(AF) 52−71

PRELIMINARY SURVEY REPORT
ON
RIAM KANAN IRRIGATION PROJECT
REPUBLIC OF INDONESIA

September 1977

JAPAN INTERNATIONAL COOPERATION AGENCY

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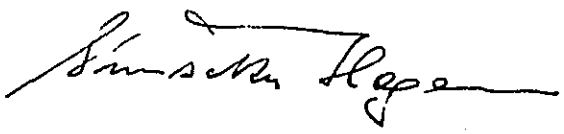
FOREWORD

The South Kalimantan Province has a high potentiality of agricultural production composed mainly of paddy rice and is developed from a relatively early time among the other areas in Kalimantan. Construction of the multipurpose dam at Riam Kanan located along a tributary of the large river, Barito, in Kalimantan and nearly at the center of the province, was commenced with cooperation of Japan and completed in 1972 to assume a leading role in regional development. Control of the water of the Riam Kanan River upon completion of this multipurpose dam enhanced the possibility of agricultural development in the lower basin. The Government of the Republic of Indonesia formulated the Barito River Basin Development Plan (1971) through technical cooperation of our country and, under the plan, formulated a Riam Kanan Irrigation Project designed for an area extending over 30,000 hectares and requested the cooperation for execution of the survey. To comply with the request, our Government decided to perform a preliminary survey and dispatched a Riam Kanan Irrigation Project preliminary survey mission consisting of six members headed by Mr. Kiyoshi Takeda, Water Resources Development Corporation, for a period of 31 days from July 13, 1977. Preliminary to the feasibility survey, the survey mission inspected the site to grasp the position of the project in the country, outline and scope of the project, area to be chosen and problems involved and, at the same time, conducted investigations concerning the plan for execution, scope of the survey, items to be investigated and their particulars, etc.

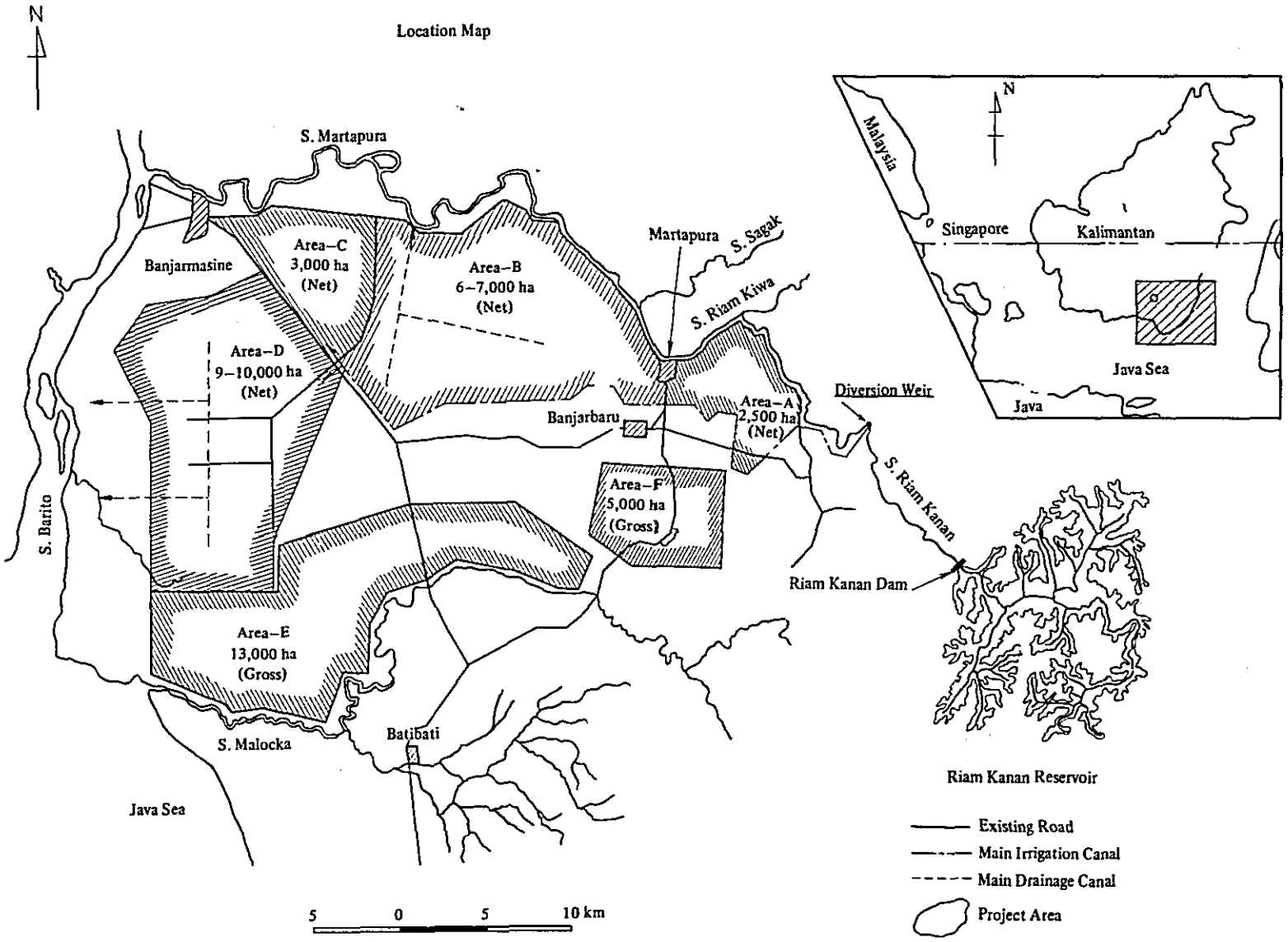
The report presented here represents the result of the survey, and I hope it will serve for preparation to the feasibility survey scheduled hereafter and be useful as a reference material for the personnel concerned.

Availing myself of this opportunity, I would like to express my appreciation for the support and cooperation extended from the personnel concerned of the Government of Indonesia, Japanese Embassy in Indonesia, Ministry of Foreign Affairs and Ministry of Agriculture and Forestry for execution of the survey and for the efforts of the dispatched experts.

September 1977



Shinsaku HOGEN
President,
Japan International Cooperation Agency


Location Map
N
S. Martapura
Banjarmasine
Area–C
3,000 ha
(Net)
Area–B
6–7,000 ha
(Net)
Martapura
S. Sagak
S. Riam Kiwa
Area–D
9–10,000 ha
(Net)
Banjarbaru
Area–A
2,500 ha
(Net)
Diversion Weir
S. Riam Kanan
Area–F
5,000 ha
(Gross)
S. Barito
Riam Kanan Dam
Area–E
13,000 ha
(Gross)
S. Malocka
Batibati
Java Sea
5 0 5 10 km
N
Malaysia
Singapore
Kalimantan
Java Sea
Java
Riam Kanan Reservoir
Existing Road
Main Irrigation Canal
Main Drainage Canal
Project Area

Contents

1. INTRODUCTION

1–1 Background and Objective of the Survey

The South Kalimantan Province is an area in Kalimantan which is comparatively well developed, and it forms a strategic area on the seaway and the air route to Java Island and other areas. The proposed Riam Kanan Irrigation Project Area is the area which joins Banjarmasin city, the capital of South Kalimantan Province, with Banjarbaru and Martapura cities. The concentration of population in this area is fairly good, and this area forms the center of administrative, commercial and industrial activities.

Several development projects have hitherto been implemented in this area, among which the project of power supply connected with the Riam Kanan dam has played an important role in promoting modernization of the area. The plan of establishing a new capital at Banjarbaru city has already been formulated, and various industrial development projects which could not be realized due to the shortage of electric power are going to be realized in the near future.

As the cityward concentration of population progresses it could be anticipated that the qualitative and quantitative demand for food will increase, and this area is forced to develop the agriculture of the area to respond to the anticipated changes in the demand.

The Riam Kanan Irrigation Project had already been proposed in the Barito River Basin Development Plan of 1970 as the project to be implemented with top priority. Banjarmasin and the area surrounding it have shown a remarkable growth since then. For the next stage of development of this area, agricultural development is indispensable. Elevation of the standard of living of the farmers who support the base of the economy of the area will become the powerful motive power for the development of the entire area, and the significance is great of the Riam Kanan irrigation Project as the pioneer agricultural development project involving a large area having enormous potentialities.

The Riam Kanan Irrigation Project based on the Barito River Basin Development Plan (1970) was formulated in a short period in spite of the insufficient available basic data such as topographic maps, etc. However, this irrigation project itself is significant as a conception.

The Riam Kanan dam was already completed in 1972 and power generation was commenced in 1973. Data based on the results of utilization of the dam and the power station are available. Besides the preparation of the topographic maps of 1/50,000 scale with technical cooperation provided by OTCA, soil survey, geological survey and preparation of the topographic maps related to the Riam Kanan Irrigation Project have been carried out partially by the Government of Indonesia. It could be concluded that the basic data necessary for carrying out the feasibility study required for the implementation of the Riam Kanan Irrigation Project are ready. The preliminary survey was carried out this time to determine the scope of the project area, method of promoting the project, and the direction of development before carrying out the feasibility study. The another purpose was to find out what data should be supplemented and also to make a judgement on consolidation of the data for promoting efficiently the feasibility study.

1–2 Composition of the Survey Mission

Name	Assignment	Present Post
Mr. Kiyoshi TAKEDA	Leader	Director, Construction Division, First Engineering Department, Water Resources Development Corporation
Mr. Kazuo ONOZAWA	Irrigation & Drainage	Senior Officer of Agricultural Civil Engineering, Design Division, Construction Department, Hokuriku Regional Agricultural Administration Bureau, Ministry of Agriculture and Forestry
Dr. Yasuo HARADA	Soil Chemistry	First Laboratory, Section of Soils and Fertilizers, Department of Chemistry, National Institute of Agricultural Sciences, Ministry of Agriculture and Forestry
Mr. Taizo KATAOKA	Hydrology	Chief of First Subsidized Project Section, Irrigation and Drainage Division, *Construction Department,* Agricultural Structure Improvement Bureau, Ministry of Agriculture and Forestry
Mr. Masao SOEJIMA	Agro-Economy	Agro-Economist Japan International Cooperation Agency
Mr. Yutaka MURAI	Dam & Irrigation Structure	Consulting Engineer Agricultural Development Consulting Association
Counterparts		
Ir. Djoko Sardjono	Team Leader	Chief counterpart, Directorate of Planning and Programming, Jakarta
Drs. Syamsul Nasution	Agro-Economy	Directorate of Planning and Programming, Jakarta
Ir. Rachmad Norlias	Irrigation & Drainage	Public Work, South Kalimantan
Ir. Hutomi D.	Soil Chemistry	Deputy of chief counterpart, Directorate of Planning and Programming, Jakarta
Drs. Guridno Wardoyo	Hydrology	Directorate of Planning and Programming, Jakarta
Ir. Pardiyono	*Dam & Irrigation Structure*	*Public Work, South Kalimantan*

1–3 Itinerary of the Survey

Date	Description
Jul. 13 (Wed)	(Takeda, Soejima, Onozawa and Kataoka) Tokyo to Jakarta.
Jul. 14 (Thu)	Indonesia's religious holiday (Mahommed Ascension). Talk with Mr. Hirotaka Arai, expert in Colombo Plan.
Jul. 15 (Fri)	08:30 Curtesy call to Directorate General of Water Resources Development, Ministry of public Works and Electric Power. Arrangement with Mr. Suyono, Director General; Mr. Atamimi, Sub-director, Sub-directorate of Foreign Aid Projects; and Mr. Mardjono, Director, Directorate of Planning and Programming. 11:00 Courtesy visit to Japanese Embassy.
Jul. 16 (Sat)	Arrangement with Directorate General of Water Resources Development. Talks with Mr. Mardjono, Director, and Mr. Djoko Section Chief, with respect to the survey.
Jul. 17 (Sun)	Collection of Data. Preparation of Scope of Works and schedule.
Jul. 18 (Mon)	Preparation of Scope of Works and schedule. Data collected at Meteorological Agency and Directorate of Electric Power. 14:00 Scope of Works and schedule presented to Directorate of Planning and Programming.
Jul. 19 (Tue)	Visit to Design Section, Directorate of Irrigation (Bandung). Collection of data. Scope of Works and schedule presented to Directorate of Planning and Programming.
Jul. 20 (Wed)	Collection of data including purchase of maps in Jakarta. Data collected at Institute of Hydraulic Engineering (DPMA) and Directorate of Geology, Ministry of Mining. Harada and Murai, members of the survey team, arrived Jakarta.
Jul. 21 (Thu)	Harada and Murai – Courtesy visit to Directorate of Planning and Programming, Directorate General of Water Resources Development. Talks with Colombo Plan Experts Fujimori and Sakai at Design Section, Directorate of Irrigation.
Jul. 22 (Fri)	Hearing of the status of investigations at Soil Institute, Agricultural Research Center of the Ministry of Agriculture (Bogor). Called Mr. Djoko Sardjono, Chief Counterpart, at Directorate of Planning and Programming, Directorate General of Water Resources Development. Arrangement of the field survey. Interim report to Embassy and Jakarta Overseas Office.
Jul. 23 (Sat)	Conference prior to departure to the field survey.

Date	Description
Jul. 24 (Sun)	Preparation for departure to the field survey.
Jul. 25 (Mon)	Jakarta to Banjarmasin.
Jul. 26 (Tue)	Courtesy visit to Mr. Pansuri Basri, Director, Irrigation Department, South Kalimantan Provincial Public Works.
	Visit to Local Planning Board to hear briefing of long tern plans of the province.
Jul. 27 (Wed)	Inspection of rivers and agricultural activities in the southern part of the projected area.
	Visited PLN Office in Banjarbaru. Hearing of the power condition and future plan.
	Inspection of the Riam Kanan dam.
Jul. 28 (Thu)	Visit to Provincial Agricultural Office in Banjarbaru.
	Check of hydrological data at Provincial Public Works.
	Inspection of the gauge station (Martapura River) of Water Service Office, Banjarmasin.
	Inspection of agricultural activities at high land near Ulin Airfield.
Jul. 29 (Fri)	Data collected at Meteorological Observation Station in Banjarmasin.
	Data collected at Agricultural Research Institute in Banjarmasin.
	Data collected at Muncipal Water Service of Banjarmasin.
Jul. 30 (Sat)	Data collected at Land Use Office.
	Reconnaisance of the site scheduled for head work, and inspection of agricultural activities along the Martapura River.
Jul. 31 (Sun)	Inspection of Riam Kiwa River Level Observation Station. Inspection of the Binuang Irrigation Project.
	Farm household survey.
	Inspection of agricultural activities, water utilization and drainage in the southern part of Banjarmasin.
Aug. 1 (Mon)	Inspection of agricultural activities and soil condition along the Sungai Maluka.
	Farm household survey.
	Arrangement of the data.
	Courtesy visit to Mr. Soebarujo, Governor.
Aug. 2 (Tue)	Reconnaisance flight over the projected area.
Aug. 3 (Wed)	Examination of the scope and area of the projected area.
	Data check and collection.

Date	Description
Aug. 3 (Wed)	17:00 Final meeting of study held at the site.
Aug. 4 (Thu)	Arrangement of the particulars of investigation in order, and adjustment of the data. (Reconnaisance survey completed.)
Aug. 5 (Fri)	Banjarmasin to Jakarta.
	Arrangement for preparation of interim report.
Aug. 6 (Sat)	Interim report preparation work.
Aug. 7 (Sun)	Interim report preparation work.
Aug. 8 (Mon)	At the Directorate of Planning and Programming, Directorate General of Water Resources Development, report of the reconnaisance at the site, and meeting for study of the interim report (draft).
Aug. 9 (Tue)	Interim report correction work.
	Kataoka, survey team member, back to Japan.
Aug. 10 (Wed)	Conference with Mr. Suyono, Director General, Water Resources Development, and representatives of the other directorates for study and arrangement of the interim report.
Aug. 11 (Thu)	Preparation of the interim report.
Aug. 12 (Fri)	Interim report presented to Japanese Embassy, Jakarta Overseas Office and Ministry of Public Works.
	Jakarta to Tokyo.

1–4 Roster of the Personnel Concerned

Java Main Island

(1) Directorate General of Water Resources Development, Ministry of Public Works and Electric Power

– Mr. Suyono Sosrodarsono	Director General
– Mr. Atamimi	Sub-director of Foreign Aid Projects, Directorate General
– Mr. Boesono Boedidarmo	Director of Planning and Programming
– Mr. Mardjono	Sub-director of Planning and Programming
– Mr. Kuntjoro Jakti	Section Chief, Directorate of Planning and Programming
– Mr. Sarwako	Deputy, Directorate of Irrigation (Jakarta)
– Mr. Mashudi Durwadirdja	Chief, Design First Section, Directorate of Irrigation, Directorate General (Bandung)
– Miss Soelastri Djennoedin	Institute of Hydraulic Engineering, Directorate General (Bandung)
– Mr. Sudiyanto	Regional Assistant IV

(2) Soil Research Institute, Agricultural Research Center, Ministry of Agriculture (Bogor)

- Mr. Soendaroe
- Mr. Chairuddin
- Mr. Gumaia
- Mr. Soeprappohardjo
- Mr. Ismangun
- Mr. Abdura Chamandi
- Mr. Sunyuto

(3) *Geological Survey of Indonesia, Directorate General of Mines, Ministry of Mines*

- Mr. Popo Mustafa

South Kalimantan Province

(1) South Kalimantan Provincial Governor

- Mr. Soebarujo

(2) South Kalimantan Provincial Public Works

- Mr. Rosuma Nazif — Deputy for Director of Public Works
- Pansuri Basri — Director of Water Resources Development

(3) BAPPEDA, Local Planning Board

- Mr. Thamrin — Deputy

(4) Directorate of Electric Power, Ministry of Public Works and Electric Power (Banjarbaru)

- Mr. Hennyoso Soedarsons

(5) Directorate of Agriculture

- Mr. Salib
- Mr. Banban
- Mr. Amado

(6) Provincial Agricultural Experiment Station

- Mr. Noorsyamsi

(7) South Kalimantan Provincial Water Service

- Mr. Trvan Fr. BE — Director

Dispatched Experts

Dr. Arata Masumoto	(Directorate of Irrigation, Directorate General of Water Resources Development)
Mr. Hirotaka Arai	(〃)
Mr. Ikuo Fujimori	(〃)
Mr. Toshio Sakai	(〃)
Mr. Mutsuo Suzaki	(Agricultural Research Center, Ministry of Agriculture)
Mr. Shoji Ono	(South Kalimantan Provincial Public Works)

Mr. Yasuhiko Mishima	(South Kalimantan Provincial Public Works)
Mr. Mamoru Otake	(〃)

2. SUMMARY

2–1 The Present Condition

The project area of the Riam Kanan Irrigation Project, for which the preliminary survey was carried out this time, extends southeastward of Banjarmasin on the lower reaches of the Barito river, the largest river in Kalimantan. The area extends to the Maluka river on the southern side of the Martapura river, a tributary of the Barito river.

There are large swamps on the middle and lower reaches of the Barito river, and as the influence of the tides of the Java Sea reaches the point about 150 km upstream from the estuary, most of the area is the tidal land. The project consists mostly of low-lying wet land, but a part up to the mountainous area on the eastern side is the upland. This project area has a wide variation of topographical conditions from swamp area to upland.

The annual rainfall in this area is 2000–2500 mm on the plain and more than 3000 mm in the mountainous area. There are two seasons, namely, the dry season (May to October) and the wet season (November to April). The annual rainfall in the dry season is less than one-third of the total annual rainfall. The yearly fluctuation of rainfall is quite large, and there are occasions in which the droughts continue for more than 30 days during the period of July to September. In the wet season the lowland remains flooded over a long period of time. The mean annual temperature is 26°C and the humidity is 80–90%. The season does not change much, and high temperature and high humidity always prevail.

Because of the pattern of rainfall which is severe to agriculture, the cultivation of one crop of paddy a year is predominant during the period from the end of the wet season to the first half of the dry season in the area along the rivers where the inundation on the paddy field is not so significant for rice cultivation. Facilities for improving poor drainage conditions or for drawing in water for irrigation in the dry season are insufficient. Therefore, a large area of land is left uncultivated. Thus, the agricultural products other than rice are being imported from other areas to satisfy the demand in the area.

Banjarmasin is located on the confluence of the Martapura river and the Barito river. Together with Banjarbaru and Martapura located about 30 km east of the confluence, this area is the most developed area in South Kalimantan Province. IT forms the strategic point on roads, seaway and air route, and is the center of administrative, economic and industrial activities.

The demand for electric power is increasing steadily after the Riam Kanan dam was completed in 1972 and power generation commenced in 1973. The time has come to start profitable agricultural development for utilizing the water from the dam for irrigation purpose.

2–2 Project Concept

The agricultural development will play an important role in the future as one of the effective means for the development of the large Barito river basin having enormous potentials. It substantially will require much labor and time, but it should be carried out under a long-term plan with sound judgement since it will form the basis of the regional development.

Farming mainly based on rice culture practised in the area extending around Banjarmasin has been started in Kalimantan eversince the comparatively early stage. The traditional farming characterized by the low productivity and based on single cropping and the use of special local varieties, natural conditions such as the flat low-lying wet land and water level conditions subject

to floods is still dominant. The present production of upland crops other than rice and livestock products is very low and does not meet the local demand. Most of them is depending on the import from other areas.

This area, supported with favorable traffic, social and economic conditions, would cover a large potential land of over 60,000 ha for agricultural development and having a wide variation of topographic conditions covering swamps to upland. However, it is only possible at present to carry on the traditional farming on limited land within the natural constraints for more profitable farming. By introducing the modern irrigation and drainage systems to this potential area, it will be possible to form the basis for improving the present conventional, simple traditional farming to more profitable farming.

The Riam Kanan Irrigation Project certainly must become the pioneer project for such agricultural development, and the utilization of water of the Riam Kanan Reservoir together with the power generation will definitely promote the future development of Banjarmasin and its surrounding area.

Suggestions based on the results of the preliminary survey are made below before carrying out the feasibility study for the Riam Kanan Irrigation Project which was given the top priority in the Report on the Barito River Basin Development Project (1971).

2–2–1 Selection of the Project Area

The area possible for agricultural development utilizing the water from the Riam Kanan Dam would be more than 30,000 ha at the very least. However, it is inadvisable to commence the development work simultaneously on the entire area. The project should be implemented stagewise, taking into account the topography and the nature of soils in the project area. Moreover, it would be necessary to find out the most efficient way to obtain the best effect of the project at each stage of development.

Most of land in the area for development, including the existing paddy land, are low-lying wet lands, and the improvement of such low-lying land by means of the drainage is indispensable. Land improvement by means of the drainage is comparatively easy, and it is judged that it takes effect fast. In fact, the depth of flooding in the wet season on the existing paddy field is not large, and it will be possible to change a large portion of the paddy field into good farmland by providing the drainage facilities. Besides, it will be possible to open the new land for agricultural purpose. By supplying irrigation water from the dam to such lands, it will become possible to cultivate rice all the year round.

For lands on comparatively high elevations, in addition, it will be possible to prevent damage from droughts in the dry season by irrigation. Twice rice culture or a combination of single cropping of rice with one upland crop will become possible according to the topographic conditions.

Upland will not be suitable for developing into the paddy field, but it could be used for cultivation of upland crops and fruits by irrigation.

As to the project area for the irrigation development utilizing the water from the Riam Kanan Dam, the area surrounded by the three rivers, namely, Martapura, Riam Kanan and Maluk would be suitable upon consideration of the topography and the location. It will be necessary to divide the area into several sub-areas according to the conditions of soil, traffic, irrigation and drainage, and to study most suitable project implementation program taking into account the characteristics of each sub-area. The area would be divided into six sub-areas. The location, acreage, and characteristics of each sub-area are as shown below.

Sub-area	Description
1. Sub-area A	Area: 3,200 ha in gross and 2,500 ha in net Eastern part of Martapura city. The area is covered with existing paddy fields which has a part of inundation area due to poor drainage. Irrigation and drainage system is required.
2. Sub-area B	Area: 16,000 ha in gross and 6–7,000 ha in net The area between the Martapura river and U1 in highway. The main purpose of the project is the improvement of the drainage in the swampy area covered with organic soil and irrigation to the upland. Forest area which is inundated throughout the year will be excluded from the project area.
3. Sub-area C	Area: 3,700 ha in gross and 3,000 ha in net Eastern part of Banjarmasin city. The area is covered with fairly developed paddy fields. The main purpose of the project is to provide drainage in the rainy season and water supply in the dry season.
4. Sub-area D	Area: 15,000 ha in gross and 9–10,000 ha in net Gambut area and southern part of Banjarmasin. This area is also covered with existing paddy field. The main purpose of the project is to provide drainage in the rainy season and water supply in the dry season. In the southern and the western coastal parts of this area, proper drainage system should be established considering the tidal fluctuation of the Barito river.
5. Sub-area E	Area: 13,000 ha in gross The area along the Maluka river. This area is out of the gravity irrigation area. Development of this area should be implemented considering the soil conditions. Especially, careful consideration is required for the drainage system.
6. Sub-area F	Area: 5,000 ha in gross Upland area between Banjarbaru and Cempaka region. Pump irrigation system will be applied to the selected places based on the soil conditions.

2–2–2 Potential Areas for Further Development in Future

Besides the Riam Kanan Irrigation Project area being proposed, the following areas are considered as potential area for further agricultural development in future from the preliminary study of the 1/50,000–scale topographic maps. They are: –

- the area (estimated to be more than 10,000 ha in area) on the northern side of the martapura river, and
- the area (would cover about 5,000 ha of tidal land) adjacent to sub-area D on the southern part of Banjarmasin.

– Sub-area B, in addition, in which the further expansion of arable land would be possible if further improvement of the present poor drainage conditions can be made.

For these potential areas, the introduction of the well-designed drainage system suitable to the topography and soil conditions of each area is the basis, and the drainage plan in these areas is largely influenced by the fluctuation of water level of the Martapura river. Again, it is necessary to

For areas A, B, C and D, gravity irrigation system will be applied.

establish a multi-purpose water utilization plan for the overall Martapura river basin development including the Riam Kiwa river when formulating an irrigation plan.

As to these areas which could be expanded for further agricultural development in future, it was not possible at the preliminary survey carried out this time to fully grasp the location and the acreage, topography and soil conditions, and conditions for irrigation and drainage improvement, etc. However, these areas are worth studying hereafter as the most promising areas.

2–2–3 Development Works and Guidance for Farmers

As stated before, the main work of the Riam Kanan Irrigation Project will be the improvement of the present poor drainage conditions. By improving such poor drainage conditions, the present farming based on rice culture could be stabilized and expanded, and much improvement of the farming will become possible by the construction of the new irrigation system. However, this irrigation and drainage project is to be started for at least 10,000 farm households including the existing farm households going to expand their size of holding and those farm households to be newly settled into the area. Therefore, the establishment of a well-organized extension services for proper farm management by those farmers who have continued the traditional farming under natural and agricultural constraints, and the promotion of establishing the farmers' cooperatives for the expansion of the marketing system for farm products are the most important policies which should be enforced in parallel with the project implementation.

2–2–4 Development Plan and the Objective

The objective in the initial stage is to have the effect of the development work manifested quickly and easily. Stabilization and expansion of profitable farm management will become possible to a certain extent by improving the infrastructure of the existing paddy field by means of drainage. However, the ultimate objective is to secure the stable supply of food in the area and also to meet the increasing demand for agricultural products other than rice. The development project should be promoted with a view to the establishment of the diversified management agriculture fully utilizing the water available from the Riam Kanan Dam.

The irrigation project for developing the aforementioned sub-areas A, B, C and D covering an area of about 20,000 ha in total is proposed for the first stage development as one of the remaining works of the Riam Kanan multi-purpose Dam Project. As to sub-area E which lies along the Maluka river, an alternative plan of utilizing the Maluka river as a water source for irrigation should be studied since the area is located far from the proposed intake site on the Riam Kanan river, as sub-area F covers the upland area, pump irrigation would be adopted, which will call for further investigation and studies from both technical and economical points of view, and survey on sandy soil and the careful selection of suitable crops will be necessary.

Again, for further utilization of the Riam Kanan Dam, it would be advisable to use the dam in the future development project for E, F and other potential areas in combination with the use of the surplus water available from the Martapura river. When expanding the development project in the future, it will be necessary to fully study the effect to development that could be expected from the topography and soil conditions of the areas to be developed, and thereby promote the development project in the direction which would meet the tendency of the future demand for the agriculture of the area.

2–3 Development Project

2–3–1 Project Planning

1) The irrigation project area to be selected for the first stage development consists of four sub-areas, namely, Areas A, B, C and D, based on the topographic and soil maps. These four sub-areas are generally low, flat and swampy land and could be covered with gravity irrigation system. The total area of four sub-areas will be about 38,000 ha in gross and the arable land is estimated at about 20,000 ha in net.

2) A part of the secondary and tertiary canals of the irrigation system will have double functions of irrigation and drainage in that portion of lowland, comprising 1/3 to 1/4 of the total irrigation area, for repeated utilization of return flow.

3) Diversion requirement for four sub-areas is estimated to be about 26 m^3/sec considering the repeated utilization of return flow.

4) Available irrigation water depends on the discharge from the Riam Kanan hydro power station. Maximum capacity of this hydro power station is 20,000 kW and the peak output at present is about 12,000 kW. About 18 m^3/sec of water is discharged through the turbines at present. It is being planned to install an additional power plant of 10,000 kW and the peak output is expected to be about 30,000 kW in and around 1983. Under the full capacity operation, the average power discharge is estimated to be 50 to 56 m^3/sec. According to the plan of the dam project, however, the average discharge of water is about 44 m^3/sec. It is considered that available amount of water for irrigation will decrease under the remarkable growth of the power demand in this region. Accordingly, it is conceived that available discharge for this project would be less than 50 m^3/sec. However, 40 m^3/sec of discharge is at least expected to be available.

5) The intake weir is recommended to be constructed at Sungai Asam, about 12 km downstream from the Riam Kanan Dam. In case that the crest elevation is at around EL. +13.0 meters, a reservoir which has around 6 km^2 of water surface area will be created. It will be possible to regulate the daily fluctuation of discharge released from power station.

6) The main irrigation canal will pass through the northern part of Banjarbaru and U1 in air port, and reach to Gambut. Its length will amount to about 45 km and the gradient of the canal will be 1/8000 to 1/5000.

7) The rest of the discharge, about 15 m^3/sec, could be used to irrigate the remaining sub-areas E and F for which pump irrigation will be required, because they are located far from the proposed intake site and on high-elevated land. In order to select the land suitable for irrigation in these areas, in addition, it is necessary to conduct further soil investigation.

8) In a part of the area along the Maluka river (Sub-area E), acid sulphate clay[1] distributes partially, so it is necessary to study the appropriate method of drainage. In the upland area between Banjarbaru and Cempaka (Sub-area F), sandy soil contained gravel distributes, so it is necessary to make careful study on selection of suitable crops. In developing these two areas, further investigation and study from both technical and economical points of view are required. The development of these areas will start after the completion of the implementation of the above four priority areas.

9) In most of the existing paddy fields, single cropping is predominant at present. In order to introduce double crop farming and to improve the swamp areas for agricultural purpose, it is

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/1: Cat-clay and Mud-clay

indispensable to establish the well-designed drainage system as well as the irrigation system. The Construction of drainage canals will also contribute to regional development such as the improvement of living environment, transportation by ship and so forth.

10) In designing the drainage system suitable for the project area, careful consideration should be given to the tidal fluctuation of the rivers Martapura, Maluka and Barito. The river traning of the Martapura is also very effective means for the drainage of the project area, and this will be considered in future as one of the Martapura river basin development projects including the agricultural development in the right bank area of the river.

2–3–2 Effects of Development

The Project aims at the following effects of development through regulating water level condition all the year round by providing the irrigation and drainage system.

1) It makes possible to introduce double cropping of paddy a year by regulating the water levels of the existing paddy fields where single-crop farming of paddy has been practised by using the inundation water at the end of the rainy season.

2) On the relatively highland in the uncultivated area, irrigation and drainage will make it possible to introduce the double-crop farming. In a part of highland, cultivation of upland crops in the dry sea-son could be expected.

3) On the relatively lowland and swamps in the uncultivated area, single-crop farming could be at least practised by supplying fresh water.

4) In the upland area, stable cultivation of upland crops throughout the year will be possible.

5) Reclamation of such uncultivated land and the construction of the irrigation and drainage system will make it possible to settle a large number of immigrants in these newly developed areas.

6) It will be possible to introduce the high-yielding varieties of paddy and other crops by regulating the water levels, and stable farm management and increased crop production can be expected.

7) Through the improvement of canal and road networks, farm management and the living conditions of the farmers will be much improved, which will accelerate the regional economic development.

2–3–3 Project Implementation Schedule

1) Construction of project works

The construction of project works in the four sub-areas will be divided into three stages as follows:

- 1st stage (for 3 years)
  During this stage, the preparatory works necessary for constructing the intake weir and the canal system that will take time will be carried out. The main work at this stage will be the improvement of the drainage conditions in the low-lying wet land, which will facilitate the construction of the following project works. The training of the farmers in the project area for profitable irrigation farm management will also by carried out.

- 2nd stage (for 4 years)
  The major civil works including the construction of intake weir, irrigation and drainage

network, etc. will be completed within this stage. Reclamation of uncultivated land by transmigrants will be commenced from this stage.

- 3rd stage (for 3 years)
  The implementation of the project will be completed with the construction of terminal irrigation and drainage system on farm level.

2) Extension services and others

- It is very important to give proper guidance on the farm management to the existing farmers and to train the transmigrants in order to attain the aforementioned effects of the project. These services should be commenced as early as possible.
- In order to shift the present single cropping with low productivity to double crop farming, it is necessary to set up a demonstration farm for the improvement of the existing varieties and introduction of new varieties of crops. Establishment of the well-organized extension services and the farmers' cooperative including the demonstration farm should be arranged at the same time as the time of commencement of the construction.
- The distribution and marketing system for agricultural inputs and products and the financial supporting facilities for farmers should be improved in paralled with the project implementation.

3. PRESENT SITUATION

3–1 General Situation

3–1–1 Natural Conditions

Situated in lat. 1°30′–4° S. and long. 114°30′–116°30′ E., South Kalimantan Province is bordered by the East and Central Kalimantan provinces and the Java Sea. The area of the Province is about 37,000 square kilometers and its population is about 1,850,000 (according to 1976 statistics).

The Barito River, one of Kalimantan's major rivers, runs through the western part of this Province and flows into the Sea of Java by way of Banjarmasin, the capital of South Kalimantan Province.

The area which is the subject of the preliminary survey is the low land which spreads along the southern side of the Martapura River, a tributary of the Barito River. About 35,000 hectares have already been cultivated and an additional 35,000 hectares are the land which can be developed, and the total area is as wide as 90,000 hectares.

The annual mean rainfall in this area is 2,000–2,500 mm. The mountainous district along the upper stream of the Martapura River records an annual mean rainfall of 3,000 mm. Based on this rainfall distribution, the climate can be roughly divided into the rainy season extending from November to April and the dry season from May to October. The rainfall in the dry season accounts for less than 30% of the annual total. Particularly during the period of three months from July to September, there are long spells of draught. In this period, the natural conditions are extremely severe for agricultural production without irrigation facilities.

The mean temperature is about 26°C throughout the year, and there is little seasonal variation. The mean annual relative humidity is about 84%, as the area features high temperature and humidity. The annual evaporation is about 1,400 mm. The daily evaporation averages 3.7 mm in the rainy season and 5 mm in the dry season.

The Martapura River, which is the main river running through the project area, is one of the tributaries of the Barito River branching eastward at Banjarmasin. The Riam Kanan and the Riam Kiwa unite at a point about five kilometers upstream from the city of Martapura (40 kilometers from the point where the Martapura River joints the Barito River and forms the Martapura River.)

The catchment area of the Martapura River near the Martapura City is about 3,200 square kilometers. No accurate data on the annual discharge of this river are available. Judging from the annual discharge of the Riam Kanan River, the discharge of the Martapura River estimated is 4,000–7,000 million tons/year. The Barito River has a very gentle slope. The tidal range in this area is as large as 2.8 m, and it is said that the stream up to a point about 150 kilometers from the estuary is affected by the tide.

Table 3–1 Monthly Mean Rainfall and the Number of Rainy Days per Month in Principal Places in South Kalimantan Province

Upper : Precipitation
Lower : Number of Rainy days

Place	Ob. Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Banjarmasin	1961–1970	431	324	315	186	181	116	93	79	83	126	233	345	2492mm
		223	187	20.7	143	131	11.7	95	91	7.7	120	179	21.7	1787days
Martapura	〃	337	262	267	165	196	101	85	37	83	91	208	261	2093
		141	110	109	74	68	62	39	32	34	5.6	10.6	110	941
Ulin	〃	344	328	332	234	163	110	75	35	73	134	198	327	2353
		134	118	114	102	68	5.7	31	30	33	62	99	134	982
Bati – Bati	1964–1970	385	336	341	213	187	138	97	37	89	130	199	435	2587
		149	111	136	96	89	66	40	43	40	67	10.6	144	1087
Pleihari	1961–1968	339	276	284	229	122	165	39	51	32	91	224	454	2316
		155	136	127	97	81	74	31	29	26	67	10.7	148	1078
Tanjung	1961–1970	285	271	246	209	163	108	104	87	90	146	210	305	2224
		152	122	116	108	90	70	60	62	61	87	102	145	1180
Barabai	〃	291	328	234	206	177	95	117	106	85	103	230	281	2288
		125	110	10.7	81	78	5.7	58	52	55	62	10.3	130	1018

Meteorological Agency, Jakarta

3–1–2 Socioeconomic Conditions

(1) Population

The population of areas other than Java Island increases at an annual average rate of 2.6%, whereas the growth rate stands at 1% for South Kalimantan Province. Whether this is due to the imperfection of statistical data is unknown. According to the statistical data of 1976, the Province had a population of about 1,850,000 and the population density stood at 50 persons/square kilometer. The population statistics of the administrative district with which the project area is connected are given below:

Table 3–2

Place	Population Acreage (km^2)	Number of Household	Total Population	Population Density (Persons/km^2)
Banjarmasin	72.0	66,420	314,388	4,366
Banjar	6228.25	63,388	306,500	49

(2) Industry and Economy

The gross provincial product is valued at about 125,000 million Rp (US$300 million), or 64,000 Rp per capita (US$150).

With the gross provincial output in 1969 at 1, the gross provincial output stood at 3.6 (30% a year) in 1974. The actual growth rate registered was about 1.7 (11% a year) in 1974.

Agriculture is the industry which has the biggest share in the South Kalimantan Province. The agricultural population accounts for about 75% of the working population. The Province's agriculture is based primarily on rice cultivation, and the total yield is estimated at about 630,000 tons (1976), of which 80,000 to 100,000 tons are being shipped to the neighboring provinces. The lumber production of the whole Kalimantan accounts for about 60% of the national total, but that of South Kalimantan Province is about 5% of the total output of the Kalimantan. However, South Kalimantan Province turns out to be the major lumber fabrication and shipping center for the Kalimantan Provinces. Major products of the South Kalimantan Province include diamond and other mineral resources, oil and rubber. The exploitation of mineral resources turns out to be the Province's second most important industry following agriculture.

(3) Electric Power

The Riam Kanan Hydroelectric Power Plant commenced its commercial operation in 1973 and greatly improved the power condition. Up until that year, about 3–5 MW of electricity had been generated with the diesel engine. Moreover, the lack of power distribution facilities alarmingly restricted the supply of electricity.

At present, the Riam Kanan Hydroelectric Power Plant has an installed capacity of 20 MW. As there is a steady rise in the demand for electric power in the urban districts, and also the industrial plants have been established in Banjarmasin and other places, it is being planned to increase the installed capacity to 30 MW in the near future.

(4) Transportation

Roads start from Banjarmasin. The national highway linking Martapura, Kandangan and other principal districts runs east to west through the middle part of the province to cope with the motorization which has been making rapid progress in recent years. In the rural areas, however, few vehicles and cultivators are visible, although there has been some increase in the number of motorcycles. Consequently, the number of roads on which automobiles are passable is limited. Transportation by water making use of the network of small drainage channels constitutes the principal means of traffic. These water channels are used for the transport of most of the farm products, and the zone of life is also developed around these water channels.

A civil airport is situated in Ulin. Air-liners and the aircrafts owned by timber dealers keep this airport busy. At present, a new runway for the mediumsized jet passenger planes of the DC–9 class is under construction.

The dredging operations on the estuary of the Barito River started in 1974 have made possible the navigation of freighters of the 7,000–8,000 deadweight ton class to go up the river to moor in the newly completed port of Trisakti.

(5) Waterworks

Banjarmasin is the only community in the project area where waterworks are available, and the present water intake is 275 liters/sec.

The source is the Martapura River, and the intake pumping station is established at two places. One is at Sungai Bilu near the estuary and the other is at Sungai Tabuk, 16 kilometers up the river from the estuary. The Martapura River is a tributary of the Barito River, a tidal river and its salinity has been confirmed. Particularly in the case of Sungai Bilu along the downstream, the salinity increases in the dry season, and its value sometimes reaches 5,000 ppm in terms of chlorine ion. Therefore, the density of chlorine ion is measured every hour. When there is a rise in the density of the water taken in by the downstream pumping station, the Sungai Tabuk pumping station is used to supply service water. However, the completion of the Riam Kanan dam has made it possible to equilibrate the draughty water discharge in the dry season to a greater extent than before the completion of the dam, so that there is less influence of salinity of the Martapura River.

The City Waterworks Bureau is now planning to increase the water intake to 550 liters/second. When water is taken in for agricultural work along the upper stream in the future, the salinity will rise further, even if there is a return flow. For any agricultural development program, therefore, there is a need to pay full heed to its possible impact on service water.

3–1–3 Riam Kanan Multipurpose Dam

(1) Circumstances Leading to Construction of Riam Kanan Dam

Construction of the Riam Kanan Multipurpose Dam was started in 1963 with the Japanese reparation fund for power generation, irrigation and flood control. The construction was suspended due to Indonesia's political situation and the aggravating inflation and it eventually became difficult to carry on the construction only with the reparation fund. The extension of the yen loan in 1968 made it possible to resume the construction. The main body of the dam was completed in 1971. The power plant was completed in 1973. It took as many as 15 years since the survey was begun in 1959, but it is worthy of note that this dam turned out to be the biggest multipurpose dam ever constructed outside Java Island and that this proved to be the pioneer project ever implemented for the development of an area outside Java.

The Riam Kanan Dam was originally designed as a gravity type. In the light of the topographical conditions, it was later changed to an earth dam. Eventually, it was constructed as a uniform earthfill type with its dike measuring 57 meters in height, 195 meters in length and about 700,000 cubic meters in dam volume. The scale of this dam and its power generating facilities are outlined below:

Table 3–3 Main Features of Riam Kanan Hydropower Project

1.	RESERVOIR	
	Drainage basin	1,043 km²
	Total storage capacity	1,200,000,000 m³
	Submergible area	92 km²
	High water level	El. 60.0 m
	Low water level	El. 52.0 m
	Flood water level	El. 63.0 m
2.	DIVERSION	
	Coffer dam, Type	Earthfill
	Coffer dam, Height	28 m
	Coffer dam, Volume	210,000 m³
	Diversion tunnel, Length	332 m
	Diversion tunnel, Discharge	340 m³/sec
3.	MAIN DAM	
	Type	Homogeneous Earthfill
	Height	57 m
	Volume	670,000 m³
	Crest elevation	El. 66.0 m
4.	SPILLWAYS	
	Service Spillway	Morning-glory-tunnel type Discharge capacity 500 m³/sec
	Emergency spillway	Open channel type Discharge capacity 230 m³/sec
5.	POWER GENERATION	
	Gross head, max.	49.5 m
	Gross head, min.	41.5 m
	Rated head	39.8 m
	Discharge, max.	87 m³/sec
	Installed capacity (initial)	20,000 kW
	(final)	30,000 kW
	Average annual output	155,600,000 kWh
	Turbine, Type	Francis, vertical shaft
	Generator, Type	Semi umbrella
6.	70 kV transmission line	
	Circuit (initial)	Single
	(final)	Double
	Conductor	ACSR 120 mm²
	Length	52 km
	Tower	92 numbers of double circuits type steel tower
7.	Sub-station	
	Capacity of Main transformer at Banjarmasin	2 x 6,000 kVA
	– do – at Banjarbaru	1 x 3,000 kVA

(2) Power Generation

Before completion of the dam, diesel power generators had been used for generating power. The demand was small, and the electric power had been generated in Banjarmasin on a scale of 3–5 MW. Moreover, the power generators, affected by various restrictive factors, had been unable to display their full capacity and the power supply had remained very unstable. Consequently, this unstable power supply had apparently constituted a barrier to the development of this area. However, there has been made a surprisingly great improvement in the power supply in this area ever since the Riam Kanan Hydropower Plant with an installed capacity of 20 MW was put into commercial operation in 1973, and rural communities in this area also enjoy such power supply.

The peak power demand was 7,000 KW in 1974 but it soared to 12,000 KW in 1977. The power generation and water discharge in the dry season (September) of 1976 and the rainy season (January) of 1977 are shown in Table 3–1.

(3) Estimation of Power Demand

The dam consists only of a spillway, the crest height (high water level) of which is fixed, and water discharge facilities for power generation. In the event the level of the reservoir does not reach the high water level, irrigation must depend entirely on the water released through a turbine for power generation. In order to determine the volume of water which is available for irrigation, it is extremely important to estimate the future demand for electric power.

The demand for electric power in Banjarmasin and other cities is increasing year after year. According to the data prepared by PLN (the Electric Power Bureau of the Ministry of Public Works), the annual growth rate is about 10%. At present, the installed capacity is 20 MW with two 10-MW plants, and the installation of an additional power plant is being planned. By about 1983, it will become possible to assure the planned maximum output of 30 MW.

Judging from the daily variation in electric generation mentioned above, the load factor (average output/maximum output x 100%) is about 65%. If it is assumed here that this variation pattern lasts until the installed capacity reaches 30 MW, the average output will be about 20 MW and the discharge 50–56 m^3/sec. This is because the rise in the load factor is higher than the originally planned discharge of 44 m^3/sec. Therefore, it is conceivable that the demand for electric power has increased that much.

Therefore, it is necessary to study the plan of utilization of the reservoir including the electric power generation program and the agricultural development program for the purpose of well balanced operation of the dam at the planned low water level.

Fig. 3–1 Daily Variation in Power Generation of Riam Kanan Hydropower Station

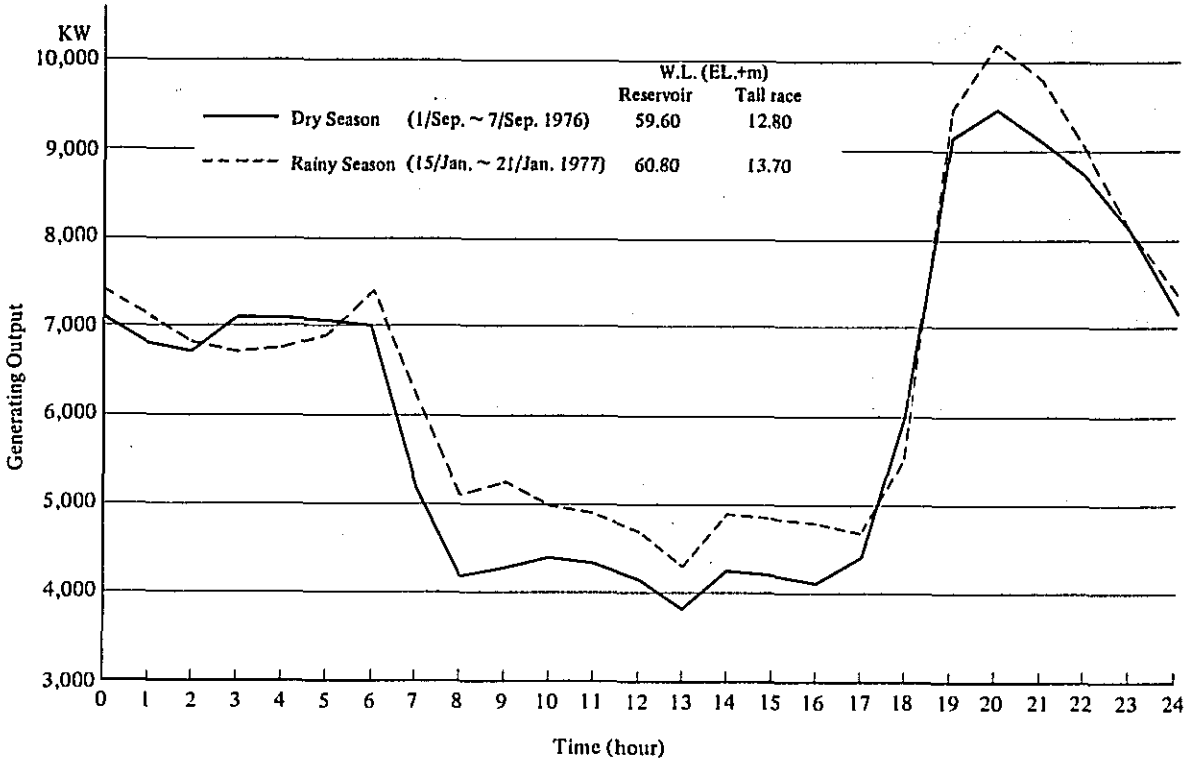


Fig. 3–2 Operating Record of Riam Kanan Hydropower Station

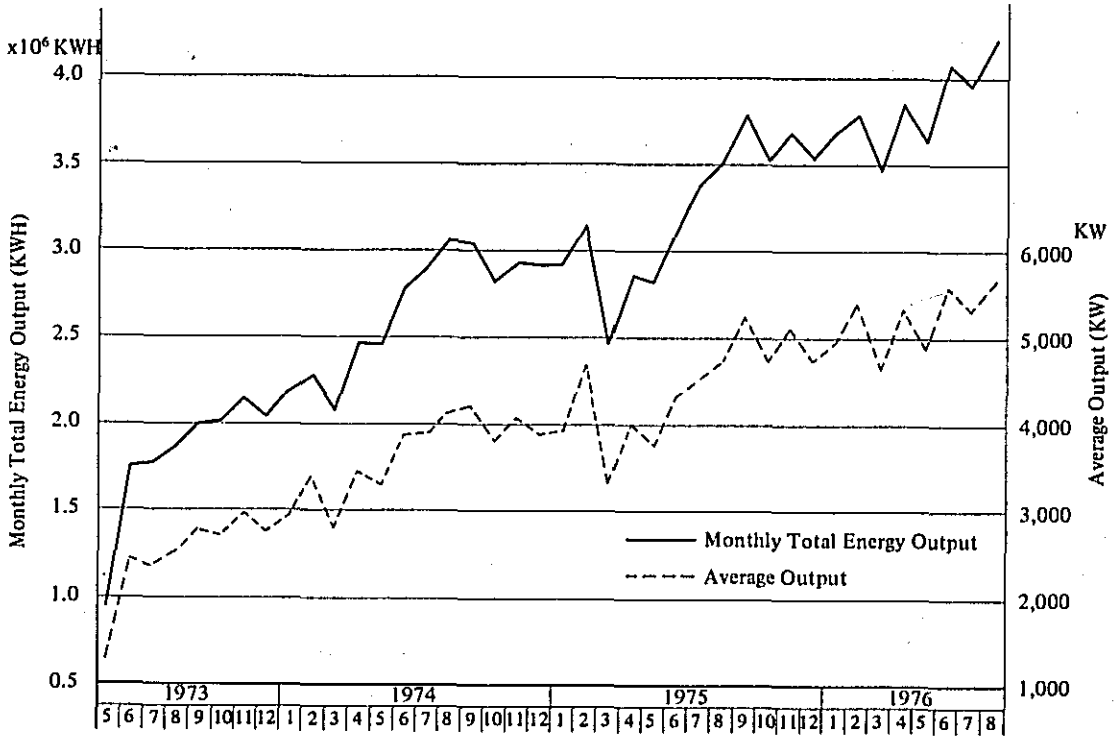
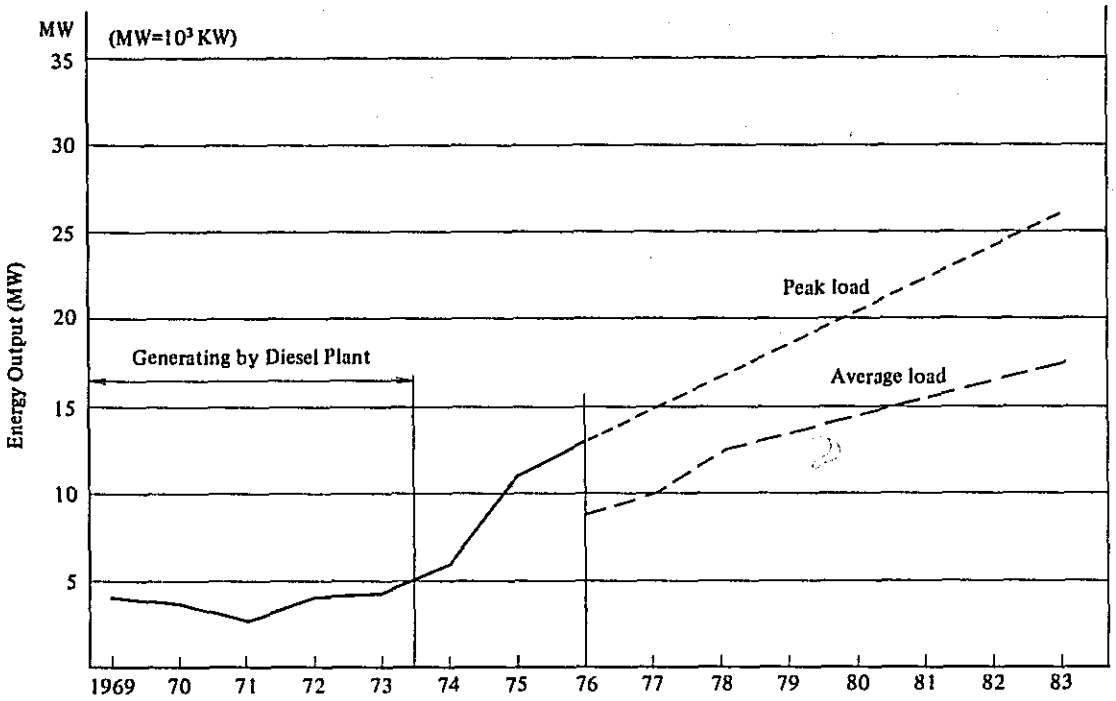


Fig. 3–3 Load Forecast by PLN



3–2 Agriculture

(1) General

The South Kalimantan Province is 36,984.5 square kilometers in total area and has a total population of about 1,848,000 (1976). Administratively, this Province is made up of one Kotamedya (city), nine Kabupaten (prefectures), 89 Kechamatan (countries) and 673 villages. There are about 403,000 households, of which some 300,000 are considered to be farm households. The cultivated land measures about 330,000 hectares, of which about 280,000 hectares are paddy fields and 20,000 hectares are upland fields. In other words, 91% of the cultivated land is used for rice cultivation.

In regard to minor cereals, 5,000 hectares are set aside for peanut, 5,000 hectares for cassava, 3,600 hectares for maize and 1,800 hectares for sweet poteto.

In the sector of fruits, about 3,000 hectares are set aside for banana, about 1,200 hectares for ranbutan and 450 hectares for tangerines. As for vegetables, onion, maize, cucumber, eggplant, tomato, etc. are cultivated on about 2,500 hectares.

In 1976, the rice production was at the level of about 606,000 tons. The average yield per hectare is 2,376 kg in terms of stalk paddy. The output of upland rice is about 30,000 tons, and the average yield per hectare is 1,759 kg. The total rice production is about 630,000 tons, of which about 80,000 to 100,000 tons are shipped to neighboring provinces a year.

In the sector of minor cereals, maize was produced at the level of 1,530 tons, cassava 21,500 tons, sweet potato 7,903 tons, penut 3,300 tons and soybean 300 tons. As for the dry field forming in the South Kalimantan Province, there is much difference between the acreage cultivated and harvested. The area of upland fields which become fruitless due to natural disasters, etc. is large, and so the agricultural production is not stabilized.

With respect to vegetables, the output cannot satisfy the demand, and a considerable amount of vegetables is being imported from Surabaja and Timor.

(2) Project Area

The project area administratively belongs to Kabupaten (Prefecture) Banjar. Centering around the city of Banjarmasin, this area encompasses some or all parts of the following seven Kechamatan (counties).

Banjarbaru
Martapura
Sungaitabuk
Kertakhanyar
Sluhaluh
Gambut
Karanjentan

(3) Present Situation of Farm Management

Of the estimated total of 56,000 hectares of the irrigation project area, about 20,000 hectares of paddy fields are available. In addition to the paddy fields, upland fields sporadically exist, where maize, cassava, sweet potato, beans and other vegetables are cultivated.

In the project area, rice is planted in the paddy fields more than five kilometers away from the main stream of the Barito River, so that the direct influence from the tide is insignificant. Some parts of the area are indirectly influenced by the tide. This area falls under the category of the so-called "indirect tidal swamp area" and rice planted in the paddy fields in this area is regarded as the east monsoon rice.

The varieties of rice and the cultivation period vary in these paddy fields, depending on the water level recorded at the end of the rainy season. Again, there are some paddy fields requiring more than three months for raising seedlings owing to the water level at the time of seeding. On permanently inundated paddy fields, rafts made of banana trunks filled with mud are floated to raise seedlings. This type of "floating nursery" is used in some areas. The vegetation period of rice in the ordinary paddy fields is 5–6 months, and cropping is done from March to June. Rice is harvested during the period of August to November. The most popular variety cultivated is the Lemo. In addition, C4 and other new varieties are being cultivated. At the interview with the farmers in Gambut, it was found out that the major varieties in this village are the following:

(1)	Bandsh padang koening	(2)	Bansh tilang
(3)	Bayar putik	(4)	Bayar kuning
(5)	Lemo harus	(6)	Lemo petengah
(7)	Lemo besac	(8)	Siam harus
(9)	Siam pentegah	(10)	Siam besar
(11)	Pendah	(12)	Bayar
(13)	Bayar pehet	(14)	Ladak

The rice cultivation method is very simple. Plowing, fertilization and pesticide spraying are not conducted at all. Because the soil is weak, few farm households are engaged in breeding cattle as draft animal. In spite of such primitive cultivation method, the harvest is unexpectedly high. At an interview carried out in the project area, many farmers replied that the yield was 3–3.5 tons/ha in terms of dry unhulled rice. According to the data available at the Bureau of Agriculture of the South Kalimantan Province, the average paddy rice crop in the past five years has been 2.5 tons/ha in terms of stalk paddy. Therefore, the rice yield in this project area is considered relatively high.

In this area, the damages are such as those caused by rice borer, leafhoppers and other insects and those by field mouse.

Practically no irrigation and drainage facilities are available. If any, they are not equipped with the control system. For this reason, transplanting of rice is delayed due to untimely filling and recession of water in the initial period of rice cultivation. Damages are also caused frequently by the lack of rainfall in the cultivation period.

The number of farm households is estimated at about 12,000, and the average farm size is 1.1–1.5 hectares/household.

Seventy-five percent of the farm households are owner farmers. The number of tenant farmers is relatively small. Tenant farming contracts are verbally concluded. The rents for tenancy are paid in kind, and 20–50% of the products are paid to the landowners.

The farm gate price of unhulled rice fluctuates widely, depending on the season. There are cases in which the price is 45–56 Rp*/kg in terms of dry stalk paddy and 60–70 Rp/kg in terms of dry paddy during the harvest season, and 100 Rp/kg in terms of dry paddy in the off-crop season.

(* US$1 = 415 Rp 1 Rp = ¥0.65)

Unhulled rice is sold to merchants who come by ship or vehicle. Gambut is the only village where an agricultural cooperative (KUD) is organized. This cooperative has rice polishing facilities and a fertilizer storehouse. Officials of the agricultural cooperative said that the cooperative was adjusting the prices of unhulled rice, but no detailed information on its functions was available. The number of the members of the cooperative was far below 100, and it seemed that it was not very active.

Table 3–4 Statistics of Crop Production

Paddy

	Area Planted	Area Harvested	Total Crop	Crop per ha
1972	233,748 ha	202,105 ha	515,000 ton	2,550 kg
1973	280,180	250,942	588,000	2,342
1974	256,830	244,281	603,000	2,969
1975	270,081	255,101	578,000	2,265
1976	270,129	255,188	606,000	2,376

Upland Paddy

1972	19,077	18,402	23,750	1,291
1973	24,829	23,305	34,420	1,471
1974	17,642	16,566	24,220	1,459
1975	19,554	18,704	28,570	1,528
1976	17,840	17,299	30,430	1,759

Maize

1972	4,129	3,644	2,955	811
1973	3,159	2,493	1,959	786
1974	2,734	2,126	1,422	693
1975	3,426	2,708	2,193	810
1976	3,592	2,156	1,530	710

Cassava

1972	4,490	2,480	3,200	1,291
1973	4,565	3,264	4,800	1,471
1974	4,679	2,754	4,020	1,459
1975	4,988	2,848	4,350	1,528
1976	5,091	3,039	5,346	1,759

Sweet Potato

1972	2,302	1,920	9,312	4,850
1973	2,093	1,738	7,250	4,171
1974	1,462	1,227	5,523	4,501
1975	1,932	1,434	7,260	5,063
1976	1,830	1,460	7,903	5,413

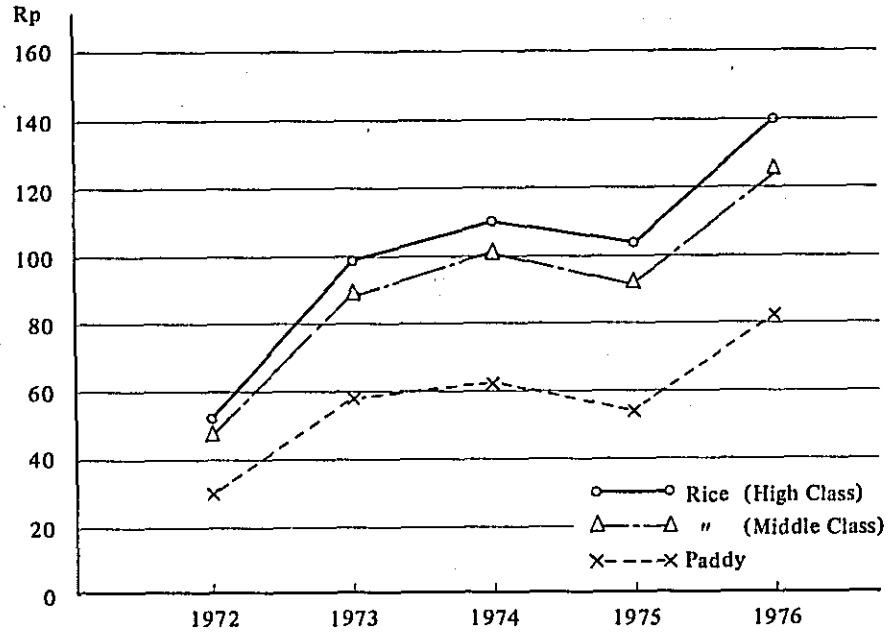
Soy Bean

1972	755	627	431	688
1973	597	489	306	626
1974	564	486	321	660
1975	586	450	307	682
1976	623	483	302	625

South Kalimantan Province Agricultural Bureau

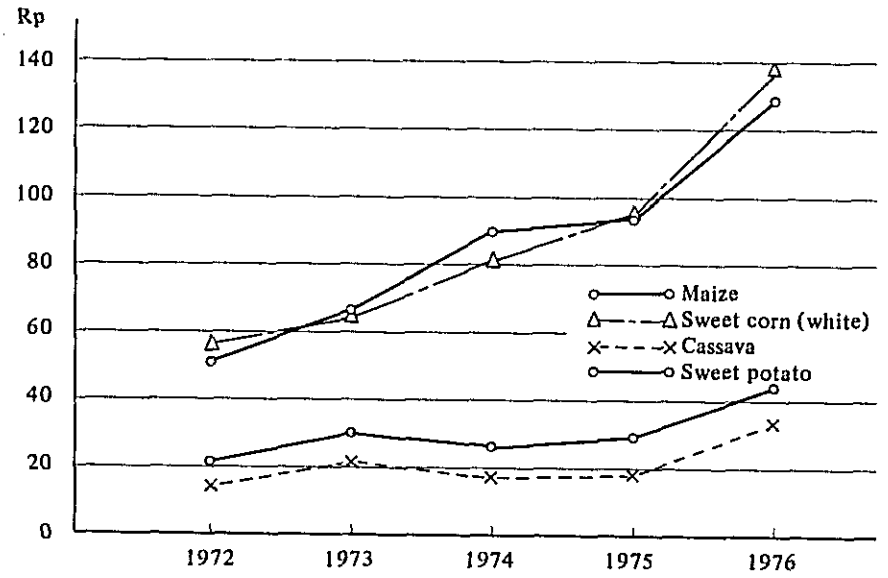
Fig. 3–4 Market Price of Main Crops

(a) Rice & Paddy

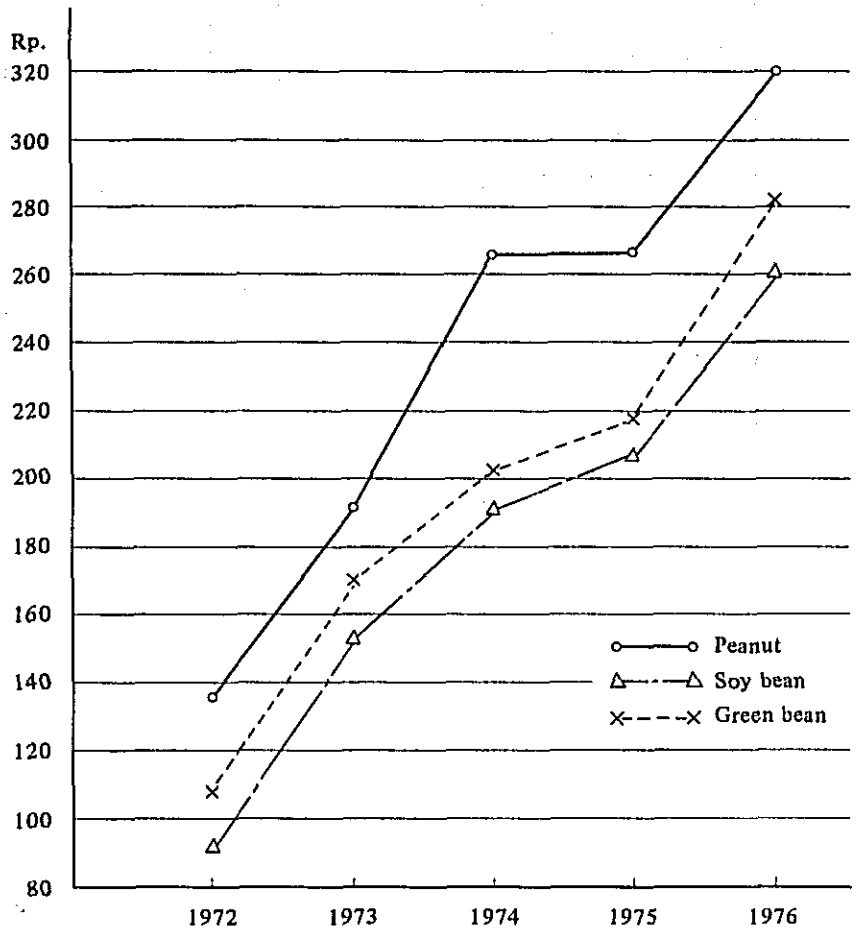


(Remarks: Price of paddy is farm gate price)

(b) Miscellaneous Grain Crops and Starch Crops



(c) Beans



Source: South Kalimantan Province Agricultural Bureau

Table 3–5 Main Market Prices of Main Crops (1976)

Crop.	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Aver.	Remarks.
Rice (High class)	124.2	140.5	152.5	162.2	167.6	157.2	132.8	114.2	124.4	134.6	134.1	136.8	140.1	
Rice (Micldle clars)	112.9	127.0	135.5	147.6	146.9	138.8	116.2	99.6	110.4	120.7	119.8	127.3	125.2	
Paddy	77.3	87.5	93.1	98.3	98.6	89.8	72.7	65.6	74.1	75.9	76.2	80.6	82.5	Farm gate price
Maize	95.0	110.0	126.9	138.6	121.5	135.0	120.0	122.5	136.3	153.3	150.0	125.0	127.8	
Sweet Corn	94.2	115.0	118.9	137.9	143.2	169.4	156.4	148.9	144.1	148.6	143.1	132.9	137.7	
Cassava	21.1	25.4	29.9	34.3	36.0	38.5	35.0	34.4	36.4	36.9	39.3	37.9	33.8	
Sweet Potato	35.4	38.5	40.0	42.5	46.1	47.6	45.6	41.4	43.8	45.2	47.8	48.2	43.5	
Peanut	285.0	296.3	303.3	319.8	333.8	333.5	317.7	310.4	321.0	339.2	330.9	341.6	319.4	
Soy Bean	255.0	271.9	266.1	260.3	279.1	269.4	258.9	253.1	247.8	250.3	250.0	265.6	260.6	
Green Bean	245.9	267.2	282.3	298.8	302.8	294.6	293.8	283.3	275.3	276.2	274.0	291.9	282.2	

Source: South Kalimantan Province Agricultural Bureau

Table 3–6 Livestock by Area and Kind (1976)

	District	Horse	Cattle	Milk Cow	Buffalo	Goat	Sheep	Pig	Chickin	Duck
1	Banjarmasin	2	1,223	88	658	656	493	4,191	189,620	37,900
2	Banjar	1,256	9,634	—	2,269	4,514	436	36	651,670	134,390
3	Tapin	482	2,000	—	1,297	2,087	434	49	320,120	50,550
4	H.S. Selatan	221	3,305	—	3,629	1,487	2,257	1,240	500,120	350,980
5	H.S.Tangah	622	4,139	10	3,985	6,541	3,924	1,060	473,070	295,660
6	H.S. Utara	112	2,373	—	8,059	4,636	2,098	229	475,480	653,100
7	Tabalong	76	8,294	—	86	5,351	434	723	422,790	67,530
8	Tanah Laut	146	16,242	—	7,610	2,107	916	—	388,650	44,030
9	Kotabaru	836	3,272	—	21,754	7,589	391	222	380,000	74,500
10	Barito Kuala	—	151	—	132	65	—	—	216,280	56,670
	Total	3,754	50,633	98	49,479	35,033	11,383	7,750	4,017,800	1,765,310

Source: South Kalimantan Province Agricultural Bureau

3–3 Soil

The Soil Research Institute in Bogor completed a soil survey of the project area in 1976, and a semi-detailed soil map[1] (1/50,000) was completed. The data are being sorted out and will not be completed till next year. The Bogor Agricultural University also carried out a soil survey of its own and completed a semi-detailed soil map[2] (1/25,000) and a report[3] in 1975. These data were used in the survey carried out this time. These data together with the report which is to be completed by the Soil Research Institute will serve as the most useful reference data in the next survey.

When classified into principal soil groups, the soil of the project area may be divided into eight groups. They are the alluvial soil, regosol, gray hydromorphic soil, podzoic soil, podzol, lateritic soil, latosol and organic soil. In general, these kinds of soils are low in fertility and their reactions are less than pH 6.

On the basis of the topographical, soil and water conditions, this area may be classified into the upland, swamp and lowland.

(1) Upland Fields

The area stretching from Banjarbaru to Cempaka is the upland. This area is being indicated as Area F. Regosol, lateritic soil and podzolic soil are observed. In the adjacent area which extends along the Ulin highway, regosol, lateritic soil and podzol are distributed. These kinds of soils feature high contents of sand and gravel, and the fertility is extremely low. They are suitable for upland field crops and fruits culture due to their favorable drainage conditions. It will be necessary to study the crops suitable for the upland and manuring control.

(2) Swamps

A swamp is situated practically in the middle of Area B, and its area is considerably large. The soil consists mainly of the organic soil. The drainage in this area is extremely bad, so that the area is constantly in a state of reduction. Plants are not dissolved and a peat layer is formed.

Practically no cultivation is carried out in this area at present, as it consists of dense woods and forests. The water (pH 4.5) which liquates from the soil and containing humus acid exerts adverse influence on crops. Therefore, it is necessary to remove this harmful water and replace it with fresh water. For this reason, it is desirable to determine the position of drainage ditches according to the distribution of the organic soil. However, dryness makes the peat layer to contract and sink to a considerable extent. Therefore, an excessive degree of dryness should be avoided in areas where the peak layer is thick. From the foregoing, it is necessary to accurately grasp the distribution of the organic soil and the thickness of the peat layer.

(3) Lowland

Lowland is observed in Areas A, C, D and E and in that part of Area B which stretches along the Martapura River, and the alluvial soil is mainly distributed. At present, considerable portions of the lowland and being used as paddy fields, and the possibility is great of using these portions as paddy fields.

These areas, situated somewhat away from the seacoast, are in the indirect tidal area, and the direct influence of the seawater is presumably not so great. These is a need to study the accumulation of salts in the soil and its impact on the crops.

There is the possibility of acid sulphate clay being partially distributed. This clay may be classified into cat-clay and mud-clay. Mud clay, being in a state of perfect reduction, contains pyrite (FeS_2) and the reaction is neutral. Oxidized pyrite changes into basic ferric sulfate $Fe_2(SO_4)_2(OH)_2$

and sulfuric acid H_2SO_4, representing strong acidity (pH 2–3). This is called cat-clay. It will be extremely noxious if the soil containing clay of this kind is dried. In the latest survey, cat-clay has been detected in the area along the Maluka River. Full heed must be paid to this factor in working out an irrigation and drainage program for such an area. For this reason, it is necessary to accurately grasp the distribution of mud clay and acid sulfate clay in the project area.

(4) In the latest survey, the soil pit was dug at the points shown in Fig. 3–5 and the following soil cross-section was found:

No. 1 Bati Bati (Podzolic soil)

1st layer – 0–14 cm, reddish brown (5 YR 4/8), SL, extremely full small breccas, cohesion weak, plasticity weak, dry, pH 4.5 (KCl)

2nd layer – 14–49 cm, bright reddish brown (5 YR 5/8), SL, extremely full of small breccas, cohesion weak, plasticity weak, dry, pH 5.0

3rd layer – 49–92 cm, bright reddish brown (2.5 YR 5/8), extremely full of small breccas, plasticity weak, dry, pH 5.0.

No. 2 Gambut (Organic soil)

1st layer – 0–45+cm, black (5 YR 1.7/1), peat soil, cohesion weak, plasticity weak, added humidity, pH 4.5

No. 3 Gambut (Alluvial soil)

1st layer – 0–8 cm, black (7.5 YR 1.7/1), SiL, cloddiness weak, full of humus, cohesion intermediate, plasticity weak, semi-humid, pH 4.5

2nd layer – 8–13 cm, blackish brown (7.5 YR 2/2) CL, cloddiness weak, full of humus, cohension intermediate, plasticity weak, semi-humid, pH 4.5

3rd layer – 13–26 cm, dark brown (7.5 YR 3/3), SiL, cloddy, full of humus, layer-like spots, cohension strong, plasticity strong, humid, pH 4.5

4th layer – 26–51+cm, grayish brown (7.5 YR 4/2), HC, shaping like big columns, layer-like spots, cohension strong, added humidity, pH 4.5

No. 4 Simpang Lianganggang (Regosol)

1st layer – 0–6 cm, black (7.5 YR 1.7/1), LS, full of humus, cohension weak, plasticity intermediate, humid, pH 5.0

2nd layer – 6–8 cm, blackish brown (7.5 YR 3/1), S, full of humus, cohesion weak, plasticity weak, humid, pH 5.0

3rd layer – 8–14 cm, brownish gray (7.5 YR 6/1), S, cohesion weak, plasticity weak, humid, pH 5.0

4th layer – 14–38+cm, black (7.5 YR 2/1), S, full of humus, cohesion weak, plasticity weak, added humidity, pH 5.0

No. 5 Ulin (Alluvial soil)

1st layer – 0–4 cm, black (5 YR 1.7/1), SL, cloddiness weak, full of humus, cohesion weak, plasticity weak, semi-humid, pH 5.5

2nd layer – 4–11 cm, black (5 YR 2/1), SL, cloddiness weak, full of humus, cohesion weak, plasticity weak, semi-humid, pH 5.5

3rd layer – 11–54 cm, dark brown (7.5 YR 3/3); SiL, cloddy, full of humus, cohesion intermediate, plasticity weak, pH 5.5

4th layer – 54–68+cm, blackish brown (7.5 YR 3/1), CL, shaping like poles, full of humus, cohesion intermediate, plasticity weak, humid, pH 5.0

No. 6 Tunggulirang (Alluvial soil)

1st layer – 0–7 cm, dull reddish brown (5 YR 3/1), SiL, cloddy, layer-like spots, cohesion intermediate, plasticity intermediate, semi-dry, pH 5.0

2nd layer – 7–15 cm, cloddiness weak, layer-like spots, cohesion strong, plasticity strong, semi-dry, pH 5.0

3rd layer – 15–20 cm, dull reddish brown (5 YR 4/4), CL, cloddy, cohesion strong, plasticity strong, semi-humid, pH 5.0

4th layer – 20–36 cm, dull reddish brown (5 YR 4/4), cloddy, cohesion strong, plasticity strong, semi-humid, pH 5.0

No. 7 Tambaksarana (Alluvial soil)

1st layer – 0–10 cm, blackish brown (7.5 YR 2/2), SiL, cloddy, full of humus, cohesion weak, plasticity intermediate, semi-dry, pH 5.0

2nd layer – 10–16 cm, blackish brown (7.5 YR 3/2), CL, cloddy, full of humus, shaping like pipes, layer-like spots, cohesion intermediate, plasticity strong, semi-humid, pH 5.0

3rd layer – 16–53+cm, grayish brown (7.5 YR 5/2), HC, shaping like big columns, layer-like spots, cohesion strong, plasticity strong, humid, pH 5.0

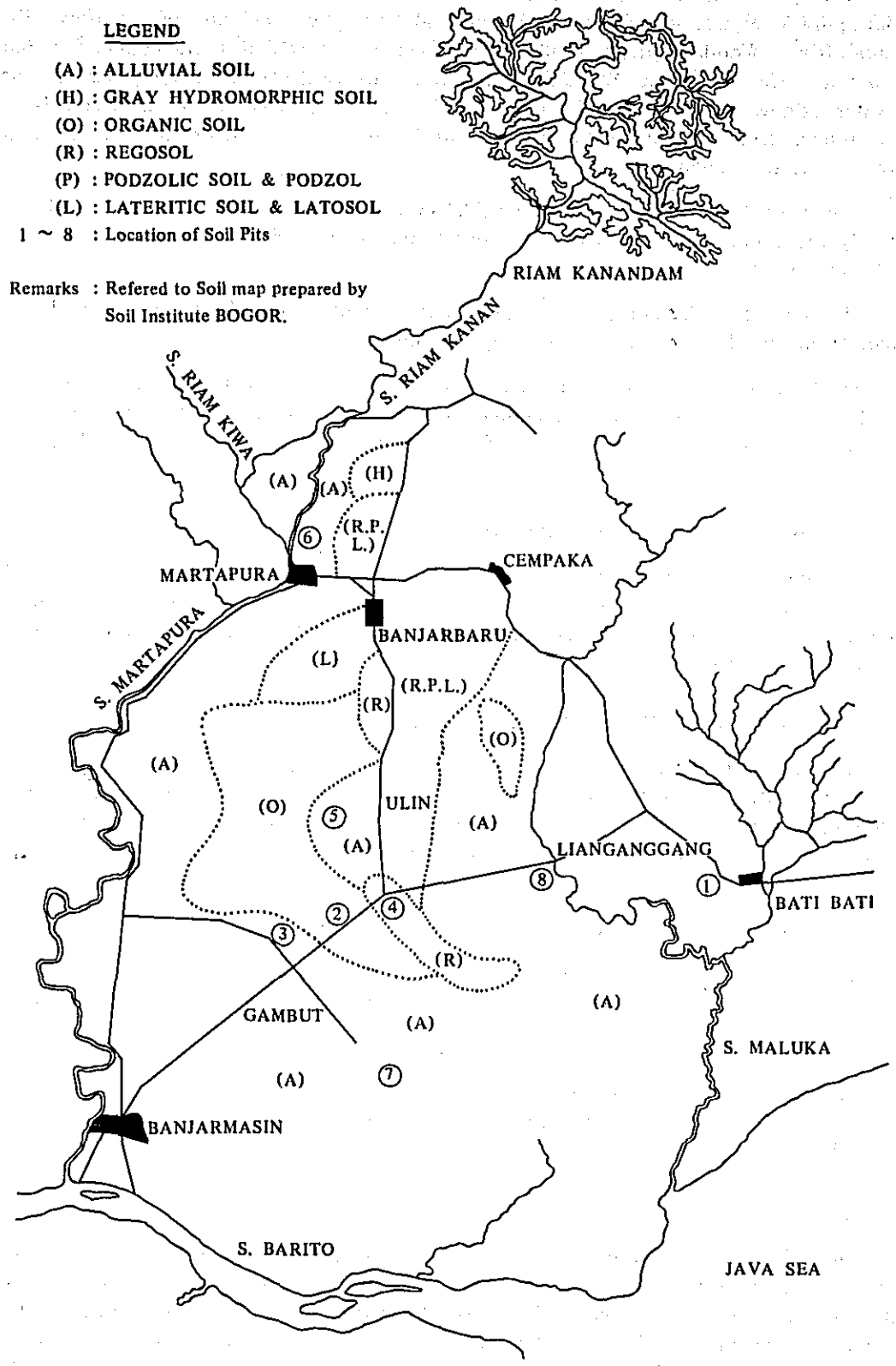
No. 8 Lianganggang (Alluvial soil)

1st layer – 0–9 cm, blackish brown (7.5 YR 3/2), SiC, Cloddiness weak, full of humus, layer-like spots, cohesion strong, plasticity intermediate, semi-humid, pH 5.0

2nd layer – 9–15 cm, black (7.5 YR 2/1), CL, full of humus, cohesion intermediate, plasticity weak, humid, pH 5.5

3rd layer – 15–43 cm, brownish gray (7.5 YR 4/1), HC, shaping like big clods, layer-like spots, cohesion strong, plasticity strong, humid, pH 5.5

Fig. 3–5 Soil Map



3–4 Irrigation and Drainage

In the project area, no irrigation facilities worthy of note are observed. In the swamp along the Martapura River, a large number of irrigation and drainage channels are connected with the Martapura River. Wooden water level adjusting devices are observed at several connecting points, but their functions are insufficient. When the water level of the river rises in the rainy season some of the river water is drawn into the channels. The same channels are used as the drainage channels in the dry season. Judging from the scale of the channels and the conditions of the project area, the drainage cannot be considered adequate.

The channels available in the indirect tidal swamp area south of Banjarmasin are also used for the supply and drainage of water, and dams using stop logs and designed to raise the water level are sporadically observed.

The channels in this area are used not only for agriculture but also for water supply and transportation, and the purposes are too many as against their scale.

The technology for farm management, as mentioned earlier, is close to natural agriculture. As long as the water level is favorable in the rainy season, it is possible to expect quite a high yield. For this reason, no positive steps are being taken for the control of the irrigation water and the drainage.

3–5 Hydrological and Meteorological Observation

The hydrological and meteorological observatories in the project area are as indicated in Fig. 3–6. The observation points required for the formulation of irrigation programs are considered well distributed, but there is a lack of observation in the indirect tidal swamp area from the south of Banjarmasin to Maluka.

(1) Observation of River Water Level and Intake

With respect to the water level of the Barito, Martapura and Maluka Rivers, the water level is observed with staff gauges at five points three times a day (0600, 1200 and 1800 hours). In addition, self-recording gauges are used at two points for observation. At any points, however, the curves indicating the water level and intake are not prepared. The water intake is made clear only at the Riam Kanan Dam.

River System	Ob. Point	Period	Ob. Method
Marutapura	Martapura	1946 – Present	Staff gauge
"	Mali mali	1953 – Present	"
"	Awangbangkal	1958 – Present	Automatic gauge
"	Pengalon	– Present	"
Maluka	Lianganggang	– Present	Staff gauge
"	Banyuhirang	1976 – Present	"
Barito	Banjarmasin bay	– Present	"

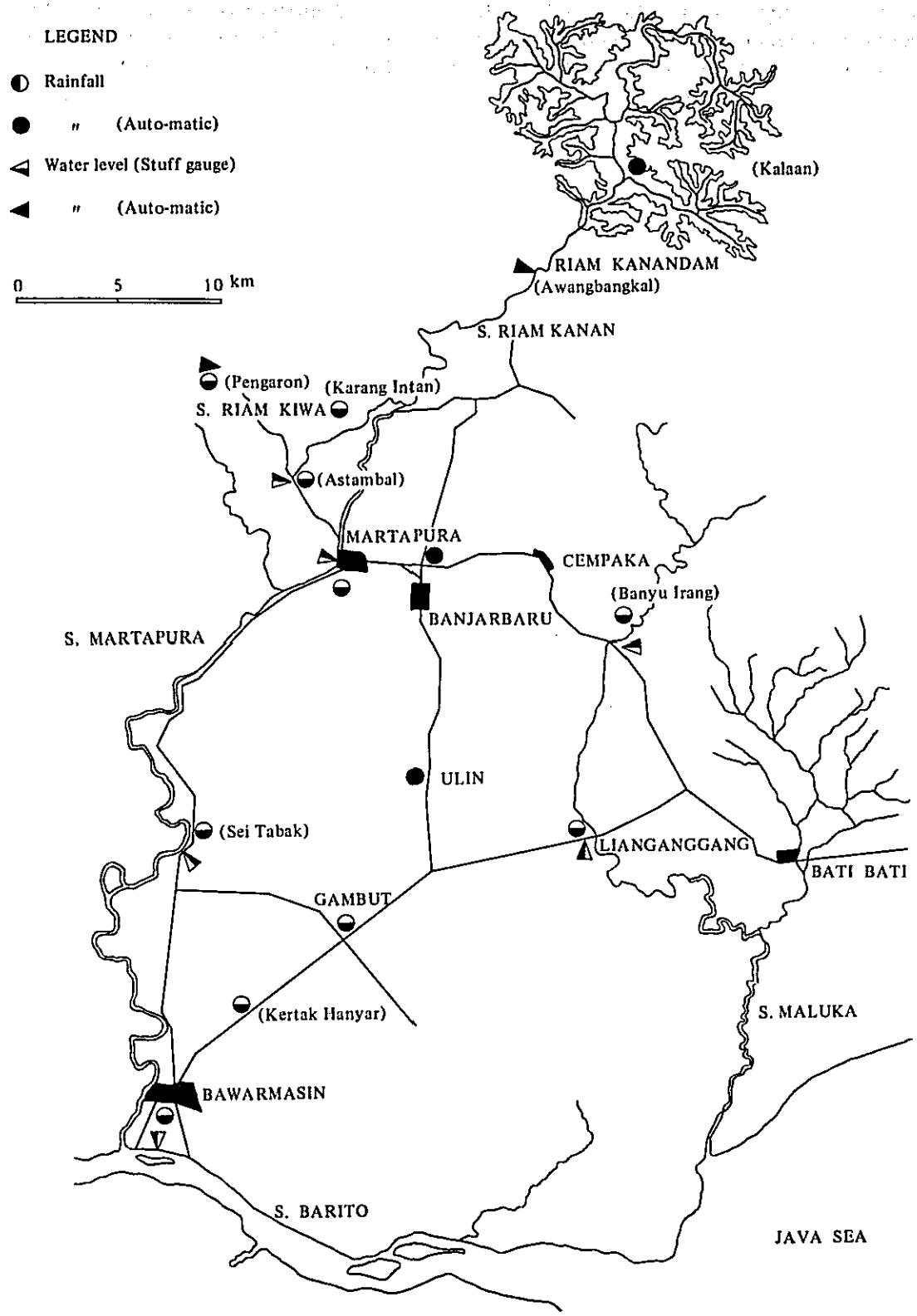
(2) Observation of Precipitation

There are 14 precipitation observation points in the project area. Of these, three points (Kalaan, Bonjarbarn and Ulin Airport) are equipped with the self-recording rain-gauge ombrograph. Of these 14 points, statistical data are collected by the Meteorological Agency at six points (Pengaron, Martapura, Banjarmasin, Karang-intan, Ulin, Batibati). The data gathered at the remaining points are controlled by the Planning Bureau of the Directorate General of Water Resources (P3SA) and Agricultural Offices (at Banjarbaru and Martapura).

(3) Other Observation

With respect to meteorological observation other than the precipitation, the observation of temperature, humidity, evaporation, wind direction, wind speed, duration of sunshine, ground temperature and atmospheric pressure was started at the Banjarbaru Meteorological Office in 1974. The observation of temperature and atmospheric pressure was begun at Ulin Airport in 1958.

Fig. 3–6 Location of rainfall and water level observation stations



4. DEVELOPMENT PROJECT

The Riam Kanan Dam started the commercial operation in 1973, and the demand for power in the project area steadily increased. Originally, the Riam Kanan Dam was a multiple-purpose reservoir intended for the generation of electric power, irrigation and flood control. However, as this dam was not provided with drainage facilities for irrigation, and also the spillway was of the morning glory shaft type with the crest height fixed, the quantity irrigation water supplied in the dry season was not sufficient in the stage when the demand for power was still low. As is obvious also from the power demand forecast, the design discharge will be reached in several years, making possible the agricultural development of the region in the lower reaches and the attainment of the initial purpose of the dam.

As described in the "Report on the Barito River Basin Development Plan" of 1971, this area is relatively well developed in Kalimantan, with high concentration of population, being the center of administration, economy and culture. Therefore, the agricultural development of this area is the stepping stone to the economic development of the Province, and is expected to play the role of a pilot project for many areas in the Barito River Basin where the agricultural development is possible.

4–1 Agriculture

(1) Agricultural Effects of the Development

Farming pattern employed in the project area is based on the method of farming using dexterously the natural conditions, but it is not very efficient. Though the soil conditions in this area are relatively favorable, the productive capability seems to have reached the maximum as long as the present agricultural techniques are employed. The introduction of a new irrigation and drainage system and new farming techniques into this area is intended to obtain the following effects.

– Increase and stabilization of production

To increase and stabilize the productivity of the rain-fed paddy fields. In most of paddy fields in the project area, planting is carried out at the end of the rainy season for harvesting in August and September, as dry season one-crop farming. Therefore, the irrigation during the growth period in the regular paddy fields must depend solely on rainfall. In the years of insufficient rainfall, damage from droughts often occurs. If irrigation facilities are completed, this damage can be prevented to stabilize and increase production.

– Introduction of improved varieties

If the water level at the end of the rainy season can be lowered promptly, planting of varieties superior to the present ones will become possible.

If Areas B, C and D (see Attached Drawing 2–1) in the project area are provided with drainage facilities to control the water level to some extent, superior varieties which have not been able to be introduced because of the planting time, cultivation period, etc. the improved varieties can be cultivated.

– Introduction of double cropping

In Area D where water level is relatively low even in the rainy season and in the areas (Area C, etc) where water level is expected to become low in the rainy season after the completion of the project, the foundation for regular introduction of twice rice culture can be secured by selecting and fixing the varieties of relatively short cultivation term (120 to 130 days).

– Introduction of up land farming

In the regions at relatively high elevation in Areas A and B which are still not cultivated due to the shortage of water, up land farming will become possible throughout the year if irrigation facilities are provided.

– Development of swampy regions

In the regions swampy because the land is relatively low (center of Area B) or in the regions where cultivation is not possible due to the water flowing out of the peat zone (such as a part of Area B along the Martapura river in Area B), flooding can be eliminated and contaminated water drained to promote creation of new paddy fields and upland fields upon completion of the drainage facilities.

– Acceptance of transmigrants

The farm land reclamation will progress in Area B and other areas, and many transmigrants are expected to be accepted.

4–2 Proposed Development Project Areas

As the result of the study made on the basis of the topographic map, soil map, land use map, and field survey, the following six areas have been selected as the most promising areas, as shown in Fig. 2–1.

1)	Area A	Gross area:	Approx. 3,200 ha.
		Net area:	Approx. 2,500 ha.

The eastern part of Martapura city, at elevations of less than +10.0 m. Alluvial soil zone, mostly covered with existing paddy fields. Partially poor in drainage.

2)	Area B	Gross area:	Approx. 16,000 ha.
		Net area:	Approx. 6–7,000 ha.

Slough between the Martapura river and Ulin highway, at elevations of less than +10.0. Alluvial soil zone along the Martapura river. The central part mostly is woody and swampy. Soil is mainly organic. This area always in the deoxidized condition due to the very poor drainage. Plant materials do not decompose, and peat layer is formed.

The gross area of Area B is about 16,000 ha, but the regions flooded throughout the year are excluded. Swampy regions remain almost unreclaimed, and what is required first of all for the development is the drainage system suitable to soil conditions, and then the introduction of fresh water.

The high level zone along Ulin highway has regosol, lateritic soil and podozol distributed, being low in fertility, but is expected to allow dry field farming and fruit culture by irrigation.

3)	Area C	Gross area:	Approx. 3,700 ha.
		Net area:	Approx. 3,000 ha.

The eastern part of Banjarmasin city, at elevations of less than +3.0 m. Alluvial soil zone. The area is generally covered with superior paddy fields. The main purpose is to reduce flooding in the rainy season and to secure water for the dry season.

4) Area D Gross area: Approx. 15,000 ha.
Net area: 9–10,000 ha.

Gambut district and the southern part of Banjarmasin, at elevations of less than +3.0 m. Alluvial soil zone. The area is generally covered with superior arable land. The project area is not directly affected by the tidal action of the Barito river, being the so-called indirect tidal area.

This area is shallow in the depth of flooding water, even in the rainy season. The depth is presumed to be about 50 cm above paddy field surface. If drainage canals with sufficient flow capacity are constructed, the depth of flooding water can be reduced further.

5) Area E Gross area: Approx. 13,000 ha.(1)

Located along the Maluka river, at elevations of less than +3.0 m. Generally, lowland, and mostly alluvial soil. However, sulfate soil is distributed partially, being very dangerous for crops in the dry state. Therefore, for development, drainage plan must be made carefully.

6) Area F Gross area: Approx. 5,000 ha.(1)

Upland between Banjarbaru and Cempaka district, at elevations of +1.0 m to +25.0 m.

Soil comprises regosol, lateritic soil and podzolic soil, with high contents of sand and gravel, and is low in fertility.

However, the soil has favorable drainage and allows dry field farming and fruit culture. In the development project, arable land should be determined, with soil properly selected.

4–3 *Stages of Development Project*

If the river water discharged from the Riam Kanan dam is raised by a weir as high as physically and economically possible for intake at a proper point of the Riam Kanan river, gravity irrigation is possible in four areas out of the above six areas, viz., Areas A, B, C and D.

These four areas are relatively favorable in soil conditions and topographic conditions, and considerable portions have been developed as paddy fields. Therefore, the introduction of irrigation and discharge system is expected to take early effects.

The remaining two areas of E and F can also be developed. However, as Area E at low elevations is far from the intake point and Area F close to the intake point is at high elevations, pumping irrigation is required. Area E is partially unfavorable in soil conditions, and sufficient care must be taken about the drainage when planning the development project.

For Area F, crops suitable for soil conditions must be selected.

In view of the above, the four areas A, B, C and D covering about 21,000 ha (net) have been designated as the areas for the first stage development. The remaining two areas must be examined more carefully from the viewpoint of the economic nature of the future development stages of this project.

Note (1): As for Areas E and F, net project areas will be determined separately, according to soil conditions and irrigation system.

4–4 Plan of Irrigation and Drainage

Farming conducted in the project area is based on the natural farming method which is primitive and produces only one crop a year in the dry season. Naturally, the yield is low, and the living of the farmers cannot be improved. In order that the farmers who are accustomed to such a situation may employ the method of producing two crops in a year in their farming. To increase and stabilize quickly the agricultural production, it would be advisable to begin with the introduction of facilities of simple control and operation. The construction cost and the maintenance and operation cost must be as low as possible, as a matter of course. In this sense, an irrigation and drainage is studied first of all for the four areas where gravity irrigation is possible.

4–4–1 Irrigable Area

The irrigable area is about 21,000 ha. as shown below.

Name of area	Area (in net ha.)
Area A	2,500
Area B	6–7,000
Area C	3,000
Area D	9–10,000
Total	21,000 ha.

4–4–2 Required Discharge for Irrigation

Water requirement estimated is 7–9 mm/day including 6–7 mm/day of evapo-transpiration and 1–2 mm/day of vertical infiltration. By adding the quantity of water required to remove the water containing humic acid coming from the tropical organic soil peculiar to the project area, the estimated total farm irrigation requirement is about 9–11 mm/day. Furthermore, if the loss incurred between the intake point and the farms is calculated, the irrigation requirement will be about 13 mm/day at the maximum. The quantity of 13 mm/day corresponds to 1.5 ltr/sec/ha, and therefore, the water requirement of the four areas comprising 21,000 ha. is about 32 m^3/sec. However, since the project area is featured by low and flat topography, the water can be partially returned for repetitive use. Assuming that the rate of repetitive use is 20%, approx. 6 m^3/sec of return flow can be used repeatedly. Therefore, the actual quantity of intake from the river is 26 m^3/sec.

4–4–3 Available Discharge at Intake Site

As mentioned before, the irrigation water is discharged through the turbines of the Riam Kanan Hydroelectric Power Station. Therefore, the quantity of water available is influenced by the power demand.

Discharges according to the variation in the generated energy in a day were approx. 24 m^3/sec max., approx. 13 m^3 min., and approx. 16 m^3/sec average, at the beginning of 1977. This variation pattern is almost constant throughout the year, and the average has been rising year after year. The peak generated energy at the above time was about 10 MW and the design output will reach the level of 30 MW in or about 1983. Therefore, it is expected that the average discharge will be about 3 times or more of the present, and 50 m^3/sec at the lowest.(1)

Note (1): At present, since the reservoir is almost full, with small generated energy, the head is high. Therefore, the water quantity can be small.

According to the design schedule of the Riam Kanan Dam, the average discharge is 44 m^3/sec. The expected average discharge of more than 50 m^3/sec means that the total demand for power will grow faster than planned at first. Therefore, the future power demand, water for agricultural use in the dry season, water for the maintenance of the Martapura river, etc. should be taken into due consideration in the calculation of water balance of the reservoir in the phase of the multiple purpose utilization of water, and thereby study the quantity of water which can be used for agriculture. Judging from the data obtained, it will be possible to secure 40 m^3/sec at least.

4–4–4 Intake Site and Trunk Irrigation Canal

As for the site for headwork, Sungai Asam point on the Riam Kanan river is considered as the most suitable site, based on the topographic map and the results of the field survey. This point is about 12 km downstream from the Riam Kanan dam on a curved portion of the river, and with the curved portion as short cut, a weir and intake works will be constructed. The present river will be used as a spillway. The design firm water surface level of tailrace of Riam Kanan dam is at an elevation of +14.10 m, and the design high water level is at an elevation of +18.90 m. Considering the elevation at the headwork point, and the water surface level of the dam tailrace, the proper crest elevation of the weir is considered to be about +13.0.(1) The crest elevation of the dam allows flood water to flow down even at the time of flood, without losing the generation capacity. If the crest elevation of the weir is +13.0 m, a reservoir with water area of about 6 km^2 is formed above the point, to serve as a re-regulating reservoir, to supply stable discharge for agriculture and river maintenance.

The trunk irrigation canal departs from the intake point, passing between Martapura and Banjarbaru, along Ulin highway at about 2 to 3 km on the northern side of Ulin highway, to reach Gambut. The total length is about 45 m. The water level of the canal at Gambut must be at an elevation of +5.00, and the bed slope of the canal will be about 1/8,000 to 1/5,000. Since the head is small compared with the canal length, the canal will have to be designed to keep the loss as small as possible.

4–4–5 Plan of Drainage

Since the project area is low and flat swamp, there is much area where drainage is more important than irrigation. The purposes of drainage can be classified into the following two major categories.

a) Especially in the case of Area B, there are swampy forests inundated not only in the rainy season but also in the dry season. Furthermore, the soil in such swampy forests is organic, and water flowing out from there is exerting bad influence on paddy fields along the Martapura river. Therefore, the improvement of drainage in this area facilitates the development of swampy forests, and makes possible the removal of the injurious water.

b) Particularly in the case of Area D, the area is mostly field with water about 50 cm above the paddy field surface in the rainy season. This is due to the insufficient flow capability of the canals in the area, and the depth of flooding water in the rainy season can be decreased by providing a proper drainage canal network. This is an indispensable condition for introducing farming based on producing two crops of rice a year.

From the above two viewpoints, several trunk drainage canals will be constructed according to the topographic features. However, drainage must be planned, paying attention to the elevation of the Barito river and the Martapura river, because both are the tidal rivers affected by the tides of the Java sea, and because the project area is a low, flat land. Furthermore, in the light of the repeated use of the return water of the irrigation water, the system to be employed for the drainage gates must be studied carefully.

Note (1): Topographic maps on a scale of 1 to 50,000 of the Barito river basin was referred to.

4–5 Comments of Survey Mission

What should be done before the feasibility study expected to be carried in the future, or points particularly necessary for the feasibility study are suggested below within the extent of the survey carried out this time.

4–5–1 Soil

- As the semi detailed soil maps drawn to a scale of 1 to 50,000 by the Soil Institute in Bogor on Areas C and D are still not complete, these should be completed.
- The distribution of organic soil and the thicknesses of peat layer in swampy regions should be surveyed.
- The distribution of sulfate cat-clay and mud-clay and their depths should be surveyed.
- The accumulation of salt in indirect tidal area and its influence on crops should be examined.

4–5–2 Hydrology

- Hydrological and meteorological data held by the Meteorological Agency and other organs concerned should be collected and arranged.
- For the drainage planning, hydrological data on rivers is considered to be still insufficient. New river stage gauging stations equipped with stage recorders as far as possible should be installed at 3 places, viz. the middle reaches of the Martapura river, and the middle reaches close to Bati-bati and the river-mouth of the Maluka river.
- The correlation between existing water-stage data and water quantity is not clarified. Therefore, the discharge rating curve should be prepared as soon as possible. Furthermore, the relation between the control points of existing water-gauges and the mean sea level should be clarified.
- For the eater taken for city water at the lower reaches of the Martapura river, river maintenance water to prevent the influence of salt should be examined, and the actual situation of sea water ascending the Martapura river and its extent should be examined. For the indirect tidal area, similar examination should be made for the drainage planning.

4–5–3 Agriculture

- The flooding in the rainy season and the dry season should be clarified, and the most suitable varieties of rice should be selected according to the water level after the completion of the Project.
- The establishment of a test farm should be discussed, in order to examine crops and varieties and farming techniques, for introducing farming producing two crops a year.
- The influence of injurious water flowing out of the peat zone on crops should be examined.

4–5–4 Irrigation and Drainage

- A detailed map drawn to a scale of 1 to 5,000 to cover the entire project area (net 21,000 ha) with min. 50 cm contour lines should be prepared.
- To obtain the actual water consumption, data collection and actual measurement in farms should be conducted.

4–5–5 Irrigation Structure

– Since the trunk irrigation canal is very long in total distance compared with the difference in head, the canal planning should be made to avoid head-loss as far as possible.

No.	Field Assignment	1978								Man-months M/M		
		May	June	July	August	September	October	November	December	Field	Home	Total
1.	Leader									3.8	3.4	7.2
2.	Irrigation and Drainage									3.8	3.4	7.2
3.	Irrigation									3.0	3.8	6.8
4.	Drainage									3.0	3.8	6.8
5.	Land Reclamation									2.0	2.0	4.0
6.	Hydrology									2.7	3.0	5.7
7.	Soil									2.7	3.5	6.2
8.	Soil									2.7	1.0	3.7
9.	Geology									2.0	2.0	4.0
10.	Agronomy									2.7	3.5	6.2
11.	Agro Economy									3.0	3.8	6.8
12.	Building									—	1.5	1.5
13.	Construction Planning									—	1.0	1.0
14.	Electric Machines									—	1.0	1.0
	Total									31.4	36.7	68.1

5. SCOPE OF WORKS FOR FEASIBILITY STUDY

The necessary investigations and items of study for the feasibility study to be carried out hereafter with respect to the Riam Kanan Irrigation Project area (in 21,000 ha net) chosen in this preliminary survey as the first stage development project area are as shown below.

5–1 Economic and Agricultural Background

(1) General and Agricultural Economy (South Kalimantan Province)

a) Basic statistics

- Economic statistics
- Population and population in area
- Labor force
- Government revenue
- Consumer price index etc.

b) Trade balance (International and domestic)

- Main export commodities & Amount
- Main import commodities & Amount
- Export and import balance

c) Characteristics of present agriculture

- Cultivated land
- Irrigated land
- Forest land
- Farm size
- Harvested area in each crop
- Agricultural production
- O & M cost in irrigation system

d) Land tenure

- Land tenure system
- Land reform
- Size of holding

e) Communications

(2) *Agricultural support services*

a) Agricultural research, organization and activities

b) Extension services

- Organization
- Extension program and activities

c) *Agricultural credit system*

d) Farmers' organization

(3) Agricultural policies and plan

a) Existing developed area

b) Development plan

- Target of development
- Investment

5–2 Survey and study on the Project area

(1) Natural Resources and Environment

a) Location and topography

- Topographic map in scale 1/5000
- Topographic maps in major structure sites (1/200 – 1/500)

b) Meteorology

- Collection and compilation of climatic data
- Additional observation if necessary

c) Hydrology

- Water level of river Barito, Martapura and Maluka
- Run-off
- Salinity intrusion

d) Geology and soil

- Geological conditions and soil phisical conditions
- Construction materials (Gravel, sand and embankment materials)

e) Soils and land use

- Soil fertility
- Land use

(2) Community and economic environment in and around the Project area

a) Population, Labor force

b) Agriculture

- Land use
- Farming practices
- Production cost
- Labour force
- Yield and production
- Farm income
- Land tenure situation

c) Agricultural support services

- Extension and its activities
- Research and its activities
- Credit and its activities
- Farmers' organization

- Distribution system of agricultural products

d) Market and prices

- Marketing (international and domestic) and prices
- Transportation system and cost

5–3 The Project

(1) Project concept

a) Purpose and identification

b) Project boundary

(2) Agricultural Development

a) General concept

b) Cropping pattern and yields

c) Production cost

d) Farm labor requirement

e) Project output

(3) Irrigation and Drainage Plan

a) Water requirement

- Consumptive use by crops
- Available rainfall
- Farm irrigation requirement
- Irrigation efficiency and utilization of return flow
- Diversion irrigation requirement

b) Drainage requirement

- Inundation area and depth
- Drainage requirement

c) Proposed project works

- Irrigation system
- Drainage system
- Road system
- Other major facilities
- Related structures

(4) Reclamation and settlement of immigrants

- Reclamation
- Transmigrant programme

(5) Agricultural output and income

a) Gross value of agricultural output

b) Net value of agricultural output

c) Production increase between "with project" and "without project"

d) Individual farm income

(6) Project Implementation Schedule

a) Construction plan and time schedule

b) Construction plan and time schedule

c) Operation and management of construction works

(7) Cost estimates

a) Capital cost estimates

b) Engineering and general expenses

c) Contingency and reserves

d) Annual disbursement cost estimates

5–4 Organization and Management

a) General aspects

b) O & M of facilities

c) Extension services program

d) Research program

e) Supply of inputs and marketing

f) Credit system

g) Project authority or farmers' organization

h) Training program

5–5 Economic Evaluation

6. APPENDIX

6–1.

SCOPE OF WORKS (DRAFT) FOR PRE-FEASIBILITY STUDY ON RIAM KANAN IRRIGATION PROJECT (SUMMARY OF CONTENTS)

1. PREFACE

The Riam Kanan Irrigation Project covers the area of about 30,000 ha which extends from 10 km to 30 km on South-East side of Banjarmasin.

The project utilizes the water resources which are discharged by the Riam Kanan Dam and the Power Station, which has already completed. Consequently, the main structures consisting of diversion works and canals are constructed. In addition, farm land consolidation and expansion of road network are carried out.

The possibility of the development of the project, which were pointed out in the report made by the survey team of the Barito River Basin in 1971, was concluded to be very high, and generation of electric power has already started.

Accordingly, the opportunity which should establish the plan to surely implement the project has already come.

2. PURPOSE OF SURVEY

Before the feasibility study, the apportionment of 30,000 ha to irrigable places, the decision as to whether each irrigable place can be watered by gravity irrigation or not, and the order of implementation of their construction should be decided in order to obtain good results of the project.

The main purpose of the survey is to make the fundamental plan for the feasibility study by means of gathering data on the project which have never been collected in the past survey and carrying out the field survey in order to facilitate and to efficiently carry out the coming feasibility study.
In addition, the selection of the irrigable area, the apportionment of 30,000 ha to irrigable places, and the order of implementation of their construction, which are referred to by the feasibility study team, are decided.

The topographical maps of the project of 1/50,000 and 1/5,000 have already been made, and the decision as to whether the feasibility study will be possible or not by means of the maps is made. The field survey on topographic condition, soil condition, agricultural condition and the condition of farmers, which are the fundamental elements in selecting the area of 30,000 ha and in deciding the priority of the area, will be carried out, if possible.

3. POLICY OF SURVEY

The survey team visits the authorities concerned as many as possible in order to satisfy the purpose of the survey, and supplements data which are insufficient in the existing reports. The survey team also grasps the fundamental matters for the feasibility study on the change in the situation between the last survey and the present survey, the advisability of the proposed weir site and canal location, topographical condition, technical problems, agricultural and social

background.

Accordingly, the survey team studys intensively the matters required for analysis in the survey, and reports as far as possible. As for the data which are dealt with in the feasibility study, the survey team collects only data and raises several points in question.

The team is planning on the survey and data collection as stated below:

1. Hydro-meteorological data
2. Power Station data
3. Water requirement of a paddy field
4. Basic idea on the design of structures for irrigation and drainage such as diversion weir, canals and so on.
5. Check of control point for water level observatory, tide level observatory, and bench mark.
6. Data on present and future demand of electric power in South Kalimantan.
7. Data on existing infrastructures in the project and planned non-irrigation development project in ordered area.
8. Agricultural technies, variety of paddy, and movement of extension.
9. Condition of rice production, and improvement and extension of rice in South Kalimantan.
10. Situation of Agricultural production and its distribution.
11. Present farmers organization.
12. Soil survey.
13. Situation of transmigration and transmigration plan in the area and its vicinity.
14. Present and future agricultural mechanization.

4. IDENTIFICATION

(1) Decision of the project area and apportionment of the area.

(2) Decision of water possible for irrigation use after operation of power station.

(3) Irrigation system of each zone and the order of implementation of the plan.

(4) Cropping pattern and increasing product of each zone.

(5) Advisability of necessity for drainage.

5. ITEMS TREATED IN ADDITIONAL SURVEY

(1) Making up the map of 1/10,000

(2) Arrangement of gauging station system

(3) Geological survey of the weir site

However, items may be added according to the present survey.

6. SURVEY REPORT

The survey team submits the interim report (draft) on the present survey before leaving for Japan, and makes efforts to send the final report (draft) to Indonesian Government in September.

6–2.

REPUBLIC OF INDONESIA
MINISTRY OF PUBLIC WORKS AND ELECTRIC POWER
DIRECTORATE GENERAL OF WATER RESOURCES DEVELOPMENT

INTERIM REPORT
OF
PRELIMINARY SURVEY
ON
RIAM KANAN IRRIGATION PROJECT

August 1977

JAPAN INTERNATIONAL COOPERATION AGENCY

August 11, 1977

Ir. SUYONO SOSRODARSONO
Director General of
Water Resources Development
Ministry of Public Works and
Electric Power
Jl, Pattimura No. 20,
Kebayoran Baru
Jakarta, INDONESIA

Dear Sir,

Subject : Submittal of Interim Report on Preliminary Survey of Riam Kanan Irrigation Project

It is our great pleasure to submit herewith an Interim Report on Preliminary Survey of Riam Kanan Irrigation Project.

The survey has been carried out sufficiently in Jakarta and South Kalimantan Province. We are grateful to your kind arrangement and cooperation of your staff and authorities concerned.

As a result of this survey, we believed that Feasibility Study for this Project should be commenced as soon as possible.
Your kind consideration for this Project will be highly appreciated.

Yours very truly,

Kiyoshi Takeda
Team Leader of
Preliminary Survey Team on
Riam Kanan Irrigation Project

CONTENTS

I. Preface

The Riam Kanan Irrigation Project area is located at about 10 to 30 kilometers southeast of Banjarmasin, the capital of the South Kalimantan Province.

The Project, which covers an area of about 30,000 ha, shall utilizes the water resources discharged by the Riam Kanan Dam. The main structures consisting of diversion weir and canals are constructed. In addition, farm land reclamation and expansion of road network are carried out.

In the report on "The Barito River Basin Development" in 1971, it was recommended to conduct further investigations in Feasibility Study due to the high possibility of development of the Riam Kanan Irrigation Project.

Commercial operation of Riam Kanan power station was commenced with 2 units of power plant from 1973. It is planned to install the third power unit as a final stage of power generation.

This dam, however, was constructed originally as a multipurpose project of the hydropower, irrigation and other water supply. For the next stage, it is considered that the regional development project by irrigation should be realized as soon as possible.

II. Purpose of Survey

In 1971, Riam Kanan Irrigation Project was planned in the report on "The Barito River Basin Development". In this plan was, however, thought out under the less available data and informations. Since then, several investigations have been conducted by the effort of Indonesian Government and cooperation of OTCA.

The main purpose in this preliminary survey is to make the basic plan and guideline for the coming Feasibility Study.

In accordance with this purpose, following surveys and studies were carried out.

(1) Collecting and checking available data and informations

(2) Field survey on the conditions of topography, soil, agriculture, irrigation and drainage

(3) Selecting of irrigable area

(4) Special items to be investigated in coming Feasibility Study.

III. Basic Consideration

1. General

Based on the operation plan of the Riam Kanan and past records of power generation, it is estimated that available discharge for the Project is around 40 m^3/sec on an average. Under the full power generating of 3 unit power plants in future, however, it is considered that available discharge for this Project will be less than above estimated value, especially in drought year.

The fluctuation of discharge due to the daily variation of power demand is regulated through the reservoir which is created by the intake weir. Intake weir will be constructed at about 12 km downstream of the Riam Kanan Dam. The crest elevation of weir is proposed to be around 13 m. The main irrigation canal will pass the northern part of

Banjarbaru and Ulin airport, and reach Gambut. Its length will amount to around 40 km. It is estimated that gradient of canal will be 1/8000 to 1/5000.

Based on the topographic and soil maps, the project area is generally low, flat and swampy. Irrigable area covered by gravity irrigation system will be around 30,000 ha in gross. Net irrigable area will amount to around 20,000 ha consisting of existing cultivation area and reclaimable area.

A part of the secondary and tertiary canals will be dual-purpose in the part of lowland, 1/3 to 1/4 of the total irrigable area.

For the gravity irrigation area, it is estimated that diversion requirement will be about 26 m^3/sec considering of repeated utilization of return flow. Accordingly, the remaining discharge, 14 m^3/sec, will be supplied to other irrigable area. But these area are so high and far from the intake weir that it is impossible to supply the water by gravity irrigation system.

Carefull attention should be paid to the drainage system as well as irrigation system. In order to establish a complete drainage system in this area, it is required to train Martapura and Maluka river.

Available discharge for agriculture in the Martapura river should be decided taking into consideration the other water supply in the dry season.
About 26 m^3/sec above mentioned will be utilized without any difficulty. In future, particularly it will be necessary to set up an overall development planning of the basin including the Riam Kiwa river.

2. Project Area

The Project area is divided into 6 areas as follows and shown in Fig. 1.

a. Area A : Eastern part of Martapura city

b. Area B : Area between Martapura river and Ulin Highway.
Forest area which is inundated whole year will be excluded from the project area. The main purposes of the project are improvement of the drainage in the swampy area covered with organic soil, and water supply to the highland.

c. Area C : Eastern part of Banjarmasin city.
This area is covered with existing paddy field.
The main purpose of the project are drainage in rainy season and water supply in dry season.

d. Area D : Gambut area and Southern part of Banjarmasin.
This area is also covered with existing paddy fields.
The main purpose of the project are drainage in rainy season and water supply in dry season.
In the southern and western coastal part of this area, proper drainage system should be established considering the tidal fluctuation of the Barito river.

e. Area E : The area along Maluka river.
This area is out of the gravity irrigation area.
For development of this area drainage works should be carried out considering soil condition.

f. Area F : Up-land area between Banjarbaru and Cempaka region. Pump irrigation system will be applied to the selected places based on the soil condition.

3. Effects of Project

Following effects will be expected under the optimum irrigation and drainage system in this Project.

a) In the existing single-crop area, it makes possible to introduce double-crop farming by the stable water supply in the dry season and drainage in the rainy season.

b) In the relatively high land of the uncultivated area, irrigation and drainage make possible to introduce double-crop farming. In a part of high land, cultivation of up-land crops in the dry season will be expected.

c) In the relatively low land and swampy area, development of new paddy land will be expected by supply of fresh water.

d) In the up-land area, stable up-land crops cultivations throughout the year will be expected by the irrigation facilities.

4. Implementation Programme

Areas A, B, C and D are the first group of the Project implementation. For the Areas E and F as the future stage, it will be required to study the problems regarding to soil, hydrology and agriculture. In the low-lying wet land of the Areas A and B, the farmers' settlement in reclaimable area will be expected by the improvement of drainage. And paddy cultivation in the rainy season will be expected to stabilize by the establishment of drainage system in the whole project area.

The construction of intake weir and main irrigation canal should be commenced at the initial stage of the Project due to the long term construction period. Drainage system should be completed as soon as possible because drainage is a basic factor for the reclamation. And this will make it easy to conduct the Project construction. But it is necessary to check the over-drain in the dry season without irrigation.
In the swamp of Area B, construction of irrigation system should be commenced after the completion of the drainage and reclamation works.
The road network should be constructed with canal works. Construction schedule is shown in Fig.–2.

It is necessary to establish agricultural extension service system including demonstration far farm for farmers in the project operation. And it is desirable to set up farmers' organization in early stage in order to expedite the function of operation and maintenance and distribution system of agricultural products.

IV. Investigations and Comments

1. Soil

In the upland area, the kind of soil are Regosol, Lateritic soil, Podzolic soil, and Pdzol. In these soils, the content of sand and gravel is high and the fertility is extremely low. However, it is considered that these soils have potentiality for upland farming or fruit culture because the drainage condition is favorable. It will be necessary to study about the suitable crops and manuring practice in future.

In the swamp area, Organic soil distributes widely. As most of this area is in confirmed poor drainage condition and the soil is completely reduced chemically, peat layer is formed. The reclamation work has not been implemented so far. For the reclamation of this area, the drainage is essential and the supply of good quality water is necessary. When stagnat water is drained out the soil with heavy peat layer may be oxidized rapidly to cause sinking of ground. Therefore, it is necessary to grasp accurately distribution of Organic soil and the depth of peat layer for the planning of the drainage canal.

In the lowland area, Alluvial soil mainly distributes. Most of this area has favorable conditions as farm-land, and reclamation has been developed to some extent. In the area near the coast, it will be necessary to study about the accumulation of salts and the influence on the cultivation.

Acid sulphate clay may distribute partially at least. As it is dangerous to dry the soil containing such a clay because of the strong acidic (pH 2 – 3) reaction, the drainage plan should be made circumspectly. Especially, it is important to investigate the distribution of acid sulphate clay.

2. Hydrology

2–1 Available Irrigation Water

The peak output of the Riam Kanan Power Station is about 12MW at present. The power demand is increasing gradually in this region and the peak output will be expected to reach 30MW of full capacity in near future.

Average discharge through the turbines is about 18 m^3/sec at present. Under the full capacity operation, it is estimated that the delivery discharge will be 87 m^3/sec in max., 40 m^3/sec in min. and about 56 m^3/sec on an average, respectively.

Considering the natural conditions of the Riam Kanan river before Dam construction, it is recommended to supply at least 5 m^3/sec of discharge for the Martapura river in dry season. Therefore, maximum available discharge for agriculture is estimated about 50 m^3/sec. After the completion of dam, severe drought beyond the design value has been experienced. It is advisable to re-check the water balance based on the harmonious utilization plan of dam for hydro power generating and agricultural development.

2–2 Hydro-meteorological observation and data

For the planning of this irrigation project, it is necessary to compile the existing hydrometeorological data and to install further observation stations as mentioned below.

(1) Available data are insufficient in the direct tidal area, southern part of Banjarmasin and along the Maluka river.

(2) It is necessary to collect and compile the long range meteorological data observed at several points.

(3) It is necessary to observe the rainfall, not only daily but hourly by the automatic rainfall gauge. As location of these stations, Riam Kanan Dam site, Banjarbaru and Ulin airport are recommended.

(4) Since the field data on evapo-transpiration are very important to estimate water requirement, it is necessary to carry out field observation in the Project area.

(5) As for the hydrological observation on the Martapura river and Maluka river, it is necessary to observe the water level at the several points by automatic gauge in order to analyze the relation between tidal fluctuation and water level of the river.

2–3 Inundation

It is necessary to clarify the condition of inundation in the dry and rainy seasons on the topographic maps for the planning of irrigation and drainage.

2–4 Salinity intrusion

Droughty-discharge of the Martapura river has been improved after the completion of dam. It will be necessary to study the problem of salinity intrusion from the Barito river for multiple utilization of Martapura river in future.

3. Agriculture

3–1 General

In project area, almost all the existing arable land is paddy field, and a few scattered upland field can be seen in some part of project area. In these upland fields, corn, cassava and other crops are being cultivated.

Due to the water level on paddy field at the end of rainy season and other reasons, different cultivation system and varieties are applied, and in general, planting season of paddy is from March to June, and harvesting season is around August to November, the most popular variety is "Lima", and over ten other varieties are introduced in this area. Cultivation practice of paddy seems to be extremely simple, namely, ploughing, fertilizer application and chemical spray for pest and disease control are not practiced. And farmers raising cattle or other big livestocks for cultivation can not be seen in the area.

In spite of above said simple cultivation method, the yield of paddy is remarkably high, and average paddy yield is considered to be 3 – 3.5 ton/ha on dry paddy.

3–2 Effects of the Project

After completion of the project, this project is expected to show the following effects on agriculture in the project area.

(1) To stabilize and increase in production of rainfed paddy by irrigation system.

(2) Paddy variety can freely be selected, namely, applied short-growing period varieties and high yield varieties by means of reducing the water level on paddy field rapidly at the end of rainy season through drainage system.

(3) To create the chance to introduce double cropping method of paddy in whole area where the water level on paddy field is comparatively low in the rainy season at present.

(4) To expedite the development of new paddy land and upland field by washing out of toxic water from peat area and drainage out the stagnant water in low area. And, a number of immigrants will be settled in these newly developed land areas.

3–3 Comment for F/S Team

1. The water level on field, and duration of inundation should be presumed accurately as far as possible and most suitable crop varieties should be recommended according to the water conditions.
2. In order to establish the condition and policy for introduction of double cropping system of paddy, the investigation and planning for development of suitable double cropping varieties, cultivation practice and extension system including demonstration farm should be conducted.
3. The influence of toxic water from peat for crops should be studied for agronomical point of view.

4. Irrigation

4–1 General

Available discharge from the Riam Kanan Dam is expected to be about 40 to 50 m^3/sec. Considering the present farming conditions in this region, simple and economical facilities will be preferable for this irrigation system. As more than half of the Project area is low-lying and wet land, irrigation system should be established in connection with the effects of drainage system.

4–2 Gravity Irrigation Area

Based on the topographic condition, soil condition and intake water level, the project area covered by gravity irrigation system will be about 21,000 ha in net as shown below.

Area	Irrigable Area in Net (ha)
Area A	2,500
Area B	6 – 7,000
Area C	3,000
Area D	9 – 10,000
Total	21,000 ha

4–3 Diversion Requirement

Diversion Requirement is assumed 1.5 L/sec/ha considering the meteorological condition, soil condition and average value obtained from the other project in this country. It is expected that return flow at the rate of 20% of diversion requirement will be used in low-lying wet area. Accordingly, though the total diversion requirement amounts to 32 m^3/sec, actual discharge from the intake weir is 26 m^3/sec.

4–4 Future Stage

The rest of discharge, about 15 m^3/sec, will be able to be conveyed to another arable land. This arable land is divided into following two areas.

Area E: Area along the Maluka river
Area F: Upland area between Banjarbaru and Campaka

Due to far distance from intake weir and high elevated land, pumping irrigation will be required in Area E and F. As the future stage of the Project, implementation of these two areas should be decided after the careful study from the economical point of view.

5. Drainage

It is indispensable to establish the drainage system in order to achieve the stable crop production and double crops farming.

In this survey, following matters are found.

a) A part of project area, especially the area between Ulin and Martapura river, is inundated even in the dry season. This is caused from the low land topographicaly and lack of drainage canals. As mentioned in "Soil" section, the organic soil exists in the forest area by the poor drainage. The toxic water from this soil makes harm to the existing paddy field along the Martapura river.
Accordingly, the establishment of the drainage system will make easy in reclaiming the forest area and to eliminate of the harm by toxic water.

b) In the indirect tidal area of the southern part of Banjarmasin, almost all area are inundated in 50 cm water depth in the rainy season. This is caused from the poor water capacity of the existing drainage canals.
After completion of proper drainage works, the water depth of inundation will be decreased up to around 30 cm on the paddy field. This is the essential conditions to introduce the double crops farming.
In this survey, we recognized that several kinds of data are available. It was, however, impossible to analyze the relation among the topographic conditions, water level of rivers and tidal fluctuation.
Consequently, in the next Feasibility Study, it should be required to study in accordance with the existing data, as mentioned below.

   a) Analysis of the topographic condition of the Project area by the precise maps.

   b) Analysis of relation between tidal fluctuation and water level of the river.

   c) Analysis of the drainage capacity of the Martapura River and existing water way.

6. Intake Weir

The intake weir will be constructed at the Sungai Asam according to the existing data and field investigation. This site is located about 12 Km downstream from the Riam Kanan Dam, and the weir will be constructed on the short cut water way at the curve of the Riam Kanan river.
The spillway will be constructed on the original water way. Crest elevation of the weir and spillway will be around 13.0 meter taking the topographic condition of the project area into account. By the intake weir, the reservoir which has around 6 km^2 of water

surface area will be created. This reservoir will have the function of the regulating pond. It is expected to supply the stable discharge for the irrigation area and Martapura river, and to regulate the flood from the Dam.

Water level of this reservoir has no influence on the power generation of Riam Kanan Dam even during the flood.

Considerations of the alternative weir site are as follows:

a) On the downstream of the Sungai Asam, elevation of the both banks of the river is low. High construction cost of the weir will be required.

b) On the upstream of the Sungai Asam, the storage capacity decrease in the same condition of crest elevation and high construction cost of main canal will be required.

Accordingly, in the Feasibility Study the alternative studies should be carried out to establish the optimum intake system taking the physical conditions, social aspects and economical aspect into account.

V. Recommendation

For the coming Feasibility Study, following items shall be performed.

a) Completion of soil maps

b) Compilation of meteorological data

c) Installation of water level gauge at Sungai Tabuk, Liang Angan and estuary of Maluka river.

d) Field observation of evapotranspiration

e) Confirmation of relation among topographic control point, tidal fluctuation and water level of river.

f) Mapping on a scale of 1/5,000 to 1/10,000 with contour interval of 50 cm at least.

CONSTRUCTION SCHEDULE