REPUBLIC OF INDONESIA
MINISTRY OF PUBLIC WORKS
DIRECTORATE GENERAL OF
WATER RESOURCES DEVELOPMENT

FEASIBILITY STUDY
ON
THE K.C.C IRRIGATION DEVELOPMENT PROJECT
(STAGE I)

VOLUME 2
MAIN REPORT

JULY 1983

JAPAN INTERNATIONAL COOPERATION AGENCY

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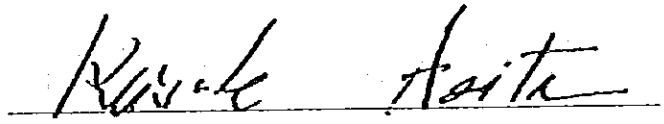
PREFACE

In response to the request of the Government of the Republic of Indonesia, the Japanese Government decided to conduct a survey on the K-C-C Irrigation Development Project and entrusted the survey to the Japan International Cooperation Agency (JICA). The JICA sent to Indonesia a field survey team headed by Mr. S. Watanabe from July to September, 1982 and another team headed by Mr. I. Inamori from October to December, 1982. The teams exchanged views with the officials concerned of the Indonesian Government and conducted field survey in and around the K-C-C area of the North Banten region in West Java Province. After the teams returned to Japan, further studies were made and the present report has been prepared.

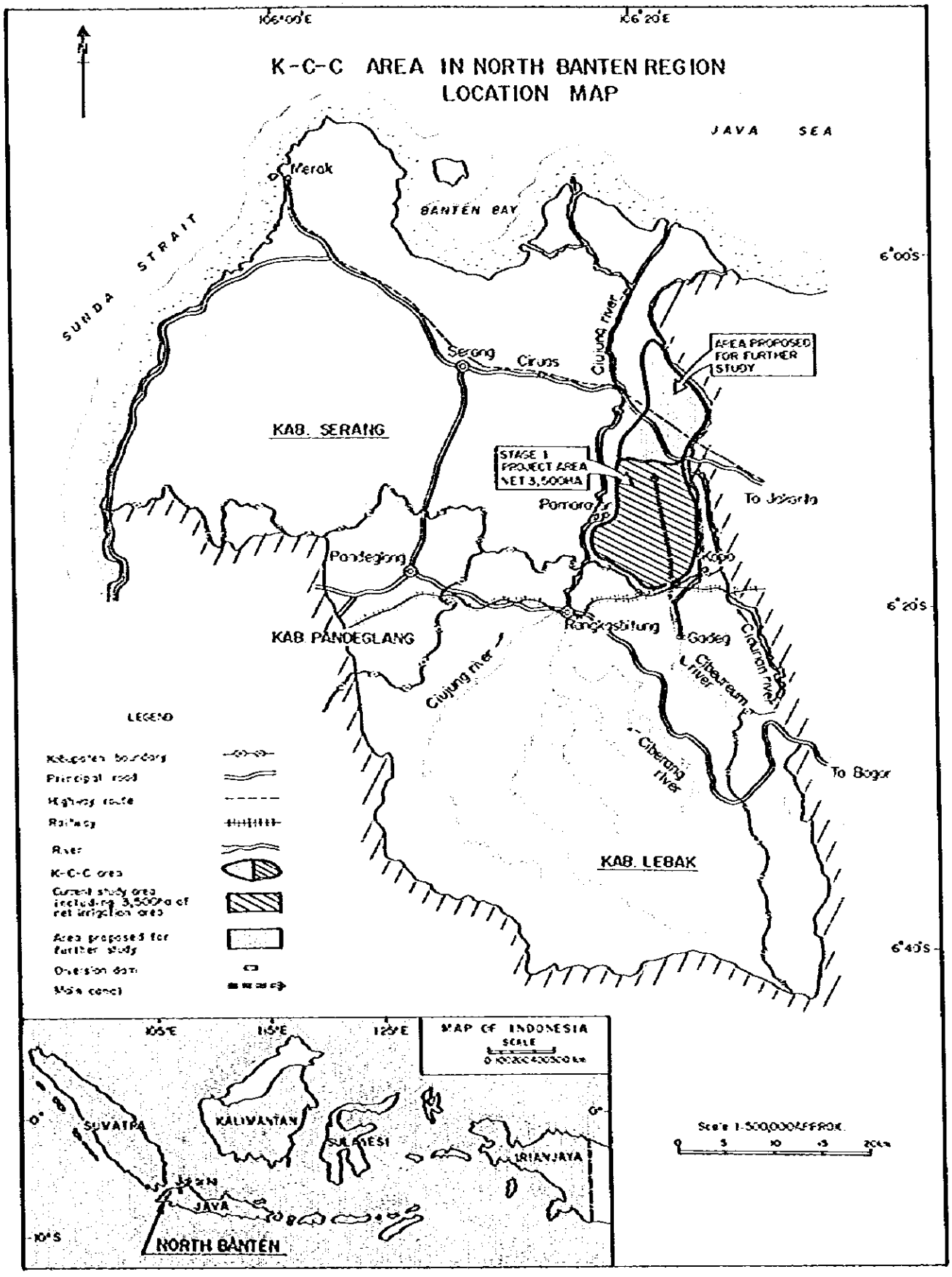
I hope that this report will serve for the development of the Project and contribute to the promotion of friendly relations between our two countries.

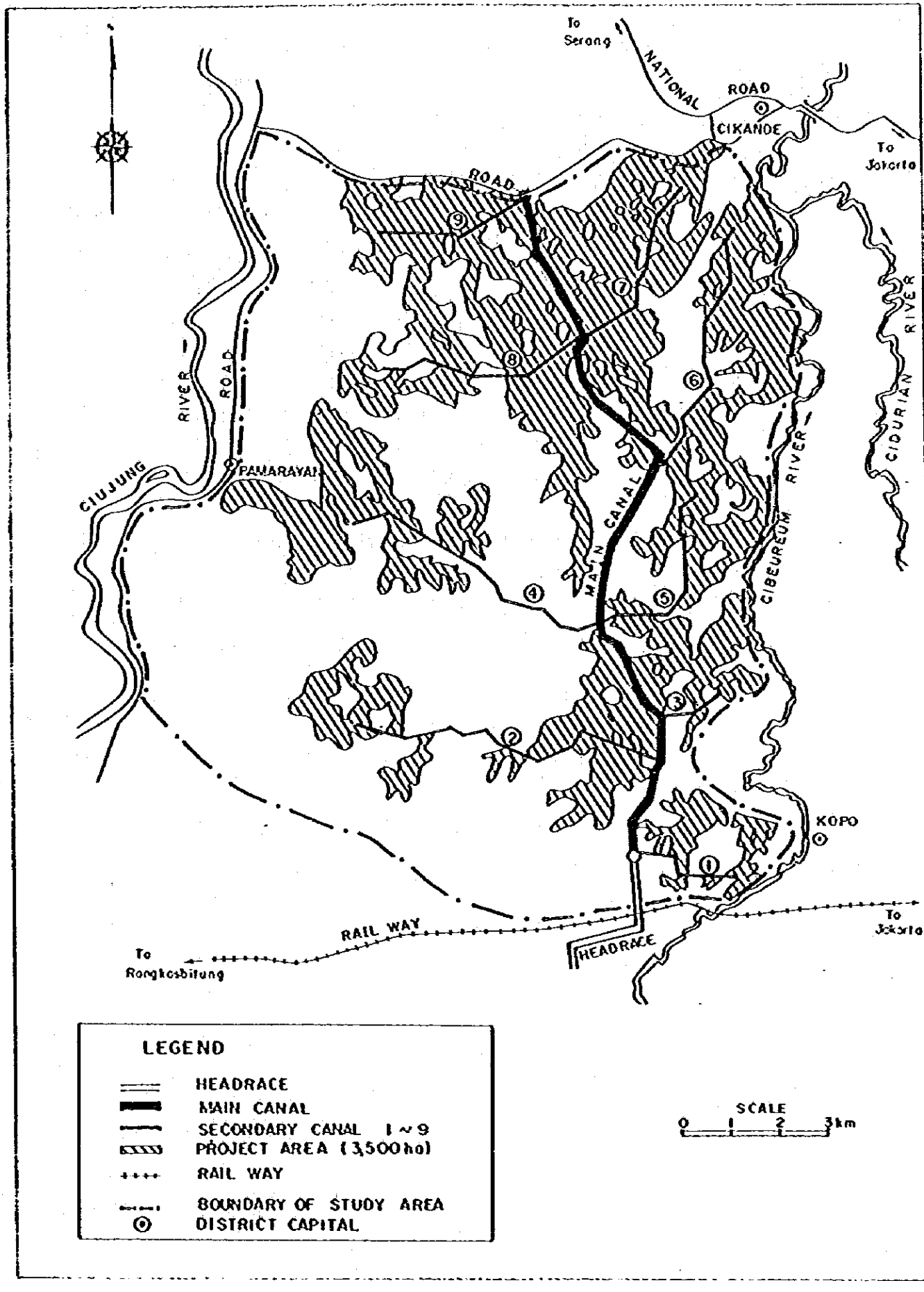
I wish to express my deep appreciation to the officials concerned of the Government of the Republic of Indonesia for their close cooperation extended to the team.

July 1983



Keisuke Arita
President
Japan International Cooperation Agency


K-C-C AREA IN NORTH BANTEN REGION
LOCATION MAP
106°00'E
106°20'E
JAVA SEA
SUNDA STRAIT
Merak
BANTEN BAY
6°00'S
Ciujung river
Serang
Cilegon
AREA PROPOSED FOR FURTHER STUDY
KAB. SERANG
STAGE 1 PROJECT AREA NET 3,500HA
Pontang
To Jakarta
Pandeglang
6°20'S
KAB PANDEGLANG
Rangkasbitung
Gadog
Ciujung river
Ciberang river
Ciberang river
Ciberang river
To Bogor
KAB. LEBAK
6°40'S
LEGEND
Principal road
Railway
River
K-C-C area
MAP OF INDONESIA
SCALE
105°E
115°E
125°E
SUMATRA
KALIMANTAN
SULAWESI
IRIANJAYA
JAWA
NORTH BANTEN
10°S
Scale 1:500,000 APPROX.



STUDY AREA AND PROJECT AREA

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FEASIBILITY STUDY
ON
THE K-C-C IRRIGATION DEVELOPMENT PROJECT

MAIN REPORT

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ABBREVIATIONS AND GLOSSARY

Ani-ani	Small finger knife to cut the rice stalk
BAPPENAS	(BADAN PERENCANAAN PEMBANGUNAN NASIONAL) National Planning Agency
BIMAS	(BIMBINGAN MASSAL) Mass Guidance for self-sufficiency in Food
BPP	(BALAI PENYULUHAN PERTANIAN) Rural Extension Center
BPS	(BIRO PUSAT STATISTIK) Central Bureau of Statistics
BRI	(BANK RAKYAT INDONESIA) Indonesian Peoples' Bank
BRI-UD	(BANK RAKYAT INDONESIA UNIT DESA) Village Unit of BRI
BULOG	(BADAN URUSAN LOGISTIK) National Food Logistics Agency
BUUD	(BADAN USAHA UNIT DESA) Village Pre-cooperative; a preliminary form of a KUD
cm	Centimeter
cm/sec	Centimeter per second
cm^2	Square centimeter
^oC	Degree centigrade
CRIFC	Central Research Institute for Food Crops
Desa	Javanese word for a village or rural community
DGWRD	Directorate General of Water Resources Development of Ministry of Public Works
DOLOG	(DEPOT LOGISTIK) Provincial Food Depot of BULOG
DPU	(DEPARTEMEN PEKERJAAN UMUM) Ministry of Public Works, or (DINAS PEKERJAAN UMUM) Provincial Office of Public Work Service
EL	Elevation above mean sea level
FAO	Food and Agriculture Organization of United Nations
Fig.	Figure
FWL	Flood water level
g	Gram
GDP	Gross Domestic Product
GRP	Gross Regional Domestic Product
H	Height

ha	Hectare
hr	Hour
HWL	High water level
HYV	High-yielding varieties (of rice and other food crops)
IBRD	International Bank for Reconstruction and Development
IDA	International Development Association
INMAS	(INTENSIFIKASI MASSAL) Mass Intensification
IPEDA	(IURAN PEMBANGUNAN DAERAH) Land tax for regional development
IR	Rice variety bred by IRRI
IRRI	International Rice Research Institute
JICA	Japan International Cooperation Agency
Kab.	Kabupaten
Kabupaten	District; administrative area below the province level
Kec.	Kecamatan
Kecamatan	Sub-District; administrative area below the Kabupaten or Kotamadya level
kios	Retail shop
kg	Kilogram
km	Kilometer
km^2	Square kilometer
Kotamadya	Municipality; having the same administrative status as a Kabupaten
KUD	(KOPERASI UNIT DESA) Village unit cooperative
ℓ (lit)	Liter (=1,000cm^3)
lit/sec/ha	Liter per second per hectare
ladang	Shifting culture land
LWL	Low water level
m	Meter
m^2	Square meter
m^3	Cubic meter
m.e/ℓ	Milligram equivalent per liter
mg	Milligram
min	Minute
mm	Millimeter
m/m	Man-month

m^3/sec	Cubic meter per second
No. (Nos.)	Number(s)
O & M	Operation and Maintenance
Paddy	Rice in the husk
padi	Rice-plant or stalk paddy
palawija	Non-rice food crops such as corn, cassava, sweet potatoes, soy beans and nuts
Panca Usaha	The five principles of good farming
P3A	(PERKUMPULAN PETANI PEMAKAI AIR) Water Users Association of Farmers
P3SA	(PROYEK PERENCANAAN PENGEMBANGAN SUMBER-SUMBER AIR) Water Resources Development Planning Project Division
PELITA	(PEMBANGUNAN LIMA TAHUN) Five-Year Development
pH	Scale for acidity
PMG	(PUSAT METEOROGI DAN GEOFISIKA) Meteological and Geophysical Center
PPL	(PENYULUH PERTANIAN LAPANGAN) Agricultural Field Extension Worker
ppm	Parts per million
PPM	(PENYULUH PERTANIAN MADYA) Agricultural Extension Officer
PPS	(PENYULUH PERTANIAN SPESIALIS) Agricultural Extension Specialist
Propinsi	Province
PROSIDA	(PROYEK IRIGASI IDA) IDA Irrigation Project Division
Pusri	(PUPUK SRIWIJAYA) Sriwijaya Fertilizer Company
Q	Discharge
REPELITA	(RENCANA PEMBANGUNAN LIMA TAHUN) Five-year Development Plan
Sawah	Wet rice field
sec	Second
t; ton	Metric ton
t/ha	Ton per hectare

TSP	Triple superphosphate
Unit Desa	Village unit; a group of 3-4 villages
US$	United States dollar
%	Percent

CURRENCY EQUIVALENT

US$1.00 = Rp.690

Rp.1.00 = US$0.00144

I. INTRODUCTION

1.1 AUTHORITY

This Feasibility Report has been prepared in accordance with the Article III of the Scope of Works (see APPENDIX-1) for the study on the North Banten Water Resources Development Project agreed upon between the Government of Indonesia and the Government of Japan. In preparation of this report, a special attention has been paid to the agreement of the Governments concerned that this feasibility study has to elaborate the K-C-C irrigation development by using water only from Cibeureum river and that the result of the study will be considered as the first stage of the whole irrigation development in K-C-C area (see APPENDIX-2).

This report deals with the feasibility study on the K-C-C Irrigation Development Project in North Banten (hereinafter referred to as the "Project") on the basis of careful review of previous studies, the results of field survey and study undertaken by the Feasibility Study Team of JICA and the comments made by the Indonesian Government agencies concerned.

1.2 PROJECT HISTORY

North Banten is situated in the western part of the Province of West Java and comprises the District (Kabupaten) of Serang, the northern part of Kabupaten Lebak and the north eastern corner of Kabupaten Pandeglang.

The Directorate of Planning and Programming (DPP) of the Directorate General of Water Resources Development (DGWRD) has been actively engaged in the assessment of water resources in the North Banten region since 1977 through its project division P3SA.

In 1978, the Directorate proposed that a reconnaissance study should be carried out in this region to examine the demands for water and the resources to meet them. With assistance from UK Technical Cooperation, engineering services were provided by Binnie & Partners, Consulting engineers of London and Hunting Technical Services of Borehamwood, UK. "Banten Water Resources Development

Reconnaissance Study" was submitted to the Indonesian Government in September, 1979.

A preliminary survey study was made in 1980 by a survey mission dispatched by IECA (International Engineering Consultants Association) of Japan on the items which were not covered and deepened by the preceding studies. "Preliminary Study Report on Banten Area Water Resources Development in West Java Province" was submitted in March, 1980, in which it is recommended to draw up a master plan of the water resource development in North Banten and at the same time, it is suggested to promote the development of matured fields of agriculture and irrigation keeping conformity with the trends of the master plan.

An expert mission which was dispatched by ADCA (The Agricultural Development Consultants Association) of Japan and headed by Dr. T. Kimura visited the Banten area after reviewing the preceding reports. It was recommended by the mission that it would be important to carry out the comprehensive water resources development study of the Banten area, but also to proceed the K-C-C Irrigation Project in parallel with the comprehensive study.

In response to the request of the Government of Indonesia, the Government of Japan dispatched the preliminary survey team of Japan International Cooperation Agency (JICA) headed by Mr. M. Yanagi in December, 1981. As a result of the field survey, the minutes of meeting on North Banten Water Resources Development was concluded on December 16, 1981.

Based on the said mimutes of meeting and the scope of works agreed upon between the Governments concerned, the Master Plan Team on North Banten Water Resources Development and the Feasibility Study Team on the K-C-C Irrigation Development Project were dispatched to Indonesia by JICA from July to September, 1982 as the first field survey of the Project.

The second field survey team for F/S was fielded by JICA in October, 1982 for further detailed studies.

1.3 SCOPE OF WORKS

The Scope of Works for the study on the North Banten Water Resources Development Project (hereinafter referred to as the "S/W") was agreed upon between

the Indonesian Government and the JICA Preliminary Survey Team in 1982. The agreed S/W is shown in APPENDIX-1 and the contents are summarized as follows:

(1) Objective of the study

The objectives of the study are to conduct a Master Plan Study with a view to promoting a comprehensive approach to North Banten Water Resources Development Project by the year 2000 (M/P) and to conduct a Peasibility Study with a veiw to promoting an efficient approach to urgent Kopo-Cikande-Carenang Irrigation Project (F/S).

(2) The area for F/S

The area proposed for the feasibility study on irrigation and agricultural development is the potentially irrigable area, which lies between the Ciujung and the Cidurian.

(3) Scope of Works (for F/S)

The activities to be undertaken by the study team will be:

1. To collect and review relevant data and information on the following items:
   - (a) Topography
   - (b) Hydro-meteorology
   - (c) Geology
   - (d) Agriculture
   - (e) Soil
   - (f) Agro-economy

2. To carry out field investigations and surveys on the following items:
   - (a) Topographic Survey
   - (b) Hydro-meteorological Survey
   - (c) Geological Survey
   - (d) Irrigation and Drainage Survey
   - (e) Soil Mechanical Survey
   - (f) Construction Material Survey

(g) Soil and Land Classification Survey
(h) Agriculture and Agro-economic Survey

3. To carry out the following analyses and studies, and prepare basic designs in the office:

(a) Selection of crops and formulation of cropping pattern
(b) Recommendation of improved irrigation farming practices
(c) Estimation of irrigation and drainage requirements
(d) Delineation of the irrigation area
(e) Preliminary designs of irrigation and drainage systems
(f) Preparation of the implementation schedule of the project
(g) Assessment of farmers' economy and cost-benefit analysis

1.4 ACTIVITIES OF THE STUDY TEAM

Pursuant to the S/W agreed upon between the Governments concerned, the field survey and feasibility study on the proposed Project were conducted by the Study Team from 20 July 1982 to 10 September 1982 as the first field survey and from 21 October 1982 to 20 December 1982 as the second field survey.

The Inception Report was prepared by the first field study team and submitted to the Government of Indonesia in September, 1982. The Interim Report was prepared by the second field study team and submitted in December, 1982, which described major findings, preliminary views and provisional conclusions reached by the field works.

The Draft Final Report was prepared and submitted to the Government in March, 1983. The comments and valuable suggestions were made on the Draft Final Report by the Indonesian authorities concerned and by the Advisory Mission of JICA. Based on these comments and suggestions, the Study Team has prepared herewith the Final Report on the proposed Project.

A list of supervisory committee of JICA and DGWRD officials concerned who supported the activities of the study team and counterpart personnel is presented in Table 1. The team members of JICA and the counterpart personnel provided by the Government of Indonesia are listed in Table 2 and their activities are illustrated in Fig. 1.

Table 1 DGWRD OFFICIALS CONCERNED AND MEMBERS OF SUPERVISORY COMMITTEE

1. DGWRD OFFICIALS

Ir. Sarbini Ronodibroto	Director of Planning and Programming, DGWRD
Ir. Mashudi Dipl. H.E.	Chief, Sub-Directorate of River Basin Development Planning, DPP, DGWRD
Mr. Yusuf Kardi Msc.	Project Manager, P3SA-CJCB
Ir. B. Sigit	Staff, Directorate of River, DGWRD
Ir. Sumarsono	Staff, Porsida, DGWRD
Ir. S.P. Kuntjorojakti	Staff, DPP, DGWRD
Drs. Pandina	Staff, DPP, DGWRD
Mr. Kurnadi	Staff, Directorate of Irrigation, DGWRD
Drs. Subandiyo	Staff, Foreign Aid Administration Unit, DPP, DGWRD
Ir. Suharto Dipl. H.E.	Staff, P3SA
Ir. Rachardjo Notosaputro	Chief, Sub-Directorate of Appraisal and Evaluation, DPP, DGWRD
Drs. Hisbullah R.	Staff, CJCB, P3SA
Ir. Mulyono	Staff, P3SA
Drs. Agus Praptomo	Staff, CJCB, P3SA
Ir. Erik Siagian	Staff, P3SA
Mr. Harry Witanto B.E.	Staff, CJCB, P3SA
Mr. M. Yuasa	Senior Colombo Plan Expert
Mr. T. Iwai	Colombo Plan Expert

2. JICA SUPERVISORY COMMITTEE

Mr. M. Yanagi	Leader	Kanto Regional Administration Office of Ministry of Agriculture, Forestry and Fisheries (MAFF)
Mr. O. Yasuda	Irrigation	Hokkaido Development Bureau
Mr. Y. Oda	Agriculture	Tokai Regional Administration Office of MAFF
Mr. T. Kanai	Irrigation	Water Resources Development Public Corporation
Mr. F. Hoshi	Economics	The Overseas Economic Cooperation Fund (OECF)

Table 2 LIST OF STUDY TEAM AND COUNTERPART PERSONNEL

1. The First Field Study Team

Mr. S. Watanabe	Team Leader
Mr. K. Kobayashi	Agronomist
Mr. S. Kayaba	Geologist
Mr. K. Yanagihara	Hydrologist

2. The Second Field Study Team

Mr. I. Inamori	Team Leader
Mr. S. Watanabe	Irrigation Engineer
Mr. T. Tanabe	Facility Engineer
Mr. K. Nakaoka	Survey/Design Engineer
Mr. S. Masumura	Agro-economist
Mr. A. Maeda	Agronomist
Mr. M. Kobayashi	Cost Estimate Engineer
Mr. S. Sekiguchi	Pedologist
Mr. K. Yanagihara	Hydrologist

3. Counterpart Personnel

Mr. Yusuf Kardi Msc.	Chief, Sub P3SA C-J-C-B, DGWRD
Ir. Budi Santoso	Staff, Sub P3SA C-J-C-B, DGWRD
Ir. Syahril	"
Drs. Sunardi	"
Ir. Nurichwan	"
Mr. Wahyudi	"
Ir. Djumpono	"
Ir. Agni Handoyoputro	"
Drs. Sumarno Kadarusman	"
Mr. Suprayitno	"
Mr. Zulkifli B.E	"

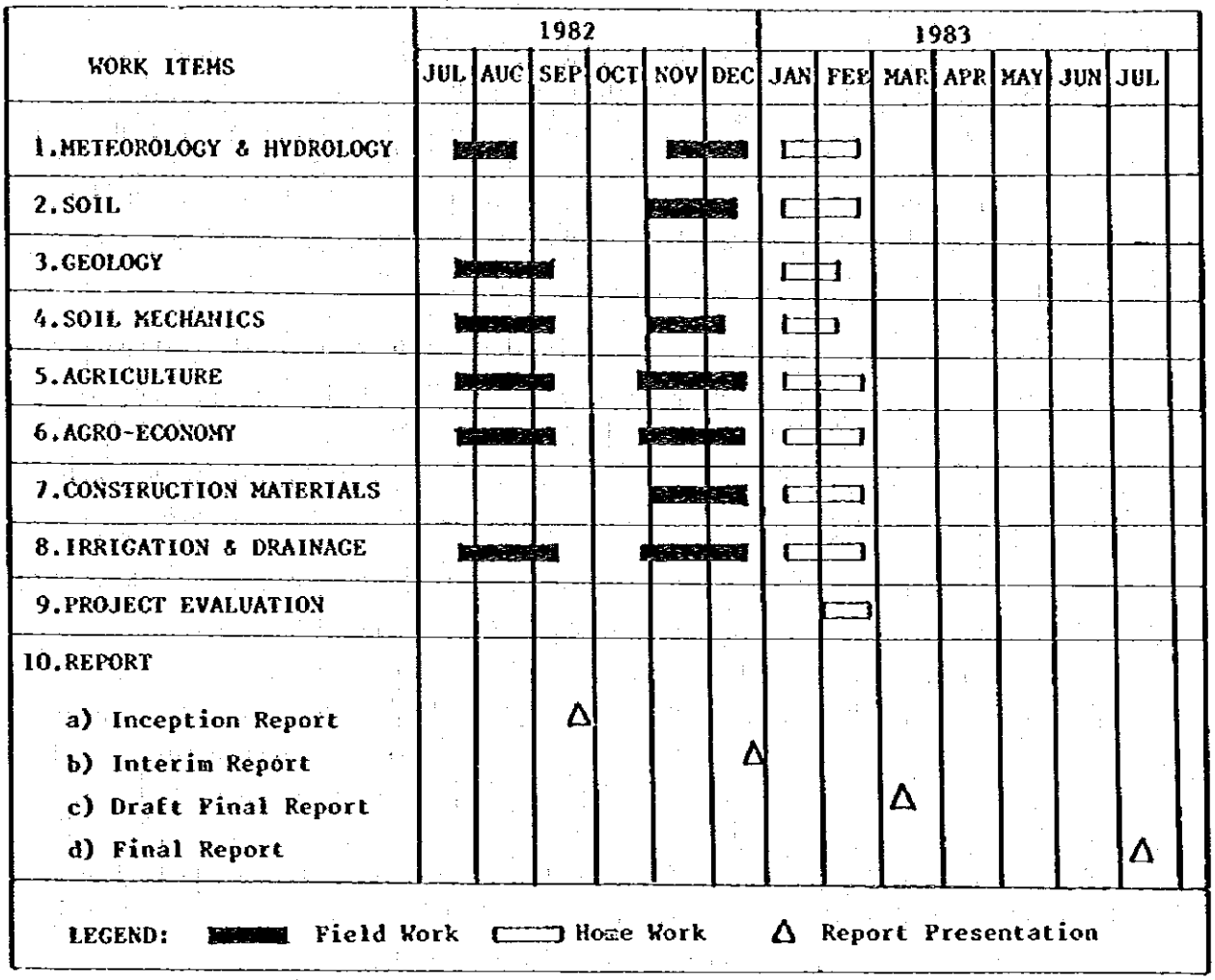


Fig. 1 ACTIVITIES OF STUDY TEAM

II. BACKGROUND

2.1 LAND AND POPULATION

The total area of the Republic of Indonesia is about 191 million ha with more than 13,000 islands, of which 16 million ha or 8% of the total area are used for agriculture. Population of Indonesia according to the result of 1980 Population Census was 147.5 million people, of which more than 60% lived in Java with the land area of only 7% of the total area of Indonesia.

Java is the fifth largest island in the nation and is administratively divided into three Provinces of West Java, Central Java and East Java and two special cities of Jakarta and Yogyakarta. Population in West Java was 27.4 million in 1980 with the population density of 591 persons per km^2 and average annual growth rate of 2.66% in the past decade.

Banten region which occupies an area of 16% of West Java province is situated in the north west corner of the province and comprises the Kabupatens (Districts) of Serang, Lebak and Pandeglang. Population of these kabupatens was 2.5 million in 1980 with average growth rate of about 2.57% per annum in the past decade.

The land of Kabupaten Serang, where the Project area is included, is 187,600ha, of which 133,000ha or 71% of the land are used for agriculture. Population in Kabupaten Serang was 1,109,186 in 1980 with population density of 591 persons per km^2 and with average growth rate of 2.85% during the past decade.

	AREA		POPULATION		
	km^2	(%)	1971	1980	(%)
INDONESIA	1,919,443	(100.00)	119,208,229	147,490,298	(100.00)
JAVA	132,187	(6.89)	76,086,327	91,269,528	(61.88)
West Java	46,300	(2.41)	21,623,529	27,453,525	(18.61)
Banten	7,632	(0.40)	1,978,359	2,486,813	(1.69)
Kab. Serang	1,876	(0.10)	859,467	1,109,186	(0.75)

2.2 NATIONAL AND REGIONAL ECONOMIES

2.2.1 Gross Domestic Product (GDP)

GDP at constant 1973 market prices during 1978-1981 indicated the average economic growth rate of 7.9% per annum in Indonesia. The agricultural sector accounted for about 30% in 1981, still playing a dominant role in national economy.

The economic structure of West Java is similar to that of whole Indonesia. The agricultural sector product accounted for about 32% in West Java in 1978. In agricultural sector, about 71% of the product was raised by farm food crops.

The gross regional domestic product (GRDP) of Banten region was about Rp. 320 billion in 1980. During the period of 1973 - 1980, the average annual growth rate of the GRDP was about 6.8%, which is similar to those of West Java province and the whole nation.

2.2.2 International Trade

The amount of export in Indonesia has remarkably increased in the past years, especially from 1975 to date. Export structure of Indonesia is characterized by its heavy dependence on the products in the primary sectors such as mineral and agricultural sector. Particularly, petroleum and its products have become the most important export goods since 1974. While the share of agricultural products such as rubber, coffee, palm oil and wood is decreasing, the total amounts are increasing substantially.

Meanwhile, imports of Indonesia has increased in relatively low pace compared with that of exports. Petroleum products, machinery for industrial and commercial use and rice are the major items of import. The import of rice had a tendency to increase annually during 1975 - 1980, but showed a substantial drop in 1981 supported by increased production of food crops.

The balance of trade in recent years showed an increasing surplus from US$2,332 million in 1975 to US$11,076 million in 1980. The major factor affecting the improved balance was the increase in the oil price.

BALANCE OF TRADE
(Million US$)

	1975	1976	1977	1978	1979	1980
EXPORT	7,102	8,547	10,853	11,644	15,590	21,910
IMPORT	4,770	5,673	6,230	6,690	7,202	10,834
BALANCE	2,332	2,874	4,623	4,954	8,388	11,076

2.3 AGRICULTURE

Agriculture is the mainstay of Indonesia's economy; in 1980, this sector accounted for about 31% of GDP, 55% of employment and almost all non-petroleum exports. In the agricultural sector, food crop production is the most important component, which amounts to about 61% of the total agricultural products.

The production of milled rice, the country's main staple, increased from 13.7 million tons in 1971 to 20.3 million tons in 1980; increase of about 4.8% per annum on average. Production of other staple food crops such as cassava and sweet potatoes did not make significant growth.

The stable production increase of rice attained in this period is attributable to the expansion of the cropped area as well as the increased unit yield resulting from the construction and rehabilitation of irrigation facilities, the introduction of high-yielding varieties and the technical guidance and financial support under the nationwide rice intensification program.

The aforementioned increase in rice production, however, has been insufficient to meet the growing domestic demand resulting from the population growth coupled with the increased per capita rice consumption. Thus, Indonesia has to import a considerable amount of staple food from abroad every year.

IMPORT OF RICE IN INDONESIA

	1975	1976	1977	1978	1979	1980	1981
Volume (1,000 ton)	693	1,301	1,973	1,842	1,922	2,012	538
Value ($US\$10^6$)	327	450	678	592	596	690	206

The increased production in food stuff can be attained by increasing the productivity of farmlands through the improvement of irrigation infrastructure as well as the introduction of new technology of farming practices.

As mentioned earlier, the agricultural sector accounted for about 32% in West Java province. In 1980, the province produced 6.5 million tons of dry paddy covering 22% of the whole country. It also produced 15% of cassava, 17% of sweet potatoes, 14% of groundnuts and 15% of soybean of the whole country. The principal activities of the Banten region are agriculture which centers upon the production of rice from the existing rice field. Production of paddy in Banten region was about 443,000 tons (dry paddy) in 1980 which occupied about 6.8% of the total production of paddy in West Java.

2.4 TRANSPORTATION

Total length of roads in Indonesia is 142,314km in 1980, including 11,533km in West Java. Road condition in West Java is comparatively better than that of outer islands. While only 40% of roads are asphalt-paved in whole Indonesia, more than 70% are asphalted in West Java.

In the K-C-C area, the trunk road connecting Jakarta to the ferry terminal at Merak is passing through Desa Cikandé, about 70km west of Jakarta. The road is asphalt-paved and well maintained throughout the year. New highway connecting Jakarta to Merak is under construction along the existing trunk road. This new road will also pass through the K-C-C area, enabling to make a faster access to the capital.

The district roads in the K-C-C area run mostly from north to south connecting Kecamatan center to Kecamatan center, of which about 43% are well

maintained. Rural roads connecting village to village, however, are unpaved and poorly maintained. Agricultural products are transported from the farm to village markets and rice mills by carrying-pole, bicycle, motorcycle and pickup-type taxis.

2.5 AGRICULTURAL SUPPORT SERVICES

2.5.1 Research

The agricultural research works in Indonesia are undertaken by seven (7) Central Research Institutes under the Agency for Agricultural Research and Development (AARD). The Central Research Institute for Food Crops (CRIFC) is one of these institutes and has seven (7) Research Institutes for Food Crops (RIFC) as its branch stations; i.e. three stations in West Java and one each in East Java, West Sumatra, South Sulawesi and South Kalimantan.

Under the Research Institute in Bogor (BORIF) of West Java, there is the Singamarta Substation in Kecamatan Ciruas, Kabupaten Serang, which is about 20km northwest of the Project area.

The research activities at the Singamarta Substation include the experiment of breeding of rice, cultivation tests of strains and the experiment on the cropping pattern using about 10ha of experimental farm.

2.5.2 Extension

Agricultural Extension Services are made available through Rural Extension Centers (REC or BPP) under the Directorate General of Food Crops, Ministry of Agriculture. The main function of each REC (BPP) is to prepare extension programs, disseminate agricultural information, train farmers on improved farming techniques at the rural level, assist in the supply of necessary farm inputs and provide guidance to farm households to promote a better family farming system. There are 10 BPP offices in Kabupaten Serang with a total of 20 Extension Officers (PPM) and about 100 Field Extension Workers (PPL). 10PPLs are serving in the working area of about 6,000ha farmland in and around the Project area in order to disseminate technical information.

2.5.3 Input Supply and Credit Facilities

The supply of farm inputs and credit to farmers in Indonesia is usually carried out under the Govenment-assisted BIMAS and INMAS programs. These programs aim to increase food production and farm income in accordance with the Government policy of supplying farm inputs at subsidized prices. BIMAS credit is financed by the Indonesian Peoples' Bank (BRI), the state bank specialized in agricultural credit. While the BIMAS farmers can obtain full credit packages, the INMAS farmers can only obtain input supplies at BIMAS subsidized prices without credit.

2.5.4 Cooperatives

Farmers' cooperative system in Indonesia has been strengthened through constant endeavour by the Government. The farm input supplies are provided to the farmers through the village unit cooperatives (BUUD/KUD) under the BIMAS/INMAS programs. BUUD is a temporary organization of farmers cooperative and all BUUDs are expected to be raised to the status of KUD (Village Unit Cooperative) after fulfilling necessary conditions. The village unit is an optimal agro-economic size for an agricultural cooperative unit consisting of 600-1,000ha of rice field. Each village unit should have its own BUUD/KUD. Each BUUD/KUD usually has 1 or 2 KIOS (retail shop) at Desa level to supply agricultural input and to purchase farm output from the farmers.

2.5.5 BIMAS and INMAS

The Government introduced the BIMAS (Mass Guidance) program in 1965 in order to increase food production and farm income by supplying credit and farm inputs at Government subsidized prices. The village unit cooperative (BUUD/KUD) or the village chief was in charge of allocation or distribution of the credit as well as the collection of the repayment. A Unit Desa (WILUD) consisting of 600-1,000ha has been selected as the basic unit for credit supplies and extension services which is handled by one field extension worker (PPL).

The INMAS (Mass Intensification) program was initiated in 1967 as a further stage of BIMAS, in which farmers have been assumed to reach a certain level of income that would allow them to be capable to provide the farm input without any credit. It is believed that the nationwide BIMAS/INMAS program has contributed to a large extent to the increase of rice production in recent years.

In Kabupaten Serang, 55,000ha of rice fields out of 66,000ha are targeted to be BIMAS/INMAS program area for the wet season of 1982/1983.

2.6 THE THIRD FIVE-YEAR DEVELOPMENT PLAN (REPELITA III)

Following the Second Five-Year Development Plan (REPELITA II), the Third Five-Year Development Plan (REPELITA III) was formulated for the period from 1979/80 to 1983/84 with the following three objectives:

1) Equitable distribution of development and its gains for the whole population,
2) A sufficiently high economic growth, and
3) A sound and dynamic national stability.

To achieve the objectives, a variety of paths to reach the goal was laid, such as: 1) fulfillment of the basic needs, especially for food, clothing and housing; 2) equitable distribution of income and the increased opportunity to receive social welfare; and 3) increased employment and job opportunity.

Based on the policies mentioned above, the target of the plan was set at an average economic growth rate of 6.5% per annum with the assumption that population growth rate will be about 2% per annum during the years of REPELITA III.

As for the agricultural development sector, the principal policies are: a) to achieve self-sufficiency in food production; b) to increase export of agricultural product; c) to increase agricultural products for industrial use; and d) to raise the living standard of farmers through the production increase.

In this context, the water resources development plays a key role in national economy with the reason that the irrigation farming is indispensable in Indonesia for raising of food production.

Under REPELITA III, there are three types of programs in the irrigation sub-sector, viz.:

1. Programs to improve irrigation network on about 536,000ha
2. Programs to construct new irrigation network on about 700,000ha; and
3. Programs to develop swamp areas on about 535,000ha (Tidal swamp irrigation on 400,000ha and swamp area reclamation on 135,000ha).

The water resources development as mentioned above is expected to support agricultural production, especially food production, transmigration programs and rural development in general.

2.7 NEEDS OF DEVELOPMENT OF NORTH BANTEN

North Banten means literally the northern part of Banten region and comprises the Kabupaten of Serang, the northern part of Kabupaten Lebak and the north eastern corner of Kabupaten Pandeglang with gross land area of 3,630km^2 including 39 Kecamatans (Sub-Districts). In spite of its short distance from Jakarta, this region has long remained under less-developed condition except only a part of the area where some modern industries have been planned and introduced. The per capita income of this region was about Rp. 130,000 in 1980 at current price, which is equivalent to about 50% of the whole country and 63% of West Java province. Low income in Banten region is mainly due to its heavy dependence on agricultural sector which can yield only very low income compared with other industries. Within Banten region, one of the least developed areas with lower income is the K-C-C area in Kabutaten Serang where traditional farming under rainfed condition is common. The average per capita income of this area is estimated to be about 65% of that of whole Kabupaten. Under these circumstances, water resources development in this region would play a key role for the development of agricultural sector as well as industrial sector since demands for water in the region come principally from irrigated agriculture and industrial area.

The proposed Project aims at increasing agricultural production through the provision of irrigation facilities in the Project area, thus improving living standard of the people in the area.

III. THE PROJECT AREA

3.1 LOCATION

3.1.1 The K-C-C Area

As shown on the location map, the K-C-C area is located in the eastern boundary of Kabupaten Serang of West Java Province, having a gross area of about 22,000ha. This area is bordered by the Cidurian and Cibeureum rivers to the east, by the boundary of Ciujung Project to the west and north and by the Kabupaten boundary to the south, all within the four Sub-Districts (Kecamatans) of Kopo, Cikande, Carenang and Pamarayan.

3.1.2 The Study Area

The study area of about 11,500ha in gross has been selected from the K-C-C area for the feasibility study taking into consideration the agricultural potentiality of development, topographic condition of the area and availability of the water. The study area thus selected is bounded by the Cibeureum river to the east, by the boundary of Ciujung Project to the west, by the Kabupaten road which connects Cikande and Babakan to the north and by the Kabupaten boundary to the south.

3.1.3 The Project Area

The Project area, having a net irrigable area of 3,500ha has been selected from the study area taking into consideration the high potentiality for the agricultural development, topographic condition and availability of water.

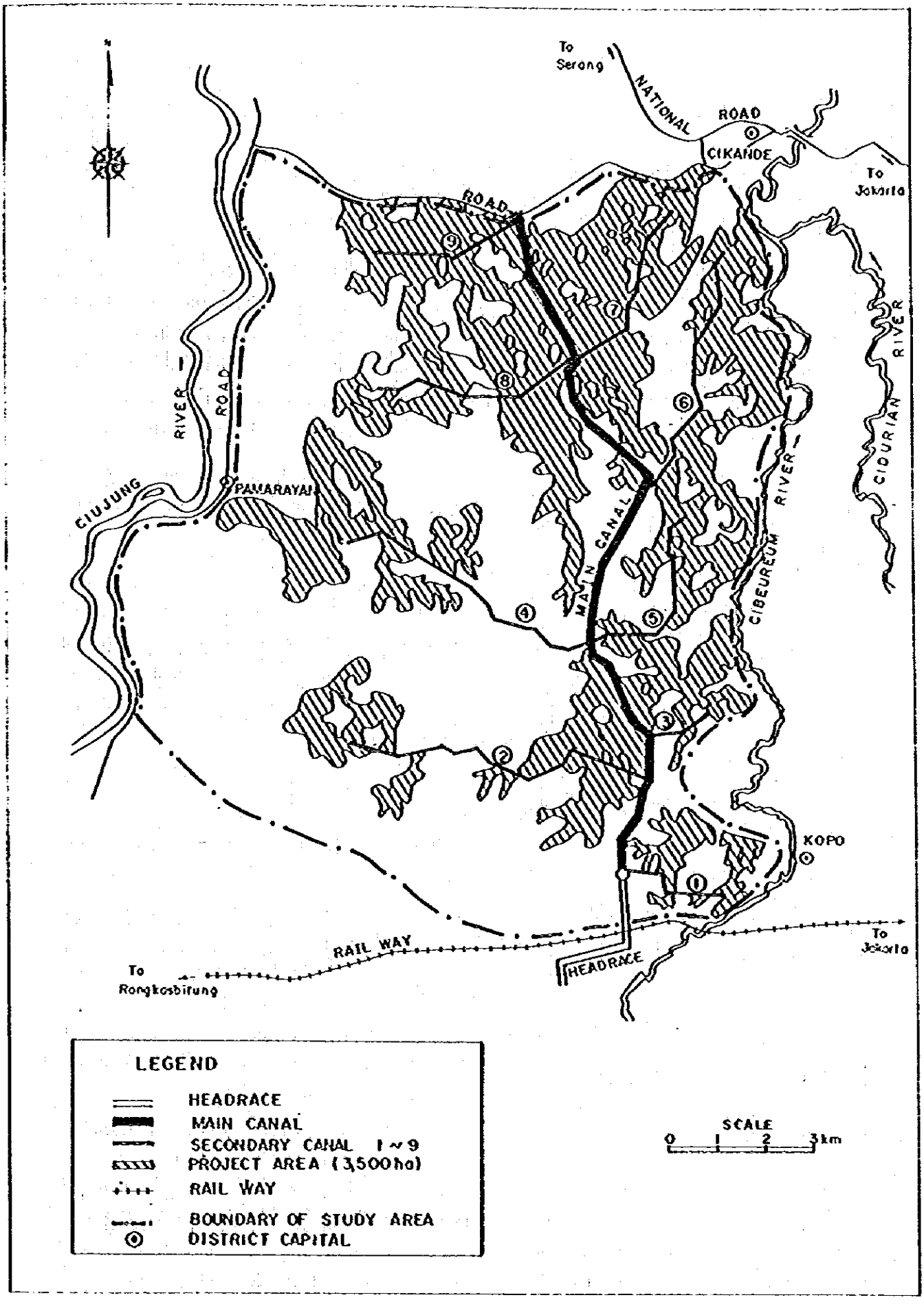


Fig. 2 STUDY AREA AND PROJECT AREA

3.2 INFRASTRUCTURE

3.2.1 Transportation

The trunk road linking Jakarta to Merak, the ferry terminal, is passing through Desa Cikande of the K-C-C area. The road is asphalt paved and well maintained throughout the year. There are several district roads in the area connecting Kecamatan center to Kecamatan center, of which about 43% are well maintained. Rural roads connecting village to village, however, are unpaved and poorly maintained which sometimes hampers the agricultural activities in this area.

Agricultural products are transported from the farm to village markets and to the rice mills by carrying-pole, bicycle, motorcycle and pickup-type taxis.

3.2.2 Telecommunication

In Kabupaten Serang where the K-C-C area is included, the telecommunication system is available in Serang town, the administrative center of Kab. Serang, about 20km west of Desa Cikande. Communication from Serang town to major cities in Indonesia is possible by telephone and by telegram, but no telecommunication system is available in the study area.

3.2.3 Electricity and Water Supply

The study area is still isolated from rural electricity supply though there are some privately owned generators driven by diesel engine in Desa Cikande.

The rural water supply system has not been developed in the study area. The water for household use in the study area mainly depends on the stream flow or ground water.

3.3 NATURAL RESOURCES

3.3.1 Topography

The K-C-C area is topographically classified into Hilly area, Plateau and Lowland. The elevations in the K-C-C area range from 50m to 5m above the sea level, gradually decreasing from the hilly area to north in the direction of Java Sea. Topography of the K-C-C area is classified as per Table 2 in the following page.

Table 3 TOPOGRAPHY OF THE K-C-C AREA

Sector	Elevation	Geologic Structure
Railway (Jakarta-Serang)	40 - 50m	Hilly area; composed of Pliocene sedimentary strata; gray tuff containing sand and clay (sand predominant); upper surface weathered.
- do -	20 - 40m	Plateau; composed of Pliocene and sedimentary deposits; upper surface weathered; pronounced erosion of valleys in branching configuration.
National road (Jakarta-Serang)	20m	same as above
Coastal plain	5 - 10m	Lowland; with exception of Pliocenic (abandoned airfield), alluvial river deposits (sand, silt, clay) cover surface strata.

Strata incline gently in the direction of NS 10 - 20°W and generally exhibit extremely mild folding. Judging from the condition of outcroppings, serious faulting, cracks, and/or joints do not appear to be present. However, examination of aerial photographs as well as conditions prevailing upstream from the site suggest possible small scale faulting at the site. Surface strata at and around the site riverbed consist of a 1m thick top layer of sandy gravel underlaid by deposits of tuff. Slopes are covered by 6 - 10m thick weathered strata. Since outcroppings of tuff are evident on hill ridges, it can be assumed that fresh rock is generally distributed at lower levels along thes locations. Weathered strata exhibits medium compaction of N=15 - 20. If grouting is executed to reduce permeability, this layer should exhibit adequate bearing capacity, for example, for the foundation of a fill type dam. The surface of weathered strata and river terrace formation shows evidence of collapse at scattered points. This is the result of erosion occuring during periods of flood, as well as erosion caused by surface runoff. The physical properties of the weathered strata at the site are as follows:

Soil: Sandy clay: fine grained, includes angular quartz clayed sand; red brown to grayish brown in color specific gravity; G = 2.39 - 2.59 granularity; sand; 1 -12, silt; 41 moisture content: Wn = 62 - 78%.

Permeability: weathered strata; Kv = 10^{-4} cm/sec, Kh = 10^{-6} - 10^{-4} cm/sec, pleistocene sedimentary strata; Kv = 10^{-6} - 10^{-3} cm/sec.

3.3.2 Geology

(1) General Geology in the Study Area

The study area is sandwiched on either side by the Ciujung and Cidurian rivers, both of which flow south to north. The surface of hill and plateau areas is covered by a 3 - 5m layer of weathered soil. Granulation of this weathered stratum is such that it falls primarily within the clayey soil classification. The layer features vertical cracks which result in a high degree of vertical permeability. Consequently, rainwater passes quickly through the weathered zone until reaching the underlying stratum of fine-grained tuff-aceous soil which is impervious. Upon reaching the direction of decreasing elevation, occasionally coming to the surface for low-lying areas. Where the amount of such water exiting the ground is substantial, slope erosion is evident, constituting a factor in the creation of branching configuration of the areas topography. Regarding geologic structure of the study area, refer to ANNEX III.

(2) Geology at Proposed Dam Site

The Gadeg dam site is located at the upper stream of Cibeureum river, about 20km up the junction of the Cidurian and the Cibeureum. River terrace deposits are distributed along both banks downstream from the site. In particular, a wide, flat area is present on the left bank at the site. Ridges on both banks range in elevation 40 - 50m, with the left bank ridge more pronounced. The river course both above and below the dam site is extremely meandering. This phenomenon appears to be due to the formation after sedimentation of faults, joints and other weak lines resulting from volcanic activity and the effects of Danau Caldera. The geology of the site consists of fine to coarse grained, gray tuff, lapilli, and pumice-tuff containing tuffaceous shale. A portion of agglomerate is packed tightly between pebbles of 10 - 15mm diameter.

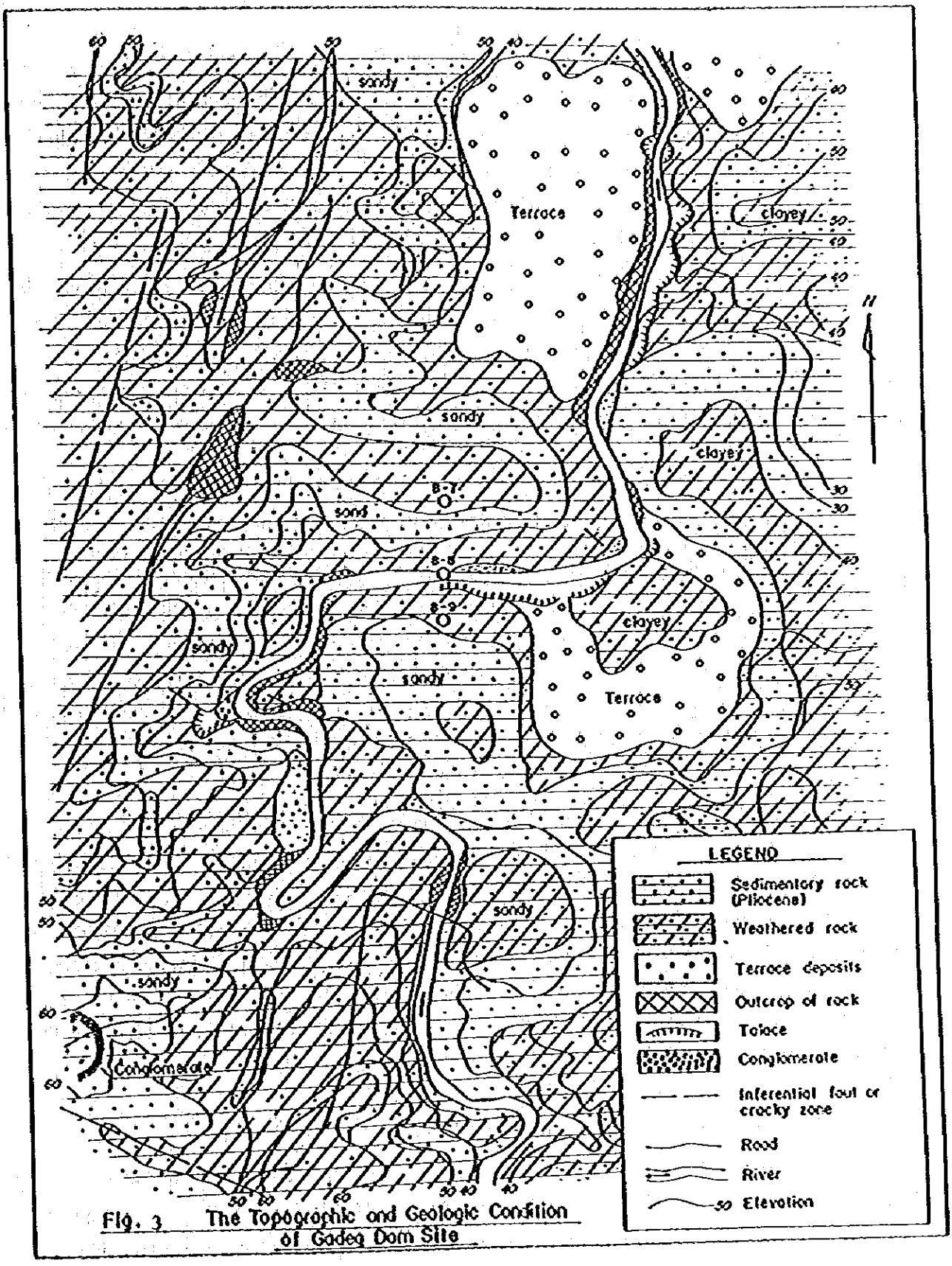


Fig. 3 The Topographic and Geologic Condition of Gadeg Dam Site

3.3.3 Soils

The soils in the survey area are classified into four (4) soil units, i.e., Eutric Fluvisols, Eutric Gleysols, Orthic Acrisols and Dystric Nitosols according to FAO/UNESCO soil classification system.

(1) Eutric Fluvisols (Grayish Brown Alluvial Soils in Indonesian System)

The soils of this soil unit are extending on the natural levee along the Cibeureum river to limited extent. The soils are derived from alluvial deposits and generally immature with no predominant morphological characteristics. The effective soil depth is generally deep. The soils of this soil unit consist of one (1) phase. The soils are presently put under cultivation of upland crops. These soils occupy about 110ha or 1.0% of the survey area.

(2) Eutric Gleysols (Gray Hydromorphic Soils in Indonesian System)

The soils of this soil unit, typical wet soils are developed on the valley bottom which densely dissects the hilly land. The soils are derived from run-off deposits from adjacent elevated areas. The soils have hydromosphic properties within 50cm of the surface. The soils are generally fine in texture. The soils are classified into three (3) phases. The soils are mainly used for the cultivation of rainfed rice. The soils of this soil unit extend over about 3,710ha or 32.8% of survey area.

(3) Orthic Acrisols (Yellowish Brown Podzolic Soils in Indonesian System)

The soils of this soil unit, extending on the hilly land, have a distinct argillic B horizon. The relief is gently undulating with steep slope at its edge. The soils are derived from tuff. The soils of this soil unit are, furthermore, classified into five (5) phases. The Phase with shallow effective soil depth includes Dystric Regosols. The soils of this soil unit are mainly used for the cultivation of rainfed rice and upland crops. The soils of this soil unit are estimated at 1,770ha or 15.7% of the survey area.

(4) Dystric Nitosols (Reddish Lataols in Indonesian System)

The soils of this soil unit are mainly developed on the sloping or undulating hilly land. The soils are derived from tuff and have shiny ped-surfaces to a great depth. The soils are generally dark reddish brown in color. The effective soil

depth is deep. The soils of this soil unit are classified into three (3) phases. The land of this soil unit is mainly covered by upland field and shrub. The soils represent 5,710ha or 50.5% of the survey area.

Based on the study, most of soils in the survey area, except for soils in the depression or having shallow effective soil depth, have no constraints for irrigated rice and upland crops cultivation.

The Land Capability Map and Soil Map are given on Fig. 4 and Fig. 5 respectively.

3.3.4 Climate

There are two (2) meteorological stations and more than thirty (30) rainfall gauging stations in and around the study area (see Fig. 6). Out of them, the stations where longer period of data are available are listed as shown in ANNEX I. The distribution of the rainfall is not uniform due to influence of mountainous areas located south of the study area. The mean annual rainfalls are 1,500 - 2,000mm in the study area and 2,500 - 4,000mm in the mountainous area and maximum annual rainfall in the mountainous area exceeds 5,000mm (see Fig. 7). The rainfall in the study area fluctuates largely and seventy (70)% of the annual rainfalls occur in wet season and remaining thirty (30)% in dry season. The rainfalls from April to May and from September to October are rather transitional. The monthly mean temperatures in the study area are 33°C at the maximum and 21°C at the minimum and average annual temperature is about 27°C. The humidity in the study area does not fluctuate largely and it ranges from 78 to 83% on average. The monthly mean wind velocity is 105 km/day and it also does not fluctuate largely through the year. The wind direction is predominant in the direction of N-W.

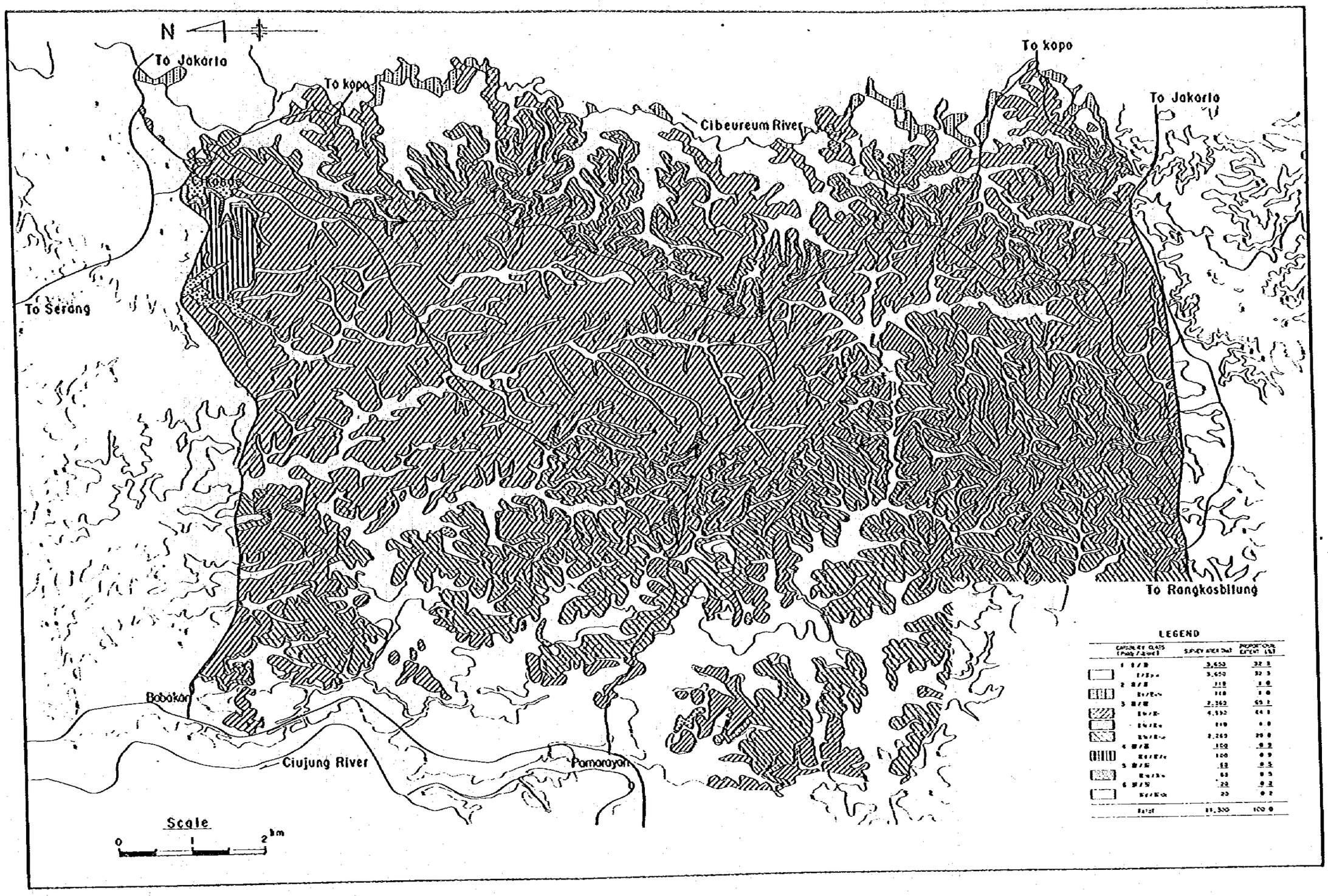


Fig. 4 LAND CAPABILITY MAP

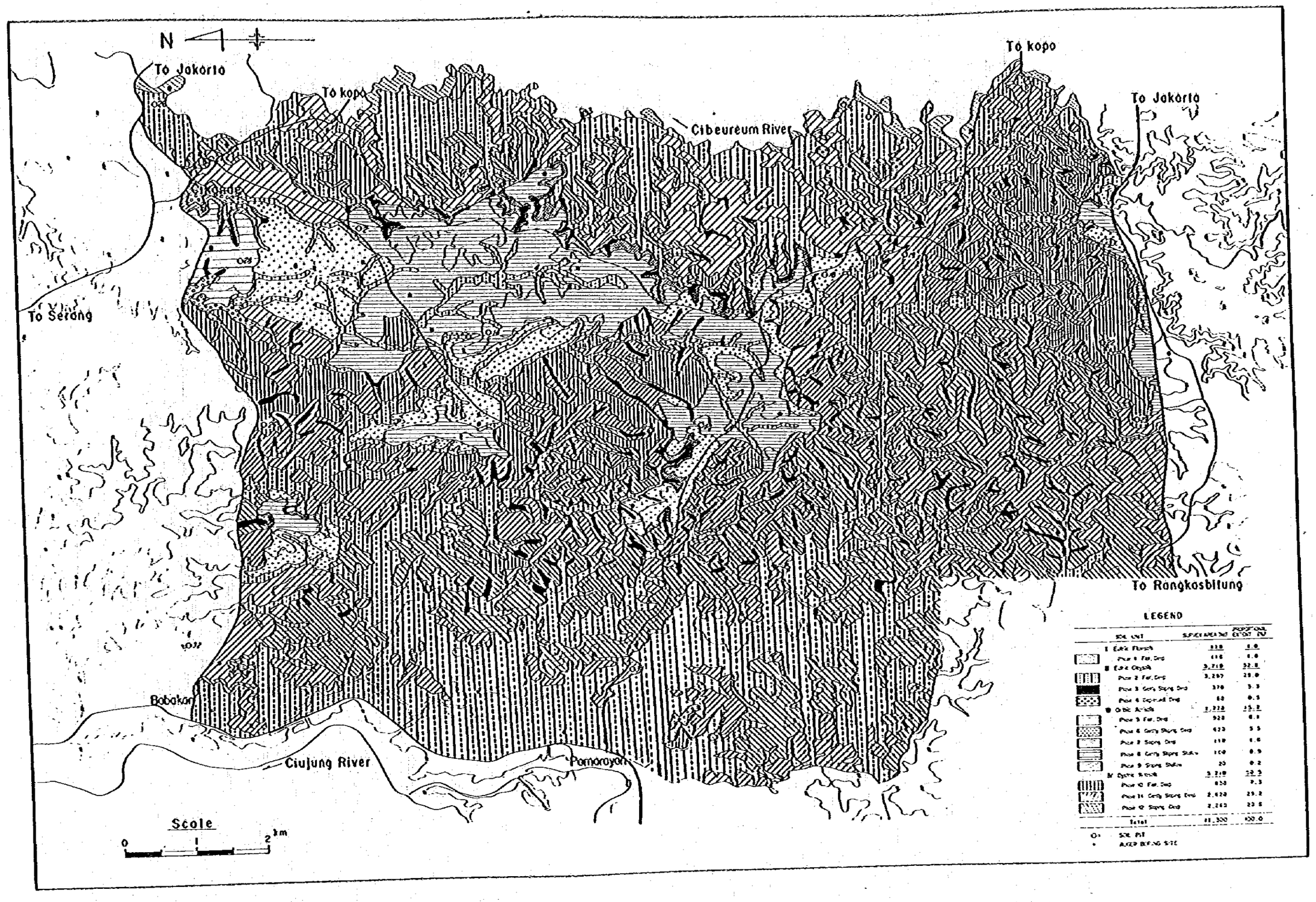
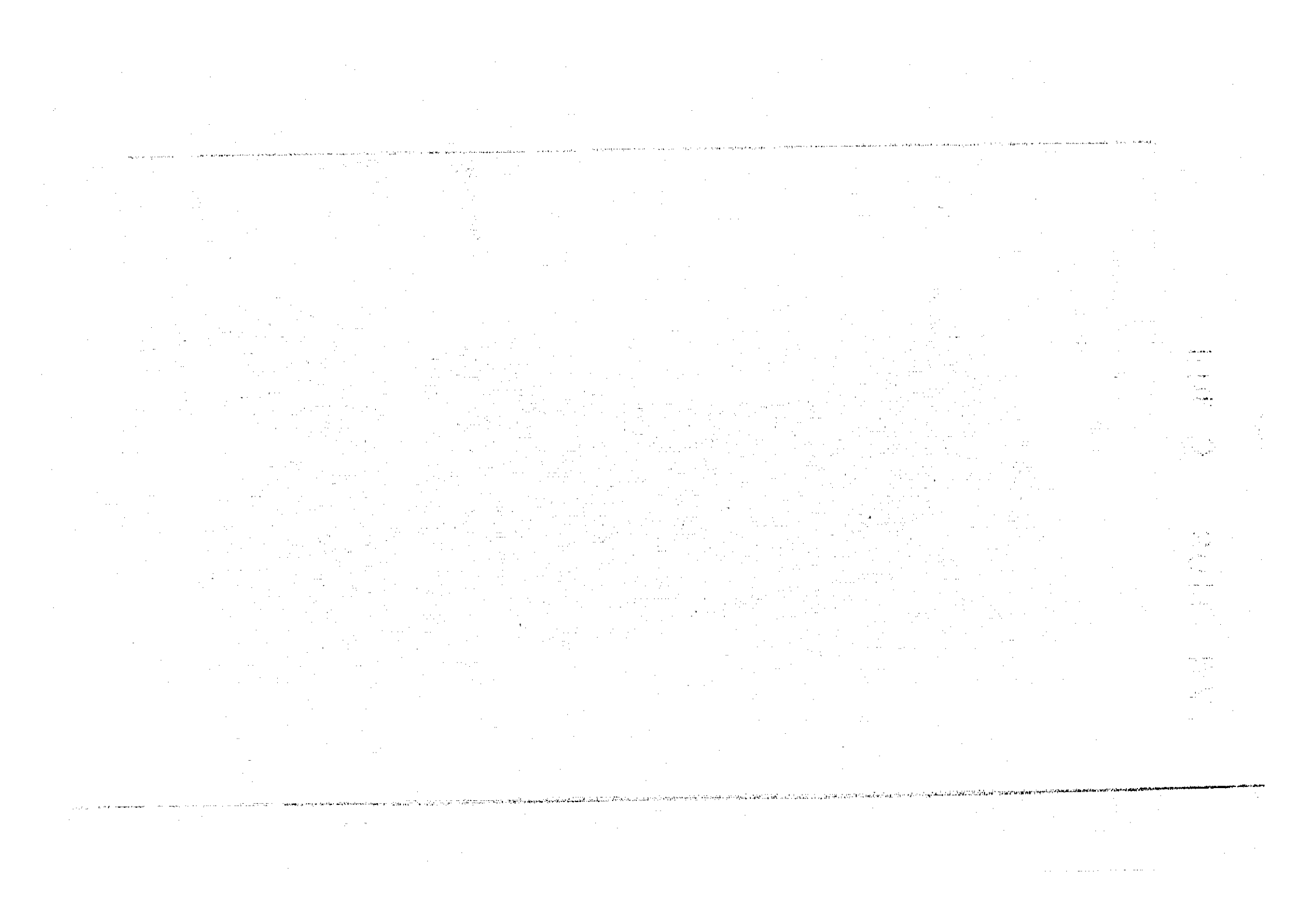


Fig. 5 SOIL MAP



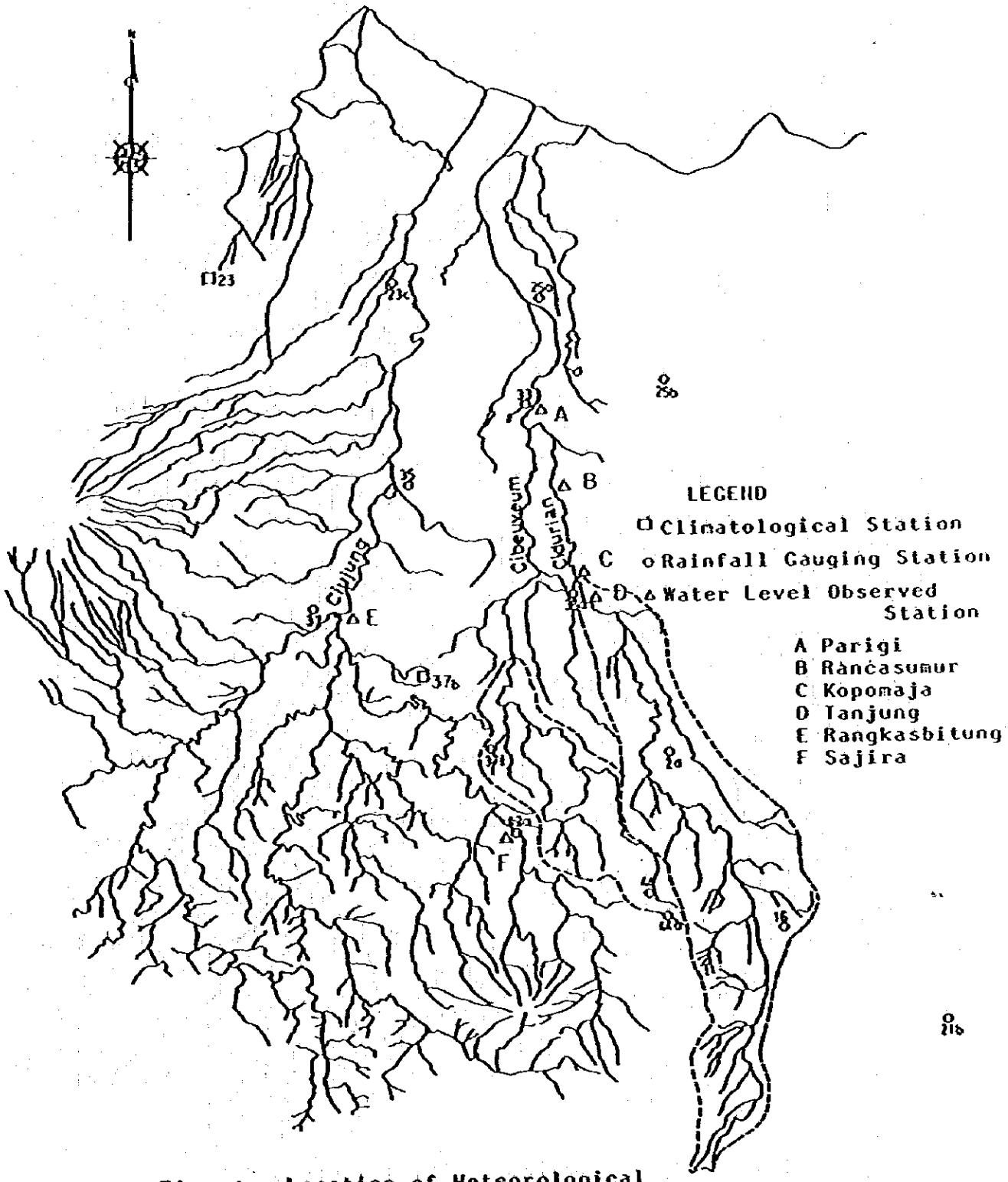


Fig. 6 Location of Meteorological and Hydrological Station

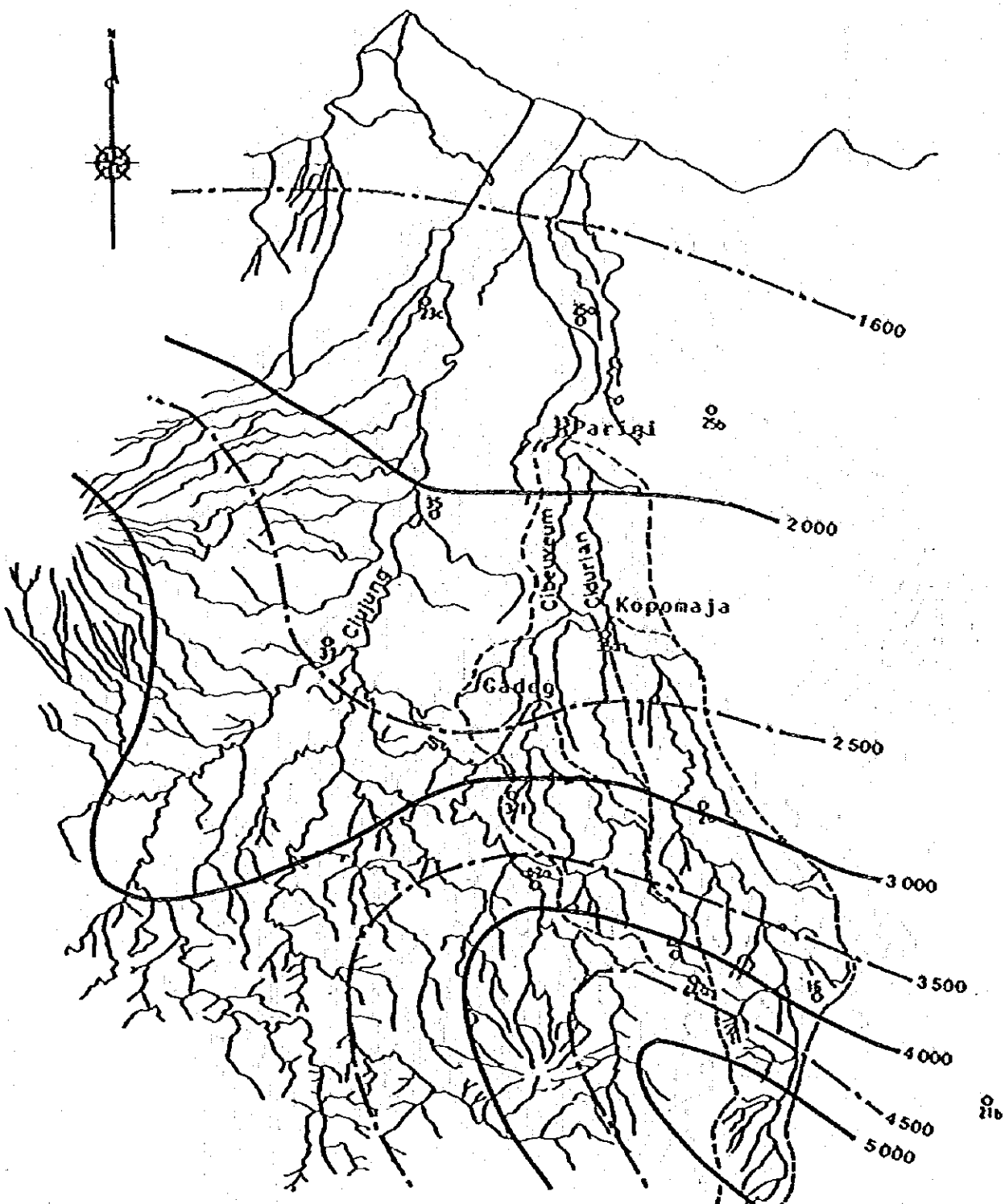


Fig. 7 Mean Annual Isohyetal Map

Source: BINNIE&PARTNERS(1979)
Banten Water Resources Development
Reconnaissance Study

3.3.5 Hydrology

(1) Cibeureum River

No complete discharge data on the Cibeureum river are available. Accordingly, the estimation of the dependable water from the Cibeureum river at Gadeg will be made using the discharge data on the Cidurian river at Kopomaja taking into consideration the hydrological characteristics of both the rivers and other hydrological data available.

(2) Return Flow

Return flows in the study area are observed. Through the field investigations, it has been confirmed that in the limited places of the study area, usually in lower area, return flows are utilized for irrigation purpose by raising the water level of the flows by means of simple hydraulic structures such as small weirs, stop-logs, etc. Also, field to field irrigation which may be defined as repeating irrigation which utilizes the return flows has been observed in the limited places of the study area.

However, the utilization of return flows in the study area is not fully developed due to confinements of the topographic conditions of the crop fields and shortage of inputs of irrigaiton facilities.

(3) Ground Water

Some official reports concerning groundwater in the study area are available, but these are insufficient for a proper understanding of the dynamics of the aquifers. Nevertheless, the reports available show that groundwater can be found more or less everywhere. At the toe of hilly part in the study area, springs are sometimes found even in dry season and they are usually used for irrigating the limited small area and for other purposes. In the flat area, wells for drinking water use are sometimes found. According to the field investigations conducted in November 1982, the water levels of these wells ranged from 5 to 7m below the ground surface. This underground water belong to the aquifer in the lower layer and the water level in the upper part of the ground is unmeasurable. Although the study area will be fitted to the gravity irrigation method, it is suggested that availability of groundwater should be assessed by appropriate methods so that the groundwater can be utilized for example for small scale pumping irrigation for the limited area where gravity irrigation method can not be applied technically and economically.

(4) Runoff, Flood Discharge and Water Level at Proposed Dam Site

Using the riverflow discharge data at Kopomaja (for the period of recent 8 years), the flood discharge at the dam site (Gadeg) is estimated to range from 97 to 119 m^3/sec. According to hearing from the people at Gadeg, the Cibeureum river once flowed with the depth of about 8.0m, which is considered as historically maximum one. This is estimated to correspond to the discharge of 400 m^3/sec.

3.3.6 Water Quality and Sedimentation

A field investigation on the water quality of the Cibeureum river was conducted at Gadeg during the first field survey on the Project. The results are shown in Annex I (Table I-24). Judging from the data obtained, there will be no problem in the water quality of the Cibeureum river for irrigation use. The sedimentation of the Cibeureum river has been calculated from the Sedimentation Rating Curve. Annual sedimentation at Gadeg dam site is estimated as 14 million tons (see details Annex I).

3.4 PRESENT CONDITION OF AGRICULTURE

3.4.1 Present Land Use

The present land use in the study area is classified into four wide categories, i.e. wetland rice field, dryland field, mixed farm and homeyard, village and others as summarized below.

Land use category	Area	Proportional extent
Total area	11,500	100
Wetland rice field	5,000	43
Dryland field	1,000	9
Mixed farm, homeyard	5,000	43
Village and others	500	5

The farmland comprising rice field and dryland field amounts to about 6,000ha or 52% of the total area. Rice field occupies about 5,000ha or 43% of the main farm land. The rice field has been developed to possible maximum extent, however most of the rice field is cultivated under rainfed condition. Dryland field of about 1,000ha is developed near to the top of hilly area and used for mainly palawija crops such as vegetables, groundnuts, chillies, cassava, etc. under the rainfed condition. In the mixed farm and homeyard most of villagers grow fruit trees such as banana, coconuts, cassava, bamboo, etc. The mixed farm and homeyard used for cultivation of crops is estimated at about 5,000ha or 43% of the total area. The remaining of about 500ha is villages, rivers, roads and others. The present land use in the study area is illustrated on Fig. 8.

3.4.2 Present Cropping Pattern

The main crop grown in the study area is wetland rice. Most of the rice field in the study area is put under the rainfed condition, consequently rice farming is concentrated in the wet season and the rice field after harvesting of the wet season crop is generally left as fallow during the dry season. The palawija crops such as vegetables, chillies and groundnuts are generally grown in the dryland field in the rainy seson. The wet season rice is planted at the onset of the monsoon, usually in October to December, and harvested in April to June depending on the variety cultivated.

The cropping patterns prevailing in the study area can be classified into five major types as follows:

	Cropping pattern		Planted area (ha)	Proportion (%)
(1)	Rice	- (fallow)	4,050	67
(2)	Rice	- Rice	290	5
(3)	Rice	- Palawija	660	11
(4)	Palawija	- Palawija	370	6
(5)	Palawija	- (fallow)	630	11
	Total		6,000	100

Data source: The data shown above are estimated based on the Laporan Rencana Akhir Penetapan Pola Pertanaman Yang Akan Ditetapkan Dalam "OPSUS" Subur Mkmur di Wilayah I Banten, Kecamatan Pamarayan dan Kopo, 1982. Agriculture Office, Serang Kabupaten.

The pattern (1) "Rice - (fallow)" is adopted in about 80% of the rice field or about 68% of the total cultivated field and predominant in the study area, and found mainly in the rainfed rice field. The Pattern (2) "Rice - Rice" is found in very limited areas at the foot of hill where very short irrigation water is available during the dry season. The pattern (3) "Rice - Palawija" is found in the rainfed rice field at the higher part of hills and never found along the bottom of valleys. The patterns (4) "Palawija - Palawija" and (5) "Palawija - (fallow)" are found in the dryland field under the rainfed condition. The present cropping intensity is estimated at about 122%. Such low cropping intensity is basically due to shortage of available irrigation water. These cropping patterns prevailing in the study area are illustrated on Fig. 9.

3.4.3 Present Farming Practices

The rice cultivation is carried out by labour intensive form from the stage of seeding to harvesting. Animal power, mainly buffaloes, is extensively used for land preparation. The use of agricultural machinery is not common. The cultivation method of wetland rice is mostly ordinary transplanting method. The varieties widely used are local varieties called as "Cerai", long growing duration from seed to seed of about five months. Besides the local varieties, new high yielding vrieties such as Cisadane, Cimandiri, Citarum have been introduced for the rainy season crop. IR 36

has been also introduced for the purposes of dry season cropping or multi cropping of rice a year due to short growing duration of about 105 days from seed to seed. The fertilizers and agrochemicals are widely used. The fertilizers being used are urea, and triple superphosphate (T.S.P.). The average dosages are 100kg of urea and 50kg of T.S.P. per hectare. Use of insecticides and rodenticides is common. Major insecticides are Diazinon and Dimecron mainly for stem borers and bugs. Application is done by using knapsack type sprayers and motorized portable sprayers. Zincphosphate and Klerat are widely used as rodenticide. Harvesting is generally done by method of "Ani-ani" (finger knife) or "Sabit" (sickle) and threshed by manpower. The cultivation of palawija crops are recently introduced by recommendation of the agricultural extension services with new varieties and cultivation methods.

3.4.4 Present Crop Yield and Production

The crop yield and production under present condition in the Project area are estimated on the basis of production data obtained from agricultural office at each Kecamatan of Pamarayan, Kopo and Cikande which are concerned with the study area.

The average planted area of rice in Kecamatans of Pamarayan, Kopo and Cikande, from 1977 to 1981, is estimated at about 13,600ha. The planted area of palawija crops is about 5,000ha on an average. The average harvested areas of rice and palawija crops from 1977 to 1981 in Kecamatans of Pamarayan, Kopo and Cikande are about 12,700ha and about 4,400ha, respectively. The difference between planted and harvested areas are considered as the areas damaged by various causes such as flood, drought, insects and rodents. The average damaged areas for rice and palawija are 900ha (or about 7%) and 600ha (or about 12%) respectively.

The average planted area and production of rice in these three Kecamatans are 13,602ha and 43,100 tons per year. The average yield of rice is estimated at 3.2 ton/ha. The average unit yield of each palawija crop in the Project area is estimated based on the said data in the study area. The present crop production in the Project area is estimated as shown below:

	Crops	Planted Area	Unit Yield	Production
		(ha)	(ton/ha)	(ton)
1.	Rice	3,800	3.2	12,160
2.	Palawija			
	Maize	38	0.7	27
	Groundnuts	152	0.8	122
	Chillies	152	1.8	273
	Vegetable beans	38	2.1	80
		380		502

3.4.5 Livestock Production

Livestock raising is not a mainline of agricultural activities in the study area. Most of livestock are grazed on a small scale in and around the rice field. The important animal is buffalo as draught animal for farming. The number of livestock animals in the study area is summarized below:

(Unit: Head)

Animals	Total Number	per farm household
Cattle	23	-
Horse	141	-
Buffalo	11,809	0.5
Goat	11,547	0.5
Chicken	153,709	6.9
Duck	14,986	0.7

3.5 AGRICULTURAL SUPPORT SERVICES

3.5.1 Research and Extension Services

The agricultural research work in Indonesia is undertaken by the Agency for Agricultural Research and Development (AARD) at Bogor in Java. There are seven Central Institutes under the AARD. The Central Research Institute for Food Crops (CRIFC) is one of these institutes having 7 Research Institutes located in South Kalimantan, West Sumatra, South Sulawesi, East Java and West Java.

The Research Institute in Bogor (BORIF) has executed various experiments on food crop development. The institute has one of branch experimental stations at Singamarta in Kabupaten Serang, about 20km north-west of the study area. Most of the experimental works of this experimental station have been devoted to the experiment of breeding of rice, cultivation tests of strains, and experiment on the cropping pattern using about 10ha of experimental farm. This experimental station is playing an important role in technical aspect of increase of crop productivities not only in selecting suitable rice varieties in this region but also introducing new crops and varieties and cultivation technique in combination with the experiment on the cropping patterns.

Agricultural Extension Service is one of the main components to promote the sustained increase of agricultural products, especially of food crops. The Directorate General of Food Crops of Ministry of Agriculture is in charge of rural extension works on food production at national level.

Extension Service in West Java is undertaken by Provincial Office of Agriculture Service (Dinas Pertanian Propinsi) through Subject Matter Specialists (PPSs), Extension Officers (PPMs) and Field Extension Workers (PPLs). Personnel of Agricultural Extension Service in Wet Java is summarized as follows:

- 5 PPSs at Provincial Office of Agriculture Service
- 4 PPSs at each Wilayah (or Regional) Office of Agriculture Service
- 1 PPS at each Kabupaten Office of Agriculture Service
- 2 PPMs at each Kabupaten Office of Agriculture Service
- 2 PPMs at each BPP (Rural Extension Center) Office
- 1 PPL per each WKPP (Rural Extension Working Area of 600-1,000ha)

There are 219 BPP offices in West Java, where 438 PPMs and 2,023 PPLs are working to provide extension service mainly for the farmers.

In Kabupaten Serang, there are 10 BPP offices including BPP Pamarayan and BPP Cikande, where each 2 PPMs and about 10 PPLs are serving. BPP Pamarayan is located at Desa Kopo (Kecamatan center) which covers Kecamatan Kopo and Kecamatan Pamarayan. BPP Cikande is located at Desa Cikande (Kecamatan center) which covers Kecamatan Cikande and Kecamatan Carenang.

10 PPLs serve in the area of BPP Pamarayan covering about 6,000ha of rice field with about 18,325 farm households. 9 PPLs serve in the area of BPP Cikande, covering about 8,800ha of rice field with about 14,843 farm households.

Agricultural extension service is provided by PPLs (Field Extension Workers), stationed in BPP offices, under supervision of PPSs and PPMs. A PPL visits 16 farmers' group area called WILKEL in every 2 weeks to transfer the new agricultural information and new farming technology and also to solve the problems, if any, in the fields as well as in farmers society.

3.5.2 Seed Multiplication and Distribution

Traditionally the farmers in Indonesia have used a part of their paddy production as seed for the next planting season. However, with the BIMAS program to help increase production through the use of new HYVs, the need for improved seed multiplication and distrubution became urgent. In 1971, the National Seed Corporation (Sang Hyang Sri) was established in Sukamandi, West Java to produce extension seed. The NSC has no problem in distributing its production but its production still remains far short of original plan.

There are three (3) seed multiplication farms in Kabupaten Serang. These farms produce about 90 tons of seed every year but this amount is very short to fill the requirement of 1,500 tons of seed in Kabupaten Serang every year. The shortage is mainly supplied by NSC and farmers' own produce.

Distribution of seed is channeled through P.T. Pertani (governmental enterprise)/KUD and private distributors.

3.5.3 Agricultural Cooperatives and Credit

Under the Agricultural Intensification Program called 'BIMAS", several kinds of services are provided to farmers at the village unit level, such as:

(1) Credit services provided by Bank Rakyat Indonesia (BRI);

(2) KIOS or retail shops for supplying agricultural inputs such as seed, fertilizer and pesticide;

(3) One or more PPLs for agricultural extension; and

(4) Processing and marketing facilities by BUUD/KUD (Village Unit Cooperative).

The idea of having village units (Wilayah Unit Desa or WILUD) has been introduced since 1971 to make farm-cooperatives' activities more effective. Before 1971, there were farm-cooperatives in mostly every Desa with the area of only 80-200ha rice field which did not allow the farmers' cooperatives to make effective function because of too small area. So some cooperatives were combined into a BUUD (Badan Usaha Unit Desa or Village Unit Enterprise Cooperative) to cover the area of 600-1,000ha (WILUD). BUUD is a temporary organization and all BUUDs are to be raised to the status of KUDs (Village Unit Cooperatives). There are one KUD in Kec. Pamarayan, two each in Kecamatans of Kopo and Cikande, and three in Kec. Carenang. Each KUD has 1 or 2 KIOS (retail shops) at Desa level to supply agricultural inputs for farmers.

BIMAS credit is financed by the Indonesian Peoples' Bank (BRI), the state bank specialized in agricultural credit. In order to provide loan service properly, the BRI began establishing their Unit Desa Banks (BRI Unit Desa) at the Kecamatan level.

In the K-C-C area, there are 6 Unit Desa Banks, one each at Kecamatans of Pamarayan and Kopo and two each at Kecamatans of Cikande and Carenang.

There are three kinds of loan for on-farm and off-farm loan, i.e. short-term, medium-term and long-term loans. The short-term credit is most frequently used by small-scale rice farmers. The Bimas credit is the short-term loan with the conditions of 7 months in loan term with 1% of monthly interest rate.

3.5.4 Marketing and Prices

Main marketing farm output is rice in the study area. The surplus of paddy produced by the farmers is sold mainly through the channel of both KUD/DOLOG and the private traders. The collected rice by small rice traders and KUD is sold to large rice traders and DOLOG respectively after milling. DOLOG is a provincial branch office of BULOG (the National Food Logistics Agency) and has its Sub-DOLOG offices at Kabupaten level. Under the Rice Price Stabilization Program, domestic procurement of paddy and milled rice has been undertaken through the KUD (Village unit cooperatives). However, because of very limited storage capacity of Sub-DOLOG/KUD, only about 20% of paddy and milled rice marketed are handled through Sub-DOLOG/KUD in Kabupaten Serang. The remaining is handled by private traders. It is desired, therefore, that Sub-DOLOG and KUD would improve their storage capacity for the effective activities in domestic procurement.

The prices of farm output fluctuate by many factors which affect supply and demand. However, considering the importance of rice to both producers and consumers, the Government is always trying to stabilize the price of rice. Under the price stabilization policy, market injections are sometimes undertaken by DOLOG. DOLOG offices purchase rice when the market price become lower than the floor price and sell the rice when the market price become higher than the ceiling price.

The market prices of major farm products prevailing in the Project area are as follows:

	Rp/kg
Milled Rice	250
Dry Paddy	135
Groundnut	450
Maize	150
Cassava	45
Soybean	300
Chilli	600

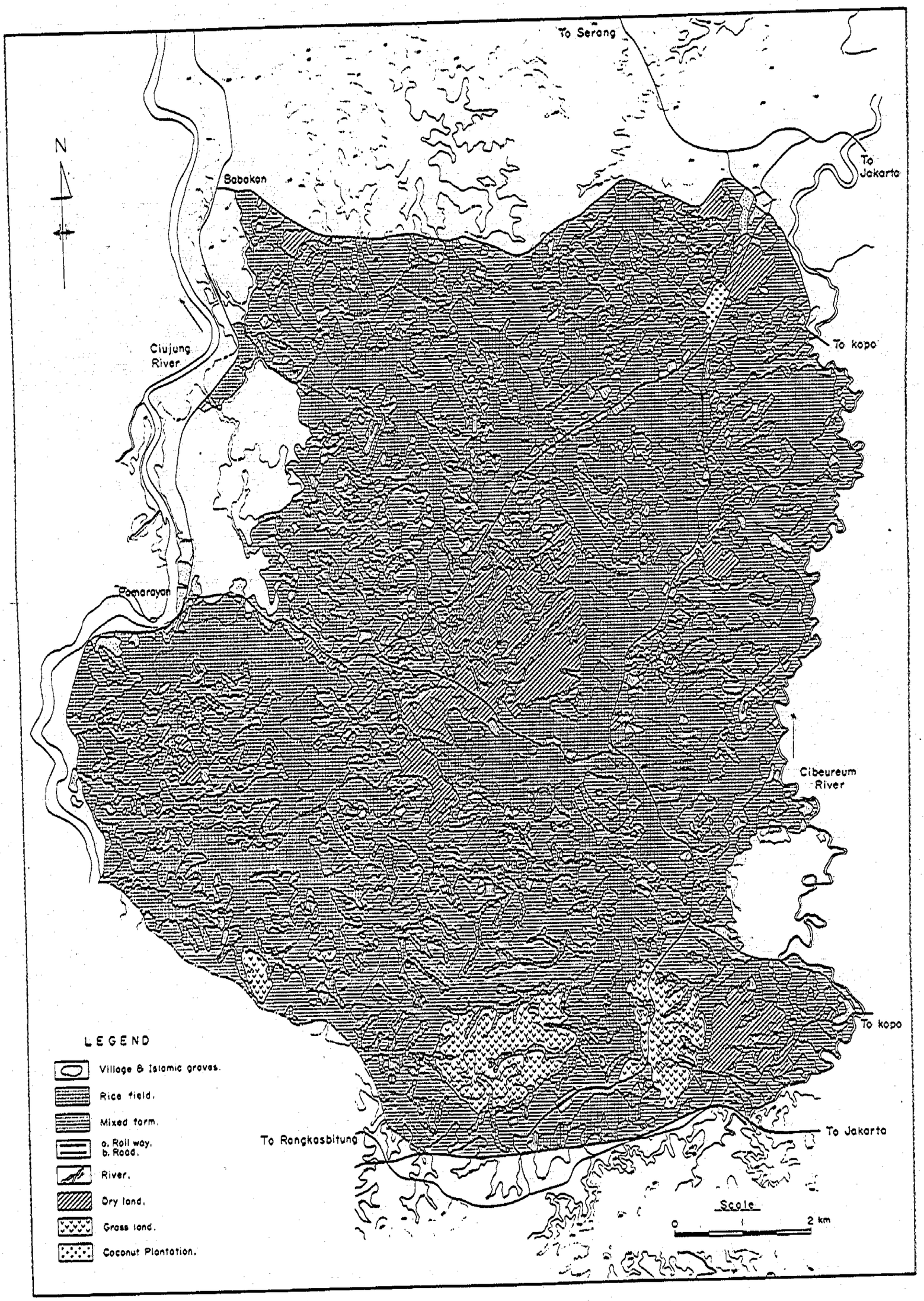
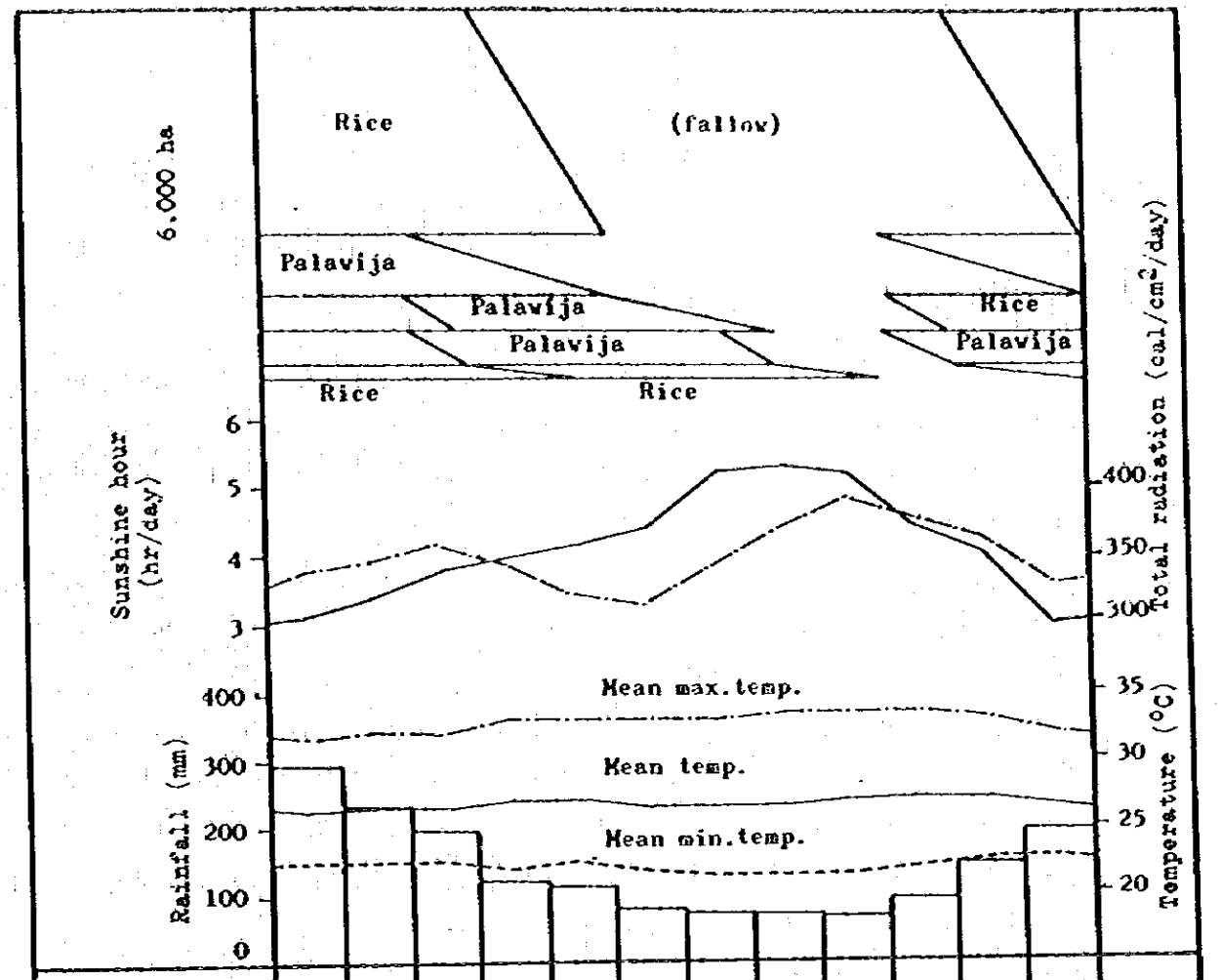


Fig. 8 PRESENT LAND USE IN THE STUDY AREA



Month	J	F	M	A	M	J	J	A	S	O	N	D
Rainfall (mm)	289	230	195	121	116	78	76	73	70	91	145	193
Mean temp. (°C)	26.3	26.7	26.6	27.0	27.1	26.6	26.4	26.6	26.8	27.2	27.1	26.6
Mean max. temp. (°C)	31.4	31.8	31.9	32.9	33.1	33.0	32.8	33.3	33.4	33.5	33.0	32.3
Mean min. temp. (°C)	22.6	22.5	22.6	22.2	22.5	21.7	21.5	21.5	21.6	22.2	22.6	22.7
Relative humidity (%)	84	82	84	82	81	80	80	78	77	77	78	82
No. of rainy day	18	16	14	11	10	6	6	6	6	8	11	15
Sunshine hour (hr./day)	3.1	3.3	3.8	4.0	4.2	4.4	5.2	5.3	5.2	4.4	4.0	3.0
Total radiation (cal/cm²/day)	336	348	337	342	322	313	340	368	391	379	363	330

Note: The values of total radiation are estimated based the sunshine hour shown above. Climatical data shown are obtained at Serang, 1942 - 1981.

Fig. 9 PRESENT CROPPING PATTERN IN THE STUDY AREA AND RELATED CLIMATOLOGICAL FACTORS

IV. THE PROJECT

4.1 PROJECT CONCEPT

The Project aims at increase of agriculturl production and thereby improvement of the farmer's living standard in the Project area through the development of water resources in the Cibeureum river basin as well as provision of prerequisite facilities for irrigation and drainage purposes.

The Project should also meet the policy of the Government for realization of social welfare in the Project area. With this view, the major concepts for agricultural development in the Project area would be summarized as follows:

(1) Unit yield and production of wet season rice should be stabilized and improved through the establishment of new irrigaiton system and introduction of improved farming practices.

(2) Planted area of dry season should be increased with year-round irrigaion system and thereby total production of rice be maximized.

(3) Attention should also be paid to the increase of irrigation area up to the possible maximum area in conformity with the government's policy.

(4) Poor drainage condition should be improved so as to ensure the high productivity of rice under the improved irrigation condition.

(5) Present farm road conditions should be improved and its network be also strengthened to make the agricultural activities more active.

(6) Agricultural institutions which support agricultural development should be strengthened.

4.2 DELINEATION OF THE PROJECT AREA

4.2.1 General

Various data on complex natural resources and interrelated land data have been collected and analized in delineating the area for irrigation development. Systematic appraisal for the soils and substrata, topography and drainage conditions

is conducted as an integrated study with economics, engineering and other disciplines in selection of land suitable for irrigation and their relative degree of suitability. This chapter aims at the delineation of the irrigation development area within the K-C-C Area.

4.2.2 Consideration Affecting the Selection

(1) Land, soil and topography

The land classification survey related to the soil topography and drainage characteristics has revealed the grade of irrigation suitability. Typical characteristics of the natural soil bodies involved are texture, structure, depth, stoniness, horizontal arrangement and layering, soluble salts (EC), pH, infiltration rate, moisture characteristics, etc. Micro and macro topography are evaluated with respect to degree and direction of slope, land capability and land development requirement. Irrigability in relation to location and topography is the main point in this context. The drainability of the area as a whole has been considered in relation to the drainage characteristics of the soil and topography.

(2) Crop value, etc.

The land classification supplemented by overall agricultural studies makes it possible to assess the crop suitability of the soil. In determination of crop values, within the framework of marketing system, estimation of these benefits has been made taking into account not only the gross value of the products but also the international market prices, national value of the products, national demand and the capacity of the existing processing factories available.

(3) People, social and economic conditions

The field survey includes figures on the population of the area and their social and economic conditions. Their farming experience, farming practices, family labor forces, land holding size, land tenure, agricultural supporting services, etc. are taken into account for future successful development.

(4) Government's policy

For the delineation of the irrigation development area within the K-C-C Area, it is important to pay attention to the Indonesian Government's development policy in agriculture.

4.2.3 Areas to be Developed under the Project

Following the result of the land suitability which was made on the basis of cultivable depth of soil, topography, flooding condition, drainability and degree of soil acidity, the land with a total area of 11,500ha in gross are tentatively taken up as the study area which includes about 5,000ha of rice field. The area thus selected, however, will further be assessed for its suitability from the viewpoints of socio- and agro-economy and the Government's policy on the irrigation development. Since the above gross area includes the non-irrigable lands such as village compounds, perennial crops, roads, forest to be conserved, and others, the net irrigable area will amount to around 3,500ha which has been determined taking into account the availability of water calculated on the basis of annual rainfall, annual effective rainfall and annual runoff at Gadeg in the basic year of 1972 (for details, vide ANNEX-VII).

4.3 Agricultural Development Plan

4.3.1 General

The Project aims at achieving the increase of agricultural production and thereby improving the living standard of the farmers in the Project area. From this point of view, an intensive agricultural development plan has been formulated considering many factors which will affect the agricultural activities in the area.

4.3.2 Change in Land Use

Upon the completion of the Project, all the rice field in the area will be fully irrigated and more intensive use of the farmland will become possible. The Project will provide the farmers with good opportunities to expand the volume of their farm business.

The present condition of rice fields will change with the Project as follows:

(Unit: ha)

Description			Without Project	With Project
1. Gross area of rice field			3,800	3,800
2. Irrigation/drainage canals and farm roads and field borders			-	300
3. Rice field			3,800	3,500
4. Net irrigation area			-	3,500
5. Area planted :	wet season	rice	3,800	3,500
	dry season	rice	0	3,500
	dry season	palawija	380	3,500
6. Area harvested:	wet season	rice	3,530	3,500
	dry season	rice	0	3,500
	dry season	palawija	330	3,500

4.3.3 Proposed Cropping Pattern

For formulation of future cropping pattern, the following basic principles which govern the selection of crops and cropping pattern under the Project, have been conceived:

(1) The crops and cropping pattern must create maximum benefits for the farmers as well as the nation as a whole,

(2) The crops and cropping pattern must make optimum utilization of water to be supplied by the Project,

(3) The crops and cropping pattern should be practicable with the limited number of family labour, and

(4) The crops and cropping pattern must conform with the existing social tradition, and be acceptable to the farmers.

In due consideration of the basic principles described above, rice and palawija crops such as groundnuts, mungbeans and soybeans are selected as the major crops, and the cropping pattern of "Rice-Rice-Palawija" a year is formulated for the Project area as the most optimum cropping pattern. Besides these above conditions,

the results of experiment/1 on cropping patterns which had been carried out at the Singamarta Experiment Station under CRIFC Bogor were fully taken into consideratin. The proposed cropping pattern is illustrated on Fig. 2.

To confirm the balance of available labour and required labour for the proposed cropping pattern with the proposed farming practices, labour balance study was made on the unit labour requirement basis as shown on Fig. 3. As the result of the study, the proposed cropping pattern is practicable to be carried out with the presently available family labour force.

4.3.4 Proposed Farming Practices

Proper irrigation farming is the most essential factor for realizing the full exploitation of agricultural potential in the Project area. It is necessary to introduce new high yielding varieties with appropriate farming practices along with the development of irrigation facilities and institutional supports. The existing farming practices with local varieties should be improved and replaced with improved farming practices.

The paddy cultivation is practiced mainly by manual operations with use of small farming equipment such as knapsack type sprayer, treadle thresher, rotary weeder, etc. Ploughing and puddling are carried out by use of draught animal. In the Project area, there exist sufficient number of baffaloes for this purpose. The rapid introduction of farm machinery is not recommendable because of undulating topography, large number of farm population, lack of farm access, etc.

The soils of the Project area are generally poor in plant nutrients, especially nitrogen, phosphorous and potassium. These chemical elements have to be supplemented by fertilization. Considering the soil condition, the suitable fertilizers are urea, triple superphosphate (TSP) and potassium chloride (KCl). The fertilizer requirement for sustaining the target yields would be 200 kg/ha of urea, 100 kg/ha of TSP and 100 kg/ha of KCl.

/1: POLA TANAM, page 53-66,
Laporan Tahunan LP3, 1977/78 - 1979/80.
Badan Penelitian dan Pengembangan Pertanian,
Lembaga Pusat Penelitian Pertanian, Bogor.

As regards the plant protection, intensive application of insecticides would be required for control of plant hoppers, stem borers, etc. Considering the life cycle of these insects, 3 to 4 times applications with 1 ℓ/ha of insecticide during one crop season are necessary.

In addition, it would be necessary to apply fungicides for control of diseases. It is recommended that plant protection works should be carried out in a systematic way through the farmers' cooperatives. In view point of safe and effective use of agro-chemicals as well as prevention of environment pollution, intensive guidances and training by the agricultural extension services would be essential. The details of the proposed farming practices are given in Table 10.

As for palawija cultivation, the present primitive methods have to be improved with improved varieties and technique recommended by the agricultural extension services. The details of the proposed farming practices for selected palawija crops are given in Tables V-18, 19 (ANNEX-V).

4.3.5 Anticipated Crop Yield and Production

After completion of the Project, the rice yield will be increased and stabilized through improvement of irrigation farming practices and further expansion of agricultural support services. The present low yields of palawija crops will be much improved by irrigation farming.

The unit yield of crops "without" project condition is assumed to be in the same level as the present yield, because the cultivation of crops in the Project area is on the considerably matured stage under rainfed condition. It is considered that the increase of unit yield without developing irrigation facilities will be insignificant for measuring the profit brought by the Project.

After the commencement of the irrigation farming in the Project area, the yield of the crops would increase year by year with the proper irrigation as well as further development of the agricultural supporting services. The crop yields during the build-up period and the anticipated crop yields at the full developed stage are assumed as shown below:

Crop	Present yield	Year after commencement of irrigation				
		1	2	3	4	5
Rice	3.2	4.0	4.4	4.6	4.8	5.0
Palawija crops:						
- Maize	0.7	1.2	1.6	1.8	2.0	
- Groundnuts	0.8	1.0	1.1	1.2		
- Mungbeans	0.7	1.0	1.1	1.2		
- Soybeans	0.7	1.0	1.1	1.2		
- Chillies/1	1.8	2.4	2.6	2.8	3.0	

/1: Non dried fruit

Based on the projected progress of increse of crop yield assumed in the above, the anticipated annual crop production and increment are estimated in Table V-22. The annual production of rice at the full development stage is estimated at about 35,000 tons, and the increment is about 22,840 tons. The annual production of palawija crops at the full development stage is estimated at about 4,200 tons, and the increment is about 3,896 tons of groundnuts for example.

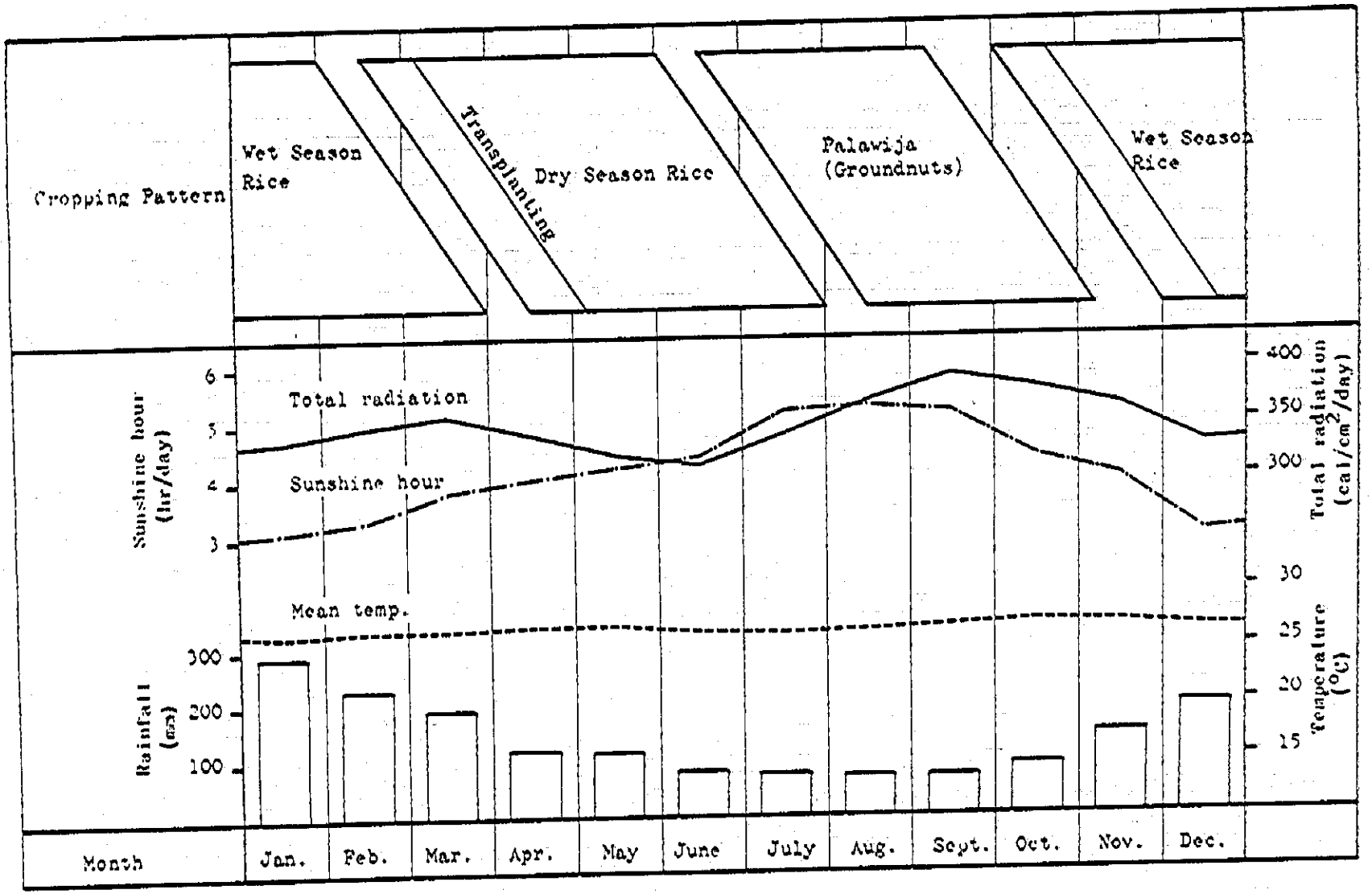
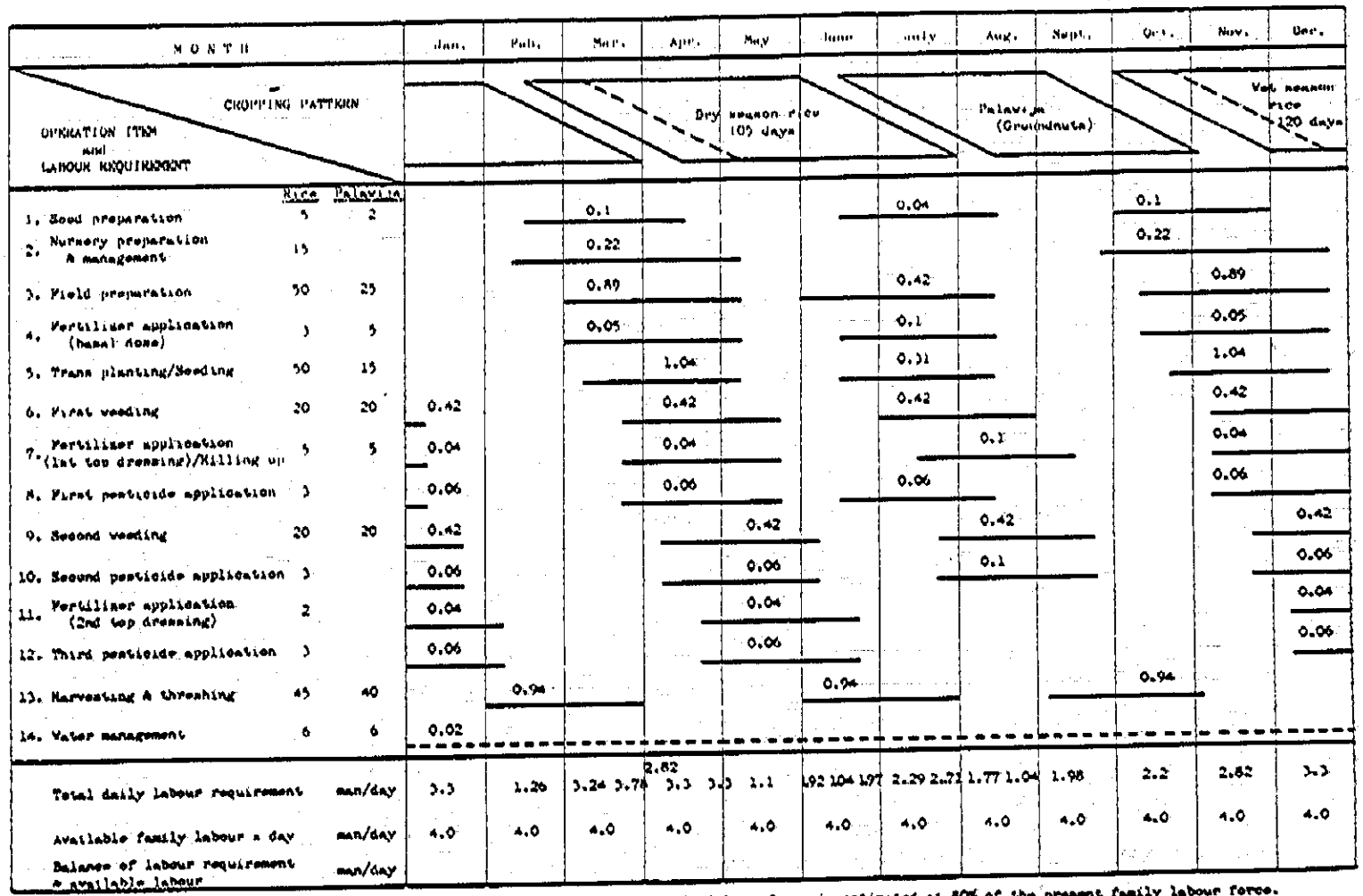


Fig. 10 PROPOSED CROPPING PATTERN



OPERATION ITEM and LABOUR REQUIREMENT	Rice	Palawija	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1. Seed preparation	5	2			0.1				0.04			0.1		
2. Nursery preparation & management	15				0.22							0.22		
3. Field preparation	50	25			0.89				0.42				0.89	
4. Fertiliser application (basal dose)	3	5			0.05				0.1				0.05	
5. Trans planting/Seeding	50	15				1.04			0.31				1.04	
6. First weeding	20	20	0.42			0.42			0.42				0.42	
7. Fertiliser application (1st top dressing)/Killing up	5	5	0.04			0.04				0.1			0.04	
8. First pesticide application	3		0.06			0.06			0.06				0.06	
9. Second weeding	20	20	0.42				0.42			0.42				0.42
10. Second pesticide application	3		0.06				0.06			0.1				0.06
11. Fertiliser application (2nd top dressing)	2		0.04				0.04							0.04
12. Third pesticide application	3		0.06				0.06							0.06
13. Harvesting & threshing	45	40		0.94				0.94				0.94		
14. Water management	6	6	0.02											
Total daily labour requirement		man/day	3.3	1.26	3.24	3.78 2.82	3.3	3.3	1.1	1.92	1.04	1.97	2.29	2.72	1.77	1.04	1.98	2.2	2.82	3.3
Available family labour a day		man/day	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Balance of labour requirement & available labour		man/day																		

Note: The number of workable days assumed at 24 per month. The available family labour force is estimated at 80% of the present family labour force.

Fig.11 UNIT LABOUR REQUIREMENT AND LABOUR BALANCE FOR PROPOSED CROPPING PATTERN PER HA

4.4 IRRIGATION AND DRAINAGE

4.4.1 Water Resources

The only water source available for K-C-C irrigation development is the discharge of the Cibeureum river. Through the Project, a diversion dam is to be constructed on the Cibeureum river at Gadeg, and water is delivered to the Project area by means of a driving canal.

Dependable discharge for irrigation is assumed to be 80% of the river flow of the Cibeureum, giving due consideration to river course conservation and domestic water requirement of inhabitants along the lower reaches of the river.

Based on the discharge data for the period 1964 - 1981, 10-day dependable water amounts were estimated. Of these amounts, the minimum usable discharge is 0.24 m^3/s (October 1973).

4.4.2 Diversion Water Requirement

To clarify the shortage of irrigation water, a balance calculation has been annually made on 10-day basis between the water resources dependable on the Cibeureum river and seasonal diversion requirement from 1963 to 1976. As the results, the maximum unit diversion water requirement has been adopted as the design diversion water requirement. Above calculation has been made following the below-mentioned steps. The consumptive use of water has been calculated by the Modified Penman Method and Christiensen-Hargreaves Method on the basis of meteorological records of the Serang Meteorological Station and the potential evapotranspiration derived from Modified Penman has been adopted to the Project.

The Percolation loss in the Project area has been estimated as follows:

- Elevated rice field 2 mm/day
- Low land rice field 1 mm/day

The percolation loss of 2 mm/day, however, is incorporated in the calculation of the irrigation water requirement for the Project.

Effective rainfall during a growing period of rice is estimated by the daily water depth balance method based on the rainfall records of the No. 33 station from 1963 to 1976.

The following assumptions are made prior to the calculation;

i) rainfall less than 5 mm/day is ineffective,
ii) rainfall exceeding 50 mm/day is also ineffective, and
iii) 70% of the rainfall between 5 mm/day and 50 mm/day is effective.

Effective rainfall for the puddling, however, is calculated on the basis of 80% of the rainfall which is greater than 5 mm/day and less than 50 mm/day.

The nursery period is estimated at 20 days and the area for the nursery is decided at 5% of total paddy field area.

The puddling water requirement including the water layer after puddling has been estimated at 140mm through the puddling period of 70 days. The water application efficiency for rice and palawija is assumed as 80% and 75% respectively. The water conveyance and operation efficiency for the Project is assumed as 80%.

The irrigation efficiency for the rice and palawija are assumed as 64% and 60% respectively. The irrigation water requirement for the proposed cropping pattern has been calculated for the 13 cropping years from 1963 to 1976.

The peak water requirements for the proposed cropping pattern and diversion water requirements are given below (for details, see Annex VII).

(1) Peak unit water requirement:

1st Rice:	1.637 l/s/ha
2nd Rice:	1.506 l/s/ha
Palawija:	0.843 l/s/ha

(2) Diversion Requirement — 5.73 m^3/sec (for 3,500ha of irrigable area, calculated based on data in basic year of 1972)

4.5 PROPOSED PROJECT FACILITIES

4.5.1 General

The general feature of the K-C-C Irrigation Development Project is to supply irrigation water of approximately 6.0 m^3/sec at the maximum to the Project area from the Cibeureum river. The facilities required for the Project include a diversion dam, headrace, canals and the relevant structures, and farm roads.

The basis for determining the facilities requirements for each function is that enough Project facilities be provided in the most effective and economical manner so that each function can be combined with and fully compatible with the other farming operations required at each stage of development.

Based on the above requirements, the following planning and preliminary design of Project facilities are prepared.

4.5.2 Gadeg Dam

The main function of the Gadeg Diversion Dam is to regulate intake water level. The dam site is located about 6km upstream the Cibeureum from the southern boundary of Project area, which has catchment area of 117km^2. The river flow at the dam site varies greatly from year to year and from month to month. The flood discharge of the Cibeureum river at Gadeg with the return period of 1/500 is estimated at 320 m^3/sec.

The river bed elevation is around EL 25.00m above the mean sea level. Rock foundation is observed 3.0 to 3.5m below the river bed.

The type of dam has been proposed as center core rockfill type, 16m high and 160m long. The details are shown below and further informations are available in Annex VII.

- Design flood discharge:	320 m^3/sec
- Design water level	
high water level:	EL 39.00m
normal water level:	EL 38.50m
- Dam portion	
Type of dam:	Zoned rock fill type with center core
Crest elevation:	EL 41.00m
Dam height:	16.0m from river bed
Length of crest:	160.00m
Catchment area	117 km^2
Pond area	480,000 m^2
- Spill way portion (on the right bank of the Cibeureum river)	
Type:	Gated overflow 2-way

Crest elevation:	EL 30.60m
	EL 36.40m
Width of bay	7.00m x 2 bays
	2.00m x 1 bay
Type of gate	Radial gate
	Roller gate
Size of gate	8.40m (H) x 7.00m (B) x 2
	2.40m (H) x 2.00m (B) x 1
Emergency water level	EL. 39.00m
High water level	EL. 38.50m

4.5.3 Intake Structure

An intake structure will be constructed on the left bank of the river. The net width of the intake structure is determined to be 7.0m for the design discharge of 6 m^3/sec and design flow velocity of 0.70 m/sec in the structure. The structure will be equipped with two steel slide gates; 1.5m high and 3.5m wide, which can be operated both manually and electrically. The outline of the intake structure is shown below.

Design discharge:	6.0 m^3/sec
Intake water level:	EL 38.50m
Design velocity:	0.70 m/sec
Sill elevation:	EL 37.20m
Width	3.50m
Type of gate	Steel slide gate
Required numbers	2

4.5.4 Irrigation Canal System

The irrigation canal system of the Proejct consists of the headrace, main canal, secondary canals, tertiary canals and quaternary canals.

(1) Headrace

A headrace with an approximate length of 9.6km is constructed in order to convey the irrigation water exploited in the Cibeureum river to the main canal. The headrace runs in the skirt of the hilly ranges on the left bank of the Cibeureum

river. The canal has trapezoidal section formed with the bottom width of 5.0m and the side slope of 1:1.5. The water depth in the canal is 1.37m. The longitudinal gradient of the canal base is 1/5000. The raised portion is lined with asphalt pitch.

The two inverted siphons will be provided for canal crossing at the railway and small natural rivers.

(2) Main canal

The main canal will run for around 13km to irrigate the Project area of 3,500ha. The design discharge at the head of the canal is around 6 m^3/sec. All the main canals mentioned above will basically be unlined and trapezoidal, but the raised portion is lined with asphalt pitch.

(3) Secondary Canals

These canals will be branched off from the above mentioned main canal to distribute water to secondary units whose size will vary from 130ha to 575ha depending on the topography. 9-secondary canals with a total length of 32.4km will be constructed in the Project ara. These canals will be unlined and trapezoidal. But the raised portion is lined with asphalt pitch.

The number and length of the headrace, main and secondary canals and number of their related structures are tabulated below:

a) Headrace	
- Canal length (km)	9.6
- Related structure (nos)	
Bridge	2
Cross drain	2
Spill way (Waste way)	2
Siphon	2
b) Main canal	
- Canal length (km)	13
- Related structure (nos)	
Bridge	7

Drop	2
Spill way	2
Check	7
Turnout	17

c) Secondary canals

- Total length (km)	32.4
- Numbers (nos)	9
- Related structure (nos)	
Drop	31
Bridge	-
Crossdrain	9
Waste way	10
Check	20
Culvert	21
Turnout	70

4.5.5 Drainage

The planning and design of the drainage facilities which will be required for the Project have not been conducted in this Feasibility Study, due mainly to the following reasons:

(1) As is clearly seen from the existing topographic conditions, undulations are commonly observed in the Project area which make the planning of the drainage economically difficult.

(2) The drainage facilities to be provided in the Project area on the basis of farm development level may be constructed without any significant difficulty, but these facilities must be connected to the main drainage canals to drain out the water outside the Project area and it seems that some of the existing rivers in the Project area may play a role as the main drainage canals. But it will require a considerable amounts of investment to facilitate such a function, because the existing rivers need much improvement to meet the said purpose.

Due to these reasons mentioned above, the drainage planning for the Project has not been involved in this study. But, it is strongly hoped that an overall planning and design of the drainage facilities to be provided for the Project will be taken up in the future plan so as to make the potentiality of this Project more high.

4.5.6 Tetiary Development

The tertiary development program will be prepared for every tertiary block to be irrigated by tertiary system. The tertiary system will consist of tertiary canal, sub-tertiary canals and quaternary canals which will respectively cover the tertiary block (50ha), sub-tirtiary blocks and quaternary block (10 - 15ha).

The typical canal layout in two representative blocks are as shown in Fig. VII-5. The following figures show the total required canal length.

Tertiary canal (km)	63.6
Quaternary canal (km)	314
Tertiary Inspection road (km)	69

4.5.7 Inspection Road

For the proper operation and maintenance of Project facilities, well arranged inspection roads are vital importance. Since these roads will also be used as village roads and farm roads after the Proejct implementation, the arrangement of the inspection roads should be made considering the existing and planned road networks.

In th Project area, the following three types of inspection roads will be provided:

- Main inspection roads along the main canals, 6m wide and paved with gravel.
- Secondary inspection roads along the secondary canals, 5m wide and paved with gravel.
- Tertiary inspection roads along the tertiary canals, 3m wide and is of earth without any metalling.

The detailed layout planning is prepared considering the existing farm and village road networks and future canal layouts, and proposed road network is shown in the map attached to Volume (Drawings).

The following figures show the respective road length.

Main inspection road (km)	14.8
Secondary inspection road (km)	25.3
Tertiary inspection road (km)	69.0

4.5.8 Office and Quarters

Offices and quarters are required for the personnel to be engaged in the Project implementation and in the operation and maintenance of the Project facilities. The location of these facilities is proposed at Rangkasbitung.

The required number and space of these facilities are briefly estimated as follows:

(1)	Main office	1	800 m^2
(2)	Branch office	4	400 "
(3)	Repair shop	1	200 "
(4)	Store house	1	200 "
(5)	Quarters	4	200 "
(6)	Motor pool	1	6,000 "

4.5.9 Operation and Maintenance Equipment

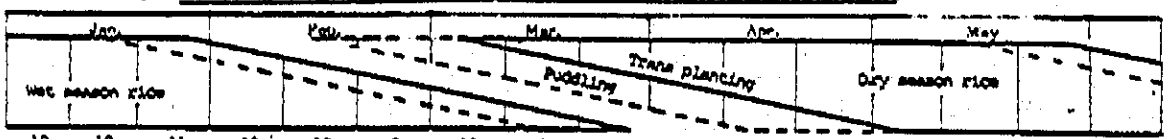
The O & M equipment shown in Table 6 will be required during the Project operation period.

Table 4 RESULTS OF STUDY ON THE BASIC YEAR FOR PLANNING

	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
Annual Rainfall	1054	1765	1691	1815	2407	1718	2637	2298	1562	2383	2471	1992	1481
at Parigi	1	6	4	7	11	5	13	9	3	10	12	8	2
	125	2.4	3.3	2.3	1.2	2.8	1.1	1.3	5.0	1.2	1.1	1.7	6.7
Annual Effective	879	1182	1091	1174	1560	1095	1646	1412	1070	1609	1468	1326	1981
Rainfall at	1	7	4	6	11	5	13	9	3	12	10	8	2
Parigi	26	2.3	3.7	2.5	1.1	3.6	1.1	1.3	4.5	1.1	1.2	1.5	8.7
Annual Rainfall	3090	2227	2096	1988	2659	2197	1953	2003	2110	2823	2678	2357	2131
at Gadeg	13	8	4	2	10	7	1	3	5	12	11	9	6
	1.1	2.9	7	12	2.0	3.2	15	10	5.5	1.1	1.2	2.9	4.2

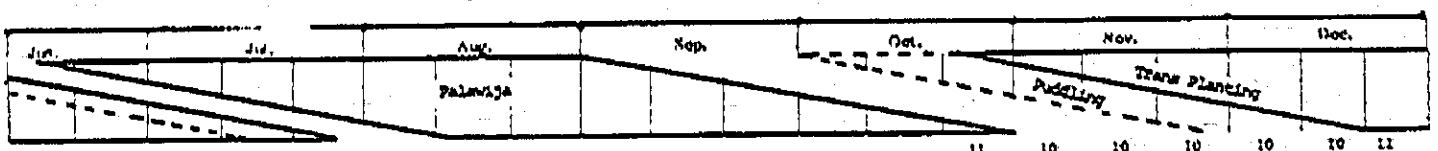
Upper figure: rainfall (mm)
Middle figure: Ranking
Lower figure: Return period (year)

Table- 5 Diversion Water Requirement and Dependable Water (Basic Year for Planning,1972)



Wet season rice	n-days	10	10	11	10	10	8	10	4								
	Ke	1.31	1.27	1.195	1.13	1.08	1.06	1.05	1.05								
	ETo (mm)	37.8	37.8	41.58	40.0	40.0	32.0	40.6	16.24								
	Cu (mm)	49.52	47.86	48.86	45.20	43.20	33.92	42.63	17.05								
	Pe (mm)	20	20	22	20	20	16	20	8								
	Wp (mm)	69.52	67.86	70.86	65.20	63.20	49.92	62.63	25.05								
	Re (mm)	119	133	70	0	142	81	70	46								
	Wp - Re	0	0	0.86	65.20	0	0	0	0								
	Ie	1.000	0.971	0.792	0.617	0.450	0.300	0.150	0.033								
	Φx①/Φx 8.64	0	0	0.008	0.466	0	0	0	0								
	Wu② /0.64	0	0	0.012	0.728	0	0	0	0								
Dry season rice	n-days							5	10	11	10	10	10	10	10	11	10
	Ke							1.17	1.18	1.24	1.33	1.40	1.35	1.275	1.225	1.095	0.99
	ETo							20.3	40.60	44.66	40.30	40.30	40.30	38.30	38.30	42.22	38.4
	①							23.75	47.91	53.38	53.60	56.42	54.41	50.86	48.00	47.58	38.02
	Pe							10	20	22	20	20	20	20	20	22	20
	Wp							33.75	67.91	77.38	73.60	76.42	74.41	70.86	67.95	69.58	58.02
	Re							70	46	35	53	6	0	91	64	0	8
	Wp - Re							0	21.91	42.38	20.60	70.42	74.41	0	3.95	69.58	50.02
	Ie							0.042	0.104	0.338	0.517	0.683	0.850	0.964	0.975	0.779	0.633
	Φx①/Φx 8.64							0	0.026	0.151	0.123	0.557	0.732	0	0.045	0.370	0.366
	Wu② /0.64							0	0.041	0.235	0.193	0.870	1.144	0	0.070	0.491	0.573
Palawija	n-days																
	Ke																
	ETo																
	①																
	Pe																
	Wp																
	Re																
	Wp - Re																
	Ie																
	Φx①/Φx 8.64																
	Wu② /0.64																
Puddling Wetseason rice	n-days																
	Ie																
	(ETo - Pe) - Ie																
	Re																
	(140 - Re) - Ie/n																
	①+②																
	Wu③/8.64 x 0.64																
Puddling Dry season rice	n-days					2	8	10	10	11	10	10	9				
	Ie					0.4/14	1.6/14	2/14	2/14	2.2/14	2/14	2/14	1.8/14				
	(ETo - Pe) - Ie					0.171	0.686	0	0	0	0	0	0				
	Re					160	92	80	56	40	60	6	0				
	(140 - Re) - Ie/n					0	0.686	0.857	1.200	1.429	1.143	1.914	2				
	①+②					0	1.372	0.857	1.200	1.429	1.143	1.914	2				
	Wu③/8.64 x 0.64					0	0.248	0.155	0.217	0.258	0.207	0.346	0.362				
	Wu Total (l/sec/ha)	0	0	0.012	0.728	0	0.248	0.155	0.259	0.493	0.400	1.216	1.506	0	0.070	0.891	0.573
	Dependable water at Gadog (m³/sec)	12.96	18.34	19.18	12.44	8.22	4.70	16.26	13.35	10.40	5.20	7.88	9.30	10.70	7.71	8.37	5.02

Table 5 (Cont'd)



												11	10	10	10	10	10	11
												1.15	1.17	1.21	1.28	1.33	1.39	1.385
												48.95	43.0	43.0	43.0	38.3	38.3	42.13
												56.29	50.31	52.03	55.04	50.94	53.23	58.35
												22	20	20	20	20	20	22
												78.29	70.31	72.03	75.04	70.94	73.23	80.35
												0	7	22	11	16	15	67
												78.29	63.31	50.03	64.04	54.94	58.23	13.35
												0.092	0.267	0.433	0.600	0.767	0.963	1.000
												0.076	0.191	0.251	0.445	0.488	0.649	0.140
												0.118	0.299	0.392	0.695	0.762	1.014	0.219
10	10	10	3															
0.98	0.98	0.98	0.98															
38.4	38.4	41.3	12.45															
37.63	37.63	40.67	12.20															
20	20	20	6															
37.63	37.63	60.67	18.20															
0	0	0	0															
37.63	37.63	60.67	18.20															
0.467	0.300	0.133	0.025															
0.311	0.200	0.093	0.018															
0.487	0.313	0.146	0.027															
8	10	10	10	11	10	10	11	10	10	10	10	10	10					
0.290	0.295	0.316	0.372	0.39	0.650	0.765	0.980	0.930	0.840	0.730	0.630	0.570	0.550					
30.72	38.4	41.5	41.5	45.65	44.60	44.60	49.06	46.70	46.70	46.70	44.50	44.50	44.50					
8.91	11.33	13.11	15.44	17.80	28.99	34.22	48.08	43.43	39.23	34.09	28.03	25.37	24.48					
—	—	—	—	—	—	—	—	—	—	—	—	—	—					
8.91	11.33	13.11	15.44	17.80	28.99	34.22	48.08	43.43	39.23	34.09	28.03	25.37	24.48					
0	0	0	0	18	26	0	0	0	0	0	0	0	0					
8.91	11.33	13.11	15.44	0	2.99	34.33	48.08	43.43	39.23	34.09	28.03	25.37	24.48					
0.067	0.217	0.383	0.550	0.725	0.900	0.996	1.000	0.917	0.750	0.583	0.417	0.250	0.083					
0.009	0.028	0.058	0.098	0	0.030	0.441	0.506	0.461	0.341	0.230	0.132	0.073	0.024					
0.014	0.047	0.097	0.164	0	0.050	0.688	0.843	0.768	0.568	0.383	0.220	0.122	0.039					
											5	10	11	10	10	10	10	4
											1/14	2/14	2.2/14	2/14	2/14	2/14	2/14	0.8/14
											0.461	0.921	0	0	0	0	0	0
											0	0	0	.6	26	13	18	6.
											2	2	2	1.886	1.629	1.814	1.743	1.914
											2.461	2.921	2.	1.806	1.629	1.814	1.743	1.914
											0.445	0.528	0.362	0.341	0.295	0.328	0.315	0.346

0.501	0.360	0.243	0.191	0	0.050	0.688	0.843	0.768	0.568	0.383	0.665	0.650	0.519	0.640	0.687	1.023	1.077	1.360	0.219
1.75	1.14	0.76	0.60	0.52	2.79	2.29	1.33	0.48	0.38	0.47	0.24	0.46	2.94	2.38	4.16	3.60	4.83	7.65	8.57

Note: Kc Crop Factor; ETo Evapotranspiration; Cur Kc x ETo; Pc Percolation; Wr ET + Pc; Re Effective Rainfall (mm); Wu Unit Water Requirement (l/sec/ha); Wu Total: Unit diversion Water Requirement (l/sec/ha); Ic Crop Intensity

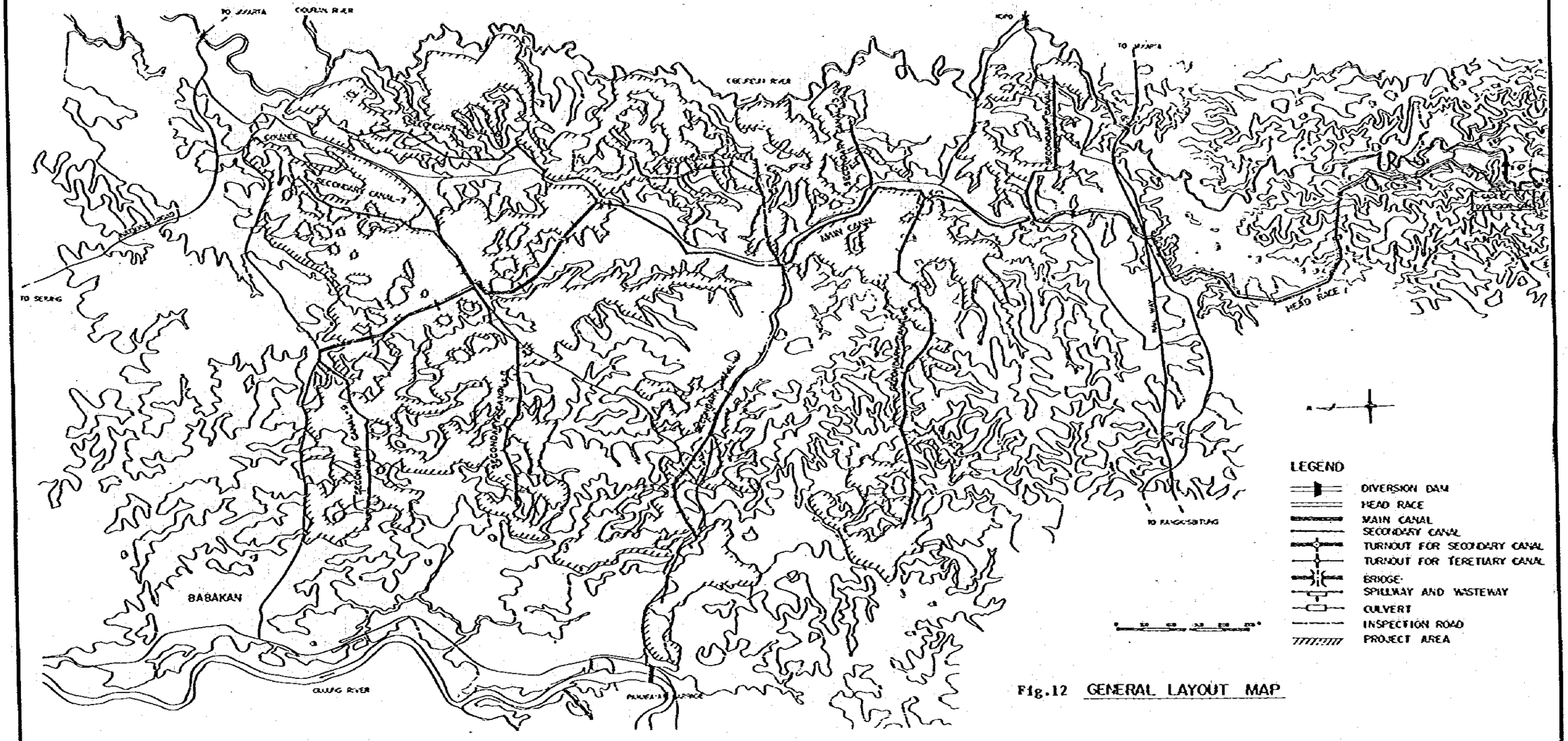


Fig.12 GENERAL LAYOUT MAP

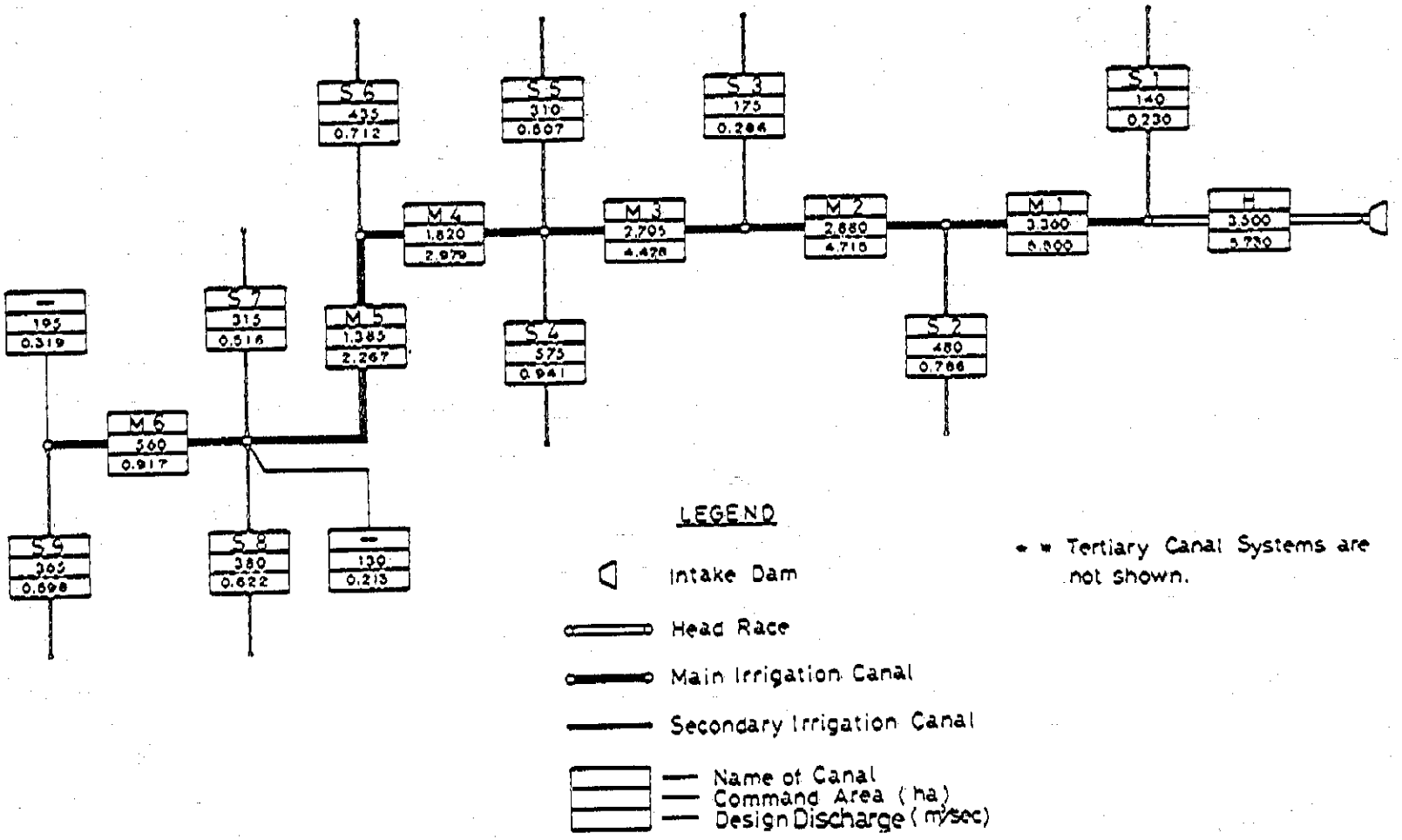


FIG. 13 GENERAL IRRIGATION CANAL DIAGRAM

FIG. 14

SAMPLE LAYOUT OF TERTIARY SYSTEM

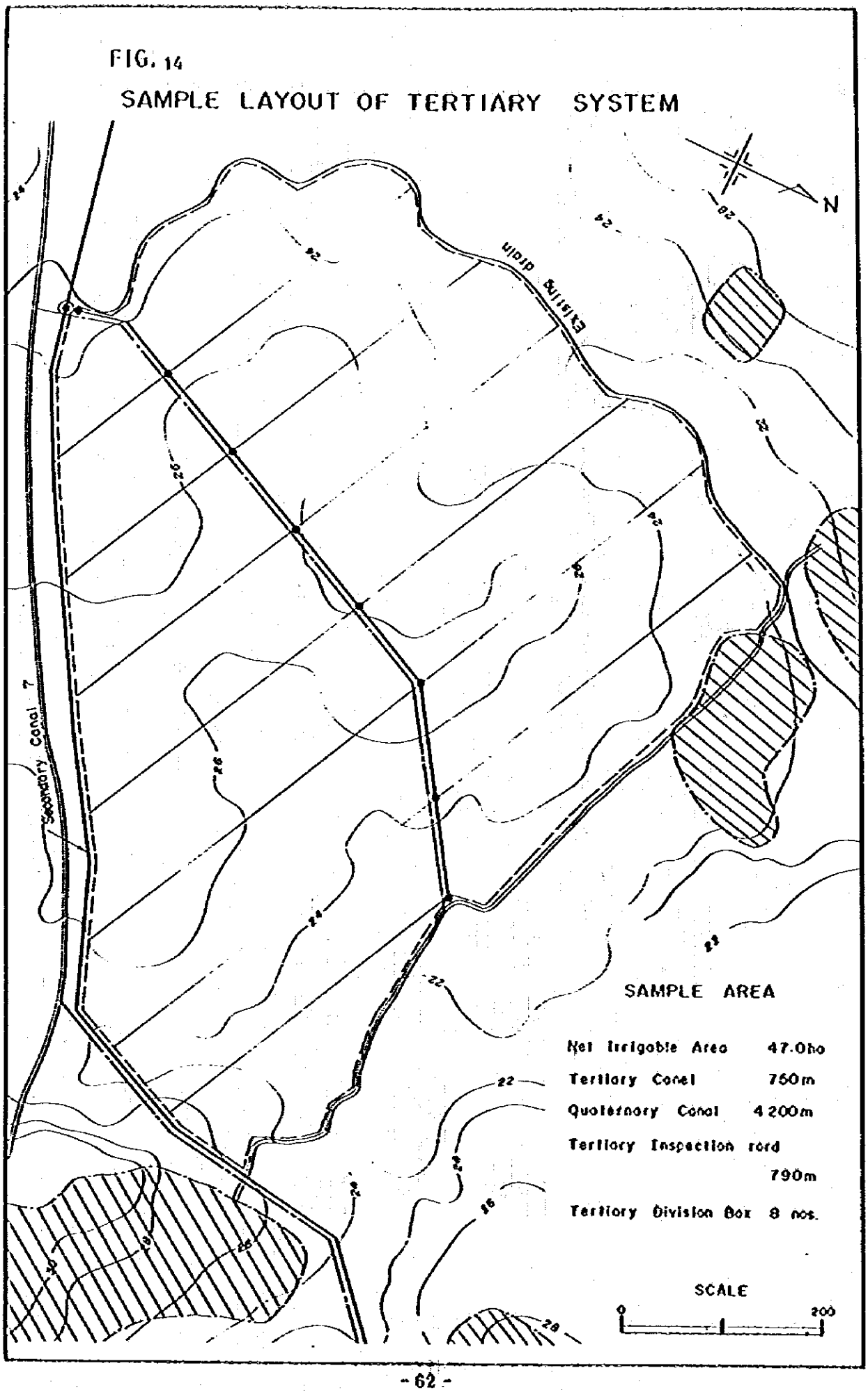
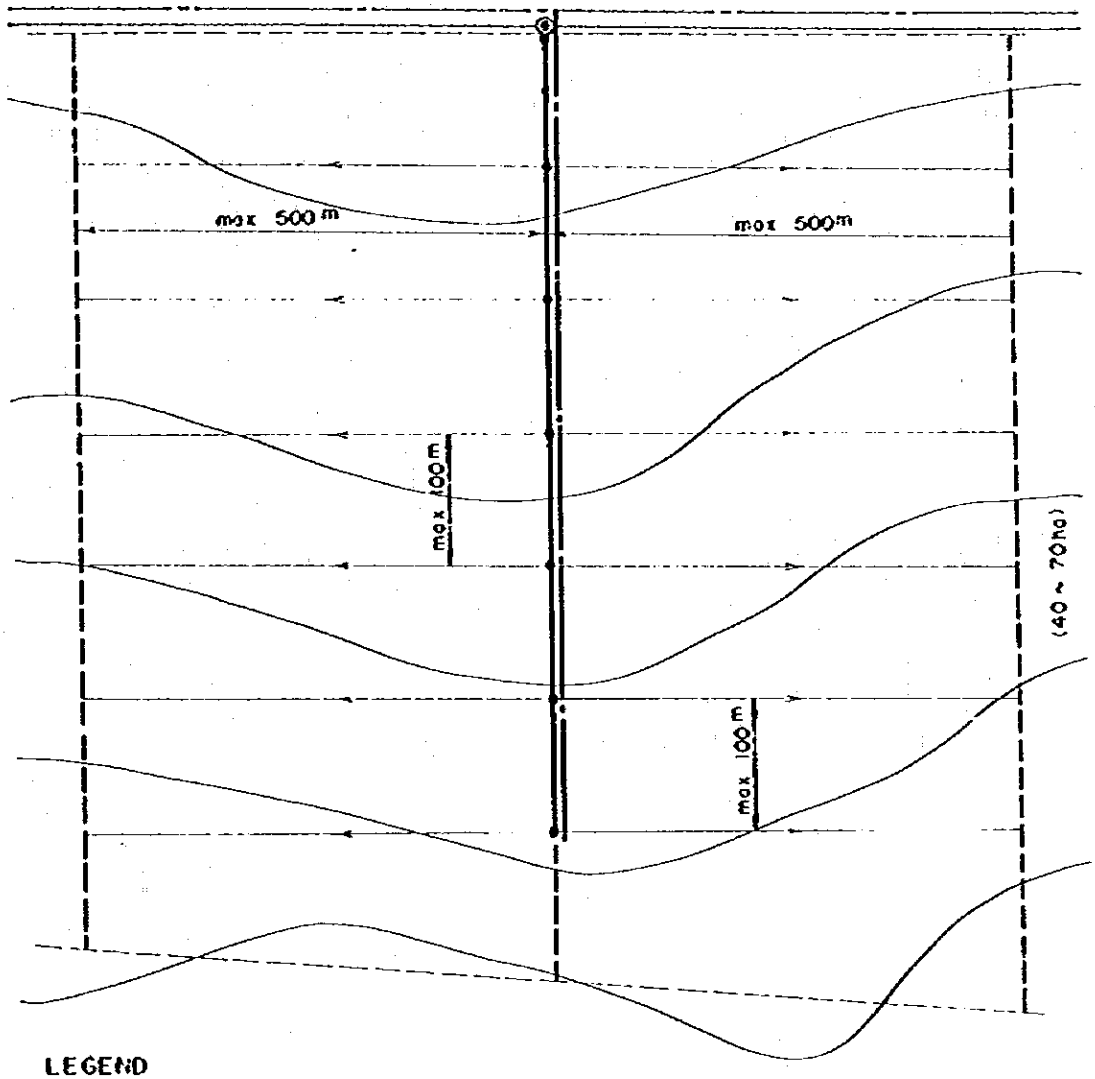


FIG. 15

TYPICAL LAYOUT OF TERTIARY SYSTEM



LEGEND

- Main or Secondary Canal
- Tertiary Canal
- Quaternary Canal
- Main or Secondary Inspection Road
- Tertiary Inspection Road.
- Boundary of farm
- Turnout for Tertiary Canal
- Tertiary Division Box

Table 6 REQUIRED NUMBER OF MAJOR EQUIPMENT FOR OPERATION AND MAINTENANCE

Item No.	Equipment	Required No.
1.	Dragline, 0.8 m3	1
2.	Crawler crane	1
3.	Bulldozer, 11 ton	1
4.	Submersible pump with engine	1
5.	Generator, 10kW	1
6.	Dump Truck, 2 ton	1
7.	Jeep, four wheel drive	1
8.	Sedan	1
9.	Repair shop tools	L.S.
10.	Spareparts (20% of the above)	L.S.

Estimated value: US$600,000.00

4.6 CONSTRUCTION SCHEDULE

The Project will be implemented taking the following two phases in consideration of the scale of the Project:

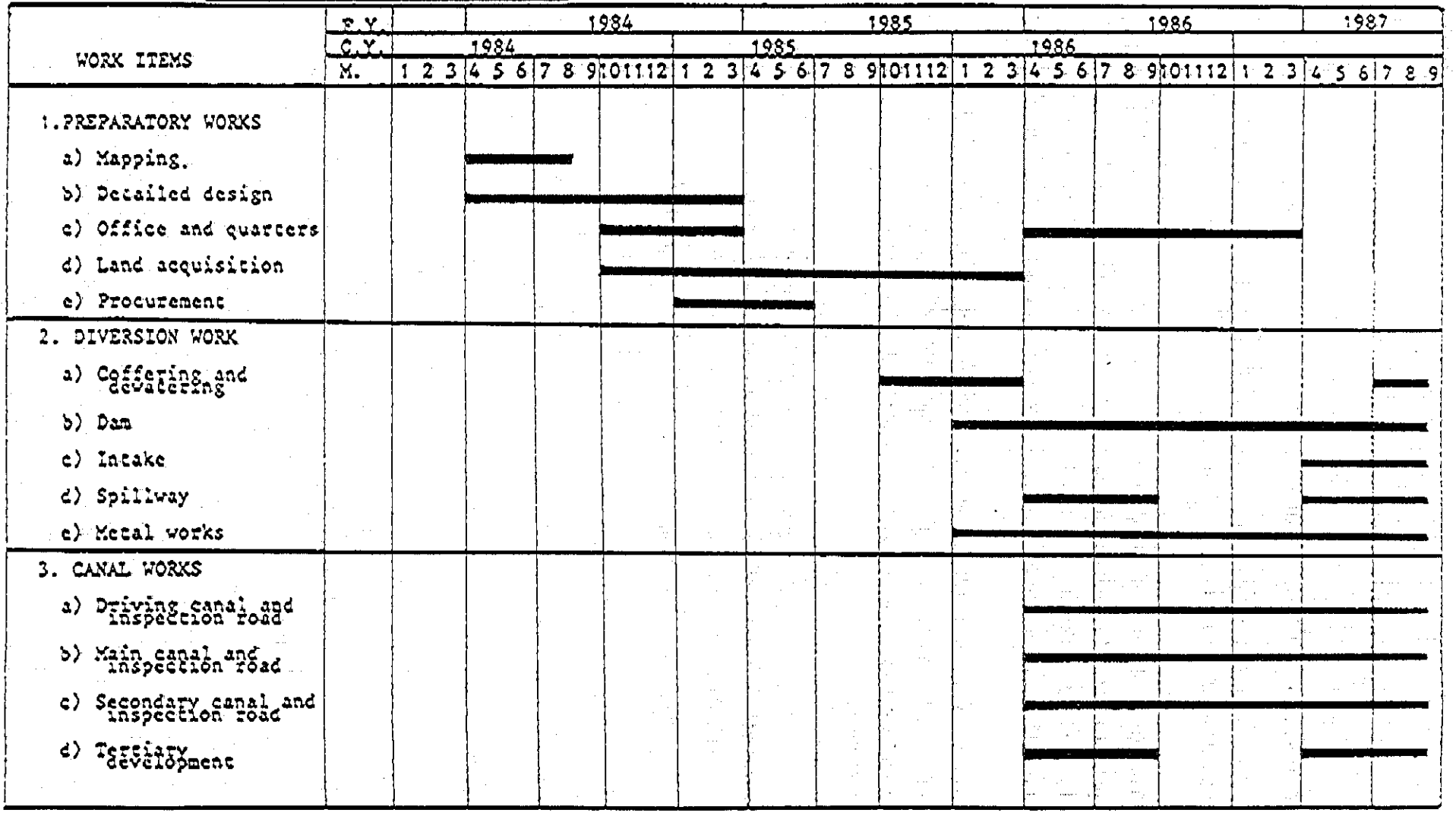
(1) The first phase will be devoted to the mapping, detailed design, tendering, procurement of construction materials and O & M equipment for about one year. Prepartory works for the construction of the major components of the Project facilities will be also carried out before the start of the construction works.

(2) The second phase will be for actual construction of diversion works which consist of diversion dam, intake gate, spillway, coffering and dewatering works and the canal works which consist of headrace, main canals and inspection road for about two years.

Considering the scale of this Project, the construction of diversion works, main to tirtiary canals and the related structures will be carried out concurrently so that all irrigation network can be completed by September 1987.

The proposed implementation schedule is shown in Fig. 16.

Fig. 16 PROJECT IMPLEMENTATION SCHEDULE



V. ORGANIZATION AND MANAGEMENT

5.1 ORGANIZATION FOR THE PROEJCT IMPLEMENTATION

The Directorate General of Water Resources Development, the Ministry of Public Works, will be the executing agency for the implementation of the Project. The Directorate of Irrigation under the said Directorate General of Water Resources Development will have direct responsibility for the Project implementation. The Provincial Department of Public Works, West Java, will be responsible for the implementation at the provincial level. In order to implement the Project successfully, however, it is proposed to establish the K-C-C Project Office under the superintendence of the Provincial Department of Public Works (for the details of organization, vide Annex IX).

The main functions of the Project Office are as follows:

(1) financial arrangement needed for construction of irrigation and road networks, and operation and maintenance of the Project facilities,
(2) design and construction supervision of all the construction activities down to tertiary systems,
(3) assistance to farmers in construction of quaternary canals, and
(4) accounting and management of construction works.

The Project Office will consist of one main office and four branch offices. It is proposed to establish the main office at Rangkasbitung before getting into the major construction works of the Project. The branch offices will be established at Gadeg, Kopo, Pamarayan and Cikande, in keeping pace with the progress of the Project construction works. Total number of the staff required for the Proejct Office would be around 220 at maximum.