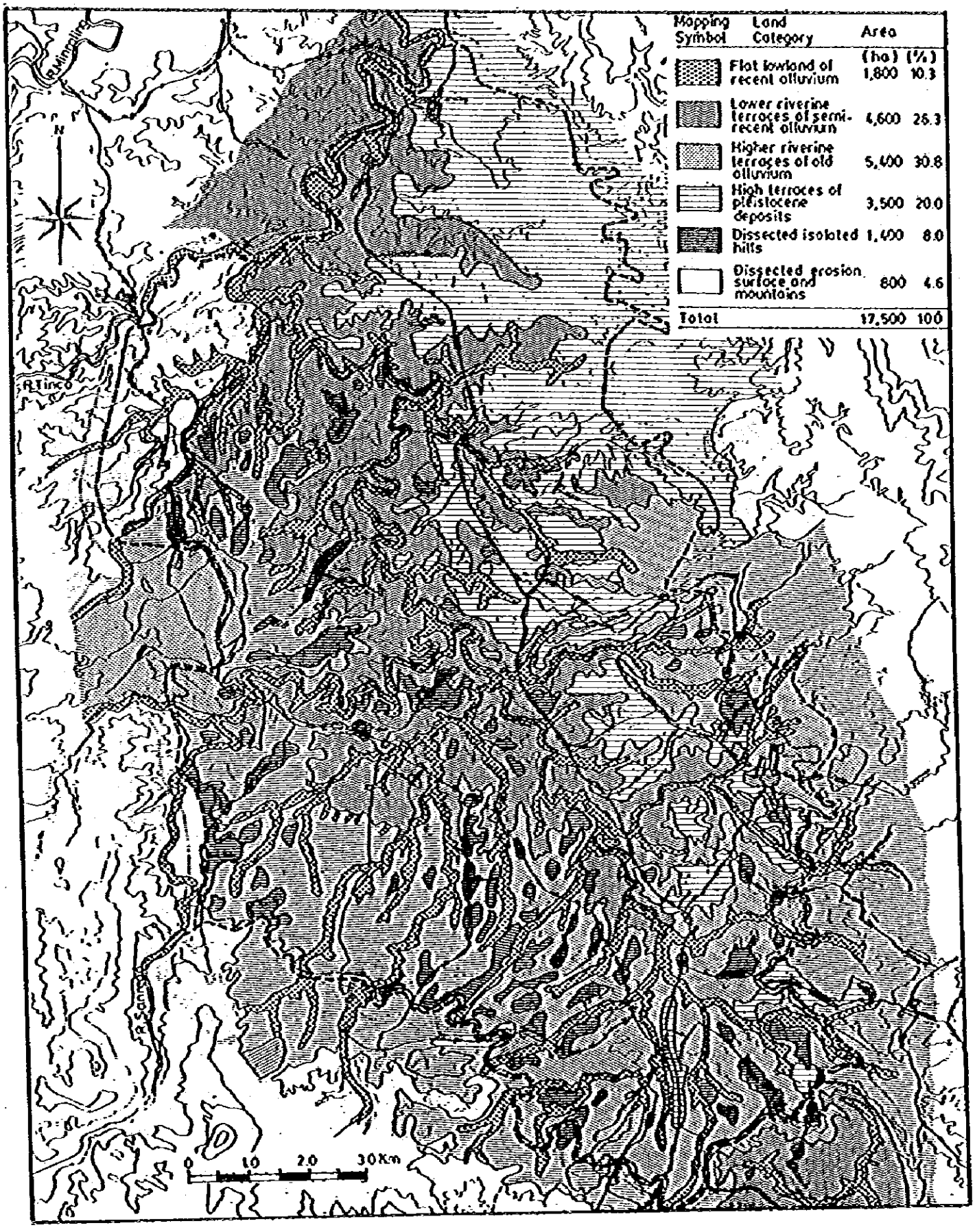

Fig. IV.2.1 LAND-FORM CLASSIFICATION MAP

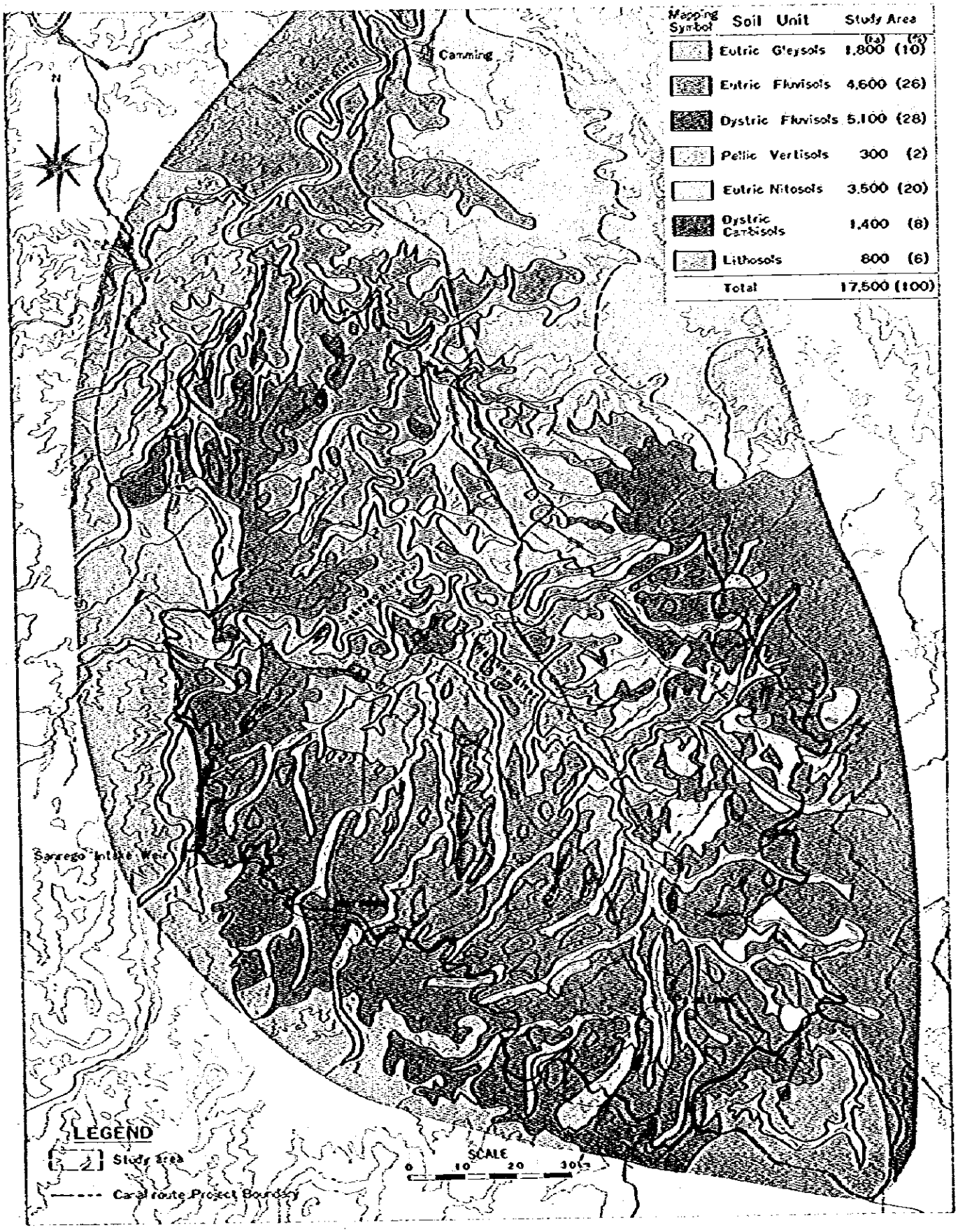

Fig. IV.2.2 SOIL MAP

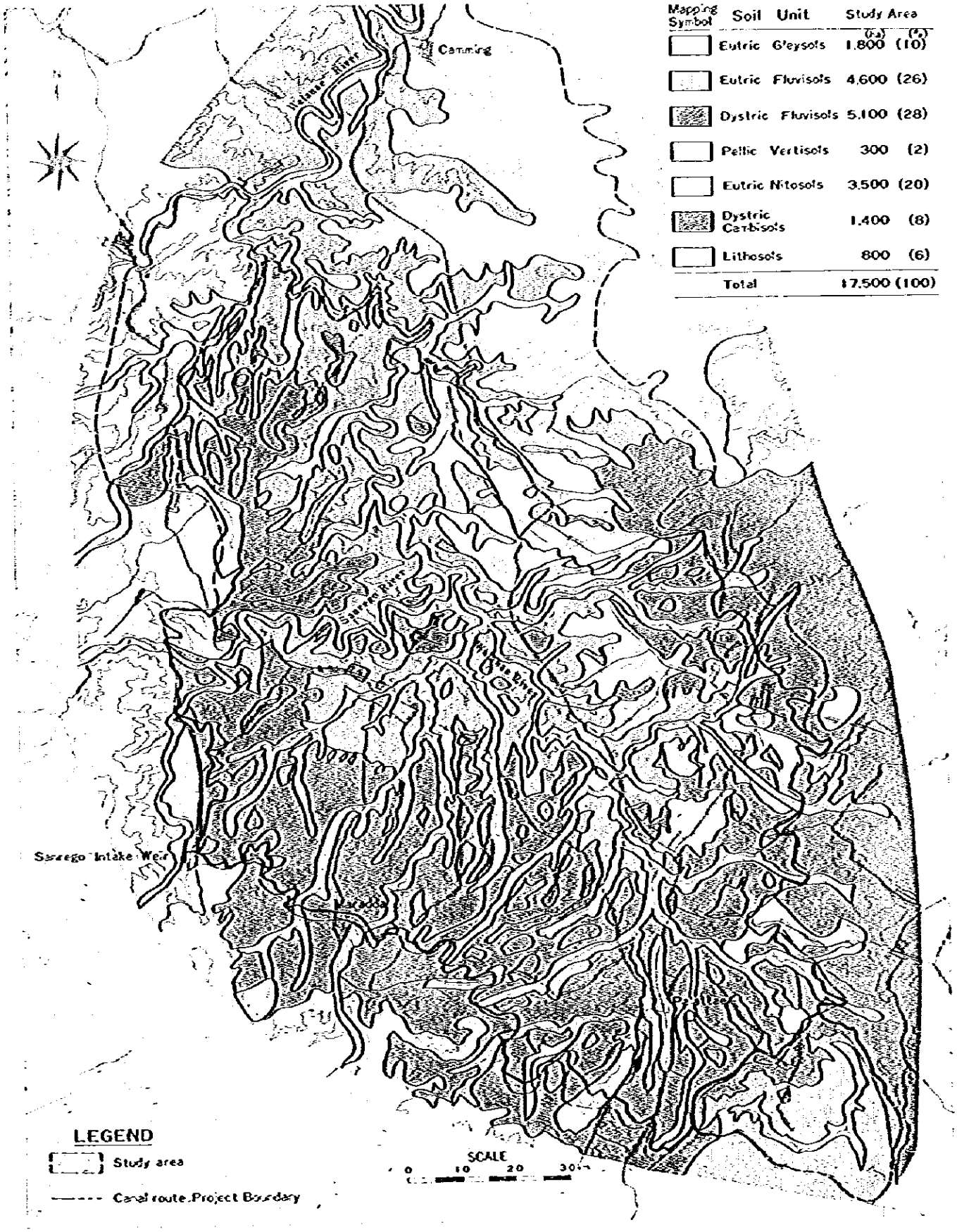

Fig. IV.2.2 SOIL MAP

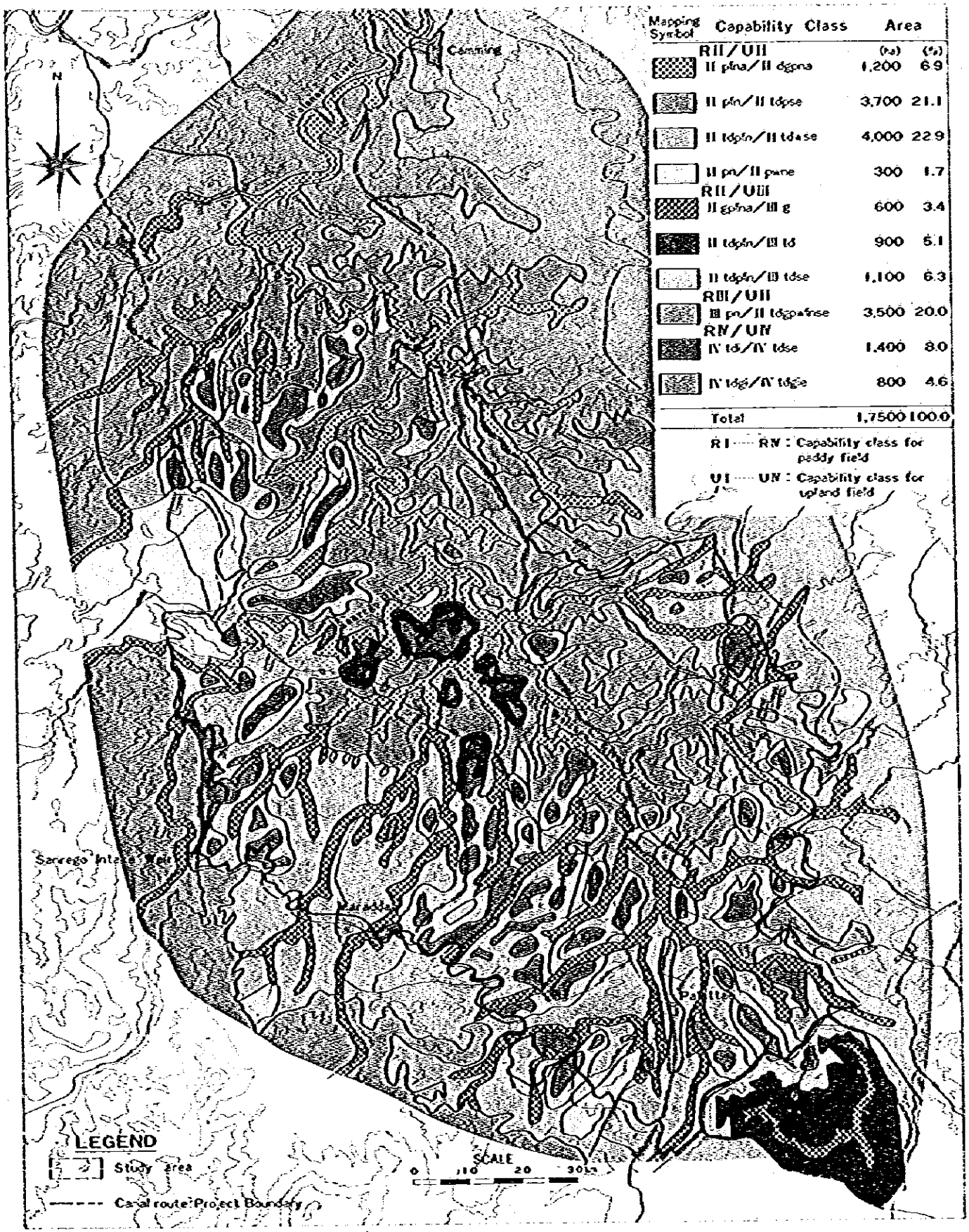

Fig. IV.3.1 LAND CAPABILITY CLASSIFICATION MAP

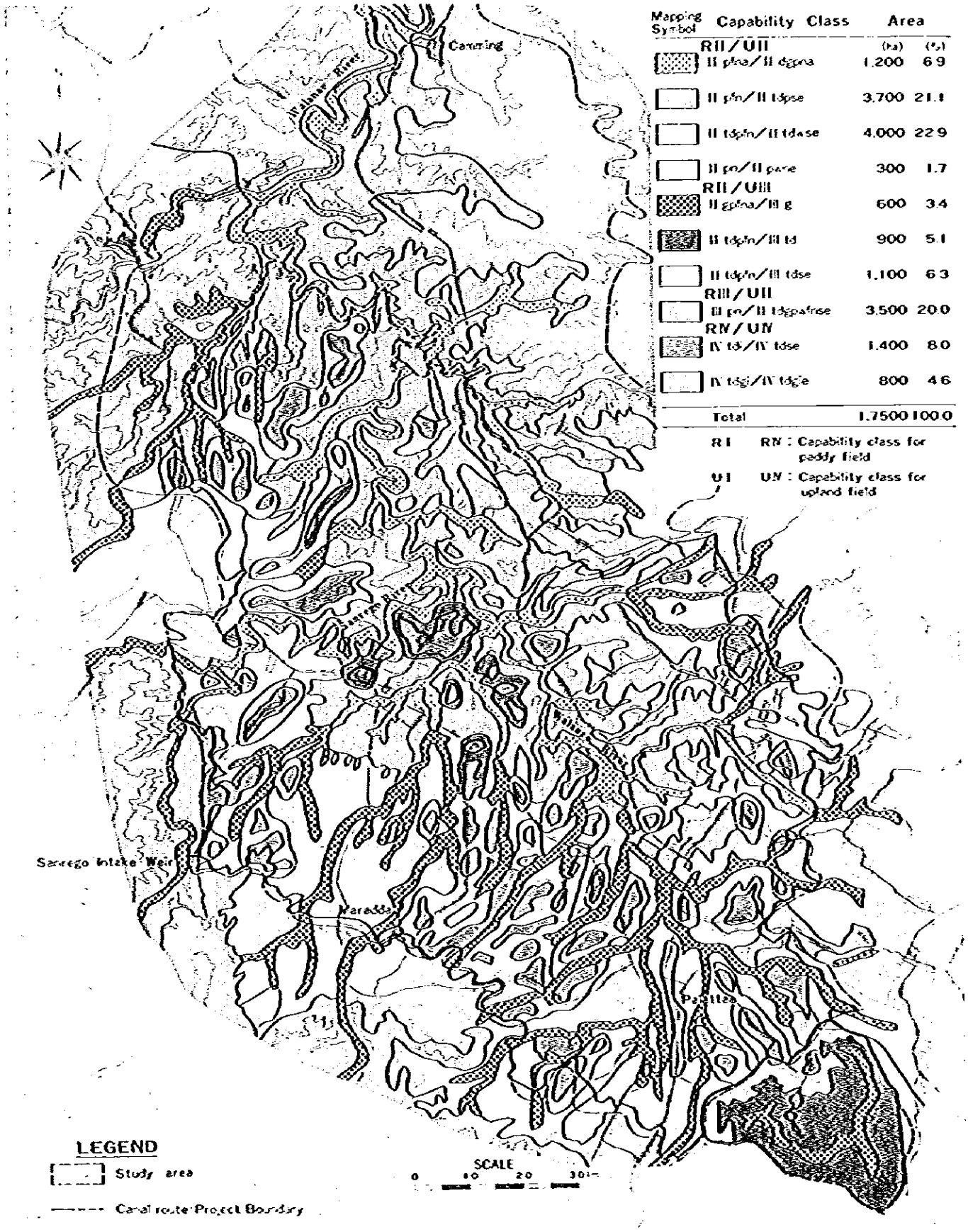

Fig. IV.3.1 LAND CAPABILITY CLASSIFICATION MAP

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ANNEX - V

AGRICULTURE AND AGRICULTURAL ECONOMY

ANNEX - V AGRICULTURE AND AGRICULTURAL ECONOMY

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1. GENERAL

The present studies of agriculture and agricultural economy in the study area were mainly designed for the purpose to assume the possible differences in agricultural production between conditions with and without the Sanrego Irrigation Project and to estimate the repayment capacity of the Project benefited farmers.

The main objectives of these studies are:

(1) to study the present status of agricultural production and rural economy in the study area,

(2) to find the optimum cropping patterns in the area and evaluate the development potential in agricultural production,

(3) to estimate the improvement of agricultural outputs and farmer's economy under the with project condition, and

(4) to assume the irrigation benefits derived from the Project and repayment capacity of the benefited farmers.

In order to clarify the prevailing agricultural conditions and the development potential, the field investigation and data collection were made over about 17,500 ha of the study area which was delineated out of the total gross area of about 38,000 ha within 14 Desa boundaries in and around the study area.

The data and information were mainly obtained from the Government authorities concerned such as various departments of Provincial Ministry of Agriculture, Agriculture office in Kabupaten Bone, Central Research Institute of Agriculture (CRIA), Bogor, South Sulawesi Branch Research Station of CRIA in Maros, Seed Centre in Maros, BAPPEDA office, IPEDA office, Agrarian office, Indonesian People's Bank (BRI) of South Sulawesi Province and their branch offices in Kabupaten Bone, Bupati office, Census and Statistics, Rural Extension Center of Kabupaten Bone, and Kecamatan offices of Kahu, Libureng, Tonra and Salomekko. The data and information collected are listed in Table V.1.1.

In parallel with such data collection, an extensive field investigation was made on the basis of the results of field investigation and preliminary results of data analysis. Besides, the farmer's interview was made on 100 representative farm households, so as to confirm the data and information mentioned above and also to obtain more practical and reliable information on farm economy. In addition to these activities, the yield diagnosis survey for wet season paddy was also carried out in order to identify the defects hampering the increase of unit yield of paddy under present condition.

2. PRESENT CONDITION OF AGRICULTURE

2.1 Present Demographic Condition

The study area is located in the southeastern corner of the Central South Sulawesi apart about 100 km east by north from Ujung Pandang, the capital of South Sulawesi Province. It extends along upper reaches of the Walanae river and lower reaches of the Sanrego river which is a major tributary of the Walanae river. Administratively, the study area comes under four (4) Kecamatan of the Kabupaten Bone and covers 14 Desa as shown below:

(Unit: ha)

Kecamatan	Desa		Area
1. Kahu	(1)	Sanrego	2,950
	(2)	Biru	2,410
	(3)	Palakka	2,460
	(4)	Cenrana	2,280
	(5)	Balle	2,690
	(6)	Cakkela	2,860
	(7)	Labuaya	2,350
2. Libureng	(8)	Tappale	4,400
	(9)	Pitumpidange	4,200
	(10)	Polewali	3,200
3. Tonra	(11)	Paccing	1,640
	(12)	Hassila	2,000
4. Salomekko	(13)	Masago	2,000
	(14)	Patimpeng	2,600
Total			38,040

The administrative divisions are illustrated on Fig. V.2.1.

The total population in the above-mentioned Desa which are partly or entirely covered by the study area, is 38,400 as of 1981. The population density is about 100 persons per km^2 on an average over the total area of 380 km^2. The population growth rate is estimated at about 2.3% per annum during the recent decade. The total workable population in the age group of 15 - 49 years old is about 16,300 which corresponds to 43% of the total population. The population comprises 48% of male and 52% of female, showing the female rate of 1.09. In the age group of 15 - 49, the female rate become large, showing 1.35. The total number of household is about 6,740. The average size of family is 5.7 persons per household. The number of farm household is about 6,270. It accounts for about 93% of the total number of household. The general feature of the demographic condition is shown in Table V.2.1. The details of the population structure in the study area are given in Table V.2.2.

The present demographic condition is characterized by high female rate especially in economically active age groups and high rate of child population below 15 years of age. The former indicates that there is a considerable population outflow from the area and most of them seem to be working outside temporarily to supplement their livelihood with some off-farm incomes because of insufficient crop incomes especially in the dry season. This presumption has been evidenced by the farm economy survey. The high rate of child population will build a stable base of labour for area development if work opportunity is sufficiently provided.

2.2 Present Land Use

The statistical land use information was collected from Agriculture office in Kabupaten Bone and Kecamatan offices concerned, and it was confirmed and adjusted through aerial photo interpretation. Two series of aerial photos were used; one was taken in March, 1977 on a scale of 1/25,000, and the other in August, 1982 on a scale of 1/10,000. These aerial photos were fully used for almost all the aspects of the agricultural studies. The present land use conditions are illustrated on Fig. V.2.2.

The lands in the study area are classified into six (6) land use categories, comprising paddy field, upland field, orchard, grassland, forest, villages and others. The present land use in the study area is summarized as shown below:

Land Use Category	Area	Proportional Extent
	(ha)	(%)
Paddy field	9,000	51
Upland field	2,800	16
Orchard	600	4
Sub-total	12,400	71
Grassland	3,900	22
Forest	300	2
Village/others	900	5
Total	17,500	100

The farmland comprising paddy field, upland field and orchard amounts to about 12,400 ha or 71% of the study area. Paddy field occupies about 9,000 ha or 73% of the farmland. It has been mainly developed on the alluvial plains and riverine terraces along the Walanae and Sanrego rivers and their tributaries. Most of paddy fields are generally cultivated under rainfed condition. The cultivated area of paddy fluctuates year by year due to wide variation of annual rainfall. Polowijo crops which are planted on paddy field after harvest of wet season paddy are mainly groundnuts and greenbeans.

Upland fields of about 2,800 ha extend around the village areas, relatively elevated lands and slopes. These are presently used for cultivation of maize, groundnuts, cassava, sweet potato, etc. Most of orchard of about 600 ha are sporadically located around the village and isolated hills, and are cultivated with coconuts, banana, mango, candlenuts, kapok, etc. The remaining of about 5,100 ha are grasslands, forests, villages and others. The aerial photos taken in 1982 indicate that the existing farmlands, especially paddy fields, are gradually depleted. The main reason for these abandoned farmlands may be low productivity of land which is mainly attributable to shortage of available water for farming and poor fertility of soils. This fact was confirmed through the farm economy survey.

The details of present condition of farmland by Desa are given in Table V.2.3.

2.3 Land Holding and Land Tenure System

The investigation and study on the present land holding and land tenure system are made based on the population census in 1980 and other information provided by the Census and Statistic offices of South Sulawesi Province and Kabupaten Bone, and are supplemented by the farm economy survey in and around the study area.

The land holding size of farmer in the South Sulawesi, as measured by the cultivated area per household, is generally small because of the limited availability of arable land and large number of farm population. According to the agricultural census in 1973, the average size of farms is about 1.74 ha of which 1.13 ha is paddy field.

In the study area, the land holding size of farmer averages 2.36 ha, out of which paddy field accounts for 1.42 ha (see Table V.2.4). This average size is larger by 0.62 ha than that of the whole province.

The total number of farm households in and around the study area is estimated at about 6,270, out of which about 95% or 5,990 households are holdings their own farmlands (see Table V.2.5). The distribution of holding size over these land owner farmers is as follows (for details, vide Table V.2.6):

Land Holding Size (ha)	Total Nos. of Farm Household
less than 0.5	1,902
0.5 - 1.0	1,312
1.0 - 1.5	918
1.5 - 2.0	764
2.0 - 5.0	625
more than 5.0	471
Total	5,992

The small farmers who own 0.1 to 1.0 ha of land occupy about 54% of total farmers. As the present crop incomes of these peasant farmers under rainfed field condition are insufficient to maintain the livelihood of farmers, most of these farmers are engaged in various sideline business.

Tenant systems are complicated but most of them are of share cropping. Tenant charge is generally about 50% of total productions.

2.4 Present Cropping Patterns

The main crops grown in the study area is paddy, followed by polowijo crops mainly groundnuts and green beans. Upland crops presently cultivated are maize, groundnuts, sweet potato, cassava, etc. Other crops grown as adjunct to rice farming are coconuts, banana, mango, candlenuts, coffee, clove, kapok, etc. They are generally grown in the orchard and estate crops field.

Most of paddy cultivation are generally made under rainfed condition. Irrigation facilities are quite limited in the study area. The paddy cultivation is concentrated in the wet season and is very limited in the dry season. The cultivation pattern is generally affected by seasonal distribution on rainfall. The planted and/or harvested areas fluctuate year by year, depending on the available rainfall water.

In cases of wet season paddy in 1977, the planted area was 5,470 ha or about 60% of total paddy field, and the damaged area was 2,790 ha or about 50% of the total planted area. The damaged area are classified two cases; about 80% of draught damage and 20% of insects and rodents damage. The average planted area and cropping intensity from 1977 to 1981 are summarized below:

Description	Area	Cropping Intensity
	(ha)	(%)
Total Paddy Field	9,000	
Planted Area		
Wet season paddy	7,120	79
Dry season paddy	800	9
Polowijo crops	1,750	19
Total	9,670	107

The wet season paddy is planted at onset of the monsoon, generally from March to May, and harvested from July to September. The cultivation of dry season paddy and the polowijo crops generally starts in November and December. Polowijo and upland crops are grown primarily for home consumption as a partial substitute for a complement to rice consumption. When the production of paddy is very low due to various damages, that planted areas of polowijo and upland crops are expanded not only to paddy and upland fields but also to orchard/estate crops field and houseyard.

The average planted area, harvested area and damaged area of major crops within the boundaries of Desa under study, are shown in Table V.2.7. These are summarized as follows:

(Unit: ha)

Crops	Planted Area	Damaged Area	Harvested Area
Paddy	7,920	1,330	6,590
Wet season paddy	7,120	1,280	5,840
Dry season paddy	800	50	750
Polowijo Crops	1,750	-	1,750
Groundnuts	1,670	-	1,670
Greenbean	80	-	80
Upland Crops	4,340	-	4,340
Maize	2,470	-	2,470
Groundnuts	1,440	-	1,440
Cassava	220	-	220
Sweet Potato	210	-	210

The average planted areas of paddy and polowijo crops are 7,120 ha for wet season paddy, 800 ha for dry season paddy and 1,750 ha for polowijo crops. These figures correspond to 80%, 9% and 20% of the total paddy field. The present multicropping intensity on the paddy field is estimated at about 110% on an average. Such low cropping intensity is basically attributable to shortage of available water.

The average harvested areas of paddy and polowijo crops are 5,840 ha for wet season paddy, 750 ha for dry season paddy and 1,750 ha for polowijo crops, respectively. The differences between planted and harvested areas are considered as the areas damages by various causes like drought, insects and rodents.

The crop rotation patterns adopted on the paddy field within the boundaries of Desa under study area can be classified into three major types. They are:

	Cropping Pattern	Cropping Intensity (%)	Area (ha)
(1)	Paddy - Polowijo crops	90 - 120	8,600
(2)	Paddy - Paddy	200	250
(3)	Paddy - Polowijo crops - Paddy/Polowijo crops	200 - 250	150
	Total	110 (Ave.)	9,000

The pattern (1) is predominant in the study area, accounting for about 96% of the paddy fields. The pattern (2) double cropping of paddy a year, is found in the Maradda semitechnical irrigation area and partly on the alluvial plain extensing along the Walanae and Sanrego rivers and their tributaries, where the irrigation water is sufficiently available throughout the year. Pattern (3), triple cropping of paddy and/or polowijo crops, is practiced on the swampy paddy fields of very limited area along the small streams. These present cropping patterns are illustrated on Fig. V.2.3.

2.5 Farming Practices

The paddy cultivation is carried out by labour intensive form from the stage of seedling to harvesting. All the members of family contribute their labour to rice farming. Animal power, mainly oxen and buffaloes, is extensively used for land preparation. The use of agricultural equipment is not common.

The new high yielding varieties have been introduced in the area through the Lappo Ase Paddy Intensification Programme, 1980/1981, carried out by BIMAS Building Board and BIMAS Executing Boards cooperated with the Goverorment. The major varieties introduced are IR32 and IR42, which are medium matured varieties with growth period of 140 days per crop, and IR28 and IR36, which are early matured varieties with growth period of 115 days per crop. These new varieties occupy about 50 to 70% of the paddy fields. The local varieties are still used mainly for home consumption.

Paddy seeds are selected from last harvest or are supplied from the seed centers. Paddy seeds are generally sown at the rate of 25 to 30 kg per ha on the nursery which is prepared in the size of about 1/20 to 1/25 of the paddy field to be transplanted. The seedlings are generally grown for 20 to 25 days.

The land preparation, ploughing and harrowing are made before transplanting by using animal power. Puddling is also carried out immediately after sufficient water become available. Transplanting is generally carried out by hand. The random transplanting is common and number of seedlings (hills) for transplanting is generally not many, being 10 to 18 per m^2. After transplanting, weeding is practiced one or two times by hand for each cropping season.

The use of fertilizer and agro-chemicals is generally low in the study area except for the limited area under the BIMAS program. The average dosages of the BIMAS package are 100 kg of urea, 50 kg of T.S.P, 2 liter of insecticide and 2 kg of rodenticide per ha. Potasium fertilizer is not generally used. Fertilizers are generally broadcasted by hand. Insecticide is applied to the field by use of knapsack type sprayers.

Harvesting is generally practiced in two methods depending on the varieties; one is the method of cutting all straws using sickles, which is applied for new high yielding varieties, and the other is the traditional method for local varieties, so-called "ani-ani", cutting only

panicles. The harvested paddy is dried on the ground surface of the paddy field and/or near the houseyards.

The cultivation method of polowijo and upland crops is very primitive. Neither fertilizers nor improved varieties are used. On about 50% of the upland fields inter-cropping with maize and groundnuts is practiced.

The farm inputs and labour requirements for cultivation of paddy, polowijo and upland crops under present condition are estimated on the basis of statistical data collected and results of the farm economy survey, and are shown in Table V.2.8.

2.6 Present Crop Yield and Production

The crop yield and production under present condition are estimated on the basis of production data at Desa level obtained from four Kecamatan offices. These data indicate that the crop yield and production largely fluctuate year by year due to wide variation of annual rainfall and unexpected damages caused by drought, insects and diseases. The crop yields and production under present condition are therefore estimated to be average from 1977 to 1981.

The average unit yield of paddy (dried paddy) during recent 5 years is 2.23 ton/ha for wet season paddy and 2.50 ton/ha for dry season paddy. In 1981, the Lappo Ase programme was operated on about 4,700 ha or about 50% of the paddy fields under rainfed condition within the boundaries of Desa under study. The average unit yield obtained through the Lappo Ase programme was 3.5 to 4.0 ton/ha. This spectacular increase was not only due to the Government special effort but also sufficient and well distributed rainfall during the wet season of 1981.

The unit yields and production of polowijo and upland crops also fluctuate year by year and place by place, depending on availability of water. Since no farm inputs like fertilizers and agro-chemicals are used, unit yields are generally low. The average unit yields of polowijo and upland crops are 0.73 and 0.59 ton/ha of groundnuts, 0.40 ton/ha of greenbeans, 0.63 ton/ha of maize, 5.96 ton/ha of cassava and 3.26 ton/ha of sweet potato.

Crops	Harvested Area	Unit Yield	Production
	(ha)	(ton/ha)	(ton)
Paddy	6,590		14,900
Wet season paddy	5,840	2.23	13,020
Dry season paddy	750	2.50	1,880
Polowijo Crops	1,750		1,250
Groundnuts	1,670	0.73	1,220
Greenbeans	80	0.40	30

Crops	Harvested Area	Unit Yield	Production
	(ha)	(ton/ha)	(ton)
Upland Crops	4,340		4,400
Maize	2,470	0.63	1,560
Groundnuts	1,440	0.59	850
Cassava	220	5.96	1,310
Sweet potato	210	3.26	680

The detailed crop production data during recent 5 years in the study area are given in Tables V.2.9 (unit yield of paddy), V.2.10 (annual paddy production), V.2.11 (polowijo crop) and V.2.12 (upland crops).

2.7 Livestock Production

Livestock raising is not a mainline of agricultural activities in the study area. The number of livestock animals within the boundaries of Desa under study is as follows (for details, see Table V.2.13):

(Unit: head)

Livestock	Total Number	Per Farm Household
Cattle	12,200	1.95
Buffalo	5,220	0.83
Horse	2,540	0.41
Goat	870	0.14
Fowl	26,710	4.26
Duck	2,350	0.38

Most of livestock are generally grazed on grassland and/or the paddy fields after harvest. No special feeding to them is practiced.

The livestock plays an important role in farm operation and transportation as motive power, and also in protein food supplies. The livestock products are used for home consumption and also are sold from time to time to meet special expenses. Annual income from livestock is, however, of little significance to the Project. It will be excluded from project economy.

2.8 Marketing and Prices

For the estimation of marketable surplus paddy in the study area, the balance of surplus and deficit is examined on the basis of following assumption.

(1) Annual production of dried paddy is estimated based on the average from 1977 to 1981.

(2) Annual per capita consumption is assumed to be 230 kg of dried paddy.

(3) Handling and storage losses of paddy are taken at about 5% of the total production.

(4) Seed stock is taken at 35 kg per ha.

(5) Feed of livestock is taken at about 2% of total production.

The total annual production of paddy is estimated at about 14,900 tons. The marketable surplus amount of dried paddy is estimated at 4,740 tons, after deducting 8,840 tons of the home consumption, 740 tons of the handling and storage losses, 280 tons of the seed stock and 300 tons of the feed of livestock. The surplus and deficit of paddy in the study area are shown in Table V.2.14.

The surplus of paddy produced by the farmers is generally sold to KUD and/or middle men through brokers. The paddy collected by KUD is sold to DOLOG after milling, while the paddy collected by middle men is generally transported to outside of the study area. About 86% of surplus paddy is marketed through these two channels. The remaining 14% of the surplus paddy is sold at local markets in and around the study area by small brokers and/or directly by farmers. Marketing flow of rice are shown on Fig. V.2.4.

There are 3 major marketing centers in and around the study area. The most important centre is Tana Batue, Desa Swadaya located on the main provincial road connecting Ujung Pandang, Pare-Pare and Watanpone. According to the CIDA estimate/1, about 60% of the outflow of agricultural commodities in and around the study area are traded through this market centre. The second market centre of importance is Palattae, capital of Kecamatan Kahu. This centre has about 30% share of the outflow of agricultural commodities. The third market centre having about 10% of share is Camming, the capital of Kecamatan Libureng, located in the northern part of the study area.

The present low production and poor quality of polowijo and upland crops has resulted from poor marketability together with large fluctuation of market prices. Most of these surplus crops such as groundnuts and greenbeans are traded by middle men, and directly sold at local market by farmers.

The price of rice is generally controlled by the Government through DOLOG. In 1980/81, the floor price of milled rice is set at Rp.175/kg and the ceiling price at Rp.190/kg. When the market price is down under the floor price, DOLOG purchases the marketed rice and when the price is over the ceiling price, DOLOG sells its stocks. The retail prices of major crops both in South Sulawesi Province and Kabupaten Bone are shown in Table V.2.15 and illustrated on Fig. V.2.5. The present farm gate

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Remarks: /1: Project Design for the Integrated Rural Development of the Sanrego Area, Mission Report and Work Plan Dec. 1981

prices of the farm products and farm inputs in the study area are estimated as shown in Table V.2.16, and summarized as follow:

(Unit: Rp/kg)

Crops	Price	Crops	Price
Dried paddy	85	Maize	70
Groundnuts	260	Cassave	65
Greenbeans	205	Sweetpotato	85

2.9 Present Agricultural Production Value

The crop production cost under present condition was estimated on the basis of data obtained from Agriculture office of Kabupaten Bone and confirmed through the farm economy survey carried out in and around the study area.

The crop production cost comprises the expenses for (1) farm inputs like seeds, fertilizers and agro-chemicals, (2) labour (mainly family labour) and (3) indirect expenses for depreciation for farm houses, farm tools and equipment, interest on capital investment, taxes, etc.

The present crop production cost per hectare for each crop is estimated at about Rp.130,000 for paddy, Rp.84,000 for polowijo crops and Rp.76,000 for upland crops, respectively, as shown in Tables V.2.17, V.2.18 and V.2.19.

The gross crop production value under present condition is estimated at Rp.2,064 million (US$3.1 million) as a whole in the study area as shown below:

Crops	Annual Production (tons)	Unit Price (Rp/kg)	Production Value (10^6 Rp)
Paddy	14,900		1,267
Wet season paddy	13,020	85	1,107
Dry season paddy	1,880	85	160
Polowijo Crops	1,250		324
Broundnuts	1,220	260	317
Greenbeans	30	205	7
Upland Crops	4,400		473
Maize	1,560	70	109
Groundnuts	850	260	221
Cassava	1,310	65	85
Sweet potato	680	85	58
Total	-	-	2,064

The crop production cost under present condition totals Rp.1,438 million (US$2.1 million), as summarized below:

Crops	Planted Area	Unit Production Cost	Total Production Cost
	(ha)	(Rp/ha)	(10^6Rp)
Paddy	7,920		1,000
Wet season paddy	7,120	125,000	890
Dry season paddy	800	138,600	110
Polowijo Crops	1,750		168
Groundnuts	1,670	97,000	162
Greenbeans	80	70,000	6
Upland Crops	4,340		272
Maize	2,470	42,000	104
Groundnuts	1,440	91,000	131
Cassava	220	83,000	18
Sweet potato	210	89,000	19
Total	-	-	1,440

The annual net production value under present condition within the boundaries of Desa under study is then calculated at Rp.624 million (US$0.9 million) in total, be deducting the total production costs from the total gross production value. The details of calculation are given in Table V.2.20.

3. AGRICULTURAL SUPPORT SYSTEM

3.1 General

The South Sulawesi Province, one of the 27 provinces in whole Indonesia, is administratively divided into 21 Kabupaten (Districts) and 2 Kota Madya (Municipalities), headed by "Bupati" and "Walikota", respectively nominated by the Governor of the Province. These Kabupaten and Kota Madya are subdivided into 169 Kecamatan (Sub-districts) headed by "Camat" nominated also by the Governor. Under the Kecamatan, there are 1,136 Desa (Villages) which are the basic units of administrative structure in Indonesia. One Kecamatan covers about 7 Desa on an average in South Sulawesi Province.

The village chief (Kepala Desa), elected from among the people in the village every five years, has the responsibility of carrying out the following function under supervision and guidance of respective governmental authorities concerned.

(1) Agricultural development

(2) Public health and sanitation

(3) Public education

(4) Village welfare and security

(5) Encouragement of industries and co-operative, and

(6) Construction, maintenance and repair of public transportation facilities.

The Kabupaten Bone where the study area entirely covered, has 21 Kecamatan and 205 Desa. In the study area, 4 Kecamatan and 14 Desa are included.

3.2 BIMAS/INMAS and Lappo Ase Program

3.2.1 BIMAS/INMAS Program

As for the agricultural development, the agricultural intensifications programs has been promoted by Indonesian Government in the irrigated area in order to facilitate production increase with coordination of all the effort of agricultural support services so as to provide as a "package" of agricultural inputs to the farmers since 1963.

The food plant intensification which is carried out by using the financial aid from the credit package prepared by Indonesia People Bank (BRI) is called BIMAS (Bimbingan Massal) and the intensification which does not use the BIMAS credit facilities is called INMAS (Intensifikasi Massal).

Since 1973, for further development of BIMAS and INMAS Programs, the Government has initiated to organize a village unit (Wilayah Unit Desa) as the lowest executive unit of the Programs.

According to the Presidential Decree No. 4, 1973, the aims of establishing the village unit area: (a) to assure the realization of agricultural product increasing program, particularly food production effectively and efficiently, and (b) to give the certainty to producer farmers in particular and village community in general, that they have the responsibilities not only to take part in increasing the said production but also to raise their living standard and welfare. Each village unit generally comprises 2,000 farmers in 6 villages, with 600 to 1,000 ha of irrigated paddy field.

To adjust the National BIMAS conception the following functions have been set up to serve the certain services:

(1) At least one Field Extension Worker (PPL) equipped with information appliances in order to diffuse the necessary information to the farmers in the village unit concerned.

(2) Village unit branch of Indonesia People Bank having the main function of BIMAS credit service within its service area that may consist of more than one village unit area.

(3) KIOSK of village unit assigned to distribute farm inputs such as seeds, fertilizer, agro-chemical, farm machinery and tools, etc.

(4) BUUD/KUD (Village Unit Executive Body/Village Unit Cooperative) having the function of processing and marketing of agricultural product. The BUUD is established as an economic institution in the form of co-operative which may constitute joint undertaking merger of agricultural co-operative found in the village unit area at its initial stage of growth, and be merged in one village unit co-operative (KUD) under the regulation of Ministry Manpower, Transmigration and Co-operative in a certain period of time according to its progress.

Following to the direction of the policy, the Provincial Government has been initiated to establish the village units with other related institutions covering whole province since 1973. Total number of village units in the Province is 620 in 1979.

In order to further promote the BIMAS/INMAS programs, Special Intensification Program (Intensifikasi-Khusus) so-called "INSUS" has been launched since 1979. The INSUS program is a special form of BIMAS for farmer's groups which are voluntary organized by progressive farmers. There is no special BIMAS package for the farmer's groups under INSUS program. Each farmers group can decide and apply any form of package with the advice of PPL, who visits the farmer's group once a week.

In the study area, there are 3 village units with 1 BUUD/KUD, 13 KIOSK and as shown in Table V.3.1. As compared with the said general standard of village unit in the study area is far exceeded on size, however on the aspect of functional institution, it has much rooms to be developed.

The area served by the BIMAS/INMAS programs in the study area are estimated at about 825 ha and 985 ha, respectively in 1982 as shown in Table V.3.2. Amount of BIMAS package for paddy and polowijo is given in Tables V.3.3 and V.3.4. About 27 farmer's groups have been organized and about 75 farmers or 10% of the member are served by INSUS program. This very low coverage in comparison with about 50% of the whole Indonesia in 1979/1980 is mainly due to very fact that there are few notable technical and semi-technical irrigation facilities and in sufficient agricultural supporting services in this area.

3.2.2 Lappo Ase Program

Lappo Ase Program is the one of the agricultural supporting program in South Sulawesi in order to increase rice production especially on rainfed paddy field area. This program is controlled under the Ministry of Agriculture. Lappo Ase means pile of paddy or abundantly paddy production. Operation of Lappo Ase in planting season 1981 at South Sulawesi was executed based on South Sulawesi Governor's Instruction No. 521/352/Ekon dated Jan. 20, 1981. As a special activity in executive structure organization of Lappo Ase Program also have been formed a special unit called Pimpinan Harian or Daily Manager helped by assistant. The organization chart of Lappo Ase Program is illustrated on Fig. V.3.1.

The main purpose of this program is to increase of rice production especially on rainfed paddy field area. Under this program, new improved varieties like IR36, IR42 and IR50 were introduced to the area with a well sophisticated package including fertilizers and agro-chemicals and a credit plan making the package available to all the participant farmers. The technical assistance was also intensified to make the program more effective.

In 1981, operation area comes under 3 Kabupatens, Bone Sinjai and Bulukumba. The operation area covered about 4,700 ha or about 60% of the total planted paddy field in the study area. About 5,300 farmers take part in this operation. This new program has given great effort in increasing of rice production. Before Lappo Ase Operation the production is about 12,000 tons and in Lappo Ase Operation production increase to 17,400 ton. This is caused by the increasing of unit yield from 2.5 ton/ha to 3.7 ton/ha as shown in Table V.3.5. This spectacular increase was not only due to the government special effort but also rainfall during the monsoon was sufficient and well distributed and the response of farmers to this undertaking was unexpectedly high.

Under this program, a farmer gets a package of subsidized inputs with credit from the Government through Indonesia People Bank (BRI). This operational fund has two sources. One is the BIMAS Project Fund for 1981/1982 and the second is President Supporting Fund based on Kepres No. 019/B/1981 dated March 31, 1981. This Supporting Fund amounts to Rp.83,110,000. Total credit in the study area amounts to Rp.139,784,000 as shown in Table V.3.6. The farm inputs recommendation for this operation is given in Table V.3.7.

3.3 Research

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

The Research Institute usually undertake the experimental works and collect the information concerning technical problems on agricultural matters from farmers through several experimental farms scattered over their commanding areas. These branch stations also produce the foundation seed of newly recommended varieties of main crops.

The Maros Research Institute for Food Crops (MARIFC) is located at Maros, about 40 km north from Ujung Pandang. This MARIFC has 146 ha of experimental fields of which 110 ha are for rice experimental fields. About 40% of experimental works are devoted to the experiment of rice such as variety test, fertilizer test and test for control of pests and disease on irrigated paddy. For the execution of experimental works, about 60 senior technical staff are engaging with 220 personel including administrative staff under the technical assistance of the International Rice Research Institute, Philippines.

The MARIFC is playing an important role in technical aspect of increase of rice productivities through BIMAS Technical Team consisting of the expert from Hasanudding University, Provincial Agricultural Extension Service and South Sulawesi Branch Research Station.

There are 2 branch experimental stations under the control of the MARIF. One is located at Lanrang, Kabupaten Sidrap and is mainly carrying out the rice experiment with 44 ha of irrigated paddy field. The other located at Gowa, is mainly undertaking upland crops such as maize, sorghum, groundnuts, etc.

3.4 Extension Service

In order to promote and accelerate the agricultural extension education activities on field level by separating extension service with general agricultural administrative services, the Agricultural Extension Service Development Program has been launched in Indonesia since 1974. In the Central Government, the Agency for Agricultural Education, Training and Extension was established as one of the extra-ministerial bureaus under the Ministry of Agriculture. At the same time, in the provincial level, the establishment of the Agricultural Development Center (ADC) has been promoted with the provision of functions of adaptation tests of new agricultural techniques recommended by research institutions and in-services training for field extension workers. In the Kabupaten level, several Rural Extension Centers (REC) have been established as a base camp for extension education activities with functions of preparation of extension program, dissemination of agricultural information and training for leading farmers at the local level.

Following the basic policy, the Agricultural Extension Service Development Program in South Sulawesi has also been developed year by year since 1974. Although an Agricultural Development Center is not formally decided yet, the Rural Extension Centers have already commended their daily works.

As illustrated on Fig. V.3.2, the organization of Agricultural Extension Service in South Sulawesi is formed by two separate lines, i.e. administrative line and operational line under the supervision of inspector of Provincial Agricultural Extension Service. The subject-matter specialist (PPS) staying in each Kabupaten assists and advises about 10 Extension Supervisors (PPM) of which 2 to 4 are working in Kabupaten office and the rests are staying in the Rural Extension Centre (BPP) and they assist and advise about ten (10) field extension workers (PPL).

The main activities of extension workers are to deliver the new technological guidance and, to help the farmers in solving their problems by visiting the farmers group regularly and periodically. EVery field extension workers are requested to visit a farmers group in each extension area once a week. There are 16 extension areas under each village unit. The extension workers visits 4 extension areas a day and whole 16 areas during 4 days from Monday to Thursday every week, and receives training on Friday and Saturday. This system is called T.V. system (Training and Visit system).

The greater part of the study area is under the BPP Palattae. The remainder part in Kecamatan Tonra is under BPP Mare. Total members of PPM & PPL under BPP Palattae and BPP Mare are 4 and 16, respectively, and in the study area covered 3 village units and 112 key farmers, as illustrated on Fig. V.3.3.

Taking the future agricultural development into consideration, after the completion of irrigation facilities, the irrigated paddy field will need high techniques of rice cultivation. The present Rural Extension Service office in Palattae will be extended and some additional housing and vehicles will be required.

3.5 Seed Multiplication

The government of Indonesia has placed particular emphasis on the improvement of paddy since the beginning of BIMAS program in 1963. The provincial seed center located at Maros about 40 km north from Ujung Pandang is only one institute which produces stock seeds of new recommended varieties of paddy in South Sulawesi. The foundation seeds supplied from the Central Research Institute for Food Crops (CRIFC) are multiplied to the stock seed at this Center. The seed center distributes these stock seeds to 37 seed stations managed by each Kabupaten office.

There is one seed station in Kabupaten Bone located at Bengo. This seed station has 10 ha of paddy field manage by a technician and his assistants. This station produces the extension seeds and distributes them to 8 seed growers covered about 30 ha of paddy and 20 ha of polowijo crops field in 1981/1982. The seed growers produce paddy seeds and supply them to the farmers through BUUD/KUD according to the BIMAS/INMAS program. New varieties of IR42 and IR52 are introduced to Kabupaten Bone in 1981/1982 and these varieties are used more than 50% of total paddy fields.

3.6 Agricultural Credit

The Indonesia People's Bank (BRI-Bank Rakyat Indonesia) is the state bank specialized in agricultural credit covering whole country and has a broad network composed of many regional offices, branch offices and sub-branch offices (village unit BRI). The bank is authorized to finance BIMAS package credit for farmers. There are several kinds of BIMAS packages. The credit amount is fixed for each BIMAS package. The loan condition is fixed at the interest rate of 1% per month and the repayment period of 7 months.

In the study area, there are 1 branch office and 4 sub-branch offices of the Indonesian People's Bank (BRI). The loan amount for BIMAS package has steadily increased and it exceeds about Rp.35 million in 1982 in the command area of said 4 sub-branch offices as shown in Table V.3.8.

3.7 Farm Inputs Supply

Distribution of fertilizers is handled by PT. PUSRI and agro-chemical is handled by PN. PERTANI, the government enterprise in the South Sulawesi Province. According to the BIMAS/INMAS programs, fertilizers and agro-chemicals are supplied to 4 sub-distributors appointed by PT. PUSRI at Ujung Pandang and then necessary amounts of such farm inputs are transported by sub-distributors to the retailers and/or KUD at the local level.

The distribution prices of these agricultural inputs are controlled by the Government. Distribution prices of Urea and TSP to the farmers are fixed at Rp.70/kg and the agro-chemicals at Rp.1,230/lit in 1981/1982.

3.8 Farmers Cooperatives

Farm inputs supplies, processing and marketing of farm products are primarily made through the establishment of cooperatives which have been promoted by the Government through the Cooperative office in each Kabupaten since 1945 when the Cooperative Acts in Indonesia was enacted. In spite of Government efforts, however, the cooperative movement has not been well development mainly because of weakness in management and shortage of operational fund.

In order to improve such stagnant condition of cooperative movement, establishment of Village Unit Cooperative (KUD) has been promoted since 1973 when the President Decree for Village Units was enforced, as previously mentioned.

The main activities of this organization are to purchase the farm products directly from farmers and to re-sell those to DOLOG. The other activities of BUUD/KUD are the supply of necessary inputs such as improved seeds, fertilizers, agro-chemicals, some farming instruments, and the marketing of farm products.

In the study area, 1 KUD has been organized so far and total number of KUD members including candidates is about 15. The main processing facility owned by BUUD/KUD is rice mill. The number of rice mill is counted for 65 and most of the rice mill have small capacities.

4. RESULT OF PADDY YIELD SURVEY

4.1 Method of Paddy Yield Survey

The paddy yield survey was carried out during the period of August 23 to September 10, 1982 to identify the defects hampering the increase of paddy yields under present condition. The paddy sampling was made for wet season paddy at 32 sites of paddy fields in total, of which 22 samples were taken from the rainfed paddy field area and 10 samples from the Maradda semi-technical irrigation area.

The varieties of paddy samples were IR42 and IR36, the dominant varieties in the study area. About 80 - 120 hills were harvested at random at each sampling site. The average number of panicle per hill for the sample hills was calculated and about 20 hills were taken, as the

representative hills, from the hills which have the nearest number of panicles per hill to the average value. The panicles of selected 20 samples were then separately cut off and only the panicles of each sample hill were weighed, and the average weight was computed. Out of 20 sample bundles of panicles, 3 samples which have the nearest weight to the average, were selected for laboratory analysis.

In the laboratory, the paddy samples were analyzed in accordance with the method described in "Rice Cultivation for the Million/1", and the following yield components were determined:

(1) number of hills per m^2

(2) number of panicles per hill

(3) number of grains per panicle

(4) percentage (%) of ripened grains

(5) 1000 grain weight

In the laboratory, the representative hills taken from the sampling site were threshed by hand and all the rachis-branches were removed. The grains thus obtained were dried for 2 days under the shade. The dried grains were then put into a salt solution with 1.06 specific gravity and stirred for 1 min. By this operation, the grains are well divided into two groups, i.e., a floating group and a sunken group. All the sunken grains can be taken as fully ripened grains and all the floating grains as non-ripened grains.

The floating grains were scooped out with net spoon and dried and counted. The sunken grains were also counted after taking them out of the salt solution by transferring the solution to another vessel by using a sieve and washing them well with water. Then, the number of grains per panicle was calculated by dividing the total number of grains, which is the sum of the number of floating grains and that of sunken grains, by the total number of panicles of the representative hills.

The percentage of ripened grains is easily calculated by dividing the number of sunken grains by total number of grains.

It is considered that all the sunken grains represent the actual yield. The sunken grains were well dried upto the moisture content of 14% under the sun. The dried grains were then accurately weighed. The 1,000 grain weight was calculated by dividing the weight of dried grains by the total number of sunken grains. The grain yield of rice is the product of these yield components. The unit yield is expressed by the following equation:

Unit Yield (ton/ha)

= Number of hills per m^2

Remarks: /1: S. Matsushima, Rice Cultivation for the Million, Japan Scientific Societies Press, 1980

x Number of panicles per hill

x Number of grains per panicle

x Percentage of ripened grains

x 1,000 grain weight

÷ 1,000 (conversion to one grain weight)

x 10,000 (conversion to yield per ha)

÷ 1,000,000 (conversion to metric ton in weight)

4.2 Results of Paddy Yield Survey

The result of paddy yield survey and analysis carried out by the Team in August/September, 1982 (wet season paddy) are given in Table V.4.1. The paddy yield survey for the Saddang Irrigation Project area made by the JICA Feasibility Study Team for the Bila Irrigation Project in August/September 1981 (wet season paddy) is also summarized in Table V.4.2.

The Sadang Irrigation Project, covering Kabupaten Pinrang and Sidrap, is a well-known irrigation project, sponsored by PROSIDA, where modern irrigated rice farming has been practiced under full guidance of agricultural extension workers. The farmers in this area annually occupy the top ranks in the paddy yield contests of the South Sulawesi Province. Examining the paddy yield in the Sadang area makes it possible to detect more clearly the defects of present paddy cultivation in the Sanrego area and also to collect the basic data for estimating the future paddy yield with the project. The results of yield survey carried out by the Master Plan Team in March/April, 1978 (dry season paddy) are also given in Table V.4.3.

The grain yield of rice can be increased through improvement of defects involved in each yield component. In order to find the defects of the present paddy yield, the relation between unit yield and each of yield component was examined, (see Fig. V.4.1 and V.4.2). There is a clear correlation between unit yield and number of grains per m^2 (nos. of hills per m^2 x nos. of panicles per hill x nos. of grains per panicle) for both wet season paddy and dry season paddy. While, there is no correlation between unit yield and other yield components. Only percentage of ripened grains is generally low. The most important factors for increase of paddy yield in the study area are twofold i.e., the number of grains per m^2 and percentage of ripened grains. In general, the percentage of ripened grains under normal condition should be more than 80%. For improvement of rice cultivation, attention should be first given to the increase of this percentage.

The percentage of ripened grains is generally determinated during the period from the neck-node differentiation stage to the time 30 days after heading. Therefore, the causes for low percentage of ripened grains must have resulted from the some defects occured during this period. The shortage of available water during this period is the main reason for low percentage of ripened grains. The methods for increasing the percentage of ripened grains are:

(1) to create favourable condition during the period from initiation of youg panicles to heading,

(2) to prevent the production of an excessive number of spilelets,

(3) to make the rice plant head at the optimum time when good weather lasts for 15 days before heading and 20 days after heading,

(4) to apply nitrogenous fertilizers at full heading stage,

(5) to reduce damages caused by drought, flooding and diseases and pests after heading,

(6) to prevent the rice plant from lodging,

(7) to make the plant ripen before wet season starts (dry season paddy), and

(8) to select the varieties which yield a high percentage of ripened grains.

In the Sanrego area, the number of grains per m^2 is positively correlated with the unit yield as shown in Fig. V.4.3, and it is generally low compared with those in the Sadang area:

Yield Component	Sadang	Sanrego	
		Harrada	Rain-fed
(1) Nos. of hills per m^2	20.4	19.9	18.1
(2) Nos. of panicles per hill	18.3	17.2	13.0
(3) Nos. of grains per panicle	101.9	66.8	67.8
Nos. of grains per m^2	37,538	22,864	15,953

The most decisive factor is the number of grains per panicle, which is generally determined during the period of 25 days before flowering. Any conditions during other growth periods do not affect spikelet number per panicle. The unfavourable conditions, like shortage of available water, lack of fertilization and too high temperature and low solar radiation during the period of 25 days before flowering make the number of spikelets low. The proper water management, fertilization and cropping schedule, considering the stage of plant growth, should be the key to increase the number of spikelets, and thereby to increase the unit yield.

The other yield component, the number of hills per m^2 could also be increased by dense planting. The regular planting with a space of 30 cm x 15 cm, which is recommended under the INSUS programme, will increase this number up to 22.2 hills per m^2. The another yield component, the number of panicles per hill is determined in early stages of plant growth, generally before maximum tiller number stage, and the measures to increase the number of panicles per m^2 are:

(1) to raise the healthy seedlings,

(2) to apply basal fertilizers before transplanting,

(3) to transplant in shallow depth, and

(4) to surpress the non-bearing and late-emerging tillers.

The problem is how the number of grains per m^2 can be increased without lowering the percentage of ripened grains. Reduction of emerging non-productive tillers is the key to solve this problem. The generation of non-productive tillers can be minimized by drying practices and proper fertilization, considering stages of plant growth.

The general guideline for improvement of rice cultivation is given in Fig. V.4.4. The detailed explanation on proposed rice cultivation is given in Chapter 6.

5. SELECTION OF CROPPING PATTERN

5.1 Basic Principle

Following the completion of the Sanrego Irrigation Project, most of the existing rainfed paddy fields will be up-graded to the technical irrigation paddy fields and more intensive use of the farmland will become possible. The adequate supply of irrigation water will lead to certain changes of crops and cropping patterns within the project area. It is difficult, however, to forecast how the farmers will change their cultivation pattern of crops. Despite differences of opinion, the following basic principles which govern the selection of crops and cropping patterns under the project, have been generally accepted among the authorities concerned:

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

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

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

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

5.2 Selection of Crops

In due consideration of the basic principles described above, rice and polowijo crops including groundnuts and greenbeans, are selected in making alternative cropping patterns as the major crops.

(1) Rice

Rice is the most profitable crop, among other possibly grown crops, under present economic situations. The farmers have long experience for

rice cultivation and are likely to master the irrigated rice cultivation and to realize the maximum irrigation benefits under the project. As Indonesia is still rice import country, the increase of rice production will possibly contribute to foreign exchange saving.

(2) Polowijo Crops

Most of polowijo crops do not require much water compared with rice. The growth periods are relatively short. The polowijo crops could be grown in between two crops of paddy. The present low production of polowijo crops has resulted from poor marketability together with large fluctuation of market prices. Such poor marketability is mainly due to poor quality of product. Generally, groundnuts and greenbeans, are profitable and have large market outlet if quality is good enough. After completion of the project, the polowijo crops could also be grown under the irrigated condition with proper farming practices and therefore it is anticipated that the best quality products are produced.

5.3 Alternative Cropping Patterns

In order to determine the most optimum cropping pattern, four (4) alternatives are considered as follows:

(1) Pattern A: Double cropping of paddy a year

(2) Pattern B: Wet season paddy and a combination of paddy and polowijo crops in the dry season

(3) Pattern C: Three crops of paddy and two of polowijo crops in 2 years

(4) Pattern D: Two crops of paddy and three of polowijo crops in 2 years

These four (4) alternative cropping patterns are illustrated on Fig. V.5.1. These alternative cropping patterns are prepared under careful studies on climatic condition, agronomic requirement for farming practices and seasonal water availability.

The pattern A is double cropping of paddy using early matured varieties with growth period of 115 days per crop like IR36, IR28 and IR50. The pattern B is same as pattern A except in the dry season cropping include the polowijo to a same extent. The patterns C and D are prepared with a view to make the maximum use of available land and water and include a polowijo cropping during the transitional period from September to November.

5.4 Selection of Irrigation Area

(1) Irrigable area

For determination of the most optimum cropping pattern, water balance study was firstly made through the water requirement calculation for each alternative pattern and assessment of the available water resources.

According to the result of water balance study made on the basis of the Sanrego river flow and three majors tributaries, the maximum irrigable areas for each pattern with 80% dependability are:

(Unit: ha)

	Wet Season Pattern	Dry Season Paddy	Polowijo Crops	Cropping Intensity (%)
Pattern A	8,000	4,000	-	150
Pattern B	8,000	3,000	3,000	175
Pattern C	8,000	2,300	6,400	210
Pattern D	8,000	-	10,400	230

The details of water balance study are given in ANNEX-VI.

(2) Available labour force

In order to estimate the availability of labour under with-project condition, the total workable population in the year of 1990 is forecasted, using the present demographic data, to be about 25,600, comprising 12,100 of male and 13,500 of female. The estimated workable population is then converted into an adult-man equivalent by using the factors, 0.90 for a male and 0.75 for a female between 15 - 49 years of age. The total workable population in adult-man equivalent as of 1990 is thus estimated at about 21,000 which provides of 3.12 man-day per household or 905 man-days per household in 290 work days per year, and is summarized in Table V.5.1. The estimated workable population in 1990 shows 58% increase from 1980 figure of 13,300 which correspond to an average of 1.97 man-day or 570 man-days per year per household.

According to agricultural statistic in each Desa concerned, the average area cropped per household is 2.36 ha consisting of 1.42 ha for paddy, 0.40 ha for upland crops and 0.54 ha for orchard. The labour requirement for these cropping practices is around 235 man-days per year per household. In addition, about 60 man-days for herding and approximately 160 man-days for household work are used on an average. The present labour requirement is therefore approximately 455 man-days per year in total per household, leaving presently 115 man-days idle per household. In forthcoming 1990, the workable population would increase and, if the project would not be realized and/or present economic situation would not significantly change, about 450 man-days per year would become idle per household.

The available labours force for paddy cultivation, both on irrigable and rainfed paddy fields, is estimated at about 2.19 man-day per household, by deducting 0.93 man-day of the labour requirement for farm operations on upland and orchard and for household work and herding from 3.12 man-day of the forecasted total workable labour force, as shown in Table V.5.2. The available labour force for 8,000 ha of irrigable paddy field with project condition is estimated at 1.63 man-day per ha by deducting the labour requirement for rainfed field.

The labour balance study was made on the basis of the available labour force thus estimated, on the assumption that there is no possibility to increase the workable population from the outside of the area due to almost same farming patterns adopted in the surrounding areas. The peak labour requirements per ha are calculated at 1.61 man-day for Pattern A, 1.62 man-day for Pattern B, 1.80 man-day for Pattern C and D. The details of labour balance study and the potential maximum area under each alternative cropping pattern are shown on Figs. V.5.2 and V.5.3, and summarized as follows:

Alternative	Peak Labour Requirement	Maximum Adaptable Area
	(man-day/ha)	(ha)
Pattern A	1.61	8,000
Pattern B	1.62	8,000
Pattern C	1.80	6,500
Pattern D	1.80	6,500

The present extensive farming practices, with low inputs and therefore low output, would be changed to intensive one under irrigated condition. As the total cultivation areas would not change even in future, the unit available labour force per ha under the project would, therefore, depend on the scale of the project area. If the project area is fixed at smaller scale, intensive cropping will become possible. On the contrary, if the project area is maximized upto the potential maximum area of about 8,000 ha, only the pattern A and pattern B, are practicable with the forecasted available labour force.

Based on these maximum irrigable areas for each pattern, comparative study was made on profitability for each alternative.

5.5 Selection of Proposed Cropping Pattern

The profitability of each pattern, calculated by net production value per ha annum, is shown in Table V.5.3. The labour requirement for each alternative pattern is estimated on a 10 day basis and compared with available labour force of the average size farmer. The results are given in Fig. V.5.3. Water requirement for each pattern is estimated as total farm water requirement per ha per annum under same assumption given in ANNEX-VI. The results of the comparative studies are summarized as follows:

Alternative	Cripping Intensity	Profitability	Labour Requirement	Water Requirement
	(%)	(10^3Rp/ha)	(man-day/ha)	($10^3 m^3$/ha)
Pattern A	150	1,122.6	217.4	13.8
Pattern B	175	1,110.4	231.8	13.9
Pattern C	210	1,129.7	251.8	14.5
Pattern D	230	1,021.6	253.6	13.4

The Pattern C is the most profitable followed by Pattern A and Pattern B. The Pattern D is less profitable.

The unit net production values per man-day of labour and per m^3 of irrigation water are calculated for each alternative pattern, as shown below:

Alternative	Unit Profitability	
	Labour	Water
	(10^3Rp/man-day)	(Rp/$m^3$of water)
Pattern A	5.16	81.3
Pattern B	4.79	79.9
Pattern C	4.49	77.9
Pattern D	4.03	76.2

The pattern A will create the largest economic returns from unit irrigation water to be supplied by the project and also from the unit labour to be spent for farming works under the project.

The possible total net production values for each alternative pattern are also calculated on the basis of the maximum adoptable areas. 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-climatic data, is illustrated on Fig. V.5.4.

The framework of cropping calender is designed so as to expand the irrigable area as much as possible through the water balance study. The comparative study result is shown below:

The framework of cropping calender is designed so as to expand the irrigable area to the utmost through the alternative study on the water balance calculation during 9 years between the available water and the diversion water requirement. The beginning point of the cropping calender is shifted every 1/3 month for each alternative. The results of alternative study indicate that the proposed cropping calender is the best selected to maximize the irrigable area with the available water

in the project area. The irrigable area with the available water from the Sanrego river for each alternative is listed as below:

	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7
Wet Season Paddy Average Value	7,100	8,000	7,700	7,400	7,100	6,700	5,700
Dry Season Paddy Average Value	3,200	4,200	4,600	5,000	5,200	5,500	5,200
Total	10,300	12,200	12,300	12,400	12,300	12,200	10,900

where, Case 1: BP of Cropping Calender, +1 month to Proposed one
Case 2: BP of Cropping Calender, +2/3 month to Proposed one
Case 3: BP of Cropping Calender, +1/3 month to Proposed one
Case 4: Proposed Cropping Calender
Case 5: BP of Cropping Calender, -1/3 month from Proposed one
Case 6: BP of Cropping Calender, -2/3 month from Proposed one
Case 7: BP of Cropping Calender, -1 month from Proposed one

6. PROPOSED FARMING PRACTICES

Proper irrigation farming is the most essential factor for the realizing the full exploitation of agricultural potential in the Project area. The proposed farming practices for the proposed cropping pattern (Pattern A: double cropping a year, wet season paddy and dry season paddy), is presented in this chapter.

6.1 Paddy Cultivation

In due consideration of the diagnosis results of paddy yield survey and also of growth stages of rice plant, the proposed farming practices of paddy cultivation are conceived as follows (Table V.6.1 and Fig. V.6.1, to be referred):

(1) Seeding and nursery preparation

Early-matured high yielding varieties like IR28, IR36 and IR50 are proposed. The seed requirement is 30 kg per ha. Although the seed treatment is not commonly carried out at present, the paddy seeds to be used will have to be the certificated extension seeds and be selected by using a solution of 1.13 specific gravity before pre-germination. The selected seeds will also have to be disinfected by using adequate seed disinfectant like Benlate. Pre-germination practice is recommendable for increasing the germination percentage.

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. Fertilizer application is essential. The recommendable dosage is 5 kg of Urea per 1/20 ha. Careful water management is very important for healthy growth of seedlings. The nursery period is 25 days after seeding.

(2) Field preparation

The field preparation is carried out by animal power, at least 10 days before transplanting. Harrowing and pudding works are also required after plowing. The puddling is also carried out by animal power. In the Project area, there exist sufficient number of cattle for this purpose with the average of 1.95 heads per farm household at present. Prior to the harrowing, the basic fertilizer application is practiced to prepare a fertile soil foundation for the transplanting.

(3) Transplanting

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 seedling per hill is recommendable. In due consideration of close correlation between numbers of panicles per m^2 and unit yield, more dense planting is recommendable. The irrigation water has to be drained just before transplanting so that transplanting in shallow depth is enforced for accerelating vigorous tillering. Irrigation water is taken into the field again after rooting.

(4) Fertilizer application

Proper application of fertilizer is essential for full exploitation of agricultural potential under irrigated condition. The soils of the project area are generally poor in plant nutrients, especially nitrogen and phosphorus. These chemical elements have to be supplemented by fertilization. Considering the soil condition, the suitable fertilizers are urea and triple superphosphate (T.S.P). The total fertilizer requirement for substaining the target yields would be 200 kg/ha of urea, 100 kg of T.S.P. The basic fertilizer application is 65 kg/ha or urea, 100 kg/ha of T.S.P. when field preparation is practiced. Top dressing is made in 2 times, i.e., just before the maximum tillering stage of about 15 days after transplanting and at the spikelet differentiation stage corresponding to 25 days before heading. The amount of fertilizer to be applied per ha is about 65 kg of urea at each top dressing time. In the paddy field where the percentage of ripened grains is low, top-dressing with the same dosage of urea at the full heading stage is often quite effective.

(5) Weeding

After transplanting, weeding is carried out in 3 times, depending the conditions of weed growth, by manual operations. For effective operation of weeding, it is recommended that the rotary weeder, being widely used in Java, be introduced in the area. At present, herbicides have been developed for weeding purposes, and their efficiency are highly acceptable particularly for saving labour. However, the use of herbicides is not recommendable under present economic situation. The cost of herbicides is too expensive.

(6) Plant protection

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 rodenticide for each cropping season. In selecting suitable insecticides and fungicides, chemical toxicity, which directly or indirectly affects the humanbeing, should be taken into consideration. It is recommended that plant protection works should be carried out in a systematic way through the farmer's cooperatives. Individual protection is not recommendable because insects and diseases are not limited to the individual farm which will be re-infected unless systematic protection is undertaken.

Basic principle of plant protection is, however, to make the plant healthy. If the rice plant is strong and healthy, it would be hardly suffered from diseases and insect pests. In this sense attention should be paid to proper water management and fertilization.

(7) Harvesting

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

6.2 Mechanization

Rapid introduction of farm mechanization to the Project area seems to be difficult because of undulating topography, small size of farmland, lack of farm access, etc. In principle, farm mechanization has a lot of advantages such as (1) increase of labour productivity, (2) speedy and smooth work flow from field preparation to harvesting (3) more timely and effective farm operation, (4) emancipation of farmers from laborious work and (5) more efficient use of land, irrigation water and labour. At present, farm mechanization in the Projct area has been progressed in the field of rice processing and spraying of agro-chemicals. Tractorization is still not common. In the Project area, there still remains sociological and technical problems for smooth expansion of mechanization as mentioned below:

(1) The farm plot is generally small due to undulating topography. The proposed farming practices could be carried out by the available farming labour force,

(2) The research and experiment works for proper farm mechanization have not been fully carried out, and there is no technical criteria for effective and efficient farm mechanization at present,

(3) The price of farm machinery is very high as compared with other agricultural commodities, for example the price of 12 Hp tractor amounts to about Rp3.2 million.

(4) The agricultural support system for farm mechanization has not been developed yet. There is no guidance services for proper operation and maintenance of farm machinery, and

(5) Land consolidation works including construction of farm roads, large farm plots and drainage facilities, which provide sufficient bearing for efficient operation of machinery, have not been carried out.

Under such circumstances, it seems that rapid introduction of farm mechanization is not practical in the Project area. However, farm mechanization for farmers having larger farmland is further proceeded, and it is expanded to other areas where the present conditions are more suitable for mechanization. With this in view, it is recommended that research works for proper farm mechanization be started as early as possible and technical training of extension workers be also followed.

7. MARKETING AND PRICE FORECAST

7.1 Marketing

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 decreased, the shortage situation will be continued as a whole.

The South Sulawesi Province is one of the largest rice surplus provinces in Indonesia. The total population in the province is about 6,144,000 as of 1981. The total areas of the paddy fields are about 520,000 ha. The total production of paddy is reported to be about 3,198,000 tons in 1981. On the contrary the total consumption is estimated at about 1,413,000 tons on the assumption that per capita consumption is 230 kg of dried paddy per annum. The surplus of paddy is then estimated at about 1,785,000 ton (see Fig. V.7.1). It is also reported that the rice surplus condition will increasingly continue in the province.

The Kabupaten Bone, in which the Project area is included, is also one of surplus regions in the province. The annual surplus from Kabupaten Bone is estimated around 339,000 ton 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 by used 2.36% of annual growth rate, is estimated at 10,850 tons on the assumption that per capita consumption is 230 kg of dried paddy. The seed stock feed of livestock handling and storing losses are estimated at 4,620 tons or 7.7% of total Production of paddy. The annual marketable surplus amout of paddy is estimated at 44,530 tons. These surplus of paddy are marketed to the rice-deficit regions.

The present capacity of rice mills will be insufficient for processing the increased paddy production at the full development stage of the project. Moreover, most of the existing milling facilities are one-pass system which simultaneously carry out two processes of husking and whitening and produce a lot of broken rice. The increase and improvement of these facilities have to be gradually made together with improvement of drying practices for attainment of better marketability.

Market flow of major farm inputs such as fertilizers and agro-chemicals is broadly divided into two flows, free market flow and controlled market flow. The former is for private farms and estates, and the latter is for BIMAS/INMAS program which is controlled by the Government. For the farmers under BIMAS/INMAS programs, distribution of fertilizer is mainly handled by P.T. PUSRI, and agro-chemicals and some farm implements are dealt by P.T. PERTANI. They are the government enterprises in the South Sulawesi Province.

7.2 Price Forecast

The increased production of paddy after the completion of the Project would be marketed in domestic markets in Indonesia, as the substitute of import rice. In this meaning, import substitution price of paddy is forecasted for the economic evaluation.

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, as shown in Table V.7.1. 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, as shown in Table V.7.2. The economic farm gate prices of farm inputs, i.e., fertilizers, agro-chemicals and others, are shown in Table V.7.3. The economic prices of all the farm products and inputs at farm gate are summarized in Table V.7.4.

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, and given in Tables V.7.5 and V.7.6. For financial evaluation, the average farm gate price of dried paddy at Rp105,000/ton in 1982 will be used.

7.3 Crop Production Costs

The crop production costs of paddy and polowijo crops are estimated for both future without and with Project condition. The production costs under without project condition is estimated on the basis of those under present condition. The present agricultural condition would not change significantly unless a new irrigation project could be implemented. For the estimation of 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 328,600 per ha for dry season paddy as shown in Table V.7.7. This anticipated increase is primarily attributable to increase of expenses for fertilizers, agro-chemicals and labours.

The production costs of polowijo crops under without and with project condition are shown in Table V.7.8. The production costs of upland crops and orchard products under without condition are shown in Table V.7.9.

8. IRRIGATION BENEFITS

8.1 Basic Assumptions

The irrigation benefits of the Sanrego Irrigation Project will be primarily derived from the increased crop production due to improved irrigation water supplies through implementation of infrastructural facilities. These benefits are estimated as the difference of the annual net crop production values under future without and with the project conditions. The net production value is defined as the difference between the gross production value and the gross production cost.

8.2 Change in Land Use

After the implementation of the Sanrego Irrigation Project, the farmland within the Project area will be fully irrigated and more intensive use of the farmland will become possible.

The present land use in the Project area will change with project as follows:

Description	Without Project	With Project
Total area	12,000	12,000
Non irrigable lands/1	2,900	2,900
Gross irrigable area	9,100	9,100
Field borders and lands to be used for new canal and farm roads	800	1,100
Total net arable lands	8,300	8,000
Net irrigation area	-	8,000
Land use within net arable irrigation area		
- paddy field	7,050	8,000
- upland	510	-
- orchard	130	-
- grassland	610	-
Total	8,300	8,000
Area planted		
- paddy field	7,050	8,000
- upland	510	-
- orchard	130	-
Total	7,690	8,000
Area harvested		
- paddy field	5,780/2	8,000
- upland	510	-
- orchard	130	-
Total	6,420	8,000

Remarks: /1: villages, roads, rivers and the elevated lands to topographically not irrigable.

/2: average rate of present crop damages in area is deducted.

The irrigation area of 8,000 ha comprises the existing paddy field of about 6,800 ha and upland, orchard and grassland of 1,200 ha. All these existing lands within the proposed irrigation area would be changed into the irrigated paddy fields under the Project.

8.3 Anticipated Crop Yield

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 farming practices supply of irrigation water and further expansion of agricultural supporting services.

The anticipated dried paddy yields are estimated as follows:

(Unit: 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 condition, climatological environment, degree of irrigation water supplies, and farm management practices. The soils of the Project area is generally suitable for paddy cultivation due to their general characteristics of heavy texture and slow permeability. Although the soils are poor in plant nutrients, the deficits will be possibly supplemented by application of fertilizers. The adequate amounts of fertilizers are calculated and included in the proposed farming practices. 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 under the Project, as the uncontrollable factors.

Paddy yield can be formulated as:

$$\text{Yield (ton/ha)} = \text{nos. of grain per } m^2 \times \text{1,000 grain weight (gr)} \times \text{percentage of ripened grains (\%)} \times 10^{-5}$$

According to the yield survey mentioned in section V.4.2, among other yield components "the number of grains per m^2" is recognized as the decisive factor which causes low paddy yield.

It is generally conceived that the factor "the number of grain per m^2" is positively correlated with daily solar radiation and negatively with the daily mean temperature during the 25 day period before flowering. The International Rice Research Institute (IRRI), Philippines, made a series of rice experiments in this respects and reported the following empirical formula for estimation of "potential maximum number of grain per m^2" using climatic data:

$$N = S(278 - 7.07t)$$

where, N: potential maximum number of grains per m^2

S: average daily solar radiation during 25 days before flowering (cal/cm^2)

t: average daily temperature during 25 days before flowering (°C)

Using 23g for 1,000 grain weight and 75% per percentage of ripened grains (mean values of the paddy yield survey for IR42 under irrigated condition in the Langkemme and Sadang areas), the paddy yield could be estimated as:

$$Y(ton/ha) = S(278 - 7.07t) \times 23 \times 0.75 \times 10^{-5}$$

Applying the actual records for solar radiation and temperature in the Sanrego 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 Table V.4.1).

The actual paddy yields are, however, generally affacted by another uncontrollable factor "farm management practices". This factor includes water management, farming operations, farm inputs supplies, post-harvest operations, extension services and other agricultural activities to support the proper irrigation farming. 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.

With the view of existing irrigated area and of statistic data, the anticipated paddy yields under with project condition are conservatively estimated. As seen from Table V.4.2 the average unit yield of paddy in 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.

As for the anticipated yield under without project condition, constraints such as rainfed cultivation, low level of farming technique, unactive agricultural supporting services and unawareness of modern rice cultivation, keep the present crop yield at 2.28 tons per ha for wet season paddy and 2.5 ton per ha for dry season.

8.4 Increased Crop Production

Based on the proposed cropping pattern (Pattern A: double cropping a year, Paddy - Paddy), the cropped area, crop yields and total crop production under future without and with 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 as shown in Table V.8.2.

8.5 Irrigation Benefits

The irrigation benefits of the Sanrego Irrigation Project primarily accure from the increased crop production attributable to stable irrigation water supplies. The irrigation development for the whole project area will be completed by the end of the fiscal 1988/89. After 10 years of buld-up period from the completion of construction works, the full development stage will be attained in 1997/98.

The Sanrego Project includes the land reclamation works of 1,200 ha for development of new paddy fields, comprising about 500 ha of upland field, about 100 ha of orchard field and about 600 ha of grassland. The losses of farmland which will become unproductive owing to the construction of the project facilities, total about 300 ha. These losses or negative benefits are counted in the estimation of the primary incremental production value by deducting these losses or negative benefits from the expected production values under future with project condition.

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 Table V.8.3 and V.8.4.

9. FARM ECONOMY

9.1 General

In order to grasp economic activities of the farmers in the study area, the form economy survey was carried out for 100 samples of farm households selected at random during the period from August 31 to September 24, 1982.

The study on the present farm economy is made based on the date and information obtained mainly from the above farm economy survey. The analysis is made for three different sizes of farmers; i.e., the average size farmer with a land holding of 2.36 ha and two sizes of the peasant farmers holding of 1.0 ha and 0.5 ha. The peasant farmers who are holding a land of less than 1.0 ha occupy about 54% of the number of farm households in the study area.

For the financial evaluation of the Project and assessment of payment capacity for water charge, farm budget analysis is also made on the average size farmer and two sizes of peasant farmers under both the future without and with project conditions.

9.2 Analysis of Farm Budget

At present, the total number of farm households in the study area is about 6,270, out of which about 95% or 5,990 households are land owner's. The average size farmers cultivate 2.36 ha of farmland, comprising 1.42 ha of paddy field, 0.40 ha of upland field and 0.54 ha of orchard field.

The farmers in the study area get their income mainly from farming activities particularly from the paddy production, and partly supplemented by sales of polowijo crops in excess of their requirements for home consumption. However, the present farm incomes of the farmers under rainfed field condition are insufficient to maintain the livelihood of farmers, most of these farmers are engaged in various sideline business, such as carpenter, seasonal labour work and migration to Watanpone, Pare-pare and Ujung Pandang in the dry season. As animal husbandry is not a mainline of agriculture in the study area, income from the sales of livestock is very limited.

According to the statistical data and the farm economy survey, the average size of family is 5.7 persons per household. The annual family living expenses are estimated at about Rp416,000 on an average for the average size farmer, as shown in Table V.9.1. In general, the amount of family living expense depends on individual income.

The results of farm budget analysis under present condition are given in Table V.9.2 and summarized below:

Description	Average Size Farmer	Peasant Farmer	
Total Farm Land (ha)	2.36	1.00	0.50
Gross Income (Rp)	529,400	399,800	338,100
Farm income*	347,600	163,800	82,100
Farm labour income**	54,500	70,800	76,800
Off-farm income***	127,300	165,200	179,200
Gross Out-go (Rp)	520,800	393,200	333,100
Farm expenses	104,800	46,200	23,100
Living expenses	416,000	347,000	310,000
Net Reserve (Rp)	8,600	6,600	5,000

Remarks: *: income from sales of own farm products
**: income as cash compensation for farm labour work on neighbouring large farms
***: income from side-line business

The above farm budget analysis indicates that farm incomes of the average size and peasant farmers are insufficient to maintain their family living expenses. Even though the average size farmer earns about Rp181,800 or 34% of gross incomes from farm labour and off-farm business, the net reserve is generally negligible small.

As far as farmer's intentions for the development in the area concerned, the farm economy survey also indicates that about 90% of farmers put stress on acquiring irrigation water from Sanrego river, followed the provision of new marketing facilities and the construction of farm roads network. As for future cropping pattern under irrigated condition, over 95% of farmers intend to adapt double cropping of paddy and polowijo crops per year.

It is concluded that from these results, double cropping of paddy under year round irrigation system would be recommendable in the area, if irrigation water is sufficiently available.

9.3 Payment Capacity for Water Charge

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 income which the project-benefited-farmers can earn annually from the project.

In order to assess the payment capacity of the farmers, the farm budget analysis is made on the average size farmer and peasant farmers under future with and without project conditions.

After completion of the project, about 1,200 ha of paddy field will be newly developped through land reclamation of upland, orchard and grassland, and about 300 ha of farmland will be used for the construction of project facilities. These changes in land use are counted on the estimation of farm size under with project condition. The farm labour and off-farm incomes are estimated on the basis of surplus labour force after deducting farm labour requirement from total available labour force. The family living expenses are estimated through analysis of the relationship between living expenses and total gross income, using the data obtained from the present farm economy survey (see Fig. V.9.1).

The results of the farm budget analysis under future with and without project conditions are shown in Tables V.9.3 and V.9.4, and are summarized as follows:

(1) Without project condition

	Average Size Farmer	Peasant Farmer	
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	504,500	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 Condition

	Average Size Farmer	Peasant Farmer	
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

Farm incomes under with project condition are expected to increase by about 2.3 times compared with those under without project condition. Farm labour incomes with project condition will also increase about 3.5 to 4.4 times of those under without project condition, because the Project will enable the intensive farm activities under year-round irrigation system, and will provide the farmers with larger employment opportunity.

Annual net reserve or payment capacity will be about Rp482,100 for the average size farmer, Rp202,900 for 1.0 ha holding farmer and Rp112,400 for 0.5 ha holding farmer at full development stage. The increased net reserve would offer incentives for further development to the farmers, the substantial payment capacity would enable them to pay some charges for irrigation water.

10. RECOMMENDATION

10.1 Agricultural Development Concept

The Project area is one of the most depressed areas in agricultural productivity in the Central South Sulawesi. Most of the population in the Project area are engaged in agriculture and related activities. In spite of high potentials for agricultural development, the Project area has not been fully developed mainly due to the lack of irrigation facilities. At present, irrigation facilities are quite limited in the area and paddy cultivation is generally made under rainfed condition. Paddy cultivation is concentrated in the wet season and is very limited in the dry season. The areas under paddy cultivation fluctuate year by year, depending on available rainfall. As far as cultivation technique is concerned, there is much room for improvement. In the Project area, agricultural extension services are not so active. The farmers are not well aware of modern rice farming.

All these constraints keep the present crop yields at low level, with an average unit yield of 2.2 tons/ha for wet season paddy and 2.5 tons/ha for dry season paddy. In addition to the above, the present poor road conditions except the provincial road in the Project area make the transportation of farm inputs and outputs so difficult and also hamper agricultural activities.

The Sanrego Irrigation Project aims at increasing crop production and thereby improving the living standard of the local inhabitants in the Project area through implementation of irrigation facilities. Maximum effective use of water and land resources, and introduction of improved irrigation farming are the most important key factors for the development of the Project area. With this in view, the basic concept for development in the Project area would be as follows:

(1) Special attention should be paid to the increase in irrigation area by use of available water resources to the possible maximum extent,

(2) Unit yield and production of wet season paddy should be stabilized and improved through establishment of new irrigation system and introduction of irrigation farming practices,

(3) Total planted area of dry season paddy and/or polowijo crops should be increased with year-round irrigation system and thereby total crop production be maximized,

(4) Present rural road network should be improved and the agricultural activities be made more active, and

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

10.2 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. identificatin 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 public 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.

10.3 Agricultural Support Services

The major objectives of the Sanrego Irrigation Project are to increase the agricultural production through the irrigation development and thereby to raise the level of living standard and welfare of the inhabitants. For this purpose, the Project will provide with necessary infrastructures such as irrigation facilities and road network for agricultural development of the area. However, 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.

Such ancillary works include (1) extension services, (2) agricultural research, (3) credit, (4) farm inputs, supplies, (5) farmers cooperatives movement and (6) social development. Most of these agricultural support services are considered under the said CIDA integrated rural development project, as shown in Table 10.1. From the viewpoint of the irrigation development, however, 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 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 Manos Research Institute for Food Crops (MARIF) 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 INSUS programme 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 and to propagate the recommendable farming practices including new varieties to the farmers through the existing extension channel.

10.4 Associated Schemes

In order to assure the successful implementation of the Project, it is recommended that two associated schemes be realized in parallel with the construction of the Project, i.e., a pilot demonstration scheme and a post-harvest improvement scheme. Aothough neither of these schemes is included in the Project, it is hoped that these schemes will be implemented by the Ministry of Agriculture in close coordination with the Project and the CIDA project and the other government authorities concerned.

10.4.1 Pilot demonstration scheme

(1) Objectives

The Sanrego Project area is mostly covered with rainfed paddy field at present and most of the farmers have no experiences on modern irrigation rice farming as well as construction of on-farm irrigation facilities. Such being the situation, the realization of the project objectives would be delayed unless strong services and guidance could be given to the farmers. 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:

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

b. Demonstration and guidance of systematic water management at tertiary, quaternary and on-farm level,

c. Demonstration and guidance of proper irrigation and farming practices for double cropping of paddy, and

d. Multiplication 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.

(2) Main activities of pilot demonstration scheme

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

(a) Preparation of land ledger and cadastal map

The accurate land ledger and cadastral 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. In addition, these data will also be essential for organizing farmers groups and Water User's Associations. These data are not well mapped at present. The pilot scheme will give a good example for consecutive survey and mapping in the whole project area.

(b) Establishment of Water User's Association

In the Sanrego area, there is no systematic farmers organization such as Water User's Association (P3A) at present. In order to establish an executive body of construction and management of on-farm irrigation facilities in each tertiary irrigation block, the Water User's Association should be organized according to the construction schedule. The member of the Association should be decided so as to include all the land owners and/or the cultivators whose lands are located in each same irrigation block. 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.

(c) Organizing the farmers group

The extension service in Indonesia is usually made through the farmers groups comprising about 10 - 20 farmers per each group as

the contact unit for extension activities. 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 techniques 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.

(d) Construction of on-farm irrigation facilities

In many cases of irrigation projects inIndonesia, 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.

(e) Strengthening of extension service

After completion of construction works of the Sanfeto 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.

(f) Strengthening of seed multiplication

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 tons for wet seasonpaddy and about 120 tons 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.

(3) Selection of Scheme Area

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

(a) Scale of scheme area

One tertiary irrigation block should be selected for making the successful attainment of the guidance of water management practice. In addition to the factor of the irrigation system, the scheme area should belong to one administrative unit (village unit) for simplification of farmer's organization to be established in the scheme area.

(b) Irrigation water availability

The pilot scheme area should be supplied stably and easily with irrigation water with temporary facilities at the beginning stage. After completion of the main irrigation system of the Project, the scheme area should be efficiently incorporated into and supplied with the project irrigation system.

(c) Drainage condition

So as to control the drainage water without constructing the large scale drainage measures, the scheme area shouls be located in the somewhat elevated area.

(d) Access

Due attention should be paid to the access from the trunk road and all weathered rural road to the scheme area for ensuring smooth transportation and communication.

(e) Soil and topography

The soils in the scheme area should be representative for the Project area. The scheme area should have flat and gentle topography for successful demonstration of the water management.

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, and shown on Fig.10.1. 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.

The scheme area extends over the gently undulating alluvial plain along the Biru river and on the Dystric Fluvisols or Low Humic Gley Soils which are generally suitable for irrigated rice cultivation. All the part of area is being cultivated with double cropping of paddy a year by used irrigation water of the Maradda semi-technical irrigation system which consists of a permanent intake weir constructed across the Biru river and the main and secondary irrigation canals. Natural rivulets adjacent to paddy fields function as the main drainage canals in the system.

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.

(4) Facilities Required for the Scheme

In order to achieve the objectives of the scheme, the following facilities are required:

(a) Biru intake weir (Existing)

- Type of weir	:	Overflow type
- Crest elevation	:	EL.170.3 m
- Crest length	:	27.5 m
- Height of weir	:	3.0 m
- Width of scouring sluice	:	1.0 m

(b) Main irrigation canal (Existing)

- Type of canal	:	Earth canal with the trapeziodal section
- Canal length	:	1.1 km

(c) Tertiary and quarternary system

- Tertiary canal		
rehabilitated	:	1.2 km
newly constructed	:	0.5 km
- Quaternary canal	:	4.6 km
- Tertiary drain	:	3.3 km
- Tertiary division box	:	13 nos.

(d) Farm road

- Inspection road	:	2.8 km

(e) Office

- Pilot scheme office	:	150 m^2

10.4.2 Post-harvest improvement scheme

(1) Objectives

After completion of the Project, the paddy production will be increased from the present level of about 15,000 tons per annum to the annual production of about 60,000 tons. The present state of post-harvest system is rather primitive and will not meat the future production. There exist 65 rice mills in the Project area at present. Most of them are of small scale one-pass type and produce a lot of broken rice. The average capacity of the existing rice mill is around 0.3 ton per hour. The total milling capacity in the area corresponds approximately to the present paddy production. There is no artificial drying facilities. The harvested paddy is generally dried under the sun using local bamboo mats. The storing capacity of paddy is also very limited; 250 tons of DOLOG and 300 tons of KUD warehouses. The surplus of the harvested paddy is generally stored in the sheds and lofts of the dwelling houses. All these primitive states of post-harvesting cause the large loss of paddy (about 20% of harvested 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.

(2) Outline of the Scheme

The main features of the scheme will comprise:

a. establishment of new facilities for paddy processing,

b. construction of new warehouses,

c. provision of transportation facilities, and

d. improvement of paddy collecting system.

For effective realization and operation of the scheme, the Project area is to be divided into six (6) sub unit KUD under which a total of 35 field blocks KUD be established as shown in Fig. V.10.2. The organizational set-up for post-harvest management is given in Fig. V.10.3. The village unit cooperative (KUD) at Palattae will be responsible for overall management of the scheme and 6 sub unit KUD and 35 field block KUD will be newly established. The areas covered by each of sub unit KUD and field block KUD are shown in Table V.10.2.

In each sub unit KUD, dryers, rice milling facilities, warehouses, and transportation equipments will be provided. In each field block KUD, drying floors, simple storing spaces and transportation equipments will be provided. The requirements of each sub unit KUD and field block KUD are shown in Tables V.10.3 and V.10.4.