社会開発調査部報告書

THE REPUBLIC OF INDONESIA

THE STUDY ON IKK SYSTEM WATER SUPPLY PROJECT IN PROVINCES OF CENTRAL JAVA, EAST JAVA AND BALI INDONESIA

FINAL REPORT

MAIN REPORT

June 1992

JAPAN INTERNATIONAL COOPERATION AGENCY
(JICA)

PREFACE

In response to a request form the Government of the Republic of Indonesia, the Government of Japan decided to conduct a development study on IKK System Water Supply Project in Provinces of Central Java, East Java and Bali, Indonesia and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Indonesia a study team headed by Mr. Eijiro UENO, Pacific Consultants International Co., Ltd. and composed of members from Pacific Consultants International Co., Ltd. and Kajitani Engineering Co., Ltd. four times between August 1990 and January 1992.

The team held discussions with the officials concerned of the Government of Indonesia, and conducted field Surveys at the study area. After the team returned to Japan, further studies were made and the present report was prepared.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of Indonesia for their close cooperation extended to the team.

June, 1992

Kensuke Yanagiya
President
Japan International Cooperation Agency

THE STUDY
ON
IKK SYSTEM WATER SUPPLY PROJECT
IN PROVINCES OF CENTRAL JAVA, EAST JAVA AND BALI

Mr. Kensuke YANAGIYA
President
Japan International
Cooperation Agency

June, 1992

LETTER OF TRANSMITTAL

Dear Sir,

It is our great pleasure to submit to you the final report entitled "The Study on IKK System Water Supply Project In Provinces of Central Java, East Java and Bali".

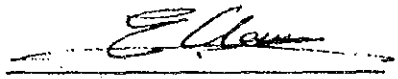
This report has been prepared by the Study Team in accordance with the contracts signed on 2 August 1990, 22 February 1991, 13 May 1991 and 23 March 1992 between the Japan International Cooperation Agency and Pacific Consultants International Co., Ltd./Kajitani Engineering Co., Ltd.

The report describes the results of the Basic Plan of Water Supply Facilities for 121 IKKs in Central Java, East Java and Bali and the Feasibility Study for 30 high priority IKKs selected among 121 IKKs.

The report consists of the Executive Summary, Main Report and Supporting Report. The Summary summaries the results of all studies. The Main Report contains background conditions, socio-economic background, water sources, Basic Plan of water supply facilities, Feasibility Study for high priority IKKs and recommendations. The Supporting Report includes details of study conditions, investigation on water resources, drawings for Basic Plan and Feasibility Study and data for cost estimation.

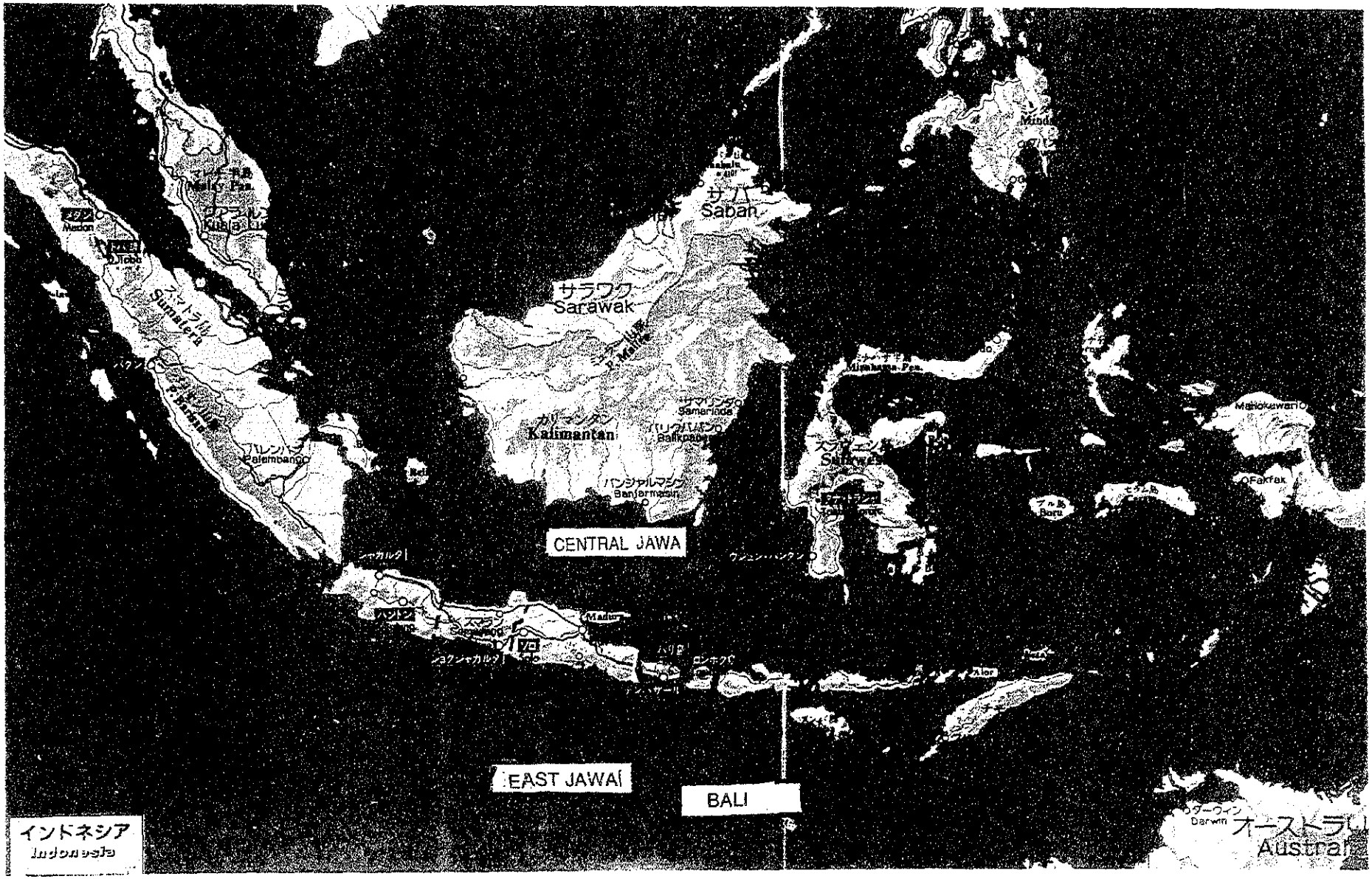
All members of the Study Team wish to express grateful acknowledgement to the personnel of your Agency, Ministry of Foreign Affairs, Ministry of Health and Welfare and Embassy of Japan in Indonesia, and also to officials and individuals of the Government of Indonesia for their assistance extended to the Study Team. The Study Team sincerely hopes that the results of the study will contribute to increase the water supply ratio and to the improvement of sanitary condition, and also to the socio-economic development of the study area.

Yours faithfully,



Eijiro UENO
Team Leader

LOCATION MAP



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CHAPTER 1 INTRODUCTION

Chapter 1 Introduction

1.1 Background of the Study

The Government of Indonesia (GOI) has been continuously placing efforts on the development of water supply systems since the first Five-Year Development Plan was issued in 1969.

During the past four five-year Development Plans (REPELITAS 1,2,3,4), there has been an increased investment in the water supply sector to provide safe and potable drinking water to the people. In particular, during the International Drinking Water Supply and Systems Sanitation Decade (1981-1990), investment in a water was extended to the Sub-District Capitals called Ibu Kota Kecamatan (IKKs) having populations between 3,000 and 20,000.

At the end of REPELITA 4 in early 1989, about 60 percent of the urban and IKKs population had access to public water supply systems and 30.5 percent of the rural population had reliable supplies mainly from handpumped wells. These percentages compare with targets of 70 percent for the urban and IKK population, and 55 percent for the rural population.

Since the total population of Indonesia is estimated at 160 million (approx. as of 1983), out of which about 120 million (75 percent) live in rural areas and 40 million (25 percent) in urban and IKK areas, it can be estimated that 99 million people still depend on water from open dug wells, spring, streams, lakes and rain water, most of which are doubtful in quality and/or unstable in quantity. This was mainly caused by the lack of funds and staff available for the actual preparation and implementation of the schemes.

By the end of Repelita 5 (in 1994), GOI aims to achieve a target of 80 percent of the urban and IKK population with access to safe water supplies, and a target of 60 percent for rural areas.

Under the circumstances mentioned above, GOI requested the study on IKK System Water Supply Project in provinces of Central Java, East Java and Bali. Japan International Cooperation Agency (JICA) was appointed as the responsible agency for this study.

1.2 Objective of the Study

The objectives of the Study are

1. to formulate basic water supply system plans for 121 IKKs in Central Java, East Java and Bali,

2. to identify high priority IKKs (Max. 30 IKKs).
3. to conduct feasibility studies on water supply systems for the high priority IKKs.

1.3 Study Area

The Study area covers 61 IKKs in Central Java, 40 IKKs in East Java and 20 IKKs in Bali. The names of 121 IKKs are shown in the Table 1.1 and 1.2 and the locations in Fig. 1.1.

Table 1.1 List of IKKS Central Java

No.	Kabupaten	IKK
1	BREBES	Bantarkawung
2		Bulakamba
3		Paguyangan
4		Salem
5		Losari
6	CILACAP	Dayeuhluhur
7		Gandrungmangu
8		Jeruklegi
9		Kesugihan
10		Nusawungu
11	PURWOREJO	Butuh
12		Banyuurip
13		Grabag
14		Kaligesing
15		Kemiri
16		Purwodadi
17		Bayan
18		Ngombol
19	BANJAR NEGARA	Banjarmangu
20		Karang Kobar
21		Madukara
22		Pagentan
23		Punggelan
24		Purwonegoro
25		Purworejo Klampok

26	KEBUMEN	Karangsambung
27		Ambalresmi
28		Demangsari
29		Setrojenar
30		Karanggayam
31		Klegenwonosari
32		Mirit
33		Petanahan
34		Prembun
35	KENDAL	Gemuh
36		Sukorejo
37		Singorojo
38	BLORA	Banjarrejo
39		Jepon
40		Mendenrejo
41	KUDUS	Dawe
42	PATI	Batangan
43		Tayu
44	REMBANG	Kaliori
45		Sale
46	SRAGEN	Tangen
47		Miri
48		Gondang
49		Jenar
50		Plupuh
51		Sambirejo
52	WONOGIRI	Jatiroto
53		Nguntoronadi
54		Giriwoyo
55		Jatipurno
56		Bulukerto
57		Manyaran
58	SEMARANG	Bawen
59		Suruh
60	KLATEN	Bayat
61		Karangnongko

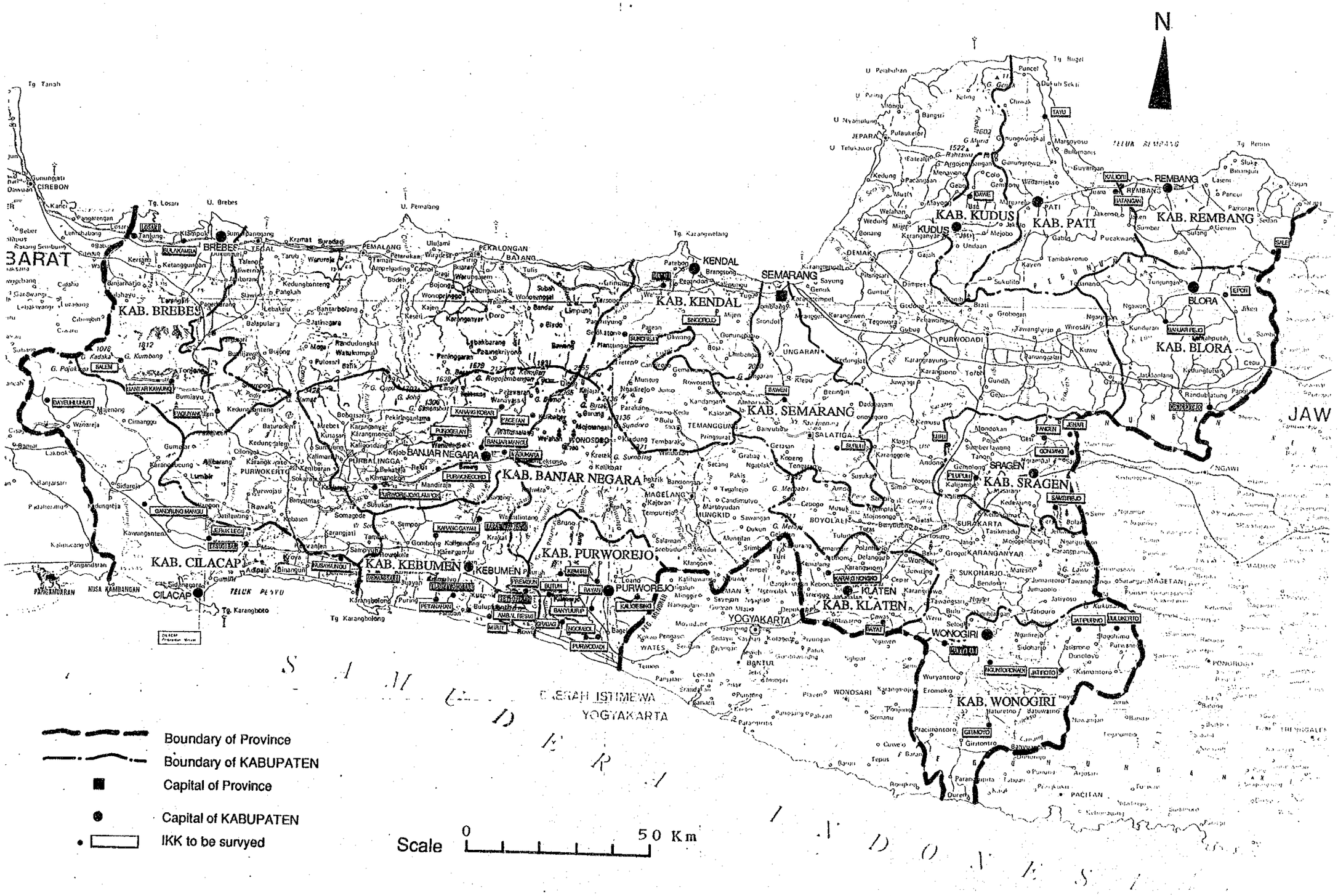
Table 1.2 List of IKKS East Java (Including Bali)

No.	Kabupaten	IKK
1	BOJONEGORO	Balen
2		Baureno
3		Kapas
4		Sumberrejo
5	TUBAN	Bangilan
6		Bulu
7		Parengan
8		Jenu
9		Kerek
10	LAMONGAN	Karanggeneng
11		Kembangbahu
12		Tikung
13		Ngimbang
14		Brongong
15	JOMBANG	Diwek
16		Gudo
17		Kudu
18		Megaluh
19		Mojowarno
20		Ngoro
21	MADIUN	Jiwan
22		Mejayan
23	MOJOKERTO	Dlanggu
24		Gedeg
25		Jatirejo
26		Kutorejo
27		Pacet

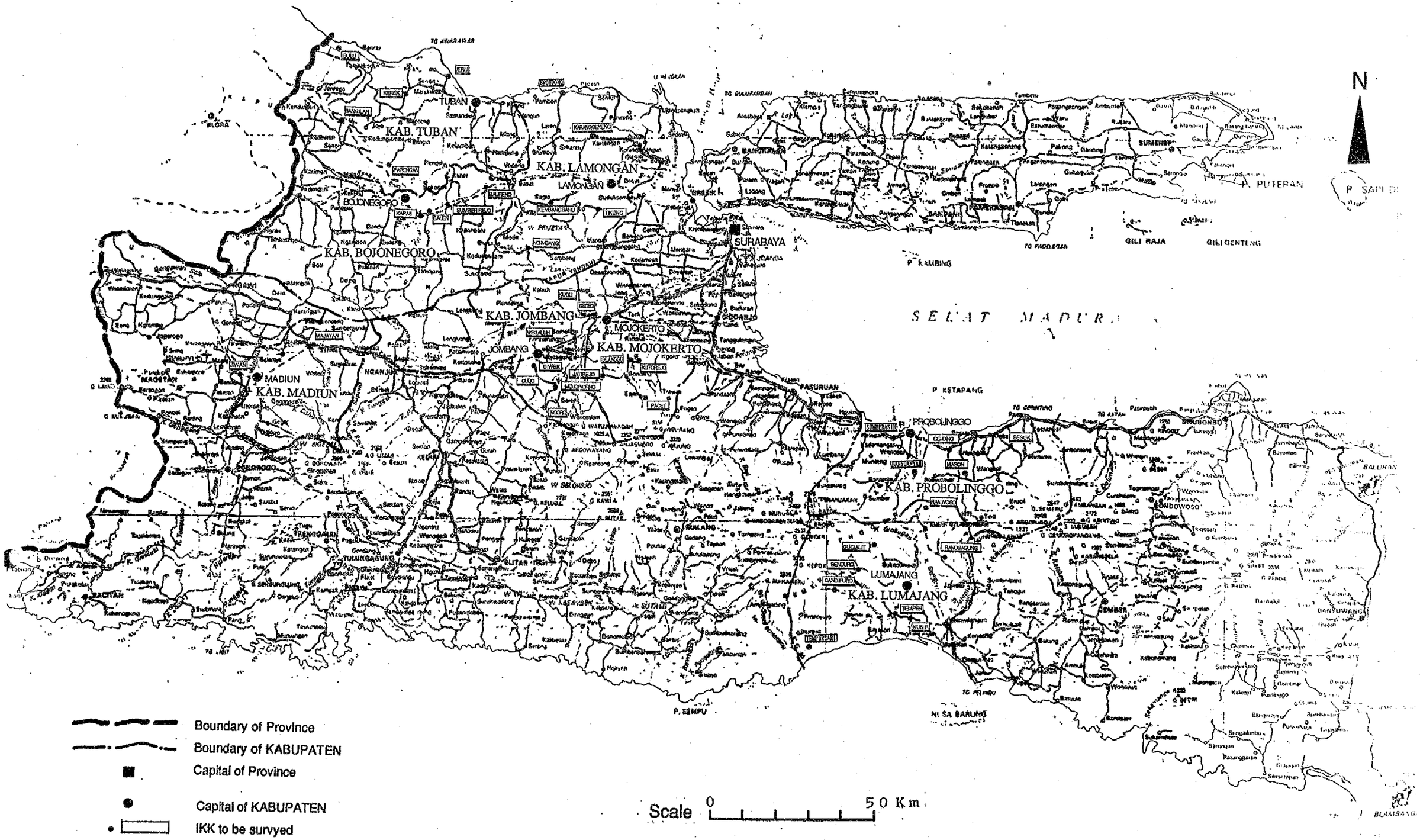
28	LUMAJANG	Candipuro
29		Gucialit
30		Tempeh
31		Kunir
32		Randuagung
33		Ranuyoso
34		Senduro
35		Tempursari
36	PROBOLINGGO	Banyuanyar
37		Besuk
38		Gending
39		Maron
40		Sumberasih
41	BADUNG	Blah Kiuh
42	BULELENG	Munduk
43		Tista
44		Sangsit
45		Panji
46	GIANYAR	Singakerta
47		Tampak Siring
48		Tegalalang
49		Ketewel
50	JEMBRANA	Asahduren
51	KARANG ASEM	Abang
52		Bebandem
53		Menanga
54		Sibetan
55	KLUNGKUNG	Sakti
56	TABANAN	Marga
57		Pupuan
58		Antap
59	BANGLI	Bangbang
60		Tiga

Fig 1.1 Location Map of 121 IKKs

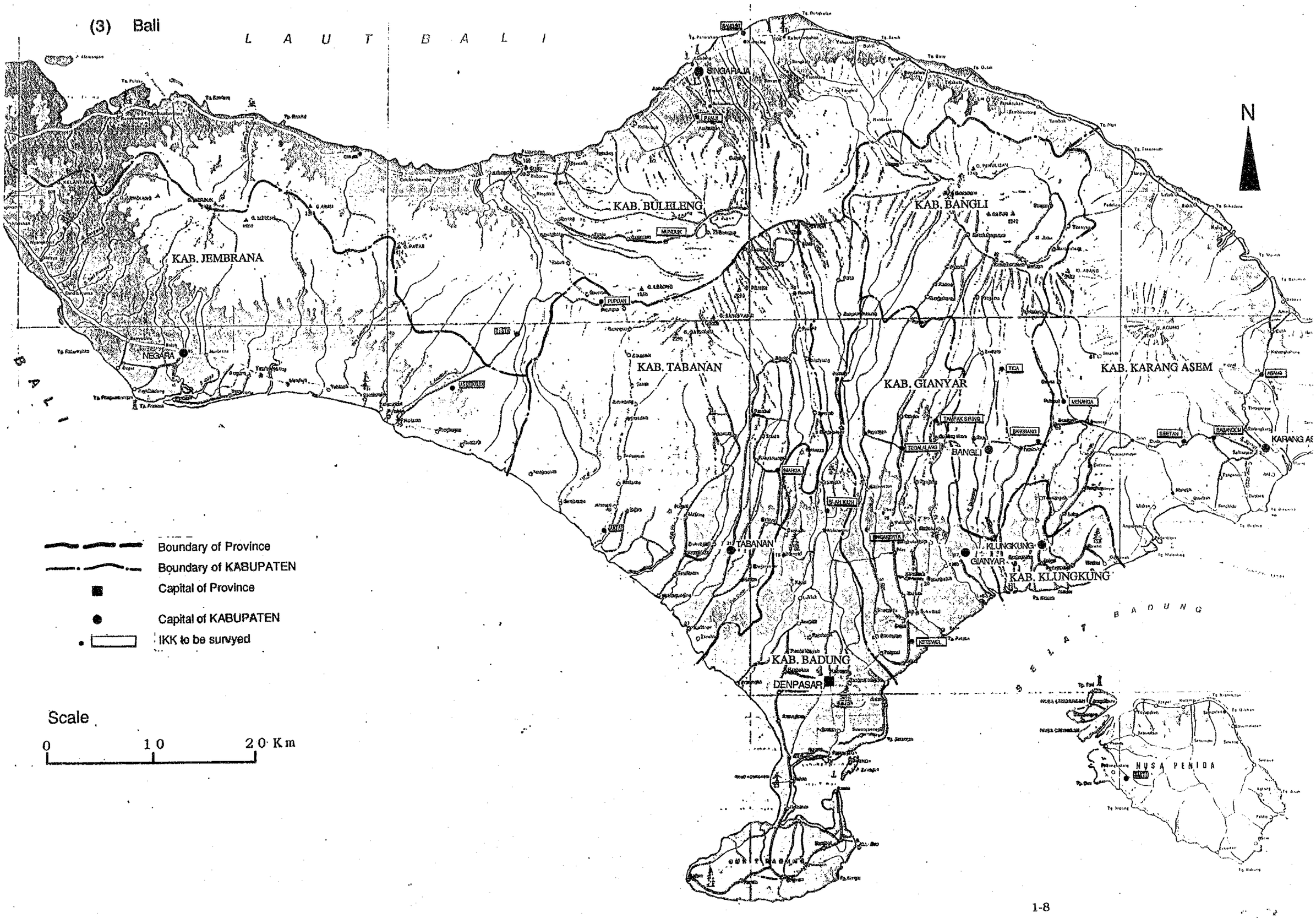
(1) Central Jawa



(2) East Jawa


N
TUBAN
KAB. TUBAN
KAB. LAMONGAN
LAMONGAN
BOJONEGORO
KAB. BOJONEGORO
SURABAYA
KAB. JOMBANG
JOMBANG
MOJOKERTO
KAB. MOJOKERTO
MADIUN
KAB. MADIUN
PROBOLINGGO
KAB. PROBOLINGGO
LUMAJANG
KAB. LUMAJANG
SUMENEP
P. PUTERAN
P. KAMBING
GILI RAJA
GILI GENTENG
SELAT MADURA
P KETAPANG
P. SEMPU
NUSA BARUNG
BLAMBANG
Boundary of Province
Boundary of KABUPATEN
Capital of Province
Capital of KABUPATEN
IKK to be survyed
Scale 0 50 Km

(3) Bali


L A U T B A L I
SINGARAJA
KAB. BULELENG
KAB. JEMBRANA
NEGARA
KAB. TABANAN
KAB. BANGLI
KAB. GIANYAR
KAB. KARANG ASEM
BANGLI
TABANAN
GIANYAR
KLUNGKUNG
KAB. KLUNGKUNG
KAB. BADUNG
DENPASAR
B A D U N G
S E L A T
N U S A P E N I D A
N
Boundary of Province
Boundary of KABUPATEN
Capital of Province
Capital of KABUPATEN
IKK to be surveyed
Scale
0 10 20 Km

1.4 Implementation of the Study

1.4.1 The Study was carried out by the Japanese consultant team retained by the Japan International Cooperation Agency (JICA) and counterpart staff of the Directorate of Water Supply (DWS), Directorate General of Human Settlements, Ministry of Public Works.

DWS was assigned as the counterpart executing agency of the Government of Indonesia while JICA was assigned as the official agency responsible for the implementation of the technical cooperation program of the Government of Japan.

The Study was conducted from August, 1990 to June, 1992. The members involved in the Study are listed below.

(1) JICA Study Team

Mr. E. Ueno (PCI)	:	Team Leader
Mr. T. Ozawa (PCI)	:	Water Supply Planning
Mr. K. Saiki (KEC)	:	Hydrogeology
Mr. N. Okazaki (PCI)	:	Geophysical Survey
Mr. Y. Takaishi (KEC)	:	Hydrology . Water Quality
Mr. K. Nakahara (PCI)	:	Water Facilities Planning
Mr. K. Kubo (KEC)	:	Test Well Drilling Supervise
Mr. M. Morii (KEC)	:	Construction Planning . Cost Estimator
Mr. K. Ohno (PEI)	:	Socio-economic Analysis

(2) Indonesian Government

Ir. Rachmadi B.S.	:	Director General of Human Settlements (Cipta Karya)
Ir. Soeratmo Notodipoero	:	Secretary of Dit. Gen. Cipta Karya
Ir. Parulian Sidabutar	:	Director of Program Development
Ir. A.R. Tambing, Dipl. SE	:	Director of Water Supply
Ir. Prijono Salim, Dipl. SE	:	Head of Foreign Aid Administration Sub. Dit., DPD
Mr. Moch. Noer Burhanuddin, BAE	:	Head of Administration Div., DWS
Ir. Rachmat Rani, Dipl. SE	:	Head of Technical Planning Sub. Dit, DWS
Ir. Achmad Ruyadi	:	Head of Eastern Region Implementation Sub. Dit., DWS

Ir. Tri Harsono, Msc	:	Head of Technical Development Sub. Dit., DWS
Ir. Suwandi Sanudi K.	:	Head of Western Region Implementation Sub. Dit., DWS
Dra. Karyatun	:	Chief of Foreign Aid Admistration Sub Division, DWS
Ir. Djoko Rismianto	:	Chief of Raw Water Section, DWS
Ir. Poedjastanto, CES., DEA.	:	Chief of Western Region Planning Section, DWS
Ir. M. Sjukrul Amien	:	Chief of Eastern Region Planning Section, DWS
Ir. Susetyo Sabar Rachman	:	Chief of Planning Evaluation Section, DWS
Ir. Chairul Sjafri Hatta	:	Chief of Western Region Implementation Preparation Section, DWS
Ir. Dadan Krisnandar	:	Chief of Evaluation Western Region Implementation Section, DWS.
Ir. M. Natsir Basuki	:	Chief of Region II Western Region Implementation Section, DWS.
Ir. Budi Giyanto	:	Chief of Eastern Region Implementation Preparation Section, DWS.
Ir. Parlin Sianipar	:	Chief of Region II Eastern Region Implementation Section, DWS.
Ir. Nurkia Tambunan	:	Chief of Evaluation Eastern Region Implementation Section, DWS.
Ir. Purnama	:	Project Manager of PPSAB for Central Java
Ir. Deka Paranoan	:	Project Manager of PPSAB for East Java
Ir. Sutiknyo	:	Project Manager of PPSAB for Bali
Masanori Takizawa	:	JICA Water Supply Expert
Nobutoshi Wakaoka	:	JICA Water Supply Expert

1.4.2 The Study comprises the following two phases.

Phase 1:
1) Collection and review of existing data/information,
2) Preparation of basic water supply system Plans for 121 IKKS, and
3) Indentification of high priority IKKs (MAX. 30 IKKs)

Phase 2: The feasibility study on water supply systems for the high priority IKKs

Study items in each phase are shown in Fig. 1.2 Work Flow Chart.

(1) In phase 1, Basic Plan of water supply facilities for 121 IKKs requested by Government of Indonesia was made after data collection, site survey for each IKK including hydrological and hydrogeological observations, and geophysical survey for IKKs, for which ground water was conjectured to be a water source.
Moreover the identification of high priority IKKs, for which feasibility study would be done in Phase 2, was conducted.

(2) In phase 2, high priority IKKs were decided after discussion between JICA team and the officials of DWS.
Then feasibility study was conducted after in-depth field surveys for each IKK such as topographical survey, test well drilling and pumping tests, and water quality analyses, etc.

(3) In this main report investigation on water resources in Phase 1 and Phase 2 is described in a lump in Chapter 3.
And Basic Plan in Phase 1 and Selection of High Priority IKKs are shown in Chapter 4 and Chapter 5 respectively.

(4) The results of feasibility study in Phase 2 are summarized in Chapter 6.

(5) In addition to the above feasibility study, a supplementary study for 30 high priority IKKs was conducted, based on the request from GOI, from April to June, 1992.
In this study, an alterative implementation plan, adopting a stage wise approach to water supply installation to meet Repelita V objectives, has been proposed.

That is, in the initial stage of implementation, the water supply will be based on Public Hydrant only, to minimize the initial investment, and after that House Connections will be expanded in the final stage before target year, so that the Water Supply Facilities should be the same as the original figures.
The results are shown in Chapter 7.

1.5 Composition of Report

This report consists of two (2) volumes : Main Report and Supporting Report.

The Main Report presents the summarized results of all the studies.

The Supporting Report includes the following Studies;

A : Socio-Economic Condition
B : Investigation on Water Resources
C : Basic Plan of Water Supply Facilities for 121 IKKs
D : Plan of Water Supply Facilities for 30 IKKs
E : Management Plan
F : Supplementary Study

Fig. 1.2 WORK FLOW CHART

Phase	Phase 1		Phase 2		
Year	1990		1991		
Month	August	August - December	January	February - November	December - January
Place	Preparation Work in Japan	Survey Work in Indonesia	Work in Japan	Survey Work in Indonesia	Work in Japan
Main Subjects	1. Study on Existing Data and Reports 2. Study on Survey items and Procedure 3. Preparation of Inception Report	1. Collection of Data and Information 2. Field Survey and Reconnaissance 3. Preparation of Progress Report (I)	1. Preparation of Basic Water Supply System Plans 2. Identification of high Priority IKKS 3. Preparation of Interim Report	1. Submission and Discussion of Interim Report 2. Decision of High Priority IKKS 3. Supplementary Data Collection and In-Depth Field Surveys 4. Preparation of Progress Report (II,III)	1. Preparation of F/S Report 2. Preparation of Draft Final Report

Study Items

(1) Study on Existing Data and Information
(2) Study on Survey Items and Procedure

Preparation of Questionnaire

Preparation of Inception Report (Draft)

Submission and Discussion of the Draft inception Report, Questionnaire and the Survey Schedule

Collection of Data and information
(1) Data for the Study on Water sources
1) Meteorology and Hydrology
2) Topography
3) Geology
4) Hydrogeology
5) Water resources
6) Others
(2) Data for Design Standards
(3) Data for Operation and Maintenance of Water Facilities
(4) Construction Materials and Cost

Field Survey and Reconnaissance
(1) Survey for Water Sources for 121 IKKS
1) Topographical and Geological Reconnaissance
2) Hydrological Survey and Well Survey
3) Hydrogeological Survey
(2) Study on Design Standard and Basic Plan, Survey for Existing IKK Water Supply Systems

Survey for Basic Plan in 121 IKKS
(1) Data Collection and Reconnaissance
1) Population and numbers of house holders
2) Socio-economic conditions
3) Land use
4) Water supply conditions
5) Quality of existing water sources
(2) Basic plans for water supply systems for 121 IKKS

Arrangement of Survey Results

Preparation and submission of Progress Report (I)

Preparation of Basic Water Supply System Plans
(1) Classification of 121 IKKS by type of water resources and water supply systems
(2) Preparation of basic water supply system plans for 121 IKKS

Identification of High Priority IKKS
Identification of IKKS for which feasibility studies will be conducted in Phase 2

Detailed Survey Plan in Phase 2

Preparation of Interim Report

Submission and Discussion of Interim Report

Decision of high priority IKKS for which F/S will be conducted

Collection of Supplementary Data for F/S

In-Depth Field Surveys
(1) Field Surveys for Data Collection
(2) Topographical Surveys
(3) Water Quality analyses
(4) Test Well Drilling and Investigations

Analyses of field Surveys
(1) Decision of Water Sources
(2) Design Condition

Study on Water Supply System
(1) Population served
(2) Water supply system plans
(3) Outline design of water facilities
(4) Preliminary cost estimation

Preparation of Water Supply System Plans

Preparation and submission of Progress Report (II)

Preparation of F/S Report
(1) Study on institutional, management, and financial conditions
(2) Water Supply Systems
(3) Operation and Maintenance Plan

Preparation of Draft Final Report

Reports	△ Inception Report	△ Progress Report (I)	△ Interim Report	△ Progress Report (II)	△ Progress Report (III)	△ Draft Final Report

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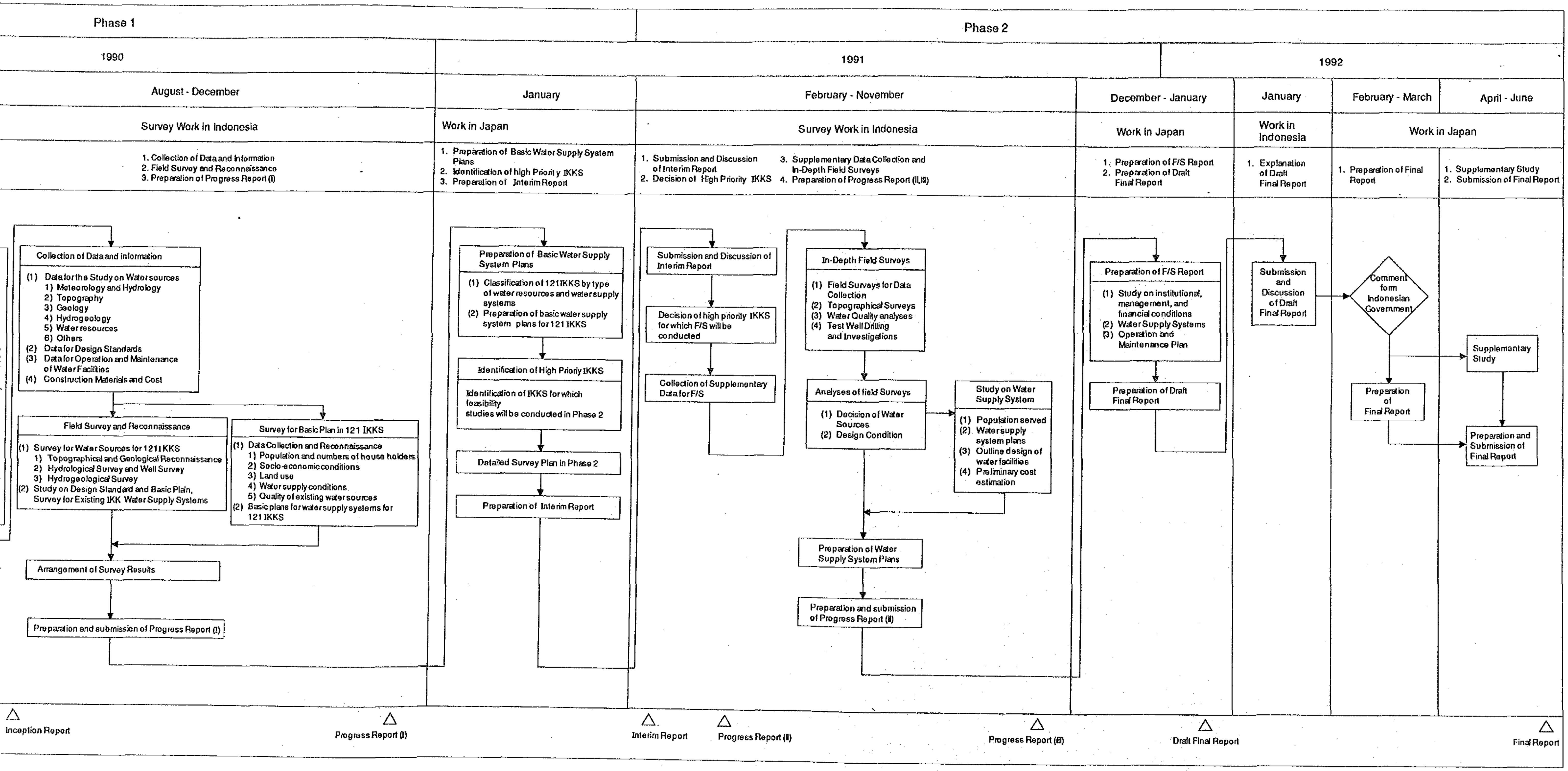
Phase 1
Phase 2
1990
1991
1992
August - December
January
February - November
December - January
January
February - March
April - June
Survey Work in Indonesia
Work in Japan
Survey Work in Indonesia
Work in Japan
Work in Indonesia
Work in Japan
1. Collection of Data and Information
2. Field Survey and Reconnaissance
3. Preparation of Progress Report (I)
1. Preparation of Basic Water Supply System Plans
2. Identification of high Priority IKKS
3. Preparation of Interim Report
1. Submission and Discussion of Interim Report
2. Decision of High Priority IKKS
3. Supplementary Data Collection and In-Depth Field Surveys
4. Preparation of Progress Report (II,III)
1. Preparation of F/S Report
2. Preparation of Draft Final Report
1. Explanation of Draft Final Report
1. Preparation of Final Report
1. Supplementary Study
2. Submission of Final Report
Collection of Data and Information
(1) Data for the Study on Water sources
1) Meteorology and Hydrology
2) Topography
3) Geology
4) Hydrogeology
5) Water resources
6) Others
(2) Data for Design Standards
(3) Data for Operation and Maintenance of Water Facilities
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(1) Survey for Water Sources for 121 IKKS
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3) Hydrogeological Survey
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3) Land use
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(2) Water supply system plans
(3) Outline design of water facilities
(4) Preliminary cost estimation
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Preparation of F/S Report
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(2) Water Supply Systems
(3) Operation and Maintenance Plan
Preparation of Draft Final Report
Submission and Discussion of Draft Final Report
Comment form Indonesian Government
Supplementary Study
Preparation of Final Report
Preparation and Submission of Final Report
Inception Report
Progress Report (I)
Interim Report
Progress Report (II)
Progress Report (III)
Draft Final Report
Final Report

CHAPTER 2 SOCIO-ECONOMIC BACKGROUND

Chapter 2 Socio-Economic Background

2.1 Economic Structure

2.1.1 National Economy

(1) Gross Domestic Product

In 1988, Gross Domestic Product (GDP) of Indonesia grew to Rp.139,452 billion at current market prices at an average annual rate of 16.7% for the period 1986-1988, while the real annual growth rate was 5.2% on average during the same period (Table 2.1.1).

Per capita GDP at current market prices amounted to Rp.804 thousand in 1988 at the average annual growth rate of 14.3% since 1986, and the real growth rate was 3.1% for the period 1986-1988 (Table 2.1.2). As seen in the above figures, the growth in the per capita GDP showed a low rate compared with that of the GDP. This was due mainly to a high growth in population.

(2) Government Budget

In the fiscal year 1988/89, budget expenditure of the Central Government amounted to Rp.32,990 billion, consisting of Rp.17,482 billion for the routine sector and Rp.12,251 billion for the development sector. These amounts, compared with the 1987/88 budget expenditure, increased by 22% for the whole expenditure, 19% for the routine sector and 29% for the development sector (Table 2.1.2). Such a considerable increase in the development budget is notable as a positive policy of the Government to the national socio-economic development.

(3) National Economic Development Plan

The economic development of Indonesia is being promoted at present on the basis of the Fifth Five-Year Development Plan (Repelita V) for the period 1989/90-1993/94, which aims to improve the living standards of people and to establish a strong foundation for the next development stage.

During the period of Repelita V, the real economic growth rate is envisaged to reach an average of 5.0% per annum, and it is expected that the per capita income also will increase at a rate of 3.1% per annum, under an average population growth rate of 1.9% per annum.

2.1.2 Regional Economy

(1) Gross Regional Domestic Product

Gross Regional Domestic Product (GRDP) at current market prices in 1987 amounted to Rp.11,977 billion for Central Java, Rp.18,458 billion for East Java and Rp.1,954 billion for Bali, and during the period 1985-1987 the average annual growth rate showed 14.2%, 14.6% and 16.5%, respectively (Tables 2.1.3-1, 2.1.3-2 and 2.1.3-3). Total amount (Rp.32,389 billion in 1987) of the GRDP of the said three provinces corresponded to 26% of the GDP of the country as a whole. However, the growth in GRDP of these provinces showed lower rate than that in the GDP of the country every year, because they have not big cities such as Jakarta and Surabaya in their territories. On the other hand, the real growth rate was only 5.3% for Central Java, 5.5% for East Java and 7.6% for Bali during the same period.

In 1987, the average annual income per capita indicated Rp.376 thousand for Central Java and Rp.534 thousand for East Java, and as for Bali although there are not available income data, it is estimated to be about Rp.800 thousand based on the per capita GRDP of Bali given in Table 2.1.3-3. These income per capita, in comparison with that of the country as a whole, was low in Central Java and East Java, but considerably high in Bali.

(2) Prices

Table 2.1.4 shows consumer price indexes for the period from 1985 to 1989 in Jakarta and other major cities close to the Study Area. During this period, the average annual price rise rate of general goods indicated 7% or more for each cities except for Jakarta. In particular, the prices in Denpasar were a high rise rate of 10.7%.

(3) Average Monthly Income per Household in 30-IKK

During the field surveys at both stages of the Master Plan and Feasibility Studies, an average monthly income per household was surveyed for objective IKKs as shown in Table 2.1.5. As a result, the average monthly household income is estimated at Rp.128,428 for the whole 30-IKK, Rp.122,610 for 14-IKK in Central Java, Rp.129,649 for 12-IKK in East Java and Rp.145,125 for 4-IKK in Bali. These incomes would be used as a basic condition for formulating the water supply plan and for estimating the water tariff to be quoted in financial analysis.

2.2 Population and Household

2.2.1 Population

Population of Indonesia and Provinces

In recent years, population censuses of Indonesia were conducted in 1980 and 1990. The 1990 population amounted to 179,322 thousand on the increase by 31,832 thousand against in 1980 population, and the average annual growth rate showed 1.97% during the period 1980-1990.

On the other hand, the 1990 population of three provinces amounted to 28,522 thousand for Central Java, 32,488 thousand for East Java and 2,777 thousand for Bali, at the average annual growth rate of 1.18%, 1.08% and 1.18% during the same period, respectively (See Table 2.2.1).

Population of Kabupaten

The census population for each of 21-Kabupaten related to 30-IKK is given in Table 2.2.2. The 1990 population was 19,020 thousand for the whole 21-Kabupaten, 10,803 thousand for 11-Kabupaten in Central Java, 7,536 thousand for 8-Kabupaten in East Java and 680 thousand for 2-Kabupaten in Bali, and during the period 1980-1990, the average annual growth rate was 0.97%, 0.98%, 0.94% and 0.92%, respectively.

Population of 30 IKKs and the Study Area

Table 2.2.3 shows the 1990 population and the estimated 2000 population for the IKK area and the Study Area. The 1990 population was 335,515 for the whole of 30 IKKS, consisting of 154,317 for 14 IKKs in Central Java, 151,707 for 12 IKKs in East Java and 30,497 for 4 IKKs in Bali. The IKK-population corresponds to 87% of the total population of the Study Area (Desas related to the IKK) for the whole of 30 IKKs, and this proportion in the said three provinces was 92%, 81% and 100% on average, respectively.

The 2000 population of each IKK is estimated using the 1990 population and the intercensal growth rate between the years 1980 and 1990. As a result, it is forecasted that the 2000 population will amount to about 400 thousand for the whole IKK at the average annual growth rate of 0.95%, and 171 thousand, 165 thousand and 33 thousand in total of IKKs in each province at the annual growth rate of 1.05%, 0.85% and 0.93%, respectively. Detail for each IKK is given in Table 2.2.3.

2.2.2 Household

According to the National Population Censuses, the average size of household (hh) Indonesia decreased from 4.9 persons/hh in 1980 to 4.5 persons/hh in 1990. Such a tendency to decrease also appeared in three provinces of Central Java, East Java and Bali, i.e. the average household size showed 4.3 persons/hh in 1990 against 4.7 persons/hh in 1980 for the whole of 21-Kabupaten which contains the 30-IKK. The breakdown is given in Tables 2.2.1 and 2.2.2.

2.3 Institutional and Organizational Aspects

2.3.1 Laws and Regulations

Domestic water supply administration of Indonesia at present is basically prescribed by the following Joint Decrees of the Minister of Home Affairs and the Minister of Public Works:

[1] The Joint Decree, No.3/1984, No.26/KPTS/1984, on "Procedures to propose the Water Supply Installation, to carry out the Temporary Management and to transfer the Management to the Regional Government".

[2] The Joint Decree, No.4/1984, No.27/KPTS/1984, on "Establishment of the Regional Water Supply Enterprises (Perusahaan Daerah Air Minum; PDAM)".

[3] The Joint Decree, No.5/1984, No.28/KPTS/1984, on "Guidelines of Organization, Accounting System, Operation and Maintenance Techniques, Structure and Calculation of Water Supply Tariff, Water Supply Services to Consumers, Water Supply Management in Kecamatan Capital (IKK) and Public Water Tap Management, for the Regional Water Supply Enterprise (Perusahaan Daerah Air Minum; PDAM) and the Water Supply Agency (Badan Pengelola Air Minum; BPAM)".

In addition to the Joint Decrees mentioned above, establishment of the BPAM is prescribed by the following decree of the Minister of Public Works:

[4] The Decree, No.269/KPTS/1984, on "Establishment of the Water Supply Agency (BPAM)".

2.3.2 Establishment, Organization and Function of BPAM and PDAM

A. Water Supply Agency, BPAM

The Water Supply Agency (Badan Pengelola Air Minum; BPAM) is established by the Minister of Public Works in accordance with the Minister Decree (No.269/KPTS/1984), with the object of supporting the Government program on water supply management in the administrative level II of regions. The majority of BPAMs related to 30 IKKs were established in the 1980s, except the BPAM of Wonogiri Kabupaten which was founded in 1976 (See Table 2.3.1).

The BPAM has the following functions:

(1) To operate and maintain the water supply installation.
(2) To conduct production, transmission and distribution of drinking water.
(3) To provide water supply services for customers.
(4) To train employees for the water supply management.

Organization of the BPAM is established by the Director General of Cipta Karya on the basis of the said Joint Decree (No.5/1984, No.28/KPTS/1984). The

standard organization structure is classified into three types in accordance with number of customers as shown below:

a.	Type A	0	-	2,500 customers
b.	Type B	2,501	-	5,000 customers
c.	Type C	5,001	-	10,000 customers

Almost all of the BPAMs related to 30 IKKs are organized by Type A (Fig. 2.3.1).

B. Regional Water Supply Enterprise, PDAM

The Regional Water Supply Enterprise (Perusahaan Daerah Air Minum; PDAM) is established in accordance with the Regional Regulations, based on Act No.5/1962 and Act No.6/1969. In the Study Area, the PDAMs are organized in eleven Kabupatens at present, including the PDAMs which were transferred from organizations of the BPAMs in 1990 and 1991 (See Table 2.3.1).

Main objective of the PDAM is to supply adequate and safety water to communities. The scope of works is as follows:

a. To build, operate and maintain the water supply installation.
b. To guide, develop and supervise a suitable and efficient use of drinking water.
c. To conduct a supervision in order to prevent illegal water use.
d. To provide a proper water supply services to communities.

The standard organization structure of the PDAM is classified into three types in accordance with number of customers as follows:

a.	Type A	less than	50,000 customers
b.	Type B	50,001 -	100,000 customers
c.	Type C	more than	100,001 customers

All PDAMs shown in Table 2.3.1 have organizations of Type A or a modified Type A (Fig. 2.3.2).

According to the said Joint Decree (No.5/1984, No.28/KPTS/1984), number of employees of the PDAM is based on number of customers. It is considered to be one (1) person per 100 customers, which is defined as an index number of one (1), and generally the index number would be more than one (1) for less than 20,000 customers and less than one (1) for more than 20,000 customers.

2.3.3 Financial Aspects of BPAM and PDAM

A. Accounting System

Finances of the BPAM and PDAM are maintained by income from water supply to customers, based on a capital and fund reserved at the initiation, and the income is allotted to operating and maintenance costs consisting of personnel expenses, power rates, equipment and materials costs, general administration cost, depreciation cost, and loan interest.

During the period of field survey, the JICA Study Team collected financial data such as the balance sheet and the profit-and-loss statement of BPAMs and PDAMs related to 30 IKKs (See Table 2.3.1). In general, a capital of the BPAM is bigger than that of the PDAM, because the BPAM holds more fund reserved than the PDAM. Result of the above-mentioned survey shows that the average capital (including the fund reserved) of the whole BPAM/PDAM is approximately Rp.1,624 million, consisting of Rp.2,294 million for the BPAM and Rp.1,137 million for the PDAM.

In 1990, the profit-and-loss account of the BPAM showed an unfavorable balance for the nine BPAMs (90% of the total number of BPAMs), and the BPAM of Kabupaten Wonogiri was the only agency with a favorable balance. To the contrary, the profit-and-loss account of the PDAM was the favorable balance for

the four PDAMs (80% of the total number of PDAMs), except the PDAM Kabupaten Karangasem of the Bali Province (Table 2.3.1).

As shown in the said table, the organizations of four Kabupaten BPAMs of Banjar Negara, Sragen, Wonogiri and Lamongan were transferred to the PDAM from 1990 through 1991, and it is said that the BPAM organization of Kabupaten Tuban also will be transferred to the PDAM in 1992.

B. Water Supply Tariff

Revenue from water supply to the BPAM/PDAM is based on a water supply tariff, and the standard tariff structure is prescribed by the foregoing Joint Decree (No.5/1984, No.28/KPTS/1984). This tariff structure is set in conformity to population size of community, quantity of water consumption and customer group, taking account of water demand and affordability to pay of customer groups, and revenue of the BPAM/PDAM (See Table 2.3.2).

The JICA Study Team collected existing water supply tariff data of the BPAM/PDAM related to the 30 IKKs during the period of field survey in 1990 and 1991, and the data include 21 sorts of tariff tables consisting of 14 BPAMs and 7 PDAMs. Among these data, the tariff structure for household is summarized in Table 2.3.3.

The tariff per m^3 is divided into four rate groups in accordance with quantity of water consumption per month; 0 m^3 - 10 m^3, 11 m^3 - 20 m^3, 21 m^3 - 30 m^3 and over 30 m^3, based on the standard tariff structure indicated in Table 2.3.2. But, these rates are not constant for all the BPAM/PDAM and varies according to social and economic conditions in respective Kabupatens (See Table 2.3.3). An average rate of the water supply tariffs for household which are being adopted at the 14 BPAMs and the 7 PDAMs is as follows:

Average Rate of Water Supply Tariff
for Household at 14 BPAMs and 7 PDAMs

(Rp/m^3)

	No.s	Water Consumption (m^3/month)			
		0 - 10	11 - 20	21 - 30	over 30
BPAM	14	144	210	277	409
PDAM	7	129	192	265	420
Whole	21	139	204	273	413

Regarding the water supply tariff, almost all of BPAMs and PDAMs adopt a minimum consumption system so as to be regarded as 10 m^3 for water consumption less than 10 m^3 per month. Besides the water supply tariff, the BPAM/PDAM impose maintenance cost of meters and administration cost on customers, at the rate of approximately Rp.500/month per customer, respectively (See Table 2.3.3).

Table 2.1.1 TRENDS OF GDP, GNP AND NATIONAL INCOME, INDONESIA, 1986-1988

Description	at Current Market Prices			Average Annual Growth Rate (%)	at 1983 Constant Market Prices			Average Annual Growth Rate (%)
	1986	1987	1988	(1986-1988)	1986	1987	1988	(1986-1988)
1. GDP (Billion Rps.)	102,546	124,539	139,452	16.71	90,014	94,302	99,697	5.24
2. Per Capita GDP (Rps.)	616,417	733,229	804,152	14.31	541,032	555,209	574,902	3.08
3. GNP (Billion Rps.)	98,353	118,522	132,715	16.24	86,211	90,054	96,319	5.71
4. Per Capita GNP (Rps.)	591,215	697,802	765,300	13.85	518,228	530,200	555,423	3.53
5. National Income (Billion Rps.)	86,697	105,112	117,631	16.58	78,265	80,789	84,969	4.20
6. Per Capita Income (Rps.)	521,150	618,849	678,321	14.18	470,418	475,538	489,977	2.06

Source : Statistical Year Book of Indonesia, 1987 & 1988, Biro pusat Statistik.

Table 2.1.2 RECEIPT AND EXPENDITURE OF CENTRAL GOVERNMENT, INDONESIA

Unit : Rp Billion

Year	Receipt			Expenditure		
	Routine	Development	Total	Routine	Development	Total
1985/86	19,252	3,572	22,824	11,951	10,873	22,824
1986/87	16,141	5,751	21,892	13,559	8,332	21,891
1987/88	20,803	6,158	26,961	17,482	9,477	26,959
1988/89	23,004	9,991	32,995	20,739	12,251	32,990

Source : Statistical Year Book of Indonesia, 1988 & 1989, Biro Pusat Statistik

Table 2.1.3-1 TRENDS OF GROSS REGIONAL DOMESTIC PRODUCT (GRDP) AND REGIONAL INCOME, CENTRAL JAVA PROVINCE, 1, 1985-1987

Description	at Current Market Prices			Average Annual Growth Rate (%)	at 1983 Constant Market Prices			Average Annual Growth Rate (%)
	1985	1986	1987	(1985-1987)	1985	1986	1987	(1985-1987)
1. GRDP (Billion Rps.)	9,177	10,465	11,977	14.24	8,034	8,495	8,905	5.28
2. Per Capita GRDP (Rps.)	341,368	384,830	435,512	12.95	298,861	312,381	323,806	4.09
3. Regional Income (Billion Rps.)	8,213	9,228	10,342	12.22	7,161	7,441	7,626	3.20
4. Per Capita Income (Rps.)	305,511	339,345	376,057	10.95	266,387	273,630	277,323	2.03

Souce : Central Java in Figures, 1989, Statistical Office of Central Java Province

Table 2.1.3-2 TRENDS OF GROSS REGIONAL DOMESTIC PRODUCT (GRDP) AND REGIONAL INCOME, EAST JAVA PROVINCE, 1985-1987

Description	at Current Market Prices			Average Annual Growth Rate (%)	at 1983 Constant Market Prices			Average Annual Growth Rate (%)
	1985	1986	1987	(1985-1987)	1985	1986	1987	(1985-1987)
1. GRDP (Billion Rps.)	14,052	15,824	18,458	14.63	12,131	12,894	13,514	5.55
2. Per Capita GRDP (Rps.)	450,932	501,138	577,033	13.14	389,288	408,337	422,488	4.18
3. Regional Income (Billion Rps.)	13,115	14,620	17,076	14.14	11,326	12,040	12,613	5.53
4. Per Capita Income (Rps.)	420,851	462,985	533,851	12.66	363,456	381,274	394,320	4.16

Source : East Java in Figures, 1988, Statistical Office of East Java Province

Table 2.1.3-3 TRENDS OF GROSS REGIONAL DOMESTIC PRODUCT (GRDP), BALI PROVINCE, 1985-1987

Description	at Current Market Prices			Average Annual Growth Rate (%)	at 1983 Constant Market Prices			Average Annual Growth Rate (%)
	1985	1986	1987	(1985-1987)	1985	1986	1987	(1985-1987)
1. GRDP (Billion Rps.)	1,440	1,693	1,954	16.49	1,073	1,153	1,244	7.67
2. Per Capita GRDP (Rps.)	545,509	632,570	720,593	14.94	406,247	430,708	458,707	6.26
3. Regional Income (Billion Rps.)	-	-	-	-	-	-	-	-
4. Per Capita Income (Rps.)	-	-	-	-	-	-	-	-

Source : Statistical Year Book of Bali, 1989, Statistical Office of Bali Province

Table 2.1.4 CONSUMER PRICE INDEXES OF MAJOR CITIES RELATED TO THE STUDY AREA, 1985-1989 (April 1977 - March 1978 = 100)

City	Sector	Year					Average Annual Rise Rate (%) (1985-1989)
		1985	1986	1987	1988	1989	
Jakarta	General	229.9	242.5	264.3	283.8	301.0	6.98
	Food	206.2	224.0	246.3	277.3	300.9	9.92
	Housing	268.7	278.5	293.2	308.1	324.2	4.81
	Clothing	193.3	201.2	221.7	229.6	240.0	5.59
	Micellaneous	240.1	249.0	279.7	289.5	299.6	5.76
Semarang	General	253.9	270.4	295.7	321.1	341.6	7.71
	Food	215.6	236.1	263.5	289.0	327.4	11.02
	Housing	292.6	307.0	322.0	337.8	357.3	5.12
	Clothing	284.1	303.4	344.4	367.8	388.1	8.16
	Micellaneous	271.3	280.6	306.2	318.1	328.3	4.91
Yogyakarta	General	271.3	288.8	317.6	344.0	363.0	7.56
	Food	239.9	259.5	293.4	337.3	365.4	11.13
	Housing	333.0	352.1	372.5	391.0	402.3	4.85
	Clothing	223.4	238.3	271.7	284.8	297.6	7.50
	Micellaneous	280.9	294.2	320.9	330.9	338.8	4.83
Surabaya	General	273.3	288.3	317.1	342.5	368.0	7.73
	Food	254.6	276.4	309.1	343.9	373.4	10.06
	Housing	293.7	302.9	322.1	338.7	370.0	5.97
	Clothing	238.9	248.8	287.5	304.9	321.0	7.76
	Micellaneous	296.0	307.8	338.5	352.5	373.9	6.04
Denpasar	General	284.3	314.6	352.8	394.1	427.6	10.75
	Food	302.7	349.7	401.8	480.0	535.8	15.38
	Housing	280.6	294.1	314.6	324.6	339.8	4.91
	Clothing	234.6	259.1	322.5	331.7	340.3	10.09
	Micellaneous	265.1	279.1	294.7	299.8	313.9	4.33

Source : Statistical Year Book of Indonesia 1989, Biro Pusat Statistik.

Table 2.1.5 AVERAGE MONTHLY INCOME PER HOUSEHOLD IN 30-IKK

NO.	IKK	Master Plan Stage		Feasibility Study Stage			Monthly Income to be applied for Feasibility Study (Rp)	
		Monthly Income (Rp.)	Monthly Expenditure (Rp)	Monthly Income (Rp) Low	Medium	High		
	(1) CENTRAL JAVA PROVINCE							
1	Bulakamba	54,312	47,872	75,000	137,500	187,500	137,500	
2	Jeruklegi	109,167	94,167	51,567	107,166	174,569	107,166	
3	Kemiri	60,934	58,744	75,000	150,000	300,000	150,000	
4	Madukora	116,667	91,667	30,000	100,000	200,000	100,000	
5	Punggelan	112,917	87,917	40,000	60,000	80,000	112,917	*
6	Karanggayam	79,167	79,167	37,500	52,500	262,500	79,167	*
7	Petanahan	109,167	109,167	45,500	80,000	105,000	109,167	*
8	Sukorejo	97,917	97,917	70,000	-	200,000	97,917	*
9	Jepon	139,167	119,167	70,000	160,000	310,000	160,000	
10	Batangan	97,917	82,917	50,000	200,000	300,000	200,000	
11	Gondang	86,667	71,667	-	37,500	147,000	86,667	*
12	Jenar	78,042	74,542	45,000	67,000	104,000	78,042	*
13	Giriwoyo	94,167	84,167	60,000	143,000	187,500	143,000	
14	Bawen	79,167	74,167	96,000	155,000	300,000	155,000	
	Average of (1)	93,955	83,803	57,351	111,513	204,148	122,610	
	(2) EAST JAVA PROVINCE							
1	Balen	131,728	-	87,250	125,500	160,770	131,728	*
2	Baureno	135,812	-	105,000	120,000	145,000	135,812	*
3	Jenu	110,526	100,526	60,000	81,000	105,000	110,526	*
4	Kembangbahu	110,526	105,526	49,775	107,245	159,715	110,526	*
5	Diewk	82,895	-	35,000	175,000	325,000	175,000	
6	Jiwan	118,421	-	84,250	168,500	337,000	168,500	
7	Kutorejo	102,632	-	80,000	105,000	128,000	105,000	
8	Tempeh	63,158	55,658	60,000	80,000	120,000	80,000	
9	Kunir	94,737	74,737	40,000	50,000	195,000	94,737	*
10	Tempursari	120,789	117,789	104,750	150,750	199,000	150,750	
11	Banyuanyar	86,842	86,842	132,600	145,560	174,820	145,560	
12	Sumberasih	98,684	-	119,200	147,650	170,250	147,650	
	Average of (2)	104,729	90,180	79,819	121,350	184,963	129,649	
	(3) BALI PROVINCE							
1	Tampak Siring	59,831	-	75,000	115,000	200,000	115,000	
2	Ketewel	113,263	98,263	135,000	180,000	270,000	180,000	
3	Menanga	77,221	-	105,000	140,500	225,000	140,500	
4	Sibetan	99,748	84,748	53,000	145,000	241,000	145,000	
	Average of (3)	87,516	91,506	92,000	145,125	234,000	145,125	
	Average of Whole	97,406	86,242	71,427	120,220	200,454	128,428	

Note : The medium income, except incomes marked (*) which are quoted from data at the master plan stage, is adopted to the feasibility study.

Table 2.2.1 POPULATION, NUMBER OF HOUSEHOLD AND HOUSEHOLD SIZE IN THE 1980 1990 CENSUSES OF INDONESIA, CENTRAL JAVA, EAST JAVA AND BALI

Region	Population ('000)		Average Annual Growth Rate (%)	Number of Household ('000)		Average Household Size (Persons/HH)	
	1980	1990	1980-1990	1980	1990	1980	1990
Indonesia	147,490	179,322	1.97	30,372	39,689	4.9	4.5
Province	57,012	63,787	1.13	12,250	14,860	4.7	4.3
Central Java	25,373	28,522	1.18	5,286	6,414	4.8	4.4
East Java	29,169	32,488	1.08	6,479	7,845	4.5	4.1
Bali	2,470	2,777	1.18	485	601	5.1	4.6

Source : Hasil Sensus Punduduk 1990, Indonesia.

Table 2.2.2 POPULATION, NUMBER OF HOUSEHOLD AND AVERAGE HOUSEHOLD SIZE OF KABUPATENS RELATED TO THE STUDY AREA IN THE 1980 AND 1990 CENSUSES

Kabupaten	Census Population		Average Annual Growth Rate (%)	Number of Household ('000)		Average Household Size (Persons/HH)	
	1980	1990	1980-1990	1980	1990	1980	1990
(1) Central Java	9,778,070	10,803,430	1.00	2,050	2,462	4.8	4.4
1. Brebes	1,264,078	1,521,835	1.87	272	335	4.7	4.5
2. Cilacap	1,333,395	1,487,308	1.10	275	335	4.8	4.4
3. Purworejo	697,301	700,788	0.05	149	165	4.7	4.2
4. Banjar Negara	676,751	771,774	1.32	138	169	4.9	4.6
5. Kebumen	1,032,226	1,120,982	0.83	209	242	4.9	4.6
6. Kendal	702,074	799,117	1.30	152	184	4.6	4.3
7. Blora	696,523	767,292	0.97	146	180	4.8	4.3
8. Pati	975,521	1,064,115	0.87	211	262	4.6	4.1
9. Sragen	758,461	825,517	0.85	163	193	4.7	4.3
10. Wonogiri	935,453	958,892	0.25	187	217	5.0	4.4
11. Semarang	706,287	785,810	1.07	148	180	4.8	4.4
(2) East Java **	6,864,784	7,536,051	0.94	1,517	1,794	4.5	4.2
1. Bojonegoro	999,066	1,103,944	1.00	208	252	4.8	4.4
2. Tuban	871,739	977,614	1.15	183	222	4.8	4.4
3. Lamongan	1,049,808	1,143,344	0.86	213	249	4.9	4.6
4. Jombang	941,789	1,048,682	1.08	199	242	4.7	4.3
5. Madiun	622,243	633,873	0.19	140	159	4.4	4.0
6. Mojokerto	688,997	786,943	1.34	156	190	4.4	4.1
7. Lumajang	874,263	924,856	0.56	207	238	4.2	3.9
8. Probolinggo	816,879	916,795	1.16	211	242	3.9	3.8
(3) Bali	620,443	680,151	0.92	122	141	5.1	4.8
1. Gianyar	306,129	336,738	0.96	57	65	5.3	5.2
2. Karangasem	314,314	343,413	0.89	65	76	4.8	4.5
(4) Total	17,263,297	19,019,632	0.97	3,689	4,397	4.7	4.3

Source : * Hasil Sensus Punduduk 1990, Indonesia.

Note : ** Population in the East Java Province excludes persons without permanent residences.

Table 2.2.3 POPULATION OF THE STUDY AREA AND 30 IKKs

NO.	KABUPATEN	IKK	Average Annual Growth Rate (%) 1990-2000	1990 Population		2000 Population		Ratio (2)/(1) or (4)/(3) (%)
				Study Area (1)	IKK Area (2)	Study Area (3)	IKK Area (4)	
	(1) CENTRAL JAVA PROVINCE		1.05	168,115	154,317	186,600	171,360	92
1	BREBES	Bulakamba	0.35	18,444	18,444	19,100	19,100	100
2	CILACAP	Jeruklegi	1.57	15,720	15,720	18,370	18,370	100
3	PURWOREJO	Kemiri	1.75	12,493	12,493	14,860	14,860	100
4	BANJAR NEGARA	Madukora	1.09	6,568	6,568	7,320	7,320	100
5		Punggelan	1.37	9,066	5,630	10,390	6,450	62
6	KEBUMEN	Karanggayam	1.19	6,707	4,371	7,550	4,920	65
7		Petanahan	0.32	9,521	8,155	9,830	8,420	86
8	KENDAL	Sukorejo	0.66	14,054	14,054	15,010	15,010	100
9	BLORA	Jepon	1.56	12,549	12,549	14,650	14,650	100
10	PATI	Batangan	0.93	9,207	9,207	10,100	10,100	100
11	SRAGEN	Gondang	0.99	19,554	18,423	21,580	20,330	94
12		Jenar	0.96	11,658	7,180	12,830	7,900	62
13	WONOGIRI	Giriwoyo	0.25 *1	6,953	5,902	7,130	6,050	85
14	SEMARANG	Bawen	1.36	15,621	15,621	17,880	17,880	100
	(2) EAST JAVA PROVINCE		0.85	186,709	151,701	203,330	165,080	81
1	BOJONEGORO	Balen	1.00 *1	15,122	13,489	16,700	14,900	89
2		Baureno	1.00 *1	11,539	11,235	12,750	12,410	97
3	TUBAN	Jenu	1.15 *1	9,584	9,584	10,740	10,740	100
4	LAMONGAN	Kembangbahu	0.86 *1	5,891	5,891	6,420	6,420	100
5	JOMBANG	Diewk	1.08 *1	18,324	12,891	20,400	14,350	70
6	MADIUN	Jiwan	0.19 *1	19,737	18,716	20,110	19,070	95
7	MOJOKERTO	Kutorejo	1.34 *1	20,161	14,139	23,030	16,150	70
8	LUMAJANG	Tempeh	0.56 *1	20,239	13,385	21,400	14,150	66
9		Kunir	0.56 *1	22,396	18,179	23,680	19,220	81
10		Tempursari	0.56 *1	14,673	10,856	15,510	11,480	74
11	PROBOLINGGO	Banyuanyar	1.16 *1	19,401	14,547	21,770	16,330	75
12		Sumberasih	1.16 *1	9,642	8,789	10,820	9,860	91
	(3) BALI PROVINCE		0.93	30,497	30,497	33,450	33,450	100
1	GIANYAR	Tampak Siring	0.96 *1	7,932	7,932	8,730	8,730	100
2		Ketewel	0.96 *1	8,404	8,404	9,250	9,250	100
3	KARANGASEM	Menanga	0.89 *1	5,270	5,270	5,760	5,760	100
4		Sibetan	0.89 *1	8,891	8,891	9,710	9,710	100
	(4) TOTAL		0.95	385,321	336,515	423,380	369,890	87

Source: * IKK Population Survey in 1990 and 1991, JICA Study Team and Local Consultant ENCONA.

Note: *1: Population Growth Rate of Kabupatens concerned.

Table 2.3.1 EXISTING CONDITION OF FINANCE OF BPAM/PDAM RELATED TO 30 IKKs

NO.	BPAM or PDAM	KABUPATEN	Name of IKK belong to Kabupaten	Establishment Year	Number of Employee	Number of IKK with W-Supply System already	Capital and Fund Reserved (1000 Rps.)	Profit and Loss Statement (in Thausand Rps.) 1987/88 Profit	Loss	Balance	1988/89 Profit	Loss	Balance	1989/90 Profit	Loss	Balance
	(1) CENTRAL JAVA PROVINCE															
1	BPAM	RREBES	Bulakamba	-	104	7	-	-	-	-	-	-	-	-	-	-
2	BPAM	CILACAP	Jeruklegi	1983	60	3	5,847,740	-	-	-	240,056	228,009	12,047	398,637	784,771	(386,134)
3	PDAM	PURWOREJO	Kemiri	1974	69	1	2,357,934	356,438	289,283	67,155	586,555	514,796	71,759	645,202	576,586	68,616
4.1	BPAM	BANJAR NEGARA	Madu.& Pung.	1983	35	3	-	97,095	63,054	34,041	115,773	81,624	34,149	144,737	215,486	(70,749)
4.2	PDAM	BANJAR NEGARA	Madu.& Pung.	1990	35	3	1,127,002	-	-	-	-	-	-	-	-	-
5	BPAM	KEBUMEN	Karan.& Petan.	1987	32	2	-	-	-	-	-	-	-	-	-	-
6	PDAM	KENDAL	Sukorejo	1986	56	4	691,265	148,573	174,488	(25,915)	318,918	275,706	43,212	353,360	280,635	72,725
7	BPAM	BLORA	Jepon	1983	53	6	2,631,816	168,232	249,769	(81,537)	173,787	275,497	(101,710)	-	-	-
8	BPAM	PATI	Batangan	1981	52	5	1,032,498	-	-	-	-	-	-	-	-	-
9.1	BPAM	SRAGEN	Gond.& Jen.	1983	38	4	1,349,994	96,658	181,816	(85,158)	103,056	204,382	(101,326)	211,749	245,203	(33,454)
9.2	PDAM	SRAGEN	Gond.& Jen.	1990	38	4	1,515,754	-	-	-	-	-	-	-	-	-
10.1	BPAM	WONOGIRI	Giriwoyo	1976	57	4	-	141,895	182,492	(40,597)	174,599	199,598	(24,999)	283,983	274,918	9,065
10.2	PDAM	WONOGIRI	Giriwoyo	1990	57	4	665,600	(transfer from BPAM to PDA since balance came to plus in 1990)								
11	PDAM	SEMARANG	Bawen	1980	499	3	-	-	-	-	-	-	-	-	-	-
	(2) EAST JAVA PROVINCE															
12	BPAM	BOJONEGORO	Balen & Baur.	1982	40	3	1,044,692	144,220	195,385	(51,165)	193,132	243,552	(50,420)	266,346	361,938	(95,592)
13.1	BPAM	TUBAN	Jenu	1985	40	8	-	105,671	168,284	(62,613)	216,417	225,223	(8,806)	195,958	284,177	(88,219)
13.2	PDAM	TUBAN	Jenu	1992	40	8	938,034	-	-	-	-	-	-	-	-	-
14.1	BPAM	LAMONGAN	Kembangbahu	1984	80	5	-	-	-	-	282,152	447,006	(164,854)	429,905	507,433	(77,528)
14.2	PDAM	LAMONGAN	Kembangbahu	1991	80	5	1,692,884	-	-	-	-	-	-	-	-	-
15	BPAM	JOMBANG	Diewk	1981	48	5	1,613,728	157,824	178,604	(20,780)	162,825	181,667	(18,842)	201,997	250,130	(48,133)
16	BPAM	MADIUM	Jiwan	1989	33	8	3,167,830	-	-	-	-	-	-	62,858	206,909	(144,051)
17	PDAM	MOJOKERTO	Kutorejo	1980	51	1	649,195	127,451	115,262	12,189	206,387	180,569	25,818	-	-	-
18	PDAM	LUMAJANG	Tem,Kun & T-sa	1983	59	3	1,815,350	-	-	-	-	-	-	-	-	-
19	BPAM	PROBOLINGGO	Bany.& Sumbe.	1989	48	7	-	-	-	-	-	-	-	-	-	-
	(3) BALI PROVINCE															
20	BPAM	GIANYAR	Tam-Si,& Ket.	1980	63	6	1,666,588	-	-	-	-	-	-	-	-	-
21	PDAM	KARANGASEM	Mena.& Sibe.	-	52	6	481,827	-	-	-	89,951	104,913	(14,962)	134,264	139,653	(5,389)

Source: Financial Data of BPAM and PDAM.

Note : Figures in ( ) shows minus.

Table 2.3.2 STANDARD TARIFF STRUCTURE

Water Consumption (m3) Per Month	Customer Groups								
	I		II		III		IV		V
	A	B	A	B	A	B	A	B	
(1) Small and Medium Cities (500,000 population and less)									
0 - 10	1a	0.8a	1a	1a	2.5a	4a	3a	5a	15a
11 - 20	0.8a	1a	1.5a	1.5a	2.5a	4a	3a	5a	15a
21 - 30	-	1.5a	2a	2a	5a	8a	6a	10a	15a
more than 30	-	2a	3a	3a	5a	8a	6a	10a	15a
(2) Large City and Metropolis (more than 500,000 population)									
0 - 15	1a	0.8a	1a	1.5a	4a	5a	4.5a	6a	20a
16 - 30	0.8a	1.5a	2a	2.5a	4a	5a	4.5a	6a	20a
31 - 50	-	2a	3a	4a	8a	10a	9a	12a	20a
more than 50	-	3a	5a	6a	8a	10a	9a	12a	20a

Source : Joint Decree (No.5/1984, No.28/KPTS/1984) of Ministry of Home Affairs and Ministry of Public Works.

Note : Coefficient "a" is given by dividing the total cost of operation and maintenance by the total quantity of water consumption (Rps./M3).

Remarks : CUSTOMER GROUPS

Group I : Social
- A. General - public tap, public bath room and public toilet
- B. Special - public health service, official clinic and hospital, and religious facilities

Group II : Non-Commercial
- A. Household
- B. Government office and facilities

Group III : Commercial
- A. Small commercial
- B. Large commercial

Group IV : Industry
- A. Small industry
- B. Large industry

Group V : Special - Harbor and Air Port

Table 2.3.3 WATER SUPPLY TARIFF OF BPAM AND PDAM FOR HOUSEHOLD

NO.	BPAM or PDAM	KABUPATEN	Name of IKK belong to Kabupaten	Establishment Year	Number of Employee	Number of IKK with W-Supply System already	(1) Water Supply Tariff (Rp./m3) 0 - 10 (m3)	11 - 20 (m3)	21 - 30 (m3)	over 31 (m3)	(2) Maintenance Cost of Mater (1/2") (Rp/month)	(3) Administration Cost (Rp/month)	(4) =(2)+(3) Total	(5) Remarks Minimum Rate (Rp/month)	
	(1) CENTRAL JAVA PROVINCE														
1	BPAM	BREBES	Bulakamba	-	104	7	125	175	225	300	-	-	-	IKK:2500	
2	BPAM	CILACAP	Jeruklegi	1983	60	3	100	150	200	300	250	10%	-	Min:10m3	
3	PDAM	PURWOREJO	Kemiri	1974	69	1	100	150	200	300	400	150	550	Min:1000	
4.1	BPAM	BANJAR NEGARA	Madu.& Pung.	1983	35	3	160	200	250	350	250	10%	-	Min:10m3	
4.2	PDAM	BANJAR NEGARA	Madu.& Pung.	1990	35	3	-	-	-	-	-	-	-	-	
5	BPAM	KEBUMEN	Karan.& Petan.	1987	32	2	125	185	250	375	300	20%	-	Min:10m3	
6	PDAM	KENDAL	Sukorejo	1986	56	4	160	240	395	790	500	500	1,000	-	
7	BPAM	BLORA	Jepon	1983	53	6	150	225	300	450	500	10%	-	Min:10m3	
8	BPAM	PATI	Batangan	1981	52	5	150	225	300	450	300	200	500	Min:10m3	
9.1	BPAM	SRAGEN	Gond.& Jen.	1983	38	4	150	225	300	450	-	500	-	Min:10m3	
9.2	PDAM	SRAGEN	Gond.& Jen.	1990	38	4	-	-	-	-	-	-	-	-	
10.1	BPAM	WONOGIRI	Giriwoyo	1976	57	4	165	245	330	495	-	500	-	Min:10m3	
10.2	PDAM	WONOGIRI	Giriwoyo	1990	57	4	-	-	-	-	-	-	-	-	
11	PDAM	SEMARANG	Bawen	1980	499	3	140	210	275	410	750	250	1,000	Min:1000	
	(2) EAST JAVA PROVINCE														
12	BPAM	BOJONEGORO	Balen & Baur.	1982	40	3	125	187.5	250	375	250	550	800	Min:10m3	
13.1	BPAM	TUBAN	Jenu	1985	40	8	135	202.5	270	405	250	400	650	Min:10m3	
13.2	PDAM	TUBAN	Jenu	1992	40	8	-	-	-	-	-	-	-	-	
14.1	BPAM	LAMONGAN	Kembangbahu	1984	80	5	200	300	400	600	750	500	1,250	Min:10m3	
	BPAM	LAMONGAN	Kembangbahu	1984	80	5	1890	(specific rate per month)			300	310	2500	for IKK	
14.2	PDAM	LAMONGAN	Kembangbahu	1991	80	5	-	-	-	-	-	-	-	-	
15	BPAM	JOMBANG	Diewk	1981	48	5	160	200	225	275	250	500	750	Min:10m3	
16	BPAM	MADIUM	Jiwan	1989	33	8	125	187.5	250	375	250	500	750	Min:10m3	
17	PDAM	MOJOKERTO	Kutorejo	1980	51	1	100	150	200	300	-	-	-	Min:1000	(1983 tariff)
18	PDAM	LUMAJANG	Tem,Kun & T-sa	1983	59	3	160	240	320	480	1,000	0	1,000		(1991 tariff)
19	BPAM	PROBOLINGGO	Bany.& Sumbe.	1989	48	7	125	187.5	250	375	500	300	800	Min:10m3	
	(3) BALI PROVINCE														
20	BPAM	GIANYAR	Tem-Si,& Ken.	1980	63	6	150	225	300	450	900	-	-	Min:10m3	
21.1	PDAM	KARANGASEM	Mena.& Sibe.	-	52	6	120	180	240	360	500	-	-	Min:10m3	
21.2	PDAM	KARANGASEM	(Selat)	1987	52	6	75	115	150	225	500	-	-	-	
21.2	PDAM	KARANGASEM	(Kubu,Rendang,Mangis)		52	6	250	375	500	750	500	-	-	-	

Source: Tariff Tables of BPAM and PDAM

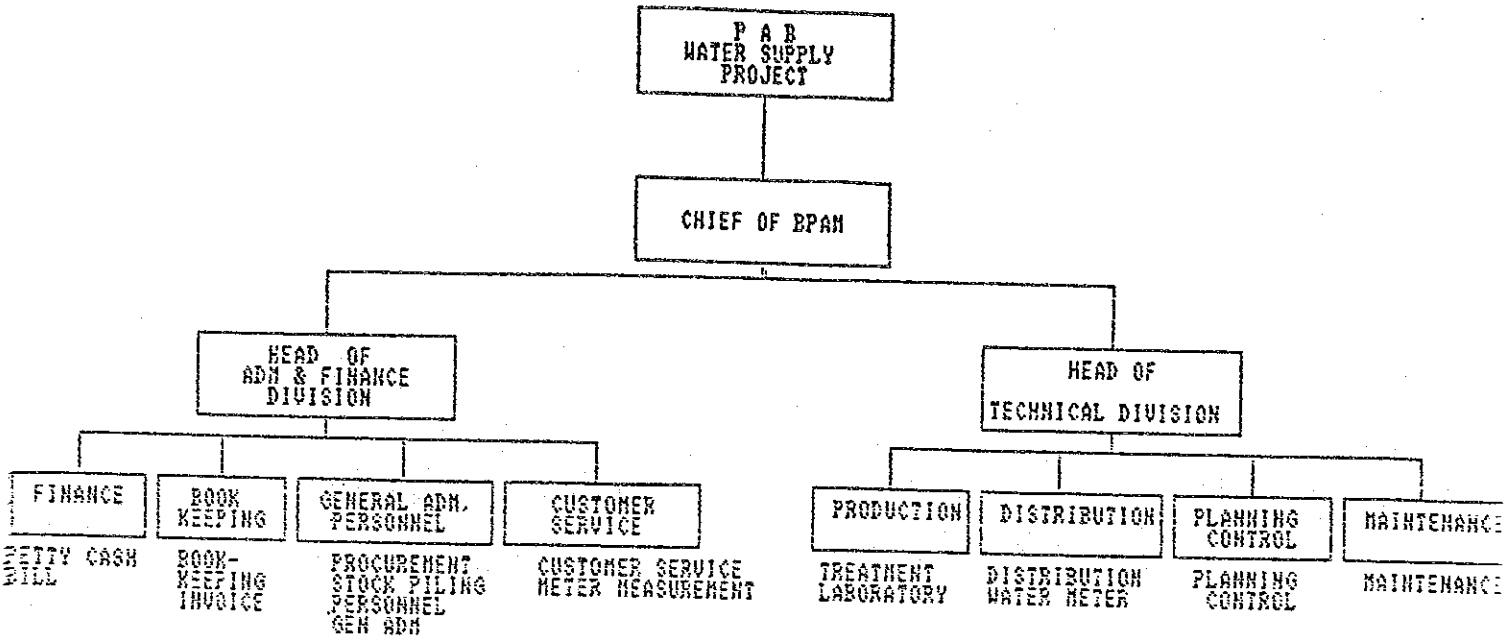

Fig. 2.3.1 ORGANIZATION STRUCTURE OF BPAM, TYPE A

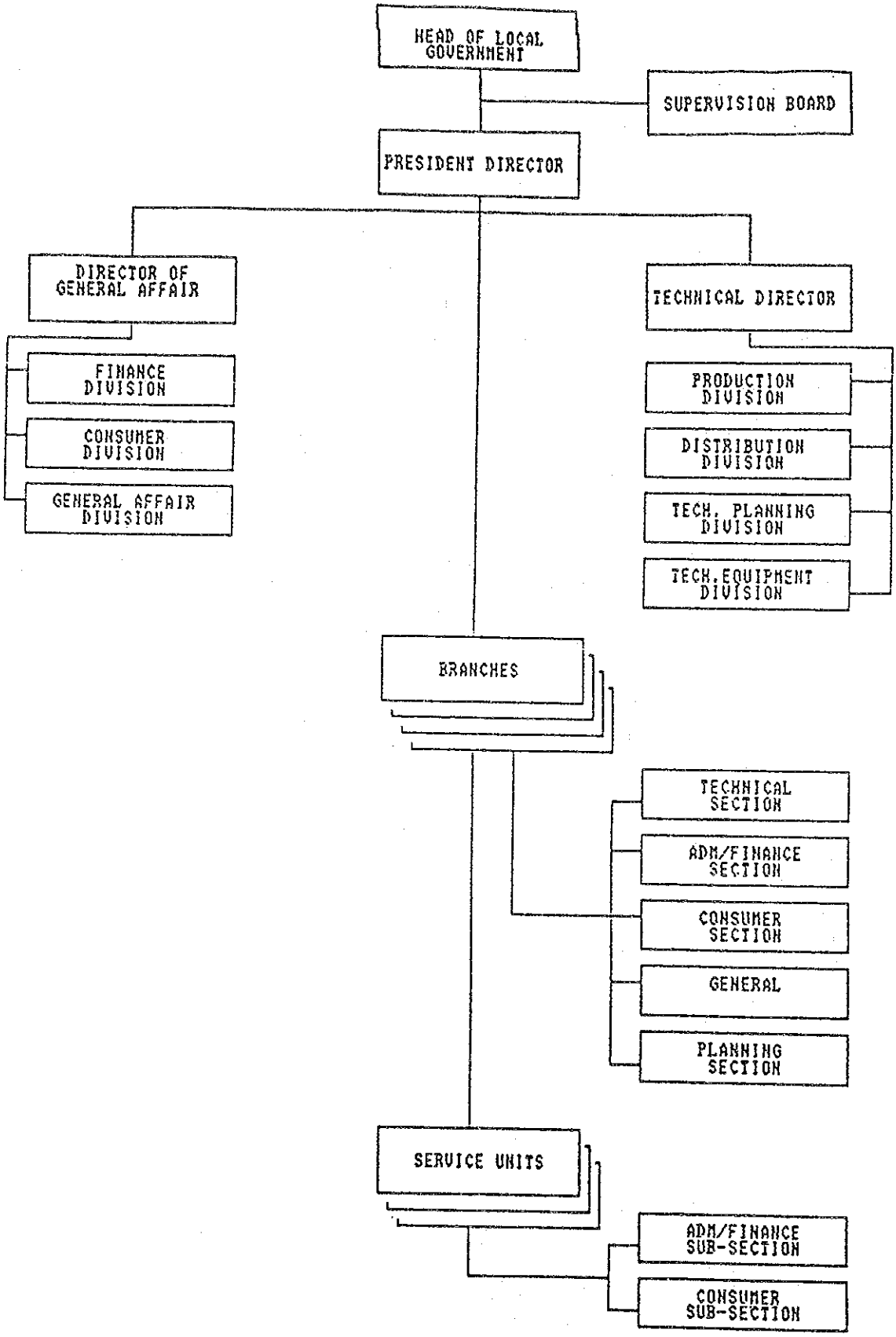

Fig. 2.3.2 ORGANIZATION STRUCTURE OF PDAM, TYPE A

CHAPTER 3 INVESTIGATION ON WATER RESOURCES

Chapter 3 INVESTIGATION ON WATER RESOURCES

Introductory Remarks

This chapter presents all information related to and developed from site investigations on water resources performed during the Phase I works in 1990 and the Phase II works in 1991 for a water supply source study of designated IKKs in Central Java, East Java and Bali.
Site investigations on water resources consisted of the following activities.

Phase I

1) Collection and review of existing data and information; on topography, geology, meteorology, hydrology, hydro-geology, and test well results.
2) Field survey and site reconnaissance; on topographical and geological conditions, fluctuation of surface water level and groundwater level, existing well conditions, potential springs, and bacteria and coliform detections in water of springs and dug wells.
3) Geophysical resistivity survey; by the Schlumberger method and the loop-loop method.

Phase II

1) Supplementary data collection.
2) Confirmatory site observations; on geological and hydrological conditions.
3) Test well drilling and pumping test.
4) Water quality analysis; on proposed spring water and groundwater.
5) Review and analysis of investigated results.

3.1 Meteorology and Hydrology

3.1.1 Meteorological and Hydrological Features of the Study Region

(1) Meteorological Features

The climate of Java and Bali is typical of tropical region and is divided into two seasons, i.e. the dry season (the dries) and wet season (the rainy season or the rains in other words). Temperature is high (25°C-30°C) all the year round except some plateau areas such as Pagentan, Dieng, and Wonosobo in Central Java and Mountain top areas, where mean temperature is less than 20°C. Humidity is also high especially in the wet season. Wind comes from the south in general.

Generally the dry season extends from June to October, but in some mountainous areas it begins in July and ends in September and in some coastal areas it begins May and ends in September-October. The other months are classified as the wet season. Monthly variation of rainfall at representative cities nearby studied regions and at Kabupatens related to studied area is summarized in Fig. B.1.1 and B.1.2 of accompanied SUPPORTING REPORT B. According to these figures, more than 80% of annual rainfall occurs during the wet season, and there is little rainfall in August and at some places in September.

Rainfall isohyete map is provided for the Central and East Java and the Bali in Fig. B.1.3 and Fig. B.1.4 of SUPPORTING REPORT B.

Generally speaking, stratovolcano zone receives much rainfall of more than 3,000mm/year and the north coastal zone receives the lowest rainfall of less than 2,000mm/year. In the hilly region and in the south coastal area, the annual rainfall ranges from 1,500mm to 3,500mm.

(2) Hydrological Features

Island of Java and Bali consist mainly of mountains and hills. In other words, the watershed gradient is high and the drainage length is relatively small.

In addition to these topographic features, the terrain is generally covered by brown soil stratum that is of practically impervious.

From such geophysical conditions, it can be said that runoff of rainfall is rapid, the time of concentration or duration is relatively short, and infiltration of rainfall during heavy rains is small; therefore, high percentage of rainfalls will drain out through rivers.

During the rains of high intensity fall, rivers are subjected to flooding. Water level in river rises several meters in such a case. For example, the Cissanggarung river raises its water level up to 6m high during a flood in the downstream area. The water depth of this river is only about 0.25m during the dry season. At an middle-upstream area of the Solo river, the water level rises 4.5-5.0m during a flood compared with normal flow conditions. Such a phenomenon was identified from the flood mark during the field reconnaissance.

Groundwater is recharged by rivers of upstream region and by rain water infiltration in the mountainous area of high rainfall. In Bali, terraced rice fields is another source of recharge. Groundwater emerges as seepage and spring if topographical and geological conditions satisfy its requirements. River and groundwater interplay each other. At some place and at some time a river gains water from groundwater, and at the other place and time it looses water to recharge groundwater. Replenishment of river and groundwater is accomplished during the rains, and depletion of them occurs during the dries.

During the field survey in August through October, 1990, it was noticed that most rivers flow a little water and many dug wells are at a depleted condition. According to hearing, seasonal fluctuation of water level in dug wells is more than 5m at some places and is about 2m or less at other places.

Regarding the evapotranspiration a few data were obtained. Annual evaporation is 1,820mm in the Madiun city of El.+65m and 1,110mm at Ngebel of El.+735m in the west flank of Mt. Wilis. Potential evapotranspiration for short grass area is estimated to be about 1,700mm/year for Demak plain and Juwana plain, which decrease to about 1,300mm/year at a place of El.+1,000m.

3.1.2 Flow Rate of Spring Water

In case of assuming the capacity of water source, it is necessary to study a long term monitored record of flow variation of sources together with relevant record of rainfall, infiltration, eveporation and etc. But unfortunately, except some short term rainfall records, such long term monitored records couldn't be obtained; therefore, study of inter-correlation between rainfall and flow rate was practically impossible.

During the site survey of 121 IKKs in the Phase I, the flow rate of springs was measured on site as many as possible, and seasonal fluctuation of spring flow and of water level of wells were investigated through hearing from the local people.

After the Phase I study, 30 IKKs were selected as high priority IKKs, and 9 IKKs among them were scheduled to take in water from springs. To confirm the availability of proposed springs, the flow rate of springs proposed as water source for those 9 IKKs measured at site in August 1991.

Some springs have been used as sources for irrigation and some others are under planning to be used for other water supply.

Accordingly, availability of those springs was confirmed through hearing from officials of related Kecamatan and Bappeda or PDAM.

All springs proposed for 9 IKKs have enough and to spare discharge water.

Table B.1.1 of accompanied SUPPORTING REPORT B shows flow rate and availability of proposed springs.