CHAPTER 7 WATER RESOURCES MANAGEMENT PLAN

7.1 Institutional Development

Focusing on the water resources functions of Dinas PU, this section reviews relevant factors and proposes institutional reforms with a view to realizing integrated water resources management. It also considers water supply arrangements, financing for raw water and drinking water and regulatory measures that will be necessary to attain the institutional reforms. A road map for the institutional development is provided at the end.

7.1.1 Water Resources Management

(1) Factors to be Considered for Institutional Reforms

The institutional framework that would enable integrated water resources management in Bali needs to solve the issues. They are:

- The jurisdictions over water resources management between the province and the regencies/city are not clearly defined;
- Inter-agency arrangements between water resources related government offices are not clear enough to ensure systematic coordination.
- Part of routine technical activities of Dinas PU/Sub-Dinas SDAPP are still conducted by APBN working units using the central government budget; and

The confirmation that Bali is one river basin and one groundwater basin will resolve the first issue, by clarifying that the provincial government is responsible for water resources management for the entire Bali except for irrigation, for which the responsibilities are shared between the province and the regencies/city. Additional factors that need consideration are:

- The Water Resources Law No.7/2004 provides for setting up of Provincial Water Resources Coordination Council and similar councils at regency/city and/or basin levels as appropriate. Unlike PTPA (see 1.12 (2)), 50% of the members must be from non-government sectors.
- The central government including Ministry of Public Works (DEPPU) is decreasing APBN spending on regional tasks in line with the Law on Fiscal Balance No.33/2004. This is being accompanied by increase in the central government's direct transfer (DAK) to regional governments. As a result, the net reduction is not significant, but it means that it will be increasingly important for the regional governments to allocate the local budget in accordance with identified priorities. Obviously, water resources management deserves more attention and higher priority than being accorded at present.
- It is reported that Bali may be declared as a "nationally strategic river basin" and be brought under the responsibility of the central government (in accordance with Articles 13 and 14 of the Water Resources Law No.7/2004).

(2) Options for the Institutional Framework

During the Phase I of the study, the following two options were presented:

- Option I: Continue with the existing arrangement
- Option II: Introduce the Balai PSDA structure in order to have better focus on technical implementation

Balai PSDA is a technical implementation unit for water resources management that works directly under Dinas. The concerned Regulation of the Minister of Home Affairs No.179/1996 provides that three technical sections be established in Balai PSDA: i) data operation and management; ii) maintenance and rehabilitation; and iii) control and security.

For Option II, four theoretical variations were presented with different jurisdictional coverage by the Provincial Balai PSDA. They were:

- **Variation A**: The province is responsible for cross-regency/city rivers and for overall coordination and guidance.
- **Variation B**: The province is responsible for an expanded area, covering strategically important rivers in view of water demands, potential conflicts, and other key factors.
- **Variation C**: The province is responsible for the entire Bali.
- **Variation D**: Bali is declared as a nationally strategic river basin and comes under the direct responsibility of MPW through National Balai PSDA or a similar body.

(3) Evaluation of the Options

The Study Team carried out further fact-finding and consultation with concerned government officials and other stakeholders during the Phases II & III to identify the best possible institutional arrangement for Bali. During the Phase II, the Study Team recommended that Bali should be considered as one river basin and one groundwater basin and be managed accordingly (i.e. by the province). As mentioned earlier there is now a consensus toward this end in Bali and between Bali and the central government. The exception is irrigation systems, for which the regencies/city are responsible if they are located within the regency/city in irrigation areas of less than 1,000ha (in accordance with Article 41 of the Water Resources Law No.7/2004 and its elucidation). In addition, the introduction of Balai PSDA, following the examples in other river basins, will be necessary to bring technical discipline to the organization and to increase the effectiveness of water resources management. These considerations lead to the choice of either Option II-C or Option II-D.

It appears that the central government does not intend to re-centralize water resources related authority, if it decides to designate Bali as a "nationally strategic river basin." Rather, it will have direct charge of development activities but will most likely expect the provincial and regency/city governments to be responsible for management of water resources including finance. If that is the case, the institutional arrangement will be Option II-C where development activities will be undertaken either by a national body or by APBN working units of the provincial Dinas. (There is a possibility of the province becoming responsible for development in the long run, but this will require significant fiscal decentralization, which is infeasible at least in the short to medium term.) The Study Team has chosen to focus on Option II-C to detail out our recommendations for the new institutional arrangement. Should a decision is made that the central government assumes direct responsibility for Bali basin both for development and management, this model needs a modification, which is essentially to convert the proposed provincial Dinas structure into a national body. A summary of this discussion on the conceivable options is shown in Table-II-7.1. The subsequent discussion assumes that (ii) or the shaded option in the table (i.e. development by APBN Working Units and management by the provincial Dinas) will be pursued. The proposed institutional arrangement is applicable to (i) and (iii) as well.

Table-II-7.1 Conceivable Options for the Institutional Framework

Strategic or not Activity	Bali as Regular River Basin	⇩ Bali as Nationally Strategic River Basin		
Development	By ABPN Working Units	By APBN Working Units	By a national body	By a national body
Management	By Provincial Dinas + Balai	By Provincial Dinas + Balai	By Provincial Dinas + Balai	By a national body (with some activities delegated to Provincial Dinas)
Option	(i)	(ii)	(iii)	Option II-D
	← Option II-C →			

(4) Allocation of Responsibilities in the Proposed Institutional Framework

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-II-7.2 and Table-II-7.3 below respectively.

Table-II-7.2 Existing Institutional Arrangement for WRM in Bali

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
	Development	O&M			
PROVINCE					
Dinas PU				**X** (from surface water licenses)	**X** (but depends)
- APBN W/Units	**X**	**X**	**X** (for Kab/Kota)		
- Sub-Dinas WR		**X**	**X** (trans-Kab/Kota OR 1,000-3,000ha)		
Other offices	**X** (Sub-Dinas TRP for supply and drainage facilities)			**X** (tax on water use by DISPENDA)	
Regency/City					
Dinas PU					
- Sub-Dinas WR			**X** (within Kab/Kota & less than 1,000ha)	**X** (from groundwater & spring licenses)	
Sedahan Agung (only in Tabanan and Denpasar)					**X** (by Bupati, but depends)
Other offices	**X**(PT.TB-private participation-for water supply)	**X** (PDAMs & PT.TB for water supply)			

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
PROVINCE					
Dinas PU			**X** (by Governor for surface water)		
- APBN W/Units	**X**			**X**	
- Sub-Dinas WR				**X**	
Other offices	**X** (BMG)			**X** (BAPEDALDA)	**X** (BAPEDALDA)
Regency/City					
Dinas PU			**X** (by Bupati for groundwater and spring)		
- Sub-Dinas WR					
Sedahan Agung (only in Tabanan and Denpasar)					
Other offices				**X** (BAPEDALDA, but depends)	

Table-II-7.3 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?)			

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
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					
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. For water resources management, while structural measures, i.e. infrastructure development and rehabilitation, will continue to be necessary, more attention must be paid to non-structural measures particularly with respect to water allocation and water quality control. And this should be done by a professional organization dedicated to water resources with sufficient status and authority.

It may be noted that in many parts of Indonesia particularly where water issues are significant, Dinas PSDAs have already been established. It may also be noted that Sub-Dinas SDAPP is larger than many Dinases of the Bali provincial government in terms of staffing and budget (See Table-II-7.4), and therefore restructuring of the provincial government will be quite reasonable.

Table-II-7.4 Budget and Staffing of Dinases in Bali Province

Dinas	2003 Budget (million Rps.)		2004 Budget (million Rps.)		2005 Budget (million Rps.)		No. of Civil Servants
	APBD I	APBN	APBD I	APBN	APBD I	APBN	
PU (Public Works)	**85,112**	**439,316**	**72,283**	**327,949**	**73,622**	**568,919**	**723**
Sub-Dinas SDAPP	**4,846**	**286,466**	**5,801**	**118,687**	**5,879**	**315,503**	**266**
Industry and Trade	7,014	2,643	n.a.	2,030	n.a.	n.a.	212
Cooperatives	3,447	8,441	n.a.	4,693	n.a.	n.a.	77
Man Power	5,335	5,869	n.a.	3,847	n.a.	n.a.	261
Health	16,004	57,300	n.a.	54,720	n.a.	n.a.	494
Education	31,096	125,094	n.a.	174,134	n.a.	n.a.	476
Transportation & Telecom	n.a.	5,875	n.a.	34,372	n.a.	n.a.	203
Social Prosperity	5,638	14,729	n.a.	28,962	n.a.	n.a.	175
Culture	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	256
Tourism	4,473	1,350	n.a.	2,114	n.a.	n.a.	102
Forestry	n.a.	2,697	n.a.	2,365	n.a.	n.a.	289
Sea and Fishery	n.a.	31,716	n.a.	9,247	n.a.	n.a.	118
Plantation	n.a.	6,463	n.a.	5,932	n.a.	n.a.	356
Agriculture	11,888	32,903	n.a.	46,066	n.a.	n.a.	346
Livestock	n.a.	6,088	n.a.	7,649	n.a.	n.a.	151
Revenue	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	260

Source: Bali Provincial Government and Dinas PU (as of January 2005 for the 2005 Budget the number of Sub-Dinas SDAPP civil servants and as of June 2005 for the rest of the information)

When establishing Dinas PSDA, some additional functions need to be transferred from other sections of Dinas PU and other government offices. The Study Team believes this will be extremely important for ensuring enabling conditions for integrated water resources management in Bali. The additional functions are:

- Groundwater monitoring and technical assessment (currently performed by Groundwater Section of Sub-Dinas Mining).
- Preparation of recommendations to the Governor on issuing licenses for groundwater and spring (transferred from Regency/City Dinas PU). The licensing authority for groundwater and spring will be transferred from Bupati/Walikota back to the Governor.
- Preparation of recommendations to the Governor on issuing licenses for surface water (transferred from Sub-Dinas Program and Control of Dinas PU).
- Water quality examination (transferred from UPTD of Dinas PU).
- Some functions for administration, program and control, and technical guidance that are relevant to Dinas PSDA (transferred from respective Sub-Dinas of Dinas PU).
- Water quality monitoring and analysis. The current duplicative function performed by BAPEDALDA will be absorbed by Balai PSDAs. BAPEDALDA will instead concentrate on policy guidance, supervision and coordination for water environment improvement.
- Regulatory authority over river border areas (transferred from Regency/City, while monitoring tasks may be delegated to the regencies/city).

In addition, Dinas PSDA will manage a civil service investigation function focusing in particular on water quality control through civil service inspection officers, which will be attached to Balai PSDAs. This will be a new role of Dinas and is in line with Article 93 of the Water Resources Law No.7/2004.

Dinas PSDA will be responsible for planning, programming, budgeting, management of APBN working units and supervising Balai PSDAs.

Balai PSDAs

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. The main responsibilities of Balai PSDAs will be as follows:

- O&M (irrigation facilities, dams, river improvement, flood control, beach conservation, etc.)
- Water quantity management (for surface water, groundwater and spring including conducting technical assessment before licensing, and for measuring and analyzing customary water use)
- Water quality management and control (including inspection of rivers for detecting any unlawful activities by civil service investigation officers)
- Development and management of water resources information system
- Technical support to Provincial Water Resources Coordination Council and its Sub-Councils
- Technical guidance to regency/city Dinas PU/Sub-Dinas SDAPP as necessary

When Balai PSDAs are established, their initial work will be the continuation of the existing functions performed under different sections and APBN working units. In particular, Balai PSDAs need to make sure that the O&M and monitoring functions currently performed by APBN working units will be well integrated into the Balai activities. Then, the functions of Balai PSDAs will be gradually expanded so that they can perform full-fledged water resources management supported by necessary capacity development. Under each Balai PSDA, circuit offices will be established to undertake field operations. If regency/city Dinas PU/Sub-Dinas SDAPP is ready to take on any of the functions, Dinas PSDA/Balai PSDA may delegate the functions to the concerned regency/city, while Dinas PSDA will retain the ultimate authority. An example would be the groundwater monitoring function in Buleleng and Karangasem, where the EU-assisted groundwater development project is working with regency PU officials to develop their capacity for monitoring. The data evaluation needs to be conduced at the provincial level, for which there needs to be a systematic reporting arrangement between the two levels. In light of the proposed priority projects, a practical way-forward would be to set up a smaller Balai at the beginning for managing Ayung Dam and water allocation ("Ayung Balai PSDA"), which can later be transformed into a full Southeastern Balai PSDA.

Water Resources Coordination Council

The third element of the new institutional arrangement is Provincial Water Resources Coordination Council (PWRCC). As mentioned before, the Water Resources Law No.7/2004 requires establishment of a PWRCC with half of the members from non-governmental sectors. As the PTPA, a similar mechanism established earlier nation-wide, was a committee of government bodies (established in Bali in 1996 but has met rarely), it needs to be re-established with a fresh or revised regulation. At the national level, setting up of National Water Resources Coordination Council and a government regulation to guide the establishment of PWRCC and similar councils at regency/city and river basin levels are under preparation. In Bali, under PWRCC, there can be "sub-councils" corresponding to the respective areas of Balai PSDAs to discuss the area specific issues. In order for PWRCC and its sub-councils to play meaningful roles, their terms of reference must be specific and they must be supported by a competent secretariat function. Dinas PSDA and Balai PSDAs are expected to perform this function. 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. In light of these purposes, the core activities of PWRCC may be defined as follows:

- Review and approve mid-term and annual water resources development and management plans.
- Review provincial and regency/city annual budget proposals related to water resources (before they are sent to the respective parliaments).
- Review the activities of the past year and related expenditures incurred. (Each water resources related government office will be required to present their annual activities, results and expenditures. The subject areas should include water quality control and watershed conservation.)
- Review and approve water allocation plans
- Discuss water re-allocation. Provide a platform for discussion and negotiations between concerned parties.

Sedahang Agung

The fourth aspect concerns the regency/city level. The regencies/city will continue to be responsible for development, rehabilitation and O&M in irrigation areas of less than 1,000 ha. Also, as mentioned earlier, they can take on additional responsibilities if delegated by the province. Another important function at the regency/city level is coordination with subaks. As described in 1.11, 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. Through stakeholders' meetings, the Study Team has identified that there is an urgent need to re-institute a governmental focal point for subaks using the traditional name of sedahan agung (as this name carries a sense of respect and trust among subaks). 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. This arrangement will fulfill the intention of the 1972 Bali Provincial Regulation on Irrigation (see 1.11) as to the roles of sedahan agung. But at the same time, it is important to ensure "fit" between the position and the expectation of the clients (i.e. subaks), and therefore each regency/city is requested to decide on the administrative location of sedahan agung in consultation with subaks. Sedahan agung will act as a government "one stop shop" for subaks, where subaks can come for any information or consultation, but the core role of sedahan agung must be on water issues. 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.

At the same time, the regencies/city may consider upgrading Dinas SDAPP of Dinas PU to Dinas PSDA in parallel with the restructuring at the provincial level. And if the head or a senior official of Dinas PSDA is designated as *sedahan agung*, this will introduce an institutional consistency that would ensure the best possible conditions to cope with water issues.

Under the new institutional arrangement, the link between the province and the regencies/city on water resources will be ensured through the following mechanisms:

- Regency/city Dinas PU/Sub-Dinas SDAPP (or Dinas PSDA), sedahan agungs, and other offices are represented in the PWRCC and/or its sub-councils.
- Balai PSDAs are represented in the regency/city Subak Coordination Units (through the relevant circuit offices).

(5) Inter-Agency Arrangements

With a view to realizing integrated management of water resources in Bali, arrangements between certain government offices need to be clarified and systematized. The areas and the concerned offices are described below.

- Water quantity monitoring: BMG and BP-DAS Unda Anyar (of the Ministry of Forestry) collect and monitor rainfall data, which should be shared with Dinas PSDA on a regular basis. Explicit interagency arrangements are necessary to this end.
- Water quality monitoring: BAPEDALDA undertakes quality monitoring for 21 rivers but this function had better be performed by Dinas PSDA/Balai PSDAs. Instead, BAPEDALDA should focus on policy-oriented activities including improving the content and enforcement of the regulations and coordinating efforts for improving water environment.

- Water resources cost recovery: The collection of the taxes on the use of surface water, groundwater and spring by Provincial DISPENDA must be supported by the licensing information to be managed by Dinas PSDA. An interagency arrangement is necessary in this regard.

In addition, from a wider perspective of watershed management, the responsibilities, rules and procedures in the following areas need to be systematized and clearly understood by water resources stakeholders:

- Spatial planning and land management involving BAPPEDA, Dinas PU/Sub-Dinas SDAPP, Dinas PU/Sub-Dinas TPR and BKPRD (Spatial Arrangement Coordination Board) at both the provincial and regency/city levels.
- Watershed conservation involving BP-DAS Unda Anyar of the central government and Dinas Forestry of the provincial and regency/city governments.

7.1.2 Water Supply Management

Drinking water supply will continue to be provided by PDAMs. Private participation like the concession agreement with PT.TB in Badung may be expanded in the long-run, but it will be subject to tariff increase and improvement in management autonomy and financial conditions of PDAMs. As corporatized entities (though 100% government owned), PDAMs shoulder repayment responsibility for new facilities, though construction is done by the government (by Sub-Dinas TRP of Dinas PU) using APBN. This means rehabilitation and addition of drinking water supply facilities will inevitably require financial restructuring of PDAMs

In response to increasing needs for water transmission across regencies/city in SARBAGITAKU and in line with the Government Regulation No.16/2005 and the Ministry of Public Works Regulation No.294/2005, the five PDAMs have signed a MoU (in December 2005) proposing to establish a new water production entity to be charged with managing water transmission facilities and bulk water supply to PDAMs, and to be jointly owned by the province, the five regencies/city and perhaps the central government. A "cooperation board" (Badan Kerjasama) has been established in the Bali provincial government to consider this proposal and to undertake a feasibility study covering technical, financial and managerial aspects. The Study Team considers such a new institutional arrangement will be important in view of the following:

- The new entity will enable investment finance necessary for the construction of transmission facilities by creating a mechanism to share the financing (and repayment) responsibility among the regencies/city, the province and the central government.
- The new region-wide entity will reduce transaction costs, which will be incurred if PDAMs negotiate and agree on water transmission separately. It will also enable optimal and equitable re-allocation of water among PDAMs from a region-wide perspective.

The new entity, however, may create a quasi-monopoly power in raw water use in the region, gaining more bargaining power vis-à-vis other water users like *subaks*. Such a risk must be mitigated by a mechanism to ensure fairness and equity in the Water Resources Coordination Council (or a sub-council).

7.1.3 Financing Measures

In view of the need for the provincial as well as regency/city governments to graduate from their dependence on the central government's funding and to finance water resources management on their own, measures for cost recovery including the following must be considered:

- It is recommended to convert the provincial taxes on the use of surface water, groundwater and spring into "special purpose taxes" so that the generated revenue will be earmarked and allocated to the purposes of water resources management.
- Other existing water resources related revenue sources, the rates and the collection mechanisms need to be reviewed. The existing revenue sources include water licensing fees and penalties for violating water quality requirements.
- Other sources of water resources related revenue must be identified. Potential sources include charges on water sports and recreation and raw water provision to hydropower generation.

Introduction of various charges on the use of raw water (they can be called "water resources management fees" or "water utilization fees") may face political hurdles. In particular, increasing the fees charged to PDAMs will inevitably create further needs for PDAMs to raise their drinking water tariffs (which has already been facing enormous political difficulties). In addition, pricing by the new water production entity must come into the picture. In order to solve the pricing issues on the three fronts (i.e. raw water provision, water transmission and drinking water supply), well coordinated public relations campaigns with the aim of raising awareness on the need to finance for the management of both water resources and water supply would be necessary. Messages may be crafted centering around the changing nature of water and the benefits of the financing, such as cleaner water, more stable water supply and meeting increasing demands, which will help economic growth. In doing so, simultaneous efforts to improve operational efficiency of the Dinas and PDAMs will be crucial. Otherwise, calls for tariff increase and introduction of new charges will not be persuasive.

7.1.4 Regulatory Measures

Table-II-7.5 summarizes the existing legal and regulatory framework for water resources at the national level as well as in the Bali province. As mentioned in Chapter 1, government regulations are needed to implement many aspects of the Water Resources Law No.7/2004. But in other areas, Bali Province can go ahead and introduce relevant regulations or governor's decrees (or bupati/walikota's decrees) to introduce the required changes in the institutional arrangement. The areas that require regulatory measure in the province and regencies/cities in Bali are highlighted (shaded) in the same table.

Table-II-7.5 Laws and Regulations on Water Resources

National Level		In Bali	
Key Existing Law/Regulation	Draft Revised Regulation	Province	Regency/City
Key Aspects of WR Law No.7/04: Irrigation			
• GR 77/2001 on Irrigation: Irrigation Committee at Regency/City for irrigation management incl. water distribution. Transfer significant responsibility for irrigation management to water users associations (WUAs). For irrigation water use, a permit is issued to WUAs. • MD Kimpraswil (from No.529/KPTS/M/201) from & Home Affairs (No.50/2001) on the transfer of authority for irrigation management to water users associations → This was later suspended by the Ministry's letter in 2003.	• GR on Irrigation: The permit system mentioned in GR 77/2001 is withdrawn. The responsibility for primary and secondary irrigation facilities will be with the government in accordance with Article 41 of WR Law No.7/2004.	• PR No.2/PD/DPRD/1972 on Irrigation in Bali: The first official recognition of the subak system and their organizations in the form of a regulation, in an effort to reconcile the subak system with the central government legislation. The role of Sedahan Agung is mentioned as coordinator for irrigation water use. • GD No.180/1986 on Formation and Composition of irrigation Committee • Governor's Instruction No.8/1991 on Management, Operation and Maintenance of Irrigation Network Constructed by Bali Irrigation Project • GD No.426/1994 on Implementation of Irrigation Service Contribution (IPAIR) in Bali • Governor's Instruction No.2/1995 on Implementation of Irrigation Service Contribution (IPAIR) • GD No.509/1999 on Irrigation Service Fee → Some trial introductions were made, but in consideration of the existing in-kind contribution by *subak* members, these regulations were not implemented. ➢ ***A fresh provincial regulation will be required to resolve confusion that may have resulted from the GDs issued in 1980s and 1990s and in line with the new GR on***	→ Regency/city regulations were issued in 1990s, which were mostly about confirming the organizational arrangement of subaks that had already existed. ➢ ***A new regulation is necessary to re-institute Sedahan Agung, located ideally in Dinas PU/Sub-Dinas Water Resources (or Dinas PSDA), and to establish a Subak Coordination Unit.***

National Level		In Bali	
Key Existing Law/Regulation	Draft Revised Regulation	Province	Regency/City
		irrigation. The role of Sedahan Agung as mentioned in the PR No.2/1972 should be reconfirmed in accordance with the proposed new institutional framework.	
Key Aspects of WR Law No.7/04:Water Resources Management			
• Regulation of Minister of Public Works NO.39/PRT/1989 on Division of River Basin Units • MD of Public Works No.48/PRT/1990 on Water and Water Resources Management • MD of Public Works NO.49/PRT/1990 on System and Legal Conditions in Using Water and Water Resources • Regulation of Minister of Public Works No.63/PRT/1993 on River Border Lines, River Benefit Areas, River and Former River Control Areas • GR 35/1991 on Rivers • GR No.27.1991 on Swamps • Ministerial Regulation No.63/PRT/1993 on River Boundaries	• GRs on Water Resources Management, Rivers, and criteria and procedures for determining river basins and groundwater basins • PD on river basins and groundwater basins • GR on development of other surface water sources, development of groundwater, cloud utilization, and utilization of sea water	• On river border areas, Provincial Dinas PU follows the criteria provided in the Ministerial Regulation No.63/1993, but BAPPEDA provides another set of guidelines in the spatial plan. ➢ ***In view of flood control requirements in the Master Plan, a new provincial regulation will be needed to determine river border areas.*** ➢ ***On other matters, depending on the content of the GRs to be introduced, corresponding provincial regulations will be necessary.***	• On river border areas, Walikota/Bupati Decrees are available in Denpasar and Badung providing river-wise border lines.
Key Aspects of WR Law No.7/04: Groundwater Management			
• PD No.64/1972 on Authority and Management of Geothermal Steam, Groundwater and Hot Spring Water • MD No.1451K/10/MEM/2000 from Ministry of Energy & Natural Resources on Groundwater (technical guidance)	• GR on Groundwater	➢ ***A provincial regulation is necessary to prohibit any further development of groundwater in places where saline intrusion is occurring (i.e. Kuta, Nusa Dua, Sanur, Negara, and Nusa Penida).*** ➢ ***In the future, a similar restriction may be necessary in Denpasar corresponding to population increase. New Buildings may be required to install rain water treatment wells.***	
Key Aspects of WR Law No.7/04: Licensing for Water Use			
• GR 22/1982 – Article 19: A license is required for the extraction of surface or ground water for all purposes other than basic daily living needs. Stipulates procedures and requirements for awarding permits except for agricultural and power supply needs. • MD of Public Works No.49/PRT/1990 on Procedures and Conditions of Water Usage and Water Source Licensing: Every usage of water or water source for certain needs is obliged to get permit based on WR development plan.	• GR on water use rights and water "exploitation" rights: Licenses are required for commercial use of water resources but not for basic daily needs and for "public agriculture."	• PR No.15/1988 on Control of Groundwater and Surface Water Taking • GD No.445/1989 on Implementation of PR No.1988. ➢ ***These are no longer valid and will have to be replaced by a new provincial regulation in light of the proposed new institutional arrangement. The licensing authority for all water resources (i.e. surface water, groundwater and spring) must be consolidated at the provincial level. In addition, the procedures and requirements for licensing will have to be clearly established by the new regulation.***	• GR 22/1982 – Article 19: A license is required for the extraction of surface or ground water for all purposes other than basic daily living needs. Stipulates procedures and requirements for awarding permits except for agricultural and power supply needs. • MD of Public Works No.49/PRT/1990 on Procedures and Conditions of Water Usage and Water Source Licensing: Every usage of water or water source for

National Level		In Bali	
Key Existing Law/Regulation	Draft Revised Regulation	Province	Regency/City
			certain needs is obliged to get permit based on WR development plan.
Key Aspects of WR Law No.7/04: Water Quality			
• GR No.82/2001 on Water Quality Management and Water Pollution Control: Divides water quality into four classes and specifies 38 parameters for each class. Requires obtaining permit from Bupati/Walikota for wastewater disposal/release. Stipulates penalties, relying on local government to set values. But grounds of violation are not clearly defined.	• GR on Water Quality Management	• PR No.16/1988 on Monitoring and Control of Environmental Pollution by Sewerage • GD No.174/1990 on Implementation of RR No.16/1988 • GD No.515/2000 on Environmental Quality Standards ➢ ***GD No.515/2000 is currently in the process of review and re-drafting in light of GR No.82/2001. Based on Article 20 of GR No.82/2001 that authorizes regional governments to determine pollution retention capacity and requirements for wastewater disposal to water/water resources, the Bali provincial government is recommended to stipulate detailed provisions to be able to effectively regulate wastewater quality and to penalize violating activities.***	• GR No.82/2001 on Water Quality Management and Water Pollution Control: Divides water quality into four classes and specifies 38 parameters for each class. Requires obtaining permit from Bupati/Walikota for wastewater disposal/release. Stipulates penalties, relying on local government to set values. But grounds of violation are not clearly defined.
Key Aspects of WR Law No.7/04: Drinking Water			
• MD of Public Health No.907/2002 on Standards and Control of Drinking Water Quality	(The following were issued in 2005) • GR No.16/2005 on Drinking Water Supply System • MD of Public Works No.294/PRT/M/2005 on Supporting Body for Drinking Water Supply System	➢ ***A set of regulations will be needed to establish and operationalize a new water production entity once it is approved.***	
Key Aspects of WR Law No.7/04: WR Conservation			
n.a.	• GR on water source protection and conservation, water preservation and WR conservation activities	• 19/PD/DPRDGR/69 on Forest Protection (No.40.1971) • 21/PD/DPRDGR/69 on Valley Protection (No.42/1971) • 2/PD/DPRDGR/73 on Prohibition Order for Taking Sand, Grovel, Stone, Limestone, etc. • PR on Mining of C Class Material (1984) (sand, limestone, gravel, stones, etc.) • PR on licensing, supervision and control of mining C class material ➢ ***A new provincial regulation will be necessary to protect the 218km^2 drainage basin of the proposed Ayung dam.(See Part-II-9.4.)***	
Key Aspects of WR Law No.7/04: Flood control			
• PD No.3/2001 on National Coordination Board for Disaster Mitigation and Refugee		➢ ***A provincial regulation will be necessary to introduce the system of flood evacuation system***	

National Level		In Bali	
Key Existing Law/Regulation	Draft Revised Regulation	Province	Regency/City
Handling • MD of KIMPRASWIL No.410/KPTS/M/2002 on National Disaster Management Implementation Unit • Decree of Secretary General of KIMPRASWIL No.02/KPTS/SJ/2003 on coordination of National Disaster Management Unit		***involving the local communities.***	
Key Aspects of WR Law No.7/04: Coordination			
• MD of Public Works No.67/PRT/1993 on Provincial Water Management Committee • PD No.9/1999 on Coordination Team for River Utilization and Sustainable Watershed Management • PD No.123/2001 on Coordination Team for Water Resources Management	• GR on organizational structure and procedure of the coordination body	• GD No.180/1996 & Decree of the Chief No. SK/002/PPTA/1996 on Formation of Water Management Committee (PPTA) in Bali Province ➢ ***PPTA must be replaced by Provincial Water Resources Coordination Council (PWRCC). 50% of the member must be from non-governmental sectors. In Bali, two or three sub-councils may be introduced at the same time corresponding to the respective areas of to-be-established Balai PSDAs. The responsibilities of PWRCC should include review of annual WRM plans and budget as well as results.***	
Key Aspects of WR Law No.7/04: Construction			
• MD of Public Works No.98/KPTS/1993 on Dam Safety Organization			
Key Aspects of WR Law No.7/04: O&M			
n.a.	• GRs on WR inventory and management plan, O&M, and information system ➢ ***In addition, a MD will be necessary to enable the transfer of assets constructed under APBN projects to the provincial and regency/city governments so as to have them fully responsible for O&M.***		
Key Aspects of WR Law No.7/04: Stakeholders and Communities			
n.a.	• GR on empowerment, supervision and the role of community in WR management		
Key Aspects of WR Law No.7/04: WRM Financing			
• GR No.6/1981 on Fee for Water Resources Infrastructure: Fees to be collected by Corporation	• GR on Financial Management of Water Resources	• PR No.3/2004 on Intake and Exploitation Tax of Ground Water and Surface Water	

National Level		In Bali	
Key Existing Law/Regulation	Draft Revised Regulation	Province	Regency/City
from legal entities, social institutions and individuals who directly benefit from the water availability as outcome of the development of WR infrastructure. Farmers are exempted. The amount of fee is determined by Ministers of Finance and Home Affairs • Law No.18/1997 on Regional Taxation and Levies (amended by Law No.34/2000): On regional tax on surface water and groundwater utilization at a rate not higher than 20%. The tariff is based on the type, volume, quality and location of the water source. GR No.19/1997 provides exemptions. • GR No.65/2001 on Regional Taxation: The tax rate on exploitation and utilization of surface water and groundwater set at 10% and 20% respectively.		- Ground water includes spring water. - xempt from taxation: intake/exploitation by governments & SoEs; for irrigation of people's agriculture: basic needs of households; religions, research, and fire fighting needs. - Tax base: value of water obtained. - Rates: 20% for ground water; 10% for surface water. - Governor has the authority of collection of both taxes. • GD No.30/2004 on Basic Price of Water for Tax Imposition on Intake and Exploitation of Ground Water and Surface Water: Provides the price list for each category of business/establishment and each range of usage volume • GD No.31/2004 on Collection Procedure for Intake and Exploitation of Tax on Ground Water and Surface Water: Provides the procedures and forms for the taxation and penalty. ➢ ***A provincial regulation will be necessary to enable to-be-established Balai PSDAs to collect fees from issuing licenses for the use of surface water, groundwater, and spring. The regulation may be amended later to add other sources of revenue.*** ➢ ***PR No.3/2004 may be amended to convert the groundwater and surface water tax to a special purpose tax with the aim of financing WRM activities.***	
Key Aspects of WR Law No.7/04: WRM Organization			
• GR 93/1999 on PJT I & GR 94/1999 on PJT II • Guideline of the State Minister for State Administration Reform 1995 for Technical Implementation Unit (UPT), Regional Implementation Unit (UPD) and Technical Implementation Unit of Service (UPTD) • MD of Home Affairs No.179/1996 on Organizational Roles and Work Procedures of Water Resources Management Office (Balai PSDA)	• GRs on PJT I, PJT II (& PJT III?)	➢ ***The following provincial regulations will be required:*** - ***to restructure Sub-Dinas WR of Dinas PU into Dinas PSDA*** - ***to establish Balai PSDAs and to provide their structures and functions*** - ***to provide for inter-agency arrangements i) between Dinas PSDA and BMG and BP-DAS Unda Anyar (on rainfall data), ii) between Dinas PSDA and Dinas Revenue on the water licenses information.*** - ***to reform the role of BAPEDALDA in water environment improvement.***	

GR: Government Regulation [Peraturan Pemerintah=PP], PD: Presidential Decree [Keputusan Presiden=Keppres]
MD: Ministerial Decree [Peraturan Menteri=Permen], PR: Provincial Regulation [PERDA Propinsi]
GD: Governor's Decree [SK-Gub]
Sources: The central government (including the website of BAPPENAS), the Bali provincial government and the regencies/city. Courtesy to the Jeneberang River Basin Management JICA Study Team for many of the national level laws and regulations and their translations.

7.1.5 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-II-7.6. It is based on the assumption that the option detailed out above in 7.1.1 (3) & (4), that is, the combination of APBN Working Units and Balais PSDAs working under Dinas PSDA, will be selected toward the end of 2006. Subsequent to the decision, a preparation team comprising of key officials of Dinas PU needs to be established to work out details of i) a re-organization plan including staffing, assets and equipment transfer, organizational structures and functions, and ii) a detailed capacity development plan. At the same time, an inter-departmental, joint province/regency/city team may be created to deliberate on and recommend specific regulatory measures.

Table-II-7.6 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	● Work out detailed reorganization plan including staffing, assets & equipment transfer, organizational structure, and functions. ● Work out capacity	● 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	● 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
	support from MPW.	development plan. ● Organizational set-up of Dinas PSDA and Balai PSDAs including physical arrangements	the central government and external services. ● Improve planning and budget preparations. → ● Support the operationalization of PWRCC & Sub-Council(s). →	
● 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 operetionanlize 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	

7.2 Water Environment Improvement Plan

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.

7.2.1 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. The overall practical strategies of surface water environmental improvement are summarized in Table-II-7.7.

(1) Short-Term Strategies

<Elimination of Garbage Disposal in Surface Waters and Public Health Aspect>

Elimination of garbage disposal into the surface waters of rivers and streams including the riverine/riverbank areas is identified as the most important basic strategy for the mitigation of water pollution, aesthetic nuisance and floods due to interference with free flow of water.

Garbage disposal into rivers including the use (abuse) of riverbanks as final disposal sites of solid waste is prevalent all over the Province of Bali. The solid waste collection service ratio in the year 2002 in the whole province (solid waste that is actually collected for final disposal and other waste management) was estimated at only 56.8% as per the Regional Environmental Status Report of Bali Province. So this basic strategy will also incorporate improvement of solid waste collection service in tandem with public campaign and education to the residents on not to throw garbage into rivers and other surface watercourses.

It is strongly recommended that each regency to develop a solid waste collection service improvement program with the corresponding development of solid waste final disposal site and other beneficial use oriented waste management measures like composting so as to increase the solid waste collection service ratio gradually on an annual basis. In this respect, more than one regency may share final disposal site and other beneficial use oriented waste management measures. However, each regency should administer solid waste collection service independently as the means to ensure regional accountability on the provision of solid waste collection service. Concerning the improvement of collection service, designation of temporary garbage storage areas (transfer stations of small scale) that is easily accessible for an organized group of residents for disposal of their garbage as well as garbage collection vehicles is recommended to be established with community involvement. The proposed target for urban areas (regional city centers of all regencies of Bali) is to achieve at least a solid waste collection ratio of 90% within the next five years and for the entire regencies of the whole Bali Province within the next 10 years.

Also as the most important basic strategy for improvement of public health sanitation, campaign against use of surface watercourses as toilet is required in all regencies of the province aiming the elimination of such practice within the next 5 years until the year 2010.

<Inspection of Pollution Control Measures by Industries>

It is understood that consequent to AMDAL (EIA) process all industries in Bali, other than home industries, are equipped with their own wastewater treatment facilities as a requirement for the grant of

permit for their operation. However, it seems that they (intentionally) do not properly operate their waste treatment plants in order to save their operational cost. Periodic and sudden on the spot inspection of industrial waste treatment plants is identified as the immediate action plan to ensure proper and continued operation of waste treatment plants by industries, though it is not that easy task.

Industries that do not properly operate their waste treatment plants shall be penalized. The amount of penalty fine need to be set at much higher level than the cost of treatment so as to encourage proper treatment rather than to use the penalty fine simply as form of additional tax on industries. In other words industries must be convinced that it is much cheaper to properly treat their wastes rather than pay a penalty fine for noncompliance with industrial waste treatment requirements.

<Enhancement of Natural Purification Potential of Streams and Surroundings>

In general fast flowing streams (high velocity) have higher pollutant assimilative capacity (purification potential) than slow flowing ones due to their higher mixing and reaeration potential. In this respect elimination of irrigation weirs that are no longer used effectively typically in Badung river due change in land use from agriculture to other developments would increase the flow and hence the natural assimilative capacity of river. Moreover, increased flow would also assist in flood control. In other words natural treatment potential enhancement of river with elimination of a weir may be planned as an integral component of natural river purification and flood control. Further enhancement in natural assimilative capacity of river could be achieved with grading the riverbed with pebble stones to facilitate growth of bacteria in riverbed for the treatment of water.

Another practical option to increase natural treatment (purification) of river water is to provide temporary storage (detention) of water in the form of a pond (runoff reservoir) and to facilitate the growth of water hyacinth (and other fast growing water plants like *kangkung* and elephant grass) that would be harvested regularly so that the water plant (hyacinth) will be maintained at continuous state of proliferation (high growth potential) thereby facilitating fast uptake of the nutrients in water for plant growth resulting in water treatment. Moreover, periodic desludging of the pond to remove accumulated waste sludge would also assist in overall removal accumulated pollutants in the pond (river) bed. Such water plants could also be grown directly and maintained at high growth mode in slow moving river stream reaches as well.

Still, maintaining a fast growing floating plant like water hyacinth directly in a moving river reach will require careful control to limit its area of proliferation within a predetermined controlled river space. Uncontrolled proliferation in river would interfere with free flow of water that would also become a major cause of flooding specially under high flow condition in addition to be an aesthetic nuisance. In this respect maximum harvesting of water plant grown directly in flowing river, including complete removal of entire water plant if warranted, may be required at the beginning of the rainy season to ensure no interference with free flow of flood discharge. In other words, if required, direct growth of water plants in rivers may be confined to the dry season only during which water quality deterioration is significant and completely eliminated in rainy season of flood discharge (during which water quality deterioration is not significant) so as to avoid any interference to free flow of flood discharge.

Moreover, a pond with water plants maintained at high growth mode targeting natural water purification may also be provided prior to the discharge of water into the river nearby the riverine area. This temporary storage of water in pond with plants (hyacinth) could also be planned as an integral component of natural retarding basin (pond) of flood control. During floodwater discharge of rainy season the pond will function as natural retarding basin for flood control, while under dry whether condition with acute water quality deterioration the pond will function as a natural wastewater treatment (water purification) plant with water plants like water hyacinth being maintained at high growth mode. This water hyacinth will also hide the polluted dirty water with its aesthetically pleasing greenery in appearance.

It is also noted that the water plants mentioned above have potential economic beneficial use such as in case of water hyacinth it could be used as raw material in handicraft (such an industry for handicraft does not exist in Bali currently, though exists in Java), elephant grass as feed for livestock and *kankung* as vegetable (a very popular green vegetable) for human consumption.

Double river canal section with smaller inner and deeper section to convey dry weather flow and the entire (large) canal section to convey the total wet weather flow of rainy season is also a practical option

to increase flow of polluted river water in dry season. Still, it would require paving of riverbed that is unfriendly to the aquatic ecosystem of the river and hence not recommendable. Still, naturally most riverbeds in Bali are essentially V-shaped due to topographic feature and hence to a great extent this condition is naturally met.

Finally it is emphasized that these natural treatment enhancement strategies of river water quality have limitation with respect to their purification potential and cannot be a substitute for reduction in pollution load runoff into rivers with development of sewerage system, in particular for a developed urban area like Denpasar, and hence should be considered as a short-term temporary measure (or a supplementary measure) of river water pollution control other than for a suburbanized (rural) area.

<Introduction of Dilution Water as Environmental Flow>

If relatively freshwater source is available in dry season with no other beneficial use at least in the short term, which is a very difficult condition to meet in general, then introduction of such excess water using existing canal/river network or with simple modification of existing canal/river into the polluted river could be used as a strategy of water quality improvement.

In this respect the possibility of such dilution water introduction into Badung River from Ayung river may be considered since Badung river at its most downstream reach in Estuary dam is currently used as a potable water source, while Ayung River has no such use in its most downstream reach. In general quality of Ayung river even at its most downstream reach is relatively better than Badung river and hence has the potential to be used as dilution water if water is available in excess of all other beneficial use requirement including the required maintenance flow for the river under dry weather flow condition.

It is emphasized that the use of freshwater having other beneficial use solely for the purpose of dilution of polluted water as environmental flow is essentially wastage of freshwater resource and should not be considered as a strategy unless under exceptional circumstance as in this case of Badung and Ayung rivers where Badung River is used source of potable water supply at its most downstream reach. It is emphasized that introduction of dilution water in itself results in no net reduction in pollution load in river since there is virtually no treatment of any waste.

(2) Long-Term Strategies

<Optimization of Solid Waste Generation with 3R Concept>

In the long-term as the important improvement strategy of solid waste management, optimization on the very generation of solid waste so as to minimize the waste requiring final disposal needs to be applied. Promotion of the 3R concept of Reduce, Reuse and Recycle of generated solid waste at source by residents will form the basis of this strategy. In fact an integral component of 3R will inevitably include waste separation at source by residents such as separation of organic wastes amenable for composting as fertilizer, combustible matter, noncombustible matter, recyclable matter and others as appropriate. Reduction of the very solid waste generation with the promotion of 3R concept including the promotion of organic waste composting as organic fertilizer has the benefit of reduced potential for disposal of solid waste (garbage) into rivers and streams as well.

<Industrial Policy Focused on Industrial Estate Development>

The long-term strategy of industrial pollution control will be based on the realization of precautionary principle that is to control the discharge of pollutants to the water environment to the maximum possible extent.

Most industries in Bali are food and textile related and hence their waste is amenable for conventional biological wastewater treatment. However, operation of wastewater treatment plant involves cost and it seems industries are not willing to pay for this cost to conform to the polluters pay principle even when they have such a treatment plant as prerequisite to obtain operational license. Also widespread nature of industries makes inspection of their wastewater treatment system very difficult. It is considered that precautionary principle forms the basis for the requirement of wastewater treatment plant for an industry to obtain operational license.

Accordingly, it is recommended to make necessary policy plans to establish industrial estates to relocate industries with common wastewater treatment facility within industrial estates as the long-term strategy so that the overall industrial performance itself not just their performance of waste management could be

easily monitored. Any new industrial plant in future should also be confined within an industrial estate. Moreover, scale merit realized from the increased quantity of wastewater for treatment would also result in potential reuse of treated wastewater within industries thereby serving as an important incentive for proper wastewater treatment and reduction in overall industrial water demand. In fact the operational management of the treatment plant could be entrusted to an authority independent of any particular industry located in the industrial estate thereby ensuring its proper operational management.

Moreover, future development of diffusive home industries will be banned. Concerning existing home industries they shall be encouraged to treat their wastewaters in collective communal treatment plants as far as practicable. Also cluster of such an area could be reclassified as an industrial estate of small-scale. Similar policy with common treatment facility as far as possible and individual treatment facility incase it is impractical should be continuously enforced for the tourism industry of hotels and restaurants as well. It is noted that in case non-concentrated small scale hotel and restaurants simple septic tank system would be sufficient to treat the entire wastewater within land that would basically eliminate any runoff of wastewater to surface waters.

Confinement of industries only within industrial estates is recommended to be achieved completely within the next 15 years (2020).

<Agricultural Runoff Pollution Control>

Agriculture, principally intensive wet rice farming in case of central and east Bali areas with elaborate surface river water based irrigation systems and other miscellaneous fruits, vegetables and cash crops like cloves and coffee in other areas is well developed all over Bali.

Use of inorganic fertilizers of nitrogen and phosphorus as growth supplement for crops and use of insecticides and pesticides for crop protection potentially results in water environmental pollution of rivers and other surface watercourses as non-point source of agricultural runoff pollution. In particular, drainage basins of intensive wet rice farming like those of central and east Bali have high potential for such non-point agricultural pollution runoff into rivers.

Precautionary principle based on pollution control at source to the maximum possible extent that could also be interpreted as cleaner agricultural production will be the basis for the strategy on agricultural runoff pollution control.

The feasible (practical) strategy for control of this difficult and diffusive non-point source of surface water pollution as per the precautionary principle is composed of promotion of use of organic fertilizers including organic compost derived from organic solid wastes (garbage) to the maximum possible extent (minimize the use of inorganic fertilizers), natural means of soil fertilization with crop rotation to include legume crops in the cropping pattern to fix naturally nitrogen in soil that would eventually minimize the requirement any form of artificial soil fertilization either with organic or inorganic fertilizers in the overall cropping cycle and integrated pest management (IPM) to use biological control of pests and insects (including natural predators) as much as possible so as to minimize the use of synthetic pesticides and insecticides in the overall cycle of cropping. Still, these techniques should be continuously developed and refined to suit farming requirements and policy changes including the advancement of any new technological innovation in biological pest and insect control.

It is extremely important to continuously educate the farmers through *subaks* on up to date advancement in the knowledge and techniques on the effective use of organic fertilizers and IPM including field demonstration and experimental farming using optimum amount of water for irrigation, so as to convince the farmers on the effectiveness of the techniques and they do not result in decrease of farm productivity. It is emphasized that control at source with minimum use of inorganic fertilizers and insecticides and pesticides (IPM) with optimum amount of irrigation water is the only practical means of pollution control for water courses due to agricultural runoff (non point diffusive source of pollution) and obviously the available pollution control strategy of both short and long terms.

It is noted that these agricultural pollution control techniques at source, in particular incorporation of legume crop as *Palawija* in the cropping pattern of rice farming (with the restriction of rice farming to a maximum of only two times a year) and IPM to minimize the requirement of synthetic pesticides and insecticides, has already been promoted by Dinas Pertanian (Agriculture Service) of Bali Province in cooperation with Udayana University and hence the concept is well entrenched. Dinas Pretaminan has already conducted a training program on IPM covering most *Subaks* in Bali during 1995 to 2000 and has

been conducting continuous follow-up with farmers through *Subaks*. It is reported by Dinas Pertaminan that about 80% of the rice fields are currently planted with *Palawija* crop at least once a year and legume crop accounts for half of the planted *Palawija* crop. Even in case of three times (throughout a year) rice cultivation that accounted for 18% of rice fields in 2004 farmers are well aware of the importance of not to plant the same variety of rice continuously so as not to acclimatize the pests and insects to any particular variety of rice and to use only certified healthy seeds. Moreover, bio-pesticides (microorganism as natural pesticide) and botanical pesticides (plant extract as natural pesticide) developed by the Department of Agriculture of the Udayana University have already been used in horticulture as primary component of IPM.

These source based pollution control strategies of agricultural pollution have the following overall benefits. First of all any reduction in the use of fertilizers, insecticides and pesticides has potential economic benefit in the form of reduction in cost of agricultural produce. Hence in overall the benefit could be dual economic and environmental benefit that basically justifies the use of precautionary principle (and also cleaner agricultural production) in agricultural runoff pollution control. The other most important benefits of IPM in addition to the obvious reduction in runoff pollution into rivers are reduced potential for bioaccumulation of synthetic insecticides and pesticides, which are essentially POPs (persistent organic pollutants) that are not easily biodegradable, in aquatic fauna and flora that may eventually consumed by humans and also reduced potential for the mutation and evolution of insects and pests that are resistant to synthetic insecticides and pesticides.

<Development of Sewerage System for Urban Areas>

Development of sewerage system to collect and treat the entire wastewater generated in an urban area due to various use of piped water like domestic, institutional and commercial and others is the ultimate long-term strategy of wastewater management for an urban area, though it requires high investment cost. Still, ideally provision of piped potable water supply for an urban area should incorporate necessary plan for future sewerage system development since the piped water is the source of wastewater generation, though this aspect is often overlooked principally due to financial constraints for sewerage development.

Nevertheless, development of sewerage system for the most developed and urbanized areas, including tourism areas, of the Bali Island, namely, Denpasar city, Sanur and Kuta is currently under implementation with JBIC funding, which is known as DSDP (Denpasar Sewerage Development Project). Similarly, feasibility on development of sewerage system for other developed urban centers like Singaraja, Tabanan, Negara and Gianyar need to be studied as long-term strategic plan for urban water environmental and sanitation improvement. In this respect Singaraja and Negara are considered as higher priority cities as they are located in arid zones and hence not only have relatively higher surface river water environmental degradation but also have high potential for beneficial reuse of treated wastewater.

(3) PROKASIH Plan

The basic surface water quality improvement strategies identified in the foregone sections are in fact incorporated in the objectives and vision of PROKASIH (Program Kali Bersih/ that was first planned in 1989 targeting major Indonesian rivers for implementation by the relevant local governments. The plan was introduced in Bali in 1995 initially targeting the 2 most deteriorated reaches of Badung River and Tebe (Mati) River.

The basic aim of PROKASIH plan is to focus water quality improvement of major important rivers of significant water quality deterioration and those of multiple beneficial uses. Currently, under PROKASIH both Regency of Badung and Municipality of Denpasar in overall conduct regular monitoring and cleanup of the three most important rivers of Badung, Mati (Tebe) and Ayung involving basically removal of floating garbage and other debris. Moreover, BAPEDALDA of Bali Province has completed the inventory of major pollution sources discharging into Badung and Mati (Tebe) rivers.

PROKASIH is not basically intended to focus on the development of sewerage system for urban areas for the management of domestic and other wastewaters or management of solid wastes requiring extensive technical and financial arrangements. Its main focus is the mitigation of water pollution due to garbage disposal, which is a very serious basic problem to be dealt with, and cleanup of garbage and other debris. Accordingly, public involvement in keeping and maintaining the rivers clean of garbage

disposal is also emphasized. In addition beautification of riverine/riverside areas with planting trees and other greenery is also targeted.

Moreover, BAPEDALDA of Bali Province has identified 7 major additional rivers that pass through more than one regency and also with multiple beneficial uses for inclusion into the PROKASIH. They are Ayung River, Pakerisan River, Yeh Leh River, Sungi River, Sabah River and Jinah River.

Since, the vision of PROKASIH 2005 is so comprehensive and covers virtually the entire aspects of watershed management effective coordination and cooperation among a variety of institutions is required. Still, the most important aspect of PROKASIH is understood as to enhance the awareness on the importance of improved management of surface water resources and to undertake practical means by all concerned agencies, even with limited finance, to improve river water environmental condition.

Table-II-7.7 Strategies for Water Environment Improvement

Program	Strategic Action
1. Public Awareness Enhancement	**Short-Term Measure:** Eliminate garbage disposal in rivers and increase awareness on water environmental sanitation **Short and Long-Term Measure:** Continue until the practices become history
2. Improvement of Solid Waste Management	**Short-Term Measure:** Improve solid waste collection service **Short and Long-Term Measure:** In addition promote 3R (Reduce, Reuse, Recycle) concept
3. Industrial Pollution Control	**Short-Term Measure:** Inspect and enforce waste treatment by industries **Short and Long-Term Measure:** Continue as long as dispersed industries exist **Long-Term Measure:** Industries only within an industrial estate
4. Conservation of Natural Purification System	**Short-Term Measure:** Enhanced natural purification potential of rivers with removal of unused river structures, temporary storage with water plant at high growth mode and grading riverbed with pebble stones **Short and Long-Term Measure:** May be satisfactory for rivers in relatively undeveloped areas
5. Environment Flow	**Short-Term Measure:** Introduce dilution water to dilute polluted water when fresh water with no other beneficial use is available
6. Agricultural Runoff Pollution Control	**Short-Term Measure:** Agricultural runoff pollution control with maximum use of organic fertilizer, legume crop in cropping pattern and IPM (Integrated Pest Management) **Short and Long-Term Measure:** Permanent measure as the only practical means of non-point source runoff pollution control
7. Sewerage System	**Long-Term Measure:** Development of sewerage system for developed urban areas. The only practical long-term water environment improvement measure for developed areas (example DSDP)

7.2.2 Proposed Water Environment Improvement Plans

A target area based action plans and programs of water environmental improvement formulated based on the strategies identified above are summarized in Table-II-7.8. The salient features of the plans that basically incorporates PROKASIH as the means to achieve basic environment improvement measures and those plans focused on the urban river reaches of highly polluted areas of Denpasar and Kuta (Badung and Mati rivers) and also relatively polluted dry zone river reach areas of Singaraja and Negara are illustrated below. In this respect the water environmental condition of the rest of the areas in Bali is considered very satisfactory and hence no specific water environmental improvement measures are warranted other than basic environment improvement measures focused on proper disposal of garbage and use of sanitary toilet facilities.

(1) PROKASIH

PROKASIH has been incorporated into this master plan of water environmental management improvement as a well-established river water improvement program in Indonesia. Still, it is recommended that all regencies in Bali under PROKASIH, as the primary responsible institutions for its execution, shall focus on all rivers within its regency as the minimum requirement on the elimination of garbage disposal into rivers and cleanup of rivers of any disposed garbage and other debris on a regular basis. A very significant improvement in river water environmental condition in Bali could be achieved with this very basic, but seems to be not that easy to realize, achievement. Moreover, public education campaign on the importance of water environmental sanitation will also be incorporated into PROKASIH until the practices of garbage disposal in rivers and using rivers as toilet become history. Still, a target time frame of 5 years is recommended as reasonable time limit to achieve this basic water environmental improvement throughout Bali.

(2) Badung and Mati Rivers of Denpasar and Kuta Areas

Badung and Mati river reaches passing along the developed Denpasar and Kuta areas are the most deteriorated river reaches in the Province. However, with the accomplishment of ongoing DSDP project funded by JBIC significant improvement in their water qualities are expected. Still, until such time considering the highly polluted nature of the rivers, it is strongly recommend to strictly protect all those low land areas surrounding the rivers that function as natural purification treatment system with water plants. Moreover, it is recommended to initiate a regular harvesting program of these water plants to maintain them at high growth rate mode to facilitate effective treatment of water. Such water plants cultivation is recommended to be initiated in the slow flowing river reaches (those are also accessible for easy harvest of the water plant to ensure high growth rate mode) of both of these rivers within the river waters including the continuation of water hyacinth plant cultivation in the Estuary Dam of Badung River. Moreover, continued frequent removal of garbage accumulated in screens of these rivers as well as regular removal of floating garbage will be continued.

Still, quick accomplishment of DSDP project is also recommended to facilitate early long-term water environmental improvement of these rivers. In this respect with development of potable water supply as per this master plan, necessary expansion plan for the sewerage system to incorporate the newly potable water served areas also into the sewerage system is recommended to be formulated.

It is also emphasized that environmental improvement projects requiring major investments like those of solid waste management projects including those of collection service improvement and final disposal in sanitary landfill and other final waste management techniques and sewerage system development for developed areas, similar to that of ongoing DSDP project, are considered as beyond the scope of this master plan and hence are not incorporated as specific plans. Still, it is important to investigate and implement these measures as separate independent project plans to realize long-term urban water environmental improvement.

(3) Arid zone urban river reaches of Singaraja and Negara

The surface river water environmental deterioration is quite significant during the dry season in the urban centers of Singaraja and Negara that are located in the relatively arid zones of Bali, though not deteriorated to that severe level as the urban rivers of Denpasar and Kuta (Badung and Mati Rivers).

As the short-term measure of surface water quality improvement direct growing of water plants like water hyacinth in slow moving river reaches (and runoff river ponds) is identified as the only feasible strategy. Topographic feature of the rivers in both city areas are essentially of V-shaped channels until the very near coastal river mouth reaches. Accordingly, there exists no low land area for natural water (runoff wastewater) treatment cum retarding pond prior to the disposal of water into the rivers.

As the long term water environmental improvement strategy feasibility studies on the development of sewerage systems for these two cities is recommended to be carried out as soon as possible, preferably within the next 3 years so that sewerage systems would be operational in about 10 years time. The feasibility study on sewerage development shall focus not just on the treatment of wastewater for disposal as treated wastewater to the environment but on the potential reuse of treated wastewater for irrigation, in particular fruits and horticulture irrigation, and other beneficial uses in particular during the dry season, since these areas are located in relatively arid zone.

7.2.3 Water Quality Monitoring Program Optimization

Currently, surface (rivers and lakes) water quality monitoring program is being conducted by more than one agency, which amounts to repetition and inefficient use of financial resource. Still, it also seems that all the programs are somewhat irregular with respect to monitoring frequency that depends on the availability of funding arrangement. Of all the ongoing surface water quality monitoring program the most significant programs covering the surface waters of the whole province of Bali are those of PPSA of Dinas PU (since 1999) and BADEDALDA (since 2002) of Bali Province.

Practically, almost all surface waters covered by the monitoring program of BADEDALDA are incorporated into that of PPSA. Accordingly, it is recommended to continue consistently on regular basis the monitoring program of PPSA in all of its 60 established monitoring stations annually and two times a year, each during dry season (September-October months) and rainy season (January-February months). The 60 surface water quality monitoring stations of PPSA and the available results until the year 2003 has already been incorporated into the GIS system developed in this study facilitating efficient information (data) sharing. BADEDALDA is recommended to share the data obtained by this PPSA program concerned to surface water quality.

Finally, it is emphasized that monitoring program alone just involves cost and has no direct benefit on environmental improvement though it is a very important tool to identify, understand and justify the relevant environmental issues and improvement measures. It is the necessary action programs initiated based on the monitoring results that would result in any real environmental improvement. Accordingly, it is important to share the information and data obtained from any comprehensive monitoring program as far as possible among concerned agencies so as to optimize the resources including cost of a monitoring program and to focus instead on the required environmental improvement measures. In a nutshell maximum actions to improve environmental condition with minimum monitoring is the target.

Table-II-7.8 Water Environmental Improvement Plan

Action Plan	Target Area	Effect/Benefit	Time Frame of Significant Action	Principal Responsible Agency
Public education and campaign under PROKASIH -No garbage disposal into rivers -Use sanitary toilet	Entire province on regency basis	Eliminates aesthetic nuisance of rivers due to floating garbage, mitigates flooding due to interference to free water flow, prevents surface water pollution and public health improvement	To be accomplished within next 5 years until 2010	BAPEDALDA and Dinas Kesehatan (Health Service) of each regency
Improvement of solid waste management along with promotion of 3R concept	Entire province on regency basis	Overall living environmental sanitation improvement (in particular in urban/ developed areas) in addition to surface water environmental improvement, flood mitigation and resource conservation	Raise solid waste collection ratio to at least 90% in regency capitals within next 5 years (2010) and in regencies within 10 years	Dinas Kebersihan (Cleansing Service) of each regency
Industrial pollution control with industrial estate development	Entire province on regency basis, initially focused on regencies with significant industries, Denpasar, Badung, Tabanan, Gianyar and Karangasem	Mitigation of surface water pollution, promotion of precautionary principle and cleaner production concept, reuse of treated industrial wastewater (optimize industrial water consumption)	Confinement of industries within industrial estates be targeted for complete achievement within next 15 years (2020)	BAPEDALDA and Dinas Trade and Industry of each regency
Natural water purification enhancement of rivers with water plants and others.	Major urban river reaches of Denpasar and Kuta (Badung and Mati) and rivers in city areas of Negara and Singaraja	Surface water quality improvement along with cultivation of water plants having potential economic benefit	Immediate implementation with no specific time frame for termination	Dinas PU of relevant regencies
Introduction of dilution water as environmental flow	Badung river in Denpasar with water from Ayung river	Water environmental improvement including raw water quality improvement for water supply from Estuary dam	When excess water in Ayung River is available in dry season in particular after the completion of Ayung Dam	Dinas PU of Bali Province
Agricultural runoff pollution control	All regencies in particular the major rice	Potential economic benefit with reduced cost spent on	Currently under implementation and to be	Dinas Pertanian

Action Plan	Target Area	Effect/Benefit	Time Frame of Significant Action	Principal Responsible Agency
	producing ones of Badung, Tabanan, Gianyar, and Buleleng	fertilizers, insecticides and pesticides, mitigation of surface water pollution, promotion of precautionary principle based on pollution control at source and cleaner agricultural production concept justified by the mitigation of bioaccumulation of POPs (persistent organic pollutants) and mutation of resistant species of insects and pests	continued and updated focused on new agricultural technological development and change in farming practice	(Agriculture Service) and BAPEDALDA of Bali Province
Sewerage development	Singaraja and Negara cities in arid zones (for Denpasar area sewerage development is on going as DSDP)	Long-term surface water and urban living environmental sanitation improvement in addition to potential reuse of treated wastewater	Feasibility study within next 3 years so that sewerage system will be operational in next 10 years (2015)	CIPTA KARYA of Buleleng and Jembrana regencies

7.3 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

7.3.1 Forest Conservation Plan

(1) 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.

According to the Master Plan, target achievement areas of forest and land rehabilitation in Bali Province are 33,250 ha (18,500 ha in Forest and 14,750 ha outside forest) in total during 5 years (2004-2008). The target areas are around 25% of current forest areas in Bali.

Current forestry areas in Bali are around 130,000 ha 23 % of total Bali Province area. Out of the total forest areas, more than 100,000 ha were classified as critical forest areas including heavy critical areas of 3,500 ha. Currently the forest in Bali are classified into the following categories:

- Hutan Lindung (Conservation Forest)
- Hutan Wisata (Tourism Forest)
- Taman Hutan Rakyat (Park Public Forest)
- Taman Nasional (Forest For National Park)
- Cagar Alam (Forest For Natural Conservation)
- Hutan Produksi Terbatas (Forest For Limited Production)
- Hutan Produksi Tetap (Forest For Sustainable Production)

(2) 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.

(3) Strategy and Program

<Strategy>

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.

<Program>

Establishing effective management, conservation and rehabilitation of the forest resources

Objective: Directed to increasing the security and protection toward forest yield, maintaining biodiversity, to recover, to maintain and to up-grade forest function that was damaged or un-productive and critical in the non forestry area.

Activities: Maintaining/reconstruction of the forest boundary, seeding, firing mitigation, traditional community (desa pakeraman) advisory, extension, controlling and treat (carantina) flora distribution, and others.

Agro-business development

Objective: Directed to develop forest yield, standardization, efficiens and effecktive supply raw material for the forest industry (up/ followed sector).

Activities: Extending productive plant, develop ‘kayu putih’ industry (kind of oil for healing), retribution, legalization, build up marketing scheme and information, guidance and monitoring of the forest yield, and others.

Institutional Reorganization and Procedure

Objective: Directed to up-grade organization performance, procedure, discipline, and law enforcement.

Activities: Intensify coordination on forestry planning, coordination for services, and reporting on evaluation and monitoring, and others.

Statistical Improvement and Development

Objective: Directed to improving and developing statistical data for better contribution on forestry development it self

Activities: Neraca Sumber Daya Hutan (Balance of Forestry Resources), Statistik Kehutanan (Forestry Statistic) book making, and others.

Improvement of the Government facilities

Objective: Directed to upgrade facilities support on maximizing institutional function and operation. Main activities

Activities: Building construction / rehabilitation and others

Inventory of Equipment

Objective: Directed to upgrade equipment support on maximizing institutional function and operation.

Activities: Inventory buying and maintaining, and others.

Upgrade Personnel Capacity

Objective: Directed to motivate staff on their duty and services

Activities: Improving staff remuneration, training, administration activities, and others.

7.3.2 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.

(1) 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 consist of natural reef with white sand. Currently eroded beach in the southern Bali amounts to be more than 50 km. Specially, 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
- HumanActivities:
  - ✓ Marine based activities
  - ✓ Land based activities
  - ✓ Destructive fishing
  - ✓ Beach material exploitation

(2) Target

17 location of identified coastal erosion in Bali are planned to be handled in coming five years. Names and volume of the target area is stated bellow:

- Pantai Segara Rupek : 789.80 m
- Pantai Nusa Penida : 4,854.80 m
- Pantai Sanur : one package
- Pantai Nusa Dua : one package
- Pantai Kuta : one package
- Pantai Cupel : 2,250.00 m
- Pantai Kedungu : 1,000.00 m
- Pantai Yeh Gangga : 600.00 m
- Pantai Pasut : 750.00 m
- Pantai Tangtu : 200.00 m
- Pantai Pabean : 200.00 m
- Pantai Keramas : 225.00 m
- Pantai Bukti : 572.00 m
- Pantai Air Sanih : 2,156.00 m
- Pantai Singaraja : 1,250.00 m
- Pantai Serangan : 309.00 m
- Pantai Ujung : 1,250.00 m

Some serious critical areas are set to be priority handled those are: Sanur (Padang Galak), Nusa Dua, Kuta and Tanah Lot.

(3) Strategy and Program

Strategy for coastal conservation is set to meet specific conditions in the selected area. It is consist of following method:

<Soft Protection>

- 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 Protection>

- 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

7.4 GIS Database for Water Resources Management

7.4.1 Structure of GIS Database

Dinas-PU of Bali Province had prepared a database concerning with water resources. Based on it, the new GIS database had constructed through this study. The JICA Study Team had added and revised the data and created new function on the GIS database. The base map is the topographical maps with the scale of 1:25,000 prepared by Survey Coordination and National Mapping Board, consisting of 51 sheets of maps in Bali Province. Those topographical maps were compiled based on aero photographs which were taken on 1993-1994 with the scale of 1:50,000 and based on the revision by the field survey on 1999-2000. In this GIS database, “UTM (Universal Transverse Mercator's) projection is applied to project map data.

The GIS database includes three file formats such as MapInfo, Microsoft Access and Jpeg which are managed by MapInfo version 7.5. MapInfo files consist of map data and attribute data that are

corresponded to map data one to one. Topographical maps are scanned and stored as Jpeg files. Ms-Access files include socio-economic data, irrigation data and observational data. Such Ms-Access files are external files, which are linked to map data through data code such as a regency code, a station code and so on.

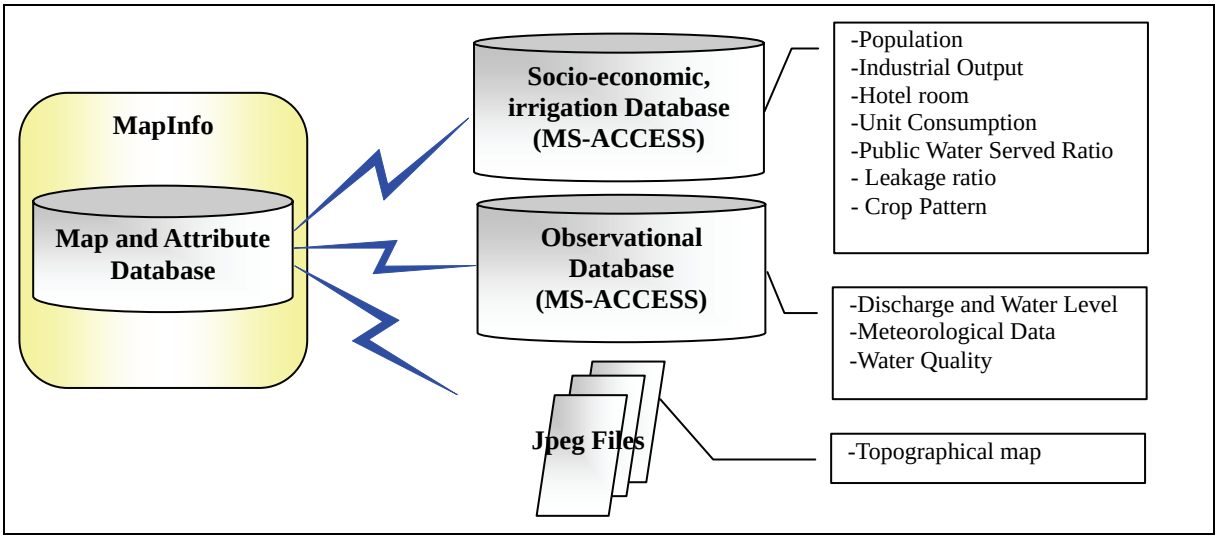


Figure-II-7.1 Configuration of GIS Database

The GIS database prepared by the JICA Study Team is shown are Table-II-7.9 and Table-II-7.10. Refer to appendix "GIS Database Definition" in detail.

Table-II-7.9 MapInfo Data

No.	Layer Name	Data Type	Number	Data Source	Notes
Public Administration					
1	Bali	polygon	1	MAP	boundary of Bali Province
2	Regency	polygon	10	MAP	boundary of regency (Penida islands are to be independent)
3	District	polygon	55	MAP	boundary of district
4	Village	polygon	687	MAP	boundary of village
5	Capital of Regency	point	9	MAP	location of capital of regency
6	Capital of District	point	55	MAP	location of capital of district
Topographical and Natural Condition					
7	Sub Basin	polygon	20	Study Team	boundary of sub-basin area (newly proposed)
8	Old Sub Basin	polygon	20	PU	boundary of old sub-basin area
9	River Basin	polygon	550	MAP	boundary of river basin area
10	Lakes	polygon	4	MAP	boundary of lakes
11	Springs	point	744	PU & Study Team	location of springs
12	Rivers	polyline	-	Landsat & MAP	centerline of rivers
13	Contours	polyline	-	MAP	over 200m: interval 12.5m under 200m: interval or 6.5m
14	Index Contour	polyline	-	MAP	main contour; interval 50m
15	Land use	polygon	-	Landsat	boundary of land use (17 categories)
16	Irrigation Area	polygon	-	Landsat	boundary of irrigation area abstracted from land use
17	Geology	polygon	-	GEO	boundary of geology (17 categories)
18	Hydrogeology	polygon	-	GEO	boundary of hydrogeology (7 categories)
19	Soil	polygon	-	AGR	boundary of soil (15 categories)
20	Isohyet	polyline	-	Study Team	isohyetal map (annual rainfall)

No.	Layer Name	Data Type	Number	Data Source	Notes
21	Natural Protect Area	polygon	-	HUT	boundary of natural protect area (4 categories)
Institutional Condition					
22	Existing Dams	polygon	4	PU	boundary of dam reservoir
23	Existing Dams Catchment Area	polygon	4	PU	boundary of dam catchment area
24	Wells	point	321	PU & Study Team	location of wells
25	Weirs	point	443	PU & Study Team	location of weirs
26	Hydrological station	point	42 (49)	PU	location of water level and discharge station(include 7 old stations)
27	Hydrological Catchment	polygon	44	Study Team	boundary of station's catchment area
28	Rainfall Station(PU)	point	32	PU	location of rainfall stations managed by PU
29	Rainfall Station(BMG)	point	104	BMG	location of rainfall stations managed by BMG
30	Meteorological Station(PU)	point	9	PU	location of meteorological stations managed by PU
31	Meteorological Station(BMG)	point	4	BMG	location of meteorological stations managed by BMG
32	Water Quality	point	81	PU & Study Team	location of water quality sampling point
Transportation					
33	Roads	polyline	-	MAP	centerline of roads
34	Port	point	16	MAP	location of ports
35	Airport	point	1	MAP	location of airport
36	Bus terminal	point	6	MAP	location of bus terminals
History and Culture					
37	Historical place	point	9	MAP	location of historical place
38	Cultural facility	point	24	MAP	location of cultural facility
Disaster History					
39	Flood area	point	121	Study Team	location of flood area
40	Debris flow area	point	10	Study Team	location of debris flow area
41	Slope failure	point	6	Study Team	location of slope failure
42	Landslides	point	73	Study Team	location of landslides
Plan					
43	Proposed Dam	point	29	PU	location of proposed dam by PU
44	DamSite	point	2	Study Team	location of proposed dam by JICA Study Team
45	Reservoir Area	polygon	1	Study Team	boundary of Ayung dam reservoir area
46	AyungDamCacthmentArea	polygon	1	Study Team	boundary of Ayung dam catchment area
47	TerminalPoint	point	2	Study Team	location of water terminal point
48	Pipeline	polyline	2	Study Team	centerline of pipeline
49	Water Treatment Plant	point	3	Study Team	location of water treatment plant
50	River Improvement	polyline	10	Study Team	river improvement zone
Flood Simulation Model					
51	tArea	polygon	1	Study Team	flood simulation area for Badung, Mati river
52	Flood_Elv	point	1343	Study Team	elevation data for flood simulation model

No.	Layer Name	Data Type	Number	Data Source	Notes
Others					
53	Topographical map	raster	51	MAP & Study Team	scanned files (jpeg)
54	Grids	polygon	51	MAP	boundary of grids of topographical map

PU : Data provided by Public Works Service of Bali Province
HUT : Data provided by Forestry Service of Bali Province
BMG : Data provided by Meteorological and Geophysical Agency
MAP : Topographic map (scale 1:25,000) prepared by Survey Coordination and National Mapping Board
GEO : Reconnaissance hydrogeological map prepared by the Geological of Indonesia (scale 1:250,000 on 1972)
AGR : Soil map prepared by Ministry of Agriculture (scale 1:250,000 on 1970)
Study Team: Inventory survey or created by JICA Study Team
Landsat: Landsat7 on 2003

Table-II-7.10 Ms-Access Data

No.	Table Name	Data Source	Notes
Observational data			
1	Hydrological Data	PU	daily discharge and water level from 1968 to 2003
2	Meteorological Data (BMG)	BMG	daily rainfall, temperature, evapotranspiration, wind from 1961 to 2003
3	Meteorological Data (PU)	PU	daily temperature, evapotranspiration, wind from 1993 to 2003
4	Water Quality	PU & Study Team	BOD, COD, Ph, temperature and so on
5	Subak	PU & Study Team	Subak list
Socio-economic data			
6	Population	Study Team	population by regencies and Nusa Penida
7	Domestic Unit Consumption	Study Team	domestic water unit consumption by regencies and Nusa Penida
8	CMRatio	Study Team	ratio to domestic water demand
9	Industrial Output	Study Team	industrial output by regencies and Nusa Penida
10	Industry Unit Consumption	Study Team	industry water unit consumption by regencies and Nusa Penida
11	Hotel Room	Study Team	hotel rooms by regencies and Nusa Penida
12	Hotel Unit Consumption	Study Team	hotel water unit consumption by regencies and Nusa Penida
13	Served Ratio	Study Team	public water served ratio by regencies and Nusa Penida
14	Leakage Ratio	Study Team	leakage ratio by regencies and Nusa Penida
Irrigation data			
15	Irrigation Area	Study Team	irrigation area by regencies
16	Crop Pattern	Study Team	crop Pattern by regencies
17	Crop coefficient	Study Team	crop Pattern by regencies and crops
18	Effective Rainfall	Study Team	effective Rainfall by regencies
19	Evapotranspiration	Study Team	crop evapotranspiration by regencies
20	Irrigation others	Study Team	other data for irrigation water demand parameter
Water Balance System			
21	C_DemandArea	Study Team	code number of regencies and Nusa Penida
22	C_PlanDemandArea	Study Team	code number of public water service area
23	C_Regency	Study Team	code number of regencies
24	Water Potential	Study Team	water potential by sub-basins
25	Supply Plan	Study Team	public water supply planning data by public water service area
26	Irrigation Area Ratio	Study Team	irrigation area ratio by regencies and sub-basins

PU : Data provided by Public Works Service of Bali Province
BMG : Data provided by Meteorological and Geophysical Agency
Study Team: Inventory survey or created by JICA Study Team

7.4.2 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.

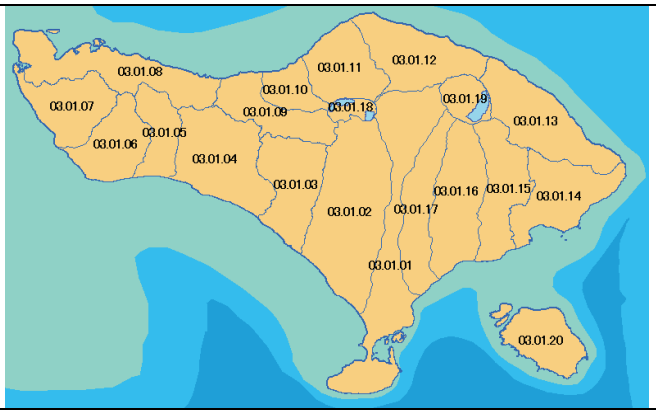
Table-II-7.11 Outline of Water Balance System

Simulation Item	Contents	Output
Water potential and water demand in future	Compare water potential and water demand in future in whole Bali, regencies and sub-basins. Water potential ● surface water included spring water ● ground water Water demand in 2005, 2010, 2015, 2020 and 2025 ● domestic water ● commercial/institutional water ● industry water ● hotel water ● irrigation water	Tables and Graphs as an excel file. ● Whole Bali (1 sheet) ● Regency and Nusa Penida (10 sheets) ● Sub basin (20 sheets)
Public water supply and public water demand in future	Compare public water supply in future and public water demand in future in public water service areas. Public water supply in 2005 to 2025 ● existing ● planning Public water demand in 2005 to 2025 ● domestic water ● commercial/institutional water ● industry water ● hotel water	Tables and Graphs as an excel file. ● Public water service area (11 sheets)

Note: refer to Table-7.4 for regency and Nusa Penida, sub-basin and public water service area.
refer to Table-7.5 for example output.

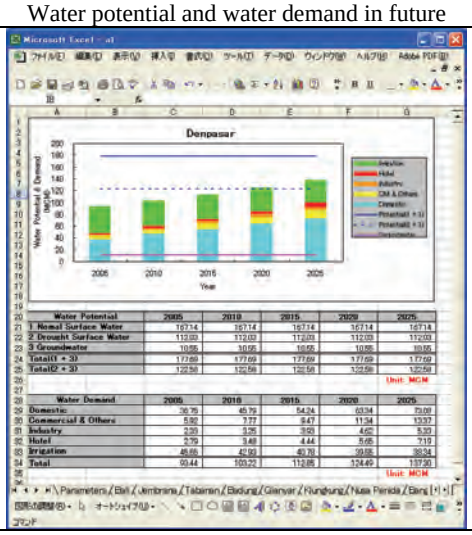
Regency and Nusa Penida

Sub basin



Public water service area

Water potential and water demand in future



Public water supply and public water demand in future

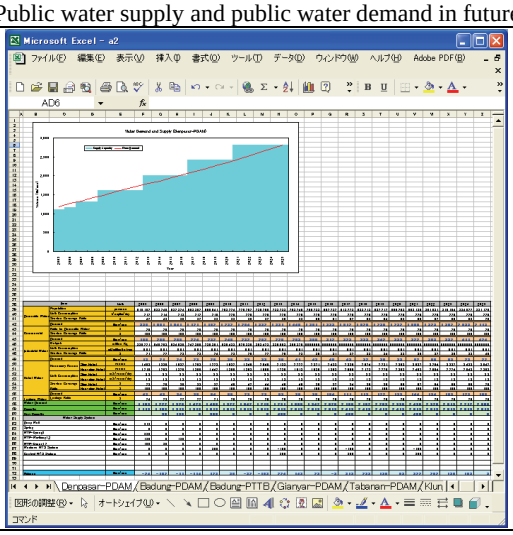


Figure-II-7.2 Target Area and Example Output

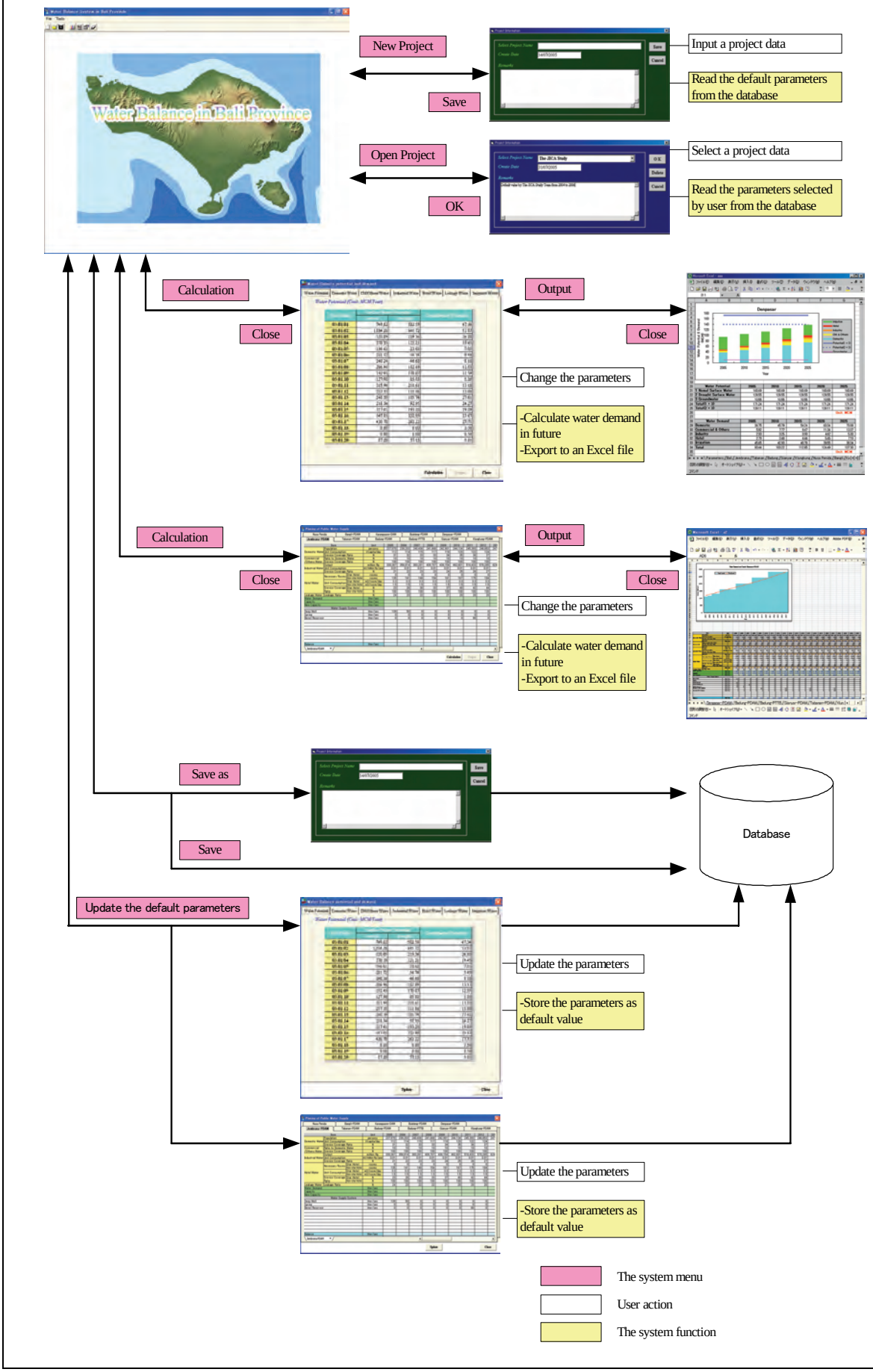


Figure-II-7.3 Workflow for Water Balance System

(1) Specific Water Balance System

<Outline of Water Balance System>

Water potential consists of surface water and groundwater. Surface water can be calculated for both normal level and drought level by arranging parameters. Spring water is included in surface water. As a basis, water potential is calculated by each sub-basin as shown in Figure-II-7.4**.**

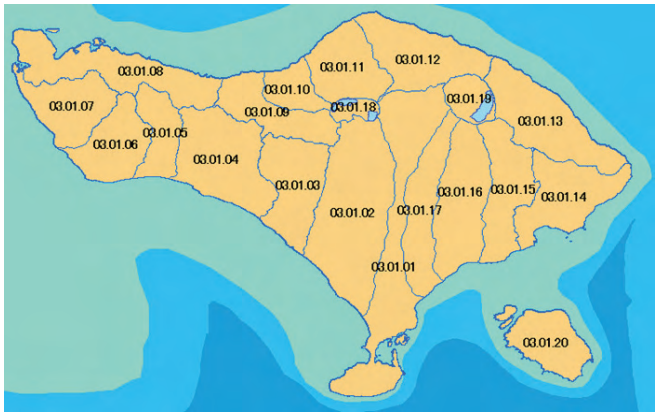


Figure-II-7.4 Water Potential Calculation Unit (Sub-Basin)

<Water Demand in Future>

Water demand consists of domestic water, commercial/institutional water, industrial water, hotel water and irrigation water with considering water losses. As a basis, water potential is calculated by each regency and Nusa Penida as shown in Figure-II-7.5. Parameters for water demand calculation are set for each 5 years from 2005 to 2025.

Figure-II-7.5 Water Demand Calculation Unit (Regency and Nusa Penida)
Estimation methods for each water demand are as follows.

<u>Domestic Water Demand</u>

Domestic water demand is estimated by multiplying population by unit water consumption. Water consumer is divided into PDAM user and non-PDAM user, unit water consumption for each user is different.

DWD (20XX) = POP (20XX) x SR (20XX) x UC1 (20XX) / (1-LKG (20XX))
+ POP (20XX) x (1-SR (20XX)) x UC2 (20XX)

Where,

DWD: domestic water demand (l/day)
POP: population
SR: service ratio of PDAM (%)
UC1: unit water consumption by PDAM user (l/capita/day)
UC2: unit water consumption by non-PDAM user (l/capita/day)
LKG: leakage ratio (%)
20XX: 2005, 2010, 2015, 2020 or 2025

Commercial/Institutional Water Demand

Commercial/institutional water demand is estimated by multiplying domestic water demand by a certain ratio.

CWD (20XX) = DWD (20XX) x R (20XX) x SR (20XX) / (1-LKG (20XX))
+ DWD (20XX) x R (20XX) x (1 - SR (20XX))

Where,

CWD: commercial/institutional water demand (l/day)
DWD: domestic water demand (l/day)
R: ratio of commercial/institutional water demand against domestic water demand (%)
SR: service ratio of PDAM (%)
LKG: leakage ratio (%)
20XX: 2005, 2010, 2015, 2020 or 2025

Industrial Water Demand

Industrial water demand is estimated by multiplying industrial output by unit water consumption.

IWD (20XX) = IO (20XX) x UC (20XX) x SR (20XX) / (1 – LKG (20XX))
+ IO (20XX) x UC (20XX) x (1 - SR (20XX))

Where,

IWD: industrial water demand (m^3/day)
IO: industrial output (million rupiah)
UC: unit water consumption by PDAM user (m^3/million rupiah/day))
SR: service ratio of PDAM (%)
LKG: leakage ratio (%)
20XX: 2005, 2010, 2015, 2020 or 2025

Hotel Water Demand

Hotel water demand is estimated by multiplying number of necessary hotel rooms by unit water consumption.

HWD (20XX) = HR1 (20XX) x UC1 (20XX) x SR1 (20XX) / (1 – LKG (20XX))
+ HR1 (20XX) x UC1 (20XX) x (1 - SR1 (20XX))
+ HR2 (20XX) x UC2 (20XX) x SR2 (20XX) / (1 – LKG (20XX))
+ HR2 (20XX) x UC2 (20XX) x (1 – SR2 (20XX))

Where,

HWD: hotel water demand (m^3/day)
HR1: number of necessary star hotel rooms
HR2: number of necessary low class hotel rooms
UC1: unit water consumption by star hotel (m^3/room/day)
UC2: unit water consumption by low class hotel (m^3/room/day)
SR1: service ratio of PDAM (%)
SR2: service ratio of PDAM (%)
LKG: leakage ratio (%)
20XX: 2005, 2010, 2015, 2020 or 2025

Irrigation Water Demand

Irrigation water demand is estimated by multiplying irrigation area by requirement water, and dividing by irrigation efficiency.

IWD (20XX) = IA (20XX) x RW / E

Where,

IWD: irrigation water demand (m^3/day)
IA: irrigation area (ha)
RW: requirement water (m^3/day/ha))
E: irrigation efficiency (%)
20XX: 2005, 2010, 2015, 2020 or 2025

<Water Balance>

The system can output results of water balance in whole Bali, in each regency and Nusa Penida and in each sub-basin. Parameters for calculation are also shown as output. Each result data are divided by sheets, are indicated by graph and table. Refer to Figure-II-7.6.

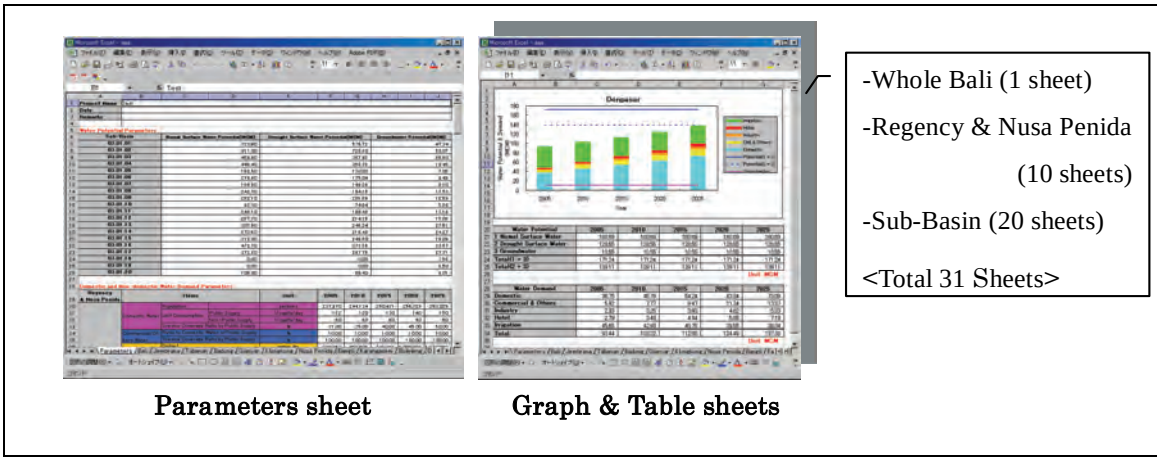


Figure-II-7.6 Output from Water Balance System

Since water potential is set by sub-basin and water demand is estimated by regency and Nusa Penida, conversion to each other is necessary for calculation of water balance. Water potential in a sub-basin is simply allocated by ratio of overlapping sub-basin and each regency. However, land use pattern is considered for estimating water demand by sub-basin. Domestic, commercial, industrial, hotel water demand are allocated by ratio of overlapping sub-basin and residential area of each regency and irrigation water demand is allocated by ratio of overlapping sub-basin and irrigated paddy field of each regency. Refer to Figure-II-7.7 and Figure-II-7.8.

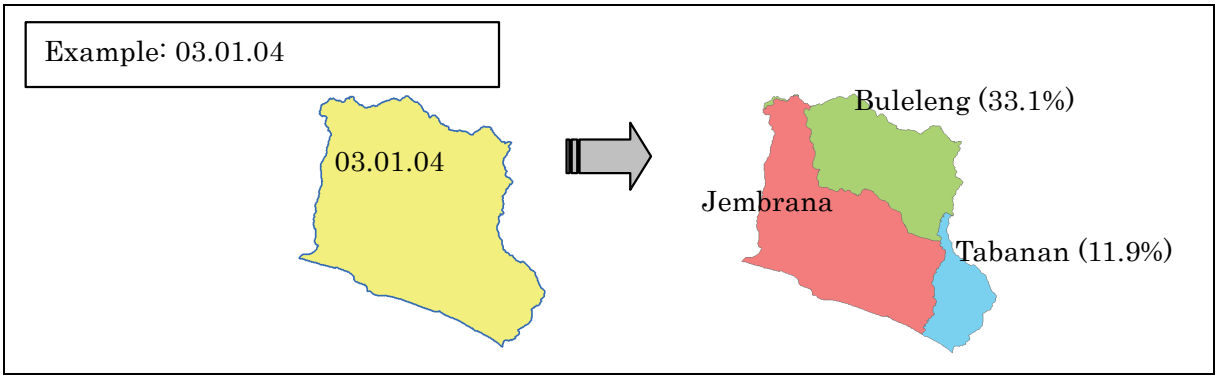


Figure-II-7.7 Allocation Water Potential from Sub-Basin to Regency

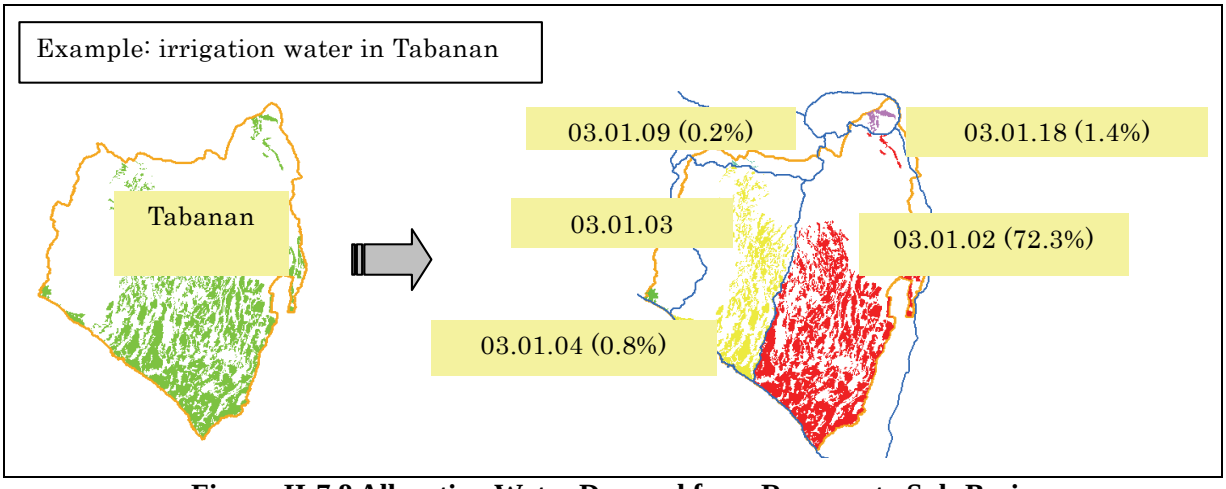


Figure-II-7.8 Allocation Water Demand from Regency to Sub-Basin

7.4.3 Utilization of GIS Database for Water Resources Management

Although it is absolutely impossible to figure out all of any motion within water cycle under the complicated natural and social condition, to develop analytical model and system of evaluation and analysis of the result obtained from the model is a great help for decision making of measures to water-related issues with reasonable view point. Furthermore, it becomes important to gain common recognition and consensus with stakeholders for water-related issues through information disclosures and explanations.

For these purpose, it is necessary to effectively utilize information technology such as database, numerical model, GIS, Web and so on. However, an information technology is a tool to the last, and engineers or experts need to examine and judge item and accuracy of data to input, concept of a model, and accuracy verification of results.

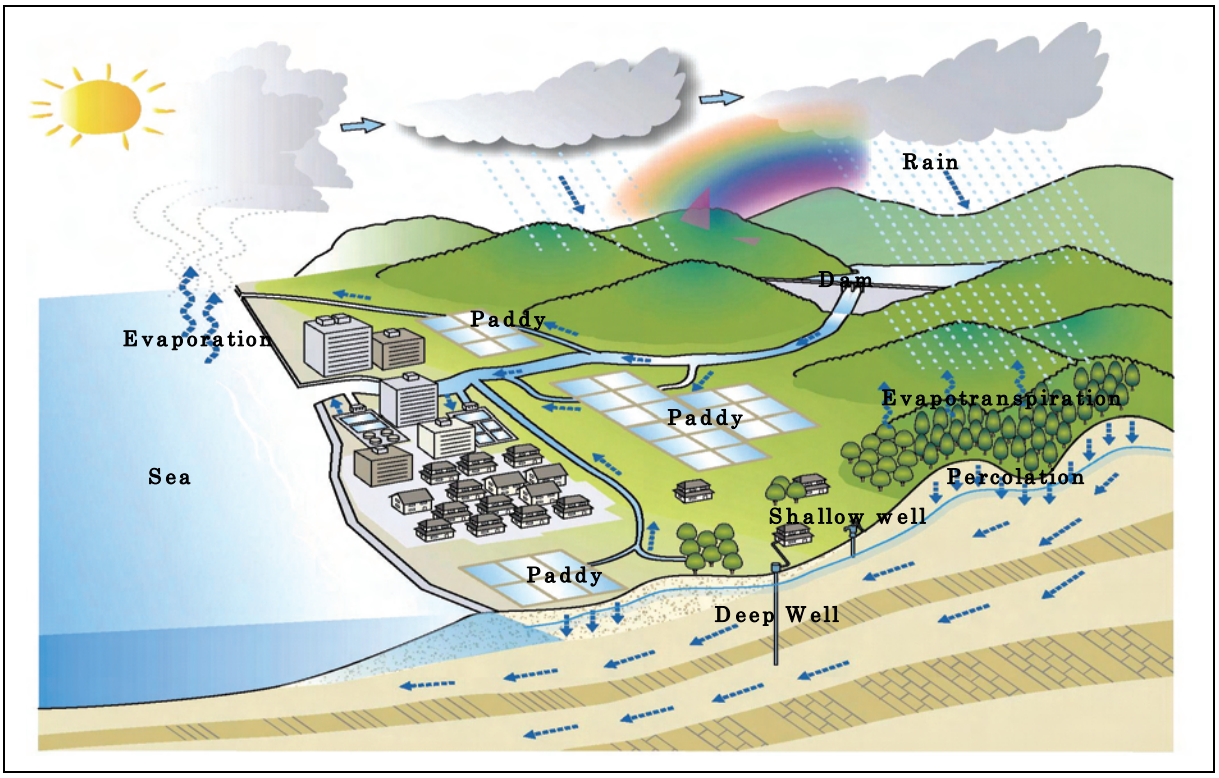


Figure-II-7.9 Water Cycle

In order to grasp a water problem with sufficient accuracy and quantitatively, careful investigation of actual conditions of nature and society related water and is essential to minimize uncertainty. Since the results of an investigation become huge, it is need to utilize database technology for management data systematically. In order to arrange data systematically, the united code system in the province level or nation level shall be applied. In Indonesia, united code system has been applied for river basins, hydrology and meteorology gauging stations, administrative units and so on. Besides, Bali Province has set code system for rivers. These systems should be utilized and expanded.

As a nature, some numerical data have “one to one relationship” with map data, others have “one to many relationship” such as time-series data. Map data and “one to one relationship” data are compiled in GIS database, while “one to many relationship” data are constructed in the separate database. Although each data exists independently, they are linked by code data. As an example, the image figure which fixes hydrology data is shown in Figure-II-7.10.

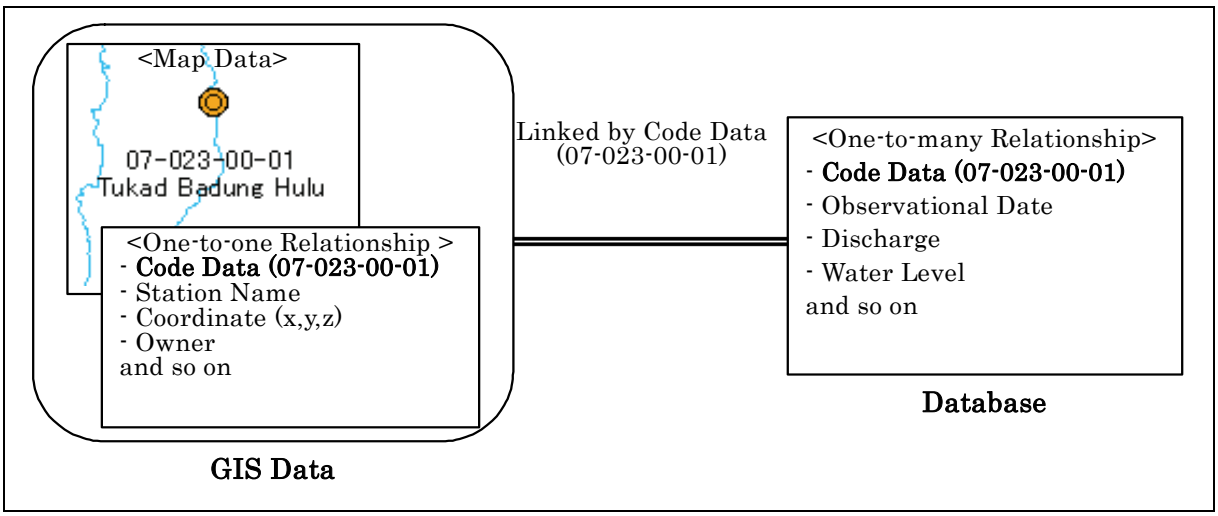


Figure-II-7.10 Example of Data Character (hydrological data)

The GIS database which is developed in the Study is necessary to be updated in this manner. The data item especially important to be updated and their purposes are shown in Figure-II-7.11.

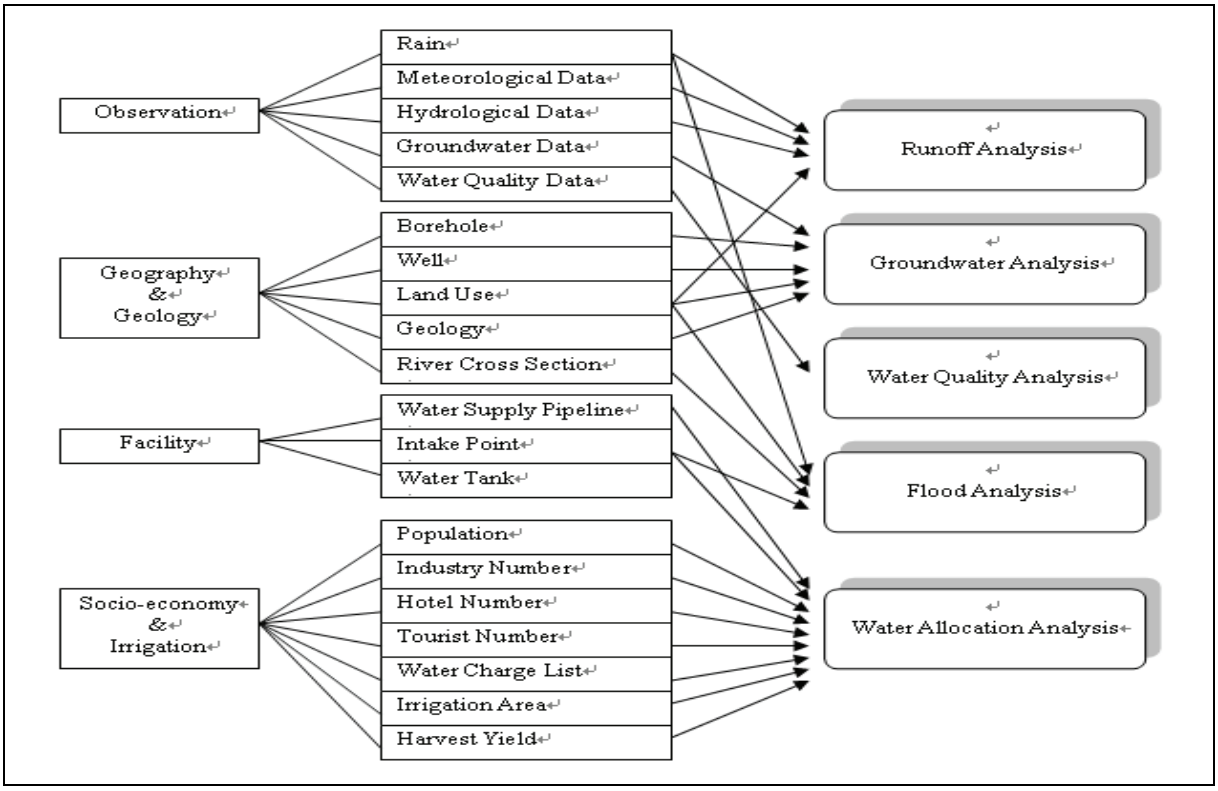


Figure-II-7.11 Update Data and Purpose

The GIS data base developed in the Study is an effective tool in interlocking a database and an analysis models by means of extracting parameters form database through GIS to analysis models and showing the results of analysis visually by GIS. By visualizing, GIS can support to carry out accountability.

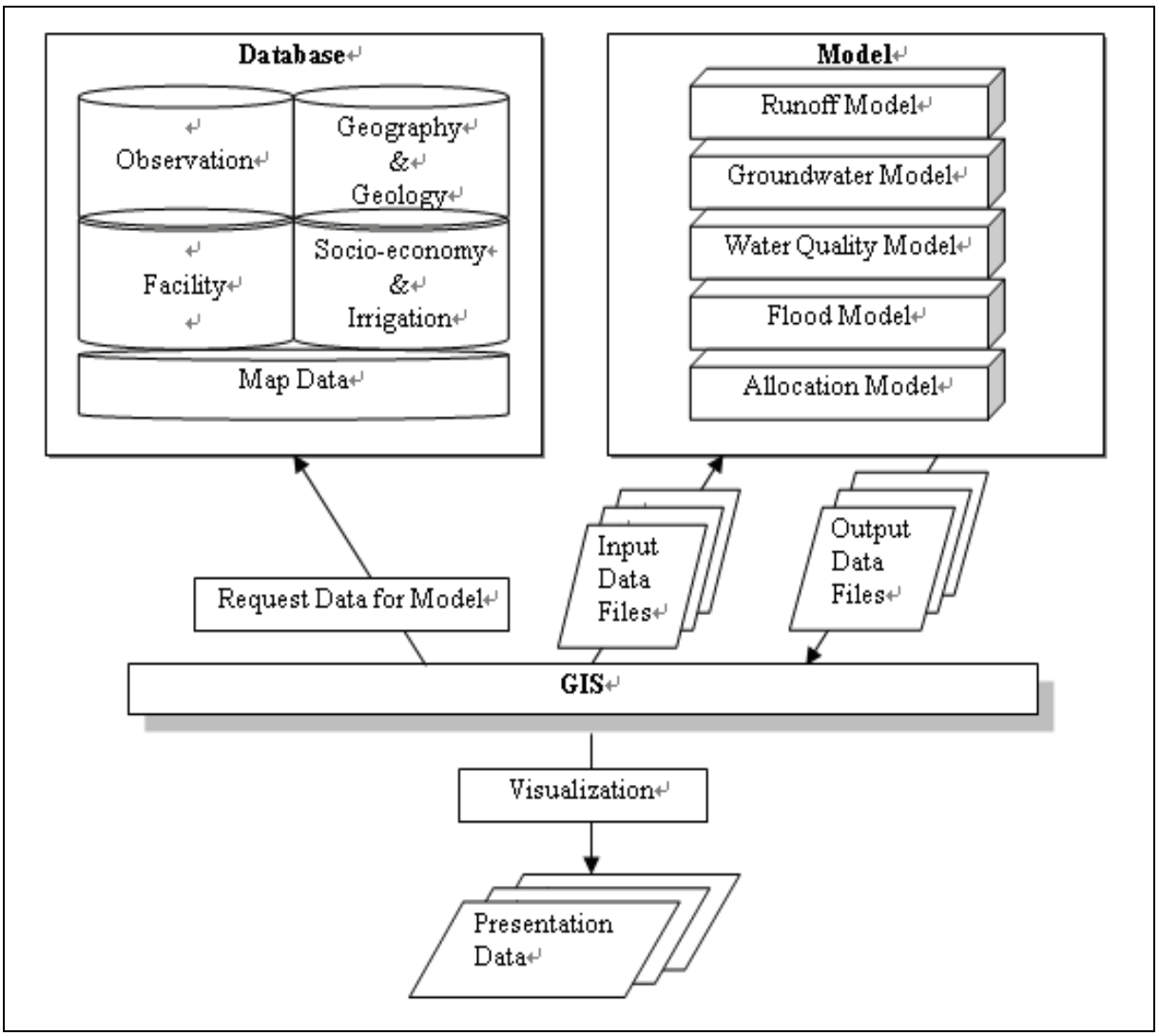


Figure-II-7.12 Cooperation of Database and Analysis Model

7.5 Capacity Development Program

Under the proposed institutional arrangement, the technical and managerial capacity of Dinas PSDA and Balai PSDAs will be the key to enabling integrated water resources management in Bali. Hence, the capacity development of Dinas PSDA and Balai PSDAs requires special attention and the combined support of DEPPU (that has already accumulated experiences in guiding other Balai PSDAs in the country) and external expertise.

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-II-7.12.

Table-II-7.12 Capacity Development Program

Areas and Elements of Water Resources Management under the New Institutional Framework	Exiting Training (by Dinas PU & Civil Service Board)	Needs for Additional Support
1-1. Integrated Perspectives		
◆ Understanding on features and principles of integrated water resources management and broadening perspectives		← Integrated water management expertise (to be provided through organized courses)
Database Development & Maintenance		
◆ Development and maintenance of database which includes the following: - 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 *subaks*		← Data collection & updating procedures ← GIS expertise ← Computer skills
Water Quantity Management		
◆ Observation, monitoring and analysis - 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 - 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		← 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		
◆ Monitoring and analysis - Maintenance of measuring stations - River flow measurement - Observation of wells for groundwater levels and salinity - Civil service inspection		← 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		
◆ Construction management - Procurement & contracting - Construction supervision - Quality assurance		← 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)		
◆ 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:	● Dam safety training (regular training) ● Weir gate keeping (regular training)	← Dam operation expertise ← Planning and implementation procedures

Areas and Elements of Water Resources Management under the New Institutional Framework	Exiting Training (by Dinas PU & Civil Service Board)	Needs for Additional Support
◆ Field inspection ◆ Operation ◆ Routine maintenance ◆ Periodical maintenance ◆ Rehabilitation (by Dinas PSDA)		
1.7 Flood Management		
◆ 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		← Establishing flood control and evacuation systems
1.8 Watershed Management		
◆ Assessment of land use ◆ River improvement and management including sediment control ◆ Disaster control and management ◆ Coordination with forest and land use management offices on forest conservation and management	● Land slide disaster management (regular training)	← Overall river management capacity
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)	● 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		

Areas and Elements of Water Resources Management under the New Institutional Framework	Exiting Training (by Dinas PU & Civil Service Board)	Needs for Additional Support
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 *subaks* be provided with appropriate guidance and support to sustain their livelihood and organizational integrity. ◆ Identify areas where *subaks* 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 *subak* 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		

"Capacity" is a broad concept but basically comprises two aspects: institutional capacity and human capacity. The former refers to a set of laws, regulations, rules, procedures and managerial system that enable an organization or a group of organizations to undertake duties and activities. The latter entails skills and knowledge of individuals who constitute an organization. The capacity development program below focuses on human capacity and covers institutional capacity to the extent directly relevant to the organization. The institutions beyond the current Dinas PU and future Dinas PSDA, i.e. laws and government (central and local) regulations, are not included, as they are already in the pipeline or are expected to be developed by the province and regencies/city.

It is assumed that external support will be provided in some core areas as part of the Ayung Multipurpose Dam Development Project.

CHAPTER 8 IMPLEMENTATION PLAN

8.1 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-II-8.1. Implementation bodies includes to new bodies such as DINAS-PSDA, BALAI-PSADA, water resources bo s ard, BALAI-PSDA, water resources coordination council, *Sudahan Agung* and *Subak* Coodination unit proposed by Master Plan.

Table-II-8.1 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. Bali PSDA	Central Government ＊5	Bali Province
		BENEL Reservoir				
	Water Supply Project	Water Supply for DENPASAR Metropolitan Area	(New) Dinas PU/ Sub-Dinas TRP	(New) Water Supply Bodies	Central, Province, City＊6	(New) Water Supply Bodies
		Water Treatment (WARIBANG-2): DENPASAR		PDAM or Autonomos Association	Central, Province, City	PDAM or Autonomos Association
		Water Treatment (BENEL): JEMBRANA				
		Water Supply – Well *1				
		Water Supply – Spring *1				
	Flood/Sediment Control Project	BADUNG/MATI River Flood Control	(New) Dinas PSDA	(New) Prov.Balai PSDA	Central Government ＊5	Province
		Flood Control for NEGARA Area				
		Flood Control for SINGRAJA Area				
		Flood/Sediment Control *2				
	Irrigation Project	Irrigation Improvement (from AYUNG Reservoir)	(New) Dinas PSDA	(New) Prov.Balai PSDA	Central ＊5	Province
		Irrigation Improvement (from BENEL Reservoir)				
		Irrigation Improvement: Related Regencies *3	Regency Dinas PU	Regency Dinas PU		Regency
Water Resources Management	Institutional Reform	Establishment of DINAS-PSDA	Province, Dinas PU (Dinas PSDA)		Province	
		Establishment of BALAI-PSDA				
		Establishment of W/R Coordination Council				
		Establishment of SUDAHAN A. & SUBAK Coordination Unit	Regency, City		Regency, City	
		Preparation of Regulations & Guidelines for New WR Law	Central, Province, City		Central, Province, City	
	Water Environment Improvement	Public Education and Campaign	Province, Regency, City BAPEDALDA, Province Public Health Agency, Province industrial Agency		Central, Province, City	
		Environmental Flow for BADUN & MATI Rivers	(New)Province Balai PSDA		Province	
	River Basin Conservation	Forest and Land Rehabilitation *4	Province, Regency, City Forestry Agency		Central ＊5	Provice, Regency
		Sediment Control (Included in Flood Control)	(New) Province Dinas PSDA	(New) Province Balai PSDA		Province
		Coastal Protection for Related Areas				
	Capacity Building Program	Personnel Assignment	Province, Dinas PU (Dinas PSDA)		Central, Province	
		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 mechanisim for introduction of allocation between central government, provincial government, regional government and city government shall be adopted by the agreement with relevant organizations.

8.2 Implementation Schedule

Implementation schedule of the projects proposed in the Master Plan is shown in Table-II-8.2. 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

(1) Multi-purpose Dams

Considering the distinctions mentioned above, Ayung reservoir project for the purpose of water supply, power generation and irrigation should start as soon as possible in order to meet the rapidly increased water demand of Southern Bali Area. This project aims at the completion within 10 years including preparatory period such as budget, planning, procurement, land acquisition and indemnity. Since main objective of Benel Reservoir is irrigation water supply and urgency of water supply demand relatively small, Benel Reservoir Project can commence after the year of 2010.

(2) Water Supply Projects

Integrated Public Water Supply Project for Southern Bali Area should be implemented with staging method according to demand increase. Waribang Treatment Plant Phase-2 Project under the existing program should be completed until the year of 2010. Staging of Integrated Public Water Supply Project for Denpasar Metropolitan Area and Waribang Project are summarized in Table-II-8.2.

Table-II-8.2 Stage of Integrated Public Water Supply Project for Southern Bali Area

Stage	Period	Project Component
1	2006-2010	◆ Western P/W/S: Intake from Penet River, Kapal WTP (300 lit/sec) ◆ Central P/W/S: Water Conveyance from West P/W/S (300 lit/sec) ◆ Eastern P/W/S: None ◆ Waribang WTP Phase 2 (150 lit/sec) ◆ Water Conveyance from Ayung WTP1,2 (PT.TB) to Central system (50lit/sec)
2	2011-2015	◆ Western P/W/S: Return from Central P/W/S (100 lit/sec) ◆ Central P/W/S: Ayung Intake and WTP (600 lit/sec) ◆ Eastern P/W/S: Intake from Petanu River Mouse, Petanu WTP (300 lit/sec)
3	2016-2020	◆ Western P/W/S: Return from Central P/W/S (100 lit/sec) ◆ Central P/W/S: Expansion of Ayung WTP (600 lit/sec) ◆ Eastern P/W/S: Intake from Unda River, Unda WTP (250 lit/sec)
4	2021-2025	◆ Western P/W/S: Return from Central P/W/S (100 lit/sec) ◆ Central P/W/S: Expansion of Ayung WTP (600 lit/sec) ◆ Eastern P/W/S: Expansion of Petanu and Unda WTP (250 lit/sec)

Water supply to Jembrana from Benel reservoir should be commenced in line with Benel Reservoir construction and water treatment construction should be divided into two phases in line with demand increase.

Water supply by small scale well and spring development should be implemented by step by step in line with increased demand.

(3) Flood/Sediment Control Projects

Flood Control Projects for Badung and Mati River, Singaraja Area and Negara Area should start as soon as possible. Especially, Flood Control Project of Badung and Mati River has urgent necessity since the project surrounding area has been rapidly developed. More delay of commence of the project, more difficult to implement such as regulating landuse of retarding basin and access to the sites. 30 proposed projects for flood/sediment control should be implemented with staging construction.

(4) Irrigation Projects

As for irrigation projects, rehabilitation and improvement of irrigation networks to increase irrigation efficiency should be firstly implemented in order to improve irrigation efficiency. Construction of irrigation water storages or ponds should be implemented according to increased demand. Irrigation improvement from Ayung and Benel Reservoir should commence in line with reservoir construction schedules.

8.3 Water Resources Management Projects

(1) Institution Reform and Capacity Building Program

Organization set-up for DINAS-PSDA, BALAI-PSDA, W/R Coordination Council and Sedahan Agung should start immediately. After these organizations set-up and personnel assignments, capacity building supporting program can be commenced. Regulations and guidelines for New Water Resources Law can be implemented as components of capacity building support program.

(2) Water Improvement Projects

Public education and campaign should commence immediately and implement periodically since improvement of people's awareness and attitude takes long period.

Environmental flow for Badung and Mati River should commence in line with Flood Control Project for Badung and Mati Rivers.

(3) River Basin Conservation Projects

On-going and existing planned projects for forest and land rehabilitation, sediment control and coastal protectionshsould be implemented in line with there plans.

Implementation schedule for Proposed Projects are as shown in Table-II-8.3.

Table-II-8.3 Implementation Schedule for Proposed Projects

Projects	(1) 2006 - 2010	(2) 2011 - 2015	(3) 2016 - 2020	(4) 2021 - 2025
1. WATER RESOURCES DEVELOPMENT				
◆ **Integrated Water Resources DevelopmentProject**				
➢ 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	———	———		

CHAPTER 9 EVALUATION OF MASTER PLAN

9.1 Technical Evaluation

The proposed Master Plan on Water Resources Development and Management in Bali Province was formulated according to the following technical information, standards, judgment and proper planning procedures. Therefore the projects proposed in the Master Plan are assessed to be technically feasible as a result.

1) The information related to socio-economic conditions, topographical and hydro-geological conditions, hydrological conditions, environmental conditions, water use conditions and so on were collected from the data and information that Government of Indonesia as well as Bali Province own. These information and data were 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 with applying the same method in the draft of "Revised Spatial Plan of Bali Province (2003-2010)" on August 2003 issued by the Bali Provincial Government.
3) In order to attain the sustainable water resources development, the Plan was established based on the study on the possibility of safe water supply with estimating the water resources potential of each basin in Bali and considering the probability evaluation. Concretely, draught discharge for the surface water and safe yield for the ground water were applied in the Master Plan.
4) The intake point of water resources should be found near the demand area, especially in Denpasar and its surrounding Regencies such as Badung and Gianyar. The intake point of the water resources shall be considered base on not only the economic view point but also the technical view points such as 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 for the planned water supply.
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 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 actively among the Study Team and organizations related to river basin in Bali Province through the stakeholders' meetings and work shops.

The proposed Master Plan of the Comprehensive Study on Water Resources Development and Management in Bali Province set the targeting year 2025. The Plan was formulated based on the population and economic growth projection conducted by the Study Team, and the Plan should be reviewed and revised, if necessary, according to the change of socio-economic conditions and additional collection of data.

9.2 Economic and Financial Evaluation

Economic evaluation aims to select the project that is judged to be the most optimum from the viewpoint of national resources distribution. Economic evaluation of Master Plan is carried out in this chapter on the following 6 projects individually:

- Multipurpose Ayung Dam Project
- Water Supply Project for Southern Area of Bali
- Flood Control Project

9.2.1 Assumptions

Economic evaluation is calculated based on the economic cost and benefit. The following assumptions are applied to estimate the economic cost and benefit as shown in Table-II-9.1 and Table-II-9.2.

Table-II-9.1 Basic Conditions

Items	Assumptions	
1. Prices	As of beginning 2005	
2. Exchange Rate	1 US$ = Rp.9,260 1 US$ = 106.97 Yen	Average of middle rate from May/2004 to April/2005
3. Conversion Factor	Conversion rate of 0.9 for local portion cost	
4. 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	
5. Replacement Cost	Pumping motors: to be replaced in every 15 years	
6. Salvaged Value	The residue value of investment cost: to be salvaged at the 30th year.	

Source: Study Team

Table-II-9.2 Benefits

Benefit Items	Assumptions
A. For Multipurpose Ayung Dam Project	
1. Central Water Supply	Same as B
2. Hydropower Generation	Alternative annual cost of thermal power plant construction: Rp.118.6billion (Note) Study Team estimate based on US$1million/MW of Indonesia Power
	Alternative annual cost of thermal power plant operation and maintenance: Rp.72.4billion (Note) Study Team estimate based on Rp.2,000/kWh of Indonesia Power
	Trade for clean development mechanism (CDM) on CO2 emission right (CO2 emission right): Rp.2.2billion (Note) 742g/kWh x US$5/t-CO2
3. Irrigation Water Supply	Without-case: soybean product (Rp.1.2million/ha) With-case: paddy product (Rp.4.3million/ha) (Note) Study Team estimate based on information of Food Crops Agriculture Service of Bali Province
B. For Water Supply Project for Southern Area of Bali	
1. Domestic Water	Rp.1,800/m^3 3% of presumed household income of Rp. 1,600,000/month. Household consumption: 26 m^3/month (Note) Household income is estimated by the Study Team based on the GRDP and interview. Actual data of 3 PDAMs and PT.TB.
2. Commercial/Public /Institutional Water	Rp.3,600/m^3 for Denpasar and Badung South (PT.TB area) Rp.3,030/m^3 for Badung North and Gianyar (Note) Actual data of PDAM Badung and PT.TB
3. Industrial Water	Rp.7,590/m^3 for Denpasar and Badung South (PT.TB area) Rp.6,620/m^3 for Badung North and Gianyar (Note) Actual data of PDAM Badung and PT.TB
C. Flood Control Project	
1. Annual Average Benefit	Expected annual flood damage decreased by the project See Chapter 9.2.3.(4)

Source: Study Team

For the economic evaluation, 10% to 12% of opportunity cost of capital is generally applied. In Indonesia, 12% of opportunity cost of capital is commonly utilized for economic evaluation of the public projects, so that the same opportunity cost of capital is applied to this master plan study. And 30 years of evaluation time horizon is applied to this master plan study.

9.2.2 Economic Cost

The project cost that was presented in previous chapter is, so to speak, financial cost. The financial cost has to be converted into economic cost applying the conversion factor of Table-II-9.1 to local portion of the financial cost. Thus, the economic cost of Multipurpose Ayung Dam Project is set up as shown in Table-II-9.3. However, Ayung Dam is multipurpose dam for water supply to Central System, hydroelectric power generation and irrigation. Accordingly, the cost of Multipurpose Ayung Dam Project is separated and allocated to respective purpose as presented in Table-II-9.3 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-II-9.3 Economic Cost of Ayung Dam Project

Cost	Multipurpose Ayung Dam (Rp.billion)	Cost allocated to (Rp.billion)		
		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

Note: 1) Cost of Central System includes allocated cost of Ayung Dam.
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

The financial cost of Water Supply Project for Southern Area of Bali and Flood Control Project is converted into economic cost in the same manner as shown in Table-II-9.4.

Table-II-9.4 Economic Cost of Water Supply Project and Flood Control Project

Cost	Water Supply Project for Southern Area of Bali (Rp.billion)				Flood Control Project (Rp.billion)		
	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

9.2.3 Economic Evaluation of Each Project

I In economic evaluation, three economic tools are generally utilized for the analysis. These tools are EIRR, B/C Ratio and NPV. Taking into consideration the features, EIRR and B/C Ratio are utilized for economic evaluation of Mater Plan.

(1) Multipurpose Ayung Dam Project

The project aims for 1) municipal water supply to Central System, 2) hydroelectric power generation, and 3) irrigation water supply.

EIRR of the project shows 12.2% that exceeds the 12% of opportunity cost of capital. B/C ratio of the project shows 1.02 that exceeds 1.0. Accordingly, Multipurpose Ayung Dam Project is assessed to be economically feasible. See Table-II-9.5.

Table-II-9.5 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 %
B/C Ratio	1.02	1.03

Source: Study Team

(2) Water Supply Project for Southern Bali

The aim of the project is to supply municipal water to southern area of Bali by integrating 3 systems of 1) Western System, 2) Central System, and 3) Eastern System.

EIRR of the project shows 12.3% as shown in Table-II-9.5 that exceeds the 12% of opportunity cost of capital. Also B/C ratio shows 1.03 that exceeds 1.0. Accordingly, Water Supply Project of Master Plan is assessed to be economically feasible.

(3) Sensitivity Analysis

<B/C Ratio by Discount Rate Variation>

Although both Multipurpose Ayung Dam Project and Water Supply Project for Southern Area of Bali are judged economically feasible, B/C ratio results in only slightly higher than the breakeven point of 1.0.

12% of opportunity cost of capital is applied to economic evaluation of the master plan projects because, in Indonesia, the same cost is commonly utilized for economic evaluation of the public projects. However, for water resources development projects, a large investment cost is indispensable at initial stages. On the contrary, benefit of the project is a relatively small size, even though the benefit is generated continuously over the long period. For this kind of project, 12% of opportunity cost of capital might be rather too high to attain economical viability.

It is an important national project to develop safe and stable water resources in order to secure and fulfill "basic human needs". So the Government financing and external soft loan is suggested in Chapter 9.3 as priority procurement measures for the initial investment cost. The weighted-average interest rate of the Government funds and external soft loan is estimated at 4%, which could be considered the lowest level of opportunity cost of capital for the projects. Thus, sensitivity analysis is conducted here by applying tree alternative opportunity costs of capital that are; 1) 4% - the above cost, 2) 8% - mean cost between above 4% and 12% that is applied to the master plan, and 3) 10% - lowest cost among 10% and 12% that are generally applied for public projects in the world. As a result, respective B/C ratios are confirmed to be sufficiently higher than the breakeven point of 1.0 as shown in Table-II-9.6.

Table-II-9.6 Result of Sensitivity Analysis on B/C Ratio

Items	Discount Rate	Multipurpose Ayung Dam Project	Southern Bali Water Supply Project
Evaluation	12%	1.02	1.03
Sensitivity Analysis	10%	1.2	1.2
	8%	1.5	1.4
	4%	2.4	2.1

Source: Study Team

<EIRR by Demand Variation>

Among various factors that compose water demand projection, the following 3 material factors that are utilized for sensibility analysis on water supply requirement are also selected and applied to this sensitivity analysis.

Population Growth

The projected growth is set up at 1.18% (middle growth) until 2010 and 1.05% (lowest growth) from 2011 by referring to the Spatial Plan of Bali Province. In this sensibility analysis, the following 3 types of growth that are applied to the Spatial Plan of Bali Province are also applied until the target year of 2025;

Scenarios		Remarks
1) High 1	1.26%	Spatial Plan of Bali Province
2) High 2	1.18%	Spatial Plan of Bali Province
3) Low	1.05%	Spatial Plan of Bali Province

The result of the sensitivity analysis is presented in Table-II-9.7. For both projects, EIRR of above

variation 1) and 2) shows slightly higher than EIRR of Master Plan. Even though EIRR of above variation 3) shows lower than EIRR of Master Plan, its EIRR still exceeds the 12% of opportunity cost of capital 12%.

Manufacturing Industry Growth

The projected growth rate is set up at 5.5% until 2005, and 7% from 2006 by referring to the Spatial Plan of Bali Province. In this sensibility analysis, the following 2 types of scenarios are applied.

Scenarios		Remarks
1) High	8.4%	Spatial Plan of Bali Province from 2006
2) Low	5%	30% lower than the projection from 2006

The result of sensitivity analysis is presented in Table-II-9.7. For both projects, EIRR of above variation 2) shows lower than EIRR of Master Plan; however, its EIRR still exceeds the 12% of opportunity cost of capital 12%.

Foreign Tourist Increase

The projected increase rate is set up at 4.5%. In this sensibility analysis, the following 2 types of scenarios are applied.

Scenarios		Remarks
1) High	5%	10% higher than the projection
2) Low	4%	10% lower than the projection

The result of sensitivity analysis is presented in Table-II-9.7. For both projects, EIRR of above variation 2) shows slightly bellow the 12% of opportunity cost of capital. The tourism water demand in 2025 decreases by 1.3% (78lit/sec) compared to the demand in Master Plan.

However, EIRR deteriorates by 4.4% for Water Supply Project and by 2.4% for Ayung Dam project which is larger than the 1.3% of water demand decreasing rate. This is because the benefit of industrial sector including tourism is larger than that of other sectors, which means tourism sector is much more sensitive to the demand variation. Tourism sector is the most important industry in Bali Province, so that the Government expects to improve and accelerate more the attractiveness of tourism resources in Bali Island.

Table-II-9.7 EIRR by Sensitivity Analysis

Variation	Multipurpose Ayung Dam Project	Southern Bali Water Supply Project
1. Demand Variation		
1.1 Population Growth		
1) high 1: 1.26%	12.4%	12.7%
2) high 2: 1.18%	12.3%	12.4%
3) low: 1.05%	12.1%	12.2%
1.2 Manufacturing Industry Growth		
1) high: 8.4%	12.3%	12.5%
2) low: 5%	12.1%	12.1%
1.3 Foreign Tourist Increase		
1) 5%	12.3%	12.5%
2) 4%	11.9%	11.8%
2. Cost Variation		
1) disregard for contingency	13.0%	13.5%

Source: Study Team

<EIRR by Cost Variation>

Generally the physical contingency is taken into consideration in estimating the project cost by adding to its construction cost. In Master Plan, 10% of physical contingency is applied. In this regard, the physical contingency is an additional cost provided for unforeseen incidents. Accordingly, this analysis

is conducted by disregarding this physical contingency.

The result of sensitivity analysis is presented in Table-II-9.7. It is obvious that EIRR of both projects exceed 13% and shows sufficient economic viability.

(4) Flood Control Project

Flood control benefit is generally defined as the reduction of potential flood damage by the project. The reduction can be obtained from the difference of the flood damages between with- and without-project conditions. In this study, the flood damages are estimated only from probable direct damage to houses as described bellow.

<Value of Houses of Badung Regency and Denpasar City>

Total value of houses in Badung Regency and Denpasar City in 2004 is estimated as shown in Table-II-9.8.

Table-II-9.8 Value of House

Area	<20m^2	20-49m^2	50-99m^2	100-149m^2	150m^2<	Total
1. Number of Household by House Size						
Badung Reg.	12,737	19,728	41,499	7,758	5,750	87,470
Denpasar City	36,120	38,211	30,651	13,097	15,184	133,263
2. House Construction Price						
Rp./m^2	480,000	680,000	950,000	1,360,000	1,770,000	-
3. Value of House (Rp.billion)						
Badung Reg.	122	463	2,936	1,314	1,527	6,362
Denpasar City	347	896	2,169	2,218	4,031	9,661

Source: 1) Measurement and Technical Planning of Sungi River and Mati River in Final Report of Water Management and Flood Control in Bali1997/98, Public Work Dept. of Bali Province, 2) Bali in Figures 2003, BPS of Bali Province, , and 3) Study Team

<Flood Damage>

As mentioned in previously chapter, flood area ratio in the residential area is estimated at 4% in Badung Regency and 25.5% in Denpasar City. Flood damage to houses by area is estimated by applying the flood area ratio and direct damage ratio adopted in Japan, and summarized in Table-II-9.9.

Table-II-9.9 Direct Flood Damage by Area

Area	Direct Damage Ratio		Flood Area Ratio in the Residential Area	Flood Damage (Rp.billion)
	House	Household Inventory		
Badung Reg.	8.3%	8.6% (for reference)	4.0%	21.6
Denpasar City			25.5%	210.5

Note: Direct damage under the condition of less than 50cm floor level inundation
Source: 1) Manual for River Works in Japan, Ministry of Construction of Japan, and 2) Study Team

<Annual Average Benefit>

The annual average benefit is defined as the reduction of probable damage under with- and without-project conditions. The Project is proposed on 25-year probable flood. The annual benefit accruing from implementation of the Project is estimated, under the present conditions of year 2005, at Rp.7.0billion for Mati River Project and at Rp.2.8billion for Badung River Project.

<Economic Analysis>

Economic analysis, under present condition of year 2005, on Badung & Mati Rivers Flood Control Project was made by applying all data mentioned above based on the flood return period of 25 years, and indirect flood damage of 10% on the direct flood damage, which resulted in 13.4% of EIRR and 1.1 of B/C ratio.

Accordingly, the project could be assesses economically feasible. Obviously it must be emphasized that, taking into consideration increasing population and houses in future, these economic figures under future condition may result in very much higher.

9.2.4 Financial Consideration

(1) Multipurpose Ayung Dam Project

As previously mentioned the project cost of Rp.718.8billion has to be separated and allocated to relevant projects of 1) Central Water Supply System of Water Supply Project for Southern Area of Bali, 2) hydroelectric power generation and 3) irrigation water supply. Accordingly, financial consideration of Multipurpose Ayung Dam Project should be made separately as follows:

- Water Supply Project for Southern Area of Bali, taking into consideration the allocated amount from Multipurpose Ayung Dam Project, is studied in following chapter.
- For hydroelectric power generation, parties interested such as Indonesia Power, an exclusive national electric company, could be expected to join the project fully or partly.
- Financial burden for irrigation water supply has to be discussed prudently with the parties interested such as SUBAK to avoid conflicts.

(2) Water Supply Project for Southern Area of Bali

The project cost amounts to Rp.1,037.0 billion including allocated cost of Rp.308.1billion from Multipurpose Ayung Dam Project. Obviously, 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 including previous year's surplus. Accordingly, financing of Central Government loan and/or foreign soft loan would be inevitable in implementing the project. This loan composition might be expected as presented in Table-II-9.10.

Table-II-9.10 Expected Loan Composition

(1) Loan	(2) Portion	(3) Expected Interest Rate	(4) Weighted average Rate	(5) Expected Loan Term including Grace Period
Central Government Loan	20%	14%*	4%	Roll over for 30 years
Foreign Soft Loan	80%	1.5%		30 years

Note: * Government Bank loan for investment purpose
Source: Study Team based on data from web side of Central Bank of Indonesia and Japan Bank for International Cooperation

Annualized cost can be regarded as annual due amount of repayment and interests of above loan, which can be calculated based on the above loan conditions that are 1) the loan amount of Rp.1,037.0, 2) weighted average interest rate of 4%, and 3) loan term of 30 years.

Annualized project cost of the above loan will be Rp.59.9billion, which accounts for 6.6% of annual revenue of the Provincial Government.

(3) Flood Control Project

The project cost of Rp.117.2billion is also so big for the financial capability of Provincial Government, so that, on this, financing from Central Government and/or foreign soft loan may be required.

9.3 Initial Environmental Examination

9.3.1 Introduction

An Initial Environmental Examination (IEE) for the master plan on the development and management of water resources in the Province of Bali is presented below on a comprehensive basis. The environmental and social implication consequent to the realization of the master plan is postulated principally focused on the long-term (permanent) environmental and social effects in an overall sense. Detailed environmental and social effects including short-term effects due to the construction works shall be studied in details by the respective environmental impact assessment (EIA) studies for the project components of the master plan targeted for subsequent (and also future) feasibility study and/or detailed engineering works as appropriate.

In this respect IEE could be also regarded as a preliminary EIA focused on the long-term environmental and social consequence of the master plan in a comprehensive manner to illustrate and justify its sustainability.

9.3.2 Baseline Environment of Master Plan Area

(1) Climate and Topography

The study area of master plan for comprehensive water resources development and management is the entire Province of Bali, including the Penida islands with an area of about 5,633 km^2. The climatic condition of the Bali Island is characterized as tropical being located just 8^0 south of equator having two distinct seasons of dry season and wet season. The wet season in general runs from November to March during which most of the annual rainfall occurs. The average annual rainfall is about 2000 mm though it is subjected to geographic and altitudinal variation in addition to being seasonal with high altitude central mountain range receiving higher rainfall.

Topographically the Island is characterized by a ridge of volcanoes that run from east to west along the central mountain range, which also virtually divides the island into two large drainage basins of north and south. The northern basin is relatively arid in comparison to the southern basin.

(2) Natural Environment

<General>

The natural environment of Bali had been long modified since ancient times consequent to human activities, principally due to rice farming (paddy cultivation), which is understandable as being a highly populated small fertile island. Lately, its development as a famous tourism destination in a sense exerts further pressure on the natural environmental resources of the Island. Nevertheless, since it is such natural environmental resources that sustain the tourism development and hence tourism development has also helped in increased awareness on the importance of protection and conservation of natural environment.

The most significant scenic feature of the Island, in addition to the terraced rice fields, is the 4 natural lakes in the central mountainous region, namely Lake Batur, Lake Beratan, Lake Buyan and Lake Tamblingan and the mountains of Gunung Agung and Gunung Batur. In fact the steep topography around the central mountain range renders the area unsuited even for terraced agricultural development and hence this region virtually remains as forestation, still with significant human induced agro-forestation (plantations of clove, coffee, cocoa and others). Most of these highland forests are declared as protected areas and constitute as the principal water catchments for the 4 natural lakes and the numerous rivers of the island.

The significant coastal natural resources having much tourism importance as well include golden (white) sand beaches concentrated in southern coasts of Bali (Sanur, Kuta, Jimbaran and Nusa Dua), and coral reefs concentrated principally in southern coastal waters of Sanur and Nusa Dua as well as the small islands of Nusa Lembongan (and Nusa Ceningan) and also the eastern (Amed and Tulamben areas) and western (Menjangan Island) coastal waters of the mainland Island.

The other most significant coastal natural resource of the Island is its mangrove forestation principally concentrated in the southeastern coast of the Island along the Benoa Bay that is also declared as a protected coastal forest area (Ngurah Rai Great Forest Park).

<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. Such terrestrial mountainous protected areas include, but not limited to, the following;

- Batukaru Nature Preserve Area located around Batukaru mountain range
- Natural Tourist Park of Lake Buyan-Tamblingan located around these lakes
- Natural Tourist Park of Sangeh located in the tourism area of monkey forest
- Natural Tourist Park of Penelokan located around Lake Batur

The other protected areas that are composed of lowland terrestrial area and/or coastal marine waters include, but not limited to, the following;

- Bali Barat National Park (BBNP) or Taman Nasional Bali Barat located in the western region of Bali including the coastal marine areas around Gilimanuk Bay and Menjangan Island and hence incorporates coastal mangrove vegetation and coral reefs as well. This is the largest contagious protected area in the Island.
- Ngurah Rai Great Forest Park located around the Benoa Bay at southeast coast, the largest mangrove forest area in the Island

These protected and nature reserve areas of the whole Bali Island, accounting for a significant area of about 1200 km^2 or 21% of the total land area of Bali, is shown in Figure-II-9.1 (along with significant project facilities of the master plan). These protected areas, in particular the BBNP, serve also as important habitat for the rare and endangered fauna and flora of the island.

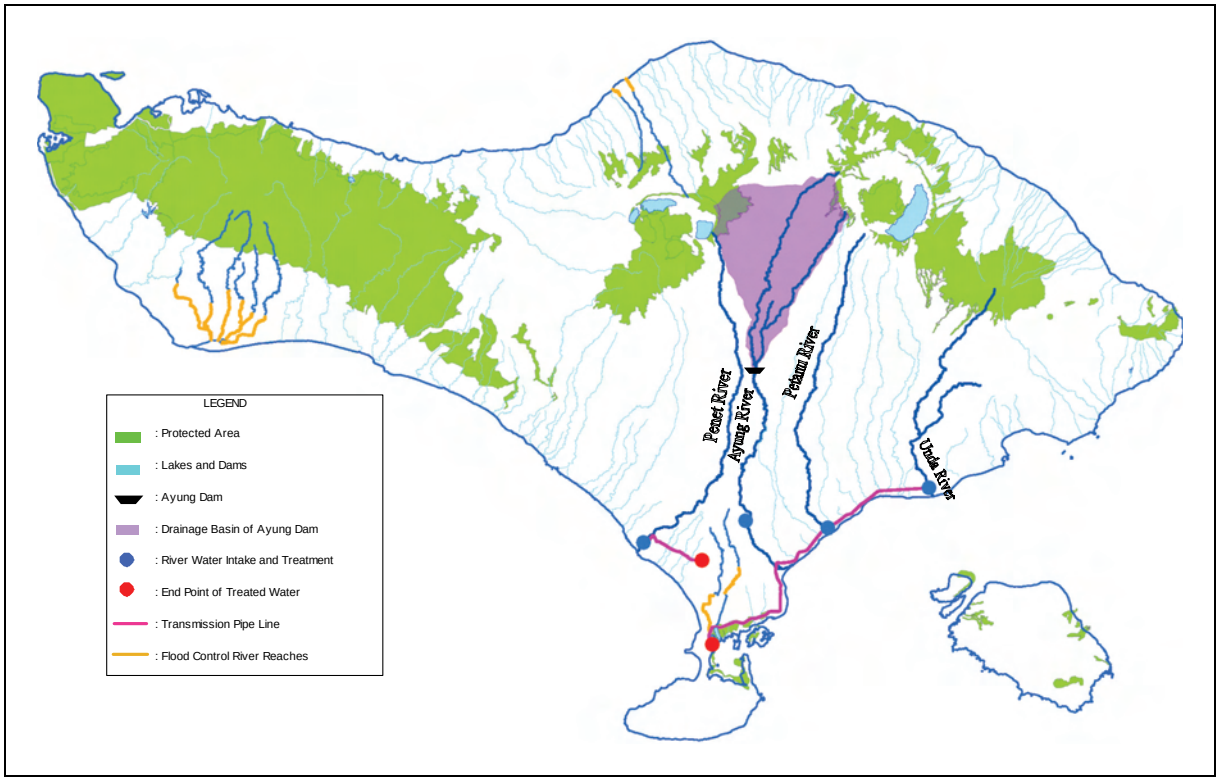


Figure-II-9.1 Protected Areas and Projects of Master Plan

<Fauna and Flora>

Bali is a geologically young island. As such basically there is no native fauna and flora species specific to the island. In other words virtually everything exists here is basically migrated from somewhere around. Still the favorable tropical climate of the Island along with its wide variation in altitude and high fertility renders it habitable for a variety of fauna and flora. Nevertheless, since nearly the entire island other than the steep slope mountainous region has been cultivated over centuries, anthropogenic (human) effects on the environment and hence on the fauna and flora of the island is very significant. Existence of a variety of flowering plants all over Bali could be considered as the most significant consequence of anthropogenic (human) effect on the flora species of the island. Human effects on fauna is evident from existence of a variety of domesticated animals and livestock (pigs, chicken, ducks, cows, dogs and others).

Consequent to the extensive cultivation induced human effects on species of the island, traces of earlier plant life could be found only in the BBNP. Accordingly, conservation and management of this national park is very important. In fact BBNP serves as habitat for a number of endangered fauna and flora of the island, of which the most significant fauna is the bird species endemic to Bali, the Bali Starling (*Leucopsar rothschildi*), which is locally known as *Jalak Putih/Jalak Bali*. BBNP is reported as the habitat to a total of 10 species of endangered fauna and 14 species of endangered flora.

The coastal marine water around Bali is also home to a rich variety of marine fauna and flora including corals and mangroves as noted above and also fish, turtles, dolphins (mostly in the northern coastal

waters off Singaraja), seaweeds and others. In fact the beauty of the corals and the rich marine life surrounding them is an important element of marine tourism (diving/snorkeling) in the island. Of the marine life of Bali the most significant marine fauna that is endangered and hence its capture as well as gathering of its eggs is legally banned (in fact banned throughout the Indonesian coast), is the two turtle species of green sea turtle and hawksbill turtle.

(3) Water Environment

<Rivers>

There are over 160 rivers in Bali with Ayung and Unda rivers being the 2 major ones. Irrigation off-takes mostly with weirs is widely distributed in almost all rivers with significant flows. Hence, most rivers in Bali have been modified to serve as prime conduits of irrigation water and virtually there remains no river with natural flow without the interference of a river structure like weir. Water quality in rural and upstream reaches of most rivers is good. A representative river with very good water quality is Telagawaja River, which is the upstream rural river reach of Unda River. On the other hand the Badung and Mati Rivers passing through the highly developed Denpasar and Kuta area in South Bali is evaluated as the worst polluted rivers in the whole province, which is also visually discernable. BOD levels even exceeding 70 mg/l were measured in these two rivers. Untreated disposal of wastes arising from various human activities of domestic, commercial, industrial and other origin is the cause of this severe water quality deterioration.

Other regional rivers of significant water quality deterioration are identified to be located in the most downstream-developed river reaches of relatively arid regions like Negara and Singaraja and their surroundings.

<Lakes>

There are 4 scenic caldera lakes in the central mountainous region of which the 3 lakes of Beratan, Buyan and Tamblingan are pristine and have the best water quality for a lake. Also the quality of the other Batur Lake is good, though it has rather high natural dissolved solids.

<Groundwater and Springs>

In overall, the quality of groundwater of South Bali area in the Central Denpasar and further south at Kuta and Nusa Dua is regarded as not suited as potable water sources since their dissolved solids content is high, in addition to the high salinity due to seawater intrusion in case of Kuta and Nusa Dua areas located adjacent to the coast. Moreover the coastal groundwater in Penida Islands of Nusa Penida and Nusa Lembongan is also saline due to seawater (salinity) intrusion. This salinity intrusion in coastal areas is attributed to unsustainable over-exploitation of groundwater for tourism (hotels), domestic and other uses. The groundwater in the other mainland area of Bali Island is regarded as good and suited for unrestricted beneficial use.

There exist numerous springs in Bali. In fact contribution of springs to base flow of rivers is very significant. Concerning the water quality of springs, those in mainland Bali Island are good and suited for unrestricted beneficial use. On the other hand in Nusa Penida Island there exists at least one freshwater spring with good water quality named Guyangan Spring, though there may exist additional springs of good water quality. Still there are also springs either with high dissolved solids (Sakti Spring) or saline (Angkal Spring) that is basically not suited as a potable source.

(4) Social Aspects

The province of Bali is one of the most densely populated areas in Indonesia with a population over 3 million and hence also serves as the major reason for its ecological modification due to intensive crop cultivation dominated by rice farming that virtually resulted in the modification of rivers with weir off takes to serve as prime conduits of irrigation water rather than natural rivers, and other human activities. The population density of Bali with 559 persons/km^2 is 5 times that of the average of the whole country.

Balinese society, centered on crop (rice) cultivation, is characterized by *Subaks*, socio-religious agriculture communities dealing with water management for crops. The *Subak* system that has been in existence for centuries is an important social aspect of Balinese society. Topographic condition of Bali

as well as the perspective of Hinduism, the predominant religion of Balinese, are said to have contributed to the development of intricate system of irrigation in steep mountain slopes and valleys in Bali (with terraces) since the ninth century. As also noted under water environment of above this irrigation culture has resulted in the modification of virtually all rivers to be prime conduits of irrigation water with weirs and other off-take river structures.

For Hindu Balinese water plays a very significant role in their religious life. Water always used in religious activities. Quite often especially during important temples' ceremony water should be taken from several holy springs located at places very difficult to access due to deep ravine. No wonder that Hindu Religion in Bali was previously called "*Agama Tirtha*" or "Water Religion".

Balinese believe that the water comes from the mountain-ward and thus, the mountainous area; the upstream must be handled with care. Mountain-ward is believed to be holy or sacred. The great temples like Besakih, Ulun Danu Batur, Ulun Danu Bratan, and Batukaru temples are located in the high elevation of the protected forest regions.

The sea the antipodal to the holy mountain on the other hand, is the place to recycle the waste, so that sea is considered as the holy place to purify the dirt or impurity. When the mountain ecosystem damages, due to its forest cover have been destroyed, it will be reflected in the muddy and polluted water entering the sea. This in turn may bring adverse effect on the ecosystem, climate, and weather, because water vapor brought by the wind may become difficult to condense into rain. But when it rains, the flooding frequently occurs. The harmony between mountain and sea (*Nyegara-Gunung*) is believed to have a supernatural power. And, with respect to orientation, mountainous area represents *Kaja* which for the people of South Bali is North and for those who live in North Bali it is South direction. This is because Bali Island is apparently divided roughly speaking from East to West by the chain of hills and volcanoes of which the peak is Mount Agung. The sea, as the antipodal to the holy mountain is impure and dirty or profane. The *Kelod* is less pure than the *Kaja*.

Beside the *Nyegara –Gunung* concept or the "mountain-sea" dichotomy, the Balinese also believe in an East-West contrast. The East (*Kangin)*, where the sun rises, is believed as sacred, and the West (*Kauh*) where the sun sets, is profane. So, the *Kaja-Kangin* is the most sacred orientation to the Balinese. The *kaja-kelod*, sacred-profane, high-low, up-down concept is indeed deeply ingrained in the Balinese psyche.

Religious ritual seems to dominate the daily activities of the Hindu Balinese. It is a reflection of implementation of the so called *Tri Hita Karana (THK)* principle that governs the daily life of Hindu Balinese. THK means "three causes of happiness /prosperity/peacefulness" consisting of three elements: *parhyangan* (supernatural realm/ belief in God), *pawongan* (social realm), and *palemahan* (environmental realm*)*. In order to achieve happiness /prosperity/ peacefulness, man should constantly devote himself to God the Almighty through praying and offering, preserve harmonious relationship with other human beings and with his natural environment as well. Through religious rituals, harmonious relation between man and God, between man and his fellow beings, and between man and nature may be realized.

Routine temples' anniversaries, public as well as clan or family temple are usually performed every 210 days according to lunar calendar by the Hindu Balinese. Beside the temple ceremony, there are also many kind of religious ceremony to be performed every 6 months (210 days), among them are Galungan (a day symbolizes the victory of the good over the evil), Kuningan (10 days after Galungan as a following up of Galungan ceremony), Tumpek Kandang (signifies the harmonious relation with animals especially the domesticated ones and as expression of gratitude to God for His Blessing, which may be considered as"Fauna Day"); Similarly, Tumpek Uduh/ Tumpek Bubuh signifies the harmonious relation with plants /trees/ crops may be considered as "Flora Day". The New Year ceremony held around the month of February or March is known as Nyepi, when every one must stay at home all day long and no lighting is allowed. One day before Nyepi a holy sacrifice is to be performed in an effort to maintain the harmonious relation of man with his natural environment.

THK principle has been mostly applied by Balinese farmers especially paddy farmers in managing irrigation water. Various kinds of ritual closely related to the stage of rice growing are also performed, starting from the watering of the rice field ("water opening ceremony" /magpag toya), seeds planting,

land preparation, rice transplanting, rice blooming, harvesting, until the rice harvest stored in granary. These rice related rituals vary from subak to subak, and almost similar with the religious rituals related to rite of passage of the human being.

Modern concept of sustainable environment management seems to be quite relevant with the THK principle as practiced by Balinese particularly by the rice farmers organizing themselves in the subak. In this context, subak has played important role in preserving the ecosystem of Bali Island. In spite of such noble principle, however, the balance of Bali ecosystem has been disturbed and degraded. This is brought about by the advance of Green Revolution, rapid development of tourism, and increasing urbanization. This indicates that the noble values and spirit of THK seems to have lost its practical meaning. Thus, THK needs revitalization and its implementation should be put into real action not just symbolically through rituals. Many people just throw garbage at wish which makes river water polluted and inundation becomes common phenomena almost every year.

The very existence of the subak has been threatened. Paddy fields have been converted to other usage such as for housing estate, roads, hotels, shopping centre and other facilities. Many villas were built even in steeply slope areas that endanger the catchments area. Since the last few years about 1,000 ha of rice fields lost every year. Sky rocketing land prices, high land tax, better paid occupation in the tourism sector, are important factors responsible for forcing farmers to sell their rice fields. In addition, the younger generation tends to seek off-farm job to get better paid and bring higher status

Now, many people began to realize that tourism is quite vulnerable to the changing political, and social security situation. Relying the livelihood entirely on tourism may be quite risky as has been experienced several times. For example during the War in Middle East, issue on cholera, and bombing for the second time that killed many tourists, the number of tourists coming visiting Bali dropped considerably and many employees were compelled to lose their livelihood while farmers could still survive. Many of the Balinese raised their voices that agricultural sector particularly the rice farming should not be neglected but must be preserved. If rice farming is abandoned, subak will be dying, and if subak died the Balinese culture may be degraded since subak with its rice culture is believed to be the backbone of Balinese culture itself. The multi-functionality of the subak with its irrigated rice culture is a *rationale* for the need to slowing down or even to limiting the rapid rice field conversion to non farming usage. Irrigated agriculture does not only produce food and fiber but also other intangible goods such like flood protection, soil erosion control, ground water recharge, air purification, biodiversity preservation, provision of beautiful landscape, provision of rural livelihood, rural tradition and so on. The loss of paddy fields may also imply the loss of such invaluable non market multi-functional benefits.

It seems necessary to note here, that since the Kingdom Era until prior to the entrance of Dutch Colonial Government to Bali Island, water resources was developed and managed by the farmers themselves on completely a self help basis without any external support from the kings. In those days, the role of the King focused on licensing of water taking along the river by diversion structures or intakes, the permission of opening new land for rice fields, and taking land tax from the farmers. This task was assigned to the *Sedahan Agung* who was also the treasurer of the King. He is assisted by a number of *sedahan* in certain areas along the watershed. A part of the collected land tax which was in form of harvested rice, was then used for subak ritual performed at the lake temple (*Pura Ulun Danu*) and to certain extent also for rehabilitation of the intake/weir that destroyed by flood almost every year. When Bali was under the Dutch Government around 1906, the role of *Sedahan Agun*g was preserved, since it is quite potential for enhancing the government revenue. Around 1920's the Dutch Government started engaging in irrigation development effort. Several permanent weirs were constructed but mostly only the upgrading of the existing structures formerly built by the farmers themselves.

The policy to make the best use of the role of *Sedahan Agung* has been maintained by Indonesian Government since after independence. He has been given a Civil Servant status. Although his important task is related to the water resources matters and subak affairs in particular, for so many years the tax collection seems to be the dominant task, whereas the subak guidance and supervision tend to become secondary. One possible explanation is due to the increasing role of the government agencies such as Water Resources Office in dealing with water resources problem including the subak supervision and guidance on the technical aspects of irrigation, and Agricultural Office on agricultural matters. Quite

recently, many regencies have abolished the existence of *Sedahan Agung.* This situation has created confusion not only to the farmers /subaks but also to many related government agencies as well. Especially for the subaks they do not know how to do and where to report if any problem being encountered. Many think that *Sedahan–Agung* should be restored and revitalized at each Regency/City since it is inseparable part of the subak existence with the main function is dealing with subak supervision and guidance rather than tax collection. Based on the Provincial Government Regulation No. 02 /PD/ DPRD/1972 on Irrigation, in fact the *Sedahan Agung* has nothing to do with tax collection task. The regulation even does not at all specify either explicitly or implicitly about tax collection matter.

9.3.3 Social and Environmental Evaluation of Master Plan

(1) Social Evaluation

< General >

The Master Plan as proposed by the Study Team has incorporated programs and projects such as water resources development and water supply, water quality improvement, river basin conservation, and institutional strengthening essentially reflects the felt needs of most stakeholders. Again, capacity building one of so many important programs included in Master Plan is of primary important, particularly when the institutional reform in water resources would have been realized, that is to say when the present *Sub Dinas* of Water Resources and Rural Infrastructure has got its new status as Dinas. Many of development projects in the past have neglected this capacity building component of the project so that the operation and maintenance of the project was not optimal. The related staff and officials in Water Resources Office have expressed their opinions what particular areas are needed for enhancing performance in carrying out their respective tasks. Thus, important components and prioritization of programs and projects mostly constitute the stakeholders' felt needs or in other words, they are generally in tune with stakeholders' needs and aspirations. This is because of the fact that in effort to formulate the Master Plan for Water Resources Development and Management in Bali Province, the Study Team has intensively employed a participatory approach in obtaining information through several times of Stakeholders' Meetings, Technical Meetings, Steering Committee Meetings, and Workshops.

The involvement of numerous stakeholders in decision making process in any planning stages may create sense of belonging and sense of responsibility to the results of the study. It is hoped that the Study Team could contribute a kind of learning process to the local people in participatory planning in an effort to compile Water Resources Master Plan for Bali up to 2025. Since from the beginning, The Study Team has already involved various stakeholders including the subaks' representatives.

Moreover, one of the strategies for the Master Plan is respecting the unique culture and tradition of the Balinese which based on the principle of Tri Hita Karana. Based on the participatory approach, it is likely that the Master Plan will get strong support from the stakeholders. In fact many stakeholders even want quick realization of the expected projects / programs as included in Master Plan. In this context, Master Plan is considered to be socially feasible.

The Study Team has attempted to introduce the participatory planning or bottom up planning in water resources development to the local people and the bureaucrats which seems to be quite timely and demanded in this era of reformation, transparency, openness, and regional autonomy. In the past, development planning in several countries had put emphasis more on top-down rather than bottom-up approach.

The Master Plan also stresses the important of respecting the existing subaks and their needs and aspiration are to be taken into account in water resources development and management. It is also well recognized that with special regard to the use of surface water for other uses outside rice farming, care is to be taken to avoid conflict with the subak. In addition, since the Master Plan also intends to introduce volumetric measurement in water allocation among farmers and among intakes /subaks, it is also considered of great important to take extra care with its implementation and to involve subak and farmers in decision making process, if possible through a pilot project by employing a participatory action research.

Involving farmers at every stage of irrigation project planning is of crucial important to avoid frustration among farmers when the project failed to meet their needs and aspirations, as once experienced by a number of countries in the past when the national governments attempted to modernized their irrigation systems. The project implementers did not give ample room to local participation and too often did not take into account the needs and aspiration of the existing traditional water users associations (WUA). Many of the newly introduced system seem to be more suitable for "government-managed" rather than "farmer-managed' systems. As a result, many newly-built systems have become dysfunctional or not so effective. Such experience of government "intervention" in a number of countries has made irrigation planners aware of the importance of employing participatory approach by involving local WUA in any stage of irrigation development planning. Drawing a lesson from such experience, the present Master Plan is respecting the existing subaks and trying to be more careful in dealing with irrigation development planning in Bali.

It is true that in the past, the rice farmers were the most important actor in the provision of water supply for the people in Bali by diverting river water for irrigation as well as for domestic use. Historically, it was the subaks themselves that developed and managed the water resources in Bali. No wonder, that subaks will not tolerate any effort for taking water from the existing weir to be transferred for other uses which may reduce irrigation water supply. However, it may not necessarily means that they will also refuse to share water with other users so long as they can be convinced that they truly using excessive water under existing cropping pattern. This could be realized by a participatory action research through persuasion, intensive dialogue and negotiation. The subaks may be persuaded to finally accept the fact that river water as a *common property* should be used for the benefit of all not only for the farmers alone. Again, as a matter of fact the farmers themselves need clean water too. In this case, a team work consisting of several disciplines such as hydrologist, agronomist and sociologist can make a try out for two crop seasons with definite water share among intake along the river. If the allocated water right can prove that the concerned subak is really in excess of using water, they may accept the new water share arrangement. The most important thing is, it must be based on mutual agreement, transparency, and equity/ fairness. Even though the water is inadequate, they may still agree, when arranged on a rotation basis, or through water borrowing mechanism among intakes. It is quite possible because the water resources management implemented by subak coincides with principle of good governance: autonomous, democratic, justice oriented, transparency, accountability, and strict law enforcement based on the rule and regulation (*awig-awig*) agreed upon by consensus.

Now days, water in Bali has become very critical. The demand for water both quantity and quality tends to increase in the coming decade. This is due to the increasing urbanization and increasing number of hotel and restaurants. The need for water exceeds its availability. This implies that the competition in the use of water becoming very keen. As a result, water conflict among farmers and non farmers has been inevitable. In former days, the people could take and use water directly from irrigation canal for cooking, drinking, washing and bathing. But now, water is polluted, and most people and even the farmers themselves also want clean water. No wonder that water becoming scarcer and scarcer.

This means, that Master Plan for water resources development and management in Bali as has been formulated is becoming even more important and therefore it is highly expected and welcome by the Bali community, since it may help gradually cope with the problems related to water resources in Bali.

<Beneficial Effects>

The beneficial effects of the programs/projects to be included in the Master Plan from the social point of view may be described as follows.

People Empowerment

The involvement of various stakeholders in contributing opinion, suggestion, and proposal related to water resources development and management is considered as quite beneficial to local people since it may enhance their knowledge and skill in participatory planning. The Counterpart Team and staff of *Sub-Dinas SDAPP* were also trained on Project Cycle Management (PCM) method which is a tool for managing the entire cycle of a development project. The PCM training may improve the capability of

staff of Public Works Office in building sustainable plans based on logical steps that can meet felt needs of the local people.

More over, institutional strengthening as one component of the Master Plan in which it will include capacity building activity is also considered very useful since it may guarantee the sustainability of projects that are to be implemented, since the staff responsible for the operation and maintenance of the projects would be well prepared to handle it properly. But, efforts need to be taken that the trained staff would not move to other irrelevant office or departments, so that their acquired skill will not become idle.

Again, soft measures for flood mitigation program in form public campaign and education how to treat domestic waste and garbage will gradually change the attitude of people in the long run so that clean river and improved environmental health can be ensured.

Improvement of Public Health and Sanitation

The provision of clean water supply which based mostly on surface river waters, the improvement of water quality, and the flood damages mitigation programs component of Master Plan, may provide a long term beneficial effect to the society in general. Until now many people still use open dug well, river and spring as sources for bathing and washing and even for drinking. The implementation of the Master Plan would make it possible for more and more people to get clean water for domestic uses. Meanwhile, flooding is considered as one of so many factors that caused the spread of certain diseases to the community, loss of life, loss of public facilities, and disturbing transportation system. Accordingly, flood damages mitigation both through hard as well as soft measures such like public campaign and education on environmental friendly garbage disposal may help improve the environmental health and the people's quality of life.

Creation of New Job Opportunity

The implementation of Master Plan is expected to be able to generate employment opportunity to the community both during construction and post construction phases. During construction stage a great number of unskilled laborers are required. Local people would be able to participate as sub contractor for certain kind of activities, e.g., as provider of construction material, transportation for dredged riverbed material, etc. Especially for large scale project such like Ayung Reservoir, after it is operational, business opportunity related to tourism may emerge. Employment creation, however, shall be introduced carefully to avoid the disorder of livelihood due to temporary revenue increase for the local resident.

Development of Recreational Facilities for Leisure

River improvement to mitigate flooding, large reservoir development such as Ayung Reservoir may be quite potential for the emergence of recreational facilities for leisure in the future. For example in case of Ayung Multipurpose Development Project, due to its potential in restoring fish aquatic ecology in the down stream river reaches, the community can be able to use this places for fishing either just for leisure or for additional earning for some people. Regulation with strict law enforcement to avoid river pollution and environmental degradation shall be formulated. River improvement is potential for the emergence of recreational activities such like canoeing and fishing ground. This may eventually create new job opportunity which is also useful for tourism.

Increasing Farmers' Income

Increase production of irrigated agriculture very much relies on adequate and continuous supply of irrigation water. Irrigation development as one component of the Master Plan is expected to be able to meet such requirement. Through a proper linkage and partnership with various agencies, government as well as non government like tourism agency, the farmers shall be able to provide agricultural product such vegetables, fruits, and other crops having high demand potential to the hotels and restaurants. But this seems to require a pro-farmer government policy, since the farmers in many countries still need support from their respective government. If this requirement can be met, the continuous water supply for irrigation as planned according to Master Plan may increase the farmers' welfare in the near future.

<Adverse Effects>

Land Acquisition Problem

Many projects need land acquisition. In case of Ayung Reservoir development project for example, a considerable acreage of land (around 74 ha) may be adversely affected since it is potentially submerged when the reservoir is operational. Land acquisition is also required for other prioritized projects to be located at Petanu and Sugi / Penet rivers (both for raw water development) especially for the site of water treatment plants even though only just less than a hectare. In the past, owners of the land to be used for investment projects just for the sake of public interest were ready to free their lands, but many of them get frustrated because they feel the compensation's value was not quite fair and they considered themselves as a loser or a "victim" of the development project. In general, the owners of such lands will likely have no objection to free their land to be used for the project sites as long as the value of compensation is not quite disadvantageous to them. Hence, to avoid dissatisfaction among landowners, it is considered necessary to handle land acquisition problem with care, through negotiation in a transparent, accountable, and honest manner.

Removal of Human Settlement and Temples

Considering the fact hat Bali is known as "an island of a thousand temples", there a great possibility for any water resources development project to disturb the existing temples. The local residents living adjacent to the project sites generally worry so much about the possible removal of houses and temples. However, it is the strategy of the Master Plan to respect local culture and avoid as could as possible the removal of human settlement and other objects or facilities with historical and religious value. As a matter of fact through feasibility study no removal of human settlement and temples is required by the prioritized projects like Ayung Reservoir, Petanu River Raw Water Development, Sugi River Raw Water Development, and Badung-Mati River Flood Control.

Disturbance to Existing Holy Springs

It is well recognized that Hindu Balinese consider water as very important for religious ritual. For this purpose, water is often taken from the "holy" springs spread at many places along the river courses. In the implementation of surface water development projects, it is quite possible to affect the existing springs used by the local people for religious ritual activities. In case of Ayung Reservoir Multipurpose Project, it is found one holy spring that will be submerged However, it is still possible to persuade the local people to use other springs located some where along the river which will not be submerged. This needs to be discussed thoroughly with the local people under the guidance of the Hindu Council and the high priest.

Potential Conflict

The implementation of programs /projects as incorporated in the Master Plan may create potential local conflict of interest especially when surface water is to be used for potable water sources by constructing intake at upper stream. It is recognized that the related subaks will not agree with any water taking upstream that would reduce their current water supply. The potential conflict is to be avoided in the plan by locating the intake at the lowest stream of the river such as the case of Sugi, Petanu, and Unda Rivers.

Another possible conflict that may arise is due to the use of outsiders during the construction stage as unskilled laborer. Usually, a considerable number of workers are needed especially for digging, excavation, carrying construction material, carrying dredged riverbed material, etc. Although local people want to be involved in such kind of works, it will not be sufficient. Still a large number of unskilled workers are needed from outside especially for large project like Ayung Multipurpose Project. The causes of conflict may be among others envy on the part of local people due to not being recruited as workers, outsiders' attitude of being disrespectful to local custom merely because of their own ignorance which may be considered as an insult to the local people, criminal act such as stealing by outside laborer may induce anger of local people, etc.

The Master Plan also has potential social conflict of interest especially with regard to the sharing of project benefit after its implementation. The upstream community tends to consider that the beneficiary

of the project is mainly the lower stream community. Whereas in fact, it is the upstream people who are considered to be blamed for any deterioration of catchments area. In this context, it is of prime importance to take into account the equity dimension of any water resources development project after it is operational.

(2) Environmental Evaluation

<Beneficial Effects>

Mitigation of Salinity (Seawater) Intrusion into Groundwater

The planned future water resource development for potable water supply for the Southern Bali Area (Metropolitan area of Denpasar and its surroundings) is solely based on surface river waters since there is no potential for further groundwater development in Southern Bali Area. In fact the ongoing overexploitation of groundwater in the tourism developed coastal areas like Kuta has already resulted in salinity intrusion in groundwater. With the provision of water supply as per this master plan this ongoing salinity intrusion and the resultant water quality deterioration of groundwater could be mitigated, a very significant long-term beneficial effect.

Improved Public Health and Quality of Life of Water Served Population

Improved public health and sanitation resulting in overall enhancement of quality of life of potable water served population is the very basic purpose of provision of water supply service. Accordingly, this beneficial effect does not require any further explication.

<Adverse Effects>

Potential Deterioration of Dam Function and its Water Environment

The beneficial effects of above concerned to the Ayung Dam is conditional on protection of the drainage basin of dam against any further significant development as well as proper management of dam water quality against potential eutrophication with the introduction of suitable plankton grazing fish species as appropriate. In fact the protection of dam drainage basin is the basic requirement to control both potential eutrophication (due to increased nutrient inflow as phosphorus) and potential rapid reduction in storage capacity of the dam thereby affecting the functioning of the dam (due to increased sediment inflow).

In this respect, reforestation of affected critical lands in the Ayung Dam drainage basin, including maintaining all public lands as conserved forestation, would form a core element of forestry management.

It is also noted that as structural measure of controlling sediment inflow to the Ayung Dam, 2 check-dams at the upstream river reaches to the dam inlet is provided in the two rivers of Ayung (main river) and Siap (tributary of Ayung). It is important to regularly remove (dredge) the accumulated silt material in both check-dams, in principle at the end of each rainy season, so that their functioning would be effective in settling the suspended solids in river water. It is noted that accumulation of silt material in check-dams would occur mostly in rainy season under the condition of flood discharge in both rivers. Such silt material removed from the check-dams could be beneficially used as construction material. Accordingly, regular removal of the accumulated silt material could be contracted out to some construction material sourcing company. The importance of regular and timely removal of accumulated silt material is emphasized so as to ensure long-term viability of the Ayung Dam, which is the most important structural mitigation measure incorporated in the overall design of dam against potential rapid siltation of dam.

With the implementation of these protection measures potential adverse effects on dam function including its aquatic environment could be mitigated and in fact in the long-term pristine aquatic ecology in dam could be attained. The cost of these protection measures is taken into account in the overall operational cost estimation of Ayung Dam.

Effect of Water Iintake River Structure including Decreased Flow at Downstream

As potable sources using surface rivers, direct water intakes with small weirs (as river structure) are

planned for all three rivers, Penet and Petanu and Unda Rivers in their most downstream river reach. The most significant reason for the selection of most downstream river reaches is not to interfere with existing irrigation water user (farmer) rights. Accordingly, any social conflict due to water intake is mitigated in the plan (in-built in the whole water supply development plan).

Still the intake weirs are located near their respective river mouth areas and hence have potential to interfere with migration of fish. As the design mitigation measure so as not to affect fish migration requirement for the provision of fish ladder shall be duly investigated during the environmental impact assessment (EIA) studies of these projects during their feasibility study. In this respect it is noted consequent to the EIA study for the Penet and Petanu River intake based water supply schemes, for which feasibility study was conducted as part of this study (refer to Part-III of this report), fish ladders has been incorporated as in-built design mitigation measure for both intake weirs. Similar requirement for Unda River intake weir shall be studied during its EIA study in future. Moreover, even after the withdrawal of water for potable water supply sufficient remaining water flow as environment flow is ensured for all three water intake plans so as not to affect the aquatic ecology of the rivers at downstream of weirs.

Accordingly, potential long-term adverse effects are duly considered and pertinent mitigation measures are incorporated in the planning of all three direct river water intake schemes.

Wastewater Generation Consequent to Potable Water Supply

Provision of potable water supply, in particular for the development of a large metropolitan area like Denpasar and its surroundings (Southern Bali Area), would inherently result in very significant generation of wastewater (about 80% of the consumed water is disposed as polluted wastewater) requiring sewerage system with treatment of collected wastewater. In this respect sewerage development project for Denpasar and the surrounding tourism area is ongoing as DSDP as the means of restoration of existing deteriorated surface water environment (Badung and Mati Rivers). Accordingly, gradual future expansion of the sewerage service area to incorporate the increased water supply service area consequent to the increased water supply provision as per this master plan would be required as the continued long-term surface river water environmental improvement measure. Similarly, sewerage development for other urban areas like Singaraja and Negara also need to be planned.

Siltation and Other Damage of Improved Urban River Reaches of Flood Control

The flood control plans for urban river reaches are planned with due technical consideration to mitigate siltation of improved river reaches that would eventually affect their effectiveness of flood control. Still, the flood control function to be effective periodic removal of accumulated debris including garbage is very important. In particular the importance of elimination of disposal of garbage into surface waters is emphasized as the basic flood mitigation measure.

Still, siltation and scouring of riverbed, including structural damage of revetment and others, at some stage is possible, in particular following an event of flood discharge that exceeded the design flood discharge. Accordingly, periodic inspection of improved river reaches including measurement of riverbed level, in particular after the end of each rainy season, so that any required rehabilitation including dredging work of river improvement could be accomplished before the start of the subsequent rainy season, is identified as the most significant sustained mitigation measure of flood control schemes.

Other Adverse Effects

Other adverse effects caused to the construction of Ayung dam except shown in above 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.

(3) Conclusion of Social and Environmental Evaluation

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.

In fact the protected terrestrial environmental area will be expanded due to the requirement for the protection of Ayung Dam drainage basin with a significant net area of about 200 km^2 in order to ensure the storage of water with good water quality to be the source of potable water and also to mitigate any potential eutrophication and unduly high sediment inflow into the dam. In other words protection of Ayung Dam drainage basin, an important requirement for the sustainability of the most significant project facility of the Master Plan also contributes to terrestrial environmental conservation in mutually beneficial manner.

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

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.

CHAPTER 10 PRIORITY PROJECTS

10.1 Criteria for Setting Priority

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 posses 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.

10.2 Selection of Priority Projects

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. Refer to Table-II-10.1. Feasibility Study shall be executed for the selected priority project.

Table-II-10.1 Proposed Priority Projects

Projects			*(1) 2006-2010	*(2) 2011-2015	Selected Priority Project for F/S
Water Resources Development	Multi purpose dam Project	AYUNG Reservoir	X	X	▲
		BENEL Reservoir		X	
	Water Supply Project	Integrated Water Supply for DENPASAR Metropolitan Area	X	X	▲
		Water Treatment (WARIBANG-2): DENPASAR	X		
		Water Treatment (BENEL): JEMBRANA		X	
		Water Supply – Well: Related Regencies	X	X	
		Water Supply – Spring : Related Regencies	X	X	
	Flood/Sediment Control Project	BADUNG/MATI River Flood Control	X	X	▲
		Flood Control for NEGARA Area	X	X	
		Flood Control for SINGRAJA Area	X	X	
		Flood / Sediment Control: Related Regencies	X	X	
	Irrigation Project	Irrigation Improvement (from AYUNG Reservoir)		X	
		Irrigation Improvement (from BENEL Reservoir)	X	X	
		Irrigation Improvement: Related Regencies	X	X	
Water Resources Management	Institutional Reform Program	Establishment of DINAS-PSDA	X		
		Establishment of BALAI - PSDA	X		
		Establishment of W/R Coordination Council	X		
		Establishment of SEDAHAN A. & SUBAK Coordination Unit	X		
		Preparation of Regulations & Guidelines for New WR Law	X		
	Water Environment Improvement Program	Public Education and Campaign	X	X	
		Environmental Flow for BADUN & MATI River	X		
	River Basin Conservation Program	Forest and Land Rehabilitation	X	X	
		Sediment Control (Included in Flood Control)	X	X	
		Coastal Protection for Related Areas	X	X	
	Capacity Development Program	Personnel Assignment	X	X	▲
		Capacity Building Support for BALAI-PSDA	X	X	

*(1) 2006-2010; First 5 years projects start in 2006
*(2) 2011-2015; Next 5 years projects start in 2111