REPUBLIC OF INDONESIA

SURVEY FOR DEVELOPMENT OF BARITO RIVER BASIN KALIMANTAN

Data Collections & Survey Programmes

Appendix: Riam Kanan Irrigation Project
— Pre-feasibility Report

prepared for

OVERSEAS TECHNICAL COOPERATION AGENCY

GOVERNMENT OF JAPAN

by

JAPANESE SURVEY TEAM FOR DEVELOPMENT

OF THE BARITO RIVER BASIN

March 1971

PREFACE

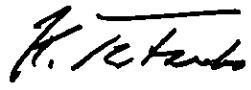
In compliance with the request of the Republic of Indonesia, the Government of Japan agreed to undertake the survey for development of the Barito river basin, Kalimantan, and entrusted the Overseas Technical Cooperation Agency with its execution.

The Agency organized a survey team comprising 15 experts headed by Mr. Kazuo Hosoda, Councilor, Engineer General, Water Resources Development Public Corporation, and dispatched it to Indonesia for a period of two months from September to November 1970. During the said survey period, the team conducted field investigations and basic data collection with Bandjarmasin as the main base of its activities, and further held discussions with the competent government offices of Indonesia.

Upon completion of the draft report prepared after the team's return to Japan, Mr. Hosoda and three other members of the team visited Djakarta again in March 1971 for a two-week stay during which explanations were given to and opinions were exchanged with the competent officials of the Directorate General of Water Resources Development, Ministry of Public Works and Power, with respect to the draft report and future development of the Barito river basin.

The present report contains, as suggested by its sub-title, the data collection and survey programmes drawn up on the basis of the team's survey activities which are proposed to be implemented for mapping out the master plan for the Barito river basin development. The report also embodies, in its appendix, the pre-feasibility report on the Riam Kanan Irrigation Project.

On behalf of all the team members, I wish to take this oppurtunity to express my heartfelt gratitude to the Central Government of Indonesia, Provincial Government of Central and South Kalimantan, and the staff of the Japanese Embassy in Djakarta for the valuable cooperation and assistance extended to the team throughout the survey period.



Keiichi Tatsuke
Director General

Overseas Technical Cooperation Agency
Tokyo, Japan

March 1971

LETTER OF TRANSMITTAL

Mr. Keiichi Tatsuke
Director General
Overseas Technical Cooperation Agency
Tokyo, Japan

Dear Sir,

Transmitted herewith is a report (Data collection and survey programmes) on the survey for the development of the Barito river basin, Kalimantan, Republic of Indonesia, conducted from the beginning of September to late November 1970 in compliance with your request.

This report defines survey programmes for obtaining basic data required for working out a master plan of the Barito river basin development, and at the same time, it gives an analysis of the present state and the future of the basin and briefly touches on the feasibility of resources development.

Southern part of Kalimantan is given a high priority by the Government of Indonesia together with the Southern Sulawesi in developing the eastern region of the country, and in fact efforts are being made to promote the immigration to this area from the nearby densely populated districts such as Eastern Java, Madura and Bali.

The Barito river basin is a vast plain extending in both South and Central Kalimantan Provinces and covering an area of about 60,000 km^2, and despite of years of efforts of the Government and people of Indonesia, the majority of the basin still remains undeveloped. For this reason, the development of the basin is expected to have a potential influence on the future growth of the Republic of Indonesia.

As the report covers all the facts in various fields, I firmly believe that it will greatly contribute to the planning of the Barito basin development.

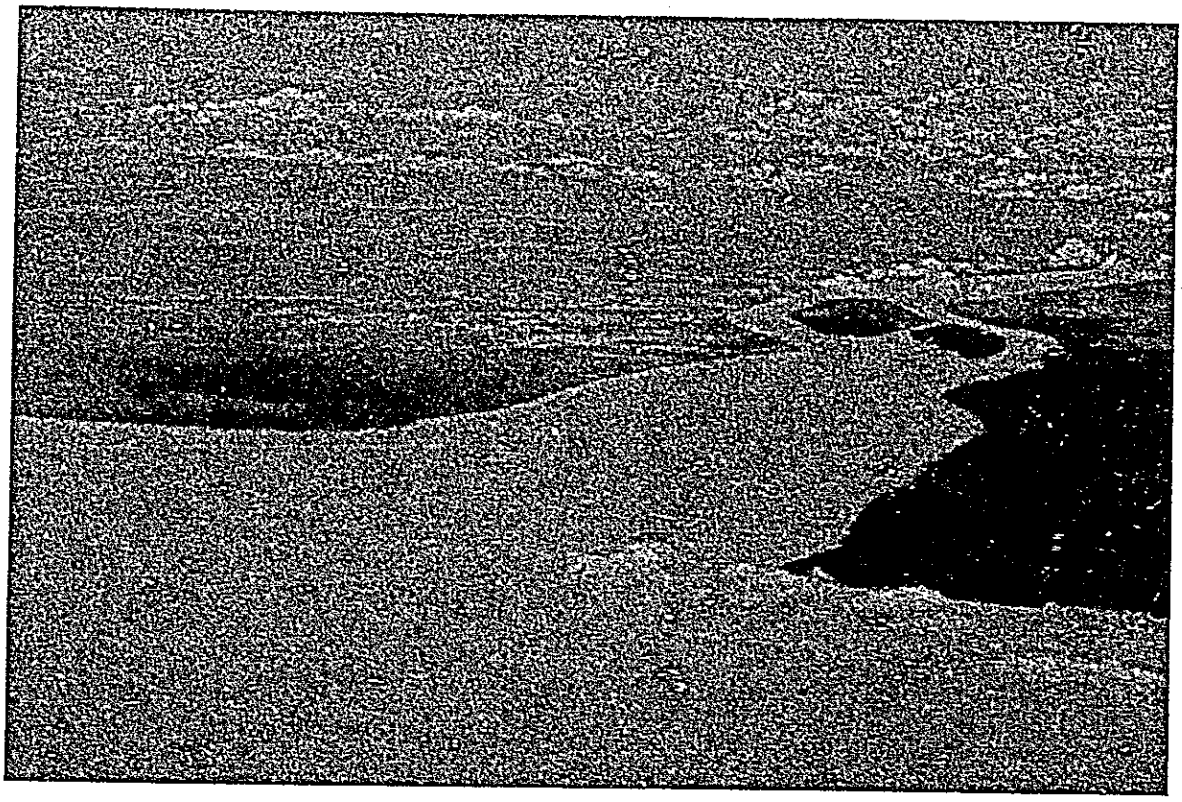
Finally, I wish to take this opportunity to express my appreaciation and gratitude to officials of various agencies of the Government of the Republic of Indonesia, particularly those of the Directorate General of Water Resources Development, Ministry of the Public Works and Power, and officials of the Provincial Governments of Central Kalimantan and South Kalimantan and also to the staffs of the Japanese Embassy in Indonesia for their wholehearted cooperation and support in the course of field survey and the preparation of the report. My appreciation also goes to Mr. K. Baba (BAPPENAS, Djakarta) and Mr. S. Tanimoto (Institute of Hydraulic Engineering, Bandung), the CP experts stationed in Indonesia who provided the team with valuable advices.

It is my sincere hope that the survey for development of the Barito river basin will be carried out as early as possible.

Kazuo Hosoda

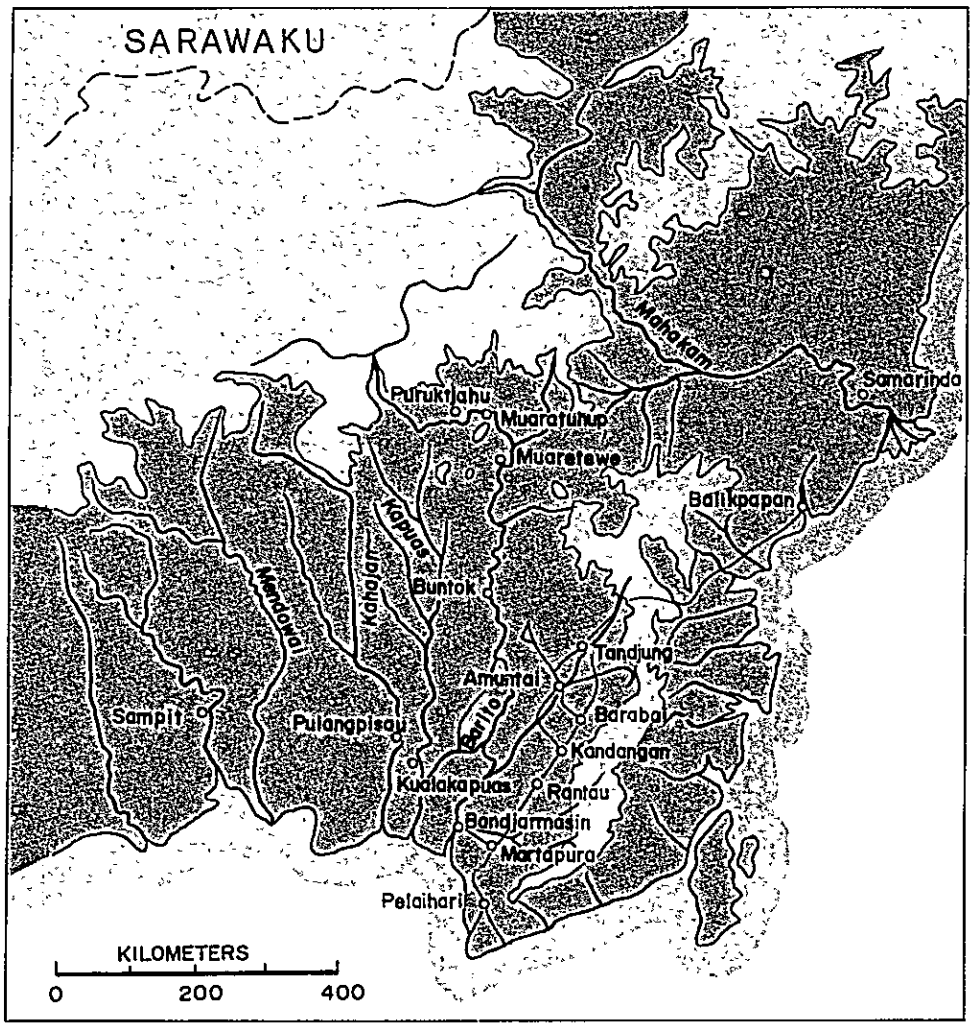
Kazuo HOSODA
Chief, the Second Japanese
Survey Team for the Barito
River Basin
OTCA, Tokyo, Japan

March 1971



Estuary of the Barito river
Kalimantan, Indonesia

BARITO RIVER LOCATION MAP



ERRATA

SURVEY FOR DEVELOPMENT OF BARITO RIVER BASIN, KALIMANTAN

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42	Table 3-1	10m/√km	10 mm/√km
48	Table 4-1	200 m long and 8-16 m	200 m long and 8-9 m
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B: the line from the bottom

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PART I

PART III

PURPOSE AND BACKGROUND OF SURVEY

1. Purpose of Survey

The purpose of this survey is, following the previous survey, to formulate survey programmes for collecting fundamental data which would be required to set up a master plan for the development of the Barito river basin, and to get primary recognition of the feasibility of resources development.

2. Background

In February 1969, the Government of the Republic of Indonesia proposed the following two-stage surveys for the early preparation of the master plan for the water resources development of the Barito river basin. The first stage covering about one year included aerial photography, data collection, reconnaissance and survey, preparation of the master plan, and identification of projects and determination of their priority.

The second stage which covers about one year and a half, consisted of feasibility report preparation and design of the selected projects.

The projects under consideration were related to irrigation, swampy area development (development of farm land and reclamation by means of drainage canal), flood control, hydro-power development, and forest resources development (in relation to water sources and soil conservation).

Upon this proposal, the Government of Japan considered it most essential for the development of such a vast area as the Barito river basin that the master plan, which determines the basic course of development, is to be set up only after the feasibility of resources development in the region has been studied from technical and economical point of view based on the sufficient and complete data obtained by field surveys, and suggested the following five-stage development programmes to the Government of Indonesia.

Stage 1: Formulation of investigation programmes for collecting basic data which would be required to set up the master plan; and

Primary recognition of the feasibility of resources development.

Stage 2: Implementation of field investigations based on the above investigation programmes, and

Formulation of the master plan for development of the Barito river basin.

Stage 3: Feasibility study of priority projects.

Stage 4: Detailed designs of the above mentioned projects.

Stage 5: Construction of the above projects.

Upon acceptance of this proposal by the Government of the Republic of Indonesia, the survey for Stage-1 (the first and the second surveys) were decided to be implemented in 1970 through technical cooperation of Japan.

With this as background, the first survey team was sent to Indonesia during the period from late March to late April of 1970 and the second survey team from early September to mid-November of the same year. The second survey team was to give in its report prospects concerning the feasibility of resources development including that for the Riam Kanan Irrigation Project. The members of the second survey team were selected from various fields in compliance with the recommendation made by the first survey team.

3. Formation of Survey Team

The Second Barito River Survey Team comprises the following members:

	Name	Present Occupation	Assignment
1.	Kazuo HOSODA	Councilor, Engineer General, Water Resources Development Public Corporation	Chief (General)
2.	Yoshio TERAMOTO	Engineer General, Chiba Pref. Office	Assistant Chief (Regional Development)
3.	Atsushi YOSHIKAWA	Research Staff, Research Bureau, Economic Planning Agency	Member (Socio-Economy)
4.	Yukio OZAKI	Chief, Room of Planning, Geographical Survey Institute, Ministry of Construction	Member (Topography)
5.	Yoshinori AOKI	Chief of Material Laboratory, Port and Harbour Research Institute, Ministry of Transport	Member (Water Transportation)
6.	Hajime WATANABE	Managing Director, Nikko Consultant Co., Ltd.	Member (Mineral Resources)
7.	Koji NAGASE	Official of Planning Division, Forest Agency	Member (Forest Resources)
8.	Shozo SAKAGUCHI	Engineer of Agriculture & Soil, Department of Land Reclamation, Ministry of Agriculture & Forestry	Member (Soil & Crops)
9.	Kiyoshi TAKEDA	Senior Engineer of Irrigation & Drainage, Designing Division, Construction Dept., Bureau of Agricultural Land, Ministry of Agriculture & Forestry	Member (Irrigation)
10.	Katsuhiko KIMURA	Senior Engineer of Irrigation & Drainage, Chief of Surveying Section of Shinano River Project, Bureau of Agricultural Land, Ministry of Agriculture & Forestry	Member (Drainage & Reclamation)
11.	Joh CHIBA	Deputy Chief of Djakarta Office, Nippon Koei Co., Ltd.	Member (Agro-economy)
12.	Akira NAGUMO	Deputy Chief of Water Works Department, Central Consultant Co., Ltd.	Member (Hydrology)
13.	Noboru YAMAGUCHI	Shorenji Dam Project Manager, Water Resources Development Public Corporation	Member (Dam & Reservoir)
14.	Hiroshi KIMURA	Officer, Development Survey Division, Overseas Technical Cooperation Agency	Member (Liaison)
15.	Kan FUNATSU	Staff, International Engineering Consultants Association	Member (Accounting)

PART I CONCLUSIONS AND RECOMMENDATIONS

1. CONCLUSIONS

The following conclusions were reached as a result of the survey for the development of the Barito river basin (data collection and survey programme).

(1) Although no sufficient materials and information are available on the Barito river basin, field investigations and discussions have led to the estimation that the basin has a high growth potential that could largely contribute to the future development of Indonesia. Immediate measures should therefore be taken for collection of basic data and materials which are indispensable for formulating the development plan.

(2) Economy of this region is on a considerably low level. This is considered attributable to the stagnated progress of economy over many years in the past which, in turn, has now occasioned the basin's accelerated development to be strongly required.

(3) In the initial stage of development, highest priority should be given to the increase in agricultural production. For this purpose, agricultural development should be supported by a comprehensive measure that assures to fulfil such basic conditions as flood control and development of infrastructure involving roads and navigation canals.

To encourage the region's economic activities, equally high priority should be given to more productive utilization of industrial resources for the region's economy. Promotion of industries that directly serve to stimulate the region's economic activities, such as timber industry, would be effective to attain this object regardless of their scale.

(4) With the exception of part of the lower basin, area along the Barito main stream is generally undeveloped and sparsely populated. On the other hand, the eastern part of the lower basin extending along a number of tributaries such as the Negara and the Martapura is fairly well developed and has a relatively large population. The region's growth will be effectively achieved if the initial development efforts are concentrated in this part of lower basin. Progress of agricultural development projects in this area is expected to call for a comprehensive river development project covering flood control, water sources and their utilization.

(5) All development schemes in the region are heavily hampered by the extremely poor condition of roads. Development of roads, which will give a large incentive impact on the region's development and elevation of people's livelihood, should be given immediate attention.

The major arterial road conceivable at present is the one that connects the strategic point, which is Amuntai-Tandjung District with Bandjarmasin in the south, Balikpapan in the east and Buntok on the main stream. Areas designated for important projects such as agricultural development are to be connected with these arterial roads by branch roads.

(6) Maps and aerial photos required for various development programmes and surveys in the Barito river basin are extremely deficient. Aerial photography, ground control and mapping should therefore be implemented promptly and systematically to produce the required maps and photos.

It is desirable that the aerial photography be immediately ensued by aerial photo interpretation for the survey of forests, soil and geology in the basin.

(7) Geographical conditions of the region make it an imperative to give immediate attention to the development and improvement of ports and inland waterways. With respect to port facilities, higher efficiency will be attained if full-scale improvement is effected to one selected port to assure its satisfactory function. In this connection, selection of Bandjarmasin as the region's gateway to the outside world is justifiable, though this plan will incur a huge capital investment for dredging work in the estuary of the Barito and for the improvement of inland waterways. However, considering the remarkable increase of timber export noted recently and the benefit derivable from the anticipated augmentation of timber shipment, the plan is promising and deserves serious consideration.

(8) Petroleum (Tandjung) and diamond (Martapura) are the only mineral resources in production, and new exploitation of mineral resources has been almost stagnant in recent years. Of major mineral occurrence areas in the region, Pelaihari area, Martapura-Pengaron area and Tandjung area have already been covered by preliminary survey. Survey of Puruktjahu area must therefore be made in future. During the present survey, the team noted with interest the diamond deposit near Martapura, placer gold and primary deposit of gold in the vicinity of Puruktjahu and silica sand in the eastern part of lower basin.

Mechanization is required for higher productivity and increase of diamond and placer gold production.

(9) Upstream area of the Barito embraces an extensive area of tropical rain forest that promises an enormous stock of forest resources. Active forest development in recent years has resulted in the sharp increase in timber export. To meet the strong demand for forest products in the world economy, timber export is expected to follow a steady upward trend in future and contribute much to the economic growth of Indonesia. For this reason, surveys on forests should be conducted to map out an optimum forest development plan, with measures also taken for improvement of facilities of the timber shipping port.

(10) It is hoped that consideration be given to the rehabilitation of the numerous alang-alang areas in the region from the viewpoint of land conservation.

(11) Agriculture in the region is handicapped by deficient irrigation and drainage facilities, and its productivity is extremely low due to the prevalence of customary farming. Expansion of agricultural land and increase in agricultural production may not be hindered by the conventional farming practices for some time to come. For the future development of Indonesia, however, development of advanced agriculture should be planned with efforts directed to productivity increase.

(12) Elevation of agricultural productivity calls for the development of the region's infrastructure which should be coupled by such other measures as the shifting from the currently practised customary farming to advanced agriculture, introduction of improved varieties, application of fertilizers, pest and disease control, and introduction of animal driven and powered farm equipment. Further, due consideration should be given to the diversification of farm management involving livestock farming, vegetable production and fruit tree breeding.

(13) In general, farmer's income level is extremely low. Many farmers engage themselves in non-agricultural side-work to earn extra money to make their living. Stabilization of farmer's economy and fostering of self-supporting farms must be pushed forward in the region. For this purpose, attention should be directed to the establishment of the agricultural credit system to provide farmers with management funds, agricultural cooperative association for joint sales and procurement activities, irrigation association for management and maintenance of common facilities, and the Government assurance of the floor price of rice.

(14) The Riam Kanan Irrigation Project planned to utilize the reservoir of the Riam Kanan dam should be given higher priority over any other agricultural projects in the region. Feasibility study for this project should be commenced immediately. The project area is situated favourably and embraces various typical topographic features and soil conditions found in the region. The project therefore serves as a pilot project of the advanced agricultural development of the region.

(15) With respect to other agricultural development projects, the following four are worth paying attention to.

(a) Amuntai Area Development Project
(b) Tidal Area Reclamation Project
(c) Rehabilitation Project of Gravity Irrigation Facilities
(d) South Bandjarmasin Area Irrigation and Drainage Improvement Project

(16) The power utilization plan for the Riam Kanan Power Plant should be drafted as early as possible in such a manner that it directly enhances the region's industrialization and the modernization of rural communities and also acts as a motive of the basin's development.

New power demand, if incited in the region by the utilization of power from Riam Kanan, will be effectively coped with by the development of the Riam Kiwa because of the river's proximity to the consuming centres.

2. RECOMMENDATIONS

Based on the conclusion given in the preceding chapter, the following recommendations are made.

1. Feasibility study of the Riam Kanan Irrigation Project should be undertaken immediately.

2. With respect to basic data and materials required for mapping out the development plan, the following surveys should be initiated at an earliest possible date for data collection. Surveys cited below are either useful for all development projects in the region or require a long period before their completion or are indispensable for the agricultural development to which the highest priority is given under the region's development scheme.

(1) Topographic Survey

Aerial photography; levelling, topographic mapping; and control survey

(2) Hydrologic Observation

Observation of water level and discharge, precipitation and meteorological conditions

(3) Vegetation and Soil Survey

To be conducted in areas having a high potential of agricultural development

(4) Socio-economic Survey

Survey on population migration, manufacturing plants (business establishments), employment structure, inter-regional traffic of commodities, market prices and farm economy

3. In addition to above, the following surveys for basic data collection should be carried out according to the progress of respective development projects.

(1) Survey on Port and Water Transportation (Survey of dredging in the estuary of the Barito)

Survey on economic conditions, estuary hydraulics, observation of marine phenomena, bottom materials, sounding, canal route investigation

(2) Survey on Mineral Resources (Survey of upstream area of Puruktjahu)

Airborne magnetic and radioactive survey:
preliminary and detailed geologic surveys; and drilling survey

(3) Survey on Forest Resources

Survey on forest area and stock of forest resources by means of air-photos; survey on the growth and natural regeneration; and test planting for pilot forest

(4) Surveys for Agricultural Development

Topographic survey; hydrologic survey; meteorologic observations; consolidation of agricultural statistics covering agricultural population, acreage of farmland, production of crops, farm economy, marketing and distribution, prices of agricultural products, etc.; analysis of soil and water quality; and investigation of irrigation and drainage requirements

(5) Surveys for River and Dam Development

River survey (covering the records, scope and damages of floods and records and damage of drought); survey on water utilization (existing state and forecast of various types of water utilization); survey on hydro-power; survey on sediment load; survey on navigation; and survey on fishing

4. Table for Data Collection and Survey Programmes for Development of the Barito River Basin

Survey programmes for collection of basic data described in Items (2) and (3) are tabulated in the following table,"Data Collection and Survey Programmes for Development of the Barito river basin".

Data Collection & Survey Programmes for Development of the Barito River Basin

(Each phase covers about 5 years.)

Item	Description	Estimated Cost				Remarks
		1st Phase		2nd Phase		
		Quantity	US$	Quantity	US$	
Topographic Survey						
Aerial Photography	Coverage: Approx. whole basin Scale: 1/40,000 – 1/50,000	about 75,000 km^2	220,000		–	District adjacent to the Barito River basin to be included
Detailed Levelling	Coverage Main roads from the estuary to Amuntai, Tandjung and Buntok	" 900 km	112,000		–	Tidal area to be included
Small Scale Topographic Mapping	Scale: 1/250,000	" 75,000 km^2	70,000		–	Revision of existing maps covering the middle and lower reaches to be included
Middle Scale Topographic Mapping	Scale: 1/50,000	" 75,000 km^2	370,000		–	In combination with photo interpretation
Ground Control	Astronomical observation		–	10 points	20,000	For each 2,500 km^2 in the lower basin
	Triangulation of the first order		–	30 points	60,000	For each 100 km^2 in the lower basin
	Triangulation of the second and third order		–	1,000 points	300,000	For each 15 km^2 in the priority areas
	Sub total				380,000	
Total			772,000		380,000	
Hydrological Observations						
A. Construction cost						
Water level and discahrge gauging stations		17 sites	153,000	6 sites	102,000	Survey boats, equipment and material to be included
Rainfall and meteorological stations		1 sites	12,000	13 sites	24,000	Meteorological station to be established at one site
	Sub total		165,000		126,000	
B. Maintenance cost						
Water level and discharge gauging stations			236,500		327,000	
Rainfall and meteorological stations			46,500		78,000	
	Sub total		283,000		405,000	
C. Technical Guidance Cost			216,000		–	
Total			664,000		531,000	
Vegetation and Soil Survey	One soil profile description for each 500 ha for coverage of approx. 500,000 ha of alable land		410,000		288,000	
Total			410,000		288,000	
Social-economic Survey						
Demographic Movements						
Industrial Structure of Labour Force						
Inter-regional Commodity Movements			165,000		–	
Marketing and Distribution						
Farm Economy			282,000		–	
Total			447,000		–	
Port and Water Transportation Survey						
Economic Survey			6,000		–	
Technical Survey	Survey on estuary hydraulics, marine phenomena, bottom geology; sounding; and canal route investigation		194,000		–	
Total			200,000			
Survey on Mineral Resources						
Airborne Survey			25,000		–	70 km x 35 km, interval of survey line – 1 km
First Geological Survey	Surface Survey	2,450 km^2	110,500			
Second " "	Detailed surface survey	940 km^2	158,500			Pit excavation and preparation of geological maps inclusive
Boring Survey			–	70 points	650,000	Average boring depth : 150 m
Total			294,000		650,000	
Survey on Forest Resources						
Forest Area and Stock of Forest Resources			30,000		–	
Growth and Natural Regeneration			70,000		–	
Test Planting			63,000		–	
Total			163,000			
Agricultural Development Survey						
Consolidation of Statistical Data			100,000		200,000	
Basic Technical Survey						
Total			100,000		200,000	
River and Dam Development Survey						
River Survey						
Water Utilization Survey						
Hydro-power Survey			50,000		131,000	
Sediment Load Survey						
Water Transportation and Fishery Survey						
Total			50,000		131,000	
Grand Total			3,100,000		2,180,000	

PART II SUMMARY

The Barito river is a large river that flows through two provinces in the southeastern part of Kalimantan, Central Kalimantan Province and South Kalimantan Province, with its basin covering an area of as wiue as 60 thousand km^2. With the exception of the Schwaner and Muller Mountains in the north where the river rises and the Meratus Mountains in the east, the basin generally presents a flat topography. The extensive area spreading far out along the middle and lower reaches of the river is all swampy.

The area along the middle and upper reaches of the Barito river main stream is yet to await future development, though there are found a limited number of villages. However, development is fairly in progress in the basins of two eastern tributaries, the Negara and the Martapura, which join the downstream of the Barito-river. The majority of the basin's population, which stands at about two million, is concentrated in this area.

With respect to the basin's growth potential, no definite conclusion can be reached due to the deficiency of data and information. However, insofar as the team learned from the available data and through its field investigations and discussions with the Indonesian authorities and experts, it appears that the basin is gifted with a high growth potential by virtue of its rich variety of resources such as water resources, vast land that could be turned into arable areas, forest resources and mineral resources. The team is of the opinion that this potential of the basin's development, which is briefed in the following sections, will carry a vital weight in the future development of Indonesia, and therefore hopes that the collection of basic materials and data required for comprehensive development of the region will be undertaken as early as possible.

1. SOCIO-ECONOMIC DEVELOPMENT

The basin's economy in general may be considered to be on a level substantially lower than that attained in Java district or other countries of Southeast Asia which are placed under the similar tropical natural conditions, though its accurate quantitative analysis is made impossible by the lack of dependable statistical data. This low level of basin's economic activities is considered

attributable to the stagnated progress of economy over many years in the past, but it has, on the other hand, occasioned the basin's accelerated development to be urgently required.

Agriculture holds the dominant position in the basin's production, far outstripping manufacturing industries that occupy an exceedingly small share. Though rice constitutes the major agricultural product, its production is not yet sufficient to satisfy the basins demand and is further subject to an extreme instability invited by various factors.

Major export items of the basin are the primary products such as petroleum and timber, while import items comprise agricultural products such as rice and vegetables and virtually all manufacturing products. The basin's trade gap is largely affected by the fluctuation of rice production. The current economic activities of the basin, which are undertaken by the national enterprises or foreign capitals that resort to such industrial resources as petroleum and timber, contribute to the increased foreign exchange earnings. These activities, though expected to make further expansion in future, do not seem to contribute much to the region's socio-economic development.

Judging from the existing state, the desired development of the basin will require quite a long period of time. Hence, in the initial development stage, prime efforts would have to be directed towards (1) elevation of agricultural productivity centering on rice production with the view to attaining the balance of supply and demand of food, and (2) effective utilization of industrial resources for the basin's economy in order to encourage the overall regional economic development.

As for the need for augmenting agricultural production, which will be discussed later in Chapter 7. Agricultureal Development, the team wishes to point out here that the development of infrastructure involving roads and canals is no less important than the agricultural development itself. With respect to industrial resources, plans for their more productive utilization should be mapped out in the future. However, in view of the existing state of the basin, it would be advisable to consider the promotion of timber industry or the like that serves to encourage the region's economic activities rather than to contemplate the immediate implementation of a laege-scale utilization plan.

With the construction of the Riam Kanan Dam expected to be completed in 1972, it is hoped that the planning of power utilization will be prompted and completed at an early date in conjunction with the market research on electricity to be supplied by the Riam Kanan Power Plant. The power utilization plan, it is to be added, should be such that directly enhances industrialization of the region and modernization of its rural communities, and also serves as the motive of its comprehensive development. It is also quite important to make full and successive use of the progress attained in manpower development through the construction of modern facilities of the Riam Kanan Dam for other development projects of the basin. In this connection, the team proposes an irrigation project which envisages the reservoir of the said dam as the source of water supply.

Timber export from this region has been conspicuously on the increase in recent years and is expected to pursue a steady upward trend in future because of the large stock of forest resources and the strong estimated demand for forest products in the world economy. The anticipated expansion of timber export will

call for the development of infrastructure including ports and canals. Though development of these facilities is certainly indispensable for both region's economic growth and development, it is desirable, for the sake of efficient investment, to establish the centre for collecting and shipping timbers at one suitable place. The team proposes Bandjarmasin as the gateway of the region to the outside world and recommends that dredging work be carried out at the estuary of Barito river.

As outlined above, the region's development must first be preceded by the establishment of the scope of development, which in turn demands the collection of various basic materials and data with which to make an accurate judgement and analysis. Detailed description on this subject will be given in Chapter 1, Socio-economic Development of Part III.

2. REGIONAL DEVELOPMENT

In the vast Barito river basin, the area along the middle and upper reaches of the mainstream is swampy and mostly undeveloped. However, the lower eastern basin through which a number of tributaries including the Negara and the Martapura flow and join the mainstream are fairly well developed, and the majority of the basin's population is found in this downstream area. Major cities in the lower basin are Bandjarmasin, Amuntai and Tandjung. Bandjarmasin, which is the centre of the lower basin, is also the capital city of South Kalimantan Province and has a population of 260 thousand. It serves as the basin's gateway to outside world. Amuntai situated in the north is the centre of agriculture of the neighbouring areas where the water supply is ample and soil conditions are favourable. Farther north of Amuntai is Tandjung which is the centre of petroleum production.

Judging from the existing state of the Barito basin, it appears appropriate to concentrate the initial development efforts in the lower eastern basin for the desired development of the whole basin.

Generally speaking, development of the Barito basin is still in a very early stage and should be preceded by implementation of such plans that would provide the whole project region with economic and functional aptitude to digest the proposed comprehensive development. Development of infrastructure involving water and land transport facilities and river training for flood control are indispensable for the region's agricultural and other development projects. Productive utilization of various resources for encouraging the regions' economy is also an important key to the accelerated development.

Development and consolidation of the above-mentioned basic conditions and facilities, which would be materialized by public investment, is hoped to be conducted on an extended scale for the promotion of the region's development.

The only roads available in the Barito river basin are the two trunk roads, one connecting Bandjarmasin and Tandjung in the east and the other leading to Pelaihari in the south, and a few branch roads. These trunk roads have a small width and bridges constructed on their routes are not satisfactory either.

As already mentioned, roads play a vital role in the region's development.

At the present stage, however, it entails many difficulties to forecast the region's future scale of economy and the distribution of its industrial establishments for the purpose of deciding on the scope and plans of road investment so as to map out a definite arterial network plan. Accordingly, the team considers it necessary and practical to establish a tentative plan of a network of arterial roads which is to be carried out step by step preferentially in expectation of its trigger effect on the region's development.

The major trunk roads conceivable at present are those which link the Tandjung-Amuntai district, assumed as the centre of the northern part of lower basin, with Bandjarmasin in the south and Balikpapan in the east. Construction of a trunk road connecting Amuntai and Buntok on the mainstream in addition to the above-mentioned two roads is also considered quite useful. Branch roads are essentially intended for meeting local transport load and their construction would prove useful if planned in line with the agricultural development project.

Natural conditions of the lower basin call for the availability of a perfectly functioning port. Hence high priority should be given to the dredging of the estuary of the Barito to keep the entrance of the Bandjarmasin Port clear for free navigation.

Since Bandjarmasin is a large city with a population of 260 thousand, it is hoped that its city water works now in progress will be expedited and the implementation of projects for the city's other facilities including streets and drainage system be prompted for early completion.

3. TOPOGRAPHIC SURVEY

In conducting surveys for a regional development or implementing a project for such development, maps and air-photographs satisfying respective needs are the basic and indispensable materials. In this connection, existing air-photographs and topographic maps of the Barito river basin cannot be considered to meet the purpose of drafting a comprehensive development plan because they cover only limited portions of the basin's area or their scale is insufficient or they need corrections due to the long time elapsed after their preparation. Preparation of these basic materials is therefore urgently hoped for.

Preparation of maps should be basically carried out in conformity to a certain specificiation and programme so that the entire project area may be covered by a uniform standard, with close harmony preferably maintained with the policy and programme for National Mapping in Indonesia.

A good many steps must be gone through before completing the whole topographic surveys required for the basin's development. In the coming several years, however, the following steps should be taken consecutively and systematically for the initial stage of surveys.

(1) Preparation of Air-Photograph

Air-photo taking must be performed prior to all other surveys in order to prepare topographic maps and collect geographic information. Considering the topographic mapping and photo interpretation, the photo scale should be held within the range from 1/40,000 to 1/50,000. Since no access can

be made to many areas of the basin, photo interpretation is quite instrumental in surveying forest resources, soil condition and geology.

(2) Control Survey

Control survey in the basin should be conducted with priority given to accurate survey of elevations rather than to planimetry. Further, elevation at various points in the basin should be obtained on the basis of a unique reference plane, and this calls for the establishment of the standard elevation at Bandjarmasin. This new standard elevation should be used for early completion of the levelling network connecting bench marks of major cities and hydro-observatories situated at different locations. The levelling network thus prepared enables the detailed levelling to be conducted by the unique reference plane in accordance with the need arising from the development project. Triangulation to obtain the planimetry may be so conducted that it is completed before mapping out the development plan.

(3) Preparation of Topographic Map

To get aquainted with the general topography of the entire basin, maps on a scale of 1/250,000 with 50 m-contour interval are required. These maps can be obtained by effecting corrections by photos to the existing maps that cover part of the basin's area.

Maps on a scale of 1/50,000 with 20 m-contour interval will be required for general planning for areas whose development potential is relatively high. The said contour interval should be reduced to 5 to 10 m for flat areas.

Besides these maps, maps on a scale of 1/10,000 with contour interval of 1 to 2 m will also be required for areas whose agricultural development project comes to the stage of detailed study and review.

Since the aforementioned mapping work is both costly and time-consuming, the order of its implementation should be decided with due account taken of the progress of development project. It may be added that if maps are urgently required for unmapped areas, photo maps suffice to meet the emergency need.

The basic topographic survey described above will require a period of about three to five years. Detailed description on this subject will be given later in Chapter 4, Topographic Survey of Part III.

4. PORT AND WATER TRANSPORTATION

The Barito is closely related to the Kapuas and the Kahajan running in parallel with it in the west, and it is reasonable to consider the lower basins of those three rivers as one area. Among ports in this area, Bandjarmasin located on the Barito is the capital of South Kalimantan Province and the centre of politics and economy of this area; its population is about 260,000. Though the city has a modern wharf which was constructed in 1964, navigation of large vessels is obstructed by a large bar in the estuary of the Barito. Pulang Pisau Port located on the Kahajan was opened in 1967 for the purpose of shipping timbers, however,

no satisfactory port facilities are available in the port. Navigation is obstructed by a bar in the estuary of the Kahajan. Kuala Kapuas located on the Kapuas is a small port only for local traffic.

In this downstream area, several canals connecting these three rivers are constructed for local traffic and transport; however, these canals are of small width and small depth. Only small boats can navigate through these canals and timbers are rafted in limited parts of these canals.

Volume of cargo at Bandjarmasin Port has been scarcely increased for the last several years. The total volume of cargo handled in 1969 was 235,000 tons; of which 82,000 tons were for foreign trade (export - 78,000 tons, import - 4,000 tons) and volume of domestic cargo was 153,000 tons (outbound shipment - 52,000 tons, imbound shipment - 101,000 tons).

It is noteworthy that among export items of this area, export of timbers has remarkably increased in recent years. Volume of timbers exported from this area was 242,000 m^3 in 1969, however, the volume of export of timbers in 1970 until August amounted to 310,000 m^3. Formerly timbers for export had been collected mostly from the Kahajan and the Kapuas and shipped from Pulang Pissau Port. It is noticed, however, export of timbers from the Barito basin was started around April 1970 and the volume amounted to 17,000 m^3 in August of the same year. This is because, as described in Chapter 6, Forest Resources, the upstream area of the Barito is rich in forest resources and mechanical logging system was recently started at several places. Export of timbers is expected to further increase in the future.

In view of the geographic condition of the region, development and consolidation of ports and related inland canals will perform an important role in development of the region; and it is effective to develop and consolidate those facilities in an integrated system in one area in view of the present situation of the region's economy. Naturally, full function of a port cannot be achieved without the availability of both primary port facilities and many secondary facilities incidental to primary ones. The team recommends development of Bandjarmasin, the central city of the region, as a gateway of the region to outside world. This project requires dredging work of about 5,000,000 m^3 in the estuary of the Barito and enlargement and consolidation of inland canals, and also a considerably great amount of fund. However, in consideration of the benefit for export and import, especially for shipment of timbers which are remarkably increasing these days, it is advisable to commence the study of the dredging project at an earliest date.

Chapter 4, Port and Water Transportation of Part III gives a full account of survey items necessary for planning of dredging work in the estuary of the Barito.

5. MINERAL RESOURCES

In the Barito river basin, new development of mineral resources is recently almost stagnated. Many of the mines in the region were explored and developed before 1940; they have either ascertained outcrops or placer deposits close to the ground surface. In exploration and development in the future, exploration

of not only the surface of the earth but also of deep deposits and blind deposits must be conducted. Main mining industries now in operation are petroleum at Tandjung and diamond around Martapura. Following is the outline of mineral resources in the region that are obtained from the existing data and the results of the filed survey:

(1) Iron ore deposit: It is well known that there are iron ore deposits around Pelaihari in south-eastern part of the region, and some survey was conducted about a part of the deposits. It is recommended to continue the survey.

(2) Diamond deposit: There are extensive diamond deposits around Martapura and Pengaron, and exploration and mining are operated by the government. As the deposits are very promising, it is necessary to consolidate the production statistics and conduct surveys to find out the scale of deposits.

While mining and concentration are carried out by manual system, mechanized system must be introduced for the purposes of better mining efficiency and increase of production.

(3) Gold deposit: Around Martapura and Pengaron in the south of the basin, placer gold as a by-product of diamond is gathered, and it is confirmed that placer gold is found extensively around Buntok, Muaratewe and Puruktjahu in the upstream area of the Barito.

At present, mining of placer gold is carried out by manual system, and it is necessary to improve the efficiency by mechanizing the mining work and concentration work. As a primary deposit of gold is found around Puruktjahu, it is recommended to conduct a further survey to scrutinize the condition of the deposit.

(4) Coal: There are coal deposits around Meratus Mountains in the south-eastern basin and around Muaratewe in the upstream area of the Barito, however, these are of small scale.

(5) Petroleum: In the oil field of Tandjung, petroleum of 2,600 kl and gas of 500,000 m^3 are produced daily. Though it is considered to be promising in view of geological condition of oil occurrence, no active prospecting has been conducted recently. Effective utilization of gas must be studied with the future development of the region. In addition, drilling surveys are being conducted at several points in the basin.

(6) Non-metallic minerals: Peridotite, limestone, etc. distributed around Meratus Mountains and Bobaris Mountains are used as macadam for road-bed and construction material; these are found at places where traffic is not convenient due to poor transport means, and the scale of quarry is small. It is considered, however, that limestone can be utilized for soil improvement of farm land in the future. Silica sand is extensively distributed over the area from Rantau to Bandjarmasin. As the granular silica sand has a high content of SiO_2 and includes less amount of impurities, it is advisable to study its utilization.

Among the main places with mineral resources, such three areas as Pelaihari, Martapura - Pengaron and Tandjung were surveyed to some extent, and it

will be necessary to conduct a detailed survey in the future in Puruktjahu area which has not been surveyed yet. As for the details of the survey; reference should be made to Chapter 5. Mineral Resources of Part III.

6. FOREST RESOURCES

Forests in Kalimantan are mostly tropical rain forests characterized by an extremely rich variety of species. The most important species are those belonging to Dipterocarpaceae. The flat topography generally observed in Kalimantan provides an excellent condition for the growth of forest trees as well as for forest development.

Classified by topographic features, the abundant stock of forest resources in the vast Barito river basin can be considered under three broad categories, i.e., swampy forest, hilly and mountain forests, and alpine forest. The most important of these are the hilly and mountain forests which cover an extensive area of 2,200 thousand ha along the middle and upper reaches of the Barito mainstream. Estimated stock of forest resources in this wide area is 286 million m^3 and major species found in these forests are Meranti, Keruing and Kapur.

In contrast with this rich stock in the upstream area, the flat and hilly area in the basin of tributaries, the Negara and the Martapura, extending in the eastern part of the lower basin, is mostly unstocked land where alang-alang grows wild.

Forest development along the Barito has long been limited to the small-scale manpower logging due to economic reasons. Recently, however, large-scale mechanical logging is being undertaken at a number of places with the resultant increase in timber export from the Barito. The timber production in the basin is expected to pursue a sharp upward trend during the coming years and contribute to the economic growth of the basin and of whole Indonesia as well.

To encourage the basin's economic activities, it is considered necessary to promote the timber industry using the abundance of forest resources which are now exported in logs. Bandjarmasin and its neighbouring areas are most suited for the establishment of timber industry.

Basic data and materials do not seem to be sufficiently available for the desired forest development of the basin except that some well consolidated data are available for specific development areas. Therefore, surveys on forest area and stock of forest resources by means of air-photographs as well as the clarification of growth and natural regeneration should be undertaken as early as possible for the formulation of an optimum development plan. These surveys can never be dispensed with in conserving the ecology of natural forests in the course of large-scale forest development.

For more productive and efficient utilization of forest resources, it is desirable that the conventional manpower logging be shifted to mechanical logging which largely reduces the percentage of lower quality products incidental to the conventional method.

With respect to the extensive herb-zone of alang-alang observed in many districts of the basin, it is hoped that consideration be given to its rehabilitation from the standpoint of land conservation. Measures conceivable for this purpose include the study on the species suited to the natural environments of alang-alang area, test planting, and expansion of planting area through creation of farm forests or adoption of Taung-Ja system. At the same time, efforts must be made in enlightening the nation on the important role played by forests and in upheaving the green campaign.

7. AGRICULTURAL DEVELOPMENT

The flat area extending far out along the middle and lower reaches of the Barito embraces an extensive land having the potential of agricultural development.

In the basin's production, agriculture that centers on rice cultivation holds the predominantly large share, with the agricultural population accounting for about 83% of total population (South Kalimantan Province). However, rice cultivation generally shows a poor productivity and its production is not necessarily on a steady upward trend due to various factors. Agricultural production, particularly that of rice, falls short of the basin's demand so that a substantially large volume of agricultural products is imported each year from outside the basin. It follows, therefore, that the stabilized increase of agricultural production, rice in particular, intended to attain a higher degree of self-supply of food and to bring about a drastic change to the region's industrial make-up is a matter of utmost importance for the region's development. For this purpose, agricultural development must be backed up by a comprehensive development measure involving the river development for flood control and the road development for quicker and cheaper traffic and transport.

In the following sections, the region's agricultural development will be briefed from the viewpoint of socio-economy of rural communities, farm management techniques and land development techniques.

7-1 Considerations from the Viewpoint of Socio-Economy of Rural Communities

Rural communities in the basin are found mostly along the lower reaches of large rivers, canals and main roads. Since most farmers still follow the customary farming, their productivity is very low. It may therefore be said that efforts for awakening farmers to the importance of agricultural development and promoting their education are a prerequisite to the desired expansion of agricultural production.

Farmer's management scale in the region is generally small, with the holding of paddy field per farm household averaging about 1.1 ha and that of upland field 0.2 ha in South Kalimantan Province. Further, the general practice of customary farming and the damages invited by flood, diseases and insect pests result in their low and unstabilized level of agricultural income. A trial calculation reveals that the annual agricultural income of the average farm household is about US$75.00. To make up for this low income and support their families, many farmers seek part time works or leave their home in search of employment.

Considering the vast area embraced in the basin that can be developed into arable land and the possibility of increasing the yield per unit area through introduction of advanced farming techniques, efforts should be made for the improvement of the present condition of the rural communities by encouraging self-supporting farm management as practiced by some progressive farmers to raise the level of farm economy and increase agricultural production. For this purpose, improvement of farm management through introduction of advanced farming techniques and diversification of management should be propelled coupled with the suitable financial measures including the establishment of agricultural credit system which enables farmers to borrow the necessary management funds.

Agricultural products are transported mostly by small boats in the region and their smooth distribution seems to be hampered by the poor condition of roads. Development of roads as an infrastructure for the region's development is to be given high priority.

Sales of agricultural products and procurement of agricultural equipment and materials are conducted through free market in almost all cases. It is hoped that farmers' organizations such as agricultural cooperative associations will be established as early as possible for protection and promotion of farmer's interests. The team also considers it necessary to establish irrigation associations whose function is to take care of the management and maintenance of common agricultural facilities.

Production increase seems to be retarded due partly to the price fluctuation resulting from the transactions through free market as well as the poor transport facilities. Assurance of the floor price of rice should therefore given due consideration by the Government.

The agricultural development calls for the availability of information on the general situation of the basin's agriculture and on the socio-economic conditions affecting it. Hence, the collection and study of statistical data on agricultural population, acreage of farmland, crops, production, farm economy, marketing, prices, etc. should be carried out as early as possible.

7-2 Considerations from the Viewpoint of Farm Management Technique

Virtually all farmers in the Barito basin follow the habitual techniques in their rice cultivation without using fertilizers or agricultural chemicals. They hardly use even animal-driven harrows or plows.

Several different varieties of paddy are cultivated in the basin depending on the topographic conditions, but they all require a period of five to six months before harvesting, and even nine to ten months in an extreme case. All varieties now being cultivated are the Indica, and are characterized by the strong resistance against diseases and insect pests, low reaction to fertilizers, long stem, and good growth in the fertile soil carried by flood which, however, are handicapped by the small yield per unit area.

Soil distribution in the basin generally corresponds to topography. To be more precise, latosol and red-yellow podsol are found distributed in the hilly land and upland, whereas alluvial soil or low humic gray soil and orgonosol are observed in the lowland, swamp area and tidal area.

Of the above-mentioned variety of soils, alluvial soil found in the lowland presents no particular problems. The latosol and red-yellow podosol in the upland form clods when dry, and are vulnerable to soil erosion with a small effective soil depth. Upland field irrigation to give an optimum field moisture is therefore desirable for these soils. Improvement of pH value by lime application and soil improvement by plowing up alang-alang using a large tractor and applying it as an organic matter will have to be studied. In the swamp area, on the other hand, care must be taken of the sub-soil. Where the peat deposit is thick, settlement and other adverse effects could result from rapid oxidation. Therefore, soil improvement through drainage requires a careful examination of its method and speed. In the tidal area, the surface soil ranges from 20 to 30 cm in thickness and usually contains organic matters that somewhat reduces the soil acidity. Paddy and other crops are cultivated within this thickness. However, high acidity prevails in the tidal area due mostly by the exceedingly large sulphate content of the sub-soil, and in addition, cats-clay with a strong acidity develops when the sub-soil dries up rapidly. These two points will be the major problems to be studied in future. It is to be added that since water in the canals in the tidal area presents a high acidity due to organic acid or sulphate content, it is hoped that studies be made for drawing fresh water of the Barito and the Kapuas whose pH value is around 6.

Improvement of the current low productivity in the region calls for a comprehensive development measure which includes the shifting from the customary farming to the modern cultivation practices, introduction of improved varieties, improvement of soil productivity through facilitation and plant protection, and elevation of farm labour productivity through the use of animal-driven and powered agricultural equipment, and is also supported by the development of infrastructure. It would also be necessary to pave the way to the diversification of farm management by encouraging livestock farming, vegetable production and fruit tree breeding since none of these products satisfies even half of the region's demand.

As described above, experiments and studies needed for the smooth agricultural development of the basin's vast area must cover a wide range. It is therefore hoped that organizations for such experiments and studies be systematically established with endeavours also made in the guidance activities for farmers for far-reaching diffusion of the outcome of these studies.

7-3 Considerations from the Viewpoint of Land Development

Though irrigation or drainage facilities are observed in the region, the farmland may be said to be under nearly natural conditions. This is considered ascribable to the fact that varieties cultivated are close to wild ones and assure a certain crop without specific cultivation techniques so long as the water supply is ample and suitable and therefore, production increase has resorted solely to the expansion of planting area and practically no efforts have been made in the control of irrigation and drainage of water. The basin thus provides a vast land and climatic conditions suited for a customary agriculture, but the monotony and vastness of the basin's natural conditions may be said to be impeding a step forward towards development.

For some time to come, it may be possible to expand agricultural production simply by enlarging the planting area. However, if agriculture is to

provide the basis for Indonesia's future development, it must be promoted under a more advanced development plan.

Needless to say, irrigation and drainage are important factors that largely affect the agricultural development in this vast region, but the topographic features of the region demand that these two factors be considered in conjunction with the river development scheme in prevention of flood damages as well as with the road and river transportation since traffic conditions are equally important for agricultural development. It is to be noted that navigation canals promote agricultural development by its additional function as drainage canals.

The region's vast area can be classified into a number of typical districts by topography and water conditions as outlined below.

In the upland area where the elevation is relatively high, farm management centering on paddy cultivation is possible provided that sufficient water supply is assured. This area is also suited for diversified management including fruit tree and upland field cultivation because of its good drainage conditions. Since the region's vast area abounds in districts where paddy cultivation alone is to be promoted, introduction of crops other than paddy in this area would be preferable for the economy of the entire region.

There lies an extensive flat lowland embracing many districts suited for agriculture around the point where the Negera is joined by its tributaries. This area is inundated in the wet season and formed with fertile alluvial soil, and some districts in the area have a relatively high elevation. If soil improvement by drainage is undertaken as a first step, initial stage of development can be achieved in certain districts. However, if the development is desired to be attained more perfectly over a wide area, embankments for flood control and irrigation facilities to secure water supply in the dry season must be provided in addition to drainage. Further, if the development project becomes larger in scale, the resultant extension of the peat zone calls for the careful disposal of the effluent acid water. Supply of clean water from the upstream section is required to cope with this problem.

In the swamp area, drainage is a matter of utmost importance throughout the year. Cultivation of upland crops is practically impossible and paddy is the major crop in this area. Drainage to maintain an optimum water depth for the growth of paddy and water circulation for soil manuring and removal of harmful water are the major works to be carried out in this area. The deterred development of this area despite the fact that its soil and water conditions are almost equal to those of the tidal area excepting the larger depth of inundation during the wet season is considered ascribable chiefly to the delay in the development of roads and navigation canals.

The tidal area lying along the lowermost reaches is subjected to the strong influence of tide. At present, tidal irrigation is in practice using a number of navigation canals, with projects under a new system concurrently in progress. These attempts indicate the possibility as well as a method of agricultural development in such ill-conditioned area, but they are suggestive of the limit of development resorting to such means. Highly acid water and harmful water effluent from within the area, development of cats-clay, difficulty in obtaining sufficient clean water act combinedly to make it extremely hard to conduct soil manuring which is essential for highly developed farm management. Sucessful

agricultural development and maintenance of soil productivity in this area would require considerably large scale water management facilities and organizations for water circulation under which effluent acid water from organic soils can be discharged outside the area.

In mapping out the agricultural development plan of the Barito river basin, preparation of topographic maps and collection and consolidation of basic materials and data on meteorology, hydrology, vegetation and soils must be undertaken besides preparing various statistical data cited in Section 7-1, Considerations from the Viewpoint of Socio-Economy of Rural Communities. Detailed description on the need for such data will be given in Chapter 7, Agricultural Development of Part III.

In actually conducting the survey, it would be practical to begin with the projects described in Section 7-4, Selected Projects, in view of the vastness of the basin.

7-4 Selected Projects.

The agricultural development of the basin should in principle be so mapped out that its future course would conform fully to the overall development project of the Barito basin. However, due to the vastness of the area under consideration, it appears more practical to study the existing conditions and future prospect of respective project districts in order to determine their priority order so that the agricultural development may be balanced with the region's comprehensive development project.

The team wishes to pay its attention to the following projects from the data made available and through field investigations.

A New Projects

A-1 Riam Kanan Irrigation Project

The Riam Kanan dam is expected to be put in use upon its completion in 1972. The Riam Kanan Irrigation Project, planned for utilization of this multi-purpose dam, is estimated to have a benefited area of about 30,000 ha.

The project district is one of the fairly well developed areas in South Kalimantan Province and has a large population. It is located close to the administrative and economic centre of the Province and many of the farmers in the district possess a forward-looking attitude toward agriculture. Since the district has diversified natural conditions and embraces various typical topographic features and soil conditions observed in the Barito basin, the project is considered to play a role of pilot project for the basin's development into a modern agricultural area. Further, the manpower development achieved through the construction of the dam can be successively made use of for the efficient implementation of the project.

For these reasons, the team recommends that the feasibility study of the Riam Kanan Irrigation Project be undertaken immediately.

A-2 Amuntai Area Development Project

Development of the flat lowland extending from south to east of Amuntai deserves attention as one of the lowland area development projects. The

project area covers an area of about 40 thousand ha extending along a number of rivers such as S. Tabalong, S. Balangan and S. Batangalai, with Amuntai and many towns and villages found in its neighbouring areas. The district is favoured with good soil and water conditions and promises agricultural development if a polder scheme is implemented. The project envisages the construction of ring levees for flood control of rivers, installation of a regulating gate at inflow points of tributaries, excavation of drainage canal for discharge of stagnant water in the area, installation of irrigation facilities for water supply during the dry season, inducement of fresh river water for disposal of strong acid water effluent from the soils in the area, and the development of water and land transport routes for smoother distribution of agricultural products. For completion of all these plans, a large scale construction work must be carried on for a considerably long period. However, construction of the drainage canal and affiliated facilities alone is sure to bring about a remarkable benefit. It is therefore recommended that the aforementioned plans be implemented step by step in harmony with the overall development project of the area.

Prior to mapping out the project, the discharge of rivers flowing through the surrounding area and the topography of the area should be surveyed in detail.

A-3 Tidal Area Reclamation Project

In the tidal area extending along the lowermost reaches, tidal irrigation resorting to the tidal movement is conducted and a substantial number of farmers already settled in the area have attained fairly good results along canal banks. Besides utilizing the existing navigation canals, excavation of exclusive canals directly connected with the rivers for tidal irrigation is being promoted. As farm management is based on the single cropping of wet season paddy which requires a long cultivation period, farmer's income is not at all satisfactory. Further, if irrigation continues to be dependent on the present method of using a single canal, problem is likely to arise as to whether the soil productivity permanently assures stabilized farm management.

For future development of farmer's economy and production increase, consideration should be given to the adoption of a new irrigation system under which fresh water will be drawn in from the mainstream through a driving canal or by means of a pump while soiled and harmful water will be separately discharged out of the district through a newly provided drainage canal for satisfactory water circulation that ensures soil improvement and double cropping of paddy and cultivation of some upland crops.

However, since the district covers a wide area and is favourably situated not too far from Bandjarmasin, its future development can be expected if navigation canals and roads within the district are well developed.

B. Rehabilitation and Improvement Projects

B-1 Rehabilitation Project of Gravity Irrigation Facilities

In the neighbourhood of Rantau, Kandangan and Barabai in the eastern part of lower basin, there remain several irrigation facilities constructed during the Dutch colonial days. Though the soil condition and drainage

condition are both satisfactory, these facilities are not in full use since part of them is needful of repair. It is hoped that the rehabilitation work carried out on some of these facilities will be completed at an early date. If the rehabilitation of these facilities is to be proceeded, causes of their deficient past utilization must be cleared up. It would also be required to expand and arrange tertiary facilities with efforts made in the guidance and diffusion of management techniques required for the fullest utilization of these facilities. It is preferable to make a survey on the discharge of rivers in the neighbouring area.

B-2 South Bandjarmasin Area Irrigation and Drainage Improvement Project

Adjoining Bandjarmasin in the south, there is a lowland and swamp of about 25 thousand ha with farmland extending along a drainage canal. The drainage canal, which is utilized as a driving canal in the wet season, is not capable of fulfilling its function of discharging effluent water from soil. Therefore, soil improvement by means of this canal is practically impossible. The farm management centers on the single cropping of wet season paddy at present. The district is close to Bandjarmasin and therefore occupies a favourable ground.

Since the upstream border of this district adjoins the Riam Kanan Irrigation Project Area, double cropping of paddy would become feasible if its drainage facilities are improved coupled with disposal of return flow from the Riam Kanan Project Area with irrigation conducted with the said return flow and fresh water drawn from the Martapura.

8. RIVER, DAM, RESERVOIR AND HYDROLOGY

The Barito flows through Central and South Kalimantan Provinces along L 115°E and empties into the Java Sea near Bandjarmasin, and has a basin that covers an area of about 60,000 km^2. Annual rainfall in the region is exceedingly large, ranging from 2,500 mm to 3,500 mm. The total annual outflow of the Barito is estimated to reach 90 billion m^3 at the estuary.

Like other large rivers of the world, the Barito offers favourable natural environments suited for man's life in its extensive basin. On the other hand, however, its massive flood waters largely impede the region's development. Hence, the region's development can never be achieved unless flood control and water utilization are promoted as in other advanced countries. It is considered that the demand for such flood control and water utilization will accelerateedly increase along with the future development of the region.

The extensive swampy area spreading far out along the middle and lower reaches of the Barito is mostly undeveloped and sparsely populated though agricultural development by tidal irrigation is carried out and a few small villages are found in the lowermost area. In contrast with this, development is fairly in progress in the basin of two eastern tributaries, the Negara and the Martapura, where many towns and villages including Bandjarmasin, the capital of South Kalimantan Province, are found. The majority of the region's farmland and population is observed in this eastern part of lower basin.

Judging from the existing state, therefore, development of this part of the basin will be given priority though the future progress of the basin's development is considered to ultimately necessitate the development of the area along the mainstream through a comprehensive flood control and water utilization plan. Further, since agricultural production, particularly that of rice, carries a heavy weight in the future development because of the region's characteristics, river development will have to be planned with priority given to those agricultural development areas cited in Section 2-7, Agricultural Development.

The completion of the Riam Kanan Dam now under construction promises the hydro-power supply which is expected to contribute to both industrialization of Bandjarmasin and surrounding area and modernization of rural communities in the area. New demand for power, if occasioned in this area by such industrialization and modernization, will be effectively coped with by the development of the Riam Kiwa because of its proximity to the consuming area.

Basic materials such as hydrological data covering river discharge, rainfall and meteorology as well as topographic maps and levelling are indispensable for planning the aforementioned river development project. However, the present availability of such basic data with which to clarify the conditions of the region is extremely limited. Therefore, hydrologic stations must be established for collection of necessary data at an earliest date coupled with the required topographic mapping. Detailed description is given in Chapter 8, River, Dam, Reservoir, and Hydrology, of Part III, on the observation, collection and compilation of basic data.

In planning the hydrologic observation plan, importance must be attached to the uninterrupted and accurate observation after establishment of observatories and therefore, consideration should be given to assure their operation under an integrated and uniform system as well as the training of observatory staffs.

PART III DETAILED DESCRIPTION

1. SOCIO-ECONOMIC DEVELOPMENT

There are no reliable statistical data on the Barito river basin which are well consolidated in time series with the exception of those covering extremely limited fields. It is not possible, therefore, to make an empirical study on the basin's economy analyzing important economic indicators such as the gross national product, per capita income, industrial income and equipment investment, which directly indicate the level of economic activities of a nation and also serve for international comparison of economic development. Accordingly, it is to be understood that errors are involved in the quantitative estimation and studies constituting part of the analysis which was made for the evaluation and recommendations contained in this chapter. Though maximum efforts were made to reduce the margin of such errors through field investigations and discussions, the errors involved in the said estimation are unavoidable at the present stage. The team is greatly concerned about these errors and have allocated a large portion of its recommendations to the proposals of surveys needed to reduce the errors. If surveys are carried out in future as recommended, additional and supplementary data and information may call for some revision of the quantitative analysis given in this chapter and may also lead to certain modifications of qualitative analysis as well. The team hopes that such surveys will be made as early as possible so that its evaluation and analysis may be put to reexamination.

1-1 Development Situation

While the per capita income in Indonesia is believed to be about US$90.00, that of the basin's inhabitants appears to be somewhat lower than the national level. This inference is drawn from the fact that, as indicated in the industry-wise population ratios, the dependence on agriculture and foresty is more conspicuous in the basin than in Java and that the agricultural productivity is not particularly high in the basin in comparison with that in other parts of the country. Although the basin's per capita income could be a little higher than is assumed above because of the self-sufficient pattern of life of its inhabitants, it is considered to be substantially lower than the level in other regions of Southeast Asia under similar tropical conditions.

The poor development situation is ascribable to the stagnated progress of economy over many years in the past. Considering the steady increase in planted area and population over the past five to six years, agricultural production, particularly that of rice, must be construed to have recorded an extremely un-

satisfactory performance, though no clear picture of its trend is available due to its large annual fluctuation.

Demand for accelerated development of the basin, now voiced at home as well as overseas, has been occasioned by such deterred development and unstabilized agricultural production, and such demand is to be justified from the prospects of the basin's future development.

Table 1-2 shows the projected per capita income in future as estimated from the past population growth rate and the assumptive growth rate which was employed in the preliminary estimation for the development strategy which was adopted by the United Nations as the Tinbergen Report. The table indicates that a period of 15 to 20 years will be required before the current income level of Thailand (Approx. US$150.00) is attained and more than 30 years before reaching the level of the Philippines (Approx. US$260.00). Granting that there will be some decline of population growth, it cannot be expected to contribute much to the acceleration of the basin's development.

The basin's development, even if it were to be fortunately accelerated in the course of its progress, should be construed as a long-range scheme whose completion calls for the continued efforts of two or more generations. This is quite evident from the fact that the social transformation of the basin bears very closely upon its development. Generally speaking, a less developed community must undergo improvements and changes in its social structure and system before it "takes off" for development. In this connection, the team is of the opinion that reforms and changes should be made in various social aspects of the basin including the customs and mode of life of its inhabitants, labour practices*1, administrative systems, education, and so forth. Although the team is not ready to make specialized studies or to provide advices on the solution of these problems, it is to be pointed out that the acceleration of development will augment the need for such reform and that a considerably long period will be required before the reforms are made.*2

1-2 Economic Flow Chart and Structure

As stated in the beginning of this chapter, lack of data on important economic indices largely impeded the overall analysis of economic structure. As a consequence, the team had no choice but to make segmental analysis given in the following subsections.

1-2-1 Population

The basin has a total estimated population of two million. Among a number of provinces into which Kalimantan is administratively divided, South Kalimantan Province has a dominantly large population. The annual average growth rate of 2.6% recorded in this province over the past eight years is an average value for a developing world. The population increase due to migration or migration plans is considered to be rather limited, though nothing definite can be said because of the lack of statistics on population migration*3. Due to the lack of the same data, it is unknown whether the outflow of population, particularly that of the productive strata, is active or not, though the basin's population distribution by age shows little deviation from those in other areas of the country and therefore makes it conceivable that the outflow is small. However, it is considered that the difference in the progress of development existing between the basin and other areas is giving some impact on the pop-

ulation migration. It is hoped that the migration of population will be analized by the 1971 census data*4.

1-2-2 Industrial Structure

As stated already, the Barito basin consists of rural communities. With about 83% of the basin's total population engaged in agriculture, the manufacturing industry holds an extremely small population. The manufacturing industry is also limited to light industries for primary processing of raw materials, and its management scale is no larger than that of home industry.

Rice constitutes the major crop and occupies an overwhelming share in the basin's agricultural production. As already mentioned, however, its past production has been extremely unstable and indicates that the rice cultivation in the basin is very vulnerable to various factors. Rubber is the major cash crop for export, but its export volume is on the decline though some ups and downs have been observed in the past.

Output of forest products is considered to be substantially large but its details are unknown except for the timber production for export which has shown a sharp increase recently. Petroleum and diamond are the major mineral resources in the basin, but their overall production is unknown.

1-2-3 Trade Gap

Export (outbound shipment from the basin) includes primary products such as timber, rubber and petroleum, and import covers rice, vegetables and other agricultural products as well as virtually all manufacturing products including both consumer goods and capital goods. The trade gap, or the balance of inter-regional (and international) imports and exports, is not known. The team therefore studied the gap in the savings and investments which coincides with the trade gap, and noted that the savings apparently fall short of the investments. It is believed that this gap is financed by the contributions by the Central Government and by the introduction of foreign capital. The fluctuation of rice production appears to be the major cause responsible for the trade gap fluctuation. The budgetary appropriation by the Central Government plays a vital role in filling the gap. The trade gap mentioned above should be given due attention since it is closely related to the development strategy described later.

1-2-4 Economic Flow Chart

The skeleton of income flow in the basin's economy is as shown in the attached drawing (Fig. 1-1). Attention is to be directed to the fact that the economic flow shown in this drawing is composed of two major sectors.

One of such sectors is the one which resorts to the utilization of the basin's industrial resources such as timber and mineral resources. The upstream area of the Kapuas and the Kahajan from which timber has been removed in the past years is now giving place to the upper reaches of the Barito, with the resultant steady increase in the shipment volume. The entire shipment route from the cutting of trees to the loading of timber is established by foreign firms. These foreign firms are conducting their purchasing activities mostly on the cash payment basis which is raising the income level of workers engaged in the transportation and loading of timber and is also inviting the rise of their wage level. Timber is removed primarily for export, and is about to top the basin's export items offsetting the export fluctuation of rubber. Petroleum production is undertaken by the national enterprise in Tandjung and surrounding

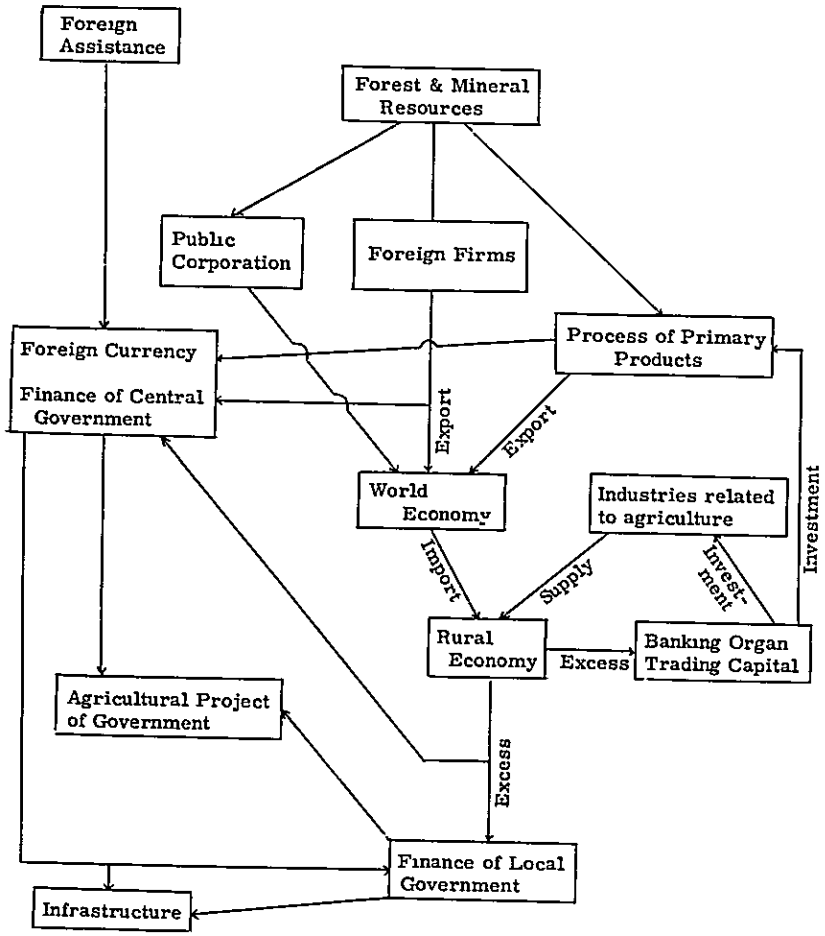
area. Diamond mining is also conducted by the national enterprise using a good number of local labourers.

As described above, the economic activities centering on the industrial resources incorporate foreign capital and national enterprises and contributes to the increased foreign reserves, but does not seem to be dynamically linked with the basin's economy. However, this sector has the potential for future expansion.

Parallel with this sector is another sector which is the rural community that embraces the majority of the basin's population. This community is to be considered to be a traditional community of settled agriculture which depends heavily on rice cultivation though it also produces some other cereals as well as agricultural products for export. This sector is not considered capable of reserving savings for future development since it is in a pressing need to attain the self-sufficiency of food.

The schematization explained above need to be understood in connection with the proposals and recommendations given in the following section.

Fig. 1-1 Skeleton of Income Flow in the Basin's Economy



1-3 Proposals and Recommendations on Development Strategy

Indonesia has the Five Year Development Plan which is already in progress, and there are a number of projects being implemented in the basin whose progress is considered to be satisfactory. The team is aware that its primary mission does not lie in making proposals on the overall development strategy, but believes it one of its tasks to present a few such proposals of fundamental nature for reasons that (1) the international development strategy for this decade was advocated in the arena of the United Nations in 1970 during which the survey was conducted by the present team and by the preliminary survey team, and that (2) the accumulation of knowledge and information on the basin for which the two teams made a humble contribution will provide the basis for preparing the master plan for the region's development in the near future.

Proposals

Proposal 1: Estimation of the framework of development strategy

The current Five-Year Development Plan does not provide in set terms for the regional development projects in each region of the country. While this drawback could be approved of as consequence of the lack of statistical data, the team considers that the preparation of a master plan for the region's development is a prerequisite to the development strategy. Preparation of the master plan will call for statistical surveys and researches recommended in Proposal 2 below.

Proposal 2: Excution of survey programmes (statistitical surveys inclusive)

The team is required, on the one hand, to make recommendations on the basic surveys needed for mapping out a long-range comprehensive development plan of the basin's economy, and to advise, on the other, on the surveys which are considered indispensable for effective implementation of specific projects planned to accelerate the development of specific areas. Hence, it is recommended that the following surveys be carried out.

(A) Basic surveys *5

i. Population migration

iii. Industrial establishments (covering the number of employees, their wages, power installed, equipment investment, output and shipments, and raw materials consumed).

iii. Industrial distribution of labour force

iv. Inter-regional movement of commodities

v. Marketing

vi. Farm economy

Estimated cost of the above basic surveys is shown in the table 1-1.

Table 1-1 Estimated Cost of Proposed Survey (Socio-economy)

Item	Description	Estimated Cost			
		1st Phase		2nd Phase	
		Quantity	U.S.$	Quantity	U.S.$
Demographic Movements Industrial Structure of Labour Force Inter-regional Commodity Movements Marketing and Distribution			165,000		-
Farm Economy			282,000		-
Total			447,000		

(B) Specific surveys

As a result of a prudent study, the team reached the conclusion that there are a number of areas fairly suited for advanced agricultural development. Since these areas are favourably conditioned for implementing agricultural development projects, the team proposes that surveys be conducted on the following.

i. Population migration (Not required if the 1971 census makes the estimation possible to some extent)

ii. Inter-regional movements of commodities (to be conducted as an alternative of a survey on farm economy and household finance of respective farm households which will entail many difficulties).

iii. Market prices (periodical survey to be conducted on the prices of products and consumer goods).

Due attention should be paid to development areas when division of survey areas is required for the statistical survey by provincial governments, and data collection for such development areas should be carried out separately.

(C) Urgent Surveys

Survey on the estimated power demand in the prospective service area of the Riam Kanan Power Station is of urgent necessity. According to the data of the provincial government, the Riam Kanan Project Area is estimated to have a population of about 560 thousand and about 580 industrial establishments. It is therefore recommended that a total of 60 man-days be secured for the survey on industrial establishments. As for the demand for household power supply, no particular mention is made here for its survey since various kinds of surveys can be made by virtue of the flexibility of sample size. It is also recommended that the said survey on power demand will be ensued, without delay, by the planning of power utilization since it will become the basis of a comprehensive development of this area involving its industrialization, moernization of its rural communities, and development of its infrastructure.

Proposal 3: Periodical review of the progress of development project ((inclusive of survey programmes) and preparation of reports

Reviewing the progress of programmes and plans incorporated in the development project and compiling its results into a report is necessary not only for effective adjustment and timely implementation of the project but also facili tates the request for foreign aids with the data that can be presented to the contributing party. It appears that the basin is backward in this task which is basically to be conducted by both the provincial government and the Central Government. With the progress of development, it will become necessary to consider the dispatch of project planners (foreign experts or staffs of the Central Government) to the provincial governments as advisors. At the present stage, implementation of this task is made impossible by various situations of the basin. In this connection, it is hoped that a system will be established under which the staffs of the Central and South Kalimantan Provinces can work in close cooperation with each other.

Proposal 4: Establishment of a standard for appropriating the contributions of the Central Government

Filling the trade gap (or the gap between savings and investments) will remain a matter of grave concern for the basin's fi ture development. Granting that foreign aids will increase in future, it is believed that, after abolition of the ADO system, the Central Government will finance the greater part of funds with which to fill the trade gap. A recent analysis on the finance of the Central Government presented some ambiguous points with respect to the distribution of the past appropriation among provinces, particularly the standard for distribution, of the contributions *6.

For the future development of the basin, the team hopes that the Central Government will soon establish the standard for such distribution on the basis of the size of regional trade gap. It is to be noted that in establishing such standard, the definition of trade gap and the method of its estimation should be determined with reference to the estimation of the framework mentioned in Proposal 1.

Proposal 5: Implementation of measures for more productive utilization of industrial resources

Efforts for more productive utilization of the basin's industrial resources should be made in parallel with active agricultural development. Development of industrial resources generally produces the following merits.

(i) Increased foreign currency earnings

(ii) Incentive impact on industrialization

(ii-A) Refining and smelting near the mines

(ii-B) Reinvestment

(ii-C) Manpower development of local inhabitants in managerial and technical abilities

(ii-D) Business cooperation with local capitalists

(iii) Development of infrastructure combined with the development of resources

The following may be said about the basin's industrial resources when diagnosed with respect to the above merits.

(i) Increased foreign currency earnings appear to be the largest merit derivable from the development of industrial resources.

(ii-A) Activities of the modern manufacturing industry can be seen only at two plants, i.e., PERTAMINA plant at Tandjung and the paper mill at Martapura which is scheduled to be put in operation this year. With the exception of these two, all plants in the basin including sawmills and rubber refineries are operating on a small scale. In the mean time, therefore, concentrated efforts should be made to make the paper manufacturing at Martapura get under way and develop into a profitable business.

(ii-B) There seem to be no signs for reinvestment. In the case of timber, it appears that foreign firms center on the purchasing activities and are not inclined to embark on the timber processing with the profit they earn. Investment reported to be currently made by them for mechanized transportation of timber is therefore hoped to be expanded to cover planting activities. Timber is considered to yield a higher overall profit when sold in logs and has little inducement to the development of manufacturing industries which use it as raw material. However, since the timber processing is fairly in progress in the Philippines, Sabah and Sarawak, it could become one of the basin's core light industries if continued efforts are made for its encouragement from the long-range viewpoint. With respect to mineral resources, no resources have yet been found excepting petroleum that serve as a powerful incentive tool for the basin's industrialization. Petroleum induces industries which require a huge capital investment, but the development of such petroleum-oriented industries in the basin is beyond prediction.

(ii-C) Since the timber production is supported by the purchasing activities of foreign firms not inclined to invest in timber-affiliated industries, there hardly exist the chances for local workers to elevate their managerial and technical abilities. A substantially large number of labourers are being employed in the civil engineering work of the Riam Kanan Dam which is not directly related to the development of manufacturing industry. As things stand now, there are no opportunities for making a successive and effective use of the improved quality of labourers attained through the dam construction. With the completion of the dam drawing closer, the problem is pressing and manpower development through a next project must be planned. The team proposes the irrigation project for this purpose.

(ii-D) Although Bandjarmasin has the possibility of the largest capital concentration in the region, the team did not receive the impression that there are entrepreneurs who have a sizable capital and are engaged in other business lines than commerce and servicing business.

(iii) Timber transportation in the region encountered no particular problems in the past through the utilization of the mainstream and tributaries of the Barito and canals. With the sharp upward trend of timber export noted recently, however, the existing poor condition of canals and the port is expected to hamper smooth timber transportation in the near future. It is also expected that the rehabilitation of farm economy will result in smoother commodity distribution. Hence, the team wishes to emphasize the need for drawing up a long-range plan for improvement of canals and port facilities. It is also to be pointed that a specialized centre of timber shipment should be established for effective investment in infrastructure.

1-4 Conclusion

By priority order, the aforementioned proposals can be arranged as follows:

(1) Execution of basic surveys and specific surveys

(2) Establishment of a standard for appropriating the contributions of the Central Government

(3) Periodical review of the progress of survey and development projects for preparation of reports

(4) Drawing up of a plan for overall utilization of resources

(5) Estimation of the scope of development

. . . . . .

*1 Labour practices and efficiency of local labourers are important factors to be considered in pushing forward a development scheme. This is particularly so if the development is planned in the tropical zone. The "Report on the Survey for Forest Resources Development in Kalimantan, 1962" which was prepared by Nanpo Ringyo Kaihatsu Iinkai (The Committee for Development of Forest Resources) contains a rather critical comment on the labour practices and efficiency of Indonesian labourers in Kalimantan. Further, a report on the labour efficiency in the tropical zone (Malya) states that the farmer's working hours averages 3.3 hours (1.3 hours of heavy manual labour, 1.2 hours of moderate labour and 0.8 hours of light labour). It is hoped that studies on the labour practices and efficiency will be made with various factors in Kalimantan taken into consideration.

*2. Plentiful sociological data on Java are made available by the prewar Dutch studies conducted chiefly by Leiden University and by the postwar American researches centering on Cornell University. In contrast with this, the sociological findings on Kalimantan are extremely limited. Only one small village in Kalimantan is taken up even in the "Villages in Indonesia (ed. Koertjaraningrat)" which is a well known outcome of postwar studies on Indonesian rural communities. It is considered that the sutdies on Indonesia by overseas academic circles have not yet reached the stage that makes it possible to give any definite statement on the general conditions of rural communities in Kalimantan.

*3. Population increase by migration is considered to be small on the basis of data and information contained in G. McNicoll's "Net Migration between Java and Outer Islands" (Bulletin of Indonesian Economic Studies, March 1969). It may be added that A. Partadiredja gives an evaluation based on more detailed data in his "Economic Survey of South Kalimantan" (BIES, July 1970).

*4. Refer to G. W. Jones, "The Growth and Changing Structure of the Indonesian Labour Force, 1930 - 1981" (BIES, June 1966) in which the estimated structure of labour force by age is given. It is unknown, however, how the factors of population migration are treated in this report.

*5. Preparation of statistical data for mapping out the region's development can be considered to follow the following steps.

Step 1 - Region's production activities are known for the most part and its disbursements are clarified to some extent.
Population statistics are complete.

Step 2 - Roughly classified statistics on the inter-regional movements of products are available. Population migration is clarified.

Step 3 - Statistical data are available on capital stock, labour force, wages and other incomes, money flow, and capital movement.

Step 4 - Industry-wise indices are made clear.

The team hopes that steps 1 and 2 will be attained in the near future.

*6. M. Sanders, "Regional Finance" (BIES, July 1970), p. 69

Table 1-2 Projected Per Capita Income

	Projected Annual Growth Rate	Projected Annual Growth Rate of Population	Per Capita Income		
			(1980)	(1990)	(2000)
Case A	4.5	2.6	108	129	148
B	6.0	2.6	125	171	222
C	6.5	2.6	130	189	261
D	7.0	2.6	138	211	311

Notes: 1. 1970 (per capita income - US$90) is taken as the base year.

2. Estimated growth rate for all cases is taken from the estimation for development strategy in the Tinbergen's Report which was adopted at the United Nations.

2. REGIONAL DEVELOPMENT

2-1 Present Condition of the Barito Basin

The area of the Barito basin is reported to be about 60,000 km^2. In the flat topography with hilly areas in eastern and northern parts, plains and swampy area extend over the midstream area down to the downstream area. Though the greater part of the basin is neglected for utilization and development, this vast undeveloped area seems to have a great growth potential. For development of the basin, it is necessary to make a thoroughgoing survey on natural conditions of this region which has a vast and flat topography, high temperature through the year and excessive volume of water. It is also necessary to find out if the region's detered development is due to its severe natural conditions or some other impediment.

Natural water in the basin is giving its inhabitants both benefits and threats. A new development must be commenced with control and utilization of such natural water, which, however, require basic data such as reliable topographic maps, meteorologic and hydrologic records made by continuous observation for a long period, and also proper analysis of characters of natural and land conditions according to such data. Kalimantan is still left behind other islands like Java with respect to surveys required for the clarification of natural and social conditions, and also lacks in important statistical data covering a long period. Development must be started with the fundamental enlightenment for the understanding of the importance of such data, establishment of observational system and training of observation. Investment for the above-mentioned purposes will prove useful for the future.

2-2 Industrial Development

(1) For the development of the region, the first necessity is to raise the standard of living of farmers who are reported to occupy more than 80% of the total population, namely, to secure self-supply of food, increased income and stabilized livelihood for poor farmers. Rice cultivation is the main line of agriculture in the region. However, farmers income is small and unstable, as planted area per family is small, they follow the traditional farming method, and the greater part of the agricultural products is consumed by themselves.

In order to satisfy the said recessity, modernization of land use and diversification of farm management are to be implemented with the enlightenment of farmers and strong measures for assisting them. Without such measures, no fruitful results will be yielded by the food production increase plan which requires a large investment and high-level technique, because education is not spread far and wide and per capita income is very small in the region. Farmers have long been adapting their way of production, selection of variety and farming method to the characteristics of land and climate. Even a partial change in their farming system may cause a considerable revolution to their pattern of life, untiring efforts for a long period will be required for introduction of an advanced production system into such a traditional mode of farming. Therefore, it is necessary to gradually educate and persuade the farmers with practical experiments and actual results of crops.

The team observed that some fine agricultural facilities were not put into effective use and felt the need for a thoroughgoing follow-up in implementing agricultural development.

(2) The projects now under way with public investment must be pushed forward from the overall viewpoint, because planning of rivers, agriculture, forestry, port and road construction are closely related to each other in the development of the region.

Agricultural production, especially that of rice is directly subject to the effect of water control. It is heavily damaged by flood, and yet the damage is in a chronic state by repeated flood. It is necessary to conduct a quantitative survey on the damage incurred on agricultural production, and agricultural development project and measures for both flood control and water utilization must be complehensively planned. Economic evaluation of such project and measures is considered to be probable. A huge amount of funds and a long period of time are required for overall development of the Barito basin and therefore an overall regional development plan is necessary for partial implementation or step-by-step implementation of development project from tributary areas. It is an urgent advice to make a basic survey for river development.

Distribution of commodities is carried out in a small volume and within a small sphere. Balance of demand and supply of agricultural products is not attained, and prices are unstable. For the purpose of improving and developing agriculture, it is necessary to protect farmers' interest through wholesome improvement of cooperative organizations and introduce modern farming techniques, and also to improve transport means and distribution system of fertilizers and products. There are some cases where crops are rotten due to excessive stocks caused by lack of shipping means. Comprehensive planning of fundamental conditions for development is closely related to the extensive regional development, the greater part of which must necessarily rely upon public investment. It is necessary to make efforts to enlarge investment for development.

(3) Percentage of the unemployed or latent unemployed in rural communities seems to be very high. Farmers are subjected to a low standard of living with a large family and a small income. Improvement of agricultural productivity is naturally indispensable, and industrial development is required for giving an impetus to economy and enlarging employment.

As for mineral and forest resources, development of latent resources must be carried out with modern techniques, and enlargement and mechanization of mining system must be propelled to encourage region's economy in the future.

Small-scale timber mills of manual operating system scattering all over the region must be unified, coupled with the modernization of facilities and introduction of mechanized system, and it is advisable to develop these mills to induce other industries in the future. It is better to centralize these at several key points, enlarge employment, increase consumption and and connect the industry gradually to the regional development. Such an industry will be influenced by water to be obtained from the Barito by water control in the future.

2-3 System of Development

(1) It is necessary to confirm the present condition of land use and its characteristics by conducting a detailed survey using the existing simple land use map which is available in South Kalimantan. In this case, it is necessary to read such a map together with proper topographic map that is fatally lacking at present. The map will manifest that many areas which are available for development are left unused. It is recommendable to estimate the possibility of land use, plan a trunk road network enough for a future demand for transport and promote step-by-step development projects for various fields. As waterways are important transport routes like roads, it is necessary to establish effective connection between waterways and roads.

In East Kalimantan Province, a project is in progress for the road between Samarinda, the capital of the province and a port for shipment of timbers, and Balikpapan, a base for petroleum. This project will become a motive power for the development of the area.

In South Kalimantan, road improvement is planned from Amuntai and Tandjung to East Kalimantan and a part of this project was already started.

It is recommended to promotethis project of raod construction. In Amuntai area, an agricultural development project is being undertaken. This area is blessed with favorable conditions of land and water and will be a promising farming area if measures for river training are taken. In Tandjung area, production of oil and gas is managed by PERTAMINA plant, and this area keeps a possibility of industrial development. Therefore, regional development resorting to a road network between this area as the key point for development of the northern area and Bandjarmasin in the south and Balikpapan in the east will be effective, and will be followed by some effective economic propagation and promotion of development plans.

As for the area between Bandjarmasin and Tandjung, a national road runs through the eastern hilly zone. This road is not well maintained, and requires some reinforcement. For reinforcement of road network, it is recommendable to plan a new network from the viewpoint of development of the basins of eastern tributaries, and such a project must be planned in integration with the river development and agricultural development.

(2) Indonesia consists of five large islands and other so many small islands. Accordingly, the coastwise service has been the main traffic means between producing areas and consuming areas, and overland traffic has been developed from ports. Kalimantan is no exception and Bandjarmasin Port and others have steadily been improved. However, they are still not in a satisfactory condition. The estuary of the Barito is remarkably blocked up by sediment load to obstruct the development of navigation. It is considered that development of inland transport and communication facilities must be planned as an integrated project.

Media for exchanging information are still undeveloped among islands, regional differences are very outstanding, each race has its own indigenous language, little economic interchange is made with each other and population density is ill-balanced. No large commodities movements are observed

between South Kalimantan and East and Central Kalimantan, too, and the routes among the three provinces have not been considered to be important traffic network. It is of vital importance to improve Bandjarmasin Port and waterways connecting Kapuas and Kahajan areas. It is also necessary to plan development projects for roads in inland areas and effective connection of traffic routes on the basis of an economic and technical study on the overland and marine transport.

2-4 Road Development

Road, port, aeronautical transport, telecommunications, etc. are still underdeveloped. Road extension of the entire Indonesia is as small as 0.05 km per km^2. and it is considered that road extension in Kalimantan must be even smaller. The Five-Year Development Plan of Indonesia attaches importance to road plan aiming at improving more than 50% of the existing roads and constructing required road at minimum.

In South Kalimantan Province, national roads are slightly consolidated only for such routes that connect Bandjarmasin with Kandangan, Amuntai and Tandjung in the north and Pelaihari in the south. Roads are paved with thin penetration asphalt and their width is small, and bridges are in a poor condition. No other well equipped roads than these are observed. Traffic in Central Kalimantan Province depends upon waterways. Such poor development of transport means is a serious impediment to regional development. Improvement of roads must be undertaken at an earliest date, because roads give an effective impact on industrial development and modernization and elevation of living standard.

As investment in roads as social overhead capital calls for a huge investment and a long period, it is necessary to estimate economic structure and industrial arrangement in the future and set up project plans for trunk roads adequate for future demand for transport. For the region, however, it is extremely difficult to calculate the scale of industry and economy in the future by means of various data available at present to estimate an adequate scale for investment in road improvement. It is rather advisable to promote road improvement preferentially as an initiator for development. Regional development shall be promoted by such an impetus.

It will be effective to connect, by a road, Amuntai area and Buntok or other villages situated along the main course of the Barito. Construction of such a road must be planned in combination with agricultural development plan and river improvement plan under economic and technical study, for example, for construction of roads that also serve as embankments. As the region is swampy, construction of roads will require a huge amount of funds and a thoroughgoing study from civil engineering viewpoint. As for the areas that are frequently damaged by flood, comparative study is necessary to determine whether a perfect flood-free road should be constructed or a low-cost road which may be submerged by flood water be provided. In the latter case, maintenance cost must be included every year.

In addition to the above-mentioned trunk road network plan, development of branch roads to be available for local traffic must be planned. Planning of agricultural development project should be accompanied by consideration of some transport routes through which products are shipped out and fertilizers are transported, and transferred to the trunk road. Development of branch roads are in close relation with farmers' life.

As for the canal zone, it will be useful for the future to plan projects of transport route and trunk roads including utilization of excavated soil of canal construction according to a long-range viewpoint.

2-5 Urban and Rural Communities

(1) It is observed that population is concentrated in Bandjarmasin and other places located along the trunk road in the eastern hilly zone, as well as in places along the river bank where habitation and development must be comparatively easy.

Planning of development project of the region requires survey on distribution of these communities, condition of location, and wisdom of life for adaptation to particular natural conditions.

Some study and survey must be made about religion which is considered to have influence upon inhabitants' view of life and living.

Bandjarmasin is a large city with a population of 260,000. However, it is not well equipped with sufficient facilities and function as an urban community. Some appropriate countermeasure must therefore be taken. In this city, sanitary thought is not yet well diffused among the citizens and their way of life is exposed to danger of infectious diseases. It is advised to undertake an urgent improvement of urban facilities such as street planning and sewerage system, in company with promotion of the waterworks project now in progress.

(2) People are observed to be living in alang-alang area which is the mark of shifting cultivation and in degenerated forests. Long-range survey by means of experiments is necessary to study the adaptation to the natural conditions in such areas.

2-6 Conclusion

In conclusion, it is recommended that development of the region be synthesized with flood control and water utilization and development projects for agricultural and other industries and various fields. Though it is naturally important to make efforts for development of resources reserved in the vast basin and to activate economy, an urgent necessity for the moment is to raise the living standard of the farmers, the greater part of inhabitants.

Development of the region must be promoted step-by-step centering on basic points, and development of infrastructure must be pushed forward as it is a motive power for regional development.

It is recommended to start, at an earliest date, collection and consolidation of basic data such as topographic maps and others.

3. TOPOGRAPHIC SURVEY

3-1 Existing Availability of Topographic Maps

In conducting surveys for a regional development or implementing a project for any development, adequate maps or air-photographs covering the project area can never be dispensed with. Present status of these basic data on the Barito basin cannot be considered satisfactory as mentioned below.

(1) Air-photographs: Air-photographs on the basin were prepared by the U.S. Forces around 1947, but they lack uniformity in both coverage and scale.

In 1969, an area of approximately 10,000 km^2 in the lower Barito basin was oovered by aerial photograph conducted by KLM Aerokarto on a scale of 1/50,000 (See Fig. 3-1).

(2) Topographic Maps: There are topographic maps covering the greater part of the basin on a scale of 1/500,000. Besides these, there are maps prepared on a scale of 1/250,000 and 1/100,000 which mainly cover the lower basin (See Fig. 3-1). All these maps are outdated and need revision because of secular changes which have been brought in these nearly 20 years. Further, maps on a scale of 1/50,000 which are most needed for the development planning are nearly inexistent.

Apart from the above, there are maps such as prepared by P.N. PERTAMINA for geological survey. These maps, however, cover only a part of the districts and have no standard specification in details and scale, and are kept by respective organizations, and not concentrated to any single organization.

3-2 Basic Principle for Topographic Mapping

As described above, existing maps of the Barito basin were prepared many years ago and have no standard specification in both details and scale. Further, there still remains an extensive unmapped area in the basin. It is thterefore necessary to establish a certain specification and programme for covering the entire project area by a uniform standard, and then to carry out, on the basis of such specification and programme, revision or compilation of the existing maps and mapping of unmapped areas.

In carrying out the topographic mapping programme for the extensive area of the basin systematically, it is preferable to keep close coordination with the National Mapping Programme in Indonesia. The topographic mapping programme is as outlined below.

Air-photo taking of unmapped areas and collection of existing air-photographs should be given priority over any other surveys because air-photographs on an adequate scale are needed above at first for topographic mapping and photo-interpretation for any purpose. When drawing up the programme, due attention should be paid to scale and specification so as to be able to make full use of the modern photo interpretation techniques. This will make it possible to get information on soil condition, geographic features, geological condition and forest resources by photo interpretation. Topographic maps which provide the basis for representing these results should be prepared in advance using the techniques of photogrammetry.

Control survey in the basin should be conducted with priority given to precise levelling rather than to planimetric survey. However, geodetic co-ordinates of necessary control points with adequate accuracy and density should be prepared to be in time as the basic data for the future development projects. Detailed programmes for respective items are as given below.

3-3 Air-Photo Taking

Air-photo taking in the Barito basin should be performed at the earliest possible date prior to any other surveys.

Considering the photogeometric conditions for topographic mapping, photo interpretation, and meteorological conditions, the entire basin should be covered with a photo scale of 1/40,000 to 1/50,000. For the 10,000 km^2 area in the lower basin embracing Bandjarmasin, air-photographs on a scale of 1/50,000 taken by KLM AEROKARTO in 1969 may be utilized.

For specific areas which demand maps on a large scale of about 1/10,000 for implementation of irrigation and other development projects, air-photographs on a scale of 1/20,000 to 1/30,000 will also be required.

3-4 Control Survey

The standard height gauge in Bandjarmasin should be re-examined connecting with the tide observations in order to determine the mean sea level at Java Sea as the height reference plane of Kalimantan. This should preferably be conducted with a tide-gauge station constructed at least temporarily on the direct seaside to avoid the influence of river water.

This new standard height should be used as the reference of the forthcoming levelling work along the main roads connecting major cities such as Bandjarmasin, Rantau, Kandangan, Barabai, Paringin, Amuntai, Tandjung, Buntok and additional routes to hydro-observatories which will be established on the river banks in future. (See Photo 3-1)

In this case, kilometer posts on the main roads (Photo 3-2) will serve as bench marks. These levelling networks can be completed within two years.

The levelling networks thus prepared are considered as primary networks, and further detailed levelling for individual project, such as irrigation, can be carried out starting from these primary networks.

Triangulation survey will take much more time than the case of levelling. It should therefore be started with a sufficient time so that the results can be used for the implementation of actual project that calls for its outcome.

Astronomical points should be established for about every 100 km and triangulation networks should be established based on these astronomical points. Modern distance measuring instruments with electrical or optical wave will be very effective for these triangulation works.

3-5 Mapping

In order to get the general view of the entire basin, maps on a scale of 1/250,000 with 50 m contour are required. There exist several maps on this scale which cover portions of the basin, but they need revision survey to renew the details which can be easily realized using new air-photographs.

Maps on a scale of 1/50,000 with contour interval of 20 m will be required for these areas where development potential is relatively high. The contour interval should be reduced to 5 or 10 m for flat area and hilly areas.

In addition to these, maps on a scale of 1/10,000 with contour interval of 1 to 2 m will be required for such areas as Riam Kanan Irrigation Project Area where the agricultural development project has come to the stage of detailed study and review. Compilation of these maps should be carried out by the following normal procedures for which prudent preparation works should be made in advance:

Establishment of air-photo signal, control survey, air-photo taking, field reconnaissance, aerial triangulation, and plotting

In the aerial triangulation, electronic computers should be used to obtain the results with the sufficient accuracy within a short period.

Since the aforementioned mapping work is both costly and timeconsuming, the order of its implementation should be decided carefully considering the progress of each project.

If maps are urgently required, photo maps will meet the emergency need. It is also worthwhile to consider the possibility of substituting the conventional topographic maps with orthophoto maps that can be prepared by the orthophoto technique which has shown a remarkable progress recently.

The Barito basin is still underdeveloped and has a small population, and no diversification is yet attained in its land use. Presentation of land condition rather than land use should therefore be given importance, and maps should preferably be prepared with the aid of photo interpretation to serve the dual purpose of topographic map as well as land condition map, because maps so prepared will prove useful for practical purpose.

3-6 Photo Interpretation

Since field surveying works are very difficult in the basin, photo interpretation is indispensable for surveying forest resources, soil condition, geology, etc. Hence, it is necessary to consider the conditions for photo interpretation when determining the photo scale, and topographic maps should be compiled using the results of these photo interpretations with the minimum field works. Maps so prepared are basic topographic maps, which can also be used as land condition maps to some extent by entering the results of photo interpretation.

Colour photographs, infrared photographs, and pseudo colour photographs are quite effective in identifying forest trees, in detecting diseases and insects and in surveying geology, soil condition faults, etc. Aerial photography of these special type is therefore advisable.

It goes without saying that photo interpretation for geological or forest survey must be conducted under the close cooperation with the experts in respective fields.

3-7 Priority and Cost of Topographic Survey

Topographic survey should be carried out with due attention paid to the progress of development project, and priority should be given to those areas showing the most advanced progress of project. Meanwhile, due account should be taken of the smooth execution of continuous flow work so as not to cause time lag to the following works or any obstacles on the accuracy or detail works.

Under the present status of very poor existence of reliable maps on the Barito basin, the priority should be given to air-photo taking.

And levelling in the most important areas should also be given high priority to provide one of the basic data for flood control and water utilization.

Besides these two surveys which should be implemented before all other survey, there also are topographic surveys needed for various survey projects and other basic surveying which should be started immediately because of the lengthy time it requires.

Priority order and cost of these surveys are given in Table 3-1.

Table 3-1 Priority Order and Cost Estimation of Topographic Survey

Priority	Item	Description	Coverage	Estimated Cost (US$)
1st stage	Aerial Photography	Scale 1/40,000 - 1/50,000	Approx. whole basins about 75,000 km^2	220,000
	Detailed Levelling	Along the main road Tolerance of Accuracy: $5mm\sqrt{km}$ $5mm\sqrt{km}$ $10\ m\sqrt{km}$	Estuary of the Barito river, Amuntai, Tandjung . . . . . 900 km Tidal Area . . . . . 400 km Tandjung-Buntok . . . . 200 km	112,000
	Revision of Small Scale Map	Revision of the existing Map (1/250,000)	Middle- and downstream area Upstream area 75,000 km^2	70,000
	Compilation of Small Scale Map	Mapping of the unmapped area		
	Compilation of Medium Scale Map	Scale 1/50,000 (with photo interpretation)	Middle- and downstream area Up- and middlestream area 75,000 km^2	370,000
			Sub-total	772,000
2nd stage	Control Point Survey	Astronomical survey 10 points 1st order triangulation 30 points 2nd and 3rd order triangulation 1,000 "	For each 2,500 km^2 in the lower basin " 100 km^2 " " 15 km^2 in the priority area	380,000
			Total	1,152,000

As all these topographic surveys provide the basis for all other surveys and project, they should be embarked upon as early as possible.

3-8 Conclusion

While maps are the most basic and indispensable data to be furnished for any surveys or development project, availability of maps and air-photographs of the Barito basin is extremely limited at present. Therefore, the preparation of such maps and air-photographs and the control point survey should be implemented on the basis of a long-range plan.

It entails many difficulties requiring enormous man power, expense and time, to carry out the sequence of fundamental surveys such as control point survey, air-photo taking, photo interpretating and plotting simultaneously.

These surveys should thterefore be implemented in accordance with the priority order needed for development and other survey works. Also, these which provide basic data for other surveys are given the highest priority. Areas requiring these surveys should also be arranged by the priority order, and those areas having the greatest demand should be given the top priority. It is to be noted, however, that such priority order should never disturb the systematized flow of total survey activities or impede the long-range survey schedule.

According to the said priority order, air-photo taking and topographic mapping for the master plan of the entire basin should be carried out first. Therefore, air-photo taking on a scale of 1/40,000 to 1/50,000 covering the Barito basin and precise levelling along the main roads that connect the important places in the basin must precede all other surveys. At the same time, revision of the existing maps on a scale of 1/250,000 and mapping of the unmapped area with this scale should be carried out as well as the extension of the levelling up to Buntok in the middle stream.

The above surveys should ensued by the compilation of maps on a scale of 1/50,000 which cover major areas of the basin and which should concurrently serve as land condition maps with the additional results of photo interpretation.

As the next stage, maps on a scale of 1/10,000 will be prepared to cover respective development project areas. In this case, however, photo maps on a scale of 1/50,000 could be prepared if the demand is pressing.

Control point survey for the entire basin which will be started with astronomical observation, should be planned to have a sufficient time allowance so that it will meet the future requirement of detailed survey and topographic survey.

Photo interpretation should be so planned that it is conducted systematically with the close cooperation of experts specialized in respective fields, such as forestry and geology to provide all the necessary information in time.

Fig. 3-1 Coverage of Existing Maps and Aerial Photos
(KLM AEROKARTO)

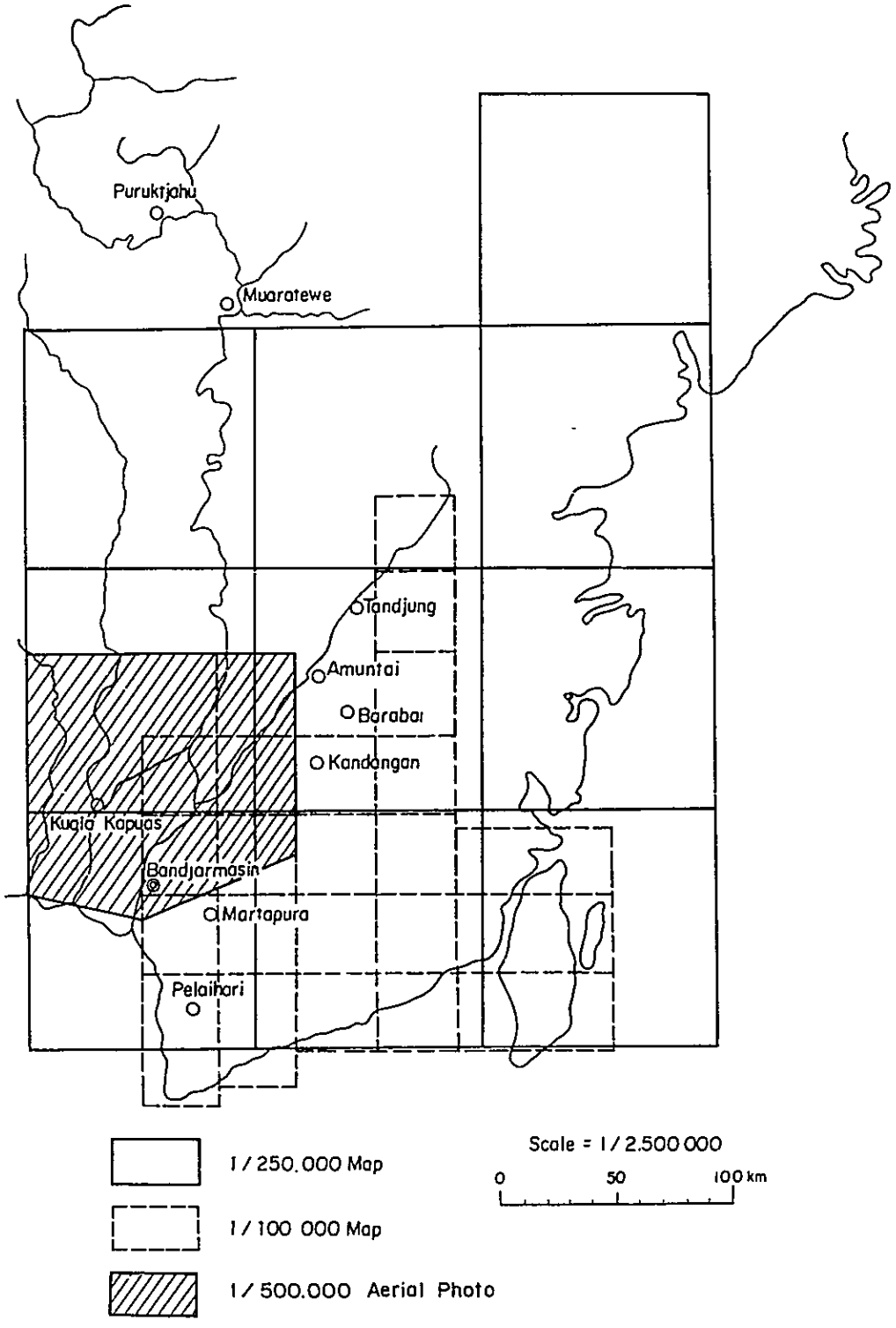
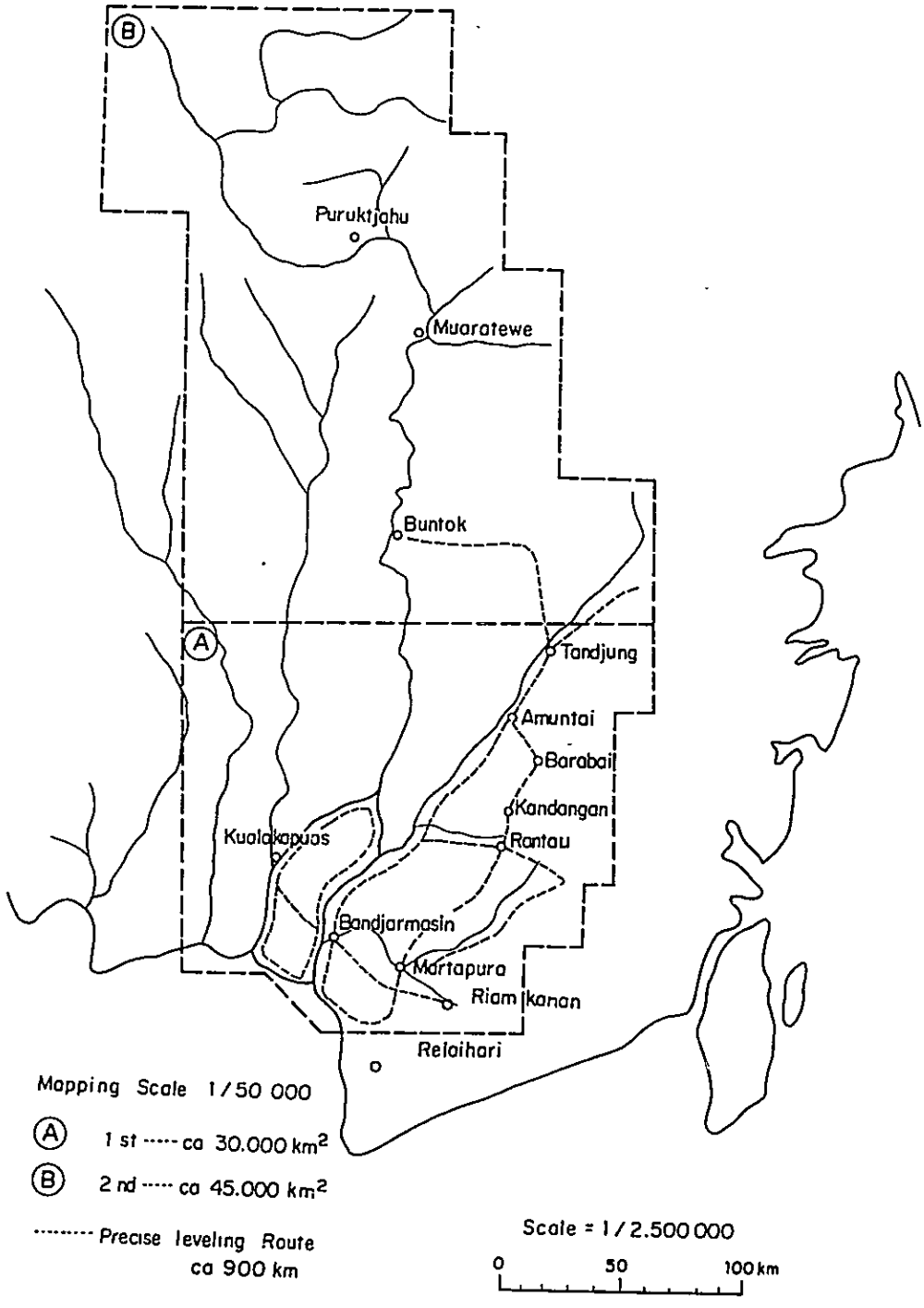
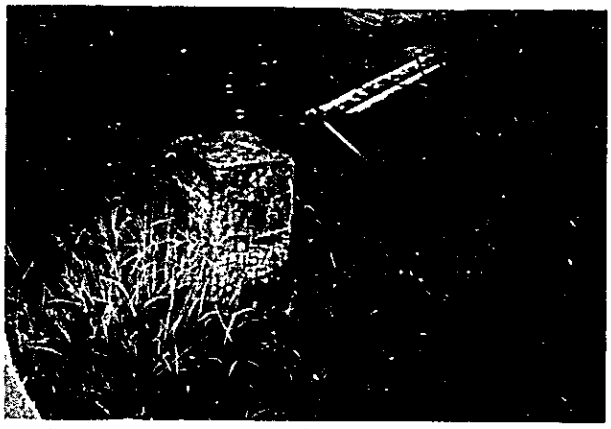


Fig. 3-2 Proposed Mapping Area





3-1 standard Height Gauge

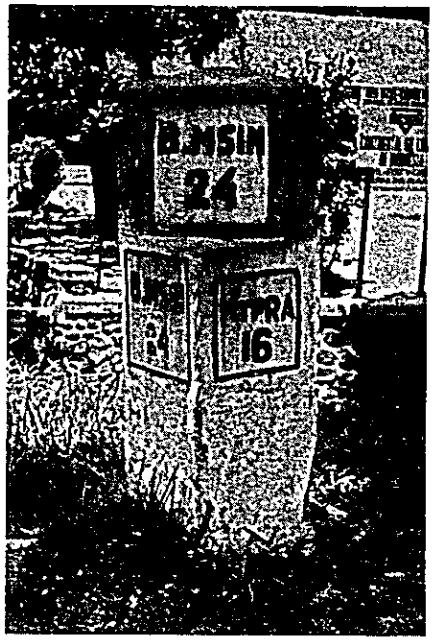


Photo 3-2 Kilometer Post

4. PORTS AND WATER TRANSPORT

4-1 Ports and Water Transport Facilities in the Basin of the Barito

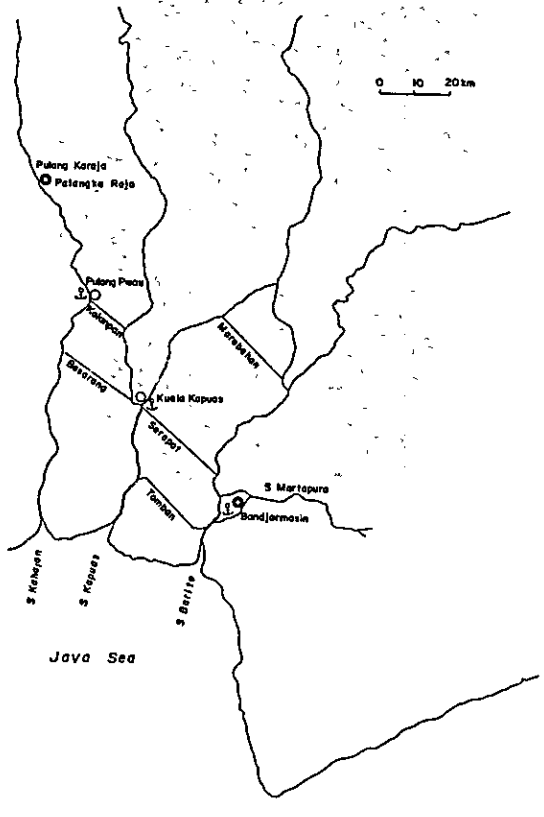
4-1-1 Outline

Though the object of the survey was the basin of the Barito, the two rivers running in parallel to the Barito, namely, the Kapuas and the Kahajan and canals linking these rivers cannot be ignored when discussing ports and water transport for the region. The ports in region include, besides the Port of Bandjarmasin, the largest city in the region, Pulang Pisau Port, a timber shipping port, in the lower reaches of the Kahajan and Kuala Kapuas Port on the Kapuas. The location of these rivers, canals and ports is shown in Fig. 4-1.

One of the major obstacles to the smooth function of ports in the region is the development of huge bars at the estuary of each river, making the water depth very shallow and preventing the entry of large ships.

Vessels of the 500 - 3,000 D/W class are being operated on the line for inter-insular service including the line for Singapore with which the region is closely related. At the Port of Bandjarmasin 235,000 tons of cargo, mainly rubber for export, is handled annually (1969) by ships of the above-mentioned tonnage and by sail boats of less than 100 tons on coastal service. Export of timber from Pulang Pisau Port, meanwhile, is mainly for Japan and 43,000 m^3 of timber is being shipped monthly (August 1970) by the 3,000 - 5,000 D/W class vessels. However, because of a bar developed at the estuary of the Kahajan, the volume of loading at Pulang Pisau Port is limited to about 2,000 m^3 and the remainder is loaded in the sea off Taboneo near the estuary of the Barito or in Sabangan Bay in the west of the estuary of the Kahajan.

Fig 4-1 Location of Ports and Canals



4-1-2 Port Facilities and Movement of Cargo

In Bandjarmasin there are an old port which has been developed from old times on the bank of the Martapura, a tributary of the Barito, and a new port (in the district of Trisakti) which was completed in 1964 on the bank of the main course of the Barito. While the old port is situated almost in the center of the city of Bandjarmasin, the new port is located approximately 3.5 km from the center of the city area. As the Martapura curves sharply before it meets the Barito, obstructing navigation of large ships, a short-cut is provided by Bromo canal. Their geographical locations are shown in Fig. 4-2. Port facilities in Bandjarmasin are shown in Table 4-1.

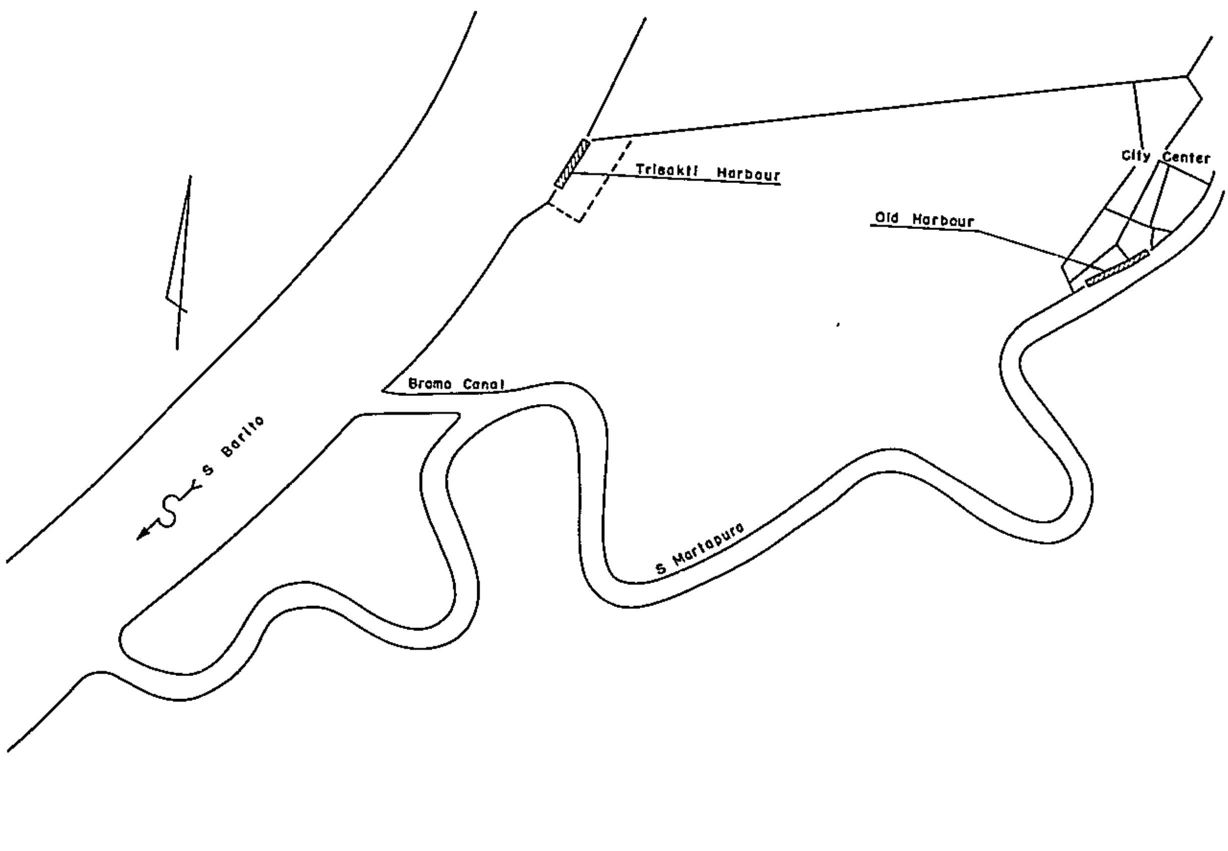
Table 4-1 Facilities of the Port in Bandjarmasin

Description	Dimensions and capacity	Remarks
Mooring facilities of old port	348 m long and 10.5 m wide Withstand the load of 950 kg/m^2	Wooden pier
Mooring facilities at Trisakti Port	200 m long and 8 - 16 m deep	Concrete apron
Transit sheds (old port)	5 buildings, each having a floor space of 1,000 m^2	A, B, C, D & E.
(Trisakit port)	One building with a floor space of 6,000 m^2	
Warehouse (old port)	10,000 m^2	
Cargo handling machinery	10 t	Owned by Riam Kanan Project
	25 t	Owned by PN PERTAMINA
Fuel supply	Difficult	
Supply of drinking water		Target of completion set for 1972
Wireless station		Target of completion set for the end of 1970
Jetty wharf for sail boats	15 m in length	Old Port
Petroleum pier	30 m in length	Owned by PN PERTAMINA
Repair & maintenance facilities	Up to 100 tons	Slipway

At the old port there is a wooden pier, 348 m long and 10.5 m wide, built of mainly ulin (iron wood). This pier is estimated to withstand a vertical load of about 1 t/m^2 and is also considered to be serviceable for many years in the future. The water of the pier front is 2.5~5.0 m deep. In the district of Trisakti there is a modern pier with a concrete apron extending 200 m. The water depth of the pier front is 8.0~9.0 m. Besides, there is a jetty wharf, 15 m in length, for specific use by sail boats at the old port. The volume of cargo which can be handled annually in these quay walls is estimated at 200,000 tons in the district of Trisakti and 115,000 tons at the old port, totaling 315,000 tons. There are five transit sheds (A, B, C, D & E), each having a floor space of approximately 1,000 m^2, at the old port area and one shed with a floor space of 6,000 m^2 in Trisakti district. Sheds B and E at the old port area and the one in Trisakti district are new structures. Radio communication facilities (Radio Station) are scheduled to be completed at the end of 1970. Water supply system for drinking water is scheduled to be improved along with the expansion of water system in Bandjarmasin scheduled for 1972. The existing bunker is not adequate and its improvement in the future is hoped for.

The town of Pulang Pisau is a small town with a population of about 5,000 and the port which was opened there in 1967 handles only timber. Consequently, the only facility of the port is a simple landing pier besides the water area for anchorage and timber pond.

Fig. 4-2 Location of Bandjarmasin Port



Kuala Kapuas Port seldom sees the entry of large ships. However, the port seems to play its part as an important point of local communications and there are some landing piers for small vessels.

Nearly half of the ships calling at the port of Bandjarmasin is accounted for by the ocean-going freighters in terms of tonnage but the sail boat has an overwhelming share in the number of ships calling at the port. In 1969, for example, while there were 127 ocean-going vessels with a total of 470,000 tons, the sail boat numbered 1,999 with a total of 240,000 tons, the inter-insular vessel 481 with a total tonnage of 270,000 and the coastal vessel 122 with a total tonnage of 20,000 (Note 1).

No statistical data are available for oil-tankers, bulk-carriers and passenger vessels.

The volume of cargo handled at the Bandjarmasin Port is shown 4-2.

60% of the domestic cargo are being handled by sail boats. The pier 15 m long alone is allowed for use by sail boats and as a result, this pier alone is in congestion while other piers are relatively less crowded. (See Photos 4-1 4-3). As for the composition of export cargo based on the average of the 1965 - 1969 period, rubber accounts for 80%, timber 6% and rotan 5%. For imports, rice accounts for 50%, wheat 15%, textiles 10%, asphalt 10%, machinery 5%, sugar 2% and others. For domestic cargo, agricultural products accounts for 25%, sugar and other daily necessities 20% respectively, and construction materials 10%.

Pulang Pisau Port handles only export of timber. In 1969 a total of 240,000 m^3 of timber was exported from this port. In 1970 a total of 163 ships (610,000 D/W) called at the port by the end of August and transported 266,000 m^3 of timber.

Export of timber in the basins of the three rivers began in the past 3-4 years and the timber now holds the largest share in the total volume of cargo handled at the ports.

The volume of timber export from the three ports in recent years is shown in Table 4-3.

According to the Port Authority of Pulang Pisau, 65% of the timber exported from the port are cut in the basin of the Kapuas and the remaining 35% are from the basin of the Kahajan.

Export of timber from the port of Bandjarmasin began in April 1970 and the volume of timber exported reached 17,000 m^3 in August of the same year. However, the figure shown was not the volume of timber loaded at the port. The timbers cut in the upper stream of the Barito are carried to the estuary via Bandjarmasin and the ship which completed the first loading at Pulang Pisau Port picks up the second load at the estuary of the Barito (off Taboneo). As is evident from the above table, the timbers exported from Pulang Pisau Port hold an overwhelmingly large share in the total timber export at present. It is worthy to note, that this figure from Bandjarmasin is an indication that the development of timber resources got under way in the basin of the Barito. The timbers in the basin of the Kapuas are carried to Pulang Pisau via Kelampan canal.

Table 4-2 Volume of Cargo Handled at the Port of Bandjarmasin

(In 1,000 tons)

Year	Foreign Trade			Domestic Cargo			Total	Remarks
	Exports	Import	Sub-total	Out-bound	Inbound	Sub-total		
1965	47	5	52	105	91	196	248	
1966	51	4	56	91	85	176	232	
1967	61	4	65	58	67	125	190	
1968	66	6	72	61	79	141	213	
1969	78	4	82	52	101	153	235	
1970	30	11	41	53	76	129	170	until June

Source: Bandjarmasin Port Authority

Table 4-3 Export of Timber

(千 m^3)

Port / Year & month	Bandjarmasin	Kuala Kapuas	Pulang Pisau	Total
1969	-	2	240	242
January 1970	-	-	30	30
February	-	-	34	34
March	-	-	35	35
April	0	-	33	33
May	0	6	27	33
June	-	4	38	42
July	5	6	26	37
August	17	(5)*	43	65
1970 Total	22	22	266	310

Source: Bandjarmasin customs office and Pulang Pisau Port Authority

Note: Figures with *mark are estimated figures.

4-1-3 Estuaries of the Barito and the Kahajan

One of the most serious problems confronted by the ports of Bandjarmasin and Pulang Pisau is the bar developed at the estuaries on the two rivers.

Fig. 4-3 shows the location of the estuary of the Barito and the Port of Bandjarmasin.

While the Barito has a water depth of 6 m or more, the bar having a water depth of less than 2 m extends nearly 6 km in the offing of the estuary. The section where the water depth is less than 6 m extends over 11 km. According to various dredging plans worked out to date, the volume of dredging required is said to be as shown in Table 4-4. For the required depth of water of 6 m from L. W. L. (hereinafter all references to the water depth should be interpreted to be the depth from L. W. L.) and a width of 100 m, the volume of earth to be dredged is estimated at about 5 million m^3. In the table the figures representing the volume of earth to be dredged are those for the case in which the present river course and the navigation channel are brought to the same line.

Table 4-4 Volume of Earth to be Dredged at the Estuary of the Barito

(1,000 m^3)

Depth (m)	Width (m)	Volume of earth to be dredged
2.5	60	600
4.0	60	1,000
5.0	60	2,500
6.0	120	5,800*
8.0	80	6,000

Source of Item with * mark: Bandjarmasin Port Authority

The bar developed at the estuary of the Kahajan does not differ greatly from that at the estuary of the Barito in size and the section where the water depth is less than 2 m extends over about 7 km. However, the main stream of the river is less than 6 m in depth in some section and if the depth of 6 m is to be maintained in the river, the required dredging is said to amount to about 9 million m^3.

4-1-4 Inland Canals

The waterways centering around Bandjarmasin are the main stream of the Barito with its tributaries and four canals (Serapat, Tamban, Kelampan and Besarang), providing a linkage between the Barito, Kapuas and Kahajan. The network of these canals is shown in Fig. 4-1. The Barito is navigable for a section of about 700 km during the rainy season and about 500 km in the dry season. The width of river ranges from 300 m to 500 m during these seasons. The Kapuas is navigable for a section of about 200 km during the rainy season and about 150 km in the dry season with the width of the river in these seasons being 250~400 m. Elements of each canal are shown in Table 4-5. Besides the canals mentioned previously, the role of the Marabahan Canal and of a branch of the Barito, which joins the Kapuas, is also important.

Fig. 4-3 Estuary of the Barito River and the Port of Bandjarmasin

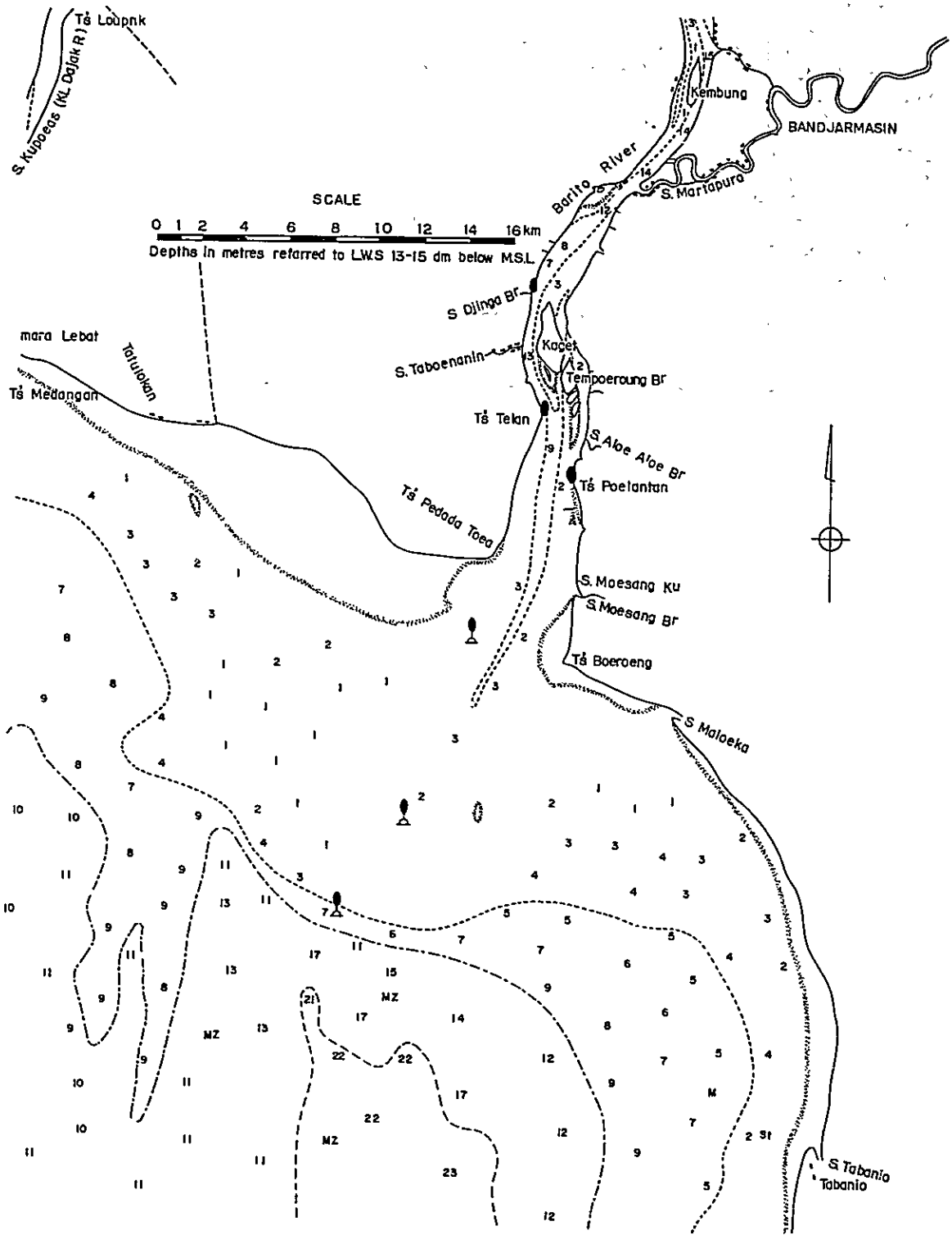


Table 4-5 Elements of Canals

Name	Total length	width	Depth (from ground surface)	Depth of * water	Time of measurement
Serapat	28 km	25~30 m	3 ~5 m	1.4 m, 2.1 m	9/29 7:25~10:05
Tamban	26 km	20~25 m	2.5~5 m	0.8 m, 1.1 m	9/30 9:40~10:50
Kelampan	14 km	20~25 m	2.5~5 m	1.4 m	9/30 6:20~ 7:00
Besarang	24.5 km	25~30 m	3 ~5 m	0.9 m~2.3 m	9/29 10:50~12:45

Note: * mark shows actually measured value during the survey.

In the above table the depth of water shows the results of actual measurements obtained at time of the team's passage of each canal during the survey. As these canals are influenced considerably by the tide, the water depth from the low tide level and the hourly change of water level are preconditions for the navigation. However, the only available tide table for this region is that for the port of Bandjarmasin. No data is available about the time lag of the tide and the extent of attenuation between the port of Bandjarmasin and each of these canals.

As the team passed through these canals at time of fairly high water level after selecting the hour on the basis of the tide table for Bandjarmasin, the depth of water shown in the above table should be interpreted to be that under a relatively favourable condition. When the water level is low, therefore, the depth will be considerably less than that shown in the table. For example, the depth of water in some section of the Tamban Canal is reduced to about 30 cm at low tide. In the Serapat Canal the traffic is heavy and during the 2-1/2 hours navigation in this canal a total of 40 vessels were observed exclusive of canoes. In this canal, however, many ilung float around and obstruct the navigation. It will be necessary to take some steps to solve this problem in the future.

The next canal with heavy traffic following the Serapat Canal is the Kelampan Canal. Timbers sent from the Kapuas are carried on floats to Pulang Pisau through this canal. As the canal is very narrow, the navigation of other ships is almost impossible while the raft passes through the canal. Other canals are not being used for navigation except by canoe.

According to the observation by the Land and Inland Waterways Services, the inland waterway transport centering around Bandjarmasin consists of mainly communication with the upper stream of the Barito and that with Kuala Kapuas via the Serapat Canal.

During the period from January to August 1970, a total of 60,000 persons and 23,000 tons of cargo were transported to Bandjarmasin via main stream of the Barito and a total 60,000 persons and 8,000 tons of cargo were also transported via the Serapat Canal.

4-2 Natural Conditions at the Estuary of the Barito

4-2-1 Availability of Data

The Hydrographic Division of the Indonesia Navy made a survey using a survey boat on the estuary of the Barito during the period from May 19 to August 5, 1970.

Survey items included were position survey, observation of current and wave height, survey on bottom materials and such meteorological observations as the observation of wind and precipitation.

A navigation channel having a depth of 3 5 m and a width of 50 m was provided at the estuary of the Barito by the Bandjarmasin Port Authority by means of dredging during the period from December 1969 to June 1970. The dredging was provided for the 2,380 m section on the side of the estuary and the 825 m section on the outside of the bar and the work was suspended leaving the navigation channel ending before crossing the bar completely. A sounding survey was conducted during the period from one month to six months following the suspension of dredging. Figure showing the volume of fill-up has been made. There is a meteorological station at the airport (Ulin) in Bandjarmasin which provide required meteorological observations. Besides, meteorological observations are provided by other weather stations around Java Sea and the data on the weather for a wide area is readily available.

4-2-2 Marine Meteorology

Sea level: The size and the lag of each component tide at the estuary of the Barito are shown in Table 4-6.

Table 4-6 Component Tide at the Estuary of the Barito*

Component tide	M_2	S_2	K_1	O_1	P_1	N_2	K_2
Height (cm) (cm)	34	5	64	33	20	9	5
Lag of the tide (°)	137	66	332	274	326	99	88

Tidal current: The velocity of tidal current at the tip of the bar at time close to low tide is 1.3 knot in southwest direction and that at flood tide in northwest direction or at almost right angles to stream centerline is 0.5 knot or more. In the stream centerline near the mouth of the river where the water depth is 6m, the velocity of tidal current at low tide is about 3 knots along the stream centerline and 0.6～1.0 knots at flood tide toward the inner section of the estuary.*

Wave height: During the observation period from May 26 to June 16, 1970, the sea at the estuary was generally calm except 8 days in which waves having a height of 20 cm～50 cm and period of 0.2 0.3 were observed.*

4-2-3 Meteorology

The wind with a velocity of more than 5 m/sec and up to 10 m/sec. blowing from the southeast or the south southeast was observed for 8 days.*

(Footnotes) * According to the results of a survey by the Hydrographic Division of the Indonesia Navy.

4-2-4 Bottom Materials and Littoral Drift

Sampling of bottom materials at 28 points shows that the bottom materials within the depth of one meter are composed of mostly dark brown or black clay. In the east of the bar, however, the bottom material contains a small quantity of sand*.

The survey on bottom material is conducted sometimes though on small scale and all the results of these surveys show that the bar developed at the estuary is made of clayey deposits. Sounding surveys were conducted in 1950, 1955, 1968 and 1970. According to the results of the previously mentioned survey on the change of the sea-bottom conducted by the Port Authority following the dredging of the bar, there was a maximum fill-up of 1.3 m at some points one month after the dradging. This fill-up, however, was noticed only at the point where the bottom was dredged excessively deep and, on the contrary, the point where dredging was shallow, the bottom became deeper by itself. Generally speaking, the depth of 3.2~3.7 m is maintained at the bar.

4-3 Selection of Gateway to the Region and Enhancement of Canal Facilities

4-3-1 Basic Concepts

In planning a port and water transport project for the basins of the Barito, Kapuas and Kahajan, which are under such conditions as previously mentioned, the following four points should be given careful attention.

(1) Each of the three river is being prevented from allowing the entrance of large ships because of extensive bars developed at their estuaries.

(2) All of the three rivers run almost in parallel through swampy land and are linked by four canals.

(3) In the past there has been scarcely any industry in the basin which might have required the investment for port and water transport facilities.

(4) In recent years, however, development of forest resources has become quite active in the upper stream of these rivers and as a result, export of timber is increasing.

When the present state of the economy in the region which covers both South and Central Kalimantan Provinces and the fact that the region lacks a good natural harbour are taken into consideration, it is essential that the main foreign trade port is provided at one specific location to ensure effective capital investment. The fact that the water transport functions of the three rivers may be easily utilized to form a waterways network by expanding the existing canals or by digging new canals cannot be overlooked.

Fundamentally, for the port to function efficiently, there must be such secondary facilities as customs office, quarantine, port authority, banks, trade firms, cargo handling firms, ship repair and maintenance facilities, waterworks, bunker facilities, radio station, power facilities, road railways and waterways as a means of the secondary transport to and from the hinterland, in addition to the so-called primary facilities including navigation channel, anchorage, mooring facilities, transit shed and warehouses.

In this connection, the district of Bandjarmasin is not only equipped with such primary port facilities as shown in Table 4-1 but also possesses many functions and facilities as the central city of the region. Moreover, nearly 500,000 people live in and around Bandjarmasin. Improvements of infra-structure is under steady progress, including the construction of a radio station scheduled to be completed in the near future, construction of a power station at the Riam Kanan dam, scheduled to be completed in 1972 and the additional waterworks being progressed for the completion by the target year of 1972.

Among the methods used for the development of a certain region, there is one which provides first a new port as a key of the regional development. Though there are no economic activities in the basins of the three rivers, except the timber, which might require construction of a new port at present, it is hoped that the port is equipped with the function of a new port as a key of the regional development when the improvement of the port for export of timber is planned. For the development of the region which lacks the center of economic activities linked by land route, the planning of a new port as a key of the regional development will be one of the most effective means.

The port of Pulang Pisau on the Kahajan, meanwhile, has been giving satisfactory results as a port for the export of timber for the region. However, the port completely lacks the function as a port except it has anchorage. This may be adequate as a port for the export of timber and the possibility of the port being grown to the level above the monistic nature as a port for export of timber is very dim even when a new port is provided. The port of Kuala Kapuas on the Kapuas is most advantageously situated for collecting timber from the three rivers. However, in consideration of the accumulated merits in a broad sense as mentioned previously, the improvement of the port of Bandjarmasin by dredging the estuary of the Barito as a gateway to the region is considered most appropriate to ensure early effect of the port as the key point of the regional development. Since the main cargo item for the present is timber, it will be be essential to improve the existing canals so that the timber cut in the upper stream of the Kahajan may be carried on floats to the Barito.

The capital investment required for the improvement of these facilities is expected to be a huge sum. However, in consideration of the benefit for the development of timber resources in the upper reaches of the three rivers and its export which has increased sharply in recent years, improvements of the port is considered to be an urgent matter which requires serious consideration as a trigger of the development of the region. The implementation of the project calling for the improvement of canals extending to both South and Central Kalimantan Provinces along with the improvement of the port as a gateway to the region will inevitably require further efforts of the parties concerned in solving problems concerning the interests of local governments and in maintaining effective communications between the agencies of the Central Government.

4-3-2 Dredging of the Estuary of the Barito

As for the details of the effective method for the dredging of the estuary of the Barito, appropriate judgement can be made only after a careful study has been made on the hydraulic characteristics, bottom material, marine meteorology and weather conditions. Details of the required surveys will be discussed at a later section and in this section a plan, which is considered most reasonable judging from the existing data, will be presented as follows.

Recently, the timber carrier has become larger and larger in size. This is due to the fact that, unless the freight is held down by using larger carriers to ship timber, the timber industry will be placed at a disadvantage in the international competition for price. Due to the fact that the sea with a depth of 6 m extends over several km from the mouth of the Barito and that there are sections in the river where the depth of water is only 6 m, dredging to a depth greater than 6 m will increase the volume of dredging sharply. As many of the present timber carriers are of the 6,000 DWT class, the entry of timber carriers of this class will meet the minimum requirement. Since the rise of at least 2 m above the L.W.L. is seen at flood tide at the mouth of the Barito, the navigation channel with a depth of 6 m will allow the exit of the 6,000 D/W class vessels at flood tide. In consideration of these points, a depth of 6 m is to be planned for the navigation channel as the first step. As the bar, though shallow in general, has fairly deep portion in the center on the line of the extension of the stream centerline from the mouth of the river to the tip of the bar, the center line of the navigation channel is to be established along this line. In this way, requirement for dredging at the initial stage will be minimized and the subsequent maintenance will be easier. Moreover, the center line of the navigation channel will be straight up to the point where the width of the river becomes greater and about 100 m in width will be sufficient for dredging as a navigation channel. The volume of dredging for the navigation channel of this scale is estimated at less than 5 million m^3. As stated previously, the soil at the bar consists of mainly silts and there are no confirmed soils which may hamper dredging operation. As the weather is calm in the March, April and May period and the September, October and November period, the work may be continued for a considerably lengthy period. When the above-mentioned conditions are taken into consideration, the unit cost of dredging is estimated at about US$0.80/$m^3$.

Since the bottom material at the bar consists of mainly silts as mentioned previously, the flow of water at a moderate speed may prevent the accumulation of bottom material. If a flow of water is introduced by providing a navigation channel along the stream centerline, a reduction in the volume of maintenance dredging may be possible. If such a measure would not work for the reduction in the volume of maintenance dredging, a simple jetty may be effective. Though the location and the length of the jetty cannot be determined until the results of a necessary survey have been studied, it may be assumed that the jetty is about 10 km long and constructed by filling dredged earth behind the wooden retaining wall. The jetty of this structure will cost only about US$200 per meter.

4-3-3 Improvements of Inland Waterways

It has already been mentioned that, in providing dredging at the estuary of the Barito to make the port of Bandjarmasin as a gateway to the region, the improvement of the canals so that the timber may be transported from the Kahajan and the Kapuas to the Barito is indispensable in view of the fact that the most important cargo for the present is the timber for export. For that purpose, two ways are conceivable. One is to expand and dredge the existing Serapat canal and Kelampan canal and the other is to dig a new canal.

In consideration of the draught of tag boats which tow the raft of timber, a depth of 1.5 m will be sufficient. A width of about 40 m will be sufficient for the time being. In expanding and dredging the existing canals or in digging a new canal, however, it is advisable to secure land space on both sides of the canal so that it may be expanded to a width of 60 m in the future.

If the expansion and dredging of the Serapat canal and the Kelampan canal are planned, the volume of required dredging is estimated as follows. Assuming that the elements of the existing canals are:

Total length: 42 km
Average width: 20 m
Average depth of water: 0.5 m
Elevation of the present ground level: 2.5 m

$\{(2.5 + 1.5) \times 40 = (2.5 + 0.5) \times 20\} \times 42,000 = 4,200,000\ m^3$

For the case of new canals, the elevation of the present foundation is assumed to be 2.0 m.

$(2.0 + 1.5) \times 40 \times 45,000 = 6,000,000\ m^3$

For digging a new canal, it is assumed that the material involved in the dredging is mainly earth which will cause no specific problem for the execution of the work and will be easily disposed on both sides of the digging, and the cost of dredging is estimated at about US$0.6/m^3. Though the volume of the required dredging in the case of the expansion and dredging of the existing canals is about 2/3 of that required for the new canal, the question of the compensation for the residents and the disposition of the dredged earth must be taken into consideration. Therefore, a careful study must be made on the merits and demerits of the plan for the improvement of the existing canals in comparison with the plan of the new canal. Here, assumption is made that there is not a great difference between the expansion and dredging of the existing canals and the digging of a new canal. When a new canal is planned, it will be necessary to provide necessary coordination with the departments concerned since it is also related with agricultural development.

4-3-4 Estimated capital investment required for the project

Funds required for the dredging of the estuary of the Barito and the improvement of canals will be as follows.

Dredging of the estuary:	5,000,000 m^3 x US$0.80/m^3	= US$4 million
Improvement of canals:	6,000,000 m^3 x US$0.60/m^3	= US$3.6 million
When a jetty is required:	10,000 m x US$200/m	= US$2.million
	Total approx.	US$10 million

The above figure is only a rough estimate and detailed calculation cannot be made until a detailed plan has been worked out on the basis of the surveys which will be discussed later.

It must be noted, however, that the investment amounting to a little over half of US$6 million, the amount required for the improvement of the navigation channel at the estuary of the Barito including construction of a jetty, for the improvement of canals will result in the expansion of hinterland and enhance the value of the port of Bandjarmasin to two to three times as a port for exporting timber.

It is obvious that the additional dredging of the estuary of the Kahajan instead of concentrating the work on the port of Bandjarmasin is uneconomical in view of the fact that there is not a great difference between the estuaries of the two rivers.

4-4 Survey Programmes

4-4-1 General

The initial investment under the previously mentioned project including cutting a new inland canal is estimated at such a huge sum as 7 to 8 million US dollars when the construction of a jetty is not included and at nearly 10 million US dollars when the construction of a jetty is included.

It is essential therefore, that the project planning is initiated only after the feasibility of the project has been confirmed by complete basic surveys and required studies have been made on such essential factors as the optimum center line of navigation channel, efficient method of dredging, requirement for a jetty and the location of the jetty when it is need, and the estimated volume of required maintenance dredging.

With the navigation channel at the estuary of a river like in this case, the maintenance of required water depth often becomes an issue. It is prime importance that an advance estimate is made on the volume of dredging required for the maintenance of required water depth prior to the start of dredging of the estuary. This is required because there are cases at times in which the subsequent dredging for the maintenance of the required water depth is not possible after the completion of the initial dredging work, thus making the initial investment a total waste.

If the outlook is for an increase in the volume of dredging for the maintenance of the required water depth against a small initial investment, a more economical alternative must be considered even when it requires a somewhat larger initial investment. Some sources estimate the volume of maintenance dredging at about 1,200,000 m^3annually in comparison with the estuary of the Belawan, but this estimate is not reliable at all. For the estimate of the volume of maintenance dredging, a complete and sufficient survey must be conducted. As the bar developed at the estuary of the Barito is extremely large in scale, excessive emphasis on the accuracy in technical aspect in working out a survey programme may lead to uneconomical results. It is important that the scale of the survey programme is held to a minimum while attention is paid to aboid overlooking of important elements.

Though the Barito is a mammoth river with a catchment area, where precipitation is 2,500 mm~3,500 mm/year, extending over 60,000 km^2, it does not show an extremely sharp flood discharge at its estuary. If the characteristics of the rainy and dry seasons are grasped, it seems that the outline of the nature of the river may be understood. It must be kept in mind, however, that there is a great difference in the nature of the river, both the rainy season and the dry season, depending on the year. As it is economically impractical to continue the survey for many years, it is advisable to conduct a survey on the characteristics of the rainy season and the dry season for each one season, and to interprete the difference between years ay comparing the precipitation and other phenomena in a certain year with the trends of the past years.

For the feasibility study of the project, it is important to make estimation on the benefit derived from the implementation of the project as well as to calculate the initial investment and the maintenance cost.

4-4-2 Survey Programme

a) Establishment of marked points: As the survey of the estuary of the Barito involves a vast sea area (15 km x 15 km), determination of the location (position) becomes an important factor. For that purpose, the first requirement is to establish on the sea marked points by means of scaffoldings at such intervals as to allow measurement by transit compass. As these marked points may be used for earth boring and observation of tidal current, as well as for the principal work and as channel marks, they should be of durable structure even when made of wood. It is advisable that the position of marked points is measured accurately with the use of such instruments as Hydrodist.

b) River discharge: As the Barito is under the influence of the tide up to 140 km from its estuary in bee-line and has tributaries and branch rivers on this section, it is quite difficult to determine its discharge. It is advisable, therefore, to take a measurement of the section area of a section designated at the point near the estuary and to observe water level and the velocity of flow for 25 hours to determine the discharge of the river.

c) Content of suspended materials: Content of suspended materials in the river water should be determined by taking samples near the estuary.

d) Salt wedge, salinity: In order to determine the characteristics of the hydraulics at the estuary, the state of salt wedge should be checked with an echo-sounder and the salinity of river water should also be checked.

e) Survey on bottom material: In order to determine the composition of the bottom materials at the bar, sampling of bottom materials must be made and grading analysis must be provided. In consideration of the future requirement for deeper water, earth boring for a depth of 10 m should be provided to obtain comprehensive data on soil composition.

f) Current pattern observation (Fixed point): Observation of the velocity of flow should be made over the bar, on the stream centerline and on the outside of the bar, and a measurement of the velocity distribution in relation to the depth should also be provided.

g) Current pattern observation (Float tracking): The current pattern including the bottom current pattern at the estuary should be checked by tracking floats.

h) Tide level observation: See river hydrology

i) Wave height observation: A wave recorder of the direct recording type should be used at the point where the depth of water is 5~6 m on the outside of the bar.

j) Sounding survey: Because of shallow water at the bar, use of a survey ship is possible only at flood tide. In order to obtain data on the change of the bar, periodic sounding surveys should be provided by taking into account the rainy and dry seasons.

k) Survey on the canal route: As a sharp change in the topography is not conceivable for the swamps in the lower reaches of the Kahajan, Kapuas and Barito River, field survey of these areas is to be made in part and a map study, including a check on the state of settlement of farmers and the coordination with agricultural development projects, is to be made.

l) Economic study: A study is to be made on the terminal cost of the timber exported under the present state of the port and calculation is to be made to obtain the difference between the present terminal cost and that for the case under improved conditions of the port. Estimation is to be made on the future volume of timber for export against various F.O.B. prices.

Of the above-mentioned survey items, those under the paragraphs b), d), f), g) and j) must be provided at least twice, once in each of the rainy season and dry season. It is advisable that the survey under the paragraph j) is provided near the end of each two consecutive seasons. Table 4-7 shows estimated cost of the survey.

For a large scale survey, establishment of a base near the estuary may be more practical and efficient since the estuary is about 30~40 km from the city of Bandjarmasin. It is desirable to have a model test to determine the effect of the jetty.

Table 4-7 Estimated Cost of Survey (Port and Water Transportation)

Items	Cost (US$)	Remarks
First Technical Survey	79, 700	Setting of marked point River discharge (1st) Sounding (1st) Current pattern observation (1st)
Second Technical Survey	62, 000	River discharge (2nd) Current pattern observation (2nd) Suspended material (1st) Salt wedge, Salinity (1st) Canal route survey
Third Technical Survey	30, 600	Bottom materils Suspended material (2nd) Salt wedge, Salinity (2nd)
Preparation, Arrangement, etc.	21, 700	
Sum of Technical Survey	194, 000	
Economic Study	6, 000	
Total	200, 000	

4-5 Summary

Because of the stagnant development, the basins of the three major rivers, namely, the Barito, Kapuas and Kuhajan, have had almost no noticeable industries. In recent years, however, development of forest resources in the upper streams of these rivers has become quite active and the volume of timber for export has increased sharply. In August 1970 alone, 65,000 m^3 of timber was exported from the basins of the three rivers and there is an indication that the volume will increase further in the future. On the other hand, the region is favoured by a good inland water transport provided by canals which link these three rivers. As for ports and harbours, each of the three rivers has its own port such as Bandjarmasin, Kuala Kapuas and Pulang Pisau. Each of them, however, has a huge bar developed at the estuary, which restrict the entry of larger ships. In view of the fact that the region lacks the center of economic activities which is linked by a land route, it is considered essential to improve a port as a gateway to the region first for the development of the region. On the other hand, the need for a port which allows the entry of large ships is felt more keenly with a increase in the export of timbers in recent years, and the bars developed at the estuaries of the major rivers are posing a serious problem. Though the timbers are cut in the basins of the three rivers, dredging of bars for the three rivers to allow the entry of large ships will require a huge amount of investment and may further require a considerable amount of investment for future maintenance dredging. In view of these facts, it is more practical and effective to concentrate efforts on the dredging of one specific location out of the three rivers to make it a gateway to the region and to utilize inland canals for the transportation of timber to a specific point.

In this connection, it is desirable that the port of Bandjarmasin be selected as a gateway to the region, with emphasis placed on the overall achievements and experiences of the said port. Dredging of the estuary of the Barito will stimulate and expand the function of the port and may turn the port to a strategic point for the development of the whole region. It is true that the said port is not advantageously located for collecting timbers from the other two rivers. This disadvantage, however, may be eliminated if the canals were improved. The cost of dredting of navigation channel at the estuary, including construction of a jetty, is estimated at US$ 6 million and the total initial investment including the cost required for the improvement of canals will not exceed US$ 10 million. This amount is considered feasible when the benefit for the export of timber derived from the improved port facilities is taken into account.

Against the present level of timber export amounting to 70,000 m^3 monthly, it is considered reasonable to expect the export of timber amounting to more than 1,500,000 m^3 annually upon completion of the improvement of the port. The important aspect of this concept is that through regional development by establishing a new port as a key of the regional development with the uti ization of the development of forest resources, the benefit of the development of resources may be returned to the region.

Development of forest resources is already in progress and the time is already ripe for the improvement of port facilities. However, as the bar development at the estuary presents a very serious problem also from a technical point of view, careful and complete surveys should be conducted to select the most economic and effective method.

4. PORTS AND WATER TRANSPORT (1)

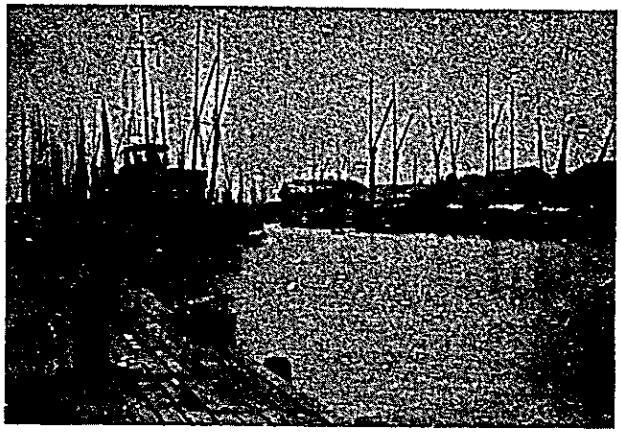


Photo 4-1 Pier at Bandjarmasin Old Port

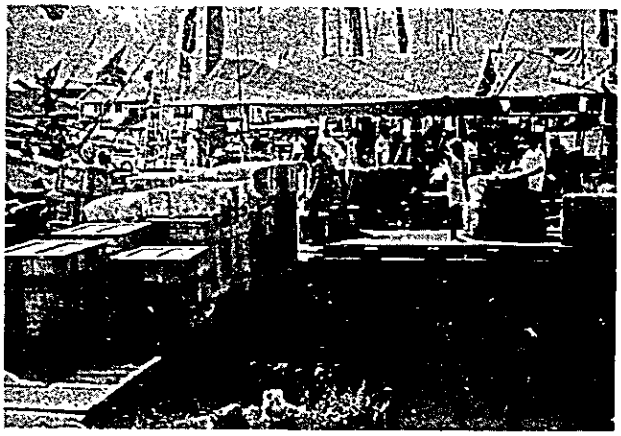


Photo 4-2 Pier for Sail Boats

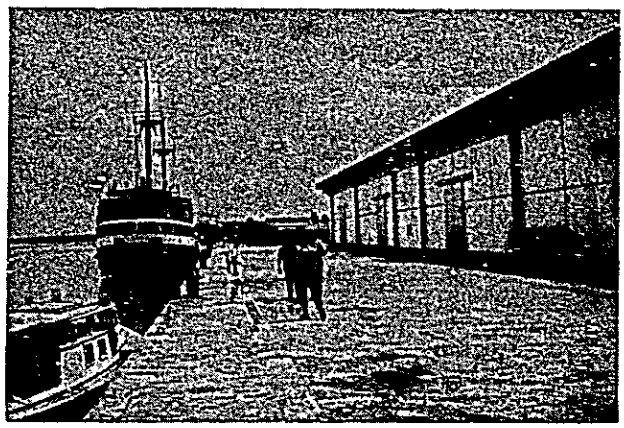


Photo 4-3 Pier of Trisakti

Photo 4-4 Warehouse at Trisakti Pier

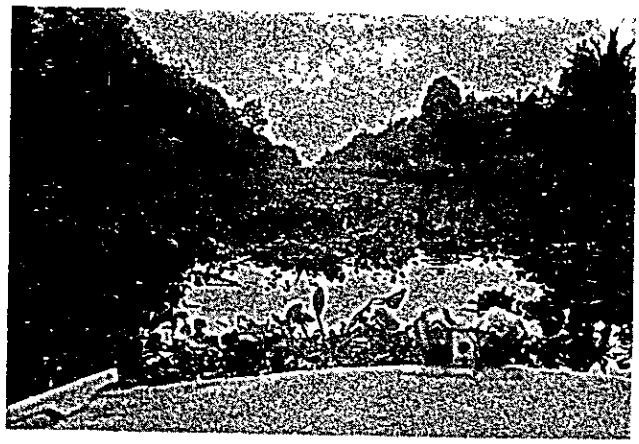


Photo 4-5 Ilung in the Canal

Photo 4-6 Rafts in Kelanpan Canal

5. MINERAL RESOURCES

5-1 General Geological Situation of Barito Basin

The Barito Basin has been sedimented in the duration from the early Tertiary up to the present age in the form that the geosyncline surrounding Sunda Shelf which runs through Malay Peninsula and middle south coasts of Sumatra and occupies the central part of south west Kalimantan was filled with the Tertiary series.

This sedimentation was caused by the transgression arising from the eastern projecting part of Sumatra geosyncline, after the sand and gravels forming the basis had been heaped, thick and unaltered shale sediments accumulated under the conditions of semi-deep sea.

The western part of Barito Basin lies on Sunda Shelf and the layers are thin so that the basis was reached at the depth of 300 m by an oil drilling made near the estuary of Barito River. Contrariwise on the eastern side of Barito River, the lavers gradually increase their thickness eastward which reaches 6000 m in the vicinity of Meratus Mts.

Meratus Mts. which divides Barito Basin and Makasar Basin is said to have been formed by the final upheaval that took place in the Plio-Pleistocene after many up and down movements had occurred throughout the Tertiary.

On the west side of Meratus Mts., the folding develops in the direction nearly from north to south, whereas on the east side it develops from north east to south west.

The base rocks of Maratus Mts. are peridotite, pyroxenite, gabbro, diorite, granite, granodiorite and crystalline schist, all of them lower Cretaceous and widely distributed.

The sedimentary rocks of the Tertiary which fill Barito Basin consist of sandstone, shale, conglomerate and limestone in the underlayer and marl and limestone in the upper layer, and the Quaternary consist of clay, sand and gravel.

This time the team went upstream Barito river about 800 km, but no outcrop was seen between Bandjarmasin and Buntok, whereas some outcrops of sandstone and shale were observed in places between Buntok, Muaratewe and Puruktjahu which indicates that there exists an alternate layer zone of sandstone and shale. Mt. Muro which is located at Mankahoi above Puruktjahu has widely distributed igneous rocks such as andesite, basalt, tuff, etc.

5-2 Mineral Resources in Barito River Basin

5-2-1 State of Occurrence Classified by Mineral

(1) Iron ore deposits

i) General situation

In Barito river basin, iron ore deposits occur in the area south-west of Bobaris Mts. i.e. around Pelaihari.

As to this area, USSR carried out airborne magnetic survey, surface geological survey and also drilling with the main objective to research into iron ore deposits during the time from January 1963 to May 1965.

According to the USSR report, the iron ore deposits in this area belong to Skarn iron ore deposits and composed of widely distributed boulder of magnetite and hematite, derived from contact metasomatic genesis.

This time the team surveyed three mines near Pelaihari. All of them had widely distributed boulders of magnetite and hematite of 60%-70%Fe, but the team was unable to ascertain the existence of primary deposits.

It is to be mentioned, however, that USSR made drilling at Gunung Ulin and Gunung Tembaga located in Djilatan 13 km south of Pelaihari and as the result it is said that they derived from primary deposits of magnetite and hematite at both places, but their spread, ore grade etc. are unknown.

ii) Consideration on iron ore deposits

Three mines were investigated in Pelaihari area, but only boulder zone of iron ore were seen in all of them and no primary deposits were ascertained.

Judging from the state of boulder zones distrubution, the scale of ore deposits appears relatively small. However, as mentioned above, some primary deposits are said to have been ascertained by diamond drilling at Gunung Ulin and Gunung Tembaga. Besides, it is recorded that quite a few iron ore deposits are scattered in this area.

Since those surveys are not yet completed, it is hoped that they will be continued and brought to a conclusion.

Further, it is said that some considerable quantity, though low in grade, of so-called lateritic iron ore which was formed by the weathering of ultra-basic rocks such as peridotite and serpentine is accumulated in south-east Kalimantan.

Therefore, further studies would be required for the utilization of lateritic iron ore as the source of low grade iron ore and nickel chrome ore.

(2) Diamond deposits

i) Distribution of diamond deposits

There are a number of diamond occurrences in the region of Martapura, Tjempaka, Pengaron and Riam Kanan, and P.N. Aneka Tambang mainly is conducting exploration and mining.

P.N. Aneka Tambang which at present owns diamond mining concessions of about 360 km^2 in Tjempaka area near Martapura is conducting exploration by means of pitting, but the grade and quality of diamond are not well known.

Pits are normally dug in grids of 20 m - 50 m x 100 m, and about 2,000 pits have already been finished only around Tjempaka.

At present 50-60 persons are engaged in pitting every day and they dig 50-60 pits of 3-5 m deep in one day, but no statistics are available on the output of diamond in Barito river basin.

Besides the above, diamond was collected as a byproduct of placer gold in Pelaihari area in the south, but it has been suspended since 1965.

Further, diamond is collected as a byproduct of gold panning in the vicinity of Puruktjahu, 700-800 km up Barito river, where placer gold is widely distributed, but its output is not well known. The grade and quality are also unclear, but its diamond grade seems to be lower than that of Martapura ~ Pengaron area.

ii) Geology of diamond deposits

ii)-1 Base rock of diamond deposit

The base rock of diamond was found by Koolhaven in 1935 at the bottom of Bobaris Mts., in S. Pamali which is a tributary of Riam Kanan and also in S. Ahim, a tributary of S. Pamali.

The matrix of diamond found in S. Pamali resembles the kimberlite well known in South Africa which is ultra-basic peridotite and is called "pamalibreccia" that is a kind of brecciated peridotite.

According to "Geology of Indonesia", this brecciated peridotite makes a pipe form of 150-300 m dia. keeping in contact with serpentinized peridotite diorite and porphyrite, and its high grade portion is 0.35 carat, whereas its average grade is 0.01 carat/ton or so.

Peridotite of Meratus Mts. is said to contain no diamond.

ii)-2 Placer deposit of diamond

The river beds originating in Bobaris Mts. and the alluvial plains lying in those river basins contain diamond. Namely, placer deposits of diamond which are mainly the Quaternary are found in the benches of S. Riam Kiwa and S. Riam Kanan, Martapura and Pengaron in their center, and also in the gravel layers newly formed in those rivers.

Diamond is also found in mixture with conglomerate and sandstone of the Eocene.

The placer deposits of diamond generally contain gold, platinum, corundum, rutile, chromite, pyrite, etc. so that gold and platinum are collected as byproducts.

The gravel layer which contains diamond is called diamond bearing gravel (D.B.G.). D.B.G. existing in the alluvial plains of this area is normally 0.2 m - 5 m thick.

However, if only the area where P.N. Aneka Tambang is operating is taken up, the thickness of D.B.G. is 0.8 m and its diamond grade is estimated at 0.015-0.025 carat/ton.

There are the following two types of D.B.G.

1. Conglomerate deposit (D.B.G. in alluvial plains)
2. Loosed deposit (D.B.G. in river beds)

D.B.G. of conglomerate deposit is in a compact state, but D.B.G. of loosed deposit, being crumbly, is in a loose state which makes the estimation of its diamond grade almost impossible.

iii) Mining of diamond deposits

In the case of river bed, the mining of diamond is conducted by panning on the spot of D.B.G. gathered from the river bed. But in the case of alluvial plain D.B.G. is gathered from pits dug at a depth of 3-7 m and at intervals of 3 m-4 m, carried out of the pits by human power and then panned off in stream or pond. In both cases, there prevails reckless mining so the mining extraction is extremely low.

Up to now, the concentration has been performed only by panning with human power several thousand persons at work daily, but a dressing plant of 300 ton/day is under construction at present.

The diamond of this area is normally octahedral crystal, but some are combined with other type faces and some have rounded edges. Diamond of white lustre occupies about 30% of the whole and others are yellow, brown and blue. Its size is normally under one carat and primary stones of above two carats are few. There is a record that the output in Martapura~Pelaihari area was 3,292 carats for one year in 1940, but the present state is unknown.

The statistics of diamond output stated in "Geology of Indonesia" are as follows:

Table 5-1 Statistic of Diamond Output

Year	Martapura & Pelaihari		Year	Martapura & Pelaihari	
	Carats	Guilders		Carats	Guilders
1920	410	50,000	1933	428	11,652
1921	1,770	180,000	1934	591	11,321
1922	1,920	168,283	1935	636	6,512
1923	1,140	77,068	1936	391	6,390
1924	349	22,778	1937	907	24,925
1925	667	51,785	1938	509	37,171
1926	276	19,878	1939	2,007	41,150
1927	250	25,000	1940	3,292	59,890
1928	236	20,177			
1929	570	36,705			
1930	447	20,231			
1931	287	18,961			
1932	267	13,764			

iv) Consideration on diamond deposits

Martapura~Pengaron area which is located close to diamond base rock and blessed with large alluvial plains appears promissing in future. Therefore, efforts should be made in the direction to grasp the amount of diamond reserves by the reinforcement of geological survey and pitting with the objective to expand the production of diamond and also gold and platinum as its byproducts in this area. Further, as both mining and concentration is yet at the stage of primitive operation mostly relying on human power, it is recommended to introduce mechanization as early as possible upon studying the application of gravity concentration, grease belt concentration, electrostatic separation, etc. in order to increase the output and raise the productivity. And the first necessity for doing this would be the preparation of production statistics.

(3) Gold deposits

i) Primary deposits of gold

The primary deposits of gold and siver at Pelaihari in south-east Kalimantan and at Puruktjahu up Barito river occur in andesite, especially augite andesite, but in some cases accompany such acidic rocks as dacite and liparite. It is recorded that in some areas gold bearing veins are included in granitic rocks and altered sedimentary rocks. However, what the team was able to investigate this time was only Gunung Muro near Puruktjahu where some primary deposit of gold was ascertained. Gunung Muro is 20 km distant from Mankahoi village which is upstream Puruktjahu and can be reached from there in six hours on foot. An outcrop of quartz vein which bears lead and zinc was observed in the bank of S. Anak Muro, a tributary of S. Muro at 200-250 m above the sea level.

The following are the assay results of that outcrop:-

Table 5-2 Assay Results of Gunung Muro Gold Ore

Sample No	Species	Au	Ag	Cu	Pb	Zn
No. 1	Country rock (Quartz)	1.3 g/t	15.0 g/t	0.29 %	0.83 %	0.60 %
No. 2	Ore of high grade	7.1	47.0	0.07	12.05	40.45

Sample No. 1 was taken from quartz vein of low grade and Sample No. 2 represents the ore of high grade portion. The gold grade of Sample No. 2 is unexpectedly low, but it shows high grade of lead and zinc, 52% in total.

It is said that, besides that one ascertained by the team, there are 7-8 outcrops at Gunung Muro, but they were not investigated at this time. In the area around Puruktjahu, two mountains i.e. G. Baruh and G. Ujang are said to have primary deposits of gold.

ii) Placer gold

Gold in the form of placer gold is widely distributed around Martapura, Pengaron in the south and also in the vicinity of Buntok, Muaratewe and Puruktjahu up Barito river,

In Martapura, Pengaron area, gold and platinum are produced as byproducts of diamond. Also in alluvial plains around Pelaihari, gold bearing gravel layers are widely distributed. But the grade of gold and ore reserves are unclear on all of them.

Up Barito river. the area around Puruktjahu appears to have the largest ore reserves. Placer gold is widely distributed in the basins of the rivers originating from gold primary deposits, namely in the beds and basins of S. Mankahai, S. Menjoko, S. Bubuat, S. Luit, S. Manuang and S. Muro all of which rise in G. Muro, S. Halon and S. Ontu both rising in G. Baruh and also S. Ujang and S. Kunji both rising in G. Ujang.

It appears that, when the water level falls in dry season, several hundreds persons do panning in the main stream and also above-mentioned tributaries of the Barito river.

The quantity of gold per day/person collected by means of panning upstream Puruktjahu is said to be 10 grams at the peak time of dry season which however is uncertain.

iii) Consideration on gold deposits

In Barito river basin, placer gold is collected as a byproduct of diamond in Martapura , Pengaron , Riam Kanan area in the south, and wide occurrence of placer gold is ascertained in Buntok , Muaratewe, Puruktjahu area upstream of Barito river. However, the output of gold is unclear and even its general situation is difficult to grasp.

The operation of gold is made entirely by human power and accordingly inefficient. In order to increase the output utilizing the large potentiality of gold resources, the mechanization of operation such as the introduction of small excavating vessels like jet ejector equipped with concentrating facilities should be studied.

As to the afore-mentioned three mountains, i.e. Muro, Baruh and Ujang where primary deposits are expected to exist, it is recommendable that the nature of primary deposits be grasped through geological survey and diamond drilling.

Further, it could be envisaged as a vision in the near future to put up a gold refining of small scale near Bandjarmasin in order to increase the additional value of gold.

(4) Coal

i) General situation

A number of small scale coal mines exist around Meratus Mts. The first coal mine that was found in Indonesia is said to be Riam Kiwa, 20 km north-east of Pengaron.

The existence of several coal fields near Muaratewe is also known. Most coal seems occur in Eocene, Miocene and Pliocene. Lignite of good quality and coking coal occur in sedimentary rocks of the Miocene and ordinary lignite in those of the Pliocene.

This time the team investigated roughly coal mines at Rantau, Pengaron and Martapura in the south and at Muaratewe upstream the Barito river.

The three mines surveyed in the south all occur in alternate layers of sandstone and shale, and the coal seams are 3-7 m in thickness with inclination 50°-60°.

Their ganging and foot walls being weak and steep, opencut mining is difficult to apply. As the scale of the deposits also is small, it seems not to be promising to develop those three mines.

The coal seam at Muara Bakah near Muaratewe up the Barito river is 3-5 m thick with inclination 20° - 30°. Its hanging wall is clay seam, foot wall sandstone and over-burden is 3-5 m thick. This mine is being operated by opencut mining with 40 persons and its monthly output is 400 tons.

Table 5-3 Assay Results of Muara Bakah Coal

	Moisture %	Ash %	Calorie
No. 1 Outcrop	1 4 0	0. 4	6, 1 6 0
No. 2 Outcrop	1 3 0	0. 8	6, 4 8 0

These assay results indicate that the coal is suitable for boiler use due to its low ash content.

There is another coal mine at Kampon Luwe, further 15 km upstream Muara Bakah with a coal yard on the river bank.

The team was told that the coal seam at Muara Bakah and that one at Kampon Luwe are the same continuous one, but this would need further investigations.

ii) Consideration on coal deposits

In south-east Kalimantan, there seems to exist a number of coal mines in the circumference of Meratus Mts. and Bobaris Mts., but they cannot be the objects of large scale development, since the scale of deposits is all small.

Nevertheless, the coal seam at Muara Bakah up the Barito river would be of some interest as a domestic fuel source in Indonesia, as it is low in ash and seems to have 6,000 calorie.

(5) Petroleum

i) General situation

As to the oil field in south-east Kalimantan, P.N. PERTAMINA is carrying out prospecting and oil mining in the north of Tandjung, while Continental Oil Co. (CONOCO) of the U.S. is now conducting prospecting in the south of Tandjung under a contract concluded for prospecting and development over an area of 16,800 km^2.

The oil field at Tandjung was discovered in 1938 after geological survey, geophysical survey and drilling had beencarried out in 1931-1935, and later in 1965 P.N. PERTAMINA undertook its operation.

It drilled 89 wells in total, of which 73 are productive wells, and produces 2600 kilolitre of oil and 500,000 m^3 of gas per day with 2,000 workers.

The oil produced at Tandjung is being carried to Balikpapan by 20 inch pipe over a distance of 238 km. However, little prospecting was conducted thereafter the Second World War.

ii) Geology of Tandjung oil field

Tandjung oil field exists in an anticline extending almost from south to north over a folding zone on the west side of Meratus Mts.

The west side of this anticline is steep and has many faults, whereas its east side is a gently-sloping unsymmetrical anticline.

The salient feature of Tandjung oil field is that it is the only oil field in Kalimantan that is producing oil from the Eocene strata. Conglomerate and sandstone of the Eocene and also the metamorphic rocks of Pre-Tertiary underlying them constitute the oil bearing strata.

There are six oil bearing strata in total which are distributed in depth between 670 m and 1300 m.

iii) Consideration on oil fields

Tandjung oil field is regarded as promising according to the geological conditions of oil occurrence, but prospecting was not positively performed thereafter the Second World War.

The prospecting once made around Buntok up the Barito river has also lately been suspended. As there still remains a fairly large unprospected area around Tandjung, positive prospecting in future is desirable.

(6) Other non-ferrous minerals

According to the data kept in Operation Room of the Ministry of Public Works, chromite in the vicinity of Batakan 40 km south of Pelaihari and molybdenite at Paringin in the south of Tandjung are recorded as the other non-ferrous minerals existing in Barito river basin, but the team was unable to ascertain them this time.

Local people stressed that there were also a mercury mine near Batakan in the south of Pelaihari, a manganese mine at Muaratewe and a bauxite deposit near Puruktjahu, but the team was also unable to ascertain them.

There are no noteworthy deposits of copper, lead and zinc. The output of these non-ferrous minerals is insignificant, being produced as byproducts of placer gold or as accompanying minerals of small gold deposits. As mentioned before, primary deposits of gold of G. Muro at Puruktjahu are accompanied by galena and sphalerite.

(7) Non-metallic minerals

i) Quarry plant

Granite, diorite, diabase, basalt, andesite, peridotite and limestone which are distributed in Meratus Mts. and Bobaris Mts. are utilized as roadbed macadam and construction material.

However, as sites are remote and road condition is insufficient, their scale is very small.

ii) Silica sand

Silica sand which was sedimented between the Neogene and the Quarternary is widely distributed over the area from Rantau to Bandjarmasin.

This time the team investigated the area near Martapura and observed there a sediment of 2 - 3 m thick spreading over an area of approximately 100 km^2 (20 km x 5 km).

At this sediments laver is in the state of sand and gravel, the collected sample was assayed after separating it into sand and gravel, and the following results were obtained.

Table 5-4 Assay Results of Silica Sand

	SiO_2 %	Aℓ%	Ca %	Fe_2O_3%
Grain form	99.35	0.18	0.00	0.02
Powder form	89.25	3.66	0.02	0.32

As grain form i.e. gravel has 99% up SiO_2 with little impurities according to the above assay results, it would be advisable to study whether the gravel classified by screening can be utilized as the raw material for metallic silicon and glass.

Further, a large amount of kaolin is sedimented as the underlayer of silica sand. Kaolin was distinctly detected by X-Ray diffraction method. Therefore, if kaolin is separated from silica sand by hydraulic elutriation, the utilization of kaolin can be considered.

iii) Limestone

In the south-eastern area of Barito basin, limestone of upper Paleogene and lower Neogene is widely distributed.

This time the team visited the limestone zone at S. Djaro 80 km north of Tandjung. As the quality of its limestone is good, it would be necessary to study the possibility to utilize it as soil improving material or raw material for cement.

5-2-2 State of Occurrence Classified by Area

The team endeavoured to sight as many mines as possible, area-wise and species-wise, in order to grasp the actual conditions of occurrence and production of the mineral resources of Barito river basin.

Although the scope of investigation, restricted by the fixed time schedule and the traffic at the mine sites, cannot be said as sufficient, the team believes that it was able to get the general picture.

For convenience's sake, Barito river basin may be classified into the following four areas from the aspect of distributed conditions of mineral resources.

(1) Pelaihari area

The team investigated one placer gold zone and three iron ore mines in Pelaihari area.

Placer gold is of little interest, as its grade seems low. The iron ores are magnetite and hematite of contact metasomatic deposits of 60-70% Fe grade, but the scale of the deposits is small.

However, as the deposits are many in number and besides primary deposits seem to have been ascertained by the USSR geological survey, iron ore deposits are the object of interest in Pelaihari area.

(2) Martapura , Pengaron area

The team investigated two coal mines, one manganese mine and seven places of diamond zone in Martapura , Pengaron area.

Coal and manganese mines cannot become the object of development, the scale of their deposits being small. Accordingly, priority should be given to the development of diamond in this area.

(3) Tandjung area

The team investigated two coal mines in Tandjung area, but the scale of coal deposits there also is small and cannot become the object of development. Therefore, the development of oil is of primary importance in this area.

(4) Puruktjahu area

In view of the fact that placer gold abounds in this area and primary deposits of gold are ascertained as at G. Muro, the team would recommend an extensive survey being made by means of airborne, surface geological survey and drilling in order to grasp the potentiality of placer gold and its primary deposits.

5-3 Exploration Plan in Future

5-3-1 General

After reviewing the state of prospecting and development of mineral resources in Barito river basin, the team would mention that almost all existing mines were found before 1940 and that the development was confined to the deposits close to the surface which were either ascertained outcrops or placer deposits.

As the technics of prospecting, mining, concentration, smelting and refining have since greatly advanced, the team recommend for the development of Barito river basin that investigation be conducted anew not only on the surface but also on deeper yet unprospected deposits and blind deposits from a new aspect.

As mentioned before, Pelaihari area, Martapura area, Tandjung area and Puruktjahu area can be listed as the mineral occurrence area in Barito river basin.

Of these, Pelaihari, Martapura, and Tandjung areas were pretty thoroughly investigated and topographical and geological maps of them are nearly complete.

Therefore, the team would recommend that detailed investigation be conducted on Puruktjahu area up the Barito river.

The resume of the recommended survey is to conduct airborne magnetic survey, radio active survey, surface survey and prospecting by drilling over an area of 70 km x 35 km = 2,450 km^2 linking the villages of Puruktjahu, Mankahoi, Lahung and Kunji along the Barito river.

5-3-2 Expenses and Terms for Exploration

The expense and period to be required for the above-mentioned survey are as follows:-

Table 5-5 Summary of Survey Expenses (Mineral Resources)

Item of Survey	Amount (U.S.$)	Remarks
Airborne survey	25,000	70 km x 35 km, distance of survey line 1 km
First geological survey	110,500	Surface survey 2,450 km^2
Second geological survey	158,000	Detailed surface survey 940 km^2 including pits, geological mapping
Prospecting by diamond drilling	650,000	70 holes, average depth 150 m
Total	944,000	

Table 5-6 Survey Schedules and Expenses (Mineral Resources)

Item of Survey	1st phase	2nd phase
Geological survey (Airborne survey, 1st & 2nd geological survey)	▬▬▬	
Prospecting by diamond drilling		▬▬▬
Survey expenses	294,000 US$	650,000 US$

5-4 Conclusion

The investigation of mineral resources in Barito river basin at this time was made as a part of the integrated project to develop resources in this area, and the scope of our investigation extended over approximately 1000 km in total from Pelaihari in the south up to Puruktjahu in the north.

The development of mineral resources in Barito river basin has been almost at a standstill since the end of the Second World War, and those under operation now are only oil at Tandjung and diamond around Martapura.

The alluvial plains in which diamond occurs being large, its potentiality is promising, but both the amount of ore reserves and the output are unclear.

Several thousand persons, if the massessare included, are working for the extraction of diamond, but the operation is a primitive one entirely relying on human power.

In order to raise the mining extraction and increase the output, the application of hydraulic power to mining and transportation in the occurrence area where overburden is thin, along with the promotion of mechanization in the concentration, is recommended for study.

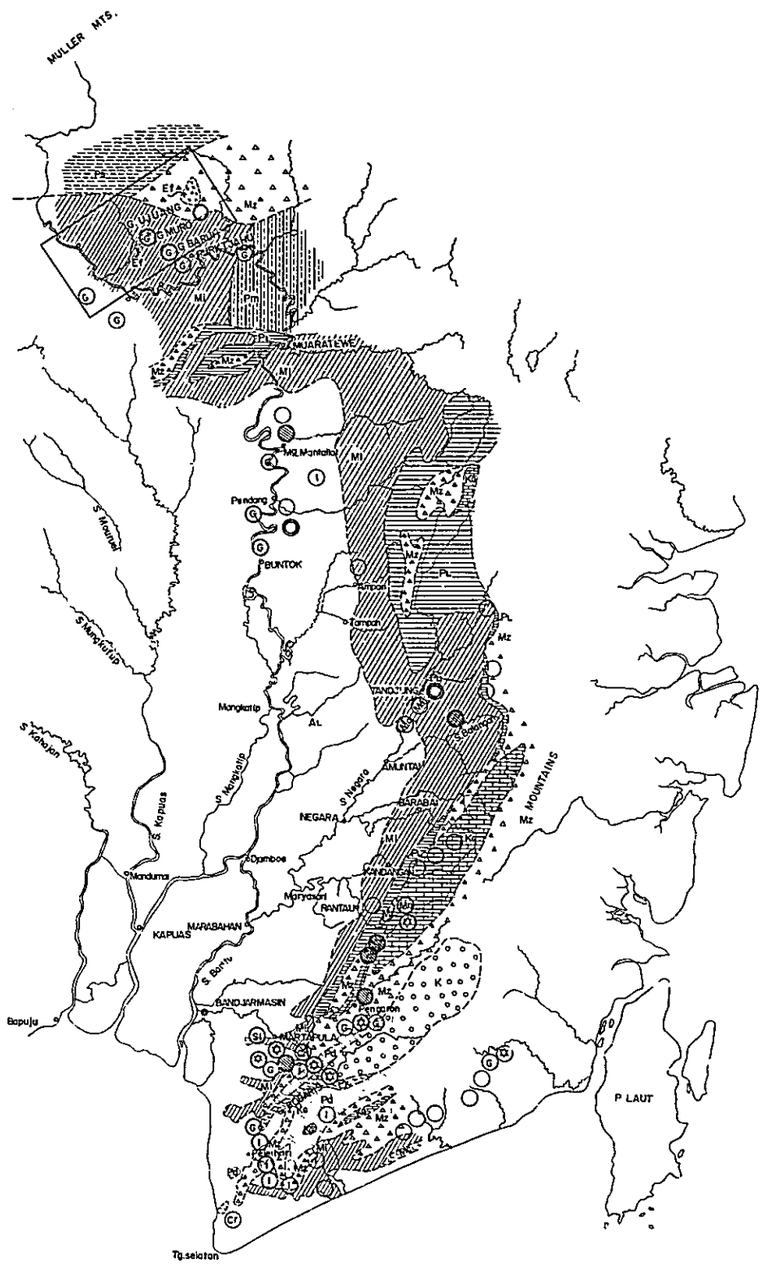
Placer gold likewise is being mined by human power. This should also be switched over to mechanization by the introduction of small excavating vessels like jet ejector.

Of late, airborne magnetic survey, surface survey and prospecting by diamond drilling have been carried out in the circumference of Meratus Mts. and Bobaris Mts. and it is hoped that such surveys will be completed.

Detailed geological maps are yet unavailable on the area adjacent to Puruktjahu up the Barito river, therefore, it is desirable that detailed investigation of that area be performed by means of airborne magnetic survey, radio-active survey, surface survey and prospecting by drilling for which an exploration expense of US$944,000 in total will be required.

Fig. 5-1 GEOLOGIC MAP OF BARITO RIVER BASIN

Attached Mineral Resources



Investigated Deposits by the Survey Team		not Investigated Deposits, Information only	
◎	DIAMOND	◎	DIAMOND
G	PLACER GOLD	G	PLACER GOLD
I	IRON ORE	I	IRON ORE
Mn	MANGANESE ORE	Mo	MOLIBDENITE
○	OIL FIELD	Cr	CHROMITE
▨	COAL	○	COAL
Si	SILICA SAND	○	BAUXITE

Legend

- AL — Alluvium
- Mc — Clastical deposit
- Ml — Sandstone, clay and marl
- Pl — Basal conglomerate limestone and clay marls
- Pm — Marine sediment
- Ps — Plateau sandstone
  (Pm, Ps: Palaeogene)
- K — Upper Cretaceous sedimentary and volcanic facies
- Mz — Mesozoic sediment
- PzC — Crystalline schist
- Ef — Effusive rock
- KG — Granite and Ganodiorite
- Pd — Ultrabase rock
- Planning Area by airborne survey (70 KM x 35 KM)

Barito River Survey Team
March 1971

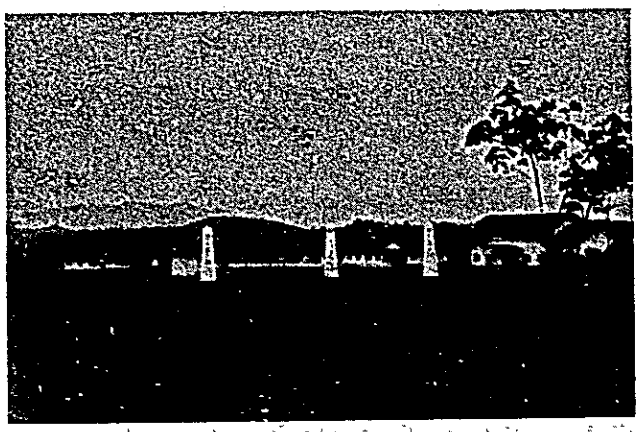


Photo 5-1 Aneka Tambang Office at Bandjarbaru which has office rooms, laboratory and washing plant

Photo 5-2 Panning of Placer Gold in the vicinity of Pelaihari

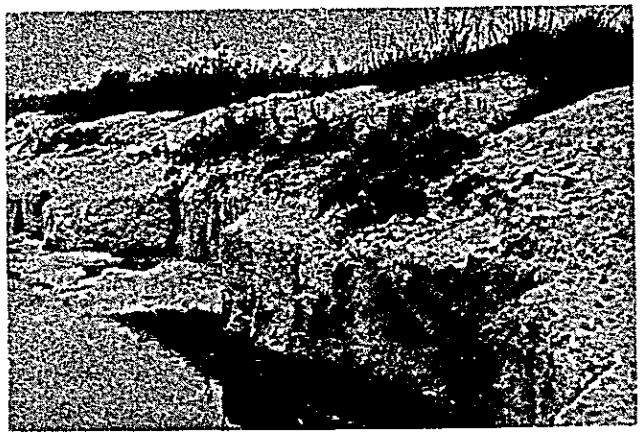


Photo 5-3 Sediment layer of silica sand in the Martapura area. Attention is directed to its high SiO_2 content and little impurities.

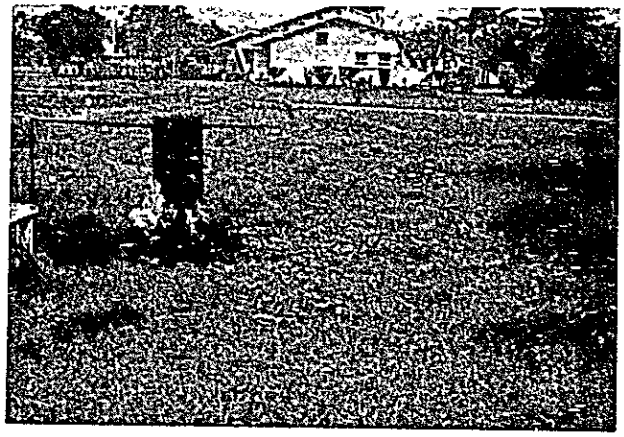


Photo 5-4 Oil field of PERTAMINA at Tandjung. Natural gas is burnt away within the company's premises.

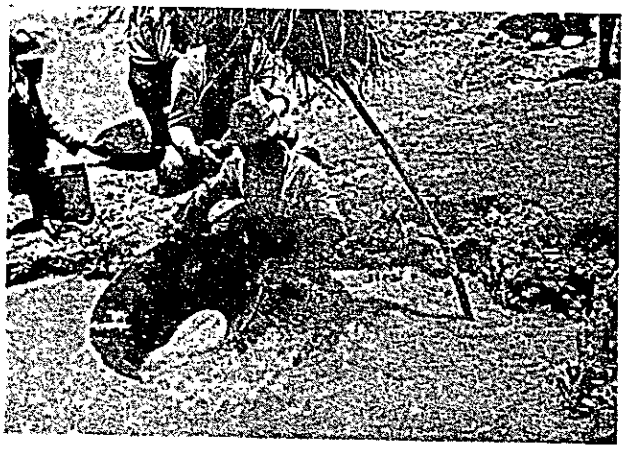


Photo 5-5 Diamond panning in Tjempaka area. Several hundred workers are employed in this area alone.

6. FOREST RESOURCES

6-1 Existing State of Forests

Forests in Kalimantan are mostly tropical rain forests. As a characteristic of tropical forests, they are composed of extremely rich and diversified variety of species, the most important of which are those belonging to Dipterocarpaceae. Geographically, Kalimantan is known for its generally flat topography and old geological composition. The old geology is usually conductive to a rather infertile forest land, but it is offset by the flat topography of the area which provides excellent conditions for the growth of forest trees as well as for forest development.

Forest land in the extensive Barito river basin is also covered with rich resources of tropical rain forests belonging to Dipterocarpaceae which are highly valuable not only for Indonesia but for the entire southeast Asia. They are expected to play a major role in Indonesia's economic development.

6-1-1 Existing State of Forests in Barito River Basin

Forest in the Barito river basin can be topographically divided into the following three.

a) Swampy forest
b) Hilly and mountain forest
c) Alpine forest

General description of these three types of forests are as given below.

a) Swampy Forest

Sailing against the Barito river as far as 200 km from the estuary, one would find nothing but swampy areas with Kaju Puti growing sparsely here and there, and would fail to observe any appreciable forest resources. As one sails further upstream, however, one would note substantial "swampy forests" extending up to 300 km from the estuary (up to the vicinity of Buntok). These swampy forests are composed of thickets which are utilized by inhabitants in certain localities. The swampy forests are estimated to cover an area of 400,000 ha.

b) Hilly and Mountain Forest

At a point approximately 300 km upstream of the estuary, land on either bank turns into dry land with hilly and mountain forests stretching towards the upper reaches. Up to about 400 km from the estuary, however, 30 to 40% of land on either bank is studied with cultivated cut-over areas, while the rest of land is occupied by dense forests rich in resources belonging to Dipterocarpaceae sp.

The basin is generally flat throughout its entire area. On the right bank, in particular, flat land extends up to Puruktjahu (located about 700 km from the estuary), with hilly areas having a small elevation (10 to 40 m) stretching as far as the Kahajan beyond the Kapuas. On the northern side of the Puruktjahu is the highest mountain (El. 1,350 m) in the area beyond which lie extensive and exploitable forests.

These hilly and mountain forests cover an estimated area of about 2,200,000 ha, and their total resources amount to approximately 286,000,000 m^3. The whole of these forest areas allows for future development. Major species constituting these forests are Maranti (Shorea Gen. of Dipterocarpaceae), Keruing (Dipterocarpus Gen. of Dipterocarpaceae) and Kapur (Dryobalanops Gen. of Dipterocarpaceae). They are used to manufacture a wide range of products such as plywood, lumber for structures, etc.

c) Alpine Forest

In the vicinity of the uppermost reaches of the Barito river where it meets the boarder lines of the East and West Kalimantan Provinces, there are ranges of mountains shooting up to an elevation of about 1,700 m. Though the forests in this district is little different from hilly and mountain forests in their type, their development in the immediate future is not considered practical because of their high elevation and steep slope. These alpine forests are estimated to extend over an area of about 700,000 ha.

6-1-2 Existing State of Forests in Tributary Basin

Basins of major tributaries such as the Riam Kanan, the Riam Kiwa, the Balangan and the Tabalong, which embrace flat and hilly areas, are virtually all unstocked. This is ascribable to the shifting cultivation conducted repetitively over many years in the past and to the resultant devastation of the alang-alang grassland.

Forests in the mountain area of the Meratus range are untouched virgin forests, but their resources are somewhat poorer than those of the forests along the main stream. Further, they have steeper slopes and less favourable land condition and forest type. In the upper reaches of the Tabalong, however, a forest land with rich resources and a gentle slope is found.

Since the discharge of rivers flowing through these forest areas is deficient for log floating, river transport planned for forest development along the main stream is not conceivable. Overland log transportation from these areas is not practicable either because they are far from the cultivated areas and there exist no logging road.

Development of forest areas along the tributaries, which must be preceded by the provision of transport means, is not therefore considered to merit immediate attention. Their development will be given due consideration when a satisfactory overland transportation system has been established at a future data.

In addition, natural rubber is produced in numerous rubber plantations in the Barito river basin. Export of natural rubber through Bandjarmasin marked 50 thousand tons in 1967, 51 thousand tons in 1968 and 56 thousand tons in 1969. However, the prospect of future demand for natural rubber is not very promising because of the prevailing use of synthetic rubber in all fields of industry. It was felt that no much is expected of future rubber export. The team noted that most rubber plantations are aged and the majority of relatively young plantations are left without tending.

6-2 Existing State and Prospect of Forest Development and Wood Industry

6-2-1 Forest Development

Despite the favourable growing stock of forest resources, logging in the basin used to be depend on the small-scale manpower logging due chiefly to the backwardness of socio-economic conditions. Forest development in the past, hindered likewise by the slow social and economic development, used to resort to a rather primitive method of transporting log from inner forest areas when rainfall brought about a rise in the water level of rivers. In recent years, however, large-scale mechanical logging came into being, which the team noted to be in active operation at seven places of the basin. Since concessions are already established to cover a substantially wide area, forest development in the Barito river basin can be safely expected to make a rapid expansion. The team is of the opinion that the timber production in the basin will largely increase in the near future and contribute to the economic development of Indonesia (Export volume of timber from Badjarmasin marked 17,000 m^3 in August 1970, which by far surpassed the monthly records registered up to the preceding month).

As for the regeneration of natural forests in the basin, lack of data renders it impossible to reach any definite conclusion. It appears, however, that the regeneration is generally believed to take 30 to 60 years under the selective cutting system now being practised. Assuming that the resources of hilly and mountain forests, which amount to 286,000,000 m^3 as mentioned in the preceding paragraph, are subjected to a cutting cycle of 60 years, the annual cut volume would be about 4,170,000 m^3. Assuming, again, that the yield per percentage in logging obtainable from the said cut volume is 55%, approximately 2,600,000 m^3 of log can be produced each year. And this means that 220,000 m^3 of log would be collected at the estuary of the Barito river for shipment to domestic as well as overseas markets. (It may be added that the log volume exported from Pulang Pisau registered 240,000 m^3 throughout 1969).

6-2-2 Wood Industry

Wood industry in the Barito river basin may be represented by one paper manufacturing plant in Martapura and a number of sawmills in Bandjarmasin. Though manpower sawing is still practised both in Bandjarmasin and Kuala Kapuas as well as many other places along the Kahajan, its output is not known.

With raw materials readily obtainable from the resourceful forest area and with the overland and water transport means at their disposal, Bandjarmasin and the surrounding areas are quite suited for establishment of wood industry. Along with the future repletion of social and economic conditions, wood industry in these area will certainly make a phenomenal development. It may safely be predicted that the first stage of development will center on the improvement of sawmill facilities that assures, on the one hand, a higher utilization rate of resources (use of timber not meeting export standards for sawlog), and serves, on the other, to dispense with the existing manpower sawing. In the ensuing stage of development, efforts will be directed to the production of wooden prefabricated houses. And on establishment of these basic conditions, the wood industry will embark upon the production of veneer and plywood.

It goes without saying that these production facilities should be established at suitably selected sites, with their production capacity designed carefully to comply with an integrated long-term plan.

6-3 Problems Outstanding at Present

6-3-1 Basic Data on Forest Resources

At present, one finds no basic data on forest resources covering forest area, growing stock, natural regeneration, etc. The only material now available is the inventory data prepared for the proposed development areas. The team conducted reconnaissance by plane and made an estimation of growing stock with the aid of foresters of site. It is recommended that aerial photography over the entire forest area be conducted at an early date to determine the forest area by forest type, and that the inventory be subsequently carried out to clarify the growing stock.

For the forests in the Barito river basin, which happen to be all natural forests, no attempt has yet been made to determine their growth and natural regeneration. Since both are basic and indispensable for the formulation of a working plan, relevant data collection should be commenced without the least delay.

6-3-2 Existing State of Forest Development

There are some problems that demand solution respecting the forest development in the basin of the Barito river as well as of the Kapuas and Kahajan.

Timber produced by manpower logging Kuda Kuda system invariably have a far lower quality as compared with those turned out by the mechanical logging system. For the effective utilization of forest resources, mechanical logging system is naturally far more advantageous. Mechanical logging is fairly in progress for the forest development in the Barito river basin, but is lagging in the basins of the Kapuas and Kahajan. Efforts should therefore be made to check any further expansion of manpower logging and to shift it to mechanical logging.

Progress of rapid and large-scale forest development must be attended by careful forest protection that serves to safeguard the ecology of natural forests. Specifically for assurance of regeneration and prevention of forest land erosion, it is mandatory to enforce statutory restrictions controlling the falling rate and falling method. And this again calls for the availability of consolidated basic data.

6-3-3 Pilot Forest and Promotion of Green Campaign

Pilot forests preserved in many places of the tropical zone serve for various studies peculiar to respective localities.

The pilot forest in the Barito river basin, when established, would be assigned, above all, with the task of studying the feasibility of silviculture in the alang-alang area. The vast herb-zone of alang-alang is now dotted with low-lying lands here and there where forests and houses are found. This deserves further study, because it indicates the possibility of silviculture in some parts of the alang-alang area.

The objective at which the pilot forest should aim at in future is the rehabilitation of the extensive but devastated alang-alang area which should be pushed forward in line with the development of inner forest areas. For this purpose, test planting of different species should be undertaken at first to find species most adaptable to the natural conditions of the alang-alang area.

Constant availability of abundant forest resources and the sparse population seem to cause the inhabitants in the Barito river basin to have little appreciation of the direct and indirect benefits which the forests bring about for their communities. Noting that human life is supported by forests dotting the vast alang-alang area, the team felt the keen necessity for forest protection and enhanced silvicultural efforts. The team therefore wishes to recommend to initiate the planting in the neighbourhood of individual farmhouses for the gradual expansion of planting area through creation of farm forests or adoption of Taung-ja system.

It is desirable that the entire nation be enlightened with the significant role played by forests in land conservation, and that efforts be augmented for upheaving the green campaign. For this purpose, the Indonesian Government is urged to provide accelerated financial and other assistances whenever necessary.

6-4 Conclusion

With the progress in the felling, regeneration and wood-utilization techniques, forests in the Barito river basin will promise unlimited supply of forest resources. It must be noted that the forest development, which will produce direct incentive effect on the economic growth, should be accompanied by studies and surveys for basic data collection. (See Table 6-1)

6-4-1 Survey of Forest Area and Growing Stock

In conducting the above-mentioned studies and surveys, priority should be given to air-photo taking and its mapping for determination of forest area and also to the survey of forest description for determination of growing stock.

6-4-2 Survey of Growth and Natural Regeneration

Suitable test areas should be established in the basin for growth observation and clarification of natural regeneration.

Survey of natural regeneration should be conducted over an extensive area including cut-over-areas.

6-4-3 Test Planting for Pilot Forest

Based on the principle of "Right Tree on Right Site," species best adaptable to the natural environments of the alang-alang area should be selected, and studies should be made to find the most compatible planting method. In the course of the present survey, the team was much attracted by the excellent growth condition of Pinus Merkusii planted in the front yard of farm houses in the vicinity of Bandjar Baru. The team learned that they had been transferred from Java. Inclusion of this species among those for test planting is therefore recommendable.

Test planting of Pinus Merkusii and other suitable species should be included in the irrigation and polder projects for observation of their growth condition over several years.

Table 6-1 Estimated Cost of Survey on Forest Resources

Item	Description	Estimated Cost			
		1st Phase		2nd Phase	
		Quantity	U.S.$	Quantity	U.S.$
Survey on Forest Resources					
Forest Area and Stock of Forest Resources			30,000		-
Growth and Natural Regeneration			70,000		-
Test Planting			63,000		-
Total			163,000		-

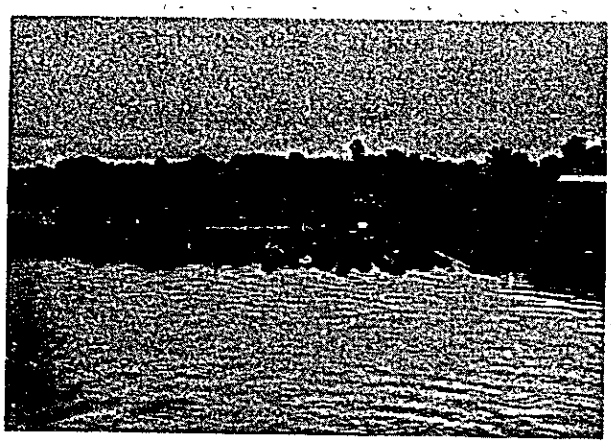


Photo 6-1 Floating of rafts

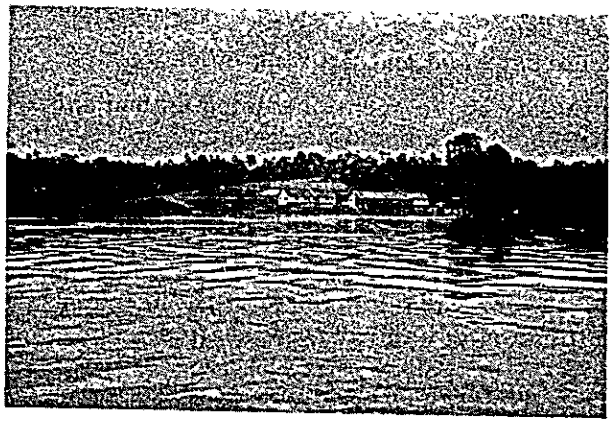


Photo 6-2 Site of Forest Development
(Base and Dumping place)

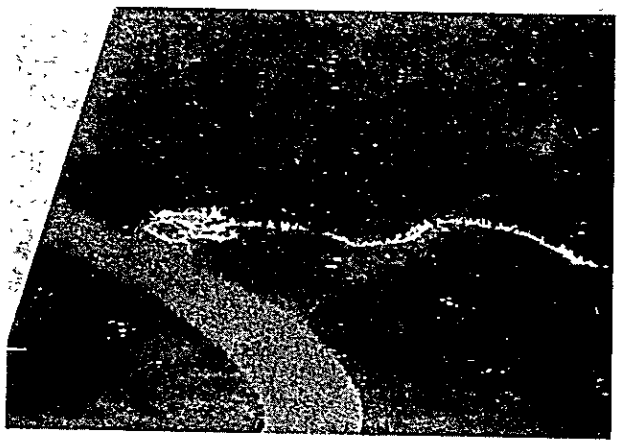


Photo 6-3 Logging Road

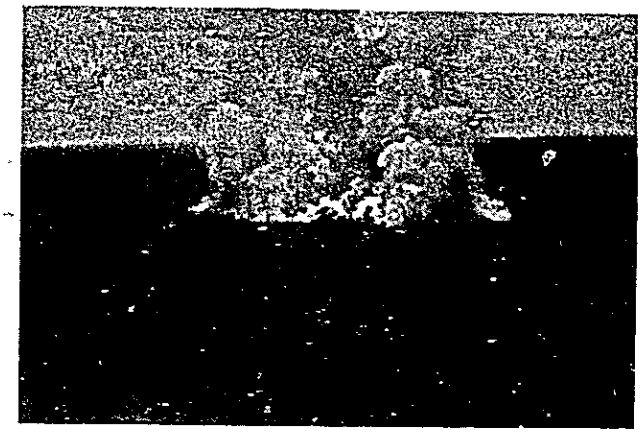


Photo 6-4 Burning for shifting cultivation

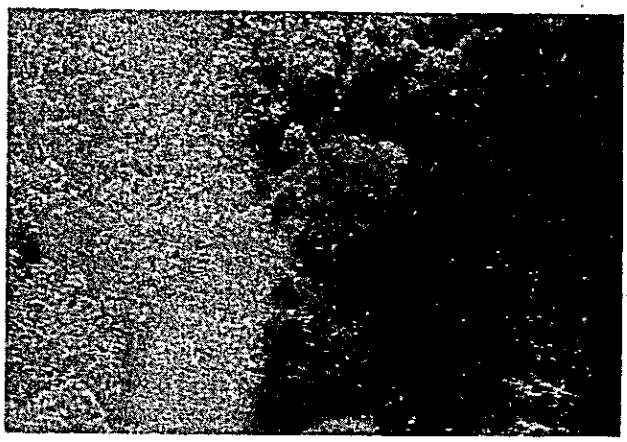


Photo 6-5 Forest of Dipterocarpaceae

Photo 6-6 Forest of Dipterocarpaceae

7. AGRICULTURAL DEVELOPMENT

7-1 General Condition of Agriculture in South Kalimantan

7-1-1 Natural Conditions

The Barito river basin having an area of approximately 60,000 km^2 has a special soil condition, being influenced by the characteristic flat topography and the tropical climate. This has an important significance in connection with the agricu ltural development of this region.

(a) Topographical condition

With the exception of the mountainous areas on the northern part and the eastern part, this river basin has a wide variation of topography such as the plains, river plain and river valley along the tributary, swamps in the middle stream area, and low, damp areas in the tidal compartment on the downstream. Topographically, almost the entire basin can be used as farmland. In fact, quite a large area is already being used as farmland where natural conditions are favorable and effective water control is possible.

The general characteristic is that the land has a very easy grade, and so the basin forms a vast region of poor drainage as the results of the overflowing of the rivers in the rainy season and the influence of tides which extend to the point about 200 km upstream from the estuary. The area in which the tributaries of the Barito river on its eastern side such as S. Tabalong, S. Balangan, and S. Batangalai, etc. flow through is inundated every year in the rainy season, and is called the "Lake Region", but is an area with fertile soil transported by the rivers. Those upstream areas of the tributaries including the hilly districts are free from floods in the rainy season, but are subjected to draughts in the dry season. In the lower basins of the Barito river and of S. Kapus and S. Kahajan flowing to the west of the Barito river which are subjected to the influence of tides, the tidal amplitude is very large, and is in fact larger than the difference of the water level of the main stream between the rainy season and the dry season. The tidal amplitude at the spring tide is 280 cm at the estuary, and is as large as 220 cm at Marabahan which is about 60 km upstream from the estuary. These areas have the sedimentation of soil grains transported by the flooding of the main stream at high tide because of this large tidal amplitude.

(b) Meteorological conditions

The mean annual rainfall in the plains in this basin is 2,800 mm, but it is said that it is 3,500 mm or more at Meratos Mountain Range which forms the basin of the left bank of the Barito river. The climate can be classified roughly into the rainy season (west monsoon, November to April) and the dry season (east monsoon, May to October). Rainfall in the rainy season reaches 65 to 85% of the annual rainfall, but the deflection by year is unexpectedly large. The type of rainfalllis the typical tropical torrential rain concentrated on a locality, and because of this, a long spell of draughty days continues for more than a month or more, making the natural conditions extremely harsh for the crops in the areas having favorable drainage. Temperatures at Bandjarmasin have been studied as follows. As Bandjar-

masin is located right on the equator, the length of day and night is almost equal, and the annual mean of max. and min. daily temperatures are 32.1°C and 22.3°C. respectively. Daily mean is 26.8°C, and the monthly deviation is small. The relative humidity is between 78% and 88% (monthly mean) and the annual mean is 84%. Naturally, evaporation is small, and the average is 3.7 mm/day in the dry season and 1.6 mm/day in the rainy season. However, evaporation sometimes reaches as high as 9.7 mm/day in the dry season. (See attached table of Meteorological Data)

Meteorological Data

(a) Meteorological data of Bandjarmasin: Monthly Averages over the period 1904 - 1964

Month	Temperature C°			Wind Direction	Wind Velocity m/sec	Relative Humidity %	Atmospheric Pressure mb
	Highest	Mean	Lowest				
Jan	30.8	26.2	22.2	N	2.5	87	1009.0
Feb	31.4	26.5	22.8	W	3.5	88	1009.2
Mar	31.6	26.7	22.8	NE	1.7	87	1009.4
Apr	32.2	26.9	23.1	N	1.2	86	1009.1
May	32.6	26.5	22.9	NE	2.3	87	1008.9
Jun	31.9	26.8	22.2	N	2.2	85	1009.5
Jul	31.8	26.6	21.2	N	4.7	85	1009.5
Aug	32.5	26.4	21.4	E	4.5	79	1009.6
Sep	32.6	27.1	22.1	N	2.9	78	1009.7
Oct	33.8	27.7	21.4	NE	3.4	76	1009.6
Nov	32.4	27.0	22.3	N	1.9	83	1009.4
Dec	30.9	26.7	23.3	N	2.5	85	1009.4
Year	32.1	26.8	22.3	N	2.7	84	1009.4

(b) Rainfall data of Banjarmasin, Marabahan and Kuala Kapuas

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
Average rainfall (mm)													
Bandjarmasin (50th)	321	304	297	221	160	142	95	83	96	132	206	321	2,388
Marabahan (1917-41)	318	253	283	211	160	128	71	75	95	103	206	264	2,767
Kuala Kapuas (1917-41)	298	252	325	277	135	127	68	63	86	112	213	284	2,210
Average rainy days													
Bandjarmasin	22	19	19	15	13	12	9	9	8	12	16	21	175
Marabahan	18	14	14	11	9	8	5	4	6	7	11	15	122
Kuala Kapuas	17	14	15	12	10	8	5	5	6	8	13	16	136
Max. and Min. rainfall of each month and each year at Bandjarmasin (Period: 19 years)													
Maximum	572	490	386	376	320	246	224	183	289	234	361	496	2,614
Minimum	195	165	149	112	74	32	3	5	10	36	79	144	1,743

(c) Soil

The soil in the Barito river basin can be roughly classified into the following four types.

(i) Latosol

Due to intensive weathering and eluviation, this type of soil does not show clear differentiation of soil layer. It is mostly found in hilly districts and tablelands. Eluviation takes place in the rainy season, and the bases of Si and Ca are washed away, and Al and Fe remain. In the dry season, the alkali base rises and Al Fe turn to hydroxide compounds in the process. These compounds remain on the upper stratum and dehydrate. Dehydrated Al Fe compounds are irreversible, but Si base, etc. are eluviated every rainy season. Such dehydrated Fe compounds present reddish color, form conglomerates of iron clump and band together to form a hard stratum which does not allow plant roots to penetrate. Naturally, the contents of organic matters and vegetable nourishment are low. The soil indicates the pH value of 4.5--5.5, and improvement of soil to quite an extent will be required for raising crops.

(ii) Red-yellow Podsol

This type of soil is found in the low hills and tablelands adjacent to the areas where Latosol is distributed. The nature of this soil is similar to that of Latosol. It is characterized by soft Lateritic soil. The base of the surface soil has eluviated and A_2 stratum of light grey color or yellowish color is formed, and below this stratum is accumulated laterite. Same as the type of soil mentioned under (i), this type of soil contains little organic matters. The pH value is low, and the soil is subjected to erosion.

(iii) Alluvial soil or Low humic gray soil

This type of soil has been formed newly from alluvial or colluvial deposits, but sectional differentiation is little as the soil stratum is premature, and it changes directly from A stratum to C stratum. This type of soil is found distributed widely around the Barito river and the Kapuas river, but low humic gray soil is distributed over the inland area because of the poor drainage, the color of which on the surface stratum is dark, and that on the lower stratum is grayish or bluish gray. The marine alluvial soil is distributed over the coastal area, forming coastal clay at the end. This area is mostly covered with coconut trees and mangroves.

The river alluvial soil contains the deposits transported by the flooding of the rivers or the compounds of such deposits and the organic matters, and is very fertile, but peat is found in the inundated area to quite an extent. pH value of this soil is 4--5 and is rather acid, but this area is the area most suitable for growing paddy rice.

Marine alluvial soil is distributed over the tidal area which is affected by the sea water level. This type of soil is characterized by the organic acid, and is strongly acid due to sulphate from the sea water.

As regards the surface stratum, it is comparatively rich in nitrogen and phosphoric acid, but it is said the soil contains very little Ca, Mg and other bases. The sulphate content of the lower strata is remarkably high, and this is the main factor of its strongly acid, forming acid sulphate soil and potential-acid sulphate soil. The latter particularly shows strong acidity (pH 2--3) when dried rapidly. This yellow soil created by drying is called "cats-clay", which hardens and nothing can grow on such soil. The soil in the tidal area generally has the surface stratum about 20 to 30 cm, usually contains organic matters, and acidity is slightly weakened. Paddy rice, cassava, pineapple, etc. are being cultivated on this type of soil.

(iv) Organosol

This type of soil exists in the area bordering the area with the type of soil mentioned under (iii) above, but it is distributed more over the swamp-lake region where it is saturated always. Some contain a large quantity of organic matters and have turned into glei. Strata of peat or muck of various depths do exist.

Distribution of the above-mentioned four types of soil is as shown below.

	(i) Latosol	(ii) Red-yellow Podosol	(iii) Alluvial or Low Humic Gray soil	(iv) Organosol
Bandjarmasin	-	-	◎	○
Bandjar	○	○	◎	○
Tanah Laut	◎	○	○	○
Barito Kuara	-	-	◎	○
Tapin	○	○	◎	○
Hulu Sungai (STU)	○	○	◎	○
Tabalong	○	◎	○	-

(Note) ◎ shows the type of soil most widely distributed.

The soil in the Barito river basin is closely related to the topographical conditions. The following table shows this relationship. (See Fig. 7-1)

	(i) Latosol	(ii) Red-yellow Podosol	(iii) Alluvial or Low Humic Gray soil	(iv) Organosol
Hilly land or upland	○	○	-	-
Flat land or lowland	-	○	○	○
Swamp or tidal land	-	-	○	○

7-1-2 Agricultural Population and Its Distribution

Since there are no statistics of the agricultural population, accurate figures are not available. However, it is said that the total population of the farmers and their families comprises approximately 83% of the total population of Kalimantan Province (1, 777, 000 persons as of 1969). It is estimated that the total number of farm households is 213, 000 or about 60% of the total number of households. (See attached Table 7-3). The farming people live in the lower basins of the major rivers and in the areas located along the banks of the waterways and main roads. They manage farm located within 4 to 5 km along the waterways or roads.

In this way, long strips of farmlands have developed in places conveniently situated with water readily available. Kandangan, Bararai, and Amuntai are in low wet area subjected to frequent floods, but this area is comparatively densely populated with farms situated in places far away from the main roads. This is mainly due to the fertile soil and good water quality, and also because the utilization of water is possible throughout the rainy season and the dry season.

The history of settlement of the farming people in this area is still new. It was some time after 1820 at the earliest. It is only 50 to 60 years since the farmers began to live in the southern part of South Kalimantan and the tidal area. Naturally the population is fluent, and there are many who immigrate to other areas when new waterways are completed and development of new lands becomes promising, all in search of more favorable conditions.

The state of ownership of land is as shown in the following table. About 70. 5% of the total number of farm households are the owner farmers, and 22. 0% are owner-tenant farmers, and 7. 5% are tenant farmers who do not own any farmland. About 86. 5% of the farmland is being used by the owner farmers, and 13. 5% by the tenants. According to the survey made in 1969, the total acreage of cultivated land was approximately 255, 000 hectares (about 210, 000 ha of paddy field and about 45, 000 ha of upland field). Therefore the acreage of cultivated land per farm household was 1. 3 ha.

This small acreage of cultivated land per farm household in spite of the comparatively sparsely populated area having vast uncultivated area is due to the slow development of the enterprises relative to irrigation facilities and the the facilities for land improvement as well as the conventional primitive method of farming still being employed in this area. (See Fig. 7-2)

The State of Land Ownership

	Owner farmers	Owner-tenant farmers	Tenant farmers	Total
Number of farm households (%)	143 (70. 5%)	44 (22%)	15 (7. 5%)	202 (100%) (Unit: 1000 farm households)
	Owner farmers' land	Tenant land	Total	
Acreage of cultivated land (%)	187 (86. 5%)	29 (13. 5%)	216 (100%)	(Unit: 1, 000 ha)

(Agricultural Census 1963 Statistic Indonesia 1968)

7-1-3 The State of Land Use and the Major Crops

As stated in the foregoing paragraphs, the land use in South Kalimantan is largely influenced by the natural conditions, and is changing widely from year to year. In a year of heavy rainfall, there are places where the harvesting acreage of paddy rice is reduced to half of the planted acreage due to the flooding of the rivers. The total acreage of harvesting area and the planting area and the acreage of cultivated land per farm household in 1969 are as given below.

	Paddy Field (1,000 ha)		Upland field (1.000 ha)	Acreage per farm household (ha)
	Harvest	Planting		
Bandjarmasin	3.2	3.4	–	0.1
Bandjarbaru	1.5	1.8	0.4	1.7
Bandjar	37.5	42.0	10.2	
Tanak Laut	14.2	15.3	4.8	2.2
Barito Kuala	40.6	42.7	0.2	2.4
Tapin	7.3	17.3	5.4	2.2
Hulu Sungai Selatan	3.1	11.0	2.6	1.2
Hulu Sungai Tengah	11.3	27.4	5.7	1.2
Hulu Sungai Utara	20.3	29.4	4.3	1.2
Tabalong	6.0	9.8	6.3	1.1
Kota Baru	8.8	9.8	5.7	1.2
Total	153.8	29.9	456	1.3

(Data obtained Sept. 1970)
(Agricultural Extension Service Center, Bandjarbaru)

As shown in the above table, about 56,000 ha of paddy field did not produce any rice due to floods, draughts, insect pests and diseases. This clearly shows the farm management in this area is extremely unstable. Concerning the upland field, no accurate statistics on the acreage of orchards are available, but about 2,600 ha estimated from the number of fruit trees is included in the table. It seems fruit trees are grown in a wider area.

Besides the above, it is said that there are over 10,000 ha of coconut plantations and 106,000 ha of rubber plantations. Estate farms growing rubber trees occupy 20,600 ha of the total area of rubber plantations, but no replanting have been carried out since they were nationalized, and many farms are in a state of desolation. Also, rubber trees owned by the inhabitants looked rather aged.

As regards the major crops of the upland field, upland rice occupies a total acreage of 27,000 ha. Upland rice is cultivated in the rainy season throughout the province with the exception of Bandjarmasin and Barito Kuala where there are upland fields only around the residences.

Cassava is the crop which occupies a large acreage of cultivated area next to upland rice. This is planted all over the province on about 5,000 ha. It is planted between October and December of the year and harvested in August to October of the following year. Cassava has high per unit calory and grows well even when the soil is not fertile. It can be grown on strongly acid soil where alang-alang grows. Starch made from cassava is known as tapioca.

Maize comes next, which is planted in the area having Barabai as its center on approximately 4,000 ha. Cultivation period is four months; and it is possible to raise three crops a year if irrigation facilities are available. However, the production of maize for export in this area on paying basis like in the eastern part of Java would be quite difficult. This crop is being cultivated in this area mostly for local consumption.

As stated before, the accurate acreage of orchards cannot be grasped, but the pineapple fields in the tidal area seems to be quite large. According to the information gathered at the agricultural experiment station, all year round fruits in the order of the quantity of production are banana, pineapple, bread fruit, papaja, etc. Seasonal fruits are rambutan, durian, duku and mangosteen. As these fruit trees are planted around the residences, in the borders of the paddy fields, and even along the roads, it is quite natural that the accurate acreage cannot be calculated.

Vegetables are planted on an acreage of about 2,000 ha centering around Hulu Sungai area, but no statistics classified by the crop is available. They are, in the order of the quantity of production, pumpkin, spinach (Ipoemoea Uptans), cucumber, long green bean (Vigra-Knenss), chili (Capsicum), egg plant, water melon, and white pumpkin.

Sweet potatoes are also planted on about 2,000 ha, but the total production is for local consumption.

Peanut and soy bean are planted on 1,600 ha and 500 ha of land respectively in the areas around Tandjung area, but they are not for processing.

Green bean is also planted on about 500 ha of land around Barabai.

The following table shows the yield per ha of each crop in 1969. Target and realization area and production of South Kalimantan Province are shown in Table 7-1.

Crop	kg/ha	Crop	kg/ha
Paddy rice	2,185 (dry grain)	Peanut	725
Upland rice	1,520 (dry grain)	Soy bean	660
Maize	900	Green bean	650
Cassava	5,940	Vegetable	1,770
Sweet Potato	5,035	Fruits	3,340

(Agricultural Extension Service Center, Bandjarbaru)

7-1-4 Existing Condition of Agricultural Development and Evaluation of Farmland

Agricultural development in Kalimantan centered on paddy cultivation in the past and expanded in the middle and lower basins of the Barito river and in the basins of its eastern tributaries where the natural water level condition is favourable.

In the eastern tributary area, there are intake facilities for irrigation at more than ten places which were constructed for agricultural development during the Dutch colonial days and after the termination of World War II. These development efforts, however, produces no appreciable results because they were not ensued by the installation of satisfactory tertiary facilities and the education and enlightenment of farmers. Hence, some of these intake facilities are not in the serviceable state.

In sharp contrast with the stagnated development in the eastern tributary area, paddy cultivation is actively carried out in the area extending along the lower reaches of the Barito river, the Kapuas River and the Kahajan River, where lateral canals connecting to a number of navigation canals such as the Serapat and the Besarang are serving as drainage and irrigation canals to facilitate paddy cultivation and induce the settlement of many farmers. Acreage of paddy field in this area is approximately 150,000 ha. The tidal irrigation project now in progress in this area is based on a special water control system in which soiled water can be drained and fresh water supplied by the fluctuation of water level which is brought about by tide. The system, devised from the favourable effect of navigation canal on the creation of paddy field, is successfully in operation with the new settlement of farmers already initiated.

On either side of the arterial roads leading out from Bandjarmasin, there extend substantially wide farmlands which are considered to have been developed by the drainage effect of the ditches excavated at time of road construction. It appears that the improved crop transportation to the market which was realized by the road construction served as a strong incentive to the farmers in this area.

Although the eastern tributary area is favoured with physical conditions which promise the stable development of agriculture, expansion of farmland is conspicuous in the swamp area around Bandjarmasin and in the tidal area. This is considered ascribable to the overland and river transport facilities available in these areas which allows the production and supply of agricultural crops to readily meet the demand of consumer centers. Wet monsoon single cropping prevails in Kalimantan for paddy cultivation, but upland rice is also produced where land conditions permit if the market price of rice soars in the consuming areas.

As described later in this chapter, production of crops other than rice in deficient in Kalimantan and calls for their import from Java. Farmlands capable of producing vegetables are extremely small in area, and it is no exaggeration to say that agriculture in Kalimantan is limited to the habitual paddy cultivation which resorts to the rise in water level in the wet season.

Agricultural development in Kalimantan calls for a number of promotional measures such as the improvement of water control techniques, installation of water control facilities, introduction of diversified farm management to cope with the varying demand, and improvement of distribution system and transport facilities. However, it entails great difficulty to determine the priority order of these measures. The situation at present is such that all these measures remain unfulfilled condition which interact to produce the existing balance which is far from promising.

The condition of the farmland in this region for planting and rearing of agricultural crops is almost the same as the natural condition. Of course there are some areas in the region in which farmlands in the neighboring areas of roads and waterways constructed newly are being used as the secondary effects of the construction of such roads and waterways. Again, in some other areas, irrigation and drainage facilities have been constructed on quite a large scale, but these are either not fully utilized or are left unused.

Most of the varieties of rice grown in this area are close to wild varieties, which do not require any special farming technique, and a certain amount of yield can be expected only if the natural water level is suitable. Naturally, the farmers do not feel the necessity of thinking out new methods of farming, and the only means of increasing the yield is to increase the acreage of the farmland. No efforts have been made for the active management of irrigation and drainage, and the introduction of improved varieties of course and second crops have not been carried out, and so it seems almost impossible to improve the techniques of farm management. However, the natural conditions in this region are most suitable for farm management of the primary stage, farmlands of a large acreage have been developed easily without requiring much efforts, and the total acreage of the cultivated land is quite large at present. It could be considered that such favorable natural conditions, on the contrary, have affected adversely on the progress of the techniques of farming in this region. It may be possible to cultivate rice or upland crops during the dry season partially or for a short period by using small-scaled facilities and new farming method, but the present condition of the region is too poor to expect the improvement of the techniques of farming and increased yield through introduction of new improved varieties, fertilization and pest contrcl, etc. completely and on permanent basis. Such monotonous and vast natural conditions are favorable for the primitive method of farming, but they obstruct further development of such farmlands.

It may be possible to expand the acreage of farmland for some more years in the way which is being employed now, but it is believed that it is now time that some drastic plan should be promoted for the procurement of the farmland as the basis for the support of the future of the country as well as for further development and prosperity.

Such a plan should be studied on the basis of a way of thinking which is entirely new and different from the conventional way of thinking. This will require the organizing power of a very high degree. Introduction of new varieties or the improvementtof farming techniques alone would not be sufficient to produce such results which are worthy of expectation. The objective can be attained only when such should be employed together with the most efficient use of agricultural facilities, the major items of which are the irrigation and drainage facilities.

When promoting farmland exploitation and land improvement in this region, it would be necessary to divide the region into several areas. The standards for the division of the region naturally are the two conditions, namely, irrigation and drainage. This should also be closely connected with the plan of flood control of the tributaries of the Barito river. Besides this water condition, another important condition for the agricultural development is a means of communication. The agricultural development should be something which contributes to the elevation of the living standard of the farming people by promoting farmland exploitation, settlement of the farmers, and the supply of agricultural products to the markets. A good means of communication is one of the important factors which decides the success of the agricultural development. Condition of the use of development of farm villages in this region clearly show that they are closely connected with the existence of roads and waterways. These waterways, displaying the secondary effect as drainage canals, are promoting the farmland exploitation. When promoting the overall agricultural development of the entire region, roads and waterways should be studied together.

7-1-5 Present Level of Farm Management Techniques

(a) Present condition of rice crop

The methods of rice cultivation now being employed in South Kalimantan are classified into the following five types according to the topographical and meteorological conditions.

(i) Sawah barat (West monsoon rice field)

This type of ricefield occupies the largest acreage among the five types, and is seen over approximately 80,000 ha in Hulu Sungai area with Barabai its center. As this type of ricefield is not equipped with drainage facilities, there are cases in which there will be no harvest at all like in 1969 when 40,000 ha or about half of the total acreage suffered flood damages and other damages. This type of ricefield is found mostly in the flat lowland area lying between hilly land and swamp area. When floods are gentle and do not last for a long time, comparatively high yield can be secured that year because of the fertile soil transported by the flood flow. Sowing period is October or November, and transplanting is done in February, and the harvest time comes in June or July. The major varieties are the Lemo and the Raden Djawa. Cultivation period of 7 to 8 months is required. These methods have been employed eversince 1820.

(ii) Sawah timur (East monsoon rice field)

This type of ricefield is found over 30,000 to 40,000 ha in the lake region or the swampy area around Amuntai. This region is perfectly inundated in the rainy season, and so rice cultivation is impossible. However, rice cultivation becomes possible in the dry season when the water level of the lake goes down. Transplanting is done in May or June, and harvesting in September or October. Cultivation period is about 5 to 6 months. This method has been employed since around 1910.

(iii) Sawah surung (Floating rice field)

This type of ricefield can be seen in the swampy area, but the yield is unstable being subjected to the influence of the natural conditions. This type of ricefield is seen only over 2,000 to 3,000 ha around Amuntai. Sowing is done in September, and the rice plant grows as the water level of the swamp rises. The growth is possible up to 20 cm a day. This method of cultivation cannot be employed in the area where the water level rises more than 20 cm a day or in the tidal area where the water level rises more than 20 cm a day or in the tidal area where the water level changes frequently. The harvesting time is February. Requires a cultivation period of about 5 to 6 months. Has been cultivated since around 1930.

(iv) Sawah bajar/Sawah pasan surut (Tidal Swamp rice cultivation)

This type of cultivation method is being employed in the vast tidal area. There are many settlers who settled at the newly reclaimed land where unfavorable irrigation condition was improved by the artificial canal system in or around 1920. It is estimated that the total acreage of tidal area in South Kalimantan and Central Kalimantan is 3,600,000 ha, and this method of cultivation is being used on about 80,000 ha in South Kalimantan. This is the typical method of cultivation used in Kalimantan in which sowing is done in October, transplanting twice thereafter in November and January respectively, and final transplanting in March, and harvesting in August. This method requires a cultivation period as long as 9 to 10 months. The varieties used are mostly the Lemo and the Raden Djawa same as in case of (i), and other varieties follow in the order of Bajar Putin 462/10 and Bajar Melintang 10/13.

(v) Landang (Upland rice)

Cultivated from older days in the upland area having gentle slopes except Barito Kuala, on land reclaimed by burning. Sowing is done in November and harvesting in April or May.

The condition of the above-mentioned 5 types of cultivation is as shown in Table 7-2, but the following table shows that the methods of cultivation employed are in accordance with the topographical conditions.

	West Monsoon	East Monsoon	Floating	Tidal	Upland
Bandjarmasin	-	-	-	◎	○
Bandjar	○	○	-	◎	○
Tanah Laut	○	-	-	◎	○
Barito Kuala	○	-	-	◎	-
Tapin	◎	○	-	-	○
Hulu Sungai (STU)	◎	◎	○	-	○
Tabalong	◎	○	-	-	○

Note: ◎ Used most

The method of cultivation is perfectly a primitive method, in which fertilizer and agricultural chemicals are not used at all. Hallowing by using oxen as seen in Djawa Island is not used. Probably this method of farming is natural since most of the varieties used are Indica, which are disease and pest resistant and show weak reaction to fertilizers. Having long stalk and low optimum density against nitrogen, these varieties were growing well like weeds on the fertile soil transported by the monsoon floods. Agricultural implenents used are the instrument called "ani-ani" for cutting sprouts, and other simple tools such as spade and garden trowel.

(b) Present condition of agricultural machines

A large building built with the Soviet aid along the roadside of Bandjarbaru draws attention. This is the P. N. MEKATANI-III of South Kalimantan, which is possessing about 60 tractors.

International and Furgason tractors are being used by the civilians, but they are for use on upland farms, and not a single machine has been used on paddy fields.

Agricultural machines other than the above now being used are the hand winnowing machine which can be found in each farm household, and about 450 hullers (small rice mill) and 14 large rice mills. The capacity of all the rice mills together is not large enough to polish 1/3 of the total production of rice. The remaining 2/3 is hand polished by women and children of the farm households. (See Photo 7-1 and 7-2)

(c) Present Condition of Livestock Farming

According to the data obtained at the Livestock Veterinary Office (Inspektorat dinas Peternakan) situated at Bandjarbaru, the number of livestock as of 1969 is as follows.

	Horse	Cattle	Buffalo	Goat	Sheep	Pig	Chicken & duck
Bandjarmasin	–	930	44	1,055	349	815	92,794
Bandjar	1,083	7,030	900	4,028	260	–	374,009
Tapin	83	1,213	904	1,427	266	–	38,668
H.S. Selatan	180	2,006	2,758	1,201	1,775	382	462,031
H.S. Tengah	526	2,733	2,995	4,477	2,735	486	906,499
H.S. Utara	69	1,445	5,963	3,608	1,785	–	697,615
Tabalong	70	5,655	61	3,848	276	644	239,336
Tanah Laut	176	10,922	5,534	1,453	242	89	307,422
Kota baru	539	1,752	16,114	5,360	222	138	234,401
Total	2,726	33,686	35,273	26,457	7,910	2,554	3,352,778

Cattles are white cattles called Ongele cattle similar to the Indian cattle. They are raised in the area around Pelaihari. There are some who own nearly 200 cattles each, and one or two ketp at each farm household are used for pulling the cart or as work cattle. However, cattles are not used for fallowing like they do in Java, and each cattle is sold at 40,000 - 50,000 Rupiahs as beef cattle.

Buffaloes are raised more in the swampy area in Hulu Sungai region. In the rainy season, a buffalo-boy is hired, and the buffaloes are raised on a raft-type cowshed large enough for 150 to 200 buffaloes to sleep in it only at night. About 30,000 goats and sheep are being raised in the area around Hulu Sungai for food.

As regards milkcows, about 200 cows called Gerati (Holstein x local variety) have been brought in from East Djawa, but it seems rather hard to increase the number.

A total of 3,352,000 ducks and chickens are raised everywhere in the region. The rate of laying eggs a year is only about 200. Efforts are being made to improve the strain by importing Kimber 137, 141 and 155 white chickens from USA.

There is a trial farm of about 16 ha for cultivating pastural plants. Elephant grass (pamicum maximum) and giring giring (Crotalaria) have been cultivated without using fertilizers or chemicals for soil improvement to successfully wipe out alang-alang. Again, the grass eaten mostly by the buffaloes in the swampy area is known as Banta grass (Heercia Hexandra). (See Photo 7-3)

7-1-6 Agricultural Experiments and Research; and Extension Services

Out of 53 field experiments made at the testing farms last year, only 29 experiments were successful in harvesting. Others failed because of the floods, diseases and insect pests. This shows the poor facilities of the testing farms. 22 experiments were connected with paddy rice, and others were mostly the pure line selection tests of the native varieties, and fertilizing tests were also carried out. Lemo and Bajar Raden Rate (native varieties) showed the maximum increased yield of 226% and 171% respectively against the same varieites without fertilizing. The yield per ha exceeded 4 tons (dry paddy). (See Table A). Fertilizing test was conducted on the new varieties. The yield was 5.1 tons/ha for PB-5 (IR-5) and 4.3 tons/ha for PB-8 (IR-8). (See Table B). The results of the experiments carried out this year had not been officially summarized, but two crops a year cultivation using C_4-63 (Peta x BP.I_F6), a new variety of I.R.R.I., tested at Handil manarap testing farm was successful though the yield was not large, being 2.1 tons and 2.8 tons for the first and second crops respectively. Compared with P.B.5, the yield is slightly less in case of C_4-63, but the taste is better and requires 126 days to become mature, about 10 days shorter than the number of days required for P.B.-5. As regards the upland field crops, fertilizing tests of three elements and lime on peanut and soy bean were conducted, and each test proved the effect of fertilization was increasing the yield.

As the organization for agricultural extension and guidance, Agricultural Extension Service of South Kalimantan Province is located at Bandjarbaru. There is one branch office in each Kabupatan, and each detachment at 64 places in 87 Katjamatan. A total of 201 persons consisting of 117 technicians and 84 assistants are engaged in the extension work and guidance. There are 14 demonstration plots each about 0.1-1 hectare in size, and five Seed Stations, one each in Sungai Tabuk, Pantai Hambawang, Barabai, Tapus and Amuntai. Demonstration farm having 2 ha each has been established at 3 places financed by the Central Government's subsidy (50,000 Rps. /ha), and each is being operated by 3 full-time workers. It had been planned to increase the acreage of the mass demonstration farms to

500 ha (250 places) in 1970 to conform to the New BIMAS Plan and further enlarge the acreage to 40,000 ha in 1971. However, the actualization of this plan will be encountered by many difficulties.

Besides the above, the INMAS Plan is now being promoted, which is a plan of establishing Mass Intensification farm of a unit of 100 ha at 10 places to be cultivated by the farming people themselves with obtaining the subsidy of 11,000 Rp/ha from the Provincial Government. PB-5, C4-63 and such improved varieties are being used under this plan expecting to obtain good results, but the introduction of new varieties to the areas where irrigation and drainage facilities and such basic facilities are incomplete will be accompanied by many difficulties.

7-1-7 Demand and Supply

(a) Demand and supply of rice

The total population of the Province of South Kalimantan in 1969 was 1,777,000. The demand for rice for food, seed and emergency stock* for the same year was 541,000 tons (stalk paddy**). Against this, the total rice production in the same crop year was approximately 369,000 tons recording a shortage of about 172,000 tons. The shortage was due to more flood damages, plant diseases and insect pests than in normal year, and about 18% of the area under cultivation was damaged. The average annual production in the past five years was 415,000 tons, but there still was a shortage of about 126,000 tons. The shortage was covered by importing from other islands and other provinces. (See Table 7-4 & 7-5).

In a normal crop, the average yield of rice per hectare is approximately 1.85 tons. In order to meet the demand mentioned above, it is necessary to exploit newly about 70,000 hectares of farmland or increase the yield to more than 2.5 tons/ha. Again, the annual rate of population growth is about 2.5%, and it is necessary to increase the acreage and the yield per unit acreage beyond the extent mentioned above to meet the increasing demand.

Bandjar, Barito Kuala, and Tapin are the only three districts in the inland region of the Province of South Kalimantan which are producing rice exceeding the demand, and these districts are forming the major rice supplying region in this province.

* Emergency stock = 5% of the demand
** Stalk paddy x 52% = Polished rice

(b) Demand and supply of agricultural products other than rice

As most of the agricultural products other than rice are produced for own consumption, no statistics showing accurate quantity of production are available. With the exception of potatoes and fruits, the quantity of agricultural products sold on the market is very small, and the shortage is more serious than in the case of rice.

Among miscellaneous cereals, maize is the major crop, the annual

Table A. Yield (Kg/Ha Dry Grain) of Lemo and Bajar Raden Rata Varieties at Different Fertility Levels *
KP, Sungai Tabuk, West Monsoon 1968/1969

Treatment (kg/ha) N P_2O_5 K_2O	Lemo	Bajar Raden Rata	Average	Difference
0– 0–0	1750	2333	2042	–
20– 0–0	1917	2750	2333	291
40– 0–0	2628	3361	2994	952
60– 0–0	2944	2583	2763	721
0–20–0	2916	3083	2999	957
0–40–0	3111	3388	3249	1207
0–60–0	2722	3194	2958	916
20–20–0	3277	3500	3388	1346
20–40–0	3333	3222	3277	1235
20–60–0	3972	3694	3833	1791
40–20–0	3888	3611	3749	1707
40–40–0	3666	4000	3833	1791
40–60–0	3944	3916	3930	1888
60–20–0	3833	3750	3791	1749
60–40–0	3833	4000	3916	1874
60–60–0	4055	3500	3777	1735
Average	3236	3367	–	–

L.S.D. 5% Main plot: 447 Sub plot: 540
1% 1031 728

Design : Split plot Main plot: Varieties
Sub plot : Fertilizer

* from Agricultural Extension Service Center Bandjarbaru, 1970

Table B. Yield (Kg/Ha Dry Grain) of PB5 and PB8 at Different Fertility Levels*
KP. Pabahanan, West monsoon 1968/1969

Treatment	P.B.5	P.B.8	Average	Difference
0– 0–0	2167	2567	2367	–
30– 0–0	2667	2967	2817	450
60– 0–0	2967	3033	3000	633
90– 0–0	3000	3467	3233	866
0–20–0	2367	2767	2567	200
0–40–0	3133	3033	3083	716
0–60–0	3233	3167	3200	833
30–20–0	3433	3200	3316	949
30–40–0	2233	3067	2650	283
30–60–0	3500	3400	3450	1083
60–20–0	3633	3533	2583	216
60–40–0	3667	3633	3650	1283
60–60–0	2567	3300	2933	566
90–20–0	4100	3867	3983	1616
90–40–0	4533	4200	4366	1999
90–60–0	5100	4333	4716	2349
Average	3269	3346		

L.S.D.	5%	Mainplot :	729	Sub plot:	388
	1%		1681		516

Note: Design : Split plot
Main plot: Varieties
Sub plot : Fertilizer

* from Agricultural Extension Service Center Bandjarbaru, 1970

average production of which in the past five years has been approximately 3,000 tons. Other products are approximately 1,500 tons of pulses, 3,600 tons of vegetables and greens, and about 11,790 tons of fruits. Even adding the quantity consumed domestically and not included in the statistics, the total production is far from meeting the demand. Only cassava and potatoes are produced in quantities close to the demand when compared with other crops.

(c) Demand and supply of livestock products

Domestic animals raised are mainly cows and buffaloes for food. The history of livestock farming is new, and cattles particularly are being imported from Djawa and Madura. Recently, about 5,000 cattles are imported each year, and although the number is increasing year after year, the total number of cattles is estimated at about 34,000 and that of buffaloes about 35,000.

Smaller domestic animals are goats and sheep, but the number is small. Domestic fowls are mostly ducks and chickens, and most of the farms are raising them as the demand is quite large because of the eating habits of the people. However, no large scale management can be seen.

About 5 kgs of animal products for food per person is required per year in this region, but the supply is only about 1 kg. per person a year including smaller size animals because only about 11 to 12% of the large animals raised is slaughtered. It is necessary to increase the production to 5 times or more. This is why cattles are being improted from Djawa, transported by sailboats during the east monsoon season when the freight is low. Cattles are being transacted at the price of about 90,000 Rps per 1,000 kgs of living body. However, the transport efficiency is poor under the present circumstances, it iwll require many years to satisfactorily meet the demand. For this reason, positive development of the livestock farming is necessary.

7-1-8 Farm Household Economy in South Kalimantan

(a) Condition of the standard farm household

The history of settlement of the general farmers in Kalimantan is still new, and there are many farm households which are simply following the traditional farming method. The labor productivity is low, and since the farmers do not have countermeasures against natural calamities, and particularly against floods, diseases and insect pests, they suffer damages which not only reduce the farmers' incom but also make the agricultural income unstable.

The average acreage of farmland per farm household in South Kalimantan is estimated at 1.1 hectares of paddy field and 0.2 ha of upland field. The trial calculation of income of a standard farm household (1.2 ha of paddy field and 0.3 ha of upland field) in Kabupaten Bandjar is as shown in attached Table 7-6. The annual agricultural income* including income from livestock and its products is US$75.00. For this reason, most of the farm households make their living by getting income from subsidiary business or side jobs other than agriculture. They get their secondary income by working in rubber estates and in the excavation of

mineral resources. This is because of the extremely low agricultural productivity resulting from the primitive traditional farming method which makes the growth period of paddy extremely long, and moreover, the farmers have plenty of surplus time since they do not conduct farming or other work of taking care of the plant. Therefore, it is difficult for the farmers to live on agriculture alone with the present scale of the standard farm household unless they should improve the production techniques or diversify the management.

* Agricultural income = Agricultural gross receipts - Agricultural expenditures

(b) Multiple farm and large rice farm

There are some farms in the neighborhood of Bandjarmasin which have become self-supporting through multilateral management with having comparatively large acreages. Type C farm shown in attached Table 7-6 is getting an annual agricultural income of approximately 770 US dollars from 3 ha of paddy field and from fruits and vegetables grown on 4 ha of upland field. Again, Type B farm is a large rice farm having 4 ha of paddy field, and its agricultural income is approximately 285 US dollars only from rice. It is evident that increased agricultural income can be obtained from agriculture alone in this region if the farmers plan to expand the scale of management and improve the substance of management.

As this region has a large acreage of arable land, it is evident that the farms can sufficiently become self-supporting as speciality farms through agriculture improvement and improvement of management techniques if they should improve the land condition. The farmers should make efforts for the stabilization of the farm household economy by establishing agriculture as a speciality.

Further, the fresh fish farming, using the rivers and marshes which are numerous in this country, is one of the most promising side jobs which should be preserved and encouraged as a source of nutrition together with the raising of chicken, duck and other domesitc fowls. For this purpose, the use of agricultural chemicals, etc. should be made with exercising due prudence when planning the modernization of agriculture.

7-1-9 Distribution of Agricultural Products and the Establishment of Farmers' Organizations

Marketing of agricultural products and the purchasing of agricultural materials are mostly conducted through the free market, and farmers carry the small quantity of the products other than those for their own consumption to the closest market directly and sell them or send their products to the market through brokers. Because of this, the production of the agricultural products other than rice and the quantity of shipment made cannot be grasped accurately.

With the exception of some areas, rice other than for own consumption is bought up by the rice mill in the form of dry paddy (buying price is 17-18 Rps/kg) and then is sold to the market after polishing it. (Selling price at rice mill is 28-30 Rps/kg of polished rice on an average). The market price of polished rice is 30-35 Rps/kg on an average, but the prices of rice, same as those of other agricultural products, vary largely depending on the area, and also crop season

or off-crop season. Particularly the prices of rice in this region are the lowest in October and November, the harvest time. Moreover, the farmers gain nothing from the difference between the high prices and low prices because they cannot afford to keep the rice in stock, and only the rice mills and those brokers get the profit out of such price difference.

The construction of roads is much behind, and most of the raods are narrow farm roads where even small vehicles cannot pass through. Long distance transport depends largely on waterways, and naturally the sphere of distribution of agricultural products is limited to a small area. This tendency is more conspicuous in case of vegetables and green vegetables which lose the freshness quickly due to high temperature and high humidity. This is why there is a wide price difference between the producing area and the consuming area. However, the market prices do not seem to rise sharply even if there is a large demand because the purchasing power is weak resulting from the low income level of the general people.

The farmers do not have any farmers' organization like the agricultural cooperative association to protect their own interests, and the present situation is that the farmers are being exploited by the brokers, who are third persons, on the phase of distribution as well as on the phase of the primary processing of agricultural products such as rice milling, etc. It is necessary that the farmers establish an organization with which they can protect their own interests.

In this region, groups of like-minded persons called "Kepala Padang" existed in the past. They were the organization of the farmers developing the activities like those of the water management association, but they are now extinct because no protection whatsoever was given to such groups. In the future, it will be necessary to promote healthy growth of such organizations of the farmers and provide proper guidance and protection.

The local prices of major agricultural products are as shown in Table 7-7, but there is a slight variation according to the season and the location.

7-1-10 Present Condition of the Agricultural Immigration

The history of immigration to the provinces in Kalimantan from the over-populated areas such as Java, Madura, etc. is comparatively old. During those years when Kalimantan was under the sovereignty of the Netherlands, the immigrants were mostly the agricultural workers in the rubber estates. During and after World War II, there were many who continued to stay in Kalimantan after serving in the military forces.

It was in 1950 and thereafter that the Indonesian Government earnestly promoted to the immigration systematically with appropriating the government subsidy to Kalimantan where there was a shortage of labor. A total of 10,000 households have been sent to the provinces in Kalimantan by 1970. There are about 3,000 households in South Kalimantan Province and about 1,100 households in Central Kalimantan Province.

Most of the immigrants were sent as agricultural immigrants to the area around Bandjarmasin, lower basins of Barito, Kapuas, and Kahajan rivers, and the reclaimed land in the so-called tidal area along the waterways joining these rivers. (See Table 7-8).

Table 7-1 Target and Realization Area and Production of South Kalimantan Province (1)~(9)

(1) Low-land rice

Kabupatan	1 9 6 8				1 9 6 9				1 9 7 0			
	target		realization		target		realization		target		realization	
	area ha	production ton	area ha	production ton	area ha	production ton	area ha	production ton	area ha	production ton	area ha	production ton
1. Bandjarmasin	2,465	6,484	3,055	7,191	3,375	8,775	3,171	8,245	3,590	9,693	3,582	9,671
2. Bandjarbaru	43,554	94,265	40,844	88,229	45,575	99,419	1,450	3,325	1,950	3,400	2,250	4,331
3. Bandjar							37,534	84,432	46,821	100,273	37,058	87,295
4. Tanah Laut	13,962	23,057	14,413	22,497	15,040	36,536	14,245	27,534	15,136	39,353	15,679	28,037
5. Barito-Kuala	29,854	56,849	41,832	95,094	41,832	95,094	40,578	93,219	42,782	99,551	40,806	93,515
6. Tapin	35,312	62,706	16,365	41,858	23,834	55,435	7,343	16,631	22,720	53,525	16,308	40,964
7. Hulu Sungai Selatan	39,396	64,660	15,805	41,983	19,779	49,668	3,050	5,308	20,000	52,000	19,077	38,511
8. Hulu Sungai Tengah	31,402	93,495	24,744	65,774	25,500	63,750	11,270	20,544	28,100	73,060	24,512	59,730
9. Hulu Sungai Utara	37,971	73,707	21,117	42,680	32,582	68,197	20,279	49,205	31,848	66,793	26,925	64,080
10. Tabalong	14,027	30,461	9,706	21,749	10,850	25,040	5,994	12,677	11,900	29,750	10,094	23,985
11. Kota Baru	10,006	16,406	9,547	20,213	9,170	21,837	8,832	14,930	10,000	21,000	7,348	11,068
Total	257,889	522,054	197,428	447,268	227,537	523,751	153,746	336,150	234,847	548,398	203,639	461,187

Extension Service Center, Bandjarbaru

(2) Up-land rice

Kabupatan	1968				1969				1970			
	target		realization		target		realization		target		realization	
	area ha	production ton	area ha	production ton	area ha	production ton	area ha	production ton	area ha	production ton	area ha	production ton
1. Bandjarmasin	–	–	–	–	–	–	–	–	–	–	–	–
2. Bandjarbaru							255	255	350	350	280	378
3. Bandjar	6,797	12,218	7,447	13,610	5,322	7,983	7,713	11,770	5,484	12,577	7,776	11,255
4. Tanah Laut	5,052	5,105	3,220	3,864	3,010	4,425	3,020	3,624	3,450	4,140	5,605	7,287
5. Barito-Kuala	–	–	–	–	–	–	–	–	–	–	–	–
6 Tapin	2,345	1,952	2,671	5,712	925	1,480	3,395	6,541	2,500	5,000	3,655	7,229
7. Hulu Sungai Selatan	4,010	5,903	1,933	4,288	1,500	2,400	985	1,135	3,000	5,100	2,490	4,490
8. Hulu Sungai Tengah	3,205	6,142	2,490	5,535	2,500	4,250	2,444	4,165	3,000	5,100	2,500	4,250
9. Hulu Sungai Utara	5,665	11,024	3,057	4,336	2,500	4,000	2,688	4,291	2,765	4,735	2,862	4,671
10. Tabalong	4,740	5,507	3,955	3,778	3,050	4,886	3,319	3,172	4,000	7,500	4,104	6,566
11. Kota Baru	8,967	8,542	4,397	8,002	2,810	4,588	3,170	5,170	4,000	6,800	5,105	8,933
Total	40,781	56,393	29,170	49,125	21,617	34,012	26,989	40,123	28,549	51,302	34,377	55,059

(3) Vegetable

Kabupatan	1968				1969				1970			
	target		realization		target		realization		target		realization	
	area ha	production ton	area ha	production ton	area ha	production ton	area ha	production ton	area ha	production ton	area ha	production ton
1. Bandjarmasin	41	80					–	–	100	200		
2. Bandjarbaru							26	39	45	68		
3. Bandjar	418	525					378	489	478	588		
4. Tanah Laut	169	180	no data		no data		101	121	–	–	no data	
5. Barito-Kuala	40	90					50	76	59	88		
6. Tapin	336	350					302	390	–	–		
7. Hulu Sungai Selatan	831	1,300					305	610	278	556		
8. Hulu Sungai Tengah	444	400					316	632	298	596		
9. Hulu Sungai Utara	171	250					270	540	452	904		
10. Tabalong	554	750					261	526	475	710		
11. Kota Baru	336	440					81	162	250	375		
Total	4,125	4,345					2,099	3,585	2,435	4,085		

(4) Maize

Kabupatan	1968				1969				1970			
	target		realization		target		realization		target		realization	
	area ha	production ton	area ha	production ton	area ha	production ton	area ha	production ton	area ha	production ton	area ha	production ton
1. Bandjarmasin	–	–	–	–	–	–	–	–	–	–	–	–
2. Bandjarbaru							9	8	15	14	7	6
3. Bandjar	924	950	436	304	864	975	378	300	882	995	365	284
4. Tanah Laut	1,580	1,175	295	295	1,505	1,175	450	450	675	675	530	530
5. Barito-Kuala	–	–	–	–	–	–	–	–	–	–	–	–
6. Tapin	622	400	389	389	906	550	113	113	960	576	145	145
7. Hulu Sungai Selatan	1,670	1,325	1,115	1,115	1,250	1,250	702	702	1,300	1,300	876	863
8. Hulu Sungai Tengah	717	450	136	122	200	180	1,229	1,111	1,181	1,062	46	47
9. Hulu Sungai Utara	449	350	193	174	350	330	339	300	342	308	260	260
10. Tabalong	526	300	387	293	500	413	370	265	632	482	457	366
11. Kota Baru	363	150	167	148	250	200	284	232	250	200	113	88
Total	13,851	5,100	3,118	2,840	5,825	5,103	3,874	3,472	6,237	5,612	2,800	2,590

(5) Cassava

Kabupatan	1968				1969				1970			
	target		realization		target		realization		target		realization	
	area ha	production ton	area ha	production ton	area ha	production ton	area ha	production ton	area ha	production ton	area ha	production ton
1. Bandjarmasin	–	–	–	–	–	–	–	–	–	–	–	–
2. Bandjarbaru							108	540	151	755	38	199
3. Bandjar	2,070	10,575	603	4,575	1,910	10,000	714	5,360	1,450	7,930	530	5,077
4. Tanah Laut	1,451	10,600	387	2,202	1,380	10,600	642	3,852	1,500	12,000	794	4,784
5. Barito-Kuala	165	700	350	378	–	–	107	556	–	–	122	427
6. Tapin	1,003	2,700	476	3,808	1,084	4,020	123	984	3,109	11,452	292	2,336
7. Hulu Sungai Selatan	673	6,300	436	3,488	250	2,020	57	456	185	1,480	160	1,280
8. Hulu Sungai Tengah	828	3,850	380	2,660	300	2,100	440	3,080	759	5,313	162	1,134
9 Hulu Sungai Utara	1,242	5,950	388	2,566	728	5,060	345	2,459	827	5,789	590	4,165
10. Tabalong	1,590	8,275	525	5,159	1,050	8,880	1,311	5,055	750	3,750	171	1,539
11. Kota Baru	2,452	11,950	547	4,376	1,100	8,800	1,411	8,877	1,200	9,600	304	2,168
Total	11,474	60,900	4,092	29,212	7,802	52,240	5,258	31,219	9,931	58,069	3,163	23,109

(6) Sweet potato

Kabupatan	1968				1969				1970			
	target		realization		target		realization		target		realization	
	area ha	production ton	area ha	production ton	area ha	production ton	area ha	production ton	area ha	production ton	area ha	production ton
1. Bandjarmasin	–	–	–	–	–	–	–	–	–	–	–	–
2. Bandjarbaru							21	84	42	168	11	39
3. Bandjar	642	3,230	263	1,671	590	3,285	341	2263	585	3,270	104	1,174
4. Tanah Laut	573	4,050	167	668	523	4,050	210	839	595	2,380	260	1,040
5. Barito-Kuala	–	–	–	–	–	–	–	–	–	–	–	–
6. Tapin	398	1,850	270	1,620	439	2,000	66	396	459	2,295	129	774
7. Hulu Sungai Selatan	1,128	6,050	1,277	2,809	750	4,500	501	3,002	2,020	12,160	432	2,094
8. Hulu Sungai Tengah	301	850	175	700	200	800	224	896	295	1,180	66	264
9. Hulu Sungai Utara	368	1,120	192	931	276	838	277	1,108	204	791	223	1,105
10. Tabalong	566	1,450	255	910	575	1,809	269	894	600	1,800	215	648
11. Kota Baru	318	850	120	410	250	1,250	223	1,254	300	1,200	102	474
Total	4,294	19,450	2,719	9,719	3,603	18,532	2,132	10,736	5,100	25,244	1,542	7,612

(7) Peanut

Kabupatan	1968				1969				1970			
	target		realization		target		realization		target		realization	
	area ha	production ton	area ha	production ton	area ha	production ton	area ha	production ton	area ha	production ton	area ha	production ton
1. Bandjarmasin	–	–	–	–	–	–	–	–	–	–	–	–
2. Bandjarbaru							8	6	10	7	3	2
3. Bandjar	536	390	352	234	490	620	306	214	518	559	272	187
4. Tanah Laut	237	235	107	64	200	235	151	88	230	230	95	47
5. Barito-Kuala	–	–	–	–	–	–	–	–	–	–	–	–
6. Tapin	2,196	875	462	448	2,340	1,760	109	109	2,410	2,410	175	175
7. Hulu Sungai Selatan	1,031	600	63	32	150	120	75	38	115	58	55	36
8. Hulu Sungai Tengah	399	250	169	152	150	135	270	243	149	134	93	84
9. Hulu Sungai Utara	113	75	130	108	160	131	144	115	163	134	78	61
10. Tabalong	456	125	257	205	475	385	329	207	480	400	297	238
11. Kota Baru	215	75	131	70	250	150	198	133	–	–	109	59
Total	5,183	2,625	1,671	1,313	4,215	3,536	1,590	1,153	4,075	3931	1,177	889

(8) Soybean

Kabupatan	1968				1969				1970			
	target		realization		target		realization		target		realization	
	area ha	production ton	area ha	production ton	area ha	production ton	area ha	production ton	area ha	production ton	area ha	production ton
1. Bandjarmasin	–	–	–	–	–	–	–	–	–	–	–	–
2. Bandjarbaru							2	1	10	7	–	–
3. Bandjar	} 65	55	} 63	42	} 65	60	67	44	70	65	73	68
4. Tanah Laut	40	30	18	9	30	30	25	13	45	32	50	25
5. Barito-Kuala	–	–	–	–	–	–	–	–	–	–	–	–
6. Tapin	30	25	–	–	30	25	–	–	–	–	6	30
7. Hulu Sungai Selatan	75	60	–	–	–	–	–	–	–	–	–	–
8. Hulu Sungai Tengah	75	60	90	76	75	60	106	85	98	78	100	80
9. Hulu Sungai Utara	20	20	–	–	5	2	25	15	4	3	37	30
10. Tabalong	389	170	224	165	375	289	228	173	400	300	280	175
11. Kota Baru	187	55	90	45	200	150	51	25	300	180	77	39
Total	882	475	485	337	780	616	504	356	927	665	623	397

(9) Green bean

Kabupatan	1968				1969				1970			
	target		realization		target		realization		target		realization	
	area ha	production ton	area ha	production ton	area ha	production ton	area ha	production ton	area ha	production ton	area ha	production ton
1. Banjarmasin	–	–	–	–	–	–	–	–	–	–	–	–
2. Bandjarbaru							3	2	13	9	–	–
3. Bandjar	} 8	10	} 61	38	} 63	45	60	41	66	52	26	17
4. Tanah Laut	10	10	2	1	10	10	4	2	15	15	–	–
5. Barito-Kuala	–	–	–	–	–	–	–	–	–	–	–	–
6. Tapin	30	25	–	–	30	25	–	–	–	–	–	–
7. Hulu Sungai Selatan	70	55	–	–	–	–	–	–	–	–	–	–
8. Hulu Sungai Tengah	50	40	50	30	60	54	171	137	215	170	34	27
9. Hulu Sungai Utara	20	15	5	3	20	12	90	54	24	139	18	14
10. Tabalong	150	40	128	83	150	100	131	72	160	100	130	77
11. Kota Baru	132	30	107	58	150	100	69	36	150	100	83	84
Total	470	225	353	213	483	346	528	344	643	585	293	170

Table 7-2 1968/1969 Five-type Rice Field and Production of South Kalimantan Province

Kabupatan	West monsoon rice					East monsoon rice					Flooting rice				
	Planting area ha	Damage area ha	Harvested area ha	Av. yield gt/ha	Production ton	Planting area ha	Damage area ha	Harvested area ha	Av. yield gt/ha	Production ton	Planting area ha	Damage area ha	Harvested area ha	Av. yield gt/ha	Production ton
1. Bandjarmasin	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
2 Bandjarbaru	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
3. Bandjar	5,806	432	5,371	17.8	9,533	7,713	1,713	6,000	18	10,800	–	–	–	–	–
4 Tanah Laut	5,085	255	4,830	18	8,694	–	–	–	–	–	–	–	–	–	–
5 Barito-Kuala	5,846	290	5,556	22.8	12,668	–	–	–	–	–	–	–	–	–	–
6 Tapin	16,238	9,920	6,318	23	14,531	1,090	65	1,025	20	2,050	–	–	–	–	–
7. Hulu Sungai Selatan	10,589	7,950	2,639	17	4,486	465	54	411	20	822	–	–	–	–	–
8. Hulu Sungai Tengah	21,160	14,840	6,320	17	10,744	6,200	1,250	4,950	20	9,900	–	–	–	–	–
9. Hulu Sungai Utara	9,282	4,185	5,097	17.9	9,124	18,795	4,913	13,882	20	37,481	1,350	50	1,300	20	2,600
10. Tabalong	7,658	3,064	4,594	21.5	9,877	2,150	750	1,400	20	2,800	–	–	–	–	–
11 Kota Baru	3,762	380	3,382	19.5	6,595	6,000	550	5,450	15.4	8,385	–	–	–	–	–
Total	85,426	41,319	44,107		86,252	42,413	9,295	33,118	22	72,238	1,350	50	1,300	20	2,600

Kabupatan	Tidal swamp rice					Up-land rice					Total				
	Planting area ha	Damage area ha	Harvested area ha	Av. yield gt/ha	Production ton	Planting area ha	Damage area ha	Harvested area ha	Av. yield gt/ha	Production ton	Planting area ha	Damage area ha	Harvested area ha	Av. yield gt/ha	Production ton
1. Bandjarmasin	3,375	204	3,171	26	8,245	–	–	–	–	–	3,375	204	3,171	26	8,245
2. Bandjarbaru	1,750	300	1,450	23	3,335	275	20	255	10	255	2,025	320	1,705	21	3590
3. Bandjar	28,435	2,272	26,163	24.5	64,099	8,604	891	7,713	153	11,770	50,558	5,311	45,247	26	96,202
4. Tanah Laut	10,200	785	9,415	20	18,830	3,093	73	3,020	12	3,624	18,378	1,113	17,265	18	31,148
5 Barito-Kuala	36,867	1,845	35,022	23	80,551	–	–	–	–	–	42,713	2,135	40,578	20.5	93,219
6. Tapin	–	–	–	–	–	3,405	10	3,395	19	6,451	20,733	9,995	10,738	21.6	23,032
7. Hulu Sungai Selatan	–	–	–	–	–	1,035	50	985	11.5	1,135	12,089	8,054	4,035	16	6,443
8. Hulu Sungai Tengah	–	–	–	–	–	2,500	56	2,444	17	4,165	29,860	16,146	13,714	18.9	24,809
9. Hulu Sungai Utara	–	–	–	–	–	2,872	184	2,688	15.2	4,291	32,299	9,332	22,967	23.3	53,496
10. Tabalong	–	–	–	–	–	3,335	16	3,319	9	3,172	13,143	3,830	9,313	17	15849
11. Kota Baru	–	–	–	–	–	3,270	100	3,170	16	5,170	13,032	1,030	12,002	16.7	20,150
Total	80,627	5,406	75,221		175,060	28,389	1,400	26,989	15.2	40,033	238,205	57,470	180,735	20.8	376,183

Extension Service Center Bandjarmasin

Table 7-3 Total Area, Population, Density and Number of Ketjamatan & Desa in South Kalimantan

District (Kabupatan)	Name of Capital City of Kabupatan	1968					1969
		Area (Km^2)	Population	Density (man/Km^2)	Number of Ketjamatan	Number of Desa	Population
Propinsi Kalimantan Selatan	Bandjarmasin	36,985	1,737.4	48	87	674	1,776.9
Kotamadya Bandjarmasin	Bandjarmasin	72	261.1	3,626	4	20	267.1
Kalripaten Barito Kuala	Marabahan	3,284	104.2	32	11	62	106.6
Kalripaten Bandjar	Martapura	6,228	284.3	46	11	111	2908
Kalripaten Tapin	Rantau	2,315	88.1	38	6	43	90.1
Kalripaten Hulu Sungai Selatan	Kandangan	1,703	189.1	111	8	53	193.4
Kalripaten Hulu Sungai Tengah	Barabai	1,472	215.3	144	8	67	220.2
Kalripaten Hulu Sungai Utara	Amuntai	2,771	254.5	92	11	78	260.4
Kalripaten Tabalong	Tandjung	3,946	123.7	31	6	53	126.5
Kalripaten Tanah Laut	Pelaihari	2,150	80.0	36	5	49	81.7
Kalripaten Kota Baru		13,044	137.0	10	17	138	140.1

Government office of South Kalimantan Province
Bandjarmasin

Table 7-4 Total Population, Rice Production and Consumption in South Kalimantan, 1969

Name of Kabupatan	Population 1969	Area & Amount of Production					Consumption							
		Area			Production Stalk Paddy (ha)	Production Polished Rice Equivalent 52% of 7 (ton)	Stalk Paddy Food demand 279/kg/head/year	Stalk Paddy Seed 50/kg/ha	Farmers Reserve 5% of 9	Waste 3% of 7 (ton)	Total Production		(Stalk Paddy) Surplus (kg)	Shortage Stalk Paddy
		Planting Area (ha)	Damage Area (ha)	Harvest Area (ha)							Stalk Paddy Total (ton)	Polish Rice (ton)		
1 2	3.	4.	5.	6	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.
1. Bandjarmasin	256,813	3,375	75	3,300	8,580	4,462	71,651	169	3,591	257	75,668	39,347	–	67,088
2. Bandjar	246,296	49,245	1,510	47,735	100,677	52,352	68,717	246	3,448	3,020	75,431	39,224	25,246	–
3. Barito Kuala	112,038	42,682	1,044	41,638	73,758	38,354	31,259	213	1,574	2,213	35,259	18,335	38,499	–
4. Tanah Laut	91,337	18,364	789	17,573	21,957	11,418	25,483	918	1,320	659	28,380	14,758	–	6,423
5. Bandjarbaru	34,890	2,005	300	1,705	2,637	1,371	9,734	100	491	79	10,404	5,410	–	7,767
6. Tapin	106,657	20,771	2,919	17,852	39,394	20,485	29,757	1,039	1,540	1,182	33,518	17,429	5,876	–
7. H.S. Selatan	184,895	15,694	7,193	8,501	12,039	6,260	51,586	785	2,619	361	35,351	28,783	–	43,312
8. H.S. Tengah	220,138	29,860	16,596	13,264	21,199	11,023	61,419	1,493	3,146	636	66,694	34,681	–	45,495
9. H.S Utara	260,330	38,456	10,425	28,031	51,050	26,546	72,632	1,923	3,728	1,532	79,815	41,504	–	28,765
10. Tabalong	126,433	13,730	182	13,548	27,114	14,099	35,275	687	1,798	813	38,573	20,058	–	11,459
11. Kota Baru	140,017	13,485	3,282	10,203	10,679	5,553	39,065	674	1,987	320	42,046	21,864	–	31,367
Total	1,779,844	247,667	44,315	203,352	369,084	191,923	496,578	8,247	25,242	11,072	541,139	281,393	69,621	241,676

Agricultural Extension Service Center
Bandjarmasin, January 1970

Table 7-5 Average of Rice Field & Rice Production in South Kalimantan, 5 Years (1965-1969)

Kabupatan (District)	1969					1968				
	Planting Area (ha)	Damage Area (ha)	Harvesting Area (ha)	Production/ha (ton)	Total Production (ton)	Planting Area (ha)	Damage Area (ha)	Harvesting Area (ha)	Production/ha (ton)	Total Production (ton)
Bandjarmasin	3,375	75	3,300	2.6	8580	3,065	10	3,055	2.4	7,192
Bandjar	49,245	1,510	47,735	2.1	100,677	49,502	952	48,550	2.1	101,846
Bandjarbaru	2,005	300	1,705	1.5	2,637	–	–	–	–	–
Tanah Laut	18,364	789	17,575	1.3	21,957	18,162	1,134	17,028	2.0	34,938
Barito Kuala	42,682	1,044	41,638	1.8	73,758	42,682	852	41,830	2.3	95,587
Tapin	20,771	2,919	17,852	2.2	39,394	20,283	1,333	18,950	2.7	50,677
Hulu Sungai Selatan	15,694	7,193	8,501	1.4	12,039	24,114	4,177	19,937	2.4	47,727
Hulu Sungai Tengah	29,860	16,596	13,264	1.6	21,199	27,340	375	26,965	2.7	71,160
Hulu Sungai Utara	38,456	10,425	28,031	1.8	51,050	26,264	3,354	22,910	2.1	47,572
Tabalong	13,730	182	13,548	2.0	27,114	14,190	534	13,656	2.0	26,945
Kotabaru	13,485	3,282	10,203	1.1	10,679	16,155	1,482	14,673	1.7	24,533
	247,667	44,315	203,352	1.8	369,084	241,757	14,203	227,554	2.2	508,177

Kabupatan (District)	1967					1966				
	Planting Area (ha)	Damage Area (ha)	Harvesting Area (ha)	Production/ha (ton)	Total Production (ton)	Planting Area (ha)	Damage Area (ha)	Harvesting Area (ha)	Production/ha (ton)	Total Production (ton)
Bandjarmasin	2,495	12	2,483	2.1	5,321	2,498	5	2,493	1.8	4,487
Bandjar	48,004	1,648	46,356	2.2	103,544	48,009	2,478	45,531	1.6	74,819
Bandjarbaru	–	–	–	–	–	–	–	–	–	–
Tanah Laut	20,037	1,867	18,170	2.2	39,253	23,259	2,914	20,345	2.3	27,213
Barito Kuala	22,495	786	21,709	2.3	51,088	24,824	500	24,324	1.8	42,919
Tapin	30,151	3,218	26,933	2.6	69,303	32,421	1,180	31,241	1.2	36,004
Hulu Sungai Selatan	27,358	3,917	23,441	2.6	60,807	40,797	5,199	35,598	1.7	59,425
Hulu Sungai Tengah	24,708	1,244	23,464	2.6	60,414	27,757	215	27,542	1.9	51,450
Hulu Sungai Utara	30,847	5,125	25,722	2.4	61,837	32,484	1,697	30,787	1.9	59,307
Tabalong	13,770	768	13,002	2.1	26,837	14,542	808	13,734	1.6	22,066
Kotabaru	12,648	933	11,715	1.9	22,242	13,720	1,668	12,052	3.0	36,642
	232,513	19,518	212,995	2.3	500,666	260,311	16,664	243,647	1.7	414,332

Kabupatan (District)	1 9 6 5					Average for five years (1 9 6 5 – 1 9 6 9)				
	Planting Area (ha)	Damage Area (ha)	Harvesting Area (ha)	Production/ha (ton)	Total Production (ton)	Planting Area (ha)	Damage Area (ha)	Harvesting Area (ha)	Production/ha (ton)	Total Production (ton)
Bandjarmasin	2,343	48	2,295	1.4	3,213	2,755	30	2,725	2.1	5,798
Bandjar	45,759	7,197	38,562	1.1	43,057	48,104	2,757	45,347	1.9	84,947.6
Bandjarbaru	–	–	–	–	–	2,005	300	1,705	1.5	2,637
Tanah Laut	19,440	3,998	15,442	1.0	15,932	19,972	2,140	17,832	1.5	27,060
Barito Kuala	27,513	14,049	13,464	1.4	19,326	32,037	3,444	28,593	2.0	56,640
Tapin	21,445	902	20,543	2.1	43,046	25,006	1,900	23,106	2.2	51,701
Hulu Sungai Selatan	18,856	3,283	15,573	2.0	30,821	25,364	4,754	20,610	2.0	42,104
Hulu Sungai Tengah	26,567	1,221	25,346	2.2	56,063	27,276	3,961	23,315	2.2	52,063
Hulu Sungai Utara	36,253	11,403	24,850	1.7	42,433	32,921	6,461	26,460	2.0	54,440
Tabalong	12,379	1,125	11,254	1.9	21,605	13,722	683	13,039	1.8	23,630
Kotabaru	9,358	697	8,661	1.5	13,062	12,873	1,532	11,341	1.2	14,035.6
	219,913	43,923	175,990	1.6	288,558	242,035	27,962	214,073	1.9	415,056.2

Table 7-6 Farm Household Economy in South Kalimantan
(In Terms of Value)

September 1970
Unit: Rps. (US$)
(US$1 = Rps. 380)

Items	Type A (1.5ha) (Standard Farm)	Type B (4ha) (Large Rice Farm)	Type C (7ha) (Large Maltiple Farm)
1) Agricultural income (a) - (b)	29,000 (76.3)	108,000 (284.2)	292,000 (768.4)
(a) Agricultural gross receipts	69,000 (181.6)	196,000 (515.8)	444,000 (1,168.4)
Rice	8,000 (126.3)	196,000 (518.8)	223,000 (586.8)
Other upland crops	6,000 (15.8)	–	20,000 (52.6)
Fruits and nuts	–	–	201,000 (529.0)
Livestock and its products	15,000 (39.5)	–	–
(b) Agricultural expenditures	40,000 (105.3)	88,000 (231.6)	152,000 (400.0)
Rice	32,000 (84.2)	88,000 (231.6)	70,000 (184.2)
Other upland crops	6,000 (15.8)	–	80,000 (210.5)
Fruits and nuts	–	–	
Others	2,000 (5.3)	–	2,000 (5.3)
2) Non-agricultural income	36,000 (94.7)	72,000 (189.5)	–
3) Total income of farm household 1) + 2)	65,000 (171.1)	180,000 (473.7)	292,000 (768.4)
4) Tax and public imposts	3,000 (79)	25,000 (65.8)	35,000 (92.1)
5) Living expenditures	44,000 (115.8)	73,000 (191.1)	60,000 (157.9)
6) Net surplus 3) - [(4)+5)]	18,000 (47.3)	82,000 (215.8)	197,000 (518.4)
Note: Area of paddy field	1.2 ha	4 ha	3 ha
Area of upland field	0.3 ha	–	4 ha
Yield of paddy (stalk)	2 t/ha	2.4 t/ha	2.4 t/ha
Location	Bandjarbaru	Gamput	Gamput

Table 7-7 Prices of Agricultural Products in South Kalimantan

September 1970

	Farm gate price (Rps. per kg.)	Market price	US$1 = Rps. 380
Grains			
Dry paddy	17 – 20	–	
Polished rice	–	30 – 35	(The prices are different according to the grade.)
Maize	13 – 15	17 – 18	
Potatoes & Starch			
Sweet potatoes	6 – 15	10 – 20	
Cassaba	3.5	6	
Pulses			
Soy beans	60 – 65	70 – 75	
Peanuts	80 – 85	90 – 95	(dried with shell)
Green beans	75 – 78	95 – 100	
Long beans	75 – 78	30 – 35	
Vegetables			
Cucumbers	13 – 15	15 – 17	
Egg plants	15 – 17	20 – 23	
Red chile	–	100 – 125	
White melons	–	15	
Water melons	–	40	
Cabbages	–	35 – 40	
Fruits & Tree-crops			
Bananas	10 – 11	12 – 13	
Pineapple	10–12.5/piece	15–16/piece	
Citrus	60 – 70	80 – 90	
Rambutans	20	25 – 30	
Coconuts	9–10/piece	15–16/piece	

Note: The prices are slightly different in each Kabupatan.

Table 7-8 Condition of Immigration to South Kalimantan Province

Year	Farm Household	Population	Name of Place
1953	724	2,595	Takisung
1957	200	1,121	Tamban
1959	231	946	Marabahan
1960	81	324	Berangas
1960	132	557	Marabahan
1961	2	2	Marabahan
1961	320	1,405	Belandean
1961	86	377	Sebelimbingan
1961	1	1	Borangas
1962	569	2,605	Belandean
1962	25	119	Sebelimbingan
1962	76	366	Berangas
1963	147	1,076	Belandean
1963	121	516	Belangas
1963	14	57	Sebelimbingan
1963	4	17	Marabahan
1964	1	3	Berangas
1964	9	39	Belandean
1966	102	373	Bantuil
1970	140	638	Barambai
Total	2,985	13,137	

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At the beginning, there were some immigrants who abandoned the land given to them and left agriculture because the facilities for the farmland in the settlers' land were not ready, and the unfavorable natural conditions and location condition on the phases of agriculture and communication when compared with those in Java and other areas.

Recently, irrigation and other facilities for the reclaimed land have been improved and preparations to receive immigrants are ready. Domiciliation condition of the settlers has been good, and the number of settlers is increasing year after year.

The government's subsidy to the settlers is 225,000 Rps per household, and a household is given the travelling expenses, a house, agricultural machinery, seeds, kitchen utensils, food (rice and oil sufficient to last for one year) and 2 ha of land within this budget.

7-2 Problems Concerning Agricultural Development of the Barito River Basin

7-2-1 Problems of Farm Village Society and Economy and the Counter-Measures

(a) Elevation of the consciousness of the farming people and the education of the farming people

Although the contents of the government's policy of promoting agriculture will exert much influence on the consciousness of the farmers about the agricultural development, they lack the consciousness of making efforts to increase the agricultural productivity through modernization of agriculture because of their low social standing and poor economic power, and there are few who have doubts about the inefficient factors of the traditional old-fashioned method of farming still being used in this region.

Therefore, many irrigation and other facilities constructed in the past and after the independence of Indonesia are neglected without being fully utilized, mainly because of the imperfect terminal waterways, low technical standards of the users, and lack of understanding. In some areas, waterways are being intercepted by the farmers and the fishermen at their own convenience for their own interests, and no efforts are being made to understand the necessity of administration and maintenance of the public utilities.

It would be necessary that the farmers realize that agriculture is one of the important producing industries, and farm management is not merely for producing agriclutural products for their own consumption. They should realize that agriculture is one of the most important production enterprises which increases their own income and elevate the living standard and economic standing of the entire region through increased production and production of products of superior quality. For this purpose, it will be necessary to teach the farmers the most effective use of the agricultural facilities, improve positively the traditional method of farming, and to carry out appropriate on-the-spot training of the farmers.

Those settlers in the newly reclaimed land in the tidal area particularly do not have much experience in agriculture. A pilot farm should be established in the settlers' land to give practical training to those settlers concerning crops and farming method most suitable to the area, and it should also be considered to include one or two leading farmers in the group of new settlers.

(b) Fostering of self-supporting farmers and the establihsment of agricultural credit system

Most of the farmers are not able to make their living by agricultural production alone. They are either side-work farmers of farmers who work away from home to get extra income to support their living. However, this region has a large demand for agricultural products and vast reclaimable land as mentioned before, and it is also possible to increase the unit productivity by introducing advanced farming techniques. Therefore, this region satisfies all conditions necessary for the farm households to become fully self-supporting with the agricultural income alone. Actually some farmers have designed and constructed the terminal waterways and increased the income through diversified farm management to promote modernization of agriculture. It is necessary to foster such farmers, teach the general farmers the techniques of obtaining higher yield, promote specialization of agriculture, and thereby plan for the stabilization of the farm household economy by agricultural income alone.

To foster such self-supporting farmers, investment in public utilities and provision of technical guidance by the government organs are indispensable factors, and at the same time, the establishment of the agricultural credit system is desirable for the farmers to procure their own funds.

(c) Improvement of the distribution system and the farmers' organizations

As mentioned before, the distribution of agricultural products and agricultural materials depends solely on free market at present, but in order to promote specialization of agriculture and to protect the interests of the farmers, it is necessary to organize the distribution system from the standpoint of the farmers at least for the marketing of the agricultural products and the purchasing of agricultural materials. It is also necessary to establish the farmers' organizations like the agricultural cooperative association so as to enable the farmers to manage themselves the related enterprises such as the rice mill and the primary processing of other agricultural products. This becomes more and more important with the progress of specialization of agriculture and the increase in the production, and is also important for the stabilization of the prices of the agricultural products.

Again, as a farmers' organization for the control and management of the facilities for irrigation, an organization like the water management association which coordinates the mutual interests of the farmers, controls and manages the joint utilization of the facilities should be established. It is necessary to provide guidance and protection for the establishment and operation of such an organization.

(d) Stabilization and guarantee of the prices of the agricultural products

It is inevitable that the prices of agricultural products in the free market fluctuate accordingly with the demand supply situation. However, the profit derivable from such price fluctuation cannot become the interests of the farmers in this region if production and marketing cannot be adjusted properly. This is because the farmers, who are the producers of the agricultural products, do not have any surplus economic power and depend on the extremely primitive method of farming. In a region like this, unless the prices of agricultural products are stabilized to a certain extent, the farmers are exploited and made to suffer the losses whether the harvest is good or bad, and they finally lose their desire to produce.

An important means of planning stabilization of the prices of agricultural products is to adjust the production according to the estimated demand. However, it is almost impossible at present to make the farmers in this region to estimate the future demand and formulate their production schedule, and as the geographical conditions relative to communication are unfavorable, the market for agricultural products such as fresh vegatables and fruits, which cannot be preserved long in this region without storing facilities, is rather limited. Consequently, over production occurs in the producing area causing a sharp drop in the prices while the consuming area far away from the producing area cannot get enough supply of agricultural products.

As it will become very difficult to encourage the farmers having poor economic power to increase production under such circumstances as mentioned above, it will be necessary to study carefully hereafter the establishment of a system to guarantee the floor price of agricultural products and particularly of rice, with which to prevent as much as possible the losses incurred by the farmers.

(e) Preparation of the agricultural statistical data

In order to grasp accurately the actual condition of development of agriculture and analyse various problems concerning development, statistical data showing the farming population, condition of land utilization, production of agricultural products, and investigation of farm household economy, etc. of the region are absolutely necessary. However, organizations for preparing such statistical data and for conducting investigations are not sufficiently established in this region, and so the data are limited. Improvement and reinforcement of such investigation organs are desired hereafter.

7-2-2 Problems on the Phase of Farm Management

(a) Elevation of the agricultural productivity

Rice is the most effective crop as the source of calorie for the nation and the plan of increasing the production of food-stuff is being promoted with this crop as the center.

However the unit yield of rice in terms of dry paddy in Kalimantan is less than 2 tons/ha, which is only about one-fourth of the yield in Japan. The same can be said about the production of dry field crops.

In order to get rid of this low productivity, financial measures which would replenish the capital of each individual farm household should be taken along with the improvement of the foundation of the land. The primitive method of farming, dependent solely on rainwater without even ploughing the ground, should be reformed. The elevation of the productivity of land should be planned by introducing improved varieties, fertilization, disease prevention and pest control. It is also necessary to increase the labor productivity through introduction of livestock farming and mechanical power.

(b) The necessity of diversified farm management

Agriculture, seen from the viewpoint of food life of the nation, is required to satisfy the qualitative change to fate, proteins, and vitamins in the next stage after the starch calorie is satisfied quantitatively in the primary stage. What are required for this purpose are the promotion of the livestock farming which at present is not able to meet even half of the demand, improvement of varieties of fruit trees which at present are almost wild, expansion of orchards, and stable supply of fresh vegetables based on irrigation of upland field. Since these will require farm management techniques of high standard, and so efforts should be made for the induction of experts, expansion of experiments and research works, and for the training of the extension agents.

(c) Expansion of experiments and research, and agricultural extension work

In a country where agriculture is one of the important pillars which support the nation, the existence of the agricultural experiment stations is very important, and every efforts should be made for their improvement. Compared with the vast agricultural region it has, the agricultural experiment station in Kalimantan is too small in scale and its functions are not well organized and the problems which must be solved are too many. It would be advisable for each provincial government to establish its own experiment station for carrying out practical experiments, and at the same time, use the existing state owned experiment station mainly for fundamental experiments.

The experiment of twice a year cultivation of paddy rice has been carried out successfully at the beginning of 1970 for the first time, and what is desired hereafter is to keep close connections with the extension work for the purpose of stabilization of this new cropping method and of informing the farmers of the results of the experiment made.

As regards the extension work, organized activities such as the training of technicians, forecast of diseases and pests, and guidance on fertilization, prevention and extermination, etc. should be expanded to expect still greater benefits from the project.

7-2-3 Problems concerning Improvement of Soil

There is no special problem as to the alluvial soil in the lowland area, but the soil in other areas poses many problems concerning the land use.

First of all, red yellow Podsol as well as Latosol in the upland area form clods when dry, and they are subjected to soil erosion. As the effective soil stratum is thin, upland irrigation is desirable to provide suitable moisture.

As the soil is strongly acid, it is necessary to apply lime to adjust the pH value. Land clearing by burning should be prohibited completely hereafter and improve the chemical and physical nature of the soil by means of a large tractor for mixing the soil with alang-alang as organic matter.

The soil in the tidal area and the swamp area should be handled with care. Condition of accumulation of organic matter, particularly peat, should be checked in advance.

The soil with heavy peat content, under the tropical climatic conditions, may oxidize rapidly to cause sinking of ground and other unfavorable consequences. When improving the drainage in such an area, the method of improvement and the pace of such improvement should be studied accordingly with the degree of such peat content. Again, acid-sulphate soil is widely distributed in the area affected by sea water, and this soil, when left in oxidized condition forms cats-clay. Prevention of formation of cats-clay is another subject which should be studied hereafter.

The water in the canal is brown or black brown and strongly acid containing organic acid or sulphate as shown in Fig. 7-4. When formulating an irrigation plan, induction of fresh water of pH 6 from the Barito and Kapuas rivers should be taken into consideration.

7-2-4 Problems concerning Farmland Exploitation

The objective of agricultural land development is not merely to expand the cultivable land. It should include the elevation of the level of farm management by maintaining and increasing the productivity of the farmland for many years in the future to stabilize and increase the harvest, and further, by carrying out systematic planting.

(a) Problems from the viewpoint of natural conditions of the region

In view of the natural conditions of this region, it seems that the followings are the important points which should be taken into special consideration.

Drainage is of no problem even in the wet season in hilly area, but irrigation is necessary in the dry season. For this reason, it is necessary to grasp properly the discharge duration of the tributaries and small streams.

The low damp area adjacent to the hilly area is affected by the flooding of the tributaries and small streams. Flood control and drainage are the major problems in this area. It is particularly necessary to drain out the water on the farmland in the beginning of the dry season as early as possible to make the farmland cultivable. For this purpose, it is necessary to prepare the hydrologic and hydraulic data and formulate the drainage plan based on the most rational hydrologic study. On the other hand, as there is a danger that draughts may occur in this region in the dry season due to over drainage, it is necessary to study the irrigation plan for paddy and upland field crops in the dry season together with the drainage plan. Again, this irrigation will prevent drying up of the farmland and promote effective decomposition of the soil, and drive out the organic acid water coming from the vast farmland.

In the lower damp area adjacent to the area mentioned above, drainage is a serious problem throughout the year. In this area, upland field farming is almost impossible. Paddy rice is the major crop. It is necessary to provide drainage to keep optimum water depth for the growth of paddy rice, fertilization of soil, and circulation of water to remove harmful contents.

Farmland exploitation in the tidal area can be done rather easily to a certain extent by means of large scale canals, but it will be necessary to construct large scale facilities for water control and an organization in order to maintain high productivity of the farmland permanently and to make possible the development of highly advanced farm management. It is important that the drainage canal is of the function and capacity which sufficiently eliminates the toxic water eluviating from the special soil in the area. The harmful water will increase in quantity and density as the farm management gets more and more advanced. The existence of cats-clay is another serious problem in this area. In the dry season, it is necessary to prevent the capillary rising of toxic water from underground. In the tidal area close to the sea, the counter-measure against salt injury should be stuided carefully.

(b) Other than irrigation and drainage

This could be said about the entire Barito river basin, and that is, the farmland exploitation requires not only irrigation and drainage but a farm village plan or a land consolidation plan including the improvement of the communication system. It is possible to use the navigation canal as drainage canal at the same time, but such will obstruct the function mutually. As the irrigation canals are structurally different from the roads, a general plan including other agricultural facilities should be formulated. This will become a serious problem in the future when this basin should have a large population and the social and economic activities are more activated. It is also necessary to formulate a future plan of the basin which has connection with not only the phase of agriculture but also with the development plan of other sectors such as rivers, harbors, roads, etc. Particularly when the project area includes a densely populated area or is adjacent to such concentrated area, it is necessary to study carefully how the changes in the condition of water due to the irrigation and drainage plan exert influence, and to consider the effective use of such influence. Communication facilities in the project area should be planned in connection with the existing communication system, and it should be planned in such a way that they will be the foundation for the growth of the regional society in the future.

(c) Problems concerning the implementation of the project

In view of the scale of this basin and the extent of the development promoted hitherto, it is considered that the agricultural development in this basin will be promoted gradually in several stages. It is necessary to bear in mind that the projects now under construction should serve as pilot projects, and results obtained are useful when planning other projects in future. Such results will also be very useful when educating the farmers in the region and giving guidance on how they should employ the new method of farming. As will be explained in more details later, the Riam Kanan Irrigation Project is a good example of the advanced agricultural develop-

ment, and since this will show how agriculture in Kalimantan can be developed in a similar way in the future, the planning of a project like this should be studied with due prudence.

It is evident that development projects, particularly the agricultural development projects, require full cooperation of many organizations, ranging from the Central Government to an individual farmer. The objective of any project can be attained only when design, execution of construction work, land consolidation and all other works of a large scale construction work are carried out perfectly. At present, there are several experiment institutions in Kalimantan beside the administrative institutions, and these institutions are promoting such activities as taking the statistics, investigation, observation, experiments, researches, etc. However, the data now being kept at these institutions are not satisfactory for use in the planning of a new project, since they have not been prepared systematically. The organizing power is required to promote mutual utilization of the data obtained from various sources and to fully convey the decisions made by the higher institutions to the terminal offices. Reformation and reinforcement of organizations and institutions in various fields are necessary when planning and executing a large scale project in order to make the project effective as soon as possible.

7-3 Direction of Agricultural Development of the Barito River Basin

7-3-1 Areal Classification for Agricultural Development

In order to promote agricultural development as the foundation of regional development, it is necessary to decide the general direction of development which conforms to the development of the entire region. It is also necessary to formulate a plan of production of agricultural products of the entire region according to the socio-economic condition and the natural condition. The farming pattern should be decided for each area upon careful study of the future demand for agricultural products in each area and the condition of the distribution system so that well balanced supply of agricultural products can be secured for the entire region.

When carrying out the agricultural development of this large Barito river basin, it is necessary to divide this basin into several types of areas according to the soil and water conditions, and to manage agriculture of the farming pattern suitable to each area. Again, by utilizing effectively the natural conditions, the development project can be implemented without much difficulty both technically and financially. Fundamentally, the natural conditions are most important, but the socio-economic condition of each area is also important when formulating a development project. By supplying agricultural products to the regional community and performing according to the demand, the benefit and prosperity of farm management can be expected and the objective of agricultural development as the foundation of regional development can be attained.

That this Barito river basin has many problems to be solved on various phases has been mentioned in the foregoing chapter. The agricultural development project should be formulated in the direction which would solve these problems synthetically. The development of agriculture in the past in this region was of the most primary stage, and it seems that such was possible where both the natural condition and the socio-economic condition were favorable. However,

when promoting the agricultural development having advanced farming pattern hereafter, it is necessary to think of improving these conditions in addition to their effective utilization. In this case, whether that area has the potential socio-economic growth in the future will become an important factor for deciding the priority order of implementation of the projects.

This basin has a large variety of water level conditions, being influenced by the discharge of the main flow of the Barito river, its tributaries, and by the tides of the Java Sea, and also has a variety of land conditions due to various kinds of soil conditions formed by the action of those rivers and the sea. When formulating the agricultural development project, it would be most appropriate to classify the entire region into several types of land in view of the natural conditions.

(a) Upland

The upland area is on a rather high elevation extending over the middle reaches of the tributaries of the Negara River. Uplands are also found sporadically around the upstream section of Martapura River or in the southeastern section of Bandjarmasin. The gradient of the rivers varies between 1/100 and 1/1000, and it is considered that the elevation of the land is between 5 m and 10 m above the water surface.

(b) Lowland

A vast flat lowland exists over the confluence of the tributaries and the Negara River. The gradient of the rivers varies between 1/1000 and 1/10000, and the elevation of the land is less than 3 or 4 meters above the water surface. The difference between the elevation of the river and the land gets smaller toward the downstream, and the upstream area is connected with the upland area. As this area is divided into many sections by the numerous tributaries, such a topography becomes an important factor when formulating a development plan. This area is strongly affected by the flooding of the rivers in the wet season.

(c) Swamp

The low damp area lying between the tidal land mentioned later and the above-mentioned lowland is the swamp. The major part of this swamp is between Marabahan and Negara. The gradient of the rivers is less than 1/10000 and the elevation of the ground is only 1 to 2 meters above mean sea level. This area extends over the area within 100-200 km along the flow of the river from the estuary of the Barito River, and is strongly affected by both the flooding of the rivers and the tides, and is flooded in the wet season of course, and remains submerged even in the dry season. There are several other swamp areas in the inland area between Barito, Kapuas, and Kahajan rivers, far from the river banks and not affected by the tides.

(d) Tidal land

In the areas within 70-80 km of the estuary of the Barito, Kapuas, and Kahajan rivers, the fluctuation of water level is caused more by the tide than the difference in water levels of the rainy season and the dry season. The elevation of land is less than 1-2 meters above mean sea

level, and the maximum amplitude at the estuary is 2.8 m. The salt wedge had been confirmed to reach as far as Bandjarmasin in the dry season, and it was said that its extent had been about 40 km from the estuary. It seems that the sea water intrusion on the tributaries is slight. Besides this area, the area to the south of Bandjarmasin facing the Java Sea and within several kilometers from the sea coast is affected by the tide.

7-3-2 Upland

The flood damage in this area is not serious even in the wet season, and the soil is either Latosol or Red yellow podosol easy to get eroded. It is necessary to fertilize the soil which has lost fertility through eluviation, and to preserve vegetation by adjusting the soil moisture in order to promote the agricultural development in this area. Because of the topographical condition, the development of a project covering a large acreage would be difficult, yet the effect of development of this upland area would be conspicuous.

Farming centered on rice cultivation is possible in this area if sufficient quantity of water is available. This area is also suitable for farming based on upland field and orchards because the drainage condition is favorable. It seems that the facilities constructed in the past are not being fully utilized, but this does not indicate that this area is not suitable for agricultural development. It could be considered that such has been due to the unfavorable conditions on the phase of distribution to meet the demand of the other areas. It is advisable to promote agricultural development in this area with the aim of performing multiple farming management placing emphasis on cultivation of crops other than rice. This is because the other areas have a high potentiality of rice production, and it is necessary to induce crops other than rice to promote the economic growth and raise the living standard of the farmers in the entire region. (See Photo 7-4)

The development project in the upland area requires to draw water from the tributaries and streams. It is necessary to grasp accurately the discharge of these water resources, and study the construction of reservoirs where required. The supply of irrigation water should be studied together with the irrigation projects of the adjacent lowland area on the downstream. The combination of a power project with a reservoir construction will help develop the entire region, and at the same time, produce the effect of flood control for the downstream area, and electric power for pumping irrigation and drainage.

The area lying between the section situated at comparatively high elevation and the foot of the Meratos Mountain Range is topographically unsuitable for rice cultivation, but it may be suitable for upland farming, fruit culture and dairy farming by carrying out porper moisture control in the dry season. The irrigation project for this area poses the problem of the method of supply and distribution of water rather than the problem of water source, which will become complicated and expensive because of the topographical features. Water is also required for the reclamation of the alang-alang area after burning. One of the methods conceivable is to rehabilitate forest land at several places to increase the water holding capacity as much as possible. However, this type of agricultural development must be supported by the expansion of processing of the products and the distribution system, and increased consumption demand in the region. Anticipating that the demand will increase in the near future following the population growth and elevation of the living

standard in the entire territory of Kalimantan, it is necessary to start planning now.

7-3-3 Lowland

This area is the so-called flood plain surrounded by many tributaries, and quite a large portion of the area is submerged in the rainy season for several months with a water depth of about 2 m. However, there is an area consisting of fertile alluvial soil transported from the upstream by the flood flow. As this portion of the area forms an elevated zone and has favorable conditions as farmland, roads have been developed along this portion, population is concentrated at several places, and farmland exploitation has been developed to quite an extent. Other portions are lower elevated zones due to insufficient soil sedimentation, which are characterized by humic gray-soil or organosol peat resulting from the vigorous growth of aquatic plants and their accumulation. The entire area is inundated in the rainy season, but those portions on higher elevations have draughts in the dry season. For this reason, stabilized farm management is impossible in this area. With the exception of a part of the area along the roads joining the major cities and villages in the area, the facilities of communication are extremely poor. Such a situation as this largely hinders the new settlers in this portion of area from participating in the distribution of agricultural products and their social activities.

The lowland area is also known as the lake region. Multiple farm management based on rice cultivation is possible with proper water control. Rice cultivation is possible in a large portion of this area extending over a vast area both in the rainy season and the dry season. It is also possible to conduct upland field farming in the dry season with the exception of the extremely low portions. If the agricultural development of the farming pattern now being employed in Kalimantan is to be carried out, it will be easy to attain the objective in this area just by improving the drainage. However, in order to carry out advanced agricultural development over an extensive acreage, it is necessary to consolidate drainage and irrigation facilities. The study of the runoff mechanism of each river in the rainy season and the plan which conforms to the discharge-duration of the rivers are required for drainage and flood control. It is necessary to grasp accurately the minimum flow of each river, and formulate an integrated plan of water use which includes the adjacent upland area mentioned before.

This area is divided into small areas by many large and small rivers, and this becomes an important factor when deciding the boundary area of the development project. If the project is going to be of a large scale in which a block is over 10,000 hectares, due consideration should be given to the disposal of the acid water eluviating from peat. Particularly when taking in irrigation water from the drainage canal, it is necessary to drain this acid water out of the block or draw water of good quality from the rivers on the upstream to dilute the acid water. There are some marshes in some areas in the region which are being used together with the river flow running through the low damp sections for fish farm, breeding of ducks, and for grazing buffaloes. These are the main sources of supply of protein food for the inhabitants of the region. Therefore, it is necessary to formulate an integrated farmland development plan, taking in account the above-mentioned fact.

As explained above, tthe agricultural development of this region makes possible the diversified farming, and at the same time, it is possible to provide flexibility to the demand of the market. For this purpose, it is necessary to carry

out land consolidation in each block so that the cropping pattern can be diverted according to the location, elevation and the extent of water control of each block. It certainly is not advisable to develop this vast region uniformly under the same condition. Roads and waterways should be improved in conformity to the land consolidation for farm operations, marketing of agricultural products, and other social activities of the farmers. (See Photo 7-5, 7-6, 7-7).

7-3-4 Swamp

It is considered that this area including the tidal area had been the sea in the past where the formation of land was stimulated by the accumulation of transported soil accelerated by the vigorous growth of the aquatic plants. Different from the lowland mentioned before, there is more accumulation of plants in this area than the sedimentation of soil carried by water. Most of this area is inundated even in the dry season. Consequently, the agricultural development of this area has to be based on rice cultivation. As organosol is rich and the area is with confirmed poor drainage, the disposal of strongly acid soil and eluviated water poses a serious problem. As this area is an extremely monotonous low damp land, the irrigation project of this area should be planned in consideration of the topographical relations with the adjacent land, and particularly with the upstream area along the rivers. In this area, the objective of the development should be set on the year-round cultivation of rice.

The present condition of the agricultural zone in the Barito river basin shows that reclamation has not progressed much in the swamp area compared with the upland, lowland and the tidal land. However, the soil and water condition is almost the same as that of the tidal land except that the water depth of inundated area in the rainy season is larger. The main reason for the slow development of this area in spite of the fact mentioned above was probably the difficulty in developing roads and waterways. There are no waterways branching off from the main stream of the Barito river and the Nagara river, and sound roads run up to Negara only. As the scale of the rivers is too large, it is not easy in this area to adjust the water level for conducting stabilized rice cultivation. For the agricultural development of this area, a development project covering a wide range including river improvement will be required. The development of the swamp lying in the inland part between Barito, Kapuas and Kahajan rivers should be studied together with the development of the tidal land mentioned below.

7-3-5 Tidal Land

Tidal land is the area which is strongly affected by the tide. The development project in this area depends largely on how the tide has affected on the formation of land in the past and the degree of the necessity to take into consideration the tidal action when promoting the agricultural development.

This area is low and damp, and the gradient of the river is almost level, but this does not interfere with the method of rice cultivation now being employed in Kalimantan. However, the method of rice cultivation based on separation of irrigation and drainage canals will involve much difficulty. The condition of the paddy field in this area at present indicates the method of reclamation which can be employed under such unfavorable conditions. However, the fact that it indicates the limit of such method of development should not be overlooked. This area will be encountered by many serious problems with the progress of the development such as the generation of cats-clay, strongly acid

water and toxic water eluviating from the inner land, and unavailability of sufficient quantity of fresh water, etc. The present condition of the area is unfavorable for employing advanced method of farming which requires manuring control of the farmland. It is necessary to set the objective of the agricultural development on stabilized rice cultivation for raising two crops of paddy rice a year from the viewpoint of farm household economy. However, it should be said that the method of irrigation and drainage using the tidal movement now being employed in this area is not a constructive method.

Communication with the remote places in this area is solely dependent on transportation by ship. Improvement of the communication system including the repair of the existing waterways is necessary. In this case, however, the construction of new waterways should be planned in such a way that it would conform to the agricultural development project. In some places, small waterways are being used for short distance transportation. This interferes with the function of the terminal facilities of the irrigation canal. Some measures must be worked out concernign this point. As far as this area is concerned, it is not appropriate to utilize the reclaimed area along the old waterway for new agricultural development projects as the socio-economic foundation for the future development. This is because the present condition for irrigation is particularly unfavorable.

To improve soil condition and irrigation condition in this area, a drastic plan is necessary. The agricultural development of this area may have to be based on the overall development plan covering a wide area which includes the development of the vast swamp lying in the upstream area.

If it is for the purpose of attaining the level of farming which is now being conducted in this area, the development of paddy field would be quite easy. However, it should be planned from now on by setting the target of development, taking a wide, over-all and long-range view, for the sake of improvement of the farm household economy and the prosperity of the region.(See Photo 7-8, 7-9).

7-4 Selection of the Projects

In view of the present condition of the Barito river basin,, immediate development of the whole region is very difficult in many respects. However, there are some areas where the conditions for development are ready, and early implementation of the development projects and the effect of such development can be expected. It would be advisable to begin with such projects under the present circumstances. (See Fig. 7-5)

7-4-1 New Projects

(a) Riam Kanan Irrigation Project

The Riam Kanan Dam, which is now under construction on the upstream of the Martapura river, will be completed in 1972, and the multiple-purpose use of the reservoir will become possible. Martapura river is one of the tributaries of the Barito river, which branches off at Bandjarmasin and then separates into the Riam Kanan and the Riam Kiwa rivers at the point about 40 km east of Bandjarmasin. The total length of the river is about 110 km. There is a plan of irrigating the area around the lower basin as one of the uses of the reservoir. The proposed irrigation area includes the area lying between the Martapura river and the Maluka river centered

on Martapura City and Bandjar Baru City, and the area on the eastern part of Bandjarmasin City. This area is a comparatively well developed area in Kalimantan, forming the center of administration, economy and culture, and the concentration of population is rather high. There are some progressive people among the farmers in this area, and the government institutions such as the Agricultural Research Station and the Agricultural Mechanization Corporation are concentrated in this area.

The condition of farm management in this area is based mostly on the traditional farming of extremely poor efficiency, and the productivity has already reached its limit in spite of the relatively favorable natural conditions of this area. It is therefore necessary to expand the farmland to improve the farm management. However, it is necessary to take drastic measures for the expansion of the facilities and the improvement of the farming techniques. In view of the present condition of the area, it seems it is now the time to carry out such expansion and improvement. As the potentiality of this area is large and the socio-economic condition is most favorable for the agricultural development, it is expected that the implementation of the project will contribute largely to the benefit of the local community very quickly.

The area of the farmland on which the water from the reservoir can be used directly is estimated at approximately 30,000 ha. Including the related project area for the improvement of drainage, it is estimated that the agricultural development based on the rationalization of the water control can be carried out over a total area of 40,000 ha. The conditon of farmland in this area is diversified, and it contains all types of land in the Barito river basin mentioned before. Although the scale of the project area may not always be large, it is possible to employ various farming patterns in the same project area. As the Riam Kanan Irrigation Project can be considered to represent the agricultural development of a reduced scale of the Barito river basin, it seems that this will fully play the role of a pilot project for the agricultural development of the whole territory of Kalimantan.

According to the plan of the dam project, discharge from the Riam Kanan Dam is about 40 m^3/sec and this can be used for agricultural purposes. This makes possible the rice cultivation in the dry season in the related area. In the low damp area already reclaimed to paddy field water is rather acid and the fertility of soil is low because of poor circulation of water. By irrigating the rice field with sufficient quantity of good water and remove the toxic water, it is possible to increase the productivity of the farmland. For the purpose of induction of high yielding varieties and cultivation for raising two crops a year, superior water control facilities are absolutely necessary. The introduction of upland field crops besides paddy rice would be effective as a means of improving the farm household economy and the living standard of the farmers. On point of promotion of the farming techniques by conducting farm management based on rotation of rice field and upland field, it will be possible to conduct farm management which would be more flexible to the demand of the market. These will guarantee the stabilized farm management with excellent water control. It is necessary to guide and educate farmers who actually engage themselves in agriculture within the area on the techniques of farm management while promoting the plan of construction of irrigation

and drainage facilities and farmland exploitation. As the farming pattern aimed at in the plan of the project will be quite different from what the farmers are using at present, guidance and education for the farmers should be carried out concretely, permanently and extensively. A study should be made on the establishment of the training center and the pilot farm as the organization and the facility which are in concert with the Agricultural Research Station and the Agricultural Mechanization Corporation.

The details of the Riam Kanan Irrigation Project will be mentioned in the Appendix. It is emphasized that experiences gained from the Riam Kanan Irrigation Project should be utilized fully for the implementation of the future projects in Kalimantan.

(b) Amuntai Polder Project

As one of the development projects in the low land area, the area extending over the southern part and the eastern part of the Amuntai City can be taken up. The area surrounded by the Batangalai, Tabalong, and Balangan rivers, which are the tributaries of the Negara river, could be considered the suitable area for agricultural development under the Polder Project. The area along Tabalong river and Balangan river is slightly elevated due to the sedimentation of soil transported by the flood flow in the rainy season, while peat has developed in the inner part away from the tributaries and is low and damp but the inundation depth even in the rainy season is not large. With the exception of some swampy portions, agricultural development in this area will not involve much difficulty. A development project is now underway in the form of excavation of drainage canals, and quite a large acreage including the portions along the tributaries with favorable drainage condition has been developed into paddy field. Excepting the particularly low and damp areas, there are many places where upland field farming is being conducted in the dry season. Also, there are places where rice is cultivated in the dry season when the prices are high. However, due to the effect of the strongly acid brownish water eluviating from peat and organosol developed in the district, it is impossible to further increase the productivity unless water is induced from outside of the area in the dry season. On the other hand, irrigation condition becomes becomes favorable in the rainy season, but the area lying between Tabalong river and Balangan river is flooded every year, and it is not possible to have stabilized yield. On point of stability of the farming operations, the inner part of the area has good water condition, and even the excavation of the drainage canals alone will prove to be very effective. In spite of all the efforts made by the farmers, the extremely poor means of transportation of the agricultural products to the markets not only hinders the distribution activities but also interferes with the social activities of the farmers. At present, there is only one road which joins the populated areas such as Kandangan, Barabai, Alabio, Amuntai, Batumandi, etc. The only means of communication within each area is the canoe navigation using the drainage canals. Even this canoe navigation does not provide smooth traffic due to the thick growth of water weeds.

The scale of the Amuntai Polder Project is a large one which covers about 40,000 ha of land. The proposed project area has good drainage condition, and is surroudned by many tributaries which provide the source

of irrigation water readily. The project area has well populated areas in the neighborhood, and the socio-economic condition is favorable being bordered by the truck road. Also, many farmers have already settled in this area, and their farming techniques have improved considerably. This project area is most suitable for carrying out the agricultural development.

Planning of the Amuntai Polder Project and the land use classification should be carried out according to the soil condition and the water condition of each area, and the development plan should be formulated by taking into due consideration the various farming patterns which would be most suitable under each condition.

"High Section"

The section adjacent to the upland area on the northeastern part of the area and the section along the Balangan river and the Tabalong river on the northern part of the area consist of land of rich alluvial soil where the ground level is rather high. This section gets dry in the dry season. It is expected that this type of land will increase in acreage with the progress of the construction of the drainage canals. The farming pattern for this section will be rice cultivation in the rainy season and the upland field farming in the dry season. As this section is situated along the main roads leading to well populated areas, it can play the role of the supply source of vegetables, etc. As some portions at high elevations are free from floods in the rainy season, it is possible to meet the above-mentioned demand throughout the year.

"Low Section"

There are some sections along the border of the area where the ground water level is high but the surface soil gets dry in the dry season. The central part of the area where peat has developed well must have such sections which may be changed to such type of land upon completion of the construction of the drainage canals. As the farming pattern for this section, it is possible to raise two crops of paddy rice a year, and the upland field farming will be possible in the dry season at places where the drainage condition is favorable. However, as the ground water level is high and the soil is strongly acid, the kinds of crops cultivable will be limited. As reagrds the communication system in this section, the construction of roads is topographically difficult. Navigation on the drainage canals will become the basic transportation. For rice cultivation in the dry season, the removal of organic acid water eluviating from peat and organosol existing in the whole area, and the induction of good water from the surrounding rivers are necessary. When planning the irrigation facilities, different methods of irrigation must be employed for the surrounding area and the central area. In the area around the border of the area, the gravity irrigation from the "high section" is advisable, but the dual-purpose canal will be used in the central part of the area because the banking of waterways involves much difficulty. In this case, allocation of dry field and paddy field should be appropriate. It is necessary to pump up water separately or adjust the planting schedule.

"Low Damp Section"

Most of the central section of the area is low and damp, and the surface soil does not dry up even in the dry season. There are some portions which may change to "low section" mentioned above if the drainage condition is improved. As the inundation depth is over 1 meter in the rainy season, farming pattern in this section should be based on single crop of paddy rice a year in the dry season. Other parts where the ground level is particularly low or are marshy cannot be reclaimed to farmland due to poor development of peat. These parts should be left as they are, and it would be advisable to utilize them as the retarding basin. These marshes and the streams are now being used for fishery, raising ducks, and for keeping buffaloes. The farmers should be allowed to use these retarding basins for quite some time hereafter for the above purposes as a part of farm management.

The Amuntai Polder Project is based on the following three points:

(1) Disposal of flooding water in the rainy season and the stagnant water in the area.

(2) Facilities for irrigation in the dry season

(3) Improvement of the communication system for the distribution of agricultural products

Realization of all the above would require a huge amount of funds and a long period of time. However, the regional agricultural development project should be planned by setting the target of such development at a high level so that the development project is directly connected with the establishment of the self-supporting farm households and the prosperity of the regional community. For this purpose, it is necessary to improve the condition of the farmland which is the base of production, and therefore realization of the above three points is required. The goal of production should be set at over 8 tons/ha in case of raising two crops of paddy rice a year. However, to increase the production of the present yield of 2 tons/ha to 8 tons/ha all at once, not only the expansion of the facilities mentioned above but also the improvement of the techniques of farm management are required. Accordingly, the method of promoting the projects is to commence with the basic ones which would be most effective stagewise, and to plan for increasing the yield gradually, keeping pace with the improvement of the technics of farm management. What are required first of all in this area are the drainage facilities. When planning the construction of the drainage facilities, it should be studied in such a way that they conform to the comprehensive development plan. Flood control and the irrigation of the "high section" are costly, and since the effect of such facilities cannot be expected in the present stage, the construction of such facilities should be postponed till the final stage when the value of farmland in the area has increased.

(1) Disposal of flooding water in the rainy season and the stagnant water in the area

Excavation of the drainage canal is necessary first of all.

Several drainage canals have already been put to service, and reclaiming of land to paddy field has been promoted to quite an extent. However, the present drainage plan is not based on the study of the hydrological relations of the surrounding rivers. It is merely for the purpose of removing the surplus water in the area as soon as possible at the end of the rainy season and at the beginning of the dry season. The drainage plan should be such that it can display proper effect on each portion of the vast area of different conditions, and also possible of regulating water for improving the soil. As the floods are of large scale and continue for a long period, the perfect counter-measure is to provide a large ring dike which requires a huge amount of funds. However, it is necessary to fromulate a plan of this dike if the objective is the development of a very high level. Countermeasures for flood control, the establishment of a reservoir on the upstream of Balangan river to be used also for flood control should be studied, since these are related to the irrigation water source project, about which explanation is given later. At present, the existing main roads are functioning as small-scale embankments, but it is said floods which cross the low parts of the existing roads occur once or twice every year. The actual situation is that there are many streams and drainage canals which are connected with the Balangan river and the Tabalong river at many places, from where the water flows into the area rapidly in the rainy season and gradually flows out in the dry season. By banking the low parts of the roads and providing the regulating gate at all those portions of the rivers, it would be possible to expect good results. The ends of the drainage canals in the area discharge into the Batangalai river, and it is necessary to provide the regulating gate at these ends to prevent the reverse flow. The pumping irrigation project should also be studied.

(2) About the irrigation project

Irrigation is required only in the dry season. It is required in the higher parts to prevent droughts for the protection of upland field crops, and the low section and the low damp section require the induction of good water as a means of soil improvement rather than for irrigation purpose. Except the high section, most of the land in other sections consists of peat and organosol. These types of soil can exist under the high temperatures of the tropical zone, because they are decomposed to the utmost and decomposition cannot progress any more in the low damp area due to lack of oxygen. What should be noticed here it that decomposition of soil will be stimulated rapidly if good water is induced to raise the pH value to provide the condition for oxidation. Such would increase the quantity of toxic water eluviating into the drainage canals and also cause settlement of ground. As paddy rice can grow under the oondition of pH 4, it may be useful to keep the pH value of soil and water at around pH 4. It may be possible to obtain the source of irrigation water in the river system of the Tabalong river, It is necessary to grasp accurately the runoff of the Balangan river and the Tabalong river at the upstream, and also to study the utilization of the small streams flowing out of the hilly area on the eastern part. Since the water level will be comparatively high if the irrigation water is obtained from the Balangan river, it will be advantageous as the water source for irrigating the high section. Since the Batangalai river flowing through the southern part of the area would decide the condition

for the ends of the drainage canals rather than the source of irrigation water, it is necessary to grasp accurately the changes in the water level particularly of those in the rainy season.

(3) Improvement of the communication system

Since the trunk road running along the circumference of the area will definitely become important for purposes other than agricultural development in the future, it is necessary to expand this road. It would be advisable to improve the communication network within the area using this road as the main distribution route between the project area and the other areas. In places at a high elevation, the earth obtained from canal excavation can be used for banking to make the foundation of the roads. It would also be possible to construct small roads in the central peat zone in the same way, but dry peat is quite unstable as banking material. It is possible that such banking material may be destroyed by accidental fire. Therefore, it seems navigation on the drainage canals would be the most suitable means of transportation in the central section of this area. In such case, however, the difference in the types of transportation facilities inside and outside of the area will cause much inconvenience, and so it is necessary to open navigation canals to connect this area with other areas or establish the relay base at several places along the roads to connect navigation with land transportation.

The agricultural development of the Amuntai area is quite promising in view of its great potentiality as well the increasing demand of the area for such development. The scale of the project naturally becomes larger in order to establish the farm management of a high level, and it will be difficult to complete the project in a short space of time, but a project mainly for the improvement of drainage alone will be quite effective. It is important to promote the project stage by stage to conform to the overall development plan of the region to attain the objective of the project. The formulation of an overall investigation plan is strongly desired in connection with the development of large and small rivers surrounding this area.

(c) Tidal Area Development Project

The "tidal irrigation project", which is now being promoted on trial basis on the tidal land, has already produced fairly good results, and a substantial number of settlers are already in this area. However, the farming pattern employed in this area is based on one crop of paddy rice a year in the rainy season, and so the farm household economy is not quite satisfactory. The agricultural development should be something which makes possible the settling of the farmers in the project area, and at the same time, must have the possibility of further expansion in the future. The soil condition of this area is not very favorable, and there are some sections where the occurrence of cats-clay and the existence of toxic substances are the matters of concern. It has already been proved that it is dangerous to dry the soil rapidly. The rice field, developed on both sides of the navigation canals constructed in the past is the area in which the farmers hitherto have produced rice by the method of cultivation on this type of soil they have learnt from experience. Replacement of water is the only method which makes farming possible in this area. Though the

tidal irrigation method is not a constructive method, it certainly is a very interesting way of agricultural development. This method may be quite satisfactory according to the present level of farm management in Kalimantan, but it is doubtful whether such can maintain the productivity of the farmland to grarantee the future development of the area and the stabilized farming. Certainly it is necessary to raise two rops of paddy rice a year for the improvement of the farm household economy, and it is also necessary to provide the farm households with sufficient acreage of land for upland field farming to make them self-supporting, if possible. In this area the improvement of soil is most desirable, and it is necessary to establish a more constructive method of irrigation for this purpose. The traffic condition in this area is extremely poor. Roads are poor and are confined to limited areas. Long distance transportation has to depend on navigation. There are many cases in whcih the function of the tertiary drainage canals is not fully displayed since they are used for navigation purpose. On the contrary, the function of these tertiary drainage canals as navigation canals is much reduced since supervision and maintenance of the canals are prctically not conducted at all.

In order to carry out agricultural development of a high level in the tidal area, it is necessary to make a drastic plan in many respects. The water control on paddy field should be carried out by separating irrigation and drainage canals, and for this purpose, water of good quality must be drawn from the main stream of the river to be circulated constantly separate from the drainage canals. With the progress of expansion of farmland and settlement of the farmers, the traffic problem will become serious both in quantity and in quality. The plan of traffic routes should be studied extensively, and the plan which includes the swampy area on the upstream will become necessary. In the inland portion of this area, roads can be built by using the banking material obtained from canal excavation. In view of the soil and materials existing in the area, the type of traffic will be possible to build the roads sufficiently durable in carrying out the social activities of the farmers and the farming operations. As this area is separated from other areas by rivers, communication with those areas has to depend on navigation. Expansion of the navigation canals to connect this area with the major cities in Kalimantan and the establishment of the system for maintenance and supervision of the navigation canals are much desired.

(d) Other Projects

Besides the projects mentioned above, several other projects are also conceivable. However, most of such projects are not suitable for planning as enterprises, because the demand for development is small or the social conditions are not favorable even if the scale of the projects may be large, or even when the conditions for development are ready, the scale of the projects is too small so that the effect of such development is confined to a limited area. It is considered that the necessity of developing these projects may arise in the future as the development of the entire territory of Kalimantan progresses hereafter. These future development projects should not be limited to the projects centered on rice cultivation for which the demand is the strongest under the present circumstances, and they should be planned as the projects which would include upland field farming, fruit culture, diary farming, etc.

The future development projects centered on rice cultivation will be those to be developed mainly in the swampy area. Under the present circumstances, the agricultural development will be carried out in the area where the means of communication, both the land transportation and navigation, are comparatively good to gradually expand the area accessible to the farming people. The necessity of developing the vast swampy area will arise in the future resulting from the anticipated population growth and increased demand for foodstuff. As stated before, the drainage project will become the base for the development of the swampy area, but it is necessary to study collectively the irrigation project. In case of the swamp in the main stream area of the Barito river, it would be advantageous to make the drainage plan using the large tidal amplitude of over 1 meter. On the contrary, the gentle gradient of the river makes the gravity irrigation difficult since it is not possible to obtain sufficient quantity of water by this mehtod. The pumping irrigation should be employed in the irrigation project like in the case of the Mentaren Polder Project. In case of the swamps in the area along the tributaries of the Barito river, pumping drainage is necessary because the influence of the tide is less. As the area in which the swamps exist is quite extensive, it could be considered that the soil condition may vary depending on the location of each. Therefore, it is necessary, when working out a development plan, to carry out several tests and investigations to ascertain the possible yield derivable from the land, and thereby make a decision on the implementation of the project.

The area lying between Martapura and Rantau has a complicated topography where the low damp districts and the hilly districts are inermingled. Topographically, this area is similar to the project area of the Riam Kanan Irrigation Project where diversified agricultural development is possible. As this area is far away from the tributaries having large discharge, the convenience of water utilization is not favorable. The Riam Kiwa river is the river closest to this area, the utilization of which is technically possible. However, utilization of this reiver merely for the purpose of agricultural development of the irrigable area is economically unjustifiable. In case the power demand in this area should increase in the future and the supply of power under the Riam Kanan Power Project become insufficient, the construction of a multi-purpose dam on this river may be taken into consideration. The agricultural development may become feasible economically when such a time should come.

On the eastern side of Batibati located south of Bandjarmasin is the site for the construction of a reservoir for irrigation, the construction work of which was started with the aid given by USSR but discontinued without the reservoir being completed. What is required for agricultural development in this area is the improvement of drainage. By improving the Maluka river, it will be possible to develop an area of about 10,000 hectares. The project of excavation of drainage canals now being promoted in this area has been quite successful, and some immigrant farmers have already settled in the districts where the soil condition is favorable. In order to develop this area depending mainly on drainage, it is necessary to study the hydraulic mechanism of the whole Maluka river and plan the drainage project with which the water level can be regulated for the entire area where the undulation is so small. If the objective of the development is to raise two crops of paddy a year, an eleborate plan should be worked

out for the most effective use of the runoff from the hilly hinterland to secure sufficient quantity of water required in the dry season.

As the tributaries of the Maluka river are divided into many small streams, it is not easy to make a good plan of water use. As regards the improvement of the Maluka river, it would be necessary to make a plan with paying special attention to the reverse flow of sea water, taking into due consideration of the tides of the Java Sea.

7-4-2 Rehabilitation and Improvement Project

(a) The plan of rehabilitation of the facilities for gravity irrigation

The irrigation facilities constructed in the past still exist in the vicinity of Rantau, Kandangan and Barabai in the area surrounded by the tributaries running on the east bank of the Barito river. The irrigation area is the upland where agricultural development is possible just by irrigation alone. The plan of rehabilitation of these irrigation facilities should be planned and studied as the base for making possible the farm management of high level, and it is necessary to bring to light the reasons why these irrigation facilities were not utilized in the past. It is necessary to plan the most effective use of the farmland by educating the farmers and giving guidance on the techniques of farm management so that they can fully utilize these useful facilities, and by expanding the tertiary facilities as the soil condition and the drainage condition are favorable in this area. Since the projects to be developed in this area are smaller in scale than other areas, and many of them utilize the small rivers and streams, it is necessary to grasp accurately the runoff of each of these rivers and streams to make the most effective plan of water use.

(b) Project of Improvement of irrigation and drainage in South Bandjarmasin District

In the southern part of Bandjarmasin, there is an area about 25,000 ha consisting of low land and swamp. Those areas close to the seashore are affected by the tide. This area is close to the areas where the population is concentrated, and the traffic condition is comparatively good. Most part of this area has been developed into farmland. The farmland in this area has been developed along the drainage canals, and the farming pattern is centered on one crop of paddy rice in the rainy season. The drainage canals are being used for navigation in the rainy season. The function of the drainage canals is not sufficient in the dry season, and it is almost impossible under the present circumstances to remove the toxic water eluviating from peat and organosol to improve the soil. (See Photo 7-10)

As this area has a favorable condition that it is situated close to Bandjarmasin, it is necessary and is also possible to further expand the agriculture in this area. This area being low damp land, the farming pattern may be based on two crops of paddy rice a year or one crop of paddy rice and upland field farming in the dry season in the districts where the drainage condition is favorable. As this area is located adjacent to the project area of the Riam Kana Irrigation Project on the downstream, a drainage plan including the disposal of the return flow from the Riam Kanan project area should be studied. The irrigation project of this area may have

to use the return flow from the Riam Kanan project area and the water of the Martapura river as the source of water. It is necessary to study the method of intaking water from the Martapura river, whether by means of a weir or pumping. The drainage plan for the eastern part of the area should be included in the drainage plan of the Riam Kanan Irrigation Area, but since the western part of the area is near the estuary of the Barito river, a drainage plan having regard to the effect of the tide is necessary. It would be advantageous to connect the end of the drainage canal directly with the Barito river on the western part, and drain the water by means of the automatic gate using the tidal movement. It is necessary to construct a levee on the coastline and at the place facing the outlet of the Barito river to prevent sea water intrusion. It is desirable to plan this levee as a structure which can be used as a road. In this area too, the ultimate objective should be the irrigation project based on separation of irrigation and drainage canals. In view of the topography and the ground condition, the construction of a levee will require a considerable amount of funds, and so the scope of the project must be decided according to the objective of the agricultural development. Any project in this area should be promoted, keeping pace with the development of the Riam Kanan Irrigation Project area.

7-5 The Plan of Investigations for the Agricultural Development of the Barito River Basin

7-5-1 Comprehensiveness of the Investigation and the Necessity of the Basic Investigation

As stated above, the agricultural development of the Barito river basin covers an extensive area and extends over a long space of time. Therefore it is necessary to decide the course of comprehensive development including the sectors other than agriculture. For this purpose, the comprehensiveness of planning and investigation is required, and the basic investigation must be carried out.

Those projects which are now underway or will be implemented in the near future can be carried out sufficiently without hindrance, with comparatively rough basic data according to the objective of each. However, those projects to be implemented in the second stage, whether new projects or the extension and improvement of the existing projects, will have to be carried out according to the results of more detailed investigations and more specified objectives set. To make perfect the new development projects, records of investigations made on many points and over as long a period as possible gathered constantly are necessary. The comprehensive use of such numerous data is certainly useful in formulating the development plan not only of agriculture but also of many other fields.

The object of agricultural development is the stabilized increased agricultural production. The agricultural production should be planned in accordance with the demand. Consequently, as the base for the development project, investigation of the population movement, economic survey, and analysis of the balance of demand and supply, etc. become necessary. Then it is necessary to decide the crops most suitable for each area in accordance with the production schedule based on the demand and supply situation. Investigation of the plant growth condition and the distribution of soil in the entire area must be carried out. The meteorological data forming the basic condition which controls farming must be prepared.

In this area, there are many districts consisting of special soils, and unless such soils are improved, it is not possible to attain high productivity. The possibility and the method of such soil improvement should be studied thoroughly.

First of all, the method of water control will decide the substance of the development project. The hydrological survey of the rivers concerned is absolutely necessary for both irrigation and drainage, and more elaborate and comprehensive survey is required for larger projects. General data on the entire basin are required for the hydrological study, but the present condition is that such data are practically not available. It is desirable that such basic investigations cover an extensive scope and also are interrelated. Regardless of whether there are concrete project plans or not, it is absolutely necessary to carry out the basic investigation of the entire area to find out the possibility and the direction of development project. In order that the agricultural development projects now being promoted can obtain better results and expand the scope of activities, an overall investigation must be carried out for the entire basin. The basic investigation includes the followings:

(a) Socio-economic investigation

How the demand for the agricultural products will change in the future is an important matter concernign the agricultural development. Market research is necessary to know how the balance of demand and supply changes. It is also necessary to investigate into the method of deciding the prices of the agricultural products and the distribution system. It is important to grasp accurately the present state of the settlers for making the future immigration schedule. It is necessary to analyse the condition of farm management, study the type of farming to be employed in each district, and thereby find out the direction and the possibility of the future development.

(b) Topographic survey

When making the agricultural development plan of the entire basin, it is urgently necessary to prepare an accurate topographic map of 1/250,000 scale particularly of the plains. Particularly concerning the east side of the Barito river, a topographic map of 1/50,000 scale should be made for the area extending from Tandjung to the southern part of Bandjarmasin.

(c) Vegetation map and soil map

It is necessary to use the above-mentioned topograph map and prepare the vegetation map and the soil map. It is necessary to prepare 1/50,000 scale maps for the districts where there are existing farmlands.

(d) Meteorological observation

It is particularly necessary for the agricultural development to grasp accurately the rainfall in the dry season. Attention should be paid to the large areal difference in the condition of the tropical squall.

(e) Hydrological survey of the rivers

When planning irrigation and drainage, a comprehensive study of the entire basin based on the possible water supply and the principles of flood control is necessary. If the plan of each area is not in accord with the

plan of the entire basin, a serious problem of unbalanced water control may arise as the scale of the development project gets larger. The area around the tributaries on the east side of the Barito river has a great possibility of agricultural development, but the quantity of water available in the dry season is limited. It is necessary to gather more hydrological data on the tributaries for the most effective use of the water, and for the water resources development.

(f) Other investigations

Besides the investigations mentioned above, it is necessary to make investigations on the problems which are characteristic to this area. They are, observation of sea level, investigation and observation of sedimentation on the waterways and the effect of tidal movement on the inland portion of the tidal area. In order to find out the possibility and the method of soil improvement of various special types of soil found in this basin, it is necessary to analyse the results of many experiences gained and the tests carried out in the past, and to carry out investigations newly and conduct more tests. Such investigations and tests may be useful for the education and guidance of the farmers on the techniques of soil improvement, fertilization, etc. It would also be necessary to study the plan of induction of the techniques of utilizing the mechanical power, and also to conduct tests at the experiment institutions and the model farms.

7-5-2 Investigations for the Planning of the Projects

In the stage of formulating concretely the project plan, it is necessary to carry out more detailed investigations using the results of the basic investigations. Of course, these detailed investigations require formulation of a plan of investigation based on the results of discussions made on the basic investigations, and it is desirable to carry out these detailed investigations following as closely as possible the plan formulated.

(a) Adjustment of the statistical data

Adjust various statistical data, and analyse the economic conditions of location and the agricultural structure of the project area, and make this the base for the evaluation of the effect of the development project. It is necessary to carry out these investigations with Desa (village) as a unit. Through these investigations, it is possible to grasp the present condition of the farmers and to find out the problems, and thereby decide the course of the development.

(b) Topographic survey

For project planning, it is necessary to prepare the topographic map of 1/50,000-1/100,000 scale covering the existing farmland, reclaimable land and the related areas. The distrnce of contour line should be 5.0 m for the hilly area and 0.5 m on the plains. For the major points in the area, levelling in cm is required.

(c) Investigation of the present condition of vegetation and land use

It is necessary to prepare a map showing the present condition of vegetation and land use, using the topographic map of 1/50,000 scale as the base, and the aerial photographs as reference, and also by carrying ing out the reconnaissance.

(d) Preparation of Soil map

Prepare a soil map of the area using the topographic map of 1/50,000 scale as the base, and by conducting soil survey at the rate of one point per 100--200 ha using the soil inspection stick; also make a test pit for every 10,000--30,000 ha togather soil samples and collect water from the nearby waterways to analyse soil and water quality.

(e) Hydrological survey of the related rivers

As the base for planning irrigation and drainage in the area, it is necessary to prepare the hydraulic and hydrological data on the rivers inside and outside of the area. The possible quantity of water available in the dry season and the water level in the rainy season are particularly necessary. In case of planning a reservoir for use as a water source, it is necessary to grasp accurately the annual runoff of the rivers. It is necessary to grasp the outflow mechanism of the rivers when planning the drainage.

(f) Analysis of soil and water quality

By analysing the soil samples and water mentioned in the foregoing paragraph, it is possible to find out whether the section of the area can be used as farmland, and the possibility and the method of soil improvement.

(g) Survey of irrigation and drainage requirement

Use meteorological observation data to obtain the effective rainfall, amount of evapotranspiration, and water requirement in depth for each kind of crop and the type of soil. Then estimate the quantity of water possible for reuse in the district to determine the total irrigation requirement. Although it is preferable to obtain water requirement in depth at the field, it is all right to obtain it at the testing lot. As it is very difficult to actually grasp the possible quantity of water available for reuse, such quantity is estimated from the condition of the irrigation and drainage systems and the streams in the area. When planning irrigation and drainage, it is important to grasp the present condition. Particularly, the condition of the shortage of irrigation water and the scope of the inundated area in recent years should be made clear by conducting careful recent years should be made clear by conducting careful reconnaissance and getting information by inquiry. As the drainage plan can be decided according to the intensity of rainfall and the runoff mechanism of the area, it is necessary to read properly the rainfall data and the topographic map.

(h) Others

By carrying out the above-mentioned investigations and adjusting the data obtained, the extent of the project area can be decided roughly, and it becomes possible to determine the scale and the arrangement of the major irrigation and drainage facilities. Before finalizing the project plan, the following investigations are necessary:

i) Localized topographical survey; geological and soil survey

ii) Detailed survey for establishing the network of tertiary canals in connection with land shaping and land consolidation

iii) Grasp the actual condition of the existing communication system and the substance of traffic and the forecast of future traffic condition for the purpose of planning villages, roads, and navigation.

iv) Economic evaluation of increased production, labor saving, reduced maintenance and administrative expenses, etc. for estimating the effect of the project.

v) To study the expansion of the organization and the establishment of model farms for giving guidance to the farmers on farm management, administration of the facilities, and induction of second cropping, etc. for early realization of farm management planned under project.

7-5-3 Investigation Plan

It is very difficult to commence the investigations all at once over the entire area of this vast Barito river basin, and such is considered unnecessary. This is because the socio-economic condition, which is the important condition for development, is extremely poor, and also this area consists mostly of the districts where the effective use of the rivers is difficult and the soil condition unfavorable. Judging from the present condition of Kalimantan, it would be more effective and sound to promote the development projects gradually, beginning with the district where the necessary conditions are ready, instead of commencing the development of the entire area. The development of undeveloped land into an agricultural area of high productivity all at once will be accompanied by many difficulties, failure and risks. Therefore, it is advisable to aim high but promote the development project stage by stage. Some of agricultural development projects are shown in Paragraph 7-4 "Selection of the Projects". Survey Programmes for justifying such development projects are shown in the following tables.

For the determination of priority order of these development projects excluding the Riam Kanan Irrigation Project, it is essential to make further study on the usefulness and potentiality of each project in the basin as a whole. Although it is a matter of course that the study should be made in conjunction with development projects covering various fields other than agricultural, it is strongly recommended that the basin-wide survey on soil and vegetation be carried out as soon as possible.

7-6 Conclusion

As stated above, the agricultural development in Kalimantan has many problems on the phases of natural, social and economic conditions. As each of these problems has complicated factors, it is difficult to solve these problems in a short space of time.

The climate of this area is of high temperatures and high humidity which gives comparatively favorable condition for farming, and there still exists a large acreage of undeveloped land. However, this area topographically is almost a flat, damp plain, and this poses a serious problem of flood control and drainage against floods in the rainy season. On the contrary, it is necessary to draw in good water for irrigation in the dry season.

Table 7-9 Scope of Work for the Field Investigation

Investigation plan		Amuntai Polder Project	Tidal Range Reclamation Project	Gravity Irrigation Rehabilitation	South B. Masin Drainage Improvement
1. Mapping from aerial photographs	a. 1/50,000 topo. map b. 1/10,000 topo. map	Area: 1,300 km^2 (See 3 Topo. Map) Area: 600 km^2 1 m contour line (plain) 2--5 m " " (hilly area)	a. Area: 6,200 km^2 (3. topo. map) b. Area: 4,000 km^2 0.5 m contour line;	a. Area: 3,700 km^2 b. Area: 1,200 km^2 0.5 m contour line	a. Area: 500 km^2 b. Area: 350 km^2 0.5 contour line
2. Hydrological & meteorological survey	a. Collection of existing data b. Meteorological obs. c. River investigation	Hydrological & meteorological observation data Gathering information by inquiry on river condition, recorded HWL & LWL Gathering information by inquiry on rainfall condition, largest value of continued rainfall & draught (See 8 Rivers, dams, hydrology)	a. Collect data on tidal effect besides those on hydrological & meteorological conditions b. Same as left c.	a. Same as left b. Same as Amuntai	a. Same as Tidal Range b. Same as left c. Observation of water level and runoff of S. Maluka
3. Investigation of irrigation & drainage systems	a. Investigation of present condition b. Investigation of irrigation c. Investigation of irrigation d Investigation of facilities e. Investigation of waterway	Condition of utilization of existing facilities and natural streams Extent, water depth and duration of inundation in rainy season; runoff in dry season Investigation of irrigation requirement: Water requirement in depth, quantity of percolation, and acreage Investigation on water source: Location and scale Irrigation & drainage facilities: location, type, and scale Distribution network, section, and structure of each waterway	a. Same as left b. Same as left, plus condition of flow of water c. } Same as left d. e.	a. Same as left b. Same as Amuntai c. } Same as left d. e.	a. Same as left b. Same as left, plus investigation of outflow from R. Kanan Irrigation Project and effect of tides c. Same as left, plus investigation of return flow from Riam Kanan Irrigation Project area d. } Same as left e.
4. Topographical survey	a. General reconnaissance b. Detailed plane surveying c. Route survey	Confirmation of the district concerned, and selection of the sites for major structures, and route location 1/500 and 1/200 plans of irrigation and drainage facilities 1/200 plans of irrigation and drainage canals	a. } Same as left b. c.	a. } Same as left b. c.	a } Same as left b. c
5. Investigation of of foundation	a. Geological survey b. Geotechnical investigation	Boring at the site of irrigation and drainage facilities and on the routes Confirmation of stability of weak foundation and banking	a. } Same as left b.	a. } Same as left b.	a. } Same as left b
6. Soil survey	a. Acreage b. Soil classification c. Analysis of soil and water quality	500 km^2 Carry out inspection by using soil inspection stick at one place for every 200 ha and make soil map and figure of soil profile Dig one test pit for every 1,000 ha, collect soil samplings from three soil layers, and collect water from waterway close by. (Soil analysis: physical, chemical & special analysis) (Water quality analysis: pH, components, ion analysis)	a. } b. } Same as left c.	a. 600 km^2 b. Soil stick inspection every 100 ha c. Test pit for every 500 ha	a. 300 km^2 b. } c. } Same as left
7. Investigation of materials		Aggregates for concrete, banking material, & other materials (Quality, quantity and source)	a. Same as left	Same as left	Same as left
8. Investigation of land consolidation	a. Reclamation of farmland b. Communication system	Planning of land consolidation for each district Route planning of roads and navigation waterways	a. } Same as left b.	a. Same as left b. Route planning for roads	a. } Same as for Amuntai b.
9. Investigation of farming	a Investigation of actual condition in the district b. Investigation of farming techniques c. Investigation of condition of farm management d. Investigation of extension activities e Investigation of farmers' consciousness f. Investigation of livestock industry g Influence on other industries	Traffic, market, labor, block, farm rent, structure of inhabitants, associations, scale of villages Tools, crops, harvest, varieties, fertilization, growing period Condition of land use; main crops Induction of new varieties, farming techniques, and secondary crops Farmers' desire, expectations, experience of new techniques	a. } b. c. } Same as left d. e. f. g.	a. } b. c. } Same as left d. e. f. g.	a. } b. c. d } Same as left e. f. g.
10. Investigation of farm house economy	a. Investigation of income b. Investigation of expenditure c. Investigation of expenses of farm management d. Investigation of living condition	Kinds of yield, quantity, prices, side income, planting area Seeds, agr. chemicals, instruments and tools, materials, maintenance and supervision	a. } b. c. } Same as left d.	a. } b. c. } Same as left d.	a. } b. c. } Same as left d.

Table 7-10 Number of Personnel required for the Investigation

Type of Investigation	Job Title	Riam Kanan Irrigation Proj.	Amuntai Polder Project	Tidal Area Reclamation Project	Gravity Irrig. Rehabilitation	South B. Masin Improvement
Field investigation						
1. General	Project manager	10	20	24	20	18
	Consultant engineer	2	4	5	4	3
	Prof. appraisal eng.	2	4	5	4	3
2. Hydrology	Hydrologist	10	28	64	36	24
3. Irrigation & Drainage	Irrigation eng.	18	30	60	60	26
4. Topography	Surveyor	28	21	44	34	18
5. Foundation	Geologist	4	4	4	10	4
	Soil mechanical eng.	5	8	16	10	6
6. Soil	Soil surveyor	5	6	12	8	4
	Agronomist	7	6	24	16	4
7. Land Consolidation	Civil eng.	4	12	18	18	9
8. Farming	Agronomist	4	4	8	10	4
	Livestock expert	2	2	4	5	2
9. Farm House Economy	Agro-economist	3	5	10	8	4
10. General Affairs	Administ	10	20	24	20	18
Total	man-month	114	174	322	263	147
	month	10	20	24	20	18
Home Office Work in Japan						
1. General	Project engineer	14	20	32	24	18
	Consultant eng.	2	5	10	9	5
	Proj. appraisal eng.	4	7	13	11	7
2. General study of the present condition of the district	Irrigation eng.	2	3	4	3	1
	Hydrologist	2	3	4	3	1
	Agronomist	2	2	2	2	1
	Geologist	2	2	2	3	1
3. Suggestions and disposition for construction work	Irrigation eng.	16	24	40	32	16
	Hydrologist	2	6	10	8	4
	Surveyor	2	3	4	4	2
	Soil surveyor	4	4	6	6	3
	Agronomist	1	2	6	6	3
4. Design of construction work, estimate of construction cost and work scheduic	Irrigation eng.	28	40	90	50	32
	Hydrologist	4	8	12	10	6
	Surveyor	2	4	6	5	3
	Soil mechanical eng.	3	2	4	3	2
	Design eng.	8	8	12	10	8
	Elect. Mecha. & Architect. eng.	15	12	24	16	12
5. Increase of farm production and income	Agronomist	2	3	6	4	3
	Livestock expert	1	2	2	2	1
	Agro-economist	3	5	10	8	6
Total	Man-month	119	165	297	216	134
	Month	14	20	32	24	18

Table 7-11 Cost Estimate of Investigation and Feasibility Study

Basic Investigation and Data Collection for the Project Planning			
District	Bandjar, Bandjarbaru, Rantau, Kandangan Barabai, Amuntai & Tidal Area		
Coverage Area	500,000 ha		
Phase	1st Phase	2nd Phase	Total
a. Soil and Vegetation Survey	$ 410,000	$ 288,000	$ 698,000
b. Farm Economy Survey	$ 282,000	–	$ 282,000
c. Collection and Consolidation of Basic Data	$ 100,000	$ 200,000	$ 300,000
Total	$ 792,000	$ 488,000	$1,280,000

Mapping and Feasibility Study of the Project Area				
Name of the Project	Project Area	Mapping	Feasibility Study	Total
Riam Kanan Irrigation Project	30,000 ha	500km^2 (Revision of Existing maps) $ 10,000	$ 450,000	$ 460,000
Gravity Irrigation Rehabilitation	55,000 ha	1,100km^2 $ 120,000	$ 1,200,000	$ 1,320,000
South Bandjarmasin Improvement Project	25,000 ha	350km^2 $ 38,000	$ 370,000	$ 408,000
Amuntai Polder Project	40,000 ha	800km^2 $ 80,000	$ 890,000	$ 970,000
Tidal Area Reclamation Project	200,000 ha	3,000km^2 $ 300,000	$ 1,730,000	$ 2,030,000
Total	350,000 ha	$ 548,000	$ 4,640,000	$ 5,188,000

Total $ 6,468,000

There are many problems besides irrigation and drainage which must be solved for the establishment of the base of agricultural production. Improvement of special types of soils distributed all over this vast area, and land consolidation must be carried out. Again, the facilities and organizations for diffusion of farming techniques and distribution of agricultural products are extremely poor compared with other districts. If these problems, which hinder the development of the area, are solved gradually through sufficient investigation, comprehensive planning, and sound judgement and development is promoted steadily stage by stage, the result will be immeasurable.

Those development projects now being carried out in many places have their respective significance, but many of them generally lack mutual relevancy and consistency of the plan. Because of this, there are many cases in which the irrigation facilities and drainage canals constructed specially are not being fully utilized. All future development projects should be carried out on the basis of the comprehensive development of the entire area. As the premise of promotion of the development projects, it is particularly necessary to prepare the following basic investigation data, and to plan the establishment of necessary organizations and systems.

(a) Preparation and adjustment of the basic investigation data

What is required first of all in the agricultural development is to grasp accurately the natural, social, and economic conditions in the area. As meteorological data for agriculture, the data showing the annual variation in each district of temperature, rainfall, sunshine hours, humidity, amount of evapotranspiration, etc. are necessary. As hydrological data, it is necessary to adjust the records and statistical data of water level, runoff, etc. of the rivers. In order to grasp accurately the condition of farming itself, it is necessary to prepare and collect statistical data on agricultural population, acreage of farmland, production of crops, farm economy, condition of markets and distribution, prices of agricultural products, etc. It is important to expand and improve the organizations and the institutions for such purposes.

(b) Preparation of various kinds of basic maps

It is necessary to prepare detailed topographic map of the area from which the condition of the farmland, the extent of the reclaimable land, and the distribution of towns and villages, etc. can be grasped, and also to prepare soil map and vegetation map based on the aforesaid topographic map.

(c) Establishment of the institutions for the education of the farmers and various social and economic organizations

To perform agriculture of new farming pattern, the level of knowledge and techniques of the farmers should be elevated, and it is necessary to establish such institutions for adults education and vocational training. This is particularly important in places where general educational facilities are poor. For the purpose of enlightening the farmers and for the protection of their interests, it is necessary to study carefully the establishment of the farmers organizations such as the agricultural cooperative association, and the irrigation association which will have control over the facilities to be established under the development projects. The establishment of trust system for the farmers should also be studied.

Fig. 7-1 Soil Map

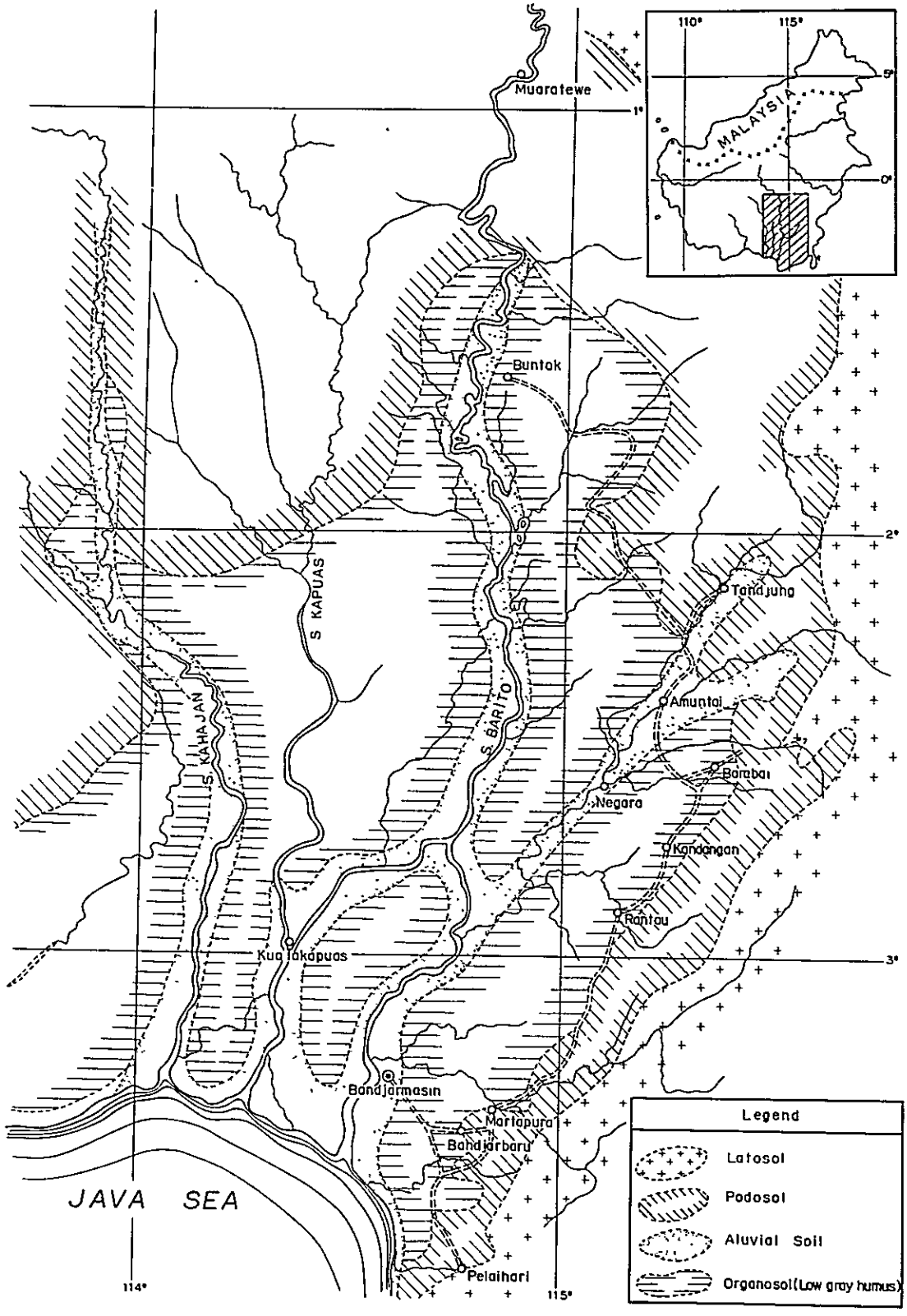


Fig. 7-2 Distribution of Agricultural Land

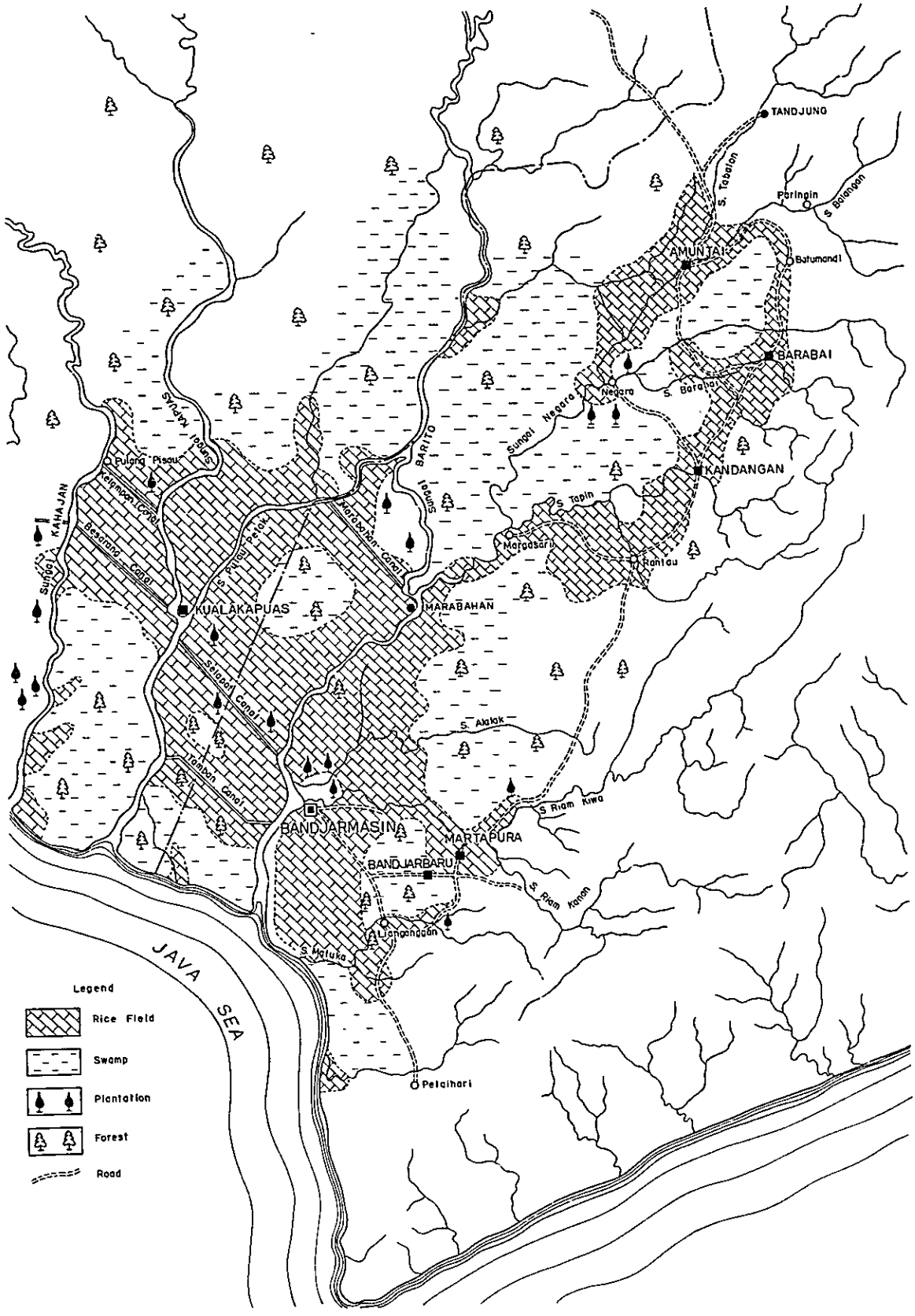


Fig. 7-3 Location of Kabupaten in the Province of South Kalimantan

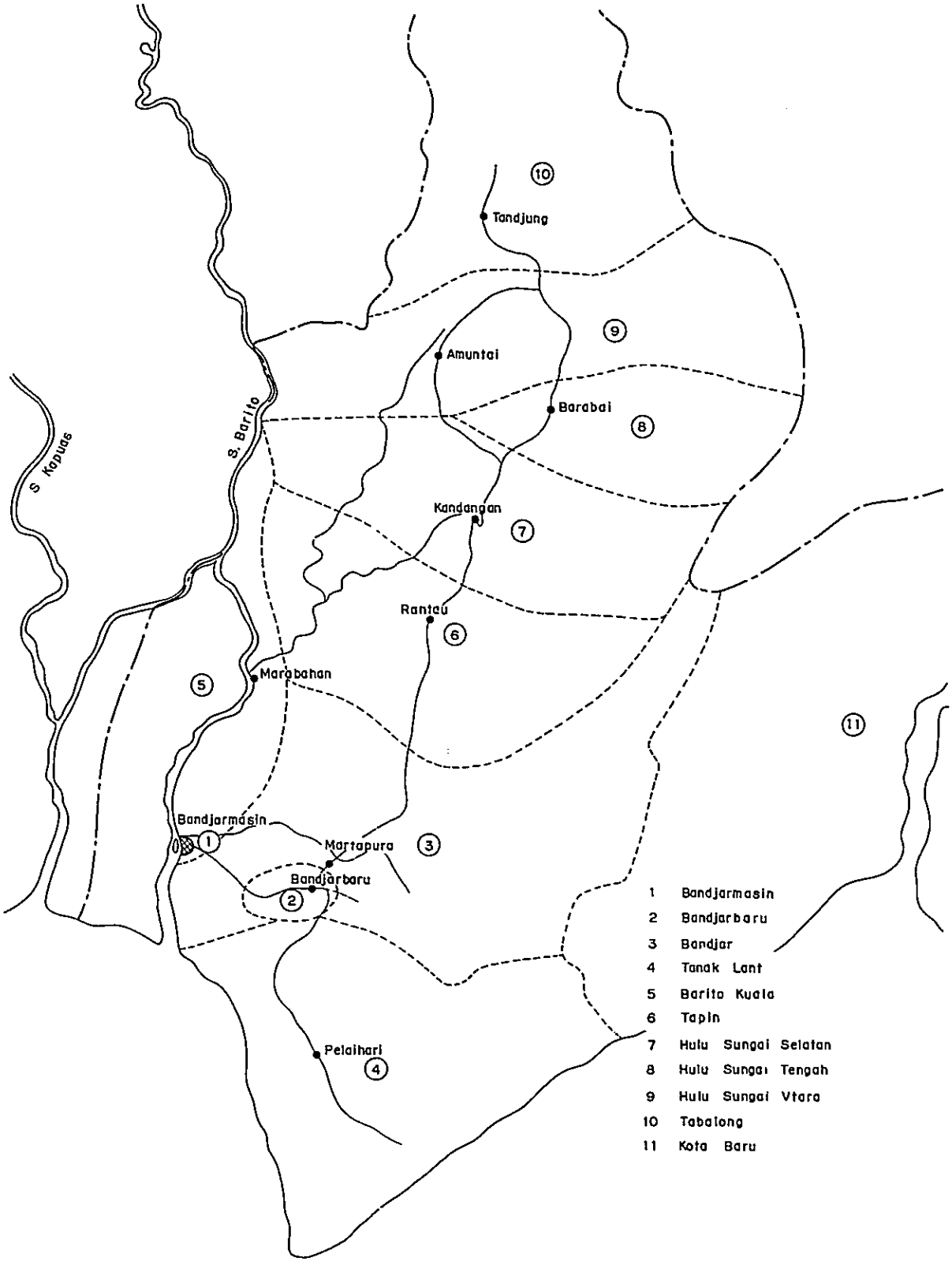
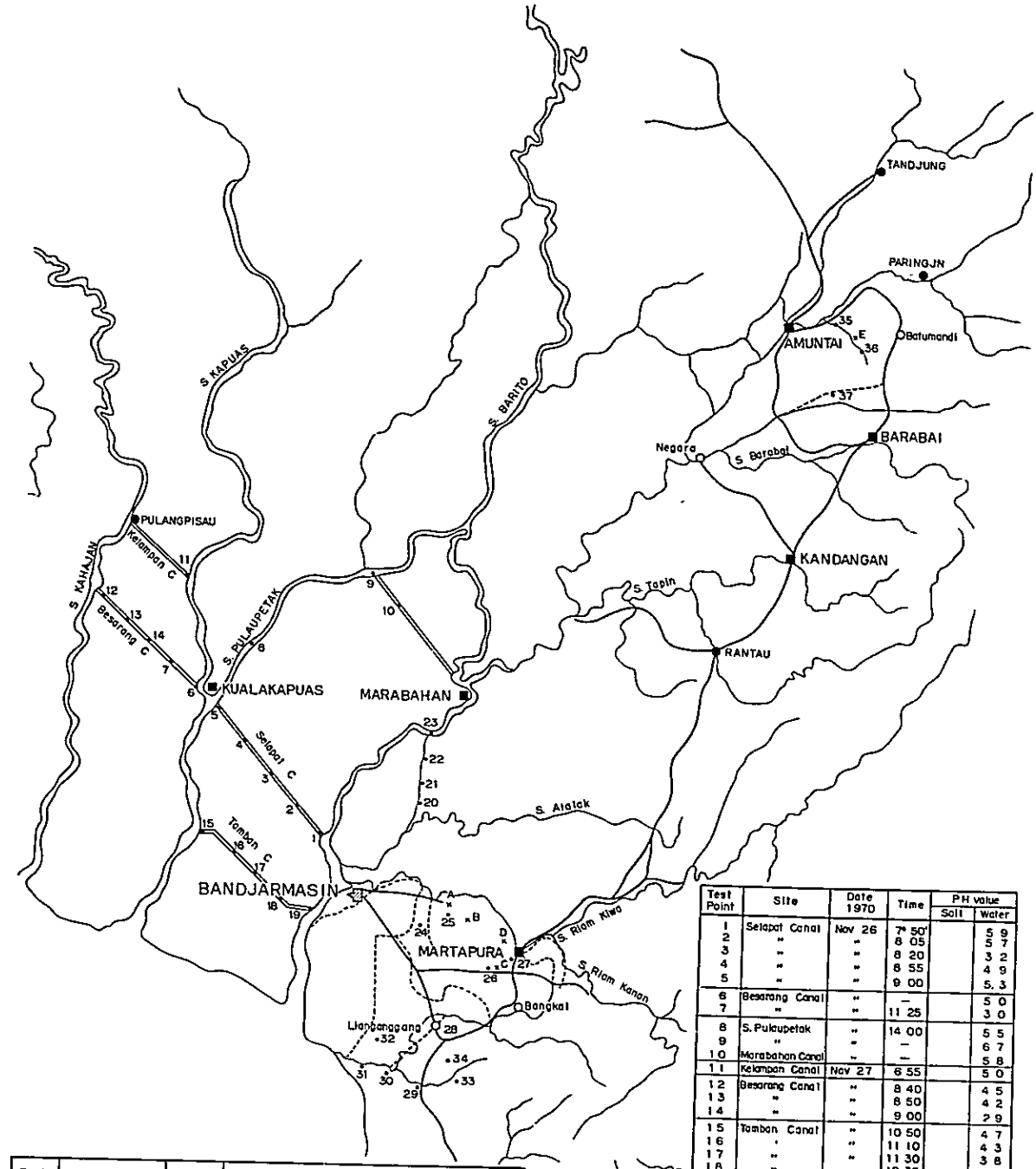


Fig.7-4 PH Value and Bearing Capacity of Various Test Points



Test Point	Site	Soil	Bearing Capacity (ton/m²) 0 1 2 3 4 depth (m)
A	Antasan Kiai	Peat	20 30 35 30 35 60
B	"	"	50 60
C	Bandjar Baru	Clay / Sand	50 20 100
D	Martapura (Paperplant)	Clay / Sand	70 100 over
E	Awang Kaludan	Peat	0-5 0-5 0-5

Test Point	Site	Date 1970	Time	PH value Soil	PH value Water
1	Selapat Canal	Nov 26	7h 50'		5 9
2	"	"	8 05		5 7
3	"	"	8 20		3 2
4	"	"	8 55		4 9
5	"	"	9 00		5. 3
6	Besarang Canal	"	—		5 0
7	"	"	11 25		3 0
8	S. Pulaupetak	"	14 00		5 5
9	"	"	—		6 7
10	Marabahan Canal	"	—		5 8
11	Kelampan Canal	Nov 27	6 55		5 0
12	Besarang Canal	"	8 40		4 5
13	"	"	8 50		4 2
14	"	"	9 00		2 9
15	Tamban Canal	"	10 50		4 7
16	"	"	11 10		4 3
17	"	"	11 30		3 8
18	"	"	12 35		5 5
19	"	"	12 48		5. 6
20	S. Buntik	Oct. 14	8 00 ~ 11 00	3 0	3 2
21	"	"			2 6
22	"	"			4 7
23	"	"			5 2
24	Gambut	Oct 6			3 5
25	Antasan Kiai	"		3 5	
26	Bandjarbaru	"			4 5
27	Martapura	"		5 0	
28	Llanganggang	Oct 7			6 1
29	Bati Bati	"			5 2
30	S. Maluka	"			5 8
31	"	"			5 8
32	Desa Kurau	"			
33	Bati Bati Dam			5 9	5 4
34	"			5 0	
35	S Awang Kaludan	Oct 16			3 7
36	"	"			3 7
37	Barabai Kombat	Oct 1			7 0

Fig. 7-5 Location Map of Selected Project Sites

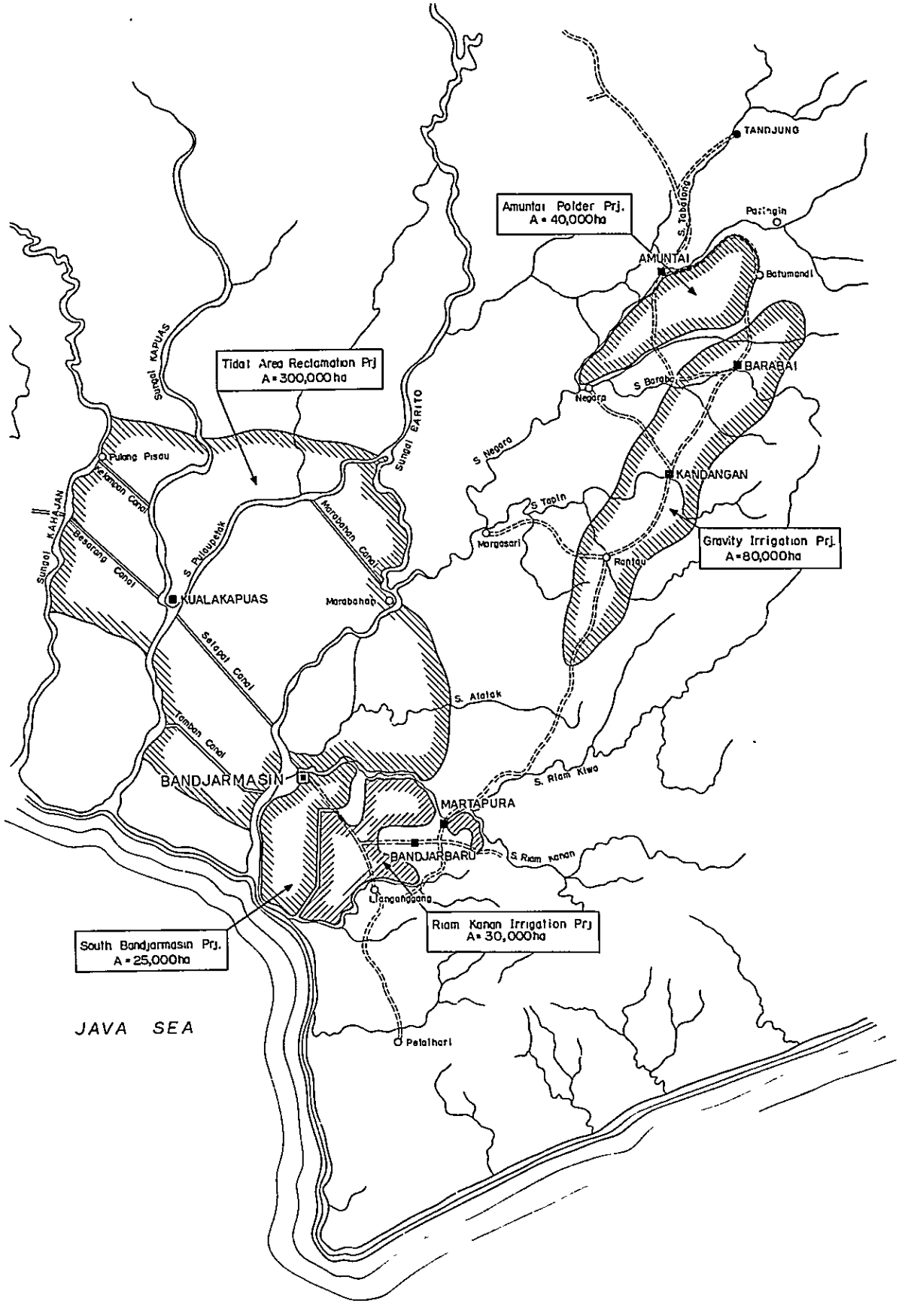


Photo 7-1 Hand winnowing machine

Photo 7-2 Hand mill

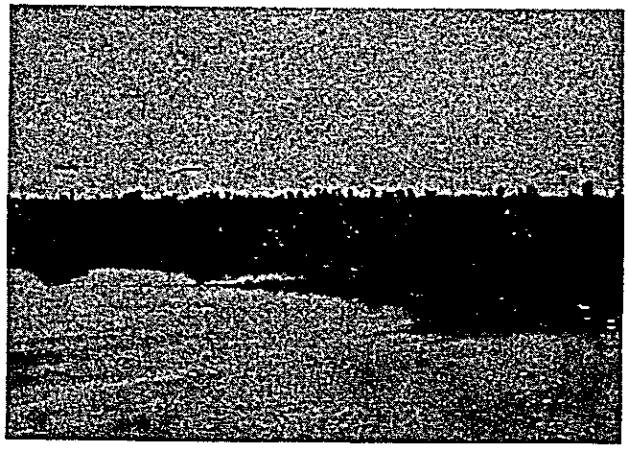


Photo 7-3 Grazing of buffaloes

Photo 7-4 Intake weir for upland rice cultivation

Photo 7-5 (1) Morning market at Amuntai

Photo 7-5 (2) Morning market at Amuntai

Photo 7-6 Upland area along the river east of Amuntai

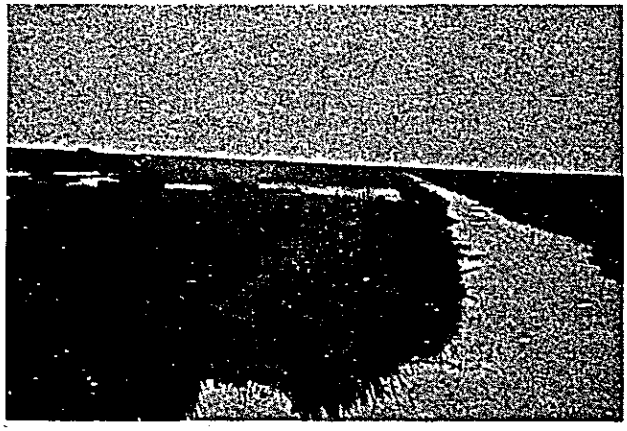


Photo 7-7 Drainage canal in the low land south of Amuntai

Photo 7-8 Canal in tidal land

Photo 7-9 New settlement area in tidal land

Photo 7-10 Drainage canal and gate for irrigation

8. RIVER, DAM, RESERVOIR AND HYDROLOGY

8-1 General Description of the Barito River

8-1-1 Existing Condition

The Barito river flows along Long. 115° E through the Central and South Kalimantan Provinces and flows into the Java Sea near Bandjarmasin, the largest city in Kalimantan. Its lower basin is an extensive swamp area formed by the Kapuas, the Kahajan and the Mendawai that flow in parallel with the Barito river in the west.

The Barito river basin is said to cover an area of about 60,000 km^2. The annual rainfall in the basin is extremely large, reaching 3,590 mm in the northern mountainous area, 3,000 mm in the eastern mountainous area, and 2,500 mm in the flat land area.* A calculation made with 3,000 mm taken as the basin's average annual rainfall and the coefficient of run-off assumed to be the value adopted for the Riam Kanan Dam Project reveals that the annual outflow at the estuary is 90 billion m^3 and the mean discharge is 2,800 m^3/s, indicating that the river offers huge water resources.

The Barito river mainstream rises in the Schwaner and Muller mountains near the borders on Sarawak, a Malaysian territory, flows through mountainous districts, and enters the hilly area at a point upstream of Tumbang Kunji. It flows eastwards in a zigzag course in the hilly area and passes through Puruktjahu, changing its course to south near Muaratuhup. The river reaches the extensive flat area in the vicinity of Muaratewe and flows in a gentle meandering way. In the area around Buntok, there are many lakes created by the meanderings after the river has changed its course.

At a point downstream of Buntok, 140 km from the estuary in bee-line distance, the river enters the tidal compartment and flows in a gentle meandering way through the flat swampy area spreading far out along its banks. At Muarapulau, the Pulaupetak branches off to flow into the Kapuas. As the Barito flows flows further downstream, the Negara river which rises in the Meratus Mountains in the east joins it at Marabahan and the Martapura also flows into it at Bandjarma Bandjarmasin.

The rapids at Hatas, upstream of Tumbang Kunji, forms a gorge with the river width narrowed to about 50 m. Even at this point, however, the basin covers an area of 16,000 km^2 and a large discharge is observed.

Downstream of Hatas, the river width is widened to 250 to 300 m, and the river gradient becomes gentler. Before the river reaches Tumbang Lahung, however, bottom rocks are observed in the river forming rapids at some places.

The discharge increases in the wet season when the rainfall is far larger than in the dry season as shown in Table 8-1. The difference in water level between the wet and dry seasons is said to reach a maximum of 7 to 10 m in areas upstream of Buntok.

In ordinary years, houses in the towns on the mainstream such as Buntok, Muaratewe and Puruktjahu are not inundated even in the wet season, but the team learned that heavy floods had attacked these towns in the past at re-

* "Reconnaissance Report on the Barito River Basin Development Project," Nippon Koei, Aug., 1968.

currence intervals of about 10 years and flooded many houses.

The water level changes daily in the downstream tidal area and the difference between the high and low water levels at spring tide is about 2.0 m at Marabahan and about 2.5 m at Bandjarmasin. Sea water intrusion covers a smaller area than the tidal compartment. On the Barito river mainstream, sea water reaches a little upstream of Bandjarmasin but is said to be hardly observed at Marabahan. The team learned that on the Kapuas river, sea water reaches as far as Kuala Kapuas during about one month period in the dry season.

The Barito river mainstream remains a natural river for the most part part with no facilities for large scale river improvement.

Many smaller tributaries rising in the Meratus Mountains in the east join the Negara and the Martapura rivers in the lower basin, and these two large tributaries flow in the Barito river mainstream at Marabahan and Bandjarmasin, respectively.

The Negara river is joined, in its upper reaches, by the Tabalong, the Balangan, the Pitap, the Batangalai, the Barabai, the Amandit and the Tapin, while the Martapura is joined, likewise in its upper reaches, by the Riam Kiwa and the Riam Kanan.

The Meratus Mountains in which the eastern tributaries rise are composed of the northern mountains with a small El. of 500 to 800 m and the central and southern mountains which are rather high with EL. ranging from 1,000 to 1,500 m.

Along the Tabalong flowing in the north is found a flat land extending up to considerably upper reaches, and the river enters the mountainous area in the uppermost section, whereas other tributaries enter the mountainous area in their middle reaches.

Relatively high portions are found along the middle parts of these tributaries, and there spreads out the flat low land area where many towns are found. Facilities for water utilization and high water works found in these tributaries basin are the irrigation canals in the neighbourhood of Kandangan - Barabai area and the ring dike in Alabio area southwest of Amuntai.

Swamp area extends along the lower reaches of the Barito River mainstream.

No accurate data are available on the water level difference between the wet and dry seasons. However, it is believed to reach several meters in the middle and upper reaches. The greater part of the flat low land and swamp area is submerged in the wet season.

8-1-2 Direction of Future Development

Like many other large rivers of the world, the Barito river offers environments suited for man's life and also brings about nature's gifts in its extensive basin, but its massive flood waters are impeding the basin's development. The abundant water resources of the Barito river have not yet been made full use of, and it can be said that the basin's inhabitants are living a life adapted to the given natural conditions. For the future development of

the basin, measures should be taken for flood control and water utilization as practised in regional development of advanced countries. As the regions' development progresses, with the increased benefits derived from rivers, damages suffered by their flood will also increase and there will occur a stronger need for flood control and water utilization. A river development project is an element that determines the direction of development of the basin and should accordingly be mapped out ot cover both flood control and water utilization with due attention paid to the interrelationship between projects planned in the river system as well as to the overall development of the basin.

The eastern tributaries basin in South Kalimantan Province along the arterial road connecting Tandjung, Amuntai and Martapura has a high population density, a large rice production, and favourable conditions for agricultural development. The standard of living in this area is higher than in any other parts of the Barito river basin. In contrast with this, the extensive swampy area spreading out along the middle and lower reaches of the Barito river mainstream is mostly undeveloped and sparsely populated, though a few towns are found on the river banks and agriculture is carried out by tidal irrigation in a limited part of the lowermost tidal area.

Concentration of initial development efforts to get the basin's development under way cannot be attempted in the mainstream basin because of its vastness and absence of socio-economic conditions required. Although the need for developing this area together with flood control and water utilization will arise as the development progresses in future, it is considered that development priority should be given to the eastern tributaries basin under present conditions. Due to the lack of necessary data, it entails much difficulty to give any suggestion about the priority order of respective development areas in the eastern tributaries basin. However, considering the overwehelming percentage held by agricultural population in the basin's total population and the pressing need for increased agricultural production in the basin, river development will have to be carried out with priority given to areas with higher demand for agricultural development. It is expected that the completion of the Riam Kanan Dam will bring about the industrial and agricultural development in the area surrounding Bandjarmasin, the largest city in the basin. If such development gives rise to increased power demand, it will be effectively coped with by the development of the Riam Kiwa involving hydro-power development because of the river's proximity to the consuming area.

(a) Development of Eastern Tributaries

In the development of the Barito river basin, priority should be given, as stated earlier, to the eastern tributaries basin because of its high demand for agricultural development. It is not considered that development projects in this area will be so large in scale as will give any undue influence on the mainstream projects to be planned in future. In planning the tributaries projects in the near future, the eastern tributaries may be considered as separate river systems independent of the mainstream basin, though this cannot be said conclusively because of the lack of data on the hydraulic relationship between the downstream of the mainstream and that of eastern tributaries and on the extent of flood along the mainstream.

The average damage area caused by floods during the five year period from 1965 to 1969 accounted for as much as 12% of the total planted area in South Kalimantan and reached about 20% in three Kabupatans of Hulu Sungai

Utara, Tengah and Selatan.* It is estimated that heavier flood damages were inflicted on limited localities. Since the increase of agricultural production is the primary target to be achieved in this area, prevention of yearly flood damages and stabilization of agricultural production will be the prerequisite to the area's future development. Construction of embankment, improvement of river course, construction of dam provided with reservoir that allows for seasonal regulation, or the combination of these will serve as an effective means for prevention of flood damages. Of these preventive measures, dam construction provides, besides serving the purpose of flood control, irrigation water for farmlands and city water for downstream urban areas, and further improves the water transportation.

The swamp, lowland and upland areas are found successively extending from downstream towards the upper reaches along the Negara and the Martapura which enter the mountainous area in their middle reaches. This mountainous area is favourably conditioned for dam construction because it is close to the lowland and upland areas which have a high potential of agricultural development as well as to such major cities as Amuntai, Barabai, Kandagan, Rantau and Martapura. There is a scheme for constructing a group of dams in South Kalimantan Province as shown in Table 8-2, but the planning of these dams go back about 30 years. The scheme will therefore have to revised into a new one on the basis of hydrological data to be accumulated over many years to come and large scale topographic maps so that it will become compatible, on the one hand, with the development projects which are planned with the future development of each area taken into account, and will incorporate, on the other, the flood control and water utilization. Of a number of dams listed in Table 8-2, the the Riam Kanan is the only one whose construction is acutally being carried out.

As for the Riam Kanan Dam, an irrigation project in the lower reaches is planned utilizing its regulated discharge in addition to hydro-power development. It is conceivable that the discharge regulated by the dam will serve to provide city water in downstream areas. Development of the Riam Kanan is expected to play the role of pilot project for the future development of other tributaries in the eastern tributaries basin, and it is considered that the experience and knowledges obtained through the Riam Kanan Project should be fully utilized for such future development.

(b) Development of the Barito Mainstream Basin

The development of the Barito mainstream in the near future is made extremely difficult by its massive discharge and the extensive swamp area spreading far out from its banks. Development of the mainstream basin necessitates the discharge control to prevent the inundation of the vast swamp area extending along the middle and lower reaches. However, to control the mainstream discharge throughout the year, a dam with an effective capacity of more than 8.2 billion tons** should be constructed. Insofar as the team discovered during the survey trip, it appears that the

* Ref. Table 7-5

** "Reconnaissance Report on the Barito River Basin Development Project," Nippon Koei, Aug., 1968.

dam site satisfying such condition could be found only in the upstream of Purktjahu, and this will inevitably delay the mainstream development. It is considered that the development of limited localities through construction of embankments around towns on the mainstream is more advisable, for the present, than the discharge regulation by a large reservoir.

(c) Projects for Eastern Tributaries Basin

The development of tributaries should include agricultural development projects in the eastern traibutaries basin described in Section 7-4.

(1) Amuntai Area

In this area, the average annual damage area by flood amounts about 20% or occasionally 30% of the planted paddy field area and village houses and roads are often inundated. Damages suffered in this area are considered to be caused by the flooding of the Tabalong and the Balangan. For prevention of flood damages in this area, the following measures are conceived of.

(i) Improvement of river course and drainage canals

The discharge capacity of rivers flowing through the area should be increased by widening their width or by construcing short-cut channels, and the drainage canals and facilities within the polder project area should be improved to increase the drainage capacity.

(ii) Improvement and expansion of embankments

At present, deposits of sediment load are observed on either bank of the Tabalong and the Balangan, and the roads running along these two rivers form low dikes. Flood water overflows these dikes and inundates the surrounding area. It is considered effective for flood control to construct embankments or increase their height or expand them using the said sediment deposits and roads after confirming the flood extent.

It will yield better effect if the above measure is combined with the construction of a dam mentioned in item (iii) below.

(iii) Construction of dams

Since the inundation of Amuntai area is caused by the flooding of the Tabalong and the Balangan, construction of dam on either river brings about a direct flood control effect. As for the Tabalong, the lowland area extends along it up to the fairly upper reaches. Construction of a dam with a large regulating capacity is not therefore feasible except on the Tabalong Kiwa. As to the Balangan, on the other hand, both its mainstream and the Pitap enter the mountainous area at a place relatively close to Amuntai area, and are therefore favourably conditioned for dam construction. Accordingly, it is considered that priority should be given to the Balangan over the Tabalong if flood control is to be planned in this area by dam construction.

The Batangalai which flows in the south of Amuntai Polder area gives an immense effect on the drainage in this area. Construction of dam on this river for discharge regulation will serve for the

prevention of inundation of this area and if the operation of this dam is carried out in close relation to that of the Balangan dam, an increased flood control effect will be obtained. It is to be added that the discharge regulation by the Batangalai dam will contribute to the agricultural development in Barabai area as described in the following paragraph.

(2) Kandangan and Barabai Area

Dam sites can be found on the Amandit in Kandangan area and on the Batangalai in Barabai area. These dam sites are located in the mountainous area near those places considered to be favourable for agricultural developments. In the upland area of these two areas, there are irrigation facilities for water utilization in the wet season alone for the present. Dam construction on the two rivers for discharge regulation will make the dry season irrigation possible. In mapping out a water utilization plan for these areas, consideration should be given not only to the existing irrigation area but also to the agricultural development in the downstream lowland areas.

(3) Development of the Riam Kiwa

If the completion of the Riam Kanan Dam promotes the industrial development and invites an increase in power demand in the vicinity of Bandjarmasin and adjacent areas, the Riam Kiwa River will be advantageous for hydro-power development since it is close to the consuming area and provides a dam site having a basin approximately equal in catchment area to that of the Riam Kanan Dam (about 1,070 km^2). It is considered that the reservoir on the Riam Kiwa will have a high water level of EL. 50.00 to 75.00 m. Assuming that the average annual rainfall is 2,830 mm*, the average coefficient of run-off is 50%, and an effective head of about 30 m can be obtained, the average annual discharge of 48.1 m^3/s will provide a mean output of about 12,000 KW and an annual energy output of about 105 million KWH.

8-2 Availability of Existing Data

Description on the existing topographic maps has already been given in Chapter 3, Topographic Survey. This section therefore deals with the hydrological data.

8-2-1 Gauge and Discharge Station

Many recording type and staff type gauging stations are established on the canals in the lower Barito basin and on the middle reaches of the Negara and the Martapura rivers. However, most of them are left broken and those in working condition do not seem to be carrying out uninterrupted and accurate observations.

Discharge observation has been made neither on the mainstream nor on the tributaries of the Barito river in the past.

The locations of existing gauging stations are shown in Table 8-3 and Fig. 8-1

* "Reconnaissance Report on the Barito Basin Development Project," Nippon Koei, Aug., 1968

Zero of gauge of gauging stations is determined in reference to the standard height gauge in Bandjarmasin and no reference is made to the mean sea level of the Java Sea, Gauging stations on the canals connecting the Kapuas and the Kahajan adopt the zero of gauge determined in reference to a different datum from that in Bandjarmasin because they are located in Central Kalimantan Province. These stations in Central Kalimantan do not maintain correlations with the gauging stations in South Kalimantan.

8-2-2 Precipitation Station

In the South Kalimantan Province, there are many precipitation stations established in the flat lowland area of the eastern tributaries basin. Precipitation stations are also established in such towns of the Central Kalimantan Province as Buntok, Muaratewe and Puruktjahu which are on the middle and upper reaches of the mainstream.

These stations have been making observations continuously since 1880 - 1903 though their activities were suspended during some periods including the World War II. Rain gauges are employed at these stations for observation of daily precipitation at the predetermined time.

Table 8-4 and Fig. 8-3 show the locations of existing precipitation stations (according to the data by Meteorological and Geophysical Service, and the South Kalimantan Province).

8-2-3 Meteorological Station

There is one meteorological station in Ulin Airport near Bandjarmasin. Wind direction, wind velocity, temperature and humidity are observed at this station.

8-3 Survey Progreamme for Data Collection

Basic data required for preparing the master plan for river development are as given below.

- o Hydrological Observations:

  Data on water level, discharge, precipitation and evaporation

- o Topographic maps and levelling:

  1) Topographic maps on a scale of 1/50,000 covering major development areas are required for mapping out the master plan.

  2) Levelling is required for topographic mapping and for surveying the elevation of the zero of gauge of gauging stations.

In selecting projects to which priority should be given for the master plan preparation, a wide range of data are required as follows:

Records, scope and damages of floods; records and damage of drought; water utilization (existing state and forecast of various types of water utilization); hydro-power; sediment load; navigation; fishing.

Estimated cost of these surveys for river development is shown in Table 8-5.

Since the availability of basic data covering hydrology and topography is most urgently demanded at present, it is hoped that measures will be taken at an earliest date for their collection. With respect to topographic mapping and levelling which are also related to other development projects, full description is given in Chapter 3, Topographic Survey, with adjustment made on the scope and priority of survey activities. In this section, therefore, consolidation of hydrological data will be discussed.

Hydrological data are required to be the records of continued observation over as long a period as possible. However, in view of the anticipated step-by-step development of the basin, hydro-observatories are planned to be established by two phases.

8-3-1 Gauge and Discharge Station

In the area affected by the tidal movement of the Java Sea observation is to be limited to water level since the daily fluctuation of water level makes it impossible to find the interrelationship between the water level and discharge. Table 8-6 and Fig. 8-1 show the locations of gauging stations.

There is no need for establishing new gauging stations in Bandjarmasin and Pulang Pisau if the existing stations are well managed and operated for satisfactory observation activities. It is hoped that observations will be made continuously in future by the two stations established on Besarang Canal and by one station established in Mandomai which is located at the entrance of Kelampan Canal.

Records of water level observed at these stations will serve for the future planning of water transportation, irrigation and drainage.

Gauge and discharge stations are to be established in the upstream area not affected by the tidal movement.

Locations of gauge and discharge stations are shown in Table 8-7 and Fig. 8-2.

Data on water level and discharge recorded at these staticns will prove useful in working out plans for flood control, river improvement and water utilization.

Establishment of gauge and discharge stations is to be carried out by stage as mentioned below in view of the basin's step-by-step development.

In the first stage, they are to be established in points downstream of Buntok on the mainstream and at points in the tributaries basin excluding the upstream areas of the Tabalong, the Amandit and the Tapin.

In the second stage, they are to be established at Muaratewe, Purktjahu and Hatas on the mainstream and at the remaining points in the eastern tributaries basin.

Since the stations to be established in the upstream area of the eastern tributaries basin are required to provide basic data on discharge not affected by the wet season inundation, they should be located at flood-free points somewhere between the mountainous area and the flat land area. Of a number of gauging stations already established on the middle reaches, those located suitably for working out plans for river improvement and water utilization of the surrounding area should be rehabilitated. If discharge observation is carried out at these statios in addition to water level observation, useful information will be obtained.

Water stage recorders should be installed at these stations for continuous recording of water level.

Zero of gauge of respective water stage recorders should be determined in reference to the mean sea level of the Java Sea so that the water level at each point may be obtained in relation to the sea level for full and integrated coverage of rivers from their upstream to the sea.

8-3-2 Precipitation Station

Generally speaking, precipitation records in flat land areas are used for agricultural development projects and those in mountainous areas are used for river discharge forecast and run-off analysis.

As stated in Section 8-2-2, precipitation stations are established in the flat land area in the eastern tributaries basin and in major towns on the mainstream.

There is not much necessity for establishing new stations in the said flat land area because there already exist many stations. Efforts should rather be made for full utilization of the existing stations to accumulate accurate observation data.

There exists not a single station at present in the mountainous area of the eastern tributaries basin. Although the development of tributaries in this area will eventually call for the precipitation observation in the mountainous area, it is considered preferable that the progress of development projects be taken into account for their establishment.

Establishment of precipitation stations will be also required in the mountainous area along the upstream of the mainstream. However, demand for their establishment will arise at a considerably later date.

From the above viewpoint, it is considered that new precipitation stations should be established in the second phase. For continuous recording of precipitation, rain recorders should be installed at new stations.

Table 8-8 and Fig. 8-3 show the proposed precipitation stations.

If the speed of development is accelerated in the eastern tributaries basin, there could arise the demand for establishing new stations at suitable points.

8-3-3 Meteorological Station

There is one meteorological station at present in the vicinity of Bandjarmasin. It is desirable that an additional station be established for collection of various meteorological data in the inland area where the development is believed to make a fair progress in future. The site of such a new station is to be sought near Amuntai because of the locational advantage and the convenience of observation activities.

Meteorological observation should cover precipitation, temperature humidity evaporation, duration of sunshine, wind direction, wind velocity and atmospheric pressure.

8-3-4 Levelling

Levelling is required because the zero of gauge of each water stage recorder should be determined in reference to the mean sea level of the Java Sea. Since the topographic mapping also calls for levelling, it is advisable that the levelling is conducted to satisfy the dual purpose.

It is conceivable that the time for establishing gauging stations does not coincide with that for levelling. If the levelling is to be carried out prior to the construction of gauging stations, bench marks should be established in the neighbourhood of the proposed sites of gauging stations, whereas if the gauging stations are to be constructed before the levelling, water level and discharge observation is to be made in advance for conversion of water level records after the elevation of the zero of gauge is determined. This arrangement will remove obstacles that could arise from the discrepancy in time between the levelling work and construction of gauging stations.

8-3-5 Estimated Cost for Hydrological & Meteorological Survey

Initial construction cost and annual operation cost of gauge and discharge stations are shown in Table 8-9, and those of precipitation and meteorological stations are shown in Table 8-10.

Table 8-11 shows the cost of technical guidances by foreign experts. Table 8-12 shows the total cost for hydrological observation system.

Cost in these tables are indicated in US dollars.

Cost for levelling for topographic mapping are summed up in Chapter 3, Topographic Survey.

8-4 Operation and Management of Hydro-observatories

8-4-1 Organization and Operation

All data on the water level and discharge of rivers in Indonesia are collected by the Institute of Hydraulic Engineering located in Bandung.

It is preferable that the said institute control the future full-scale hydrological observation activities in Kalimantan since the collection of data by such central organization will assure their wider range of application.

It is considered that the provincial government will assume the responsibility for actual observation work. For water level observation, which covers the visual inspection and replacement of recording paper and is therefore relatively simple, it will be practical to select suitable local inhabitants and assign them to the task after giving them the necessary training.

For discharge observation, which requires experience and techniques, it is advisable to train two or three groups of experts within the provincial government so that they may perform, on their own responsibility, such works as the discharge observation, arrangement of data and preparation of discharge curves at the stations to which they are assigned.

Observation of daily precipitation which constitutes part of the activities of precipitation stations will not require any change in its management since it is being conducted at present.

Rain recorders to be installed in the mountainous area require more skill in handling than rain gauges, and should therefore be operated and maintained by capable staffs. However, selection of such staffs entails some difficulty because the mountainous areas are hard of access and inhabited by a limited number of people. Rain recorders should therefore be installed in districts with relatively many inhabitants, and their operation should be entrusted to those staffs who have been carefully selected and given sufficient training.

Meteorological stations should be operated directly by the branch offices of the provincial government since the handling of many instrument and equipment requires expert knowledges and techniques.

8-4-2 Observation, and Arrangement and Recording of Data

Hydrological observations should be made accurately and uninterruptedly to obtain data accumulated over a lengthy period of time. It is to be borne in mind that the establishment of hydro-observatories promises no effect at all unless accurate observation is made continuously.

As for the arrangement of observation data, it is advisable to follow the method heretofore adopted in the country.

Records of observation forwarded from each station will be collected by the provincial government through its branch offices, and their copies will be sent to the competent organization of the Central Government.

8-4-3 Training

Though daily precipitation observation and water level observation at a limited number of places are being carried out at present, the team noted that the observation of discharge and the clarification of the relationship between discharge and water level have not yet been started. The proposed establishment of gauge and discharge stations will call for the guidance of experts on these observation activities. If the re-training of staffs now engaged in the observation of precipitation and water level is occasioned by such guidance, it will contribute to the elevation of their quality as well as to the assurance of more accurate and uninterrupted observation.

For the satisfactory observation activities in future, it is advisable to invite hydrologists of the Institute of Hydraulic Engineering or foreign experts to seek their guidance and advices on the establishment of stations, observation techniques and arrangement of data.

8-5 Conclusion

The Barito river is a large river with huge water resources, but proper and effective utlization of the resources it offers has not been achieved yet.

Development of the Barito river, which will provide the basis for the basin's development, should be planned with full consideration given to the overall development of the basin and should also ensure balanced implementation of flood control and water utilization in the basin.

To sum up the condition in the mainstream basin, the tidal irrigation programme is being carried out in the downstream area, however, the area extending along the middle and upper reaches is sparsely populated and has no noticeable industries excepting timber production. In the eastern tributaries basin, on the other hand, development is fairly in progress with a large population and a substantial agricultural production. For the future development of the Barito river basin, it is considered that the eastern tributaries basin which has a high demand for agricultural development will be given priority over the mainstream basin, and this priority order is not considered to hinder the future development of the mainstream area.

At the present stage, it is considered highly probable that the initial development efforts will be concentrated for Amuntai and Barabai-Kandagan areas due to their high demand for agricultural development as well as for the Riam Kiwa if the power demand increases in its vicinity.

Formulation of a river development plan calls for the availability of basic data such as topographic maps and hydrological data. Efforts should therefore be made for their preparation. Since the scope and priority order of topographic mapping is given in detail in Chapter 3, Topographic Survey, description in this chapter dealt only with plans for hydrological observations.

Hydrological data are required to be the records of observation accumulated over a long period of time. It is therefore hoped that the necessary observation will be started at the earliest date.

In view of the anticipated step-by-step development of the basin, establishment of observation stations should be planned by stage as detailed in Section 8-3 of this chapter.

Table 8-1 Monthly Precipitation in Barito River Basin (in mm)

(Meteorological and Geophysical Service 1959, 1960)

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Dry Season (May Oct.)	Wet Season (Nov. Apr.)
Puruktjahu	151	226	401	199	498	171	251	55	43	131	233	233	2,592	1,149	1,448
	327	268	196	339	144	90	227	65	197	157	257	364	2,631	880	1,751
Muaratewe	405	215	644	388	378	376	-	-	111	148	328	162	-		
	389	243	416	-	595	534	367	271	300	66	725	799	-		
Buntok	346	121	453	329	364	192	192	42	65	70	230	412	2816	925	1,891
	283	449	212	430	291	266	297	100	115	45	289	572	3349	1,114	2235
Tandjung	-	-	-	-	-	-	-	-	-	-	-	-	-		
	278	243	236	-	202	124	106	110	276	79	457	475	-		
Amuntai	357	157	138	3 388	205	153	51	75	7	25	190	372	2118	516	1,602
	282	359	254	202	253	36	162	63	213	36	174	347	2381	763	1,618
Barabai	151	239	264	165	175	279	101	15	88	130	234	282	2,123	788	1,335
	410	384	239	199	247	40	238	88	99	39	378	188	2549	751	1,798
Kandangan	-	-	-	357	-	139	118	110	32	141	-	-	-	-	
	280	380	188	225	173	39	220	45	141	30	151	192	2064	648	1,416
Negara	-	-	-	-	-	-	-	-	-	-	-	-	-		
	329	447	197	172	179	19	-	25	-	-	-	275	-		
Rantau	-	-	-	-	-	-	-	-	-	-	-	-	-		
	389	446	-	290	168	40	233	89	61	190	468	277	-		
Kuala Kapuas	439	225	222	148	311	162	81	25	-	75	200	249	-		
	338	297	295	149	327	57	64	44	43	26	179	211	2029	561	1,468
Martapura	328	258	222	171	198	154	85	21	68	106	221	342	2174	632	1,548
	478	560	427	115	283	81	148	-	82	-	233	185	-		
Pelaihari	-	-	-	-	-	-	-	-	-	-	-	-	-		
	383	481	235	376	402	48	274	125	82	64	253	274	2997	995	2,002
Bandjarmasin	-	-	-	-	-	-	-	-	-	-	-	-	-		
	327	522	313	201	480	205	271	86	119	67	202	274	3,067	1228	1,839

Table 8-2 Estimate for the Construction of Reservoir in South Kalimantan

No. Name of River	Watershed Area in ha	60% yearly average discharge in M3 by 2500 mm rainfall	Area of reservoir at full level in ha	Max high water level in reservoir in m	Reservoir capacity in m^3	Expected extension of irrigated area in ha	Remarks
1. Maluka (Bati-Bati)	20,000	300,000,000	2,250	6	80,000,000	25,000	The figures are only estimation.
2. Tabanio	18,000	270,000,000	2,000	15	100,000,000	10,000	
3 Riam Kanan	97,000	1,468,000,000	7,000	36	840,000,000	25,000	
4. Riam Kiwa	146,000	2,193,000,000	8,540	40	854,000,000	25,000	
5. Tapin	18,250	274,000,000	710	36	85,000,000	25,000	
6. Amandit	41,250	619,000,000	2,575	30	325,000,000	25,000	
7. Batang-alai	30,300	455,000,000	1,460	45	219,000,000	10,000	
8. Pitap	25,100	376,000,000	1,350	30	135,000,000	15,000	
9. Balangan	46,000	690,000,000	2,250	36	270,000,000	15,000	
10. Oei / Aju } Tabalong	44,192	663,000,000	4,200	21	294,000,000	30,000	
	487,192	7,308,000,000			3,202,000,000	215,000	

Table 8-3 Existing Gauge Stations in Barito River Basin

No.	Water Stage Gauge	River	Location	Site of Station	Height of Zero of Gauge	Condition
1	Staff type	Martapura	Bandjarmasin	Tiang djembatan rumah ponpa Sal. Air Minum Sel. Bilu.	+0.169 B.P. (B Masin Point)	Destroyed
2	"	Canal	Canal	Sebelah kanan masuk Andjir Muara dekat Surau.	+0.295 B.P.	Operating
3	"	Sea of Java	Pegatan Besa	Tepi Talur Djawa dekat Masdjid.	+0.326 B.P.	Destroyed
4	"	Tabenie	"	Belakang Kamp. Pegatan.	+0.301 B.P.	"
5	"	Reservir I	Takisung	Dalam Waduk dekat pintu pemberian	+101.56 T.S. (Independent site level)	"
6	"	Reservoir II	Takisung	"	+105.149 T.S.	"
7	"	Batangbanju	Bati-Bati	Dekat djembatan sebelah kiri arah ke Pleihari.	+1.9235 B.P.	"
8	"	Udjunggalam	Bati-Bati	"	+1.9665 B.P.	"
9	Staff type	Martapura	Martapura	Sebelah kanan arak ke Hulu Sungai seberangan pabrik intan dekat djembatan.	+0.009 B.P.	"
10	"	Bawahringin	Antasan Bawah Ringin	Muara sungai Ant Bawahringin/ Sei. Martp.	-2.022 B.P.	"
11	"	Sakakapar	"		-2.362 B.P.	"
12	"	Abulung	"		-1.851 B.P.	"
13	"	Limamar	"		-0.422 B.P.	"
14	"	Ratini	"		-0.504 B.P.	"
15	"	Kaliukan	"		-0.257 B.P.	"
16	"	Badandan	"		-0.075 B.P.	"
17	"	Riam Kiwa	Astambul	Sebelah Kanan djalan lama Astambul-Tandjung Djati ± 1 Km Pasar	-3.435 B.P.	"
18	"	Riam Kanan	Mali-Mali	Sebelah kiri Mrtp : K i intan ± 1/2 km dari djl. umum.	-0.356 B.P.	"
19	Recording type	Riam Kanan	Awangbangkal	Seberangan Mesdjid Awangbangkal		"
20	Staff type	T a p i n	R a n t a u	Dihilir djembatan Sei. Tapin.	+3.581 B.P.	Operating
21	"	T a a l	Kamp. Taal	Bendungan Taal.	+8.957 B.P.	Destroyed
22	Recording type	Balimau	Kamp. Balimau	Muara Tabirai	-1.637 B.P.	"
23	"	Amandit	Kandangan	Belakang Kant. P.U. Seksi.	-0.293 B.P.	"
24	Staff type	Tel. Langsat	Tel. Langsat	Bendungan Telagalangsat	+1.440 B.P.	"
25	"	Batangalai	Kp. Semanggi	Kehulu djembatan Semanggi	+6.634 B.P.	Operating
26	"	Awang Amuntai	Kp. Semanggi	Masuk Sel. Awang ± 3 Km.	+6.634 B.P.	"
27	Recording type	K a m b a t	Pasar Kambat	Belakang pasar	+5.592 B.P.	"
28	"	Batamgalai	Sei. Buluh	Menjeberang djembatan sebelah kanan arah ke Amuntai dekat VM 8 No 17	+1.534 B.P.	"
29	"	Negara	Negara	Dekat Balai Rakjat	+2.973 B.P.	"
30	"	D. Panggang Negara	Babirik	Dimurung pertemuan sungai belakang kant. Penerangan	+1 671 B.P.	Destroyed
31	"	D. Panggang	D. Panggang	Dihulu pasar ± 200 m sebelah kiri djalan arah Alabio	+1.761 B P	"
32	"	Negara	Sei Mahar	Pertemuan Sei. Mahar/Negara	+0.000 B.P.	"
33	Staff type	Negara	Amuntai	Ditiang djembatan sebelah arak ke Kelua	+0.000 B.P.	Operating
34	Recording type	Balangan	Amuntai	Dibelakang pabrik es djalan Murung	-0 031 B.P.	"
35	Staff type	Karies	Amuntai	Ditiang djembatan Sei. Karias	-0.174 B P.	"
		From data of Regional Construction Office, South Kalimantan Provincial Government				
101	Recording type	Barito	Bandjarmasin	Bandjarmasin harbor		Operating
102	"	Kahajan	Pulang Pisau	Pulang Pisau harbor		"
103	"	Kapuas	Mandomai			
104	"	Canal	Besarang Canal			
105	"	"	"			

Obtained by hearing from the Provincial Government Officials in this survey

Table 8-4 Existing Precipitation Stations in Barito River Basin

No.	Location	No.	Location
1	Puruktjahu	15	Pangiuran
2	Muaratewe	16	Pengaron
3	Buntok	17	Awang bangkel
4	Ampah	18	Kurangintan
5	Murung pedak	19	Martapura
6	Tandjung	20	Loktabat
7	Klua	21	Tjempaka
8	Paringin	22	Ulin
9	Amuntai	23	Bandjarmasin
10	Matumandi	24	Marabahan
11	Negara	25	Bati Bati
12	Barabai	26	Tanahambungan
13	Kandangan	27	Pelaihari
14	Rantau	28	Kuala Kapuas

Table 8-5 Estimated Cost of Survey for River and Dam Development

		Estimated Cost			
		1st Phase		2nd Phase	
		Quantity	US$	Quantity	US$
River Survey	(Record of damages caused by floods and drought)				
Water Utilization Survey					
Hydro-power Survey			50,000		131,000
Sediment Load Survey					
Water Transportation and Fishery Survey					
			50,000		131,000

Table 8-6 Proposed Gauge Stations

Stage	River	Location	Remarks
I	Barito	Estuary	
"	"	Bandjarmasin	Existing
"	"	Marabahan	
"	"	Muara Pulau (diverting point of S. Pulaupetak)	
"	Kapuas	Kuala Kapuas	
"	Kahajan	Pulang Pisau	Existing

Table 8-7 Proposed Gauge and Discharge Stations

Stage	River	Location	Remarks
I	Barito	Buntok	
"	S. Negara	Negara	Needs repairing of existing station
"	"	Amuntai	"
"	S. Balangan	Melunjuk	
"	S. Pitap	Bihara	
"	S. Batangalai	Baturangga	
"	"	Sei Buluh	Needs repairing of existing station
"	S. Barabai	Barabai	
"	S. Amandit	Kandangan	Needs repairing of existing station
"	S. Tapin	Rantau	
"	S. Riam Kiwa	Pengaron	
II	Barito	Muaratewe	
"	"	Puruktjahu	
"	"	Hatas	
"	S. Tabalong	Tandjung	
"	S. Amandit	Papi	
"	S. Tapin	Miawah	

Table 8-8 Proposed Precipitation Stations

(Rain Recorder)

Stage	Location	Stage	Location
II	Muara Uje (S. Tabalong)	II	Anteraku (S (S. Riam Kiwa)
"	S. Tabalong Kiwa (")	"	Muaradjuloi
"	Melunjuk (S. Balangan)	"	Up Stream of Barito
"	Huren (")	"	"
"	Bihara (S. Pitap)	"	"
"	Baturangga (S. Batangalai)		
"	Mentatai (S. Amandit)		
"	Rarahin (S. Tapin)		
Total Stage II 13 Sites			

Table 8-9 Gauge and Dischaege Stations and Equipment Cost

Estimated Cost in U.S. Dollar

Item	Description and Location	Stage I		Stage II		Remarks
		Unit	Cost	Unit	Cost	
MAIN RIVER	Sites of Gauge Stations					
Gauging Stations	Stage I Estuary, Bandjarmasin Marabahan, Muara Pulau, Kuala Kapuas, Pulang Pisau, Buntok	7	50,000			Existing at Bandjarmasin and Pulang Pisau
	Stage II Muara Tewe, Puruktjahu, Hatas			3	42,000	
Discharge Stations	Select Range near Gauge Stations at					Fathometer soundings, selection and permanent marking of discharge station
	Stage I Buntok	1	1,000			
	Stage II Muaratewe, Puruktjahu, Hatas			3	4,000	
TRIBUTARIES	Site of Gauge Stations					
Gauging Stations	Stage I Melunjuk (S. Balangan) Bjhara (S. Pitap) Baturangga (S. Batangalai) Barabai (S. Barabai) Rantau (S. Tapin) Pengaron (S. Riam Kiwa) Repair Amuntai (S. Negara) Negara (") Sei Buluh (S Batangalai) Kandangan (S. Amandit)	6 4 	48,000 14,000 			
	Stage II Tandjung (S Tabalon) Papi (S. Amandit) Miawah (S. Tapin)			3	24,000	
Discharge Stations	Stage I Select Range near Gauge Stations of Stage I	10	10,000			
	Stage II Select Range near Gauge Stations of Stage II			3	3,000	
Sub Total			123,000		73,000	
EQUIPMENT	Stage I					
Survey Boats	Stage I 24' x 9' (Out Board Engine)	1	15,000			
	Stage II 40' x 12'			1	25,000	
Measurements and Survey Equipments		1	15,000	1	4,000	
Sub Total			30,000		29,000	
Grand Total			153,000		102,000	

Table 8-9 (Cont'd) (Operation and Maintenance Cost)

Item	Description	Stage I		Stage II		Remarks
		Yearly	5 years	Yearly	5 years	
MAIN RIVER AND TRIBUTARIES						
Gauge Stations	Main River	6,300	31,500	8,400	42,000	
		5,000	25,000	7,000	35,000	
Discharging Stations		30,000	150,000	40,000	200,000	
		6,000	30,000	10,000	50,000	
Total		47,000	236,500	65,400	327,000	

Table 8-10 Precipitation and Meteorological Stations Cost

U.S. Dollars

Item	Description and Location	Stage I		Stage II		Remarks
		Unit	Cost	Unit	Cost	
Precipitation Stations						
Recording Stations	Stage I None	-		--		
	Stage II The eastern lower basin andupstream of main river			13	24,000	
Meteorological Stations	Stage I Amuntai	1	12,000			
	Stage II None			-	-	
Total			12,000		24,000	
	(Operation and Maintenance Cost)					
Precipitation Stations		-		4,800	24,000	
		-		1,500	7,500	
Meteorological Stations		8,800	44,000	8,800	44,000	
		500	2,500	500	2,500	
Total		9,300	46,500	15,600	78,000	

Table 8-11 Technical Guidance Cost

U.S. Dollars

Item	Description	Stage I	Stage II	Remarks
Technical Guidance	Experts of Hydrology 72 man/month	216,000	-	Include preliminary survey and guidance of river development project

Table 8-12 Total Cost for Hydrological Observation System

U.S. Dollars

Item	Description	Stage I			Stage II			Remarks
		Unit	Construction Cost	Operation & maintenance for 5-year period	Unit	Construction Cost	Operation & maintenance for 5-year period	
Hydrologic Stations								
Gauge Stations	Main River	7	50,000	56,500	3	42,000	77,000	
	Tributaries	10	62,000		3	24,000		
Discharge Stations	Main River	1	1,000	180,000	3	4,000	250,000	
	Tributaries	10	10,000		3	3,000		
Equipment			30,000			29,000		
Sub-total			153,000	236,500		102,000	327,000	
Precipitation and Meteorological Stations								
Recording Stations		-	-	-	13	24,000	31,500	
Meteorological Stations		1	12,000	46,500		-	46,500	
Sub-total			12,000	46,500		24,000	78,000	
Technical Guidance			-	216,000		-	-	
Grand total			165,000	499,000		126,000	405,000	
			664,000			531,000		

Fig. 8. 1

BARITO RIVER BASIN

Existing Gauge Station

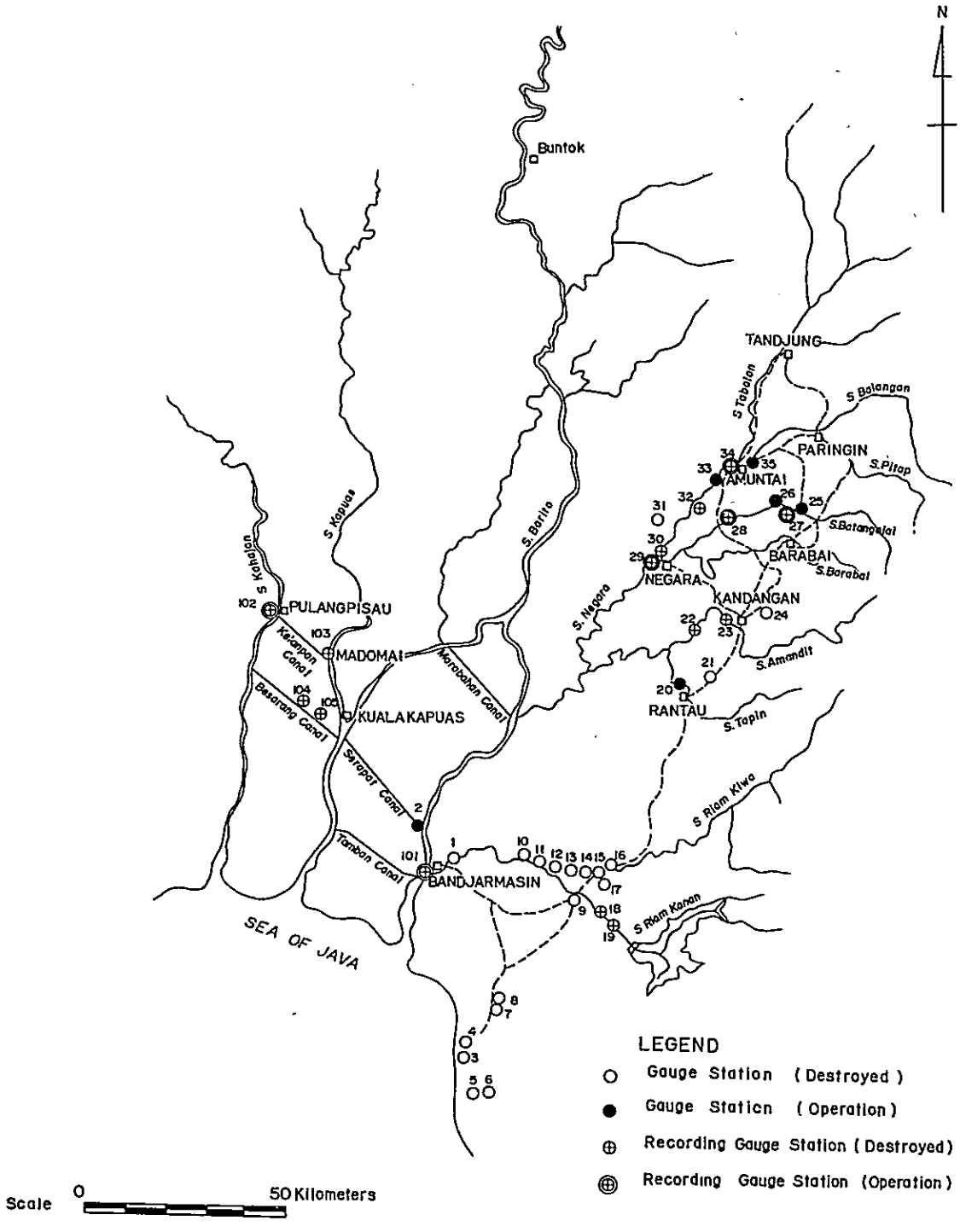


Fig. 8.2

BARITO RIVER BASIN

Proposed Recording Gauge and Discharge Station

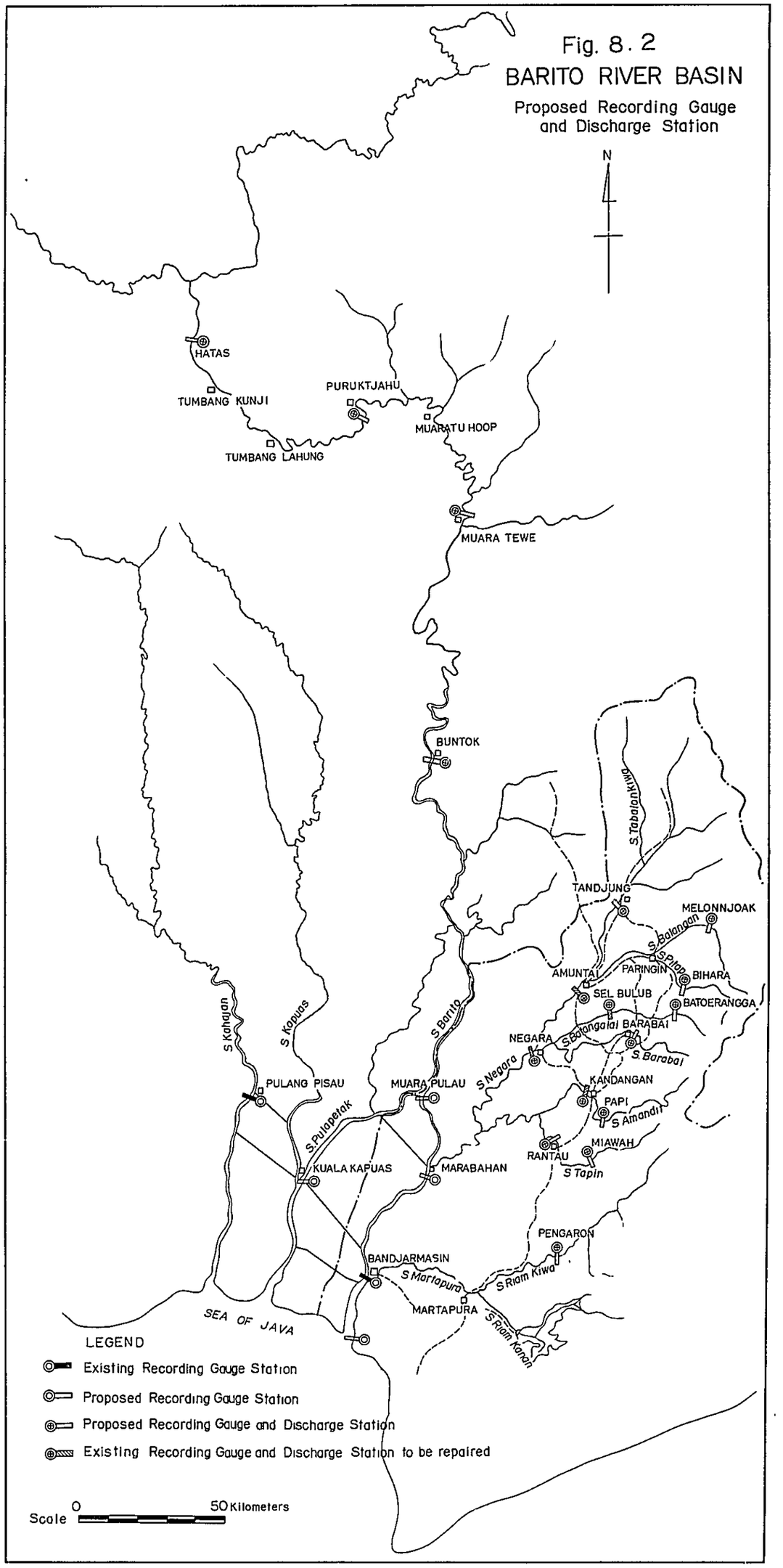


Fig. 8.3

BARITO RIVER BASIN

Existing and Proposed Precipitation Station

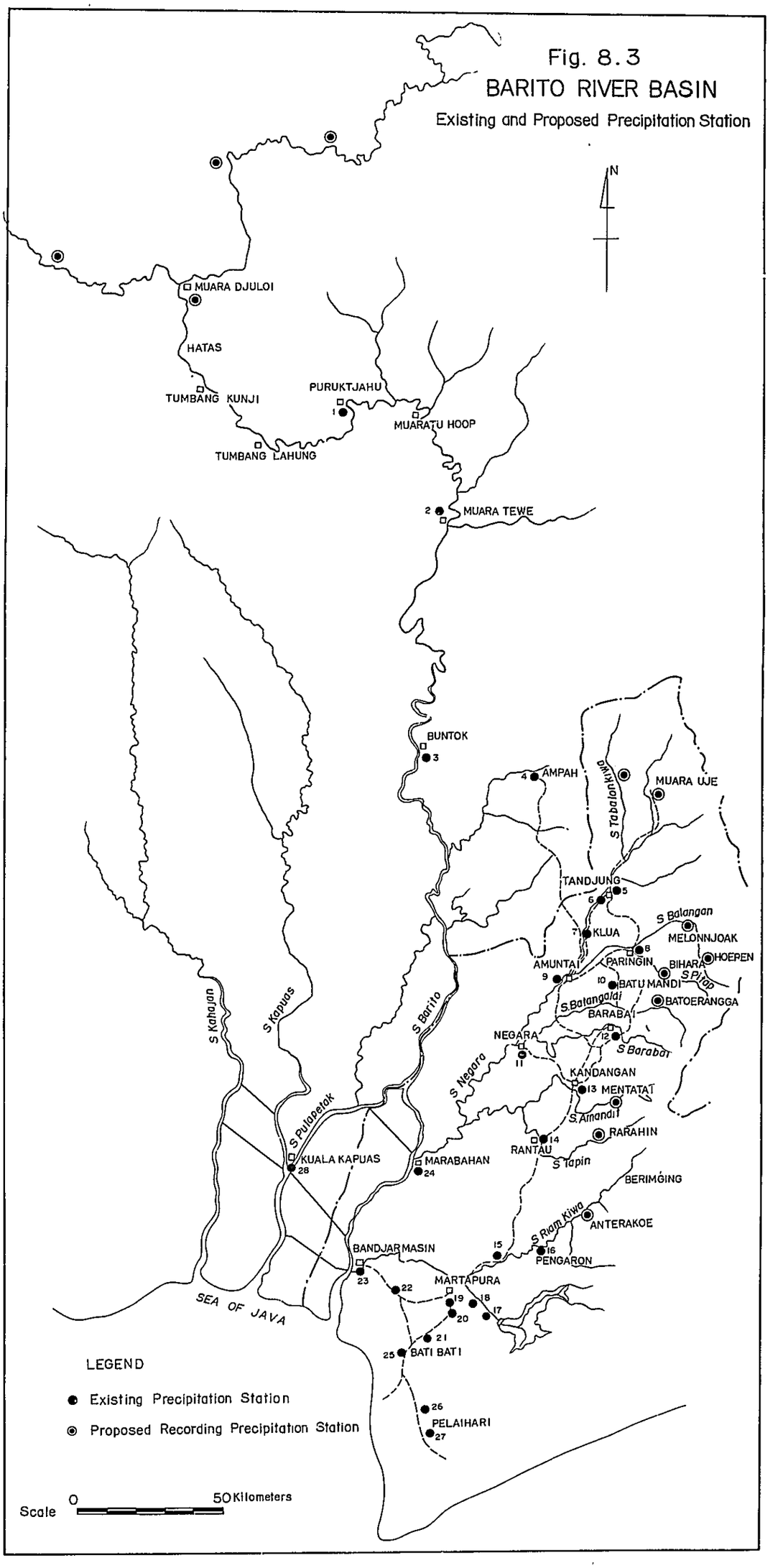


Photo 8-1 The Riam Kiwa river in the vicinity of Atiim Hulu Village. Construction of a 40-50 m high dam is feasible at this site.

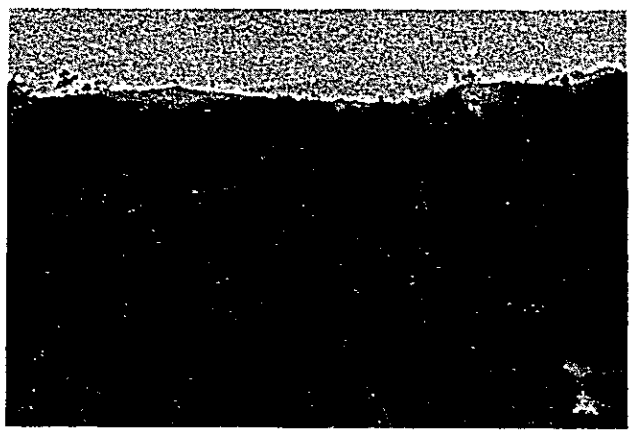


Photo 8-2 Same as Photo 8-1

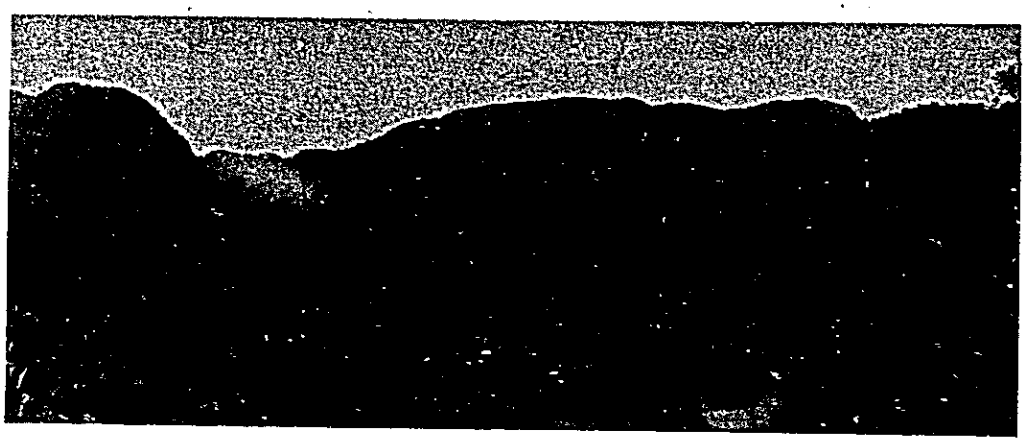


Photo 8-3 The Batang-alai river in the vicinity of Pankiki Village. (downstream of Batutangga)

Appendix

RIAM KANAN IRRIGATION PROJECT

KALIMANTAN INDONESIA

- Pre-feasibility Report -

C O N T E N T S

List of Tables and Figures

SUMMARY AND RECOMMENDATION

The Riam Kanan Irrigation Project area is one of the fairly well developed areas in South Kalimantan Province, the most densely populated region in Kalimantan. The city of Bandjarmasin, the administrative and economic center of the Province, is located at about 30 km northwest of the project area covering approximately 30,000 ha of farmland.

The implementation of the Riam Kanan Dam and reservoir project, which will be completed in 1972, has accelerated the development of agriculture in the Riam Kanan Irrigation Project Area.

The supply of rice and foodstuff in South Kalimantan is far from meeting the demand at present. It is earnestly desired to secure the stable supply of foodstuff, particularly in the urban areas, where the demand is increasing rapidly.

The project envisages the agricultural development to increase the production of foodstuff by introducing irrigation and drainage, which make possible the modernized irrigation farming by means of mechanization, proper application of fertilizers and chemicals and introduction of the farmers' cooperative. For the implementation of this project, it is strongly recommended to carry out the feasibility study as soon as possible.

The diverse conditions of agricultural land in this area reflects the typical characteristics of the Barito River Basin. Water supply project therefore must be planned according to the special characteristics of each region.

Before devising this project, a general policy should be formulated with regard to the choice of project sites, soil survey, required irrigation water, farm consolidation, drainage system, etc. At the same time, a pilot farm and training center of a suitable scale staffed with several agricultural specialities should be established for full utilization of the results of tests relating to the selection of fixed varieties, improvement of cultivation method and establishment of the rational scale of farm management, as well as for the training on farm management techniques for the prospective settlers and the existing farmers.

It is also necessary for the farmers to establish the farmers' organizations such as the agricultural cooperative association and the irrigation water association.

The basic data required for the feasibility study of the irrigation project are as follows:

1) Statistical data on agricultural economics, farm population, farmland crops, etc. of the area with desa as a unit

2) Topographic map of 1:10,000 of the area including the surrounding areas

3) Meteorological and hydrological data, especially data on water level and discharge of rivers such as S. Riam Kanan and S. Maluka, and rainfall

4) Detailed soil and vegetation map of 1:50,000

5) Data on the present condition of irrigation and drainage, particularly, condition and capacity of water utilization and control, condition of submerged areas, and draught.

In view of the diverse topographical conditions of this area it would be advisable to work out several development plans for selection of the most effective and appropriate one.

1. INTRODUCTION

Agriculture is the main industry in South Kalimantan. In fact, about 85% of the total population is believed to be engaged in farming and its related work, and there are some farmers who have progressive attitude.

The proposed area for the Riam Kanan Irrigation Project is the administrative center of the South Kalimantan Province and has favorable social and economic conditions. Projects such as the improvement of the harbor, extension of the municipal water supplying facilities, and construction of the power supply facilities based on the Riam Kanan Dam scheduled for completion in 1972, have accelerated the modernization of the community. The supply of foodstuff at present is insufficient especially in the South and the East Kalimantan Provinces, and the demand will further increase both quantitatively and qualitatively, keeping pace with the concentration of population in the urban areas.

Administratively, this area extends over the Bandjarbaru, Bandjar, and Tanah Laut Kabupatan (prefectures). Kabupatan Bandjar, which is the center of this area, has the Astanbul, Martapura, Gambut, Kertak Hanjar, Sungai Tabuk, and Aluh Aluh Ketjamatans (counties) with a total of 50-60 desas (villages).

The history of rice cultivation in this area is comparatively long in Kalimantan, and the area as a whole has favorable soil and drainage conditions. Moreover, the present condition is that there still exists vast uncultivated land around the farmland.

The aim of this project is to reclaim farmland of high agricultural productivity, which makes possible the modernized farming based on irrigation, drainage, prevention and extermination, mechnization, etc. on the premise of the two-season rice crop and the raising of two crops a year, and thereby to increase production of foodstuff and promote modernization of the rural districts through agricultural development.

2. PROJECT AREA

2-1 Land and Population

The project area extends over the south of the Martapura River, a tributary of the Barito River, and is located close to Bandjarmasin, the capital of the South Kalimantan Province. The area covers approximately 38,000 ha including about 10,000 ha of cultivated land and 20,000 ha of reclaimable swampy land.

Population of the South Kalimantan Province was 1,779,844 as of 1969 in which 256,813 was the population of Bandjarmasin according to the 1969 statistics published by the Central Bureau of Statistics. The size of farms in this area is about 1.3 ha on an average, and more than 60% of farmers hold less than 1.0 ha. each.

2-2 Climate

The climate of the project area can be divided into two distinct seasons, the west monsoon and the east monsoon. From November to April the west monsoon prevails with frequent rains, while the east monsoon keeps this area dry from May to October. According to the rainfall records kept at Bandjarmasin, the rainfall in the dry season is only about 30% of the annual rainfall. The mean annual rainfall in the project area varies from 2,200 to 2,800 mm.

The mean annual temperature is about 27°C, mean annual daily maximum being 32.1°C and mean annual daily minimum 22.3°C. Mean monthly relative humidity is between 78 and 88%. These high temperatures and high humidity are generally favorable for the crop growth.

The tidal amplitude is as large as 2.8m, making easy the tidal drainage for the vast lowland in the project area. A summary of the climatic conditions at Bandjarmasin is as follows:

		Annual mean	Annual mean of highest daily temp.	Annual mean of lowest daily temp.
Temperature	°C	26.8	32.0	23.3
Humidity	%	82	92	58
Wind velocity	m/sec	2.7 (N)		
Rainfall		Rainfall	No. of rainy days	
Annual		2,388 mm	175 (Average of 1956 - 65)	
Dry season		678 mm	63 (May to October)	
Rainy season		1,710 mm	112 (Nov. to April)	

Source: Sub-project VI-VII, Page 15 of the Pusang Surut Feasibility Report

2-3 Soil Conditions

The project area can be roughly divided into the upland area, the lowland area and the swampy area from the topographical point of view. The upland area which covers an area of about 3,000 ha, consists of latosol or red yellow podsol.

The lowland area covering about 20,000 ha consists mainly of the alluvial soil with humic gley or organic soil. The land is fertile and stable. The swampy area with about 15,000 ha consists mainly of alluvial soil. In places where the drainage is poor, the soil is humic gley soil due to a large content of organic matters. In addition to above lands, there are areas of fluvial soil with silica sand or gravel and peat soil in the project area, but they are excluded from the development due to unfavorable soil condition for cultivation.

2-4 Present Irrigation and Drainage Systems

Along the southern bank of the Martapura River, there exist some irrigation facilities in the Sawah Barat where the regulating gates are installed on the ends of the small streams from where the water is drawn into the adjacent paddy field during the irrigation period. In Ketjamatan Gambut where rice cultivation has been practiced since olden days, small scale irrigation and drainage canals have been provided, some with regulating gates and check structures.

However, they are not systematically operated and maintained at present. In the flood season, the project area, particularly those areas near the rivers are often inundated due to insufficient control facilities and measures.

2-5 Road System

In this area, a national highway is running through the center of the area from west to east, starting from Bandjarmasin and connecting Martapura, Kandangan and other major cities. This highway is coping with the traffic situation under which motorization is pervading rapidly in recent years. In the rural area, however, there are very narrow service and feeder roads passable for the cattle and people only. It is necessary to provide a sufficient road network for mechanization of farming and transportation of materials as well as agricultural products.

2-6 Agricultural Conditions

Agriculture in the project area is being practiced more intensively than in other areas in Kalimantan. About 70% of the farms are cultivated by the owner-farmers. The size of an average farm is 1.7 to 2.2 ha.

The cultivation systems are rather primitive and practiced without sufficient fertilizer, pest and disease control as well as proper management. The principal crop is paddy in the lowland, while in the upland, cassava, upland rice, sweet potato, peanut, soybean, maize, fruits, etc. are the main crops. Cultivation of vegetables is quite limited. Besides the above, rubber and coconut are planted in some areas, which are main cash crops in South Kalimantan. The yield of dry paddy is rather low, being 1.9 to 2.5 ton/ha.

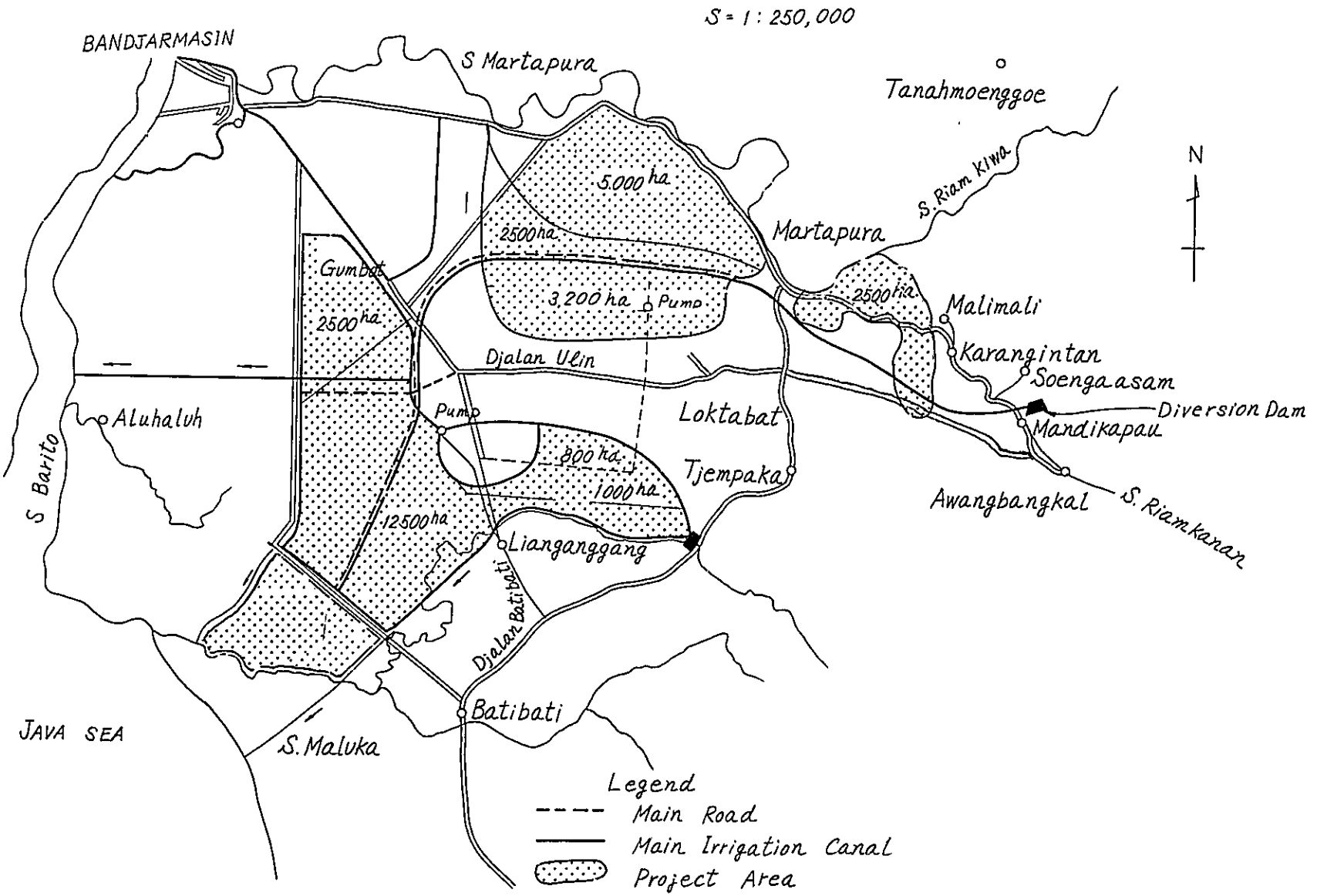
The local variety of paddy known as "Lemo" is being cultivated most in the project area. Recently the IRRI varieties such as PB5 and C4 have been cultivated on trial basis and are gradually becoming popular among the farmers.

The annual income of an average farmer is as low as about 75 US dollars equivalent. Many farmers are depending on income from side business other than farming. Neither improved farming method nor mechanization has been employed. There are some farmers in the area who cultivate more than 3 ha. They manage more diversified farming and their average annual income amounts to more than 300 US dollars equivalent.

The distribution of the agricultural products and the agricultural materials is conducted through the market (passar) and other free markets such as the rice-mill. The market price of rice (polished) is about Rps. 30-35 per kg.

An organization called "Kepala Padang" similar to the irrigation association formed by the farmers existed in this area in the past. This organization is now extinct. This area is favorably located for modernization of agriculture, because the branch of the Agriculture Experiment Station, P.N. Mekatani (Agricultural Machinery Corporation), agencies of the Department of Agriculture, the agricultural college, etc. are all located in this area.

Fig. 3 – 1 General Layout of the Project



3. PROJECT PLANNING

3-1 Outline of the Project

After the completion of the Riam Kanan Dam, it will become possible to secure about 40 m^3/sec of water for irrigating about 30,000 ha of the project area. This will make possible the irrigation farming with two crops a year.

An intake structure will be constructed at Sungai Asam, about 15 km south east of Martapura, from where water will be conveyed through a main canal to the project area. The water will be first diverted to the existing paddy field of about 2,500 ha adjacent to the eastern part of Martapura City. Then the canal will pass the point about 2 to 3 km south of the said city and runs westward to irrigate the existing paddy field of about 11,000 ha extending over the area between the Martapura River and the Djalan Ulin. This canal then turns to south at the point 2-3 km southeast of Gambut and runs parallel with Djalan Batibati for about 2-3 km on its west to irrigate about 17,000 ha of land.

In order to eliminate constant submergence and to make possible the effective fertilization, pest and disease control and mechnization of farming, the natural drainage systems with canals and gates will be provided in the lowland. Farm roads will be improved so as to meet the future mechanization of farming and to make smooth the transportation of materials and farm projects.

a) Irrigation

Twice rice cultivation	25,000 ha
Two crops a year (paddy and other crops)	2,000 "
Upland crops	1,000 "
Orchards	2,000 "

b) Drainage

Twice rice cultivation	25,000 ha
Two crops a year (paddy and other crops)	2,000 "
Upland crops	1,000 "
Orchards	2,000 "

c) Land reclamation

Twice rice cultivation	15,000 ha
Two crops a year (paddy and other crops)	2,000 "
Upland crops	1,000 "
Orchards	2,000 "

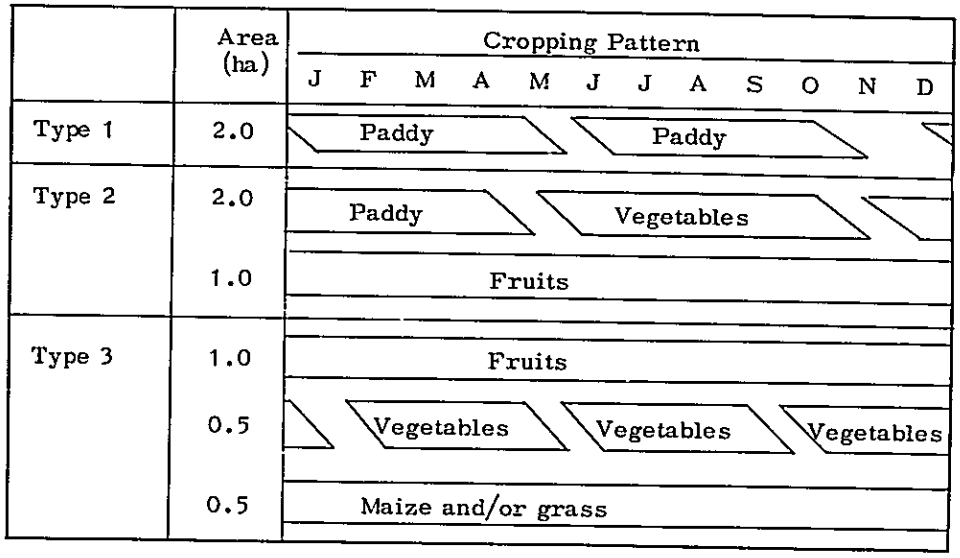
3-2 Farming Program

In view of the natural and socio-economic conditions of the South Kalimantan, the following three types of standard farms are being considered for the project area. The cropping patterns and the appropriate number of standard irrigated farms will also be established.

Table 3-1 Standard Farming Program and Planting Area

Type of farm	Size of farm (ha)	No. of farms	Area (ha)
1. Double crop of rice	2.5	10,000	25,000
2. Paddy, fruits and vegetables	3.0	1,000	3,000
3. Fruits, vegetables and livestock	2.0	1,000	2,000
Total		12,000	30,000

Fig. 3-1 Tentative Cropping Patterns



With the introduction of improved irrigation farming, the annual production of the project area will increase year by year due to the enlargement of the cultivated area and the increase of unit yield, and will reach the anticipated maximum in the fifth year and thereafter.

Kind of crop		Area (ha)	Unit yield (ton ha)	Amount (ton)
Type 1	Paddy	25,000	7.0	175,000
Type 2	Paddy	2,000	3.5	7,000
	Vegetables	2,000	10	20,000
	Fruits	1,000	10	10,000
Type 3	Fruits	1,000	10	10,000
	Vegetables	1,500	10	15,000

In the case of the Type 1 farm, the annual gross income of the irrigated farm will amount to about 875 US Dollars per ha in and after the fifth year, which corresponds to about 4.8 times of the present farm income of a farm of 1.5 ha. in size.

3-3 Irrigation System

3-3-1 Water Requirement

Since no data on irrigation water requirement is available, the consumptive use of water by each crop has been roughly estimated, based on the tentative cropping pattern and the planting area as follows:

a) Unit water requirement

Paddy, including percolation rate	13 mm/day
Upland crops, including orchards	6 mm/day

b) Irrigated area

Paddy land	25,000 ha
"	2,000 ha
Upland	1,000 ha
Orchard	2,000 ha

c) Water requirement	Max. (m^3/sec)	Aver. (m^3/sec)
Net requirement	45.1	35.3
Gross requirement[1)]	56.1	44.3

3-3-2 Irrigation Water Source

There are some stream in the project area, namely, S. Lianganggang, S. Ulin and others. In the planning of an irrigation system, it is assumed that about 80% of the river runoff of such streams as well as the return flow of the irrigation water within the project area will be used. In this case, the shortage of irrigation water will be covered by water supplied from the Riam Kanan reservoir. The balance between the requirement and the supply is calculated roughly as follows:

a) Annual water requirement	10^6m^3	Max. m^3/sec	Max. m^3/sec
Consumptive use + percolation loss	780	56.1	45.1
Effective rainfall	158		9.2
Net requirement	622	45.1	35.9
Gross water requirement	778	56.1	45.0
b) Annual supply			
S. Riam Kanan & reservoir	435	40.0	25.2
S. Lianganggang & others	78	0.8[2)]	4.5
Return flow	265	15.3	15.3
Total supply	778	56.1	45.0

1): Irrigation efficiency was considered to be 80% in which canal conveyance and operation efficiencies are included.

2): Minimum flow of the S. Lianganggang in the dry season was estimated conservatively.

3-3-3 Irrigation System

From the economic viewpoint, the trapezoidal unlined earth canal is proposed for the irrigation canal system in the project. The canal gradient will be approximately 1/6,000 in order to have a velocity of about 70 cm/sec for adequate operation and maintenance of the canal. The canal alignment will be made in due consideration of safety of the canal itself and the convenience of the drainage from the hilly land. Along with the canals, many appurtenant structures such as turnout, check, spillway, syphone, etc. will be provided to control the design flow.

In consideration of topographical features of the irrigable land, two pumping stations will be constructed. One will be constructed at about 22 km downstream of main canal from its intake to irrigate about 2,000 ha of elevated land extending over the north of the Ulin highway. The other will be constructed at the point 40 km from the intake to irrigate about 3,600 ha of land extending over the right bank of the Lianganggang River. The general alignment of the irrigation system is as shown in Fig. 3-2.

The salient features of the irrigation system are summarized as follows:

a) Irrigation area: 30,000 ha

b) Diversion weir

Radial gate	$15.0^{m} \times 5.0^{m} \times 3^{sets}$
Crest length	60 m

c) Irrigation canal

	Length(km)	Capacity (m^3/sec)
Main canal	68	40.0 – 3.5
Laterals	175	3.0 – 0.1

d) Pumping station

	Capacity (m^3/sec)	Pump head (m)
No.1 P.S.	2.6	10
No.2 P.S.	3.8	8

3-4 Drainage System

3-4-1 General

The drainage system in the project area can be divided roughly into four blocks as shown in Fig. 3-3, namely, east, west, north and south. In the eastern and northern blocks, the main irrigation canal will be planned to cross the comparatively large drainage canals or streams by means of syphon or aqueduct. The drainage water of the small streams will be drawn into the irrigation canal, and then discharged through the spillway into S. Martapura.

In the western block, the existing small drainage canals running between the existing paddy field extending over the southern part of Bandjarmasin and this block, will be expanded and improved. The drainage will be the tidal drainage by connecting the drainage canals with the Barito River through S. Maluka. The drainage in the southern block will be provided by improving the river course of the meandering S. Maluka.

Fig. 3-2 Schematic Irrigation System

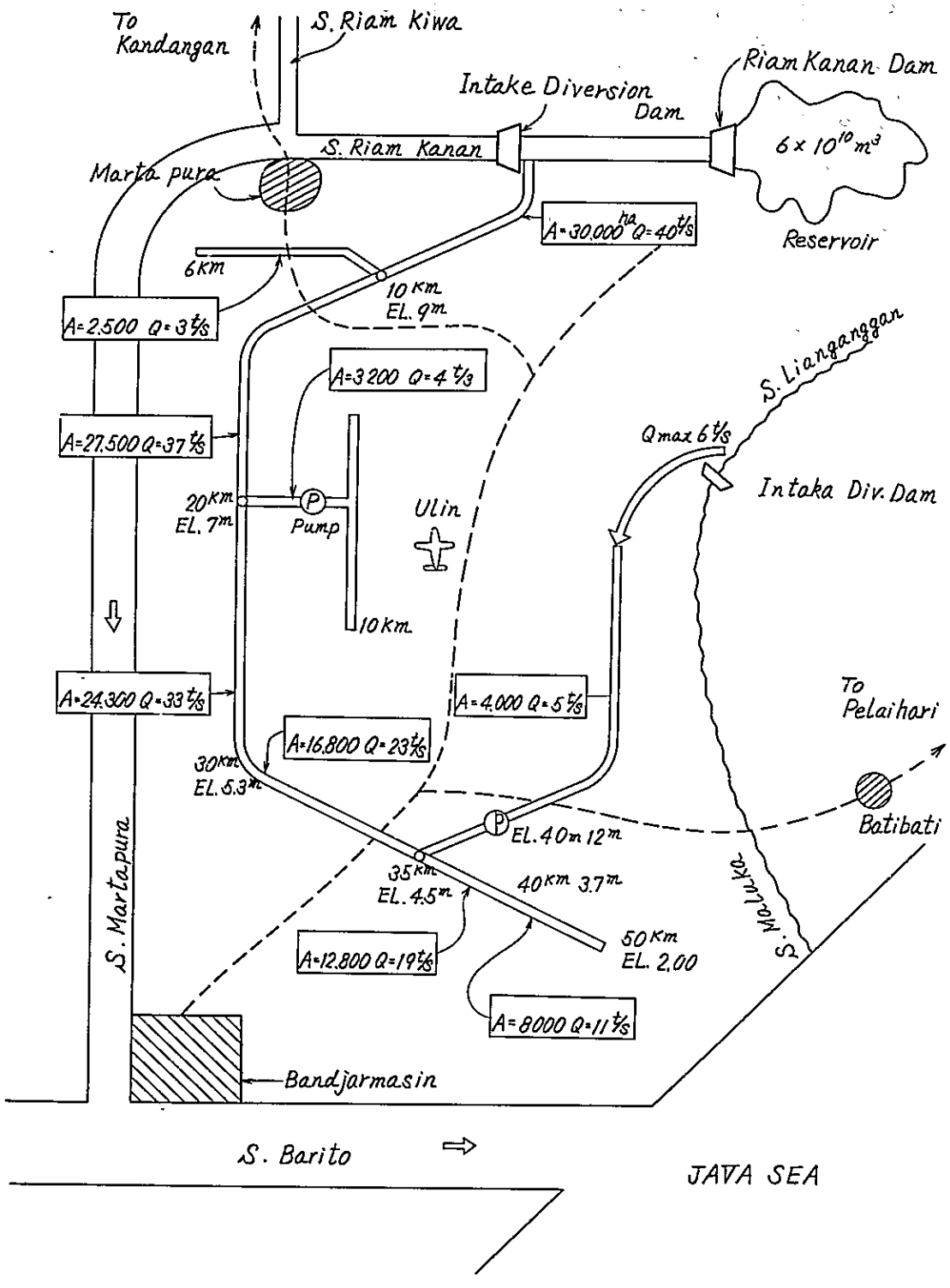


Fig. 3-3 Schematic Drainage System

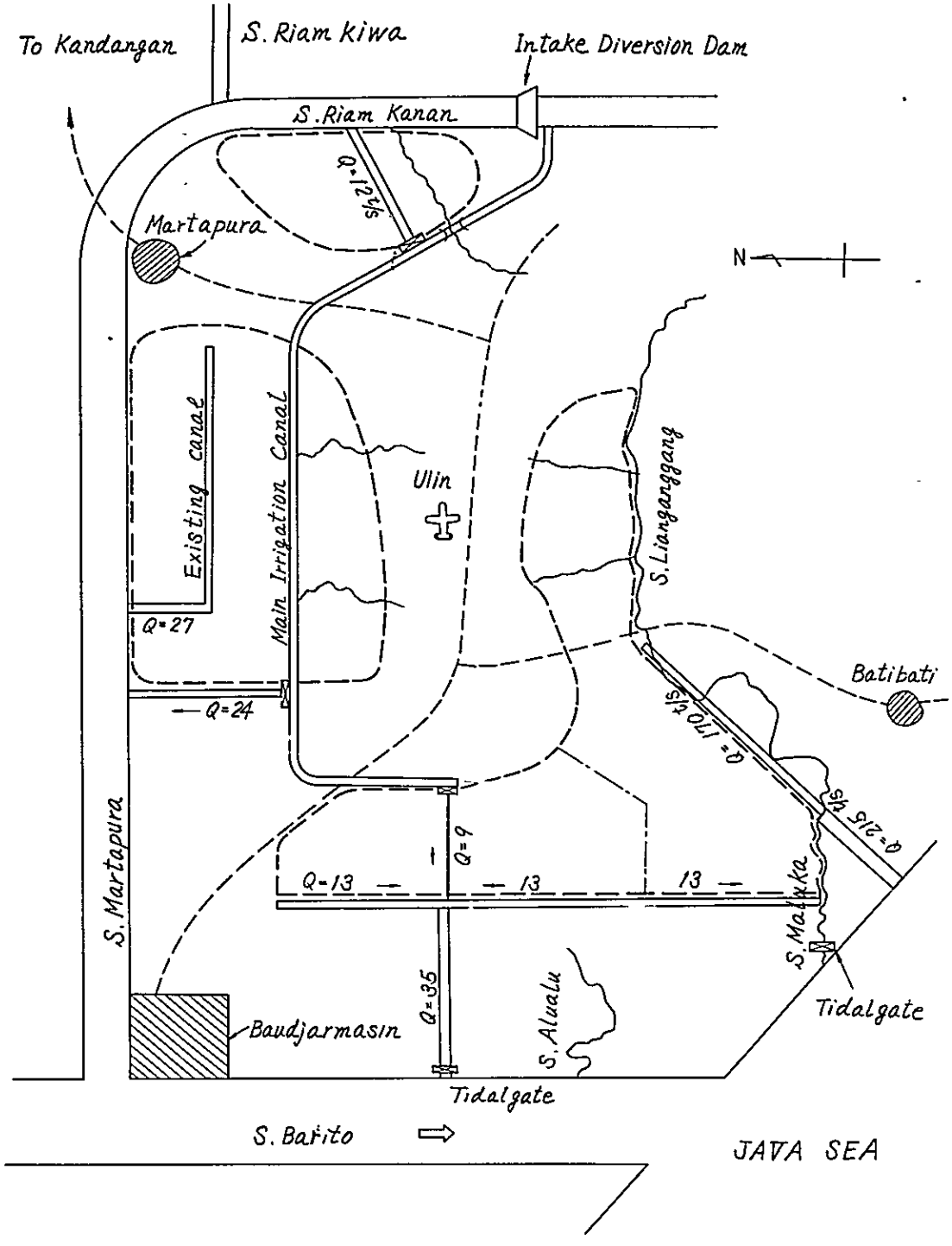
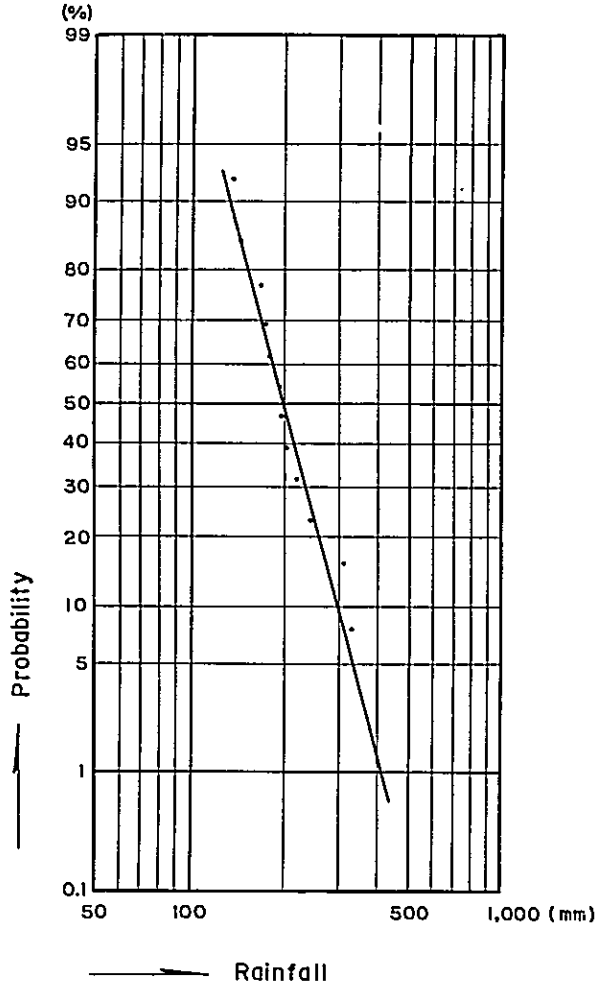


Fig.3-4 Probability of Continuous Five-Days Rainfall

1951 - 1963 in Martapura



With the implementation of the drainage system in both the western and southern blocks, considerable effect of drainage can be expected in the southern district of Bandjarmasin adjacent to the project area and in the area located at the left bank of S. Maluka.

3-4-2 Drainage Requirement

Normally, drainage facilities are designed on the assumption of a continuous five-day rainfall of ten per cent probability of occurrence. Fig. 3-4 shows the frequency distribution of continuous five-day rainfall from 1951 to 1963 in Martapura plotted on the log-normal probability paper, from which 10 per cent probability continuous 5-day rainfall was calculated as 300 mm.

Paddy rice is normally cultivated in the low flat land in the rainy season because of its fair resistance to inundation of a short period. Accordingly, the designed drainage discharge was estimated on the following assumptions:

a) The amount of five-day continuous rainfall is drained out in seven days.

b) Runoff coefficient is 0.6.

Then, the drainage discharge per km^2 is computed as follows:

$$Q_p = 300 \times 0.6 \times \frac{1,000^2}{1,000} \times \frac{1}{7 \times 86,400} \fallingdotseq 0.3 \ m^3/sec$$

In the forest land the drainage discharge is estimated at 0.5 m^3/sec in due consideration of the present stream conditions. The following table shows the calculated drainage discharge in each block.

Table 3-2 Drainage Discharge

Name of drainage system	Benefited area (ha)	Catchment area		Flood discharge	
		Mountainous area (km^2)	Plain area (km^2)	Mountainous area (m^3/sec)	Plain area (m^3/sec)
Eastern block	3,000		40		12
Northern block (highland)	2,000	-	80		24
Northern block (lowland)	7,000	-	90		27
Western block (highland)	7,000	-	30		9
Main canal in western block		-	90		27
S. Linganggang	4,000	290	100	145	30
S. Maluka	7,000	330	140	165	42
Total	30,000	620	570		

3-4-3 Drainage System

The drainage canals to be constructed in the project area are the main canal, secondary canal, tertiary canal and the catch drain. The excess water on the farms and the drainage area is drained into the tertiary canals and/or catch drains and then discharged into the Martapura River and the Java Sea through the secondary drainage canals or the main canal. The main features of the drainage canals are as follows:

a) Type of canal	Trapezoidal unlined canal
b) Length of canals	
Main canals	94 km
Laterals	140 km
c) Design discharge	
Main canals	15 - 130 m^3/sec
Laterals	2.5 - 5.0 "
d) Gradient	
Main canals	1/3,000 - 1/8,000
Laterals	1/3,000
e) Velocity	
Main canals	0.6 - 1.0 m^3/sec
Laterals	0.6 "

3-5 Road System

The Riam Kanan Irrigation Project is contemplated not only to develop the agricultural land for the year-round rotation farming, but to promote the regional development with agriculture as the main industry. In this viewpoint, a systematic road network must be build. Such a network includes farm roads to rice mills and processing factories, and highways connecting the area with those main consumint cities such as Bandjarmasin, Bandjar Baru and Martapura. The tentative layout of the road network is as shown in Plate 1, and the principal features are as shown below.

Classification	Name of road	Effective width (m)	Length (km)	Metalling
Main road	Bandjar-Bati	7.0	34	Gravel
"	Irrigation control	"	36	Gravel
"	Central	"	24	Gravel
"	Western	"	9	Gravel
Total			103	
Branch farm road		5.0	320	Gravel

3-6 Reclamation and Consolidation

In order to operate effectively the irrigation and drainage facilities, and to carry out properly the fertilization, pest and disease control and mechanization of farming, land reclamation and land consolidation of the existing farmland have been planned for the project area. The standard size of a plot and the area to be developed are as shown in the following table.

Table 3-3 Standard Size of Plot

Land category	Main crop	Natural slope	Standard size a farm	Area (ha)
Cultivated land				
Paddy field	Double crop of paddy rice	Level	$150^{m} \times 67^{m}$ = 1.0 ha	12,000
Undeveloped land				
Paddy field	Double crop of paddy rice	Level	$150^{m} \times 67^{m}$ = 1.0 ha	13,000
Paddy field	Paddy rice + vegetables	1/2,000	"	2,000
Upland farm	Three crops of vegetables, fodder crops	1/1,000		1,000
Orchard	Pineapple, banana, and orange	1/500		2,000
Total				30,000

3-7 Establishment of Pilot Farms and Farmers1 Organization

In order to increase agricultural production and raise the level of agricultural income mentioned in the farm management plan, it is necessary that all farmers in the project area become fairly proficient in the irrigation farming. However, it is not possible to expect the farmers presently residing in the project area to satisfy all the necessary conditions for the irrigation farming.

Almost all farm houses have no experience of the irrigation farming which requires fertilization, and further researches must be carried out concerning the selection of varieties and the methods of raising, and also to find out the most appropriate method of raising for this project area.

Hence, it is necessary before carrying out the agricultural development project in this project area to establish a pilot farm of a suitable scale (about 100 ha), station several agricultural specialists, and to fully utilize the results of the tests obtained. This pilot farm will carry out the followings.

1. Adaptability tests relevant to double cropping of paddy rice (Selection of varieties, improvement of cultivation method, establishment of the standard method of cultivation, establishment of the system of farming and the rational scale of farm management)

2. Introduction of improved farming technique to the farming people

3. Training of extension agents

4. Training on farm management techniques for the prospective settlers and those farmers expecting to expand their holdings

Again, this pilot farm, after the commencement of settling and expansion of holdings, besides those businesses mentioned above, will play the role of a guidance institution to teach the settlers and the acreage increasing farmers the improved techniques of farm management. It will also give guidance on the maintenance and control of the irrigation facilities and on farmers' organizations.

In short, diffusion of the techniques of farm management and formation of the farmers' organizations are essential for raising the level of agricultural production and income.

What are required first of all by the farmers in the project area are the irrigation association to carry out rational water use, soil improvement, and maintenance and control of facilities, and the agricultural cooperative association which takes charge of the supply of materials necessary for farm management, storage, processing, marketing, shipment, etc. of the agricultural products.

To avoid duplication of the farmers' organizations and to unify the activities, the agricultural cooperative association may function as the irrigation association at the same time.

As the site for the pilit farm, the neighborhood of Martapura would be most suitable.

4. CONSTRUCTION SCHEDULE

Since the greater portion of the project area is in the swampy land, the major construction works will be carried out by avoiding the rainy season as much as possible. This is because the major construction works mostly involve earthwork such as the construction of earth canals, roads, land reclamation, etc. Mechanical power will be employed as much as possible for the construction works, except at the sites for the structures. The tentative construction schedule is as shown in Fig. 4-1.

Fig. 4-1 Construction Schedule

Item of work		1st year					2nd year					3rd year					4th year					5th year					6th year				
		F	A	J	A	O	F	A	J	A	O	F	A	J	A	O	F	A	J	A	O	F	A	J	A	O	F	A	J	A	O
1. Preparatory works																														
2. Intake structure																														
Earth works	60,000 m^3																													
Concrete	6,500 m^3																													
3. Irrigation canal																														
Total length	242.3 km																													
Earth works	4,000,000 m^3																													
Concrete	9,000 m^3																													
4. Pumping Station																														
P.S. No.1	240kW x 4nos																													
P.S. No.2	330kW x 4nos																													
5. Drainage canal																														
Total length	233.5 km																													
Earth work	6,500,000 m^3																													
6. Farm road																														
Total length	119 km																													
Earth work	500,000 m^3																													
Gravel	600,000 m^3																													
7. Land consolidation																														
Unreclaimed land	18,000 ha																													
8. Priming test and adjustment																														

5. CONSTRUCTION COST

The construction cost required for the implementation of this project including preparatory works is roughly estimated as shown in the following table. The estimate does not include any import duties or taxes levied on equipment, materials, etc.

Table 5-1 Estimate of Construction Cost

Unit: 1,000 US$

	Local currency	Foreign currency	Total amount
1. Preparatory works	300	200	500
2. Intake structures	150	670	820
3. Irrigation canals	1,460	1,970	3,430
4. Pumping station	110	1,010	1,120
5. Drainage canals	1,350	2,000	3,350
6. Farm roads	1,780	1,250	3,030
7. Land consolidation	2,160	3,240	5,400
8. Sub-total	7,310	10,340	17,650
9. General expenses and Engineering services	750	1,100	1,860
10. Contingency and reserves	1,440	2,050	3,490
11. Total	9,500	13,500	23,000

Considering the stepwise development, the construction cost required for the implementation of about 10,000 ha in the first priority area is roughly estimated as shown in Table 5-2.

Table 5-2 Cost Estimate for the First Step, 10,000 ha

Unit: 1,000 US$

	Local currency	Foreign currency	Total amount
1. Preparatory works	300	200	500
2. Intake structures	150	670	820
3. Irrigation canals	600	800	1,400
4. Drainage canals	450	650	1,100
5. Farm roads	360	420	780
6. Land consolidation	430	650	1,080
7. Sub-total	2,290	3,390	5,680
8. General expenses and Engineering services	230	340	570
9. Contingency and reserves	460	690	1,150
10. Total	2,980	4,420	7,400

6. ECONOMIC EVALUATION

6-1 Direct and Indirect Benefit

With the advance of improved irrigation farming after completion of the project, the agricultural production will increase year after year. It is expected that about 3.5 ton/ha/crop of paddy will be produced in and after the fifth year of irrigation practice.

Consequently, an annual production of approximately 180,000 tons of paddy can be expected in this project area (see Section 3-2), which will give an increased yield of 158,000 tons compared with the present yield of about 22,000 tons in the same area. This amount of increased production corresponds to about 120% of the annual deficit of 126,000 tons in South Kalimantan Province.

In the meantime, the annual income of a standard farm having 2.5 ha of farmland will be as shown below.

	Per farm US Dollars)[1]	Entire project area (US$1,000)
1) Gross income	875	10,500
2) Farm operating cost	370	4,440
3) Net income	505	6,060
4) Living expense	260	3,120
5) Capacity to pay	245	2,940

1) This estimate is based on the field survey made in September 1970, i.e., the average price of paddy at farm was 19 Rp/kg in South Kalimantan. The conversion rate of Rupiah to US Dollar is 380 Rp/US$.

Besides the direct benefits mentioned above, benefits stemming from transportation, wholesale, retail, processing, etc. in the course of distribution of the agricultural products from the farms to the consumers, and benefits induced by the purchase of the agricultural machinery and materials and the increase in living expenses can be expected. Other benefits such as the elevation of the living standard of the farm households, improvement of environmental sanitation, consolidation of roads, rise in land value, increase in the income of the agricultural workers, increase in taxes, etc, can also be expected.

6-2 Economic Feasibility

For the evaluation of the economic feasibility of the project, the only direct benefit, namely, the increase of net farm profit (capacity to pay), is considered for the sake of conservative evaluation. The computation of annual benefits and costs has been made on the following assumptions:

	Economic useful life of system	50 years
	Annual interest rate	3%

The benefit-cost ratio is then calculated as follows:

i)	Annual equivalent benefits	2,785,000 US$[1)]
ii)	Annual equivalent costs	
	Annual construction cost	23,000,000 x 0.0389 = 895,000
	Annual operation & maintenance costs	345,000[2)]
	Total	1,240,000 US$
iii)	Benefit-cost ratio	2,785,000/1,240,000 = 2.25[3)]

1): Annual increase of benefits in the first 4 years was assumed to be about 60% on an average. Annual equivalent benefit was computed by multiplying the annual benefit by 0.0389 of capital recovery factors.

2): Annual operation and maintenance cost was assumed at 1.5% of the construction cost.

3): When the price of dry paddy is assumed to be Rps.15/kg, the benefit cost ratio will be calculated as 1.60.

Judging from the above-mentioned benefit-cost ratio, this project is economically sound and is a profitable project. Again, this benefit-cost ratio does not include such indirect benefits nor the benefit from increase in land value mentioned before.

6-3 Relevant Projects

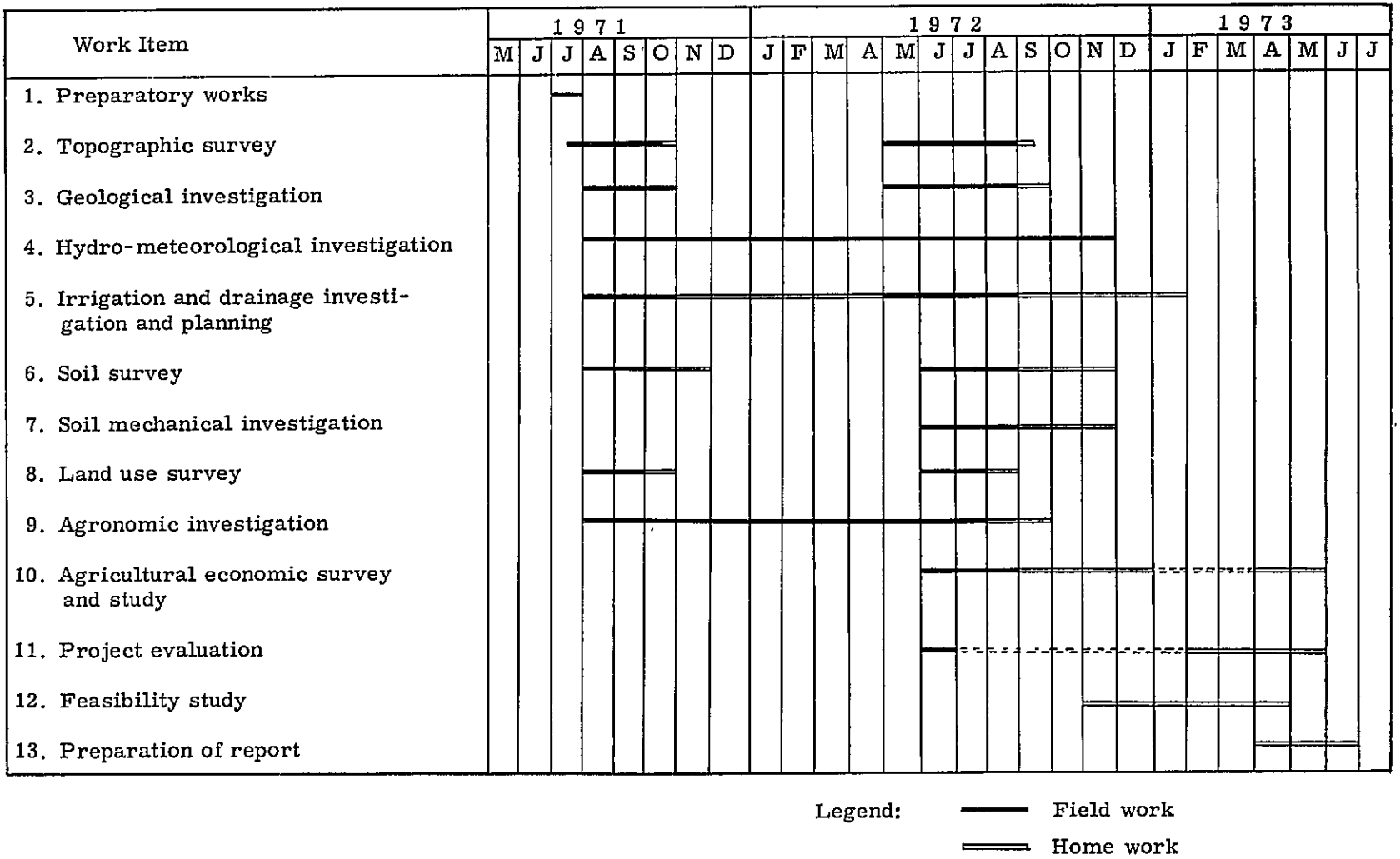
Upon implementation of the Riam Kanan Irrigation Project, considerable amount of return flow from the irrigation water in the project area can be expected. It would be possible to upply irrigation water to the tidal irrigation project area extending over the southern part of Bandjarmasin, which commands an acreage of approximately 25,000 ha including approximately 10,000 ha of existing far farmland.

The consolidation of the road network will also bring about considerable benefits not only to the traffic and transportation in the South Bandjarmasin area but also to the transportation of agricultural products in the areas around Batibati. Moreover, it would be possible to use this irrigation system for the municipal water supply system in the Bandjar Baru area, which is expected to become the future administrative center of the South Kalimantan Province.

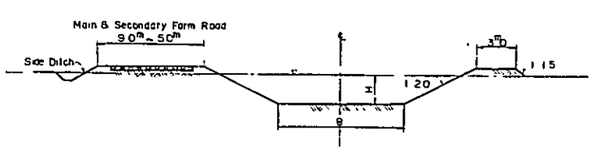
7. SCHEDULE OF FEASIBILITY STUDY

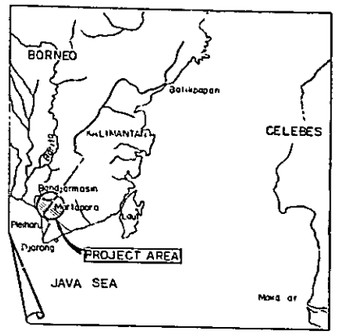
From the results of above rough studies, it is obvious that the project is technically and economically sound and is the most attractive project in the Barito River basin. Accordingly, the more detailed feasibility study is strongly recommended. The time required for the feasibility study is considered to be about 2 years as shown in Fig. 7-1, for which about 450,000 US Dollars of cost would be needed.

Fig. 7-1 Work Schedule of Feasibility Survey and Study

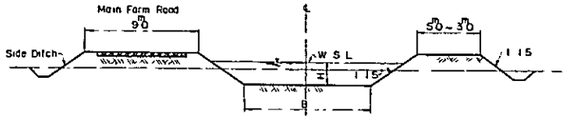


SECTION OF MAIN DRAINAGE CANAL





SECTION OF MAIN IRRIGATION CANAL



LEGEND

- Main Irrigation Canal
- Secondary Irrigation Canal
- Main Drainage Canal
- Secondary Drainage Canal
- Main Farm Road (New Construction Road)
- Existing Road
- Irrigable Area
- Irrigation Pump Station

SCALE

0 5 10 Km

PLATE 1

TENTATIVE GENERAL LAYOUT OF THE RIAM KANAN IRRIGATION PROJECT.