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

EXECUTIVE SUMMARY

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".

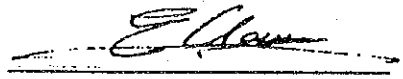
This report has been prepared by the Study Team in accordance with the contracts signed on 2 August 1990, 22 February 1991, 13 May 1991 and 23 March 1992 between the Japan International Cooperation Agency and Pacific Consultants International Co., Ltd./Kajitani Engineering Co., Ltd.

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

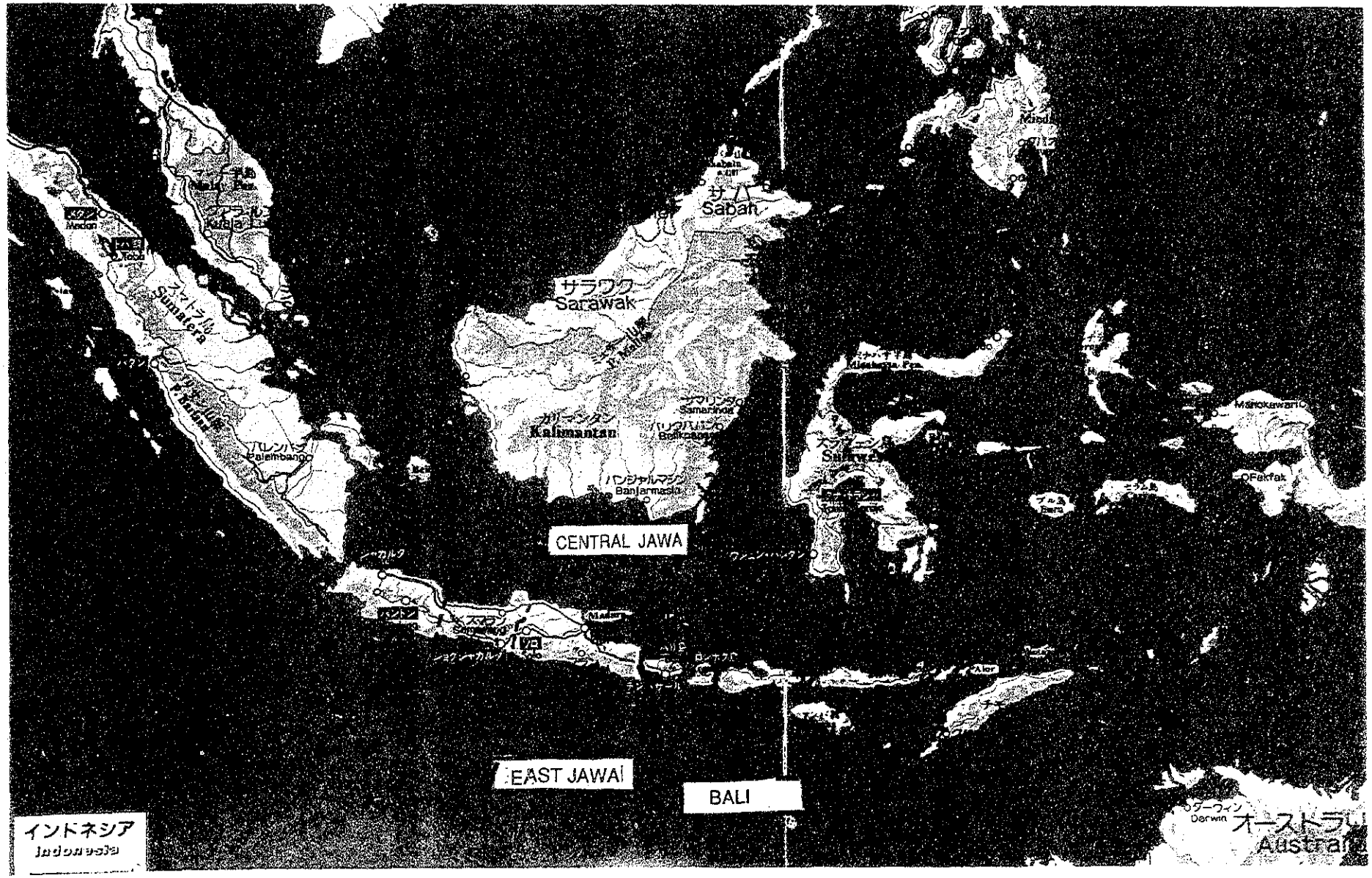


TABLE OF CONTENTS

1. Introduction

The Government of Indonesia (GOI) requested the study on IKK System Water Supply Project in provinces of Central Java, East Java and Bali to the Government of Japan.
Number of IKKs requested is 121 in three (3) provinces ; 61 IKKs in Central Java, 40 IKKs in East Java and 20 IKKs in Bali.

This study was carried out by the Study Team of the Japan International Cooperation Agency (JICA) in collaboration with the officials concerned of the GOI from August 1990 to January 1992.

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

Phase 2: The feasibility study on water supply systems for 30 high priority IKKS.

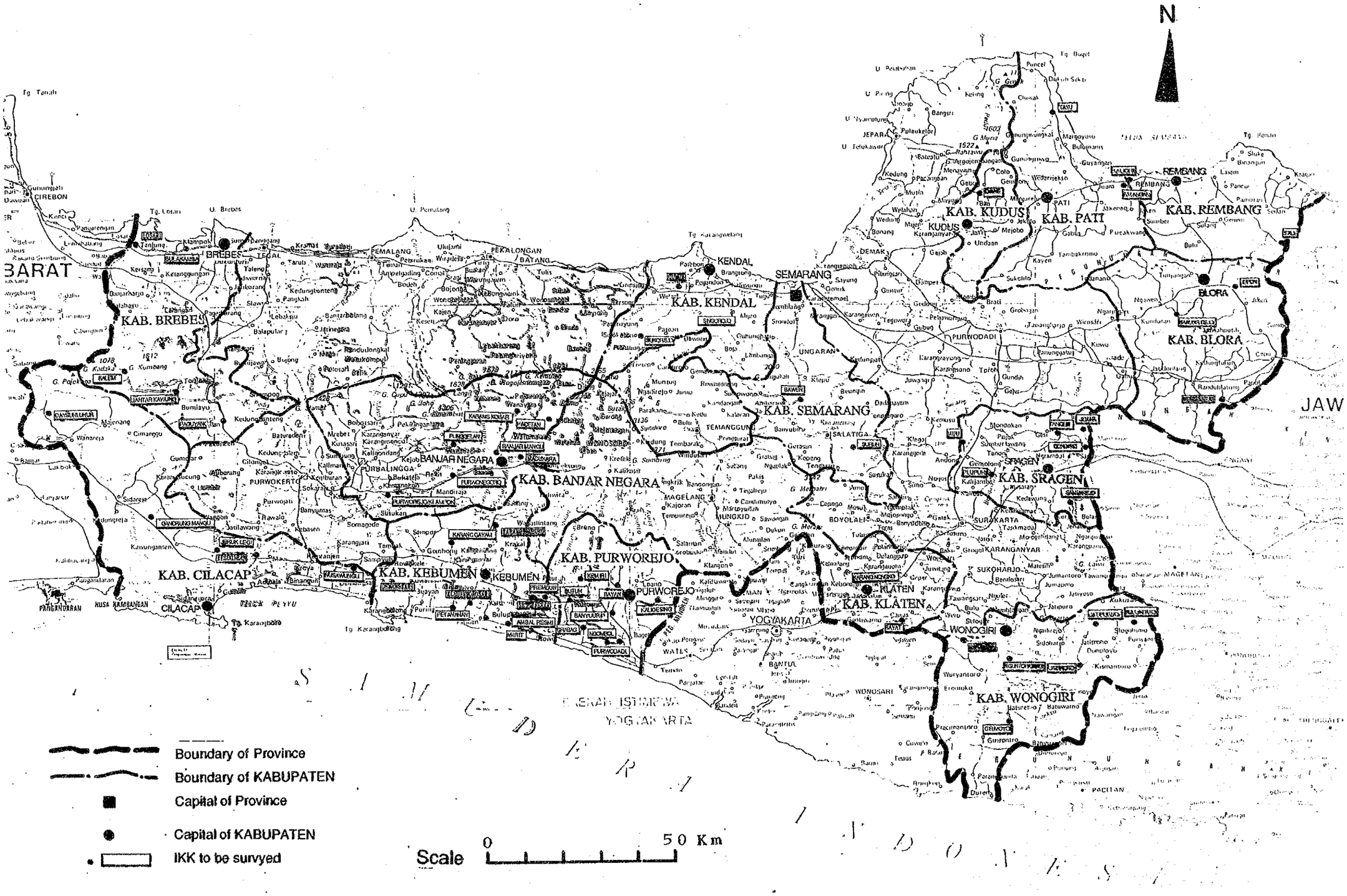
In addition to the feasibility study in Phase 2, Government of Indonesia requested to study an Alternative Implementation Plan in which a stage wise approach to water supply installation will be adopted.
This supplementary study was conducted from April to June, 1992 and the results are summarized in 6.

2. Study Area

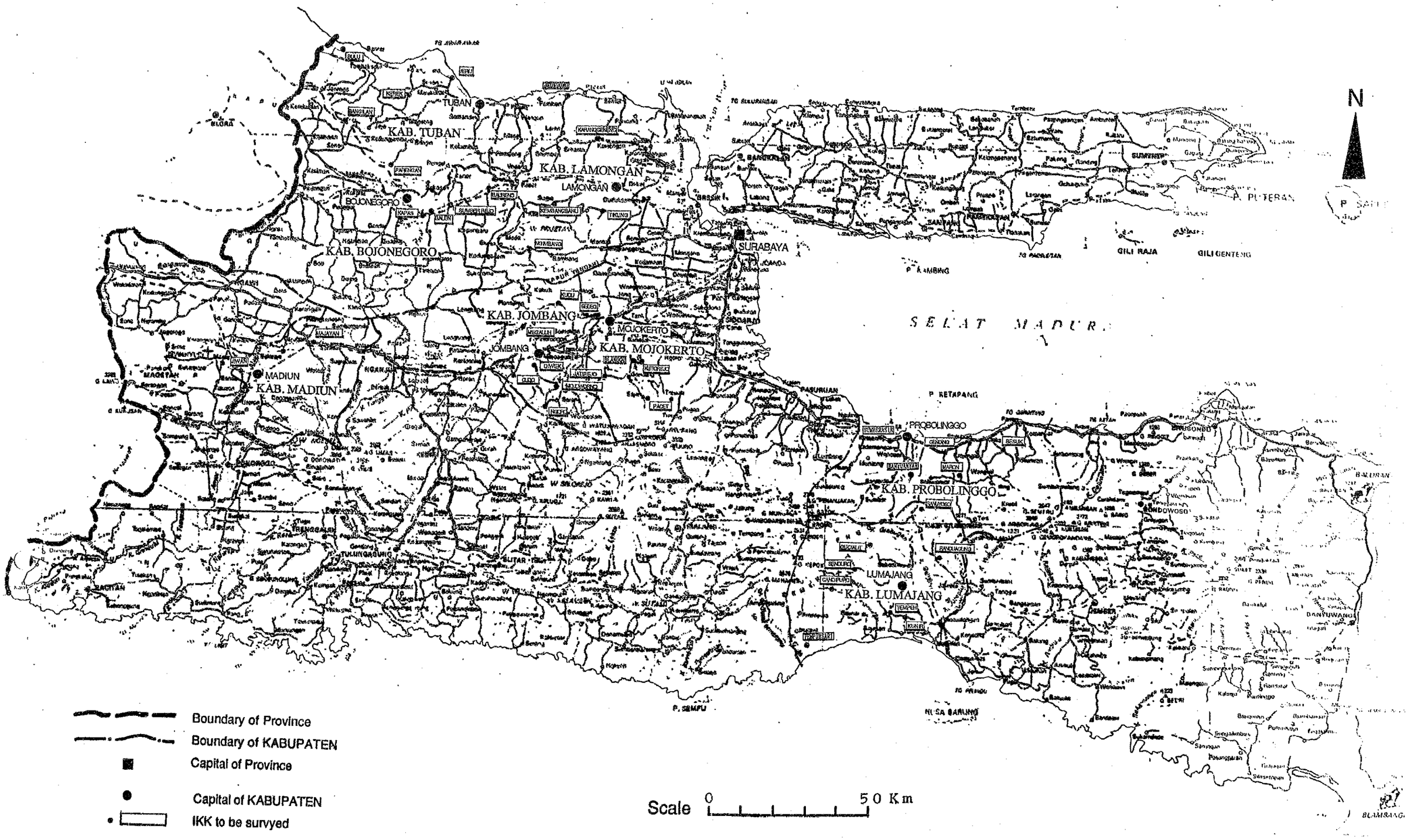
The location of 121 IKKs is shown in Fig. 1. Population of these IKKs in 1990 is around between 3,000 and 20,000.

Fig 1 Location Map of 121 IKKs

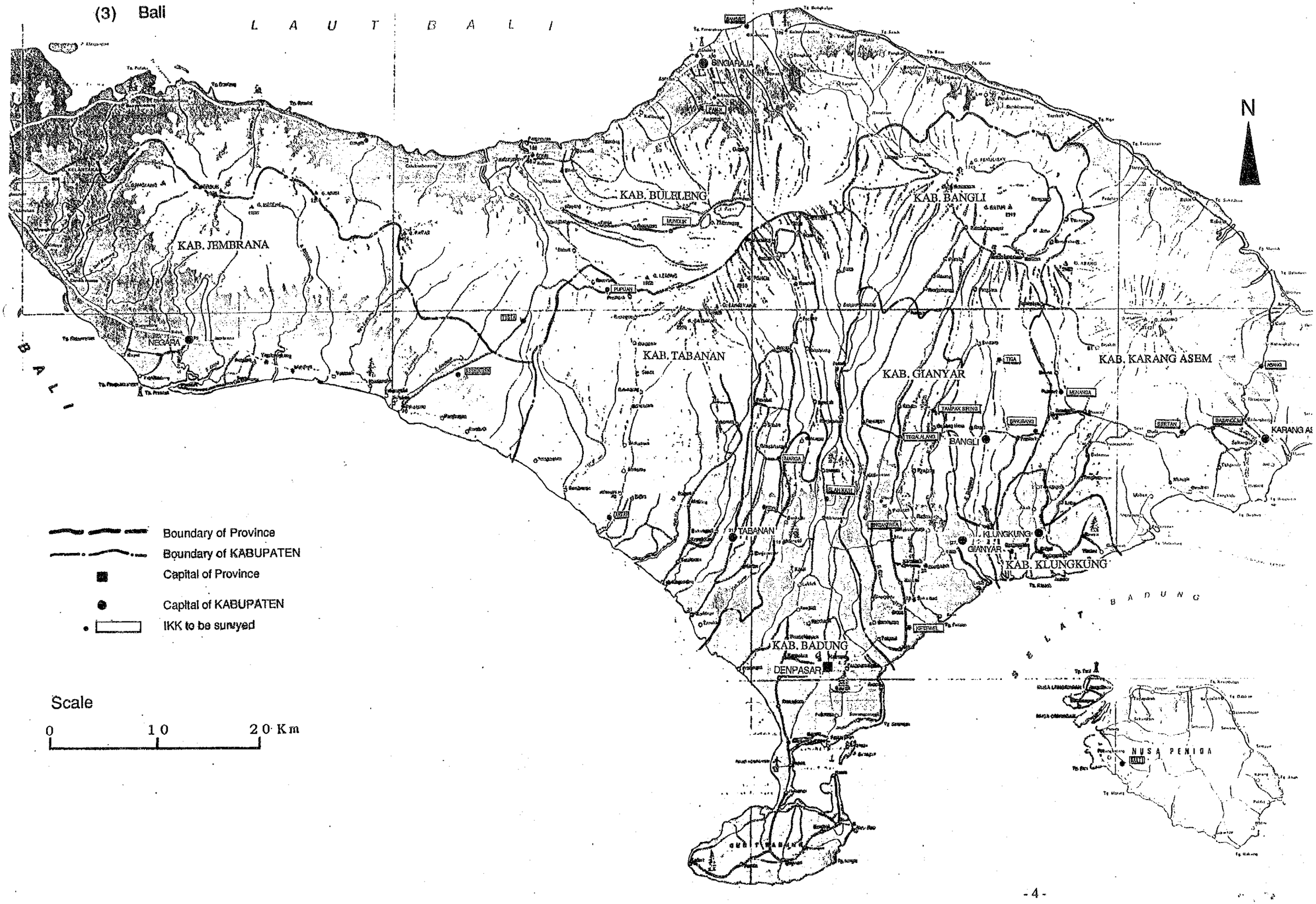
(1) Central Jawa



(2) East Jawa


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
P. KAMBING
GILI RAJA
GILI GENTENG
SELAT MADURA
P. KETAPANG
P. SEMPU
NUSA BARUNG
N
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
S E L A T B A L I
S E L A T B A D U N G
N
SINGARAJA
KAB. BULELENG
KAB. JEMBRANA
NEGARA
KAB. TABANAN
KAB. BANGLI
KAB. GIANYAR
KAB. KARANG ASEM
KAB. KLUNGKUNG
KAB. BADUNG
DENPASAR
TABANAN
BANGLI
KLUNGKUNG
NUSA PENIDA
Boundary of Province
Boundary of KABUPATEN
Capital of Province
Capital of KABUPATEN
IKK to be surveyed
Scale
0
10
20 Km

3. Basic Plan for 121 IKKs

Based on the site survey including the investigation on water resources, Basic Plan for 121 IKKs was proposed.
In this Basic Plan, outline design of water supply facilities for each IKK based on the forecast population in 2,000 was conducted.
And estimation of direct construction costs for each IKKs was also conducted for the purpose of comparison for selection of High Priority IKKs.
Number of IKKs by the type of water sources is summarized below.

Type of Source		Number of IKKS
Spring water		53
Existing system		14
Groundwater		52
(Deep well	150m deep)	(36)
(Shallow well	50m deep)	(16)
River water		2
	Total	121

4. Selection of High Priority IKKs

Among 121 IKKs, candidates of high priority IKKs were proposed by JICA Study Team.
Factors for selection are as follows.

(1) Installation cost per person served
(2) Difficulty to get the water for the people
(3) Existence of water supply facilities
(4) Income level of house hold
(5) Local condition (Balance of numbers of IKKs in each Province)

Based on the proposal, discussions between GOI and JICA Team were held in Indonesia in March 1991.
And 30 High Priority IKKs shown in Table 1 were finally decided after some changes from JICA's proposal.
Reasons of the changes were the balance of numbers among Kabupaten and Provinces and the difficulty to get the water.

Table 1 High Priority IKKs

No.	Province	Kabupaten	IKK	Type of Water Supply System
1	Central Java	BREBES	Bulakamba	D - b
2	Central Java	CILACAP	Jeruklegi	E - b
3	Central Java	PURWOREJO	Kemiri	C
4	Central Java	BANJAR NEGARA	Madukara	B - a
5	Central Java	BANJAR NEGARA	Punggelan	A - a
6	Central Java	KEBUMEN	Karanggayam	E - b
7	Central Java	KEBUMEN	Petanahan	D - b
8	Central Java	KENDAL	Sukorejo	A - b
9	Central Java	BLORA	Jepon	D - a
10	Central Java	PATI	Batangan	E - a
11	Central Java	SRAGEN	Gondang	D - a
12	Central Java	SRAGEN	Jenar	C
13	Central Java	WONOGIRI	Giriwoyo	A - a
14	Central Java	SEMARANG	Bawen	A - b
15	East Java	BOJONEGORO	Balen	D - b
16	East Java	BOJONEGORO	Baureno	D - c
17	East Java	TUBAN	Jenu	D - c
18	East Java	MADIUN	Jiwan	D - c
19	East Java	LAMONGAN	Kembangbahu	D - c
20	East Java	JOMBANG	Diwek	D - b
21	East Java	MOJOKERTO	Kutorejo	D - c
22	East Java	LUMAJANG	Tempeh	D - c
23	East Java	LUMAJANG	Kunir	D - b
24	East Java	LUMAJANG	Tempursari	B - b
25	East Java	PROBOLINGGO	Banyuanyar	D - c
26	East Java	PROBOLINGGO	Sumberasih	D - b
27	Bali	GIANYAR	Tampak Siring	B - a
28	Bali	GIANYAR	Ketewel	D - b
29	Bali	KARANG ASEM	Menanga	B - b
30	Bali	KARANG ASEM	Sibetan	B - a

5. Feasibility Study for 30 IKKs

5.1 Socio-Economy

(1) According to the 1990 Census, the population of Indonesia amounted to 179,322 thousand, and an intercensal growth rate of population indicated 1.97 % per annum for the period 1980-1990.

Population served of 30-IKK in the study area was estimated at 336,500 in 1990, and the average annual growth rate showed 0.95 % during the same period. It is forecasted that the said IKK-population served will amount to about 370,000 in the target year of 2000.

(2) An average monthly household income in IKKs, according to the field survey in 1991, was Rp. 122,600 in 14-IKK of the Central Java Province, Rp. 129,600 in 12-IKK of the East Java Province and Rp. 145,100 in 4-IKK of the Bali Province. Accordingly, the average income for the 30-IKK as a whole was Rp. 128,000.

(3) An average current tariff of domestic water supplied by 21-BPAM/PDAM indicated Rp. 139/m^3 for the consumption of 0 m^3 to 10 m^3 and Rp. 204/m^3 for the consumption of 11 m^3 to 20 m^3.

(4) According to the financial reports of 12-BPAM/PDAM in the fiscal year 1989/90, the profit and loss statement was a deficit in 9-BPAM/PDAM, except BPAM Wonogiri, PDAM Purworejo and PDAM Kendal.

5.2 Plan of Water Supply Facilities

(1) After detailed surveys shown below, plan of water supply facilities for 30 high priority IKKs was proposed.

1) Field Survey for Additional Data Collection, regarding water supply area, water surved population, income level of house-holds, etc.

2) Socio-Economic Survey

3) Topographical Survey

4) Test Well Drilling and Pumping Tests

5) Water Quality Analyses

(2) Type of water supply systems is shown in Fig. 2.
Numbers of IKKs in each type are shown in the figure.

(3) Type of water supply systems for each IKK is shown in Table 1.

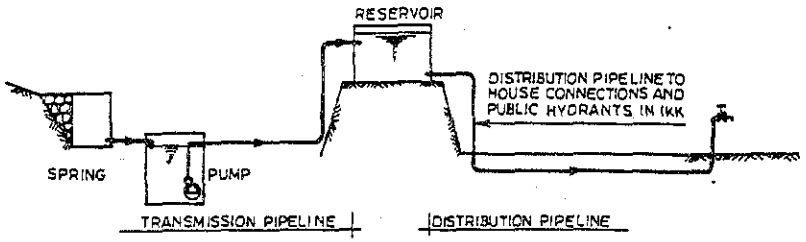
(4) Management plan for the facilities was also studied.

(5) Total of Maximum Day Demand for 30 IKKs (total source capacity required) is about 425 l/s. (Average 14 l/s)

FIG. 2 TYPE OF WATER SUPPLY SYSTEMS (1/2)

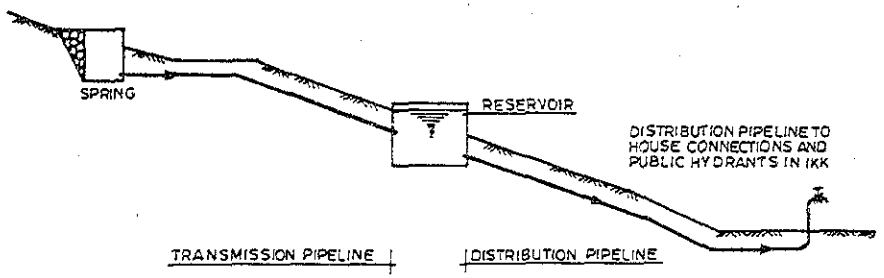
TYPE A-a | WATER SOURCE FROM SPRING BY PUMP SYSTEM

Number of IKKs : 2



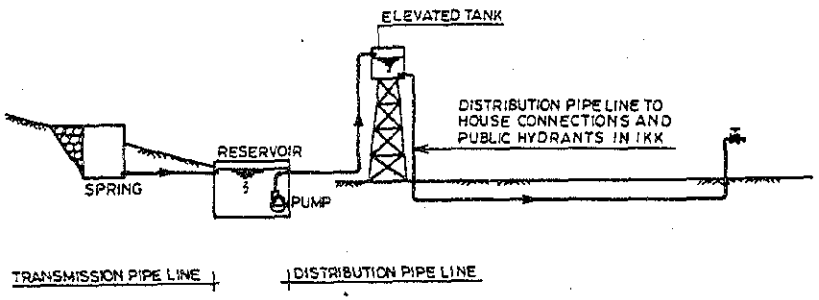
TYPE A-b | WATER SOURCE FROM SPRING BY GRAVITY SYSTEM

Number of IKKs : 2



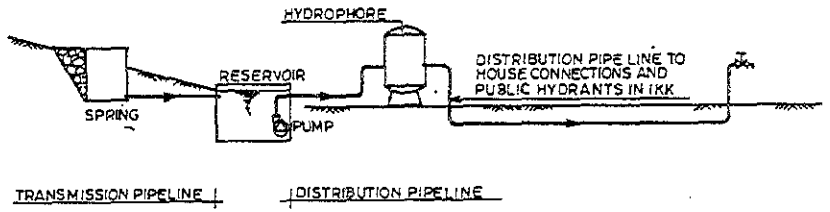
TYPE B-a | WATER SOURCE FROM SPRING WITH ELEVATED TANK

Number of IKKs : 3



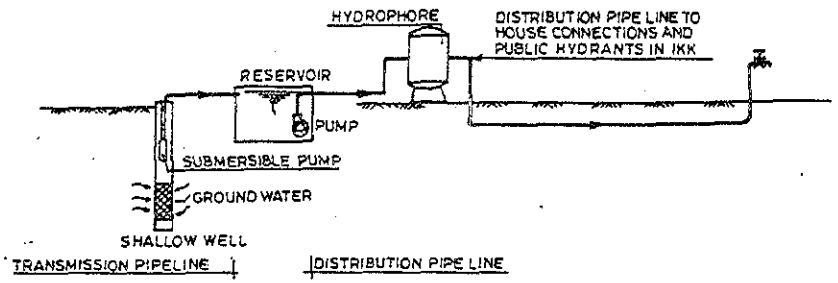
TYPE B-b | WATER SOURCE FROM SPRING WITH HYDROPHORE

Number of IKKs : 2



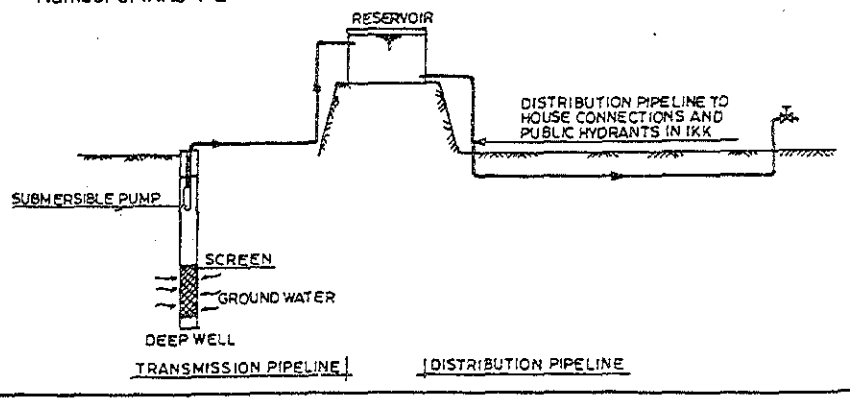
TYPE C | WATER SOURCE FROM SHALLOW WELL WITH HYDROPHORE

Number of IKKs : 2



TYPE D-a | WATER SOURCE FROM DEEP WELL WITH RESERVOIR ONLY

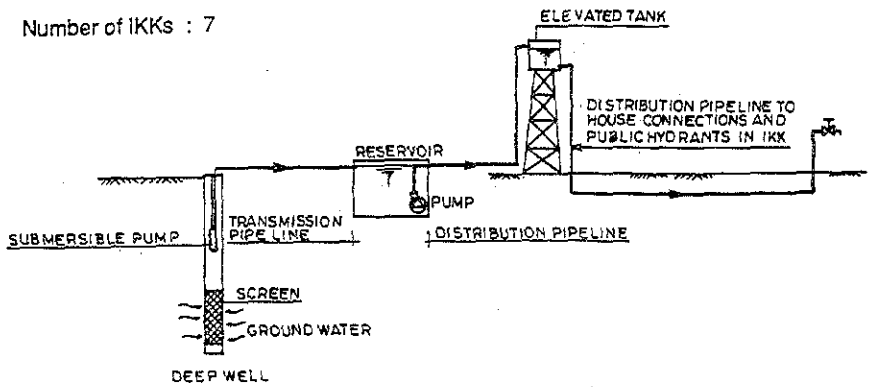
Number of IKKs : 2



TYPE OF WATER SUPPLY SYSTEMS (2/2)

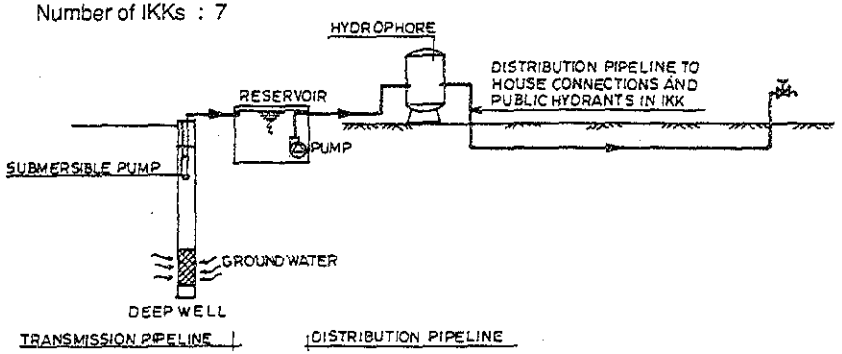
TYPE D-b | WATER SOURCE FROM DEEP WELL WITH ELEVATED TANK

Number of IKKs : 7



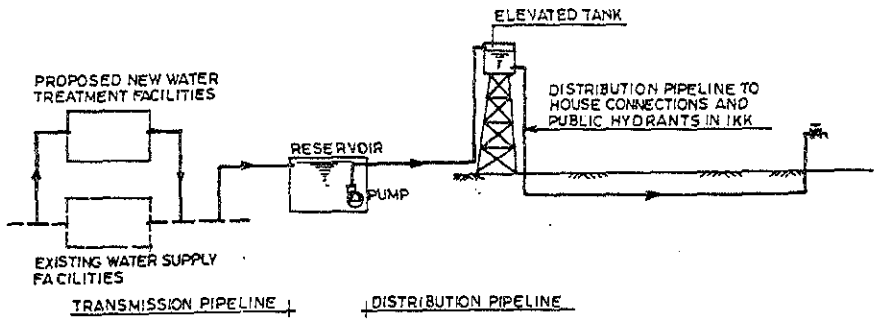
TYPE D-c | WATER SOURCE FROM DEEP WELL WITH HYDROPHORE

Number of IKKs : 7



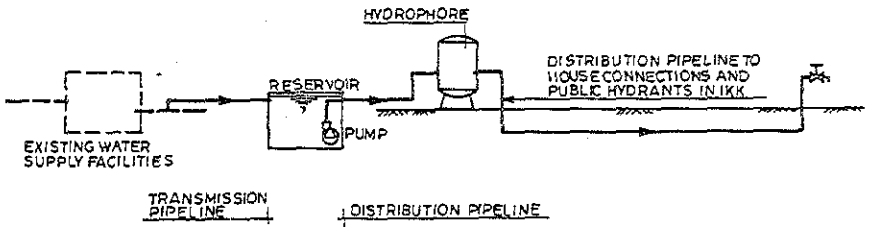
TYPE E-a | TAPPING FROM EXISTING WATER SUPPLY FACILITIES WITH ELEVATED TANK

Number of IKKs : 1



TYPE E-b | TAPPING FROM EXISTING WATER SUPPLY FACILITIES WITH HYDROPHORE

Number of IKKs : 2



5.3 Project Cost and Implementation Schedule

(1) The construction cost for 30 IKKs including price contingency and price escalation is estimated to be Rp. 46,478 million (equivalent to US$ 23.59 million).

Breakdown of the Construction Cost is shown below.

Cost Item		L/C (10^6 Rp)	F/C (10^6 Rp)	Total (10^6 Rp)
A	Direct Cost	24,880	7,472	32,352
B	Indirect Cost	3,351	2,213	5,564
C	Contingency	2,488	747	3,235
D	Price Escalation	4,976	351	5,327
Total		35,695	10,783	46,478

Note : Exchange rate : US$1.00 = Rp.1,970 = ¥136

(2) Total construction cost for 30 IKKs per person served is estimated to be Rp. 125,654 per person (equivalent to US$ 63.8 per person).

(3) The proposed works and facilities will be completed within three (3) years.

(4) The operation and maintenance cost for 30 IKKs is estimated to be Rp. 1,198 million per year (equivalent to US$ 608 thousand per year).

5.4 Project Evaluation

(1) The project evaluation is made from the financial and economic points of view. In estimating the financial revenue, two kinds of water tariff rate are prepared for the purpose of a comparison; one is an average current tariff of domestic water supplied by the BPAM/PDAM concerned (hereinafter referred to as the "current tariff"), and the other is an affordability of customers to pay for domestic water supplied. Where, the affordability to pay is assumed to be 4 % of an average income of households in IKKs concerned (hereinafter referred to as the "4 % -affordability"). On the other hand, the economic benefit is estimated based on a saving effect of time for fetching water.

(2) The financial evaluation is summarized as follows:

Case A : Evaluation under Condition of the Current Tariff

During the period of project life, the estimated cost and revenue of the project for the whole 30-IKK are as follows:

Construction Cost	:	Rp. 46,478 million
Operating & Maintenance Cost (OM Cost)	:	Rp. 199,474 million
Project Revenue	:	Rp. 246,914 million

In this case, the FIRR would come to nearly zero percent.

Case B : Evaluation under Condition of the 4 % - Affordability

The project cost takes the same value as the construction and OM costs stated in Case A, and the project revenue would amount to Rp. 719,548 million. As a result, the FIRR would come to 15.7 %.

In conclusion of the financial evaluation, the FIRR is estimated to be about 10 % and 5 % by raising the average current tariff (Rp.150/m^3) to Rp.280/m^3 (85 % up) and Rp.200/m^3 (30 % up), respectively.

(3) The economic evaluation for the whole 30-IKK is summarized as follows:

Economic Construction Cost	:	Rp. 36,568 million
Economic OM Cost	:	Rp. 1,079 million/year
Economic Benefit	:	Rp. 5,408 million/year

As a result, the EIRR comes to 10.1 %, which corresponds to the opportunity cost of capital in the study area, i.e. the project would be feasible economically.

5.5 Recommendations

(1) The proposed project for 30 High Priority IKKs is technically feasible and economically justified conditionally.
Immediate implementation of the project is recommended from the social and sanitary reasons.

(2) Because of the high costs required for the implementation, foreign financial assistance may be necessary.

(3) For another IKKs except 30 IKKs, feasibility studies are also required in the next stage.

(4) Before implementation of these 30 IKKs, a confirmatory investigation for ground water capacity in IKKs shown below, where test well drilling and pumping tests were not conducted at the proposed well points in this feasibility study, is recommended.

1) Bulakamba, 2) Kemiri, 3) Petanahan, 4) Jepon, 5) Gondang
6) Balen, 7) Baureno, 8) Kunir, and 9) Banyuanyar

Basides the test well drilling and pumping tests, geoelectrical survey for the determination of the well location and water quality analyses are also recommended.

(5) As for water quality of the following water sources, where some items of water quality showed somewhat higher than the Standard, rechecking (sampling and analyses) are recommended before implementation.

Name of IKK	Water Source	Check items
Madukara	Mudal Spring	Lead (Pb)
Batangan	Juwana System	Lead (Pb)
Kemiri	Shallow Well	Iron (Fe)
Jepon	Deep Well	Iron (Fe)
Kembangbahu	Deep Well	TDS and Chloride (Cl^-)

(6) Coliform and Bacteria showed high value at almost all existing water sources except deep wells in field surveys in Phase 1 and 2.
It is necessary to conduct a $Ca(OCl)_2$ injection to each supply water to keep a residual Chlorine at the Taps, for sanitary reasons. Education to the community is also required.

(7) Operation and Maintenance

1) Operation including the inspection of the facilities should be conducted faithfully based on the Operation Manual, to keep the people served safe and healthy and give them easiness of living.

2) During the construction period of the water supply facilities, Test Run for the facilities should be conducted before commencement of the operation.
Training of operators is also required.

3) Periodical Maintenance, based on the Maintenance Manual, is also important to prevent the facilities from accidents and deterioration.

(8) Education to the community, regarding the necessity of a clean water supply facilities and sanitation, is also required especially in rural areas.

(9) Community Participation

Community Participation for the following items will be required.

1) Cooperation to the land acquisition and construction works.

2) Cooperation and Assistance to BPAM or PDAM regarding the followings.

(i) Conservation of safety for water supply facilities, including the prevention of deterioration of the facilities and contamination of supply water.

(ii) Report to BPAM or PDAM office on accidents such as water leakage and illegal connection, etc.

(iii) Tariff payment

6. Supplementary Study

6.1 Study Condition

(1) In this study, an alternative implementation plan for 30 high priority IKKs, 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.

(2) The proposed design criteria are shown below.

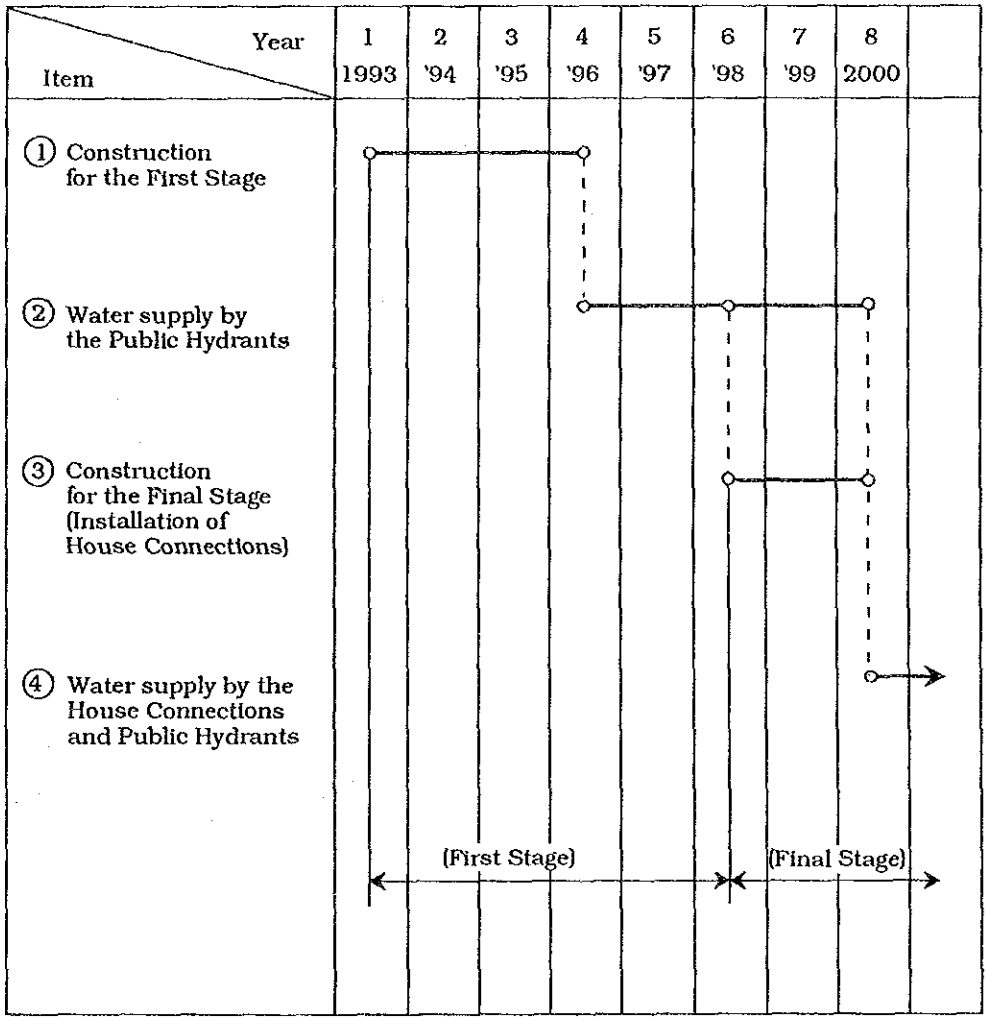
No.	DESIGN CRITERIA	FIRST STAGE *)	FINAL STAGE **)
1.	Supply Level at House Connection (H.C.) (l/c/d)	-	90
2.	Supply Level at Public Hydrant (P.H) (l/c/d)	30	30
3.	Population Served (%)	50 - 100	50 - 100
4.	Water supply capacity per population	Module system	Module system
5.	Ratio of Population served by H.C./P.H.	0/100	70/30 - 80/20
6.	Number of people per H.C.	-	10
7.	Number of people per P.H.	100	100
8.	Water allocation for non-domestic deman (%)	5	5
9.	Water allocation for leakage and losses (%)	15	15
10.	Factor for maximum day	1.1	1.1
11.	Factor for Peak Hour	1.4	1.4
12.	Target year (in future)	10 years	10 years
13.	Operation hours	24 hours	24 hours
14.	Flow restrictor	No	No
15.	Capacity of reservoir	(2 hrs)	(2 hrs)

Notes : (1) *) Means the first 2 (two) years

(2) **) Same as shown in 5.2.

(3) Construction and Operation Schedule

The tentative construction and operation schedule is considered as follows with the condition that this project will be implemented from 1993.



6.2 Plan of Water Supply Facilities

(1) The water supply systems and facilities in the final stage are the same as proposed in 5.2.

(2) The water supply facilities for the first stage are as follows.

1) The water demand less than in the final stage is taken into consideration on well construction and well pump installation to minimize the initial construction cost.

2) However, the pipeline is designed taking into consideration of the water supply capacity in the final stage. That is, the diameter of pipeline for Public Hydrants is the same as proposed in 5.2.

(3) Total of Maximum Day Demand for 30 IKKs (total source capacity required) in each stage is as follows.

First Stage : 170 l/s (Average 5.7 l/s)
Final Stage : 425 l/s (Average 14 l/s)

6.3 Project Cost

(1) First Stage

1) The construction cost for 30 IKKs including price contingency and price escalation is estimated to be Rp. 42,757 million (equivalent to US$ 21.7 million).

Breakdown of the Construction Cost is shown below.

Cost Item		L/C (10^6Rp)	F/C (10^6Rp)	Total (10^6Rp)
A	Direct Cost	22,888	6,874	29,762
B	Indirect Cost	3,081	2,037	5,118
C	Contingency	2,290	686	2,976
D	Price Escalation	4,579	322	4,901
Total		32,838	9,919	42,757

Note: Exchange rate : US$ 1.00 = Rp. 1,970 = ¥136

2) Total construction cost for 30 IKKs per person served is estimated to be Rp. 115,595 per person (equivalent to US$ 58.7 per person).

3) The operation and maintenance cost for 30 IKKs is estimated to be Rp. 695 million per year (equivalent to US$ 353 thousand per year).

(2) Final Stage

1) The construction cost for 30 IKKs including price contingency and price escalation is estimated to be Rp. 18,053 million (equivalent to US$ 9.16 million).

Breakdown of the Construction Cost is shown below.

Cost Item		L/C (10^6 Rp)	F/C (10^6 Rp)	Total (10^6 Rp)
A	Direct Cost	8,950	606	9,556
B	Indirect Cost	934	651	1,585
C	Contingency	896	60	956
D	Price Escalation	5,725	231	5,956
Total		16,505	1,548	18,053

Note: Exchange rate : US$ 1.00 = Rp. 1,970 = ¥136

2) Total construction cost for 30 IKKs per person served is estimated to be Rp. 48,807 per person (equivalent to US$ 24.8 per person).

3) The operation and maintenance cost for 30 IKKs before 2,000 is estimated to be Rp. 957 million per year (equivalent to US$ 486 thousand per year) at the 1991 price level. After 2,000, the operation and maintenance cost will be the same as shown in 5.3.

6.4 Project Evaluation

Result of the project evaluation on the supplementary study is summarized as follows:

(1) Financial evaluation

Case A. : Evaluation under Condition of the Current Tariff

During the period of project life, the estimated cost and revenue of the project for the whole 30-IKK are as follows:

Construction Cost	: Rp.	60,815 million
Operating & Maintenance Cost (OM Cost)	: Rp.	196,630 million
Project Revenue	: Rp.	240,991 million

In this case, the FIRR would come to a negative.

Case B. : Evaluation under Condition of the 4 % - Affordability

The project cost takes the same value as the construction and OM costs stated in Case A, and the project revenue would amount to Rp. 702,215 million. As a result, the FIRR would come to 12.8 %.

In conclusion of the financial evaluation, the FIRR is estimated to be about 10 % and 5 % by raising the average current tariff (Rp. 150/m^3) to Rp. 330/m^3 (120 % up) and Rp. 220/m^3 (45 % up), respectively. The above-mentioned rise of tariff would be severer than that in the original plan.

(2) Economic Evaluation

Economic Construction Cost	: Rp.	44,104 million
Economic annual OM Cost	: Rp.	1,079 million
Economic annual Benefit	: Rp.	5,408 million

Where, the annual OM cost and benefit indicate values for the period from the year 2000 to the end of project life. As a result, the EIRR indicates 7.9 %, which is lower than that (10.1 %) of the original plan. However, this rate is a relatively high as a general water supply project and then it is judged that the project has an economical feasibility.