

LIST OF REPORT

MAIN REPORT (ENGLISH)

MAIN REPORT (INDONESIAN)

SUMMARY (ENGLISH)

SUMMARY (INDONESIAN)

SUMMARY (JAPANESE)

SUPPORTING REPORT (ENGLISH)

- A. SOCIO-ECONOMY
- B. GEOLOGY.....
- C. HYDROGEOLOGY AND GROUNDWATER.....
- D. HYDROLOGY.....
- E. WATER QUALITY AND ENVIRONMENT
- F. AGRICULTURE AND IRRIGATION.....
- G. DEMAND PROJECTION FOR WATER SUPPLY
- H. WATER SUPPLY
- I. INSTITUTION.....
- J. GIS DATABASE.....
- K. COST ESTIMATE
- L. ENVIRONMENTAL STUDY
- M. ECONOMIC ANALYSIS (ECONOMIC, FINANCIAL AND SOCIAL).....
- N. SOCIAL EVALUATION.....
- O. PCM-TRAINING.....
- P. STAKEHOLDER MEETING

DATA BOOK (ENGLISH)

TABLE OF CONTENTS

	PAGE
PREFACE	
LETTER OF TRANSMITTAL	
PHOTOGRAPGS	i
MAP OF STUDY AREA.....	iii
LIST OF REPORT	iv
TABLE OF CONTENTS	v
LIST OF TABLES AND FIGURES.....	viii
LIST OF ABBREVIATION & TERMINOLOGY	xii
SYNOPSIS	Synopsis-1
CHAPTER 1 OUTLINE OF STUDY	1-1
1.1 Background to the Study	1-1
1.2 Objectives of the Study	1-1
1.3 Study Area.....	1-1
1.4 Study Schedule.....	1-1
CHAPTER 2 STUDY AREA.....	2-1
2.1 Socio-Economy	2-1
2.2 Balinese Society and Subak System	2-2
2.3 Topography, Geology and Land Use.....	2-3
2.4 Climate	2-4
2.5 Hydro-geological Condition	2-5
2.6 Natural Environment and Water Quality.....	2-6
2.7 Agriculture and Irrigation	2-7
2.8 Electricity Infrastructures and Supply Potential	2-7
CHAPTER 3 WATER DEMAND AND POTENTIAL	3-1
3.1 Future Socio-Economic Framework	3-1
3.2 Water Demand Projection for Domestic and Non-domestic Water.....	3-2
3.2.1 Conditions for Demand Projection.....	3-2
3.2.2 Water Supply Requirement of Bali Province	3-3
3.3 Water Potential.....	3-5
3.4 Water Balance between Water Demand and Potential	3-8
CHAPTER 4 MASTER PLAN FOR WATER RESOUECES DEVELOPMENT AND MANAGEMENT	4-1
4.1 Frame Work of Water Resources Development and Management.....	4-1
4.2 Water Resources Development Plan	4-1
4.2.1 Alternatives for Water Resources Development.....	4-1
4.2.2 Water Supply Plan.....	4-2
4.2.3 Water Supply for Remote and Isolated Areas.....	4-17
4.2.4 Irrigation Plan.....	4-19
4.3 Dam Development Facility Plan	4-21
4.3.1 Ayung Dam Development Plan	4-21
4.3.2 Benel Dam Development Plan	4-33
4.4 Flood Control Plan	4-35
4.4.1 Alternatives for Flood Control Plan	4-35
4.4.2 Flood Control Plan for Badung River and Mati River	4-38
4.4.3 Flood Control Plan for Banyumala River and Buleleng River in Singaraja	4-42
4.4.4 Flood Control Plan for Sowan River in Negara	4-42
4.4.5 Flood Control Plan for Other Flood Prone Areas.....	4-43
4.5 Construction Quantities and Cost Estimate.....	4-44

4.6	Water Resources Management Plan	4-46
4.6.1	Organization and Institutional	4-46
4.6.2	Water Environment Improvement Plan	4-49
4.6.3	GIS Database for Water Resources Management	4-52
4.6.4	Capacity Development Program	4-52
4.7	Implementation Plan	4-55
4.7.1	Implementation Bodies and Allocated Budgets	4-55
4.7.2	Implementation Schedule	4-56
4.8	Evaluation of Master Plan	4-56
4.8.1	Technical Evaluation	4-56
4.8.2	Analysis on Economic and Financial Aspects	4-57
4.8.3	Initial Environmental Examination	4-59
4.8.4	Social and Environmental Evaluation of Master Plan	4-60
4.9	Priority Project	4-60
4.9.1	Criteria for Setting Priority	4-60
4.9.2	Priority for Each Project	4-61
CHAPTER 5 FEASIBILITY STUDY		5-1
5.1	Outline of Feasibility Study	5-1
5.1.1	Necessity of the Project	5-1
5.1.2	Project Objectives and Component	5-1
5.2	Public Water Supply for Bali Southern Area	5-3
5.2.1	Conditions for Design	5-3
5.2.2	Design of Integrated Water Supply System for Southern Bali Area	5-4
5.2.3	Work Quantities	5-10
5.2.4	Construction Plan	5-12
5.3	Ayung Multipurpose Dam	5-13
5.3.1	General	5-13
5.3.2	Criteria for Dam Design	5-14
5.3.3	Design for Ayung Dam	5-14
5.3.4	Design for Check Dam	5-20
5.3.5	Reservoir Area Development Plan	5-20
5.3.6	Power Generation Plan	5-20
5.3.7	Construction Quantities	5-22
5.3.8	Construction Plan	5-22
5.4	Flood Control Facility for Badung River and Mati River	5-24
5.4.1	General	5-24
5.4.2	Criteria for Plan and Design	5-24
5.4.3	Flood Control Project for Badung River	5-24
5.4.4	Mati River	5-29
5.4.5	Work Quantities	5-35
5.4.6	Construction Plan	5-36
5.5	Operation and Maintenance	5-37
5.5.1	Organization Arrangement	5-37
5.5.2	Management Activities and Capacity Development Support	5-37
5.6	Cost Estimate	5-38
5.6.1	Condition of Cost Estimate	5-38
5.6.2	Project Cost	5-39
5.6.3	Operation and Maintenance Cost	5-39
5.7	Project Implementation	5-39
5.7.1	Institutional Formalities and Organization	5-39
5.7.2	Implementation Schedule	5-40
5.7.3	Financial Disbursement Schedule	5-40
5.8	Environment and Social Study	5-41
5.8.1	Environment Study	5-41
5.8.2	Second Social Study	5-42
5.9	Project Evaluation	5-45

5.9.1	Technical Evaluation	5-45
5.9.2	Analysis on Economic and Financial Aspects.....	5-46
5.9.3	Social Evaluation	5-49
5.9.4	Environmental Evaluation.....	5-52
5.9.5	Conclusion of Environmental Evaluation	5-54
5.10	Overall Evaluation	5-55
CHAPTER 6	RECOMMENDATION.....	6-1

LIST OF TABLES AND FIGURES

	PAGE
CHAPTER 1 OUTLINE OF STUDY	
Figure-1.1 Study Area.....	1-2
Figure-1.2 Study Schedule	1-2
CHAPTER 2 STUDY AREA	
Table-2.1 Actual Population and the Growth.....	2-1
Table-2.2 GDP & GRDP at 2004 Constant Price	2-2
Table-2.3 Transition of Paddy Area.....	2-7
Table-2.4 Present Electricity Sources and Supply Potential in Bali.....	2-8
Figure-2.1 Administrative Division of Bali Province	2-1
Figure-2.2 Slope Map of Bali Island.....	2-3
Figure-2.3 Geological Map	2-4
Figure-2.4 Land Use Map	2-4
Figure-2.5 Monthly Rainfall Patterns.....	2-5
Figure-2.6 Reconnaissance Hydrogeological Map (1972).....	2-5
Figure-2.7 Location of Well and Springs	2-6
Figure-2.8 Map of Protected Areas in Bali.....	2-6
Figure-2.9 Agriculture Area in Bali	2-7
CHAPTER 3 WATER DEMAND AND POTENTIAL	
Table-3.1 Future Population (Scenarios).....	3-1
Table-3.2 Population Projection	3-1
Table-3.3 Projection of Industrial Output.....	3-2
Table-3.4 Projected Necessary Hotel Rooms	3-2
Table-3.5 Base Data for Domestic Water Demand Projection	3-3
Table-3.6 Base Data for Non-domestic Water Demand Projection	3-3
Table-3.7 Water Supply Requirement by Regency of Bali Province	3-4
Table-3.8 Estimated Total Surface Water Potentials in Bali Island	3-5
Table-3.9 Surface Runoff Potential in Bali (Regency,City)	3-5
Table-3.10 Preliminarily Estimate of Infiltration from Caldera Lake	3-6
Table-3.11 Springs Water Potential	3-6
Table-3.12 Groundwater Potential in Bali.....	3-7
Table-3.13 Monthly Average Rainfall and Potential Evapotranspiration.....	3-7
Table-3.14 Hydrological Water Balance in Bali Province/Island.....	3-8
Table-3.15 Water Balance between Water Demand and Potential	3-8
Figure-3.1 Surface Water Potential in Bali.....	3-5
Figure-3.2 Calculation Case for Surface Water A to C.....	3-6
CHAPTER 4 MASTER PLAN FOR WATER RESOUCEES DEVELOPMENT AND MANAGEMENT	
Table-4.1 Water Sources by Regencies	4-3
Table-4.2 Water Supply Capacity and Water Demand in Southern Bali Area	4-4
Table-4.3 Alternative Plans of Surface Water Development for SARBAGITAKU Area	4-4
Table-4.4 Spring/Groundwater Use and Potential (SARBAGITAKU Area)	4-5
Table-4.5 Water Source Options for Water Supply (SARBAGITAKU Area).....	4-5
Table-4.6 Alternatives of Integrated Water Supply System for Metropolitan Area	4-7
Table-4.7 Comparison for Alternative Plans by Cost.....	4-13
Table-4.8 Evaluation of Alternative Plans.....	4-14
Table-4.9 Public Water Supply System for the Metropolitan Area	4-16
Table-4.10 Water Supply Capacity and Water Demand in Northern Bali Area.....	4-16
Table-4.11 Spring/Groundwater Use and Potential (Northern Bali Area).....	4-17

Table-4.12	Outline of Water Supply Plans for Northern Bali Area.....	4-17
Table-4.13	Flow Regime at Buangga Station in Ayung River (m ³ /s).....	4-21
Table-4.14	Conditions for Calculation.....	4-22
Table-4.15	Requirement Capacity Based on the Calculation Results.....	4-22
Table-4.16	Design Sediment Capacity for Ayung Dam and Check Dams.....	4-24
Table-4.17	Design Capacity Distribution for Ayung Dam.....	4-24
Table-4.18	Summary of Planned Alternative Dam Site Evaluation.....	4-26
Table-4.19	Alternative Construction Material Sources.....	4-28
Table-4.20	Comparison between Concrete Gravity Dam and Zoned Rock-fill Dam.....	4-31
Table-4.21	Specifications for Power Generation of Ayung Dan.....	4-32
Table-4.22	Specifications for Benel Dam.....	4-34
Table-4.23	System of Comprehensive Flood Control Countermeasures.....	4-37
Table-4.24	Problems and Issues in Rivers of Bali.....	4-38
Table-4.25	Alternatives for Flood Control Plan for Each Targeted Area.....	4-38
Table-4.26	Flood Control Plan for Badung River and Mati River.....	4-39
Table-4.27	Flood Control Plan for Banyumala River and Buleleng River.....	4-42
Table-4.28	Summary of River Improvement Works.....	4-43
Table-4.29	Composition of Project Cost.....	4-44
Table-4.30	Main Facilities and Works for Priority Project.....	4-44
Table-4.31	Breakdown of Project Cost for Each Component.....	4-45
Table-4.32	Summary of Project Cost for Each Phase.....	4-45
Table-4.33	New Institutional Arrangement for WRM in Bali (Proposed).....	4-46
Table-4.34	Organization for New Water Supply System on Water Resources Development, Water Supply and Water Distribution.....	4-48
Table-4.35	Road Map for the Institutional Reform.....	4-48
Table-4.36	Erosion Control in Seaside.....	4-52
Table-4.37	Capacity Development Program.....	4-53
Table-4.38	Implementation Bodies for the Proposed Project.....	4-55
Table-4.39	Implementation Schedule for Proposed Projects.....	4-56
Table-4.40	Basic Conditions.....	4-57
Table-4.41	Benefits.....	4-58
Table-4.42	Economic Cost of Water Supply Project and Flood Control Project.....	4-58
Table-4.43	Economic Cost of Multipurpose Ayung Dam Project and Allocated Cost.....	4-58
Table-4.44	Result of Economic Evaluation of the Projects.....	4-59
Table-4.45	Annual Average Benefit on Flood Damage Reduction.....	4-59
Table-4.46	Proposed Priority Projects.....	4-61
Figure-4.1	Alternatives for Water Supply for SARBAGI (With Ayung Dam).....	4-8
Figure-4.2	Alternative Plans without Ayung Dam (Surface Water Development).....	4-9
Figure-4.3	Alternative Plans without Ayung Dam (Groundwater Development).....	4-10
Figure-4.4	Alternative Plans without Ayung Dam (Surface Water Development + Groundwater Development).....	4-11
Figure-4.5	Alternative Plans with Small Scale Ayung Dam (+ Groundwater).....	4-12
Figure-4.6	Proposed Integrated Water Supply System for Metropolitan Area.....	4-15
Figure-4.7	Water Supply Plan for Kubu Area.....	4-18
Figure-4.8	Water Spring Plan for Penida Area.....	4-18
Figure-4.9	Potential Area for Improvement of Crop Intensities.....	4-20
Figure-4.10	Existing Weirs along Ayung River.....	4-21
Figure-4.11	Calculation Result of Requirement Capacity for Ayung Dam.....	4-23
Figure-4.12	Reservoir Capacity Curve for Ayung Dam.....	4-24
Figure-4.13	Location Map of Alternative Dam Sites.....	4-25
Figure-4.14	Topography around Proposed of Dam Site.....	4-27
Figure-4.15	Geological Map of Ayung Dam Reservoir Area (Source: JICA Study Team).....	4-27
Figure-4.16	Location Map of Alternative Construction Material Sources.....	4-30
Figure-4.17	Typical Sections of Concrete Gravity Dam.....	4-31
Figure-4.18	Typical Cross Section of Zoned Rock-fill Dam.....	4-32
Figure-4.19	Plan of Ayung Dam.....	4-32

Figure-4.20	Typical Section of Ayung Dam.....	4-33
Figure-4.21	Location of Benel Dam	4-33
Figure-4.22	Plan of Benel Dam.....	4-34
Figure-4.23	Typical Cross Section	4-34
Figure-4.24	Flooding Area in Bali	4-35
Figure-4.25	Flood Area in Denpasar and Singaraja	4-35
Figure-4.26	Badung River in Denpasar.....	4-36
Figure-4.27	Mati River in Badung Regency	4-36
Figure-4.28	River Condition in Singaraja and Negara Area	4-36
Figure-4.29	Flood Control Plan for Badung River And Mati River	4-39
Figure-4.30	Flood Control Plan for Badung River (Riverbed Excavation)	4-40
Figure-4.31	Flood Control Plan for Mati River	4-41
Figure-4.32	Flooding Area (April,2004).....	4-42
Figure-4.33	looding Area in October,1998	4-43
Figure-4.34	Target Area and Example Output	4-52
Figure-4.35	Protected Areas and Projects of Master Plan.....	4-60

CHAPTER 5 FEASIBILITY STUDY

Table-5.1	Project Component, Location and Main Facilities.....	5-2
Table-5.2	Work Quantities for Western Water Supply System.....	5-11
Table-5.3	Work Quantities for Central Water Supply System.....	5-11
Table-5.4	Work Quantities for Eastern Water Supply System	5-12
Table-5.5	Construction Method of Main Facility.....	5-12
Table-5.6	Construction Schedule for Southern Bali Area Water Supply System.....	5-13
Table-5.7	Criteria for Dam Design.....	5-14
Table-5.8	Specifications of Ayung Dam and Reservoir	5-16
Table-5.9	Specifications of Check Dams	5-20
Table-5.10	Development Zone and Images, Plans	5-20
Table-5.11	Economic Evaluation by C/V Method (V-C, C/V).....	5-21
Table-5.12	Specifications of Ayung Power Plant	5-21
Table-5.13	Construction Quantities for Ayung Dam	5-22
Table-5.14	Work Item of Construction Plan, Method and Quantity	5-23
Table-5.15	Construction Schedule of Ayung Dam	5-23
Table-5.16	Specifications for River Improvement of Badung River.....	5-28
Table-5.17	Specifications for River Improvement of Mati River	5-33
Table-5.18	Work Quantities for River Improvement Project	5-35
Table-5.19	Work Items for River Improvement Project.....	5-35
Table-5.20	Construction Plan for Badung and Mati River Improvement Project.....	5-36
Table-5.21	Construction Schedule for River Improvement Project	5-37
Table-5.22	Overall Water related Institutional Framework after Reforms in Bali	5-37
Table-5.23	Management Activities and Capacity Development Support.....	5-38
Table-5.24	Conditions of Cost Estimate.....	5-38
Table-5.25	Project Cost of Priority Project	5-39
Table-5.26	Estimated O&M Cost for Ayung Dam and Water Supply Project.....	5-39
Table-5.27	Estimated O&M Cost for River Improvement	5-39
Table-5.28	Implementation Schedule for Priority Project.....	5-40
Table-5.29	Disbursement Schedule of the Project	5-40
Table-5.30	Outline of Environment Study	5-41
Table-5.31	Assumptions.....	5-46
Table-5.32	Benefits	5-47
Table-5.33	Economic Cost of Water Supply Project and Flood Control Project	5-47
Table-5.34	Economic Cost of Multi-purpose Ayung Dam Project.....	5-47
Table-5.35	Result of Economic Evaluation of the Projects.....	5-48
Table-5.36	Value of House and Household Property	5-48
Table-5.37	Annual Average Benefit on Flood Damage Reduction and EIRR	5-48
Table-5.38	Evaluation Summary of Priority Projects	5-55

Figure-5.1	Location of the Proposed Projects	5-3
Figure-5.2	Western Water Supply System and Current Condition of planned WTP	5-5
Figure-5.3	General Plan of Western Supply System (Penet River).....	5-6
Figure-5.4	Central Water Supply System and Current Condition of planned WTP.....	5-7
Figure-5.5	Weir of Central Water Supply System in Ayung River.....	5-8
Figure-5.6	General Plan for Ayung Water Treatment in Ayung River.....	5-8
Figure-5.7	Eastern Water Supply System and Current Condition of planned WTP	5-9
Figure-5.8	General Plan for Petanu Water Treatment in Petanu River.....	5-10
Figure-5.9	Ayung Dam Site from Downstream.....	5-13
Figure-5.10	Basic Dimension of Ayung Dam	5-15
Figure-5.11	Comparison with Dam Shape without Plug and With Plug.....	5-15
Figure-5.12	General Plan of Ayung Dam and Reservoir.....	5-17
Figure-5.13	Plan of Ayung Dam.....	5-18
Figure-5.14	Typical Cross Section of Ayung Dam.....	5-18
Figure-5.15	Upstream and Downstream View	5-19
Figure-5.16	Relationship Between Discharge $V-C, C/V$	5-21
Figure-5.17	Photos of Damage Condition by Flood December 12, 2005	5-24
Figure-5.18	Calculation Result for Current River Flow Capacity (Badung River)	5-25
Figure-5.19	Watershed Division for Badung River Basin.....	5-26
Figure-5.20	Distribution of Basic Design Discharge (Badung River)	5-26
Figure-5.21	River Improvement Section for Badung River	5-27
Figure-5.22	Designed Longitudinal Profile for Badung River.....	5-28
Figure-5.23	General plan flood prevention project for Badung River	5-29
Figure-5.24	Calculation Result for Current River Flow Capacity (Mati River)	5-30
Figure-5.25	Watershed Division for Mati River Basin	5-30
Figure-5.26	Distribution of Basic Design Discharge (Mati River)	5-31
Figure-5.27	Distribution of Design Discharge (Mati River)	5-32
Figure-5.28	Calculation Result by Retarding Basin.....	5-32
Figure-5.29	Designed Longitudinal Profile for Mati River	5-33
Figure-5.30	General Plan of Flood Prevention Project for Mati River	5-34
Figure-5.31	Work Procedure for River Improvement Project.....	5-36
Figure-5.32	Organization for Project Implementation	5-40

LIST OF ABBREVIATION & TERMINOLOGY

Abbreviation & Technical Term	Indonesian	English	Japanese (日本語)
AMDAL	Analisis Mengenai Dampak Lingkungan	Environmental Impact Assessment	環境影響評価
APBD-KAB (or APBD II).	Anggaran Pendapatan dan Belanja Daerah Kabupaten	Regency Revenue and Expenditure Budget (District Budget)	県・予算
APBD-PROP (or APBD I).	Anggaran Pendapatan dan Belanja Daerah Propinsi	Provincial Revenue and Expenditure Budget (Provincial Budget)	州・予算
APBN	Anggaran Pendapatan dan Belanja Nasional	National Revenue and Expenditure Budget (National Budget)	国家・予算
AWLR	Pos Duga Air Otomatis	Automatic Water Level Recorder	自記水位計
BAKOSURTANAL	Badan Koordinasi Survei dan Pemetaan Nasional	National Coordination Agency for Surveys and Mapping	国家測地調整局
Balai PSDA	Balai Pengelolaan Sumber Daya Air	Water Resources Management Unit	水資源管理ユニット
BANJAR	Unit Administrasi di bawah Desa: unit tradisional masyarakat organisasi sosial berdasar daerah dan/atau keturunan. Banjar adalah unit kegiatan bersama dan saling menguntungkan. Setiap pria yang menikah yang berada di dalam daerah tsb diharapkan untuk menjadi anggota.	Administrative Unit under Desa: A traditional Balinese unit of social organization based on the territory and/or genealogy. It is a unit of communal activities and mutual aid. Each married man within a particular area is expected to become a member.	村の下の共同体 (パンジャール): 地縁、血縁に基づくバリの伝統的社会的組織。社会活動及び相互扶助の基礎単位である。一定地域に居住する既婚男性が構成員となる。
BAPEDALDA	Badan Pengendalian Dampak Lingkungan Daerah	Regional Environmental Control Agency	地域環境管理局
BAPPEDA-PROP.	Badan Perencanaan Pembangunan Daerah - Propinsi	Provincial Regional Development Planning Agency	州・地域開発計画局
BAPPEDA-KAB.	Badan Perencanaan Pembangunan Daerah - Kabupaten	Regency Regional Development Planning Agency	県・地域開発計画局
BAPPENAS	Badan Perencanaan Pembangunan Nasional	National Development Planning Agency	国家・地域開発計画局
B/C	<u>Ratio Biaya Keuntungan</u> : Dihasilkan dari Nilai keuntungan yang ditampilkan dibagi dengan biaya yang ditampilkan. Jika rasio biaya keuntungan menjadi lebih besar dari pada 1,0, maka proyek dianggap layak.	<u>Benefit Cost Ratio</u> : “Benefit Cost Ratio” that is obtained from “Present Benefit Value divided by Present Cost Value”. If B/C ratio becomes bigger than 1.0, the project is judged feasible.	便益・費用比率: 資本の機会費用で割り引いた、便益の現在価値総計と費用の現在価値総計の比率。比率が1以上であれば妥当と判断される。
BKPM-PROP.	Badan Koordinasi Penanaman Modal Daerah Propinsi	Provincial Regional Investment Coordination Agency	州・地域投資調整局
BMG	Badan Meteorologi dan Geofisika	Meteorological and Geophysical Agency	気象・地球物理局
BPDAS	Balai Pengelolaan Daerah Aliran Sungai	River Basin Management Agency	流域管理局
BPS-PROP.	Biro Pusat Statistik Propinsi	Provincial Central Bureau of Statistics	州・統計局
BPS-KAB.	Biro Pusat Statistik Kabupaten	Regency Central Bureau of Statistics	県・統計局
BRLKT	Balai Rehabilitasi Lahan dan Konservasi Tanah	Land Rehabilitation and Soil Conservation Agency, Ministry of Forestry	森林省・土地復興土壌保全局
BULOG	Badan Logistik	National Logistic Agency	国家ロジスティクス局
BUPATI	Kepala Kabupaten	Head of Regency	県知事
CAMAT	Kepala Kecamatan	Head of District	郡長
CDM	<u>Mekanisme Pengembangan Kebersihan</u> : Mekanisme pengurangan emisi CO2 oleh Kyoto Protocol, demi melawan perubahan iklim.	<u>Clean Development Mechanism</u> : CO ₂ emission reduction mechanism enacted by Kyoto Protocol against climate change.	CDM: 京都議定書で制定。地球温暖化防止のための二酸化炭素排出削減制度
CIDA	Badan Pengembang Internasional	Canadian International	カナダ国際開発機構

Abbreviation & Technical Term	Indonesian	English	Japanese (日本語)
	Kanada	Development Agency	
Conversion Factor	<u>Faktor Konversi:</u> Koefisien untuk mengubah harga lokal untuk barang2 yang tidak diperdagangkan dengan harga yg telah ditentukan untuk tujuan standarisasi semua harga ekonomi pada batas yang ditentukan.	<u>Conversion Factor:</u> Coefficient to convert local price of non-tradable goods to border price for the purpose of standardizing all economic price at border level	<u>変換係数:</u> 経済価格を国境レベルで統一するため、非貿易財を国境価格レベルに変換するための係数。
DAK	Dana Alokasi Khusus	Special Allocation Fund	特別割当金
DAU	Dana Alokasi Umum	General Allocation Fund	一般割当金
DBH	Dana Bagi Hasil	Revenue Sharing Fund	歳入配分金
DEP. PE	Departemen Pertambangan dan Energi	Ministry of Mining and Energy	鉱山エネルギー省
DEPDAGRI	Departemen Dalam Negeri	Ministry of Home Affairs	内務省
DEPERINDAG	Departemen Perindustrian dan Perdagangan	Ministry of Industry and Trade	産業通産省
DEPHUT	Departemen Kehutanan	Ministry of Forestry	森林省
DEPKEU	Departemen Keuangan	Ministry of Finance	財務省
DEPTAN	Departemen Pertanian	Ministry of Agriculture	農業省
DEPPU	Departemen Pekerjaan Umum	Ministry of Public Work	公共事業省
DESA	<u>Unit Administrasi di bawah Kecamatan:</u> sebuah desa administrasi yang diperkenalkan di seluruh Indonesia dengan UU No. 5/1979 ttg Desa Administrasi.	<u>Administrative Unit under District:</u> An administrative village introduced across Indonesia by the Law No.5/1979 on Village Administration.	郡の下の村 (デサ): 村落行政に関する 1979 年 5 号法によって定められた行政単位。
DESA ADAT	Desa Tradisional yang terdiri dari 2 atau lebih Banjar. Sampai sekarang, Desa Adat sering mewakili dasar kuat dari sosial kebersamaan bersama melebihi Desa	A traditional village comprised of two or more Banjars. Still today, Desa Adat often presents a stronger basis of social and communal cohesion than Desa.	<u>伝統的村落:</u> 2 つ以上のバンジャールから構成される伝統的村落。現在もなお、行政的村落であるデサより強い結束力を持つものも多い。
Dinas PU-PROP	Dinas Pekerjaan Umum Propinsi	Provincial Public Works Service Office	州・公共事業局
Dinas PSDA	Dinas Pengelolaan Sumber Daya Air	Water Resources Management Service Office	水資源管理局
DISPENDA	Dinas Pendapatan Daerah	Provincial Revenue Service Office	州・歳入局
DIPERTA-PROP.	Dinas Pertanian Tanaman Pangan	Provincial Food Crops Agriculture Service Office	州・農業局
DJSDA.	Direktorat Jenderal Sumber Daya Air	Directorate General of Water Resources	水資源総局 (公共事業省)
Dit. Bintek	Direktorat Bina Teknik	Director of Technical Guidance	技術局 (公共事業省)
Dit. PSDA	Direktorat Pendayagunaan Sumber Daya Air	Director of Water Resources Utilization	水資源利用局 (公共事業省)
Dit. SDA Wiltim	Direktorat Pelaksanaan Wilayah Timur	Director of Water Resources Eastern Region	東部実施局 (公共事業省)
Ditjen. SDA	Direktorat Jenderal Sumber Daya Air	Directorate General of Water Resources	水資源総局長 (公共事業省)
DIKANLA-PROP.	Dinas Perikanan dan Kelautan Propinsi	Provincial Fishery and Marine Resources Service Office	州・漁業水産資源局
DPR	Dewan Perwakilan Rakyat	House of Representatives	議会
DPRD Kabupaten	Dewan Perwakilan Rakyat Daerah Kabupaten	Regency Parliament	県議会
DPRD Propinsi	Dewan Perwakilan Rakyat Daerah Propinsi	Provincial Parliament	州議会
DPU-Propinsi	Dinas Pekerjaan Umum Propinsi	Province Public Works Service Office	州・公共事業局
DSDP	Proyek Pengembangan Saluran Limbah Denpasar	Denpasar Sewerage Development Project	デンパサル下水開発事業
EIA	Penilaian Mengenai Dampak Lingkungan	Environmental Impact Assessment	環境影響評価

Abbreviation & Technical Term	Indonesian	English	Japanese (日本語)
EIRR	<u>Pengembalian Tingkat Internal Ekonomi</u> : Tingkat pemotongan yang menyamakan jumlah dari nilai keuntungan yang ditampilkan dengan jumlah dari biaya yang ditampilkan. Jika Pengembalian tingkat ekonomi internal lebih besar daripada biaya peluang modal, maka proyek dianggap layak.	<u>Economic Internal Rate of Return</u> : Economic Internal Rate of Return means a discount rate that equalizes sum of present benefit value with sum of present cost value. If EIRR becomes larger than opportunity cost of capital, the project is judged feasible	経済内部収益率: 便益と費用の現在価値の合計が等しくなるような割引率。資本の機会費用より大きければ妥当と判断される。
GBHN	Garis – Garis Besar Haluan Negara	National Policy Guidelines	国家政策指針
GIS	Sistem Informasi Geografi	Geographic Information System	地理情報システム
GOI	Pemerintah Indonesia	Government of Indonesia	インドネシア国
GOJ	Pemerintah Jepang	Government of Japan	日本国
GUBERNUR	Kepala Daerah Propinsi	Governor (Head of Province)	州知事
HAS	Hutan Suaka Alam dan Hutan Wisata	National Forest Reserve and Recreation Forest	国家森林保護
HKTI	Himpunan Kerukunan Tani Indonesia	Farmers Association	農業組合
ICOLD	Komite Internasional untuk Dam-Dam Besar	International Committee on Large Dams	国際大ダム会議
IEE	Pemeriksaan Lingkungan Awal	Initial Environmental Examination	初期環境評価
IKK	Ibu Kota Kecamatan	Central Government Administrator of Region	県庁所在地
INPRES	Instruksi Presiden	Presidential Instruction	大統領指令
IPAIR	Iuran Pelayanan Irigasi	Irrigation Service Fee	灌漑料金
IPEDA	Iuran Pembangunan Daerah	Regional Development Fee	地域開発料金
JBIC	<i>Japan Bank</i> untuk Kerjasama Internasional	Japan Bank for International Cooperation	国際協力銀行
JICA	Badan Kerjasama Internasional Jepang	Japan International Cooperation Agency	国際協力機構
KADES / LURAH	Kepala Desa	Head of Desa	村長 (デサの長)
KELIAN DINAS	Kepala Banjar	Head of Banjar	バンジャールの長
KELIAN SUBAK	Kepala Subak	Head of Subak	スバクの長
KEPMEN	Keputusan Menteri	Ministerial Decree	大臣令
KEPPRES	Keputusan Presiden	Presidential Decree	大統領令
KIMPRASWIL	Departemen Pemukiman dan Prasarana Wilayah	Ministry of Settlement and Regional Infrastructure	居住・地域インフラ省
KUD	Koperasi Unit Desa	Village Cooperative Unit	デサ共同体
LKMD	Lembaga Ketahanan Masyarakat Desa	Village Social Activities Group, Village Welfare	デサ社会福祉組織
LSM	Lembaga Swadaya Masyarakat	Non Governmental Organization (NGO)	非政府組織
Meneg.LH	Kementerian Negara Lingkungan Hidup	State Ministry of Environment	国務環境省
Menko EKUIN	Menteri Koordinator Ekonomi, Keuangan dan Industri	Coordinating Minister for Economy, Finance and Industry	経済・財務・産業調整大臣
MPR	Majelis Permusyawaratan Rakyat	People Consultative Assembly	人民諮問機関
NPV	<u>Nilai Bersih yang Ditampilkan</u> : Selisih antara nilai keuntungan dengan nilai biaya yang secara berturut-turut dipotong oleh biaya peluang modal. Jika Nilai bersih yang didapat lebih besar dari nol, proyek dianggap layak.	<u>Net Present Value</u> : Net Present Value means the difference between present benefit value and present cost value respectively discounted by opportunity cost of capita. If NPV becomes larger than zero, the project is judged feasible.	純経済価値: 資本の機会費用で割り引いた、便益の現在価値総計と費用の現在価値総計の差。純経済価値がゼロより大きければ妥当と判断される。
NWQS	Standar Kualitas Air Nasional	National Water Quality Standards	国家水質基準
NWRC	Dewan Sumber Daya Air Nasional	National Water Resources Council	国家水資源評議会
P.T	Perseroan Terbatas	Limited Company	有限会社
P2AT	Proyek Pengembangan Air Tanah	Groundwater Development Project	地下水開発事業

Abbreviation & Technical Term	Indonesian	English	Japanese (日本語)
P3A, HIPPA	Asosiasi Petani Pemakai Air, Himpunan Petani Pemakai Air	Water User's Association (WUA)/ Group of WUAs	水利用者協会
PAB	Proyek Pengembangan Pengadaan Air Baku	Raw Water Supply Development Project	水供給原水開発事業
PAD	Pendapatan Asli Daerah	Own-Source Revenue	自己財源
PALAWIJA, POLOWIJO	Tanaman pangan kedua setelah padi, antara lain jagung, singkong, kentang, kacang-kacangan dan lain sebagainya.	Second food crops other than paddy such as corn, casaba, potatoes and beans and so on.	パラウイジャ、二次作物(稲作以外): インドネシアの固有の表現で、とうもろこし、キャッサバ、芋、豆類等の米以外の主食作物として定義される。
PDAM	Perusahaan Daerah Air Minum	Drinking Water Supply Company	飲料水供給公社
PERDA	Peraturan Daerah	Regional Regulation	地方令
PEMDA	Pemerintahan Daerah	Regional Government	地方政府
PERDA Kabupaten	Peraturan Daerah Kabupaten	Regency Regulation	県令
PERDA Propinsi	Peraturan Daerah Propinsi	Provincial Regulation	州令
PERMEN	Peraturan Menteri	Ministerial Regulation	省令
PERUM	Perusahaan Umum	Public Corporation	公共体
PERUM PERHUTANI	Perusahaan Umum Perhutanan Indonesia	State Owner Indonesian Forestry Company	インドネシア森林公団
PIB	Proyek Irigasi Bali	Bali Irrigation Project	バリ灌漑事業
PID	Proyek Irigasi Desa	Village Irrigation Project	村落灌漑事業
PIK	Penyerahan Irigasi Kecil	Small Irrigation Handover /Transfer Project	小規模灌漑移転事業
PJM	Perencanaan Jangka Menengah (Perencanaan 5 Tahunan)	Mid Term Development Planning (5-Yrs Planning)	中期開発計画 (5カ年計画)
PJP	Perencanaan Jangka Panjang (Perencanaan 20 Tahunan)	Long Term National Development Planning (20-Yrs Planning)	長期開発計画 (20カ年計画)
PJT	Perum Jasa Tirta	State Owned Company on Water Resources Management	水資源管理公社
PLN	Perusahaan Listrik Negara	National Electricity Limited Company	国家電力会社
PP	Peraturan Pemerintah	National Government Regulation	国家令
PPA	Perlindungan Pelestarian Alam	Protected Conservation Forest	保護保全林
PPTPA	Panitia Pelaksanaan Tata Pengaturan Air	River Basin Water Resources Management Committee	流域水資源委員会
Proyek PBPP	Proyek Pengendalian Banjir dan Pengamanan Pantai	Bali Flood Control and Coastal Protection Project,	バリ洪水対策海岸保全事業
Proyek PKSA-Bali	Proyek Pengembangan dan Konservasi Sumber Air Bali	Bali Water Resources Management and Conservation Project,	バリ水資源管理・保全事業
Proyek PPSA-Bali	Proyek Pengembangan dan Pengelolaan Sumber Air Bali	Bali Water Resources Development and Management Project,	バリ水資源開発・管理事業
PROKASIH	Program Kali Bersih	River Clean Water Program	河川浄化計画
PROPENAS	Program Pembangunan Nasional	National Development Programs	国家開発計画
PROPENAS TRANSISI	Program Pembangunan Nasional Transisi	Transition National Development Programs	過渡的国家開発計画
PROPERDA	Program Pembangunan Daerah	Regional Development Programs	地方開発計画
Proyek PB-PP	Proyek Pengendalian Banjir dan Pengamanan Pantai	Bali Flood Control and Coastal Prevention Project	バリ洪水対策・海岸保全事業
PTPA	Panitia Tata Pengaturan Air	Provincial Water Resources Coordination Committee	州水資源評議会
PT. TB	PT. Tirtaartha Buanamulia	-	TB 社(水道会社名)
RENSTRA	Rencana Strategis (Rincian Program Tahunan Selama 5 Tahun)	Strategic Plan (Annual Breakdown of 5-Yrs Plan)	戦略計画(5カ年計画の年次内訳)

Abbreviation & Technical Term	Indonesian	English	Japanese (日本語)
RUTRW	Rencana Umum Tata Ruang Wilayah	Regional Spatial Planning	地方空間計画
PWRCC	Badan Koordi	Provincial Water Resources Coordination Council	州水資源調整評議会
SARBAGITA	Denpasar, Badung, Gianyar dan Tabanan	Denpasar, Badung, Gianyar and Tabanan	5地区略称(デンパサル、バドゥン、ギアニャール、タバナン)
SARBAGITAKU	Denpasar, Badung, Gianyar, Tabanan dan Klungkung	Denpasar, Badung, Gianyar, Tabanan and Klungkung	6地区略称(デンパサル、バドゥン、ギアニャール、タバナン、クルンクン)
SEDAHAN AGUNG	Dulu, Sedahan Agung sebagai perantara antara raja dan petani, menagih pajak dari petani, mengatur upacara keagamaan atas nama raja dan mengawasi air irigasi. Selama pendudukan Belanda, mereka ditunjuk sebagai petugas penagih pajak, sementara itu tetap bertanggung jawab thdp alokasi air. Sedahan Agung masih ada sampai saat ini walaupun kebanyakan kabupaten meniadakan posisi itu dalam proses desentralisasi.	In old times, Sedahan Agung was an intermediary between the king and farmers, collecting taxes in kind from farmers, organizing ceremonies for them on behalf of the king, and controlling irrigation water. During the Dutch administration, they were appointed as official tax collectors, while continued the responsibility for water allocation. Sedahan Agung continued to exist until recently, when most of the regencies abolished the position in the wake of decentralization.	スダハンアグン: 王国時代に統治者とスバックを仲介し、農民に対する徴税、王族に代わっての儀式の開催、灌漑用水の調整などを行った役職。オランダ統治時代にも徴税及び灌漑用水の配分の責を負った。近年まで存在したが、地方分権化の進展により廃止されてきている。
SGS	Stasiun Pengamat Arus Air	Stream Gauging Station	河川水位観測所
SK-Bupati	Surat Keputusan-Bupati	Regency Head Decision	県知事決定
SK-Gub.	Surat Keputusan-Gubernur	Governor Decision	州知事決定
SUBAK	Kelompok Petani	Farmers Association	スバック: (バリの)農業者組合
SUBAK-AGUNG	Federasi dari Subak Gede, seperti yang telah dibentuk di dua tempat yaitu di Tabanan dan Buleleng	A federation of subak-gedes, having been formed in two places, Tabanan and Buleleng.	スバックアグン: スバック連合の更なる連合組織。タバナン県とブレレン県に一箇所ずつ組織されている。
SUBAK-GEDE	Federasi dari Subak. Perubahan fisik pada sistem irigasi membawa proyek irigasi dimulai dari tahun 1970an yang menciptakan situasi yang membantu subak di hulu sungai. Kebutuhan untuk negosiasi alokasi air diantara subak dalam sistem irigasi memacu pembentukan federasi irigasi yang didukung oleh perantara luar yang dikepalai oleh Universitas Udayana Bali. Saat ini, ada 41 subak gede di Bali, kebanyakan dari mereka berlokasi di Tabanan, Klungkung, Buleleng dan Gianyar.	A federation of subaks, physical changes in the irrigation systems brought by irrigation projects started in 1970s created situations favorable to upstream subaks. The need to negotiate water allocation among subaks within an irrigation system prompted the formation of irrigation federations supported by external facilitators led by Udayana University of Bali. At the moment there are a total of 41 subak-gedes across Bali, many of them being located in Tabanan, Klungkung, Buleleng and Gianyar.	スバックゲディ: スバックの連合組織。1970年代に始まった灌漑システム改善事業により、上流側のスバックとの連携が必要になり組織されるようになった。現在、タバナン県、クルンクン県、ブレレン県、ギアニャール県を中心に41のスバック連合が存在する。
Sub-Dinas SDAPP	Sub Dinas Sumber Daya Air dan Prasarana Perdesaan	Water Resources and Rural Infrastructure Sub-Service Office	水資源・地方インフラ部
Sub-Dinas TRP	Sub-Dinas Tata Ruang Dan Permukiman	Spatial Planning and Settlement Sub-Service Office	都市計画・居住部
SWS	Satuan Wilayah Sungai	River Basin Unit (Consist of 1 or more than 1 river basin)	河川流域単位
UPTD	Unit Pelaksana Teknis Dinas	Technical Implementation Unit	Dinas の技術実施単位
UU	Undang – Undang	National Law	インドネシアの法律
UUD Republik	Undang – Undang Dasar Republik Indonesia	National Constitution	インドネシアの憲法
WALIKOTA	Walikota	City Mayor	市長

Abbreviation & Technical Term	Indonesian	English	Japanese (日本語)
WATSAL	Pinjaman Penyesuaian Sektor Air	Water Sector Adjustment Loan	水セクター調整ローン
WISMP	Proyek Pengelolaan Sektor Irigasi dan Sumber Daya Air	Water Resources and Irrigation Sector Management Project	水資源・灌漑セクター管理事業
WLGS	Stasiun Pengamat Muka Air	Water Level Gauging Station	水位観測所
WR	Sumber Daya Air	Water Resources	水資源
Zero ΔQ Policy	Meningkatnya aliran permukaan karena perkembangan penduduk dsb., harus dikontrol pada wilayah untuk tidak meningkatkan debit air pada jalur/aliran sungai.	Increased runoff due to resident development etc., shall be controlled in the area not to increase discharge in river course	流出増分ゼロ方針: 流出増分を起こす宅地開発等では、河川流量を増加させないように、流出増分は開発地内で処理する。

SYNOPSIS

The Comprehensive Study on Water Resources Development and Management in Bali Province in the Republic of Indonesia

Study Period: September 2004 – June 2006

Recipient Agency: Public Works Services Office, Bali Province
Directorate General of Water Resources, Ministry of Public Works

1 BACKGROUND TO THE STUDY

Bali is one of the leading international tourist spots in Asia, and its local economy is based upon tourism, being followed by agriculture centering on paddy cultivation and so on. However, due to the slow development of social infrastructure related to water resources, Bali is faced with such issues on water sector as water shortages, flood damage and river water pollution. These are hindering sustainable development of the local economy.

Moreover, in Indonesia, structural reform of the water resources sector is being advanced, and a new water resources law has been established in accordance with the principle of democracy, decentralization and transparency. Nowadays, the provinces and cities/regencies have been taking the initiative in implementing water resources development and management. For this purpose, it is necessary to compile master plans of comprehensive water resources development and management in units of river basin areas.

2 OBJECTIVES OF THE STUDY

The Study is being implemented to realize the following objectives, intending to achieve the sustainable development of local society and economy through the stable supply of safe water and reduction of flood damage:

- ◆ To compile a master plan of comprehensive water resources development and management in Bali Province up to the target year of 2025;
- ◆ To implement a feasibility study for priority projects selected in the master plan; and
- ◆ To implement technology transfer concerning comprehensive water resources development and management to the Indonesian counterparts through direct participation to the Study and training programs.

3 WATER DEMAND AND POTENTIAL

3.1 Future Socio-Economic Framework

Based on the current spatial plan of Bali Province and statistical data on socio-economy, future socio-economic framework for Master Plan was set as follows:

- 1) **Population:** Future population is estimated at 4,139 thousand in 2025, considering trend projection and development projection.
- 2) **Manufacturing Industry:** Economic growth rates until 2025 were calculated and industrial output in 2025 is estimated at Rp. 6,499 billion.
- 3) **Tourism:** Necessary hotel rooms were estimated at 38,100 rooms based on statistical data.

3.2 Water Balance between Demand and Potential

According to the balance between water resources potential and water demand in Bali Province shown in Table-, the following water balance could be found in the future in Bali:

- ◆ Remaining potential in Denpasar City is limited and become less than its demand in 2025 of the target year.
- ◆ Integrated water resources development is essential for Denpasar, Badung and Gianyar since

demands are large, these three regencies form one economic block, and water resources in their territories are limited.

- ◆ Since other regencies have much water potentials, water resources in their own territory can be developed in stages to meet demand growth.

Table-1 Water Deficit and Remaining Potential in 2025

Denpasar	Deficit (PWS)	xx xx xx xx xx	xx xx xxx	1,690				
	Remaining Potential	-1,469						
Badung	Deficit (PWS)	xx xx xx xx xx xx	1,243					
	Remaining Potential	-2,833						
Gianyar	Deficit (PWS)	xx xx xx	550					
	Remaining Potential	00 00 00 00	779					
Tabanan	Deficit (PWS)	xxx	314					
	Remaining Potential	00 00 00 00 00	00 00 00 00 00	00 00 00 00 00	3,009			
Klungkung	Deficit (PWS)	x	48					
	Remaining Potential	00 00 00 00	809					
Jembrana	Deficit (PWS)	xxx	256					
	Remaining Potential	00 00 00 00 00	00 00 00 00 00	00 00 00 00 00	00 00 00 00 00	00 00 00	4,640	
Buleleng	Deficit (PWS)	xx xxx	465					
	Remaining Potential	00 00 00 00 00	00 00 00 00 00	00 00 00 00 00	00 00 00 00 00	00	7,756	00 00
Bangli	Deficit (PWS)	xx	167					
	Remaining Potential	00 00 00 00 00	00 00 00 00 00	00 00 00 00 00	00 00 00 00 00	00	6,939	00 00
Karangasem	Deficit (PWS)	xxx	302					
	Remaining Potential	00 00 00 00 00	00 00 00 00 00	00 00 00 00 00	00 00 00 00 00	00	14,340	00 00
REGENCY	UnitLit/s		1,000	2,000	3,000	4,000	5,000	

PWS: Public Water Supply

Remaining Potential: Sum of drought discharges (95% flow) of rivers which areas are 10km² and more

4 OUTLINE OF MASTER PLAN

4.1 Basic Concept of Master Plan

Vision and missions of water resources development in Bali Province are as follows:

Vision: Water resources is a component that forms identity of culture and development power of Bali People based on the philosophy of “Tri Hita Karana”.

Missions: 1) Improvement of water use, 2) Increase of food production, 3) Relief and improvement of eco-system, 4) Maintenance of identity of Bali cultures

In order to achieve above vision and missions, the following basic policies were set for Master Plan.

- ◆ Compliance with the New Water Resources Law
- ◆ Concept of “One basin (island), One plan, One management”
- ◆ Respect of Subak in water resources development and management
- ◆ Community participation in formulation process
- ◆ Prompt water resources development & allocation

4.2 Proposed Projects and Programs

The proposed projects and programs for water resources development and management and their implementation schedules are summarized in Table-2. Total project cost is estimated as Rp. 3.8 trillion (JPY 43.9 billion). Price level as average of May 2004 - April 2005, US\$1.00 = RP9,260 = ¥106.97.

Table- 2 Proposed Project and Program in Master Plan

Projects	(1)	(2)	(3)	(4)
	2006 - 2010	2011 - 2015	2016 - 2020	2021 - 2025
1. WATER RESOURCES DEVELOPMENT				
◆ Integrated Water Resources Development Projects				
➢ AYUNG Reservoir				
➢ BENEL Reservoir				
◆ Water Supply Projects				
➢ 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 Projects				
➢ BADUN/MATI River Flood Control				
➢ Flood Control for NEGARA Area				
➢ Flood Control for SINGRAJA Area				
➢ Flood / Sediment Control: Related Regencies				
◆ Irrigation Projects				
➢ 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 SEDAHAAN A. & SUBAK Coordination Unit				
➢ Preparation of Regulations & Guidelines for New WR Law				
◆ Water Environment Improvement				
➢ Public Education and Campaign				
➢ Environmental Flow for BADUN & MATI Rivers				
◆ River Basin Conservation				
➢ Forest and Land Rehabilitation				
➢ Sediment Control (Included in Flood Control)				
➢ Coastal Protection for Related Areas				
◆ Capacity Building Program				
➢ Personnel Assignment				
➢ Capacity Building Support for BALAI-PSDA				

4.3 Project Evaluation

(1) Technical Evaluation

The Master Plan is assessed to be technically feasible as results. However, the plan should be reviewed and changed if necessary according to the change of socio-economic conditions and accumulated collection of data.

(2) Economic and Financial Evaluation

Economic evaluation is conducted on the priority projects. For the economic evaluation, 12% of opportunity cost of capital and 30 years of evaluation time horizon is applied. The result of economic evaluation is summarized in Table-3 and Table-4.

Table-3 Result of Economic Evaluation

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

Source: Study Team

Table-4 Annual Average Benefit on Flood Damage Reduction

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

Source: Study Team

Comparing financial project costs and revenue of the Provincial Government, financing of central government loan and/or foreign soft loan would be inevitable in implementing the projects.

(3) Environmental and Social Evaluation

It is assessed that potential adverse effects on natural environment are considered as manageable and insignificant. However, AMDAL must be carried out before implementation of Ayung Dam project and Denpasar metropolitan water supply project.

The Master Plan was formulated with intensive dialogue with stakeholders through stakeholders meetings which held 22 times and opinions of stakeholders are fully reflected to the Master Plan.

5 OUTLINE OF THE FEASIBILITY STUDY

(1) Outline of the Project

The proposed projects consist of 1) Ayung Multipurpose Dam, 2) Southern Bali Water Supply (east, central, and west systems), and 3) Badung & Mati River Improvements. Capacity development support program for establishment of DINAS-PSDA and BALAI-PSDA is also included in conjunction with O/M plan for Ayung Multipurpose Dam and Southern Bali Water Supply. Project components and contents are summarized in Table-5, and their locations are shown in Figure-1.

Total project cost is estimated as Rp. 1.7 trillion (¥ 19.4 billion), consisting of Rp. 1.1 trillion for Ayung Multipurpose Dam, Rp. 0.48 trillion for Southern Bali Water Supply, and Rp. 0.14 trillion for Badung & Mati River Improvements. Price level as average in 2005, US\$ 1 = Rp. 9,750 = ¥ 110.74.

Table-5 Proposed Priority Projects

Project Component/Objectives	Project Location/Main Facilities and Works
<u>Multipurpose Ayung Dam</u> Development of Municipal Water, Hydraulic Power Generation, Irrigation, River Environment Maintenance	About 3km at down stream area from confluence of Ayung River and the tributary Siap Rive (Location name is Buaganga, near the regency boundary between Badung regency and Gianyar regency.): Main Dam, Spillway, Check Dam and Hydraulic Power Generation Facilities
<u>Water Supply (Western System))</u> Supply of Municipal Water (North Kuta district of Badung regency)	Weir and Treatment Plant: about 1km down stream from the confluence of Sungai river and Penet river (about 2kmupstream of river mouth) Intake Facilities: between Cemagi and Krobokan
<u>Water Supply (Central System)</u> Supply of Municipal Water (Denpasar City and South Kuta districts of Badung regency)	Weir and Treatment Plant : Existing Ayung River Treatment Plant
<u>Water Supply (Eastern System)</u> Supply of Municipal Water (Southern districts of Gianyar regency, and North Kuta district of Badung regency)	Weir and Treatment Plant: intersection of Petanu river and by-pass road (about 1km from river mouth) Intake Facilities: from Petanu river to Kuta district (Tuban) along the by-pass road
<u>Badung River Improvement for Damage Protection of Flood</u>	Middle stream area of Badung river: Riverbed excavation and bank heightening, etc
<u>Mati River Improvement for Damage Protection of Flood</u>	Middle stream area of Mati river: Banking, widening, etc of non-improved section, and conservation of retarding basin

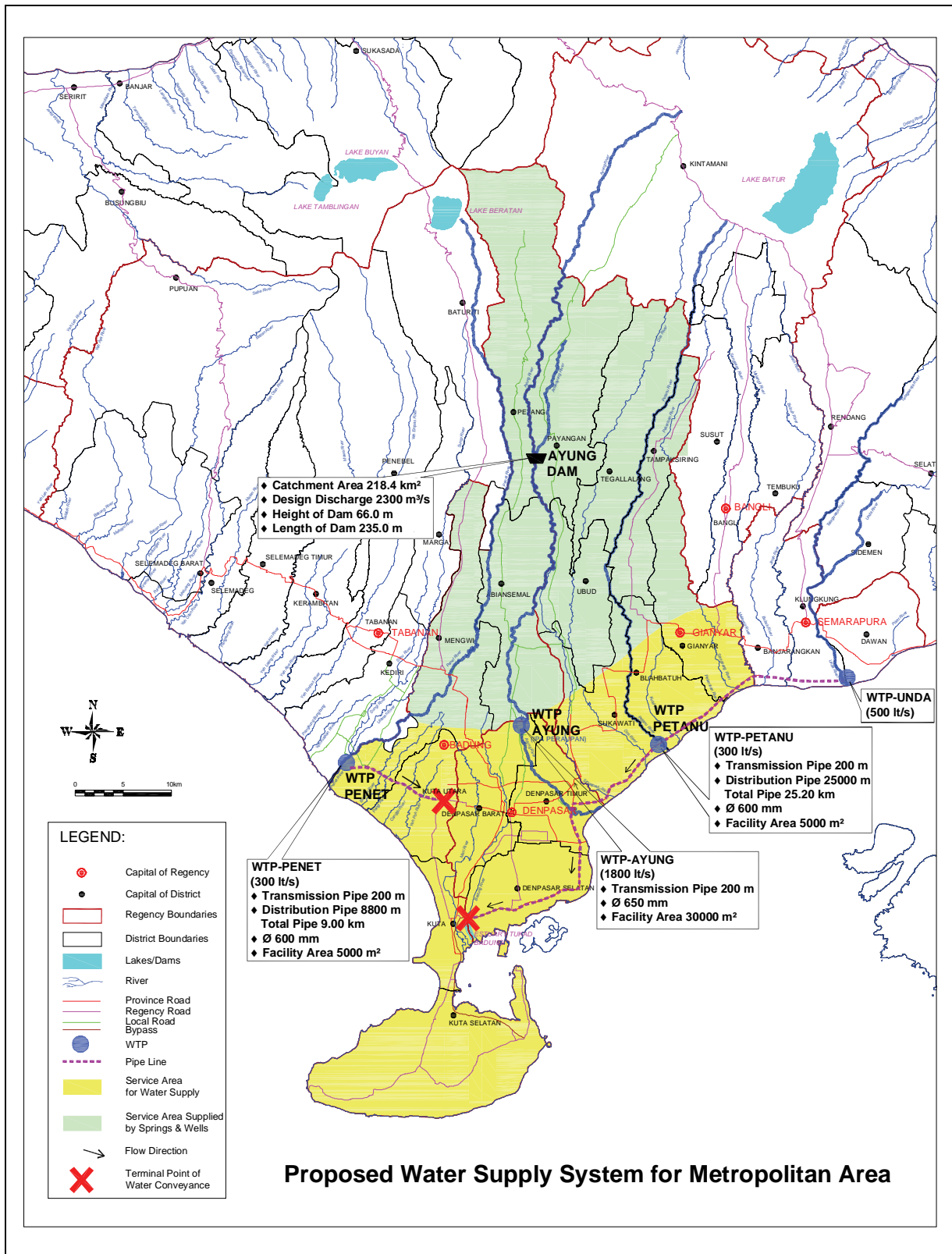


Figure-1 Locations of Proposed Priority Projects

5.2 Project Evaluation

(1) Technical Evaluation

Social and environmental conditions are fully considered in the planning and design such as setting the development capacity considering water rights downstream, examination of possibility quarry sites in Bali Island. Therefore, it is assessed to be technically feasible.

(2) Economic and Financial Evaluation

The economic evaluation is analyzed based on all data previously mentioned, and the results of the evaluation of water resources development projects (Multipurpose Ayung Dam Project and Water Supply Project for Southern Area of Bali), and Flood Control Project of Badung and Mati Rivers are presented in Table-6 and Table-7, respectively. EIRR of projects exceed 12% of opportunity cost of capital, and the projects are judged to be economically feasible.

Table-6 Result of Economic Evaluation of the Water Resources Development Projects

Items	Multipurpose Ayung Dam Project	Water Supply Project for Southern Area of Bali
EIRR	14.0%(14.2%)	12.5%

Source: Study Team

Note : () shows EIRR in case of including CDM benefit

Table-7 Annual Average Benefit on Flood Damage Reduction and EIRR

Item	Annual Average Benefit on Flood Damage Reduction			EIRR
	Year 2005	Year 2015	Year 2025	
Badung + Mati	Rp.15.5bi.	Rp.18.9bi.	Rp.20.8bi.	15.0%

Source: Study Team

(3) Environmental and Social Evaluation

According to the stakeholders meeting held in the Feasibility Study stage, proposed projects are welcomed by residents and prompt implementation is expected. However, some issues such as treat of holy places/springs, and compensation must be settled for implementation of Ayung Multipurpose Dam project. Endangered species does not exist in the projects sites. Other potential adverse effects on natural environment are considered as manageable and insignificant.

6 RECOMMENDATIONS

(1) Implementation of Projects Proposed in Master Plan

The Master Plan proposes the reasonable plans on the basis of the socio-economic framework up to the year of 2025 projected by the Study Team considering the existing plans and projection discussed in the latest Bali Spatial Plan.

The Master Plan prepared in such process proposes to solve or minimize water issues at present and in future. That is why the Master is useful and important plans to Bali people. It is very important to implement securely the plans or projects proposed in the Master Plan.

(2) Water Resources Development

The water resources are limited, effective water use (or appropriate water demand control) shall be employed. Water supply companies (PDAM) to supply water to the users shall take the following demand control methods:

- Leakage Management
- Reuse and Save Water
- Water Use Regulation

The Master Plan also discusses the water supply plans for the remote and isolated area. These plans will be sustainable if the construction is implemented with public investment (or subsidy), and users maintain the system by themselves.

(3) Water Resources Management

Water resources management plan discusses the institutional plans, water quality improvement plans, river basin conservation plans, database for water resources management and capacity building program.

The water resources database prepared in the Master Plan shall be used for the water resources management. New observed data and information will be stored in this GIS. This system is able to be

used for planning of water supply.

(4) Implementation of Priority Projects

Regarding the priority projects selected in the Master Plan the feasibility study was conducted. These projects will contribute greatly to the solution of water supply, irrigation, power generation and flood in the southern Bali areas. Urgent implementation of the projects is necessary. As EIRR of the projects are over 12%: Opportunity Cost of Capital – Indonesia, the projects are economically feasible. From the aspects of environment and social consideration, the feasibility of the projects is confirmed.

Before the implementation of the priority projects, the following matters shall be considered and conducted by the Government of Bali Province without fail:

- AMDAL – Regal Environmental Impact Assessment
- Monitoring of Water Demands
- Socialization of the Priority Projects
- Clarification of Current Water Right in Term of Discharge

As the cost of the projects is large, it is hard for the Bali Provincial Government to implement the project by himself due to the financial reason. It is recommendable that the central government gives financial assistant to the projects by employing the foreign soft loan.

(5) Disclosure of Information

To disclose more information on the Master Plan and the priority projects, it is recommendable to put the Study results in the Bali Government Homepage.

CHAPTER 1 OUTLINE OF STUDY

1.1 Background to the Study

Bali is one of the leading tourist resorts in Asia, and its local economy is based around tourism, followed by agriculture centering on paddy cultivation and so on. However, due to the slow development of social infrastructure related to water resources, Bali is faced with such issues on water sector as, 1) water shortages, 2) flood damage, and 3) river water pollution. These are hindering sustainable development of the local economy.

Moreover, in Indonesia, structural reform of the water resources sector (WATSAL) is being advanced, and a new water resources law has been established in accordance with the principle of democracy, decentralization and transparency. Nowadays, the provinces and cities/regencies have been taking the initiative in implementing water resources development and management. For this purpose, it is necessary to compile master plans of comprehensive water resources development and management in units of catchment areas. However, due to the lack of capability and experience in terms of organization and human resources, Bali Province issued a request to the Japanese Government for implementation of the master plan study.

In response to this, JICA was commissioned to dispatch the Preliminary Study Team in February 2004, and the Team held discussions and exchanged the signed S/W with the Directorate General of Water Resources (DGWR) under the Ministry of Public Works, and the Provincial Government of Bali for the study titled “the Comprehensive Study on Water Resources Development and Management in Bali Province” (the Study). Finally, the team for the Study (the Study Team) was dispatched on the late September 2004 to conduct the Study.

1.2 Objectives of the Study

The Study is being implemented to realize the following objectives, intending to achieve the sustainable development of local society and economy through the stable supply of safe water and reduction of flood damage:

- ◆ Compile a master plan of comprehensive water resources development and management in Bali Province up to the target year of 2025;
- ◆ Implement a feasibility study for priority projects selected in the master plan; and
- ◆ Implement technology transfer concerning comprehensive water resources development and management to the Indonesian counterparts through direct participation to the Study and training programs.

1.3 Study Area

The Master Plan Study targets all Bali Province (5,632.86 km²) including the islands of Bali and Penida, while the feasibility study shall target the implementation sites of priority projects as well as the scope of effects and impacts. Refer to Figure-1.1.

1.4 Study Schedule

The Study has commenced at September 22nd, 2004 and will finish 22 months later in June 2006. Indicating the Study phases, Figure-1.2 shows the overall study implementation schedule.



Figure-1.1 Study Area

2004				2005									2006									
9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7
Phase 1				Phase 2									Phase 3									
Establishment of Framework for Water Resources Development and Management				Establishment of Master Plan for Water Resources Development and Management									Feasibility Study and Final Report Preparation									
▲				▲				▲					▲							▲	▲	
IC/R				P/R1					IT/R				P/R2				DF/R		F/R			
▲				▲				▲				▲				▲				▲		
SCM1				SCM2					SCM3				SCM4			SCM5			SCM6			
				▲				▲				▲								▲		
1 st W/S							2 nd W/S					3 rd W/S										
▲								▲				▲				▲						
SHM1				SHM2					SHM3			SHM4		SHM5		SHM6						

Notes IC/R: Inception Report, P/R1: Progress Report (1), IT/R: Interim Report, P/R2: Progress Report (2), DF/R: Draft Final Report, SCM: Stirring Committee Meeting, W/S: Workshop, SHM: Stakeholder Meeting

Figure-1.2 Study Schedule

CHAPTER 2 STUDY AREA

2.1 Socio-Economy

Bali Province with its area of 5,632.86 km² includes eight regencies (*Kabupaten*) and one city (*Kotamadia*), and each regency/city has three (3) to ten (10) districts (*Kecamatan*). There are 55 districts in Bali. See Figure-2.1.



Figure-2.1 Administrative Division of Bali Province

Latest population census was carried out in 2000, which shows 3.15 million people or 1.5% of national population lived in Bali Province. Population growth rate during the period over the last decade was 1.3% (Denpasar 3.2%). Population density of Bali Province was 559 persons/km². Buleleng, Denpasar and Gianyar are the largest populated regencies.

Table-2.1 Actual Population and the Growth

Regions	Census Population (1,000 prs.)				% in Bali	Growth Rate		Density (prs./km ²)
	1971	1980	1990	2000		80-90	90-00	
Indonesia	119,208	147,490	179,379	206,265	-	2.0%	1.4%	109
Bali Province	2,119	2,470	2,777	3,147	100%	1.2%	1.3%	559
1. Jembrana	171	205	218	232	7%	0.6%	0.6%	275
2. Tabanan	329	343	350	376	12%	0.2%	0.7%	448
3. Badung	230	243	275	346	11%	1.2%	2.3%	826
4. Gianyar	272	306	337	393	12%	1.0%	1.6%	1,068
5. Klungkung	138	149	150	155	5%	0.1%	0.3%	493
6. Bangli	138	162	176	194	6%	0.9%	0.9%	372
7. Karangasem	267	314	343	361	11%	0.9%	0.5%	429
8. Buleleng	403	487	540	558	18%	1.0%	0.3%	409
9. Denpasar	171	261	388	532	17%	4.1%	3.2%	4,295

Source: 1) Web side of BPS of Indonesia, and 2) Bali in Figures 2003, BPS of Bali Province

Gross Regional Domestic Product (GRDP) of Bali Province was Rp.28.9trillion in 2004 as shown in Table-2.2. The largest contributor to GRDP was tertiary sector at 64% supported by the trade, hotel and restaurant activities. GRDP per capita of Bali Province was US\$920 in 2004 that presents 80% of Indonesia.

Table-2.2 GDP & GRDP at 2004 Constant Price

Unit: billion Rp.

Item		2001	2002	2003	2004	By Sector in 2004		
						Primary	Secondary	Tertiary
GDP and GRDP	Indonesia	2,001,252	2,088,818	2,190,664	2,303,031	24%	35%	41%
	Bali Prov.	25,917	26,750	27,704	28,984	21%	15%	64%
	% of Bali	1.3 %	1.3 %	1.3 %	1.3%	-	-	-
Growth Rate	Indonesia	3.5%	3.7%	4.1%	5.1%	0.5%	6.5%	7.0%
	Bali Prov.	3.4%	3.0%	3.6%	4.6%	3.7%	4.1%	5.1%

Note: Constant price is calculated by Study Team based on the data of statistical year book.

Source: 1) Indonesia; Statistical Year Book 2004, BPS of Indonesia, and 2) Bali; Bali in Figures 2004, BPS of Bali Province

Agriculture is an important economic sector in Bali Province in terms of employment absorption (forty percent of labor force engage in agriculture sector). The leading manufacturing industries in Bali Province are characterized by 1) food and beverage, 2) textiles and leather, and 3) wood. And most of the industries gather in Denpasar City, Badung Regency and Karangasem Regency.

Tourism is an important economic sector in Bali Province that largely depends on foreign tourists. Large number of tourists arrives during June to September. Although it is completely recovered in 2004 almost reaching 1.5 million and furthermore broke the record of 2000, the tourists decreased from October 2005 caused by bomb incident again.

The labor force of Bali Province which shows 40% of workers engaged in primary sector and tertiary sector.

The poverty line of B Bali is Rp. 158,639 in urban area and Rp. 136,166 in rural area respectively. The percentage of the population below the poverty line of Bali Province was 6.9% in 2004, which is smaller than 16.7% of Indonesia.

2.2 Balinese Society and Subak System

The Balinese society and agriculture are characterized by *subaks*, socio-religious agriculture communities dealing with water management and crop production, which have been in existence for centuries. Physical conditions in Bali as well as the perspective of the Hindu religion are said to have contributed to the development of the intricate system of irrigation on steep mountain slopes and valleys. This value system is reflected in the basic philosophy of *subak*, which is crystallized in the expression “*Tri Hita Karana*”, meaning “three reasons to reach the prosperity”. The three “reasons” refer to three types of relations: human beings and the god; human beings and their society; and human beings and the nature.

The grouping of a *subak* is based on the same water source. The area of a *subak* on average is 100 hectares, the largest being around 800 hectares and the smallest about 10 hectares. Large *subaks* are sub-divided into smaller units called *tempek*. According to the list prepared by each regency in 1993, there are a total of 1,600 *subaks* in Bali.¹

The government starting in 19707’s has been supporting strengthening of *subak* through provision of training on irrigation, agriculture production, and socio-economic-cultural aspects. The relationship between *subaks* and the government is generally cordial and cooperative. As can be seen in the development of *subak-gede* and *subak-agung*, *subaks* today continue to demonstrate its excellent organizational capacity to cope with changing situations and make adjustments within the *subak* arrangement. Increasing tensions between *subaks* and non-*subak* entities (such as PDAM) in recent years, however, indicate that the government may have to play more proactive roles in structuring water allocation and facilitating dispute resolution.

¹ *Bupati* of each Regency issued a decree in 1993 listing all the existing *Subaks* and their areas. This was done in response to a request from ADB prior to the commencement of a *subak* strengthening project.

2.3 Topography, Geology and Land Use

Bali Island is topographically divided into two areas; northern and southern parts being separated by mountain ranges of 1,500m to 3,000m in altitude running in an east-west direction. The northern area has steep topography, while the southern part has relatively gentle slopes particularly below 500 m above the sea, though the upper area is a little steeper. See Figure-2.2.

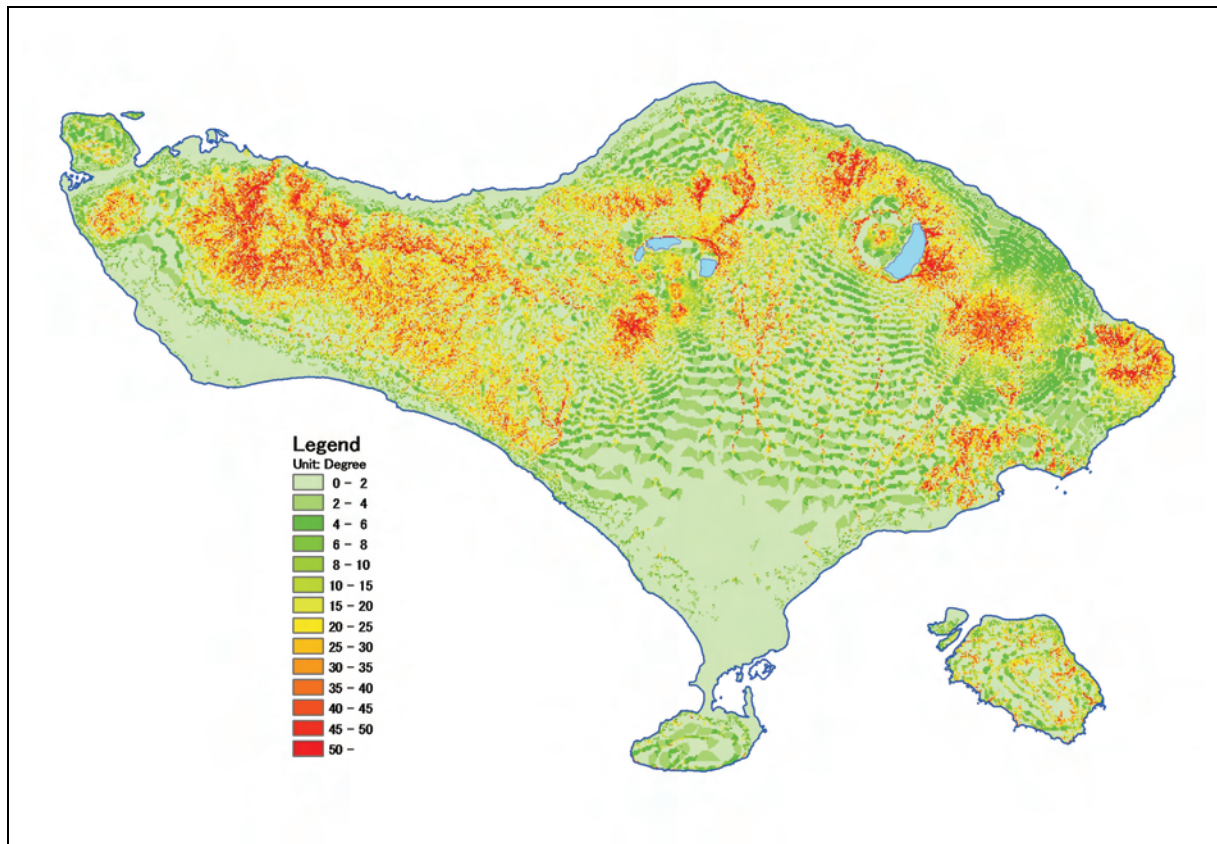


Figure-2.2 Slope Map of Bali Island

Bali island consists of Miocene to Pliocene volcanic products and marine sediment as basement rock, overlain by a thick pyroclastic flow, volcanic products and volcanic mudflow originated from intensive volcanic activities in Pleistocene to Holocene of Quaternary period.

The exposure of basement rocks observed are the Ulakan Formation (volcanic breccia, lavas and tuff) of the oldest strata distributed in an area covering from the coast to mountain slopes up to EL. 500 m in the southeast, the Sorga Formation (sandstone) seen in limited areas from northwestern to northern coast, the Selatan Formation (limestone) forming Bukit Peninsula and Nusa Penida, the Parapatagung Formation (limestone, calcareous sandstone and marlstone) distributed in Prapatagung of west end of Bali, Palaki volcanics (lavas, volcanic breccia) and the Ash Formation (lavas, volcanic breccia and tuffs). Almost all of these strata of Tertiary age are covered by the Quaternary volcanic rocks.

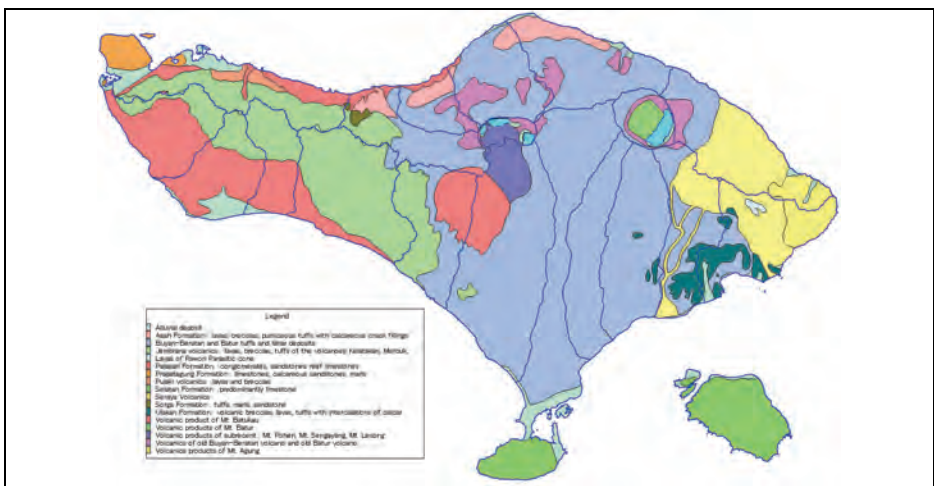


Figure-2.3 Geological Map

The agriculture land in Bali consists of the wetland paddy field, dry land and plantation, and occupies approximately 60 % of the provincial land. Data of both sources are consistent in terms of the agricultural land. Forest coverage is considered ranging within 20 % - 25 % of the provincial area.

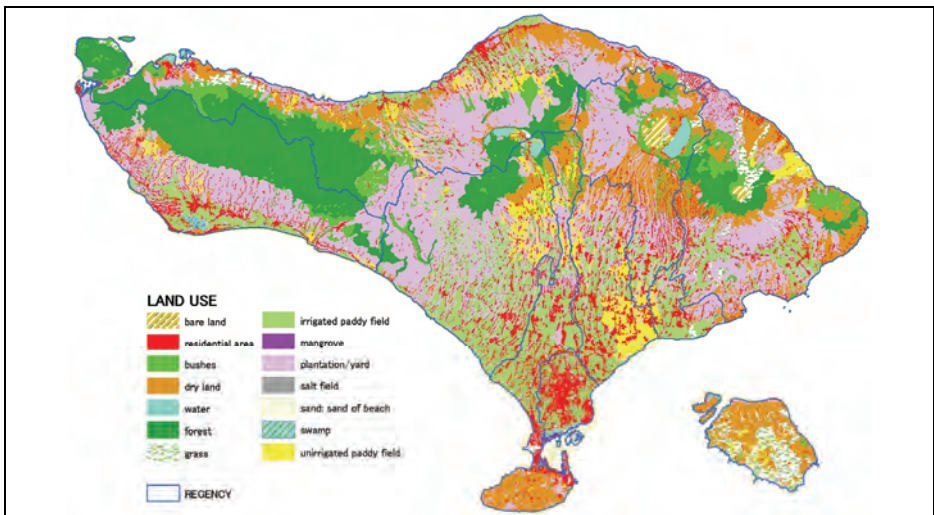


Figure-2.4 Land Use Map

2.4 Climate

The annual rainfall amount and climate in Bali Island is dependent on the altitude and also affected by the topographic condition as well as annual movement of the Inter Tropical Convergence Zone (ITCZ). In general, the annual rainfall in Bali increases with altitude. This tendency is common to most of other regions of the country.

Annual rainfall in Bali ranges from below 1,500 mm in the coastal areas to over 3,000 mm in the central mountainous areas. Mean annual rainfall in Bali Island is estimated to be 2,003 mm for the period from 1992 to 2003.

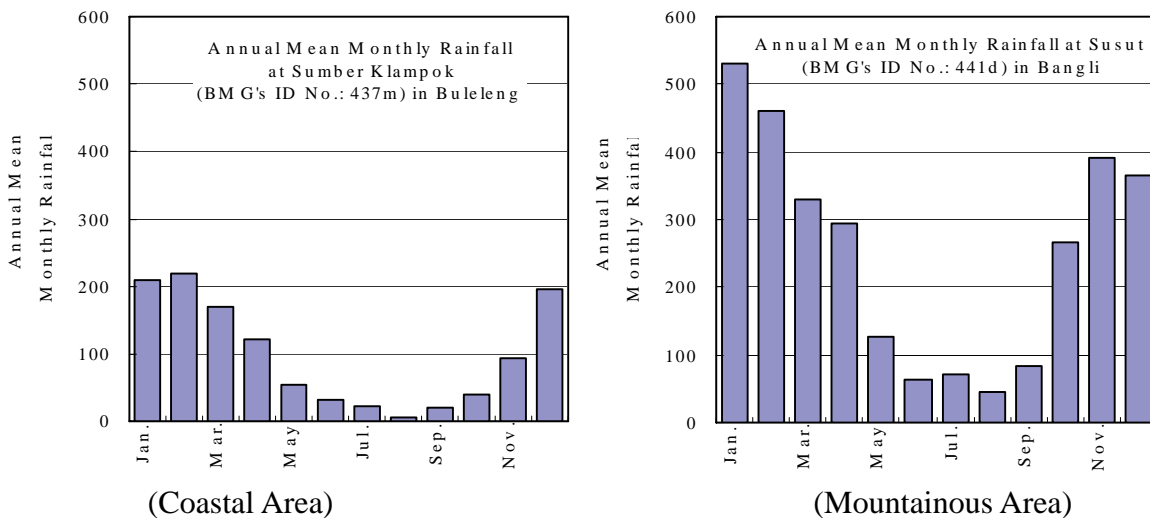


Figure-2.5 Monthly Rainfall Patterns

2.5 Hydro-geological Condition

Bali is the island covered by volcanic sediments except the west end of the island, which is Mount Prapatagung-Gilimanuk Area, and the south end of the island, which is Bukit Peninsula or Bualu Area, where limestone and calcareous stratum occur. The island of Nusa Penida is also formed by limestone. Hydrogeological features of formations are summarized below.

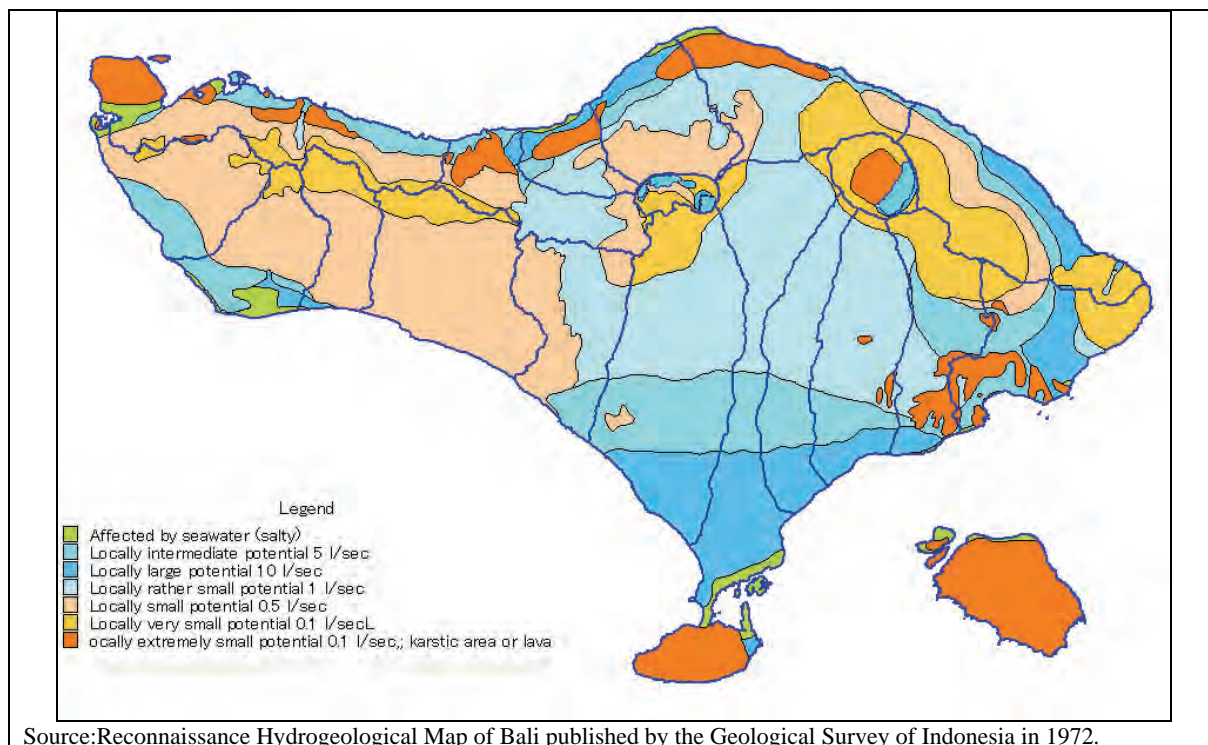


Figure-2.6 Reconnaissance Hydrogeological Map (1972)

Generally, alluvium and young volcanic sediments are highly permeable, and Lower Quaternary and tertiary sediments have wide-ranging permeability due to the formation.

The number of wells drilled up to 90 meters or less is almost 50% of the wells and about 80% of the wells were drilled up to 120 meters or less.

The wells drilled to 50 meters were only 8%, as shown below. Relatively deeper wells have been constructed in the western part, and the northwestern part, Gerokgak area, though the depths of wells drilled in the southern area vary widely

The yield of springs ranges from less than one liter to several hundreds liters per second. According to the result, there are 9 springs yielding 500 liter/sec or more, and 67 springs yield from 100 to less