The possible total net production values for each alternative pattern are also calculated on the basis of the maximum adaptable areas mentioned above. The pattern A will also bring about the largest values as shown below:

Alternative	Profitability	Maximum Adaptable Area	Total Net Production Value
	(10^3Rp/ha)	(ha)	(10^6Rp)
Pattern A	1,122.6	8,000	8,980.8
Pattern B	1,110.4	8,000	8,883.2
Pattern C	1,129.7	6,500	7,343.1
Pattern D	1,021.6	6,500	6,640.4

In the light of the basic principles for the proposed cropping pattern, the pattern A is, among the possible alternative patterns, most applicable to the Project. The proposed cropping pattern, together with agro-climate data, is illustrated on Fig. 5.1. The framework of cropping calendar is designed so as to expand the irrigable area as much as possible through the water balance study. Early matured varieties like IR28, IR36 and IR50 are proposed in order to ensure the maximum irrigable area and high yield.

5.1.4 Proposed Farming Practice

Based on the analysis of paddy yield survey, the proposed cropping pattern A (double cropping of paddy) is studied and the proposed farming practices are determined as summarized below (for details, vide ANNEX - V):

The seed requirement is 30 kg per ha. The nursery has to be prepared as flat as possible. The size of nursery is about 1/20 of the paddy field to be transplanted. Fertilization is essential and the recommendable dosage is 5 kg of urea per ha. The nursery period is 25 days after seeding. The field preparation is carried out by animal power such as oxex and buffaloes.

Transplanting is made by manual labour with a spacing of 30 cm x 15 cm, which makes the number of hills per m^2 to be 22.2, and planting 2 to 3 seedlings per one hill is recommendable. The irrigation water has to be drained just before transplanting so that transplanting in shallow depth is enforced for accelerating vigorous tillering.

The total fertilizer requirement for sustaining the target yields would be 200 kg/ha of urea and 100 kg of triple superphosphate (T.S.P). The basic fertilizer application is 65 kg/ha of urea and 100 kg/ha of T.S.P when field preparation is practiced. Top dressing is made in 2 times. The amount of fertilizer to be applied per ha is about 65 kg of urea at each top dressing time. In the paddy fields where the percentage of ripened grains is low, top dressing with the same dosage of urea at full heading stage is often quite effective. After transplanting, weeding is carried out in 3 times, depending on the conditions of weed growth, by manual operations.

As regards the plant protection, intensive application of insecticide is required for control of plant hoppers, stem borers, etc. Considering the life-cycle of these insects, 3 to 4 lit/ha of insecticides are required for 3 to 4 times application during one cropping season. In addition, it would be necessary to apply one lit/ha of fungicides for control of diseases and 2 kg/ha of rodenticides for ratting, for each cropping season.

Harvesting is carried out by manual labour. The harvested paddy is dried on the ground. In future, artificial dryers will have to be considered because a lot of harvested grains are damaged by unexpected rains. For threshing, use of treadle thresher, instead of traditional hand threshing, is recommendable.

5.1.5 Anticipated Crop Yield and Crop Production

The present paddy yield in the Project area is low and fluctuate year by year under the rainfed condition. After completion of the project, the paddy yield will be stabilized and increased through supply of irrigation water, improvement of farming practices and further expansion of agricultural supporting services.

The anticipated dried paddy yields are estimated as follows:

(Unit: dried paddy ton/ha)

Crops	Without Project	with Project
Wet season paddy	2.23	5.00
Dry season paddy	2.50	5.00

Generally, paddy yield depends on soil conditions, climatological environment, degree of irrigation water supply and farm management practices. The soils of the Project area are generally suitable for paddy cultivation. Although the soils are poor in plant nutrients, the deficits will be possibly supplemented by application of fertilizers. It is also assumed that sufficient irrigation water will be supplied to the paddy fields under the Project. Consequently, the climatological environment and farm management practices directly affect the future paddy yield.

The paddy yield can be estimated using the following empirical formula:

$$Y = S(278 - 7.07\ t) \times G \times R \times 10^{-5}$$

where, Y: paddy yield (ton/ha)
S: average daily solar radiation during 25 days before flowering (cal/cm^2)
t: average daily temperature during 25 days before flowering (°C)
G: 1,000 grain weight (g)
R: percentage of rippened grains (%)

Using mean values of the paddy yield survey for IR42 under irrigated condition in the Langkemme and Sadang areas, and applying the actual records for solar radiation and temperature in the Project area, the potential paddy yields are estimated at 6.8 tons per ha for wet season paddy and 6.7 tons per ha for dry season paddy (for details, see ANNEX - V).

The actual paddy yields are, however, generally affected by another uncontrollable factor "farm management practices". This factor includes water management, farming operations, farm inputs supplies, post-harvest operations, extention services and other agricultural activities. The efficiency of all these activities is assumed to be 75% as a whole. The anticipated yield is, therefore, set at 75% of the estimated potential yield, i.e., 5.0 tons per ha both for wet and dry season paddies.

The above anticipated paddy yields are rather conservatively estimated. The average unit yield of paddy is Sadang irrigation area, a well known irrigation project in South Sulawesi province, is 5.97 tons per ha (wet season paddy). According to the agricultural data in South Sulawesi province, the average unit yield of paddy under INSUS program where irrigation facilities are provided, was 5.90 ton per ha in 1979/80. The unit yields for past 7 years from 1974 to 1980 in Kabupaten Sidrap where the Bulu Cenrana irrigation project exists, average 5.11 tons per ha over the total area of about 55,000 ha.

Based on the proposed cropping pattern, the cropped area, crop yields and total crop production under both "with project" and "without project" conditions are estimated as follows:

Crops	Without Project	With Project	Increment
Harvested Area (ha)			
Wet season paddy	5,780	8,000	2,220
Dry season paddy	600	4,000	3,400
Polowijo crops	1,400	-	-1,400
Unit Yield (ton/ha)			
Wet season paddy	2.23	5.00	2.77
Dry season paddy	2.50	5.00	2.50
Polowijo crops	0.71	-	-
Production (tons)	14,390	60,000	45,610
Wet season paddy	12,890	40,000	27,110
Dry season paddy	1,500	20,000	18,500
Polowijo crops	(990)	-	(-990)

The annual paddy production at full development stage would amount to about 60,000 tons of dried paddy. The expected annual increment of paddy production would be about 45,600 tons.

5.1.6 Marketing and Price Forecast

The Kabupaten Bone, in which the Project area is included, is one of surplus regions in the South Sulawesi Province. The annual surplus from the Kabupaten Bone is estimated around 339,000 tons in total, corresponding to about 19% of the total surplus paddy of the province. Most of these surplus rice are transported to the rice deficit regions like Ujung Pandang and Pare-Pare, and even to other provinces. Under such demand-supply condition, the marketing channels of rice are well developed in the province. The price of rice is rather stable under Government control and is constantly increasing with a little seasonal fluctuations.

With the completion of the Project, the total production of paddy is estimated about 60,000 tons. The total consumption of paddy for the total population of about 47,200, which are projected from 1981 to 1990 using 2.36% of annual growth rate, is estimated at about 10,850 tons on the assumption that per capita consumption is 230 kg of dried paddy. The seed stock, handling and storing losses and feed of livestock are estimated at 4,620 tons or 7.7% of total production of paddy. The annual marketable surplus amount of paddy is estimated at about 44,530 tons. These surplus of paddy are marketed to the rice-deficit regions.

The economic farm gate prices of farm products and farm inputs are calculated based on the projected international market prices forecasted by IBRD in the long term range for the period of 1982 to 1990. The economic farm gate price of dried paddy is estimated at Rp214,000/ton. The economic farm gate prices of polowijo and upland crops are estimated at Rp420,000/ton for groundnuts, Rp367,000/ton for greenbeans and Rp149,000/ton for maize.

Financial prices of farm products and farm inputs at farm gate are estimated based upon available data on farm gate prices collected through the farm economy survey and local market prices at the Project area in 1982. For financial evaluation, the average farm gate price of dried paddy at Rp105,000/ton in 1982 will be used.

5.1.7 Crop Production Cost

The present agricultural condition would not change significantly unless a new irrigation project could be implemented. For the estimation of the production cost without project condition, therefore, only unit prices of production cost components are forecasted by using general prices index of major commodities in the South Sulawesi, without changing the unit requirement for farm inputs and labour. The estimated production costs under future without project condition are Rp200,400 per ha for wet season paddy and Rp202,000 per ha for dry season paddy.

The production costs would increase after completion of the project, and are estimated at Rp318,100 per ha for wet season paddy and Rp328,600 per ha for dry season paddy. This anticipated increase is primarily attributable to increase of expenses for fertilizers, agro-chemicals and labours.

5.1.8 Net Production Values per Ha without and with Project

The annual net crop production value without project is estimated at about Rp228,200 (US$340) per ha on the basis of the forecasted unit yield and prices of crops and production costs aforementioned. After completion of the project, the annual net crop production value will amount to Rp1,122,600 (US$1,675) per ha at full development stage. The primary increased production value after the build-up period will be about Rp894,400 (US$1,335) per ha per annum. The details of calculation are given in ANNEX - V.

5.2 IRRIGATION AND DRAINAGE DEVELOPMENT PLAN

5.2.1 General

Selection of the optimal development plan of the Project was made based on the technical and economical comparison taking into consideration the potential area and available water resources for the Project, as mentioned in Chapter IV.

The main feature of the proposed Project is to supply irrigation water to the Project area of 8,000 ha with the irrigation system based on the built-up DOI design and new supplemental facilities by utilizing the available water from the Sanrego river and three tributaries, i.e., Parota, Biru and Macinaga. The facilities required for the Project include an intake weir on the Sanrego river, three small-scaled intake weirs on the Parota, Biru and Macinaga rivers, main and secondary irrigation canals, connecting canals, farm roads, their related structures and tertiary system.

5.2.2 Review of Design Work Conducted by the Government

Since 1972, the Government has been making an endeavour to realize the irrigation development of the Sanrego area and almost completed the detailed design of main and secondary canal system in 1982. The irrigation facilities designed by DOI includes the Sanrego intake weir, one main canal with a length of 11.6 km, 18 secondary canals with the total length of 86.3 km and their related structures such as turnout, drop, chute, aqueduct, bridge and cross drain culvert.

Through the review works for the above facilities, it is judged that the design works by DOI were basically made with the adequacy and soundness on the basis of the design standard used in order similar irrigation Projects in Indonesia. The following some modifications are, however, recommended for the DOI design from the technical viewpoint. The details are given IN ANNEX - VII.

(1) The length of stilling basin of the Sanrego intake weir is recommended to be taken as shown below, considering the energy dissipating function of the basin:

- for upper stilling basin: L = 19.1 m (1.6 m longer than the length designed by DOI)

- for lower stilling basin: L = 17.8 m (1.0 m longer than the length designed by DOI)

(2) The downstream section of closing dike is recommended to be enlarged based on the stability analysis (see Fig. VII.2.3 in ANNEX - VII)

(3) The profile and cross section of left side wall of the intake weir are recommended to be modified so as not to change the necessary cross section of closing dike and also to prevent piping at between wall and closing dike (see Figs. VII.2.4 - 2.6 in ANNEX - VII).

(4) Upstream and downstream slopes of embankment at the right bank of intake weir are recommended to be modified from 1 : 1.5 to 1 : 2.5 for keeping the stability of embankment.

(5) To prevent seepage and erosion, the canal sections are recommended to be lined with mortar or wet stone masonry for following portions:

- for main canal : 0.9 km
- for Palaka secondary canal: 1.7 km
- for Aming secondary canal : 4.8 km

(6) Out of 79 cross drain culverts designed by DOI, 3 culverts are recommended to be enlarged their capacity in order to drain out the design flood discharge safely.

5.2.3 Proposed Irrigation and Drainage System

The design of irrigation system by DOI was made to supply irrigation water to the area of about 8,000 ha by utilizing the available water from only the Sanrego river. In this Feasibility Study, some supplemental water sources are required to supply irrigation water to the Project area of 8,000 ha based on the water balance study, and three tributaries, namely, Parota, Biru and Macinaga, are selected as the supplemental water sources for the Project. The irrigation system designed by DOI will be, therefore, used as the main and secondary irrigation system of the project with some modifications resulted from the technical review works, and new supplemental facilities are proposed to be constructed so as to incorporate into the above main and secondary irrigation system. The proposed irrigation canal system is illustrated on Fig. 5.2.

The drainage canal system will be networked so as to evacuate the excess water in the fields and also to transport the stream flows occured in the outside of the Project area. The drainage system consists of major drains and tertiary drains which are provided within the tertiary blocks. The major drains are planned to collect water from tertiary drains and to transport flood water from surrounding mountainous areas. The location of major drain is dominated by natural rivers and streams existed in the Project area. These natural rivers and streams are used as much as possible as the major drains. In the area, the density of these rivers and streams to be applied as the majors drains for the

Project is estimated at about 22 m/ha and the carrying capacities of these rivers and streams are enough for the design discharge with 5-year return period. Therefore, no major drains are proposed to be provided newly for the Project (for details, vide ANNEX - VI).

5.2.4 Proposed Project Works

(1) Sanrego intake weir

The Sanrego intake weir will be constructed about 14.5 km upstream from the confluence of the Walanae river and the Sanrego river. The Sanrego intake weir will consist of a diversion weir, intake structure on right bank, coupure channel and closing dike. The construction method to be introduced will be so-called coupure method. The diversion weir will be of cascade type to be constructed with wet stone masonry.

The principal features of the Sanrego intake weir would be as follows:

Diversion Weir

- Type of weir	Cascade Type
- Max. diversion discharge	12.91 m^3/sec
- Design flood discharge (100 year return period)	820 m^3/sec
- Crest elevation	El 170.747 m
- Crest length of overflow weir	40.0 m
- Height of weir (from stilling basin)	
Upstream weir	10.3 m
Downstream weir	12.5 m
- Length of stilling basin	
Upstream weir	19.1 m
Downstream weir	17.8 m
- Width of scouring sluice (gate size)	4.0 m (2.0 m x 2 nos)
- Intake water level	EL 170.647 m
- Width of intake structure (gate size)	6.0 m (2.0 m x 3 nos)

Closing Dike

- Type of embankment	Homogeneous
- Crest elevation	EL 177.047 m
- Crest width	8.0 m
- Max. height	26.0 m
- Crest length	250.0 m

(2) Supplemental small-scaled intake weirs

In order to supply supplemental irrigation water to the Project area, three small-scaled intake weirs will be constructed on the tributaries, i.e., Parota, Biru and Macinaga. On the Biru river, there exists a intake weir for the Maradda semi-technical irrigation

scheme and this existing intake weir will be used with minor rehabilitation works. On the Parota and Macinaga rivers, no facilities exist and therefore, new small-scaled intake weirs will be constructed.

The general features of these intake weirs are summarized as follows:

Parota Intake Weir

- Type of weir	Tirol type
- Max. diversion discharge	1.40 m^3/sec
- Crest elevation	EL 156.3 m
- Crest length	10.0 m
- Height of weir	3.5 m
- Length of intake screen	0.5 m

Biru Intake Weir

- Type of weir	Overflow type
- Max. diversion discharge	0.93 m^3/sec
- Crest elevation	EL 170.3 m
- Crest length	27.5 m
- Height of weir	3.0 m
- Width of scouring sluice	1.0 m

Macinaga Intake Weir

- Type fo Weir	Tirol type
- Max. diversion discharge	0.40 m^3/sec
- Crest elevation	EL 150.8 m
- Crest length	5.0 m
- Height of weir	2.5 m
- Length of intake screen	0.5 m

(3) Main and secondary irrigation canals

In the Project area, one main canal and 20 secondary canals will be constructed to deliver irrigation water from the intake weir to the Project area. The alignments of these canal routes are made based on the required water level for the irrigation of total project area. These canals are designed principally as unlined earth canal with trapezoidal cross section of side slope of 1 : 1.5 to 1 : 1.0, and for some portions, lining with mortar and/or wet stone masonry will be required to prevent seepage and erosion.

The total length of the main and secondary canals and the number of their related structures as shown below:

Description	Main Canal	Secondary Canal	Total
Max. design discharge (m^3/sec)	12.91	6.20	-
Canal length (km)			
- Unlined	10.7	91.0	101.7
- Lined	0.9	6.5	7.4
Related Structures			
- Turnout (nos)	10	90	100
- Drop (nos)	-	64	64
- Chute (nos)	-	7	7
- Aqueduct (nos)	1	2	3
- Bridge (nos)	4	21	25
- Cross drain culvert (nos)	21	58	79

(4) Connecting Canals

The connecting canals will be constructed to convey intake water from small-scaled intake weirs constructed on the tributaries to the main and secondary irrigation canals mentioned above. All connecting canals are designed to be unlined earth canal with trapezoidal cross section of side slope of 1 : 1.0.

The length of canals and number of related structures are as follows:

Description	Name of Connecting Canal			Total
	Parota	Biru	Macinaga	
Max. design discharge (m^3/sec)	1.40	0.93	0.40	-
Canal length (km)	1.0	1.4	2.5	4.9
Related Structures				
- Spillway (nos)	1	-	1	2
- Bridge (nos)	-	-	1	1
- Cross drain culvert (nos)	1	-	2	3
- Junction (nos)	1	1	1	3

(5) Road network

For the proper operation and maintenance of the project facilities and for making the agricultural activities more active, a well networked road system is essential in the Project area. The proposed road network consists of the existing roads available, roads planned in the integrated rural development project for the Sanrego Area by Canadian International Development Agency (CIDA), canal inspection roads and new farm roads proposed in this study.

The existing provincial road leading from Ujung-Lamuru to Sinjai via Camming and Palattae, and the existing access road connecting the above provincial road with the Sanrego intake weir site are gravel metalled and can be used as the trunk roads for the Project. In the Sanrego area integrated rural development project, some new farm roads are proposed to be constructed and the up-grading of the existing roads are also planned. The irrigation canals proposed in this study will be provided with canal inspection roads having a total width of 6.0 m with gravel pavement of 3.0 m wide.

Taking into account the above conditions, two (2) new roads are proposed by up-grading of the existing roads and new construction. The total length of the proposed new roads will be about 13.2 km having a width of 6.0 m with gravel pavement of 3.0 m wide. The details are shown in ANNEX - VI.

(6) Tertiary development

The Project area of 8,000 ha will be divided into 200 tertiary blocks having the maximum size of 77 ha and the minimum of 11 ha based on new orthophoto maps prepared by JICA at the end of 1982. The tertiary system to be constructed in the tertiary block will consist of tertiary irrigation canals, quaternary irrigation canals, and tertiary drains. The quaternary canals will be principally be constructed with dual purposes of irrigation and drainage.

The proposed length of tertiary and quaternary irrigation canals and tertiary drains are as follows:

- Tertiary irrigation canal	100 km
- Quaternary irrigation canal	480 km
- Tertiary drain	100 km

(7) Reclamation work

The proposed irrigation area of 8,000 ha consists of the existing paddy field of 6,800 ha and the upland, grassland and orchard of 1,200 ha. In order to develop new paddy fields, the reclamation works will be required for the upland of 500 ha, grassland of 600 ha and orchard of 100 ha.

5.3 IMPLEMENTATION SCHEDULE

5.3.1 Basic Considerations

The excavation works of coupure channel at the Sanrego intake weir site were almost completed by the local contractor in 1982. The tendering for construction of intake weir itself including closing dike was also finished based on the local tender by the end of 1982 and the actual construction works are scheduled to be commenced by the local contractor at the beginning of 1983.

Taking into consideration the above present situation, the project implementation schedule is formulated as follows:

(1) The Sanrego intake weir including closing dike would be constructed by the Governments own budget.

(2) The remaining works, such as main and secondary irrigation canal systems, supplemental small-scaled intake weirs on the tributaries, etc., would be executed based on the international competitive bidding with foreign financial assistance.

5.3.2 Implementation Schedule

The project implementation schedule is shown in Fig. 5.3. The total construction period including the excavation works of coupure channel will be eight (8) years from 1981/82 to 1988/89.

The Sanrego intake weir including closing dike will be constructed for three (3) years from 1983/84 to 1985/86. About six (6) months will be required for the pre-qualification and tendering for construction of main and secondary irrigation canal systems, small-scaled intake weirs on tributaries, etc.

The construction of main canal system will be commenced on October, 1984 and be completed on September, 1986. The secondary canal system will be needed about three and half (3.5) years for the construction from April, 1985 to September, 1988. The construction works of small-scaled intake weirs on the tributaries including connecting canals will be started on April, 1986 and be completed on March, 1987.

The tertiary development works will take three (3) years for the construction from April, 1986 to March, 1989. The construction of reclamation works will be done in parallel with the tertiary development works. The farm road networks will be constructed for one (1) year from April, 1988 to March, 1989.

The procurement of O & M equipment will be made on 1985/86 of fiscal year for smooth execution of operation and maintenance works for the project facilities.

5.3.3 Construction Plan

Construction works of the project comprises Sanrego intake weir, main canal system, secondary canal system, small-scaled intake weirs on tributaries, farm road networks, tertiary development and reclamation works. As construction of above works are almost occupied by earth works, due attention must be paid on a characteristic of earth materials which directly affects the earth moving plan, selection of construction equipments, specification of closing dike embankment and so on.

The construction of Sanrego intake weir including closing dike, and main and secondary canals would be mostly executed by heavy construction equipments. Tertiary canals and other minor works would be implemented mainly by manpower to increase a employment opportunity of the local people in and around the Project area.

(1) Sanrego intake weir

Sanrego intake weir is constructed by coupure method for safety protection from damages caused by flooding during construction period. After completion of foundation excavation, construction of intake weir shall be started, but stone masonry works of the crest have to be limited until EL 166.947 m because about 300 m^3/sec of flood discharge can be passed through the intake side during remaining construction of closing dike. Construction of the crest upper than EL 166.947 m would be progressed in the dry season after completion of closing dike.

Excavation method of coupure channel and foundation of the intake weir is dependent upon geological condition. Soil materials are mainly excavated by 0.7 m^3 back-hoe shovel. Weathered rock is excavated and gathered by 21 ton ripper-dozer. Solid rock is excavated mainly by blasting with use of bench cut method. Holes for charging dinamite are drilled by crawler drilling machine. Small volume of rock near from designed excavation line is blasted by skillful manpower with use of jack-hummer and pick-hummer.

Weir is almost made by stone masonry and reinforced concrete. Construction is mainly by manpower, and concrete is produced by portable concrete mixer.

(2) Main and secondary irrigation canal systems

Stripping and surface excavation of main and secondary canals would be mainly made by 11 ton bull-dozer, and sub-surface and deep excavation, by 0.35 m^3 back-hoe shovel depending on the soil condition at the working site. Weathered rock, which are hard beyond capacity of the back-hoe shovel, would be made by ripper-dozer and pick-hummer. Hard rock would be breaken by blasting with dinamite in case of beyond capacity by ripper-dozer. Manpower would mainly contribute to face smoothing, compacting of canal invert and other minor works.

The excavated materials in excess of filling requirement would be transported to spoil areas. In case of lack of the materials for filling, the materials would be supplemented from borrow areas around the site.

Earth works of related small structures would mainly be done by manpower, and the works of rather big structures such as aqueduct would be done by combination of manpower and back-hoe shovel. The structures are mainly made of stone masonry or reinforced concrete. The concrete would be produced by a portable concrete mixer.

(3) Small-scaled intake weirs on tributaries

Three intake weirs i.e., Biru, Parota and Machinaga would be constructed as a supplemental intake facilities on three tributaries. Excavation works would be made mainly by back-hoe shovel and supplementally by manpower. Stone masonry works and other works of intake weir itself are made by manpower.

Connecting canal constructions are also made by manpower except transportation of filling materials by dump-truck and excavation by back-hoe shovel at borrow areas.

(4) Farm road networks

Farm road of 13.2 km would be newly constructed for the Project. Most of embankment materials are required to be transported from the borrow areas. The materials would be excavated and loaded by 0.3 m^3 back-hoe shovel at borrow areas, and be transported by 8 ton dump-truck to the site. At site, the materials would be spreaded by 11 ton bulldozer and compacted by 3 ton vibration-roller. After completion of the embankment, gravel pavement and sod facing would be made by manpower.

(5) Tertiary development and reclamation works

Tertiary canals and reclamation works would be executed mainly by manpower, but transportation of supplemental earth materials from borrow areas would be made by 0.3 back-hoe shovel and 8 ton dump-truck. Related structure would be constructed by manpower.

5.4 COST ESTIMATE

5.4.1 Project Cost

The project cost comprises direct construction cost, land acquisition cost, procurement cost of O & M equipment, administration cost, engineering services, physical contingency and price contingency.

The following considerations are taken for the cost estimate of the Project:

(1) The exchange rate used in the estimate is:

US$1.0 = Rp670 = ¥260

(2) The construction works would be executed on the contract basis. The construction machinery and equipment required for the construction works would be provided by the contractors themselves. Therefore, depreciation cost of the machinery and equipment is considered in the estimate of the construction cost.

(3) The construction cost comprises foreign currency and local currency portions. Local currency portion is estimated on the basis of the current prices in South Sulawesi in 1982 and foreign currency portion is estimated based on the CIF prices at Ujung Pandang. The currency is classified into local and foreign portions according to the following criteria:

Local Currency Portion

(i) Labour wage
(ii) Sand, gravel, stone and wooden materials
(iii) 35% of cement
(iv) 20% of steel
(v) 50% of fuel
(vi) 15% of depreciation cost of machinery
(vii) Inland transportation charge
(viii) Transfer payment for local portions, such as general expenses, taxes and levies
(ix) Minor works

Foreign Currency Portion

(i) 65% of cement
(ii) 80% of steel
(iii) 50% of fuel
(iv) 85% of depreciation cost of machinery
(v) Expenses and fees of engineering service for foreign consultants

(4) The physical contingency related to the construction qualities is set at 15% of the direct cost. The price contingency is assumed at 7% per annum for foreign currency portion and 13% per annum for local currency portion.

The project cost is estimated at Rp36,309 million equivalent, comprising Rp15,895 million of foreign currency and Rp20,414 million of local currency as shown in Table 5.1.

The annual disbursement schedule is worked out based on the construction time schedule as shown in Table 5.2. The summary is as shown below:

(Unit: 10^6Rp)

Fiscal Year	Total	Foreign Currency	Local Currency
1981/82	943	392	551
1982/83	1,085	469	616
1983/84	1,738	993	745
1984/85	3,133	1,479	1,654
1985/86	6,640	3,520	3,120
1986/87	8,232	3,523	4,709
1987/88	8,006	3,205	4,801
1988/89	6,532	2,314	4,218
Total	36,309	15,895	20,414

5.4.2 Annual Operation and Maintenance Cost

Annual operation and maintenance cost at the full development stage is estimated at Rp266 million, comprising the costs for operation and maintenance costs of the project offices including personnel cost and project facilities. The details are given in ANNEX - VIII.

5.4.3 Replacement Cost

Some of the project facilities, especially equipment and mechanical works have some shorter useful life than the project life and require replacement a certain time within the project useful time.

The facilities required to be replaced are shown as follows:

	Name of Facilities	Useful Life
1.	Operation & Maintenance equipment	10 years
2.	Screen, back screen pipes of tirol type weir, etc.	10 years
3.	Stoplog	10 years
4.	Steel gate	25 years

The replacement cost of above facilities is totally estimated at Rp3,220 million within the project life of 50 years.

CHAPTER VI ORGANIZATION

6.1 ORGANIZATION FOR PROJECT EXECUTION

The Directorate General of Water Resources Development (DGWRD), the Ministry of Public Works, would be given the function of the executing body for the Sanrego Irrigation Project. The Directorate General would be responsible for both the engineering works and construction works of the project, and it would coordinate all activities of relevant Government agencies and regional administrative organizations in connection with project execution.

The Directorate of Irrigation under the Directorate General of Water Resources Development, would assume direct responsibility of the Project execution. The Provincial Office of Public Works, South Sulawesi would coordinate the construction of the project at the provincial level on behalf of the Directorate of Irrigation.

To smoothly execute the Project, a project office would be set up in the Provincial Public Works, South Sulawesi. The project office would operate all field works such as additional survey and investigation, settlement of field quarter, land acquisition, the detailed design and construction supervision. To effectively undertake the substantial field investigations and construction supervision, a base camp would be settled in the project site. The overall organization of the project execution would be recommended as shown in Fig. 6.1. Technical guidance services would be required for the smooth execution of all the project works.

6.2 ORGANIZATION FOR OPERATION AND MAINTENANCE

After completion of the project construction works, the operation and maintenance office will be organized under the Regional Irrigation Office of the Provincial Works. The project O & M office will be responsible for operation and maintenance of the irrigation, drainage and road networks down to inlets of tertiary blocks. The operation and maintenance of tertiary blocks down to the terminal facilities will be entrusted to the farmers' association and farmers themselves.

The O & M office will consist of one head office and three sub-offices. The main office will be responsible for the overall activities necessary for proper operation and maintenance of all the project facilities including preparation of O & M program, design and construction supervision of maintenance works, budgeting, training of staff, etc. The main office will consist of two divisions such as administrative division and technical division. The administrative division will consist of four sections, i.e. accounting section, finance section, personnel section and store section. The technical section will consist of four working sections such as the design section, operation section, maintenance section and mechanical section.

Each section in the technical division of the main office will have the following duties and tasks:

(1) Design section

i) survey, planning and design of the maintenance works,

ii) assistance and advice to farmers' organizations in design of maintenance works of tertiary canals to the terminal facilities, and

iii) collection and analysis of data on the rivers discharges.

(2) Operation section

i) estimation of water requirements and preparation of water supply schedule based on the cropping schedule obtained from the water users' association through the sub-offices,

ii) regular contact with sub-offices regarding water supply schedule, and

iii) supply of information on water supply management to the sub-offices.

(3) Maintenance section

i) periodical and routine inspection,

ii) preparation of the program for routine and periodical maintenance and emergency repair, and

iii) assistance and advice to water users' association in maintenance works of tertiary canals down to terminal facilities.

(4) Mechanical section

i) management of workshop and O & M equipment,

ii) preparation of operation schedule of O & M equipment, and

iii) repair and maintenance of total works of the project facilities.

As mentioned above, three sub-offices will be established in the Project area. The commanding areas and facilities concerned to the sub-offices are as follows:

Name of Sub-Office	Main Facilities	Commanding Area
Sanrego	- Sanrego intake weir - Biru intake weir - Main canal - Six secondary canals branched from main canal	2,300 ha
Aming	- Macinaga intake weir - Aming secondary canal - Eight secondary canals branched from aming secondary canal	3,685 ha
Palaka	- Parota intake weir - Palaka secondary canal - Four secondary canals branched from Palaka secondary canal	2,015 ha

The duties of the sub-offices are as follows:

i) collection of information of cropping schedule from the water users' associations and transfer it to the main office,

ii) supply of information on water supply schedule to the water users' association,

iii) gate operation according to the water supply schedule prepared by the main office,

iv) maintenance of project facilities in the commanding area, and

v) providing periodical consultation to the water users' association on operation and maintenance of tertiary canals down to terminal facilities.

The proposed organization for operation and maintenance is shown in Fig. 6.2.

6.3 WATER USERS' ASSOCIATION

Before completion of the construction works of the Project, it would be recommended to establish and/or reorganize a Water User's Association (P3A) in each tertiary irrigation block so as to cover all the Project area for smooth operation and maintenance of the irrigation and drainage system.

It is recommended that the following principles be considered for establishment of P3A:

(1) The member of P3A should be limited the owner farmers and/or tenant farmers whose cultivating lands would be benefited by the Project.

(2) The boundary of P3A should be demarcated an adequate irrigation area preferably covering a tertiary irrigation block.

(3) P3A should be an autonomous organization under overall operation and maintenance system.

(4) The tertiary and quaternary irrigation and drainage canals and on-farm related structures should be put under the control of P3A.

(5) Each P3A should have an advisory group consisting of a chief of village, agricultural field extension worker (PPL) and irrigation inspector concerned.

The proposed organization of P3A is shown in Fig. 6.3, together with coordinating organizations.

CHAPTER VII ECONOMIC AND FINANCIAL EVALUATION

7.1 GENERAL

The project evaluation is made in order to ascertain the feasibility of the Project in view of economic and financial aspects. The economic feasibility of the project is evaluated by internal rate of return (IRR). Sensitivity analysis is also made corresponding to changes in accured benefits, build-up period and project costs. The financial evaluation is carried out by analyzing farm budgets of the project benefited farmers and by preparing financial statement of the project as a whole. The farm budget analysis is made for assessment of the net reserve of the average size and peasant farms. The analysis of financial statement of the project is made to evaluate the repayment capacity on the basis of the estimated fund requirement with assumed financial terms of the anticipated loan and the expected revenue from the Project. The socio-economic impacts from the implementation of the project which would give the effects on the regional development are also studied briefly.

7.2 ECONOMIC EVALUATION

7.2.1 Irrigation Benefit

The irrigation benefit of the Project primarily accrue from the increased crop production due to stable irrigation water supplies. The benefit is estimated as the difference of the annual net production values under future with and without project conditions.

The crop production gradually increases after commencement of the partial operation of the Project. The build-up period for full development of paddy production is assumed to be 5 years for the existing paddy fields and 8 years for the areas to be newly reclaimed, respectively, after completion of the construction works.

The looses of farmland for project facilities total about 300 ha. These looses are counted as the negative benefit in the estimate of the primarily incremental production value by deducting these production values from the net production value under future with project condition.

The net direct benefit amounts to Rp 7,155 million or Rp 894,400 per ha at the full development stage as shown in Table 7.1. According to the proposed construction schedule mentioned in Chapter V, the benefit will initially accrue in 1988/89 and will gradually up to the full benefit in 1997/98.

7.2.2 Economic Cost

The financial cost for construction works of the Project is estimated at 1982 price level as mentioned in Chapter V. It includes some amount of transfer payment such as direct/indirect taxes and levies. The transfer payment is assumed to be equivalent to 10% of the direct construction cost. The economic cost of the project is obtained by deducting the transfer payment from the financial cost. Land acquisition cost and price contingency are not included in the economic cost.

The total economic cost of the Project is estimated to be Rp 22,668 million, consisting of Rp 11,466 million of foreign currency component and Rp 11,202 million of local currency component. The economic cost is disbursed according to the construction schedule described in Chapter V.

7.2.3 Economic Evaluation

(1) Internal rate of return

The project life is assumed to be 50 years from 1981/82 to 2030/31. The construction period is 8 years from 1981/82 including the excavation works of coupure channel at the Sanrego intake weir site already executed by the local contractor. The project benefit will accrue in 1988/89 and increase year by year to attain the maximum level in 1997/98.

The O/M cost of the Project will be initially disbursed in 1988/89 when the partial operation will commence. The O/M cost will increase year by year and will reach the full amount in 1990/91 when the full operation will start for the whole project area of 8,000 ha. The steel gates and their attachments will be replaced once during the entire period of the project life, and O/M equipment for the irrigation system will be replaced every 10 years.

The economic internal rate of return (IRR) is calculated at 15.1% based on the economic benefit and cost flows shown in Table 7.2. The result shows that the Project is economically feasible.

(2) Sensitivity analysis

Sensitivity analysis is also made in respect to changes in annual irrigation benefits, project costs and over-run of build-up period. The following five changes to be anticipated are tested:

Case - 1 : Cost is 20% increase of the total estimated one and benefit is as scheduled.

Case - 2 : Benefit is 20% decrease of the anticipated one and cost is as scheduled.

Case - 3 : Cost is 20% increase of total estimated one and benefit is 20% decrease of the total anticipated one.

Case - 4 : Build-up period requires more two years than proposed.

Case - 5 : Build-up period requires more two years than proposed and moreover, benefit is 20% decrease of the total anticipated one.

The results are summarized as below (for details, see ANNEX - IX):

Case - 1	13.5%
Case - 2	13.0%
Case - 3	11.5%
Case - 4	14.2%
Case - 5	12.3%

The Case-3 (20% increase of cost and 20% decrease of benefit) indicates the lowest economic internal rate of return, but still maintain economic feasibility. The Project is insensitive against the anticipated changes.

7.3 FINANCIAL EVALUATION

7.3.1 Capacity to Pay

Payment capacity is the ability of farmers to bear the expenses required for development of irrigation facilities. Such capacity is measured by the increase of net reserve which the project benefited farmers can earn annually from the Project.

In order to assess the payment of the farmers, the farm budget analysis is made on the average size and peasant farmers under future with and without project conditions. The result is summarized in Table 7.3 (details are given in ANNEX - V).

As shown in Table 7.3, annual net reserve or capacity to pay will be Rp 482,100 for the average size farmer, Rp 202,900 for the peasant farmer holding a land of 1.0 ha and Rp 112,400 for the peasant farmer holding a land of 0.5 ha at full development stage. The increased net reserve would offer incentives for further development to the farmers, and the substantial payment capacity would enable them to pay some charges for irrigation water.

7.3.2 Water Charge

When the project facilities are completed and water is released to the farmers, but if the water charge is not to be collected, all the costs of the project will have to be born by the Government, and such expenditure will become a heavy burden to the Government. It is generally understood that the water charge is imposed to the water

users, and the water charges thus collected is spent for the payment of O & M expenditures incurred to the Project and for the repayment of the capital cost of the project. In Indonesia, however, the farmers traditionally do not pay any water charge directly, but contribute indirectly by paying the IPEDA tax.

The recent Government's decree and agreements made with the international lending institutions provide the conditions that the Government shall collect the water charge from the water users and recover the entire O & M cost, and that the rate of water charge shall be reviewed and possibly increased to recover a portion of the capital cost of the Project.

The annual O & M cost required for the project is estimated at Rp 266 million which is equivalent to about Rp 33,250/ha. This corresponds to about 16% of the capacity to pay of the average size and peasant farmers. This prospective water charge would be the project revenue in the financial evaluation of the Project.

7.3.3 Repayment of Project Cost

The financial evaluation of the Project is made by examining the repayment capacity for the capital cost of the project. In the examination of repayment capability, it is assumed that the capital required for the project implementation will be arranged under the following conditions:

(1) As mentioned in the project implementation schedule of Chapter V, the construction of the Sanrego intake weir including the closing dike will be executed by the local contractor based on the local tender from the beginning of 1983. Therefore, the capital for construction works of the Sanrego intake weir will be financed by the budget of the Government. While, the remaining works, such as main and secondary irrigation canal system, small scaled intake weirs on three tributaries, etc., will be carried out with the anticipated loan from bilateral and international organizations.

(2) According to the above implementation schedule, the project financial cost is estimated at Rp 36,512 million, comprising Rp 13,326 million of foreign currency portion and Rp 23,186 million of local currency portion (details are given in ANNEX - IX).

(3) For the foreign currency portion plus about 25% of local currency portion (equivalence to 30% of total loan amount), the capital is financed by bilateral or international organization with an interest of 3% per annum for a repayment period of 30 years including 10-year grace period.

(4) For the remaining local currency portion, the capital is financed by the budget allocation of the Government with no repayment.

Based on the above conditions, the repayment schedule for the foreign currency portion is prepared as shown in Table 7.4. This table indicates that the direct revenue from the water charge can not cover the annual repayment of the fund, except O & M cost and replacement cost, and the repayment of the fund has to be made by the subsidy of the Government.

7.4 SOCIO-ECONOMIC IMPACTS

Various socio-economic impacts are expected as the indirect benefits from the implementation of the project. They are:

(1) Foreign exchange saving

The demand and supply of rice in Indonesia are still not well balanced mainly due to unstable paddy production resulted from uneven rainfall and also the population increase together with the increase in per capita consumption. It is reported that, although the shortage of rice in Indonesia has been considerably decrease, the shortage situation will be continued as a whole.

With the completion of the Project, the total production of paddy is estimated about 60,000 tons. The total consumption of paddy for the total population of about 47,200, which are projected from 1981 to 1990 using 2.36% of annual growth rate, is estimated at about 10,850 tons on the assumption that per capita consumption is 230 kg of dried paddy. The seed stock, handling and storing losses and feed of livestock are estimated about 4,620 tons or 7.7% of total production of paddy. The annual marketable surplus amount of paddy is estimated at about 44,530 tons. These surplus of paddy would contribute to foreign exchange saving.

(2) Demonstration effects

With the completion of the Project, the farmers in the surrounding areas, as well as those in the Project area, will become familiar with modern irrigation practices and their incentives for irrigation practices will be much enhanced. In the succeeding projects, therefore, the build-up period would be possibly shortened.

(3) Increase of employment opportunity

It is expected that the present unemployment in and around the Project area is much improved by the project implementation. For construction of the project facilities, the following common labours will be required:

Work Item	Labour Requirement
	(man-days)
Sanrego intake weir	212,000
Small-scaled intake weir	13,000
Main canal system	121,000
Secondary canal system	587,000
Farm road system	95,000
Tertiary development	856,000
Reclamation works	200,000
Total	2,084,000

After completion of the Project, the more intensive land use, resulting from a new year-round irrigation system, will surely increase the employment opportunity. In addition, the people will gain more experience, technical knowhow and skillfulness in the various working fields. These up-graded human resources would provide motive power for the future development in the South Sulawesi region.

(4) Improvement of farm products

The quality of rice will be improved through sufficient irrigation water supplies which make the crop damages minimum and assure the even maturing of rice. Such improved quality would increase the marketability of farm products.

(5) Environmental effects

The implementation of the project works will certainly lead to changes in rural economy. The local transportation system will be improved. This would contribute to the improvement of rural economic activities. For land and water conservation, it is recommended that reforestation work should be promoted in the relevant watersheds. The reforestation works would contribute to stabilization of river flow, control of seasonal floods, prevention of soil erosion, etc. The increased crop production in the Project area would stimulate the improvement of marketing system and also of agricultural support services.

CHAPTER VIII RECOMMENDATIONS

8.1 WATERSHED MANAGEMENT

8.1.1 General

The water sources for the Sanrego Irrigation Project would depend on the Sanrego river and three (3) tributaries namely, Parota, Biru and Macinaga rivers. The major objectives of the watershed management study are (1) to clarify the existing conditions of relevant watershed areas and (2) to prepare a recommendation on the measures for land concervation in each watershed of the rivers relevant to the Project.

8.1.2 Present Condition of Watershed

The present land use of the watershed areas of the Sanrego river and three tributaries is summarized as follows:

Land Use Category	Name of River							
	Sanrego		Parota		Biru		Macinaga	
	(ha)	(%)	(ha)	(%)	(ha)	(%)	(ha)	(%)
Paddy field	490	(3)	120	(4)	210	(10)	340	(39)
Upland	60	(1)	30	(1)	20	(1)	10	(1)
Grassland	6,940	(38)	1,550	(50)	800	(40)	340	(39)
Sparse forest	3,850	(21)	150	(5)	510	(25)	20	(2)
Dense forest	6,580	(37)	1,230	(40)	490	(24)	160	(19)
Total	17,920	(100)	3,080	(100)	2,030	(100)	870	(100)

8.1.3 Basic Concept for Watershed Management Plan

In the watershed, forests play an important role in conservation of soil and water resources. The forests generally fix the soils on the sloping land and control the excess percolation and surface run-off. As a result, the forests lower the maximum flood run-off and also stabilize the minimum discharge of the rivers. The forests prevent the watershed from soil erosion, therefore, the run-off water would be kept clean with good water quality. At present, the forest areas in the Sanrego and three tributaries watershed areas are:

Watershed	Catchment Area (ha)	Forest Area (ha)	Proportional Extent (%)
Sanrego	17,920	10,430	58
Parota	3,080	1,380	45
Biru	2,030	1,000	49
Macinaga	870	180	21
Total	23,900	12,900	54

The basic concept for watershed management would be as follows:

(1) Soil and water conservation will have to be made through overall watershed management including reforestation and erosion control works.

(2) In due consideration of existing conditions of watershed areas, the first priority must be given to reforestation.

(3) The present unrestricted cutting of trees in the forest areas will have to be controlled by the Department of Forestry. In particular, the trees on the ridges will have to be maintained. Once such trees are cut, natural regeneration is very difficult because of limited availability of soil moisture.

(4) Since over-grazing of livestock animals in the bush and grassland will cause damage to the newly-planted trees, animal grazing should also be controlled by the government officials.

(5) The construction of Sabo dams and erosion control works will have to be studied in the future although they will not be necessary urgently at present.

8.1.4 Reforestation Plan

On the basis of basic concept mentioned above, the following reforestation plan is considered:

(1) Tree species

The species of trees for reforestation should meet the followings at least:

(a) Seedlings are easily multiplicated and low costed,
(b) Seedlings are multiplicated in short term, and
(c) Seedlings are easily growable under unfavourable natural conditions.

In due consideration of these basic conditions, Eucalyptus sp, Acacia auriculifarmis and Pinus merkusii would be selected for the reforestation in the Sanrego river and three tributaries watershed areas.

(2) Areas for reforestation

The reforestation work will be necessary in the Sanrego river and three tributaries watersheds. The Government already aware of this matter and has paid attention to the Sanrego watershed management. The Sanrego watershed area belong to P3RPDAS Bila Walanae. The forest areas in the Sanrego river and three tributaries watersheds are still less than 55% of the entire watersheds. It is proposed that the forest area should be expanded to about 85% of the total watersheds. Therefore, the total area to be envisaged for reforestation will be about 20,300 ha as shown below:

(Unit: ha)

Watershed	Total Catchment Area	Existing Forest Area	Proposed Reforesta-tion Area	Total Forest Area	Proportional Extent
Sanrego	17,920	10,340	5,100	15,440	86%
Parota	3,080	1,380	1,250	2,630	85%
Biru	2,030	1,000	750	1,750	86%
Macinaga	870	180	300	480	55%
Total	23,900	12,900	7,400	20,300	85%

Details on the watershed management are given in ANNEX - X.

8.2 HYDROLOGICAL OBSERVATION NETWORK

The hydrological analysis in this study was made mainly for the assessment of available irrigation water in the Sanrego river and three tributaries, i.e., Parota, Biru and Macinaga. The analysis was made by the maximum use of available data obtained in and around the study area, but reliable data on hydrology are limited at present, especially on the tributaries. In order to confirm more detailed hydrological conditions in the area, the following observation networks are recommended to be urgently established:

(1) To install water level gauging stations in three tributaries namely, Parota, Biru and Macinaga, and also install rainfall gauging stations in their watersheds.

(2) To install rainfall gauging stations in the Sanrego river watershed.

(3) To strengthen observations at the existing two water level gauging stations in the Sanrego river.

(4) To conduct instantaneous discharge observations around the depressed area in the Sanrego river watershed.

8.3 INTEGRATED RURAL DEVELOPMENT (CIDA)

The Sanrego Area Development Project sponsored by the Directorate General of Tata Kota and Tata Daerah and the Canadian International Development Agency (CIDA) aims at the integrated rural development of the Sanrego area covering some 25,000 ha of cultivated area. The Project is expected to serve as a pilot and demonstration area for the development of a strategy that will be used eventually in the rural development of the whole Sanrego - Walanae river valley. The strategy applied in the Project is multiple-goal oriented in multiple sectors including agricultural production, marketing and post-harvest improvement, reforestation and regreening, infrastructural improvement and social development.

The major project components include:

(1) Agricultural production programme

a. establishment of "Agricultural Development Center (ADC)" for Tappale area,

b. establishment of "Rural Extension Center (REC)" for the Pallatae area,

c. establishment of "Industrial Crop Development Center (ICDC)" for the Bonto Cani area,

d. veterinary services for domestic animals and improvement of feeding and breeding,

* e. paddy field development of 3,000 ha,

f. rehabilitation of existing desa irrigation systems covering 400 ha,

* g. identification and construction of new irrigation schemes covering about 500 ha,

* h. rehabilitation of the existing Maradda irrigation scheme and organization of P3A (water users association) and water management studies,

i. provision of agricultural credit for food and industrial crops,

j. training of extension workers and leading farmers, and

* k. investigation and studies on land and water resources.

(2) Marketing/post harvest programme

a. strengthening and expansion of cooperative organization including establishment of 21 new KUD sub-units and 2 "Rural Cooperative Center (RCC)" and deployment of 4 KUD extension workers,

b. provision of credit to KUD activities, and

c. research studies on post-harvest technologies, rural marketing systems and processing of farm products.

(3) Forestry programme

a. regreening of the existing bare lands, which are mainly extending on upland and highland slopes, with plantations of pinus mercusi, accasia and kemiri, and

b. reforestation of 4,500 ha burned-off lands for production of useful forest.

(4) Infrastructural development programme

* a. improvement and construction of road network, and

b. development of local hydro-power.

(5) Social development programme

a. improvement of public health including the provision of a mobile health care unit and construction of 7 dispensaries mainly for eradication of TB and malaria,

b. improvement of domestic water supplies,

c. improvement of social education mainly for publid health, nutrition and cooperative movement, and

d. development of school cooperatives.

The area envisaged under the Sanrego Irrigation Project is overlapped with the southeastern part of the above-mentioned CIDA Integrated Rural Development area. It does not near that both projects are functionally overlapped each other. The large-scale irrigation development is not considered in the Project because the Sanrego Irrigation Project is already prepared. All the project components are essential for the integrated rural development of the Sanrego area, and will largely contribute to the smooth operation running-in of the Sanrego Irrigation Project. The large scale irrigation development will, on the contrary, give an impact on rural societies and will enable the integrated rural development be more effective and fruitful.

The CIDA Project is planned over the 5 year span from the fiscal year of 1983/84. The Sanrego Irrigation Project will also be implemented during almost same period. The close coordination between the two projects will be quite important for overall development of the Sanrego area, particularly in the fields of agricultural production, marketing/post-harvest and agricultural support services. As for the agricultural production sector, the items marked asterisk (*) are already included partly or wholly under the Sanrego Irrigation Project. Some modification will be required for avoiding the duplication of services. The planned activities on marketing/post-harvest improvement are not well suited to the conditions that will be created after completion of the irrigation project, i.e., the planned scale of services is too small compared with the projected production of farm products under irrigated condition. Modification will also be required on this aspect. Other agricultural and social services are generally acceptable. It is recommended that close coordination be established among the authorities concerned for smooth implementation of both projects.

8.4 AGRICULTURAL SUPPORT SERVICES

For smooth realization of the project objectives, there would remain many ancillary works which should be carried out mainly by the related institutions and farmers themselves, in parallel with the project construction. Most of the agricultural support services are considered under the said CIDA integrated rural development project.

From the viewpoint of the irrigation development, the services proposed by CIDA are considered to be somewhat inadequate for smooth operation running-in of the Project. It is hoped that the CIDA project will re-consider their planned services to cover the following requirements which will support the envisaged irrigation development:

(1) To promote the establishment of KUD with KIOSK up to the same number of Desa (14) at least in the proposed irrigation projects are by the end of the construction of irrigation facilities. In parallel with the establishment of KUD the number of members of KUD should be expanded to the maximum extent in project area,

(2) To establish water user's association (P3A) in each tertiary irrigation block comprising all the farmers in the beneficial area as the member of P3A before the completion of construction works of project,

(3) To raise up the practical rice cultivation technique of the Field Extension Workers (PPL) through practical training conducted by the Manos Research Institute for Food Crops (MARIFC) so as to be able to judge plant condition of rice and advice to the farmers properly and timely in their own paddy fields,

(4) To promote the BIMAS/INMAS and INSUS program in the project area through the expansion of grouping activities under adequate advise of PPL,

(5) To strengthen the seed multiplication activities in the project area so as to provide the project-benefited farmers with the necessary quantity of certificated extension seeds, and

(6) To strengthen the agronomic research on irrigated rice farming and to propagate the recommendable farming practices including new varieties to the farmers through the existing extension channels.

8.5 PILOT DEMONSTRATION SCHEME

In order to lead the Project up to the final goal smoothly, it would be inevitable to establish a guidance organization responsible for promoting, guiding and assisting the farmers in various fields concerning the modern irrigation rice farming and on-farm development. In this view, it is recommended that a pilot demonstration scheme be established within the frame-work of the said guidance organization as a key program for the successful implementation of the Project.

The pilot demonstration scheme would aim at:

(1) Demonstration and guidance of on-farm development (construction of on-farm irrigation facilities),

(2) Demonstration and guidance of systematic water management at tertiary, quaternary and on-farm level,

(3) Demonstration and guidance of proper irrigation and farming practices for double cropping of paddy, and

(4) Multiplecation and distribution of certified seeds.

The experiences and technical results obtained through the pilot scheme operation, would be fully utilized for the guidance of the large scale implementation.

The main activities to be undertaken by the scheme are as follows:

(1) Preparation of land ledger and cadastal map

The accurate land ledger and cadastal map in the project area will be required for detailed design of irrigation facilities as well as for land acquisition of the proposed canal and road routes. The pilot scheme will give a good example for consecutive survey and mapping in the whole project area.

(2) Establishment of water user's association

The pilot scheme will take a leading role for organization of P3A, by demonstration the representative model of P3A and also by offering the technical guidance to the farmers.

(3) Organizing the farmers group

These farmers groups should be organized so as to be unified with sub-branch units of Water User's Association for effective and efficient guidance of both cultivation techkiques and O&M of irrigation facilities. The pilot scheme will demonstrate the collective irrigation rice farming to the farmers, with the assistance of the extension workers.

(4) Construction of on-farm irrigation facilities

In many cases of irrigation projects in Indonesia, irrigation water is not fully utilized even several years after completion of construction works of the project, because of inadequate on-farm irrigation facilities constructed by farmers themselves. This shows the need of pilot demonstration together with strong guidance and supervision for construction works in the newly developed area.

(5) Strengthening of extension service

After completion of construction works of the Sanrego Irrigation Project including on-farm development, effective field guidance of cultivation technique on right time is essential together with adequate water management for achievement of the objective of the Project. The coordination relationship between irrigation development authorities and agricultural extension offices should be strengthened in the execution of the irrigation development. The Pilot Demonstration Scheme will provide the extension workers with a good opportunity for on-the-job training in the development.

(6) Estimation of seed station

There is no Seed Station in the Project area, and the seed growers are also very limited. When irrigation water become available for 8,000 ha of paddy field through the Project, the seeds requirement of improved paddy such as IR36/IR50 will amount to about 240 ton for wet season paddy and about 120 ton for dry season paddy. In order to produce the above requirement of improved seeds, the necessary hectarage of seed multiplication farm will be about 50 ha. The Pilot Demonstration Scheme will provide the establishment of pure-line reserve farm with an area of 4 ha, and the extension seeds will be produced on the neighboring seed growers farms under the contract with the scheme. Seed distribution to the farmers will be made through BUUD/KUD.

The selection of the scheme area is made taking into account the following factors:

(1) Scale of scheme area

(2) Irrigation water availability

(3) Drainage condition

(4) Access

(5) Soil and topography

Taking into account the above factors, the proposed site of the pilot demonstration scheme area is selected about 60 ha of the Maradda semi-technical irrigation area in the southern part of the Project area. The scheme area is located in Desa Biru 6 km west of Palattae, and extends near the north of the rural road which branches off from the provincial road at palattae.

At the beginning stage, irrigation water for this area will be supplied from the Biru river with the existing irrigation facilities, and after completion of the Project works, this area would be incorporated into the proposed irrigation system of the Project.

The facilities for the scheme are required:

(1) Biru intake weir (Existing)

(2) Main irrigation canal (Existing)

(3) Tertiary and quaternary system

(4) Farm road (2.8 km)

(5) Office (150 m^2)

Details on the Pilot Demonstration Scheme are given in ANNEX-V.

8.6 POST-HARVEST IMPROVEMENT SCHEME

After completion of the Project, the paddy production will be increased from the present level of about 15,000 ton per annum to the annual production of about 60,000 ton. The present state of post-harvest system is rather primitive and will not meet the feature production. There is no antificial drying facilities. The harvested paddy is generally dried under the sun using local bamboo mats. The storing capacity of paddy is also very limited. All these primitive states of post-harvesting cause the large loss of paddy.

In order to minimize the processing losses and ensure the smooth marketing flow of paddy, some improvement measures will be needed. The following indicates the broad idea of the measures.

The main features of the scheme will comprise:

(1) establishment of new facilities for paddy processing,

(2) construction of new warehouses,

(3) provision of transportation facilities, and

(4) improvement of paddy collecting system.

For effective realization and operation of the Scheme, the Project area is to be divided into six (6) sub units under which a total of 35 field blocks be established. The village unit cooperative (KUD) at Palattae will be responsible for overall management of the Scheme and 6 sub units KUD and 35 field blocks KUD will be newly established.

Based on the paddy production estimated, the capacity and number of facilities required for the Scheme are summarized as follows:

(1) Sub unit KUD

Name of Sub Unit	Covered Area	Office	Warehouse	Dryer/1	Rice Mill/2	Truck/3
	(ha)	(m^2)	(tons)	(no.)	(no.)	(no.)
Maradda	1,490	150	3,750	8	9	8
Cenranae	1,400	150	2,290	7	9	8
Palattae	1,300	150	3,180	7	8	7
Masago	1,560	150	3,680	8	10	9
Sanrego	1,430	150	3,380	7	9	8
Polewali	820	150	2,020	4	5	5
Total	8,000	900	19,300	41	50	45

Remarks: /1: Capacity of dryer; 1 ton/hr
/2: Capacity of rice mill; 1 ton/hr
/3: Capacity of truck; 5 ton

(2) Field block KUD

Name of Sub Unit	Number of/1 Field Block	Office/2	Drying/3 Floor	Ware-/4 house	Truck/5
	(no.)	(no.)	(m^2)	(tons)	(no.)
Maradda	6	6	7,920	410	23
Cenranae	6	6	7,740	390	21
Palottae	6	6	7,680	380	22
Masago	7	7	8,580	430	24
Sanrego	6	6	7,920	400	22
Polewali	4	4	4,560	230	12
Total	35	35	44,400	2,240	124

Remarks: /1: Average size of field block KUD; 230 ha, 6 tertiary blocks
/2: Size of office; 50 m^2
/3: Average size of drying floor; 1,300 m^2
/4: Average capacity of warehouse; 65 ton
/5: Capacity of truck; 2 ton

Details on the Post-harvest Improvement Scheme are given in ANNEX-V.

Table 2.1 Basic Economic Data of Indonesia

Paddy Production in Indonesia

		1976	1977	1978	1979	1980	Average
Harvested area	(10^3 ha)	8,369	8,360	8,930	8,804	9,018	8,696
Production	(10^3 ton)	23,300	23,347	25,772	26,283	29,774	25,695
Unit yield	(t/ha)	2.78	2.79	2.89	2.99	3.30	2.95

Remark: Dry paddy.
Source: Statistical Yearbook of Indonesia, 1980/81.

Paddy Production in the World (1980)

Country	Production (10^3 ton)	(%)	Yield (t/ha)
China	142,338	35.8	4.20
India	79,930	20.1	2.01
Indonesia	29,774	7.5	3.30
Bangladesh	20,822	5.2	2.02
Thailand	17,366	4.4	1.90
Burma	13,107	3.3	2.60
Japan	12,189	3.1	5.13
Vietnam	11,679	2.9	2.11
Brazil	9,748	2.5	1.57
Philippine	7,840	2.0	2.24
U.S.A.	6,629	1.7	4.95

Country	Production (10^3 ton)	(%)	Yield (t/ha)
Korea	5,311	1.3	4.35
North Korea	4,800	1.2	6.00
Pakistan	4,679	1.2	2.42
U.S.S.R.	2,791	0.7	4.19
Nepal	2,464	0.6	1.94
Egypt	2,350	0.6	5.76
Malaysia	2,171	0.5	2.84
Sri Lanka	2,133	0.5	2.59
Others	19,479	4.9	-
World total	397,597	100.0	2.77

Source: FAO Production Yearbook 1981.

Rice Import in Indonesia

1976	1977	1978	1979	1980	Average
1,301	1,973	1,842	1,922	2,012	1,810

Source: Statistical Yearbook of Indonesia, 1980/1981.

Rice Import in the World (1980)

(Unit: 10^3 ton)

Country	Amount
Indonesia	2,012
Korea	899
Bangladesh	719
Iran	670

Country	Amount
Nigeria	387
Hong Kong	350
Saudi Arabia	356
Iraq	345

Country	Amount
Senegal	275
France	253
Peru	251
Brazil	237

Source: FAO Trade Yearbook 1980.

Population in Indonesia

	1971	1976	1977	1978	1979	1980
Population	119,208	135,190	138,342	141,574	144,912	147,490
Population density in 1980 (persons/km²)						77
Population growth rate in 1971 - 1980						2.32

Source: Statistical Yearbook of Indonesia, 1980/81

Economic Active Population in Indonesia (1976)

	x 10^3	%
Agriculture	31,545	60.9
Mining	123	0.2
Manufacturing	3,856	7.4
Electricity, gas & water supply	13	-
Construction	806	1.6
Trade, restaurant & hotel	7,709	14.9
Transportation, storage & communication	1,289	2.5
Finance & insurance	43	0.1
Community services	6,395	12.4
Others	3	-
Total	51,780	100.0

Source: Statistical Yearbook of Indonesia, 1980/81.

GDP of Indonesia by Sector (1980)

	Description	Rp x 10^9	%
1.	Agriculture, forestry & fishery	11,144	26.6
	(1) Farm food crops	6,481	15.5
	(2) Non-farm food crops	1,278	3.1
	(3) Estate crops	659	1.6
	(4) Livestock	892	2.1
	(5) Forestry	1,062	2.5
	(6) Fishery	772	1.8
2.	Mining	10,968	26.2
3.	Manufacturing	3,447	8.2
4.	Electric, gas & water supply	168	0.4
5.	Construction	2,342	5.6
6.	Commerce	6,126	14.6
7.	Transport & information	1,706	4.1
8.	Finance	863	2.1
9.	Immovable property	1,178	2.8
10.	Governmental service	2,950	7.0
11.	Other service	996	2.4
Total		41,889	100.0

Source: Statistical Yearbook of Indonesia, 1980/81.

Table 3.1 General Features of Present Demographic Condition in the Study Area (1981)

Kec. Desa	Area (km^2)	Total Household	Population Male	Population Female	Population Total	Density (Persons/km^2)	Family Size (Persons/ Household)	Farm Household
Kec. Kahu								
Sanrego	29.5	795	2,129	2,204	4,333	146.9	5.5	755
Biru	24.1	557	1,359	1,510	2,869	119.0	5.2	551
Palakka	24.6	586	1,612	1,651	3,263	132.6	5.6	540
Cenrana	22.8	307	816	934	1,750	76.8	5.7	288
Balle	26.9	475	1,360	1,598	2,958	110.0	6.2	430
Cakkela	28.6	376	1,035	1,105	2,140	74.8	5.7	318
Labuaja	23.5	422	1,091	1,216	2,307	98.2	5.5	409
Kec. Libureng								
Tappale	44.0	729	2,009	2,105	4,114	93.5	5.6	682
Pitumpidange	42.0	280	673	674	1,347	32.1	4.8	278
Polewali	32.0	321	531	665	1,196	37.4	3.7	257
Kec. Tenra								
Paccing	16.4	413	1,091	1,405	2,496	152.2	6.0	354
Massile	20.0	476	1,386	1,525	2,911	145.6	6.1	443
Kec. Salomekko								
Masago	20.0	531	1,500	1,638	3,138	156.9	5.9	500
Patiepeng	26.0	470	1,774	1,848	3,622	139.3	7.7	468
Total/Average	380.4	6,738	18,366	20,078	38,444	101.1	5.7	6,273

Annual Population Growth (1972 - 1981)

Kec. Desa	Year 1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	Annual Average Growth Rate (%)
Kec. Kahu											
1. Sanrego	3,554	3,642	3,707	3,798	3,887	3,980	4,084	4,152	4,227	4,333	2.22
2. Biru	2,160	2,262	2,371	2,463	2,563	2,654	2,754	2,842	2,926	2,869	3.20
3. Palakka	2,685	2,764	2,973	3,151	3,172	3,242	3,322	3,353	3,224	3,263	2.20
4. Cenrana	1,276	1,342	1,384	1,454	1,550	1,628	1,669	1,714	1,767	1,750	3.57
5. Balle	1,853	1,961	2,056	2,162	2,257	2,366	2,471	2,564	2,639	2,958	5.27
6. Cakkela	1,414	1,546	1,636	1,755	1,822	1,905	1,964	2,060	2,139	2,140	4.71
7. Labuaja	1,635	1,724	1,821	1,915	2,009	2,113	2,207	2,302	2,368	2,307	3.90
Kec. Libureng											
1. Tappale	3,738	3,789	3,842	3,890	3,525	3,668	3,349	3,356	4,053	4,114	1.07
2. Pitumpidange	1,207	1,241	1,270	1,300	1,202	1,253	1,249	1,252	1,329	1,347	1.23
3. Polewali	1,111	1,149	1,191	1,390	1,295	1,277	1,149	1,175	1,181	1,196	0.82
Kec. Tonre											
1. Paccing	1,945	1,957	1,981	1,999	2,013	2,050	2,120	2,145	2,484	2,496	1.63
2. Massile	2,142	2,228	2,327	2,343	2,353	2,360	2,376	2,388	2,856	2,911	3.47
Kec. Salomekko											
1. Masago	3,436	3,404	3,417	3,391	3,606	3,321	3,226	3,250	3,136	3,138	-1.00
2. Patiepeng	2,988	2,998	3,014	3,067	3,112	3,307	3,045	3,042	3,622	3,622	2.16
Total/Average	31,154	32,007	32,990	30,577	34,366	35,124	34,985	35,595	37,951	38,444	2.36

Source: Census and Statistics office, Kab. Bone and each Kecamatan office.

Remark: The figures include the data within the boundaries of desa under study.

Table 3.2 Classification of Geological Strata in the Study Area

Age		Formation and Stratigraphic Relation	Rock Facies - Distribution
Period	Epoch		
Quaternary	Holocene	Alluvium	Riverbed deposit; Gravel and Sand - through a water course, 1 or 2 meters in thickness Flood water deposit; Mainly gravel with sand - in channel, make a flat plain about 1 meter height from riverbed Alluvial terrace deposit; Silt in upper half, cobble in lower half, make a flat plain about 3 meters height from riverbed
		Unconformity	
	Pleistocene	Diluvium	Diluvial terrace deposit; Dark gray silt with small pebble of limestone in upper most, bluish gray clay and light brown sandy clay in lower part - make a diluvial flat plain about 8 meters height from riverbed
		Unconformity	
Tertiary — Neogene	Pliocene	Mollase	Rhyolitic tuff breccia and tuffaceous sandstone, medially or weakly consolidated - East margin of irrigation area Sandy siltstone bearing Molluscs and punlceous sandy tuff and tuffaceous siltstone, poorly consolidated - occupy central part of irrigation area Basal conglomerate, pebble, weakly or medially consolidated - west margin of irrigation area
		Unconformity	
	Miocene	Intermediate and basic volcanic rocks	Upper; Andesitic volcanic breccia and tuff breccia - westward of irrigation area, partly occupy Parota secondary canal Middle; Alternation of siltstone and tuffaceous sandstone, medially consolidated, partly intercalate andesitic tuff breccia - westward of irrigation area, crop out in the Sanrego intake weir site Lower; Andesitic or basaltic auto brecciated lava, strongly consolidated - southward and westward of irrigation area
		Conformity	
Tertiary — Paleogene	Eocene	Limestone	Reef limestone, lower most is composed of carcalious sandstone and siltstone, yield large Foraminifero and fragment of Molluscs, dissolved and changed into porous mass - south-westward and eastward of irrigation area
	Oligocene	Conformity	
	Palaeocene	Intermediate and basic volcanic rocks	Andesitic and basaltic volcanic pyroclastics, partly intercalate welded tuff - occupy the watershed area of the Sanrego River and the Biru River
		Unconformity	
Cretaceous		bathyal deposits	Hard shale and pure sandstone abundant in quartz grain, silicificated nearly granite - restricted to the upper reach of the Biru River
Intrusive rocks		Dyke rocks; Quartz Porphyre, Porphyrite, Dolerite - abundantly intrude into the Cretaceous and Granite and rarely intrude into Limestone	
		Plutonic rock; Granite - intrude into the Cretaceous and Silicificate	

Table 5.1 Summary of Project Cost

(Unit: 10^6Rp.)

	Item	Total	Foreign Currency	Local Currency
1.	Preparation Works	844	386	458
2.	Sanrego Intake Weir	4,010	1,949	2,061
3.	Main Canal System	1,700	860	840
4.	Secondary Canal System	6,252	2,951	3,301
5.	Intake Weirs on Tributaries	63	26	37
6.	Farm Road Networks	797	293	504
7.	Tertiary Development	3,945	1,605	2,340
8.	Reclamation Works	384	160	224
	Sub-total	17,995	8,230	9,765
9.	Land Acquisition	416	-	416
10.	O & M Equipment	500	500	-
11.	Administration Expenses	532	-	532
12.	Engineering Services	2,533	2,113	420
13.	Physical Contingency	3,296	1,626	1,670
	Sub-total	7,277	4,239	3,038
	Total	25,272	12,469	12,803
14.	Price Contingency	11,037	3,426	7,611
	Grand Total	36,309	15,895	20,414

Table 5.2 Annual Disbursement Schedule

(Unit: 10^6Rp.)

Item	Total (F)	Total (L)	1981/1982 (F)	1981/1982 (L)	1982/1983 (F)	1982/1983 (L)	1983/1984 (F)	1983/1984 (L)	1984/1985 (F)	1984/1985 (L)	1985/1986 (F)	1985/1986 (L)	1986/1987 (F)	1986/1987 (L)	1987/1988 (F)	1987/1988 (L)	1988/1989 (F)	1988/1989 (L)
1. Preparatory Works	386	458	48	51	48	51	29	35	116	142	87	107	29	36	29	36	-	-
2. Sanrego Intake Weir	1,949	2,061	293	354	360	422	409	406	478	473	409	406	-	-	-	-	-	-
3. Main Canal System	860	840	-	-	-	-	-	-	172	168	430	420	258	252	-	-	-	-
4. Secondary Canal System	2,951	3,301	-	-	-	-	-	-	-	-	590	660	1,033	1,155	1,033	1,155	295	331
5. Intake Weirs on Tributaries	26	37	-	-	-	-	-	-	-	-	-	-	26	37	-	-	-	-
6. Farm Road Networks	293	504	-	-	-	-	-	-	-	-	-	-	-	-	-	-	293	504
7. Tertiary Development	1,605	2,340	-	-	-	-	-	-	-	-	-	-	481	702	562	819	562	819
8. Reclamation Works	160	224	-	-	-	-	-	-	-	-	-	-	80	112	80	112	-	-
Sub-total	8,230	9,765	341	405	408	473	438	441	766	783	1,516	1,593	1,907	2,294	1,704	2,122	1,150	1,654
9. Land Acquisition	-	416	-	11	-	-	-	-	-	203	-	121	-	61	-	20	-	-
10. O & M Equipment	500	-	-	-	-	-	-	-	-	-	500	-	-	-	-	-	-	-
11. Administration Expenses	-	532	-	63	-	63	-	67	-	67	-	68	-	68	-	68	-	68
12. Engineering Service	2,113	420	-	-	-	-	369	65	358	73	482	98	430	88	283	56	191	40
13. Physical Contingency	1,626	1,670	51	72	61	80	121	86	168	169	375	282	351	377	298	340	201	264
Sub-total	4,239	3,038	51	146	61	143	490	218	526	512	1,357	569	781	594	581	484	392	372
Total	12,469	12,803	392	551	469	616	928	659	1,292	1,295	2,873	2,162	2,688	2,888	2,285	2,606	1,542	2,026
14. Price Contingency	3,426	7,611	-	-	-	-	65	86	187	359	647	958	835	1,821	920	2,195	772	2,192
Grand Total	15,895	20,414	392	551	469	616	993	745	1,479	1,654	3,520	3,120	3,523	4,709	3,205	4,801	2,314	4,218

Table 7.1 Irrigation Benefits

Description	Without Project	With Project	Increment
1. Total Area (ha)/1	8,300	8,000	-300
2. Planted Area (ha)	9,730	12,000	2,270
Wet season paddy	7,050	8,000	950
Dry season paddy	640	4,000	3,360
Polowijo crops/2	1,400	-	-1,400
Upland crops/3	510	-	510
Orchard products/4	130	-	130
3. Harvested Area (ha)	8,420	12,000	3,580
Wet season paddy	5,780	8,000	2,220
Dry season paddy	600	4,000	3,400
Polowijo crops	1,400	-	-1,400
Upland crops	510	-	-510
Orchard products	130	-	-130
4. Unit Yield (ton/ha)			
Wet season paddy	2.23	5.00	2.77
Dry season paddy	2.50	5.00	2.50
Polowijo crops	0.72	-	-
Upland crops	1.00	-	-
Orchard products	740 (fruits)	-	-
5. Unit Price (10^3RP/ton)			
Dried paddy	214	214	-
Polowijo crops	415	-	-
Upland crops	222	-	-
Orchard products	325 (fruits)	-	-
6. Unit Production Cost (10^3RP/ha)			
Wet season paddy	200.4	318.1	117.7
Dry season paddy	202.0	328.6	126.6
Polowijo crops	149.3	-	-
Upland crops	82.3	-	-
Orchard crops	169.2	-	-

Description	Without Project	With Project	Increment
7. Gross Production Value (10^6RP)			
(3 x 4 x 5)	3,641	12,840	9,199
Wet season paddy	2,758	8,560	5,802
Dry season paddy	321	4,280	3,959
Polowijo crops	418	-	-418
Upland crops	113	-	-113
Orchard products	31	-	-31
8. Total Production Cost (10^6RP)			
(2 x 6)	1,815	3,859	2,044
Wet season paddy	1,413	2,545	1,132
Dry season paddy	129	1,314	1,185
Polowijo crops	209	-	-209
Upland crops	42	-	-42
Orchard products	22	-	-22
9. Net Production Value (10^6RP)			
(7 - 8)	1,826	8,981	7,155
Wet season paddy	1,345	6,015	4,670
Dry season paddy	192	2,966	2,774
Polowijo crops	209	-	-209
Upland crops	71	-	-71
Orchard products	9	-	-9
10. Annual Incremental Benefits per Ha			
(9 ÷ 1)/5	228,200 (US$342)	1,122,600 (US$1,675)	894,400 (US$1,335)

Remarks:
/1 : The difference between with and without project conditions means losses of farmland for project facilities.
/2 : Polowijo crops = Groundnuts and Greenbeans
/3 : Upland crops = Maize, Groundnuts, Cassava and Sweet Potato
/4 : Orchard products = Coconuts and Banana
/5 : Conversion rate US$1 = Rp. 670

Table 7.2 Annual Cost and Benefit Flow

(Unit: $\times 10^6$ Rp)

Year	Year in Order	Cost				Benefit
		Capital	O&M	Replacement	Total	
1981/82	1	844	-	-	844	-
1982/83	2	985	-	-	985	-
1983/84	3	1,486	-	-	1,486	-
1984/85	4	2,175	-	-	2,175	-
1985/86	5	4,480	-	-	4,480	-
1986/87	6	5,022	-	-	5,022	-
1987/88	7	4,429	-	-	4,429	-
1988/89	8	3,247	72	-	3,319	338
1989/90	9	-	155	-	155	1,181
1990/91	10	-	239	-	239	2,532
1991/92	11	-	239	-	239	3,883
1992/93	12	-	239	-	239	5,234
1993/94	13	-	239	-	239	6,281
1994/95	14	-	239	-	239	6,872
1995/96	15	-	239	-	239	7,005
1996/97	16	-	239	-	239	7,105
1997/98	17	-	239	662	901	7,155
1998/99	18	-	239	-	239	7,155
1999/00	19	-	239	-	239	7,155
2000/01	20	-	239	-	239	7,155
2001/02	21	-	239	-	239	7,155
2002/03	22	-	239	-	239	7,155
2003/04	23	-	239	-	239	7,155
2004/05	24	-	239	-	239	7,155
2005/06	25	-	239	-	239	7,155
2006/07	26	-	239	-	239	7,155
2007/08	27	-	239	662	901	7,155
2008/09	28	-	239	-	239	7,155
2009/10	29	-	239	-	239	7,155
2010/11	30	-	239	-	239	7,155
2011/12	31	-	239	-	239	7,155
2012/13	32	-	239	252	491	7,155
2013/14	33	-	239	-	239	7,155
2014/15	34	-	239	-	239	7,155
2015/16	35	-	239	-	239	7,155
2016/17	36	-	239	-	239	7,155
2017/18	37	-	239	662	901	7,155
2018/19	38	-	239	-	239	7,155
2019/20	39	-	239	-	239	7,155
2020/21	40	-	239	-	239	7,155
2021/22	41	-	239	-	239	7,155
2022/23	42	-	239	-	239	7,155
2023/24	43	-	239	-	239	7,155
2024/25	44	-	239	-	239	7,155
2025/26	45	-	239	-	239	7,155
2026/27	46	-	239	-	239	7,155
2027/28	47	-	239	662	901	7,155
2028/29	48	-	239	-	239	7,155
2029/30	49	-	239	-	239	7,155
2030/31	50	-	239	-	239	7,155

Table 7.3 Farm Budget of Average Size and Peasant Farmers under with and without Project Condition

Description	Average Size Farmer	Peasant Farmer	
1. Without Project			
Total Farm Land (ha)	2.36	1.00	0.50
Rainfed paddy field	1.42	0.78	0.39
Upland field	0.40	0.22	0.11
Orchard field	0.54	-	-
Gross Income (Rp)	705,100	504,400	389,200
Farm income	519,100	252,400	111,400
Farm labour income	55,800	75,600	83,300
Off-farm income	130,200	176,400	194,500
Gross Out-go (Rp)	660,100	471,000	369,000
Farming expenses	150,100	66,000	29,000
Living expenses	510,000	405,000	340,000
Net Reserve (Rp)	45,000	33,400	20,200
2. With Project			
Total Farm Land (ha)	2.41	1.02	0.51
Irrigated paddy field	1.24	0.67	0.33
Rainfed paddy field	0.32	0.17	0.09
Upland field	0.33	0.18	0.09
Orchard field	0.52	-	-
Gross Income (Rp)	1,354,800	911,000	666,000
Farm income	1,157,300	591,800	293,600
Farm labour income	197,500	319,200	372,400
Gross Out-go (Rp)	872,700	708,100	553,600
Farming expenses	247,700	118,100	58,600
Living expenses	625,000	590,000	495,000
Net Reserve (Rp)	482,100	202,900	112,400

Table 7.4 Cash Flow Statement

(Unit: $\times 10^6$Rp)

Fiscal Year	Cash Outflow				Cash Inflow					Balance
	Project Cost	O/M, Replacement Cost	Loan Repayment	Total Outflow (A)	Foreign Loan	Government Budget	Project Revenue	Government Subsidy	Total Inflow (B)	(B) - (A)
1981/82	943	-	-	943	-	943	-	-	943	0
1982/83	1,086	-	-	1,086	-	1,086	-	-	1,086	0
1983/84	1,766	-	-	1,766	700	1,066	-	-	1,766	0
1984/85	3,206	-	-	3,206	1,216	1,990	-	-	3,206	0
1985/86	6,741	-	-	6,741	4,204	2,537	-	-	6,741	0
1986/87	8,232	-	-	8,232	5,033	3,199	-	-	8,232	0
1987/88	8,006	-	-	8,006	4,578	3,428	-	-	8,006	0
1988/89	6,532	80	-	6,612	3,306	3,226	80	-	6,612	0
1989/90	-	172	-	172	-	-	172	-	172	0
1990/91	-	266	-	266	-	-	266	-	266	0
1991/92	-	266	-	266	-	-	266	-	266	0
1992/93	-	266	-	266	-	-	266	-	266	0
1993/94	-	266	1,524	1,790	-	-	266	1,524	1,790	0
1994/95	-	266	1,524	1,790	-	-	266	1,524	1,790	0
1995/96	-	266	1,524	1,790	-	-	266	1,524	1,790	0
1996/97	-	266	1,524	1,790	-	-	266	1,524	1,790	0
1997/98	-	1,001	1,524	2,525	-	-	1,001	1,524	2,525	0
1998/99	-	266	1,524	1,790	-	-	266	1,524	1,790	0
1999/00	-	266	1,524	1,790	-	-	266	1,524	1,790	0
2000/01	-	266	1,524	1,790	-	-	266	1,524	1,790	0
2001/02	-	266	1,524	1,790	-	-	266	1,524	1,790	0
2002/03	-	266	1,524	1,790	-	-	266	1,524	1,790	0
2003/04	-	266	1,524	1,790	-	-	266	1,524	1,790	0
2004/05	-	266	1,524	1,790	-	-	266	1,524	1,790	0
2005/06	-	266	1,524	1,790	-	-	266	1,524	1,790	0
2006/07	-	266	1,524	1,790	-	-	266	1,524	1,790	0
2007/08	-	1,001	1,524	2,525	-	-	1,001	1,524	2,525	0
2008/09	-	266	1,524	1,790	-	-	266	1,524	1,790	0
2009/10	-	266	1,524	1,790	-	-	266	1,524	1,790	0
2010/11	-	266	1,524	1,790	-	-	266	1,524	1,790	0
2011/12	-	266	1,524	1,790	-	-	266	1,524	1,790	0
2012/13	-	546	1,504	2,050	-	-	546	1,504	2,050	0

Remarks: Foreign Loan
Interest - 3.0% per annum
Repayment period - 30 years including 10-years grace period.

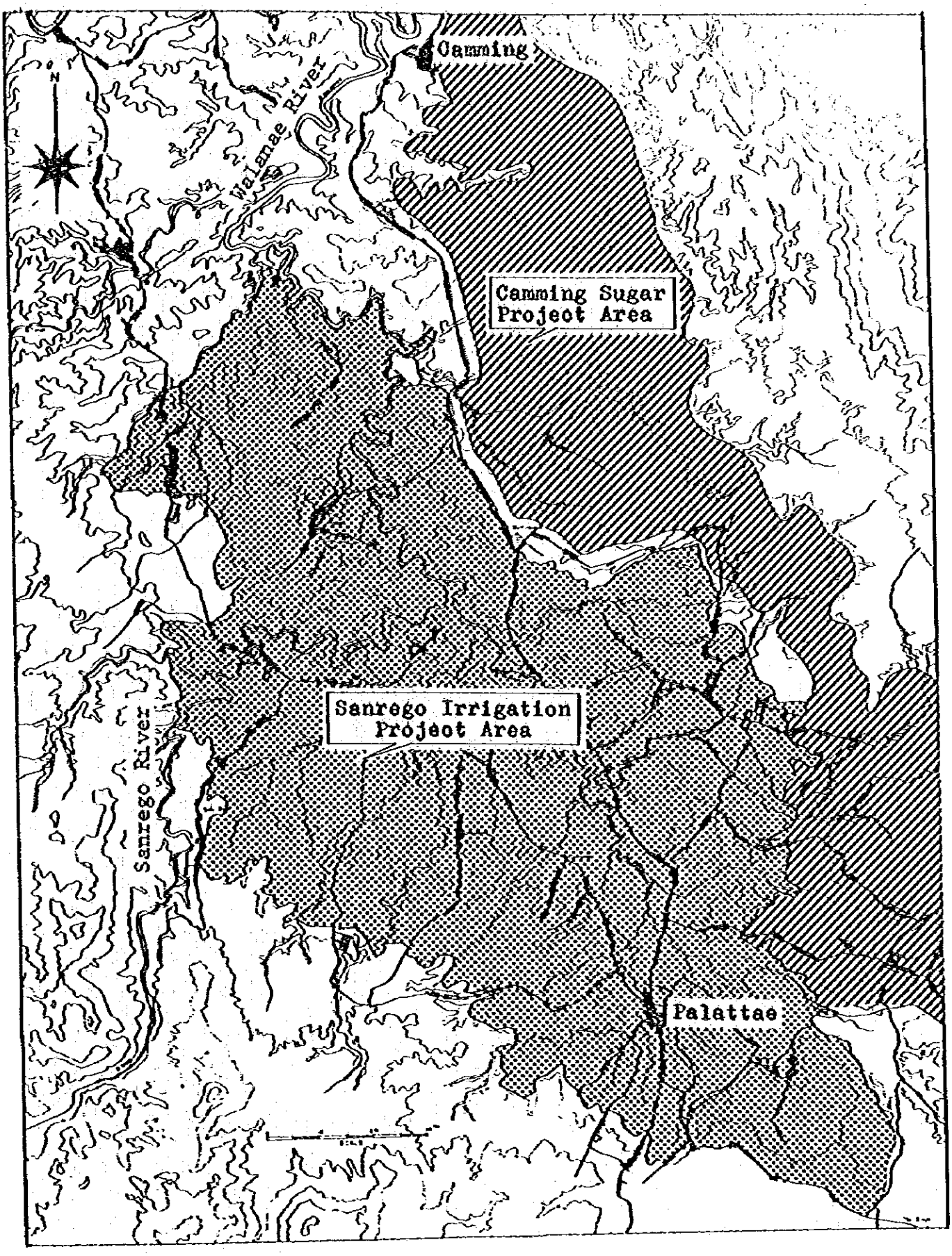


Fig. 2.1 LOCATION OF CAMMING SUGAR PROJECT AREA

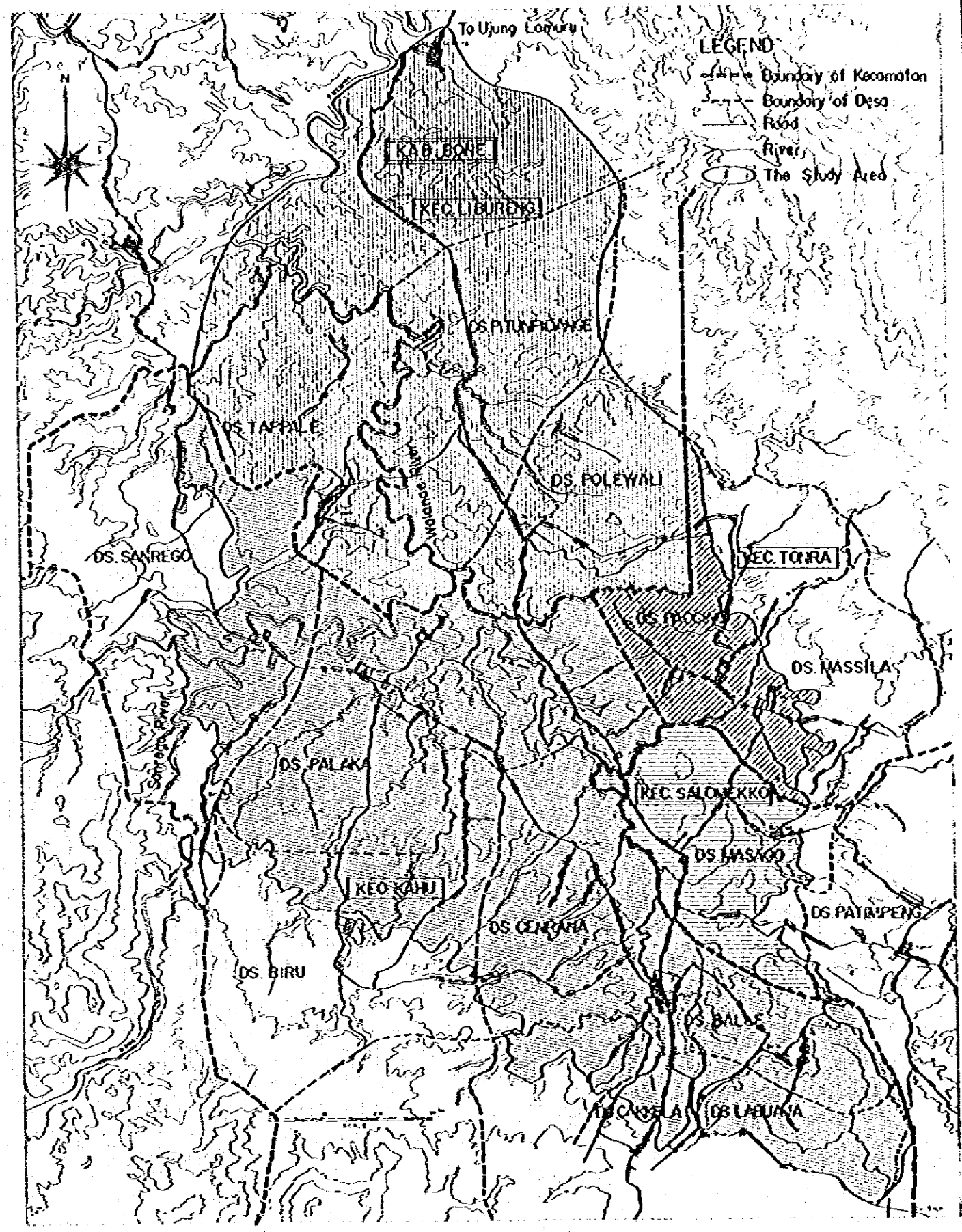


Fig. 3.1 ADMINISTRATIVE BOUNDARIES IN THE STUDY AREA

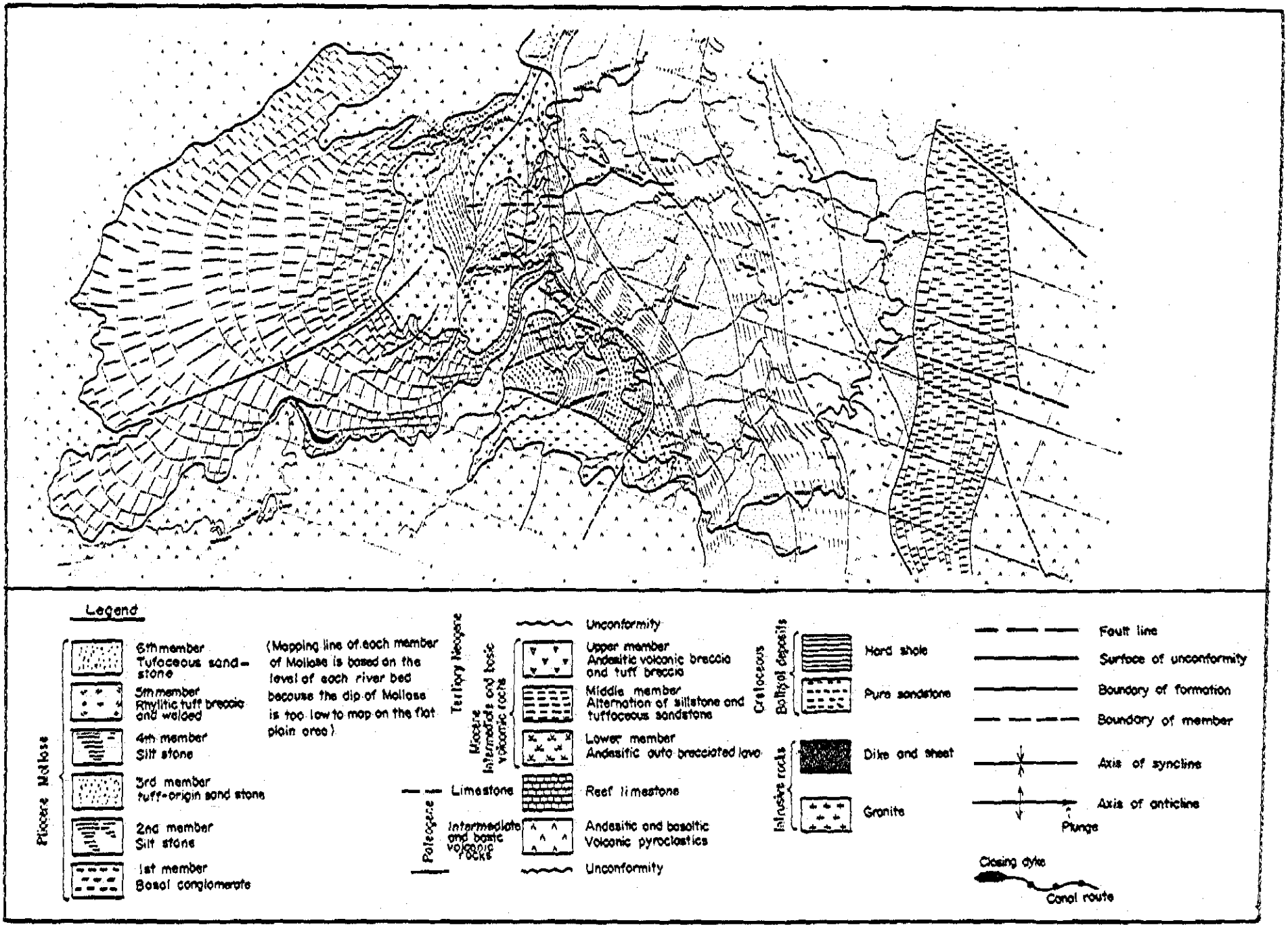


Fig. 3.2 GENERAL GEOLOGICAL MAP

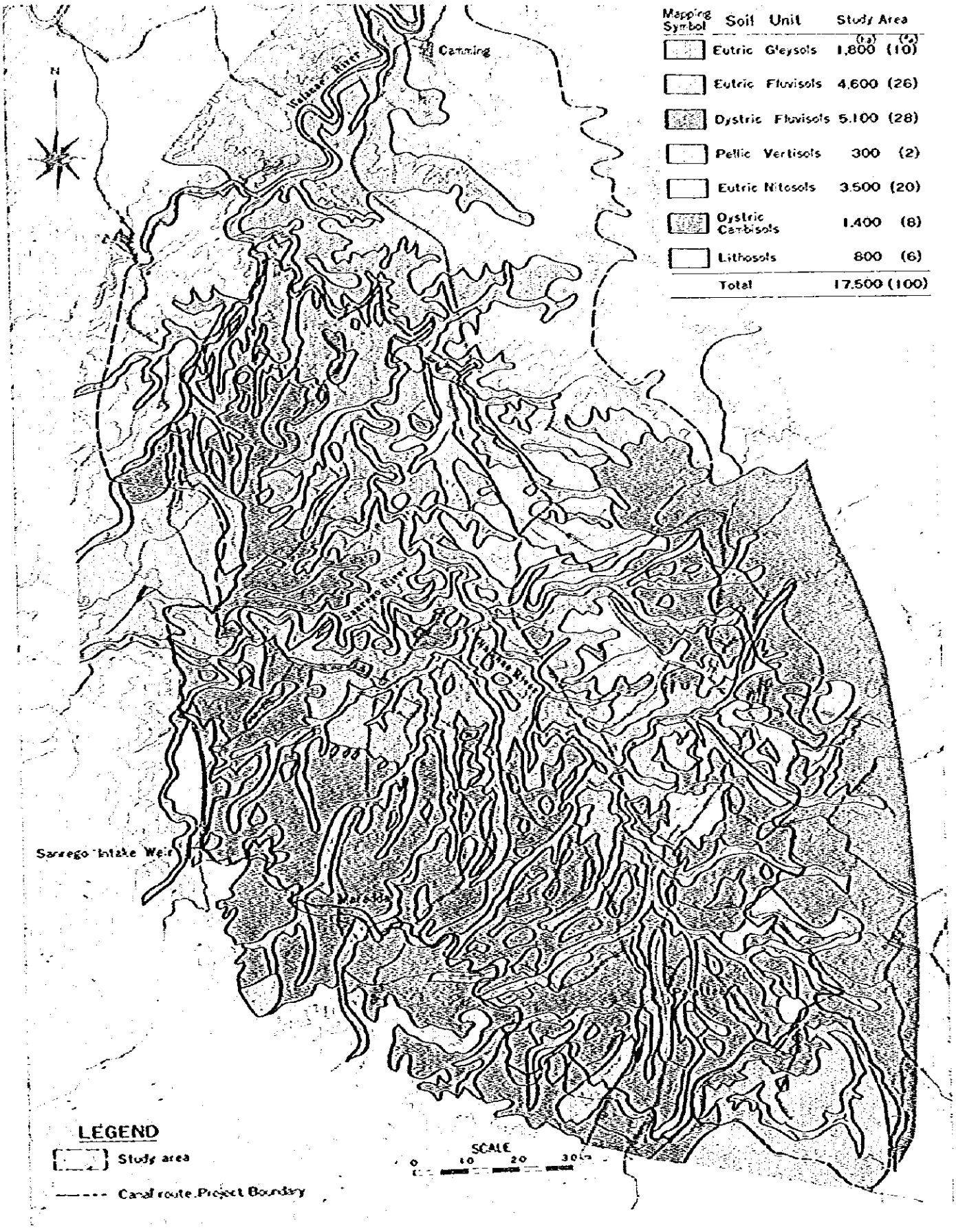


Fig. 3.3 SOIL MAP

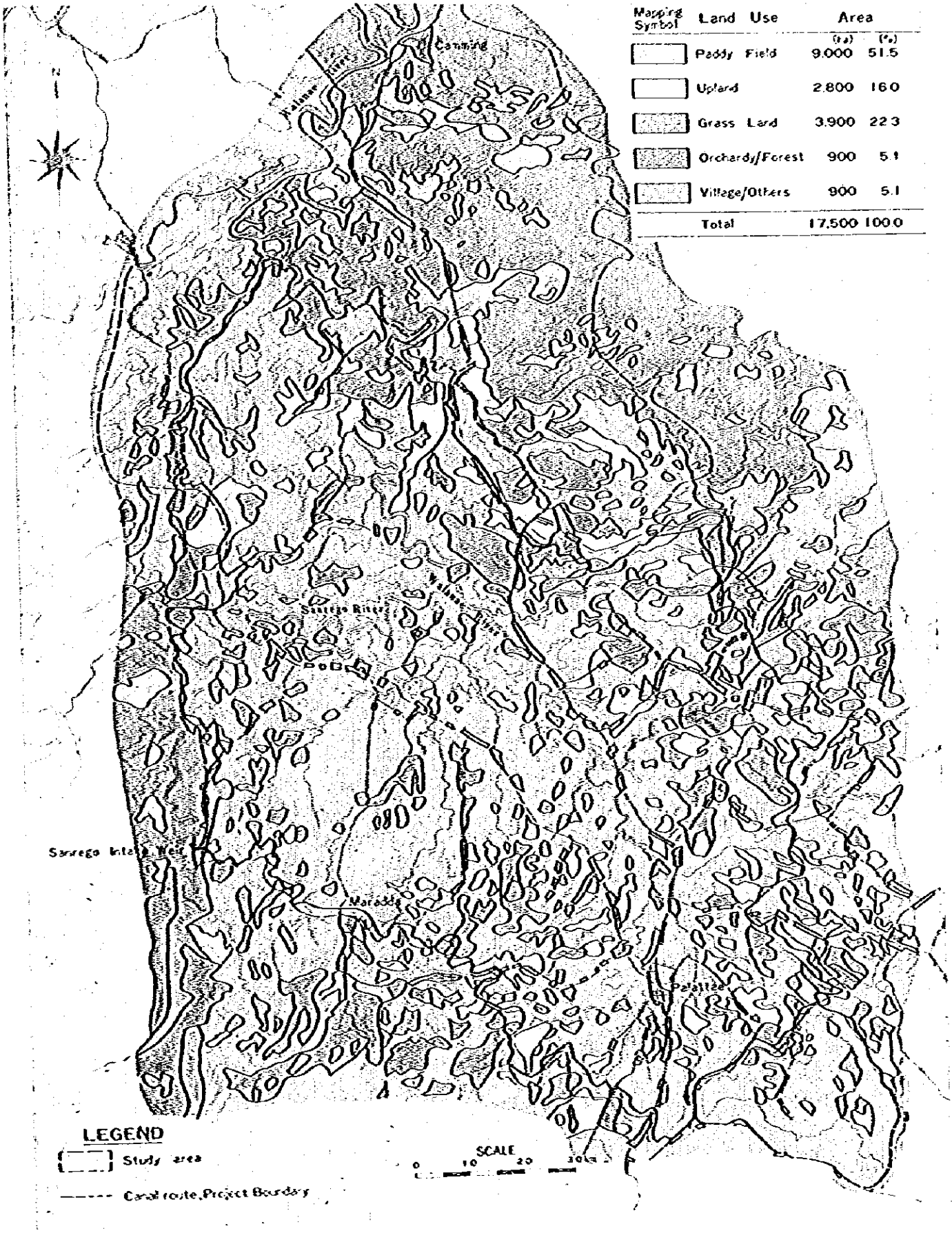


Fig. 3.4 PRESENT LAND USE MAP

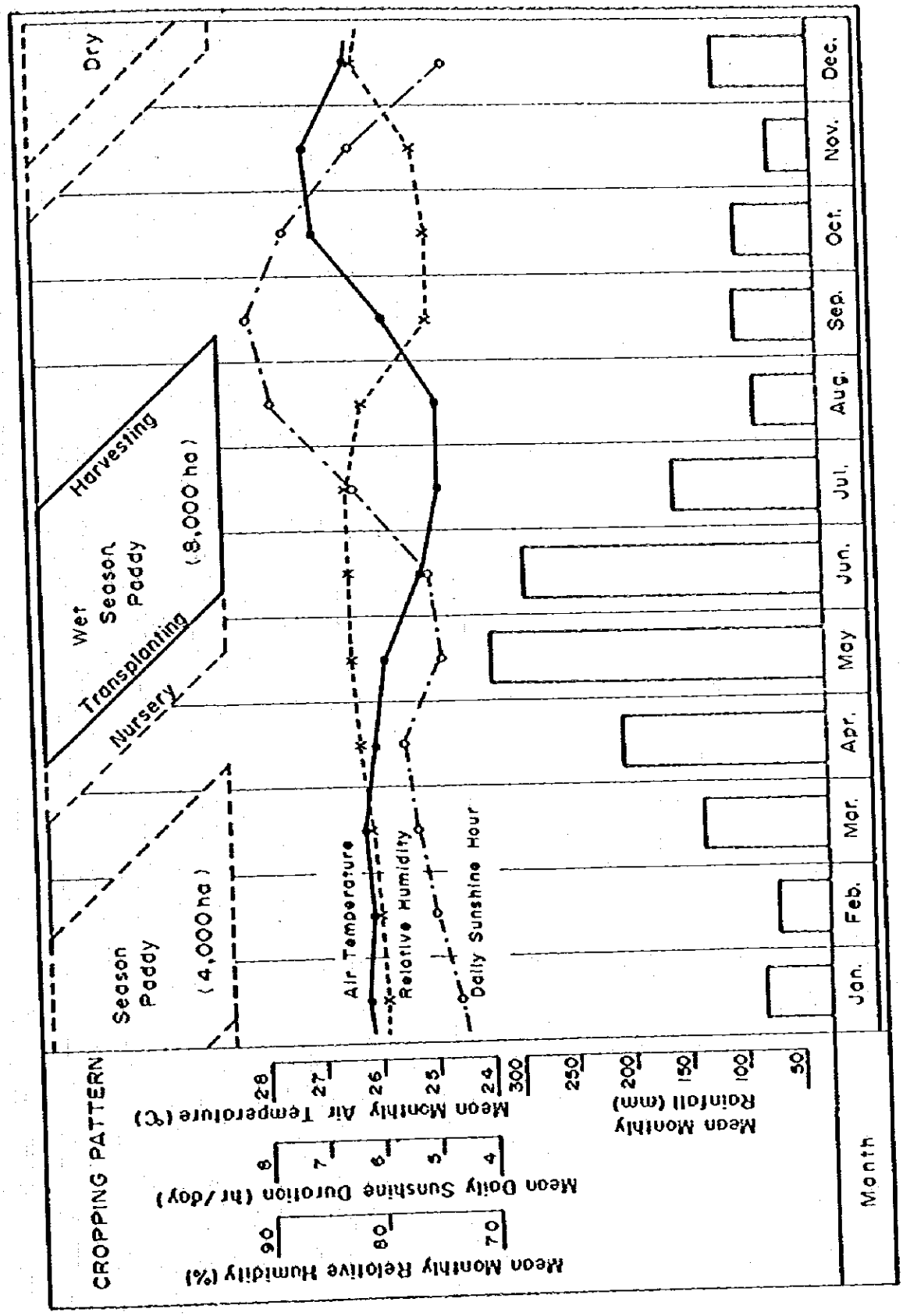


Fig. 5.1 PROPOSED CROPPING PATTERN

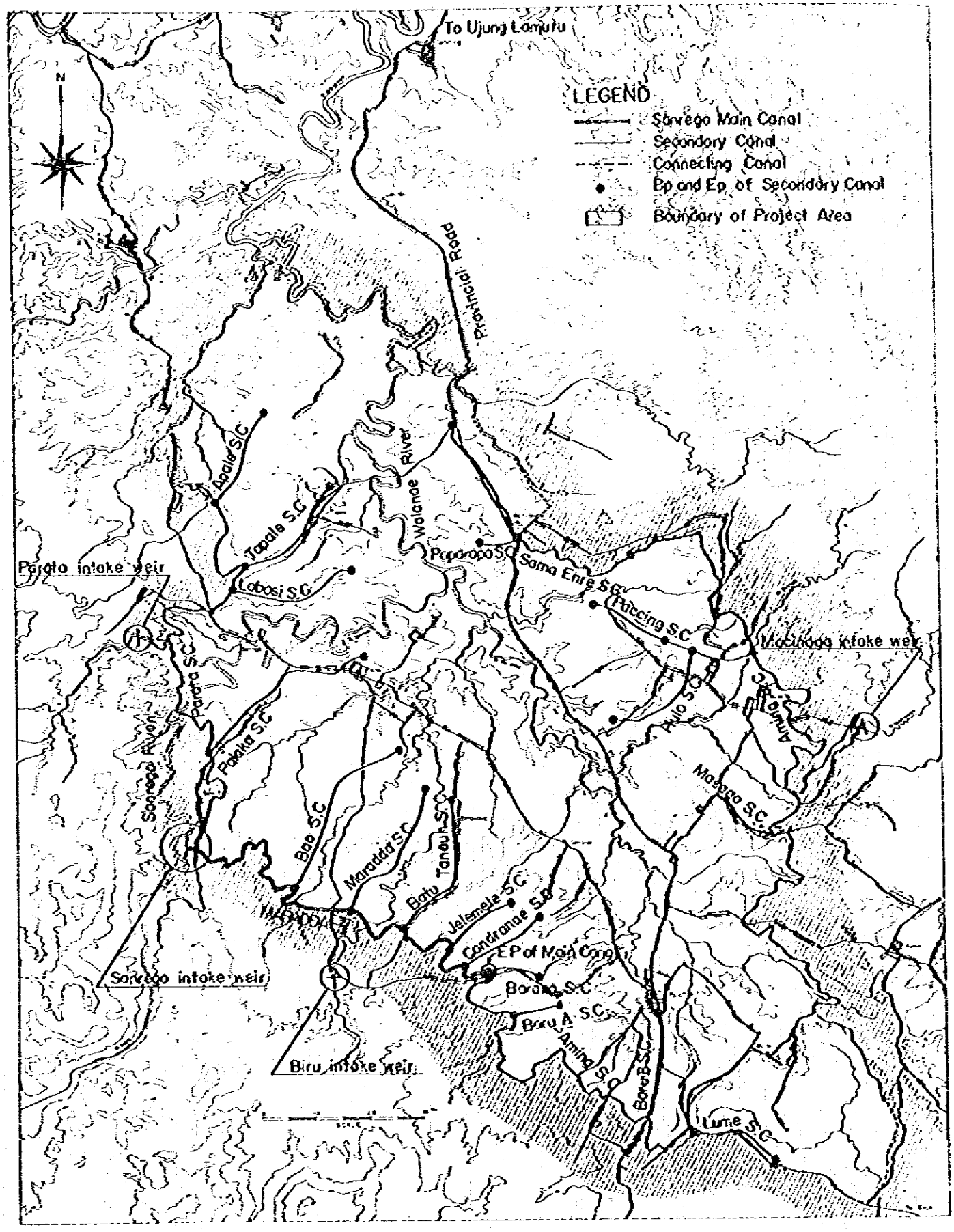


Fig. 5.2 PROPOSED IRRIGATION CANAL SYSTEM

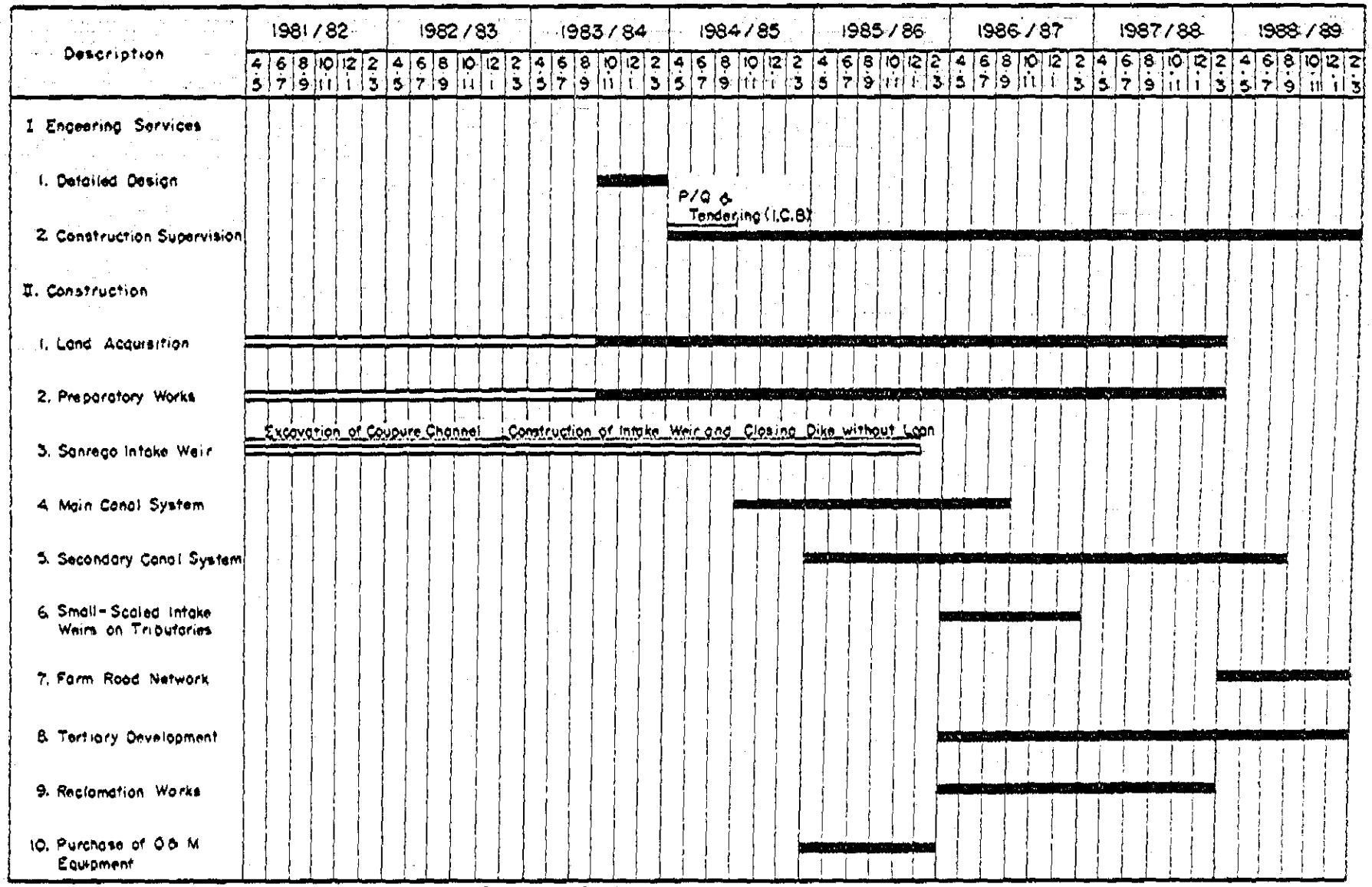


Fig. 5.3 PROJECT IMPLEMENTATION SCHEDULE

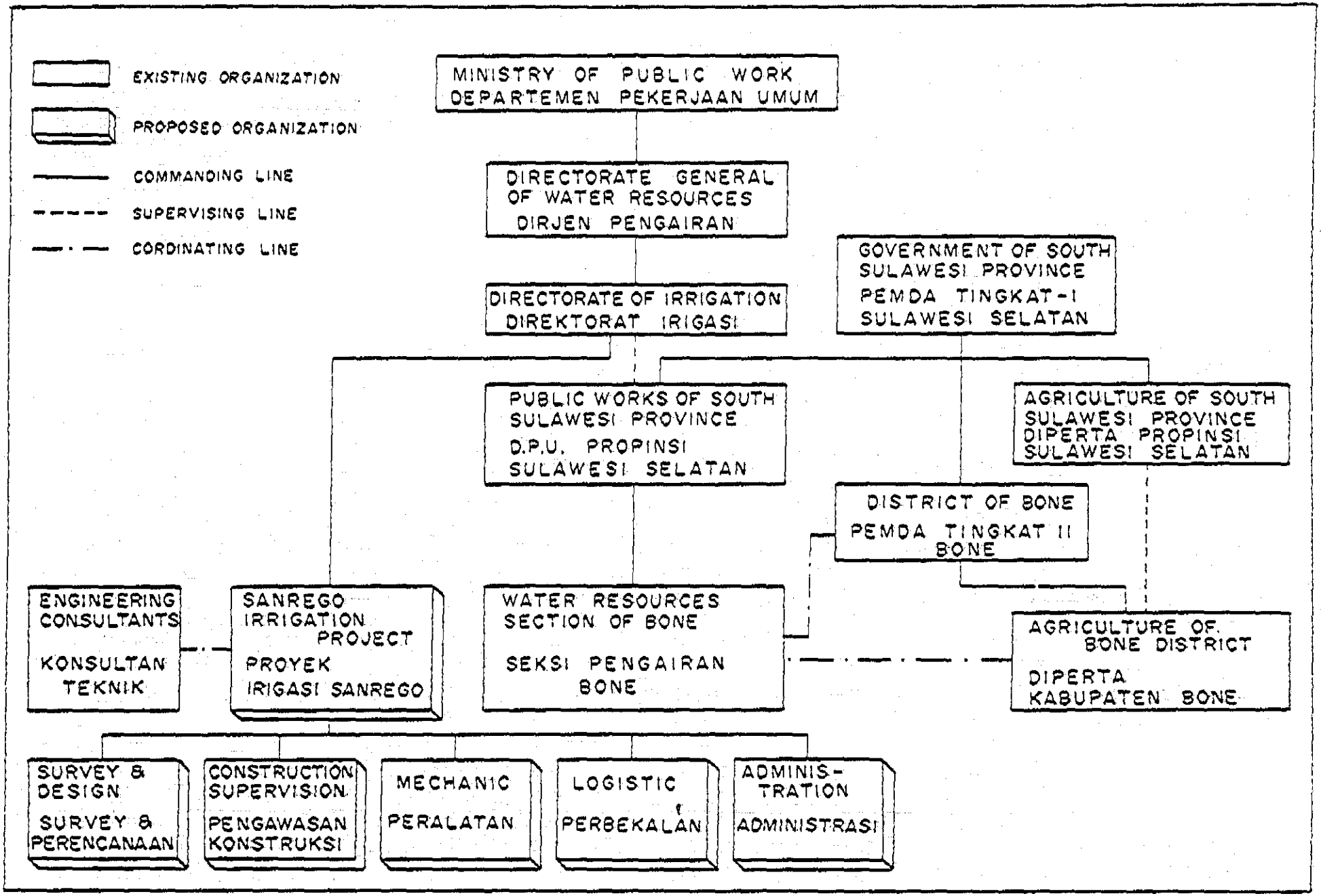


Fig. 6.1 ORGANIZATION FOR PROJECT EXECUTION

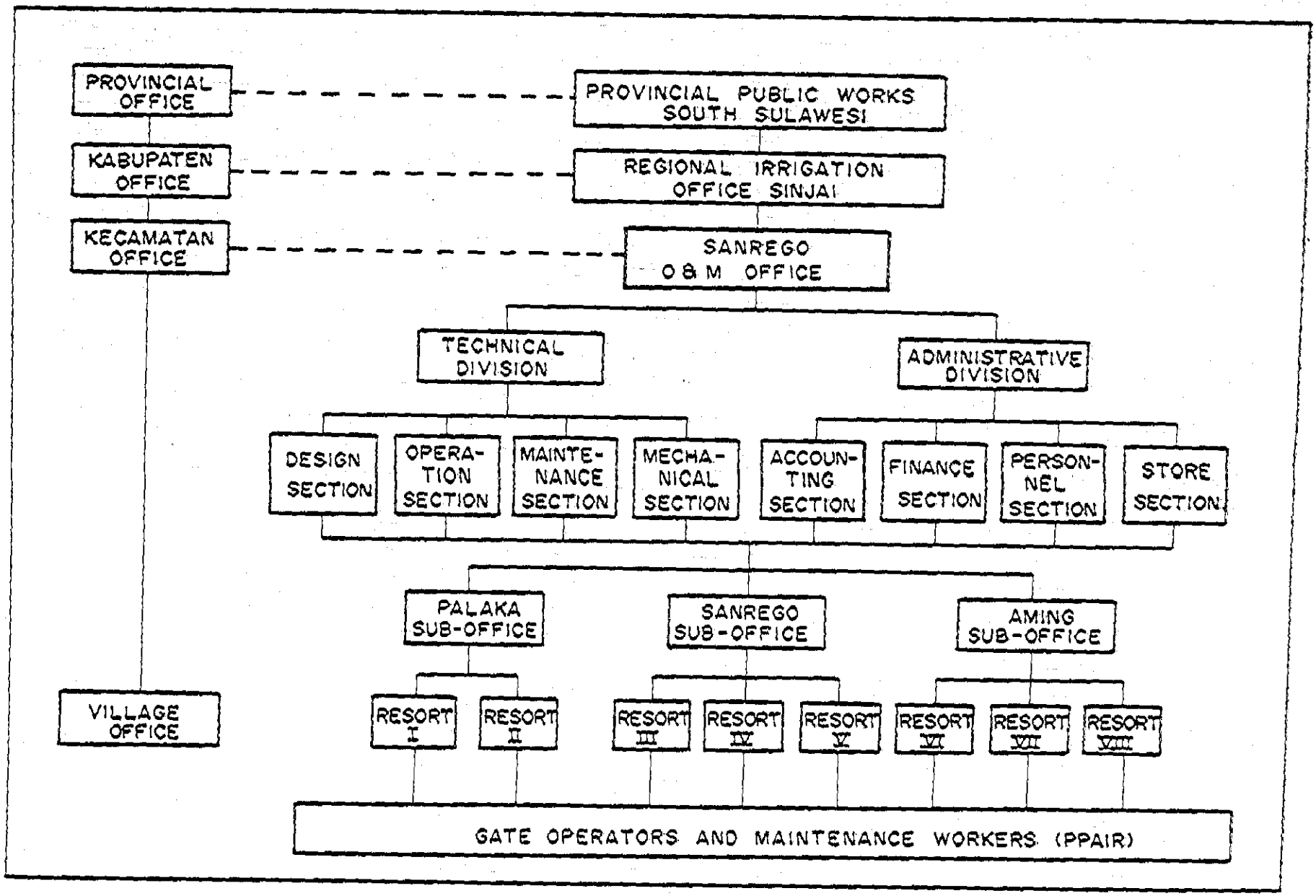


Fig. 6.2 ORGANIZATION FOR OPERATION AND MAINTENANCE

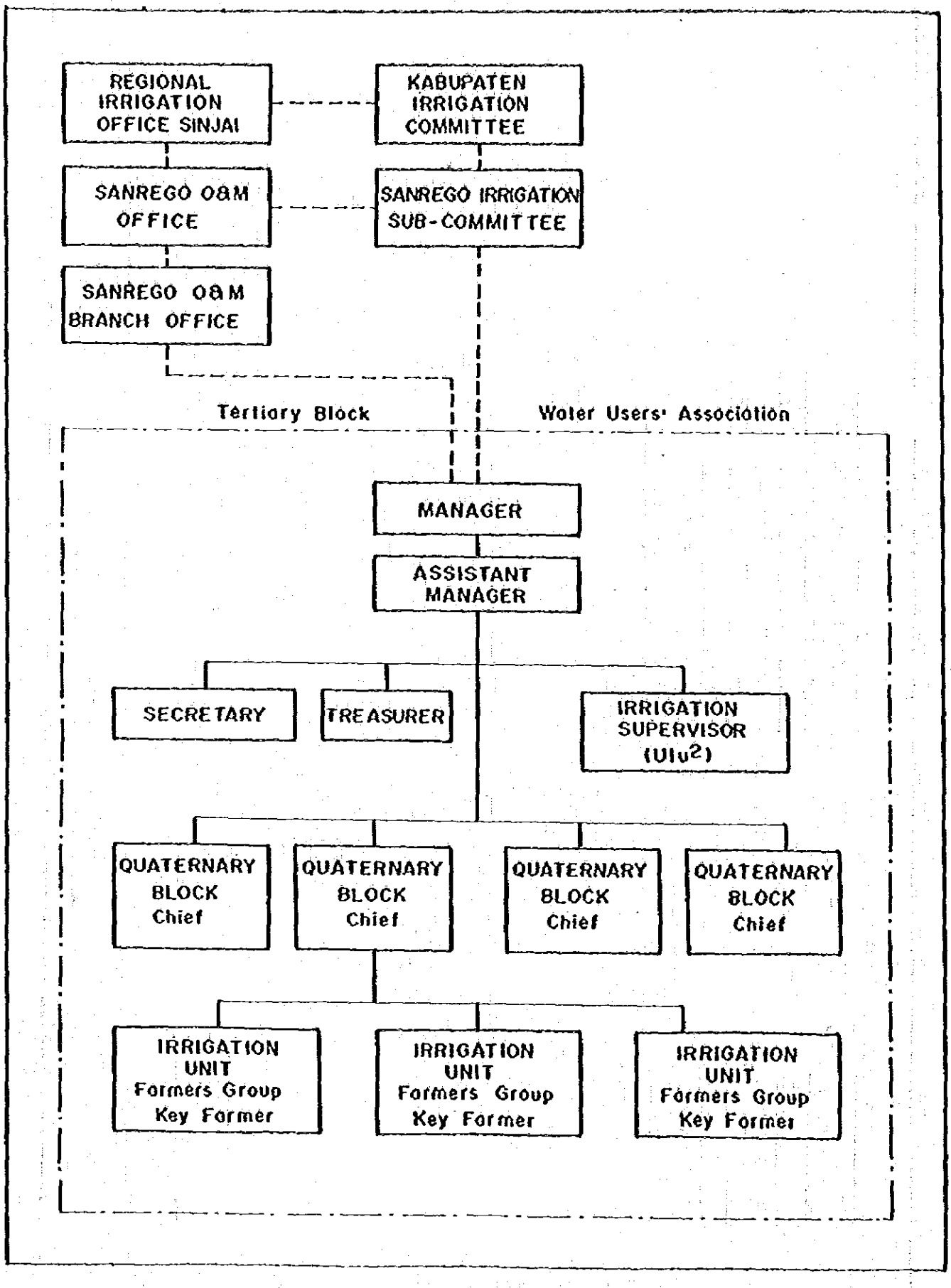


Fig. 6.3 WATER USER'S ORGANIZATION

ATTACHMENT - I SCOPE OF WORKS FOR FEASIBILITY STUDY ON THE SANREGO IRRIGATION PROJECT

I. INTRODUCTION

In 1978 the Government of Japan dispatched the survey team to Indonesia to prepare the master plan for the Central South Sulawesi Water Resources Development Project with principal emphasis on irrigation, flood control and inland fisheries development. The study in the master plan identified irrigation development potential for the land of eighty-one thousand (81,000) hectares, the necessity of the flood control in the irrigation development area and hydropower potential of the Walanae River. It is concluded in the study that promissing nine (9) development projects including irrigation, flood control, multi-purpose dam and their compound projects are proposed to be implemented for national and regional economic development and raising public welfare for the people in the Central South Sulawesi. As a result of the study, the high priority is given to the agricultural development in the upper area of the Walanae River Basin.

In accordance with the results of the previous studies and also considering the earnest request from local people, the Government of Indonesia (hereinafter referred to as "the Government") has decided to promote the realization of the Sanrego Irrigation Project (hereinafter referred to as "the Project") as the initial step of the development of the region and requested the Government of Japan the technical assistance for the feasibility study on the Project.

In response to the request of the Government, the Government of Japan has decided to offer the technical services of the Japanese Experts Team (hereinafter referred to as "the Team") for feasibility study on the Project as a part of the technical cooperation of the Government of Japan.

Japan International Cooperation Agency (JICA), the government agency responsible for execution of the technical cooperation program, will be the executing agency for the feasibility study on the Project.

This document presents the scope of works for the feasibility study to be conducted by the Team in close cooperation with the authorities concerned of the Government.

II. OBJECTIVE OF THE STUDY

The objective of the study will be:

(1) to verify the technical and economic feasibility of the Project, and

(2) to undertake on-job training and transfer of knowledge of the Indonesian counterparts in the course of the survey and study.

III. OUTLINE OF THE STUDY

3.1 The Study Area

The study area is about ten thousand (10,000) hectares of land lying along the Walanae and the Sanrego rivers, which was covered by the master plan for the Central South Sulawesi Water Resources Development Project.

3.2 Scope of Works

The scope of works to be carried out will be divided into four stages as mentioned below:

(1) Topographic Mapping

(2) Preparatory Works

(3) Field Works and Office Works in Indonesia

(4) Home Office Works

3.2.1 Topographic Mapping

Topographic maps on scales of 1:25,000 and 1:5,000 are available for the investigation and study. The study should be supported with aerial photo interpretation and field checking of the maps.

In addition, orthophoto maps on a scale of 1:5,000 shall be produced for the irrigation system planning.

3.2.2 Preparatory Works

The preparatory works will be covered by collecting the data and information concerned such as:

a. Topography	b. Hydrology	c. Meteorology
d. Agriculture	e. Soil	f. Geology

3.2.3 Field Works and Office Works in Indonesia

The activities will comprise the following:

(1) Collection and review of the data on investigation and design conducted by the Government in addition to the data collected through the previous studies such as:

a. Topographic maps and survey results

b. Geology

c. Soil mechanics

d. Hydrology and meteorology

e. Agriculture

f. Regional economy and agricultural institution

g. Present design of facilities

(2) Execution of the field investigation and survey including:

a. Topographic survey to check and confirm the present design of canals and structures and additional survey required for:

- irrigation canal routes
- major structure sites of the Project

b. Ground control survey (both horizontal and vertical) to produce the orthophoto map

c. Water requirement survey

d. Soil survey

- soil profile survey
- physio-chemical analysis for representative soils
- preparation of soil and land capability maps

e. Agriculture and agro-economic survey

- farm budget survey for representative farmers
- preparation of land use map
- analysis of present farming practice and production, and existing institutional support systems

f. Relevant investigation for irrigation, drainage and farm road planning

- present conditions of irrigation, drainage and road in the Project area
- inventory survey of the irrigation facilities provided so far in the project area

g. Geological and soil mechanical investigation on canal routes and major structure sites

h. Construction material survey

- availability and quantities of concrete aggregates, masonry, embankment materials and other construction materials

i. Upper watershed management

(3) Execution of the analysis and the study:

a. Establishment of cropping pattern and improved irrigation farming practice and assessment of farmers' economy

b. Assessment of irrigation water requirements and water availability of the Sanrego River and the other tributaries, and water balance

c. Technical review of the present design of head work, canals, and related structures, and of on-going construction works

d. Delineation of the irrigation area

e. Project formulation

f. Cost estimate of the Project

g. Project benefit

h. Preparation of the implementation schedule, and

i. Economic and financial evaluation

(4) On-job training of the Indonesian counterparts in the course of the field works.

3.2.4 Home Office Works

The home office works will comprise the following:

(1) Preparation of the orthophoto maps

(2) Finalization of the feasibility report, and

(3) Transfer of knowledge and technology to the Indonesian counterpart in the course of the home office works

IV. WORKING SCHEDULE

The working schedule is shown in the attached sheet. To carry out the study, the Government of Japan will dispatch the experts for the following specialities.

(1) Project planning
(2) Irrigation and drainage design
(3) Structural design
(4) Pedology
(5) Agronomy/Agro-economy
(6) Soil mechanic/Geology
(7) Hydrology

(8) Construction engineering

(9) Topographic survey

(10) Orthophoto map preparation

(11) Specialists as required

V. REPORTS

The following reports will be prepared and submitted to the Government.

5.1 Inception Report

Thirty (30) copies in English within one (1) month after the commencement of the preparatory works in Indonesia, presenting the inceptive approaches to the project planning, the proposed plan of operation, survey method and criteria, etc.

5.2 Interim Report

Thirty (30) copies in English at the end of the field works, presenting the findings of field investigations the results of analysis and study at the site and the tentative conclusion of the project formulation.

5.3 Draft Final Report

Thirty (30) copies in English within three (3) months after the end of the field works, presenting the proposed project formulation based on the office works.

5.4 Mapping Report

Thirty (30) copies of mapping report in English and orthophoto maps (1 set duplicable film/paper and 2 sets of printed paper) at the same time of submitting the Draft Final Report.

5.5 Final Report

Fifty (50) copies in English within two (2) months after receiving the comments of the Government on the Draft Final Report, consisting of executive summary report, main report, supporting report, drawings/maps, and ten (10) copies of data book.

VI. UNDERTAKINGS OF THE GOVERNMENT

For the purpose of the study, the Government is requested to:

(1) provide for the Team necessary entry and exit visa, resident and works permit, and travel permit for their stay in Indonesia and to arrange the usual procedure to the Kabupaten office,

(2) facilitate the customs clearance of any equipment, materials and supplies required for the field works and of the personal effects of the survey team,

(3) exempt the members of the Team from income tax and any kind of charges imposed on the instruments, equipment and materials required for the field works and on the personal effects of the members,

(4) allow the Team to take all data and materials concerned out of Indonesia according to the security regulation of the Government and return after use,

(5) provide for the Team suitable office space with equipment and utencils for the experts in Ujung Pandang and at the job site,

(6) arrange the lodging facilities to accommodate the experts in Ujung Pandang and at the job site,

(7) provide for the Team five (5) vehicles with drivers according to the expert assignment schedule without charging any cost to the Team and arrange additional vehicles during the peak period,

(8) provide for the Team of available documents such as drawings, maps, statistics, data and information concerning the study,

(9) provide the counterparts with their facilities (houses and vehicles) to cooperate and assist for the survey team during the study period,

(10) provide for the Team additional topographic surveyors with their facilities (houses and vehicles) to assist the Team timely in accordance with the finding and necessity of the field check survey,

(11) provide for the Team other materials required for the execution of the field works,

(12) carry out the following investigations and laboratory tests:

a. geological investigations of major structure sites

b. chemical and mechanical analysis of the sampled soil and construction materials taken from the project area

c. water quality analysis on the check items

d. hydrological observation at the sites

(13) arrange the required numbers of labourers for carrying out the field works,

(14) secure the Japanese Team members and their reported properties against injury and damage except for the damages arising from the willful misconduct or gross negligence of the members during their stay in Indonesia, and

(15) arrange for the Team medical services during their stay in Indonesia, if necessary.

VII. UNDERTAKING OF THE GOVERNMENT OF JAPAN

For the purpose of the study, the Government of Japan will:

(1) send the Team to conduct the study,

(2) undertake on the job training and transfer of knowledge to the Indonesian counterparts during the period of the survey and study by the Team as well as by the advisory group,

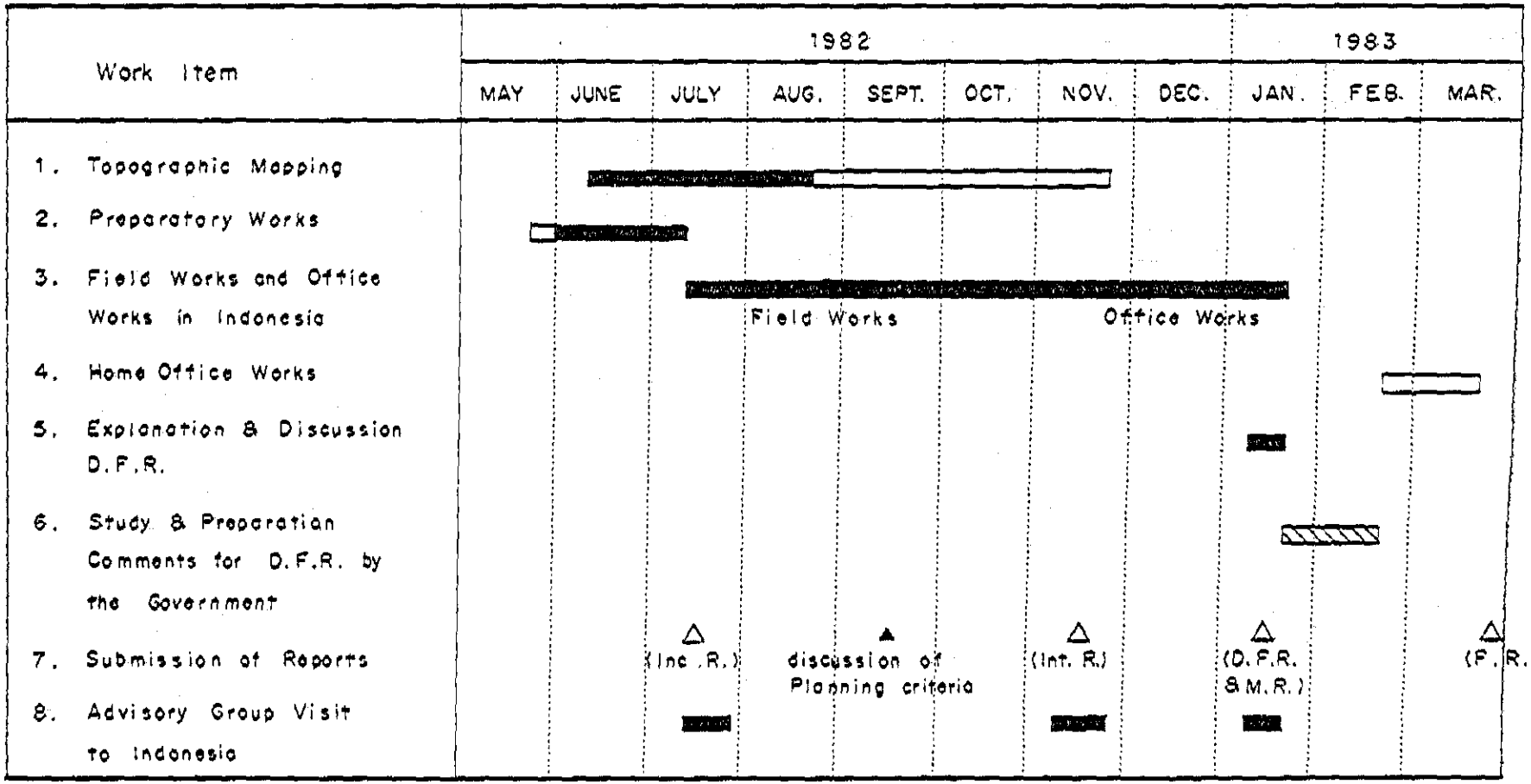
(3) prepare the equipments necessary for the execution of the field works,

(4) bear the charge of accommodation for the Team, and other necessities arranged by the Government,

(5) provide orthophoto maps (including necessary ground control survey) of the Sanrego irrigation area covering about 170 km^2 on scale of 1:5,000, and

(6) transfer of knowledge and technology to the Indonesian counterpart in the course of the home office works.

WORKING SCHEDULE



(Remarks)

- : in Indonesia
- : in Japan
- : activity by the Government

Inc. R. : Inception Report
Int. R. : Interim Report
D.F.R : Draft Final Report
F. R. : Final Report
M.R. : Mapping Report

ATTACHMENT - II MEMBER OF ADVISORY GROUP, STUDY TEAM AND COUNTERPARTS

1. ADVISORY COMMITTEE

(1)	Leader	Mr. Shin NAGAO	Deputy Director of Land Reclamation Division, Agriculture and Fisheries Department, Hokkaido Development Bureau, Hokkaido Development Agency.
(2)	Agro-Economy	Mr. Seiichi KONDO	Deputy Director of Land Development Division, Agriculture and Fisheries Department, Hokkaido Development Bureau, Hokkaido Development Agency.
(3)	Irrigation	Mr. Kenzo TAKEUCHI	Chief Irrigation Engineer of Investigation and Research Development, The Japanese Institute of Irrigation and Drainage.
(4)	Agronomy	Mr. Kiyoshi SAKAI	Deputy Director of Natural Resources Division, Planning Department, Kyushu Regional Administration Bureau, Ministry of Agriculture, Forestry & Fisheries.
(5)	Project Economy	Mr. Shigeru TAKEDA	Deputy Manager of Second Technical Appraisal Division, Economic Research & Technical Appraisal Department, The Overseas Economic Cooperation Fund.
(6)	Coordination	Mr. Koji INOUE	Officer of Technical Affairs Division, Agricultural, Forestry & Fisheries Planning & Survey Department, Japan International Cooperation Agency.
(7)	Coordination	Mr. Teruhisa TAJIRI	Officer of Technical Affairs Division, Agricultural, Forestry & Survey Department, Japan International Cooperation Agency.

2. JICA STUDY TEAM

(1)	Team Leader	Mr. Tadashi SAKAMOTO
(2)	Deputy Team Leader/ Irrigation & Drainage Planner	Mr. Takeshi KAWAGUCHI
(3)	Irrigation & Drainage Design Engineer	Mr. Kiyotaka MIZUSHIMA
(4)	Agronomist/Agro-Economist	Mr. Fumihiro NAGAO
(5)	Structural Design Engineer	Mr. Kiyoshi SHINOZAKI
(6)	Pedologist	Mr. Naoki ARIGA
(7)	Soil Mechanical Engineer	Mr. Masahiro YAMAGUCHI
(8)	Geologist	Mr. Kazuo CHOSHI
(9)	Hydrologist	Mr. Takashi KURAUCHI
(10)	Construction Planner	Mr. Yoshimitsu YUKAWA
(11)	Survey/Design Engineer	Mr. Teruo KAJIMOTO
(12)	Survey/Design Engineer	Mr. Kenichiro KONDO

3. COUNTERPARTS

P3SA, SUL-SEL.

(1)	Chief Counterpart	Ir. Abd. Yantahin
(2)	Chief Counterpart	Ir. Syamsul Arida
(3)	Irrigation Planner	Ir. Purwoko
(4)	Irrigation Planner	Mr. Kamrin
(5)	Irrigation Design Engineer	Ir. Djoko Santoso
(6)	Irrigation Design Engineer	Mr. Suharman Mattone
(7)	Agronomist/Agro-Economy	Drs. Syafiuddin
(8)	Agronomist/Agro-Economy	Miss. Syamsiah Ras
(9)	Structural Design Engineer	Ir. Supriya Triwayana
(10)	Structural Design Engineer	Mr. Amrullah
(11)	Soil Mechanical Engineer/ Construction Planner	Ir. Islamuddin
(12)	Geologist	Mr. Sriyatno BE
(13)	Hydrologist	Drs. Suwarno
(14)	Hydrologist	Mr. Syamsul Qamar
(15)	Survey/Design Engineer	Mr. Abd. Wahab
(16)	Survey/Design Engineerr	Mr. Abd. Rauf
(17)	Survey/Design Engineer	Mr. Abd. Rasyid
(18)	Survey/Design Engineer	Mr. Arifin

P.T. DACREA

(1)	Chief Counterpart	Mr. Ramly Sjarief BE
(2)	Irrigation Planner	Mr. Benny Rahim BE
(3)	Irrigation Design Engineer	Mr. Andrias Parabang BE
(4)	Agronomist	Ir. Meagaung A. Daud
(5)	Agro-Economist	Ir. Agnes D. Rampisela
(6)	Structural Design Engineer	Mr. Benyamin G. Rombe BE
(7)	Pedologist	Ir. Idham Hasib
(8)	Soil Mechanical Engineer	Mr. Moh. Husni Thamrin
(9)	Hydrologist/ Construction Planner	Mr. Frans Rahmat BE
(10)	Survey/Design Engineer	Mr. Harjono
(11)	Survey/Design Engineer	Mr. Hengky

JICA