

Table-4.24 Problems and Issues in Rivers of Bali

Zone	District/City	River Name	Problem/Issues	Countermeasures
East Bali	KARANGASEM KLUNGKUNG	Karobelahan, Daya, Nusu, Sakta, Batuniti, Kates, Kerkuk, Janga, Buhu, Unda (Telagawaja, Yeh Sah, Langon, Barak), Jinah, Lombang	1. Annual rainfall: 2,200 - 3,000 mm 2. Influenced by erupted material of Mt. Agung 3. Erosion is relatively active in the upstream, and causes sedimentation in the downstream.	1. Check dam, 2. Sand Pocket, 3. Groundsill, 4. Revetment, 5. Normalization, 6. Dike
	GIANYAR BANGLI	Melangit, Sungasang, Pakerisan, Petanu, Oos, Buhu		
Central Bali	BULELENG	Canging, Banyumala, Buleleng	1. Annual rainfall: 2,000 - 2,800 mm 2. "Bottle necks" 3. Sedimentation 4. Some rivers are influenced by tide.	1. Revetment, 2. Normalization, 3. Dike 4. Upstream Lands Conservation
	BADUNG DENPASAR	Badung, Mati, Teba		
	TABANAN	Yeh Ho, Balian, Bakung		
West Bali	BULELENG	Banyupoh, Grokgak, Tinga-Tinga, Sumaga, Gemgem, Saba, Medaum	1. Annual rainfall: 1,400 - 2,200 mm 2. Erosion is relatively active in the upstream, and causes sedimentation and river meandering in downstream. 3. Some rivers are influenced by tide.	1. Revetment, 2. Normalization, 3. Dike 4. Shortcut
	JEMBRANA	Sumbul, Bilukpoh, Sowan (Tukad Jogading, Tukad Pergung, Tukad daya Timur)		

Source: Pekerjaan Pembuatan Peta Banjir di Propinsi Bali, Proyek Pengelolaan Sumber Air dan Pengendalian Banjir Bali, 1996

<Design Scale>

For new projects, minimum design flood return periods of more than 10 years in the initial phase and more than 25 years in the final phase are recommended.

<Alternatives of Flood Control Plan>

The alternatives for flood control plan for each targeted area are summarized as shown in Table-4.25.

Table-4.25 Alternatives for Flood Control Plan for Each Targeted Area

Area	Rivers	River Characteristics and Land use	Adopted Alternatives	Another Alternatives
Denpasar City, Badung Regency	Badung	Urbanization in progress, Densely built-up area, River flows below inland elevation level	Mainly riverbed excavation due to difficulty of river widening	Diversion to adjacent rivers
	Mati	No improvement from Ulun Tanjung Weir to Umadui Weir. (paddy field except near Kuta area)	River improvement and retarding basin (securing or natural retarding function)	Diversion to asea, 2 locations retarding basin
Singaraja Area	Buleleng	Inland low-lying area in downstream, Densely built-up area, Revetment fracturing	Riverbed excavation, revetment improvement	-
	Banumala	No improvement in downstream section	Banking, Revetment	-
Negara Area	Sowan (Kaliakah, Ijogading, Aya Timur, etc)	River improvement in progress after 1998 flooding	Normalization, Revetment, Grandsill, et	Continuance of river improvement

4.4.2 Flood Control Plan for Badung River and Mati River

Outlines of flood control plan for Badung River and Mati River are shown in Table-4.26.

Considering the conditions of river basin such as land use, applied flood control systems are enlargement of flow area by riverbed excavation for Badung River, and combination of enlargement of flow area by riverbed excavation and retarding basin for Mati River.

Table-4.26 Flood Control Plan for Badung River and Mati River

River	Badung River	Mati River
Design Scale	25 years	25 years
Flood Processing System	Riverbed Excavation	Riverbed Excavation & Maintenance of Retarding Basins
Content	<ul style="list-style-type: none"> ◆ Enlargement of flow area between Buagan weir and JL.Gajamada with removing Buagan weir to improve flow capability. ◆ Irrigation channel is connecting to Tebe River. 	<ul style="list-style-type: none"> ◆ Enlargement of flow area between JL. Gunung Sopotan and JL. Bypass to improve flow capability. ◆ Regulate present land use of existing retarding basin to keep its function. (area of 15ha)
Major Works	<ul style="list-style-type: none"> 【Riverbed Excavation】 【Removal of Existing Weir】 【Environmental Improve】 	<ul style="list-style-type: none"> 【Riverbed Excavation】 【Removal of Existing Weir】 【Environmental Improve】
Subjects to be Solved	<ul style="list-style-type: none"> ◆ Consensus with farmers ◆ Disposal of excavated soil. 	<ul style="list-style-type: none"> ◆ Land acquisition/compensation ◆ Land use/spatial planning

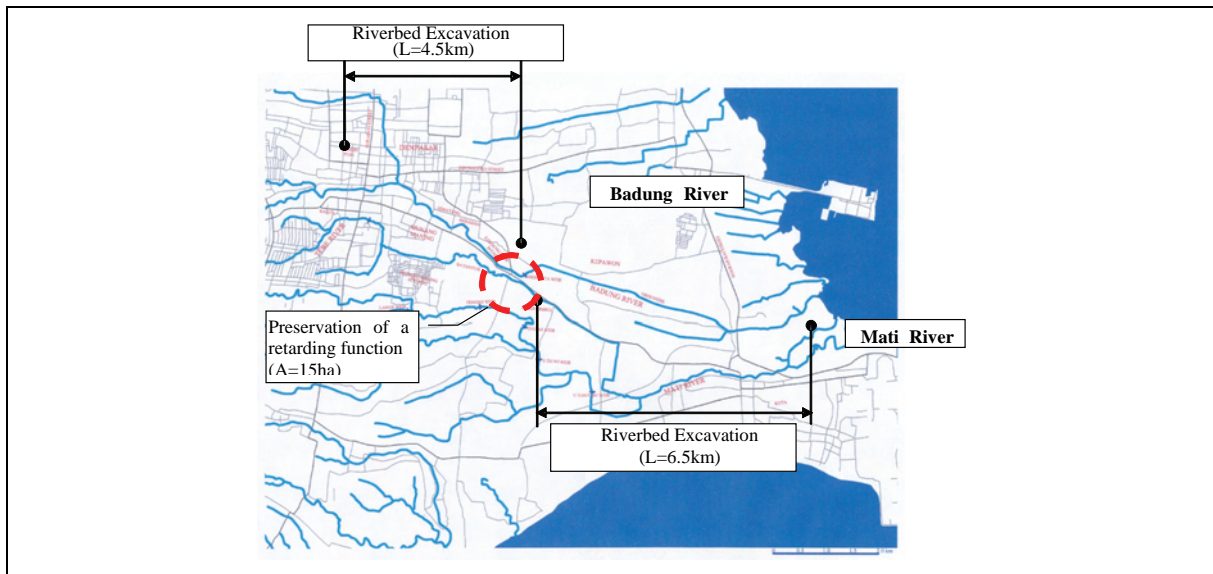


Figure-4.29 Flood Control Plan for Badung River And Mati River

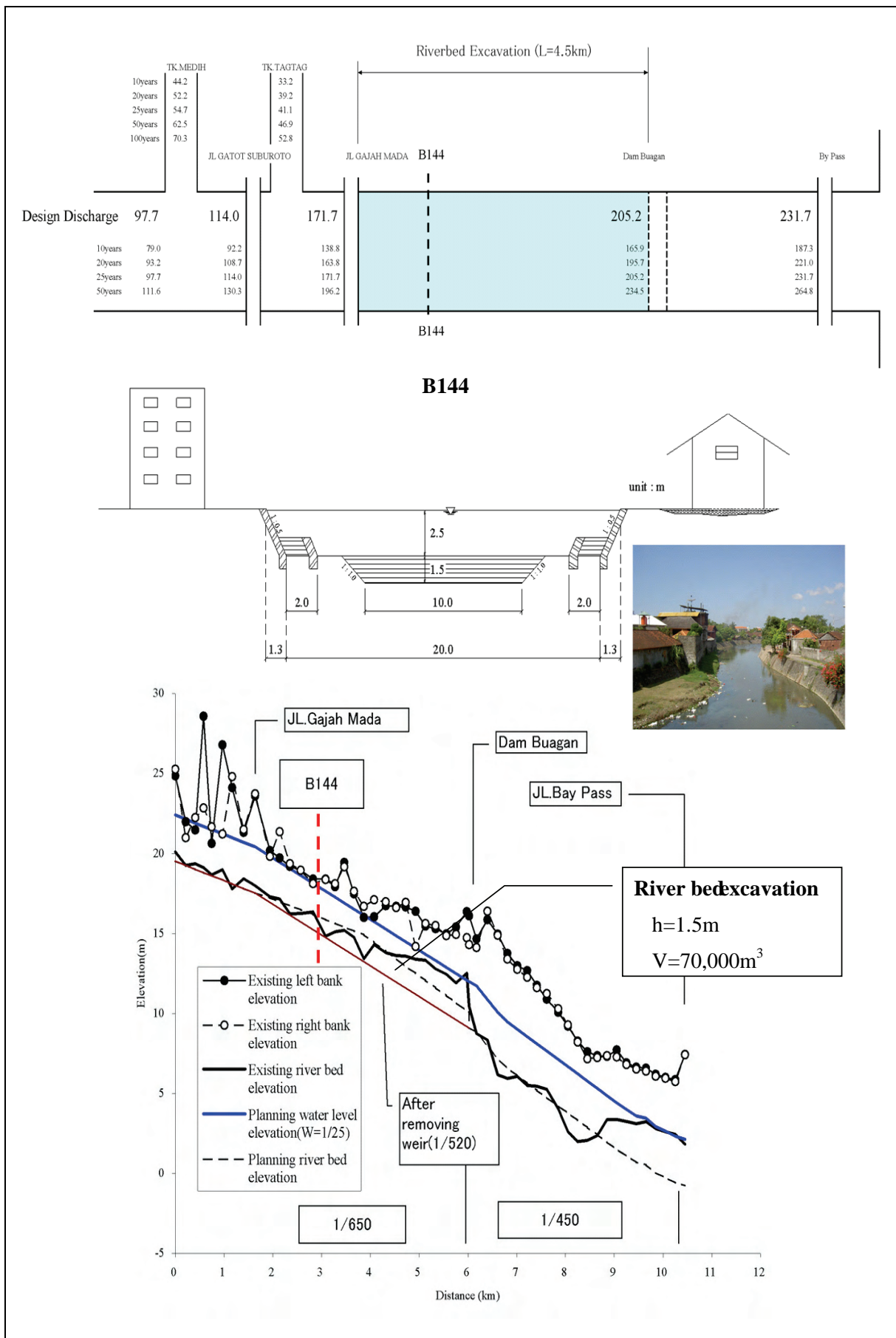


Figure-4.30 Flood Control Plan for Badung River (Riverbed Excavation)

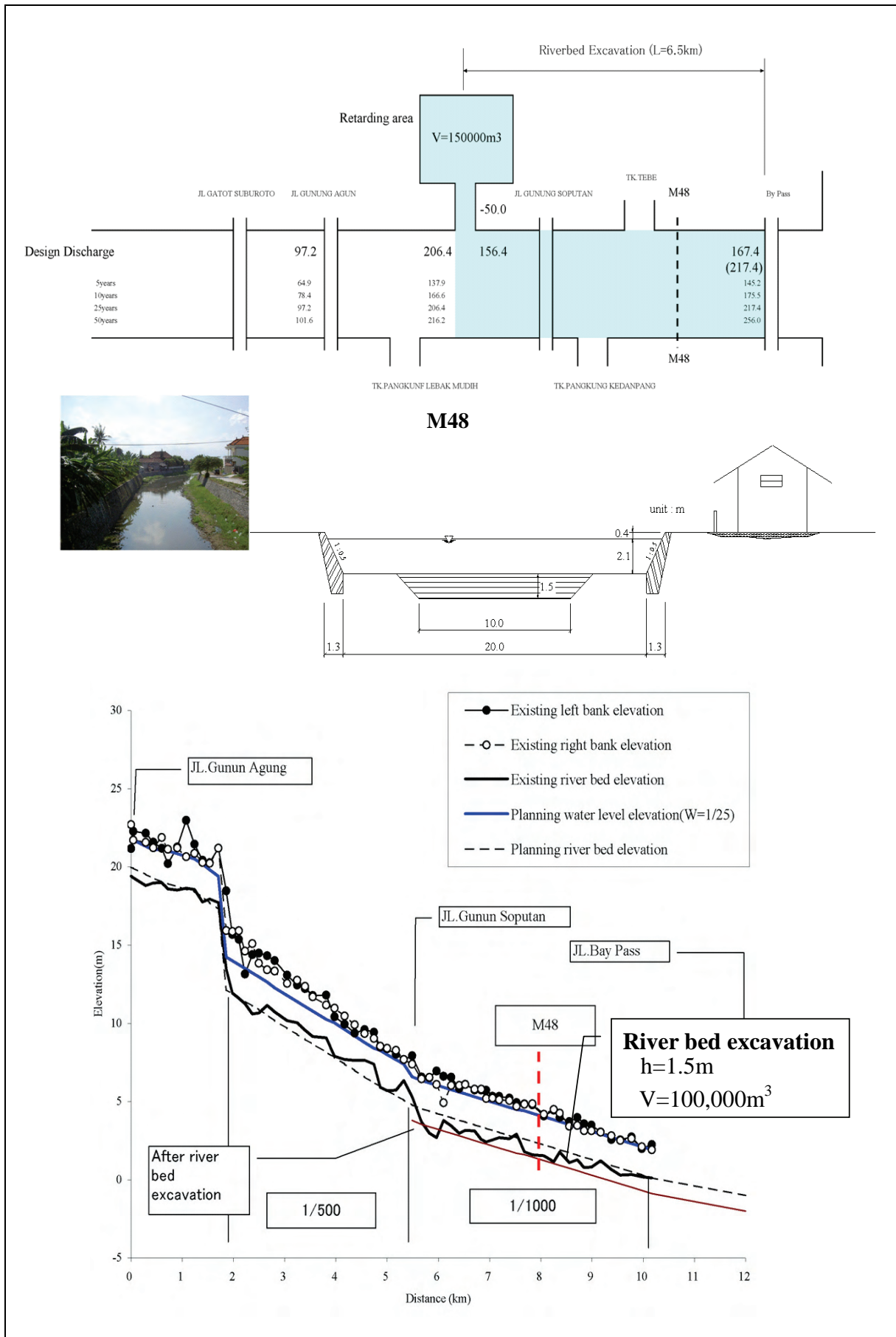


Figure-4.31 Flood Control Plan for Mati River

4.4.3 Flood Control Plan for Banyumala River and Buleleng River in Singaraja

<Current Issues>

Inundation areas ranged from riverside to parts of city center of Singaraja. It is found that there is a section in which height of right bank is low in Banyumala River, and flood is overflowed at this point. As for Buleleng River, insufficient flow area due to riverbed aggradation might be a cause of floods.

Current issues are summarized as follows

- 1) No banking or low banking in right side of downstream section of Banyumala River.
- 2) Poor drainage caused to low-lying area inland of Buleleng River.
- 3) No topographic survey results such as longitudinal section and cross sections for these area are available for river improvement plan.



Figure-4.32 Flooding Area (April,2004)

<Flood control Plan>

Considering the importance of the area and experiences in Indonesia, it is judged as proper design scale of 10 year-return period as initial phase. Although it is impossible to draw detailed plans of flood control for these rivers due to lack of basic data such as river profile and survey map, it is considered that riverbed stabilization works such as check dam and groundsill are prioritized work items as well as embankment improvement, bank protection and channel normalization.

Based on the second concept, urgent works as shown in Table-4.27

Table-4.27 Flood Control Plan for Banyumala River and Buleleng River

River	Length	Major Work Items
Banyumala River	1,350 m	<ul style="list-style-type: none"> ◆ Channel Normalization: 30 m width x 0.5 m depth ◆ Embankment: 4 m width x 2.0 m height Bank Protection: 2.5 m height
Buleleng River	1,650 m	<ul style="list-style-type: none"> ◆ Riverbed Excavation: 20 m width x 2.0 m depth Bank Protection: 2.0 m height

4.4.4 Flood Control Plan for Sowan River in Negara

<Current Issues>

Sowan River basin with a catchment area of 171.5 km²(total area of 6 catchments area) has 6 tributaries, namely Kaliakah River, Ijogading River, Aya Timur River, Subual River, Mendoyo River and Pergung River which meets each other in south Negara. Among them, Ijogading River flows through center of Negara City and has largest discharge. River length of Ijogading from river mouth of Sowan River is 29.9 km.

Floods occurred on October 14-16 in 1998, and inundation area ranged along the national road Denpasar-Glimanuk line to south part of Negara. After this flood, Flood Control and Coastal Protection Project Office of Bali Province (PPDB-Bali) drawn a river improvement plan in 2,000 and some river improvement works are being implemented under the plan.

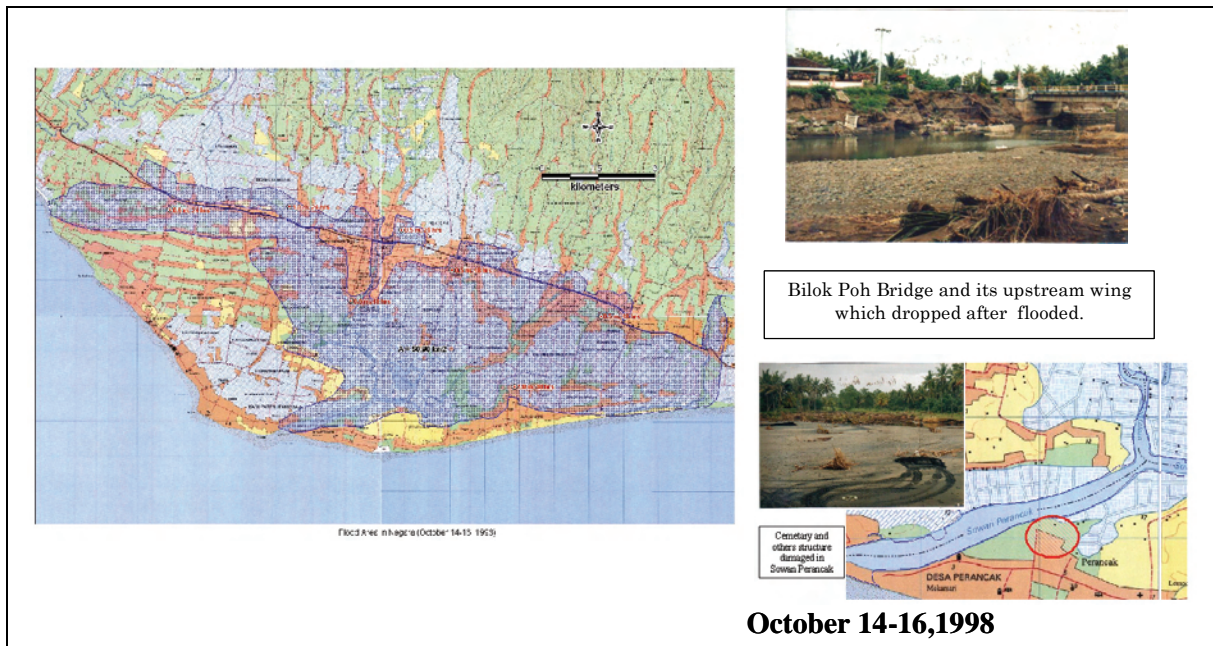


Figure-4.33 Flooding Area in October, 1998

Current river conditions for rivers are summarized as follows:

- ◆ Due to sediment supply from upstream, narrowing of flow sections in progress.
- ◆ It is difficult to wide the river width for the reason of flowing in densely houses areas for Rivers such as Kakiakah River, Ijagadeng River and Aya Timur River near Negara
- ◆ There is influence from tidal level in the section of down-stream in Sowan River.

<Flood Control Plan for Sowan River in Negara>

Design scale of 25 year-return-period is adopted for existing river improvement plan. It is recommended that river improvement works are advanced under the existing plan. River improvement works under the plan are summarized as shown in Table-4.28. Major works are channel normalization, embankment, bank protection and groundsill.

Table-4.28 Summary of River Improvement Works

Rivers	Design Discharge (m ³ /s)	Type of Works on Improvement Plan	Remarks
1) Tk. Kaliakah	59.75	Channel Normalization, Embankment, Bank Protection, Groundsill Section length L=11.0 km	New
Bayu Biru	26.49		
2) Tk. Ijogading	214.50	Channel Normalization Section length L=6.0 km	Tk. Titis (New)
Tk. Titis	76.87		
3) Tk. Aya Timur	173.03	Channel Normalization Section length L=7.0 km	
4) Tk. Subual	92.50	Channel Normalization, Bank Protection Section length L=3.0 km	
5) Tk. Mendoyo	140.17	Channel Normalization, Bank Protection Section length L=5.0 km	
6) Tk. Pergung	96.22	Channel Normalization, Bank Protection Section length L=5.0 km	

Source) *Laporan Akhir Detail Desain Sistem Pengendalian Banjir Tukad Sowan dan Anak-anak Sungainya di Kabupaten Jembrana Propinsi Bali (2000)*

4.4.5 Flood Control Plan for Other Flood Prone Areas

Except three basins mentioned previous sections, there are many rivers by which people suffer from floods or sediment disasters. Especially, in Karangasem Regency, there are many tributaries which need to be improved in order to prevent sediment problems such as debris flow, riverbed degradation and river bank erosion. In Bali Province, flood control works as well as Sabo works are executed under control of *PPBD-Bali*.

4.5 Construction Quantities and Cost Estimate

(1) Conditions of Cost Estimate

Cost estimation for the Study is based on the costs and prices in Indonesian Rupiah (Rp.) at the time of June 2005, which exchange rate of 1 US\$ = 9,260 Rp. = 106.97 yen (yen = 86.57 Rp) is applied for conversion of currencies. The project cost is composed of the following cost items shown in Table-4.29.

Table-4.29 Composition of Project Cost

Breakdown	Conditions/Components
(1) Construction Cost	Labor, material and equipment costs for construction
(2) Land Acquisition and Compensation	3% of construction cost for reservoir project, 2% of construction cost for other projects
(3) Government Administration Expense	5% of the construction cost
(4) Engineering Service	10% of the construction cost
(5) Contingency	10% of construction cost, land acquisition and compensation, administration expense and engineering services
(6) Government Tax	The government tax in Indonesia is the Value Added Tax (10%) which is not included for project cost estimation.

(2) Main Facilities and Works for Priority Project

The main facilities and works for the priority projects are summarized in Table-4.30.

Table-4.30 Main Facilities and Works for Priority Project

Projects	Facilities, Works
1 Integrated Project	
• Multipurpose Ayung Dam	Concrete Gravity Dam, Power Generation Facility (7.6MW)
• Multipurpose Benel Dam	Rock-fill Dam, Intake Facility
2 Water Supply Project	
• Western Water Supply System	Water Treatment Plant (300 lit/s), Weir, Transmission Pipe (10.9km)
• Central Water Supply System	Water Treatment Plant (1,800 lit/s), Weir, Transmission Pipe (8.9km)
• Eastern Water Supply System	Water Treatment Plant (800 lit/s), Weir, Transmission Pipe (57.5km), Pumping Station (6.0m ³ /min×33m)
• Water Treatment for Denpasar	Water Treatment Plant (150 lit/s) (Warribang-2)
• Water Treatment for Jembrana (Benel)	Water Treatment Plant (60/ lit/s)
• Water Supply – Well: Related regencies	Small-scale Well Development (for each Regency, 570 lit/s)
• Water Supply –Spring: Related regencies	Small-scale Spring Development (for each Regency, 1,315 lit/s)
3 Flood/Sediment control Project	
• Badung & Mati Rivers Flood Control	Riverbed Excavation (11km), Weir Improvement (Badung River), Retarding Basin (Mati River)
• Singaraja Area Flood Control	Riverbed Excavation, Channel Normalization, Revetment (Length: 3km)
• Negara and Other Areas	Channel Normalization, Banking, Revetment
• Coastal Protection	Serangan Aera :Revetment, Seawall Section length L=15.9km
4 Irrigation Project	
• Irrigation Improvement (from Ayung)	Irrigated Area (Approx. 9,500ha)
• Irrigation Improvement (from Benel)	Irrigated Area (Approx. 1,000ha)
• Irrigation Improvement: Related regencies	Intake/Channel Improvement

(3) Project Cost

Project cost for each phase of water resources development plan shall be summarized as shown in Table-4.31. Total project cost for water resources development plan estimated as Rp. 3,799 Billion.

Table-4.31 Breakdown of Project Cost for Each Component

(Unit: Million Rp.)

Projects	(1)	(2)	(3)	(4)	Sub-Total (1)-(4)	(5)	Project Cost
◆ Integrated Project							955,078
1. Multipurpose Ayung Dam	692,648	13,853	34,632	69,265	810,398	81,040	891,438
(1) Dam & Reservoir	553,748						
(2) Power Facilities	138,900						
2. Multipurpose Benel Dam	49,448	989	2,472	4,945	57,854	5,785	63,640
◆ Water Supply Project							828,337
3. Western Water Supply System (W1)	51,329	1,027	2,566	5,133	60,055	6,005	66,060
4. Central Water Supply System (C1)	222,666	4,453	11,133	22,267	260,519	26,052	286,571
5. Eastern Water Supply System (E5)	248,668	4,973	12,433	24,867	290,942	29,094	320,036
6. Water Treatment for Denpasar	17,235	345	862	1,724	20,165	2,016	22,181
7. Water Treatment for Jemrana (Benel)	8,044	161	402	804	9,411	941	10,353
8. Water Supply – Well: Related regencies	62,997	1,260	3,150	6,300	73,706	7,371	81,077
9. Water Supply – Spring: Related regencies	32,680	654	1,634	3,268	38,236	3,824	42,059
◆ Flood/Sediment Control Project							1,267,234
10. Badung & Mati Rivers Flood Control	91,135	1,823	4,557	9,114	106,628	10,663	117,291
11. Singaraja Area Flood Control	18,074	361	904	1,807	21,147	2,115	23,261
12. Flood/Sediment Control: Related regencies	478,632	9,573	23,932	47,863	560,000	56,000	616,000
13. Coastal Protection: Related regencies	396,800	7,936	19,840	39,680	464,256	46,426	510,682
◆ Irrigation Project							748,514
14. Irrigation Improvement (from Ayung)	71,250	1,425	3,563	7,125	83,363	8,336	91,699
15. Irrigation Improvement (from Benel)	7,500	150	375	750	8,775	878	9,653
16. Irrigation Improvement: Related regencies	502,845	10,057	25,142	50,285	588,329	58,833	647,162
◆ Total							3,799,163

Notes:

- (1): Construction Cost (2): Land Acquisition and Compensation
 (3): Government Administration Expense (4): Engineering Services (5): Contingency

(4) Project Cost for Each Phase

The project costs for each phase is also estimated and summarized as shown in Table-4.32.

Table-4.32 Summary of Project Cost for Each Phase

(Unit: million Rp.)

Projects	Phase				Total
	2006-2010	2011-2015	2016-2020	2021-2025	
◆ Integrated Project					955,078
1. Multipurpose Ayung Dam	249,753	612,221	29,464	-	891,438
2. Multipurpose Benel Dam	-	31,820	31,820	-	63,640
◆ Water Supply Project					828,337
3. Western Water Supply System (W1)	-	43,532	11,264	11,264	66,060
4. Central Water Supply System (C1)	-	151,408	67,581	67,582	286,571
5. Eastern Water Supply System (E5)	-	155,293	134,693	30,050	320,036
6. Water Treatment for Denpasar	22,181	-	-	-	22,181
7. Water Treatment for Jemrana (Benel)	-	-	10,353	-	10,353
8. Water Supply – Well: Related regencies	17,583	24,420	19,537	19,537	81,077
9. Water Supply – Spring: Related regencies	1,840	11,577	9,704	18,938	42,059
◆ Flood/Sediment Control Project					1,267,234
10. Badung & Mati Rivers Flood Control	46,917	70,374	-	-	117,291
11. Singaraja Area Flood Control	9,304	13,957	-	-	23,261
12. Flood/Sediment Control: Related regencies	154,000	154,000	154,000	154,000	616,000
13. Coastal Protection: Related Area	127,671	127,671	127,670	127,670	510,682
◆ Irrigation Project					748,514
14. Irrigation Improvement (from Ayung)	-	45,850	45,849	-	91,699
15. Irrigation Improvement (from Benel)	-	-	4,827	4,826	9,653
16. Irrigation Improvement: Related regencies	161,791	161,791	161,790	161,790	647,162
◆ Total					3,799,163

4.6 Water Resources Management Plan

4.6.1 Organization and Institutional

(1) Current Issues

Water Resources Management by Dinas PU

- Inter-agency arrangements between water resources related government offices are not clear enough to ensure systematic coordination.
- Parts of routine technical activities of Dinas PU/Sub-Dinas SDAPP are still conducted by APBN working units using the central government budget.

Water Supply System

- PDAM can not afford for the new water supply facilities, due to fallen into debt.
- New water supply agency shall be organized for the water supply of southern Bali area.

Central Government

- Central government should play the role in prevention of conflicts between Subak and new users such as PDAM as well as solution for new water use.

(2) New Organization

The responsibilities of water resources related organizations in the existing institutional arrangement and those in the new arrangement as proposed are presented in a nutshell in Table-4.33.

Table-4.33 New Institutional Arrangement for WRM in Bali (Proposed)

Key activity Level/ Organization	(1) Water Supply Capacity, River Improvement, Flood Control & Beach Conservation		(2) Irrigation (mostly O&M)	(3) Fee/Tax Collection	(4) Coordination for River Basin and Watershed Management
	Development	O&M			
PROVINCE					
Dinas PSDA	X (Planning, Programming and Budgeting)				X (Secretariat to the Council)
- APBN W/Units	X				
- BALAI-PSDAs		X	X (trans-Kab/Kota or 1,000-3,000ha)	X (licensing fee)	X (technical support to the Council)
Other offices	X (Sub-Dinas TRP for supply and drainage facilities)			X (tax on water use by DISPENDA)	
WR Coordination Council & Sub-Councils					X
Regency/City					
Dinas PU					
- Sub-Dinas WR or Dinas PSDA			X (within Kab/Kota & less than 1,000ha)		
Sedahan Agung & Subak Coordination Unit					X
Other offices (for water supply)	X (private participation & a new water production entity?)	X (PDAMs, private & the water production entity?)			
PROVINCE					
Dinas PSDA			X (by Governor)		
- APBN W/Units					
- BALAI-PSDAs	X	X	X (technical assessment)	X	X (civil service inspection)
Other offices	X (Data sharing by BMG)				X (Prokashi coordinated by BAPEDALDA)
WR Coordination Council & Sub-Councils					

Key activity Level/ Organization	(5) Water Quantity Management (for surface water, groundwater and spring)			(6) Water Quality Management	
	Hydrological Monitoring and Analysis	Water Allocation	Licensing	Monitoring and Analysis	Control
Regency/City					
Dinas PU					
- Sub-Dinas WR or Dinas PSDA					
Sedahan Agung & Subak Coordination Unit					
Other offices					

Dinas PSDA

Firstly, under the new arrangement, it is important that the current **Sub-Dinas SDAPP of Dinas PU be upgraded to Dinas PSDA** corresponding to the increasing importance of water resources management in Bali. **Sub-Dinas Mining** (of Dinas PU) that has Groundwater Section **can be joined** in Dinas PSDA.

The second feature of the new institutional framework is the introduction of **Balai PSDAs** under Dinas PSDA. There should be at least two Balai PSDAs so that the jurisdictional area of each Balai is of a manageable size and there will be healthy competition between Balais for better performance. One way would be to have one Balai PSDA to be responsible for Southeastern Bali including SARBAGITAKU, and the other for the western and northern Bali. Balai PSDAs will be structured in accordance with the guidelines given in the 1996 Regulation of the Ministry of Home Affairs. In addition, O&M for beach conservation facilities may be added.

Water Resources Coordination Council

The third element of the new institutional arrangement is **Provincial Water Resources Coordination Council (PWRCC)**. The fact that the council comprises of representatives of both government and non-government on an equal proportion means that the council can be expected to serve basically two purposes: i) providing a **platform of discussion and coordination** among stakeholders; and ii) playing the role of an **“observatory”** that monitors government activities and expenditure.

Sedahan Agung

Important function at the regency/city level is **coordination with subaks**. The institution of *sedahan agung*, whom subaks relied on for many centuries not only for tax collection but for organizing ceremonies and support to subaks including water control, is in disarray in most of the regencies/city, and subaks are left with uncertainty not knowing which government office they can consult and rely on to solve problems including water issues. In view of the increasing needs for the government to facilitate water allocation and dispute resolution, the administrative location of *sedahan agung* should be in Dinas PU/Sub-Dinas SDAPP. In order to support *sedahan agung’s* coordinating role, it is recommended to establish a **Subak Coordination Unit** under bupati/walikota in each regency/city. *Sedahan agung* will serve as a focal point of this unit.

Organization for new water supply system on water resources development, water supply and water distribution are summarized as shown in Table-4.34.

Table-4.34 Organization for New Water Supply system on Water Resources Development, Water Supply and Water Distribution

Administrarion	Supply/Distribution	Water Supply Agency		
		Construction	conveyance	Distribution
Province	Coodination Council	Dinas PU –Sub-Dinas TRP	Reginal Water Supply Unit	-
	Dinas PSDA			
	- APBN Working Units: Construction			
	- Balai PSDAs (2-3): Operation			
Regencies/City	Dinas PU (Dinas PSDA)			PDAMs PT.TB
	- Sedahan Agung			
	- Subak Coordination Unit			

(3) Road Map for Institutional Development

The reform of the institutional arrangement described in this section requires a series of coordinated and time-bound actions. A road map for the reform with a list of key actions is shown in Table-4.35.

Table-4.35 Road Map for the Institutional Reform

Phase	Discussion & Decision Making	Preparation (1 year)	Start-up (2-years)	Development (5-years)
Timeline	2005 - 2006	2007	2008-2009	2010-2015
Central Government				
Ministry of Public Works	Prepare regulations and guidelines to implement the WR Law No.7/04 and have them approved. Confirm Bali as one river basin (through a presidential decree). Guide Dinas PU/Sub-Dinas WR on the areas where MPW can provide capacity development support	Appoint and transfer key personnel to undertake Dinas PSDA and Balai PSDA operation in Bali. Provide support to the preparation process.	→	
Province				
Governor’s Office	Decide on the establishment of Dinas PSDA and Balai PSDAs. Draft instruction to regencies/city on Sedahan Agung and Subak Coordination Unit. Study on establishing the regional water production entity (with the central gov’t & regencies/city).	Draft (through an inter-departmental team) and issue regulations to enable the institutional reform. Decided on the establishment of the regional water production entity (with the central gov’t & the regencies/city). Ensure prioritization of WRM in annual budget allocation.	Draft and introduce necessary provincial regulations to implement WR Law No.7/04. Select the members of PWRCC & Sub-Council(s) in consultation with the regencies/city. Operationalize PWRCC & Sub-Council(s). Prepare the regional water production entity (with the regencies/city).	→ Operationalize the regional water production entity (with the regencies/city).
Dinas PU and Dinas PSDA (new)	Set up a preparation team to plan and guide the organizational restructuring. Identify areas where Balai PSDAs can receive capacity development support from MPW.	Work out detailed reorganization plan including staffing, assets & equipment transfer, organizational structure, and functions. Work out capacity development plan. Organizational set-up of Dinas PSDA and Balai PSDAs including physical arrangements	Draft and issue rules and procedures to support work processes of the new organization. Supervise the set-up and operationalization of Balai PSDAs. Ensure the support of the central government and external services. Improve planning and budget preparations. Support the operationalization of PWRCC & Sub-Council(s).	Identify and introduce new sources of revenue for WRM

Phase	Discussion & Decision Making	Preparation (1 year)	Start-up (2-years)	Development (5-years)
Timeline	2005 - 2006	2007	2008-2009	2010-2015
Balai PSDAs (new)			Initially, focus on the O&M functions already performed under different projects and sections. Establish water quantity management system. Establish water quality management system (incl. the new inspection unit). Establish flood control and river management systems. Improve facility O&M. Establish WR Information System. Establish fee/penalty collection system.	Integrate the new systems and processes into the organizations. (At least fully operationanlize Ayung Balai PSDA by 2013.)
Provincial WR Coordination Council (PWRCC) & Sub-Council(s) (new)			Discuss and agree on the roles and responsibilities. Convene annual meetings to review activities of the past year and plans for the next year (including budget).	Discuss water allocation and re-allocation based on improved hydrological information.
Regency/City				
Bupati/Walikota's Office	Undertake consultation with subaks to decide on the subak focal point (Sedahan Agung).	Establish a subak coordination unit. Issue and "socialize" the relevant regulations.		
Dinas PU/Sub-Dinas WR			Undertake any delegated activities in addition to the irrigation responsibilities.	
Sedahan Agung			Operationalize the roles of Sedahan Agung	
Subak Coordination Unit			Operationalize Subak Coordination Unit	

4.6.2 Water Environment Improvement Plan

<Current Issues>

The water environment improvement plan in this section initially focuses on conceivable practical strategies for surface water quality improvement of rivers in Bali Province. In this respect both short-term and long-term water environmental improvement strategies are first identified without strictly focusing on any particular applicable target area. The identified strategies are then applied as far as possible to defined target areas of Bali Province principally focused on the highly polluted river reaches of developed, urban and industrial areas like Badung and Mati rivers passing through Kuta and Denpasar and also other urban areas located in dry zones of Singaraja and Negara with significant river water quality deterioration.

(1) Strategies of Water Environmental Improvement

Surface river water environmental improvement strategies that are amenable for immediate implementation and also those of temporary ones are basically categorized as short-term strategies, while those strategies that would take long time frame to implement, difficult to amenable for a step-wise implementation and also those strategies that are essentially permanent are categorized as long-term strategies, though it is very difficult to clearly make such a distinction in a universal manner since some strategies overlap as both short and long term ones. Anyhow, it is important to consider a comprehensive strategy (of both short-term and long-term) in an overall sense based on the multiple and significant pollution sources of the target drainage basin area of river and make the required action programs and plans as appropriate so as to realize the required water environmental improvement from

both short and long-term time frames.

<Short-Term Strategies>

Short-term programs for water environment improvement are shown as follows:

- Elimination of garbage disposal in surface waters and public health aspect
- Inspection of pollution control measures by industries
- Enhancement of natural purification potential of streams and surroundings
- Introduction of dilution water as environmental flow

<Long-Term Strategies>

- Optimization of solid waste generation with 3R concept
- Industrial policy focused on industrial estate development
- Agricultural runoff pollution control
- Development of sewerage system for urban areas

<River Basin Conservation Plan>

Regarding the water resources development and management, the objectives of the river basin conservation are 1) to increase water resources volume by forests, 2) to decrease flood peak discharge by forest and 3) to minimize soil erosion. To achieve these objectives, the following government bodies are responsible for each designated duties.

- ◆ For Forest Conservation:
 - ✓ Dinas-Forestry (Province Level and Regency/City Level)
 - ✓ BP-DAS Unda Anyar (UNDA ANYAR River Basin Management Agency: Central government organization / Directorate General of Land Rehabilitation and Social Forestry, Ministry of Forestry and Plantations)
- ◆ For Erosion Control
 - ✓ Sub-Dinas-Water Resources under Dinas- PU (Public Work Services)
 - ✓ Work Unit for Flood Control and Coastal Protection
 - ✓ Work Unit for South Bali Beach Conservation

(2) Forest Conservation Plan

<Present Situations>

There is the Master Plan for Forest and Land Rehabilitation of Bali Province. The plan has been prepared by BP-DAS UNDA ANYAR and Provincial Dinas-Forestry. The Master Plan proposed that the forest and land rehabilitation shall be implemented through local people's participation with the activities: 1) Reforestation, 2) Regreening, 3) Raising of seedling, 4) Enrichment of planting and 5) Soil conservation through vegetative and mechanical means.

<Target of the Plan>

Laws No 41 / 1999 (article 18:1) stipulates that ideally the forest area of the province should be hold and maintain at least 30 percent of the total area. To achieve this rate, the Master Plan proposed the following Targets:

Optimizing present forest function through recovery treatment

- ◆ Reforestation: Targeting the critical forest (more than 100,000 ha)
- ◆ Forest Rehabilitation: To rehabilitate the damaged forest to recover natural ecosystem. Activities are conducted through maintenance of forest so that the community welfare will increase around the forest.
- ◆ Mangrove Rehabilitation: Mangrove forest in Bali is now achieving 4,200 ha (not including the area of Badung Regency that situated out of forest area).

Maintenance and Management of Forest Potential out of Forest Area including Private Forest, Temples Owned Forest (PELABA PURA), DESA ADAT Forest, Mixed Planting, and Others

- ◆ Re-greening: Non forest areas are planted to become vegetation areas.
- ◆ Basin Conservation: Monitoring and evaluation of land safety, Institutional guidance on basin management.

<Strategy and Program>

To maintain existing area and function of the forest, forest development is necessary covering:

- ◆ To establish forest area and to motivate conflict solution on forest boundary.
- ◆ To speed-up forest rehabilitation and reclamation
- ◆ To intensify monitoring toward forest security disturbance and forest conservation and to implement laws for avoiding forest resources commodities.
- ◆ To manage forest cooperation among government and community regarding benefit use, rehabilitation activities and protection.
- ◆ To expand diversity of forest production, prospective commodities and new introduced commodities.
- ◆ To increasing land productivity for food secure.
- ◆ To upgrade forestry personnel.
- ◆ To establish work system and procedure for forest development.
- ◆ To complete equipment and facilities for forest development.

(3) Erosion Control

Erosion control of Bali Province is planned and implemented mainly by two Work Units: 1) Work Unit for Flood Control and Coastal Protection and 2) Work Unit for South Bali Beach Conservation. Sheet erosion control is implemented in the projects of the forest conservation mentioned above.

Erosion control along the river courses is implemented in the river improvement project. Countermeasures for erosion control of river are check dam, consolidation dam, sand pocket, channel work and so on. After the last eruption of Mt. Agung, about 40 years ago, sediment control of volcanic product was very urgent. Currently, volcanic deposit became stable. This section mainly focuses on the coastal protection plan.

<Main Issues>

Total Bali Province coastal line is 430 km. Coastal morphology generally grouped into “Mountainous Cost”, that is coastal made by volcanic eruption. Base on shelf type and beach water, Bali categories as “Pantai Pulau” that is beach surrounding the island made by river sediments, coastal and volcanic sediments.

Coastal surrounding Bali Island is now eroded massively. These erosions caused damage of private and communal properties such as: cultivated land, houses, road, cemetery, and others.

16 % of total coastal line is consists of natural reef with white sand. Currently eroded beach in the southern Bali amounts to be more than 50 km. Especially, eroded coastal line length in southern part of Bali including Nusa Penida is bigger than that in the northern part. Eroded coastal line length in the northern Bali is around 20 km. Identified erosion caused by:

- ◆ Natural Hazard:
 - ✓ Decrease of sediment supply from the river.
 - ✓ Fragmentation of the sediment
 - ✓ Increasing wave energy due to global climate
- ◆ Human Activities:
 - ✓ Marine based activities
 - ✓ Land based activities
 - ✓ Destructive fishing
 - ✓ Beach material exploitation

<Target>

17 location of identified coastal erosion in Bali are planned to be handled in coming five years.

Table-4.36 Erosion Control in Seaside

Countermeasures	Major Works a
Soft Measures	<ul style="list-style-type: none"> ◆ Artificial nourishment / beach fill ◆ Natural reef, artificial reef in Pantai Sanur, artificial fishing reefs in Pantai Sanur, Nusa Dua, and Tanah Lot. ◆ Mangrove forest
Hard Measures	<ul style="list-style-type: none"> ◆ Revetment are proposed for some beach in Nusa Penida, Badung Regency, Pulaki and Yeh Sanih (in Buleleng), and for some beach in Jembrana Regency ◆ Seawall ◆ Groin ◆ Offshore breakwater ◆ Beach establishment is and going to be implemented in Pantai Sanur, Nusa Dua, and Kuta. ◆ Set-back program

4.6.3 GIS Database for Water Resources Management

(1) Structure of GIS Database

The GIS database prepared by the JICA Study Team is administrative information (5 items), geomorphologic information (13 items), facilities (9 items), etc.

(2) Utilization of GIS Database for Water Resources Management

The Study Team had developed the programs as a supporting tool called “Water Balance System” for water resources management. Using this system, user can simulate about water balance.

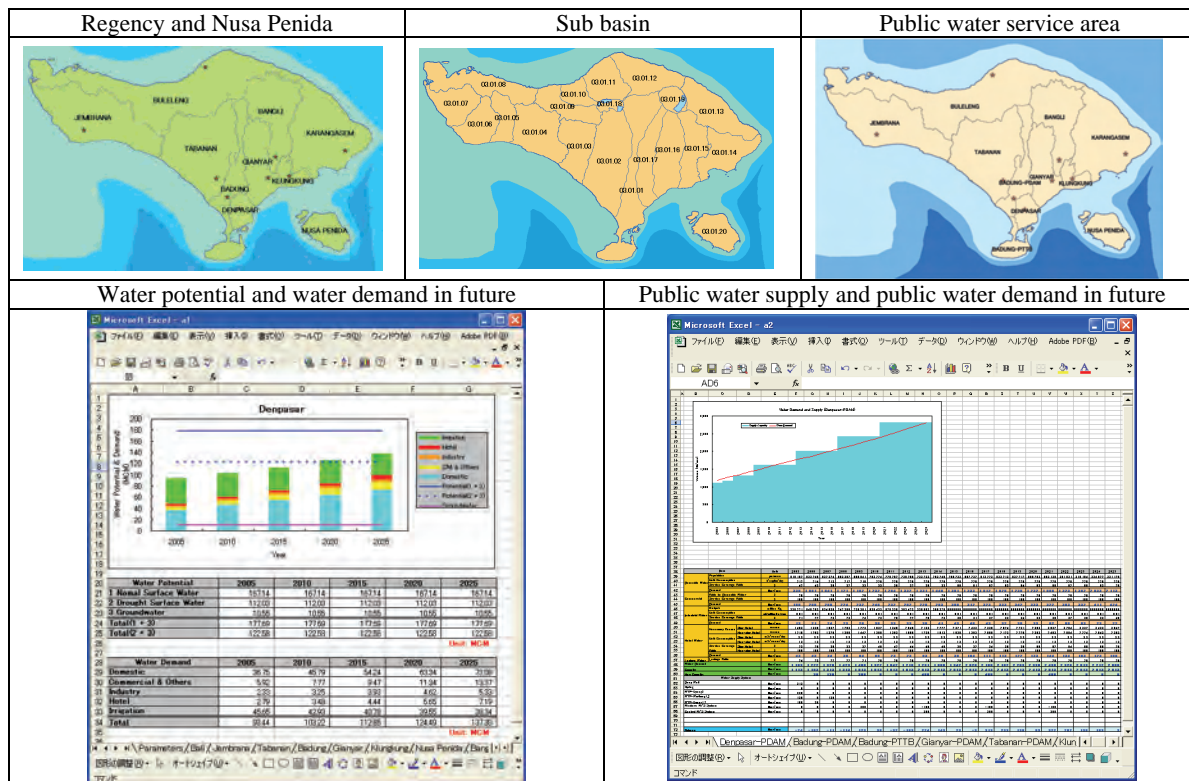


Figure-4.34 Target Area and Example Output

4.6.4 Capacity Development Program

During the Study period, a quick assessment of capacity development needs among around 40 key staff of Sub-Dinas SDAPP was conducted to identify areas and types of capacity development support that that were required as felt by the staff themselves. All of the staff surveyed was keenly aware of the need for capacity improvement for themselves and/or for their sections/units. Specific requests are reflected in the capacity development program as shown in Table-4.37.

Table-4.37 Capacity Development Program

Areas and Elements of Water Resources Management under the New Institutional Framework	Existing Training (by Dinas PU & Civil Service Board)	Needs for Additional Support
1.1 Integrated Perspectives		
<ul style="list-style-type: none"> ◆ Understanding on features and principles of integrated water resources management and broadening perspectives 		<ul style="list-style-type: none"> ← Integrated water management expertise (to be provided through organized courses)
1.2 Database Development & Maintenance		
<ul style="list-style-type: none"> ◆ Development and maintenance of database which includes the following: <ul style="list-style-type: none"> - Hydrological conditions (for surface and ground water and springs) - Water licenses issued (location, monthly abstraction, etc.) - Water quality, pollution sources - Facilities and conditions - Land use conditions (including vegetation) - Flood risk areas - Location of weirs and <i>subaks</i> 		<ul style="list-style-type: none"> ← Data collection & updating procedures ← GIS expertise ← Computer skills
1.3 Water Quantity Management		
<ul style="list-style-type: none"> ◆ Observation, monitoring and analysis <ul style="list-style-type: none"> - Maintenance of measuring stations - River flow & water intake measurement - Observation of wells for groundwater levels and salinity - Hydrological and hydro-geological data collection and analysis ◆ Water allocation management <ul style="list-style-type: none"> - Updating the inventory of licensed water users and water abstraction volume - Preparation of water allocation plans for major rivers/sub-river basins - Providing technical information to Provincial Water Resources Coordination Council and Sub-Councils for water allocation and re-allocation 		<ul style="list-style-type: none"> ← Establishment of hydrological and hydro-geological monitoring system ← Hydrological and hydro-geological analysis ← Development of water allocation plans ← Facilitation skills for discussions on water allocation and re-allocation
1.4 Water Quality Management		
<ul style="list-style-type: none"> ◆ Monitoring and analysis <ul style="list-style-type: none"> - Maintenance of measuring stations - River flow measurement - Observation of wells for groundwater levels and salinity - Civil service inspection 		<ul style="list-style-type: none"> ← Expertise on water quality monitoring, inspection and control systems with particular focus on industrial pollution control (with BAPEDALDA on regulatory measures)
1.5 Construction Management		
<ul style="list-style-type: none"> ◆ Construction management <ul style="list-style-type: none"> - Procurement & contracting - Construction supervision - Quality assurance 		<ul style="list-style-type: none"> ← Construction management (further attention to skills/knowledge transfer from consultants during construction)
1.6 Facility O&M (reservoirs, check dams, rubber dams, weirs, intakes, springs, irrigation systems, flooding dikes, and coastal protection facilities)		
<ul style="list-style-type: none"> ◆ Improvement in the O&M systems (incl. systems of observation, reporting, decisions, and equipment operation and prevention) ◆ Long-term O&M planning and budgeting ◆ Annual O&M planning and budgeting for each river and river area covering: <ul style="list-style-type: none"> ◆ Field inspection ◆ Operation ◆ Routine maintenance ◆ Periodical maintenance ◆ Rehabilitation (by Dinas PSDA) 	<ul style="list-style-type: none"> ● Dam safety training (regular training) ● Weir gate keeping (regular training) 	<ul style="list-style-type: none"> ← Dam operation expertise ← Planning and implementation procedures
1.7 Flood Management		
<ul style="list-style-type: none"> ◆ Updating maps of land use conditions including planned urban zoning in flood plain areas ◆ (With BAPPEDA) Development of procedures to control excessive land development in flood plain areas ◆ Development and dissemination of flood risk maps ◆ Regular field inspection and observation ◆ Flood warning and evacuation system 		<ul style="list-style-type: none"> ← Establishing flood control and evacuation systems
1.8 Watershed Management		
<ul style="list-style-type: none"> ◆ Assessment of land use ◆ River improvement and management including sediment control ◆ Disaster control and management 	<ul style="list-style-type: none"> ● Land slide disaster management (regular training) 	<ul style="list-style-type: none"> ← Overall river management capacity

Areas and Elements of Water Resources Management under the New Institutional Framework	Existing Training (by Dinas PU & Civil Service Board)	Needs for Additional Support
◆ Coordination with forest and land use management offices on forest conservation and management		
2.1 Human Resource Management		
◆ Formulation of human resource (HR) policies for performance enhancement including such areas/measures as job analysis, job design, staff planning (including staff regeneration), performance appraisal, promotion, and career development. ◆ Implementation of the new HR policies and evaluation		← Organizational development
2.2 Planning and Budgeting		
◆ Review and improve the existing planning and budgeting procedure		← Organizational development
2.3 Accounting and Financial Administration		
◆ Review and improve the expenditure control system (in accordance with the regional financial system to be introduced on a national basis)	<ul style="list-style-type: none"> ● Government accounting system (regular training) ● Financial administration training for treasurer candidates (regular training) 	
2.4 Internal Rules, Procedure and Communication		
◆ Review and improve the existing rules and procedures for internal decision making, work processing, communication, reporting, and information sharing. ◆ Review and improve the internal communication and knowledge management (both formal and informal)		← Organizational development
2.5 Water Resources Information System		
◆ Establishment and management of water resources information system (for internal use, external access and nation-wide networking)		← GIS and computer expertise
3.1 Laws and Regulations on Water Resources		
Objective: To enhance understanding of the relevant legal and regulatory environment in which Dinas PSDA/Balai PSDA operates for better decision making and actions ◆ Compilation of the relevant laws, government/ministerial regulations, provincial regulations, governors' decrees, etc. Production and distribution of the compiled files. ◆ Organization of task forces (with other relevant offices) to consider necessary improvements in the provincial/regency/city level regulations as appropriate. (→ presented and discussed at the platform of the Water Resources Management Council)		
3.2 Public Relations		
Objective: To increase effectiveness of the messages delivered to the stakeholders to induce their attitudinal changes and gain their support for WRM. The main issues are: water saving, pollution control, watershed protection, and the needs to finance WRM and water supply (in collaboration with PDAMs). ◆ Improve the public relations system and methods including the following: - content of communication - methods of communication (such as through leaflets, media, socialization meetings, etc.) - receipt and resolution of claims/complaints ◆ Develop medium-term and annual public relations programs		← Organizational development (communications and public relations theories and practices)
3.3 Support to Subaks		
Objective: Active involvement of local communities and their sustainable livelihood are part of integrated river basin management. Dinas PSDA will liaise with relevant provincial and regency/city government offices to ensure that <i>subaks</i> be provided with appropriate guidance and support to sustain their livelihood and organizational integrity. ◆ Identify areas where <i>subaks</i> need external guidance and support in addition to those that have been provided by government offices. Liaise with the relevant government office(s) to launch <i>subak</i> support activities. ◆ Implementation, monitoring and evaluation.		← Expertise in sociology, agro-economy, agriculture and cottage industry/small & medium business development.
3.4 Others		
◆ English language training		

4.7 Implementation Plan

4.7.1 Implementation Bodies and Allocated Budgets

For the secure implementation on water resources development project and water resources management project proposed in the Master Plan Study, Study Team propose implementation bodies as shown in Table-4.38. Implementation bodies includes to new bodies such as DINAS-PSDA, BALAI-PSADA, water resources board, BALAI-PSDA, water resources coordination council, *Sedahan Agung* and *Subak* Coordination unit proposed by Master Plan.

Table-4.38 Implementation Bodies for the Proposed Project

Project			Bodies		Budget	
			Construction	O&M	Construction	O&M
Water Resources Development	Multi Purpose Dam	AYUNG Reservoir	(New)Dinas PSDA	(New)Prov.Balai PSDA	Central Government *5	Bali Province
		BENEL Reservoir				
	Water Supply Project	Water Supply for DENPASAR Metropolitan Area	(New) Dinas PU/ Sub-Dinas TRP	PDAM or Autonomos Association	Central,province, City	PDAM or Autonomos Association
		Water Treatment(WARIBANG-2): DENPASAR				
		Water Treatment(BENEL): JEMBRANA				
		Water Supply – Well *1				
	Flood/Sediment Control Project	Water Supply – Spring *1	(New) Dinas PSDA	(New)Prov.Balai PSDA	Central Government *5	Province
		BADUNG/MATI River Flood Control				
		Flood Control for NEGARA Area				
	Irrigation Project	Flood Control for SINGRAJA Area	(New) Dinas PSDA	(New)Prov.Balai PSDA	Central *5	Province
Flood/Sediment Control *2						
Irrigation Improvement (from AYUNG Reservoir)						
Water Resources Management	Institutional Reform	Irrigation Improvement (from BENEL Reservoir)	Regency Dinas PU	Regency Dinas PU		Regency
		Irrigation Improvement: Related Regencies *3				
		Establishment of DINAS-PSDA	Province,Dinas PU (Dinas PSDA)		Province	
		Establishment of BALAI-PSDA	Regency, city		Regency, City	
		Establishment of W/R Coordination Council	Central,province, City		Central,province, City	
	Water Environment Improvement	Establishment of SEDAHAN A. & SUBAK Coordination Unit	Province,Regency, City BAPEDALDA,Province Public health Agency, Province industrial Agency		Central,province, City	
		Preparation of Regulations & Guidelines for New WR Law	(New) Province Balai PSDA		Province	
	River Basin Conservation	Public Education and Campaign	Province,Regency, City Forestry Agency		Central *5	Province, Regency
		Environmental Flow for BADUNG & MATI Rivers	(New) Province Dinas PSDA	(New) Province Balai PSDA		Province
		Forest and Land Rehabilitation *4				
Capacity Building Program	Sediment Control (Included in Flood Control)	Province Dinas PSDA	Province Balai PSDA		Province	
	Coastal Protection for Related Areas	Province,Dinas PU (Dinas PSDA)		Central, Province		
	Personnel Assignment					
	Capacity Building Support for BALAI-PSDA					

(Note)

*1 : After completion of the project, operation and maintenance is executed by autonomos association with supporting of EU.

*2 : Small scale project shall be executed as commission work to Regency and City.

*3 : Due to water resources regulation established in 2004, irrigated area of less than 1,000 ha shall be taken charge of Regency.

*4 : National forest and forest which in case of overstride two regencies shall be operated by Province.

*5 : For the allocation of project cost, it shall be needed for more discussion in case of designated national strategic basin.

*6 : New mechanism for introduction of allocation between central government, provincial government, regional government and city government shall be adopted by the agreement with relevant organizations.

4.7.2 Implementation Schedule

Implementation schedule of the projects proposed in the Master Plan is shown in Table-4.39. The following distinctions were set to give high priority to the projects proposed in the Master Plan:

- ◆ Large Water Shortage and Many Beneficiaries
- ◆ Long Period for Plan and Construction
- ◆ Large Construction Volume
- ◆ Multi-Purpose Project

Table-4.39 Implementation Schedule for Proposed Projects

Projects	(1)	(2)	(3)	(4)
	2006 - 2010	2011 - 2015	2016 - 2020	2021 - 2025
1. WATER RESOURCES DEVELOPMENT				
◆ Integrated Water Resources Development Project				
➤ AYUNG Reservoir				
➤ BENEL Reservoir				
◆ Water Supply Project				
➤ Water Supply for DENPASAR Metropolitan Area				
➤ Water Treatment (WARIBANG-2): DENPASAR				
➤ Water Treatment (BENEL): JEMBRANA				
➤ Water Supply – Well: Related Regencies				
➤ Water Supply – Spring : Related Regencies				
◆ Flood / Sediment Control Project				
➤ BADUN/MATI River Flood Control				
➤ Flood Control for NEGARA Area				
➤ Flood Control for SINGRAJA Area				
➤ Flood / Sediment Control: Related Regencies				
◆ Irrigation Project				
➤ Irrigation Improvement (from AYUNG Reservoir)				
➤ Irrigation Improvement (from BENEL Reservoir)				
➤ Irrigation Improvement: Related Regencies				
2. WATER RESOURCES MANAGEMENT				
◆ Institutional Reform				
➤ Establishment of DINAS-PSDA				
➤ Establishment of BALAI-PSDA				
➤ Establishment of W/R Coordination Council				
➤ Establishment of SEDAHAN A. & SUBAK Coordination Unit				
➤ Preparation of Regulations & Guidelines for New WR Law				
◆ Water Environment Improvement				
➤ Public Education and Campaign				
➤ Environmental Flow for BADUN & MATI Rivers				
◆ River Basin Conservation				
➤ Forest and Land Rehabilitation				
➤ Sediment Control (Included in Flood Control)				
➤ Coastal Protection for Related Areas				
◆ Capacity Building Program				
➤ Personnel Assignment				
➤ Capacity Building Support for BALAI-PSDA				

4.8 EVALUATION OF MASTER PLAN

4.8.1 Technical Evaluation

The proposed Master Plan of the Comprehensive Study on Water Resources Development and Management in Bali Province was planned according to the following technical information, standards, judgment and proper planning procedures, and is assessed to be technically feasible as a results.

- 1) The information related to socio-economic conditions, topographical and hydro-geological conditions, hydrological conditions, environmental conditions, water use conditions and so on are collected from the data and information that Government of Indonesia as well as Bali Province own and was applied to the Master Plan after precise examination and careful selection. And the standards established by the Government of Indonesia were applied for the

planning and design required in the Master Plan. In addition, the international standards such as International Committee on Large Dams and Japan were also used when necessary.

- 2) The long-term projection of the population for the estimation of future water demand was conducted applying the same method of the Bali Provincial Government based on the draft of "Revised Spatial Plan of Bali Province (2003-2010)" issued on August 2003.
- 3) In order to attain the sustainable water resources development, the plan was established based on the study of possibility of safe water supply estimating water resources potential of basins and considering probability evaluation. Concretely, draught discharge for the surface water and safe yield for the ground water were applied in the Master Plan.
- 4) The water resources should be found near the demand area especially for Denpasar and its surrounding Regencies such as Badung and Gianyar by consideration with not only the economic viewpoint but also the technical view points on the advantage of phased construction, water quality and easiness of land acquisition for the works. Judging from the large discharge during dry season in Ayung River, in particular, Ayung dam was planned at the Buangga in Badung Regency for the main source of the water supply plan.
- 5) To cope with the river flooding and inland inundation, also to mitigate flood damages by hard measures as well as soft measures, the flood control plan was applied on the basis of the policy of "Stay Harmony With Water". Based on the "Flood control Manual (Volume II)" prepared by a CIDA aid project in June 1993, the design flood return period was adopted basically for 25 years.
- 6) The information and opinions concerning the basic policy of the Master Plan and alternatives for water resources development plan as well as flood control plan were exchanged aggressively between the Study Team and organization related to river basin in Bali Province through the stakeholder meetings and work shops.

The proposed Master Plan of the Comprehensive Study on Water Resources Development and Management in Bali Province was set to target 2025 based on the population and economic growth projection conducted by the Study Team. Therefore the plan should be reviewed and changed if necessary according to the change of socio-economic conditions and accumulated collection of data.

4.8.2 Analysis on Economic and Financial Aspects

(1) Economic Evaluation

<Projects for Economic Evaluation >

Economic evaluation is carried out on the priority 3 projects selected in the Master Plan. The other projects are described in the paragraph of financial consideration.

<Assumptions and Benefits necessary for Economic Evaluation>

The necessary assumptions and benefit for economic evaluation are presented in Table-4.40 and Table-4.41.

Table-4.40 Basic Conditions

Items	Assumptions	
1. Prices	As of beginning 2005	
2. Exchange Rate	1 US\$ = Rp.9,260	Average of middle rate from May/2004 to April/2005
	1 US\$ = 106.97 Yen	
3. Conversion Factor	Conversion rate of 0.9 for local portion cost	
4. Opportunity Cost of Capital	12%	
5. Project Evaluation Period	30 years	
6. Economic Life		
1) Dam	80 years	
2) Water Treatment Plant	40 years	
3) Water transmission/distribution pipeline	40 years	
4) Pumping Motors	15 years	
5) Facilities for thermal generation plant	30 years	
7. Replacement Cost	Pumping motors: to be replaced in every 15 years	
8. Salvaged Value	The residue value of investment cost: to be salvaged at the 30 th year.	

Source: Study Team

Table-4.41 Benefits

Benefit Items	Assumptions	Remarks	Sources
A. For Multipurpose Ayung Dam Project			
1. Central Water Supply	Same as B		
2. Hydroelectric power Generation	Rp.118.6billion	Alternative cost of thermal power plant construction	Study Team estimate based on US\$1million/MW of Indonesia Power
	Rp.72.4billion	Alternative cost of operation/maintenance	Study Team estimate based on Rp.800/kWh of Indonesia Power
	Rp.2.2billion	CDM (CO ₂ emission right)	742g/kWh x US\$5/t-CO ₂
3. Irrigation Water Supply	Rp.1.2million/h _a	Without-case: soybean product	Study Team estimate based on information of Food Crops Agriculture Service of Bali Province
	Rp.4.3million/h _a	With-case: paddy product	
B. For Denpasar Metropolitan Water Supply Project			
1. Domestic Water	Rp.1,800/m ³	3% of presumed household income of Rp.1,600,000/month	Household income is estimated by the Study Team based on the GRDP and interview.
		Household consumption: 26 m ³ /month	Actual data of 3 PDAMs and PT.TB
2. Commercial/Public /Institutional Water	Rp.3,600/m ³	Denpasar and Badung South (PT.TB area)	Actual data of PT.TB
	Rp.3,030/m ³	Badung North and Gianyar	Actual data of PDAM Badung
3. Industrial Water	Rp.7,590/m ³	Denpasar and Badung South (PT.TB area)	Actual data of PT.TB
	Rp.6,620/m ³	Badung North and Gianyar	Actual data of PDAM Badung

Source: Study Team

The project cost necessary for economic evaluation is presented in Table-4.42 and Table-4.43. Incidentally, the project cost of Multipurpose Ayung Project is separated and allocated to respective purpose as presented in Table-4.43 by applying cost allocation method of multipurpose dam based on the justifiable expenditure and alternative costs of respective objectives that is generally utilized in Japan.

Table-4.42 Economic Cost of Water Supply Project and Flood Control Project

Unit: Rp.billion

Cost	Water Supply Project for Southern Area of Bali				Flood Control Project		
	Western System	Central System	Eastern System	Total	Badung River	Mati River	Total
Financial Cost	71.8	629.0	336.2	1,037.0	65.9	51.3	117.2
Economic Cost	69.0	617.5	325.6	1,012.1	59.1	45.5	104.6

Note: 1) Cost of Central System includes allocated cost of Multipurpose Ayung Dam as presented in Table-II-9.3.

2) Economic cost of each Water Supply System includes distribution pipeline cost, respectively estimated at 5.1billion for Western, 31.0billion for Central, and 13.8billion for Eastern.

Source: Study Team

Table-4.43 Economic Cost of Multipurpose Ayung Dam Project and Allocated Cost

Unit: Rp.billion

Cost	Multipurpose Ayung Dam	Cost allocated to		
		1. Water Supply (Central System)	2. Hydroelectric Power Generation	3. Irrigation Water
Financial Cost	718.8	308.1	223.4	187.3
Economic Cost	684.7	293.5	212.9	178.3

Source: Study Team

<Result of Economic Evaluation of the Projects>

Multipurpose Ayung Dam Project and Water Supply Project for Southern Area of Bali

The economic evaluation is analyzed based on the data previously mentioned, and the result of the evaluation is presented in Table-4.44. EIRR of the both projects exceed 12% of opportunity cost of capital, and the both projects are assessed economically feasible.

Table-4.44 Result of Economic Evaluation of the Projects

Items	Multipurpose Ayung Dam Project	Water Supply Project for Southern Area of Bali
EIRR	12.2 %	12.3 %

Source: Study Team

Flood Control Project of Badung and Mati Rivers

The economic evaluation of the project is carried out based on the flood return period of 25 years and probable direct damage to houses. The value of houses of the areas is estimated by referring to the number of households by different house size and construction cost in the areas. The household property value is estimated by applying the ratio of 20% to house value. The annual average benefit is defined as the reduction of probable damage under with- and without-project conditions by applying damage ratio under the condition of less than 50cm floor level inundation (Manual for River Works in Japan), the flood area, and the probability.

Table-4.45 Annual Average Benefit on Flood Damage Reduction

Item	Badung River Basin	Mati River Basin	Total
Annual Average Benefit	Rp.2.8billion	Rp.7.0billion	Rp.9.8billion

Source: Study Team

Economic analysis on Flood Control Project is made under present condition of year 2005 by applying all data mentioned above, the flood return period of 25 years and indirect flood damage of 10% on the direct flood damage. EIRR results in 13.4%; accordingly, the project is assessed to be economically feasible.

(2) Financial Consideration

<Water Supply Project for Southern Area of Bali>

The project cost amounts to Rp.1,037.0 billion including allocated cost from Multipurpose Ayung Dam Project. The project cost is far beyond the financial capability of the Provincial Government because annual revenue of the Provincial Government was only Rp.904billion in 2004. Accordingly, financing of Central Government loan and/or foreign soft loan would be inevitable in implementing the project.

<Hydroelectric Power Generation>

The electricity supply from Jawa is not sufficient to meet the whole demand of Bali, so that the thermal plants in Bali have to keep high level of operation rate and moreover a new plant is under the construction in Singaraja. Accordingly, Indonesia Power is expected to join the Multipurpose Ayung Dam Project in view of stable electricity supply and lower operation cost.

<Irrigation Water Supply>

The beneficiaries have to share the allocated cost of Ayung Dam; however, the prudent dialogue with the parties interested such as SUBAK is necessary to avoid conflicts.

<Flood Control Project>

The project cost of Rp.117.2billion is also big, so that financing from Central Government and/or foreign soft loan is required in implementing the project.

4.8.3 Initial Environmental Examination

<Protected Areas>

Most of the highland central mountainous region of the island is declared as some form of nature reserve or natural tourism park and hence remains as protected area.

The other protected areas that are composed of lowland terrestrial area and/or coastal marine waters. These protected and nature reserve areas of the whole Bali Island, accounting for a significant area of about 1200 km² or 21% of the total land area of Bali, is shown in Figure-4.35.

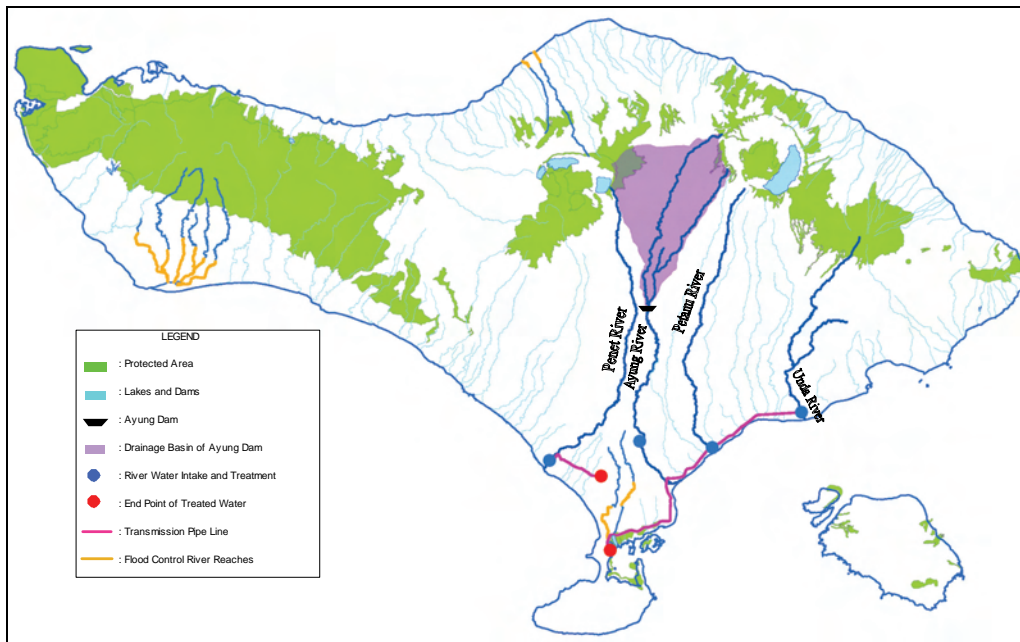


Figure-4.35 Protected Areas and Projects of Master Plan

4.8.4 Social and Environmental Evaluation of Master Plan

It is concluded that the proposed master plan for water resources development and management is ecologically and socially sustainable since it does not interfere with the sustained protection of declared protected and nature reserve areas of Bali Inland and also the existing (and future as well) irrigation water user (farmer) rights since all direct river water intakes are planned at most downstream reaches of rivers.

The master plan also would facilitate the mitigation of on-going salinity intrusion in the coastal groundwater of South Bali area and hence the long-term retrieval of groundwater quality.

Adverse effects caused to the construction of Ayung dam are anticipated as follows:

- Disappearance and variation of ecological system, especially on disappearance of vegetation, terrestrial biota and aquatic biota by submerging of reservoir.
- Change of environment as well as ecological system due to large discharge fluctuation and sediment transportation in downstream of dam.

The overall benefits due to the projects of master plan including the proposed plans on water environmental improvement (in particular, the agricultural runoff pollution control measures, is very relevant to this master plan as well since provision of additional irrigation water is also an objective of Ayung Dam) and river basin conservation along with institutional capacity building is expected to lead to long-term sustained water environmental improvement of Bali Island. Accordingly, the water resources development and management master plan is assessed as both socially and environmentally beneficial and sustainable in the long-term.

4.9 Priority Project

4.9.1 Criteria for Setting Priority

Based on the study on water resources development in Bali Province, the priority project for the water resources development projects and the water resources management projects are selected applying the following criterion:

Water Resources Development Projects

- ◆ Projects which implementation are scheduled in the first 5 years starting in 2006, also scheduled in the next 5 years starting in 2011 for 20 years covered by this plan.
- ◆ Projects which serve large amounts of municipal water to the area with severe water shortage.
- ◆ Projects which require longer implementation period for the plan, design and construction.

Water Resources Management Projects

- ◆ Plans which include basic or fundamental parts as well as additional parts for upgrading of the related projects.
- ◆ Plans which contribute the reduction of environmental load or possess the low impact to the environment with preserving of sustainable water resources.
- ◆ Plans which improve effective water use, rational operations and maintenance.
- ◆ Plans which give mind first to the preservation of Bali cultures through the execution.

4.9.2 Priority for Each Project

Out of the water resources development projects and water resources management plans proposed in the Master Plan, the following projects and programs are selected as the priority projects based on the above criterion. See Table-4.46.

Table-4.46 Proposed Priority Projects

Projects	(1)	(2)	(3)
	2006 -2010	2011 -2015	Selected Special Priority Project
1. WATER RESOURCES DEVELOPMENT			
◆ 1.1 Integrated WR Development Project			
1.1.1 AYUNG Reservoir	X	X	▲
1.1.2 BENEL Reservoir		X	
◆ 1.2 Water Supply Project			
1.2.1 Integrated Water Supply for DENPASAR Metropolitan Area	X	X	▲
1.2.2 Water Treatment (WARIBANG-2): DENPASAR	X		
1.2.3 Water Treatment (BENEL): JEMBRANA		X	
1.2.4 Water Supply – Well: Related Regencies	X	X	
1.2.5 Water Supply – Spring : Related Regencies	X	X	
◆ 1.3 Flood / Sediment Control Project			
1.3.1 BADUNG/MATI River Flood Control	X	X	▲
1.3.2 Flood Control for NEGARA Area	X	X	
1.3.3 Flood Control for SINGRAJA Area	X	X	
1.3.4 Flood / Sediment Control: Related Regencies	X	X	
◆ 1.4 Irrigation Project			
1.4.1 Irrigation Improvement (from AYUNG Reservoir)		X	
1.4.2 Irrigation Improvement (from BENEL Reservoir)			
1.4.3 Irrigation Improvement: Related Regencies	X	X	
2. WATER RESOURCES MANAGEMENT			
◆ 2.1 Institutional Reform Program			
2.1.1 Establishment of DINAS-PSDA	X		
2.1.2 Establishment of BALAI-PSDA	X		
2.1.3 Establishment of W/R Coordination Council	X		
2.1.4 Establishment of SEDAHAN A. & SUBAK Coordination Unit	X		
2.1.5 Preparation of Regulations & Guidelines for New WR Law	X		
◆ 2.2 Water Environment Improvement Program			
2.2.1 Public Education and Campaign	X	X	
2.2.2 Environmental Flow for BADUN & MATI Rivers	X		
◆ 2.3 River Basin Conservation Program			
2.3.1 Forest and Land Rehabilitation	X	X	
2.3.2 Sediment Control (Included in Flood Control)	X	X	
2.3.3 Coastal Protection for Related Areas	X	X	
◆ 2.4 Capacity Development Program			
2.4.1 Personnel Assignment	X	X	
2.4.2 Capacity Building Support for BALAI-PSDA	X	X	▲

[Note]

(1) 2006-2010; First 5 years projects start in 2006

(2) 2011-2015; Next 5 years projects start in 2111