offtake	14	19	30	-	26	37
- Culvert	4	-	19	-	25	4
- Drainage culvert	-	2	22	-	3	6
- Aqueduct	-	2	1	-	2	-
- Drops	2	2	17	-	1	-

Description	Bili-Bili irrigation scheme		Bissua irrigation scheme		Kampili irrigation scheme	
- Bridge	-	8	12	-	-	5
- Foot bridge	9	3	51	-	6	4
- Side spillway	2	1	4	-	1	1
- Buffalo wallow	-	-	2	-	-	3
- Washing step	-	-	13	-	-	-
- Drain inlet	-	-	-	-	-	-
- Siphon	-	-	-	-	1	1
- Tunnel	1	-	-	-	-	-
- Gates	118	56	291	-	185	487
5. Drainage canal						
- Discharge	46.4-0.7 m^3/sec		6.2-1.0 m^3/sec		41.5-1.2 m^3/sec	
- Nos. of canal	4		7		10	
- Total length	24.1 km		15.5 km		61.5 km	
6. Drain related structures						
- Bridge	2		5		9	
- Culvert	-		-		-	
- Drain inlet	-		-		40	
- Drain junction	3		-		8	
- Drain gate	14		-		-	
7. Tertiary development						
- Rehab. existing tertiary canal	32.75 km		-		177.75 km (*)	
- New tertiary canal	-		90 km		n.a.	

Note : The above figures do not necessarily present the current status, since they are based on the 1999 design report. The correct figures upon the completion of construction works are being prepared by the project office and will be available soon.

(*) : Existing tertiary canal for the area of 17,560 ha, a part of which belongs to Bissua irrigation scheme

Source : Final Design Report on Detail Design and construction Supervision of Bili-Bili Irrigation Project, December 1999

4.3.5 Tertiary Development

Tertiary blocks, numbering some 426 in total, are developed in the Bili-Bili irrigation project. The average area of tertiary blocks in the whole system is 55.0 ha, ranging from 0.9 ha to 169.4 ha.

List and features of tertiary development

Irrigation scheme	No. of tertiary blocks	Irrigation area (ha)	Area of tertiary Block (ha)		
			Min.	Max.	Average
Bili-Bili	54	2,380.8	0.9	157.4	44.1
Bissua	165	10,572.7	4.5	169.4	64.1
Kampili	207	10,464.6	5.0	160.6	50.5
Total	426	23,414.1	0.9	169.4	55.0

Source: Bili-Bili Irrigation Project Office

4.3.6 Future Irrigation Development in Jeneberang River Basin

From 2000 to 2001, the Directorate-General of Water Resources (DGWR) of the Ministry of Settlement and Regional Infrastructure undertook a comprehensive water management study for

Maros-Jeneponto river basin with the financial assistance of JBIC[4]. This is the surrounding river basin of the Jeneberang river. The master plan report proposed an expansion of the irrigation area by about 2,550 ha, including sugarcane plantation of 2,100 ha, and also the supply of fresh water to Gumanti fish pond area (about 3,200 ha). However, the water resources so far developed specifically by the Bili-Bili dam do not meet the water demand. Therefore, a storage dam named "Jenelata Dam" was proposed on the Jenelata river about 5 km upstream from its confluence with the Jeneberang river. These development projects were planned for beyond 2010 for the Jenelata dam and 2015 for the irrigation facilities. It is noted that the report on the irrigation sector does not discuss the above future irrigation development. It focuses only on the on-going Bili-Bili irrigation project (23,660 ha), as the future plan has not yet been officially visualized.

4.4 Institutional Setting and Water Management of Bili-Bili Irrigation Project

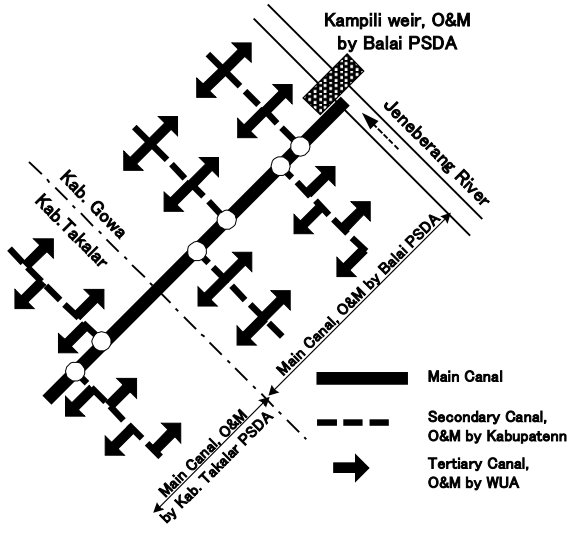
4.4.1 Organization for O&M of Bili-Bili irrigation project

(1) Government organization of O&M

The PIRASS (Proyek Irigasi dan Rawa Andalan Sulawesi Selatan) is responsible for operation and maintenance of all project facilities for a two-year period after the completion. The actual transfer to the local government of all irrigation facilities constructed and rehabilitated is expected to take place in 2006.

Beyond 2006 the Provincial governments, through the Balai PSDA in charge of the Jeneberang and surrounding basins, will be responsible for operation and maintenance of the two weirs at Bissua and Kampili. Both service the two Kabupatens of Gowa and Takalar. The Bili-Bili weir, servicing only Kabupaten Gowa, will be operated and maintained by the Gowa government. The primary and secondary canals covering the service areas over the two Districts (Kabupatens) are operated and maintained by the Balai PSDA and a Kabupaten government. The governments of Gowa and Takalar are responsible for operation and maintenance of primary and secondary irrigation canals that individually serve the

Mechanism of O&M framework



[4] Refer to "Final Report, Consulting Engineering Services for Comprehensive Water Management Plan Study for Maros-Jeneponto River Basin, November 2001, CTI Engineering Co., Ltd."

areas within a Kabupaten. The tertiary systems belong to WUAs, that are responsible for operation and maintenance of these facilities. The O&M mechanism discussed here is schematically explained for the case of Kampili irrigation scheme, as illustrated below.

The Kabupaten Gowa established Dinas PSDA. The Takalar reorganized the Public Works Office at Kabupaten level and established Sub-Dinas PSDA. Both the above PSDAs in Kabupatens are directly in charge of operation and maintenance of primary and secondary systems. The project consultant to the Bili-Bili irrigation project proposes, in its O&M manual, to strengthen the existing six Cabang (section) Dinas and to establish one new Cabang Dinas for the Bissua schemes. It also proposes to establish and strengthen 27 Juru (sub-section) under the Kabupatens' Dinas PSDA. The Juru is responsible for making decisions on O&M policies such as grouping or Golongan systems, irrigation water distribution schedules, and priorities in maintenance in primary and secondary systems. The proposed O&M organization for the primary and secondary systems is shown in Figure 4.4.

(2) Irrigation Committee

The irrigation committee has to play an important role in water management at the Kabupaten level. The Kabupaten Gowa established the irrigation committee in October 2003. Its decree stipulates that:

a. the purposes of the committee are to coordinate the policy in improving irrigation management in terms of irrigation water supply and WUA empowerment;
b. meetings are to be held periodically at least every three months; and
c. the committee is composed of twenty members including the Bupati and Kabupaten Secretary as advisors.

The irrigation committee is chaired by the Assistant Secretary for Development Administration. Its members are the representatives of PSDA as the committee's secretariat, BAPPEDA, Police, PDAM and other relevant Kabupaten governmental agencies. All chair-persons of GP3As, NGO and Hasanuddin University are also members of committees.

(3) Water Users Association (P3A)

The formation and re-formation of WUAs have been set out since 1998 when the detailed design of the Bili-Bili irrigation project commenced under the guidance of Dinas PSDA of the Province. By the end of 2003 some 307 WUAs, covering all irrigation systems, were formed on the basis of 426 tertiary blocks. The 307 WUAs form 28 federations of WUA (GP3A) along secondary canals, in principle. The distribution of WUAs and the WUA federation are summarized below:

Distribution and main features of WUAs and WUA federation

Irrigation scheme	No. of tertiary blocks	Irrigation area (ha)	Average area of tertiary block (ha)	No. of WUA	No. of WUA federation	No. of WUA member
Bili-Bili	54	2,380.8	44.1	20	4	n.a.
Bissua	165	10,572.7	64.1	126	11	n.a.
Kampili	207	10,464.6	50.5	161	13	n.a.
Total	426	23,414.1	55.0	307	28	n.a.

Source: Bili-Bili Irrigation Project Office

4.4.2 O&M Cost and Irrigation Service Fee (ISF)

(1) Present Financial Conditions

The fees for irrigation services paid by WUA members are composed of three charges: (i) charge for exploitation and maintenance funding (IPEP), (ii) charge for irrigation service (IPAIR), and (iii) membership fee of WUA. IPEP is a fixed rate amounting to Rp. 5,000/ha/crop. IPAIR is a flexible rate to be agreed between the respective Kabupaten government and irrigation system. Both IPEP and IPAIR are collected by WUAs themselves (actually collected by gate keeper/Mandor) and paid to the Kabupaten government as revenue. The irrigation service fee (ISF) is defined as a total amount of IPEP and IPAIR. The membership fee is collected within WUA for operation and maintenance of tertiary systems, and represents WUA's activity funding including fees for Mandor.

In 2002, the Kabupaten Gowa started to collect IPAIR at a rate of Rp. 50,000/ha/crop directly from farmers without going through WUA federations. This is WUA's strong complaint against the government.

The public expenditure for irrigation O&M are sourced from three funds: (i) central government budget (APBN), (ii) Kabupaten government budget (APBDI), and (iii) charge for irrigation service (IPAIR). The annual expenditure for irrigation O&M in the South Sulawesi Province for the eight year period from 1993 to 2000 was Rp. 32,170/ha. This ranged from Rp. 5.4 billion to Rp. 11 billion, or Rp. 18,000/ha to Rp. 33,000/ha.

(2) Update of Required O&M Cost

The O&M cost, as a basis for estimating ISF, is being updated by the Bili-Bili irrigation project office. The total annual O&M cost is preliminarily estimated at about Rp. 8.2 billion, covering (i) staff salaries; (ii) O&M offices running costs including power supply to weir intakes, equipment and transportation, office supply and communication; (iii) repair & maintenance and depreciation of O&M machinery; (iv) canal maintenance; (v) materials for canals and structures; and (vi) emergency allowance, as shown below.

Updated Annual O&M Cost of Bili-Bili Irrigation Project (Unit : Rp. Million)

Description	Intake	Primary and Secondary Canals	Total
1. O&M staff salary	365	3,598	3,963
1.1 PNS at Kec. level	13	939	952
1.2 PNS at Kab. level	111	880	991
1.1 Non-PNS	242	1,778	2,020
2. O&M office running cost	269	714	983
3. Repair & maintenance and depreciation of O&M machinery	193	1,732	1,925
4. Canal maintenance	0	769	769
5. Materials for canals and structures	36	319	355
6. Emergency allowance	20	180	200
Total (1) (including all PNS)	883	7,312	8,195
Total (2) (excluding PNS at Kab. level)	773	6,432	7,205
Total (3) (excluding all PNS)	760	5,492	6,252

Note: PNS : State Employee, Kab.: Kabupaten, Kec.: Kecamatan
Source: Bili-Bili Irrigation Project Office

From the above table, the amount of the ISF adopted for the Bili-Bili irrigation project would be Rp. 7,205 million for the command area of 23,660 ha, or Rp. 304,000/ha/year (equivalent to US$ 38/ha/year). This amount is based on deducting a salary for state employers at the Kabupaten levels, because they are not fully engaged in the O&M activities for the Bili-Bili irrigation project. Hence their salary would have to be funded through the government's recurrent budget.

(3) ISF and Financial Capacity of Irrigated Farmers

The Kabupaten Gowa has levied an ISF on irrigation beneficiaries amounting to Rp. 50,000/ha/crop. This ISF amount would be politically rated rather than through consideration of actual O&M cost, as estimated above. In the case of a 240% cropping intensity as envisaged in the project design, the annual ISF to be collected from the beneficiaries is simply rated at Rp. 120,000/ha/year. This corresponds to about 40% only of the assessed ISF rate of Rp. 304,000/ha/year. The study team acknowledged through the field reconnaissance that farmers are reluctant, in general, to pay such a high ISF rate of Rp. 50,000/ha/crop.

The farmers' economy has been preliminarily re-assessed based on current market prices of agro-products and inputs. The table below shows the results in comparison with those estimated in the detailed design of Bili-Bili irrigation project in 1999.

Re-assessment of net income per household Unit: Rp. 1,000/ha

Crop	Planned in 1999	Re-assessment	Balance / (%)
Dry paddy (100 %)	6,293	4,840	1,453 / (76.9 %)
Wet paddy (100 %)	5,693	4,340	1,353 / (76.2 %)
Palawija (40 %)	1,213	970	243 / (80.0 %)
Total	13,199 (US$ 1,833 equiv.)	10,150 (US$ 1,269 equiv.)	3,049 / (76.9 %) (US$ 564 equiv. / 69.2 %)

The re-assessment reveals that farmers' incomes have dropped sharply. The above farm incomes are based on assuming all agro-products are sold in markets and also family labor costs are not taken into account. The main reasons for a lowered income are, firstly, low market price for paddy, from Rp. 1,200/kg down to Rp. 1,000/kg[5] and, secondly, inflated labor costs that are as much as twice as high.

As mentioned above, the irrigation service fee was assessed at Rp. 304,000/ha/year. This covered O&M costs of intakes and primary and secondary canals. It corresponds to about 3% part of the re-assessed farm income. Thus the irrigated farmers are capable of bearing the full O&M costs required for the Bili-Bili irrigation project.

However, the dominant farmers in this area are small landholders with as little as 0.5 ha[6], or presumably irrigated fields of 0.3 ha on average, as seen in the short field reconnaissance by the study team. In the case of irrigated fields of 0.3 ha, a farmer's net income is roughly estimated at about Rp. 3.0 million, or US$ 380 equivalent per annum. With the assessed conditions that cropping intensity is 240% by mobilizing all the workable family members, other revenue opportunities such as brick production and part-time workers would be narrowed. It would be reasonably assumed, therefore, that prior to paying ISF farmers may tend to allocate the resources to food expenses, repayment of debt / interest for agro-inputs and/or family welfare, education expenses, religious activities, etc.

It is noted that the case above is for owner-farmers. The tenant farmers[7] with small land holdings face more serious conditions. ISF would be beyond tenant farmers unless it could be borne by the landowners.

In principle, ISF is an obligation of beneficiaries (farmers) of the irrigation system. However, under the recently legislated New Water Resources Law No.7/2004, it becomes the responsibility of the governments, apart from for the tertiary system. This issue is discussed in Section 4.6.2.

[5] Data of market prices of paddy and agro-inputs (fertilizers, etc.) are sourced from Agriculture, Food Crops and Horticulture Department in South Sulawesi Province. Paddy prices at farm gate further fall at harvesting seasons as low as Rp. 800/kg.

[6] The accurate distribution of landholding sizes in the Bili-Bili irrigation project area are not found at present. It is expected these will be identified in the process of ongoing tertiary development works.

[7] The distribution of land tenure conditions is not found at present in the Bili-Bili irrigation project area. This will be identified in the process of ongoing tertiary development works. An officer in Dinas Pertanian suggests that tenancy rate in the Province is as high as about 70 % of all farm households.

4.4.3 Operation and Maintenance of Irrigation Facilities

(1) O&M Guidelines and Manuals

An operation and maintenance manual for the Bili-Bili irrigation project is being drafted by the project consultant. The manual is exhaustive and covers all the components required for operating and maintaining each respective three irrigation scheme. However, it would be proposed to add the manuals and guidelines for the water users association (WUA) in a more elaborated manner. One would be a WUA strengthening module (for trainers use) and the other maintenance and rehabilitation guide for WUA member farmers.

(2) Head Discharge Measurement

The study team reviewed the measurement methods of head discharge at the intake gates of Bili-Bili, Bissua and Kampili diversion weirs in terms of its accuracy and maneuverability. As a result, it was concluded the Bili-Bili intake would not give gate operators any significant stress, however, both the intakes at Bissua and Kampili require careful gate operation for adequate discharge control. Devices to indicate intake discharge for gate control are desired at the gate decks.

4.5 Capacity Development in Irrigation

4.5.1 Present Conditions of Capacity Development

Various capacity development programs in the irrigation sector have been provided in the South Sulawesi Province, mainly with the assistance of international agencies and donor countries (World Bank, ADB, JICA, Netherlands, etc.). These programs cover both the government officials involved in irrigated agriculture and farmers as members of WUAs. The recent and on-going capacity development programs are: (i) ADB-funded farmer managed irrigation systems project (FMIS) for the period from 1997 to 2002; and (ii) World Bank/ Government of Netherlands funded water resources and irrigation reform implementation program (IWIRIP) that commenced in 2001. Both programs are briefly outlined below.

(1) Farmer-managed irrigation systems project (FMIS)

The ADB-funded farmer managed irrigation system project (FMIS) is a nationwide project, with the South Sulawesi Province being one of the target areas. FMIS adopted objectives of participatory planning and improvement of schemes, and included mobilizing farmer contributions of labor and materials towards the costs of improvement of village (non-publicly managed) irrigation schemes. Its specific components are: (i) rehabilitation and improving FMIS; (ii) strengthening Kabupaten and Kecamatan support services; (iii) strengthening WUA and local irrigation organization; and (v) project management support. The target FMISs in the South

Sulawesi Province were 149 schemes with a total area of 17,149 ha.

Along with project implementation, various materials and tools necessary for training of government officials and WUA members were developed. Intensive training programs were also provided. The training programs covered a wide range of subjects including project appraisal by government officials, project planning, design, construction, O&M, WUA strengthening and women group development. The participants to these training programs totaled about 5,000 in the South Sulawesi Province.

(2) Water resources and irrigation reform implementation program (IWIRIP)

IWIRIP consists of three components: (i) basin water resources management (BWRM); (ii) quality assurance; and (iii) irrigation management reform (PKPI). IWIRIP-PKPI covers thirteen provinces in Indonesia, including the South Sulawesi Province. This component includes support for legislation and institutional development, improvement of irrigation management and empowerment and institutional development of WUA federations. The program started in 1999 under the Java irrigation and water resources management project (JIWMP). In 2002, the irrigation reform activities were carried over to one of the components of IWIRIP funded by the Netherlands and supervised by the World Bank. The five principles adopted to the program include: (i) redefinition of tasks and responsibilities for irrigation management institutions; (ii) empowerment of WUA; (iii) irrigation management transfer (IMT); (iv) restructuring finances for irrigation management; and (v) sustainable utilization.

The South Sulawesi Province is one of the target areas, in which two Kabupatens, Pinrang and Gowa, were selected as PKPI activity areas. Six WUA federations (92 WUAs) with a total irrigation area of about 5,920 ha in the Kampili irrigation scheme in Kab. Gowa are the activities fields. At the provincial and Kabupaten levels, both the provincial and Kabupaten BAPPEDAs are responsible for IWIRIP-PKPI programs. The main activities have been concentrated in the training of government officials at all levels. The community organizers are assisting target WUAs in their institutional empowerment, however, the transfer of irrigation systems as intended in the IWIRIP is reported[8] to be still in a preparatory stage. This was identified in the field reconnaissance by the study team in Tanabangka village, which was involved in this program.

4.5.2 WUA Empowerment

(1) JICA's Technical Assistance for WUA Empowerment

With the launching of the water resources management reform policy in 1999 and the World Bank-assisted water resources sector adjustment loan (WATSAL), the Government undertook a study of WUA empowerment[9] in 2000/01. This was assisted by the Government of Japan through

[8] (1) Progress report for thirty second quarterly period April-June 2003, IWIRIP-PKPI, DHV, September 2003 / (2) Study team's interview in BAPPEDA, South Sulawesi Province

[9] The study for improvement of irrigation management and empowerment of water users' associations for enhancement of turnover program in the Republic of Indonesia, Main Report, November 2001, JICA

JICA (the WUA empowerment study). The WUA empowerment study aimed to formulate detailed action plans for the improvement of irrigation management and empowerment of WUAs for the management of the turnover program.

As a follow-up action of JICA's WUA empowerment study, coupled with the new Water Law, JICA started a three-year program of technical assistance in empowerment of WUAs in the South Sulawesi Province in April 2004. The target area is a group of five WUAs at Tanabangka village in the Kampili irrigation scheme. The technical assistance program aims at strengthening WUAs organization, achieving adequate water management, enhancing technical capacity for irrigation facility management, and improving farming systems. The assistance program is under preparation by the Benefit Management Department of Dinas PSDA, with the assistance of JICA.

(2) NGO's assistance in WUA empowerment

In 2003 there were 88 NGO groups formally registered in Kabupaten Gowa, which occupies the majority of the Bili-Bili irrigation project area. Most NGO activities involve village development or community empowerment. Of 88 NGOs, three groups are concentrated in irrigation development, namely: (i) **Yapsdamdes** (Yayasan Pengembangan Sumberdaya Masyarakat Desa), cooperating with the project consultant to the Bili-Bili irrigation project in reforming the organization of WUAs since 1998; (ii) **Lembaga Pelangi** (Lembaga Pengembangan dan pelayanan anak dan gizi), gaining the respect and trust of the community through a community development program at the farmer level since 1996; and (iii) **LSIC** (Lembaga studi Insan Cita), engaging in IWIRIP-PKPI in the South Sulawesi Province for institutional strengthening of WUA at federation level.

4.6 Irrigation Sector's Involvement in the Jeneberang River Basin Management

4.6.1 Demarcation of Irrigation Management

The Jeneberang Public Corporation (the Corporation) to be established will undertake comprehensive river basin management of the Jeneberang River. Taking the various factors, such as physical nature of facilities in connection with river control, relevant laws and regulations, and present functioning of organizations, into consideration, and through discussions with the various stakeholders in the course of the study, the irrigation management responsibility would be demarcated as follows:

(1) Three weirs with intake structures, Bili-Bili, Bissua and Kampili provided on the Jeneberang River are to be operated and maintained by the Corporation;

(2) All irrigation facilities below the above three intakes are to be operated and maintained by Balai PSDA at provincial level, Dinas PSDAs at Kabupaten level, Caban Dinas at Kecanatan level, and WUAs; and

(3) Balai PSDA is to be responsible for coordinating the water allocation at the intakes between

the three irrigation schemes of Bili-Bili, Bissua and Kampili, and the Corporation.

4.6.2 Financial Sharing to the Jeneberang River Basin Management

The irrigation sector is the largest water user, accounting for about 80% of total water demand (irrigation and municipal water without hydropower), from the Jeneberang river. This represents about 43% of average annual runoff (950 MCM) at the Bili-Bili dam site. Accordingly, the irrigation sector should bear an equitable portion of water resources O&M costs. There are two ways of interpreting this:

(1) Sharing of ISF to cover O&M cost of Irrigation Intake Facilities

Present Government Regulation No.77/2001 admits collecting ISF from irrigation beneficiaries (farmers) to cover irrigation O&M cost. This GR is, however, subject to revision because of introduction of new policy enacted by New Water Resource Law No. 7/2004 in March 2004. Nevertheless, this paragraph describes a case that the concept of ISF would continue to exist in the future.

As discussed above and based on the farmers' balance sheet, farmers appears to be capable of paying charges such as the Corporation may require in addition to, or within ISF. However, the dominant farmers are small landholders and their economic situation may not allow them to ensure their own livelihoods unless sufficient social and agricultural supporting services are provided. In principle, however, paying enough ISF to recover the costs for operation and maintenance of primary and secondary systems (including weirs and intakes) would be a prerequisite for realizing sustainable irrigation schemes.

The study team recommends that financial involvement of the irrigation sector in river basin management would be a matter of ISF sharing among the stakeholders, including WUA and such Public Corporations. In the light of operation and maintenance of weirs and intakes to be undertaken by the Corporation, the O&M costs for these facilities have to be paid to the Corporation. The O&M cost for weirs and intakes corresponds to about ten percent (10%). Consequently, it is recommended to share ten percent (10%) of the IFS actually collected with the Corporation. The governments must determine the adequate ISF rates in due consideration of socio-economic and current agricultural supporting conditions. They must also implement an extensive campaign to collect ISF in collaboration with WUAs and related stakeholders.

(2) Government Responsibility to Pay O&M Cost

Descriptions in (1) above were given on the basis of concepts set out in existing Government Regulation No.77/2001 on Irrigation. Recently, however, a revised concept of O&M of irrigation was introduced in the New Water Resources Law No.7/2004 that was enacted in March 2004.

The New Water Law sets forth the principles of irrigation O&M and water management fees as follows:

Article 64 (6):

Operation and maintenance of irrigation system shall be as follows:

a. the operation and maintenance of primary and secondary irrigation systems shall be under the authority and responsibility of the Government and the regional governments according to their authorities.

b. the operation and maintenance of tertiary irrigation systems shall be under the authority and responsibility of water users association.

Article 80 (1):

The users of water resources for basic daily needs and people's agriculture shall not be charged water management fees.

The elucidation (Para.I.12) states further detail:

- Due to the limited ability of the farmers using water, the use of water for people's agricultural activities is free from the obligation to pay the water resources management services, (but not eliminating the obligation to pay the costs for development, operation and maintenance of tertiary irrigation)

The above clearly prescribes the government obligation for the O&M of irrigation facilities, which appears to include the obligation for funding of O&M cost.

The concept set forth in New Water Law is quite different from the beneficiary-to-pay principle prescribed in the existing GR No.77/2001.

(3) Assumption in this Study

Considering the concepts in (1) and (2) above, this Study proposes the following principles may be set out:

(a) Irrigation O&M cost shall principally be paid by farmers (as beneficiary) based on beneficiary-to-pay principle.

(b) Due to the farmers' limited ability to pay, the government takes over from farmers the obligation of paying the O&M cost. This government obligation should also be applied to the O&M service cost incurred by the public corporation.

(c) The compensation to the corporation will be in the form of either subsidy or service fee under the concept of PSO (public service obligation)

O&M service fee to be paid by the government to the corporation shall include the O&M cost of irrigation weir and intake stated in (1) above and also the allocated portion of O&M cost of Bili-Bili dam/reservoir. This is discussed further in the succeeding Chapter 12.

4.6.3 Water Management by Accurate Discharge Measurement

The basis of proper water management both in the irrigation system and river control relies on accurate discharge measurement at the control points. To sustain mutual trust between the irrigation management sectors and the Corporation, discharge control at the three intakes is indispensable. The study team identified that supplemental devices with regulating rules would have to be provided at the respective three intakes to enable the Corporation to undertake accountable water delivery.

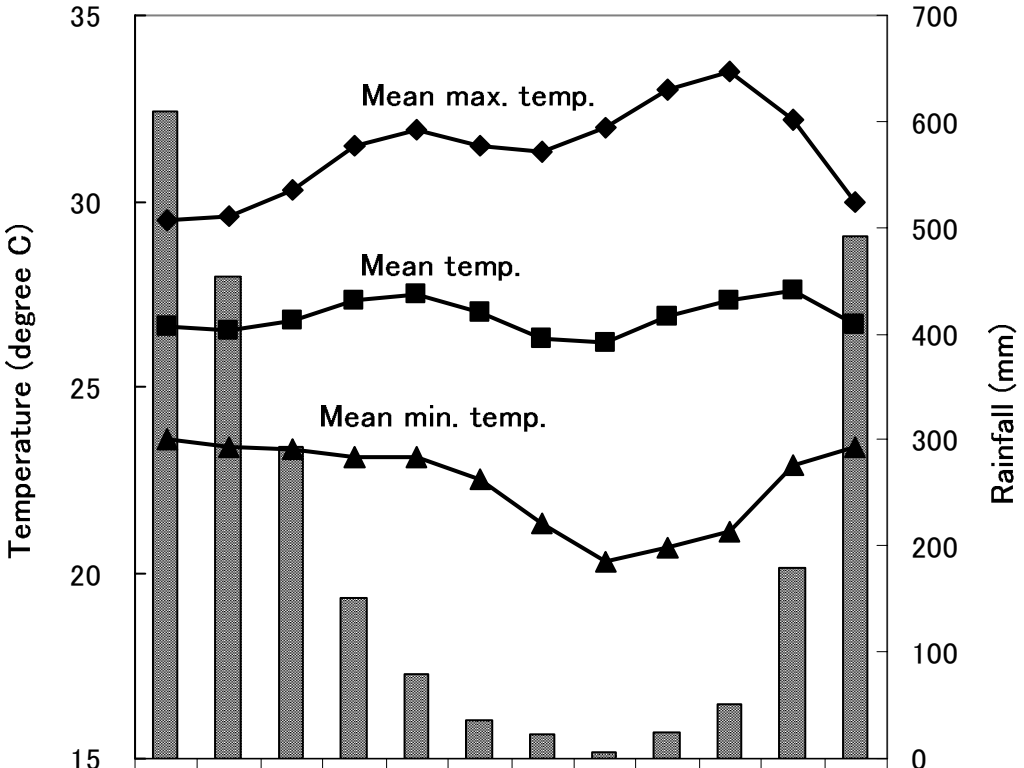
4.6.4 Drought Management

The water balance simulation for the 26-year period from 1972 to 1997 suggests that almost a full double-cropping of paddy was ensured for all except two years. On the other hand, palawija crops at a proposed cropping intensity of 40% suffer greater effects from drought than do paddies. When water shortage takes place or is foreseen, irrigation supply will be required to be reduced in accordance with an operational regulation of the Bili-Bili reservoir, with a priority being placed on water supply for domestic use. The reduced quantity and its duration will be agreed between the Balai PSDA and the Corporation. The following drought management would have to be undertaken:

(1) A comparable reduction of irrigation water supply is adopted over the irrigable area, in principle;

(2) The quantity and schedule of reduced water supply are decided on the basis of actual crop planting area, crops growing stages, and types of crops with drought tolerance, in consultation with the irrigation committees; and

(3) The Corporation assists Balai PSDA and Kabupaten Dinas PSDA in conducting a water-saving campaign.



	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Rainfall (mm)	610	454	294	152	79	36	22	6	24	52	179	492
Mean temp. (degC)	26.6	26.5	26.8	27.3	27.5	27.0	26.3	26.2	26.9	27.3	27.6	26.7
Mean. max. temp.(degC)	29.5	29.6	30.3	31.5	31.9	31.5	31.3	32.0	33.0	33.5	32.2	30.0
Mean min. temp.(degC)	23.6	23.4	23.3	23.1	23.1	22.5	21.3	20.3	20.7	21.1	22.9	23.4

Group	Cropping Pattern
Group – A	Wet Paddy / Dry Paddy / Palawija
Group – B	Wet Paddy / Dry Paddy / Palawija
Group – C	Wet Paddy / Dry Paddy / Palawija

Figure 4.1 Proposed Cropping Pattern

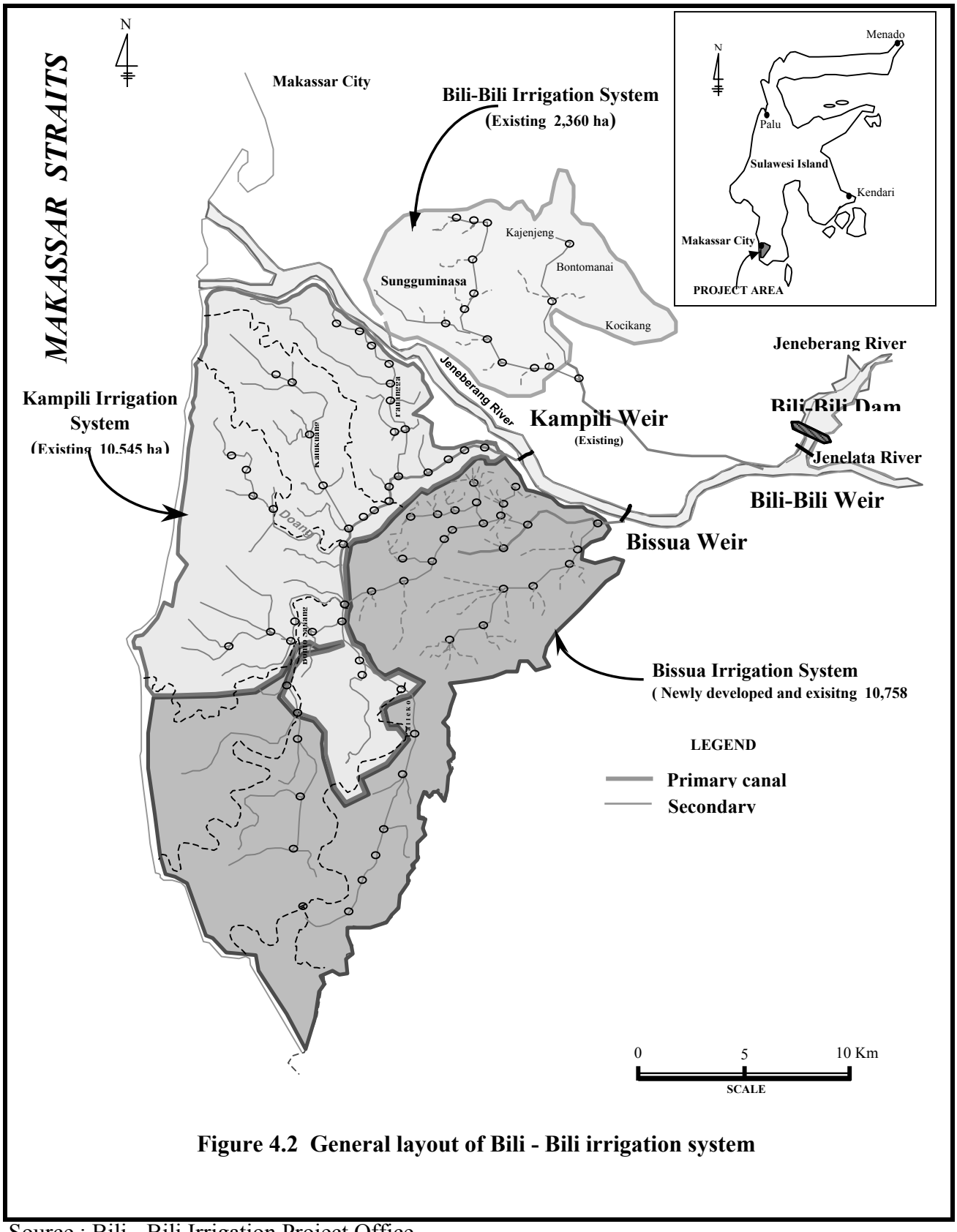


Figure 4.2 General layout of Bili - Bili irrigation system

Source : Bili - Bili Irrigation Project Office

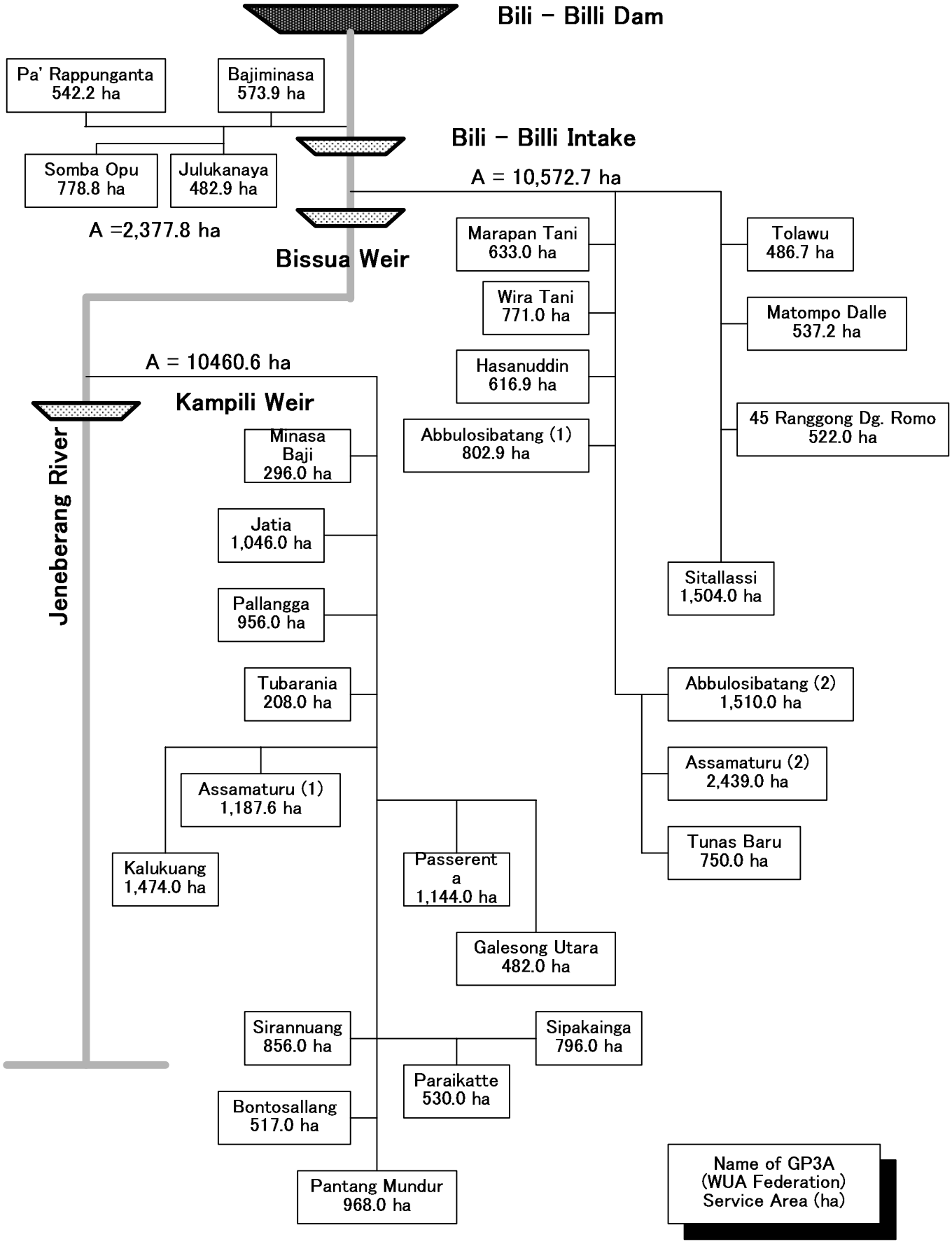
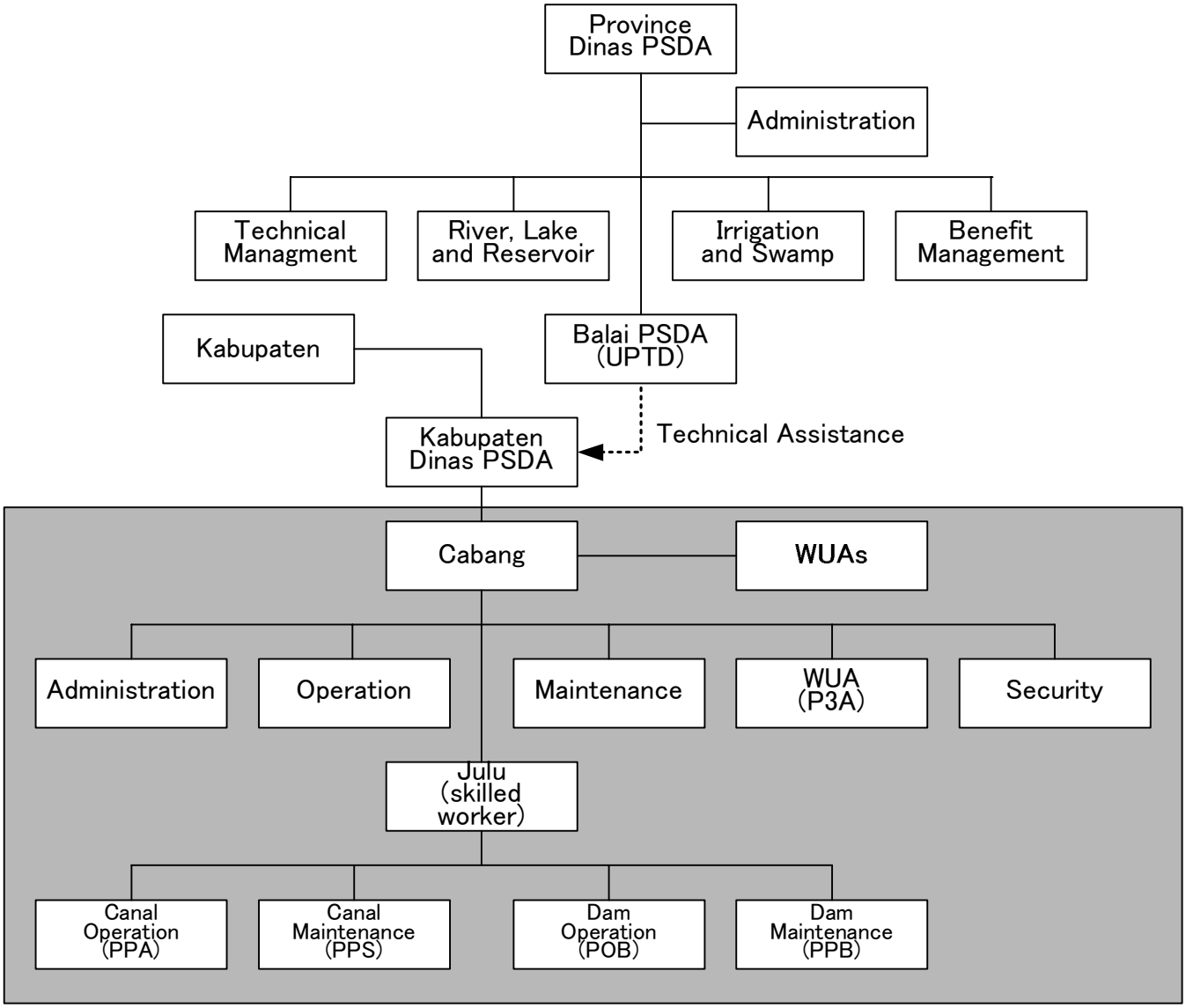


Figure 4.3 Diagram of irrigation and water users association federation (GP3A)



List of Cabang and Julu Offices

No.	Cabang	Irrigation area (ha)	Nos. of Julu	Staff and worker number		Remarks
1.	Pallangga	2,952.86	4	Head of Cabang	1	Existing
				Sub-Cabang	8	
				Julu skilled worker	4	
				PPA	22	
				PPS	14	
				POB	3	
				PPB	3	
				Total	55	
2.	Bajeng	2,641.80	4	Head of Cabang	1	Existing
				Sub-Cabang	7	
				Julu skilled worker	4	
				PPA	19	
				PPS	9	
				Total	40	
3.	Bontonompo	3,766.55	4	Head of Cabang	1	Existing
				Sub-Cabang	6	
				Julu skilled worker	4	
				PPA	11	
				PPS	10	
				Total	32	
4.	Barombong	2,043.86	3	Head of Cabang	1	Existing
				Sub-Cabang	5	
				Julu skilled worker	3	
				PPA	7	
				PPS	7	
				Total	23	
5.	Takalar	n.a.	4	Head of Cabang	n.a.	Existing
				Sub-Cabang	n.a.	
				Julu skilled worker	n.a.	
				PPA	n.a.	
				PPS	n.a.	
				POB	n.a.	
				Total	n.a.	
6.	Bontomarannu	2,357.30	4	Head of Cabang	1	Existing
				Sub-Cabang	5	
				Julu skilled worker	4	
				PPA	19	
				PPS	9	
				POB	5	
				PPB	8	
				Total	51	
7.	Bissua	3,845.44	4	Head of Cabang	1	To be
				Sub-Cabang	5	formed
				Julu skilled worker	4	newly
				PPA	15	
				PPS	15	
				POB	3	
				PPB	2	
				Total	45	

Source : Operation and Maintenance Manual (2nd draft), Detail Design and construction Supervision of Bili – Bili Irrigation Project, November 2003

Figure 4.4
Proposed organization for O&M of primary and secondary systems

CHAPTER 5

WATER SUPPLY DEVELOPMENT IN THE BASIN

5.1 Present Water Use of the Jeneberang River

At present, the following utilities are taking water from the Jeneberang River for the purpose of municipal and industrial water supply under the approval of the Dinas PSDA:

1) PDAM Makassar
2) PDAM Gowa
3) Sugar factory in Takalar Regency (PT. Perkebunan Nusantara IV (Persero))

Of the above utilities, the largest water user of the Jeneberang River is the PDAM Makassar, which is serving the water supply for most parts of Makassar City. Of the total clean water production capacity of 2,340 liter/sec for existing water treatment plants owned by PDAM Makassar, the annual water abstraction from the Jeneberang River is around 1,250 liter/sec, or about 53 % of the total.

The water supply for the service area of PDAM Gowa is wholly dependent on the water resources of the Jeneberang River basin.

It was earlier noted that abstraction from the Jeneberang River occurs at the nearby location of Bissua weir. This supplies industrial water to two (2) factories, a paper factory in Gowa Regency and sugar factory in Takalar Regency. However, it was found that the former factory had been abolished about 7 years ago and that at present only the sugar factory in Takalar Regency is in operation. The person in charge of the sugar factory informed the Study Team that it is allowed to pump up to 500 liter/sec from the Jeneberang River for use in processing in the factory as well as for irrigating the fields in the plantation.

In addition to the aforesaid municipal uses of the Jeneberang River water, the JRBDP releases water of the Long Storage to the Jongaya canal in Makassar City in the dry season in order to dilute polluted canal water and flush pollutants within when bad smells spread along the canal. This is despite the water not being categorized as being for municipal water use.

The present water use of the Jeneberang River is schematically shown in Figure 5.1.

5.2 Present Condition of Water Supply in Service Area of PDAM Makassar

5.2.1 Present Condition of Service Area of PDAM Makassar

According to the company profile of the PDAM Makassar (2003), 55.2 % of households in the service area are covered by the water supply system. The water production and number of consumers in the service area are shown in the following table:

Water production and No. of Registered Consumers in Service Area of PDAM Makassar for Recent Five (5) years

Year	Total Production Output at 5 Water Treatment Plants (liter/sec)	No. of Registered Consumers
1999	1,287.3	83,882
2000	1,234.5	91,016
2001	2,040.4	101,015
2002	2,045.4	116,870
2003	2,355.6	N.A.

Source: Informasi PDAM Kota Makassar

On the other hand, the Ministry of Health surveyed the population covered by each source of piped water from PDAM Makassar, groundwater from shallow wells, etc. in 2003 as shown in Table 5.1. As seen in the Table, it is estimated that the population covered by piped water of PDAM Makassar would be slightly less than 50 %. Thus, many people in the service area of PDAM Makassar still rely on groundwater from shallow wells.

In the Water Supply Master Plan for PDAM Makassar (September 2000), the per capita water consumption was tentatively estimated at 133 liter/person. But the report states that the value is still inaccurate and it is too hard to estimate with any accuracy for the following particular reasons specific to the service area:

i) The survey conducted in Kacamatan Makassar and Mariso shows that almost all legal consumers of the PDAM Makassar service area supply or sell their piped water to another 1.3 households (neighbors) in Kecamatan Makassar and 1.6 in Kecamatan Mariso.

ii) The sold water volume is not too large (usually 10 liter per capita per day) because most neighbors take clean water of PDAM only for drinking and cooking and use groundwater from shallow wells for other purposes.

5.2.2 Existing Water Supply System

At present, water to supply Makassar City is taken from the two (2) rivers, the Jeneberang River and Maros River. The Panaikang water treatment plant (WTP), with a treatment capacity of 1,000 liter/sec and whose water source is the Lekopancing weir on the Maros River, had been a sole bulk supplier of the treated water for Makassar City until the 1st Stage of Somba Opu WTP (with a capacity of 1,000 liter/sec) commenced operations in 2001.

At present, the PDAM Makassar has the following five (5) WTPs for water supply to its own service area in Makassar City:

List of Existing Water Treatment Plants and Their Capacities

No.	Name of Existing Water Treatment Plant (WTP)	Water Source	Capacity of Water Treatment Plant (liter/sec)	Starting Year of Operation
1	Ratulangi	Jeneberang River	50	1924
2	Panaikang	Maros River	1,000	1977
3	Antang	Maros River	90	1985, 1992, 2003
4.	Maccini Sombala	Jeneberang River	200	1994
5.	Somba Opu (1st Stage)	Jeneberang River (Bili-Bili Dam)	1,000	2001
	Total		2,340	

The service area covered by each of the above five (5) water treatment plants (WTPs) is shown in Figure 5.2. According to the "Informasi PDAM Kota Makassar, Bulan September, Tahun 2003", the actual output of each WTP in 2003 is as follows:

Actual Water Production Output of Each WTP in 2003

No.	Name of Existing Water Treatment Plant (WTP)	Capacity of Water Treatment Plant (liter/sec)	Actual Output in Year 2003 (liter/sec)	
			In December	Yearly
1	Ratulangi	50	65.89	62.4
2	Panaikang	1,000	1,078.28	983.2
3	Antang	90	36.8	31.3
4.	Maccini Sombala	200	91.81	87.5
5.	Somba Opu	1,000	1,191.5	1,191.5

As shown in the above table, the Panaikang WTP and Somba Opu WTP are operated in excess of their nominal capacities to meet the increasing water demands in Makassar City. The approximate alignment of existing and planned main distribution pipelines in the service area of PDAM Makassar is shown in Figure 5.3.

5.2.3 Present Issues of Water Supply in Service Area of PDAM Makassar

While the water supply system in Makassar City is well operated as a whole, the PDAM Makassar now faces the following issues:

(1) Issues Related to Panaikang WTP and Development Plan for Makassar City Water supply

With regard to the Panaikang WTP, which is one of the main WTPs to produce clean water for Makassar City, some issues have been highlighted. These are: i) sedimentation at Lekopancing weir site on the Maros River, and ii) insufficient water quantity/quality in the dry season. To solve these issues, some measures have been suggested in the past studies. One of these is to construct a new pipeline instead of the existing canal connecting the Lekopancing weir and Panaikang WTP, since inflow of pollutants from the built-up areas along the canal is the major cause of degradation of water quality.

PDAM Makassar is pumping up and conveying raw water from the lower Jeneberang to the Panaikang WTP in order to supplement raw water for the dry season. To solve the water quality issue, on the other hand, the 2003 Word Bank study suggests conveying clean water from the Bili-Bili Dam to the Panaikang WTP. To realize the plan, a new pipeline needs to be provided to connect the WTP and the raw water transmission main (RWTM) for Somba Opu WTP from Bili-Bili Dam. As pointed out by the World Bank study, a social environmental study will be required to be carried out, since it will have to pass through the built-up area in Makassar City.

Expansion plans of the existing plants for the Panaikang WTP are also suggested by PDAM and the previous study. These would affect the expansion plan of the Somba Opu WTP, in case the raw water for Panaikang WTP is wholly conveyed from Bili-Bili Dam in the future. It is advisable that a master plan study on the future Makassar City water supply be carried out to determine the most appropriate plan for expanding either or both the Panaikang WTP and Somba Opu WTP, as well as to clarify the future water demands for the piped water and exploitable groundwater resources in the service area.

(2) High Unaccounted-for-water Ratio

It is reported by the PDAM Makassar that the unaccounted-for-water ratio in its service area is very high at about 51 %. According to information from the PDAM Makassar, the unaccounted-for-water is composed mainly of the following elements:

- Illegal connection,
- Fire fighting,
- Social use,
- Meter inaccuracy,
- Error in meter reading, and
- Physical loss including water leakage in water transmission/distribution pipes

Although it is considered that the commercial loss such as error in metering and illegal pipe connections accounts for a higher portion of unaccounted-for-water, the composition of the commercial loss and physical loss (leakage in transmission/distribution pipes) has not yet been clarified. On the other hand, previous studies projected that the unaccounted-for-water ratio will be decreased to 25 % to 30 %. As a matter of course, it is essential to reduce the unaccounted-for-water ratio to improve the financial status of PDAM Makassar. To achieve this, as a first step it is advisable to carry out water leakage tests to find those areas in Makassar City where high water leakage takes place. In parallel, it is required to repair or replace inaccurate meters and improve the tariff collection system through training of concerned staff in order to reduce the commercial loss.

(3) Increase in Water Tariff

In the service area of PDAM Makassar, the water tariff system is set up by dividing the consumers into 17 categories. For every consumer category, the water rate is determined for each of four (4)

ranges of total monthly water consumption volume, namely: i) less than 10m^3, ii) 10-20 m^3, iii) 20-50 m^3, and iv) over 50 m^3. A higher water rate is then charged with increases in water consumption volume. The characteristics of the water tariff system in the service area of PDAM Makassar are that higher water rates are applied to the industrial categories and large-scale water consumers of some household categories. In particular, the water tariff rate for industrial use is ranked as the highest of the rates in such major cities in Indonesia as Jakarta, Surabaya, and Medan.

People in Makassar City, especially those of the low income class, usually use piped water only for drinking and cooking purposes. Groundwater in shallow wells is used for other purposes including bathing and washing, even though the water quality is low. As of May 2004, on the other hand, the PDAM Makassar intends to raise the water tariff and the bill intended for this has passed the provincial parliament. There is a fear that the rise of water tariff will make people reluctant to utilize the clean water to the same extent as before. Since the clean water is the basic human need (BHN), the water tariff should be maintained as long as possible at an adequate level within a range of affordability to pay for the people.

After the commencement of the corporation's operation, PDAM shall pay a raw water fee to the corporation. It would be a matter of discussion among the stakeholders as to whether the equivalent cost can be absorbed by PDAMs or otherwise charged to consumers in the form of raising the tariff.

(4) Constraint of Water Demand and Water Supply Capacity

In 2003, the total production output of water in the five (5) existing WTPs in Makassar City reached about 2,356 liter/sec, which is greater than the total water production capacity of 2,340 liter/sec. This means that some of the existing WTPs, especially Panaikang and Somba Opu WTPs, were operated in excess of their nominal capacities in order to meet the increasing water demand in the service area of the PDAM Makassar.

The aforesaid present situation in Makassar City implies that the mean daily water demand has already exceeded the total water production capacity. In general, on the other hand WTPs need to be newly installed to meet the maximum daily demand. Thus, the balance of water demand and water supply capacity is already greatly strained, requiring installation of new WTPs at an early stage to cope with the increasing water demands.

5.3 Present Condition of Water Supply in Service Area of PDAM Gowa

5.3.1 Present Situation of Service Area of PDAM Gowa

The service area of the PDAM Gowa covers the area along the right and left banks of the Jeneberang River and other isolated areas in Malino and Bajeng. At present, the total number of

pipe connections in the service area numbers about 8,300 as shown in the following table:

No. of House Connections to Water Supply System of PDAM Gowa

No.	Sub-Area Served	Number of Households Served
1.	Area along lower reach of the Jeneberang River	7,131
2	Malino	760
3	Bajeng	277
4	Borong Loe	107
Total		8,275

Source: PDAM Gowa Office

According to the chief of PDAM Gowa, at present there are about 5,000 applicants for the pipe connection in the service area; the total number of pipe connections was estimated to have reached about 10,000 at the end of 2004.

5.3.2 Existing Water Supply System

There are five (5) water treatment plants that are being operated by PDAM Gowa for water supply to its service area, and their total capacity is some 290 liter/sec, as shown in the following table:

List of Existing Water Treatment Plants Operated by PDAM Gowa

No.	Name of Existing Water Treatment Plant (WTP)	Water Source	Capacity of Water Production (liter/sec)
1	Bajeng WTP	Jeneberang River	20
2	Borong Loe WTP	Raw water trans. main *1	20
3	Malino WTP	Spring*2	10
4.	Unit Tompo Balang	Jeneberang River	40
5.	Unit Pandang-Pandang	Jeneberang River	200
Total			290

Note: *1 Original source of water for RWTM is Jeneberang River at Bili-Bili dam

*2 The water source of the Malino WTP is spring water in upper reach of the Jeneberang River. Hence, no chemicals are used for water treatment.

The water production records of the above five (5) WTPs are shown in Table 5.2.

Out of the total water treatment capacity of 290 liter/sec, water production is usually based on a total capacity of about 190 liter/sec because of troubles with pumping facilities. The exception is the Bajeng WTP, which was constructed with the financial assistance of JICA. Those pumps require repairs very frequently. For this reason, about 50% of households in the service area are not adequately supplied with piped water.

5.3.3 Present Issues and Problems on Water Supply to Service Area of PDAM Gowa

The present issues and problems for water supply in the service area of PDAM Gowa, which are based on discussions with the staff of the PDAM Gowa office, are itemized as follows:

1) Shortage of budget for regular maintenance works

- Although water leakage is taking place in the water distribution tower completed recently, the PDAM Gowa office has no budget to repair it.
- Existing pumps at the intake sites are out of order very frequently. While it takes 1 to 2 months to repair the pumps, they are damaged within 1 to 2 weeks after repairs. It is better to procure new pumps rather than undertake repairs, but PDAM Gowa office lacks cash to purchase them.

2) Non-revenue water

- While the yearly revenue of PDAM Gowa office is about Rp. 500 million, a yearly water tariff equivalent to a total of about Rp. 200 million could not be collected from the consumers.
- However, the PDAM Gowa office could not strongly request the payment because of the low water quality and frequent interruption of water supply attributed to pump damage and failure of other equipment and facilities.

3) Low water quality

- The raw water taken from the lower Jeneberang River deteriorates during the dry season, exhibiting high BOD values. Usually, PDAM Gowa makes good attempts to remove bacteria contained in the raw water, but doesn't perform other treatments to a sufficient level.
- The PDAM Gowa is willing to get more raw water from Bili-Bili Dam, which has a far superior water quality to that of the lower Jeneberang River. (condition before land collapse at Mt. Bawakaraeng)

4) Securing fund to expand distribution pipeline

- In the past, the distribution pipes were installed with the financial assistance of the Government of Japan. There are other areas that need to be supplied with piped water. Accordingly, the PDAM Gowa office is willing to install new pipelines in those areas with funding from donor countries.

5.4 Municipal Water Demand Projection

5.4.1 Necessity of Implementation of Master Plan Study for Makassar City Water Supply Development Plan

In Makassar City, the number of households served by the PDAM supply system is still limited to about 50 % of the total population. The remaining 50 % of households rely on private wells and

public faucets. The service coverage ratios in the surrounding regencies such as Gowa, Maros and Takalar are much smaller as compared with that in Makassar City, while an independent regional PDAM operates the water supply system for each of those regencies.

Even in the Makassar City area, a lot of people use the piped water only for dinking, while they use groundwater from shallow wells for other uses such as washing and bathing. Moreover, it is confirmed through the interviews with the citizens of Makassar City that they are willing to utilize groundwater for their entire domestic use for economic reasons, provided water quality is acceptable.

The same tendency on preference of groundwater is indicated by business owners in the KIMA industrial estate located in the northern part of Makassar City.

Concerning groundwater use, however, it appears that the groundwater quality in Makassar City is deteriorating due to poor wastewater management. To make it possible to accurately project future water demand for the piped water, it is essential to clarify the availability of groundwater in Makassar City from both quantitative and qualitative viewpoints. For the purpose of clarifying the groundwater availability, it is recommended to carry out a master plan study including water demand projection based on the exploitable groundwater resources, as well as the formulation of a future water supply plan for Makassar City and its surroundings.

5.4.2 Municipal Water Demand Projection in Previous Studies

The water demand projection for Makassar City was carried out in the course of the following five (5) previous studies:

i) Master Plan and Feasibility Study on Water Supply Development Project in 1985 under JICA (the 1985 JICA study)

ii) Comprehensive Water Management Plan Study for Maros-Jeneponto River Basin in 2001 under JBIC (the 2001 JBIC study)

iii) Study on Indonesian Urban Water Resources Improvement Project in July 2003 (the 2003 World Bank study)

iv) Water Supply Master Plan for PDAM Makassar (Rencana Induk Penyediaan Air Bershi PDAM Makassar) in September 2000

v) Study on Water Supply Improvement Service in 2003

Of the above five (5) studies, the 1985 JICA study was performed about 20 years ago and the projection covers only up to 2005. Hence, the projection results are used in this Study only for reference. Figure 5.3 shows the results of the water demand projections in each of the remaining four (4) studies. With regard to v) above, the JICA Study Team revised the water demands projected in the previous study applying the same basic conditions as those therein where appropriate as discussed in the following Subsection 5.4.4.

5.4.3 Comparison of Municipal Water Demand Projected in 2001 JBIC Study and 2003 World Bank Study

The water demands in the service area of PDAM Makassar, which were projected in the 2001 JBIC study and 2003 World Bank study, are shown in Tables 5.3 and 5.4, respectively. Based on a review of the previous water demand projections, the methodologies and procedures in these two (2) previous studies are assessed to be comparatively consistent. Nonetheless there is a large difference between the projected water demands in the service area of PDAM Makassar in both studies, especially for those in 2020. The unaccounted-for-water ratio of approximately 30 % in the former study does not, however, differ significantly from 25 % in the latter study.

The per capita water consumption of 200 liter/day in 2020 that is adopted in the former study is considered adequate and not overestimated. In addition, it assumes the water demand would be satisfied with surface water in the event of further deterioration in groundwater quality in the service area in the future.

It appears the projection in the latter study is made on a premise that a considerable portion of water supply will continue to rely on groundwater resources. It also appears that the plan places a focus on the improvement of PDAM's cashflow by means of minimizing investments and maximizing revenues.

As emphasized in the foregoing Subsection 5.4.1, it is essential to clarify the exploitable groundwater resources in the service area in order to accurately estimate water demand for piped water.

5.4.4 Water Demand Projection Adopted

In this Study, an attempt was made to project the water demands for the service area of PDAM Makassar by applying appropriate basic conditions defined in the study on Water Supply Improvement Service by PDAM Makassar in 2003. In the projection, the basic conditions applied to the latest water demand forecast for Surabaya City[/1] carried out in October 2002, were also taken into consideration as reference information. The basic conditions applied to the water demand projection are summarized below:

i) Population increase: 2.5 % per annum until 2020

ii) Service coverage

- Domestic water; 56.3 % in 2002 to 81 % in 2020
- Social water; constant at 9 % between 2003 and 2020

iii) Per capita daily water consumption

/1 : Additional Engineering Services on Review of water Resources Development Study for Water Supply in Brantas River Basin, Component Study (2A), Volume 4-Appendices to master Plan and Feasibility Study for Karang Pilang III & IV Projects, October 2002.

- Domestic water; 144 liter/day in 2002 to 172 liter/day in 2020
- Social water; it will increase gradually from 30 liter/day in 2002 to 40 liter/day in 2020

iv) Industrial water demand

- The present demand of 35 liter/sec will increase to 57 liter/sec in 2005 as projected in "F/S and D/D for Utilization of Additional Production Capacity of Ujung Pandang Water Supply Development Project (Stage I), September 1999".
- After 2006, the industrial demand is projected to increase at an annual average growth rate of 4.9 %, which corresponds to that of GRDP in Makassar City between 1998 and 2001.

v) Unaccounted-for-water ratio

- It is projected to reduce from 51 % in 2002 to 30 % in 2009 and thence to be constant at 30 % until 2020.

The water demands in the service area of PDAM Makassar, which are estimated based on the basic conditions mentioned above, are tabulated in Table 5.5.

According to the aforesaid latest study for Surabaya City, the average per capita water consumption for domestic water in Surabaya City is derived to be 178 liter/day. Hence, the projected unit water consumption of 172 liter/capita/day for the year 2020 is judged to be in a conservative range.

With regard to the unaccounted-for-water (UFW), the previously mentioned study for Surabaya City contemplates a reduction in the UFW ratio in Surabaya City from the present 41 % to 30 % in 2025 in two stages, namely the stage 1 program and stage 2 program spanning between 2003 and 2008 and between 2009 and 2025, respectively. As seen in the programs proposed for Surabaya City, the reduction of unaccounted-for-water requires elaborate and time-consuming works. Comparing with the plan in Surabaya, an assumption in the current demand projection for Makassar (reduction of UFW down to 30 % until 2009) contains an uncertainty whether it could be actually accomplished. The measures shall commence as early as possible.

As a result of the water demand projection carried out in this Study, the water demand in the service area of PDAM Makassar in 2020 is estimated at 4,404 liter/sec as shown in Table 5.5. The adopted water demand in 2020 is about 15 % smaller than those estimated in the two (2) previous studies, the 2001 JBIC study and Water Supply Master Plan for PDAM Makassar (September 2000). Thus, the water demand projection adopted in this Study is in a conservative range.

5.5 Operation and Maintenance (O&M) for Water Supply Facilities

5.5.1 Existing O&M Manual for Raw Water Transmission Main (RWTM) from Bili-Bili Dam

The Raw Water Transmission Main (RWTM) is operated and maintained in accordance with the manual prepared by the Jeneberang River Basin Development Project Office (JRBDP). The main contents thereof translated into English are shown in Table 5.6. According to the concerned staff of JRBDP, the equipment of RWTM is properly operated and maintained using the O&M manual; the only problem on O&M is an insufficient budget for repairs. For O&M of RWTM, an annual budget of 35 million Rupiah was allocated to the JRBDP after its completion in August 1999. According to O&M staff, however, the annual budget is required to be increased to 50 million Rupiah to enable a satisfactory O&M work for RWTM.

5.5.2 Matters to be Incorporated in O&M Manual for RWTM

According to the O&M staff of JRBDP, the following activities are usually undertaken as part of ordinary O&M activities for RWTM:

- Greasing of machines and equipment every 2 to 3 months
- Painting of the same 3 to 4 times per year

However, the O&M manual shown in Table 5.6 doesn't state the above maintenance works. It was also observed during the site inspection that sufficient greasing and painting have not been done, probably due to shortage of budget. It is advisable that the O&M manual includes the following:

i) Instruction manuals of machines/equipment prepared by the manufacturers

ii) Ordinary maintenance work; required frequency of inspections of machines/equipment in valve chambers and greasing/painting of machines/equipment, and other necessary ordinary activities

iii) Maintenance work in emergency; procedures/methods, tools, power supply required for urgent tentative repair works

5.5.3 Matters to be Considered in Preparing O&M Manual for Flushing/Diluting Water to Jongaya Drainage Canal

The JICA Study Team could not find the specific O&M manual for releasing flushing/diluting water from Long Storage to the existing Jongaya Drainage Canal in Makassar City. In the dry season, the Jeneberang mainstream water shall flow into Jongaya Drainage Canal based on the definite operation rule for gates on drains/channels. It is recommended that an O&M manual be prepared, which specifies periods and frequencies of gate operations in accordance with the extent of pollution in the Jongaya Drainage Canal.

5.6 Recommendations on Management of Water Use of the Jeneberang River

5.6.1 Quantitative Management of Water Taken from the Jeneberang River

Except for the Raw Water Transmission Main (RWTM) connecting the Bili-Bili intake structure and Somba Opu WTP on which flow meters are installed, at present, no apparatus to measure the water taken from the Jeneberang River are installed at the other intake sites. In order to maintain satisfactory financial management of the corporation, the quantity of water taken from the Jeneberang River must be measured and water tariffs billed to each utility based on the measured water quantity.

Furthermore, extraction of water by PDAMs shall accompany the water permits authorized by Dinas PSDA, and also water use rights after its legislation.

a) Existing Water Conveyance Pipelines Operated by PDAMs and Sugar Factory

For the other PDAM's water conveyance pipelines, which are owned and operated by PDAM and sugar factory in Takalar, the Jeneberang River water is being pumped up from the Jeneberang River to convey it to each WTP. Although the treated water quantity is being measured in each WTP, it does not accurately represent the raw water quantity taken from the Jeneberang River as it doesn't include losses of water in the pipeline and WTP. For these water conveyance pipelines, it is conceivable to measure the water quantity based on the following procedures and methods:

i) To establish a system to record the pumping operation data as so calculate the water quantities on an hourly basis,

ii) To install a flow meter on the pipeline to continuously measure discharge inside, and

iii) To install a broad weir on the channel connected to the pipeline, where possible, so as to measure the water level, which could then be converted into discharge.

In case of iii) above, it would be difficult to accurately measure the raw water quantity, since the measured discharge at the broad weir doesn't include water loss in the pipeline. Ideally, the most preferable option is to adopt method ii) above in order to accurately quantity of raw water fed from the Jeneberang river. In such a case, however, the corporation might have to bear the entire cost for construction of a flow meter chamber and procurement and installation of flow meter, which is estimated to be much higher than costs associated with the other two (2) methods.

It is recommended that the most suitable method for each water conveyance pipeline be selected after confirming the applicability of the above three (3) methods through coordination with the concerned office of PDAM and/or sugar factory offices, and taking into account budgets of the corporation.

b) Water Release to Jongaya Drainage Canal

The Jeneberang River Basin Development Project Office (JRBDP) is presently responsible for management of the Jongaya Drainage Canal in the lowest reach of the Jeneberang River, which is one of the principal drainage channels for the Makassar City area. Its secondary drainage canals are managed by Cipta Karya of Makassar City. Figure 5.6 shows the drainage canals in the lower Jeneberang River. It is proposed that the management of Jongaya Drainage Canal be transferred from JRBDP to the Cipta Karya under Makassar City at the time of establishing the corporation, since it exclusively contributes to improving the environments of the city.

During the dry season from June to September when bad odors spread along the Jongaya Drainage Canal due to pollution of the canal water, the JRBDP is obliged to release flow from the Jeneberang mainstream to the Jongaya Drainage Canal for two weeks a month, for instance in the 1st and 3rd weeks of each month. During the week, the control gates on respective reaches are operated in accordance with the gate operation rules so as to dilute the polluted water in the Jongaya Drainage Canal.

To estimate the water requirement to improve the aggravated environmental condition of the Jongaya Drainage Canal, it is advisable to monitor the water quality of the Jongaya Drainage Canal and seashore zone. Based on this the quantity of water to be released from the Jeneberang mainstream could be determined. It is foreseen that the required quantity of water to be released would increase with the future population increase, unless a sewerage system is introduced in Makassar City. One of the ways to accurately estimate the required quantity of water to be released is to observe the water levels of the lower Jeneberang and Jongaya Drainage Canal with automatic water level recorders (AWLR) or, alternatively, manual staff gages.

5.6.2 Management of Water Quality of the Jeneberang River

The Jeneberang River is a bulk water source of drinking water for people living in areas extending along the river, which include Makassar City and Gowa District. To ensure the supply of safe drinking water to consumers, the corporation will be obliged to monitor the raw water quality of the Jeneberang River and take necessary measures to improve the water quality if it deteriorates.

As far as the water quality analyses of the Jeneberang River conducted so far are concerned, the items of water quality that particularly need to be monitored include biological oxygen demand (BOD) as well as turbidity.

(a) Biological oxygen demand (BOD)

During the dry season, the BOD value becomes very high in the lower reach on which water intake facilities of PDAM Makassar and Gowa are located. Some water samples taken in the lower reach during the dry season show the values far exceed the allowable limits of raw water. The water quality condition will be worsened with a population increase. The water quality both in the lower reach and upstream of the Bili-Bili Reservoir needs to be monitored and publicly notified to people. This could be through the installation of placards and/or via media, indicating

if it is or is not harmful to human health to use or enter the water.

(b) Turbidity

After the large-scale landslide in the uppermost mountainous area of the Jeneberang River basin occurred at the end of March 2004, a huge volume of sediment has flowed into the Bili-Bili Reservoir. Since then, a highly turbid flow containing large quantities of sediments has been released from the Bili-Bili Reservoir and conveyed to the Somba Opu WTP. This has necessitated larger quantities of chemicals to treat the high turbidity of raw water from the Jeneberang River; these are reported to be some 4 to 5 times the requirements under the usual water quality conditions for raw water from the Bili-Bili Dam (condition in May 2004). This situation has taken place not only in the Somba Opu WTP, but also in other WTPs along the downstream reach of the Jeneberang River. Eventually, the high turbidity flow has resulted in much higher water production cost and higher loss of raw water at those WTPs.

A proposed water quality monitoring program is presented in Chapter 8.

Table 5.1 Population by Water Source in Makassar City in 2003

No.	Kecamatan	Population	Total Population by Water Supply System							
			Served by PDAM's Piped Water		Private Shallow Well (Groundwater)				Others (PAH and PMA)	
					Withdrawal by Pump		Withdrawal by mannual			
		(Persons)	(Persons)	(%)	(Persons)	(%)	(Persons)	(%)	(Persons)	(%)
1	Biringkanaya	100,018	5,075	5.1	15,187	15.2	30,372	30.4	49,384	49.4
2	Bontoala	59,549	47,460	79.7	2,313	3.9	4,624	7.8	5,152	8.7
3	Makassar	84,103	26,875	32.0	17,387	20.7	8,694	10.3	31,147	37.0
4	Mamajang	61,284	27,555	45.0	12,757	20.8	6,379	10.4	14,593	23.8
5	Manggalla	60,118	15,693	26.1	15,471	25.7	7,736	12.9	21,218	35.3
6	Mariso	53,283	29,453	55.3	9,648	18.1	4,825	9.1	9,357	17.6
7	Panakkukang	129,652	87,916	67.8	27,194	21.0	13,598	10.5	944	0.7
8	Rappocini	120,856	48,217	39.9	24,816	20.5	12,408	10.3	35,415	29.3
9	Tallo	120,786	68,280	56.5	15,498	12.8	30,994	25.7	6,014	5.0
10	Tamalanrea	52,150	2,173	4.2	6,204	11.9	2,408	4.6	41,365	79.3
11	Tamalate	51,415	22,926	44.6	12,357	24.0	6,179	12.0	9,953	19.4
12	Ujung Pandang	34,460	32,329	93.8	1,386	4.0	693	2.0	52	0.2
13	Ujung Tanah	46,130	21,501	46.6	4,930	10.7	9,858	21.4	9,841	21.3
14	Wajo	57,189	40,902	71.5	10,683	18.7	5,341	9.3	263	0.5
Total		1,030,993	476,355	46.2	175,831	17.1	144,109	14.0	234,698	22.8

Note

PAH: Penauspungan Air Hujan (Storage of rainwater at each household)

PMA: Penauspungan Mafe Air (Storage of water other sources than rainwater at each household)

Data Source: Provincial Office of the Ministry of Health

Table 5.2 Annual Water Production of Each WTP in PDAM Gowa in 2003

1) In Year 2002

(unit: m^3)

Month	Water Tretment Plant in PDAM Gowa				
	Tompo Balang	Pandang-Pandang	Malino	Limbung	Bolongloe
Jan.	18,388	161,984	9,311	110	0
Feb.	21,931	165,079	10,366	1,047	0
Mar.	23,494	0	9,480	960	0
Apr.	23,382	0	9,061	1,190	0
May	25,563	0	9,249	240	0
Jun.	26,434	0	9,123	1,861	0
Jul.	24,970	0	11,343	2,058	0
Aug.	28,261	0	11,965	3,964	0
Sep.	21,253	144,405	9,916	5,034	2,160
Oct.	21,787	188,197	10,831	5,415	2,273
Nov.	32,076	136,275	12,187	4,446	2,405
Dec.	30,516	123,262	11,558	5,423	3,878
Yearly	298,055	919,202	124,390	31,748	10,716
Total	1,384,111				

Data Source: PDAM Gowa

2) In Year 2003

(unit: m^3)

Month	Water Tretment Plant in PDAM Gowa				
	Tompo Balang	Pandang-Pandang	Malino	Limbung	Bolongloe
Jan.	25,920	165,881	15,304	N.A.	0
Feb.	24,192	167,050	13,045	N.A.	0
Mar.	25,056	0	12,682	N.A.	0
Apr.	25,920	0	10,561	N.A.	0
May	26,784	0	13,224	N.A.	0
Jun.	55,620	0	17,185	N.A.	0
Jul.	34,452	0	17,497	N.A.	0
Aug.	45,072	0	16,246	N.A.	0
Sep.	35,820	192,540	17,637	N.A.	2,160
Oct.	22,572	250,930	16,279	N.A.	2,603
Nov.	39,204	181,700	16,263	N.A.	2,600
Dec.	34,236	164,350	15,264	N.A.	6,358
Yearly	394,848	1,122,450	181,187	-	13,721

Data Source: PDAM Gowa

Table 5.3 Water Demand Projection by the 2001 JBIC Study

1) Domestic Water Demand

Year	Item	Makassar	Gowa	Maros	Takalar
2000	Households Connected	72,970	2,315	2,861	919
	Persons per Household	5.10	4.78	4.71	4.80
	Persons in Connected Households	372,100	11,100	13,500	4,400
	Liters Per Capita Consumption (liter/day)	120	86	96	42
	Domestic Water (liter/sec)	517	11	15	2
	Demand (MCM/year)	16.30	0.35	0.47	0.07
2010	Households Connected	188,017	38,095	14,734	12,244
	Persons per Household	4.75	4.45	4.38	4.46
	Persons in Connected Households	893,100	169,500	64,500	54,600
	Liters Per Capita Consumption (liter/day)	160	118	123	96
	Domestic Water (liter/sec)	1,654	231	92	61
	Demand (MCM/year)	52.16	7.30	2.9	1.91
2020	Households Connected	303,064	73,874	26,607	23,568
	Persons per Household	4.42	4.14	4.08	4.15
	Persons in Connected Households	1,339,500	305,800	108,600	97,800
	Liters Per Capita Consumption (liter/day)	200	150	150	150
	Domestic Water (liter/sec)	3,101	531	189	170
	Demand (MCM/year)	97.78	16.74	5.95	5.35

2) Total Water Demand

Year	Demand Item	Makassar	Gowa	Maros	Takalar
2000	(1) Household Use	16.24	0.35	0.47	0.07
	(2) Commercial/Public Service Use	6.72	0.71	0.47	0.32
	(3) Industrial Use	1.59	0.16	0.03	0.06
	(4) Sub-total of Water Demand	24.55	1.22	0.97	0.45
	(5) Conveyance Loss (Recorded Rate of Loss*[1])	23.59 (49%)	2.72 (69%)	0.86 (47%)	0.21 (32%)
	(6) Total	48.14	3.94	1.83	0.66
2010	(1) Household Use	52.16	7.3	2.9	1.91
	(2) Commercial/Public Service Use	10.3	0.88	0.58	0.39
	(3) Industrial Use	2.5	0.24	0.04	0.09
	(4) Sub-total of Water Demand	64.96	8.42	3.52	2.39
	(5) Conveyance Loss I *[1]	21.65	2.81	1.17	0.8
	(6) Conveyance Loss II *[2]	4.56	0.59	0.25	0.17
	(7) Total	91.17	11.82	4.94	3.35
2020	(1) Household Use	97.78	16.74	5.95	5.35
	(2) Commercial/Public Service Use	15.78	1.09	0.72	0.47
	(3) Industrial Use	3.92	0.38	0.06	0.14
	(4) Sub-total of Water Demand	117.48	18.21	6.73	5.96
	(5) Conveyance Loss I *[1]	39.16	6.07	2.24	1.99
	(6) Conveyance Loss II *[2]	8.24	1.28	0.47	0.42
	(7) Total	164.88	25.56	9.45	8.36

Notes *1: Conveyance loss recorded by PDAM in 1999/2000 (refer to Table A.4.1.11)

*2: Conveyance Loss 1: Projected Conveyance loss of 25% from water treatment plant to individual users (= (4) x (1//0.75-1)

*3: Conveyance Loss II: Projected Conveyance of 5% from individual users to water treatment plant (={(4)+(5)}x(1//0.95-1)

Data Source: Consulting Engineering Services for Comprehensive Water Management Plan Study for maros-Jeneponto River Basin, Final Report, November 2001

Table 5.4 Water Demands and Water Supply Development Plan by the 2003 World Bank Study

1) Assumption and Criteria for Planning Purposes

Items	Unit	Year				
		2002	2005	2010	2015	2020
I. Service Coverage						
- Total urban population	(Persons)	1,130,000	1,224,024	1,398,434	1,597,696	1,825,351
- Growth rate	(%)		2.7	2.7	2.7	2.7
- No. of people per connection	(Nos.)		7.6	7.6	7.6	7.6
- Additional new connection during year*	(Nos.)		7,000	5,000	5,000	6,000
- Total connections at end of year	(Nos.)	108,833	133,000	178,000	203,000	233,000
- Population served at end of year	(Persons)	827,131	1,010,800	1,352,800	1,542,800	1,770,800
- Population coverage	(%)	73	83	97	97	97
II. Water Production						
- UFW at end of year	(%)	51	40	25	25	25
- Average consumption	(m^3/conn/month)	25	25	25	25	25
- Average demand	(liter/sec)		1,232	1,670	1,907	2,188
- Required production rate	(liter/sec)		2,053	2,226	2,543	2,917
- Production capacity	(liter/sec)		2,290	2,840	2,840	2,840
- WTP upgrades	(liter/sec)		550*			

Notes
1. Assumed only half of the new connections in year 2004 are found under the proposed project.
2. *; Expansition plan of existing WTPs
- Antang WTP : 50 L/scc in Dec. 2006
- Panaikang WTP: 500 L/sec in Dec. 2008
Total : 550 L/sec

Source: Indonesian Urban Water Services Improvement Project by the World Bank, project Concept Report, July 2003

2) Implementation Schedule

	Total	Cash Projection (Rp million)					
		Year 1 2004	Year 2 2005	Year 3 2006	Year 4 2007	Year 5 2008	Year 6 2009
a) Engineering Consultants	1,600	1,200	400				
・ Review master plan	4,050		2,000	1,300	250	250	250
・ Detailed design and constrcution supervision							
b) Head works							
・ Connect Panaikang WTP to transmission from Bili Bili	33,000			11,000	22,000		
・ Add 50 L/S to Antang WTP	3,500			3,500			
・ Add 500 L/S to Panaikang WTP	35,000			10,000	15,000	10,000	
c) Head works							
・ Distribution system expansion	22,400			5,600	5,600	5,600	5,600
・ New house connections*	24,250	750	3,500	5,000	5,000	5,000	5,000
・ UFW reduction program	19,500	2,000	3,500	3,500	3,500	3,500	3,500
Annual Total	143,300	3,950	9,400	39,900	51,350	24,350	14,350

Note: Assumed only half of the new connections in year 2004 are found under the proposed project.
Source: Indonesian Urban Water Services Improvement Project, project Concept Report, July 2003

Table 5.5 Water Demands projected in This Study

Basic Conditions and Assumptions for Water Demand Projection

1) Number of people per household extension	6 (Persons)
2) Number of people per social extension	100 (Persons)
3) Average water consumption per extension	26-31 (m3/month)
4) Average water consumption for social	30 (liter/capital/day)
5) Annual population increase rate	2.5 (%)

Range of Unit Water Consumption

26 (m3/month)	=144 (liter/capita/day)
31 (m3/month)	=172 (liter/capita/day)

Water Demand Projection

Item		2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Population	person	1,148,312	1,177,020	1,206,445	1,236,606	1,267,522	1,299,210	1,331,690	1,364,982	1,399,107	1,434,084	1,469,936	1,506,685	1,544,352	1,582,961	1,622,535	1,663,098	1,704,676	1,747,293	1,790,975
Service Coverrage																				
- Domestic Service	%	56.3	56.6	58.7	60.7	62.7	64.8	66.8	68.8	70.9	72.9	74.9	77.0	79.0	81.0	81.0	81.0	81.0	81.0	81.0
- Social Service	%	8.7	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
Total service coverage	%	65.0	65.6	67.7	69.7	71.7	73.8	75.8	77.8	79.9	81.9	83.9	86.0	88.0	90.0	90.0	90.0	90.0	90.0	90.0
Served Population																				
- Population with domestic connection	person	647,034	666,600	707,796	750,635	795,174	841,471	889,585	939,579	991,517	1,045,465	1,101,490	1,159,664	1,220,057	1,282,745	1,314,253	1,347,110	1,380,787	1,415,307	1,450,690
- Population with social connection	person	99,400	105,932	108,580	111,295	114,077	116,929	119,852	122,848	125,920	129,068	132,294	135,602	138,992	142,466	146,028	149,679	153,421	157,256	161,188
Total Served population	person	746,434	772,532	816,376	861,930	909,251	958,400	1,009,437	1,062,428	1,117,437	1,174,533	1,233,785	1,295,265	1,359,049	1,425,212	1,460,281	1,496,788	1,534,208	1,572,563	1,611,877
Number of Pipe Connections																				
- Number of Domestic Extension	nos.	107,839	111,100	117,966	125,106	132,529	140,245	148,264	156,597	165,253	174,244	183,582	193,277	203,343	213,791	219,042	224,518	230,131	235,884	241,782
	nos.	994	1,059	1,086	1,113	1,141	1,169	1,199	1,228	1,259	1,291	1,323	1,356	1,390	1,425	1,460	1,497	1,534	1,573	1,612
Total Number of Connections	nos.	108,833	112,159	119,052	126,219	133,670	141,414	149,463	157,825	166,512	175,535	184,905	194,633	204,733	215,216	220,502	226,015	231,665	237,457	243,393
Annual Increase in Number of Connectio	nos.		3,326	6,892	7,167	7,451	7,745	8,048	8,362	8,687	9,023	9,370	9,729	10,099	10,483	5,287	5,513	5,650	5,792	5,936
Water Demand Projection																				
- Unit water consumption for domestic water	m^3/mon./ connect.	26.0	26.3	26.5	26.8	27.0	27.3	27.6	27.8	28.1	28.4	28.7	29.0	29.2	29.5	29.8	30.1	30.4	30.7	31.0
- Unit water consumption for social water	liter/mon. /person	30.0	30.5	31.0	31.5	32.0	32.5	33.0	33.5	34.1	34.6	35.2	35.8	36.3	36.9	37.5	38.1	38.7	39.4	40.0
Water Consumption by sector																				
i) Domestic water consumption	liter/sec	1,082	1,125	1,207	1,292	1,382	1,477	1,577	1,682	1,792	1,909	2,031	2,159	2,293	2,435	2,519	2,608	2,699	2,794	2,892
ii) Sosial water consumption	liter/sec	35	37	39	41	42	44	46	48	50	52	54	56	58	61	63	66	69	72	75
iii) Industrial demand	liter/sec	35	42	50	57	60	63	66	69	72	76	80	84	88	92	96	101	106	111	117
Total Water Consumption	liter/sec	1,151	1,205	1,296	1,390	1,484	1,584	1,689	1,799	1,915	2,036	2,164	2,298	2,440	2,588	2,679	2,775	2,874	2,977	3,083
Average Daily Demand																				
- Unaccounted-for Water (UFW)	%	51	49	46	41	38	35	32	30	30	30	30	30	30	30	30	30	30	30	30
- Average daily demand	liter/sec	**2,349**	**2,362**	**2,399**	**2,356**	**2,394**	**2,437**	**2,483**	**2,570**	**2,735**	**2,909**	**3,092**	**3,284**	**3,485**	**3,697**	**3,827**	**3,964**	**4,106**	**4,252**	**4,404**
Maximum Daily Demand																				
- Peak factor (Ratio of average daily dem to maximum daily demand)	-	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15
- Maximum daily demand	liter/sec	2,702	2,717	2,759	2,709	2,753	2,802	2,856	2,955	3,145	3,345	3,555	3,776	4,008	4,251	4,402	4,559	4,722	4,890	5,065
- Production capacity	liter/sec	2,290	2,290	2,340	2,340	2,340	2,890	2,890	2,890	2,890	2,890	2,890	2,890	2,890	3,440	3,440	3,440	3,440	3,440	3,440
(Capacity to be added)	(liter/sec)		(50)			(550)								(550)						

Table 5.6 Existing Operation and Maintenance Manual for Raw Water Transmission Main (RWTM) for Somba Opu WTP (1/2)

I. Operation Manual for Gate/Valve
1) Before operating the gates, make it sure that all gates of air valves are fully opened.
2) Intake gate shall be slowly opened till the gate is fully opened, while butterfly gate at Flow Meter No.1 is still closed.
3) Butterfly gate with diameter of 1.20m at Flow Meter No.1 shall be slowly opened by opening time of 1 minute per 1^{o}, and shall be opened to 90^{o}, and backed it up by sluice gate with diameter of 0.40 m, and at Blow-off No.1 the gate shall be suitably opened so that water in discharge facility No.1 does not overflow, while butterfly gate with diameter of 1.65 m at Blow-off No.1 is still closed. Sluice gate with diameter of 0.60 m shall be closed; sluice gate with diameter of 15 m shall be suitably opened according to the natural silk requirement.
4) Butterfly gate with diameter of 1.65 m at Flow Meter No.1 shall be slowly opened after water from Discharge Facility No.1 is smoothly and steadily out-flowed, and then similar to the opening method of Flow Meter No.1, Blow-off No.2 shall be suitably opened so that water in the channel does not overflow, while butterfly gate with diameter of 1.65 m at Blow-off No.2 is still closed.
5) Butterfly gate with diameter of 1.65 m at Blow-off No.2 shall be slowly opened after water from Discharge Facility No.2 is smoothly and steadily out-flowed, and then similar to the opening method of Flow Meter No.1, Blow-off No.3 shall be suitably opened so that water in the channel does not overflow, while butterfly gate with diameter of 1.50 m at Blow-off No.3 is still closed.
6) Butterfly gate with diameter of 1.50 m at Blow-off No.3 shall be slowly opened after water from Discharge Facility No.3 is smoothly and steadily out-flowed, and then similar to the opening method of Flow Meter No.1, Blow-off No.4 shall be suitably opened so that water in the channel does not overflow, while butterfly gate with diameter of 1.50 m at Blow-off No.4 is still closed.
7) Butterfly gate with diameter of 1.50 m at Blow-off No.4 shall be slowly opened after water from Discharge Facility No.4 is smoothly and steadily out-flowed, and then similar to the opening method of Flow Meter No.1, Blow-off No.5 shall be suitably opened so that water in the channel does not overflow, while butterfly gate with diameter of 1.50m at Blow-off No.5 is still closed.
8) Butterfly gate with diameter of 1.50m at Blow-off No.5 shall be slowly opened after water from Discharge Facility No.5 is smoothly and steadily out-flowed, and then similar to the opening method of Flow Meter No.1, but using sluice gate with diameter of 0.50m, at Flow Meter No. 2 shall be suitably opened so that water in flushing channel does not overflow, and butterfly gate with diameter of 1.00 m at downstream venturi at Flow Meter No.2 shall be closed, while butterfly gate with diameter of 1.00 m at upstream venturi shall have to be opened previously.
9) Butterfly gate with diameter of 0.60m at Flow Meter No.2 shall be closed, while sluice gate with diameter of 0.15m at Flow Meter No.2 shall be suitably opened according to the BLPP requirement.
10) Butterfly gate with diameter of 1.00m at downstream venturi shall be opened when WTP Batangkaluku or Somba Opu is ready to operate.
11) All air valve gates shall be closed back and its main hole shall be securely locked.

Table 5.6 Existing Operation and Maintenance Manual for Raw Water Transmission Main (RWTM) for Somba Opu WTP (2/2)

II. Manual for Security and Maintenance of Gates/Valves
1) Strict security shall be applied to the operated gates to prevent unauthorized operation.
2) During operating time of Jeneberang Raw Water Transmission Main Pipe, authorized personnel shall be dispatched to inspect any possible leakage and immediately close the butterfly gate at Blow-off chamber where there are leakages in its downstream.
3) If leakage occurs when the upper stream butterfly gate is already closed, repair shall be done immediately.
4) Operation of butterfly gate at the Blow-off shall be restored when repair is completed as conducted in the above step 2.

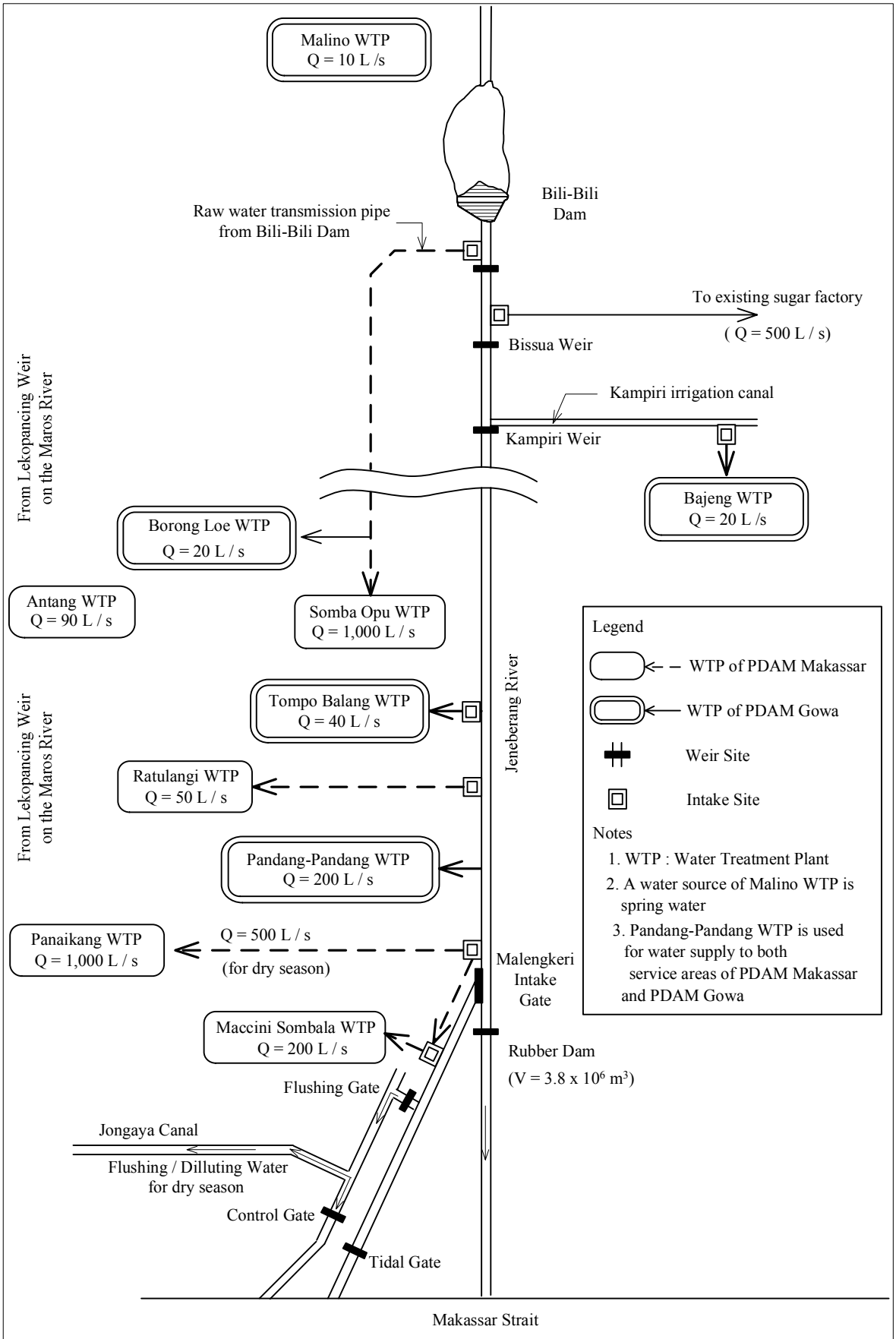


Figure 5.1 Schematic Map on Water Use of the Jeneberang River for Municipal Water Supply

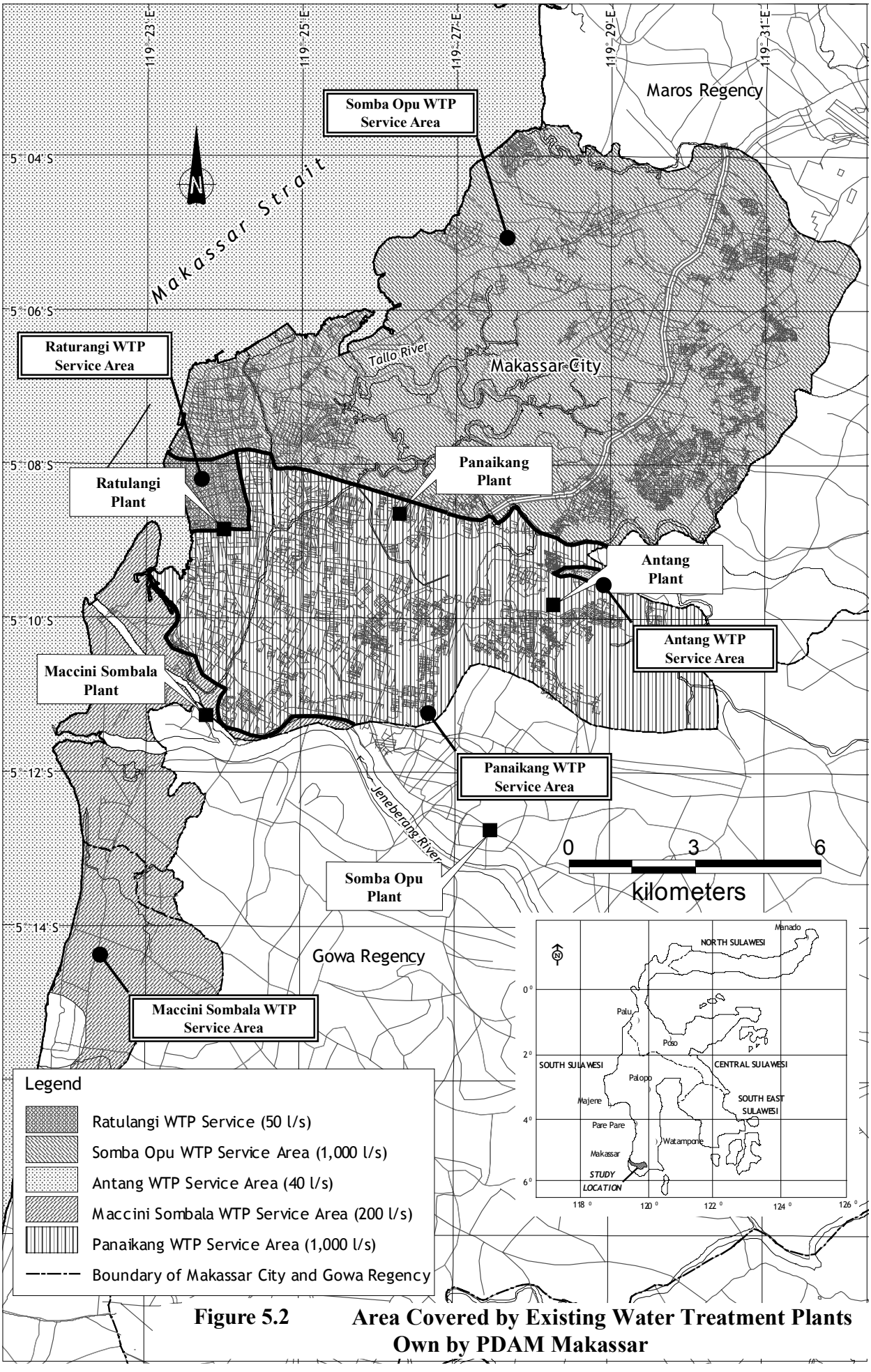


Figure 5.2 Area Covered by Existing Water Treatment Plants Own by PDAM Makassar

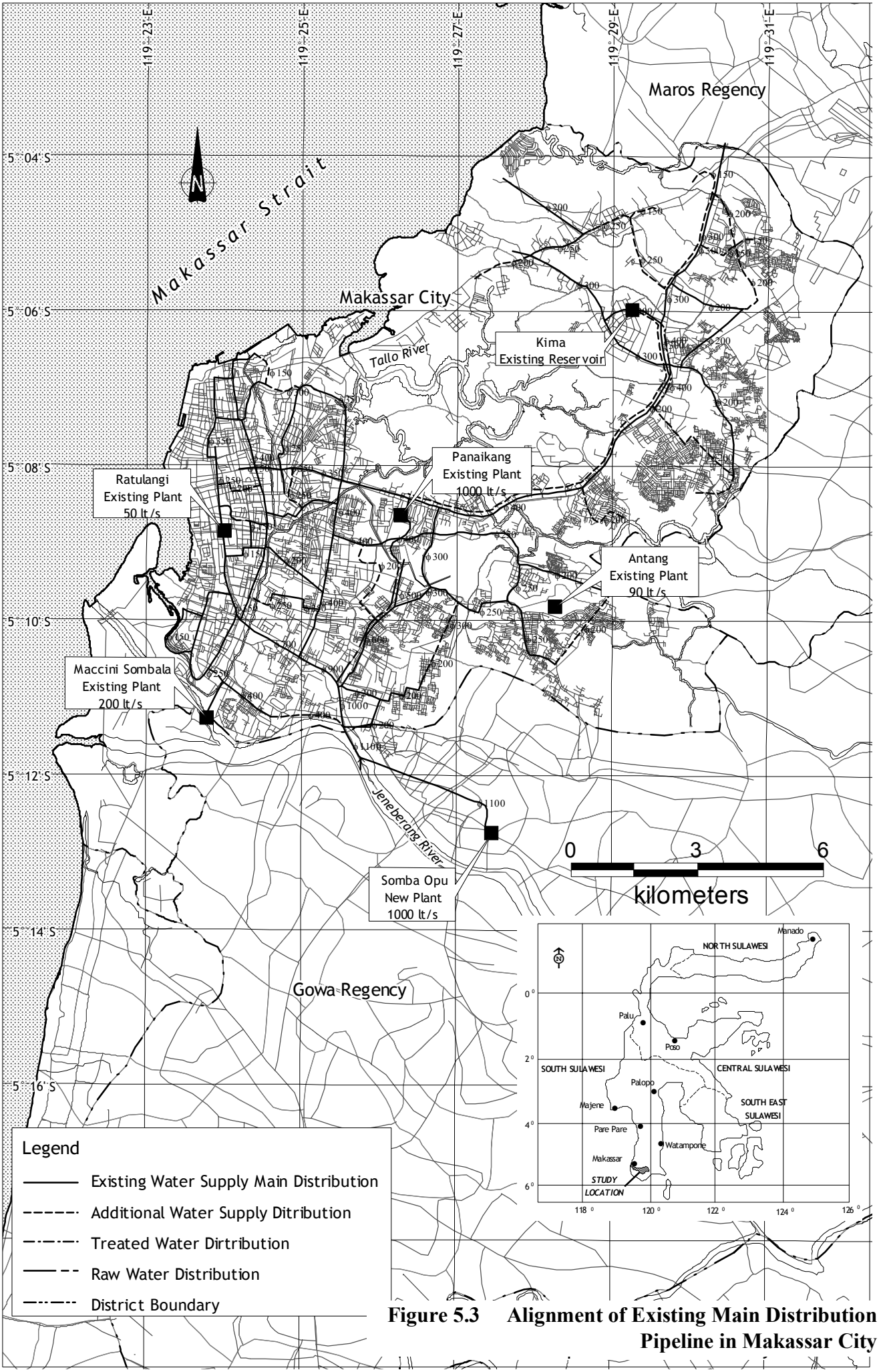


Figure 5.3 Alignment of Existing Main Distribution Pipeline in Makassar City

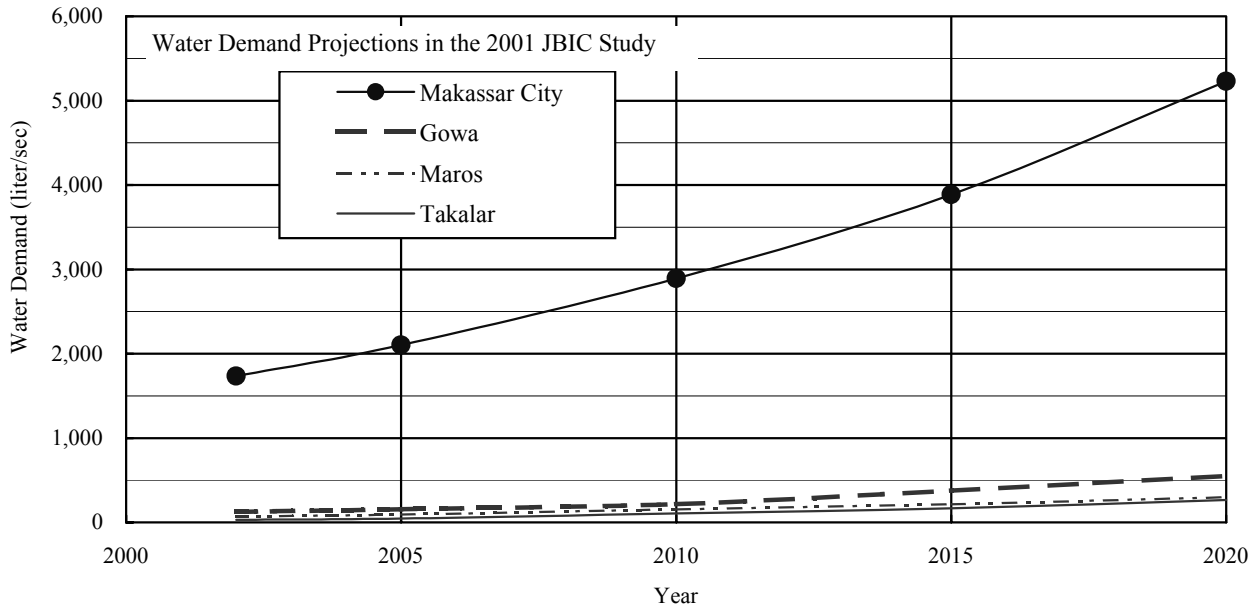


Figure 5.4 Water Demand for Each Region, Projected in the 2001 JBIC Study

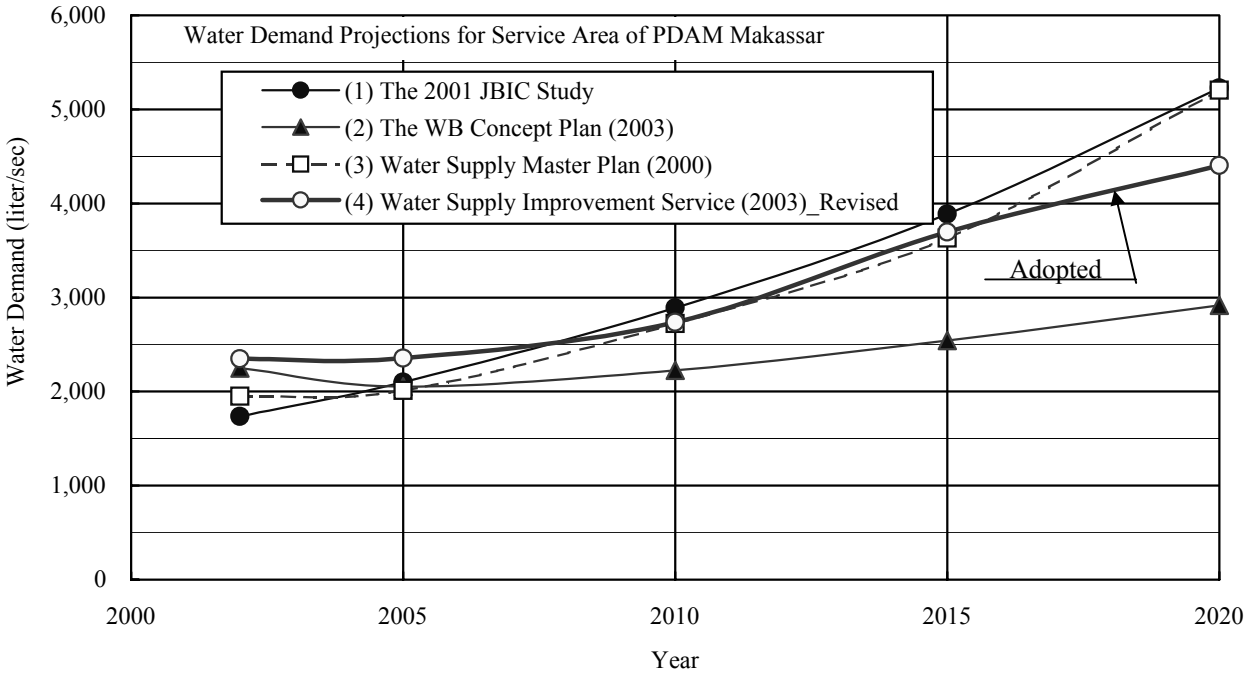


Figure 5.5 Comparison of Previous Water Demand Projection for Service Area of PDAM Makassar

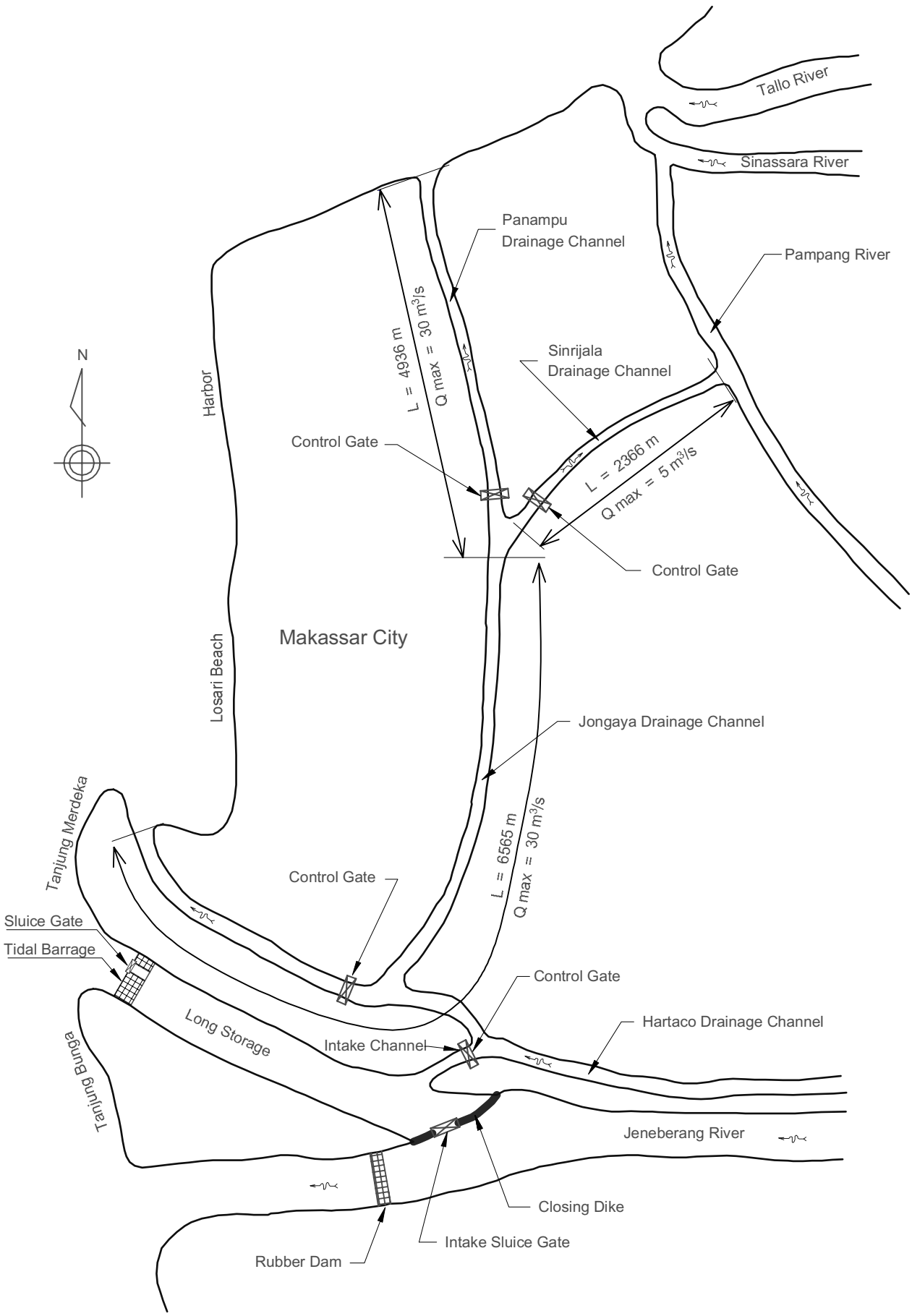


Figure 5.6 Drainage System in the Lower Jeneberang

CHAPTER 6

HYDROLOGY AND WATER BALANCE STUDY

6.1 Meteorological Conditions in Jeneberang River Basin

The Jeneberang river basin experiences a tropical climate, showing high and rather constant air temperature throughout the year but with a distinct variation in rainfall in the wet and dry seasons during the year. The northwest monsoon prevails from December to June, while the southeast monsoon extends from May to November. The northwest monsoon has a high moisture content, which is precipitated on Mt. Bawakaraeng, Mt. Lompobatang and their adjacent mountain ranges at the west edge of the river basin. As a result, the mountainous/hilly area in particular receives a large volume of rainfall during the northwest monsoon period. On the other hand, the river basin receives little rainfall during the east monsoon due to the sheltering effect by the mountain ranges.

According to the average monthly rainfall records at four gauging stations, namely Malino, Bili-Bili, Kampili and Bonto Suggu in and around Jeneberang River basin, the monthly rainfall in a rainy season from December to May is far less than in the dry season from June to November, as listed below. About 80 % to 90 % of the annual rainfall is received from December to May, and the remainder in the dry season.

Monthly Rainfall in Jeneberang River Basin

	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
Malino	864	706	532	439	216	145	91	25	49	101	381	735	4284
Bili-Bili	677	529	448	336	130	60	70	17	63	88	356	615	3389
Kampili	656	465	330	235	94	58	28	16	36	107	346	556	2926
Bonto Sunggu	669	410	273	140	89	47	23	6	24	83	203	482	2449

In addition to the above large variations in monthly rainfall, Jeneberang river basin has a large spatial variation in rainfall due to the topographic effect of the mountain ranges in the eastern part of the river basin. Among the four gauging stations, the highest gauging station is Malino followed by Bili-Bili, Kampili and Bonto Sunggu. Malino, located in the up-most reaches of the river, receives an average annual rainfall of 4,284 mm, while the annual rainfall at the lower stations decreases. Bonto Sunggu, at the lowest elevation, receives only 2,449 mm or 60 % of the total at Malino.

Climatic indices such as temperature, humidity, wind velocity, sunshine hour and evaporation were extracted from two meteorological gauging stations at Bonto Sunggu and Bonto Bili. These are summarized below:

Observed Parameter	Bonto Sunggu In Lower Reaches of Bili-Bili Dam	Bonto Bili Located adjacent to Bili-Bili dam
Mean Temperature (°C)	27.5	23.6
Mean Max. Temperature (°C)	31.4	25.9
Mean Min. Temperature (°C)	22.4	21.3
Relative Humidity (%)	85.0	81.0
Wind Velocity (m/s)	0.9	1.3
Sunshine Hour (hr/day)	7.0	4.0
Evaporation (mm/day)	5.3	4.3

The gauging station at Bonto Sunggu is located in the lower reaches below Bili-Bili dam. The station at Bonto Bili is located adjacent to Bili-Bili dam, and therefore in the more mountainous upper reaches. The particular characteristics of the above climatic indices are discussed below:

(1) Temperature

The average monthly temperatures at Bonto Sunggu show small fluctuations with a minimal difference between the highest, about 28 ^{o}C in May and November, and the lowest of about 27^{o}C in August. On the other hand, Bonto Bili shows more fluctuation with a larger difference between about 24.5 ^{o}C in December to May and 21.4 ^{o}C in August and September. Moreover, the annual average temperature of 23.6 ^{o}C at Bonto Bili is much lower than that at Bonto Sunggu of 27.5 ^{o}C. Thus, the temperature in the upper reaches tends to be lower with a greater monthly fluctuation than in the lower reaches.

(2) Relative Humidity

Both climatic gauging stations show rather small monthly variations in relative humidity, with a range from about 79 % to 88 %. There is also no distinct difference in the average annual humidity between the two stations.

(3) Wind

Similar to the relative humidity, there is no distinct variation in the monthly wind velocities at each of the two gauging stations. The annual average wind velocities between the two stations are also small with a range of only 0.9 m/s to 1.2 m/s.

(4) Sunshine

Bonto Sunggu has rather larger monthly variations in one-day sunshine hours with a range from 4.4 hours/day in January (rainy season) to 9.2 hours/day in August (dry season). On the other hand, Bonto Bili tends to show a more constant but shorter duration of sunshine hours with a range of 3.3 to 4.9 hours/day.

(5) Evaporation

Bonto Sunggu and Bonto Bili indicate average annual one-day evaporation of 5.3 mm/day (1,930 mm/year) and 4.3 mm/day (1,570 mm/year). Thus, the evaporation at Bonto Bili in the upper reaches is lower, which could be attributed to the cooler temperature and shorter sunshine hours.

6.2 Rainfall Analysis

6.2.1 Objectives of Analysis and Basic Data

The analysis aimed at clarifying: (a) the variations in long-term rainfall and (b) magnitude of probable storm rainfall in Jeneberang River Basin. Item (a) is used as the basic data to generate the long-term basin runoff discharge through a simulation model as described in the following Subsection 6.3. For item (b), the estimated value could be used as basic information for proposed flood management.

Rainfall is currently gauged at three climatic gauging stations and thirty-two rainfall stations in total in the Jeneberang river basin. These stations are under the administration of Meteorology and Geophysics Agency (BMD), Provincial Water Resources Management (Dinas PSDA) and JRBDP as listed below.

Meteorological and Rainfall Stations in Jeneberang River Basin

	BMG	Dinas PSDA	JRBDP	Total
Climatic Gauging Station	1	2	-	3
Rainfall Station	5	(20)	7	(32)

Among the above existing gauging stations, the rainfall gauged at the following nine stations were selected as the basic data for analysis of long-term average basin rainfall in due consideration of their locations and the available data length.

(1) Malino (Old non-telemetry station used before 1997);
(2) Malino (New telemetry gauging station shifted from the above old station in 1998);
(3) Jonggoa;
(4) Bili-Bili (Old non-telemetry station installed adjacent to the existing Bili-Bili dam site in 1975);
(5) Bili-Bili (New telemetry gauging station installed at the intake of the Bili-Bili dam in 1998);
(6) Kampili (New telemetry gauging station installed in 1999);
(7) Maccini Sombala;
(8) Limbunga; and
(9) Mangempang.

The irrigation water requirement for three major irrigation areas of Bili-Bili, Bissua, and Kampili irrigation areas in Jeneberang river basin had been estimated as part of the Bili-Bili Irrigation

Project in 1998. The basic rainfall data for the estimation were given from the following seven gauging stations.

(1) Kampili (Old non-telemetry gauging stations in 1974):
(2) Bontosunggu;
(3) Mandalle;
(4) Kalabajeng;
(5) Bonto Sallang;
(6) Barembeng; and
(7) Sandro Bone.

The estimated irrigation water requirement is essential for water supply-demand balance simulation, while the length of the estimation is limited to a period from 1972 to 1997. In this connection, an attempt was made to estimate the irrigation water requirement for the supplementary years from 1998 to 2001 using the rainfall records at the above seven gauging stations.

Thus, the rainfall data used in this Study totaled sixteen gauging stations. An inventory list and location map of these selected stations are shown in Table 6.1 and Figure 6.1, respectively.

6.2.2 Analysis on Long-term Rainfall

The rainfall data at the above gauging stations were collected and processed in the form of annual rainfall tables. As a result, the average monthly rainfalls for a 30-year period from 1972 to 2003 are estimated as listed below (refer to Table 6.2 and Figure 6.2):

Average Monthly and Annual Rainfall

(Unit: mm)

Gauging Station	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total	Gauge Period
Malino	864	706	532	439	216	145	91	25	49	101	381	735	4,284	72 - 03
Jonggoa	794	484	386	197	50	106	15	22	5	172	346	677	3,254	99 - 03
Bili-Bili	677	529	448	336	130	60	70	17	63	88	356	615	3,389	72 - 03
Kampili	656	465	330	235	94	58	28	16	36	107	346	556	2,926	72 - 03
M. Sombala	797	561	295	132	42	44	4	0	13	54	184	587	2,712	99 - 03
Limbunga	726	602	408	272	99	88	48	9	21	164	223	729	3,388	99 - 03
Mangenpang	1057	854	511	330	157	102	38	4	32	197	546	1097	4,925	99 - 03
B. Sunggu	669	410	273	140	89	47	23	6	24	83	203	482	2,449	78 - 02

As listed above, the Malino gauging station, which is located upstream from Bili-Bili dam reservoir, recorded an average annual rainfall of more than 4,000 mm. Mangenpang in the upper reaches of Jenelata river basin also recorded a similar range to the annual rainfall at Malino. In contrast to these gauging stations, those in the lower reaches such as Kampili, Bontosunggu and Maccini Sombala recorded far lower annual rainfalls in the range of 2,400 to 2,500 mm.

The variations in the average annual basin rainfalls from 1972 to 2003 were further estimated through the Thiessen Polygon Method. As shown in Table 6.3, the annual rainfall at each of the gauging stations tends to have a large variation year to year. The rainfall gauging station at Malino in particular shows largest variations in annual rainfall, with a range of 2,344mm in 1972 to

7,230mm in 1989. Due to this, the variation of the annual basin mean rainfall also has a large variation with a range of about 2,500mm to 5,300mm.

The seasonal distribution of rainfall is described by two (2) distinct seasons, dry from June to November and wet from December to May. Heaviest months of rainfall are December and January, while lightest rainfalls occur in August. More than 80% of the annual rainfall is concentrated in the rainy season as listed below:

Gauging Station	Rainfall in a Dry Season (Jun.-Nov.)		Rainfall in Rainy Season (Dec.-May)	
	Depth (mm)	Share to Annual Total (%)	Depth (mm)	Share to Annual Total (%)
Malino	792	18.5	3,492	81.51
Jonggoa	666	20.5	2,587	79.52
Bili-Bili	654	19.3	2,735	80.69
Kampili	589	20.1	2,337	79.86
Maccini Sombala	299	11.0	2,413	88.98
Limbunga	552	16.3	2,836	83.71
Mangenpang	919	18.7	4,006	81.34
Bonto Sunggu	386	15.8	2,064	84.25
Average	607	17.8	2,809	82.22

6.2.3 Analysis of Probable Storm Rainfall

The annual one-day maximum rainfalls gauged at the two key gauging stations, Malino and Bili-Bili, were collected for a period from 1923 to 2003. As listed in Table 6.4, the annual maxim one-day rainfall has a range from about 70 mm to the recorded maximum rainfall of 296mm.

Based on annual maximum rainfall data, probable one-day rainfall was estimated based on the Gumbel Distribution Method as listed below (refer to Figure 6.3):

Probable One-day Rainfall

Return Period	Malino	Bili-Bili
100 -years	333 mm/day	317 mm/day
50 -years	303 mm/day	291 mm/day
20 -years	264 mm/day	255 mm/day
10 -years	234 mm/day	228 mm/day
5 -years	202 mm/day	200 mm/day
2 -years	154 mm/day	157 mm/day

6.3 Runoff Analysis

6.3.1 Objectives of Analysis and Basic Data

The runoff analysis aims at estimating the long-term basin runoff discharge, which is essential for the water supply-demand balance simulation (refer to Subsection 6.3.2). The analysis was concentrated on the following two sub-basins, which are the principal water sources in Jeneberang: (a) upper reaches of Jeneberang River above Bili-Bili dam reservoir, and (b) the whole of Jenelata river basin.

(1) Discharge Data Converted from Gauged Water Level

Before completion of Bili-Bili dam, the water level had been gauged at two key gauging stations. One is Patarikan Gauging Station on Jeneberang River, which was located near the present Bili-Bili dam site and the other was Patarikan Gauging Station on Jenelata River, located at the existing Patarikan Bridge adjacent to the confluence with the mainstream of Jeneberang River. The reliability of H-Q rating curves for the two gauging stations was verified through the Detailed Design of Bili-Bili Irrigation Project. The river flow discharge converted from the water levels gauged at these key gauging stations were therefore applied to the proposed water supply-balance simulation.

After completion of Bili-Bili dam reservoir, however, the above two gauging stations were abandoned, and instead, seven telemetry water level gauging stations were newly installed in Jeneberang river basin, as shown in Figure 6.4. All H-Q rating curves at these new gauging stations have never been updated since they were originally installed, as shown in Table 6.5. As a result, the accuracy of the river flow discharge converted from the water level could not be confirmed and it is difficult to apply the available river flow discharge as a basis for the runoff-analysis.

Therefore, the available discharge data at the two gauging stations used for the water supply-demand simulation were adopted for the following gauging periods:

- Runoff discharge from Jeneberang river: From 1978 to 1990 gauged at Patarikan gauging station on Jeneberang River;
- Runoff Discharge from Jenelata River: From 1990 to 1997 gauged at Patarikan Station on Jenelata River.

(2) Rainfall and Evaporation Data Used for Runoff Simulation

In order to generate the daily runoff discharge for the period not covered by the above available water level gauging periods, a runoff simulation was undertaken based on the following rainfall and evaporation data:

- *Rainfall Gauging Data*: The rainfall gauging data applied included the sixteen rainfall gauging stations as described in the Subsection 6.2.1.
- *Evaporation*: The following monthly average evaporation gauged in Bontosunggu station from 1972 to 1997:

Evaporation for Runoff Simulation

(Unit: mm/day)

Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
4.3	4.2	4.7	5.1	4.9	4.7	5.1	6.1	6.9	6.7	5.6	4.9

6.3.2 Runoff Simulation Model

A runoff simulation was undertaken to generate long-term runoff discharge. The simulation was based on the "Tank Model Method", which has been widely practiced to simulate low flow discharge. The model physically expresses the actual runoff mechanism, which is in nature non-linear in relation to rainfall and has a function of rain infiltration into the surface or sub-surface soils.

A serial three-staged tank was applied for the Tank Model in this Study. The model structure and parameters are presented in Figure 6.5. The process of the simulation is in serial order from the upper to the middle and lower tanks as presented below:

(1) Upper Tank

Ss1(t)	= S11(t-1) + Fc x R (t-1) – Fe.Ev (t-1)	
Sql(t)	= Alf1 x [Ss1 (t) – Ha1]	: upper side outlet
Sq2(t)	= Alf2 x [Ss1 (t) – Ha2]	: lower side outlet
Sq3(t)	= Alf3 x Ss1 (t)	: bottom outlet
S11(t)	= Ss1(t) – [Sq1(t) + Sq2(t) + Sq3(t)]	

(2) Middle Tank

Ss2(t)	= S12(t-1) + Sq3 (t)	
Sq4(t)	= Bet1 x [Ss2 (t) – Hb]	: side outlet
Sq5(t)	= Bet2 x Ss2 (t)	: bottom outlet
S12(t)	= Ss2(t) – [Sq4(t) + Sq5(t)]	

(3) Lower Tank

Ss3(t)	= S13(t-1) + Sq5 (t)	
Sq6(t)	= Gam1 x [Ss3 (t) – Hg]	: side outlet
Sq7(t)	= Gam2 x Ss3 (t)	: bottom outlet
S13(t)	= Ss3(t) – [Sq6(t) + Sq7(t)]	

(4) Runoff Discharge

Q (t) = Aa x [Sq1(t) + Sq2(t) + Sq4(t) + Sq6 (t)] / 86.4

Where,

Aa	:	Catchment area (km²)
Sq1 – Sq6	:	Runoff from side outlet or infiltration through bottom outlet (mm/day)
S11, S12, S13	:	Storage depth of previous time in upper, middle and lower tanks (mm)
Ss1, Ss2, Ss3	:	Total storage depth in upper, middle and lower tanks (mm)
Ha1, Ha2	:	Height of upper and lower side outlets in upper tank (mm)
Hb	:	Height of side outlet in middle tank (mm)
Hg	:	Height of side outlet in lower tank (mm)
Alf1, Alf2, Alf3	:	Multiplying constant of upper tank
Bet1, Bet2	:	Multiplying constant of middle tank
Gam1, Gam2	:	Multiplying constant of lower tank

Fc	:	Effective rainfall ratio
Fe	:	Evaporation factor
Ev	:	Evaporation (mm/day)
R	:	Rainfall (mm/day).

6.3.3 Estimated Long-term Runoff Discharge

Based on the runoff simulation, the annual average rainfall, runoff depth and runoff ratios for a 30-year period from 1972 to 2001 are estimated as below (refer to Table 6.6):

Average Annual Rainfall Depth, Runoff Depth and Runoff Ratio

Item	Upper Reaches of Bili-Bili Dam (384.4 km^2)	Jenelata River Basin (226.3 km^2)
Rainfall Depth	4,200 mm	4,400 mm
Runoff Depth	2,900 mm	2,500 mm
Runoff Ratio	0.68	0.57

As estimated above, the annual runoff depth from the upper reaches of Bili-Bili Dam is about 2,900 mm or 1,100 million m^3 (= 2,900 mm x 384.4 km^2), which is equivalent to almost three times the effective storage capacity of Bili-Bili Dam. Adding the annual runoff of 570 million m^3 from Jenelata River Basin (= 2,500 mm x 226.3 km^2) to the runoff from the upper reaches of Bili-Bili Dam, the effective water resources of Jeneberang river basin are estimated at about 1,670 million m^3.

The long-term discharge runoff from the upper reaches of Bili-Bili dam reservoir (Bili-Bili inflow) and Jenelata River from 1972 to 2001 is further estimated as shown in Figures 6.6 to 6.8. The minimum mean monthly discharges are extracted from the results of estimation as below:

Monthly and Annual Discharge

(Unit m^3/s)

Month	Discharge at	
	Bili-Bili Inflow	Jenelata
Jan.	93.8	43.3
Feb.	85.5	43.1
Mar.	60.2	30.2
Apr.	39.4	23.2
May.	19.1	11.3
Jun.	11.5	7.4
Jul.	7.7	3.9
Aug.	3.8	1.8
Sep.	4.5	1.9
Oct.	7.4	3.1
Nov.	23.6	12.4
Dec.	64.9	33.9
Ave.	35.1	18.0

The average flow regime of Bili-Bili inflow and the discharge of Jenelata station are further described below:

Average Flow Regime

Item	Bili-Bili Inflow	Jenelata
95-day discharge	47.5 m^3/s	26.3 m^3/s,
185-day discharge	14.7 m^3/s	8.0 m^3/s,
275-day discharge	4.8 m^3/s	2.2 m^3/s
355-day discharge	2.3 m^3/s	0.8 m^3/s

6.4 Water Balance Simulation

The simulation was made to clarify the balance between the available water supply volume from and the water demand to the source of Jeneberang River. The available water supply is classified into: (a) the regulated outflow discharge from Bili-Bili dam reservoir, (b) the non-regulated runoff discharge from Jenelata River, and (c) the non-regulated runoff discharge from other residual areas. Among others, the regulated outflow discharge of item (a) is estimated from the aforesaid simulated long-term inflow discharge to Bili-Bili dam reservoir and the flow regulation effect by the dam reservoir. On the other hand, the long-term runoff discharge from Jenelata river basin could be directly assumed as the value of item (b). For the runoff discharge from other residual area (item (c)), this was assumed to be the average of the simulated runoff discharge from the upper reaches of Bili-Bili dam (item (a)) and from Jenelata river basin (item (b)).

The water demand to the source of Jeneberang River includes the municipal water demand, irrigation water demand, private factory water demand and the requirement for river maintenance flow. The water balance simulation was made on the premise of present and future incremental water demands. The future water demand is assumed on the premise of the increment of only municipal water demand. Details of these water requirements are as described in Subsection 6.4.2.

6.4.1 Water Demand

The water demand is classified into irrigation water demand, municipal water demand, and others. The details of each of these demands are described below:

(1) Irrigation Water Demand

The water demand for irrigation use is exclusively for three irrigation schemes of Bili-Bili, Bissua and Kampili, which are being developed under the on-going Bili-Bili Irrigation Project (refer to Chapter 4). The demand could be expressed as the "Net Field Requirement" and was estimated by the following formula:

(Net Field Requirement) = (Crop Requirement) – (Effective Rainfall for Cropping)

The diversion requirement from the river for the above Net Field Requirement is further estimated by the following formula:

(Diversion Requirement) = (Net Field Requirement) x (Irrigation Efficiency)

(Irrigation Efficiency) = 1 / (L1 x L2 x L3)

where:

L1: Irrigation loss of main irrigation canal (assumed at 0.90)
L2: Irrigation loss of secondary irrigation canal (assumed at 0.90)
L2: Irrigation loss of tertiary irrigation canal (assumed at 0.85)

As presented above, the irrigation water demand varies year by year depending on the effective rainfall of each year. In this connection, the half-month water demand in each of the 26 years from 1972 to 1997 had been estimated by the Bili-Bili Irrigation Project on the basis of 100% cropping intensity for both wet and dry season paddy and 40% for palawija (refer to "Design Note on Bili-Bili Irrigation Project"). In addition to the estimated value, the water demands in each of four years from 1998 to 2001 were further estimated in this Study on the same basis.

In the above estimation, the effective rainfall was assumed as 70 % of the half-month rainfalls. The half-month rainfalls from 1972 to 2001 were calculated as the average of the gauged data at seven gauging stations as mentioned in Sub-section 6.2.1 (i.e., Kampili, Bontosunggu, Mandalle, Kalabajeng, Bontosallang, Barembeng and Sandrobone) (refer to Table 6.7).

Based on the results of the estimation, the water requirement to Jeneberang River for each year from 1972 to 2001 was estimated as shown in Figure 6.9 and summarized as listed below:

Average Monthly Crop Requirement and Net Field Requirement

Month	Crop Requirement		Net Field Requirement	
	liter/s/ha	10^6m^3	liter/s/ha	10^6m^3
Jan	0.96	61.28	0.13	8.22
Feb	0.94	55.89	0.15	8.88
Mar	0.81	51.66	0.19	12.06
Apr	0.81	49.89	0.35	21.47
May	1.03	65.27	0.80	50.76
Jun	0.94	57.76	0.84	51.44
Jul	0.78	49.67	0.71	44.75
Aug	0.39	24.37	0.34	21.45
Sep	0.20	12.56	0.17	10.38
Oct	0.20	12.51	0.14	8.86
Nov	0.12	7.27	0.02	1.36
Dec	0.49	31.33	0.05	3.20
Annual		479.45		242.83

As listed above, the crop requirement shows two peaks in January and May. The peak in January is, however, in a rainy season and could be substantially covered by the effective rainfall. On the other hand, the other peak in May is in the dry season and, therefore, most of the water requirement needs to be supplied from Jeneberang River. As a result, the peak net field requirement occurs in May to June.

(2) Municipal Water Demand

The following present and future municipal water demands to Jeneberang River are estimated through clarification and assumptions in items (a) and (b) outlined below (refer to Table 6.8).

Present and Future Municipal Water to the Source of Jeneberang River

Year	Wet Season m^3/s	Dry Season m^3/s	Annual $10^6m^3/year$
Present (2004)	1.66	2.16	60.3
2018	4.02	4.52	134.8
2019	4.23	4.73	141.2
2020	4.43	4.93	147.6

(a) Present Water Demand

The actual outputs of the existing water treatment plants (WTP) for Jeneberang River in year 2003 were clarified in Chapter 5, and were assumed as the present potential municipal water demand. The actual water demand to Jeneberang River was further estimated on the premise of the following conveyance losses from the river to WTPs: 10 % for Somba Opu and Borong Loe WTP and 5 % for other existing WTPs.

(b) Future Water Demand

The future municipal water demand for PDAM Makassar was clarified in Chapter 5 and was assumed as the future water demand to the source of Jeneberang. In addition, the future water demand for PDAM Gowa was estimated as part of the future municipal water demand with reference to the projection in "Consulting Engineering Services for Comprehensive Water Management Plan Study for Maros-Jeneponto River Basin, Nov. 2001".

The treatment capacity of WTP was further assumed to increase to meet the future incremental water demand on the premise of the following conditions:

(a) All existing WTPs would recover to their designed full treatment capacity levels.
(b) The water requirement of Somba Opu WTP would increase from 1.1 m^3/s to 3.3 m^3/s[1], which corresponds to the present capacity of the raw water transmission line from Bili-Bili dam reservoir to the WTP;
(c) New WTPs would be constructed to meet part of the future incremental water demand, which could not be covered by the above two items.

(3) Other Water Demand

The following water demands are regarded as customary water use rights to be promised by supply from Bili-Bili dam reservoir and incorporated into the water supply-demand simulation:

(a) 0.5 m^3/s for water demand of Sugar Factory in Takalar District (refer to Chapter 5); and
(b) 1.0 m^3/s for river maintenance flow along the downstream reaches of Jeneberang River below Sungguminasa Bridge (as programmed under the present reservoir operation rule of Bili-Bili Dam).

[1] Alternatively, water will be partly sent to Panaikang WTP, being branched off from water transmission main

6.4.2 Result of Water Supply-Demand Balance Simulation

The results of the water balance simulation for the present water demand are as shown in Table 6.9 and Figure 6.10. As shown in this Table and Figure, among the simulated 30-year period from 1972 to 2001, three years in 1972, 1982 and 1997 are identified as drought years. During these years Bili-Bili dam reservoir dropped to its Lowest Water Level (EL. 65.0 m) with no available water supply capacity to meet the present water demand. Thus, the drought years could occur with a frequency of once every ten years (= 3 years as an identified drought year divided by 30 years of the simulation period). It was therefore concluded that the present supply capacity of Bili-Bili dam could satisfy present water demand against a 10-year drought.

The water balance simulation was further made on the premise of the future incremental municipal water demand. Based on the results of the simulation, the following years were identified as droughts years (i.e., when Bili-Bili dam reservoir could not satisfy the allocated water demand):

Drought Years against Water Demand
(in Consideration of Growth of Municipal Demand)

Year of Demand Projection	Drought year	Number of Drought Years	Frequency of Drought Years
Present (2003)	1972, 82, 97	3/30	1/10 years
2018	1972, 76, 82, 87, 92, 97	6/30	1/5 years
2019	1972, 76, 82, 83, 87, 91, 92, 97	8/30	1/3.8 years
2020	1972, 76, 82, 83, 87, 91, 92, 97	8/30	1/3.8 years

As estimated above, the frequency of occurrence of drought year would increase from 1 in 10 years at present to 1 in 5 years in 2018 and 1 in 3.8 years in 2019.

The irrigation water demand takes a dominant share of the whole water demand and, therefore, is a decisive factor in the failure to meet demands during drought years. The typical influence of irrigation water demand on occurrence of drought is seen in a three-month period from April to June. The three-month period is regarded as the critical duration such that the period is at the beginning of the dry season and, at the same time, the crop water requirements start to increase significantly during this period. The drought years tend to occur when the rainfall during this critical period is far less than those in 'normal' years as below (refer to Table 6.10):

(a) The drought years of 1972, 1982 and 1997 received rainfall of less than 110mm during the critical three-month period, which is far less than the average of 273 mm from 1972 to 2001 during those same months;
(b) On the other hand, the years of 1985, 1990 and 1993 received an annual rainfall of less than 2,000m, which is rather small value when compared to the average of 2,434 mm from 1972 to 2001. However, these years received a relatively large rainfall during the critical three-month period from April to June, and therefore did not cause droughts.

The year of 1976 is identified as the marginal non-drought year, during which full supply of the net field requirement of 381.70m^3/year is just met by the supply capacity of Bili-Bili dam reservoir on the premise that the dam reservoir also needs to meet the full supply for municipal

water and other all allocated water demands. Accordingly, the following diversion requirement for irrigation use in 1976 could be regarded as the marginal limit to be met by the supply capacity of Bili-Bili dam. This marginal limit of 381.70 million m^3 corresponds to about 1.6 times the average net field requirement from 1972 to 1983 (i.e., 242.83 million m^3).

Diversion Requirement for Irrigation in the Standard Drought Year of 1976

Month	Bili-Bili Irrigation Scheme	Bissua Irrigation Scheme	Kampili Irrigation Scheme	Total
Jan	2.35	10.72	10.49	23.56
Feb	0.00	0.00	0.00	0.00
Mar	0.00	0.00	0.00	0.00
Apr	5.71	26.11	25.53	57.36
May	7.92	36.17	35.37	79.46
Jun	7.64	34.94	34.16	76.74
Jul	7.21	32.93	32.20	72.33
Aug	3.64	16.63	16.26	36.53
Sep	1.96	8.95	8.75	19.66
Oct	1.22	5.56	5.43	12.21
Nov	0.00	0.00	0.00	0.00
Dec	0.38	1.76	1.72	3.86
Annual	38.03	173.77	169.91	381.70

6.5 Improvement Plan of Hydrological Gauging Network

The improvement plan for the hydrological gauging network was initially proposed to facilitate river basin management, including low flow and flood management as described in the following subsections.

6.5.1 Proposed Telemetry Rainfall Gauging Network

JRBDP currently gauge rainfall on a real-time basis through seven telemetry rainfall gauging station in order to facilitate effective gate operations for Bili-Bili dam, the rubber dam and other various river structures. Dinas PSDA also gauges daily rainfall through information from gauge keepers assigned to twenty non-telemetry gauging stations in order to facilitate the water management for irrigation. Moreover, BMG has six climatic gauging stations in Jeneberang river basin, of which five are now operational with one being temporarily suspended due to trouble with gauging equipment. Thus, there exist 33 rainfall-gauging stations in Jeneberang river basin, but locations are mostly biased to the lower reaches below Bili-Bili dam, as shown in Figure 6.11.

Among these, the telemetry gauging stations in particular are useful for real-time flood management as well as for low flow management. The density of the telemetry-gauging stations is 109km^2/station (=seven stations/catchment area of 762km^2), which satisfies the minimum density of 100 to 250 km^2/station recommended by the World Meteorological Organization (WMO).

However, there are some hydrological blind areas in Jeneberang river basin, and telemetry gauging stations are provisionally proposed to remove these areas (refer to Figure 6.12).

(a) Upper most area of Jeneberang River: The existing two non-telemetry gauging stations at Tanralili and Bungabaji operated by Dinas PSDA should be provided with telemetry equipment. Another new telemetry gauging station is also proposed at Lengkese, which is located just downstream of the huge sediment deposit produced from the collapse of Mt. Bawakaraeng.
(b) Upper reaches of Jene Rakikang River: One new gauging station is proposed at Patuku Village.
(c) Upstream of Jeneberang River between Bili-Bili dam reservoir and the existing Jonggoa station; Telemetry rainfall equipment should be installed at the existing telemetry water level gauging station at Bonto Jai.
(d) Upstream of Binanga Tokka; One new gauging station is proposed at Parang-Parang.

An open space with a diameter of around 10m should preferably be selected as being suitable as a rainfall gauging site. It will also be necessary to avoid narrow passes in topography, where the deviations in wind direction and velocity would cause difficulties in accurately gauging the rainfall. It is also necessary to consider accessibility of the gauging site and to avoid the risk of flood inundation.

6.5.2 Proposed Telemetry Water Level Gauging Network

JRBDP currently gauge the water level of Jeneberang River as well as its tributaries on a real-time base through seven water level gauging stations. The gauged data are useful for low flow and flood management including the gate operations of Bili-Bili dam and other various river structures.

The present water level gauging stations are well distributed to observe all critical river flow discharges. The gauging station at Bonto Jai on the mainstream of Jeneberang, in particular, is important to observe the inflow discharge into Bili-Bili dam reservoir. The Jenelata Station installed at the Patarikan Bridge is also important to observe the natural flow discharge from Jenelata River. Accordingly, it would not be necessary to expand the existing telemetry gauging network.

However, Bayang water level gauging station at the estuary of Jeneberang River has been not operational, as the gauging equipment was stolen in 2002. This gauging station is useful to observe the salinity intrusion into the river, and therefore, it is important to resume gauging operations at the earliest opportunity.

Relocation of the gauging site would be also required for Bonto Jai water level gauging station. The present location of the gauging station is just downstream of the existing Sand Pocket No.1, where stable river flow is unlikely and the riverbed tends to fluctuate readily. From these viewpoints, it is preferable to transfer the location of this gauging site to a location above the sand pocket dam, where the flow channel is fixed and more accurate flow discharge could be estimated from the gauged water level.

In addition to the necessary rehabilitation and relocation of the existing telemetry gauging stations discussed above, another crucial issue is the renewal of H-Q rating curves derived for the existing water level gauging stations.

Among the existing seven water level gauging stations, four stations, namely Jonggoa, Bonto Jai, Kampili and Jenelata station have H-Q rating curves. However, these have never been updated after their original development in 1999. The riverbeds tend to fluctuate particularly after a flood, which seriously affects the accuracy of the rating curves. In fact, extensive riverbed fluctuation has been confirmed after the collapse of Mt. Bawakaraeng in March 2004, and it is indispensable that existing H-Q rating curves be updated at the same time. This should also be followed on an ongoing basis by the establishment of a new system of rating curves at the end of the every rainy season and/or immediately after the occurrence of large floods.

Table 6.1 Climetological and Rainfall station Collected Data in this Study

Station Name	Location		Year	Type	Administration	Purpose	Remarks
	Longitude (E)	Latitude (S)	Installed				
- Kalabajen	119 26'00"	5 19'00"	1975	Mnual	Dinas	*1	
- Mandalle/Patarungan	119 24'00"	5 18'00"	1975	Mnual	Dinas	*1	
- Sandro Bone	119 22'00"	5 26'00"	1975	Mnual	Dinas	*1	
- Bontosunggu	119 25'30"	5 16'44"	1977	Automatic	Dinas	*1	Climetological Station
- Bonto Sallang	119 24'51"	5 19'51"	1975	Mnual	Dinas	*1	
- Barembeng	119 24'36"	5 20'01"	1975	Mnual	Dinas	*1	
** Malino	119 51'14.6"	5 15'11.5"	1971	Mnual	Dinas	*2	
** Malino	119 51'12"	5 15'10"	1998	Telemetring	JRDBP	*2	
** Jonggoa	119 44'37"	5 16'26"	1998	Telemetring	JRDBP	*2	
** Limbunga	119 44'05"	5 21'48"	1998	Telemetring	JRDBP	*2	
** Mangempang	119 40'50"	5 20'07"	1998	Telemetring	JRDBP	*2	
** Intake Bili-Bili	119 34'27"	5 17'20"	1975	Mnual	Dinas	*2	
** Bili-Bili	119 35'08"	5 16'46"	1998	Telemetring	JRDBP	*2	
** Kampili	119 30'40"	5 16'51"	1974	Manual	Dinas	*1, *2	
** Kampili	119 34'02"	5 17'13"	1998	Telemetring	JRDBP	*1, *2	
** Macini Sombala	119 24'50"	5 11'41"	1998	Telemetring	JRDBP	*2	

** : in the Jeneberang river basin
*1 : utilizede for calculation of Irrigation Water Requirement
*2 : utilizede for Runoff calculation by Tank model

Table 6.2 (1/5) Mean Monthly Rainfall (Malino)

Unit : mm

Year	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total	
1972	1624	566	273	221	63	0	0	0	0	0	352	342	3441	
1973	532	315	491	311	292	88	243	110	241	26	730	591	3970	
1974	375	700	1393	313	265	116	181	11	161	527	348	795	5185	
1975	621	621	558	570	275	205	63	64	23	194	472	615	4281	
1976	831	784	912	238	196	46	5	5	0	269	187	495	3968	
1977	900	1476	663	475	195	324	0	17	0	0	241	684	4975	
1978	765	655	378	371	236	237	282	111	154	156	446	987	4778	
1979	771	589	821	287	278	134	26	0	4	70	170	671	3821	
1980	969	1480	1075	868	488	129	32	12	0	252	610	1124	7039	
1981	1026	678	417	498	267	184	253	3	231	46	744	1231	5578	
1982	1114	690	818	954	190	111	1	0	2	2	113	419	4414	
1983	684	552	274	606	542	332	60	18	1	49	613	207	3938	
1984	830	770	694	794	474	220	68	48	232	218	314	1062	5724	
1985	667	486	660	595	411	199	277	0	59	105	566	460	4485	
1986	1453	415	262	416	68	113	174	42	1	134	298	436	3812	
1987	1376	952	373	264	100	11	0	0	0	6	436	1327	4845	
1988	677	1726	622	167	218	52	56	64	75	103	718	2005	6483	
1989	2015	1234	702	1133	466	604	140	105	46	89	197	499	7230	
1990	648	363	404	209	140	92	120	2	0	0	168	549	2695	
1991	1207	584	135	525	86	27	12	3	0	6	343	450	3378	
1992	579	374	328	252	94	103	94	11	46	108	86	269	2344	
1993	1039	608	877	558	176	203	14	0	36	13	357	1104	4985	
1994	575	378	583	373	249	11	3	8	0	66	172	439	2857	
1995	948	475	619	643	169	429	62	7	41	120	986	1110	5609	
1996	871	767	481	351	119	59	127	141	78	310	359	1638	5301	
1997	1028	1244	937	473	23	20	68	0	0	0	0	433	4226	
1998	338	276	474	284	138	142	249	54	124	210	413	677	3379	
1999	786	829	483	202	0	0	0	7	1	169	448	873	3798	*
2000	616	636	567	424	224	390	80	35	3	215	379	816	4385	*
2001	677	702	410	267	89	219	8	2	0	268	361	1129	4132	*
2002	705	583	498	265	173	90	7	0	0	2	125	362	2810	*
2003	1005	727	420	132	79	40	23	41	17	80	-	-	-	*
Ave.	883	726	581	439	212	154	85	29	49	119	379	768	4424	

Note : 1972 - 1977 data were obtained from previous report.

* : obtained from telemetric system.

Table 6.2 (2/5) Mean Monthly Rainfall (Intake Bili-Bili & Bili-Bili)

Unit : mm

Year	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total	
1972	1175	807	594	152	23	0	0	6	0	0	204	312	3273	
1973	505	135	407	699	193	30	168	26	371	126	772	733	4165	
1974	319	654	919	261	109	53	167	7	124	356	478	702	4149	
1975	416	565	481	737	151	25	213	16	91	52	616	593	3956	
1976	746	496	390	49	73	78	80	55	0	188	264	401	2820	
1977	1177	1527	374	442	36	81	0	24	0	0	258	540	4459	
1978	610	584	350	209	379	101	303	52	211	134	322	664	3919	
1979	877	676	538	249	134	122	0	0	7	0	239	745	3587	
1980	754	703	369	325	70	0	0	15	0	13	384	790	3423	
1981	587	390	276	262	104	88	144	0	162	121	360	824	3318	
1982	566	530	374	328	117	0	0	12	0	0	34	624	2585	
1983	245	160	265	441	184	66	87	0	28	114	445	693	2728	
1984	633	620	612	517	312	91	0	0	144	148	254	557	3888	
1985	315	404	477	405	105	106	70	0	0	102	407	353	2744	
1986	1488	275	350	189	74	58	350	0	0	170	293	479	3726	
1987	1339	384	434	157	57	0	0	0	0	0	109	1272	3752	
1988	278	757	418	218	159	40	0	42	182	129	404	442	3069	
1989	735	460	596	545	78	174	148	53	38	174	208	273	3482	
1990	679	352	257	267	319	0	0	0	0	44	119	648	2685	
1991	760	206	208	415	24	0	0	0	0	0	828	803	3244	
1992	482	422	410	17	41	7	0	0	214	114	490	318	2515	
1993	582	442	336	382	1003	408	9	0	13	45	329	818	4367	**
1994	733	523	1205	260	27	15	0	3	0	25	6	380	3177	
1995	975	477	473	381	220	217	43	0	32	86	405	642	3951	
1996	596	872	328	281	24	26	34	59	66	133	526	1166	4111	
1997	435	723	223	71	22	1	24	0	0	39	214	393	2145	
1998	188	148	406	817	221	158	41	96	23	108	714	471	3391	
1999	543	686	377	119	0	0	0	2	5	255	367	577	2931	*
2000	787	629	505	299	167	220	72	0	5	274	313	440	3711	*
2001	691	758	509	180	78	118	1	0	10	179	270	770	3564	*
2002	561	448	400	323	186	31	0	0	0	9	151	497	2606	*
2003	725	341	218	154	30	18	3	0	4	61	178	920	2652	*
Ave.	672	536	440	317	148	73	61	15	54	100	343	620	3378	

Note : 1972 - 1998 at Intake Bili-Bili station

* : 1999 - 2003 at Bili-Bili station of telemetric system.

Table 6.2 (3/5) Mean Monthly Rainfall (Kampili)

Unit : mm

Year	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total	
1972	935	494	383	69	15	-	-	-	-	-	-	-	-	
1973	-	-	-	-	-	-	-	-	-	-	-	-	-	
1974	-	-	-	-	-	-	-	-	94	203	327	452	-	
1975	362	345	310	381	99	24	82	13	69	154	326	513	2678	
1976	658	379	341	26	37	14	8	0	0	98	255	309	2125	
1977	976	618	128	107	12	82	0	41	0	0	84	393	2441	
1978	470	388	209	212	232	170	140	41	109	44	333	558	2906	
1979	657	627	385	84	135	128	0	28	13	34	69	507	2667	
1980	674	417	330	86	50	0	0	11	14	58	175	614	2429	
1981	408	200	157	198	85	33	70	13	32	62	199	366	1823	
1982	304	241	142	56	28	3	0	0	0	0	26	427	1227	
1983	272	222	120	304	121	51	49	0	3	112	482	557	2293	
1984	506	613	426	303	182	43	17	5	142	57	250	581	3125	
1985	433	273	493	213	89	73	45	3	11	34	214	315	2196	
1986	1018	355	513	143	101	151	11	0	33	348	215	311	3199	
1987	1129	371	385	167	102	10	-	0	0	8	112	1379	-	
1988	328	473	405	193	168	60	0	15	192	174	342	600	2950	
1989	750	204	285	459	82	118	116	30	24	163	330	397	2958	
1990	673	350	195	112	247	8	25	0	0	90	194	153	2047	
1991	609	489	123	251	15	0	0	0	0	0	289	483	2259	
1992	456	328	720	186	13	91	65	0	245	78	394	318	2894	
1993	873	514	247	370	157	98	0	0	0	80	28	776	3143	
1994	537	517	526	89	105	11	0	0	0	5	344	400	2534	
1995	750	406	241	449	-	7	30	0	11	52	442	798	-	
1996	483	617	237	184	0	0	0	25	0	40	97	974	2657	
1997	427	638	127	98	56	5	0	0	11	9	75	270	1716	
1998	60	168	380	1129	196	100	100	90	50	498	813	514	4098	
1999	-	-	286	127	0	0	0	0	0	122	271	501	1307	*
2000	571	651	355	183	81	95	53	4	0	0	192	410	2595	*
2001	618	900	468	151	33	76	0	0	0	119	284	817	3466	*
2002	617	441	436	168	102	42	1	0	0	0	128	139	2074	*
2003	901	406	155	121	61	25	1	0	21	87	228	802	2808	*
Ave.	602	436	317	221	90	52	29	11	36	91	251	521	2656	

* : 1999 - 2003 Kampili station of telemetric system

Table 6.2 (4/5) Mean Monthly Rainfall

Station : Jonggoa — Unit : mm

Year	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1999	1019	356	521	138	0	0	0	3	5	224	360	768	3394
2000	805	398	484	281	139	295	27	40	3	351	537	496	3856
2001	702	902	440	464	34	131	33	4	3	204	213	488	3618
2002	464	122	0	0	0	82	1	0	0	1	388	506	1564
2003	978	640	484	104	76	23	12	65	16	78	233	1128	3837
Ave.	794	484	386	197	50	106	15	22	5	172	346	677	3254

Station : Maccini Sombala — Unit : mm

Year	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1999	1178	432	318	73	0	0	0	0	7	112	185	521	2826
2000	510	735	242	226	38	61	12	2	21	75	293	403	2618
2001	801	729	430	122	50	87	0	0	27	42	244	898	3430
2002	748	473	396	125	49	57	4	0	0	0	112	409	2373
2003	749	436	89	112	72	13	4	0	9	43	84	703	2314
Ave.	797	561	295	132	42	44	4	0	13	54	184	587	2712

Station : Limbunga — Unit : mm

Year	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1999	648	412	492	176	0	0	0	3	49	291	242	682	2995
2000	673	690	590	349	133	232	137	30	6	196	108	548	3692
2001	729	956	366	365	73	109	77	4	8	217	367	841	4112
2002	704	512	347	275	103	79	11	0	0	0	180	534	2745
2003	878	439	244	195	187	21	13	6	43	114	216	1038	3394
Ave.	726	602	408	272	99	88	48	9	21	164	223	729	3388

Station : Mangempang — Unit : mm

	Jan.	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1999	919	632	577	117	0	0	0	5	29	275	588	662	3804
2000	772	784	452	313	180	319	156	4	14	227	647	488	4356
2001	965	1147	503	369	78	21	0	3	19	238	643	1483	5469
2002	1210	887	499	553	342	137	14	0	0	7	374	1101	5124
2003	1421	819	525	296	187	34	21	7	98	239	477	1749	5873
Ave.	1057	854	511	330	157	102	38	4	32	197	546	1097	4925

Table 6.2 (5/5) Mean Monthly Rainfall (Bontosunggu)

Unit : mm

Year	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1978	408	482	220	168	356	78	97	19	49	12	161	626	2675
1979	805	407	313	90	100	136	0	0	2	5	147	538	2539
1980	643	524	316	159	32	12	0	0	16	19	111	736	2567
1981	601	329	138	36	41	35	109	0	16	6	406	-	-
1982	604	463	374	69	55	0	0	0	0	0	0	159	1723
1983	126	46	25	170	55	18	0	0	0	31	415	548	1433
1984	638	599	347	180	150	9	26	0	120	52	145	518	2784
1985	452	287	470	256	109	27	28	5	106	18	207	56	2020
1986	866	184	364	170	31	27	46	3	3	85	164	152	2094
1987	975	388	495	59	63	0	0	0	6	0	66	1181	3232
1988	480	769	201	184	222	18	15	14	94	186	528	741	3452
1989	760	756	285	277	87	57	11	12	17	24	181	140	2606
1990	355	145	155	29	214	0	2	4	0	53	92	335	1384
1991	726	460	43	211	11	0	5	0	0	8	60	215	1739
1992	375	241	423	153	13	71	24	15	72	20	114	317	1837
1993	450	357	227	166	41	25	0	-	-	34	202	782	-
1994	704	364	497	143	16	10	0	0	0	12	217	232	2193
1995	772	546	408	333	111	74	11	0	19	37	412	584	3305
1996	787	782	236	115	0	11	12	0	15	59	317	1398	3731
1997	410	848	230	214	13	0	12	0	0	0	21	274	2021
1998	155	53	196	253	64	45	147	74	0	0	0	0	986
1999	2791	32	94	36	29	24	18	-	-	1190	741	630	-
2000	819	244	542	0	322	432	16	0	0	219	211	521	3326
2001	543	810	202	25	35	39	0	0	3	0	94	682	2433
2002	472	147	33	12	62	27	5	0	14	0	54	205	1031
Ave.	669	410	273	140	89	47	23	6	24	83	203	482	2449

Table 6.3 Thiessen Ratio and Basin mean Rainfall

Pattarn	Station name	Area (km^2)	Thiessen Ratio
1	Malino	200.26	0.263
	Jonggoa	128.25	0.168
	Bili-Bili	81.45	0.107
	Kampili	65.74	0.086
	Macini Sombala	66.18	0.087
	Limbunga	116.92	0.153
	Mangempang	103.19	0.135
2	Malino	377.03	0.495
	Bili-Bili	384.96	0.505
3	Malino	380.98	0.500
	Bili-Bili	249.12	0.327
	Kampili	131.90	0.173
4	Malino	200.26	0.263
	Jonggoa	128.26	0.168
	Bili-Bili	120.47	0.158
	Macini Sombala	92.91	0.122
	Limbunga	116.91	0.153
	Mangempang	103.19	0.135
5	Jonggoa	328.20	0.431
	Bili-Bili	81.46	0.107
	Kampili	65.74	0.086
	Macini Sombala	66.18	0.087
	Limbunga	117.18	0.154
	Mangempang	103.24	0.135
6	Bili-Bili	630.10	0.827
	Kampili	131.90	0.173

C.A. = 762.0 km^2

Unit : mm

Year	Malino	Jonggoa	Bili-Bili	Kampili	Macini Sombala	Limbunga	Mangempang	Basin Mean
1972	3441	-	3273	-	-	-	-	3356
1973	3970	-	4165	-	-	-	-	4069
1974	5185	-	4149	-	-	-	-	4662
1975	4281	-	3956	2678	-	-	-	3897
1976	3968	-	2820	2125	-	-	-	3274
1977	4975	-	4459	2441	-	-	-	4368
1978	4778	-	3919	2906	-	-	-	4173
1979	3821	-	3587	2667	-	-	-	3545
1980	7039	-	3423	2429	-	-	-	5059
1981	5578	-	3318	1823	-	-	-	4189
1982	4414	-	2585	1227	-	-	-	3264
1983	3938	-	2728	2293	-	-	-	3258
1984	5724	-	3888	3125	-	-	-	4674
1985	4485	-	2744	2196	-	-	-	3520
1986	3812	-	3726	3199	-	-	-	3678
1987	4845	-	3752	-	-	-	-	4293
1988	6483	-	3069	2950	-	-	-	4755
1989	7230	-	3482	2958	-	-	-	5265
1990	2695	-	2685	2047	-	-	-	2580
1991	3378	-	3244	2259	-	-	-	3140
1992	2344	-	2515	2894	-	-	-	2495
1993	4985	-	4367	3143	-	-	-	4464
1994	2857	-	3177	2534	-	-	-	3066
1995	5609	-	3951	-	-	-	-	4771
1996	5301	-	4111	2657	-	-	-	4454
1997	4226	-	2145	1716	-	-	-	3111
1998	3379	-	3391	4098	-	-	-	3507
1999	3798	3394	2931	1307	2826	2995	3804	3352
2000	4385	3856	3711	2595	2618	3692	4356	3806
2001	4132	3618	3564	3466	3430	4112	5469	4044
2002	2810	1564	2606	2074	2373	2745	5124	2780
2003	-	3837	2652	2808	2314	3394	5873	3697

Table 6.4 Maximum One-day Rainfall

Unit : mm

Year	Malino	Bili-Bili	Year	Malino	Bili-Bili	Year	Malino	Bili-Bili
1923	-	97	1950	-	-	1977	208	235
1924	-	98	1951	-	-	1978	168	148
1925	-	235	1952	-	-	1979	131	211
1926	-	113	1953	225	157	1980	138	108
1927	-	143	1954	225	102	1981	135	118
1928	-	113	1955	-	182	1982	135	147
1929	-	182	1956	193	145	1983	130	206
1930	-	152	1957	-	143	1984	190	129
1931	117	125	1958	-	143	1985	143	131
1932	115	217	1959	150	200	1986	200	215
1933	202	156	1960	235	-	1987	133	296
1934	150	210	1961	201	-	1988	275	155
1935	252	210	1962	169	-	1989	221	118
1936	118	97	1963	119	-	1990	86	169
1937	154	139	1964	-	-	1991	160	170
1938	225	165	1965	200	-	1992	99	143
1939	181	138	1966	111	147	1993	246	198
1940	143	117	1967	190	172	1994	71	193
1941	216	-	1968	127	87	1995	177	140
1942	-	-	1969	88	213	1996	108	178
1943	-	-	1970	130	131	1997	160	121
1944	-	-	1971	150	151	1998	101	138
1945	-	-	1972	205	249	1999	185	200
1946	-	-	1973	105	271	2000	237	183
1947	-	-	1974	294	194	2001	130	167
1948	-	-	1975	86	264	2002	134	213
1949	-	-	1976	134	160	2003	161	116

Source : 1931 - 1977 Malino and 1923 - 1971 Bili-Bili data are obtained from Supporting Report on Detailed Design of Bili-Bili Multipurpose Dam Project
Others are newly collected

Table 6.5 Rating Curve of Water Level Gauging Station

Station Name	Rating Curve	The Date of Creation	Update	Formula	Remarks
Jonggoa	○	1999	×	$Q=12.295(h-0.1826)^2$	No check for high flows*
Bont Jai	○	1999	×	$Q=475.22h^3-3961h^2+11046h-10272$	
Bili-Bili	×	—	—	—	dam reservoir
Kampili	○	1999	×	$Q=205.5(h+0.1451)^2$	
Maccini Sombala	×	—	—	—	
Bayang	×	—	—	—	Equipment were stallen in 2002 Now Interrupting
Jenelata	○	1999	×	$Q=82.93(h-0.614)^2$	2002.1 Flushed out 2004.2 Reconstruction

* : The water level gauge was not functioning during the peak flood perio

Source : JRBDP information

Table 6.6 Railfall and Runoff Depth at each Station

Bili-Bili Dam Site
C.A. = 384.4 km^2

Hydrological Year (Jun.-May)	Rainfall (mm)	Runoff Depth (mm)		Ratio (%)	loss
1972	2594	1806	*	70	788
1973	4782	4034		84	747
1974	4511	3677		82	834
1975	3979	2952		74	1027
1976	4669	3733		80	936
1977	3353	2568		77	785
1978	4916	3405	*	69	1510
1979	5334	4260	*	80	1073
1980	4518	3185	*	70	1333
1981	5784	3554	*	61	2230
1982	2988	833	*	28	2155
1983	4672	3339	*	71	1333
1984	4488	2540	*	57	1947
1985	4075	2610	*	64	1465
1986	4134	2761	*	67	1374
1987	4721	2834	*	60	1887
1988	7445	3288	*	44	4156
1989	3325	2052	*	62	1273
1990	3220	3299	*	102	-78
1991	2595	1366	*	53	1229
1992	3932	2726		69	1205
1993	4128	3054		74	1074
1994	3254	2315		71	939
1995	4435	3248		73	1187
1996	4951	3607		73	1344
1997	2241	1344		60	897
1998	3971	2683		68	1289
1999	3768	2609		69	1159
2000	4130	2947		71	1183
Ave.	4169	2849		68	

Jenelata Station
C.A. = 226.3 km^2

Hydrological Year (Jun.-May)	Rainfall (mm)	Runoff Depth (mm)		Ratio (%)	loss
1972	2635	1174		45	1461
1973	5075	2861		56	2214
1974	4784	2482		52	2302
1975	4597	2371		52	2226
1976	4716	2695		57	2021
1977	3671	1893		52	1778
1978	5119	2630		51	2489
1979	5955	3589		60	2366
1980	5045	2870		57	2175
1981	6458	3773		58	2685
1982	3306	1645		50	1661
1983	4842	2604		54	2238
1984	4981	2573		52	2408
1985	4280	2327		54	1953
1986	4263	2152		50	2111
1987	5190	3189		61	2001
1988	8623	5488		64	3135
1989	3444	1759		51	1685
1990	2800	2489	*	89	311
1991	2810	1524	*	54	1287
1992	3919	1986	*	51	1934
1993	4195	2702	*	64	1493
1994	3170	1985	*	63	1186
1995	4181	2403	*	57	1778
1996	4541	2108	*	46	2432
1997	2300	1142	*	50	1157
1998	3636	2254		62	1382
1999	3817	2450		64	1367
2000	4144	2796		67	1348
Ave.	4362	2480		57	

Note : * the figures are obtained from the discharge converted from gaugied water level

Table 6.7 Half Monthly Rainfall in the Irrigation Area for Calcuration of Net Field Requirement (NFR)

Average Rainfall for seven (7) Stations
(Kampili, Bontosunggu, Mandalle, Kalabajeng, Bontosallang, Barembeng, Sandro Bone)

Unit : mm

Year	Jan.		Feb.		Mar.		Apr.		May		Jun.		Jul.		Aug.		Sept.		Oct.		Nov.		Dec.		Total
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	
1972	784	38	106	328	216	120	0	61	13	0	0	0	0	0	0	4	0	0	0	0	24	106	78	120	1,998
1973	109	212	76	10	170	89	228	217	72	51	16	3	107	0	10	7	60	176	48	32	111	380	68	398	2,647
1974	192	11	219	196	402	182	126	40	22	47	8	26	27	79	0	4	78	4	137	41	71	216	183	214	2,528
1975	163	156	193	111	178	94	38	285	48	24	41	3	4	53	16	2	62	41	64	147	94	249	421	215	2,698
1976	592	101	226	192	202	250	33	10	55	2	17	17	8	0	0	0	0	0	5	47	105	154	277	147	2,438
1977	366	618	475	577	112	155	133	2	24	15	63	12	0	0	11	0	0	3	0	0	3	97	157	156	2,979
1978	274	198	289	194	95	174	136	43	132	130	48	37	87	9	7	14	43	10	32	8	72	105	159	477	2,774
1979	651	180	237	261	288	56	21	44	87	28	109	3	1	0	5	0	2	2	1	7	33	61	410	129	2,618
1980	365	306	294	192	198	117	86	86	16	11	0	9	1	0	2	0	0	5	4	11	40	44	358	306	2,451
1981	297	298	207	130	47	123	64	33	59	19	2	25	113	14	1	4	13	1	15	10	77	316	393	281	2,543
1982	287	313	412	53	205	137	12	52	34	1	12	0	0	0	0	0	0	0	0	0	1	4	14	185	1,721
1983	165	72	65	36	8	70	85	101	65	4	10	13	10	8	0	0	0	1	19	54	56	361	149	349	1,698
1984	201	389	339	179	189	56	76	70	114	33	7	6	0	13	0	1	55	8	30	30	40	132	186	381	2,536
1985	162	276	164	183	435	10	120	47	70	27	29	0	12	18	0	5	0	35	2	24	54	112	80	98	1,961
1986	534	308	186	155	170	144	109	21	29	1	42	9	8	14	0	0	0	7	52	39	72	115	101	121	2,237
1987	376	566	207	121	82	250	75	9	72	1	2	0	0	0	0	0	0	1	0	5	37	33	290	913	3,040
1988	122	236	682	146	74	274	128	16	103	44	10	6	2	3	11	10	48	35	59	71	150	201	389	204	3,025
1989	57	627	282	278	297	23	84	221	59	4	31	47	15	32	0	9	3	23	41	83	103	94	199	59	2,671
1990	373	299	176	91	172	17	35	31	62	114	7	0	4	3	0	1	0	2	0	50	65	56	80	315	1,953
1991	205	534	244	127	30	76	56	121	0	4	0	1	1	0	0	0	0	0	0	1	25	49	236	48	1,760
1992	258	79	88	94	265	188	86	19	8	3	26	17	26	0	10	1	52	39	9	17	34	111	154	172	1,755
1993	75	346	178	173	86	90	136	42	59	19	28	6	0	0	0	0	0	0	17	5	20	58	147	501	1,987
1994	205	497	175	132	288	210	40	59	36	0	0	11	0	0	0	0	0	0	4	10	41	99	124	127	2,057
1995	305	289	216	190	266	106	285	23	68	12	32	17	8	0	0	0	2	8	5	19	66	177	433	122	2,649
1996	172	432	641	210	104	181	42	38	20	3	8	7	2	2	4	0	4	2	51	24	125	74	470	476	3,092
1997	290	183	209	412	130	5	48	35	12	4	0	1	5	0	0	0	0	2	2	0	0	27	72	172	1,609
1998	65	19	56	11	5	211	226	95	105	57	36	75	32	118	26	30	2	57	45	124	263	204	241	430	2,532
1999	716	583	270	270	183	109	61	113	61	1	2	19	15	0	0	0	0	0	132	95	178	89	290	233	3,419
2000	233	441	453	188	141	231	110	92	36	46	85	46	12	5	1	0	0	0	8	60	12	190	258	121	2,766
2001	498	148	715	101	283	121	47	22	8	10	51	6	0	0	0	0	1	1	3	20	76	112	466	193	2,882
Mean	303	292	269	178	177	129	91	68	52	24	24	14	17	12	3	3	14	15	26	34	68	134	229	255	2,434

Note : Jan.-May 1972, Sep.74-Mar.75 : R(Project Area) = 0.879xR(Kampili)
Jun.1972-Aug.74 : R(Project Area) = 0.879x(0.723xR(Bili Bili))

Source : 1972 - 1997 obteined from Supporting Report for Detaile Design on Bili-Bili Irrigation Project in Dec.1999
: 1998 - 2001 Newly Collecting from Balai PSDA Jeneberang

Missing data :

Sandro Bone	Jan. and Feb. 1998
Kampili	Jan. and Feb. 1999
Bontosunggu	Aug. and Sep. 1999
Bontosallang	Jan. - Mar. 2000
Mandalle	Feb. 2000

Table 6.8 (1/2) Projected Municipal Water Demand and Diversion Requirement

Supplier	Present Condition in 2003								
	All Supply Area				from the Jeneberang River				
	WTP		Intake		WTP		Intake		
					Wet Season	Dry Season	Wet Season	Dry Season	Amount
	(m^3/s)	(MCM)	(m^3/s)	(MCM)	(m^3/s)	(m^3/s)	(m^3/s)	(m^3/s)	(MCM)
PDAM Makassar	**2.36** *1	74.30	unknown	unknoun	1.34	1.84	1.47	1.97	54.18
PDAM Gowa	**0.19** *1	5.99	unknown	unknoun	0.18	0.18	0.19	0.19	6.10

Supplier	in 2010								
	All Supply Area				from the Jeneberang River				
	WTP		Intake		WTP		Intake		
					Wet Season	Dry Season	Wet Season	Dry Season	Amount
	(m^3/s)	(MCM)	(m^3/s)	(MCM)	(m^3/s)	(m^3/s)	(m^3/s)	(m^3/s)	(MCM)
PDAM Makassar	**2.74** *1	86.25	unknown	unknown	1.65	unknown	1.80	2.30	64.71
PDAM Gowa	uknown	unknown	0.37	**11.82** *2	unknown	unknown	0.36	0.36	11.50

Supplier	in 2018								
	All Supply Area				from the Jeneberang River				
	WTP		Intake		WTP		Intake		
					Wet Season	Dry Season	Wet Season	Dry Season	Amount
	(m^3/s)	(MCM)	(m^3/s)	(MCM)	(m^3/s)	(m^3/s)	(m^3/s)	(m^3/s)	(MCM)
PDAM Makassar	**4.11** *1	129.48	unknown	unknown	3.02	unknown	3.31	3.81	112.26
PDAM Gowa	unknown	unknown	0.72	**22.81** *3	unknown	unknown	0.71	0.71	22.50

Supplier	in 2019								
	All Supply Area				from the Jeneberang River				
	WTP		Intake		WTP		Intake		
					Wet Season	Dry Season	Wet Season	Dry Season	Amount
	(m^3/s)	(MCM)	(m^3/s)	(MCM)	(m^3/s)	(m^3/s)	(m^3/s)	(m^3/s)	(MCM)
PDAM Makassar	**4.25** *1	134.11	unknown	unknown	3.16	unknown	3.47	3.97	117.30
PDAM Gowa	unknown	unknown	0.77	**24.19** *3	unknown	unknown	0.76	0.76	23.87

Supplier	in 2020								
	All Supply Area				from the Jeneberang River				
	WTP		Intake		WTP		Intake		
					Wet Season	Dry Season	Wet Season	Dry Season	Amount
	(m^3/s)	(MCM)	(m^3/s)	(MCM)	(m^3/s)	(m^3/s)	(m^3/s)	(m^3/s)	(MCM)
PDAM Makassar	**4.40** *1	138.90	unknown	unknown	3.31	unknown	3.63	4.13	122.33
PDAM Gowa	unknown	unknown	0.81	**25.56** *2	unknown	unknown	0.80	0.80	25.24

*1: Refer to Water Supply Section
*2: Refer to Main Report on Consulting Engineering Services for Comprehensive Water Management Plam Stud
for MAROS-JENEPONTO River Basin, Sector 10
*3: estimated to interpolate linear between 2010 and 2020

WTP : Requirement of Water Treatment Plant
Intake : Diversion requirement from the intake

Table 6.8 (2/2) Projected Municipal Water Demand and Diversion Requirement from the Jeneberang River

	Facility Name	Originally Programmed		Present Condition				in 2010			in 2018			Intake Point
				Plant Capacity	Actual[*5]	Intake		Actual	Intake		Actual	Intake		
		(m^3/s)	(MCM)	(m^3/s)	(m^3/s)	(m^3/s)	(MCM)	(m^3/s)	(m^3/s)	(MCM)	(m^3/s)	(m^3/s)	(MCM)	
*1	Somba Opu WTP	3.30	104.07	1.00	1.19	1.31	41.33	1.50	1.64	51.86	2.87	3.15	99.42	Bili-Bili[*3]
*1	Ratulangi WTP	-	-	0.05	0.06	0.07	2.07	0.06	0.07	2.07	0.06	0.07	2.07	Ujung Pandang
*1	Maccini Sombala WTP	-	-	0.20	0.09	0.09	2.90	0.09	0.09	2.90	0.09	0.09	2.90	Malingkeli-1
*1	the growth[*4]	-	-	-	-	-	-	0.00	0.00	0.00	0.00	0.00	0.00	Downstream
*1	Panaikang WTP (for dry season)	-	-	1.00	unknown	0.50	7.88	unknown	0.50	7.88	unknown	0.50	7.88	Malingkeli-2
*2	Bajeng WTP	-	-	0.02	0.02	0.02	0.66	0.02	0.02	0.66	0.02	0.02	0.66	Kampili Weir
*2	Borong Loe WTP	-	-	0.02	0.01	0.01	0.44	0.02	0.02	0.69	0.02	0.02	0.69	Bili-Bili[*3]
*2	Tompo Balang WTP	0.10	3.15	0.04	0.03	0.03	0.83	0.04	0.04	1.32	0.04	0.04	1.32	Sungguminasa
*2	Pandang-Pandang WTP	-	-	0.20	0.13	0.13	4.17	0.20	0.21	6.62	0.20	0.21	6.62	Padang-Pandang
*2	the growth[*4]	-	-	-	-	-	-	0.07	0.07	2.20	0.40	0.42	13.19	Downstream

	Facility Name	in 2019			in 2020			Intake Point
		Actual	Intake		Actual	Intake		
		(m^3/s)	(m^3/s)	(MCM)	(m^3/s)	(m^3/s)	(MCM)	
*1	Somba Opu WTP	2.98	3.28	103.38	2.98	3.28	103.38	Bili-Bili[*3]
*1	Ratulangi WTP	0.06	0.07	2.07	0.06	0.07	2.07	Ujung Pandang
*1	Maccini Sombala WTP	0.12	0.13	3.98	0.20	0.21	6.62	Malingkeli-1
*1	the growth[*4]	0.00	0.00	0.00	0.07	0.08	2.39	Downstream
*1	Panaikang WTP (for dry season)	unknown	0.50	7.88	unknown	0.50	7.88	Malingkeli-2
*2	Bajeng WTP	0.02	0.02	0.66	0.02	0.02	0.66	Kampili Weir
*2	Borong Loe WTP	0.02	0.02	0.69	0.02	0.02	0.69	Bili-Bili[*3]
*2	Tompo Balang WTP	0.04	0.04	1.32	0.04	0.04	1.32	Sungguminasa
*2	Pandang-Pandang WTP	0.20	0.21	6.62	0.20	0.21	6.62	Padang-Pandang
*2	the growth[*4]	0.44	0.46	14.57	0.48	0.51	15.94	Downstream

*1 : Operated by PDAM Makassar
*2 : Operated by PDAM Gowa
*3 : Intake point between Bili-Bili MultipurposeDam and Bili-Bilii Weir
*4 : Water Demand Increament which cannot be provided from existing WTP capacity and Somba Opu reinforcement
*5 : Refer to Water Supply Sector
Actual : actual requirement of Water Treatment Plant
Intake : estimated diversion requiremenr from the intake

Table 6.9 Result of Bili-Bili Reservoir Simulation

Year	Minimum Water Level (m)				Minimum Storage Volume above LWL (MCM)			
	Present (2003)	2018	2019	2020	Present (2003)	2018	2019	2020
1972	65.0	65.0	65.0	65.0	0.0	0.0	0.0	0.0
1973	87.2	86.3	86.2	86.2	130.5	120.7	119.9	119.6
1974	91.1	88.9	88.7	88.5	178.2	150.4	148.0	145.6
1975	89.7	87.3	87.0	86.8	159.9	131.0	128.3	125.6
1976	73.0	65.0	65.0	65.0	23.5	0.0	0.0	0.0
1977	82.5	76.2	75.7	75.1	84.1	42.7	39.1	35.6
1978	98.6	96.6	96.4	96.2	292.1	259.3	255.3	251.9
1979	83.8	79.1	78.4	77.9	96.1	59.7	56.4	53.2
1980	81.4	75.7	75.3	74.8	75.3	39.5	36.5	33.6
1981	90.3	87.5	87.2	87.0	167.5	133.4	130.5	127.9
1982	65.0	65.0	65.0	65.0	0.0	0.0	0.0	0.0
1983	67.4	65.0	65.0	65.0	5.2	0.0	0.0	0.0
1984	89.2	86.0	85.7	85.4	153.4	117.1	114.0	111.2
1985	89.8	87.4	87.1	86.9	161.0	132.3	129.7	127.4
1986	84.2	80.3	79.6	78.9	99.2	65.2	61.9	58.6
1987	75.1	65.9	65.0	65.0	35.6	1.9	0.0	0.0
1988	87.9	84.5	84.2	83.9	138.3	102.7	99.6	96.5
1989	98.5	97.9	97.8	97.7	289.4	279.4	278.4	277.4
1990	93.4	91.8	91.7	91.5	209.6	187.8	186.0	184.0
1991	76.1	66.4	65.0	65.0	41.9	3.0	0.0	0.0
1992	72.8	65.0	65.0	65.0	22.8	0.0	0.0	0.0
1993	86.1	83.0	82.9	82.9	118.6	88.6	88.1	88.0
1994	76.8	68.2	66.7	65.0	46.5	7.1	3.7	0.3
1995	86.3	81.5	81.1	80.6	120.3	76.3	72.6	69.3
1996	79.4	73.3	72.6	71.8	61.4	24.8	21.7	18.5
1997	65.0	65.0	65.0	65.0	0.0	0.0	0.0	0.0
1998	81.0	77.8	77.6	77.4	71.9	53.0	51.4	50.2
1999	82.1	76.6	76.2	75.7	81.3	45.6	42.5	39.4
2000	95.5	94.0	93.8	93.7	241.1	218.3	216.3	214.3
2001	95.5	94.0	93.8	93.7	126.5	92.6	89.7	86.7

Table 6.10 Areal Average Raindall in Lower Reaches of Jeneberang River below Bili-Bili Dam in the Drought Year

Year	Occurrence of Drought				Areal Average Raindall				
	Present	2018	2019	2020	Apr.	May	Jun	Total	Annual
1972	*	*	*	*	61	13	0	74	1,998
1973					444	123	19	586	2,647
1974					166	69	34	269	2,528
1975					323	72	44	438	2,698
1976		*	*	*	42	58	34	134	2,438
1977					135	39	75	249	2,979
1978					178	263	86	527	2,774
1979					65	115	112	292	2,618
1980					172	27	9	208	2,451
1981					97	79	27	203	2,543
1982	*	*	*	*	64	34	12	110	1,721
1983		*	*	*	186	69	23	277	1,698
1984					146	148	13	306	2,536
1985					166	97	30	293	1,961
1986					130	29	51	211	2,237
1987			*	*	84	73	2	158	3,040
1988					144	147	16	307	3,025
1989					305	63	77	446	2,671
1990					66	176	7	249	1,953
1991			*	*	177	5	1	183	1,760
1992		*	*	*	105	11	43	159	1,755
1993					178	79	34	291	1,987
1994					99	36	12	146	2,057
1995					308	80	48	436	2,649
1996					79	23	15	117	3,092
1997	*	*	*	*	83	16	1	100	1,609
1998					321	162	111	595	2,532
1999					174	62	21	257	3,419
2000					202	83	130	415	2,766
2001					69	17	57	144	2,882
Average					159	76	38	273	2,434

* : The year during which the storage volume of Bili-Bili dam reservoir drops to zero.

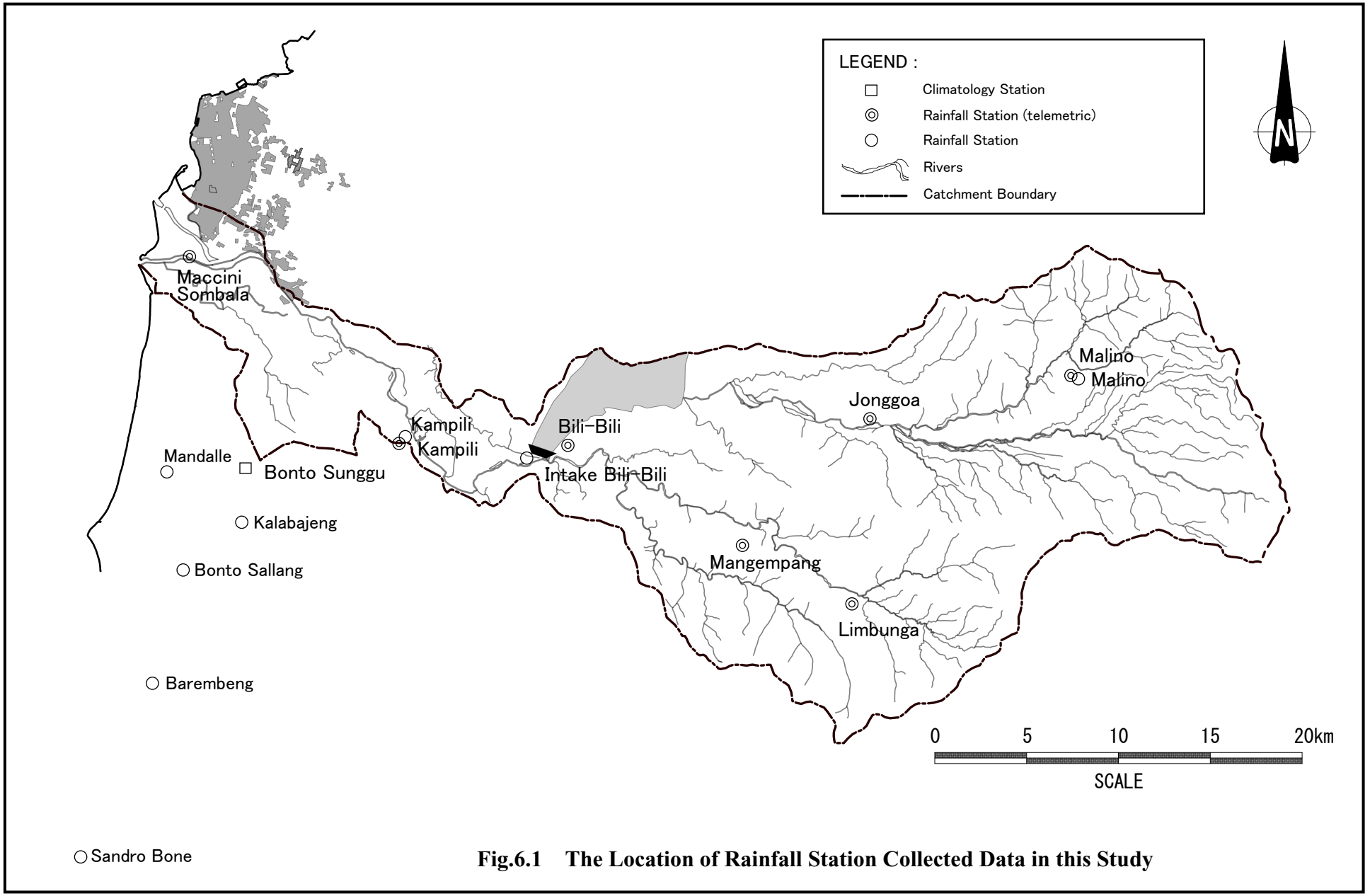


Fig.6.1 The Location of Rainfall Station Collected Data in this Study

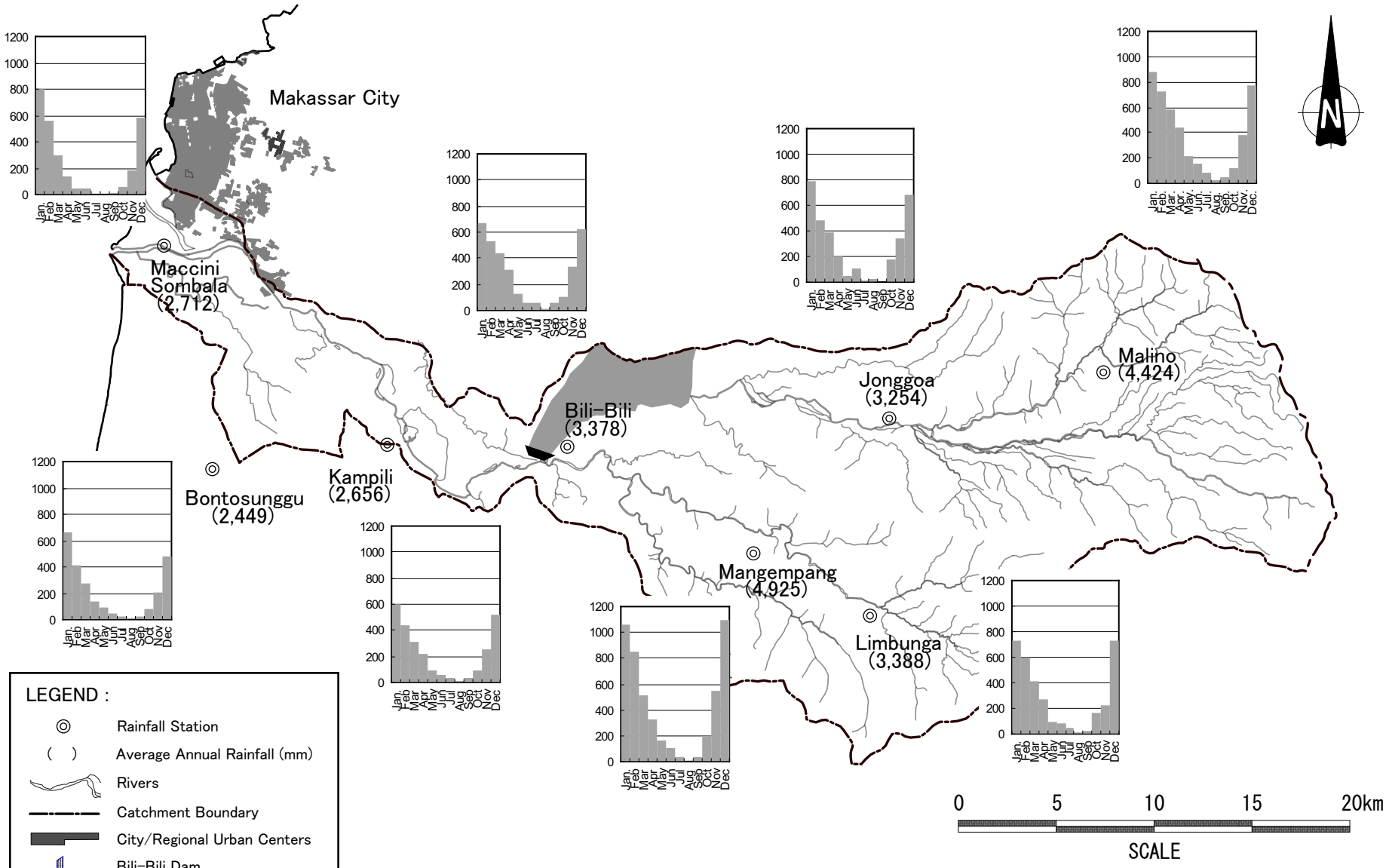


Figure 6.2 Seasonal Rainfall in the Jeneberang River Basin

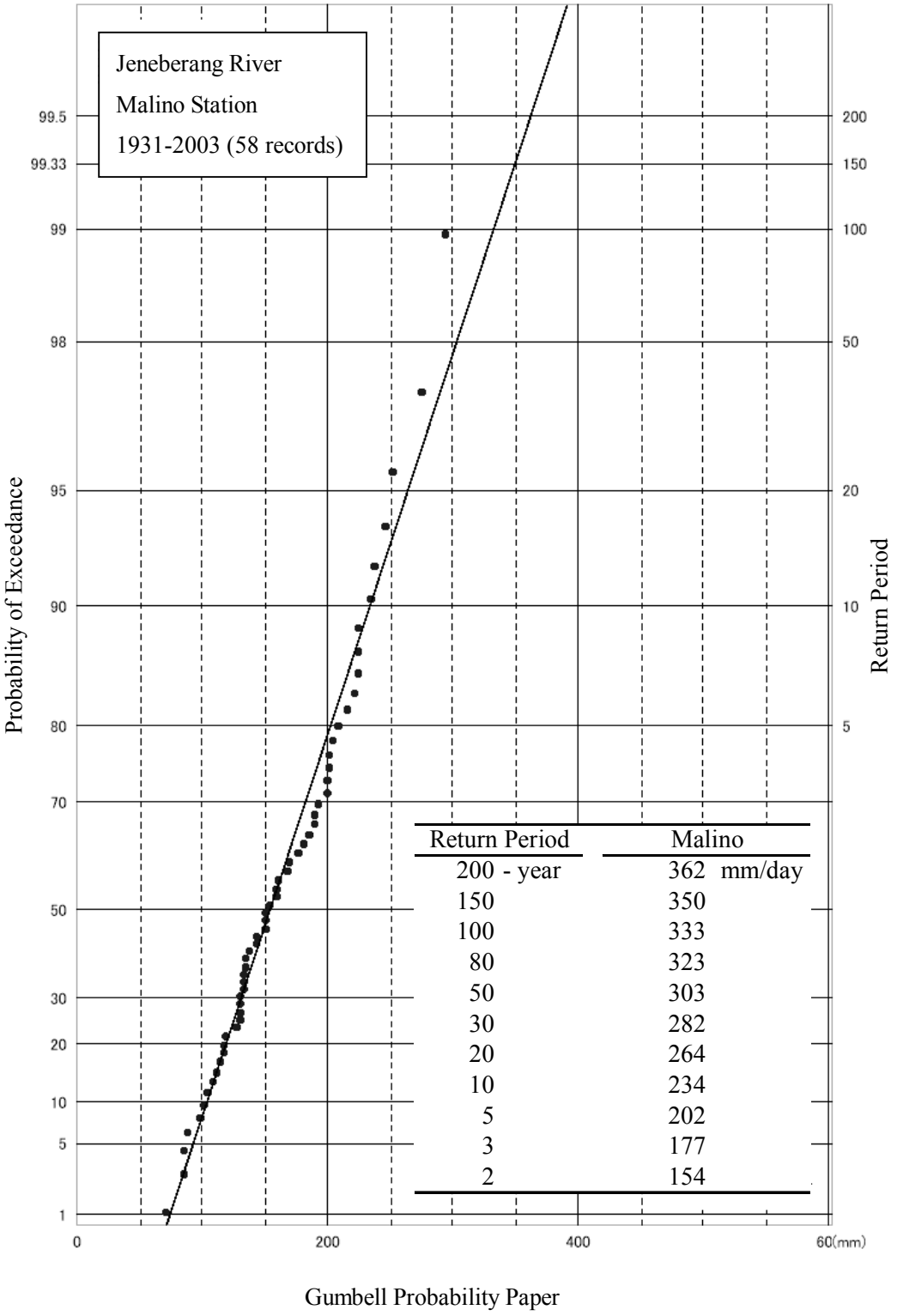


Figure 6.3 (1/2) Probable Maximum One-day Rainfall (Malino)

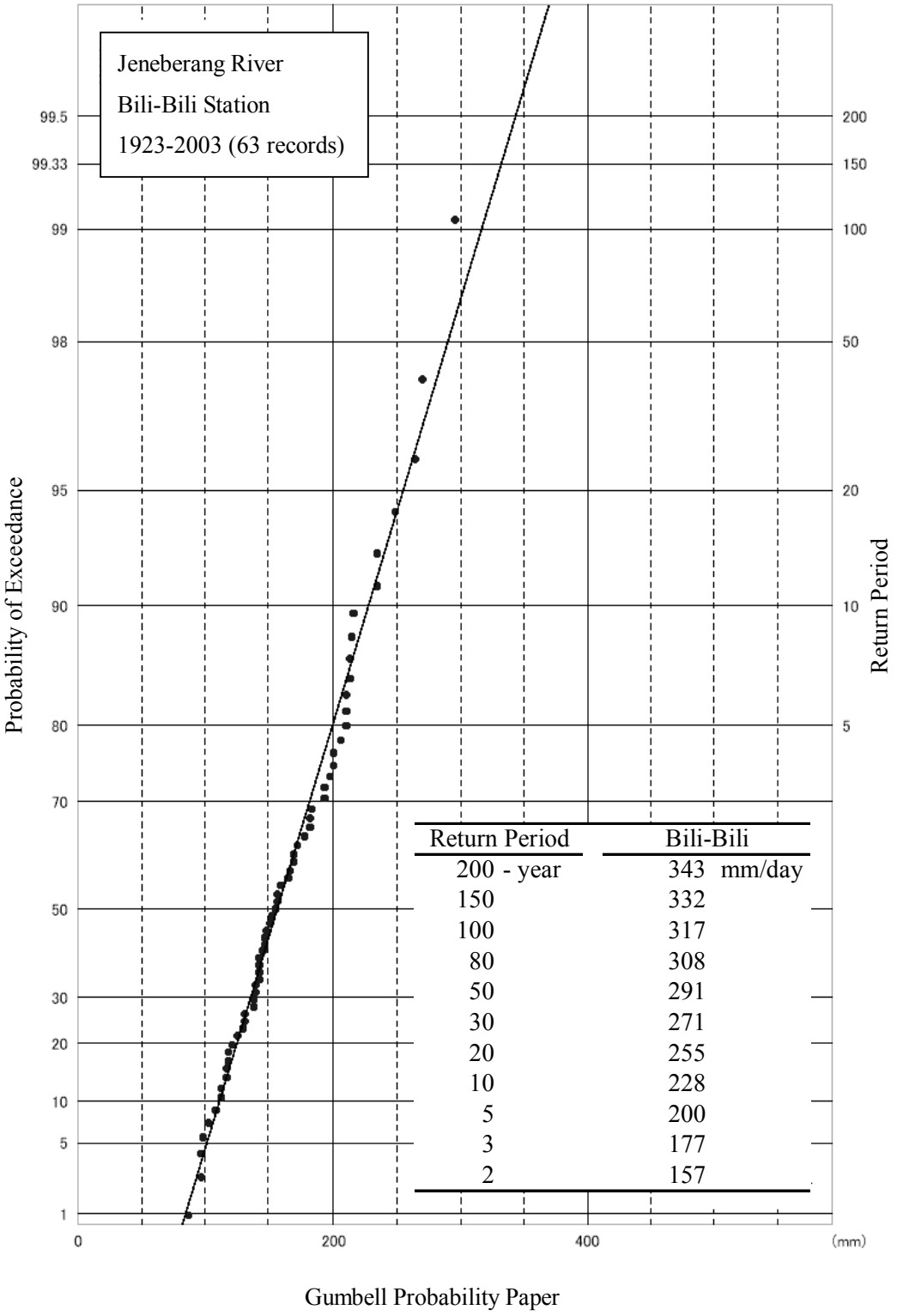


Figure 6.3 (2/2) **Probable Maximum One-day Rainfall (Bili-Bili)**

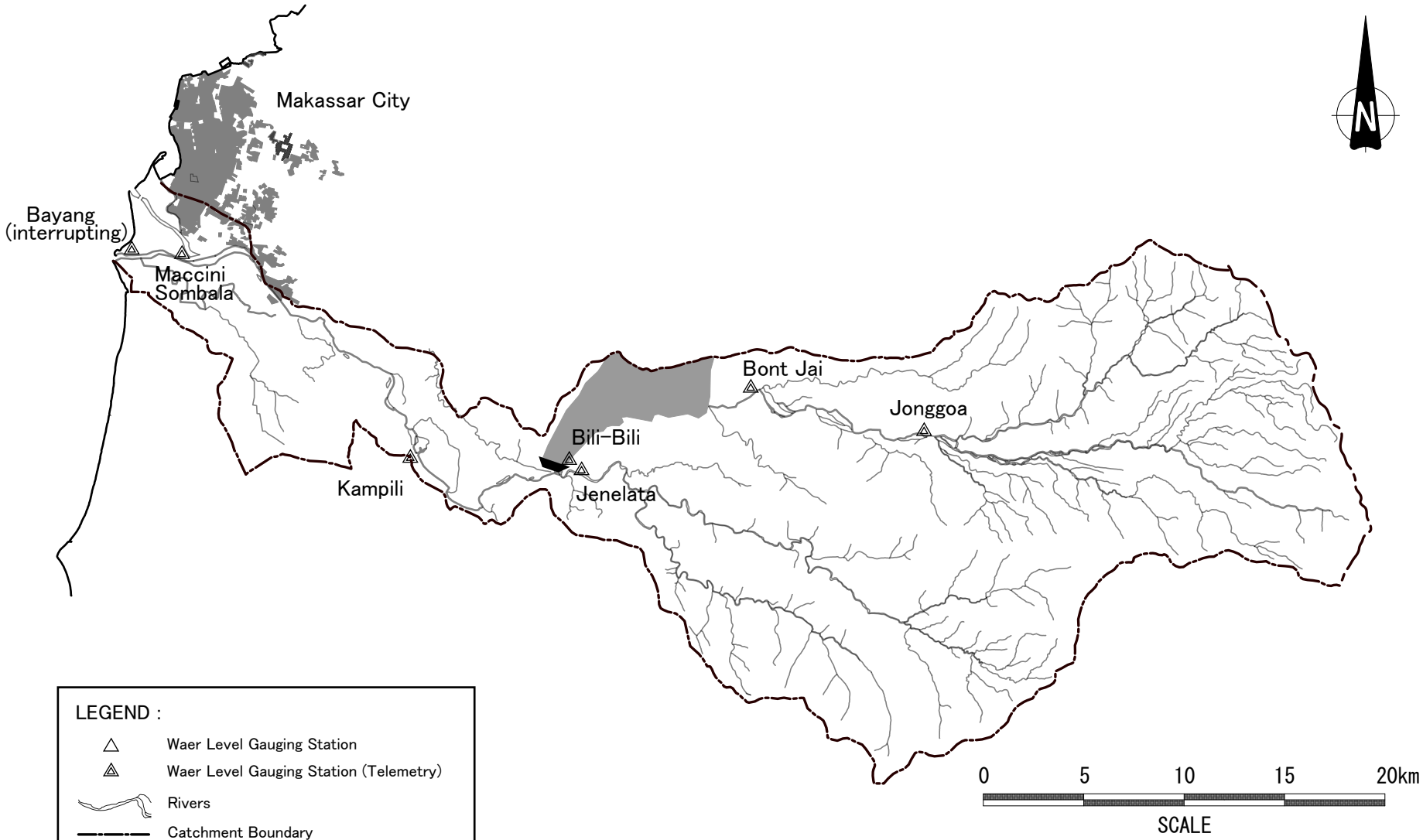
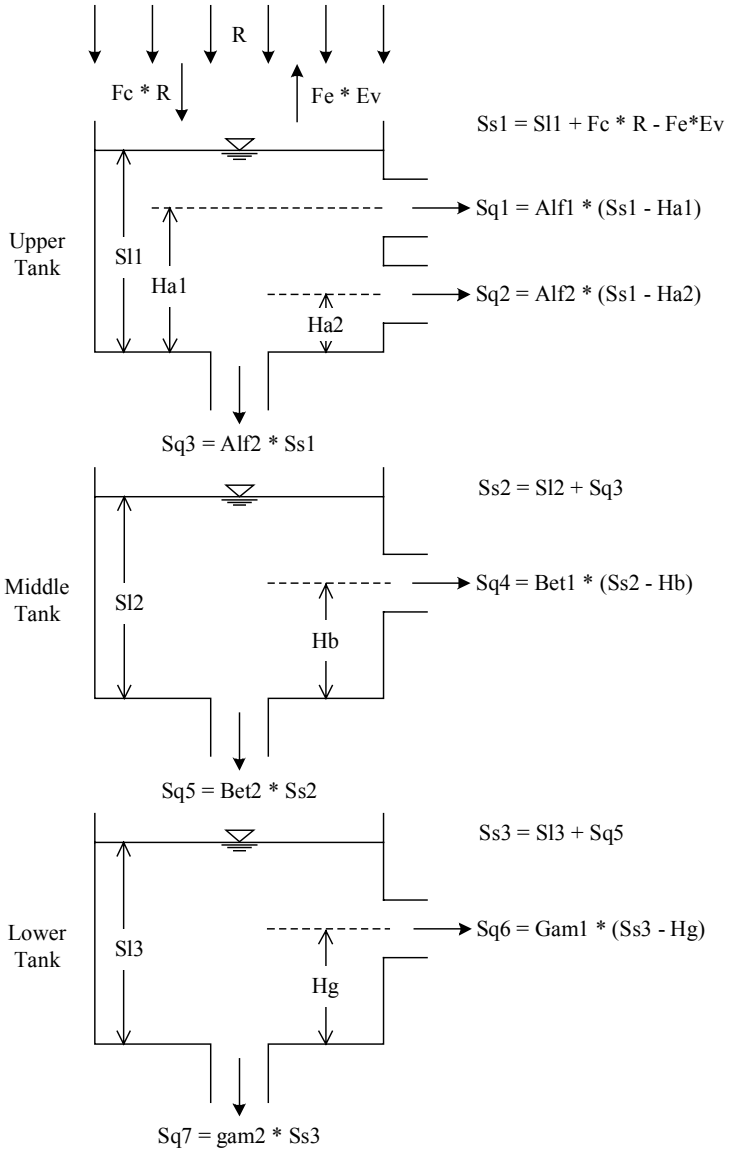
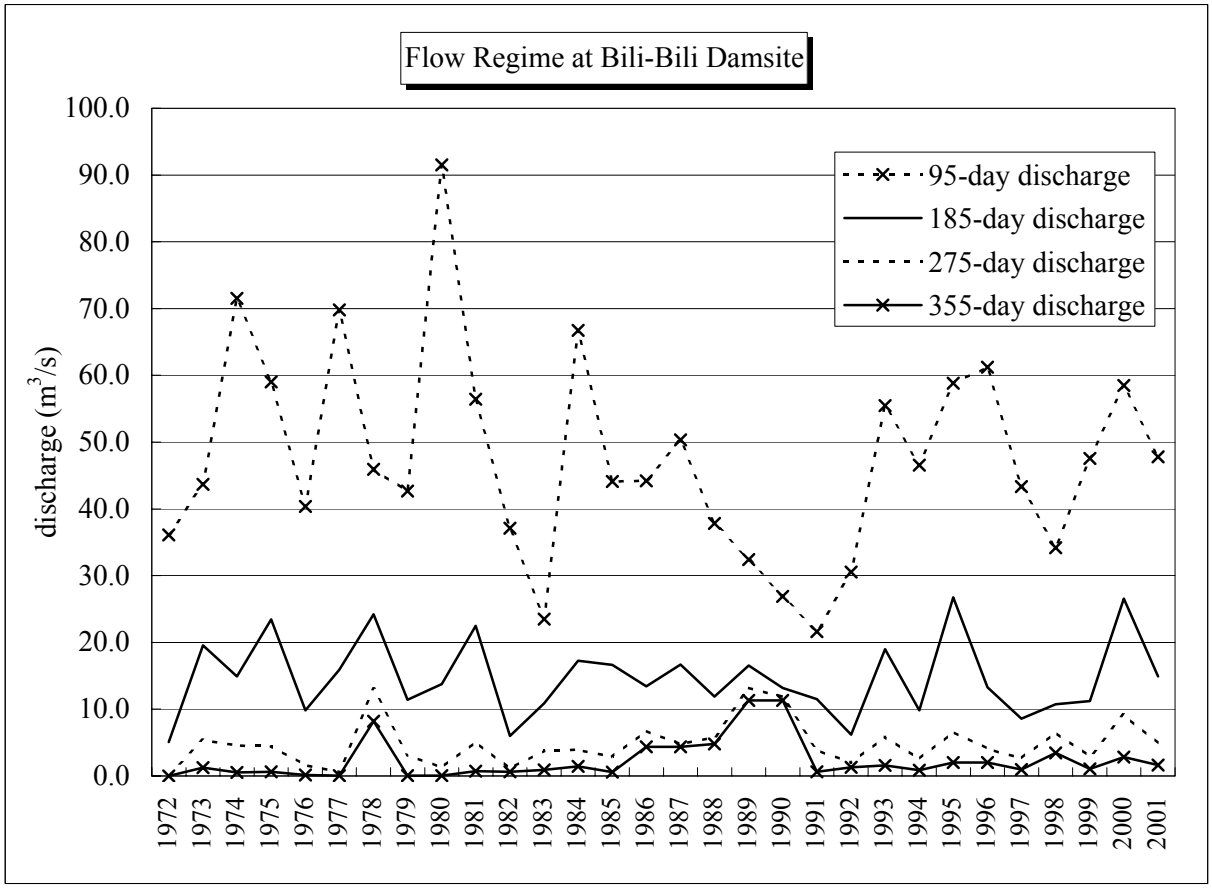


Fig.6.4 Location Map of Water Level Gauging Station in the Jeneberang River Basin



Parameter	Jeneberang River			Jenelata River		
Catchment Area (km^2)	384.4			226.3		
Multiplying Constant of Outlet (mm)						
- Upper Tank	0.900	0.600	0.200	0.700	0.260	0.130
- Middle Tank	0.050	0.030		0.060	0.020	
- Lower Tank	0.004	0.015		0.008	0.001	
Height of Outlet (mm)						
- Upper Tank	50	10		90	20	
- Middle Tank	10			20		
- Lower Tank	10			20		
Evaporation Factor	0.55			0.65		
Effective Rainfall Ratio	1.00			0.93		

Figure 6.5 Structure and Parameter of Tank Model in this Study



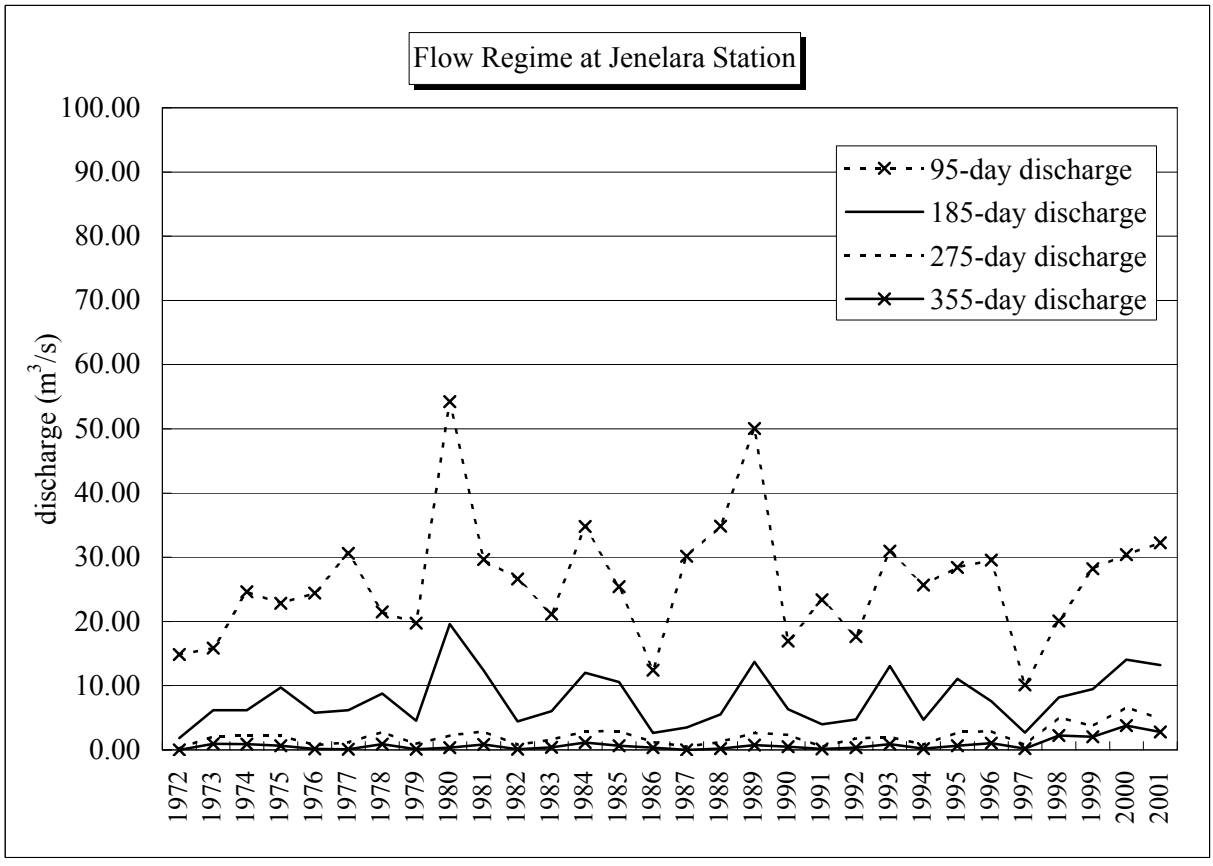


Figure 6.6 Flow Regime in the Jeneberang River Basin

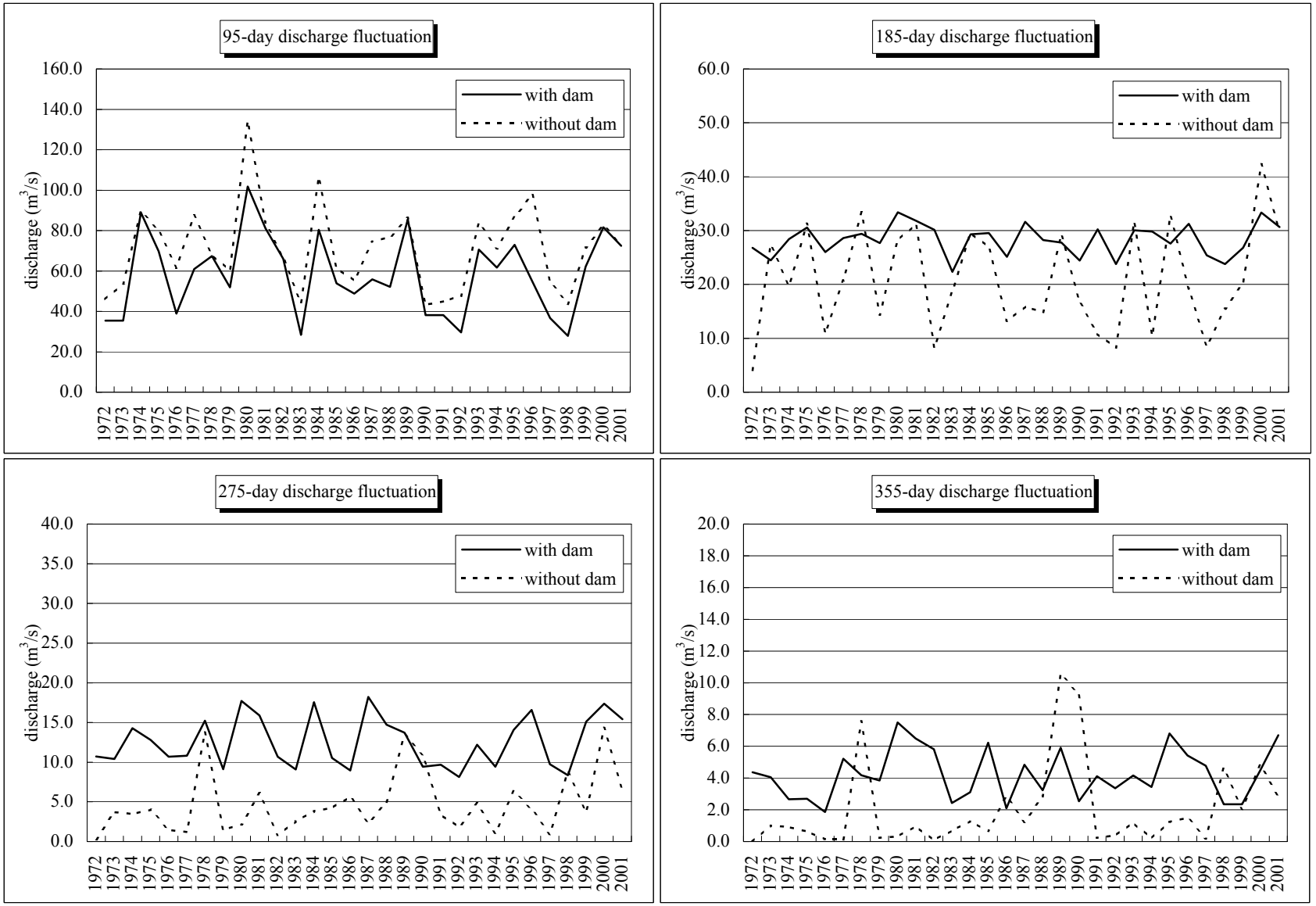
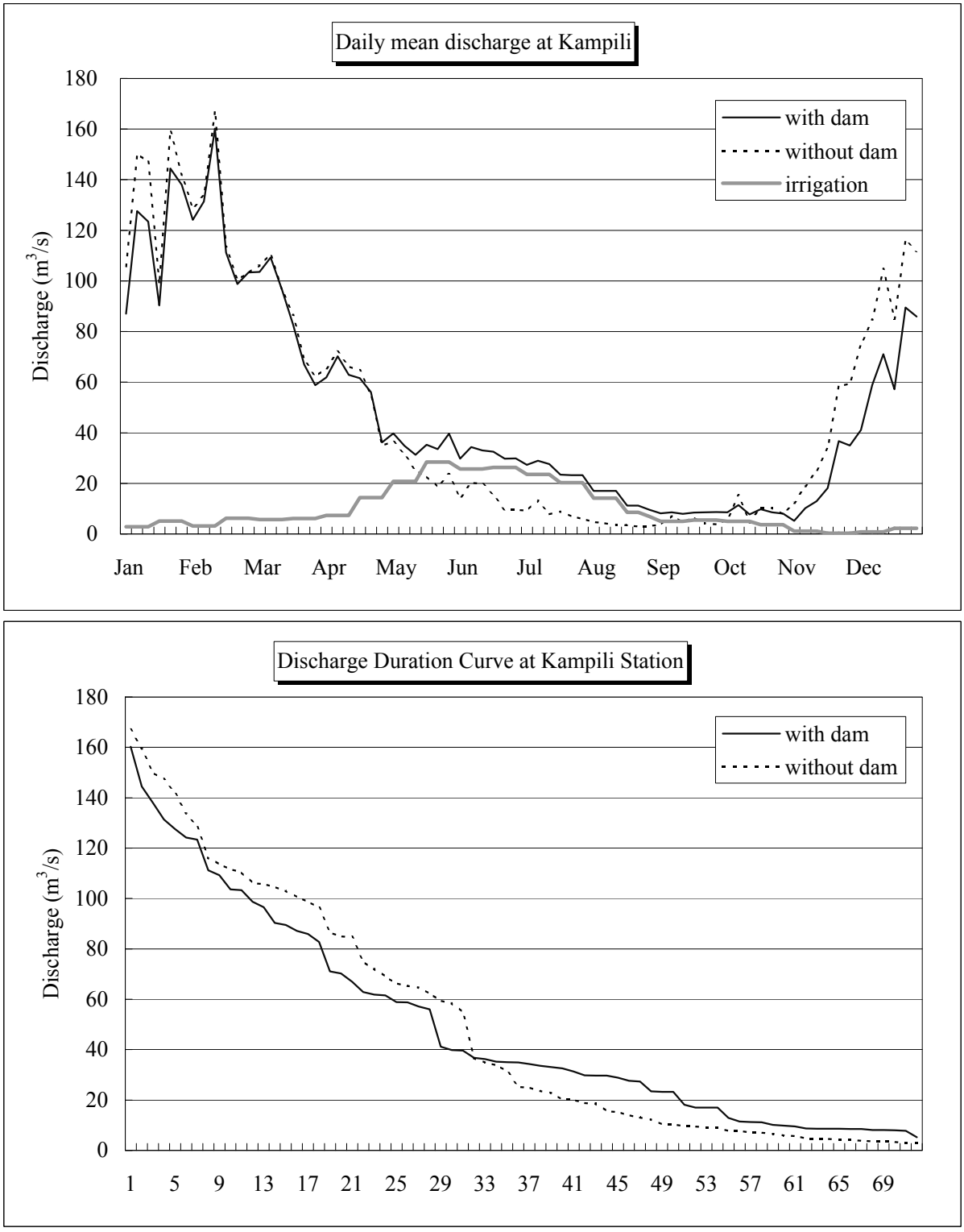


Figure 6.7 Flow Regime at Kampili Station



Data : Averaged from 1972 to 2001based on 5-days discharge

Figure 6.8 Flow Regime Improvement by Bili-Bili Multipurpose Dam

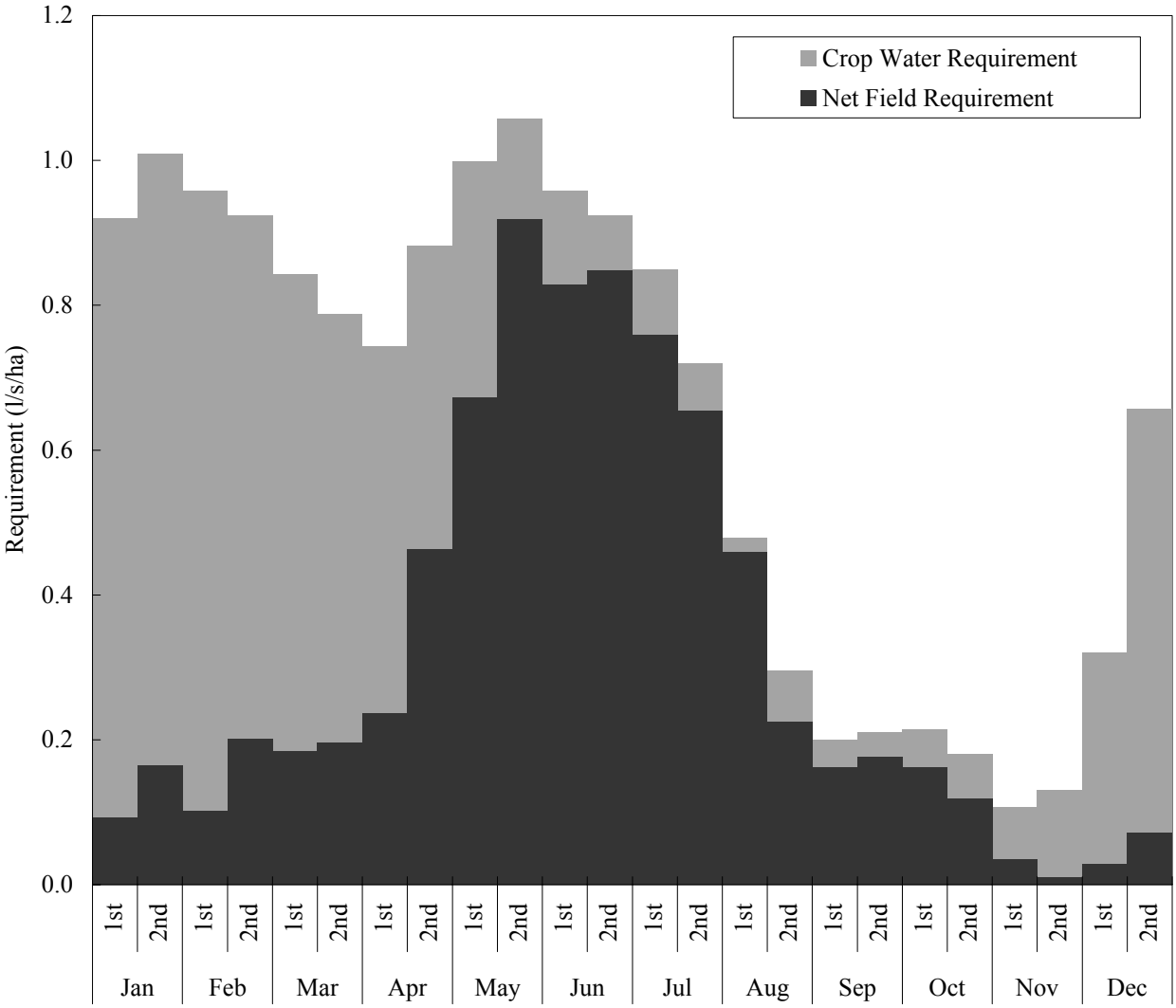


Figure 6.9 Irrigation Water Requirement

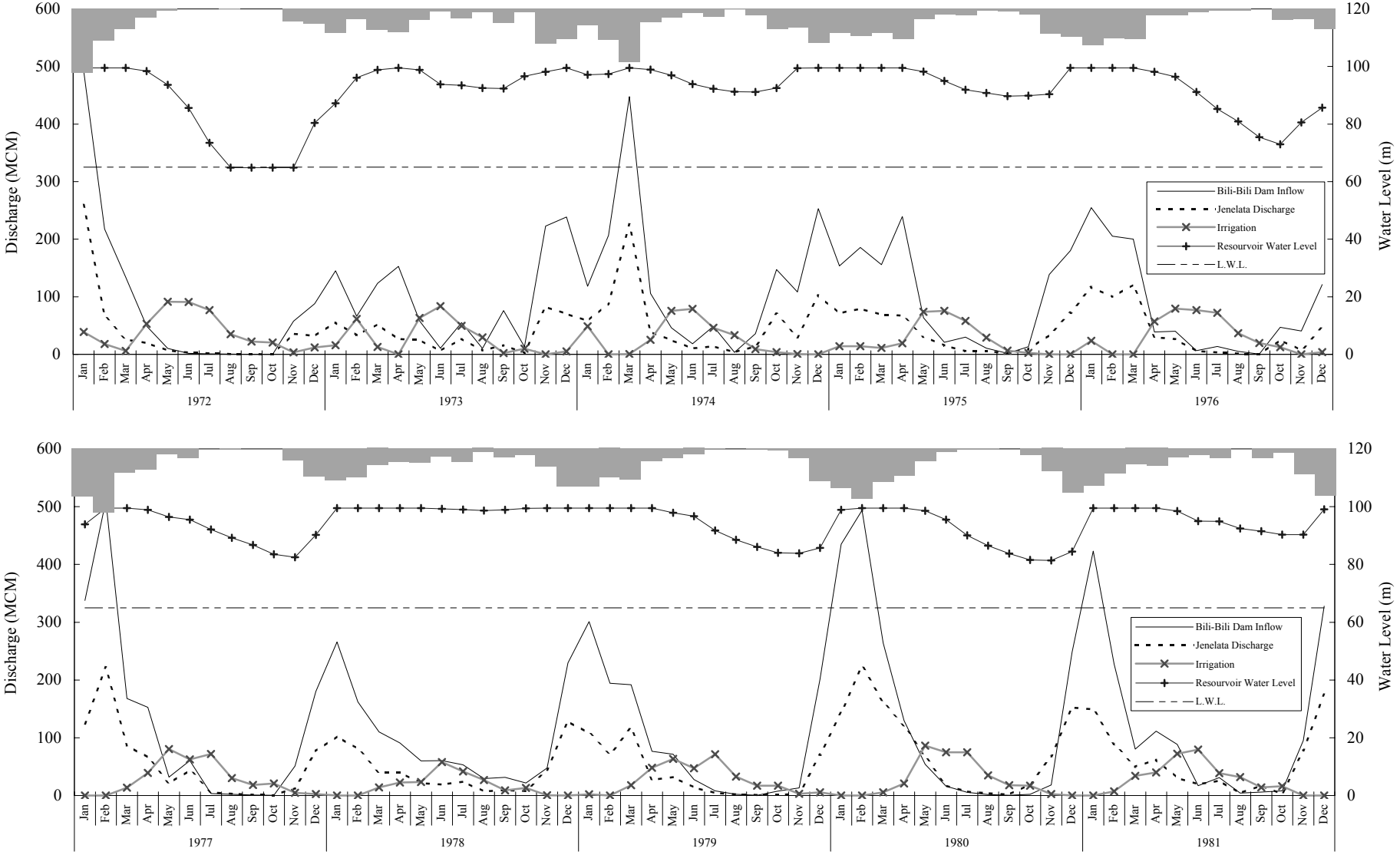


Figure 6.10 (1/3) Result of Water Balance Calculation

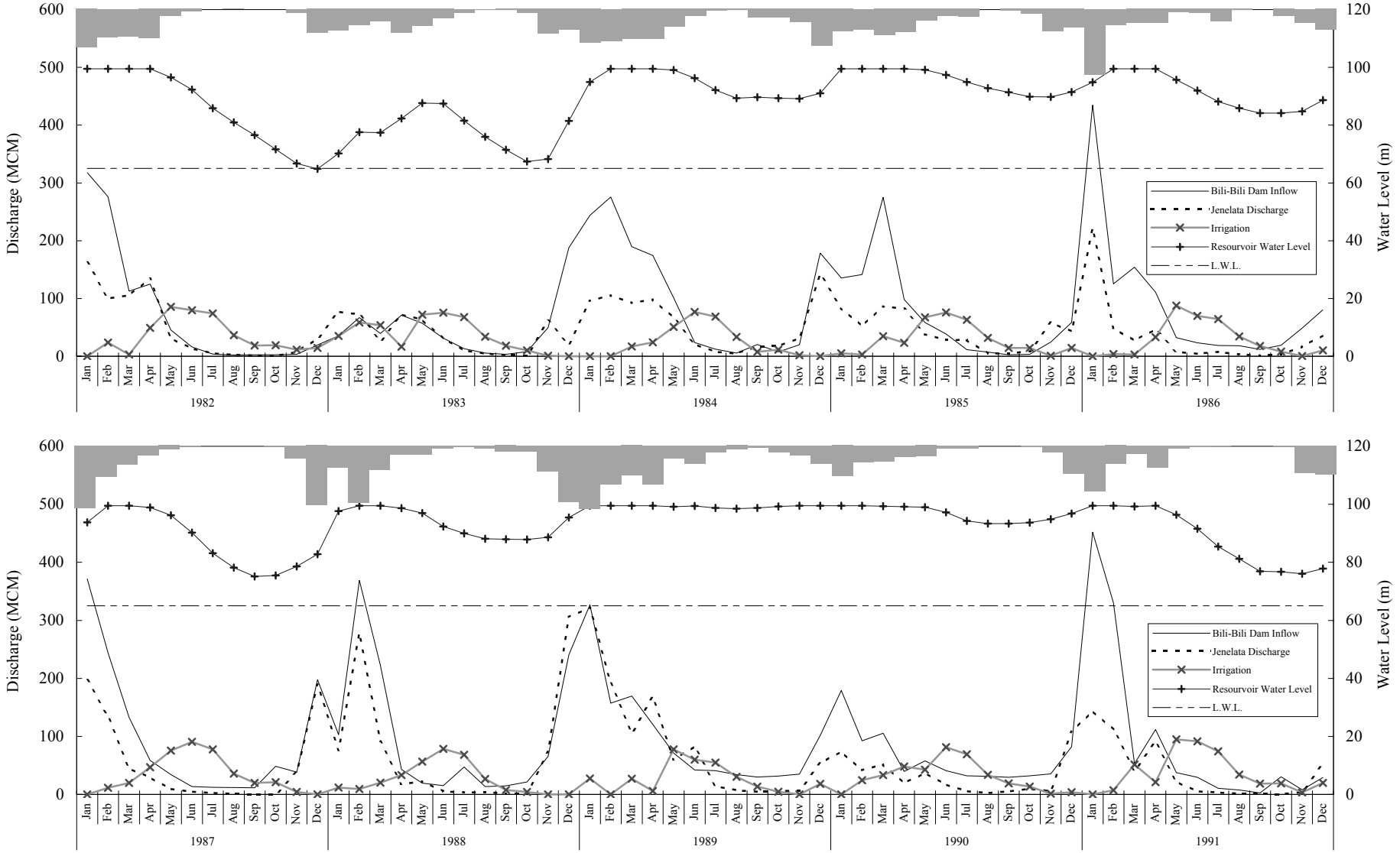


Figure 6.10 (2/3) Result of Water Balance Calculation

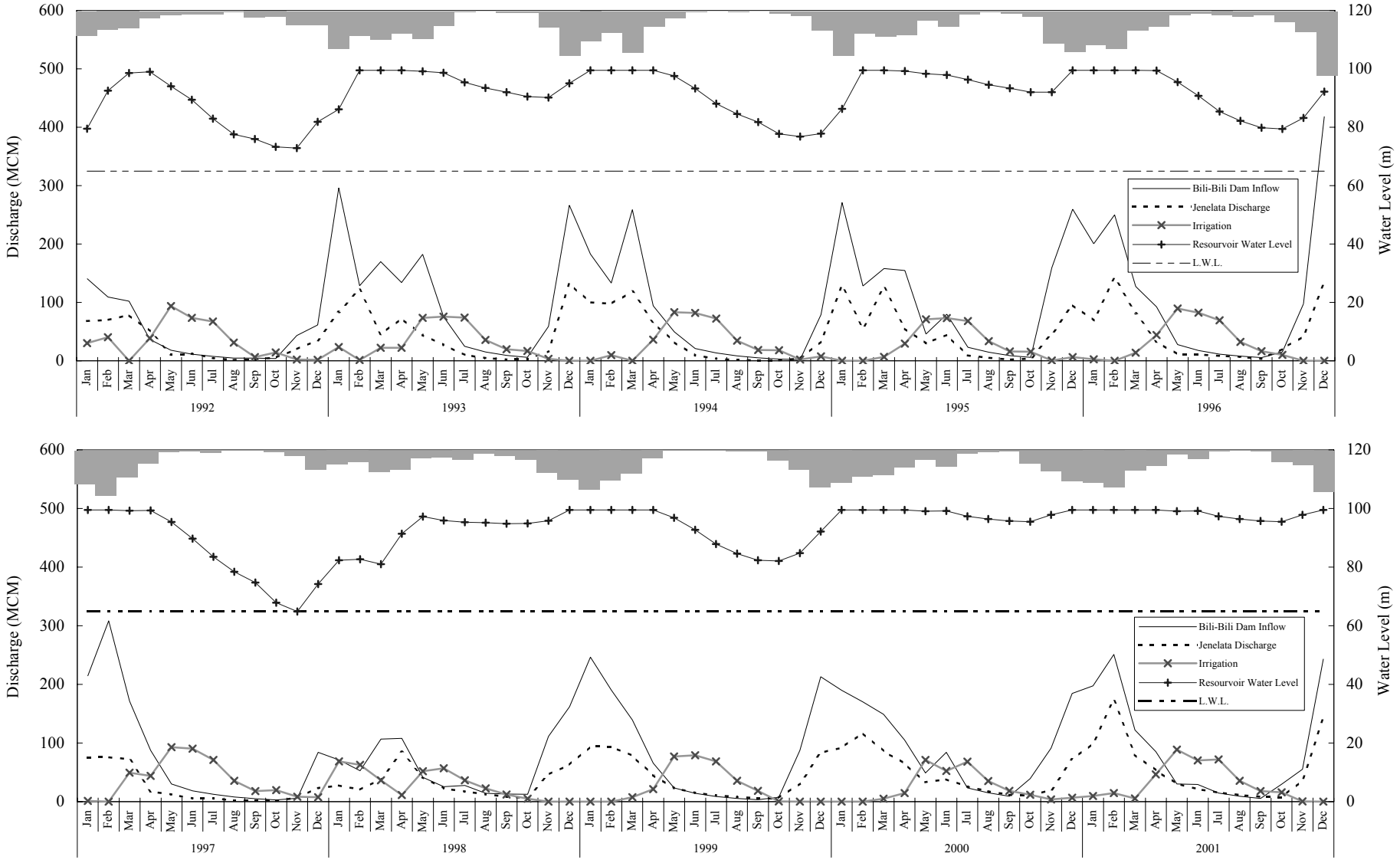


Figure 6.10 (3/3) Result of Water Balance Calculation

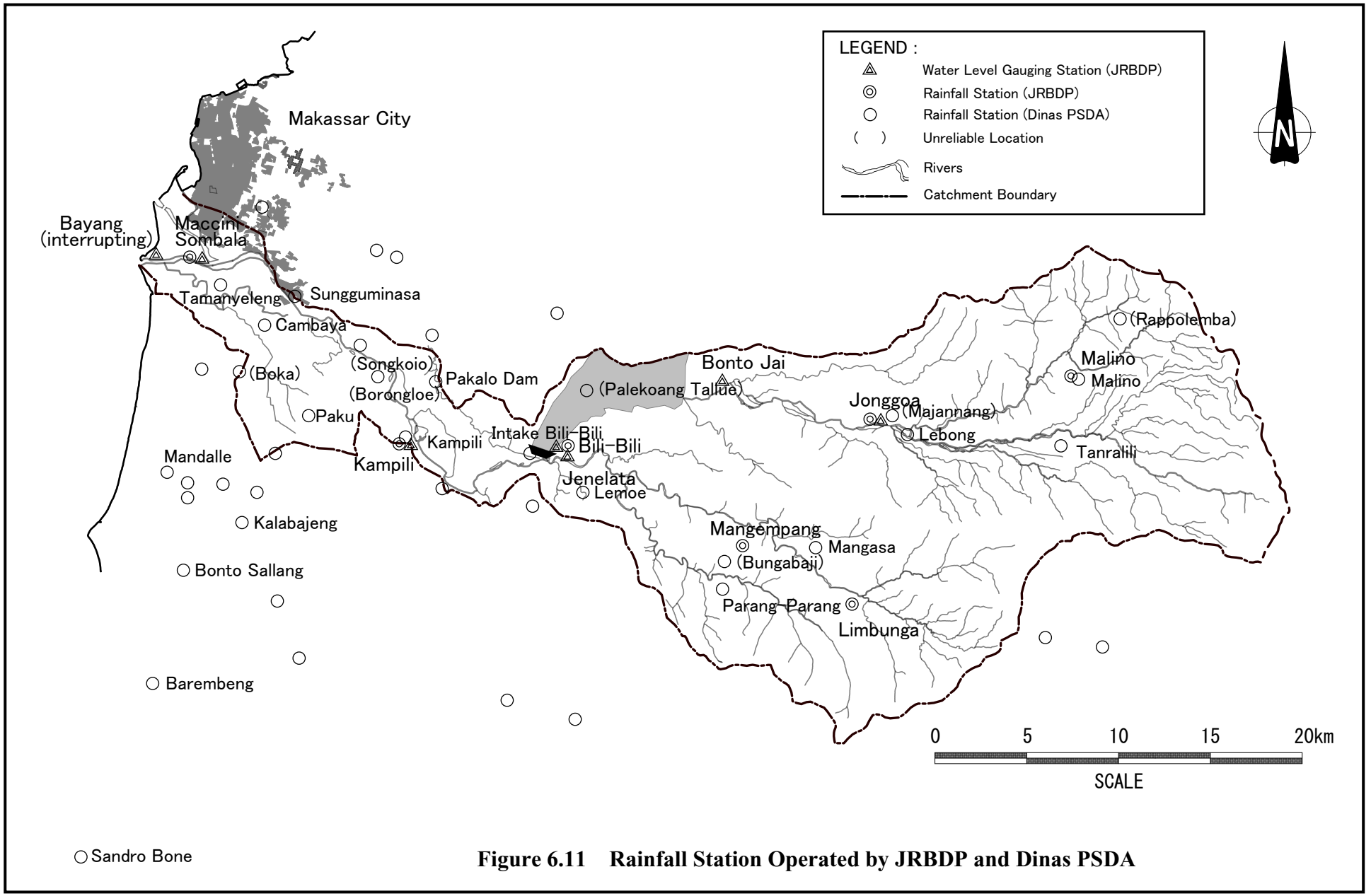


Figure 6.11 Rainfall Station Operated by JRBDP and Dinas PSDA

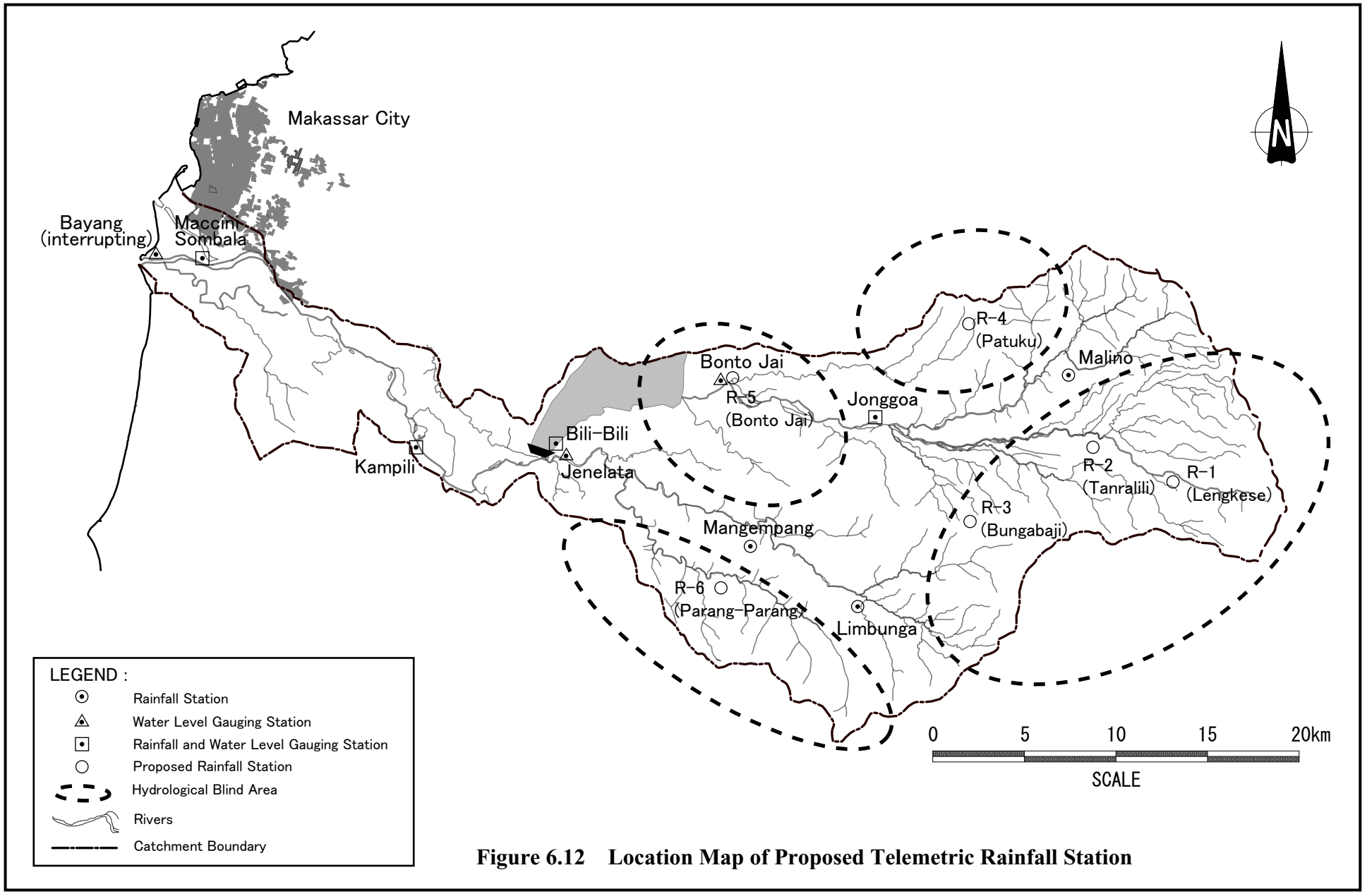


Figure 6.12 Location Map of Proposed Telemetric Rainfall Station