general, most of the wet season crops are sown in August and September and are harvested from December to February. Dry season crops start in February/March, after harvesting of the wet season crops. Mixed culture of palawija crops is common practice in the study area. The harvested area of crops is summarized as follows.

(Unit: ha)

	Wet Season*1	Dry Season*1	Total
Paddy - Wet land paddy	102	-	102
- Dry land paddy	776	422	1,198
Maize	255	343	598
Soybeans	150	238	388
Groundnuts	62	116	178
Green beans	33	64	97
Cassava	131	105	236
Rubber			500
Sub-total			3,296
Vegetables and perennial crops (Home yard)			219
Total			3,515

Remark: *1 Average figure between 1986 and 1987.
Source: Programa Penyuluhan Pertanian 1988/1989, BPP Dalu-Dalu, Dinas Pertanian Tanaman Pangan Kabupaten Kampar.

The harvested area of paddy in the study area is estimated at about 100 ha for wet land paddy and 1,200 ha for dry land paddy. These figures correspond to 0.3% and 39% of total farm lands, respectively. The palawija crops are about 1,500 ha, corresponding to 48% of the total farm lands. In addition to these crops, about 220 ha of vegetables and perennial crops are cultivated mainly in home yard. Present cropping intensity in the area is estimated at 106%.

3.5.4 Farming Practices

(1) Wet Land Paddy

Local improved varieties of paddy have been widely introduced throughout the area. Local varieties are still used mainly for home consumption and local marketing. Paddy seeds are sown at rate of 25 to 30 kg per ha in the nursery. Transplanting is generally carried out by hand. The land preparation is made before transplanting using animal power.

The fertilizers being used in the area are urea, triple superphosphate (TSP) and potassium chloride (KCl). The average dosages are 91 kg, 12 kg and 4 kg per hectare, respectively. Weed control is carried out manually on two to three occasions per crop. Application of insecticides is common practice, and these dosages average 2.4 liter/ha. Harvesting is mostly carried out by using sickles or ani-ani. The harvested paddy is immediately threshed, and is dried on the field or home yards.

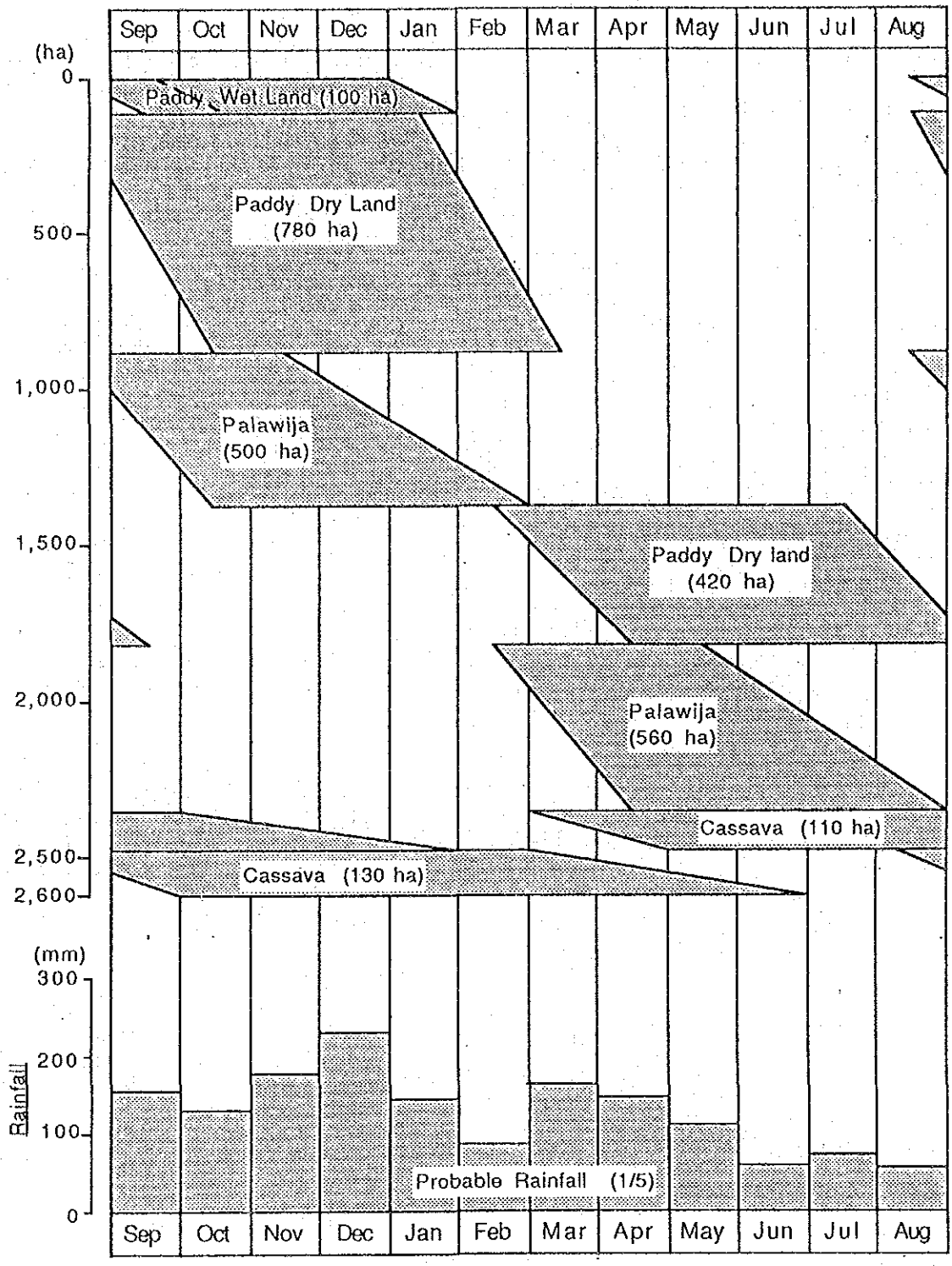

Fig.3.4 Present Cropping Pattern

(2) Dry Land Paddy

Main varieties of dry land paddy grown in the study area are Perak, Mutiara, etc. Direct seeding is common practice among the farmers, and the seed rate is about 38 kg/ha. Seeds are sown by using a wooden stick. Before seeding, plowing is done once to twice by animal and man power. The application of fertilizers and agro-chemicals is common among the farmers, and the average dosages per hectare are 63kg of urea, 44 kg of TSP, 11 kg of KCl and 1.6 liter of insecticides. Weeding is carried out by hand several times. Harvesting is carried out by the same method as for wet land paddy.

(3) Secondary (Palawija) Crops

The cultivation methods for palawija crops are very primitive, and mixed culture is common practices. After the burning of grass, plowing is done once or twice by animal and man power. Seeding is done manually by using a stick. Most of the varieties used in the study area are local, and the seed rate per hectare ranges between 25 and 30 kg.

Fertilizers and insecticides are applied, except for cassava. The application amounts of fertilizers including urea, TSP and KCl average 90 kg/ha for maize, 33 kg/ha for groundnuts, 106 kg/ha for soybeans and 11 kg/ha for green beans. The dosage of insecticides is estimated at 1.5 liter/ha on an average of palawija crops. Two to three weedings are done by hand, and herbicides are sprayed by several farmers. Harvesting is done manually. Processing and drying are carried in home yards.

3.5.5 Crop Yields and Production

The present average yield and production of crops grown in the study area were estimated below.

Crops	Harvested Area (ha)	Production (ton)	Yield (ton/ha)
Paddy - Wet land	102	283	2.8
Paddy - Dry land	1,198	1,390	1.2
Maize	598	760	1.3
Groundnuts	178	160	0.9
Soybeans	388	280	0.7
Green beans	97	60	0.6
Cassava	236	1,650	7.0

Source: Programa Penyuluhan Pertanian 1988/1989, BPP Dalu-Dalu.

The average yields of paddy in the study area are estimated to be 2.8 tons/ha for wet land paddy and 1.2 tons/ha for dry land paddy. These yields are still low as compared with the average

yields in Riau Province of about 3.3 tons/ha and 1.6 tons/ha, respectively. Such low yields are thought to be caused by various factors such as poor soil fertility, traditional farming practices, low input levels of fertilizers and agro-chemicals. Of these, the biggest constraint is water stress such as drought.

Yields of palawija crops vary substantially with varieties, soil fertility, rainfall condition and density of farm inputs. Yields are also badly affected by wild boar damage.

3.5.6 Livestock Production

The number of livestock grazed in the study area was estimated as follows:

(Unit: head)

Livestock	Cattle	Goat	Chicken	Duck
Total Number	1,900	150	34,000	150
Per Farm Household	0.62	0.05	11.07	0.05

Source: Programa Penyuluhan Pertanian 1988/1989, BPP Dalu-Dalu.

Most livestock are grazed on a small scale in and around the farm land and home yard, and annual income derived from livestock raising is of little significance to the farm economy. As far as livestock raising in the area is concerned, however, it plays an important role not only in farm operation but also in protein food supplies for local people.

3.5.7 Marketing and Prices

(1) Marketing

Most paddy produced in the study area is consumed by farmers themselves, and only a small quantity is sold at local markets in and around the study area either by the farmers themselves or through brokers in order to get some cash income. The palawija crops are also consumed by farmers and the surplus produce are sold in local markets like the paddy.

Market flows of major farm inputs such as fertilizers and agro-chemicals may be broadly divided into two flows; i.e. free market flow and controlled market flow. The latter is for crop intensification programs which are controlled by the Government. For the farmers under these programs, distribution of fertilizers is mainly handled by P.T. Pusri, and agro-chemicals and some farm implements are dealt by P.T. Pertani, the government enterprise.

Fertilizers and agro-chemicals used in the area have been distributed to the farmers through the distribution networks of P.T. Pertani and P.T. Pusri consisting of Kiosks of KUD.

(2) Demand and Supply of Rice

In the study area, the net supply of rice was estimated at about 1,080 tons, while the demand for rice was 1,960 tons. As a result, a rice shortage in the area of about 880 tons was identified. This shortage has been met mainly from North Sumatra Province.

(3) Prices of Farm Inputs and Outputs

The present farm gate prices of farm products and farm inputs in the study area were estimated as follows, on the basis of the data obtained from Agricultural Offices and through the farmers' interview survey.

(Unit: Rp/kg)

Paddy	210	Green Beans	600
Maize	175	Cassava	50
Groundnuts	680	Fertilizers	135
Soybeans	500	Agro-chemicals	5,000

Remark: As of September 1988.

The price of rice has been controlled by the Government. In order to stabilize the price of rice in the market, DOLOG generally purchases rice when the market price falls below the floor price, and when the price is over the ceiling price, DOLOG sells its stock.

3.5.8 Processing and Storage Facilities

There are 10 rice mills in the study area. Most of these rice mills are privately owned. The capacity of one unit is estimated at 4 tons/day for paddy and total milling capacity per day amounts to 40 tons. Assuming that there will be 60 workable days per crop season, this capacity would be sufficient for present production estimated at 1,670 tons.

The total number of storage facilities is estimated at 8 godowns which have floor space of only 40-60 m^2 per unit. The farm inputs and subsidies from the WFP Project are temporarily stored until its distribution to farmers. There are no facilities for storage of crops produced in the study area, and most of these are stored in farmers' houses.

3.5.9 Profitability of Crops

The crop budget analyses for each crop grown in the study area were made on the basis of the data and information obtained from agricultural office and the farm interview survey. The results of analyses are summarized below.

(Unit: Rp 10^3/ha)

	Gross Income	Production Cost	Net Income
Wet land paddy	588	259	329
Dry land paddy	252	234	18
Maize	227	217	10
Groundnuts	612	228	384
Soybeans	350	266	84
Green beans	360	143	217
Cassava	350	157	193

The main crop grown in the study area is dry land paddy, which accounts for about 43% of the total harvested area. The farmers expend a great efforts on paddy cultivation, nevertheless, the net income which they get in return for their work is negligible, due to low yields. To improve the productivity of their paddy, the farmers desire to cultivate wet land paddy under irrigation.

3.5.10 Farmers' Economy

In order to clarify the economic activities and living standards of farmers (transmigrants) in the study area, a farm budget analysis was made on the basis of a crop budget analysis and the farm interview survey. The results of the analysis are summarized below:

(Unit: Rp 10^6; Sept.1988)

Item	With Subsidy*1	Without Subsidy
I. Gross Income	737	737
Farm Income	386	386
Off-farm Income	351	351
II. Gross Outgoings	732	953
Production Cost	70	70
Living Expenses	662	883
- Foods	(452)	(673)
- Others	(210)	(210)
III. Net Reserve	5	-216

*1 Subsidies from WFP (FAO Project)

A considerable amount of the gross income is derived from off-farm income consisting of wages earned from other farms or non-farm works. Food expenses amount to 68% represent the largest portion of total living expenses. The net reserve is negligibly small, which is estimated at about Rp. 5,000. This indicates that the farmers in the study area have no reinvestment funds for improvement of their farming activities. As a result, it can be said that farmers' economy in the study area remains at the subsistence level.

3.6 Agricultural Support Services

3.6.1 Agricultural Research

In Riau Province, there is no agricultural research station. Agricultural research in this province is covered by the West Sumatra Branch Research Station, Sukarami. The main activities of this station are to execute experimental work under the instruction and supervision of the Central Station at Bogor and to collect information from extension services on the technical problems associated with the farming practices of local farmers.

3.6.2 Extension Services

In Riau Province, the total number of staff for extension is 14 subject-matter specialists (PPS), 132 extension supervisors (PPM) and 424 field extension workers (PPL). The PPS resident in each Kabupaten and advises about 10 PPMs of which 2 to 4 are working in Kabupaten Office and the rest are staying in the Rural Extension Center (BPP). The PPMs in BPP assist and advise about 7 to 10 PPLs. Each PPL is required to visit a farmers' group (Kelompok Tani) in each extension area once a week. In general, there are 8 extension areas under each village unit. One PPL visits 2 extension areas a day and all 8 areas over 4 days from Monday to Thursday every week, and receives training on Friday and Saturday.

The study area is covered by BPP Dalu-Dalu. The total number of staff in this BPP are 2 PPMs and 14 PPLs including 8 PPLs for food crops, 5 PPLs for estate crops and one PPL for livestock.

3.6.3 Agricultural Credit

The Indonesian People's Bank (Bank Rakyat Indonesia/BRI) is the state bank specializing in agricultural credit covering the whole country. The Bank is authorized to finance agricultural credit for qualified individual farmers. In order to provide an efficient loan service, BRI has a broad network consisting of regional offices, branch offices and sub-branch offices (called BRI Unit Desa or Village Unit BRI).

According to Memorandum No. 18 of the Agriculture Minister dated January 31, 1985, the BIMAS package system has been replaced by other credit system as follows: continuation of the BIMAS credit which uses the free credit system through a reliable KUD as an intensification credit channel, whereby the farmer can get a loan which is not limited by a package, and is therefore according only to their requirements.

In addition to the above credit, there are three credits; General Credit for Rural Areas (Kupedes), Small Investment Credit KIK) and Pre-financing Loan for Working Capital (KMKP). The former (Kupedes) can be utilized by farmers if a reliable KUD is

not available. Since May 1984, this credit has been extended through BRI village units for farmers who have more than 1.0 ha of sawah and 2.0 ha of upland. The second (KIK) is a Government credit program especially for small investment which is applied to land development programs where new paddy fields are to be constructed as well as KMKP. This credit is financed by cash with an interest of 1.0% per month, and has the repayment period of 4 years. The latter (KMKP) form a link in the chain of the Land Development Project, and has for its object to promote on-farm development of the farmer's group.

The KUDs in the study area have loans (BIMAS, KIK, etc.) from BRI Pasir Pengarayan. Their credit amount and its repayment situation are shown below.

(Unit: Rp 1,000)

	Credit	Repayment	(%)
SKP-C	3,400	2,465	72.5
SKP-D	18,650	13,091	70.2

Source: BRI Bangkinang.

3.6.4 Agricultural Cooperative

The existing agricultural cooperative (KUD) system was established in accordance with Presidential Decree No. 4, 1984. The purposes of the system are to increase production of food crops, and to support farmers in marketing their own produce. The main activities of KUD are as follows:

a) To purchase farm products directly from farmers and to sell them to DOLOG,

b) To supply farm inputs such as seeds, fertilizers and agro-chemicals, and

c) To channel agricultural credits from BRI to farmers.

In the study area, 6 KUDs have been organized so far. The total number of KUD members including candidates is about 49% of total farm households in the study area.

3.6.5 Land Reclamation Services

(1) Land Development Project

The DPU is responsible for implementation of irrigation projects. For construction of these projects, however, the responsibility of DPU is limited to up to the secondary canal and 50 m of tertiary canal from its turnout structure, and on-farm development within the tertiary irrigation block such as tertiary and quaternary canals, farm ditch, farm road and land reclamation

of field is left to the farmer's hand. Because of the lack of funds, inadequate local leaders and insufficient technique, this on-farm development is usually delayed in its commencement. In order to promote and facilitate the construction of this development, the Land Development Project was introduced by the Ministry of Agriculture in 1979. The Project has two components; i.e. the establishment of the pre-financing loan for working capital (KMKP) and the Small Investment Credit (KIK).

Other than credit services, the Government also assists the farmers free of charge by providing survey, design, guidance and supervision for construction works of on-farm development. The LD Project is executed under the responsibilty of the Director General of Food Crop Agriculture, and as the executing agency, UPP (UNIT PELAKSANA PROYEK) is organized in each province.

(2) PTPT

PTPT (or PLPT) is one of the new organizations established under the Ministry of Public Works with the objectives of strengthening coordination between the Transmigration office, UPP Office and Agricultural Office, and executing the transmigration program related to the Ministry of Public Works. The operation of PTPT is controlled directly by the Provincial Public Works, and has the following tasks; i) survey and planning for land clearing and public facilities, ii) execution of land clearing and iii) construction of public facilities.

The land and public facilities reclaimed and constructed by the PTPT will be handed over to Kabupaten Transmigration Office after 5 years from the completion of those facilities.

3.7 Related Projects in the Study Area

3.7.1 Existing Transmigration Project in the Study Area

Most of the farmers in the study area are transmigrants who were settled through two transmigration projects called Tanjung Medan SKP-C and -D. The settlement was started in December 1981. The SKP-C and -D comprise 9 transmigration villages; Desa Utama (DU), Desa Kucil (DK)-I, -II, -III, -IV of SKP-C; and DU, DK-I, II, V of SKP-D. Of these, the study area covers 7 villages except for DK-I of SKP-C and DK-V of SKP-D.

The number of existing transmigrants in the study area is 2,970 families as of June 1988. The land allocated to one family is 2.0 ha comprising farm land and home yard.

Home yard: 0.25 ha

Farm lands: 1.75 ha

First arable farm land (Lahan Usaha I)
- 1.00 ha (Paddy field)

- Land clearing is done by the Ministry of Transmigration, but land leveling is left to the transmigrant.

Second arable farm land (Lahan Usaha II)
- 0.75 ha (Not specified for land use)
- Land clearing and leveling are done by the transmigrant himself.

The total areas of farm land which were allocated initially by the Government are 5,325 ha. The progress of land reclamation including clearing and leveling as of April 1988 is summarized in the following table. More than 80% of the first arable farm land has already been reclaimed by the Ministry of Transmigration and transmigrants, but reclamation of the second arable farm land has been hardly started by the transmigrants.

(Unit: ha)

	Initially Allocated Area	Reclaimed Area	(%)
First arable farm land	3,041	2,486	81.7
Second arable farm land	2,284	877	38.4
Total	5,325	3,363	63.2

Source: Laporan Buran April 1988, Kantor Departemen Transmigrasi, Kabupaten Kampar.

In order to settle the transmigrants successfully, the Government has provided infrastructures with a considerable amount of subsidies consisting of certain quantities of living accommodation and commodities needed for their farming and living, during an initial period of 12 months after settlement.

3.7.2 Forest Conservation

The higher land in the outside of the border in the south-west of the study area is the projection area (HUTAN LINGUNG) by the Forestry office. Other land surrounding the study area consists of the permissible land in which the special trees could be cut (HUTAN PRODUKSI TERBATAS : HPT), non-specified land (HUTAN PRODUKSI YANG DAPAT DIKONVESI), the land scheduled for the transmigration, etc. At present, P.T. ROKAN TIMBER, P.T. ALAM SUBUR and other firms have the right to cut the tress in the area surrounding the study area.

Main trees growing in the study area are as follows :

- Kulin
- Meranti
- Medang
- Marpuyan
- Balam
- Kumpai
- Prupuk
- Marilam
- Kamayam

With regard to the area on the right side of the Kumu river in the upstream part of the study area, the Provincial Government permitted to construct a plantation of about 4,800 ha for rubber, coconut, chocolate etc. to P.T. HUTAHAEN in November 1987. The right bank main canal for the Project is planned to pass the above area and the right of way is estimated at about 5 Km in length and 0.60 m in width.

The catchment area of the proposed weir consists of 65 Km2 in the Riau Province and 475 Km2 in the Noeth Sumatra Province. The catchment area in the riau Province is mostly covered with secondary trees at present and used by local inhabitants for rubber, coffee, burning field, bushes, etc. In the catchment area of the North Sumatera Province, the transmigration area (Ujung Batu PK-I/V) of 2.525 ha in total, which is located at 15 Km to 40 Km in the upstream part of the proposed weir site, was already developed and rain-fed paddy cultivation and upland cultivation area carried out in the low land and the land with slope respectively. It is desirable to develop the catchment area at a minimum extent from the view points of the conservation of catchment area and reservation of forest.

3.7.3 Road Construction

As described in 3.4.1, the road construction plans in and around the study area include

i) Rehabilitation of the transmigration road in the study area

ii) Second stage rehabilitation of the provincial road from Rantau Berangin to the North Sumatra Province

iii) Construction of the trunk road for Dumai port to the North Sumatra Province.

The road rehabilitation plan in the study area by the Transmigration Office for item (i) is as follows:

a. Rehabilitation of road in SKP-C, Tanjung Medan (changed the name from SKP-E at present)

- Access road	Dalu-Dalu to SKP boundary	26.00 Km
- Main village road 1st	Junction to DKI	3.00 Km
	DU to KI-II	5.62 Km
	2nd Junction to DK-III	9.00 Km
	DU to DK-IV	4.51 Km
	Total length	22.13 Km

b. Rehabilitation of road in SKP-D, Tanjung Medan (changed the name from SKP-F at present)

- Access road	SKP boundary to DU	10.00 Km
- Main village road	1st Junction to DK-III	2.00 Km
	2nd Junction to DK-I	4.30 Km
	3rd Junction to DK-V	14.50 Km
	4th Junction to DK-II	2.51 Km
	Total length	23.31 Km

Rehabilitation of structure

Name of Place	Timber bridge	Iron bridge	Timber culvert	Concrete culvert
SKP-C	Nos.	Nos.	Nos.	Nos.
Access road	30	1	3	8
Main village road	19	1	-	14
SKP-D				
Access road	3	-	-	4
Main village road	12	-	-	10

The Second Stage Development Program (S.S.D.P.) is implemented by the transmigration office using the IBRD loan during the period of six (6) years from 1988/89 to 1993/94.

The total cost for SKP-C and D consisting of the costs for infrastructure land clearing, tree crop, live stock , subsidy food crop, support service, etc. is estimated at about Rp. 17,000 x 106 at present, but there is no irrigation plan.

3.7.4 Agricultural Development Projects

In the study area, there are one FAO program, three World Bank projects and one private project; i.e. i) World Food Program (WFP), ii) Small Holder Rubber Development Project (SRDP), iii) International Fund for Agricultural Development (IFAD) Project, iv) Second Stage Development Program (SSDP) and v) the estate project by PT. Hutahaean.

(1) World Food Program (WFP)

The WFP has been executed by the Ministry of Transmigration with the objective of subsidizing the food supply to settlers. This Program was commenced in 1984 and will be terminated in 1988. All of the settlers in the study area have received the above foods from WFP. According to the interview survey of settlers, they had received about 282 kg of rice, 25 kg of canned fish and 15 kg of cooking oil per family in one year.

(2) Small Holder Rubber Development Project (SRDP)

The executive agency of SRDP is the Bureau of Estate. The project period ranges from 1986 to 1990. In order to increase rubber production, SRDP has given credit to small farmers in the form of rubber seedlings and land reclamation costs for rubber fields. In the study area, there are about 16 ha of SRDP, which is located near the DK-II of SKP-D. For the distribution of rubber seedlings to the farmers, SRDP has nursery farms of 180 ha in Desa Pasir Pengarayan in Kabupaten Rambah.

(3) International Fund for Agricultural Development (IFAD)

All cattle raised in the study area were supplied through the IFAD Project which is executed by the Bureau of Livestock. The period of this Project is ten years from 1983 to 1992. The main objective is to supply animal power to farmers. The farmers who need animal power can receive one (female) or two (male and female) adult cattle from IFAD Project. Repayment is made by the cash equivalent to two calves for one adult cattle or three calves for two adult cattle.

(4) Second Stage Development Program (SSDP)

The Second Stage Development Program has been carried out by the Ministry of Transmigration with finance and technical cooperation of the World Bank. The Project aims to improve the welfare and low income of large numbers of transmigrants, and covers the whole country. In the study area, the following rehabilitation and improvements have been planned under this project.

a) Rehabilitation of road between DU of SKP-C and Dalu-Dalu.
b) Rehabilitation of road and bridge:
   - Road 18,600 m - Bridge 4 nos.
c) Improvement of shallow wells: 80 nos.
d) Reconstruction of houses: 230 nos.
e) Land clearing and relocation of farm land: 2,540 ha

In addition, cultivation of perennial crops such as hybrid coconut and rubber has been promoted by SSDP in the SKP-C and -D.

(5) Estate Project

A private company (PT. Hutahaean) has planned an estate project for rubber, coconut palm, cacao, etc. This project is located on the right bank of the Kumu river, and borders on the farm land of DK-II, SKP-C and the Kumu river between Kota Bangung and its DK-II. The total area is about 4,800ha. The main canal which will be planned by the Batang Kumu Irrigation Project will be constructed in the northern part of this estate project. It is necessary for there to be some arrangement and coordination between the parties immediately interested.

4. THE PROJECT

4.1 APPROACH TO THE PROJECT

4.1.1 Objective of the Project

The objective of the Project is to implement an irrigation project mainly for paddy cultivation aiming at contributing to increase the yield for food products to realize an economic stability in the region, and encourage the transmigration scheme and the regional development.

In the study area, the transmigrants of about 3,700 households have settled from the East Java, Central Java and Bali Island since 1981. The transmigration program has played an important role in spraisely populated area in the outer islands for agricultural development and contributed in the regional development. In the Riau Province, the peculiarity that it is blessed with substantial resources of oil and natural gas has kept it's finances and it is said that GDP excluding oil and gas has remained lower in comparison with those of the other provinces. The provincial government aims at the regional development with the balance between agriculture and other industries. Therefore, to promote agricultural development in the Project area situated in the agricultural region (northern part of the Province) contemplated by the Provincial Government is not only to contribute to the economic stabilization of the transmigrant in the Project area, but also to imply the realization of a balanced development between agricultural sector and other sectors in the Province.

For this purpose, it is necessary to realize prompt implementation of the following matters for the project area to be transmigration area and with no irrigation and drainage facilities using water resources effectively.

a) Construction of systematic irrigation facilities
b) Improvement of drainage conditions by the construction of drainage facilities
c) Development of paddy field and farm land in the uncultivated land
d) Coordination to the new transmigration/re-settlement plan in newly developed farm land
e) Construction of operation and maintenance facilities
f) Arrangement of agricultural support services and organization.

4.1.2 Project concepts

The main concepts of the Project are to :

a) The project area is selected on the both sides of the Kume river with transmigrants settled
b) The water source facility and intake water level are planned so as not to give the influence of backwater to the North Sumatra Province.

c) The plan of supplemental facilities for irrigation is taken as the one for the future.
d) The irrigable areas are delineated taking into account the above intake facility and water level, possible intake discharge, land suitability, topography, etc.
e) Taking into consideration the Government's policy for development, the farm land is allocated to be 1.0 ha for paddy field and 0.75 ha for tree crop land (rubber, hybridcoconut, etc) per one transmigration family.
f) A general plan for new transmigration in the Project area is studied.
g) To introduce diversified cropping pattern, the irrigation for paddy and polowijo crops in the dry season is planned.
h) Considerable parts of canal are linned taking into account the soilmechanical condition in the Project area.
i) The Project is formulated taking into account the future operation and maintenance as much as possible.

4.2 DELINEATION OF THE PROJECT AREA

4.2.1 Affecting Factors for Delineation of the Project Ares

In the delineation of the Project area, the following factors are taken into consideration.

(1) Location and intake water level of weir

As the intake water level is heightened, long sub-embankment to the weir is needed and the flooding area in the upstream of the weir largely spreads and influences to the North Sumatra Province. In addition, benefited area is not increased so much at the place over the elevation of 55.0 m because of the steep topography. As a result of the comparative study on two places for the proposed weir, the location of the weir was proposed at the place 3.5 km in the upstream from Kota Bangung and the intake water level was decided to be 60.50 m.

(2) Water requirement, irrigable area and diversion water requirement

The irrigation water requirements were estimated with the irrigation efficiency of 55% in accordance with the proposed cropping pattern. As a result, the maximum ten days water requirement was estimated at 1.28 l/sec/ha for wet season paddy, 1.54 l/sec/ha for dry season paddy and 0.32 l/sec/ha for polowijo in the dry season respectively.

The irrigable area is estimated by the relation between the water requirements and the water availability in the river at 7,300 ha for wet season paddy, 3,100 ha for dry season paddy and 2,700 ha for polowijo (groundnut, soybean and maize) respectively. The maximum diversion water requirement was decided to be 9.34 m^3/sec in the wet season and 4.77 m^3/sec in the dry season. During the whole period, the river in the downstream of the weir has remaining discharge.

(3) Land suitability classification

Based on the evaluation of land suitability classification due to erodability of lands, topography flooding condition, drainability of soils, fertility, soil depth for cropping and degree of soil acidity, the project area was generally classified in 5 mapping units. The lands suitable for paddy cultivation were selected in accordance with the above evaluation.

(4) Numer of household of transmigrant and allocated area

Taking into consideration the Government's policy for balanced agricultural development, the farm land was allocated to be 1.0 ha for paddy field and 0.75 ha for second arable farm land for tree crops such as oilpalm, rubber, coconut, etc.) per one transmigration family. Since the number of the existing transmigration families is 3,070, it is possible to settle new transmigrants of 4,230 families and the land use plan is delineated taking into account the homeyard irrigation area, second arable farm land, public land, etc.

4.2.2 Area to be developed

The area to be developed under the Project is delineated to be 21,400 ha on the both sides areas of the Kumu river with the transmigrants already settled. The land use of the Project area was proposed as follows:

Division	Left Side	Right Side	Total
	(ha)	(ha)	(ha)
Gross Irrigation Area	5,000	3,110	8,110
Net Irrigation Area	(4,500)	(2,800)	(7,300)
Tree Crop Land	3,175	2,100	5,275
Home Yard	1,025	700	1,725
Public Land	1,025	700	1,725
Others	1,175	3,390	4,565
Total	11,400	10,000	21,400

Table 4.1 RIVER DISCHARGE,DIVERSION REQUIREMENT & SURPLUS WATER

MONTH	RIVER DISCHARGE m3/s	DIVERSION REQUIREMENT							SURPLUS WATER m3/s
		WET PADDY 7,300ha m3/s		DRY PADDY 3,100ha m3/s		UPLAND CROP 2,700ha m3/s		TOTAL m3/s	
		q	Q	q	Q	q	Q	ΣQ	
JAN. 1	15.67	0.88	6.42					6.42	9.25
2	11.17	1.03	7.52					7.52	3.65
3	8.84	1.12	8.18					8.18	0.66
FEB. 1	7.13	0.88	6.42					6.42	0.71
2	7.03	0.61	4.45					4.45	2.58
3	8.42	0.46	1.39	0.86	2.67			4.05	4.37
MAR. 1	9.74	0.06	0.44	0.69	2.14			2.58	7.16
2	9.48	0	0	1.39	4.31			4.31	5.17
3	8.42	0	0	1.54	4.77			4.77	3.65
APR. 1	7.66			1.28	3.97	0		3.97	3.69
2	10.79			1.05	3.26	0		3.26	7.54
3	8.79			1.18	3.66	0		3.66	5.13
MAY. 1	9.10			1.30	4.03	0		4.03	5.07
2	9.44			1.47	4.56	0		4.56	4.88
3	6.30			1.37	4.25	0		4.25	2.05
JUN. 1	7.26			1.43	4.43	0.05	0.14	4.57	2.69
2	5.63			1.39	4.31	0.07	0.19	4.50	1.13
3	3.55			1.09	3.38	0.05	0.14	3.52	0.03
JUL. 1	4.93			0.69	2.14	0.16	0.43	2.57	2.36
2	4.67			0.19	0.59	0.14	0.38	0.97	3.70
3	6.04			0	0	0.14	0.38	0.38	5.66
AUG. 1	4.83			0	0	0.14	0.38	0.38	4.45
2	4.57					0.16	0.43	0.43	4.14
3	4.46					0.09	0.24	0.24	4.22
SEP. 1	7.38							—	7.38
2	10.31							—	10.31
3	10.22							—	10.22
OCT. 1	10.03	0.55	4.02					4.02	6.02
2	8.11	1.09	7.96					7.96	0.15
3	7.69	1.01	7.37					7.37	0.32
NOV. 1	10.21	1.28	9.34					9.34	0.87
2	9.27	1.22	8.91					8.91	0.36
3	12.86	0.74	5.40					5.40	7.46
DEC. 1	16.52	0.55	4.02					4.02	12.65
2	16.43	0.44	3.21					3.21	13.22
3	19.15	0.69	5.04					5.04	14.11

4.3 Agricultural Development Plan

4.3.1 Proposed Land Use

After completion of the Project, most of the farm field in the area will be fully irrigated, and about 7,300 ha of new irrigated farm field can be reclaimed. The proposed future land use in the Project area would be as follows:

(Unit: ha)

	Development Area	Existing Area	Project Area
- Paddy field (Irrigated)	7,300	-	7,300
- Perennial crops*1	5,480	400	5,880
- Villages*2	2,120	1,400	3,520
- Right of Way*3	800	-	800
- Forest		3,470	3,470
- Others		430	430
Total	15,700	5,700	21,400

*1 Total families x 0.75 ha = 7,300 x 0.75 = 5,480 ha
*2 Includes villages of new transmigrants and resettlers.
*3 10% of gross irrigable area.

Farm land allocated to the transmigrants in the Project area consists of two types; first arable farm land (Lahan Usaha I) and second arable farm land (Lahan Usaha II). Paddy cultivation with irrigation is proposed in the first arable farm land. In the second arable farm land, rubber cultivation without irrigation is recommended in accordance with a plan of SSDP which has been carried out by the Ministry of Transmigration.

4.3.2 Proposed Cropping Pattern

(1) Selection of Crops

Rice would be taken as the suitable crop to be introduced in the Project area, from such considerations as natural adaptability, profitability of crops, marketability and farmers' intention, as mentioned below.

a) Natural Adaptability

The soils in the Project area are marginally suitable for the cultivation of palawija crops, because of serious limitations such as low pH value (pH 4.3 - 5.6) and high aluminum content. But there is no problem for rice cultivation which has wide natural adaptability. From the standpoint of "right crop for right land", it is recommended to cultivate rice in the area.

b) Profitability of Rice

The profitability of rice under the irrigated condition is higher than other food crops such as maize, green beans, cassava, soybeans and groundnuts. The introduction of rice cultivation will produce good results in improving the farmers' living standard.

c) Demand and Supply for Rice

The increase in rice production in recent year has much relieved the shortage of rice supply in the whole country. Such successful increase in rice supply is mainly attributable to the Government's efforts that went into the expansion of the irrigated area and the extension of crop intensification programs. It is expected that the Government's efforts will be continued in order to meet the domestic demand for rice increasing along with population growth.

d) Farmers' Intention

Through the interview survey of farmers, it was confirmed that they have a strong intention to produce rice, whenever provision of irrigation water is permitted.

With regard to the palawija crops, none of these crops are proposed in the area just yet, because of soils limitations. Prior to the introduction of palawija crops, it is necessary to establish advanced and assured farming practices on the soils in the area.

(2) Proposed Cropping Pattern

In order to determine the optimum cropping pattern to be introduced in the Project area, alternative studies were made in parallel with the studies on crop selection. The alternative cropping patterns are summarized below. The studies were made on the first arable farm land where is irrigated by the Project.

	Type-I	Type-II	Type-III	Type-IV	Type-V
Wet Season - Paddy	4,500	7,300	7,300	6,100	7,300
Dry Season - Paddy	4,500	3,100	-	3,050	2,400
- Palawija					
With Irrigation*1		-	5,800	2,750	2,400
Traditional*2		2,700	-	-	1,000

*1 Improved farming with irrigation.
*2 Exclude poor drainage area of 1,500 ha.

The Type-I and -II consist of double cropping of paddy. In due consideration of the natural adaptability, profitability, marketability and farmers' intention as mentioned in "Selection

of Crops", the cropping pattern to be adopted in the Project area would be either Type-I or Type-II.

The Type-III to Type-V are combinations including paddy and palawija crops by improved farming with irrigation, and these are made on the basis of the assumption that soil constraints will be solved by improved farming practices in future. The studies for these types were done in order to clear the possibility of further development in future, though none of these types are recommendable just yet.

As for the Type-II and V, they have fallow areas which are estimated at 2,700 and 1,000 ha except for poor drainage area of 1,500 ha, respectively. In these fallow areas, traditional cultivation of palawija crops such as maize, groundnuts, soybeans and green beans is possible, though good yields of these cannot be expected due to the soil constraints as mentioned in preceding section. It is considered that this traditional cultivation would be carried out by the farmers, in order to get some cash income and/or take the crops for home consumption.

For the determination of the optimum pattern through alternative studies, the following key factors were set; 1) maximum irrigable area, 2) number of beneficiaries and 3) profitability (total net income and net income per ha). The results of alternative study are summarized below.

		Type-I	Type-II	Type-III	Type-IV	Type-V
Development area based on water availability	(ha)	4,500	7,300	7,300	6,100	7,300
Harvested area						
Paddy	(ha)	9,000	10,400	7,300	9,150	9,700
- WSP*1	(ha)	(4,500)	(7,300)	(7,300)	(6,100)	(7,300)
- DSP*2	(ha)	(4,500)	(3,100)	-	(3,050)	(2,400)
Palawija-IR*3	(ha)	-	-	5,800	2,750	2,400
Palawija-TR*4	(ha)	-	2,700	-	-	1,000
Total	(ha)	9,000	13,100	13,100	11,900	13,100
Cropping intensity		2.00	1.79	1.79	1.95	1.79
Number of beneficiaries	(KK)*5	4,500	7,300	7,300	6,100	7,300
Total net income	($Rp.10^6$)	6,224	7,682	7,213	7,354	7,785
Net income per ha	($Rp.10^3$/ha)*6	1,383	1,052	988	1,206	1,066

Remarks: *1 WSP = Wet Season Paddy *2 DSP = Dry Season Paddy
*3 Improved farming with irrigation. *4 Traditional cultivation
*5 KK = Families, Farm Size = 1.00 ha (Paddy Field).
*6 Net income per ha = Total net income / Development area.

Type-I has the highest net income per ha, and the highest economic internal rate of return (EIRR) among the alternatives to be evaluated in this type. Although this would be favorable from a view point of national economy, it may be not recommendable, because the number of beneficiaries would be only 62% of Type-II. This would mean that the development benefits would be to limited to 4,500 families of farmers.

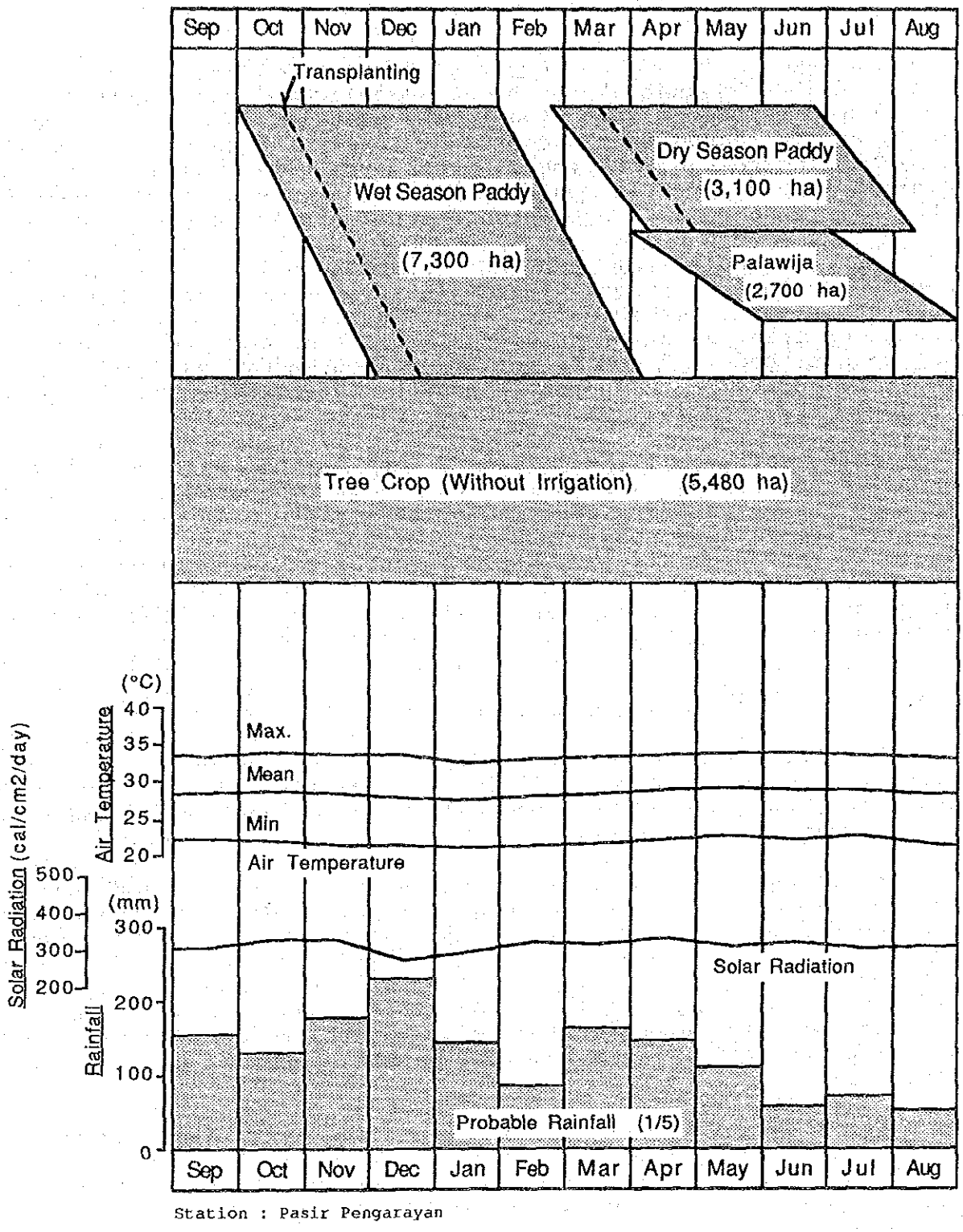

Fig. 4.1 Proposed Cropping Pattern

In case of Type-II, the total cropping area of paddy will reach 10,400 ha, and the number of beneficiaries and development area would be bigger than Type-I. The cropping intensity of paddy could be increased from the present level, though this intensity would be lower than for Type-I. This type will provide equitable distribution of development benefits to a considerable number of the farmers who have a subsistence level of living standard.

As a result, it can be said that Type-II is the most applicable to the Project area. The proposed cropping pattern, together with climatic data, are illustrated in Fig. 4.1. The annual cropping areas of this type are estimated at 7,300 ha for wet season paddy, 3,100 ha for dry season paddy and 2,700 ha for palawija crops. Cropping intensity under the future with project condition is 179%.

As for Types-III, -IV and -V, the introduction of palawija crops can save much irrigation water as compared with paddy, thereby these patterns can create the maximum cropping area. Of these, Type-V makes possible the maximum total net income as a whole. In future, if the introduction of palawija crops becomes possible technically through the experimental works which are proposed in the area, Type-V will be recommended in order to promote further development.

4.3.3 Proposed Farming Practices

The farming practices of paddy to be introduced in the area are proposed as follows. These proposed farming practices will essentially be carried out manually with animal power and some minor tools and equipment.

Early maturing and high yielding varieties like PB 46, PB 56, PB 64, Kelara and Bahhutong are proposed, which have been recommended by the Agricultural Extension Office. The average growing periods of these varieties are 120 days which include 20 days for the nursery period. The seed requirement will be 30 kg/ha. Transplanting will carried out by manual labor, and the spacing of transplanting is set to be 30 cm x 10 cm with 3 seedlings per hill. Land preparation will carried out by animal power.

The total fertilizer requirement for sustaining the target yields would be 200 kg/ha of urea, 100 kg/ha of TSP and 50 kg/ha of KCl. After transplanting, weeding is carried out manually 3 times. As regards plant protection, application of some insecticides is required for the control of brown plant hoppers, stem borers, etc. Considering the life cycle of these insects, 3 lit./ha of insecticides are required for 2 to 3 applications during one cropping season. In addition, spraying of fungicides will be recommended if the outbreak or appearance of diseases is forecast. For ratting, it is necessary to apply 100 gram/ha of rodenticide.

In selecting suitable insecticides and fungicides, chemical

toxicity which directly or indirectly affects the human being should be taken into consideration. Furthermore, fifty seven types of insecticides for enhancing the control of brown hoppers/locusts of paddy plants have been prohibited by the Presidential Decree No. 3 (November 5, 1986). The recommended insecticides are Applaud 10 WP (Buprofezin) for brown plant hoppers, and Furadan 3G, Dharmafur 3G and Curate 3G for stem borers. Mipcin 50 WP, Bassa 50 EC and Hopcin 50 EC are proposed, if there is no Applaud 10 WP. Zinc Phosphate and Clerat are recommended as rodenticide.

Harvesting and threshing are carried out by manual labor. The harvested paddy will be dried on the paddy field or home yard. For threshing, it is proposed to use a treadle thresher, instead of traditional hand threshing, because a lot of grain is being lost by this method. Moreover, it will be recommended that harvested paddy is dried on a sun-drying floor, in order to maintain the quality of the rice.

4.3.4 Anticipated Crop Yields and Production

The unit yields of paddy under the future with project condition were estimated mainly on the basis of actual yields recorded around the Project area. The average yields of paddy (wet land paddy) in Riau Province are rather low as compared with the national average yields. But the high yields show in several Kabupaten as follows.

(Unit: ton/ha)

Kabupaten	1985	1986	1987
Kampar	4.13	4.43	3.99
Indragiri Hulu	3.28	4.40	3.75
Indragiri Hilir	3.82	3.73	4.15
Benkalis	2.93	4.84	3.16
Kepulauan	2.00	2.00	2.00

Source: Laporan Tahunan 1985-1987, Dinas Pertanian Tanaman Pangan Propinsi Riau.

These high yields were obtained under similar climatic condition to those of the Project area. In addition, their paddy fields consist of semi-technical or non-technical irrigation and rainfed areas, whereas all the paddy fields in the Project area will be technical irrigation areas where the water supply can fully controlled. Judging from the above data, a yield of 5.0 tons/ha for both wet and dry seasons can be anticipated under the future with project condition.

The palawija crops under with project condition would be cultivated traditionally by the farmers. High yields of these crops in the Project area, however, cannot be expected due to soil constraints. It is estimated that the yields of these crops

under with project condition remain at present level.

The anticipated yield and production of these crops under the future with project and the future without project conditions are summarized as follows:

Crops	Without Project			With Project		
	Area (ha)	Yield (ton/ha)	Production (ton)	Area (ha)	Yield (ton/ha)	Production (ton)
Paddy-Irrigated	-	-	-	10,400	-	52,000
(Wet season)	-	-	-	(7,300)	(5.0)	(36,500)
(Dry season)	-	-	-	(3,100)	(5.0)	(15,500)
Paddy-Rainfed	1,300	-	1,673	-	-	-
(Wet land)	(102)	(2.8)	(283)	-	-	-
(Dry land)	(1,198)	(1.2)	(1,390)	-	-	-
Maize	598	1.3	760	900	1.3	1,170
Groundnuts	178	0.9	160	900	0.9	810
Soybeans/Green beans	485	0.6-0.7	340	900	0.6-0.7	585
Cassava	236	7.0	1,650	-	-	-

4.3.5 Processing and Storage Facilities

The present milling capacity for paddy in the area was estimated at 5,120 tons per one crop season (128 days = 365 days x 70% / 2 seasons). On the other hand, production of paddy in the area under the future with project condition will amounts to about 36,500 tons in the wet season. Consequently, the present capacity of rice mills will be insufficient for milling the increased paddy production at the full development stage.

At present, there are no storage facilities in the Project area, except for 8 godowns which have a floor space of less than 60 m each. After implementation of the Project, construction of storage facilities would be required in the area.

Such rice mills and storage facilities will be expected to be owned by KUD. Since the irrigation development would be provide a powerful incentive to farmers' cooperative movement in the area, many KUDs having rice mills and godowns will be established over the area.

4.3.6 Marketing of Agricultural Products

The marketable surplus of rice produced in the Project area and the domestic demand to be expected in Riau Province in 2005 were analyzed in order to assess the marketability.

The marketable surplus of rice to be produced in the Project area in 2005 is expected to be about 30,000 tons. On the other hand, the Riau Province had about 130,000 tons of rice shortage

in 1986. In 2005, this shortage will reach about 317,000 tons. By implementation of the Project, the rice shortage would be reduced only by about 30,000 tons or about 9% of its total.

As a result, the marketable surplus of rice produced in the Project area would be marketed in Riau Province with no marketing dislocation, because there is much demand.

4.3.7 Transmigration Program

(1) Land Allocation

According to the criteria of the Transmigration Office, the area of land allocated to the transmigrants is 2.00 ha per family, which consisting of 0.25 ha for home yard and 1.75 ha for farm land. The farm land is of two types, first arable farm land of 1.00 ha and second arable farm land of 0.75 ha. The land use of first arable farm land is paddy field and the land clearing is done by the Ministry of Transmigration. The second arable farm land is perennial crop field, and is opened by the transmigrants themselves. Rubber cultivation without irrigation would be recommended for this land.

(2) Number of Transmigrants

The number of new transmigrants and resettlers who have the irrigated paddy field of 1.0 ha and 0.75 ha of rubber field were estimated at 4,230 families. All of the existing transmigrants living in DU, DK-II, DK-III and DK-IV of SKP-C and DU, DK-I and DK-II of SKP-D are incorporated into this Project. About 100 families in Rantau Kasai village are also included in the Project.

(3) Community Development

For the layout of transmigration villages, group system (nucleate agricultural village community) would be adopted for the Project area, which is common among the existing transmigration villages in Riau Province. Villages by this system consist of Central villages (DU) and Small Villages (DK). The size of DU and DK which are newly established in the area are 600 and 400 families in accordance with the typical size of these existing villages. The total number of new villages is three DUs and six DKs.

In the new transmigration area, the houses and shallow wells adequate to the new transmigrants and resettlers are constructed before the settlement. The number of these facilities are 4,230 houses and 1,060 wells in total. In addition, public facilities such as school, clinic and market will also be constructed by the Government authorities concerned.

(4) Schedule of Settlement

The settlement of new transmigrants and resettlers would be implemented during the 3 years along with the progress of land clearing for Lahan Usaha I. The annual number of families to be settled in the area is estimated as follows:

(Unit: Families)

Year*1	New Transmigrants and Resettlers	Existing Transmigrants and Farmers	Total
1993/1994	1,060	3,070	4,130
1994/1995	2,110	-	2,110
1995/1996	1,060	-	1,060
Total	4,230	3,070	7,300

*1: This is assumption in order to estimate the annual settlement numbers, and does not indicate its real year.

The Transmigration Office is responsible for planning and implementation of this transmigration program. This Office will coordinate the activities of all relevant governmental agencies for implementation of the transmigration program.

4.3.8 Crop Production Cost and Farm Budget

(1) Crop Production Cost

Production cost of crops under "with project" was estimated as shown in the following table. As for the production cost of rubber, it was estimated on the basis of the plan of SSDP, because this crop would be introduced in the area along with SSDP.

(Unit: Rp 1,000/ha)

Crops	Gross Income	Production Cost	Net Income
Paddy	1,050	358	692
Maize	227	217	10
Groundnuts	612	228	384
Soybeans	350	266	84
Green Beans	360	143	217
Rubber	850	485	365

(2) Farm Budget

Typical farm budgets for both the future without and the

with project conditions are analyzed as follows:

(Unit: Rp 1,000/year)

Item	Without Project*1	With Project*2			
		With Palawija*3		Without Palawija*3	
		W. Rubber	W/O Rubber	W. Rubber	W/O Rubber
(Farm Size)	(1.01)	(1.75)	(1.00)	(1.75)	(1.00)
1) Gross Income	737	2,817	2,179	2,586	1,948
- Farm incomes	386	2,466	1,828	2,235	1,597
- Off-farm income	351	351	351	351	351
2) Gross Outgoing	732	1,384	1,234	1,335	1,186
- Production cost	70	501	351	452	303
- Living expenses*2	662	883	883	883	883
3) Net reserve	5	1,433	945	1,251	762

*1 Include subsidy from WFP Project. *2 No WFP subsidy.
*3 Palawija crops are cultivated traditionally in fallow area in the dry season.

The farm incomes of farmers under the future with project condition would be expected to increase remarkably as compared with the future without project condition, and the net reserves would also be improved up to Rp. 0.76 - 1.43 million. The increased net reserves will offer the farmers incentives for further development.

4.3.9 Agricultural Support Services

The following are the main recommendations for improvement and strengthening of agricultural support services related to the Project. It is expected that these improvements and strengthening would be carried out in parallel with the construction of Project facilities.

a) Extension Services

- Conducting training courses for extension personnel, especially about irrigation farming in order to enable them to carry out their duties effectively.

- Introducing improved cultivation and management techniques to farmers such as use of High Yielding Varieties (HYV), practice of new cropping patterns and calendars with project, and operation of field water management for the proper supply of irrigation water and draining off excessive water.

b) Agricultural Credit

BRI sub-branch office in Pasir Pengarayan should

cooperate more with the agricultural services and cooperative offices and work out a loaning plan based on the total acreage of paddy field to be cultivated by the irrigation project.

c) Agricultural Cooperative

With realization of the irrigation project, it is certain that crop production will be greatly increased and the requirements of input supply also. In order to meet the new situation, improvement of and additions to KUD facilities will be indispensable. This means that each KUD should have an adequate rice mill, storage facilities and sun-drying floor.

4.3.10 Pilot Farm

The introduction of palawija crops remains a future possibility, though the soils in the Project area have serious constraints to cultivation of these crops. Namely, if the introduction of palawija crops is possible in the area, the cropping pattern including these crops can create the maximum development benefits overall. In due consideration of these benefits, it is recommended to establish a pilot farm in order to solve the constraints. The objectives of this pilot farm will be to conduct research not only for improvement of farming practices under irrigation but also for their improvement without irrigation, in order to promote further development in and around the Project area.

It is recommended that the pilot farm be organized under the Government authority concerned. The area required for the pilot farm is estimated at around 5 ha.

4.4 IRRIGATION AND DRAINAGE PLAN

4.4.1 Water Resources

All the year round, irrigation water is required for the Project and only the Kumu river is taken as an irrigation water resources for the study.

The runoff analysis shows that the mean annual river discharge is 15.5 m^3/sec and minimum monthly river discharge is 4.6 m^3/sec in the 1/5 years probability. In the annual runoff capacity (490 x 10^6 m^3) of the Kumu river, 75.8 x 10^6 m^3 is used for wet season paddy, 42.8 x 10^6 m^3 for dry season paddy and 2.3 x 10^6 m^3 for polowijo in the dry season. The rate of utilization of river discharge is 25% of annual runoff.

4.2.2 Run-off Analysis

(1) Low water discharge analysis

The run-off analysis was carried out by the tank model method using the data on discharge observed at Kota Bangung (1982 - 1986, 12) and the rainfall data at Pasir Pengarayan. The ten days average discharges and the monthly average discharges at the proposed weir site are as follows:

(Unit: m^3/sec)

Month	First	Second	Third	Average
Jan.	27.18	19.38	15.33	20.46
Feb.	12.94	12.76	15.27	13.60
Mar.	17.80	17.32	15.38	16.79
Apr.	13.68	19.26	15.69	16.21
May	17.39	18.03	12.04	13.59
Jun.	12.67	9.84	6.20	9.57
Jul.	8.62	8.16	10.56	9.16
Aug.	12.18	11.51	11.23	11.63
Sep.	13.12	18.33	18.17	16.54
Oct.	18.77	15.17	14.39	16.05
Nov.	17.42	15.82	21.95	18.40
Dec.	27.64	21.49	32.04	29.15

Further, the ten days average discharges and monthly average discharges in the 1/5 years probability were estimated as follows:

(Unit: m^3/sec)

Month	First	Second	Third	Average
Jan.	15.67	11.17	8.84	11.89
Feb.	7.13	7.03	8.42	7.53
Mar.	9.74	9.48	8.42	9.21
Apr.	7.66	10.79	8.79	9.08
May	9.10	9.44	6.30	8.28
Jun.	7.26	5.63	3.55	5.48
Jul.	4.93	4.67	6.04	5.21
Aug.	4.83	4.57	4.46	4.62
Sep.	7.38	10.31	10.22	9.30
Oct.	10.03	8.11	7.69	8.61
Nov.	10.21	9.27	12.86	10.78
Dec.	16.52	16.43	19.15	17.37

(2) Flood run-off analysis

Three methods, that is, Melchior's method, rational formula and Haspers method were used for the comparative study on the flood run-off discharge at the proposed weir site. The result is as follows:

Return Period year	Melchior' m^3/sec	Rational m^3/sec	Haspers' m^3/sec
1,000	477	867	505
100	330	632	367
50	302	598	327
25	267	511	287
10	225	441	238
5	193	390	208
2	154	326	159

From the above table, the result by the rational formula was adopted for the design of the weir.

4.4.3 Irrigation Water Requirement

To estimate irrigation water requirement, the consumptive water use of crop is calculated by the modified Penman method and the crop coefficients due to the guideline of DGWRD using the climatological data at Pasir Pengarayan for the past 19 years. The effective rainfall is assumed to be 70% of the monthly rainfall in the 1/5 years probability and percolation 3.0 mm/day. The irrigation requirement at field level for land preparation and puddling is estimated by the method of Van de Goor and Zijlstra and the irrigation efficiency is taken as 55%. As a result, the maximum ten days irrigation water requirements are estimated at 1.28 l/sec/ha for wet season paddy, 1.54 l/sec/ha for dry season paddy and 0.32 l/sec/ha for polowijo in the dry season.

4.4.4 Irrigation Plan

(1) Water resources

The irrigation water for the Project is taken from the weir on the Kumu river for both wet and dry seasons. The maximum and minimum intake discharges are as follows:

Crops	Maximum intake discharge	Minimum intake discharge
Wet season paddy	9.34 m /sec	0.44 m /sec
Dry season paddy	4.77	0.59
Polowijo	0.43	0.14

(2) Distribution method of irrigation water

Golongan system and plot to plot irrigation will be adopted for the project area.

As to the wet paddy, the whole area of 7,300 ha will be divided into three Golongan blocks. The area of one Golongan block will become about 2,400 ha. For the sake of canal capacity, however, the Golongan system will be adopted about each secondary canal during wet season paddy cultivation only.

On the other hand, the area of 3,100 ha for dry season paddy will be divided into two blocks of 1,550 ha each.

Plot to plot irrigation method will be taken at steep slope fields at every several plots. In case of flat area, separated canals for irrigation on and drainage will be equipped in order to make a plain farming practice.

(3) Cropping period and irrigation area

The dry season paddy cultivation is proposed to start one month after the harvest of the wet season paddy and the period to release water from canal for operation and maintenance is also proposed one month after completion of irrigation period of the dry season paddy cultivation.

The following table shows the most applicable case on the basis of the study.

Crop	Commencement date of puddling	Irrigation area	Max. Diversion requirement
			l/sec/ha
Wet season paddy	Oct. 1	7,300 ha	1.28
Dry season paddy	Feb. 26	3,100	1.54
Polowijo	Apr. 1	2,700	0.16

Taking into consideration resorting a weir without storage effect, fluctuation of average ten days discharge, the planning total household of transmigrants, distribution area for paddy cultivation per household, etc., the most appropriate cropping areas in the both seasons are obtained as the above table.

(4) Ten days intake discharge

Ten days intake discharges for paddy cultivation of 7,300 ha in the wet season and 3,100 ha in the dry season, and polowijo cultivation of 2,700 ha in the dry season are estimated as shown in Table 4.

(5) Diversion requirement during development stage

During the development stage, the irrigation efficiency will be planned as 0.50 because new reclaimed paddy fields will need more irrigation water.

Therefore the diversion discharge will increase during development stage for paddy fields. These increasement of diversion discharge will be conveyed using canal free board as much as possible.

4.4.5 Drainage Plan

Provision of a suitable drainage facility is one of the important factor to improve agricultural productivity in the low-lying land of the project.

Most natural streams which is located in the project area will become main drainage canal, while smaller drainage canal, that is, secondary drain will be provided as required depending on land and soil conditions. However some of secondary drain will be constructed along the old natural river bed.

Secondary drain is planned to connect tertiary drains and natural stream, further tertiary drain will collect the drainage water from quaternary drains to the secondary drain.

Design drainage discharges are obtained dividing each catchment area into rice field and non-rice field.

4.4.6 Alternative Study on Intake Facility

(1) Location of weir

A weir to the Project area is proposed at a certain place within about 10 km on the Kumu river from Kota Bangun near the upstream part of the Project area to the confluence with the Marbi river near the boundary to the North Sumatra Province.

As a result of the field reconnaissance and the study by the available topographical maps, the following two (2) places are proposed for comparative study on the weir site.

i) Upstream site : at the place about 2.4 km in the downstream from the confluence with the Marbi river ii)

ii) Downstream site : at the place about 4.1 km further in the downstream from the upstream site

In order to compare the above sites, the conditions on the existing line of the Kumu river, river elevation, location of tributaries, sub-weir at the both sides and its possible height, temporary by-path space for construction in the case of Coupure method and others were studied.

The results of the study are summarized as follows:

Item	Upstreme Site	Downstreme Site
Location from Kaalamahato	53 km	49 km
River bed elevation	57.4 m	55.1 m
Slope of river	1:2,000	1:2,000
Catchment area	520 km^2	540 km^2
Design flood discharge		
1 in 100 year probability	620 m^3/sec	640 m^3/sec
1 in 1,000 year probability	840 m^3/sec	870 m^3/sec
Design width of weir crest	48.0 m	50.0 m
Design elevation of weir crest	61.4 m	60.6 m
Design back water height	4.0 m	5.5 m
Design flood elevation	65.05 m	64.1 m
Design height of river banks	66.55 m	65.60 m
Width of sub weir	560.0 m	510.0 m
Total submerged area in flood	295.0 ha	350.0 ha
The same in North Sumatra Province only	39.4 ha	28.5 ha
Normal submerged area in total	85.0 ha	76.0 ha
The same in North Sumatra Province only	9.0 ha	5.3 ha
Construction method	Temporary division or coupure method	Coupure method
Others	Daw can be considered	

The following matters could be mentioned by the above rough comparative study.

- The more catchment area the more flood discharge. But it is generally said the more catchment area makes the more efficiency of irrigation capacity through the increase of irrigable area.
- The upstream plan is smaller 2m in weir width, 1.5m in the height. Conversely, it increases 4,400 m in canal length, 50m in the length of sub weir. As a result, the downstream plan is favorable about 39% in the economy.
- In the upstream plan, the normal and flood submerged areas influence more in North Sumatra. It can be a problem on a view point of the irrigation purpose of Riau state.
- There are no much difference between the two in geographical conditions.
- In the upstream plan, it is also considerable to make a dam. However, it would also have the above same problem getting more influence upon the submerged areas.
- There are giographical problems in the steep area where is around E.L 85.0m. One is immediately upside of the downstream plan in the left bank and the other is downside of the same in the right bank. In the upstream plan, it is an economic problem to pass main canal in these area. In the downstream plan, it is free from the problem by the intake at the left bank.

Since, the site of weir of this Project is more favorable on the downstream plan than the upstream one by the all-round study.

(2) Mini-hydro electric power generation

It is possible to equip a facility for mini-hydroelectric power generation to the weir using the remaining river discharge except for the intake discharge for irrigation because the weir has a water head of about 5.5m. After the comparative study, however, it is found that the Diesel generation is more economical than the mini-hydroelectric power generation and it is concluded that the plan for power generation is not included in the Project.

4.5 PROPOSED PROJECT WORKS

4.5.1 General

In order to achieve the projected agricultural development in success, the construction of following infrastructures and further improvement of supporting services are required:

a) Construction of irrigation network consisting of a weir, linking, main and secondary canals,
b) Construction of drainage network of secondary drain,
c) Construction of road network which includes main, secondary and connecting roads,
d) Construction of tertiary network consisting of tertiary and quaternary canals, tertiary and quaternary drains and farm road,
e) Reclamation of new farm lands,
f) Construction of O & M facilities and provision of O & M equipment, and
g) Further improvement of the present agriculture supporting services.

The errigation water is diverted by gravity method from the weir and conveyed through the linking canal of 2.61 km on the left side of the Kumu river, and then diverted to two main canals for the left side and the right side of the Kumu river. The right main canal crosses the Kumu river by a siphon structure.

4.5.2 Weir

The design of the weir is carried out in reference to the results of the hydraulic model test by DPMA in Bandung in 1985. The result of the design is summarized as follows:

Water source	:	Kumu river
Location of intake facility	:	about 3.5 km upstream from Kota Bangung
Catchment area	:	540 km^2
Elevation of river bed	:	55.10 m
Elevation of crest	:	60.60 m
Height of weir	:	5.50 m
Height of weir body	:	7.50 m
Width of weir	:	50.0 m
Intake water level	:	60.50 m
Flood discharge	:	640 m^3/sec (1/100 year probability)
Flood water level	:	64.10 m (1/100 year probability)
- ditto -	:	64.90 m (1/1,000 year probability)
Elevation of river bank	:	65.60 m
Freeboard	:	1.50 m (1/100 year probability)
- ditto -	:	0.70 m (1/1,000 year probability) Inundated area

Inundated area	:	350 ha (28.5 ha in North Sumatra)
Type of weir	:	Fixed type
Flood way	:	Fixed weir (14m x 3 spans)
Scouring sluice	:	Undersluice (2m x 2 spans)
Intake	:	Sluice gate (2.5m x 3 spans)
Design intake discharge	:	9.34 m^3/sec
Construction method	:	Coupure

4.5.3 Irrigation canal system

Irrigation canal system up to the teriary box with teriary blocks in the Project area includes linking canal, main canals and secondary canals. The proposed layouts of the canals down to the secondary canals are shown in Fig. attached hereto.

(1) Linking canal

A linking canal with a length of 2.61 km is constructed between the weir and a diversion structure to lead the intake discharge of 9.34 m /sec in peak time to Left Side and Right Side Main Canals.

The canal has a trapezoidal section with an inside slope of 1:1.5 and has a 3.3 m wide bottom and 1.65 m water depth. The canal in lined with thin concrete and the longitudinal gradient of the canal base is 1/5,300.

(2) Main canals

The Left Side Main Canal, 25.61 km will be constructed for the irrigation of the left side of the Kumu river, 4,500 ha. This canal is designed for the discharge of 7.38 m /sec at its head.

The Right Side Main Canal will run for 18.68 km to irrigate the right side of the Kumu river of 2,800 ha. The design discharge at the head of the canal is 4.59 m /sec.

Almost all of the main canals (90%) mentioned above will basically be lined with thin concrete and trapezoidal.

(3) Secondary canals

These canals will be branched off from the abovementioned main canals to distribute water to the secondary units of which the covering areas are more than 100 ha. Nineteen (19) secondary canals with a total length of about 80 km will be constructed in the Project areas. These canals will be principally unlined and trapezoidal, but the deep excavated canal portion will be lined with thin concrete.

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

	Left Side	Right Side	Total
Main Canal			
- Canal length (km)	25.61	18.68	44.29
- related structure			
diversion (nos.)	9	6	15
turnout (nos.)	13	4	17
check (nos.)	11	11	22
spill/waste way (nos)	11	6	17
drop (nos.)	5	-	5
crossdrain (nos.)	50	37	87
bridge (nos.)	15	10	25
Secondary canal			
- canal length (km)	50.12	30.10	80.22
- related structure			
diversion	2	-	2
turnout	48	32	80
check	38	25	62
spill/waste way	18	10	28
drop	5	2	7
crossdrain	99	61	160
bridge	26	14	40

4.5.4 Drainage canal networks

The location of drainage canal is dominated by natural streams and rivers crisscrossing in the development area. These drainage canal except for small drains in the tertiary blocks of which the covering areas are less than 100ha and will be designed to collect water from quaternary drains and tertiary drains and transport collected water to streams or rivers. For the Project, 46 secondary drainage canals with a total length of 56.45 km will be excavated.

The following table shows the required canal length and the number of their related structures.

	Left Side	Right Side	Total
Secondary drainage canal			
- canal length (km)	27.74	28.71	56.45
- related structure (nos.)	15	14	29

4.5.5 Tertiary development

The tertiary development program will be prepared for every tertiary block to be irrigated by tertiary system. The tertiary system will consist of tertiary canals and quaternary canals which will respectively cover the tertiary block of 100 ha at maximum and quaternary blocks (10-15 ha), tertiary drains and quaternary drains which will also be required to evacuate excess water from the blocks, and farm roads with 1.5 m effective wide principally constructed along the tertiary canals.

The typical canal layout is as shown in Fig. 4. The following table shows the total required length of each on-farm facility.

	Left Side	Right Side	Total
On-farm facility			
Tertiary canal (km)	76	47	123
Tertiary drain (km)	73	46	119
Quaternary canal (km)	224	139	363
Quaternary drain (km)	45	28	73
Farm road (km)	90	56	146

4.5.6 Inspection road and connecting road

In the Project area except the areas for tertiary blocks, the following three types of inspection roads and connecting road will be provided:

a) Main inspection roads along the main canals, 4-meter effective wide and metalled with gravel.
b) Secondary inspection roads along the secondary canals, 2-meter effective wide and metalled with gravel.
c) Connecting roads for villages, 4-meter effective wide and metalled with gravel.

The following table shows the respective road length.

	Left Side	Right Side	Total
Main inspection road (km)	25.6	18.7	44.3
Secondary inspection road (km)	50.1	30.1	80.2
Connecting road (km)	23.7	9.6	33.3

4.5.7 Land reclamation

The clearing works of forest for Class-I land for the new transmigration program in the Project area will be carried out by the Indonesian Government. The clearing work is made and followed by firing Uprooting work is made after firing and finally the rough levelling work is carried out.

The construction of on-farm facilities and farm land including levelling work are principally carried out by the farmers themselves under the transmigration program.

Actually, however, the land clearing works of about 1,000 ha for the existing transmigrants and the land levelling works of about 5,000 ha mainly for the new transmigrants should be carried out by the Project taking into consideration the lack of fund of the farmers in the Project area.

4.5.8 Offices and quarters

Offices and quarters are required for the persons to be engaged in the Project implementation and in the operation and

maintenance of the project facilities. The required number and space of these facilities are briefly estimated as follows:

a)	Main office	:	1,000 m^2
b)	Branch office	:	300 m^2
c)	Quarters	:	1,500 m^2
d)	Store house	:	3,000 m^2
e)	Motor pool	:	3,000 m^2

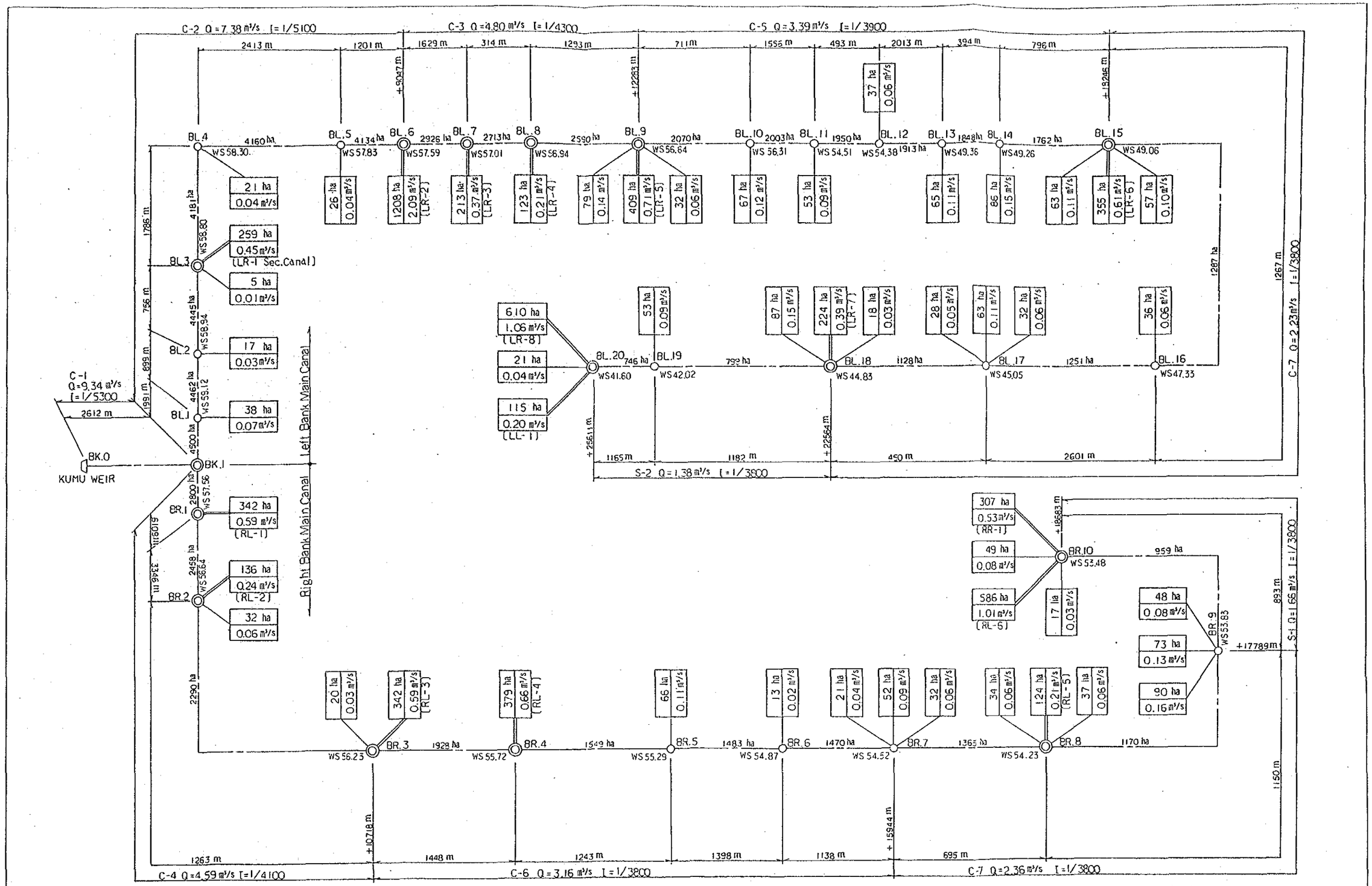

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Fig. 4.2 IRRIGATION DIAGRAM

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4.6 CONSTRUCTION PLAN

The implementation period is planned at eight (8) years from 1989 to 1996. Three (3) years from 1989 to 1991 are the necessary period for survey and investigation, detailed design of weir and irrigation and drainage facililities, tender and contract business, etc.

The whole project works would be generally divided into two stages, that is, the first stage for the existing transmigration areas (six work divisions from I to VI) and the second for new transmigration/re-settlement areas (two work divisions, VII and VIII). It is recommendable to construct the weir and linking canal at first and then other facilities to the downstream in order taking into account the above stage plan.

The construction period is estimated at five (5) years from 1992 to 1996 taking into account the scale of works, the project economy, etc. As to the construction of each work division, it is generally desirable to carry out the construction in sequence of drainage canal, main canal, secondary canal and tertiary networks and to complete the construction of tertiary networks in each work division.

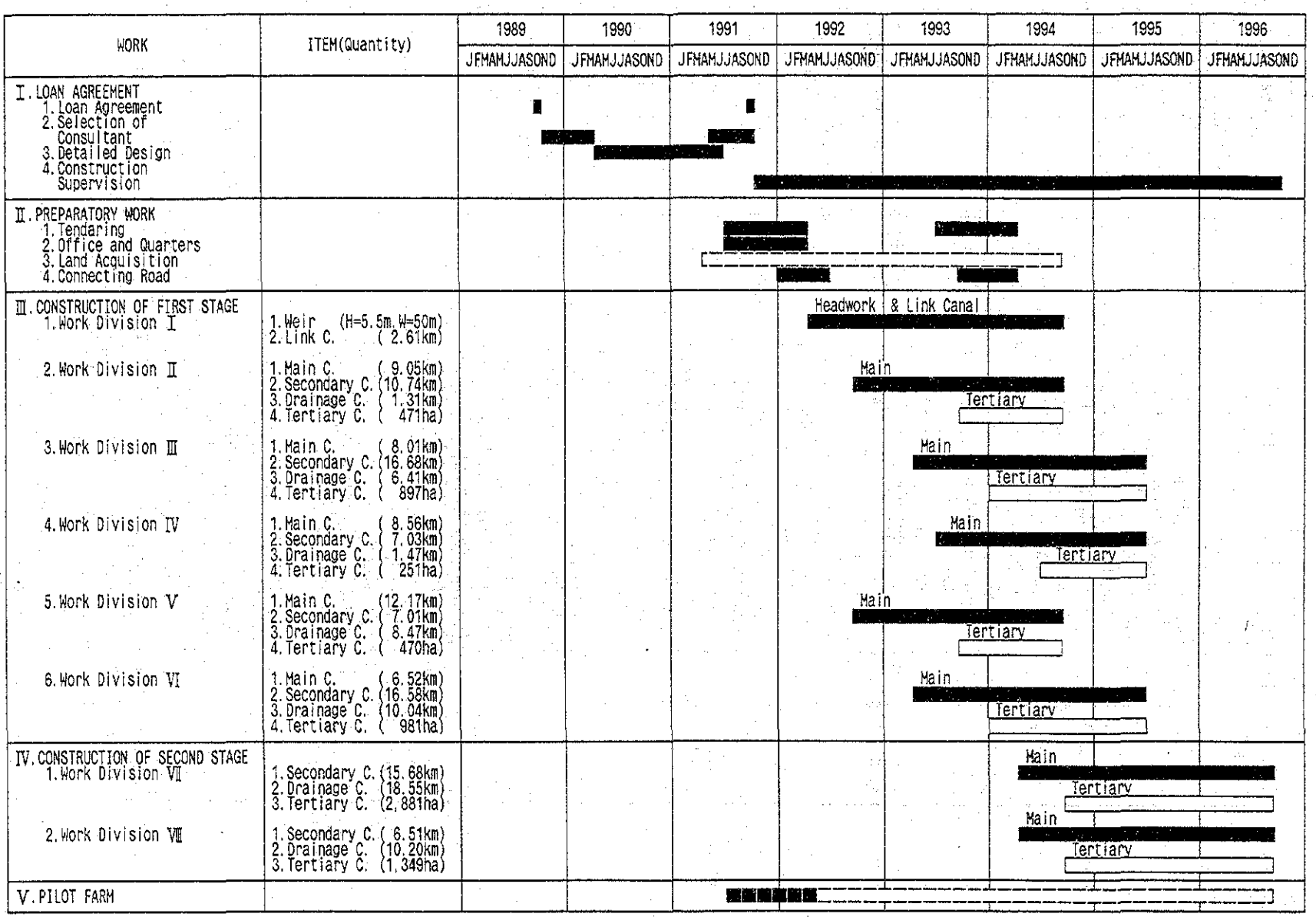
Each work division is generally shown in the following table and the implementation schedule of the project is shown in Fig. 4.3 and Fig. 4.4.

The main Work Divisions are as follows.

Stage	Work Division	Main Works	Construction Year
First	W. D－Ⅰ (Left Bank)	Weir(H=5.5m, B=50m) Link canal(L=2.61km) Construction of Canal Facilities Diversion Structure : (M.C) 1 Check Gate : (M.C) 1 Spillway : (M.C) 2 Drainage Culvert : (M.C) 5 Bridge : (M.C) 1	Year. 1992 ～ 1994
First	W. D－Ⅱ (Left Bank)	Left-side Main Canal(L=9.05km) Secondary Canal(L=10.74km) Drainage Canal(L=1.31km) Tertiary Development(471ha) Construction of Canal Facilities Diversion Structure : (M.C) 2 Turnout : (M.C) 5, (S.C) 17 Check Gate : (M.C) 2, (S.C) 9 Spillway : (M.C) 4, (S.C) 4 Drop : (S.C) 1 Drainage Culvert : (M.C) 18, (S.C) 22 Bridge : (M.C) 5, (S.C) 5 Bridge : (D.C) 1	Year. 1992 ～ 1994
First	W./D－Ⅲ (Left Bank)	Left-side Main Canal(L=8.01km) Secondary Canal(L=16.68km) Drainage Canal(L=6.41km) Tertiary Development(897ha) Construction of Canal Facilities Diversion Structure : (M.C) 3, (S.C) 1 Turnout : (M.C) 6, (S.C) 31 Check Gate : (M.C) 3, (S.C) 13 Spillway : (M.C) 3, (S.C) 6 Drop : (M.C) 2, (S.C) 1 Drainage Culvert : (M.C) 16, (S.C) 33 Bridge : (M.C) 4, (S.C) 8 Bridge : (D.C) 3	Year. 1993 ～ 1995
First	W. D－Ⅳ (Left Bank)	Left-side Main Canal(L=8.56km) Secondary Canal(L=7.03km) Drainage Canal(L=1.47km) Tertiary Development(251ha) Construction of Canal Facilities Diversion Structure : (M.C) 3, (S.C) 1 Turnout : (M.C) 11, (S.C) 17 Check Gate : (M.C) 5, (S.C) 6 Spillway : (M.C) 3, (S.C) 3 Drop : (M.C) 3, (S.C) 1 Drainage Culvert : (M.C) 17, (S.C) 14 Bridge : (M.C) 5, (S.C) 4 Bridge : (D.C) 1	Year. 1993 ～ 1995

Stage	Work Division	Main Works	Construction Year
First	W. D－V (Right Bank)	Right-side Main Canal(L=12.17km) Secondary Canal(L=7.01km) Drainage Canal(L=8.47km) Tertiary Development(470ha) Construction of Canal Facilities Syphon : (M.C) 1 Diversion Structure : (M.C) 4 Turnout : (M.C) 2, (S.C) 16 Check Gate : (M.C) 5, (S.C) 6 Spillway : (M.C) 4, (S.C) 3 Drop : (M.C) -, (S.C) 1 Drainage Culvert : (M.C) 24, (S.C) 14 Bridge : (M.C) 7, (S.C) 4 Bridge : (D.C) 5	Year. 1992 ～ 1994
Stage	Work Division	Main Works	Construction Year
First	W. D－VI (Right Bank)	Right-side Main Canal(L=6.52km) Secondary Canal(L=16.58km) Drainage Canal(L=10.04km) Tertiary Development(981ha) Construction of Canal Facilities Diversion Structure : (M.C) 2 Turnout : (M.C) 12, (S.C) 32 Check Gate : (M.C) 6, (S.C) 13 Spillway : (M.C) 2, (S.C) 6 Drop : (S.C) 1 Drainage Culvert : (M.C) 13, (S.C) 33 Bridge : (M.C) 4, (S.C) 8 Bridge : (D.C) 5	Year. 1993 ～ 1995
Second	W. D－VI (Left Bank)	Secondary Canal(L=15.68km) Drainage Canal(L=18.55km) Tertiary Development(2,881ha) Construction of Canal Facilities Turnout : (S.C) 24 Check Gate : (S.C) 12 Spillway : (S.C) 5 Drop : (S.C) 1 Drainage Culvert : (S.C) 31 Bridge : (S.C) 8 Bridge : (D.C) 10	Year. 1994 ～ 1996
Second	W. D－VII (Right Bank)	Secondary Canal(L=6.51km) Drainage Canal(L=10.20km) Tertiary Development(1,349ha) Construction of Canal Facilities Turnout : (S.C) 9 Check Gate : (S.C) 5 Spillway : (S.C) 2 Drop : (S.C) 1 Drainage Culvert : (S.C) 13 Bridge : (S.C) 3 Bridge : (D.C) 4	Year. 1994 ～ 1996

Fig.4.3 Project Implementation Program



STAGE	DIVISION	IRRIGABLE AREA	REMARK
1st.	I	- ha	Left bank
"	II	471	"
"	III	897	"
"	IV	251	"
"	V	470	Right bank
"	VI	981	"
sub total		3,070	
2nd.	VII	2,881	Left bank
"	VIII	1,349	Right bank
sub total		4,230	
Total		7,300	

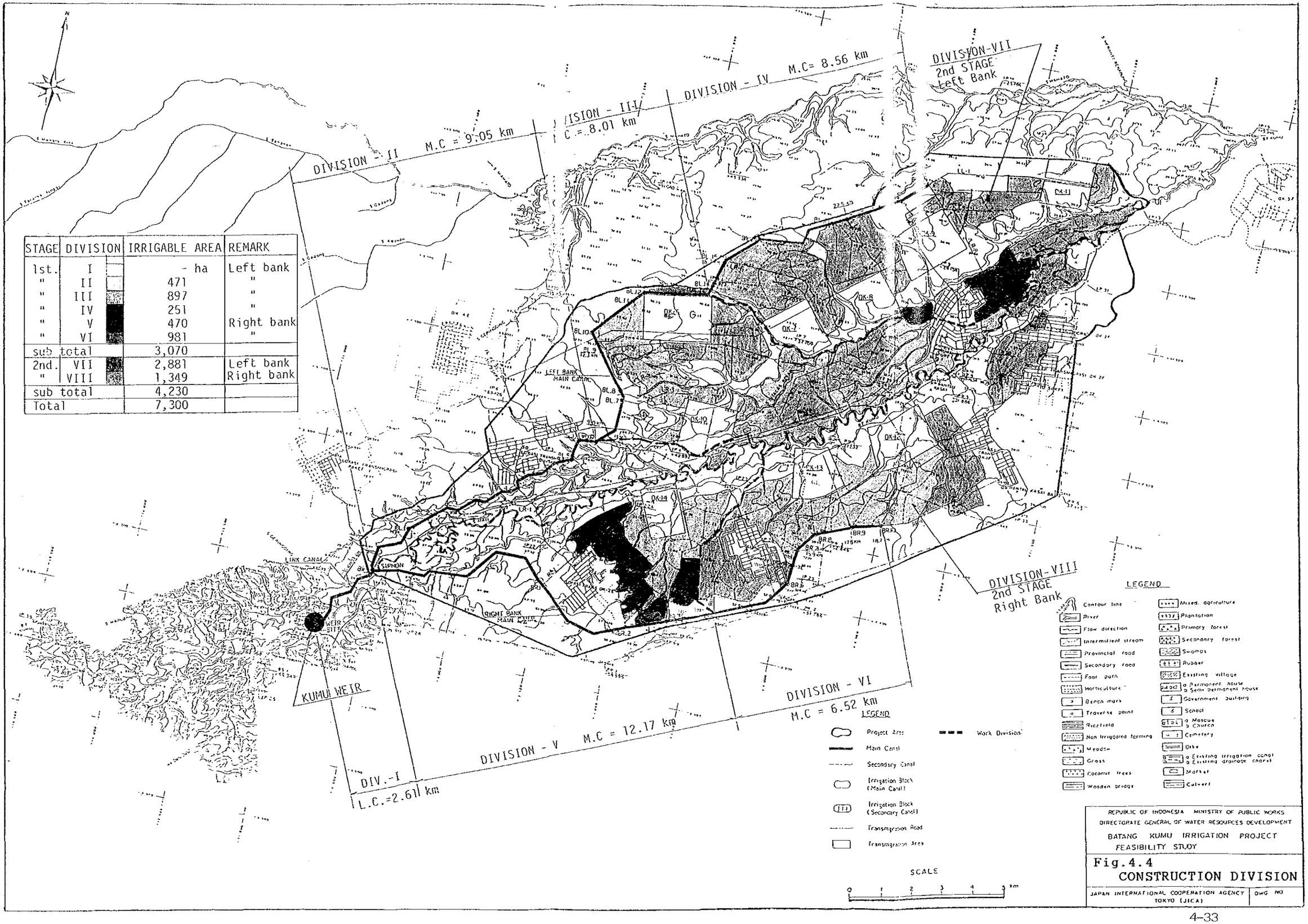


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Fig.4.4
CONSTRUCTION DIVISION

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5. ORGANIZATION AND MANAGEMENT

5.1 Organization for Project Execution

The Directorate General of Water Resources Development (hereinafter referred to as DGWRD), the Ministry of Public Works, the Government of the Republic of Indonesia would be the executing agency for implementation of the Batang Kumu Irrigation Project. DGWRD would be responsible for both the engineering works and the construction works of the Project. It would coordinate all activities of the relevant Government agencies and regional administrative organizations in connection with the project implementation.

The Directorate of Irrigation-II under the said DGWRD would direct responsibility for the project implementation. Riau Regional Public Works would coordinate the construction of the Project at the provincial level on behalf of Ministry of Public Works.

In order to implement the Project successfully, it is proposed to establish the Batang Kumu Irrigating Project Office under the superintendence of the Directorate of Irrigation-II. The main tasks of the Project Office would be as listed below.

a) Financial arrangements needed for the engineering and construction works of the Project.

b) Design and construction supervision of all the implementation activities.

c) Technical assistance and guidance for the on-farm development to be executed by the farmers.

d) Coordination between the Government authorities concerned with implementation of the Project.

e) Personnel arrangements for staff to be required during the construction and O&M stage.

f) Accounting and management of the engineering works and the construction works.

The Project Office during the construction stage will be established in the Project area. The organizational structure is proposed as presented in Fig. 5.1, taking into consideration similar project offices in Riau Province.

5.2 Operation and Maintenance of the Project

After completion of the construction works, the Project Office will be reorganized into the O&M office which will responsible for the operation and maintenance of all facilities down to inlets to tertiary blocks. The operation and maintenance

of the tertiary blocks down to terminal facilities will be entrusted to the water user's association (P3A) and farmers themselves.

The proposed organizational structure of the O&M Office will have four sections: Operation Section, Repair and Maintenance Section, Farmers' Assistance Section and Administrative Section (see Fig. 5.2). The main tasks of these sections are summarized below.

a) Operation Section

- Planning of irrigation schedule
- Water distribution
- Control of water delivery
- Hydrological measurement
- Data collection and data processing

b) Repair and Maintenance Section

- Repair and maintenance of facilities and equipment
- Management and inspection of facilities and equipment

c) Farmers' Assistance Section

- Guidance and training to water users
- Monitoring and evaluation

d) Administrative Section

- Personnel services
- Accounting and cashiering
- General affair services

The O&M Office will be set up at the Project site. The Operation Manager would be responsible for operation and management of the irrigation system through the above mentioned sections. The staff necessary for the O&M Office are estimated at 100 persons including water management engineers, hydrologist, mechanics, driver/operators, accountant, etc.

5.3 Water User's Association

The O&M of irrigation and drainage facilities in the tertiary block will be done by the water user's association (P3A). Before completion of construction of the project facilities, this association should be established in each village with guidance from the O&M Section*1/O&M Office and the agricultural extension office.

In order to ensure effective water supply and smooth

*1 O&M Section is established under the Project Office (see Fig. 5.1).

operation and management of irrigation facilities, it is recommended that the water user's associations be established in the Project area, taking the following items into consideration.

a) Establishment of water user's associations should be on a village basis and covering several tertiary blocks, and such that every farmer who is either a land proprietor or a share-cropper in the tertiary block must be a member.

b) The management and operation of the water user's association should be conducted by a manager with technical assistance under supervision of the Public Works and Agricultural Services at both of Kabupaten and/or Kecamatan levels.

c) Good relationships with the concerned government agencies such as Public Works, Agricultural Service, Rural Extension Center and KUD will promote the successful performance of the activities of these associations.

The proposed organization of a water user's association is presented in Fig. 5.3. The association would have a Board, and be staffed by a manager, treasurer, secretary and several Ulu-Ulu (water masters). It is suggested that a unit water user's association be set up in each tertiary block, which will take overall responsibility for distributing irrigation water. One Ulu-Ulu would be appointed in each tertiary block in the association to carry out water management. In order to fulfill their missions, it is necessary that they have a through knowledge of water management in the Project as well as at farm level. They will, therefore, be trained by the staff of the O&M Office.

The number of water user's associations to be established in the Project area was estimated at seventeen (17).

Table 5.1 O&M EQUIPMENT

			Numbers	
(1)	Backhoe	0.3 m3	1	
(2)	Bulldozer	6 tons	1	
(3)	Wheel Loader	0.6 m3	1	
(4)	Motor Grader	Blade 3 m	1	
(5)	Tire Roller	6-8 tons	1	
(6)	Tamper	80 kg	2	
(7)	Portable Concrete Mixer	0.2 m3	2	
(8)	Concrete Vibrator	Dia.45	2	
(9)	Submersible Pump	Dia.150	2	
(10)	Generator	10 kW	2	
(11)	Dump Truck	4 tons	2	
(12)	Truck with Crane	4 tons	1	
(13)	Jeep	4WD	3	
(14)	Motorcycle		20	
(15)	Micro Computer, Floppy Disc, Printer		1	Set
(16)	Automatic Rain Gauge		5	
(17)	Automatic Water Level Gauge		1	
(18)	Current Meter		2	
(19)	Meteorological Measuring Instrument		1	Set
(20)	Wireless Radio		4	
(21)	Tools and Equipment for Repair		LS	
(22)	Spare Parts (15 % of the above)		LS	

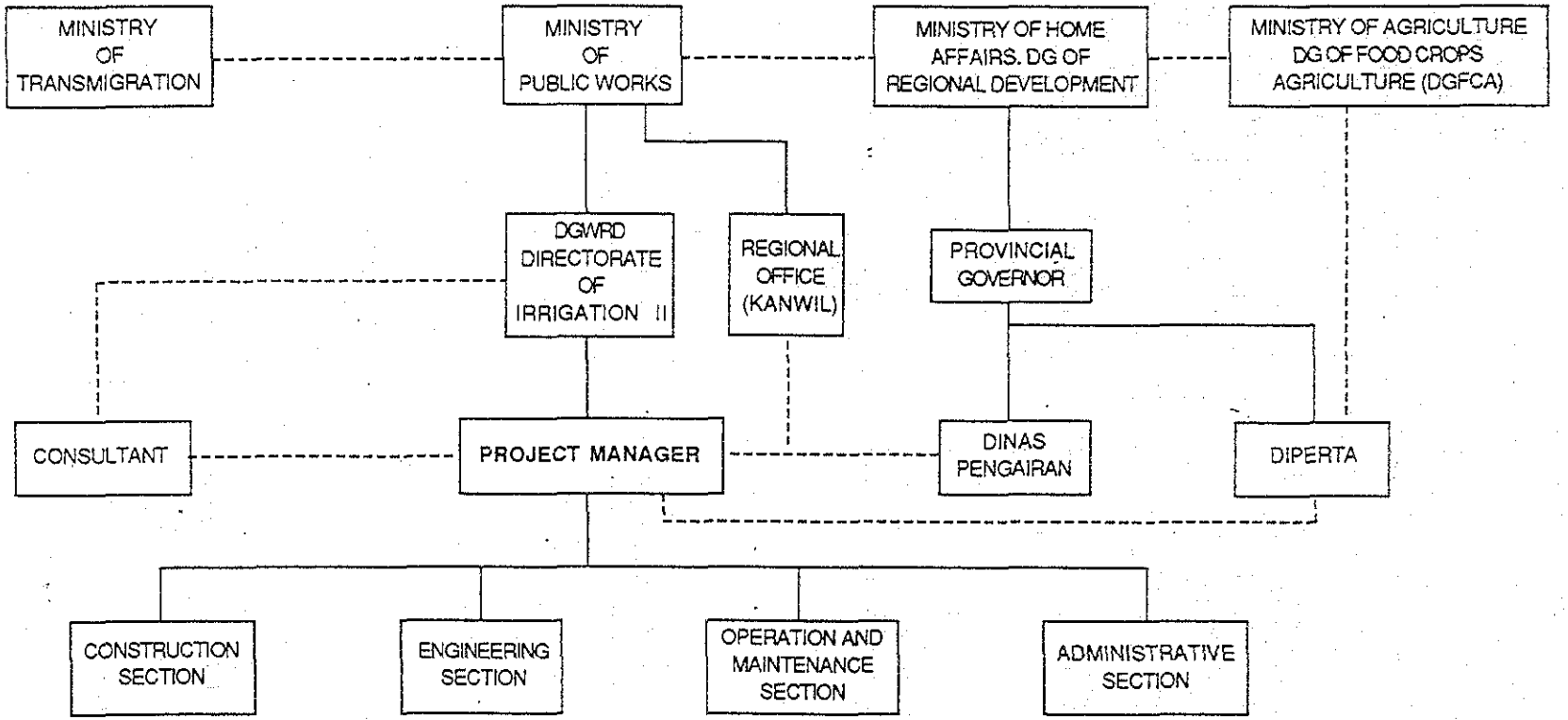

Fig. 5.1 Proposed Organization of Project Executing Office

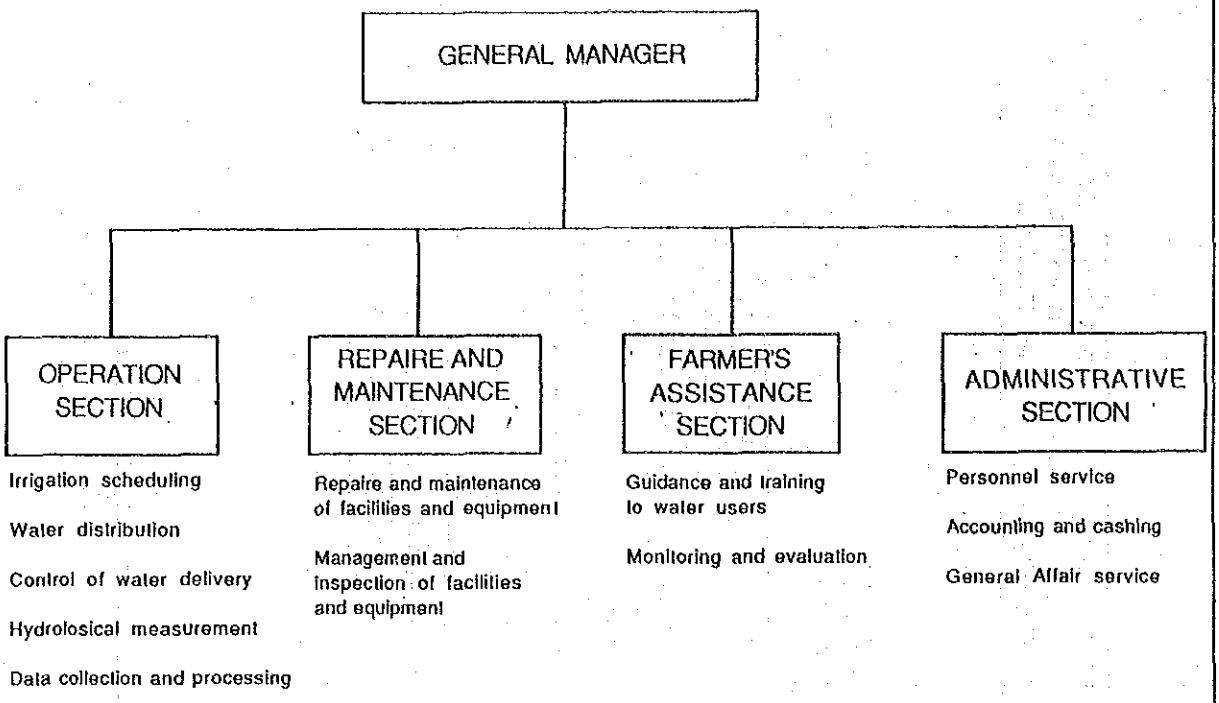

Fig. 5 . 2 Proposed Organization of O & M Office

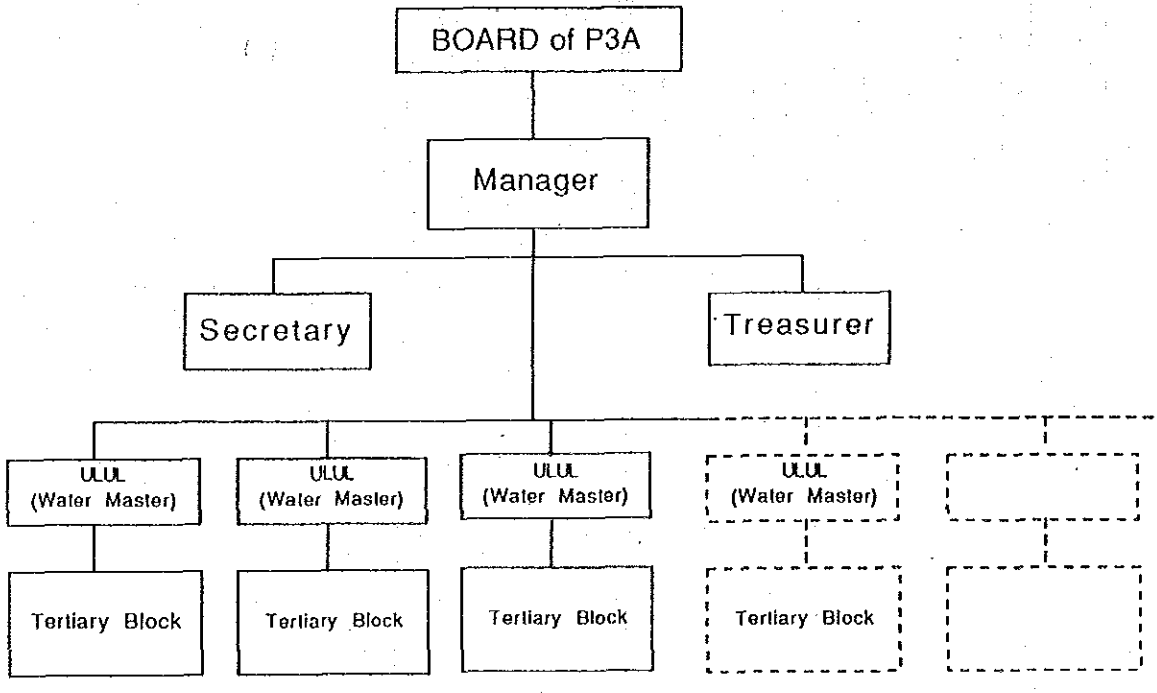

Fig.5 . 3 Proposed Organization of Water User's Association (P3A)

6. COST ESTIMATION

6.1 Conditions

Construction cost required the development plan is estimated under the following conditions.

(1) Exchange Rate : 1.0 U$ = 1710 Rp.
(2) All the construction work is under contract by a contractor with his own construction machinery.
(3) Unit cost of the construction works is calculated by the actual cost of materials and labour costs in the end of 1988.
(4) Construction cost consists of portions of foreign currency and local one and each of them includes the following items.

Local currency portion

- Labour force
- Aggregate, Gravel and timber
- Fuel, oil, etc.
- Costs of internal transport
- General fee of Indonesian Government during the construction period
- Expenses & benefit of internal contractors
- Engineering service fee of the internal consultants
- and others.

Foreign currency portion

- Reinforcement and structural iron material
- Iron gate, Diesel power generator, motor and other iron works
- Cost of the depreciation of construction machinery
- Viscles required for construction supervision and operation and management.
- Expenses & benefit of foreign contractors
- Engineering service fee of foreign consultants

(5) A part of the cost clearing trees & bush off, is included in the preparatory works.
(6) the cost of land reclamation works is included a little.
(7) The physical contingency is given 5% of the direct costs. And the price contingency for the foreign currency portion is calculate about 4% per annum and for the local currency portion 10%.
(8) The associated costs to be financed by the Government, such as the cost for strengthening the extension services, facilities of the water users' association, and improvement of the social infrastructures are not included in the estimate.

6.2 Estimate

Total cost of this project is about 4.3×10^6 U$ consist of 2.0×10^6 U$ in local portion and 2.3×10^6 U$ in foreign portion.

The detail of total cost estimation is shown in Table 6.1.

6.3 Annual Disbursement Schedule

Annual disbursement schedule is carried out based on the annual construction plan. It is shown in the following table.

	Foreign C.	Local C.	Total
1990	1,428	405	1,833
1991	1,029	474	1,503
1992	1,996	1,293	3,289
1993	5,216	4,233	9,449
1994	6,921	6,569	13,490
1995	5,806	6,193	11,999
1996	960	664	1,624
Total	23,356	19,831	43,187

Table 6.1 SUMMARY OF PROJECT COST

Unit: 10^3US$

Item	Foreign Portion	Local Portion	Total
1. Preparatory Expenses	840	360	1,200
2. Civil Work for 1st Stage			
2.1 Head Work (Div-I)	1,719	583	2,302
Link Canal (〃)	393	261	654
2.2 Main & Sec. (Div-II)	1,698	1,347	3,045
Tertiary (〃)	214	92	306
2.3 Main & Sec. (Div-III)	1,616	1,192	2,808
Tertiary (〃)	318	136	454
2.4 Main & Sec. (Div-IV)	1,049	773	1,822
Tertiary (〃)	154	66	220
2.5 Main & Sec. (Div-V)	1,671	1,218	2,889
Tertiary (〃)	186	80	266
2.6 Main & Sec. (Div-VI)	1,471	1,088	2,559
Tertiary (〃)	428	183	611
Sub-Total	10,917	7,019	17,936
3. Civil Work for 2nd Stage			
3.1 Secondary (Div-VII)	756	593	1,349
Tertiary (〃)	1,220	523	1,743
3.2 Secondary (Div-VIII)	312	269	581
Tertiary (〃)	573	246	819
Sub-Total	2,861	1,631	4,492
4. O&M Facilities	524	175	699
5. Land Acquisition Cost	–	180	180
6. Administration Cost	–	657	657
7. Engineering Service			
7.1 Detailed Design	1,440	160	1,600
7.2 Construction S/V	2,160	240	2,400
Sub-Total	3,600	400	4,000
Total	18,742	10,422	29,164
8. Physical Contingency	937	521	1,458
Total	19,679	10,943	30,622
9. Price Contingency	4,261	7,641	11,902
Grand Total	23,940	18,584	42,524

7. PROJECT EVALUATION

7.1 Economic Evaluation

7.1.1 Project Costs

The project costs for economic evaluation would consist of construction cost, annual operation and maintenance (O&M) cost, replacement cost and transmigration cost. These economic costs can be obtained by applying economic conversion factors (ECF) to the financial costs.

The total economic construction cost would amount to Rp. 39.6 billion (see Table 7.1). The O&M cost would be initially disbursed in 1994/1995 when partial operation would be commenced, and would reach the full amount of Rp. 175 million in 1997/1998 when full operation would start. The steel gates installed in the project facilities would be replaced once during the entire period of the project life, and the O&M equipment would be replaced every 10 years. The transmigration cost which consists of construction costs of houses and shallow wells, etc. would amount to Rp 8.0 billion.

Land acquisition costs were excluded from the project economic costs, and production foregone earmarked for negative benefit was evaluated, instead of the land acquisition cost. Since EIRR of the Project is measured at constant prices, provision for price contingency was excluded from the project costs.

7.1.2 Project Benefits

Economic prices of farm inputs and outputs were forecast in order to evaluate the expected monetary benefits. Economic prices of trade goods such as rice, maize, soybeans, groundnuts and fertilizers were estimated on the basis of the projected world market prices of these commodities forecast by the World Bank in the long term range for the period from 1990 to 2000. Non-trade goods such as, cassava, seeds and animal power were valued at financial prices which were estimated on the basis of current market or farm gate prices prevailing in the Project area in September 1988. As for farm labor, it was valued at a shadow wage rate, based on the ECF of 0.75.

The project benefits consist of irrigation benefits and negative benefits. The irrigation benefits are defined as the difference in net return from crops between the future with and the future without project conditions. The annual irrigation benefit at full development stage was estimated at Rp 8.56 billion (see Table 7.2). The benefits would start to accrue from 1994/1995, and would gradually increase up to the full benefit in 2002/2003.

Negative benefits will occur on lands to be occupied by

project facilities. About 800 ha of farm land, grass land and forest, would be required for right of way for newly installed project facilities. For the farm land, production foregone was evaluated as a negative benefit, instead of its land acquisition cost. This production foregone was already counted in the estimation of irrigation benefits by deducting this area from the paddy fields under the future with project condition. As regards the forest and grass lands, no opportunity cost in a national economic sense was evaluated, since there was no potential alternative.

7.1.3 Economic Evaluation

(1) EIRR, B/C and B-C

In order to compute the EIRR, B/C and B-C, the annual economic costs and benefits flows were firstly prepared as shown in Table 7.3. From this table, the EIRR was estimated to be 12.7%. In addition, the B/C and B-C at the discount rate of 10% were also estimated as follows:

EIRR	(%)	12.7
B/C		1.32
B-C	(Rp. 10^6)	10,520

As shown in the above table, these results indicate that the Project is economically viable.

(2) Sensitivity Analysis

Project sensitivity in terms of the EIRR was analyzed in respect of changes in project costs and benefits. The results of analysis are summarized below.

Project costs increased	Benefits Decreased 0%	Benefits Decreased -10%	Delay of 1 year in commencement of construction
0%	12.7	11.6	11.6
+10%	11.7	10.7	10.7

As a result of sensitivity analysis, if project costs increase by 10% and project benefits decrease by 10%, the feasibility of the Project is economically marginal.

7.2 Financial Evaluation

7.2.1 Repayment Capability

The repayment capability of the Project was studied by preparing cash flow statements on the basis of an annual disbursement schedule of the construction costs, fund requirement and anticipated project revenue. The transmigration cost was excluded from this study, because the repayment capability was studied in relation to the project executing agency which construct the irrigation facilities.

The annual disbursement schedule of the construction cost was prepared as shown in Table 7.4. The price contingency shown in this table was estimated on the basis of the world manufacturing unit value index forecast by the World Bank and recent trends of consumer price index in the country.

For the estimation of funding requirements, it was assumed that the capital required for project implementation would be arranged in terms of the following financial conditions:

Foreign Currency Portion

The capital will be financed by an international organization with the following loan conditions:

- Interest rate : 2.7% per year
- Grace period : 10 years
- Repayment period : 30 years (including grace period)

Local Currency Portion

The capital is arranged by budget allocation of the Government with no interest and no repayment.

According to the above assumptions, the total fund requirement for international organizations was estimated at about Rp. 40.9 billion.

As for the anticipated project revenue, it will accrue from irrigation service fees. Although farmers traditionally do not pay any fees except for the O&M costs of tertiary systems, Government policy will now be to collect irrigation service fees for main and secondary systems. Considering the above recent movement, cash flow statements of the Project executing agency were prepared for two cases, i.e. 1) with irrigation service fee and 2) without irrigation service fee. The prospective fee was estimated to be Rp 30,000/ha/annum. The annual project revenue which accrue from the fees would amount to Rp. 219 million.

Cash flow statements of the Project executing agency are shown in Tables 7.5 and 7.6. These statements indicate that the project revenue from the irrigation service fees cannot cover

the annual repayment of the fund which is estimated at about Rp. 2.6 billion on average during the repayment period. Repayment of the fund will have to be made by subsidy from the Government.

7.2.2 Capacity to Pay of the Farmers

In order to assess the capacity to pay of farmers, the analysis of their farm budget was made under the future with project condition.

(Unit: Rp 1,000/year)

Item	Without Project*1	With Project*2			
		With Palawija		Without Palawija	
		W. Rubber	W/O Rubber	W. Rubber	W/O Rubber
(Farm Size)	(1.01)	(1.75)	(1.00)	(1.75)	(1.00)
1) Gross Income	737	2,817	2,179	2,586	1,948
2) Gross Outgoing	732	1,384	1,234	1,335	1,186
3) Net reserve/ Capacity to Pay	5	1,433	945	1,251	762
4) Irrigation Service Fee		30	30	30	30

*1 Include subsidy from WFP Project. *2 No WFP subsidy.

The net reserve or capacity to pay of farmers would increase remarkably from Rp 5,000 under the future without project condition to Rp 0.76-1.43 million under the future with project condition. The increase in net reserve would enable farmers to pay the irrigation service fee, if it is imposed to them.

7.3 Indirect Benefits and Socio Economic Impacts

After implementation of the Project, various indirect benefits and socio-economic impacts are expected as mentioned below.

(1) Employment Opportunities

The Project would create a demand for farm labor due to the increased farming activity, more intensive use of land and higher agricultural production. In the existing transmigration area, the incremental farm labor requirement was estimated to be about 426,000 man-days per annum.

In addition, construction of the Project would increase employment opportunities in the area. During the construction stage, the majority of workers would be un-skilled laborers, most of whom would come from farmers and ordinary laborers in and around the Project area.

(2) Farmers' Income

After implementation of the Project, income of farmers is expected to increase considerably as a direct result of the increase in crop production. Such increase in income would contribute to improving farmers' living standards. Moreover, it is expected that farmers' purchasing power would increase along with improvement of their living standards, and this increased purchasing power would benefit the development of the regional economy.

(3) Marketing of Farm Products

Future marketing in the area is likely expand as compared with the present condition. With anticipated higher agricultural production, more farm products could be marketed by the farmers and the proportion of sales would also increase relative to consumption. The KUDs and merchants would have a larger turnover which could increase their incomes.

(4) Food Supply

The shortage of rice in the province in 2005 is forecast to be 317,000 tons, while the Project would produce a marketable surplus estimated at 30,000 tons of rice. The Project area will have to be a supply base to the province for this crop.

(5) Other Effects

Implementation of the Project would certainly lead to changes in rural socio-economy in the area. By the construction of inspection roads along the canals, the local transportation system would also be improved, which will contribute to the improvement of rural socio-economic activities.

Table 7.1 ANNUAL DISBURSEMENT SCHEDULE OF ECONOMIC CONSTRUCTION COST

(Unit: Rp Million)

Item	Total Cost			*3 1990/1991	1991/1992	1992/1993	1993/1994	1994/1995	1995/1996	1996/1997
	F/C*1	ECF	E/C*2							
1) Preparatory Works	2,052	0.71	1,457	437	583	291	146	-	-	-
2) Civil Work for 1st Stage										
- Head Work and Link Canal*4	5,055	0.71	3,589	-	-	998	1,514	1,077	-	-
- Main and Secondary Canals*5	22,440	0.71	15,932	-	-	1,441	7,094	6,524	873	-
- Tertiary Canal*6	3,175	0.80	2,540	-	-	-	638	1,566	335	-
3) Civil Work for 2nd Stage										
- Secondary Canal*5	3,300	0.71	2,343	-	-	-	-	937	936	470
- Tertiary Canal*6	4,381	0.80	3,505	-	-	-	-	877	1,753	875
4) O&M Facilities and Equipment	1,195	1.00	1,195	-	-	-	-	299	597	299
5) Land Acquisition	308	-	-	-	-	-	-	-	-	-
6) Administration	1,123	0.99	1,011	152	152	152	152	152	152	97
7) Engineering Service	6,840	0.90	6,156	1,724	923	739	923	1,108	554	185
8) Physical Contingency	2,493	-	1,886	116	83	181	523	627	260	96
Sub-Total	52,362		39,614	2,429	1,741	3,802	10,990	13,167	5,460	2,022
9) Price Contingency	20,352	-	-	-	-	-	-	-	-	-
Total	72,714		39,614	2,429	1,741	3,802	10,990	13,167	5,460	2,022

(Unit: US$ 1,000)

Item	Total Cost			*3 1990/1991	1991/1992	1992/1993	1993/1994	1994/1995	1995/1996	1996/1997
	F/C*1	ECF	E/C*2							
1) Preparatory Works	1,200	0.71	852	256	341	170	85	-	-	-
2) Civil Work for 1st Stage										
- Head Work and Link Canal*4	2,956	0.71	2,099	-	-	584	885	630	-	-
- Main and Secondary Canals*5	13,123	0.71	9,317	-	-	843	4,149	3,816	510	-
- Tertiary Canal*6	1,857	0.80	1,486	-	-	-	374	916	196	-
3) Civil Work for 2nd Stage										
- Secondary Canal*5	1,930	0.71	1,370	-	-	-	-	548	547	275
- Tertiary Canal*6	2,562	0.80	2,050	-	-	-	-	513	1,025	512
4) O&M Facilities and Equipment	699	1.00	699	-	-	-	-	175	349	175
5) Land Acquisition	180	-	-	-	-	-	-	-	-	-
6) Administration	657	0.90	591	89	89	89	89	89	89	57
7) Engineering Service	4,000	0.90	3,600	1,008	540	432	540	648	324	108
8) Physical Contingency	1,458	-	1,103	68	49	106	306	367	152	56
Sub-Total	30,622		23,167	1,421	1,019	2,224	6,428	7,702	3,192	1,183
9) Price Contingency	11,902	-	-	-	-	-	-	-	-	-
Total	42,524		23,167	1,421	1,019	2,224	6,428	7,702	3,192	1,183

*1 F/C Financial cost *2 E/C Economic cost

Remarks: *3 Year is assumption in order to estimate the price contingency and dose not indicate its real year.

*4 Weir *5 Irrigation and drainage systems *6 Land clearing and on-farm development

Note: US$ 1.00 = Rp. 1,710 (October 29-31, 1988)

Table 7.2 PROJECT BENEFITS

Crops	First Stage			Second Stage*			Total
	Harvested Area (ha)	Net Return per Hectare (Rp 1,000/ha)	Total Value (Rp Million)	Harvested Area (ha)	Net Return per Hectare (Rp 1,000/ha)	Total Value (Rp Million)	(Rp Million)
1) With Project							
Paddy (Irrigated)							
- Wet season	3,070	797	2,447	4,230	797	3,371	5,818
- Dry season	1,300	797	1,036	1,800	797	1,435	2,471
Maize	380	-58	-22	520	-58	-30	-52
Groundnuts	380	523	199	520	523	272	471
Soybeans/Green Beans	380	111	42	520	111	58	100
Total	5,510		3,702	7,590		5,106	8,808
2) Without Project							
Paddy (Rainfed)							
- Wet Land	102	427	44	-	427	-	44
- Dry Land	706	59	42	492	59	29	71
Maize	352	-58	-20	246	-58	-14	-34
Groundnuts	105	523	55	73	523	38	93
Soybeans	229	-15	-3	159	-15	-2	-5
Green Beans	57	236	13	40	236	9	22
Cassava	139	227	32	97	227	22	54
Total	1,690		163	1,107		82	245
Benefit			3,539			5,024	8,563

Remark: * Out of total upland field at present, about 990 ha are located outside of the existing transmigration area where is the first stage development area.

Table 7.3 PROJECT COSTS AND BENEFITS FLOWS

(Unit: Rp Million)

Year	Year In Order	Project Costs					Project Benefits	Balance
		Construction	Replacement	O&M Cost	Transmigration	Total		
1990 /1991	(1)	2,429	-	-	-	2,429	-	(2,429)
1991 /1992	(2)	1,741	-	-	-	1,741	-	(1,741)
1992 /1993	(3)	3,802	-	-	1,256	5,058	-	(5,058)
1993 /1994	(4)	10,990	-	-	3,243	14,233	-	(14,233)
1994 /1995	(5)	13,167	-	99	2,736	16,002	-	(16,002)
1995 /1996	(6)	5,460	-	150	743	6,353	2,399	(3,954)
1996 /1997	(7)	2,922	-	175	-	2,197	4,131	1,934
1997 /1998	(8)	-	-	175	-	175	5,491	5,316
1998 /1999	(9)	-	-	175	-	175	6,347	6,172
1999 /2000	(10)	-	-	175	-	175	7,204	7,029
2000 /2001	(11)	-	-	175	-	175	8,060	7,885
2001 /2002	(12)	-	-	175	-	175	8,437	8,262
2002 /2003	(13)	-	-	175	-	175	8,563	8,388
2003 /2004	(14)	-	-	175	-	175	8,563	8,388
2004 /2005	(15)	-	-	175	-	175	8,563	8,388
2005 /2006	(16)	-	-	175	-	175	8,563	8,388
2006 /2007	(17)	-	996	175	-	1,171	8,563	7,392
2007 /2008	(18)	-	-	175	-	175	8,563	8,388
2008 /2009	(19)	-	-	175	-	175	8,563	8,388
2009 /2010	(20)	-	-	175	-	175	8,563	8,388
2010 /2011	(21)	-	-	175	-	175	8,563	8,388
2011 /2012	(22)	-	-	175	-	175	8,563	8,388
2012 /2013	(23)	-	-	175	-	175	8,563	8,388
2013 /2014	(24)	-	-	175	-	175	8,563	8,388
2014 /2015	(25)	-	-	175	-	175	8,563	8,388
2015 /2016	(26)	-	-	175	-	175	8,563	8,388
2016 /2017	(27)	-	996	175	-	1,171	8,563	7,392
2017 /2018	(28)	-	-	175	-	175	8,563	8,388
2018 /2019	(29)	-	-	175	-	175	8,563	8,388
2019 /2020	(30)	-	-	175	-	175	8,563	8,388
2020 /2021	(31)	-	-	175	-	175	8,563	8,388
2021 /2022	(32)	-	-	175	-	175	8,563	8,388
2022 /2023	(33)	-	-	175	-	175	8,563	8,388
2023 /2024	(34)	-	-	175	-	175	8,563	8,388
2024 /2025	(35)	-	-	175	-	175	8,563	8,388
2025 /2026	(36)	-	-	175	-	175	8,563	8,388
2026 /2027	(37)	-	2,297	175	-	2,472	8,563	6,091
2027 /2028	(38)	-	-	175	-	175	8,563	8,388
2028 /2029	(39)	-	-	175	-	175	8,563	8,388
2029 /2030	(40)	-	-	175	-	175	8,563	8,388
2030 /2031	(41)	-	-	175	-	175	8,563	8,388
2031 /2032	(42)	-	-	175	-	175	8,563	8,388
2032 /2033	(43)	-	-	175	-	175	8,563	8,388
2033 /2034	(44)	-	-	175	-	175	8,563	8,388
2034 /2035	(45)	-	-	175	-	175	8,563	8,388
2035 /2036	(46)	-	-	175	-	175	8,563	8,388
2036 /2037	(47)	-	996	175	-	1,171	8,563	7,392
2037 /2038	(48)	-	-	175	-	175	8,563	8,388
2038 /2039	(49)	-	-	175	-	175	8,563	8,388
2039 /2040	(50)	-	-	175	-	175	8,563	8,388

EIRR (%): 12.7 B/C (Discount Rate = 10%): 1.32 B-C (Discount Rate = 10%): 10,520

Table 7.4 ANNUAL DISBURSEMENT SCHEDULE OF FINANCIAL CONSTRUCTION COST

(Unit: Rp Million)

Item	Total Cost			1990/1991*1		1991/1992		1992/1993		1993/1994		1994/1995		1995/1996		1996/1997	
	F.C.*1	L.C.*2	Total	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.
1) Preparatory Works	1,436	616	2,052	431	185	575	246	287	123	144	62	-	-	-	-	-	-
2) Civil Work for 1st Stage																	
- Head Work and Link Canal*4	3,612	1,443	5,055	-	-	-	-	1,017	388	1,510	622	1,084	433	-	-	-	-
- Main and Secondary Canals*5	12,834	9,607	22,441	-	-	-	-	1,153	877	5,710	4,282	5,263	3,926	708	522	-	-
- Tertiary Canal*6	2,223	952	3,175	-	-	-	-	-	-	559	239	1,370	588	294	125	-	-
3) Civil Work for 2nd Stage																	
- Secondary Canal*5	1,826	1,474	3,300	-	-	-	-	-	-	-	-	730	590	730	588	366	296
- Tertiary Canal*6	3,066	1,315	4,381	-	-	-	-	-	-	-	-	766	330	1,534	657	766	328
4) O&M Facilities and Equipment	896	299	1,195	-	-	-	-	-	-	-	-	224	75	448	149	224	75
5) Land Acquisition	-	308	308	-	-	-	92	-	123	-	62	-	31	-	-	-	-
6) Administration	-	1,123	1,123	-	169	-	169	-	169	-	169	-	169	-	169	-	108
7) Engineering Service	6,156	684	6,840	1,724	192	923	103	739	82	923	103	1,108	123	554	62	185	21
8) Physical Contingency	1,602	891	2,493	108	27	75	31	160	88	442	277	527	313	213	114	77	41
Sub-Total	33,651	18,712	52,363	2,263	573	1,573	641	3,356	1,850	9,288	5,816	11,072	6,578	4,481	2,386	1,618	869
9) Price Contingency	7,286	13,065	20,351	179	120	186	212	530	858	1,858	3,548	2,690	5,072	1,282	2,262	561	993
Total	40,937	31,777	72,714	2,442	693	1,759	853	3,886	2,708	11,146	9,364	13,762	11,650	5,763	4,648	2,179	1,862

(Unit: US$ 1,000)

Item	Total Cost			1990/1991*1		1991/1992		1992/1993		1993/1994		1994/1995		1995/1996		1996/1997	
	F.C.*1	L.C.*2	Total	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.
1) Preparatory Works	840	360	1,200	252	108	336	144	168	72	84	36	-	-	-	-	-	-
2) Civil Work for 1st Stage																	
- Head Work and Link Canal*4	2,112	844	2,956	-	-	-	-	595	227	883	364	634	253	-	-	-	-
- Main and Secondary Canals*5	7,595	5,618	13,123	-	-	-	-	674	513	3,339	2,504	3,078	2,296	414	305	-	-
- Tertiary Canal*6	1,300	557	1,857	-	-	-	-	-	-	327	140	801	344	172	73	-	-
3) Civil Work for 2nd Stage																	
- Secondary Canal*5	1,068	862	1,930	-	-	-	-	-	-	-	-	427	345	427	344	214	173
- Tertiary Canal*6	1,793	769	2,562	-	-	-	-	-	-	-	-	448	193	897	384	448	192
4) O&M Facilities and Equipment	524	175	699	-	-	-	-	-	-	-	-	131	44	262	87	131	44
5) Land Acquisition	-	180	180	-	-	-	54	-	72	-	36	-	18	-	-	-	-
6) Administration	-	657	657	-	99	-	99	-	99	-	99	-	99	-	99	-	63
7) Engineering Service	3,600	400	4,000	1,008	112	540	60	432	48	540	60	648	72	324	36	108	12
8) Physical Contingency	937	521	1,458	63	16	44	18	93	52	259	162	308	183	125	66	45	24
Sub-Total	19,679	10,943	30,622	1,323	335	920	375	1,962	1,083	5,432	3,401	6,475	3,847	2,621	1,394	946	508
9) Price Contingency	4,261	7,641	11,902	105	70	109	124	310	503	1,086	2,075	1,573	2,966	750	1,322	328	581
Total	23,940	18,584	42,524	1,428	405	1,029	499	2,272	1,586	6,518	5,476	8,048	6,813	3,371	2,716	1,274	1,089
Price Index (1988 = 100)				107.9	121.0	111.8	133.1	115.8	146.4	120.0	161.0	124.3	177.1	128.6	194.8	134.7	214.3

Remarks: *1 F.C. Foreign currency portion *2 L.C. Local currency portion

*3 Year is assumption in order to estimate the price contingency and dose not indicate its real year.

*4 Weir *5 Irrigation and drainage systems *6 Land clearing and on-farm development

Note: US$ 1.00 = Rp. 1,710 (October 29-31, 1988)

Table 7.5 CASH FLOW STATEMENT - WITH IRRIGATION SERVICE FEE

(Unit: Rp Million)

Year	Year in Order	Cash Outflow							Cash Inflow					Balance
		Capital Cost		Loan Repayment*3		O&M Cost	Replacement Cost	Total	Construction Fund		Revenue*4	Government Budget	Total	
		F.C.*1	L.C.*2	Interest	Principal				F.C.*1	L.C.*2				
1990	(1)	2,442	693	-	-	-	-	3,135	2,442	693	-	-	3,135	0
1991	(2)	1,759	853	66	-	-	-	2,678	1,759	853	-	66	2,678	0
1992	(3)	3,886	2,708	113	-	-	-	6,707	3,886	2,708	-	113	6,707	0
1993	(4)	11,146	9,364	218	-	-	-	20,728	11,146	9,364	-	218	20,728	0
1994	(5)	13,762	11,650	519	-	44	-	25,975	13,762	11,650	44	519	25,975	0
1995	(6)	5,763	4,648	891	-	88	-	11,390	5,763	4,648	88	891	11,390	0
1996	(7)	2,179	1,861	1,046	-	197	-	5,283	2,179	1,861	197	1,046	5,283	0
1997	(8)	-	-	1,105	-	219	-	1,324	-	-	219	1,105	1,324	0
1998	(9)	-	-	1,105	-	219	-	1,324	-	-	219	1,105	1,324	0
1999	(10)	-	-	1,105	-	219	-	1,324	-	-	219	1,105	1,324	0
2000	(11)	-	-	1,105	2,047	219	-	3,371	-	-	219	3,152	3,371	0
2001	(12)	-	-	1,050	2,047	219	-	3,316	-	-	219	3,097	3,316	0
2002	(13)	-	-	995	2,047	219	-	3,261	-	-	219	3,042	3,261	0
2003	(14)	-	-	939	2,047	219	-	3,205	-	-	219	2,986	3,205	0
2004	(15)	-	-	884	2,047	219	-	3,150	-	-	219	2,931	3,150	0
2005	(16)	-	-	829	2,047	219	-	3,095	-	-	219	2,876	3,095	0
2006	(17)	-	-	774	2,047	219	996	4,036	-	-	219	3,817	4,036	0
2007	(18)	-	-	718	2,047	219	-	2,984	-	-	219	2,765	2,984	0
2008	(19)	-	-	663	2,047	219	-	2,929	-	-	219	2,710	2,929	0
2009	(20)	-	-	608	2,047	219	-	2,874	-	-	219	2,655	2,874	0
2010	(21)	-	-	553	2,047	219	-	2,819	-	-	219	2,600	2,819	0
2011	(22)	-	-	497	2,047	219	-	2,763	-	-	219	2,544	2,763	0
2012	(23)	-	-	442	2,047	219	-	2,708	-	-	219	2,489	2,708	0
2013	(24)	-	-	387	2,047	219	-	2,653	-	-	219	2,434	2,653	0
2014	(25)	-	-	332	2,047	219	-	2,598	-	-	219	2,379	2,598	0
2015	(26)	-	-	276	2,047	219	-	2,542	-	-	219	2,323	2,542	0
2016	(27)	-	-	221	2,047	219	996	3,483	-	-	219	3,264	3,483	0
2017	(28)	-	-	166	2,047	219	-	2,432	-	-	219	2,213	2,432	0
2018	(29)	-	-	110	2,047	219	-	2,376	-	-	219	2,157	2,376	0
2019	(30)	-	-	55	2,047	219	-	2,321	-	-	219	2,102	2,321	0
2020	(31)	-	-	-	-	219	-	219	-	-	219	-	219	0
2021	(32)	-	-	-	-	219	-	219	-	-	219	-	219	0

Remarks: *1 Foreign Currency Portion *2 Local Currency Portion
*3 Interest: 2.7 % per year. Grace period: 10 years. Repayment period: 30 years (including grace period).
*4 Revenue from irrigation fee to be collected from farmers.

Note: The cash flow statement was prepared for the project executing agency of irrigation project, and investment costs for transmigration and rubber cultivation which were proposed in the agricultural development plan were excluded from this cash flow statement.

Table 7.6 CASH FLOW STATEMENT - WITHOUT IRRIGATION SERVICE FEE

(Unit: Rp Million)

Year	Year In Order	Cash Outflow							Cash Inflow				Balance
		Capital Cost		Loan Repayment*3		O&M Cost	Replacement Cost	Total	Construction Fund		Government Budget	Total	
		F.C.*1	L.C.*2	Interest	Principal				F.C.*1	L.C.*2			
1990	(1)	2,442	693	-	-	-	-	3,135	2,442	693	-	3,135	0
1991	(2)	1,759	853	66	-	-	-	2,678	1,759	853	66	2,678	0
1992	(3)	3,886	2,708	113	-	-	-	6,707	3,886	2,708	113	6,707	0
1993	(4)	11,146	9,364	218	-	44	-	20,772	11,146	9,364	262	20,772	0
1994	(5)	13,762	11,650	519	-	88	-	26,019	13,762	11,650	607	26,019	0
1995	(6)	5,763	4,648	891	-	197	-	11,499	5,763	4,648	1,088	11,499	0
1996	(7)	2,179	1,861	1,046	-	219	-	5,305	2,179	1,861	1,265	5,305	0
1997	(8)	-	-	1,105	-	219	-	1,324	-	-	1,324	1,324	0
1998	(9)	-	-	1,105	-	219	-	1,324	-	-	1,324	1,324	0
1999	(10)	-	-	1,105	-	219	-	1,324	-	-	1,324	1,324	0
2000	(11)	-	-	1,105	2,047	219	-	3,371	-	-	3,371	3,371	0
2001	(12)	-	-	1,050	2,047	219	-	3,316	-	-	3,316	3,316	0
2002	(13)	-	-	995	2,047	219	-	3,261	-	-	3,261	3,261	0
2003	(14)	-	-	939	2,047	219	-	3,205	-	-	3,205	3,205	0
2004	(15)	-	-	884	2,047	219	-	3,150	-	-	3,150	3,150	0
2005	(16)	-	-	829	2,047	219	-	3,095	-	-	3,095	3,095	0
2006	(17)	-	-	774	2,047	219	996	4,036	-	-	4,036	4,036	0
2007	(18)	-	-	718	2,047	219	-	2,984	-	-	2,984	2,984	0
2008	(19)	-	-	663	2,047	219	-	2,929	-	-	2,929	2,929	0
2009	(20)	-	-	608	2,047	219	-	2,874	-	-	2,874	2,874	0
2010	(21)	-	-	553	2,047	219	-	2,819	-	-	2,819	2,819	0
2011	(22)	-	-	497	2,047	219	-	2,763	-	-	2,763	2,763	0
2012	(23)	-	-	442	2,047	219	-	2,708	-	-	2,708	2,708	0
2013	(24)	-	-	387	2,047	219	-	2,653	-	-	2,653	2,653	0
2014	(25)	-	-	332	2,047	219	-	2,598	-	-	2,598	2,598	0
2015	(26)	-	-	276	2,047	219	-	2,542	-	-	2,542	2,542	0
2016	(27)	-	-	221	2,047	219	996	3,483	-	-	3,483	3,483	0
2017	(28)	-	-	166	2,047	219	-	2,432	-	-	2,432	2,432	0
2018	(29)	-	-	110	2,047	219	-	2,376	-	-	2,376	2,376	0
2019	(30)	-	-	55	2,047	219	-	2,321	-	-	2,321	2,321	0
2020	(31)	-	-	-	-	219	-	219	-	-	219	219	0
2021	(32)	-	-	-	-	219	-	219	-	-	219	219	0

Remarks: *1 Foreign Currency Portion *2 Local Currency Portion
*3 Interest: 2.7 % per year. Grace period: 10 years. Repayment period: 30 years (including grace period).

Note: The cash flow statement was prepared for the project executing agency of irrigation project, and investment costs for transmigration and rubber cultivation which were proposed in the agricultural development plan were excluded from this cash flow statement.

APPENDIX COLLECTED DATA

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28. Peta struktur SKP-F S= 1 : 20,000, Nov. 1985

29. Peta RSKP IIIA & IIIB S= 1 : 20,000 Nov. 1985

30. Peta WPP XII - SKP E/Vegetasi & Tata Guna Lahan S= 1 : 20,000

31. Jaringan Setasiun-Setasiun Gumatologi Pertanian di Sumatera Bagian Utara

32. Peta Lokasi Rencana Areal PTP dan Transmigrasi di Tapanuli Selatan, Sumatera Utara, S= 1 : 250,000

33. Peta rencana Pengukuhan dan Penatagunaan Hutan Propinsi Dati I Sumatera Utara, S= 1 : 500,000

34. Peta Lokasi Areal dan Transmigrasi di Kecamatan osa dan Kec. Barumun, Sumatera Utara, S= 1 : 250,000

35. Peta Rencana Struktur SKP-D Ujung Batu, WPP- IXb Sibuhuan, Sumatera Utara

36. Peta Areal PIR Akselerasi PT Perkebunan VII Sosa Tapanuli Selatan, Sumatera Utara, S= 1 : 50,000

Hydrological Data

1. Meteorological Data at all stations in Riau from 1980 to 1986 by P3.S.A. office

2. Meteorological Data at Pasir Pengarayan, Pasar Kampar Bangko Jaya, and Kota Lama, 1987 by P3.S.A.office

3. Daily Rainfall Data at Pasir Pengarayan from 1970 to 1979 by P3.S.A. office

4. Daily Rainfall Data at 9 (nine) places 1987 by P3.S.A. office

5. Daily Rainfall Data at Pasir Pengarayan and Dalu Dalu 1988 by P3..A. office

6. Mean Monthly Rainfall Data from 1931 to 1960 on the Islands outside Java and Madura by B.M.G. Jakarta

7. Monthly Rainfall Data in Sumatera Utara from 1954 to 1979 and location map by B.M.G. Jakarta

8. Monthly Rainfall Data in Riau from 1974 to 1979 by B.M.G. Jakarta

9. Monthly Rainfall Data in Riau and Sumatera Utara from 1980 to 1985 by B.M.G. Jakarta

10. Hydrological Data Register for North Sumatra, Aug. 1980 by D.P.U. Medan

11. Daily Rainfall Data at Simirik in Sumatra Utara from 1978 to 1987 by RISPA, Medan

12. Daily Rainfall Data at Ujung Batu (1985-1987, Balanka Sitongkon (1981-1987) and Binanga (1984-1987) by Coordinate office B.P.P. Padang Sidempuan and B.M.G. Medan

13. Daily Rainfal Data at Gunungtuan and Panyabungan on 1978, 1980 and 1986 by D.P.U. (P3.S.A.) Medan

14. Monthly Rainfall Data at all stations in Kab. Tapanuli Selatan from 1980 to 1987 by Pertanian, Padang Sidempuan

15. Daily Record of Discharge Observation from 1977 to 1987 at 7 (seven) places by P3.S.A. office

16. Data on Rating curve from 1977 to 1988 at 7 (seven) places by P3.S.A office

17. Record of Water level by Automatic Water Level Gauge at Kota Bangun during the flood by P3.S.A. office

Geological Data

1. The Geology of the Padangsidempuan and Sibolga Quadrangle, Sumatra, Scale 1 : 250,000 published by Geological Research & Development Center in 1982 (Explanatory note and geological map)

2. -dito- Lubuksikaping published in 1983

3. -dito- Pakanbaru published in 1982

4. -ditto- Dumai published in 1982

5. Geological map of Sumatra, scale 1 : 1000,000 published by Geological Research & Development Center

6. Pedoman Penyelidikan Geologi Teknik & Mekanika Tanah untuk Perencanaan Teknis D.P.U. Proyek Monitoring Pelaksanaan, Aug. 1980.

Transmigration Data

1. SECOND STAGE DEVELOPMENT PROGRAMME

   Feasibility Studies & Detailed Engineering

   - EXECUTIVE SUMMARY
   - VOLUME 1 ; Regional Context & Pre Feasibility Study
   - VOLUME II : Feasibility Study & Detailed Engineering
   - VOLUME III : STANDARD Operating Procedures
   - ANNEX-1/2
   - ANNEX-2/2
   - ATTACHED MAPS

2. SECOND STAGE DEVELOPMENT PROGRAMME

   - Tender Document for Civil Work of Road and Drainage, VOLUME V-1, Drawings of Road Improvement Feb., 1988
   - Tender Document for Civil Work of Road and Drainage, VOLUME V-2, Drawings of Drainage Improvement Feb., 1988

BATANG KUMU REPORT BY PT.ISUDA & CV.AIR KONSUL

1. PENYELIDIKAN GEOLOGI TEKNIK DAN MEKANIKA TANAH / PRENCANAAN TEKNIS PENDAHULUAN D.I.BATANG KUMU 1985/1986 — Issued on May.1986 by PT.ISUDA

2. FINAL REPORT / PERENCANAAN TEKNIS PENDAHULUAN DAERAH IRIGASI BATANG KUMU PROPINSI RIAU
SURVEY PENELITIAN LAHAN DAN PENELITIAN KWALITAS AIR — Issued on May.1986 by PT.ISUDA

3. LAPORAN AKHIR SEMENTARA / PERENCANAAN TEKNIS PENDAHULUAN DAERAH IRIGASI BATANG KUMU DI PROPINSI RIAU
PENYELIDIKAN GEOLOGI TEKNIK DAN MEKANIKA TANAH RENCANA TANGGUL PENUTUP DAN SALURAN INDUK 1986/1987 — Issued on Dec.1986 by PT.ISUDA

4. FINAL REPORT / PERENCANAAN TEKNIS PENDAHULUAN DAERAH IRIGASI BATANG KUMU DI PROPINSI RIAU
PRENCANAAN TEKNIS PEMBANGUNAN IRIGASI II PEMASANGAN AWLR DAN ARR 1986/1987 — Issued on Jan.1987 by PT.ISUDA

5 LAPORAN AKHIR / PERENCANAAN TEKNIS PENDAHULUAN DAERAH IRIGASI BATANG KUMU DI PROPINSI RIAU
PRENCANAAN TEKNIS PEMBANGUNAN IRIGASI II PENGUKURAN TRACE SALURAN / FINAL REPORT — Issued on Jan.1987 by PT.ISUDA

6. LAPORAN AKHIR / PERENCANAAN TEKNIS PENDAHULUAN DAERAH IRIGASI BATANG KUMU DI PROPINSI RIAU
PRENCANAAN TEKNIS PEMBANGUNAN IRIGASI II PRARENCANA BENDUNG / FINAL REPORT — Issued on Jan.1987 by PT.ISUDA

7 EXECUTIVE SUMMARY REPORT/ PERENCANAAN TEKNIS PENDAHULUAN DAERAH IRIGASI BATANG KUMU DI PROPINSI RIAU
PRENCANAAN TEKNIS PEMBANGUNAN IRIGASI II PENYELIDIKAN GEOLOGI TEKNIK DAN MEKANIKA TANAH RENCANA TANGGUL PENUTUP DAN SALURAN INDUK 1986/1987 — Issued on Jan.1987 by PT.ISUDA

8. PERENCANAAN TEKNIS PENDAHULUAN DAERAH IRIGASI BATANG KUMU DI PROPINSI RIAU
PERENCANAAN TEKNIS PEMBANGNAN IRIGASI II 1987/1988 — Issued on Aug.1987 by CV.AIR KONSUL

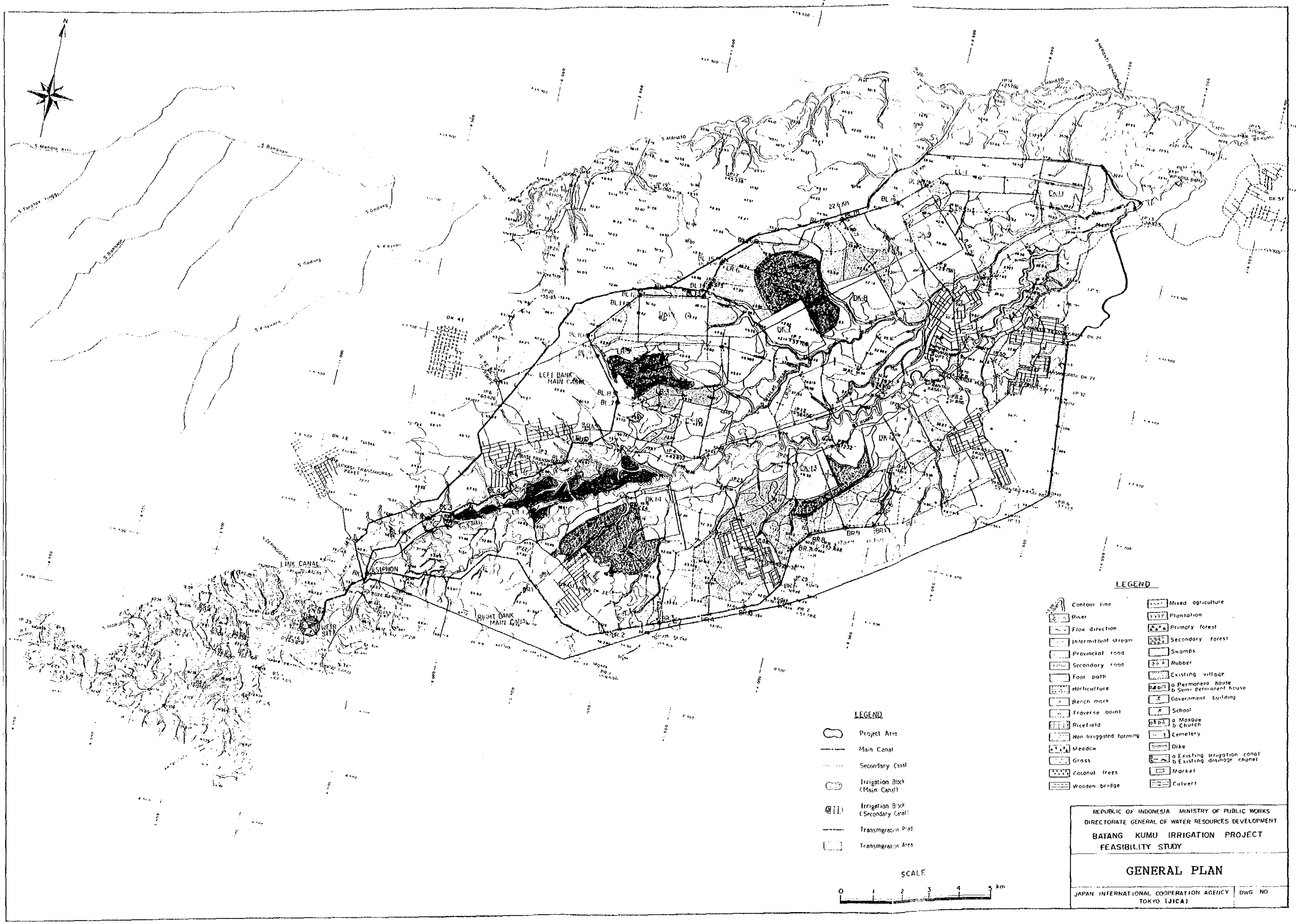
BATANG KUMU REPORT BY PT.ISUDA (2)

1. DRAFT FINAL REPORT / PERENCANAAN TEKNIS PENDAHULUAN
DAERAH IRIGASI BATANG KUMU
PROPINSI RIAU
Jan, 1986
Issued on Jan.1986
by PT.ISUDA

2. FINAL REPORT / PERENCANAAN TEKNIS PENDAHULUAN
DAERAH IRIGASI BATANG KUMU
PROPINSI RIAU
PENGUKURAN TOPOGRAFI
LOKASI BENDUNG,TRACE SALURAN
DAN PROPIL SUNGAI
Issued on May.1986
by PT.ISUDA

3 EXECUTIVE SUMMARY REPORT/ STUDY RECONNAISSANCE
D.I. BATANG KUMU
KABUPATEN KAMPAR PROPINSI RIAU
1982/1983 FINAL REPORT
Issued on Jan.1983
by PT.ISUDA

4. PENYELIDIKAN GEOLOGI TEKNIK DAN MEKANIKA TANAH/
RENCANA BENDUNG, TANGGUL PENUTUP DAN BORROW AREA (177M)
1984/1985



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

BATANG KUMU IRRIGATION PROJECT
FEASIBILITY STUDY

GENERAL PLAN

JAPAN INTERNATIONAL COOPERATION AGENCY
TOKYO (JICA)

DWG NO