4.2.6 Development Alternatives

Alternatives for the comparative study are composed of four combined components such as exploitable water resources, crop intensity, irrigation canal system and irrigable area on the common condition that the maximum storage capacity of the dam would be 132 MCM as mentioned in Sub-section 4.2.2. Three (3) Alternatives selected are described as follows:

1) Alternative I

   a) The existing paddy field of 8,600 ha in net would be irrigated by the reservoir with a maximum storage capacity of 132 MCM.
   b) Direct diversion from the reservoir would be applied for the whole irrigation area of 8,600 ha by facilitating a headrace to connect with the irrigation canal system.
   c) The whole irrigation area of 8,600 ha would be irrigated by a gravity irrigation system.

2) Alternative II

   a) The existing paddy field of 5,880 ha in net would be irrigated by the reservoir with a maximum storage capacity of 132 MCM.
   b) Intake weir at the downstream would be installed to supply water to 5,880 ha.
   c) The whole irrigation area of 5,880 ha would be irrigated by a gravity irrigation system.

3) Alternative III

   a) The existing paddy field of 7,000 ha in net would be irrigated by the reservoir with a maximum storage capacity of 132 MCM.
   b) Intake weir at the downstream would be installed to supply water to 6,560 ha of which 5,880 ha are irrigated by gravity irrigation system and 680 ha are by pump irrigation.
   c) In addition, pumping units would be provided for 440 ha scattered in the upstream area.

4.2.7 Water Balance Study

(1) General

The purpose of the water balance study is to clarify the relationships among the proposed dam scale, irrigable area, cropping pattern, and cropping intensity for each alternative. The calculation of water balance is carried out under the following basic conditions:

1) Cropping pattern of Type B (paddy-palawija-paddy) is first examined as the most preferable pattern to the Project.

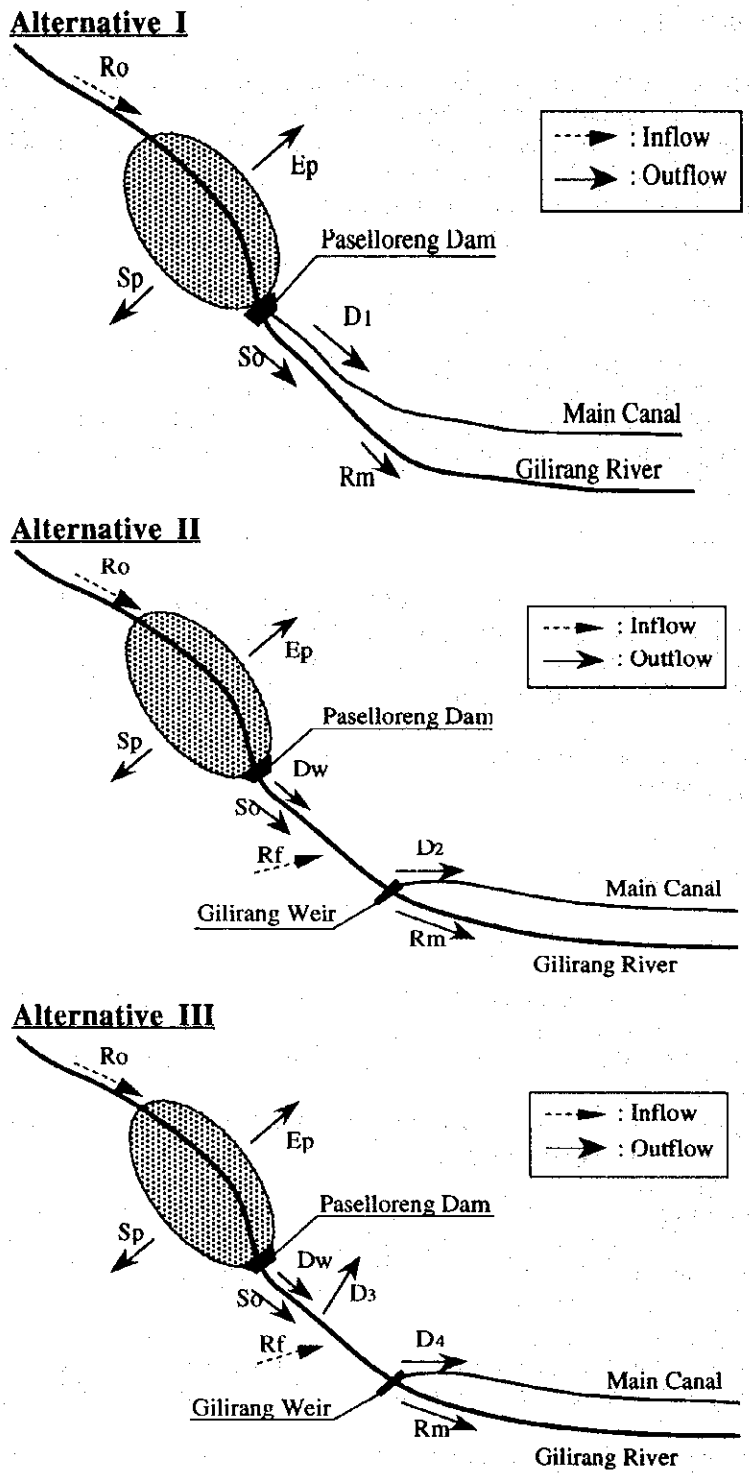
2) If the amount of irrigation water is not enough to maintain 300% of cropping intensity, the intensity of palawija is firstly reduced. And if the amount of irrigation water is unable to maintain 200% of cropping intensity, the intensity of the dry season paddy is reduced.

3) If water resources are exploited in excess of the irrigation requirement, the storage capacity of the reservoir is reduced by decreasing the scale of the dam.

Calculation of water balance for each alternative is carried out for a fifteen (15) year period from 1979 through 1993 based on runoff estimated in the hydrological study and estimated irrigation water requirement for each alternative. The calculations are made on a half-monthly basis.

(2) Basic components for calculation

The water balance calculation is executed in accordance with some basic components. The components of inflow and outflow in the water balance calculation for each alternative are illustrated below and the components are described hereinafter.



1) Inflow components

Ro : Runoff at the proposed dam site
Rf : Inflow from the residual basin between the proposed dam site and intake weir site

2) Outflow components

Ep : Evaporation from the water surface of reservoir
Sp : Seepage loss from the reservoir
D1 : Irrigation water demand for 8,600 ha of the gravity irrigation scheme
D2 : Irrigation water demand for 5,880 ha of the gravity irrigation scheme
D3 : Irrigation water demand for 440 ha of the pumping irrigation scheme
D4 : Irrigation water demand for 6,560 ha (5,880 ha of the gravity and 680 ha of the pumping irrigation schemes)
Rm : River maintenance flow
Dw : Diversion water requirement from the dam
So : Spillout discharge from the dam

(3) Procedure of water balance calculation

The water balance study is made in the following manner.

$$Se = Sb + I - Or - Os$$

where, Se : Reservoir storage volume at the end of the period
Sb : Reservoir storage volume at the beginning of the period
I : Inflow to the reservoir during the period (Ro)
Os : Spillout discharge (So) during the period in case the reservoir storage volume at the end of the period exceeds maximum storage capacity, if any
Or : Outflow from the reservoir during the period including diversion water requirements (Dw), seepage loss (Sp) and evaporation loss (Ep) (where, $Dw = D1 + (D2/0.9) + Rm - Rf$)

If the storage volume at the end of the period is less than the dead water storage, the outflow in the period is assumed to be zero for the convenience of calculation. Therefore minimum storage volume is equal to the dead storage capacity (17,000,000 m^3), and the period of dead storage capacity is considered as a drought period in the calculation.

The maximum storage capacity of which frequency of drought occurs twice is defined as gross the storage capacity corresponding to each cropping pattern or intensity.

(4) Results of the Water Balance Calculation

The result of the water balance calculation is as summarized below:

	Irrigable Area and Cropping Intensity			Max. Storage
	Wet Season Paddy	Palawija	Dry Season Paddy	Capacity of Dam
Alternative I	8,600 ha (100 %)	0 ha (0%)	7,400 ha (86 %)	132 MCM (NWL 50.5 m)
Alternative II	5,880 ha (100 %)	5,880 ha (100 %)	5,880 ha (100 %)	125 MCM (NWL 50.0 m)
Alternative III	7,000 ha (100 %)	2,000 ha (29 %)	7,000 ha (100 %)	132 MCM (NWL 50.5 m)

(Further details are referred to in Annex 2)

The fluctuations of storage volume in the reservoir, inflow and out flow volumes at the proposed dam site and spillout volume from the reservoir for each alternative are illustrated in Figures 4.2.2, 4.2.3 and 4.2.4. The probable frequencies of full storage in the reservoir for 15 years are 60 % in case of Alternative I, 80 % in case of Alternative II, and 73 % in case of Alternative III.

4.2.8 Preliminary Layout and Cost Estimate

(1) Preliminary layout

The general layouts of major facilities based on Alternative I, II and III are illustrated on Figure 4.2.5, 4.2.6 and 4.2.7 respectively. The features of major project components in each Alternative are as follows:

Alternative I			
(1)	Rockfill Dam :	Maximum storage capacity	: 132 MCM
		Crest elevation	: EL 56.5 m
		Dam height	: 44.5 m
(2)	Headrace :	Length	: 6.0 km
		Design canal discharge	: 15.0 m^3/sec
		Type of canal	: Unlined canal
(3)	Main canal :	Total length of canal	: 74.0 km
		Design discharge (left)	: 4.4 m^3/sec
		Design discharge (right)	: 10.6 m^3/sec
		Type of canal	: Unlined canal
Alternative II			
(1)	Rockfill Dam :	Maximum storage capacity	: 125 MCM
		Crest elevation	: EL 56.0 m
		Dam height	: 44.0 m
(2)	Weir :	Type of weir	: Fixed type
		Material of weir	: Concrete
		Intake water level	: EL 18.0 m
		Width of scoring sluice	: 2.0 m x 2 nos.
			3.0 m x 2 nos.
(3)	Main canal :	Total length of canal	: 47.5 km
		Design discharge (left)	: 3.5 m^3/sec
		Design discharge (right)	: 6.7 m^3/sec
		Type of canal	: Unlined canal
Alternative III			
(1)	Rockfill Dam :	Maximum storage capacity	: 132 MCM
		Crest elevation	: EL 56.5 m
		Dam height	: 44.5 m
(2)	Weir :	Type of weir	: Fixed type
		Material of weir	: Concrete
		Intake water level	: EL 18.0 m
		Width of scoring sluice	: 2.0 m x 2 nos.
			3.0 m x 2 nos.
(3)	Main canal :	Total length of canal	: 47.5 km
		Design discharge (left)	: 3.7 m^3/sec
		Design discharge (right)	: 7.6 m^3/sec
		Type of canal	: Unlined canal
(4)	Pumping unit :	1.4 m^3/min., 4 inch	: 6 nos.
		3.5 m^3/min., 6 inch	: 22 nos.
		6.0 m^3/min., 8 inch	: 13 nos.

(2) Cost estimate

The result of the cost estimate for each Alternative is given in Table 4.2.1 and summarized

as follows:

Alternative	Total Cost (Rp. million)	Per Ha Cost (Rp. 1,000/ha)	Per Ha Cost (US$/ha)
Alternative I	251,819	29,281	13,556
Alternative II	157,311	26,754	12,386
Alternative III	160,687	22,955	10,627

4.2.9 Evaluation of Alternatives

(1) Economic comparison

1) Estimate of economic benefit

Irrigation benefit to be derived from each Alternative is estimated by applying the procedures of benefit calculation mentioned in Section 7.2. The annual irrigation benefit from each Alternative is as follows:

Alternative	Total Benefit (Rp. Million)	Per Ha Benefit (Rp.1,000/ha)	Per Ha Benefit (US$/ha)
Alternative I	19,728	2,294	1,062
Alternative II	18,557	3,156	1,461
Alternative III	18,760	2,680	1,240

2) Economic costs

The financial costs estimated in sub-section 4.2.8 and tabulated above are converted into economic costs by applying the procedures mentioned in Section 7.2. The economic cost for each Alternative is estimated as follows:

Alternative	Total Cost (Rp. Million)	Per Ha Cost (Rp.1,000/ha)	Per Ha Cost (US$/ha)
Alternative I	154,616	17,979	8,323
Alternative II	96,588	16,427	7,605
Alternative III	98,645	14,092	6,524

3) Economic comparison

The economic comparison for each Alternative is made in terms of economic internal rate of return (EIRR) and other indexes adopted in the economic evaluation. The results of the economic comparison between Alternatives are as follows:

Alternative	EIRR (%)	B/C*	B-C* (Rp. Million)
Alternative I	9.3	0.93	-7,591
Alternative II	13.5	1.40	27,224
Alternative III	13.3	1.37	26,248

*: Discount rate of 10% is adopted in computing of Benefit (B) and Cost (C).

The above economic comparison shows nearly the same results in Alternative II and III, although Alternative II is slightly superior to Alternative III. Alternative I is not attractive in terms of economic feasibility.

(2) Financial comparison

The financial construction cost per ha is the cheapest in Alternative III (Rp. 23.0 million) followed by Alternative II (Rp. 26.8 million), and Alternative I (Rp. 29.3 million) as

presented in Sub-section 4.2.8. While the financial net income per ha from crop production is the best in Alternative II (Rp. 2.95 million/ha) followed by Alternative III (Rp. 2.37 million/ha), and Alternative I (Rp. 2.02 million) as seen in table below:

(Rp. 1,000/ha)

Alternative	Gross Farm Income	Production Cost	Net Income
Alternative I	3,572	1,555	2,017
Alternative II	5,359	2,406	2,952
Alternative III	4,274	1,906	2,368

According to these comparisons, it can be said that Alternative II has a higher investment and higher return per farm household and Alternative III has less investment and less return. Alternative I is not attractive in financial comparison and is the highest in investment and smallest in gross income per ha.

(3) Socio-economic aspect

The number of beneficiaries is the largest in Alternative I followed by Alternative III and Alternative II. The net farm income of the average holding farmer is the best in Alternative II and the smallest in Alternative I as shown below:

Alternative	Household (No.)	Population (person)	Gross Income/H.H (Rp. Million)
Alternative I	3,800	19,000	4,720
Alternative II	2,600	13,000	6,908
Alternative III	3,100	16,000	5,541

4.2.10 Selection of Optimum Project Scale

Based on the results of the above , final selection would be made between Alternative II and III, because both alternative plans are economically feasible with similar EIRRs. Alternative I would not be feasible, although this alternative plan envisages the maximum development area. In the comparison between Alternative II and III, Alternative II is superior to Alternative III in financial return, because Alternative II can introduce a maximum cropping intensity of 300%. In the meantime, Alternative III is superior to Alternative II in the project scale and in the number of beneficiaries. Furthermore, the per hectare investment cost for Alternative III is lower than in Alternative II. In regard to the project scale and the number of beneficiaries, Alternative III would be finally selected as the optimum alternative plan for this project.

CHAPTER 5 THE PROJECT

5.1 Agricultural Development Plan

5.1.1 General

The agricultural development plan presented hereinafter is formulated on the optimum project scale of Alternative III selected in Chapter 4. The formulation of the plan is carried out based on the results of the assessment made on the present conditions of agriculture including the constraints to the development and taking the basic concept for the development into account. The details of the agricultural development plan are presented in Annex 6.

5.1.2 Change in Land Use

The proposed land use in the Project area is given in Table 5.1.1. As the possible development area for irrigation farming, a gross Project area of approximately 10,230 ha was selected from the study area based on soil, land use, and the results of topographic surveys. Out of this, paddy fields occupy about 78% (8,020 ha), and the remainders are upland fields, orchards, grass lands, etc. The irrigation development of the Project is focused on this paddy field, and a net Project area amounting to 7,000 ha is delineated from the above paddy field through the study on the formulation of optimum project scale (see Chapter 4). After completion of the Project, most of the paddy fields in the net Project area will be fully irrigated and a more intensive use of the farmland will become possible.

About 220 ha of land will change into the right of way for irrigation facilities under with project condition, and the present average holding size of 2.34 ha will reduce to 2.27 ha per household. Total beneficiaries of the Project are estimated at 3,100 farmers. The land use patterns will not basically be changed without provision of irrigation development, and the land use in the surrounding areas which are not incorporated in the Project area will remain as is.

5.1.3 Proposed Cropping Pattern

(1) Crop selection

The study on the selection of proposed crops is made in parallel with the alternative study on the optimum cropping pattern. As a result of the study, rice is to be taken as the suitable crop to be introduced to the Project, taking the following points into account.

1) Over 70% of land in the gross project area is covered by Vertisols, and this soil is suitable for rice cultivation.

2) The profitability of rice under irrigated conditions is higher than other food crops such as maize, mungbeans, soybeans, and groundnuts. Considering the subsistence level of the farmers' living standard in the area, the introduction of rice cultivation will produce a good result in improving their living standard.

3) Rice still has a good and stable marketing potential in the country. The result of a recent study made on demand and supply of rice indicates that Indonesia's annual domestic demand of rice will exceed its production by about 4.6 million tons in 2003 and 7.8 million tons in 2008. The sustenance of self-sufficiency in rice production is

thus one of the most important policies of the Government of Indonesia.

4) Through the household survey of 250 farmers, it is confirmed that they have a strong intention to cultivate paddy, whenever provision of irrigation water is permitted.

5) The Provincial Government has given a high priority to rice production in the six Kabupaten called "BOSOWA SIPILU" including Kab. Wajo. The Provincial Government is now doing much to increase rice production in these six Kabupaten.

As for palawija crops, soybeans, groundnuts, and mungbeans are recommended in accordance with the crop diversification policy of the Government. The common palawija crops grown in the Project area are these three crops, and farmers have a superior ability in cultivation of them. As for vegetables, large scale cultivation is not recommended even under with project condition, since vegetables have unstable prices and no marketing controls. A large scale cultivation of vegetables would involve much risk owing to fluctuation of prices depending on demand and supply conditions. Production of vegetables represented by chilies is therefore recommended only to 10% of the area of total palawija crops.

(2) Proposed cropping pattern

As mentioned in Sub-section 4.2, Type B (Paddy-Palawija-Paddy) with 229% of cropping intensity is proposed for the Project. The proposed cropping pattern is illustrated in Figure 5.1.1.

A land preparation period of one month is allowed both for the wet and the dry season paddy, and five (5) to ten (10) days for palawija and vegetable crops. The growing period both for the wet and the dry season paddy is put at 85-100 days from transplanting to harvesting after a nursery period of 20 days. Irrigation water is not required during the last two weeks of the growing period when the crop is in the ripening stage. On an average, 90 days are allowed for palawija and vegetable crops from seeding to harvesting.

(3) Cropping area

The cropping areas of paddy and palawija are decided through the study on optimum project scale (see Chapter 4). Annual cropping area under with and without the project is summarized as follows.

Annual Cropping Area under With and Without Project Conditions

(Unit: ha)

	Without Project	With Project
Rainfed Paddy Field		
Wet Season Paddy	7,220	-
Dry Season Paddy	-	-
Palawija and Vegetables	720	-
Irrigated Paddy Field - Gravity		
Wet Season Paddy	-	5,880
Dry Season Paddy	-	5,880
Palawija and Vegetables	-	1,680
Irrigated Paddy Field - Pump		
Wet Season Paddy	-	1,120
Dry Season Paddy	480	1,120
Palawija and Vegetables	-	320
Total	8,420	16,000
Multi-Cropping Intensity	117%	229%

Multi-cropping intensity will be 229% with the project condition. It is foreseeable that most farmers in the Project area will agree to introduce the proposed pattern with this intensity because the result of the household survey shows that about 62% of sample farmers intend

to introduce Type B and 36% Type A.

5.1.4 Proposed Farming Practices

(1) Proposed farming practices and farm inputs

The proposed farm inputs and labor requirement under the future with project condition are summarized as follows.

Farm Inputs Requirement per Ha under With Project Condition

		Paddy		Mung-beans	Soy-beans	Ground-nuts	Chilies (Large)
		WS	DS				
1) Seed	(kg)	30	30	25	45	60	0.4
2) Fertilizers							
- Urea	(kg)	250	200	50	50	30	300
- TSP	(kg)	50	50	50	100	50	250
- KCl	(kg)	100	100	50	50	50	250
- ZA	(kg)	25	25	-	-	-	150
3) Agro-chemicals							
- Insecticides	(lit.)	1	1	1	1.5	1	2.5
- Herbicides	(lit.)	-	-				
- Rodenticides	(kg)	0.5	0.5				
4) Labor	(man-day)	103	103	67	83	97	285
- Family				43	54	59	200
- Hired				24	29	38	85
6) Animal Power	(day)	2.04	2.04	5.22	5.22	12.43	13.04
7) Mech. Power	(day)	2.03	2.03	-	-	-	-

Note: Proposed farm inputs are estimated on the basis of the recommendation of BIMAS package technology in 1994/1995 and 1995. (Rekomendasi, Paket Teknology Tanaman Pangan Propinsi Sulawesi Selatan - MT 1994/1995 dan 1995, Tim Teknis BIMAS Propinsi Sulawesi Sulatan, August 1994)

Under without project condition, it is assumed that the farming practices will remain at the present level and use of farm inputs will also be the same.

For the control of insects and weeds, ecological control is recommended. In the proposed cropping pattern, 3 months of fallow period or palawija cultivation are set in the dry season from September to November. This pattern would effectively control insects and weeds. This long fallow and dry period is effective to cut the life cycle of insects and control aquatic weeds. At present, almost no herbicide is sprayed by the farmers in the Project area. Present weeding is carried out manually and weeds are completely eradicated. It is proposed that this method continue in the future. As is the proposed practice, weeding is carried out manually 3 times after transplanting, depending on the condition of the weed growth. For effective weeding, it is recommended that a rotary weeder, namely "landak" being widely used in Java, be introduced in the area.

As for plant protection, application of some insecticides will be required for the control of brown plant hoppers, stem borers, etc. Considering the life cycle of these insects, 1 liter/ha of insecticides is to be sprayed during one cropping season. In addition, spraying of fungicides will also be recommended, if outbreak or appearance of diseases occurs in the area. For ratting, it is necessary to apply 0.5 kg/ha of rodenticides for each cropping season. These chemicals should be sprayed, when serious damage by pests, diseases and rats is expected in the area. It is proposed that plant protection works should be carried out in a systematic way through the farmer's cooperatives. Individual protection is not recommended because insects and diseases are not limited to individual farm plots. Since 1986, fifty seven types of insecticides for controlling of brown plant hoppers/locusts of paddy plants have been prohibited by the Presidential Decree No. 3 (November 5, 1986). The Government's recommended insecticides are Applaud 10 WP (Buprofezin) for brown

plant hoppers, and Furadan 3G, Dharmafur 3G and Carate 3G for stem borers. Mipcin 50 WP, Bassa 50 EC, and Hopin 50 EC are also proposed, if Applaud 10 WP is not available. Zink Phosphate and Clerat are recommended as rodenticides. The chemicals in the Project area should also be selected in accordance with the regulation.

The supply of farm inputs required under the future project would be supplied by the existing suppliers (PT. PUSRI and PT. PERTANI). The seeds would also be supplied through PT. PERTANI and existing extension systems of the Government.

(2) Labor requirement

The result of the labor balance study for farming under the proposed cropping pattern (with project condition) is summarized as follows:

Labor Balance Study for a Typical Farmer

(Unit: man/day/household)

	Jan.		Feb.		Mar.		Apr.		May		June		July		Aug.		Sept.		Oct.		Nov.		Dec.	
	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II
A	2.7	1.7	1.6	0.9	2.2	2.4	2.6	2.2	2.9	2.7	1.7	1.6	0.9	3.6	2.8	1.9	0.4	0.4	0.2	0.0	2.7	1.0	2.3	2.9
B	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1
C	0.4	1.4	1.5	2.2	0.9	0.7	0.5	0.9	0.2	0.4	1.4	1.5	2.2	-0.5	0.3	1.2	2.7	2.7	2.9	3.1	0.4	2.1	0.8	0.2

Remarks: A = Total peak labor requirement for farming per household.
B = Available labor force per household C = Labor balance
Note: (1) Holding size of a typical farmer = 2.27 ha, (2) Total workable days per month = 24 days

As shown in the above table, labor shortages will occur in the harvesting season in July, which is estimated to be 0.5 man/day/household. This shortage will be covered by hired labor from outside areas. Almost all farmers in the Project area are now carrying out harvesting work under a contract basis, even though they have enough family workers. In the harvesting season, many contractors for harvesting from outside are working in the Project area.

5.1.5 Anticipated Crop Yields and Production

After completion of the Project, it is expected that unit yields of crops would increase considerably on account of adequate irrigation water supply and improved farming practices. The anticipated unit yields of crops under with project condition are estimated on the basis of actual yield record, experimental data, and target yields of Repelita VI in South Sulawesi Province. These yield data are summarized together with the anticipated yields as follows.

Summary of Unit Yield Data and Anticipated Yield

	Present Yields*1	South Sulawesi*2	Maros*3	*4 Repelita VI	Anticipated Yield
Paddy	3.0 - 4.0	5.0	6.3 - 7.0	6.4	6.0
Mungbeans	0.8			1.5	1.5
Soybeans	0.9	1.2	1.3 - 2.4	1.5	1.5
Groundnuts	1.1	2.2		1.5	1.5
Chilies (Large)*5		3.9			3.0

*1 Figures indicate the yields at present condition in the Project area (Household Survey, JICA Study Team, 1994)
*2 Present yields investigated by the Provincial Agricultural Service Office.
Source: Laporan Analisa Usahatani Padi, Palawija dan Hortikultura 1993/94, DINAS Pertanian Tanaman Pangan, Propinsi Sulawesi Sulatan.
*3 Yields at experimental fields of the Maros Research Station.
Source: Laporan Tahunan 1992/93, Balai Penelitian Tanaman Pangan Maros.
*4 Target yields of Repelita VI for 1998 in South Sulawesi Province.
Source: Repelita-VI Propinsi Sulawesi Sulatan, DINAS Pertanian Tanaman Pangan, Propinsi Sulawesi Sulatan.

*5 Dry pods

The unit yield of 6 tons/ha for paddy both for the wet and dry seasons is anticipated under with project condition. As for palawija crops, the anticipated yields of 1.5 tons/ha are adopted for mungbeans, soybeans and groundnuts, and 3.0 tons/ha for vegetables (as chilies).

The annual crop production under with project condition is estimated by multiplying the anticipated unit yields with the future cropping areas as shown in the following table.

Annual Crop Production under With Project Condition

Crops	Area (ha)	Unit Yield (ton/ha)	Production (ton)
Paddy*1	14,000	6.0	84,000
Palawija*2	1,800	1.5	2,700
Vegetables (As Chilies)*3	200	3.0	600

*1 Dry grain *2 Shelled *3 Dry pods

In order to achieve the anticipated yields, the optimum application of farm inputs must be required together with an effective water supply. With the advance and extension of these conditions, the unit yields will increase gradually from the present level to the anticipated yield level in the 5th year after completion of the Project. The yields of these crops under without project condition are estimated to remain at the present level.

5.1.6 Marketing

(1) Marketing of crops

The marketable surplus of paddy produced in the Project area and domestic demand to be expected in the whole country in 2003 are analyzed, in order to assess the crop marketability. The result of the analyses is summarized as follows:

Analysis of Demand and Supply Balance of Paddy

Item		Yr. 2003
- Marketable surplus in the Project area	(ton)	80,100
Total paddy production		84,000
Population (3,100 household x 5.14)		15,900
Per-capita consumption of paddy (220 kg)		
Total consumption in the area		3,500
Seeds and loses (10%)		400
- Surplus in South Sulawesi	(ton)	739,000
- Deficit in the whole country	(ton)	4,600,000
- Percentage of marketable surplus	(%)	1.7

The deficit of rice supply coming from a increase in domestic demand along with population growth will be estimated at 4.6 million tons in 2003, based on the result of the FIDP study. On the other hand, the marketable surplus of rice produced in the Project area in 2003 will be about 80,000 tons which will account for about 1.7 % of the rice deficit in the whole country.

As for the expected surplus of palawija crops, they will also be marketable through the existing marketing channels for paddy. The important element for the marketing of these crops will be quality improvement. After the completion of the Project, quality of the products is expected to be improved through the introduction of irrigation farming with

advanced technology.

(3) Processing and storage facilities

Annual production of paddy will reach about 84,000 tons in the Project area. A certain part of production will be milled within the Project area and/or other nearby towns including Sengkang for local consumption and for markets outside of the Kabupaten, and the remaining portion will flow outside in the form of grain paddy. Although reliable data on the actual requirement of the milling capacity is not available, an assessment on the existing milling capacity in the related three Kecamatan and in Kab. Wajo is carried out compared with the future production in these areas under with project condition.

As a result, as seen in the table below, the existing milling capacity in the three Kecamatan (178,000 tons/year) and in Kab. Wajo (355,000 tons/year) are evaluated to be insufficient if all the production in these areas under with project condition are processed. However, this would not be a serious problem, and all the products in the related three Kecamatan and in Kab. Wajo could be milled, if rice millers extend their daily operation for one or two hours in addition to the present operation of seven hours.

Comparison of Present Milling Capacity and Future Production

(Unit: ton/year)

	Present Milling Capacity	Present Pro-duction	Production in Project		Future Production
			Without Project	With Project	
Three Kecamatan	177,800	174,000	23,580	84,000	234,400
Kabupaten Wajo	357,700	355,000	23,580	84,000	415,400

The existing storage capacities in the related three Kecamatan and Kab. Wajo are also assessed for storing the future marketable surplus under with project condition as seen below:

Present Storage Capacity Compared with Required Storage Capacity

		Three Kec.	Kab. Wajo
1. Existing Storage Capacity	(ton)	68,900	130,500
2. Marketable Surplus			
a. Present wet season production	(ton)	149,500	305,300
b. Future wet season production without the Project	(ton)	21,700	21,700
c. Future wet season production with the Project	(ton)	42,000	42,000
d. Farm population	(prn)	72,600	269,500
e. Per capita consumption *1	(kg)	242	242
f. Total consumption (2d x 2e)	(ton)	17,600	65,200
g. Marketable surplus (2a + 2c - 2b)	(ton)	152,200	260,400
3. Required Storage Capacity			
a. Marketable surplus	(ton)	152,200	260,400
b. Period for collection	(day)	45	60
c. Period for shipping	(day)	120	120
d. Required capacity *2	(ton)	95,100	130,200
4. Balance (1 - 3.d)	(ton)	26,200	310
(1 / 3.d x 100)	(%)	72.4	100.2

*1: Assumed that farmers keep their paddy for annual home consumption including use for seeds and losses.

*2: (3.a / 3.b) - (3.a / 3.c) x 3.b

Source: Agricultural service office and warehouses in Kab. Wajo.

As a result, the existing storage capacity in the three Kecamatan is evaluated to be insufficient to store the marketable surplus from the wet season production for which

maximum storage capacity is required. While, the existing storage capacity in Kab. Wajo is evaluated to be nearly the same as the required storage capacity. Therefore, some expansion and/or new construction of storage facilities would be required in or around the Project area. The sufficient storage facilities to meet the increase in crop production would be required not only for the purpose of storage but also for keeping quality of products high and minimizing storage losses at the farmer's level. Such storage facilities will be expected to be owned by KUD. Since irrigation development would afford a powerful incentive to the farmers' cooperative movement in the area, many KUDs with warehouses, will be established over the development area.

5.1.7 Farm Budgets

After completion of the Project, year round irrigation will be provided in the Project area, thereby, making possible an increase in crop yield and production. In the future with project condition, therefore, a significant increase in farm income is expected. On the other hand, no substantial increase in farm income is to be incurred in the future without project condition. The typical farm budgets for the future with and without the project conditions are analyzed as shown in the table below. The details are as shown in Table 5.1.2, and net return per each crop used in the analysis are presented in Table 5.1.3.

Farm Budget Analysis

(Unit: Rp.1,000/ha)

	Without Project		With Project	
	Rainfed	Pump	Gravity	Pump
1) Gross Income	3,037	5,840	10,199	10,199
- Farm Income	2,624	5,427	9,904	9,904
- Off-Farm Income	237	237	119	119
- Others	176	176	176	176
2) Gross Outgoing	2,804	4,348	6,336	6,663
- Production Cost	1,564	3,108	4,477	4,804
- Living Expenses	1,240	1,240	1,859	1,859
3) Net Reserve	233	1,492	3,863	3,536

Note: 1) It is assumed that living expenses under with project increases 1.5 times from the present level.
2) The average farm size under the future with project condition will decrease from 2.34 to 2.27 ha, because some farm lands will be converted into right of way.

The farm incomes under with project condition will increase remarkably compared with without project condition. The net reserves will also be improved from Rp. 230,000 (rainfed) to Rp. 3,860,000 (gravity irrigation) on an average.

5.1.8 Agricultural Support Services

(1) General

As evaluated in Section 3.6, it can be said that the institutional structure of the supporting system for crop agriculture development is considerably well established in Kab. Wajo as well as in South Sulawesi Province. Under the BIMAS program, SUPRA INSUS, INSUS and INMUM have been implemented in the Project area. Three BPPs have also been organized in the Project area to provide extension services to the farmers. Three KUDs are responsible for marketing farm inputs and outputs, and BRI provides various agricultural credits to meet borrowers' requirement.

From the above viewpoint, the agricultural supporting plan would be programmed within the present framework of institutional structures, for the services. The following is pointed out to improve and strengthen the supporting services in the Project area, from the standpoint of sustaining the project and further developing the farmers' living standard and

regional socio-economy.

(2) Extension services

The Government has place much emphasis on the agricultural extension activities, and the agricultural extension system has already been established over the Project area. In addition, the farmers in the Project area have relatively high techniques for crop cultivation. It is required however, to provide some strengthening programs to the existing system. These are as follows:

1) It seems that PPLs in the area have minor technical experience in irrigation farming. It is therefore required to conduct training courses for PPLs to enable them to carry out their duties effectively in the irrigated paddy field.

2) It is required to provide at least two or three demonstration farms in each village. BPP will appoint several excellent farmers as demonstrators who will cultivate the proposed crops with advanced practices so as to demonstrate them to neighboring farmers. PPL will provide the required farm inputs including recommended seeds, fertilizers, and chemical, and deliver technical and managing guidance periodically.

3) It is proposed to issue several farming leaflets with more visual information. As one of their activities, the extension office is now issuing various leaflets describing advanced farming practices to the farmers, but the contents of the leaflets are difficult for the farmers to understand .

4) The Government is now implementing extension services utilizing radio and TV broadcasting. In addition, it is recommended to issue local newspapers or bulletins periodically.

The existing three BPPs in the Project area do not have enough extension equipment and facilities. It is necessary to equip them with the following to strengthen the extension activities.

a) Printing machine (electric stencil cutting machine and rotary mimeograph)
b) Photo copy machine
c) Motorcycle for each PPL to ensure adequate mobility and effectiveness of the services.
d) Several pick-up trucks for transportation of seeds and farm inputs to be provided to the demonstration farmers.
e) Overhead projector
f) Video and TV set

(3) Agricultural cooperative

To meet with the new irrigation systems, the role of KUD's would become more important in the future. The existing KUDs should expand their business to provide better services to the farmers in the Project area. In the initial stage, the cooperation business would concentrate their efforts on farm input supply and the marketing of production. For instance, in cooperation with the KUT credit system, KUD would take responsibility for handling all fertilizers and agro-chemicals required in the Project area. In cooperation with the DOLOG system, KUDs marketing services would be strengthened both in purchasing and selling of farm products. To strengthen the existing KUDs, it is recommended to implement and adopt the following programs:

1) Since KUDs are still weak in accounting transactions, it is necessary to implement staff training focusing on this aspect.

2) As one of the KUD activation programs, it is proposed to involve more farmers and

younger people in the cooperative activities. The present low rate of farmer's participation (50%) has to be increased. It seems that the young generation have comparatively higher education than the older generation. They will gain experience in cooperative activities through their work, and it is hopeful, will be leaders not only in the farmers' organization but also in the village community.

(4) Agricultural credit

At present, credit services are inactive in the Project area, and almost no farmers use credit for crop cultivation. It can be said that this situation is attributable to inactive agricultural production due to natural disasters. This constraint would however be settled through the construction of irrigation facilities, and it is foreseeable that the farmers' requirement for credits will increase. The following credits would especially be required to achieve the project target and to encourage further development.

1) For group or individual farmers: Credit for maintenance and replacement of pumping facilities.

2) For KUD and individual farmers: Funds for purchasing farm inputs such as fertilizers and agro-chemicals.

3) For KUD: Working capital for handling products.

To the above 1), KUPEDES is applicable. This credit is for individual farmers. In case of group operation, one representative farmer should take responsibility for this credit. The maximum credit amount of KUPEDES is Rp. 25,000,000 with an interest of 18% p.a. KUT will be provided to individual farmers for purchasing farm inputs through KUD. It seems that the banker has no objection to release KUT to the farmers under irrigation farming. KPP is available for working capital of KUD. Since 1989, BRI has loaned Rp. 3.4 billion to 79 KUDs in Kab. Wajo. It would be possible to provide this credit to KUDs in the Project area.

To make smooth implementation of the above credit services, it is recommended to adopt the following system to the present credit program:

1) Delinquent repayment is one of the problems in developing agricultural credit services. To settle this problem, it is proposed to adopt a system of group lending in which group members guarantee mutual repayment. Under this system, KUD provides a required amount of loan to a group. A representative of the group collects repayments from members and repays it to KUD, and collection is not made by KUD.

2) Procedures for credit application should be simplified either for individual or group farmers, so that the realization of agricultural credit could meet the need of farmers in time. Thereby, the provision of a simplified application form with easy procedure and the preparation of farmers' background data are necessary in making rapid credit applications.

5.1.9 Women in Development

After the implementation of the Project, more intensive farming would be introduced over the Project area, and multi-cropping intensity would increase from 117% to 229%. Under this situation, the following negative and positive impacts on women's living is expected.

The Project needs various kinds of supporting services for marketing of farm inputs and products, post harvest, transportation, institutional activities, etc. These activities would be strengthened by the Government agencies concerned and the farmers. In parallel with the

economic and social development, farming women would also have opportunity to participate in these activities. In addition, 139 P3As would be established over the Project area, and they would play an important role in O&M of the tertiary system of the Project. It is proposed to involve women's power in P3As' activities so as to promote women's participation in public affairs. PKK is expected to promote this proposal.

Heavy farm work such as transplanting and weeding would increase more from the present level, and women would be forced to do this works, although they are carried out commonly by both males and females present. To lighten this work for women, it is proposed to introduce a manual transplanting machine with a rotary weeder. Although the labor requirement for transplanting can't be reduced by the use of this machine, it is possible to lighten the heavy work. This machine is assembled from parts of bicycles, and its maintenance is easy. This machine could be transported easily by bicycle.

5.2 Irrigation and Drainage Development Plan

5.2.1 Delineation of the Project Area

The proposed route of the main canals of Alternative III has been examined based on the 1:5,000 topographic map (partly on 1:25,000 map) and the result of the canal route survey. The whole potential irrigable area is estimated at 7,000 ha in net consisting of 5,880 ha of gravity irrigation system and 1,120 ha of pump irrigation system. The area of the gravity system is to be irrigated by constructing an intake weir at the downstream of the proposed dam. The pump irrigation systems cover 440 ha located upstream of the Gilirang river and 680 ha located along the proposed main canals. The general layout of proposed irrigation area or Project area is illustrated in Figure 4.2.7, and distribution of the area is summarized as follows:

Distribution of Irrigation Development Area

	Gravity Irrigation	Pump Irrigation	Total
a) Left Main Canal	2,030 ha	75 ha	2,105 ha
b) Right Main Canal	3,850 ha	605 ha	4,455 ha
c) Upstream Area	0 ha	440 ha	440 ha
Total	5,880 ha	1,120 ha	7,000 ha

5.2.2 Water Resources

As assessed in Section 4.2, the construction of the dam is indispensable for the effective use of water resources of the Gilirang river, which is the only water source in the Project area. By constructing a dam with a maximum crest elevation of EL. 56.5 m, the maximum storage capacity is to be 132 MCM and the effective storage capacity is to be 115 MCM. With this reservoir, irrigation water will be supplied to the whole irrigation area of 7,000 ha for the cultivation of the wet and dry season paddy and 2,000 ha for the dry season palawija, as also assessed in Section 4.2.

5.2.3 Irrigation and Drainage Water Requirement

(1) Irrigation water requirement

The irrigation water requirement is estimated based on the following formulas for both paddy and palawija. The estimate is carried out on a half-monthly basis.

a) Irrigation water requirement for paddy

$$WRD = (CU + PL + LP - ER) / E$$

b) Irrigation water requirement for palawija

$$WRD = (CU - ER) / E$$

where,
- WRD : Irrigation water requirement (mm)
- CU : Consumptive use of water (mm)
- PL : Percolation loss (mm)
- LP : Land preparation requirement (mm)
- ER : Effective rainfall (mm)
- E : Combined irrigation efficiency

The consumptive use of water is estimated as a product of potential evapotranspiration with the crop coefficient at the rating crop growth stages of the alternative cropping pattern. The modified Penman method is employed in predicting the potential evapotranspiration for reasons of accuracy and available data. The climatological data at Sengkang is used for the calculation of the continuous fifteen (15) years from 1979 until 1993.

Percolation loss of 2 mm/day is assumed for both wet and dry season paddy based on the observed data. Land preparation requirement, including the requirement for a water layer replacement, nursery water requirement, and puddling water requirement, is calculated using the formula recommended by DGWRD Design Standard with the condition that the total requirement is 250 mm. The land preparation period is set at 30 days.

Effective rainfall is estimated using rainfall data at Sakkoli station. The effective rainfall for the paddy field is estimated using daily rainfall data with an assumption that 80 % of the daily rainfall, which is greater than 5 mm/day and less than 40 mm/day, is effective. The effective rainfall for palawija is estimated based on the evapotranspiration/precipitation method prepared by USDA on a half-monthly basis.

Irrigation efficiencies for paddy and palawija are estimated as follows, taking into account the condition that the unlined canals up to rotation blocks are adopted and the palawija is irrigated by surface irrigation.

Irrigation Efficiencies for Paddy and Palawija

Irrigation efficiency	Paddy field	Upland field
Conveyance efficiency	85 %	85 %
Application efficiency	75 %	60 %
Overall efficiency	64 %	51 %

The unit diversion water requirement of 1.76 l/sec/ha is gained in accordance with the above estimate. The details are given in Annex 4.

(2) Drainage water requirement

In the irrigation project, there are generally two kinds of drainage water requirements. One is the drainage water requirement to remove excess water in the Project area, and the other is to transport the runoff from outside of the Project area. The drainage water requirements for both areas are estimated in accordance with DGWRD Standard using a probable 3-day rainfall for inside the Project area and a probable 1-day rainfall for outside the Project area with a return period of five (5) years, at Sakkoli station. The details are shown in Annex 4.

5.2.4 Layout of Irrigation and Drainage Canal Networks

(1) Irrigation canal system development

Irrigation canal system in the Project area consists of main canals, secondary canals, tertiary canals and quaternary canals. The alignment of the main canal has been made carefully based on the following considerations:

a) Canal construction cost should be minimized.
b) Irrigation development area should be maximized.
c) Work quantity in canal construction should be minimized.
d) Attention should be paid to the sections at foot hills to avoid damages from heavy rain.

In the Project area, two main canals, i.e. the left main canal and the right main canal, will be constructed to deliver water from the intake weir to the downstream area. Total length of the left and right main canals will be 21.0 km and 26.5 km, respectively. Total length of secondary canals will be 37.2 km including 1.7 km for the upstream pump irrigation system.

(2) Drainage canal system development

The Project area extends over the foot of the low mountainous ranges and continues to the low-lying area along the Gilirang river. Flood runoff from the mountainous area flows directly to the Project area. Accordingly, the proposed drainage system should have enough capacity to transport the flood runoff and remove excess water in the irrigation area.

The drainage canal layout has been worked out based on the 1:5,000 topographic map and the field investigation taking the following concepts into account:

a) The natural drainage system should be carefully studied so as to be included in the proposed system as much as possible.
b) Drainage canal alignment should be made paying attention to the present land use.
b) Drainage canal routes should be designed as straight as possible and laid out on lower elevated areas to remove the runoff smoothly and decrease the construction cost.

The drainage canal system will consist of major, tertiary, and quaternary drains. The tertiary and quaternary drainage canals will be developed at the on-farm level. The function of the major drain is to transport water from the tertiary drains and flood water from the surrounding mountainous area to the disposal points. The irrigation system layout and topographic condition are the main factors in determining the location of drainage canals. The route of the major drains is generally selected in the natural stream lines and low depressions.

5.3 Water Resources Development Facilities

5.3.1 Dam and Ancillary Works

The purpose for constructing the Paselloreng dam is to reserve and regulate the flow of the Gilirang river and to divert the required amount of water for the irrigable area in the downstream reaches. The proposed dam site is about 11 km upstream from the Gilirang gauging station.

The maximum crest elevation of the dam was fixed at EL. 56.5 m in accordance with the

results of the technical and economical study considering its topographic limitation, as follows;

1) The lowest elevation of the narrow ridge at Desa Arajang is EL. 56.7 m and the saddle dam section and numbers suddenly increase if the crest elevation becomes higher than EL. 56.5 m. The optimum crest elevation would be estimated to be EL. 56.5 m as a result of the economical evaluation. (Refer to Annex 3)

2) If the elevation of non-overflow crest is higher than that of the narrow ridge, the possibility of erosion of embankment increases due to wave action in case of flood, and so the safety of the dam would deteriorate at maintenance.

The freeboard is determined to be 6.0 m by adding the overflow depth at the spillway and wave height. Thus, the maximum normal water level is determined to be EL. 50.5 m. The maximum storage capacity of dam is estimated at 132 MCM from the topographic conditions of the reservoir area. The dead storage capacity is 17 MCM in consideration of the sediment in the reservoir and the effective storage capacity is 115 MCM. According to the water balance study for a fifteen year period, the effective storage capacity will ensure successful irrigation for the Project area with the proposed cropping pattern and intensities with a dependability level of more than four years out of five years (80 %).

The main dam will be a rockfill dam having a central impervious earth core. The maximum height of dam will be 44.5 m from the foundation rock. Foundation treatment including grouting, impervious soil trench cutoff, and drainage system will be provided for the dam foundation.

A double line of diversion tunnels will be constructed at the right bank to regulate the design flood inflow of a 10-year flood with a peak flood of 680 m^3/sec. The respective length of the diversion tunnels will be 340 m and 360 m with a diameter of 6.0 m. One of them will be used as an intake for diverting the irrigation water after completion of the dam construction.

A non-gated spillway of a side channel overflow weir type will be constructed on the right abutment of the main dam. The spillway is designed to be capable of releasing the design flood of 1,300 m^3/sec which will correspond to a 1,000-year flood. A chuteway, a stilling basin, and an open channel will be constructed in the downstream of the side overflow channel.

Intake facilities will be constructed by use of a diversion tunnel with installation of a sluice gate at the inlet, and a guard and regulation valves at the outlet. The design intake discharge is 13.5 m^3/sec.

The principal features of the Paselloreng dam are summarized as follows: (See Figure 5.3.1 and 5.3.2)

a) General

- Catchment area (at dam site)	:	169 km^2
- Reservoir surface area at N.W.L.	:	11.0 km^2
- Storage capacity		
Maximum storage capacity	:	132 MCM
Effective storage capacity	:	115 MCM
Dead storage capacity	:	17 MCM
- Water level		
High water level	:	EL.53.8 m
Normal water level	:	EL.50.5 m
Low water level	:	EL.34.0 m

b) Dam
- Type : Rockfill dam having central impervious earth core
- Crest elevation : EL.56.5 m
- Dam height : 44.5 m
- Crest length : 230.0 m

c) Spillway
- Type : Non-gated side channel overflow weir
- Design flood discharge : 1,300 m^3/sec
- Crest elevation : EL.50.5 m
- Crest length : 101.0 m

d) Diversion tunnel
- Type : Pressured tunnel
- Design diversion discharge : 680 m^3/sec
- Diameter : 6.0 m

e) Intake
- Design discharge : 13.5 m^3/sec

5.3.2 Intake Weir

The Gilirang intake weir will be constructed on the east of Gilirang village and about 11 km downstream of the dam site. The Gilirang intake weir will consist of a diversion weir, gated intakes on left and right banks, operation bridge, and river closure embankment. The diversion weir will be a fixed type constructed with concrete.

The diversion structure has been designed using the maximum design flood discharge with a return period of 100 years following the DGWRD Standard. Probable peak flood discharge, which is the recurrent flood of 100-years after the dam constructions is adopted for the design.

The crest level of the weir is determined at EL. 18.2 m to provide a water level of EL. 18.0 m at the head of left and right main canals. The design diversion discharge is 11.41 m^3/sec consisting of 3.66 m^3/sec for the left main canal and 7.75 m^3/sec for the right main canal. In order to control sediment discharge, scoring sluices will be provided on both side ends of the weir.

The principal features of the Gilirang intake weir are summarized as follows: (See Figure 5.3.3 and 5.3.4)

a) Diversion weir
- Type of weir : Fixed type
- Material of weir : Concrete
- Crest elevation : EL.18.20 m
- Design flood discharge : 570 m^3/sec
- Intake water level : EL.18.00 m
- Design flood discharge : 570 m^3/sec
- Diversion discharge
  Left main canal : 3.66 m^3/sec
  Right main canal : 7.75 m^3/sec
- Crest length of fixed weir including piers : 78.6 m
- Width of scoring sluice
  Left side : 2.0 m x 2 Nos.
  Right side : 3.0 m x 2 Nos.
- Width of intake
  Left side : 1.3 m x 2 Nos.

Right side	: 2.2 m x 2 Nos.
- Height of weir (from stilling basin)	: 6.2 m
- Operation bridge	
Total width	: 6.0 m
Total length	: 93.6 m

b) Closure embankment

- Type of embankment	: Homogeneous
- Crest elevation	: EL.21.63 m
- Crest width	: 5.0 m
- Max. height (from riverbed)	: 9.63 m
- Crest length	: 740 m

5.3.3 Pumping Units

Pumping units to be introduced to the Project have been decided in accordance with the following criteria:

a) To introduce small scale pumps which are familiar with farmers in the Project area.
b) To introduce similar type of pumps having similar capacities to make maintenance easy and spare parts available.
c) To introduce a movable type of pump for easy storage during the off-season.

In addition to the above criteria, size of the irrigation area, required discharge of the irrigation water, and required total pump head have been examined for each tertiary block. The pump irrigation systems will be introduced for a total area of 1,120 ha consisting of 38 tertiary blocks, 5 blocks on the left main canal, 23 blocks on the right main canal, and 10 blocks on the upstream area. Out of 10 tertiary blocks on the upstream area, 6 blocks will form one secondary block. The command area of each tertiary block varies from 3 ha to 134 ha. The required total pump head of each block also varies form about 3 m to 9.5 m.

Through the examination, the following three (3) types of irrigation pumps have been selected for the Project:

a) Type I with a pumping capacity of 1.4 m^3/min., 4 inches, and 10 PS of engine,
b) Type II with a pumping capacity of 3.5 m^3/min., 6 inches, and 18 PS of engine, and
c) Type III with a pumping capacity of 6.0 m^3/min., 8 inches, and 27 PS of engine.

The table blow shows the summary of pump irrigation systems to be introduced under the Project:

Main Features of Pump Irrigation Systems

	Pump Area (ha)	Tertiary Block (No.)	Numbers of Pump			
			Type I	Type II	Type III	Total
Left main canal	75	5	1	4	0	5
Right main canal	605	23	5	15	6	26
Upstream area	440	10	0	3	7	10
Total	1,120	38	6	22	13	41

5.4 Irrigation and Drainage Facilities

5.4.1 Irrigation Canal and its Related Structures

(1) Design criteria

The design of the proposed canals has been carried out based in principle on the DGWRD standard. The design criteria are summarized as follows (for details refer to Annex 4):

Summary of Design Criteria for Earth Canal

Velocity (m/sec) :	(m/sec)
	0.3 - 0.7
Roughness (Value for Manning's formula) :	
(Discharge: m^3/sec)	
< 1.0	0.0285
1.0 - 5.0	0.025
5.0 - 10.0	0.0235
(Concrete flume)	(0.015)
Freeboard	
(Discharge: m^3/sec)	(m)
0.5 - 1.5	0.5
1.5 - 5.0	0.6
5.0 - 10.0	0.75
Canal base width/water depth (B/h) ratio	
(Discharge: m^3/sec)	
0.5 - 1.5	1.2 - 1.8
1.5 - 3.0	1.8 - 2.3
3.0 - 5.0	2.3 - 2.9
5.0 - 7.5	2.9 - 3.5
7.5 - 10.0	3.5 - 3.9
Side slope	
(Discharge: m^3/sec)	
<1.5	1.0
1.5 - 10.0	1.5

(2) Proposed main and secondary irrigation canals

The proposed layout of the irrigation system is shown on Figure 5.4.1, and the irrigation diagram is given in Figure 5.4.2. The typical cross sections of these canals adopted in this design are shown in Figure 5.4.3.

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

Main Features of Main and Secondary Irrigation Canals

Description	Left Bank	Right Bank	Total
Main Canal			
- Canal length (km)	21.0	26.5	47.5
- Related structure			
Turnout w/check (for gravity)	16	23	39
Turnout w/check (for pump)	5	23	28
Aqueduct	0	1	1
Road crossing (culvert)	7	8	15
Spillway/wasteway	8	10	18
Cross drain (box culvert)	8	7	15
Cross drain (pipe culvert)	57	39	96
Measuring device	1	1	2
Secondary canal			
- Nos. of secondary canal	5	9	14
- Length of secondary canal	8.1	29.1	37.2
- Related structures			
Turnout w/check (for gravity)	14	38	52
Road crossing (culvert)	2	7	9
Spillway/wasteway	1	5	6
Cross drain (box culvert)	0	1	1
Cross drain (pipe culvert)	13	44	57
Drop	4	2	6
Syphon	0	1	1

5.4.2 Drainage Canal and its Related Structures

(1) Design of the drainage canal system

1) Design discharge

The drainage diagram which shows the drainage area and the design discharge is illustrated in Figure 5.4.4.

2) Canal section

The drainage canal sections are designed based on the following criteria:

Type of canal	:	Trapezoidal earthen canal
Permissible velocity	:	0.3 - 0.6 m^3/sec
Roughness coefficient	:	0.03 (for the use of Manning's formula)
Side slope of canal	:	1:1.0

3) Related structures

The structures related to the drainage system will be bridges, drops, and drainage junctions. The bridge will be provided at the road crossing points. The drops will be of cascade type with trapezoidal sections. The gabion mattresses will be used for the drainage drops. The drainage junctions will be provided at the connecting points of major drains to protect against bed erosion.

(2) Proposed drainage canal system

The typical cross sections of the drainage canal adopted in the design are shown on Figure 5.4.3. There are 17 existing major drains (natural streams and branches of the Gilirang river) with a total length of 151.9 km in the Project area. It is proposed to excavate some parts of the above major drains with a total length of 57.2 km. Major drains in the Project

area are summarized as follows (for details refer to Annex 4):

Major Drains in the Project Area

Nos. of existing major drains	17	drains
Total length within the Project Area	151.9	km
Proposed length for excavation	57.2	km

5.4.3 On-farm Development

The tertiary development program is prepared for every tertiary block based on the DGWRD standard. The tertiary block is further divided into several subordinate blocks like sub-tertiary blocks and quaternary blocks. The typical layout of the tertiary system is shown in Figure 5.4.5. The layouts of representative tertiary systems are shown in Figures 5.4.6 to 5.4.8. There will be 139 tertiary/sub-tertiary blocks in the Project area. The total length of tertiary canals will be 236 km. The average length of the tertiary canal per block is estimated at 1.7 km/block. The area of each block will vary from 3 ha to 197 ha due to the topographical conditions, some vast blocks will be divided into several sub-tertiary blocks for easy water management.

5.4.4 Farm Road Network and Inspection Road

For the proper construction, operation and maintenance of the project facilities, a well arranged road network is vital. The Project area presently had poor road conditions during the wet season. For construction purposes selected village roads transversing the area will be improved. After completion of the Project, these roads will be transferred to the village link roads. In addition, canal inspection roads will be provided along with the main, secondary and tertiary irrigation canals. These will also be used as farm roads.

(1) Farm road

Farm roads totaling 27.5 km will be improved and networked with the provincial roads. The roads are designed to have a width of 6 m with a gravel pavement width of 3 m. Catch drains will be provided on both sides along the road to carry rainfall from the road surface and surroundings into the drainage canals. Cross drains with concrete pipe culverts will also be constructed under the road at approximately 500 m intervals to pass drainage water into the catch drain. The proposed farm roads to be improved are four (4) sections as summarized below:

Farm Roads to be Improved under the Project

Section (Passage Village)	Length (km)
1. Gilirang - Arajang - Dam site	7.5
2. Benceng-2 - Bacubaccue - Padewakeng	6.2
3. Pontoe - Sarammae - Allapporeng	8.3
4. Sarammae - Bacubacue	5.5
Total	27.5

(2) Main inspection road

Main inspection roads are required for inspection, operation, and maintenance of the main canals. The main inspection road is designed to have a width of 6 m with a gravel pavement width of 3 m, taking into account the future increase of vehicles for these purposes and the heavy construction equipment required for canal maintenance. The road will also be used as a farm road for the transportation of agricultural inputs and outputs.

(3) Secondary inspection road

Secondary inspection roads will mainly be provided along the secondary irrigation canals. All these roads will have a width of 6 m with gravel of 3 m width. These roads will link the paddy fields to the main road and will also be used for farm operations.

(4) Tertiary inspection road

For the same purpose as the secondary inspection roads, tertiary inspection roads will be constructed along one side of all tertiary canals. These roads will have a width of 3 m without pavement. The length of each type of inspection road is shown below:

Tertiary Inspection Road to be Constructed

Road	Length (km)
Main inspection road	47.5
Secondary inspection road	37.2
Tertiary inspection road	236.0

The typical cross sections of the proposed farm roads and inspection roads are shown in Figure 5.4.3.

5.5 Implementation Schedule

5.5.1 Basic Considerations for Construction

Project implementation schedule is formulated based on the following considerations:

Civil works to be executed by the Project are broadly classified into main civil works and tertiary development works. The civil works consist of construction of the main project facilities such as the Gilirang intake weir, Paselloreng dam, main and secondary canals, major drainage canals, and construction roads. The tertiary development works include all the facilities below the tertiary outlets such as the tertiary irrigation canals, tertiary drains, farm ditches, and their related structures.

The main civil works will be undertaken by a qualified civil work contractor/ contractors with assistance of foreign technical services, and should be selected through competitive bidding, and the tertiary canals drains and roads, by the local contractors. The quaternary canal networks in the tertiary system will be constructed by farmers under the guidance of the local government.

As the main civil works of the Project include a large volume of earth works, mechanized construction will principally be introduced. In order to increase the employment opportunity in and around the Project area, however, manpower construction will be adopted as much as possible. The tertiary development works will be carried out by manpower with minor construction equipment.

Taking into account the large scale of civil works, the Project will be implemented in three stages; i) detailed design of the main project facilities, ii) construction of the main project facilities and iii) the detailed design and construction of the tertiary development works. The tertiary development works will be initiated simultaneously with the main works, so that upon completion of the main works, immediate benefits can be envisaged.

5.5.2 Implementation schedule

The Project implementation schedule is shown in Figure 5.5.1. It includes the project preparatory works and the construction works. The project preparatory works will last 24 months including the time necessary for additional photo mapping works, the detailed design works, mobilization, and construction of offices and quarters. The construction works will last 43 months for the main civil works and tertiary development works.

Project mobilization which includes financing, legalization, and establishment of the project organization will have to be completed by the middle of 1996. In order to facilitate the early commencement of construction works, tendering should be promoted for October 1997.

5.5.3 Construction plan

(1) Basic assumptions

Twenty five (25) days per month are applied as workable days of normal works such as concrete works, foundation treatment works, construction works of irrigation facilities, etc. On the other hand, as the impervious materials of the dam embankment are affected by heavy rainfall, the workable days for these materials in the wet season are reduced. The time suspended is set for the respective ranges of daily rainfall as follows:

Daily rainfall depth (mm)	Time to be suspended (day)
0 - 10	0
10 - 30	0.5
30 - 50	1.0
more than 50	2.0

The workable days are estimated to be 250 days per annum.

(2) Preparatory works

Preparatory works such as additional aerial photo mapping, detailed design, construction of office and quarters, and land acquisition will be started in April of 1996. An Aerial photo map on a scale of 1:5,000 with a contour interval of 0.5 m will have to be prepared for the Project area of 5,000 ha. This map will be used for the design and construction of the tertiary development. The detailed design of the Gilirang intake weir, the Paselloreng dam, irrigation system and drainage system will be started in April 1996. The design will be completed by the end of March 1998. The project office and quarters will be completed prior to the major construction works, and will be started from November 1996 and completed by the end of September 1997. The land acquisition for the project facilities will be completed at least one year prior to the construction works.

(3) Gilirang intake weir

The weir consists of various components such as an intake weir, intake, bridge, diversion channel, closure embankment, etc. The weir will be constructed by means of a diversion channel. The time required for construction of the intake will be 36 months from the start of the preparatory works.

The construction of the weir will be carried out in the excavated site on the diversion channel under dry conditions. Since the weir consists mainly of concrete, it will be constructed by machine and the time required for completing the weir will be 25 months. The construction of the weir will start on the beginning of September 1998 and be completed by the end of September, 2000.

After completing the intake weir, the excavation of the diversion channel will be started and

completed by the end of February, 2001. Earthfilling of the closure embankment will be carried out using the excavated material from the diversion channel, so that the embankment will be conducted in parallel with the construction of the diversion channel. Since these works involve a large volume of earthworks, heavy equipment will mainly be employed.

(4) Paselloreng dam

The time required for completing the dam will be about 43 months from the start of the preparatory works at the beginning of September 1998. Following the completion of the diversion works, the main dam construction will be started in August, 1999 and completed by the end of December, 2001. Diversion tunnel excavation will be executed by blasting and picking, and the excavated muck will be hauled to the stock pile by dump truck. Concrete lining will be done using steel form.

Excavation of the dam foundation will be made mainly by heavy equipment such as bulldozer, ripper-dozer, and back-hoe shovel. Rock excavation will be executed by blasting. After excavation of the dam core trench, curtain-grouting will be executed by a combination of boring machines and grouting pumps. Embankment materials to be transported from the proposed areas will be spread and compacted by bulldozers at the specified thickness.

The concrete work of the spillway will be executed in parallel with the embankment work of the main dam, starting in January, 2000 and completed by the end of July, 2001. The construction of the intake and installation of the gates will be executed in 6 months and completed by the end of November, 2001.

After completion of all the works concerning the dam construction, plug works in the diversion tunnel will be executed.

(5) Irrigation system, drainage system and, construction roads

Construction of the main irrigation canal including the main inspection road will be carried out for 22 months from December, 1998 through September, 2000. In parallel with construction of the main irrigation canal, the construction of secondary irrigation canals will be started in October, 1999, and completed within 17 months. The construction of the irrigation canal will be executed from the upper reaches to the lower reaches. In the rainy season, the earthworks will be suspended and the main effort will be paid to the construction of related structures. Excavated materials from the canals will be used for the embankment of canals and for inspection roads.

The construction road for access to the construction site will be started in October, 1998, in parallel with the construction of the main canal and inspection roads. The inspection roads will be utilized as access roads during the construction. The construction of major drainage canals will be executed from January, 2000 to the end of March, 2001.

Pavement of the inspection roads and construction roads will be made during the final stages of the respective construction periods.

(6) Tertiary development

Detailed design of the tertiary development will be started from April, 1998 based on additional aerial photo maps and field survey results. The construction will be executed in stages. The construction will be started in February, 2000 from the upper part of the Project area, and be completed by the end of November, 2001.

5.6 Cost Estimate

5.6.1 General

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

1) The exchange rate used in the estimate is :

US$ 1.0 = Rp. 2,160 = ¥97.27

2) Construction works will be executed on a contract basis. The construction machinery and equipment required for the construction works will be provided by the contractors. Therefore depreciation costs of the machinery and equipment is considered in the estimate of the construction cost, instead of the procurement cost of machinery and equipment.

3) The construction unit price comprises foreign currency and local currency portions. The foreign currency portion and the local currency portion basically include the following costs:

   a) Local currency portion
      - Local labor cost
      - Cost of local materials
      - Inland transportation cost
      - Contractor's general expenses

   b) Foreign currency portion
      - Foreign labor cost
      - Cost of imported materials and foreign portion of local materials
      - Contractor's general expenses

4) The construction unit prices are estimated on the basis of the current price in South Sulawesi and of data obtained from on-going irrigation projects around the Project area, i.e. the Bila and the Langkeme Irrigation project. Labor cost, material cost, and equipment cost of those unit prices are adjusted to the prices in August 1994, based on the statistical data. The labor cost, the material cost, and the equipment cost are presented in Annex 7.

5) Physical contingency related to the construction quantities is set at 10% of the direct cost in view of the preliminary nature of the estimate. The price contingency of 2.5% per annum for the foreign currency portion and 6% per annum for the local currency portion is included in the estimate.

6) Associated costs to be financed by the Government, such as the cost for strengthening extension services, construction of facilities of the water users' association, and improvement of social infrastructures are not included in the estimate.

5.6.2 Project Cost

(1) Estimate of construction cost

The construction cost comprises direct construction cost, cost for preparatory works, cost for O&M equipment and facilities, land acquisition and compensation cost, administration cost, engineering services cost, physical contingency, and price contingency. The total construction costs of the Project are estimated at Rp. 160,688 million, comprising Rp. 61,063 million of local currency and Rp. 99,625 million equivalent of foreign currency. A

summary of the total construction cost is shown in Table 5.6.1. A breakdown of the direct construction cost and the construction unit prices are presented in Annex 7.

The cost breakdown of O&M equipment and facilities, land acquisition and compensation, and engineering services are presented in Annex 7.

(2) Annual disbursement schedule

The annual disbursement schedule is worked out based on the construction time schedule as shown in Table 5.6.2. The summary is shown below:

Annual Disbursement Schedule

(Unit : Rp. Million)

Year	Foreign Currency	Local Currency	Total
1996	4,368	1,384	5,752
1997	5,894	1,956	7,850
1998	11,185	6,674	17,859
1999	23,842	13,163	37,005
2000	30,589	23,815	54,404
2001	23,747	14,071	37,818
Total	99,625	61,063	160,688

5.6.3 Annual Operation and Maintenance Costs

Annual operation and maintenance costs at full development stage are estimated at Rp. 804 x 10^6, comprising costs for i) salaries and wages, ii) running costs and iii) maintenance costs of the project facilities. These costs are presented in Annex 7.

5.6.4 Replacement Cost

Some of the project facilities, especially equipment and mechanical works have a shorter useful life than civil works, and require replacement at a certain time within the project's useful life. The replacement cost is estimated at Rp. 12,505 x 10^6. The breakdown of the cost and the useful life are presented in Annex 7.

CHAPTER 6 PROJECT ORGANIZATION AND MANAGEMENT

6.1 Organization for the Project Execution

The Directorate General of Water Resources Development (DGWRD), the Ministry of Public Works will be the executing agency for implementation of the Gilirang Irrigation Project. DGWRD will coordinate all activities of the relevant Government agencies and regional administrative organizations in connection with the project implementation.

The Directorate of East Region Implementation (DERI) under DGWRD will have direct responsibility for the project implementation including both the engineering and the construction works. DERI comprises five (5) Sub Directorates by each region, and the Project will belong under the Sub Directorate of Regional-II Implementation, South Sulawesi. The South Sulawesi Provincial Public Works for Water Resources (DINAS PU Pengairan Sulawesi Selatan) will coordinate the construction of the Project at the provincial level on behalf of the Ministry of Public Works.

The Construction Office of the Gilirang Irrigation Project (the Gilirang Project Office) will be newly established in or near the project site. At present, there is an existing DERI construction office at Sengkang, Kabupaten Wajo for the Bila Irrigation Project Office which is now managing three (3) on-going irrigation projects located in and around Kabupaten Wajo; i.e., Bila, Langkeme, and Luwu Projects. It is proposed that the Gilirang Project Office also belongs to the Bila Project Office. The organizational structure is proposed as presented in Figure 6.1.1, referring to the Bila Project Office. The proposed Project Office has almost the same organizational structure with that of the on-going projects. Necessary staff will be despatched from DERI and the DINAS PU Pengairan, Ujung Pandang.

6.2 Organization for Operation and Maintenance

The DINAS PU Pengairan which is under the Provincial Government is responsible for the operation and maintenance (O&M) of irrigation systems of the Province. After completion of the project works, all project facilities constructed by the Gilirang Project Office will be handed over to this Office. O&M of the tertiary blocks down to terminal facilities is entrusted to the water user's association (P3A).

The DINAS PU Pengairan has many branch offices which are classified into three ranks according to the size of the irrigation service area; i.e., Cabang (25,000 ha), Ranting (5,000 ha), and Sub Ranting Offices (1,000 ha). The O&M Office of the Project having about 7,000 ha will be ranked as a Ranting Office, and will have several Sub Ranting Offices. The Ranting Office of the Project would be established in or near the project area, and the Sub-ranting Offices would be established in the project area. For smooth and effective management, it is proposed to divide the service area into four areas (4 Sub Ranting Offices); one in the upstream area including the dam and intake weir, one in the left bank area, and the remaining two in the right bank area. The planned organizational structure of the O&M Office is shown in Figure 6.2.1, based on PU regulations and that of several existing offices. The proposed O&M Office will be divided into 5 sections; i.e. Security, Operation, Repair and Maintenance, Tertiary, and Administrative Affairs.

The existing irrigation systems in Kab. Wajo are managed by the Soppeng-Wajo Cabang Office which is located at Watang Soppeng, Kab. Soppeng. The O&M Office of the Project will be under this Cabang Office. It is planned to establish a new Cabang Office in Kab. Wajo following the Government's policy of localization of O&M for irrigation systems. In

this case, the operation and maintenance of the Project will be implemented by a new Cabang Office under Kab. Wajo. In either case, it is foreseeable that the organizational structure of the Cabang Office itself will not be drastically changed in its functions.

O&M equipment required during the O&M stage are bulldozers, motor graders, vehicles, measuring instruments, and so on. The Ranting Office of the Gilirang Irrigation Project will have this equipment.

6.3 Water User's Association

The policy of the Indonesian Government on O&M of irrigation facilities is meant to arouse a sense of belonging and responsibility to the farmers to keep and operate the irrigation system. Based on this policy, water user's associations called "Perkumpukan Petani Pemakai Air" (P3A) have been established. A P3A is organized in every tertiary block without exception. In accordance with the above policy, the following P3As would be established in the Project area.

Number and Size of P3A to be Established in the Project Area

		Left Bank*1	Right Bank I	Right Bank II	Right Bank III*1	Total
Gravity Irrigation						
- Irrigable Area	(ha)	2,030	1,299	1,301	1,250	5,880
- No. of P3A	(No.)	28	32	26	15	101
- Average Size of P3A	(ha)	73	41	50	83	58
Pump Irrigation						
- Irrigable Area	(ha)	75	859	186	-	1,120
- No. of P3A	(No.)	5	24	9	-	38
- Average Size of P3A	(ha)	15	36	21	-	29
Total						
- Irrigable Area	(ha)	2,105	2,158	1,487	1,250	7,000
- No. of P3A	(No.)	33	56	35	15	139
- Average Size of P3A	(ha)	64	39	42	83	50

*1 Irrigation block covered by the Sub Ranting Offices.

The organizational structure of P3A is planned as shown in Figure 6.3.1, referring to the existing associations located in Kabupaten Sidrap and the guideline prepared by the DINAS PU Pengairan. P3A will have a Board, and be staffed by three leaders (a manager, treasurer, and secretary) and a "Mandor Wae" (water master). One Mandor Wae is employed in each P3A to carry out operation and management of the tertiary block. The Gilirang O&M Office and Tertiary Scheme Section in the Soppeng-Wajo Cabang Office are responsible for establishment of P3A's in cooperation with the offices concerned (Administrative Offices of Kabupaten, Kecamatan, and Desa). In particular, the Tertiary Scheme Section will provide full technical guidance and advice for water management and maintenance of the irrigation facilities, because the farmers in the Project area have no or little experience of on-farm water management. The activities of the P3A's leaders and Mandor Wae are important for proper water management both at on-farm level and at project level. In order to fulfill their missions, it is necessary that they have thorough knowledge of water management in the Project as well as at on-farm level.

Standard articles and by-laws of P3A have been prepared by the PU Pengairan under several Decrees. These articles and by-laws are adopted by all P3A's in the Project area. Tertiary block P3A's fill out this document and submit it to the Bupati Office witnessed by Camat and Kepala Desa. The Bupati Office registers the association according to the Decrees, thereby authorizing it as water a user's association. There are two specific items in the articles and by-laws. One is concerned with membership of tenant farmers, and the other is concerned with punishment. The tenant farmers have a right to join P3A after election by the leaders (chairman, treasurer, etc.), and are duty bound to pay the irrigation service and membership fees, like the owner farmers. In accordance with the articles and by-laws, P3A

can inflict punishment on members who use irrigation water and facilities illegally and do not pay the fees.

P3A's are established in all the tertiary blocks under the guidance of the Gilirang Ranting Office and the Cabang Office at Soppeng. The establishment and training of P3A's are carried out in parallel with the construction of each tertiary block. The training is implemented at the existing training centers. At present, there are two training centers in Kabupaten Sidrap and Pinrang. The leaders of P3A and Mandor Wae are despatched to these training centers which are operated by PTGA (Water Management Project, DINAS PU Pengairan). The following points are recommended to ensure effective operation and management of P3A's.

1) Every farmer who is either a land proprietor or a share-cropper in the tertiary block must be a member.

2) The strength of each P3A depends on the leader's capability. More importantly, because trust, leaders must execute all accounting matters fully and professionally. A training scheme is therefore proposed for leaders and P3A staff which focuses on accounting practices; Auditors will also be elected from the members to periodically check all accounting matters and report their findings in general meetings.

3) Cooperation with the Kepala Desa is crucial for establishing village level associations and their successful operation. The Kepala Desa is elected by the village people, and in general, he is a major influence in leading people in the village community. Even though the O&M office offers intensive training and a lot of supporting services to P3A's, little result will be expected in P3A's activities without the cooperation of the Kepala Desa. Although training to Kepala Desa is now implemented by PTGA, more intensive training is needed to obtain his powerful cooperation by having a good understanding of P3A's activities.

4) At present, LKMD is organized in each Desa which is responsible for village community development (see Sub section 3.10.7 and Figure A.6.7 in Annex 6). It is proposed that this LKMD keeps in contact with P3As established in the Desa and offers powerful support to them.

6.4 Irrigation Service Fees

Several recent Government decrees have altered the irrigation fees and the Government policy now is to collect irrigation service fees and recover all O&M costs in the main and secondary systems using a fund from the fees. There are three kinds of irrigation service fees; i.e., i) IPEP (Iuran Pembiayaan Eksploitasi dan Peneliharaan), ii) IPAIR (Iuran Pelayanan Irigasi), and iii) Membership Fee of P3A. In 1987, IPEP was decided equally for all irrigation areas without any classification. IPEP is a fixed rate amounting to Rp.5,000/ha per every planting season or Rp.10,000/year. The implementation of IPEP however was not very smooth and also was not effective, however the Government requires funds for maintenance of the irrigation system. Under these circumstances, the Government changed its irrigation service fee from IPEP to IPAIR in 1989. This new service fee is a flexible rate which is calculated by each Kabupaten and irrigation system. The Government's basic concept for IPAIR is that the irrigation service fee should be estimated according to the quality of services and the amount of repairing and maintenance cost of each system. IPAIR will be introduced to the Project area, calculated by the following formula. The amount of IPAIR to the farmers is estimated to be Rp.96,000/ha/year (prices in 1994).

IPAIR =(Total Maintenance Cost + Collecting Cost of IPAIR)/Total Irrigation Area

Annual Amount of IPAIR in the Project Area

Irrigation Area: 7,000 ha	Total Cost (Rp. Million)	IPAIR per Ha (Rp./ha/year)
Direct Operation and Maintenance Cost	583.5	83,000
Collecting Cost (15%)	87.5	13,000
IPAIR in 1994 Prices	671.0	96,000

O&M of the tertiary blocks is P3As' responsibility and the necessary budget is covered by the membership fees collected from the members. Of the total amount, 40% is paid to the staff including chairman, secretary, treasurer, and Mandor Wae, and the remaining 60% is invested in the maintenance of the facilities. The amount of membership fees is assumed at Rp.3,000/ha/season (current price in 1994), referring to the fees of a P3A in Kabupaten Sidrap. A typical P3A in the Project area has about 50 ha of paddy field, and the total annual budget for O&M will amount to Rp.180,000/year (50 ha x Rp.6,000/ha/year x 60%). It seems that this amount will enable P3A to maintain the irrigation facilities, because funds are used to only repair division boxes, as other maintenance works are done mainly by manpower under the Gotong Royong system within the members.

IPAIR is collected by BAMUS which is the Government's collecting agency through the chairman of P3A and BRI. Membership fees are kept by P3A and invested in the maintenance of facilities in the tertiary block.

CHAPTER 7 PROJECT EVALUATION

7.1 General

The objective of the project evaluation is to assess the economic and financial feasibility of the Gilirang Irrigation Project. For the economic evaluation, three measures of project worth, namely, economic internal rate of return (EIRR), benefit-cost ratio (B/C), and benefit minus cost (B-C) were examined. In addition, a sensitivity analysis in terms of EIRR was made to evaluate the economic viability of the Project against possible changes in project costs, benefits, and build-up period. For the financial evaluation, repayment capability of the Project and capacity to pay of the farmers were analyzed. Indirect benefits and socio-economic effects, which would impact on the regional and national socio economy, were also briefly studied.

7.2 Economic Evaluation

7.2.1 Basic Assumption and Economic Conversion Factors

The economic evaluation of the Project is made based on the following basic assumptions:

a) Useful life of the Project is taken as 50 years from project implementation,
b) For the calculation of EIRR, only direct benefits are counted, and no indirect and intangible benefits are taken into account,
c) Exchange rate of Indonesian Rupiah (Rp.) to US. Dollar (US$) is taken to be Rp. 2,160 equivalent to US$ 1.00 (as of August, 1994), and
d) Constant prices at 1994 level are used in the economic evaluation.

The standard conversion factors (SCF) which are available in the Guideline for Water Resources Projects, Ministry of Public Works are used to convert financial to economic values.

7.2.2 Economic Costs and Benefits

(1) Economic costs

The project costs for economic evaluation would consist of construction cost, annual O&M cost, and replacement cost. These economic costs can be obtained using SCFs on the financial costs. The economic cost for construction of the Project includes the costs for i) preparatory works, ii) construction of project facilities such as dam, intake weir, irrigation and drainage canals, and farm roads, iii) procurement of O&M equipment iv) resettlement of people living in the reservoir area, v) administration expenses, vi) engineering services, and vii) physical contingency. These total costs would amount to Rp. 91.0 billion.

Economic Construction Cost

(Unit: Rp. million)

	Financial Cost	ECF	Economic Cost
1) Preparatory Works	4,131	0.71	2,933
2) Civil Works			
- Weir	8,984	0.71	6,379
- Dam	35,901	0.71	25,490
- Main System	23,029	0.71	16,351
- Secondary System	6,531	0.71	4,637
- Tertiary System	4,453	0.71	3,162
- Drainage System	1,973	0.71	1,401
- Farm Road Network	1,494	0.71	1,061
- Pump Station	234	1.00	234
3) O&M Facilities and Equipment	1,058	1.00	1,058
4) Resettlement Cost*1	2,721		1,815
5) Administration	2,164	0.90	1,948
6) Engineering Services	25,788	0.90	23,209
7) Physical Contingency	11,846		8,968
Total	130,307		98,645

*1 Convert land acquisition and compensation cost into resettlement cost.

Annual O&M cost for the project facilities is estimated at Rp. 643 million by applying 0.8 of SCF to the financial cost. Regarding the replacement cost, steel gates, pump and O&M equipment installed in the project facilities would be replaced several times during the entire period of the project life. Their useful lives are assumed to be 25, 15 and 10 years, respectively.

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

(2) Project benefits

Economic prices of farm inputs and outputs are estimated in order to evaluate the expected project benefits. Economic prices of trade goods such as rice, mungbeans, soybeans, groundnuts, and fertilizers are estimated on the basis of the projected world market prices of these commodities forecast by the World Bank in the long term range for the period from 2000 to 2005. Non-trade goods such as, chilies, seeds, and animal power are valued at financial prices which are estimated on the basis of current market or farm gate prices prevailing in the Project area in August 1994. As for farm labor, it is valued at a shadow wage rate, based on SCF of 0.75 for unskilled labor.

The project benefits consist of irrigation benefits and negative benefits. The irrigation benefits will accrue primarily from increased crop production owing to a stable irrigation water supply. The irrigation benefits are defined as the difference in net return from crops between the future with and the future without project conditions. Annual irrigation benefit at the full development stage is estimated at Rp 18.8 billion, as shown below. The benefits would accrue from 2001, and would gradually increase up to the full benefit in 2006.

	Without Project		With Project		
	Harvested Area (ha)	Total value (Rp.Million)	Harvested Area (ha)	Total value (Rp.Million)	Incremental Benefit (Rp.Million)
Rainfed Area					
Paddy (Wet Season)	7,220	3,841	-	-	-3,841
Palawija*1	720	138	-	-	-138
Irrigated Area					
Paddy (Wet Season)	-	-	7,000	10,806	10,806
Paddy (Dry Season)	480 *2	408	7,000	10,958	10,550
Palawija*1	-	-	1,800	1,044	1,044
Vegetables (Chilies)	-	-	200	339	339
Total	8,420	4,387	16,000	23,147	18,760

*1 Average value of mungbeans, soybeans, and groundnuts.
*2 Pump irrigation.

As for the net return under the future without project condition, it is assumed to remain at the present level, because the present low yields are due mainly to water shortages. This problem in the area is unable to be solved radically without the implementation of the irrigation project. Moreover, almost no change in the cropping area is expected under the future without project condition. At present, about 480 ha of paddy field are irrigated by pumping facilities in the dry season. It is difficult to expand this irrigation system in the area without exploitation of new water resources.

Negative benefits (production foregone) will occur on lands to be occupied by the project facilities. After completion of the Project, 420 ha of existing farm land in the reservoir area will be submerged under water, and its production foregone amounts to Rp. 368 million per annum. Regarding forest and grass lands in the reservoir area, no opportunity cost in a national economic sense is evaluated, since there are no potential alternatives. Losses of farm lands for irrigation facilities total about 220 ha. This production foregone is already counted in the estimate of irrigation benefit by deducting the areas from the paddy field under the future with project condition.

7.2.3 Economic Evaluation

In order to compute EIRR, B/C, and B-C, annual economic costs and benefits flows are firstly prepared as shown in Table 7.2.1. From this table, EIRR is estimated to be 13.3%, as shown below. B/C and B-C at the discount rate of 10% are also estimated to be 1.37 and Rp. 26.2 billion, respectively.

		Whole Project	Gravity Irrigation	Pump Irrigation
Area	(ha)	7,000	5,880	1,120
EIRR	(%)	13.3	13.5	11.9
B/C		1.37	1.40	1.21
B-C	(Rp.billion)	26.2	23.9	2.4

The economic evaluation indicates that the Project is economically viable. The Project area consists of 5,880 ha of gravity irrigation area and 1,120 ha of pump irrigation area. Thus the economic evaluation is made on each development. The results of the evaluation are tabulated above.

The project sensitivity of the whole project in terms of EIRR is analyzed in respect of changes in project costs and benefits. The result of the analysis is summarized below:

(EIRR: %)

Project costs increased	Benefits Decreased 0%	Benefits Decreased -10%	Benefits Delay in 1 Year
0%	13.3	12.1	12.0
+10%	12.3	11.2	11.1

7.3 Financial Evaluation

7.3.1 Repayment Capability

Repayment capability of the Project is studied by preparing cash flow statements on the basis of an annual disbursement schedule of construction cost, fund requirement, and anticipated project revenue. The annual disbursement schedule of the construction cost is as shown in Table 5.6.2. The price contingency shown in this table is estimated on the basis of the world manufacturing unit value index forecasted by the World Bank and recent trends of the consumer price index in South Sulawesi Province. The total project cost including price contingency is estimated to be Rp. 160.7 billion.

To estimate fund requirements, it is assumed that the capital required for the project implementation would be arranged in terms of the following financial conditions:

Foreign Loan (International Fund)

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

a) Interest rate : 2.6 % per year
b) Grace period : 10 years
c) Repayment period : 30 years (including grace period)

Items not eligible for financing are as shown below.

a) General administration expense
b) Taxes and duties
c) Purchase of land and other real property
d) Compensation
e) Other indirect items

Government Budget

The capital is arranged by budget allocation of the Government with no interest and no repayment. The capital excluded from the foreign loan is covered by this budget.

Based on the above assumptions, the total fund requirement for construction of the Project is estimated at about Rp. 152.8 billion, as shown below.

	(Rp. Million)
Total Cost	160,687
International Fund	152,796
Government Budget	7,891

Anticipated project revenue will accrue from the irrigation service fees. The Government policy will now be to collect irrigation service fees (IPAIR) and recover all O&M costs in main and secondary systems from the fees. The prospective fee is estimated to be Rp.

144,000/ha/annum in 2001 prices as shown below, based on the Government regulations for IPAIR amount. The annual project revenue which will accrue from the fees would amount to Rp. 1,009 million.

	(Rp. Million)	(Rp./ha/year)
Direct Operation and Maintenance Cost	583.5	83,000
Collecting Fee (15%)	87.5	13,000
IPAIR in 1994 Prices	671.0	96,000
Price Contingency in 2001 (150.4%)	338.2	
IPAIR in 2001 Prices	1009.2	144,000

The cash flow statement of the project executing agency is presented in Table 7.3.1. The annual total repayment of the loan is estimated at 7.8 to 11.6 billion during the repayment period from 2006 to 2025. Repayment of loan will have to be subsidized from the Government.

7.3.2 Capacity to Pay of the Farmers

In order to assess capacity to pay of the farmers, analysis of farm budget under the future with project condition is carried out.

(Unit: Rp 1,000/year, 1994 Price)

		Present Condition		With Project	
		Rainfed Area	Pump Area	Gravity Area	Pump Area
1	Gross Income	3,037	5,840	10,199	10,199
	- Farm Income	2,624	5,427	9,904	9,904
	- Off-Farm Income	237	237	119	119*1
	- Others	176	176	176	176
2	Gross Outgoing	2,804	4,348	6,336	6,663
	- Production Cost	1,564	3,108	4,477	4,804
	- Living Expenses	1,240	1,240	1,859	1,859*2
3.	Net Reserve (Capacity to Pay)	233	1,492	3,863	3,536
4.	Irrigation Service Fees*3			218	218

*1 50% of present condition. *2 150% up from present condition.
*3 1994 Prices. Rp. 96,000/ha/year x 2.27 ha = Rp. 218,000

Net reserve or capacity to pay of farmers would increase remarkably from Rp. 0.2 - 1.5 million at present to Rp 3.5 - 3.8 million under the future with project condition. The increase in the net reserve would enable farmers to pay the irrigation service fee, if it is imposed on them.

7.4 Indirect Benefits and Socio-economic Impacts

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

(1) Employment opportunities

The Project would create a demand for farm labors due to increased farming activity, more intensive use of land and higher agricultural production. In addition, the construction of the Project would increase employment opportunities in the area. During the construction stage, the majority of workers would be unskilled laborers, most of whom would come from in and around the Project area. The labor employment under the construction stage will be

expected to reach over 140,000 man-days in total. All these would contribute to activate the regional economy.

(2) Farmers' income

After implementation of the Project, income of the beneficiary farmers of 3,100 households is expected to increase considerably as a direct result of an increase in crop production. Such an increase in income would contribute to the improvement of farmers' living standard. Moreover, it is expected that farmers' purchasing power would increase along with improvement of their living standard, and this increased purchasing power would accelerate the development of the regional economy.

(3) Marketing of farm inputs and outputs

Future marketing in the area is likely to expand compared with the present. With an anticipated higher agricultural production, more farm products could be marketed by the farmers and the proportion of sales would also increase relative to consumption. The merchants would have a larger turnover which could increase their incomes. Marketing functions would not only be influenced by agricultural outputs. It would be estimated that when agricultural production develops as a result of the Project, the Project area would be a good market for farm supplies. The farmers need to operate with farm supplies such as fertilizers, tools, equipment, and bags. Both ends of the marketing channels could therefore expect substantial beneficial impacts from the Project.

(4) Food supply

Demand and supply forecasts indicate that Indonesia will increase annual domestic demand over its paddy production by about 4.6 million tons in 2003 and 7.8 million tons in 2008. It is expected to increase paddy production to meet the domestic demand increasing along with the population growth. The project will support it, which will produce about 80,000 tons/year of marketable surplus.

(5) Mitigation of water shortage

The Project area has serious water shortages not only for agricultural production but also for domestic supply in the dry season. After completion of the irrigation facilities, the Project would provide irrigation water to the fields through the canals spread over the area. People can utilize this irrigation water domestically during the serious period, meaning that the Project would mitigate the water shortages.

(6) Mitigation of flood damages

The downstream area of the Gilirang river is sometimes flooded in the rainy season, and some parts of village roads are submerged for about a half day. Although such flood damage is not a serious constraint in the Project area, operation of the Paselloreng reservoir will have effects on flood control to a certain extent through reduction in flood frequency and peak discharge.

(7) Other effects

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

7.5 Environmental Impacts

(1) General

The Project is formulated paying much attention to minimizing expected adverse impacts on the environment by employing mitigation measures, e.g. determination of river maintenance flow considering the water demand in the downstream reaches of the Gilirang river, drainage planning taking the existing brackish water ponds into account, and introduction of farming practices which utilize small amounts of agro-chemicals. However, it is predicted that the Project would cause various impacts on various environment components due mainly to the construction of the dam with 132 MCM of maximum storage capacity and the conversion of 7,000 ha of rainfed paddy field into irrigated paddy fields. These impacts are assessed based on the study result of the JICA Study Team hereinafter in this Section. An environmental management plan and a monitoring plan formulated following the impacts assessment are also presented in this Section. (see Annex 9 for details).

(2) Environmental impact assessment

The result of the identification and evaluation of the impacts caused by the different project activities at different project stages is as shown in matrix form in Table 7.5.1. Environmental components in the matrix table are 9 physical-chemical components, 5 flora and fauna components, and 11 social, economical, and cultural components. The different project activities at different project stages are 3 activities at pre-construction stage, 10 activities at construction stage, and 5 activities at operation stage. The predicted locations of the impacts are also indicated in the matrix table.

1) Pre-construction stage

Environmental impacts related to the involuntary resettlement of inhabitants in the submerged area of Paselloreng dam are predicted to be significant at the pre-construction stage, i.e. inhabitants would be anxious about the new resettlement site, the resettlement activity itself, and compensation. They would lose their present jobs and villages.

2) Construction stage

At the construction stage, the Project would cause significant impacts on the environmental components of physiography and topography, soil erosion, water quality, etc. The project would further cause changes in the mangrove forest in the downstream areas.

3) Operation stage

At this stage, significant impacts are predicted on changes in the surface water hydrology due to the construction of the dam, water quality, sedimentation in the downstream area, and groundwater level. These would cause further impacts on mangrove forests and fishes. A positive impact is expected on the water supply to the inhabitants in the project area after operation of the irrigation system. Contamination of the water quality is predicted due to the introduction of 229% of cropping intensity, although farming with a small amount of agro-chemicals is to be practiced under the Project. Accordingly, the drainage canal layout of the Project is programmed that drainage water would not directly enter into brackish water ponds. Through the introduction of irrigated agriculture, a positive impact is also expected on the increase of job opportunities, an increase of income, and activation of the regional economy as mentioned in Section 7.4.

(3) Environmental management plan

Based on the above result of the environmental impact assessment, mitigation measures are examined as an environmental management plan for the environmental components which will be significantly impacted by the Project. The summary of the environmental management plan is as shown in Table 7.5.2 (see Annex 9 for details).

(4) Environmental monitoring plan

An environmental monitoring plan is formulated through the clarification of the source of the impact, monitoring objective, and monitoring methodology, monitoring execution agency, etc. The summary of the environmental monitoring plan is as shown in Table 7.5.3 (see Annex 9 for details).

(5) Environmental Impact Assessment of DGWRD

All the results of the above mentioned environmental impact assessment including environmental management and monitoring plans were handed over to DGWRD in the middle of December 1994. Based on this result, DGWRD is going to prepare a report on environmental impact assessment according to the Indonesian laws and regulations through explanation and discussion with the committee for environmental assessment which is organized both at provincial level and national level.

CHAPTER 8 RESULT OF EXAMINATION ON MINI-HYDROPOWER AND DOMESTIC WATER SUPPLY

8.1. General

This Chapter presents the result of examination on the development of mini-hydropower and domestic water supply in accordance with the request made by Indonesian side. The examination on mini-hydropower development was originally programmed in the Inception Report following the Scope of Works (see Attachment-2), but that on domestic water supply to Sengkang was carried out as an additional study in response to the request of DGWRD in the meeting on Inception Report (see Attachment-3).

The following is a brief description on this examination. The details both for mini-hydropower generation and domestic water supply are presented in Annex 4.

8.2 Development Potential of Mini-hydropower

8.2.1 Mini-hydropower Development Plan

(1) Estimate of generated output

The generated output is estimated based on the following conditions:

1) Discharge

The mini-hydropower generation is governed by the reservoir operation for irrigation purposes. The maximum, normal and minimum discharge are estimated by using the released flow duration curve prepared based on the dam operation in the water balance study as follows:

- Maximum discharge: 4.0 m^3/sec
- Normal discharge: 3.6 m^3/sec
- Minimum discharge: 3.1 m^3/sec

2) Head loss

Hydraulic head losses are estimated as given below depending on the maximum, normal and minimum discharges respectively:

- 0.60 m under the maximum discharge of 4.0 m^3/sec
- 0.50 m under the normal discharge of 3.6 m^3/sec
- 0.30 m under the minimum discharge of 3.1 m^3/sec

3) Headwater level

Mini-hydropower generation plant is to be operated within the effective head between 120% and 70% of the normal hydraulic head. The normal water level for operation of water turbine is set at EL 47.80 m, while the tail water level is set at EL 34.0 m. Based on these figures and the above mentioned head loss, the effective head of water turbine is calculated at 15.9 m at 120%, 13.3 m at 100% and 9.3 m at 70%.

The generated output is thus calculated as follows:

	Reservoir Water Level		
	EL 50.50 m	EL 47.80 m	EL 43.60 m
Q: Discharge (m^3/sec)	4.0	3.6	3.1
H: Effective head (m)	15.9	13.3	9.3
Et: Efficiency of water turbine	0.86	0.83	0.77
Eg: Efficiency of generator	0.85	0.82	0.77
P: Generated output (kW)	455.6	319.4	167.5

Equation : P = 9.8 x Q x H x Et x Eg

(2) Selection of water turbine and generator

A tubular turbine of S-type is selected by using the turbine selection diagram taking the effective head and maximum discharge into consideration. An induction generator is also selected because of its simplicity. The selected water turbine and generator are specified as shown below:

Item	Capacity
Tubular turbine (S-type)	350 kW
Induction generator	350 kVA

(3) Preliminary cost estimate

Preliminary cost of the mini-hydropower generating facilities is estimated at Rp. 2,997 million as shown below:

- Generating equipment:	Rp. 1,920	million
- Civil works:	Rp. 900	million
- Transmission line:	Rp. 177	million
Total Cost	Rp. 2,997	million

(4) Annual power generation

On the basis of the results of the water balance calculation, the maximum and minimum annual power generation for the past 15 years are calculated as follows:

- Maximum annual power generation (1987): 3,144,000 kWH / year
- Minimum annual power generation (1982): 646,000 kWH / year

8.2.2 Required Power Generation

The use of generated hydropower is limited only for the operation of proposed irrigation facilities such as gates of the dam and weir and portable pumps for pump irrigation systems. The required power generation for these facilities is estimated at 1,190 kW as follows:

- Weir	:	30 kW for operation of gates
- Dam	:	60 kW for operation of gates, valves, lighting and other utilities
- Pumps	:	1,100 kW for 41 pumps
Total		1,190 kW

8.2.3 Cost Comparison

Cost comparison between the mini-hydropower development and the other power sources are carried out at preliminary level. In the comparison, mini-hydropower is assumed to be supplied only for the operation of dam, weir and 10 units of pumps, since the capacity of water turbine

installed (350 kW) is evaluated to be insufficient to fulfil the required power generation (1,190 kW).

Weir operation	30 kW
Dam operation	60 kW
Pump operation	
- Type(II) (6 inch) x 4 units	100 kW
- Type(III) (8 inch) x 6 units	220 kW
Total required power in gross	410 kW
Total required power in net (*)	approx. 350 kW

(*) : It is assumed that the gate operation and pumping irrigation would not be carried out at the same time.

(1) Annual equivalent cost of mini-hydropower development

The construction cost of the mini-hydropower development is Rp. 2,997 million as mentioned above. This construction cost is converted into an annual equivalent cost of Rp. 352 million by applying 10% p.a. of discount rate and 20 years facilities useful life.

(2) Cost of other power sources

1) Introduction of PLN electric power for operation of dam and weir

Initial cost required for the construction of distribution lines including some accessories is estimated at Rp. 39.1 million. This annual equivalent cost is calculated at Rp. 4.6 million by applying the above mentioned discount rate and useful life.

2) Annual PLN electric charge for operation of dam and weir

PLN electric charge per annum is estimated at Rp. 7.2 million consisting of Rp. 4.6 million for the operation of hydraulic equipment at dam site and Rp. 2.6 million for the operation of gates at weir site.

3) Diesel cost for pump operation

In addition, the annual cost of diesel for operation of 10 pumps is estimated at Rp. 61.8 million.

(3) Cost comparison

The cost comparison is summarized as follows:

- Mini-hydropower development : Rp. 352.0 million
- Other power sources : Rp. 73.8 million

The estimated annual equivalent cost of mini-hydropower development is about 4.7 times higher than that of other power sources.

8.2.4 Conclusion

The development of mini-hydropower generation is technically possible. However, the hydropower generation is evaluated to be insufficient for the operation of all the gates for dam and weir and pumps for pump irrigation systems and covers only about 30% of the requirement. Further, the development of mini-hydropower generation is not attractive in the cost comparison made with other power sources. Due mainly to these reasons, the development of hydropower generation is excluded from the proposed project.

Instead of the mini-hydropower generation, PLN electric power is proposed for the operation

of hydraulic facilities at dam and weir site, and diesel-driven pumps is also proposed for the operation of 41 pumps for pump irrigation systems, as designed in the proposed project. PLN transmission line of 20 kV will be available both at dam and weir sites, although installation of additional distribution lines of 0.5 km for the weir site and 1.0 km for the dam site are required.

8.3 Development Potential of Domestic Water Supply to Sengkang

The development possibility of domestic water supply to Sengkang is examined mainly from a technical viewpoint. Major items examined are i) domestic water requirement in Sengkang, ii) water availability from the Paselloreng reservoir, iii) topographic conditions of pipeline route location, iv) required facilities and v) cost estimate of the required facilities. The results of this examination are presented hereinafter.

8.3.1 Water Requirement and Availability

The result of hydrological and water balance study shows that the Paselloreng dam is possible to release a necessary amount of water for domestic purpose in Sengkang which is estimated based on the following assumptions:

- Population of Sengkang : 23,000 (population of Tempe in 1992)
- Predicted Population in 2000 : 25,000 (with a 0.09 % of annual increase)
- Water requirement /person/day : 60 lit./person/day (minimum requirement)
- Total water requirement : 1,500 m^3/day

8.3.2 Topographical Conditions and Water Intake Site

Based on the available topographical map with a scale of 1/50,000, the route of pipeline is examined, proposing that water would be taken at the proposed intake weir site for irrigation with an elevation of EL 18.0 m.

The water would be conveyed by pipeline along the provincial road via Anabanua to Sengkang with a total distance of 35 km. The pipeline route to Sengkang would run through the high land with an elevation of EL 110 m. Because of this topographic condition, booster pumps and other equipment would be required and cause sharp increase of the construction cost.

8.3.3 Required Facilities and Preliminary Cost Estimate

(1) Total diversion requirement

Total diversion requirement is estimated at 1,650 m^3/day assuming 10% of the conveyance loss.

(2) Required pump capacity

The maximum water consumption per hour is applied for the design diversion requirement per day as shown below:

Design diversion requirement per day
= (Total diversion requirement) x 1.3 = 2,145 m^3/day
Required pump capacity = 2,145 / (24 x60) = 1.5 m^3/min.

(3) Required number of pump unit

Two units of pump are required for this plan, one is for regular use and the other is for stand-

by use, considering the changes of conveyance water volume and dispersion of risk, etc.

(4) Conveyance system

The following conveyance system is proposed based on the topographical conditions described above.

a) A pump station will be installed at the intake site.
b) A distribution reservoir will be constructed at the highest point (EL 110 m), about 9.5 km from the intake site.
c) A water tower and elevated tank will be constructed in Sengkang, about 25.5 km from the highest point.
d) Water will be pumped up from the intake site to the distribution reservoir.
e) Water will be conveyed by gravity from the distribution reservoir to the elevated tank in Sengkang.
f) A 536 m^3 of 6 hours' water requirement will be applied as effective capacity for both the distribution reservoir and elevated tank.(2,145 m^3/day x 6/24=536 m^3).

(5) Required diameter of steel pipe

1) From intake site to the distribution reservoir

250 mm of steel pipe is recommended comparing the diameter of pipe and pump bore, based on the following conditions:
- Total length of conveyance pipeline = 9.5 km
- Actual head = 90 m
- Diversion requirement = 1.5 m^3/min.
- Required diameter of steel pipe = 250 mm
- Friction loss of pipe line = 21 m
- Specification of pump : Pumping capacity = 1.5 m^3/min., Pumping head = 111m, Motor = 1,450 rpm, 45 kW

2) From the distribution reservoir to Sengkang

250 mm of steel pipe is also recommended considering anticipated head loss of conveyance pipe. The hydraulic dimension of the pipeline can be summarized as given below:
- Total length of conveyance pipeline = 25.5 km
- Actual head = 92 m
- Diversion requirement = 1.5 m^3/min
- Friction loss of conveyance pipe = 60 m

(6) Summary of required main facilities and preliminary cost estimate

Required main facilities from the proposed intake site to Sengkang and estimated preliminary cost are summarized below:

Item/ Description	Quantity	Cost (Rp. MIL.)	
1) Pump Station			
a. Pump facilities			
- Capacity : 1.5 m^3/min.	2 units	504	(*)
- Pumping head : 111 m			
- Motor : 1,450 rpm, 45 kW			
b. Pump house	1 house	100	
2) Distribution reservoir			
- Capacity : 536 m^3	1 unit	26	
3) Water tower and elevated tank			
- Capacity : 536 m^3	1 unit	26	
4) Steel pipe (250 mm)	35 km	26,746	(**)
Total		27,402	

Note : (*) ; Including installation of equipment and spare parts, etc.
(**) ; Including installation of pipe, civil work

CHAPTER 9 RECOMMENDATIONS

9.1 Early Implementation of the Project

Through the investigation and studies on the Gilirang Irrigation Project, it has been shown that the implementation of irrigation and drainage systems on the Gilirang river basin over 7,000 ha together with construction of the Paselloreng dam is technically sound, economically feasible, and financially viable. The Project will contribute to i) stabilizing supply of agricultural production, particularly of rice, ii) achieving rural development and better balanced regional development, iii) creating and stabilizing employment opportunities, and iv) ensuring an increase in farmers' income and living standard. It is recommended, therefore, to implement the Project as early as possible.

9.2 Environmental Preservation

DGWRD will be responsible for the finalization of an environmental impact assessment on the Gilirang Irrigation Project in accordance with Indonesian laws and regulations. However, it is recommended to consider the formulated plans by the JICA Study Team on environmental management and monitoring in the implementation of the Project. Important items to monitor are changes in water quantity and quality due to dam construction, mangrove forests, and fishes in the downstream areas.

9.3 Resettlement Program

With regard to the resettlement of inhabitants in the submerged area of the Paselloreng dam, the government's explanation is required to intensively mitigate their anxiety on resettlement, as programmed in the resettlement program prepared by the Government. In addition, it is recommended to obtain the inhabitants' consent on resettlement before commencement of the land acquisition. Construction of a new site for inhabitants is also recommended to be arranged before land acquisition. Moreover, it is recommended to arrange the required funds for execution of resettlement as soon as possible.

9.4 Watershed Management

Watershed management in the Gilirang river basin is of vital significance for rational land and water resources development in the basin. Through the reconnaissance survey made in the catchment area of the Gilirang river, it was confirmed that a certain part of its forest areas have been changed into grass land due mainly to the unrestricted cutting of trees. Since the forests play an important role in conservation of soil and water resources, it is recommended to restrict the cutting of trees in the basin. In addition, it is recommended to strengthen the replantation of trees undertaken by the forest office in Kab. Wajo. Countermeasures on soil erosion in the basin are also required to be examined.

9.5 Activation of Agricultural Supporting Services

Through the study, it was confirmed that the agricultural supporting services are considerably well established in Kab. Wajo as well as in South Sulawesi Province. However, these should be activated to a certain extent for the sustainability of the Project and further development of farmers living standard and regional socio-economy. The

activation of supporting services is required to be arranged in a comprehensive and co-ordinated manner under the leadership of BUPATI office, Kab. Wajo.

TABLES

Table 1.5.1 Personnel Assigned for the Study

Speciality	Expert	Counterpart Personnel
Team Leader/ Irrigation Engineer	Mr. Y. Yamamoto	Ir. Purwoko, Dipl. HE
Co-team Leader/ Agronomist	Mr. M. Ishizuka	Ir. Alnasar Dewang Mr. Abd Latif Kadir
Meteorologist/ Hydrologist	Dr. J. Nozaka	Drs. M. Iliyas Nuntung
Geologist	Mr. H. Nishinosono	Mr. Syarifuddin N. Bsc.
Pedologist/ Land Use Planner	Dr. I. Tanabe	Drs. Abd. Wahab, CES. Ing.
Agro-economist	Mr. T. Murono	Drs. Abd. Wahab, CES. Ing.
Construction Planner/ Survey Supervisor	Mr. K. Shimazaki	Ir. Purwoko, Dipl. HE
Dam Planner/ Soil Mechanics Engineer	Mr. K. Kameyama	Ir. Irham Abu
Environmentalist	Dr. N. Mochizuki	Mr. Hasanuddin Thaha, BE.
Design Engineer/ Cost Estimator	Mr. T. Nakatsukuma	Mr. Samuel Tandisosang, BE.

Table 3.4.1 Inventory of Pumping Irrigation Facilities

Kecamatan (District)	Desa (Village)	Dusun (Sub-village)	Existing Pump System: Capacity (Dia.=inch)	Nos.ofUnit	Irrigation Area (ha)	Water Source	Ownership 1)	Nos. of Users /Members	Location (See Figure)	Remark (Experience)	Operation Cost: Rp./season	Rp./season/ha
Maniangpajo												
1.	Arajang	Lawareng	6	1	60	Gilirang river	(P)	70	A	12 years	3,240,000	54,000
			6	1	25	Gilirang river	(P)	30	B	5 years	1,620,000	64,800
			6	1	10	Gilirang river	(P)	10	C	3 years	648,000	64,800
			6	1	10	Gilirang river	(P)	N.A., 5)	D, 6)			
2.	Gilirang	Ale Limpo	3	1	5	Gilirang river	(P)	10	E, 6)	2 years		
3.	Paselloreng	Lurae	8	1	50	Gilirang river	(P)	50	F			
			6	1	50	Gilirang river	(P)	50	G			
			6	1	50	Gilirang river	(P)	45	H	8 years	2,280,000	45,600
			4	1	15	Gilirang river	(P)	15	I	8 years	480,000	32,000
	(Sub-total - I)			9	275							
Sajoanging												
1.	Akkajeng	Mualla	8	2	70	Mualla river	(G), 3)	60	J, 6)			
2.	Doping	Doping baru	4	1	25	Ground water	(P)	20	K			
3.	Lawesso	Doping lama	3	1	20	Spring/pond	(P)	15	L			
4.	Barangmamase	Bottotella	4	1	15	Kulampu river	(P)	15	M			
5.	Sakkoli	Cinaga	3	1	5	Ground water	(G), 4)	N.A.,5)	N			
6.	Akkotengeng	Toduma	8	4	200	Gilirang river	(C), 2)	150	O	2 years	5,832,000	29,160
	(Sub-total - II)			10	335							
Majauleng												
1.	Botto Benteng	Benceng-2	6	1	30	Girilang river	(G), 3)	30	P	4 years	1,080,000	36,000
	(Sub-total - III)			1	30							
	(Total)			20	640						(Average)	46,623

Source: Kantor Dinas Pertanian and interviewed with the farmers by the Study team

Note: 1) : (P) Private, (C) Company, (G) Government
2) : BWR (Binawan Wajo Raya)
3) : Supported by DINAS
4) : P2AT (PU Pengairan Propinsi Sul-Sel, Kab. Wajo)
5) : Not Available
6) : Changing location by season

Table 3.4.2 Poor Drainage Area

	Desa	Sub-village	Area (ha)	Drainage Condition	Remark	Location (See Figure)
1	Sakkoli/ Laerung	Taruntpakkai	80	1 day inundation once a year Flooding of Girilang river	E.L. approx. 17 .0 m	(1)
2	Salobulo	Salobulo	150	Joinnig point of Gilirang river and its branch (Marepi river), 2-3 days continuous inundation in every 2-3 years, 0.5 m of depth	Drainage improvement will be efective E.L. approx. 6.0 m	(2)
3	Akkajeng	Babana	300	2 - 3 days continuous inundation once a year, with tidal influence	E.L. approx. 2.0 - 3.0 m	(3)
4	Padaelo	Allapporange	200	Poor drainage condition of the small stream (branch of Girilang river) flowing through near Polewali village 1-2 days inundation once a year	Drainage improvement will be efective E.L. approx. 8.0 m	(4)
5	Akkajeng	Mualla	50	Poor drainage condition of Muala river(small stream) Inundated with heavy rain, much influenced by tide	E.L. approx. 7.0 m	(5)
6	Doping	Dopinglama	30	Poor drainage condition of Doping river(small stream) Inundated with heavy rain, much influenced by tide	E.L. approx. 6.0 m	(6)
		(Taotal area)	810			

Source : Interviewed with Extension Workers of Agricultural Office and the farmers

Table 3.5.1 (1/2) Monthly Cropping Area and Damage - Paddy

	Planted Area (ha)													Harvested Area (ha)	Area by Damage (ha) *1			
	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Total (1)		PD	DR	FL	(%)
1988/89-1989																		
Maniangpajo	923	655	934	0	0	0	0	92	1,459	4,610	0	0	8,673	8,262	0	411	0	4.7
Sajoanging	727	3,969	1,662	0	0	0	0	1,946	10,480	2,449	0	0	21,233	20,651	0	582	0	2.7
Majauleng	2,524	1,035	756	0	0	0	0	1,381	4,836	3,794	0	0	14,326	13,534	0	792	0	5.5
Total	4,174	5,659	3,352	0	0	0	0	3,419	16,775	10,853	0	0	44,232	42,447	0	1,785	0	4.0
1989/90-1990																		
Maniangpajo	0	220	171	0	173	0	0	23	5,763	431	0	0	6,781	6,781	0	0	0	0.0
Sajoanging	0	24	285	60	0	0	5	6,081	8,794	0	0	0	15,249	15,227	0	22	0	0.1
Majauleng	0	410	1,053	79	0	0	0	196	10,104	0	0	0	11,842	11,842	0	0	0	0.0
Total	0	654	1,509	139	173	0	5	6,300	24,661	431	0	0	33,872	33,850	0	22	0	0.1
1990/91-1991																		
Maniangpajo	0	0	214	182	0	0	0	2,101	4,146	0	0	0	6,643	6,384	0	259	0	3.9
Sajoanging	0	0	400	184	0	0	12	8,266	6,602	0	0	0	15,464	15,371	0	93	0	0.6
Majauleng	0	0	123	72	139	0	0	6,309	4,013	0	0	0	10,656	10,040	0	616	0	5.8
Total	0	0	737	438	139	0	12	16,676	14,761	0	0	0	32,763	31,795	0	968	0	3.0
1991/92-1992																		
Maniangpajo	0	0	186	797	847	0	0	5,058	1,318	0	0	0	8,206	8,206	0	0	0	0.0
Sajoanging	0	0	0	637	904	0	325	13,754	1,146	0	0	0	16,766	16,766	0	0	0	0.0
Majauleng	0	0	58	557	521	0	71	8,819	1,562	0	0	0	11,588	11,588	0	0	0	0.0
Total	0	0	244	1,991	2,272	0	396	27,631	4,026	0	0	0	36,560	36,560	0	0	0	0.0
1992/93-1993																		
Maniangpajo	0	157	336	402	0	0	0	625	5,798	0	0	0	7,318	4,046	0	3,272	0	44.7
Sajoanging	0	1,267	2,458	925	0	0	0	10,936	4,289	0	0	0	19,875	19,400	0	475	0	2.4
Majauleng	28	714	301	0	0	0	0	3,025	7,122	201	0	0	11,391	7,359	0	4,032	0	35.4
Total	28	2,138	3,095	1,327	0	0	0	14,586	17,209	201	0	0	38,584	30,805	0	7,779	0	20.2
1993/94-1994																		
Maniangpajo	0	212	250	151	45	0	0	4,143	2,288	0	0	0	7,089	7,089	0	0	0	0.0
Sajoanging	0	225	285	510	135	0	860	14,365	0	0	0	0	16,380	16,380	0	0	0	0.0
Majauleng	4	17	274	652	0	0	0	8,615	2,031	136	0	0	11,729	11,729	0	0	0	0.0
Total	4	454	809	1,313	180	0	860	27,123	4,319	136	0	0	35,198	35,198	0	0	0	0.0
Average	701	1,484	1,624	868	461	0	212	15,956	13,625	1,937	0	0	36,868	35,109	0	1,759	0	4.8

Remarks: PD = Pests and Diseases, DR = Drought, FL = Flood

Source: Agricultural Services Office, Kabupaten Wajo.

Table 3.5.1 (2/2) Monthly Cropping Area and Damage - Palawija

	Planted Area (ha)													Harvested Area	Damaged (ha) *1			
	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Total	Area (ha)	PD	DR	FL	(%)
MAIZE													(1)	(2)				
1988/89-1989																		
Maniangpajc	0	2	8	0	2	2	4	4	2	0	4	2	30	30	0	0	0	0.0
Sajoanging	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
Majauleng	0	0	0	0	0	0	8	3	1	0	0	0	12	12	0	0	0	0.0
Total	0	2	8	0	2	2	12	7	3	0	4	2	42	42	0	0	0	0.0
1989/90-1990																		
Maniangpajc	6	2	5	38	8	36	2	2	21	3	4	2	129	129	0	0	0	0.0
Sajoanging	0	3	0	0	0	0	0	0	0	0	0	0	3	3	0	0	0	0.0
Majauleng	0	27	1	1	5	0	0	17	11	0	0	0	62	57	0	5	0	8.1
Total	6	32	6	39	13	36	2	19	32	3	4	2	194	189	0	5	0	2.6
1990/91-1991																		
Maniangpajc	7	92	124	346	24	4	34	29	7	4	4	0	675	675	0	0	0	0.0
Sajoanging	1,050	0	0	0	0	0	0	0	0	0	0	0	1,050	885	0	165	0	15.7
Majauleng	67	0	78	17	0	0	47	0	0	0	0	0	209	207	0	2	0	1.0
Total	1,124	92	202	363	24	4	81	29	7	4	4	0	1,934	1,767	0	167	0	8.6
1991/92-1992																		
Maniangpajc	0	60	258	59	37	29	9	7	0	0	0	15	474	474	0	0	0	0.0
Sajoanging	1	11	15	0	0	0	0	0	0	0	0	10	37	37	0	0	0	0.0
Majauleng	0	141	191	0	0	0	0	52	0	0	0	12	396	304	0	92	0	23.2
Total	1	212	464	59	37	29	9	59	0	0	0	37	907	815	0	92	0	10.1
1992/93-1993																		
Maniangpajc	67	29	0	72	0	5	0	0	0	0	0	0	173	173	0	0	0	0.0
Sajoanging	129	23	0	0	0	5	7	25	0	8	19	30	246	231	0	15	0	6.1
Majauleng	30	0	0	0	0	0	14	7	5	0	0	0	56	41	0	15	0	26.8
Total	226	52	0	72	0	10	21	32	5	8	19	30	475	445	0	30	0	6.3
Average	271	78	136	107	15	16	25	29	9	3	6	14	710	652	0	59	0	8.3
SOYBEANS																		
1988/89-1989																		
Maniangpajc	0	0	0	2	0	1	1	2	0	0	0	0	6	6	0	0	0	0.0
Sajoanging	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
Majauleng	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
Total	0	0	0	2	0	1	1	2	0	0	0	0	6	6	0	0	0	0.0
1989/90-1990																		
Maniangpajc	0	0	2	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0.0
Sajoanging	0	0	8	0	0	0	0	0	0	0	0	0	8	3	0	5	0	62.5
Majauleng	0	0	0	3	0	0	0	0	0	0	0	0	3	3	0	0	0	0.0
Total	0	0	10	3	0	0	0	0	0	0	0	0	13		0	5	0	38.5
1990/91-1991																		
Maniangpajc	54	334	62	0	0	0	0	0	0	0	0	41	491	230	0	261	0	53.2
Sajoanging	41	132	0	0	0	0	0	0	0	0	0	0	173	29	0	144	0	83.2
Majauleng	111	716	0	0	0	0	0	0	0	0	23	15	865	662	0	203	0	23.5
Total	206	1,182	62	0	0	0	0	0	0	0	23	56	1,529	921	0	608	0	39.8
1991/92-1992																		
Maniangpajc	147	133	745	0	0	3	0	0	0	0	0	45	1,073	201	0	872	0	81.3
Sajoanging	75	20	263	0	0	0	0	0	0	0	0	45	403	97	0	306	0	75.9
Majauleng	85	382	810	0	0	0	0	0	0	0	0	41	1,318	604	0	714	0	54.2
Total	307	535	1,818	0	0	3	0	0	0	0	0	131	2,794	902	0	1,892	0	67.7
1992/93-1993																		
Maniangpajc	510	0	0	25	0	0	0	0	0	0	0	0	535	535	0	0	0	0.0
Sajoanging	91	2	0	0	0	0	0	0	0	0	0	30	123	40	0	83	0	67.5
Majauleng	8	166	0	0	0	0	0	0	0	0	0	47	221	17	0	204	0	92.3
Total	609	168	0	25	0	0	0	0	0	0	0	77	879		0	287	0	32.7
Average	224	377	378	6	0	1	0	0	0	0	5	53	1,044	366	0	558	0	53.4

*1 PD = Damages of insects and diseases, DR = Drought damage, FL = Flood damage

Source: Agricultural Services Office, Kabupaten Wajo.

Table 3.5.2 Farm Budget Analysis - Present Condition

	Rainfed Paddy Area				Pump Irrigation Area			
	Area (ha)	Yield (t/ha)	Unit Price (Rp./kg)	Amount (Rp.1,000)	Area (ha)	Yield (t/ha)	Unit Price (Rp./kg)	Amount (Rp.1,000)
1. Gross Income				3,037				5,840
1.1 Farm Income								
- Wet season paddy*1	2.34	3.0	320	2,246	2.34	3.0	320	2,246
- Dry season paddy					2.34	4.0	320	2,995
- Palawija & vegetables	0.23			192				
- Perennial crops	0.35			186	0.35			186
1.2 Livestock Income*2				96				96
1.3 Off-farm Income				237				237
1.4 Credit				10				10
1.5 Others				70				70
	Area (ha)	Unit Cost (Rp./ha)		Amount (Rp.1,000)	Area (ha)	Unit Cost (Rp./ha)		Amount (Rp.1,000)
2. Gross Outgoing				2,804				4,348
2.1 Production Cost				1,564				3,108
- Wet season paddy*3	2.34	403		943	2.34	403		943
- Dry season paddy*3					2.34	467		1,093
- Palawija & vegetables*3	0.23	422		97				
- Others				113				113
- Land rent*4	1.07			411	1.07			959
2.2 Living Expenses				1,237			*5	1,237
- Food				718				718
- Other than food				519				519
2.3 Loan Repayment				3				3
3. Net Reserve				233				1,492

*1 Cultivated area = Land holding size
*2 Including income of draft power rented to other farmers.
*3 Costs of family labor, own animal and machine were excluded from the farm budget analysis.
*4 Land rent = 40% of products
*5 Applied living expense of rainfed paddy farmers, because of no detailed data. It seems that living standard of pump irrigation farmers is higher than that rainfed farmers.

Table 3.5.3 (1/2) Financial Crop Budget - Present Condition

			Rainfed Paddy		Irrigated Paddy*1	
1. Gross Income						
- Unit Yield	(t)			3.0		4.0
- Unit Price	(Rp./kg)			320		320
- Gross Income	(Rp.)			960,000		1,280,000
2. Production Cost		Unit Price (Rp.)	Q'ty	Value (Rp.)	Q'ty	Value (Rp.)
1) Seed	(kg)	600	30	18,000	30	18,000
2) Fertilizers						
- Urea	(kg)	260	183	47,580	183	47,580
- TSP	(kg)	480	32	15,360	32	15,360
- KCl	(kg)	350	3	1,050	3	1,050
- ZA	(kg)	295	54	15,930	54	15,930
3) Agro-chemicals						
- Liquid type	(lit.)	13,200	0.48	6,336	0.48	6,336
- Powder type	(kg)	3,000	1.1	3,300	1.1	3,300
4) Labor						
- Nursery	(man-day)	3,400	3.2	10,880	3.2	10,880
- Land Preparation	(man-day)	5,400	15.8	85,320	15.8	85,320
- Transplanting	(man-day)	5,400	18.6	100,440	18.6	100,440
- Fertilizing	(man-day)	3,400	2.5	8,500	2.5	8,500
- Spraying	(man-day)	3,400	2.0	6,800	2.0	6,800
- Weeding	(man-day)	3,400	20.1	68,340	20.1	68,340
- Irrigating	(man-day)	3,400	-	-	2.0	6,800
- Harvesting	(man-day)	7,300	17.0	124,100	17.0	124,100
- Drying	(man-day)	3,400	3.0	10,200	4.0	13,600
5) Transportation of Products				39,000		52,000
6) Animal Power	(day)	23,000	2.04	46,920	2.04	46,920
7) Mech. Power	(day)	29,000	2.03	58,870	2.03	58,870
8) Operation Cost of Pump*2			-	-		46,600
9) Others (5%)				33,346		36,836
Total				700,272		773,562
3. Net Return				259,728		506,438

*1 Pump irrigation.

*2 Operation cost of pump per one season is estimated to be Rp.46,600/ha. based on the existing pump irrigation system.

Table 3.5.3 (2/2) Financial Crop Budget - Present Condition

			Maize		Mungbeans		Soybeans		Groundnuts	
1. Gross Income										
- Unit Yield	(t)			2.0		0.8		0.9		1.1
- Unit Price	(Rp./t)			250		690		950		1,000
- Gross Income	(Rp.)			500,000		552,000		855,000		1,100,000
2. Production Cost		Unit Price (Rp.)	Q'ty	Value (Rp.)	Q'ty	Value (Rp.)	Q'ty	Value (Rp.)	Q'ty	Value (Rp.)
1) Seed*1	(kg)		20	6,000	20	13,800	40	48,000	120	216,000
2) Fertilizers										
- Urea	(kg)	260	-	-	-	-	25	6,500	40	10,400
- TSP	(kg)	480	-	-	-	-	100	48,000	60	28,800
- KCl	(kg)	350	-	-	-	-	25	8,750	-	-
- ZA	(kg)	295	-	-	-	-	-	-	-	-
3) Agro-chemicals										
- Insecticides	(lit.)	13,200	-	-	-	-	1.5	19,800	-	-
4) Labor	(man-day)									
- Family Labor		3,400	76	258,400	36.0	122,400	45.0	153,000	49	166,600
- Hired Labor		3,400	-	-	19.6	66,640	24.5	83,300	32	108,800
5) Animal Power	(day)	23,000	4.35	100,000	5.22	120,000	5.22	120,000	12.43	286,000
6) Mech. Power	(day)		-	-			-	-	-	-
7) Others (5%)				18,220		16,142		24,368		40,830
Total				382,620		338,982		511,718		857,430
3. Net Return				117,380		213,018		343,282		242,570

*1 Unit prices of seeds (Rp./kg):

Maize	300
Mungbeans	690
Soybeans	1,200
Groundnuts	1,800

Note: Production costs of palawija were estimated on the basis of the Household Survey (JICA Survey Team, 1994) and the "Laporan Analisa Usahatani Padi, Palawija dan Hortikultura 1993/94 (Dinas Pertanian Tanaman Pangan, Propinsi Sulawesi Sulatan).

Table 3.6.1 Status of KUD and Non-KUD in Kabupaten Wajo (1992)

Kecamatan	Total House-hold	Farm House-Hold *1	KUD						Non-KUD					
			No. of KUD	No. of Mem-ber	Average Member-ship	Partici-pation Rate	Saving Amount	Saving Amount per Member	No. of Non-KUD	No. of Mem-ber	Average Member-ship	Partici-pation Rate	Saving Amount	Saving Amount per Member
	(No.)	(No.)	(No.)	(No.)	(No./KUD)	(%)	(Rp.10^6)	(Rp./Mem.)	(No.)	(No.)	(No.)	(%)	(Rp.10^6)	(Rp./Mem.)
	(1)	(2)	(3)	(4)	(4)/(3)	(4)/(2)	(5)	(5)/(4)	(6)	(7)	(7)/(6)	(7)/(1)	(8)	(8)/(7)
1) Sabbangparu	6,916	6,700	1	1,206	1,206	18.0	1.83	1,517	2	180	90	2.6	4.25	23,611
2) Tempe*1	10,049	2,500	1	2,939	2,939	117.6 *3	15.48	5,267	37	5,600	151	55.7	358.53	64,023
3) Pammana	7,067	5,200	1	1,813	1,813	34.9	12.27	6,768	1	103	103	1.5	3.04	29,515
4) Takkalalla	8,218	6,900	4	891	223	12.9	8.55	9,596	0	0	0	0.0	0.00	0
5) Sajoanging *2	7,373	5,300	5	1,691	338	31.9	16.65	9,846	2	297	149	4.0	47.31	159,293
6) Majauleng *2	6,786	4,100	4	1,064	266	26.0	4.00	3,759	1	24	24	0.4	2.88	120,000
7) Tanasitolo	7,964	4,500	3	3,401	1,134	75.6	16.46	4,840	0	0	0	0.0	0.00	0
8) Belawa	6,806	4,400	2	2,599	1,300	59.1	26.12	10,050	1	235	235	3.5	31.21	132,809
9) Maniangpajo *2	4,622	3,900	2	2,922	1,461	74.9	36.23	12,399	1	227	227	4.9	5.83	25,683
10) Pitumpanua	11,467	12,100	5	3,206	641	26.5	27.00	8,422	1	350	350	3.1	44.93	128,371
Three Kecamatans *2	18,781	13,300	11	5,677	516	42.7	56.88	10,019	4	548	137	2.9	56.02	102,226
Kab. Wajo 1992	77,268	55,600	28	21,732	776	39.1	164.59	7,574	46	7,016	153	9.1	497.98	70,978
Kab. Wajo 1991	76749	*	28	20,148	720	*	124.51	6,180	43	5,655	132	7.4	413.27	73,080
1990	76,272	*	28	18,479	660	*	107.69	5,828	37	5,655	153	7.4	379.79	67,160
1989	72,613	*	28	21,191	757	*	44.83	2,116	36	5,620	156	7.7	207.41	36,906
1988	71,906	*	27	14,830	549	*	39.33	2,652	35	5,082	145	7.1	208.58	41,043

*1 Figures in 1993. (Source: Agricultural Census 1993, Statistic Office Kabupaten Wajo.)
*2 Three Kecamatans related to the study area. (Sajoanging, Majoanging and Maninanpajo)
*3 Including members living in other Kecamatans.
Source: Office Koperasi Kabupaten Wajo (Cooperative Office, Kab. Wajo)

Table 3.7.1 Inventory of Public Facilities in Desa Paselloreng

Item	Unit	Q'ty
Village Office		
Land	m2	1,000
Building	m2	140
Village Office		
Land	m2	2,000
Barracks	m2	400
Elementary School		
Land	ha	2
Buildings	m2	1,200
Furniture	Ls.	1
Junior High School		
Land	ha	2
Buildings	m2	1,000
Furniture	Ls.	1
Houses for School Principal		
Land	m2	3,000
Buildings	m2	600
Mosque		
Land	m2	6,000
Buildings	m2	500
Health Facilities		
Land	m2	2,000
Buildings	m2	200
Furniture	Ls.	1
Water Supply System	Ls.	1
Micro Hydro Electric	Ls.	1
Farmer Meeting Facilities	m2	150
Cemetery	m2	5,000

Table 4.1.1 Environmental Components Idetified in IEE

I. Environmental components which unquestionably suffer significant impact from the project
  1 Social environment
    - Planed residential settlement
    - Involuntary resettlement
    - Change in basis of economic activity
    - Occupation change and loss of job
  2 Natural environment
    - Change in vegetation
    - Encroachment into tropical rain forest and wild land
    - Changes in surface water hydrology
    - Sedimentation

II. Environmental components which are likely suffer induced significant impact from the project
  1 Social environment
    - Population increase
    - Drastic change in population consideration
    - Increase in income disparities
    - Increase in use of agrochemicals
    - Residual toxicity of agrochemicals
    - Increase in domestic and other human waste
  2 Natural environment
    - Soil erosion
    - Soil contamination by agrochemical and others
    - Change in ground water hydrology
    - Water eutrophication

III. Environmental components which may or may not suffer significant impact from the project
  1 Social environment
    - Substantial change in way of life
    - Conflict among communities and way of life
    - Adjustment and regulation of water and fishing rights
    - Change in social and institutional structures
    - Change in existing institutions and customs
    - Spreading of endemic diseases
    - Impairment of historic remains and cultural assets
    - Damage to aesthetic sites
    - Impairment of buried assets
  2 Natural environment
    - Negative impact on important or indigenous diversity
    - Degeneration of ecosystems with biological diversity
    - Destruction or degeneration of mangrove forests
    - Water contamination and deterioration of water quality
    - Sea water intrusion

Table 4.2.1 Feature of Alternatives and Cost Comparison

	Alternative - I	Alternative - II	Alternative - III
Total Irrigation Area	8,600 ha	5,880 ha	7,000 ha
Intake System	Divert from reservoir	Intake from weir for 5,880 ha	Intake from weir for 5,880 ha and pumping for 1,120 ha (440 ha from upstream Gilirang river and 880 ha from main canals)
Main facilities	1. Dam 2. Headrace, connected with main canal 3. Main canal	1. Dam 2. Weir 3. Main canal	1. Dam 2. Weir 3. Main canal 4. Pumping facilities
Dimension of main facilities			
1. Dam			
Type of Dam	Rockfill	Rockfill	Rockfill
Maximum storage capacity	132 MCM	125 MCM	132 MCM
Dam height	44.5 m	40.0 m	44.5 m
Crest length	230 m	220 m	230 m
Crest elevetion	EL 56.5m	EL 56.0 m	EL 56.5 m
Catchment area	169 km2	169 km2	169 km2
2. Weir			
Type of Weir	-	Fixed type	Fixed type
Material of weir	-	Concrete	Concrete
Intake water level	-	EL 18.00 m	EL 18.00 m
Width of scoring sluice	-	2.0 m x 2 Nos. 3.0 m x 2 Nos.	2.0 m x 2 Nos. 3.0 m x 2 Nos.
3. Headrace			
Design canal discharge	15.0 m3/sec	-	-
Length	6 km	-	-
Type of canal	Unlined canal	-	-
4. Main canal			
Total length of canal	74 km	47.5 km	47.5 km
Design discharge of left main	4.4 m3/sec	3.5 m3/sec	3.7 m3/sec
Design discharge of right main	10.6 m3/sec	6.7 m3/sec	7.6 m3/sec
Type of canal	Unlined canal	Unlined Canal	Unlined Canal
5. Pumping facilities			
Nos of pump unit			
(I) 1.4 m3/min., D=4 inch, 10HP	-	-	6
(II) 3.5 m3/min., D=6 inch, 18 HP	-	-	22
(III) 6.0 m3/min., D=8 inch, 27 HP	-	-	13

Preliminary cost estimate (Rp. Million)				
	Item			
1	Dam	35,901	34,331	35,901
2	Weir	0	8,984	8,984
3	Headrace	41,854	0	0
4	Irrigation & drainage system	84,758	36,077	37,480
5	Pumping facilities	0	0	234
6	Others	89,306	77,919	78,088
	Grand total	251,819	157,311	160,687

Table 5.1.1 Proposed Land Use and Cropping Area - With Project

	Present Condition		Net Project Area under With Project	Net Project Area under Without Project
	Gross Project Area	Net Project Area*1		
1. Proposed Land Use				
Paddy Field	10,130	7,220	7,000	7,220
Upland Field	140	-	-	-
Orchard	1,260	-	-	-
Grass Land	200	-	-	-
Bush/Forest	210	-	-	-
Village and Others	360	-	-	-
Right of Way*2	-	-	220	-
Total	12,300	7,220	7,220	7,220
2. Cropping Area				
Rainfed Paddy Field				
Wet Season Paddy	10,130	7,220	-	7,220
Dry Season Paddy	-	-	-	-
Palawija and Vegetables*3	1,010	720	-	720
Irrigated Paddy Field - Gravity				
Wet Season Paddy	-	-	5,880	-
Dry Season Paddy	-	-	5,880	-
Palawija and Vegetables	-	-	1,680	-
Palawija	-	-	1,510	-
Vegetables	-	-	170	-
Irrigated Paddy Field - Pump				
Wet Season Paddy	-	-	1,120	-
Dry Season Paddy*4	480	480	1,120	480
Palawija and Vegetables	-	-	320	-
Palawija	-	-	290	-
Vegetables	-	-	30	-
Upland Field	140	-	-	-
3. Multi-Cropping Intensity				
Total Farm Land*5	10,270	7,220	7,000	7,220
Total Cropping Area*6	11,760	8,420	16,000	8,420
Multi-Cropping Intensity	1.15	1.17	2.29	1.17

*1 Indicate area to be irrigated by the Project.

*2 Land acquisition area for irrigation facilities.

*3 Area of palawija cultivated in paddy field is estimated as follows, based on the average harvested areas in three Kecamatans related to the project area (Sajoanging, Majauleng and Maniangpajo) from 1988 to 1992.

	Harvested Area in 3 Kecamatans (ha)	%	Gross Project Area (ha)	Net Project Area (ha)
Paddy Field	36,230		10,130	7,220
Palawija	3,446	10.0%	1,010	720

*4 No expansion of pump irrigation area is estimated under the without project condition, because over 480 ha of pump irrigation is difficult without development of new water resources.

*5 Paddy Field + Upland Field

*6 Area cultivated in paddy and upland fields.

Table 5.1.2 Farm Budget Analysis - With Project

	Gravity Irrigation Area				Pump Irrigation Area			
	Area (ha)	Yield (t/ha)	Unit Price (Rp./kg)	Amount (Rp.1,000)	Area (ha)	Yield (t/ha)	Unit Price (Rp./kg)	Amount (Rp.1,000)
1. Gross Income				10,199				10,199
1.1 Farm Income								
Wet season paddy*1	2.27	6.0	320	4,358	2.27	6.0	320	4,358
Dry season paddy	2.27	6.0	320	4,358	2.27	6.0	320	4,358
Palawija & vegetables	0.66			1,002	0.66			1,002
Perennial crops	0.35			186	0.35			186
1.2 Livestock Income*2				96				96
1.3 Off-farm Income*3				119				119
1.4 Credit				10				10
1.5 Others				70				70
	Area (ha)	Unit Cost (Rp./ha)		Amount (Rp.1,000)	Area (ha)	Unit Cost (Rp./ha)		Amount (Rp.1,000)
2. Gross Outgoing				6,336				6,663
2.1 Production Cost				4,477				4,804
Wet season paddy*4	2.27	548		1,244	2.27	620		1,407
Dry season paddy*4	2.27	523		1,187	2.27	595		1,351
Palawija & vegetables*4	0.66	508		335	0.66	508		335
Others				113				113
Land rent*5	1.04			1,598	1.04			1,598
2.2 Living Expenses*6				1,856				1,856
2.3 Loan Repayment				3				3
3. Net Reserve				3,863				3,536

*1 Holding size under with project = 2.34 ha x 97% = 2.27 ha (excluding area of irrigation facilities.)
*2 Including income of draft power rented to other farmers.
*3 50% of present condition
*4 Costs of family labor, own animal and machine were excluded from the farm budget analysis.
*5 Land rent = 40% of products
*6 150% up from present condition.

Table 5.1.3 (1/2) Financial Crop Budget - With Project

			Gravity Irrigation				Pump Irrigation			
			Paddy				Paddy			
			Wet Season		Dry Season		Wet Season		Dry Season	
1. Gross Income										
- Unit Yield	(t)			6.0		6.0		6.0		6.0
- Unit Price	(Rp./kg)			320		320		320		320
- Gross Income	(Rp.)			1,920,000		1,920,000		1,920,000		1,920,000
2. Production Cost		Unit Price (Rp.)	Q'ty	Value (Rp.)	Q'ty	Value (Rp.)	Q'ty	Value (Rp.)	Q'ty	Value (Rp.)
1) Seed	(kg)	600	30	18,000	30	18,000	30	18,000	30	18,000
2) Fertilizers										
- Urea	(kg)	260	250	65,000	200	52,000	250	65,000	200	52,000
- TSP	(kg)	480	50	24,000	50	24,000	50	24,000	50	24,000
- KCl	(kg)	350	100	35,000	100	35,000	100	35,000	100	35,000
- ZA	(kg)	295	25	7,375	25	7,375	25	7,375	25	7,375
3) Agro-chemicals										
- Insecticides	(lit.)	13,200	1.0	13,200	1.0	13,200	1.0	13,200	1.0	13,200
- Herbicides	(lit.)		-	-	-	-	-	-	-	-
- Rodenticides	(kg)	12,000	0.5	6,000	0.5	6,000	0.5	6,000	0.5	6,000
4) Labor	(man-day)									
- Nursery		3,400	3.2	10,880	3.2	10,880	3.2	10,880	3.2	10,880
- Land Preparation		5,400	15.8	85,320	15.8	85,320	15.8	85,320	15.8	85,320
- Transplanting		5,400	20.0	108,000	20.0	108,000	20.0	108,000	20.0	108,000
- Fertilizing		3,400	2.5	8,500	2.5	8,500	2.5	8,500	2.5	8,500
- Spraying		3,400	3.0	10,200	3.0	10,200	3.0	10,200	3.0	10,200
- Weeding		3,400	30.0	102,000	30.0	102,000	30.0	102,000	30.0	102,000
- Irrigating		3,400	2.0	6,800	2.0	6,800	2.0	6,800	2.0	6,800
- Harvesting		7,300	20.0	146,000	20.0	146,000	20.0	146,000	20.0	146,000
- Drying		3,400	6.0	20,400	6.0	20,400	6.0	20,400	6.0	20,400
5) Transportation of Products				39,000		39,000		39,000		39,000
6) Animal Power	(day)	23,000	2.04	46,920	2.04	46,920	2.04	46,920	2.04	46,920
7) Mech. Power	(day)	29,000	2.03	58,870	2.03	58,870	2.03	58,870	2.03	58,870
8) Operation Cost of Pump *1			-	-	-	-		68,633		68,633
9) Others (5%)				40,573		39,923		44,005		43,355
Total		103		852,038		838,388		924,103		910,453
3. Net Return				1,067,962		1,081,612		995,897		1,009,547

Remarks: *1 Operation cost of pump is estimated as follows.

			Type 3	Type 4	Type 5	Total
HP of Engine		(HP)	10	18	27	
No. of Pump Units		(No.)	6	22	13	41
Operation Hour per Year		(hr/year)	3,112	3,112	3,112	
Fuel Cost						
- Unit Fuel Consumption		(Lit./hr)	1.17	2.11	3.16	
- Total Fuel Consumption		(lit.)	21,846	144,459	127,841	294,146
- Unit price of Diesel		(Rp./lit)	389.6	389.6	389.6	389.6
- Total Fuel Cost		(Rp.)	8,511,202	56,281,226	49,806,854	114,599,282
- Lubricant (20%)		(Rp.)	1,702,240	11,256,245	9,961,371	22,919,856
Annual Repair and Maintenance Cost		(Rp.)	5% of procurement cost			11,731,200
Annual Depreciation Cost		(Rp.)	Useful life 15 years			15,641,600
Total Cost		(Rp.)				164,891,938
Irrigation Area	Cropping Area		Double cropping of paddy and			2,403
- Wet S. Paddy	1,120	(ha)	palawija (29%)			(1,120)
- Dry S. Paddy	1,120	(ha)	Operation hour of palawija is			(1,120)
- Palawija	325	(ha)	estimated to be 50% of its paddy.			(163)
Operation cost per ha						
- Paddy		(Rp./ha)				68,633
- Palawija		(Rp./ha)				34,317

Note: Proposed farm inputs were estimated on the basis of the recommendation of BIMAS package technology in 1994/1995 and 1995. (Rekomendasi, Paket Teknology Tanaman Pangan Propinsi Sulawesi Selatan - MT 1994/1995 dan 1995, Tim Teknis BIMAS Propinsi Sulawesi Sulatan, Agustus 1994)

Table 5.1.3 (2/2) Financial Crop Budget - With Project

			Gravity Irrigation								Pump Irrigation							
			Mungbeans		Soybeans		Groundnuts		Chillies (Large)		Mungbeans		Soybeans		Groundnuts		Chillies (Large)	
1. Gross Income																		
- Unit Yield	(t)			1.50		1.50		1.50		3.00		1.50		1.50		1.50		3.00
- Unit Price	(Rp./t)			690		950		1,000		1,100		690		950		1,000		1,100
- Gross Income	(Rp.)			1,035,000		1,425,000		1,500,000		3,300,000		1,035,000		1,425,000		1,500,000		3,300,000
2. Production Cost		Unit Price (Rp.)	Q'ty	Value (Rp.)	Q'ty	Value (Rp.)	Q'ty	Value (Rp.)	Q'ty	Value (Rp.)	Q'ty	Value (Rp.)	Q'ty	Value (Rp.)	Q'ty	Value (Rp.)	Q'ty	Value (Rp.)
1) Seed*1	(kg)		25	17,250	45	54,000	60	108,000	0.4	45,000	25	17,250	45	54,000	60	108,000	0.4	45,000
2) Fertilizers																		
- Urea	(kg)	260	50	13,000	50	13,000	30	7,800	300	78,000	50	13,000	50	13,000	30	7,800	300	78,000
- TSP	(kg)	480	50	24,000	100	48,000	50	24,000	250	120,000	50	24,000	100	48,000	50	24,000	250	120,000
- KCl	(kg)	350	50	17,500	50	17,500	50	17,500	250	87,500	50	17,500	50	17,500	50	17,500	250	87,500
- ZA	(kg)	295	-	-	-	-	-	-	150	44,250	-	-	-	-	-	-	150	44,250
3) Agro-chemicals																		
- Insecticides	(lit.)	13,200	1	13,200	1.5	19,800	1	13,200	2.5	33,000	1	13,200	1.5	19,800	1	13,200	2.5	33,000
4) Labor	(man-day)																	
- Family Labor		3,400	43.2	146,880	54.0	183,600	58.8	199,920	199.5	678,300	43.2	146,880	54.0	183,600	59	199,920	199.5	678,300
- Hired Labor		3,400	23.5	79,900	29.4	99,960	38.4	130,560	85.5	290,700	23.5	79,900	29.4	99,960	38	130,560	85.5	290,700
5) Animal Power	(day)	23,000	5.22	120,000	5.22	120,000	12.43	286,000	13.04	300,000	5.22	120,000	5.22	120,000	12.43	286,000	13.04	300,000
6) Mech. Power	(day)	29,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7) Operation Cost of Pump*2			-	-	-	-	-	-	-	-		34,317		34,317		34,317		34,317
8) Others (5%)				21,587		27,793		39,349		83,838		21,587		27,793		39,349		83,838
Total				453,317		583,653		826,329		1,760,588		487,634		617,970		860,646		1,794,905
3. Net Return				581,683		841,347		673,671		1,539,412		547,366		807,030		639,354		1,505,095

*1 Unit prices of seeds (Rp./kg):

Maize	300	Groundnuts	1,800
Mungbeans	690	Chillies	112,500
Soybeans	1,200		

*2 50% of operation cost for paddy = Rp.68,633 x 50% = Rp. 34,317 /ha

Note: Production costs of palawija were estimated on the basis of the Household Survey (JICA Survey Team, 1994) and the "Laporan Analisa Usahatani Padi, Palawija dan Hortikultura 1993/94 (Dinas Pertanian Tanaman Pangan, Propinsi Sulawesi Sulatan).

Table 5.6.1 Summary of Construction Cost

Unit : Rp. Million

Item	F.C.	L.C	Total
1 Preparatory Works (5% of 2)	2,583	1,548	4,131
2 Civil Works			
2.1 Weir	4,252	4,732	8,984
2.2 Dam	25,423	10,478	35,901
2.3 Main System	15,588	7,441	23,029
2.4 Secondary System	3,919	2,612	6,531
2.5 Tertiary System	-	4,453	4,453
2.6 Drainage System	1,389	584	1,973
2.7 Farm Road Network	1,018	476	1,494
2.8 Pumping Facilities	70	164	234
Sub-Total 2	51,659	30,940	82,599
3 O & M Facilities and Equipment	741	317	1,058
4 Land Acquisition and Compensation	-	3,734	3,734
5 Administration (2.5% of 1&2)	1,354	810	2,164
6 Engineering Services	23,009	2,779	25,788
7 Physical Contingency (10% of 1,2,3,4,5 & 6)	7,935	4,013	11,948
Total	87,280	44,141	131,421
8 Price Contingency	12,345	16,922	29,267
Grand Total	99,625	61,063	160,688

Table 5.6.2 Annual Disbursement Schedule

Unit : Rp. Million

Item	Total		1996		1997		1998		1999		2000		2001	
	F.C.	L.C	F.C.	L.C	F.C.	L.C	F.C.	L.C	F.C.	L.C	F.C.	L.C	F.C.	L.C
1 Preparatory Works	2,583	1,548	-	-	-	-	2,583	1,548	-	-	-	-	-	-
2 Civil Works														
2.1 Weir	4,252	4,732	-	-	-	-	390	613	1,171	1,190	1,836	1,216	855	1,713
2.2 Dam	25,423	10,478	-	-	-	-	2,095	936	4,380	1,730	6,949	3,980	11,999	3,832
2.3 Main System	15,588	7,441	-	-	-	-	623	297	8,574	4,093	6,391	3,051	-	-
2.4 Secondary System	3,919	2,612	-	-	-	-	-	-	705	470	2,783	1,855	431	287
2.5 Tertiary System	-	4,453	-	-	-	-	-	-	-	-	-	3,162	-	1,291
2.6 Drainage System	1,389	584	-	-	-	-	-	-	-	-	986	415	403	169
2.7 Farm Road Network	1,018	476	-	-	-	-	-	-	-	-	723	338	295	138
2.8 Pumping Facilities	70	164	-	-	-	-	-	-	-	-	35	82	35	82
Sub-Total 2	51,659	30,940	-	-	-	-	3,108	1,846	14,830	7,483	19,703	14,099	14,018	7,512
3 O & M Facilities and Equipment	741	317	-	-	-	-	519	222	222	95	-	-	-	-
4 Land Acquisition and Compensation	-	3,734	-	1,120	-	1,494	-	747	-	373	-	-	-	-
5 Administration	1,354	810	-	-	-	-	142	84	370	187	492	352	350	187
6 Engineering Services	23,009	2,779	3,798	-	4,997	-	2,891	361	3,774	806	3,774	806	3,774	806
7 Physical Contingency	7,935	4,013	380	112	500	149	924	481	1,920	894	2,397	1,526	1,814	851
Total	87,280	44,141	4,178	1,232	5,497	1,643	10,167	5,289	21,116	9,838	26,366	16,783	19,956	9,356
8 Price Contingency	12,345	16,922	190	152	397	313	1,018	1,385	2,726	3,325	4,223	7,032	3,791	4,715
Grand Total	99,625	61,063	4,368	1,384	5,894	1,956	11,185	6,674	23,842	13,163	30,589	23,815	23,747	14,071

Table 7.2.1 Economic Internal Rate of Return -Whole Project

(Unit: Rp. Million)

Year	Year in Order	Project Costs				Project Benefits			Balance
		Construction	Replace-ment	O&M	Total	Benefits	Negative Benefits	Total	
1996	1	4,359			4,359			0	-4,359
1997	2	5,745			5,745			0	-5,745
1998	3	11,758			11,758			0	-11,758
1999	4	23,059		64	23,123			0	-23,123
2000	5	31,806		322	32,128			0	-32,128
2001	6	21,918		514	22,432	4,690	-368	4,322	-18,110
2002	7		0	643	643	11,256	-368	10,888	10,245
2003	8		0	643	643	14,070	-368	13,702	13,059
2004	9		0	643	643	15,946	-368	15,578	14,935
2005	10		0	643	643	17,822	-368	17,454	16,811
2006	11		0	643	643	18,760	-368	18,392	17,749
2007	12		0	643	643	18,760	-368	18,392	17,749
2008	13		0	643	643	18,760	-368	18,392	17,749
2009	14		0	643	643	18,760	-368	18,392	17,749
2010	15		0	643	643	18,760	-368	18,392	17,749
2011	16		2,196	643	2,839	18,760	-368	18,392	15,553
2012	17		0	643	643	18,760	-368	18,392	17,749
2013	18		0	643	643	18,760	-368	18,392	17,749
2014	19		0	643	643	18,760	-368	18,392	17,749
2015	20		0	643	643	18,760	-368	18,392	17,749
2016	21		235	643	878	18,760	-368	18,392	17,514
2017	22		0	643	643	18,760	-368	18,392	17,749
2018	23		0	643	643	18,760	-368	18,392	17,749
2019	24		0	643	643	18,760	-368	18,392	17,749
2020	25		0	643	643	18,760	-368	18,392	17,749
2021	26		2,196	643	2,839	18,760	-368	18,392	15,553
2022	27		0	643	643	18,760	-368	18,392	17,749
2023	28		0	643	643	18,760	-368	18,392	17,749
2024	29		0	643	643	18,760	-368	18,392	17,749
2025	30		0	643	643	18,760	-368	18,392	17,749
2026	31		10,075	643	10,718	18,760	-368	18,392	7,674
2027	32		0	643	643	18,760	-368	18,392	17,749
2028	33		0	643	643	18,760	-368	18,392	17,749
2029	34		0	643	643	18,760	-368	18,392	17,749
2030	35		0	643	643	18,760	-368	18,392	17,749
2031	36		2,431	643	3,074	18,760	-368	18,392	15,318
2032	37		0	643	643	18,760	-368	18,392	17,749
2033	38		0	643	643	18,760	-368	18,392	17,749
2034	39		0	643	643	18,760	-368	18,392	17,749
2035	40		0	643	643	18,760	-368	18,392	17,749
2036	41		0	643	643	18,760	-368	18,392	17,749
2037	42		0	643	643	18,760	-368	18,392	17,749
2038	43		0	643	643	18,760	-368	18,392	17,749
2039	44		0	643	643	18,760	-368	18,392	17,749
2040	45		0	643	643	18,760	-368	18,392	17,749
2041	46		2,196	643	2,839	18,760	-368	18,392	15,553
2042	47		0	643	643	18,760	-368	18,392	17,749
2043	48		0	643	643	18,760	-368	18,392	17,749
2044	49		0	643	643	18,760	-368	18,392	17,749
2045	50		0	643	643	18,760	-368	18,392	17,749

EIRR (%) =	13.3		
B/C (Discount Rate 10%) =	1.37	B-C (Discount Rate 10%, Rp. Million) =	26,248

Table 7.3.1 Cash Flow Statement

(Unit: Rp. Million)

Year	Year in Order	Cash Outflow: Capital Cost *1 Internal Fund	Capital Cost *1 Government Budget	Loan Repayment*2 Interest	Loan Repayment*2 Principal	Total O&M Cost*3	Replacement Cost *3	Total	Cash Inflow: Construction Fund	*3*4 Revenue	Government Budget	Total	Balance
1996	1	4,367	1,387	-				5,754	5,754		0	5,754	0
1997	2	5,894	1,960	114				7,968	7,854		114	7,968	0
1998	3	16,534	1,324	267				18,125	17,858		267	18,125	0
1999	4	35,722	1,282	697		359		38,060	37,004		1,056	38,060	0
2000	5	53,228	1,173	1,625		760		56,786	54,401		2,385	56,786	0
2001	6	37,051	765	3,009		1,209		42,034	37,816	504	3,714	42,034	0
2002	7			3,973		1,209	0	5,182	0	1,009	4,173	5,182	0
2003	8			3,973		1,209	0	5,182	0	1,009	4,173	5,182	0
2004	9			3,973		1,209	0	5,182	0	1,009	4,173	5,182	0
2005	10			3,973		1,209	0	5,182	0	1,009	4,173	5,182	0
2006	11			3,973	7,640	1,209	0	12,821	0	1,009	11,812	12,821	0
2007	12			3,774	7,640	1,209	0	12,623	0	1,009	11,614	12,623	0
2008	13			3,575	7,640	1,209	0	12,424	0	1,009	11,415	12,424	0
2009	14			3,377	7,640	1,209	0	12,226	0	1,009	11,217	12,226	0
2010	15			3,178	7,640	1,209	0	12,027	0	1,009	11,018	12,027	0
2011	16			2,980	7,640	1,209	2,613	14,441	0	1,009	13,432	14,441	0
2012	17			2,781	7,640	1,209	0	11,630	0	1,009	10,621	11,630	0
2013	18			2,582	7,640	1,209	0	11,431	0	1,009	10,422	11,431	0
2014	19			2,384	7,640	1,209	0	11,232	0	1,009	10,223	11,232	0
2015	20			2,185	7,640	1,209	0	11,034	0	1,009	10,025	11,034	0
2016	21			1,986	7,640	1,209	280	11,115	0	1,009	10,106	11,115	0
2017	22			1,788	7,640	1,209	0	10,637	0	1,009	9,628	10,637	0
2018	23			1,589	7,640	1,209	0	10,438	0	1,009	9,429	10,438	0
2019	24			1,390	7,640	1,209	0	10,239	0	1,009	9,230	10,239	0
2020	25			1,192	7,640	1,209	0	10,041	0	1,009	9,032	10,041	0
2021	26			993	7,640	1,209	2,613	12,455	0	1,009	11,446	12,455	0
2022	27			795	7,640	1,209	0	9,643	0	1,009	8,634	9,643	0
2023	28			596	7,640	1,209	0	9,445	0	1,009	8,436	9,445	0
2024	29			397	7,640	1,209	0	9,246	0	1,009	8,237	9,246	0
2025	30			199	7,640	1,209	0	9,047	0	1,009	8,038	9,047	0
2026	31					1,209	11,989	13,198	0	1,009	12,189	13,198	0
2027	32					1,209	0	1,209	0	1,009	200	1,209	0
2028	33					1,209	0	1,209	0	1,009	200	1,209	0

Remarks: *1 F.C. = Foreign Currency Portion, L.C. = Local Currency Portion
*2 Interest: 2.6% per year. Grace Period: 10 years. Repayment Period: 30 years (including grace period).
*3 Prices in 2001.
*4 Revenue from irrigation service fees to be collected from the beneficiaries.

Note: The cash flow statement was prepared for the project executing agency of the Gilirang Irrigation Project.

Table 7.5.1 Matrix of Impact Identification and Evaluation

Activities / Environmental Component	Pre-Construction Stage			Construction Stage										Operation Stage					Location of Impact		
	Location survey and stake out	Land acquisition	Resettlement	Land clearing	Heavy equipment mobilization	Labour mobilization	Construction of access and construction road	Base camp erection	Transportation of building materials	Sand and gravel mining	Construction of dam and Diversion weir	Construction of Irrigation network and farm roads	Reservoir impounding	Reservoir operation	Reservoir maintenance	Operation of irrigation network	Operation of farm and inspection paths	Distribution of irrigation water	Upstream rolling area	Central plain area	Downstream coastal area
I.Physical-Chemical																					
a.Climate				B	B		B		B					B	B	B	B	B	*	*	*
b.Physiography and										B	A	B							*	*	*
Topography																					
c.Land use										B	A		B						*	*	*
d.Water quantity				A			B			B	A		B	B	B	B		B	*	*	*
e.Soil erosion				A			A	A	B	A	A	B	A	A	B	B	B	B	*	*	*
f.Ground water				B						B			B	B	B	A		B		*	*
g.Water quality				B			B	B	B	B	A	B	B	A	B	A		B	*	*	*
h.Domestic water utilization														A		A				*	*
II.Flora and Fauna																					
a.Vegetation				B			B	B		B	B	B	B						*	*	*
b.Mangrove													A	A	B						*
c.Fish										B	B	B	B	A	B				*	*	*
d.Plankton										B	B	B	B	B	B						
e.Wild life				B							B		B	B					*		
III.Social, Economic, and Culture																					
a.People perception	B	A	B			B								B				B	*	*	*
b.People anxiety		A	A			B		B						B				B	*	*	
c.Social jealousy				B		B		B						B				A	*	*	
d.Job opportunity			A	B		B			B	B	B	B		A		A				*	*
e.Income			A						B	B	B	B		A		A				*	*
f.Regional economics										B	B			A		A				*	*
g.Public health			B	B	B				B	B	B	B	B							*	*
h.Inhabitant mobility			B									B		B			B		*	*	*
i.Safety and social security			B					B			B		B				B		*	*	*
j.Culture			A					B											*	*	*
h.Public facilities			A		B				B		B								*		

Note) A : Important impact
B : Less inportant impact

Table 7.5.2 (1/3) Environmental Management Plan

I. Pre-Construction Stage

Description of Impact	Source of Impact	Environmental Management Plan
1. Land Acquisition a.People's expectation b.People's anxiety c.Disturbance of safety and public order	a.Unsatisfactory process of resettlement and amount of compensation	a.To carry out extension service and intensive approach to people b.To decide amount of compensation based on agreed figures c.To decide amount of compensation according to types and functions of people d.To disburse compensation directly to inhabitants e.To compensate relocation of the remaining and provide a new cemetery in new area
2. Resettlement of Paselloreng Villagers a.Complaints b.People's anxiety and disturbances to safety and public order c.Decrement of income d.Decrement of occupation	a.Lack of project attention during resettlement b.Lack of public facilities and road infrastructure c.Lack of farmer occupation in new area d.Mosquito increment vector and degeneration of well and ground water quality	a.To get people perception on suitable area before land acquisition and relocation b.To provide help to people moving their buildings c.To provide a new location with public facilities similar to Paselloreng d.To construct access roads between the new area and surrounding villages

II. Construction Stage

1. Land Clearing, Fill, and Soil Compaction a.Decrement of plantation b.Increment of dust c.Endanger labor health and safety	a.Cutting trees in the reservoir area b.Utilization of heavy equipment c.Soil compaction d.Lack of worker's safety devices	a.To provide safety facilities and management b.To provide a location for residue of trees and shrubs c.To provide guidance on safety to workers e.To provide safety devices to workers
2. Heavy Equipment Mobilization and Transport of Bridge Material a.Road damages b.Disturbance to people's mobility and economics c.Disturbance to people's comfort and health d.Increment of dust and noise	a.Utilization of heavy equipment and trucks b.Increment of trucks and motor vehicles c.Lack of transportation vehicle maintenance	a.To control operation during the night b.To improve and reinforce the road and bridge
3. Mobilization and Recruitment of Workers a.Negative perception of local people b.People's jealousy c.Disturbance to safety and public order d.Increment of job opportunity	a.Lack of priority to local people b.Workers from the outside area	a.To give priority to local people based on their capability b.To provide extension and intensive approach c.To provide guidance to workers
4. Base Camp and Storage Shed		

Table 7.5.2 (2/3) Environmental Management Plan

Description of Impact	Source of Impact	Environmental Management Plan
a.Environment pollution around Base Camp b.Water pollutant caused by oil, grease and solid waste / liquid waste generated by workers	a.Solid and liquid waste generated by workers b.Oil drops from garage and workshop	a.To provide facilities for solid and liquid waste collection b.To provide sufficient sanitary facilities in the base camp c.To collect waste oil and grease
5. Sand and Gravel Excavation and Quarry a.Change of physiography and topography b.Increment of erosion c.Decrement of river water quality	a.Excavation of rock, sand, and gravel b.Soil erosion transported into river	a.To control excavation along the river bank b.To carry out replantation in the excavation area
6. Dam and Diversion Weir Construction a.Change of physiography and topography b.Increment of solid waste c.Increment of dust and noise d.Water quality degeneration e.Degradation of aquatic biota f.Disturbance to wild life	a.Utilization of heavy equipment b.Increment of washout and mud c.Decrement of water flow in the river	a.To backfill excavated soil properly b.To provide sufficient equipment to workers c.To provide guidance to workers
7. Irrigation Canal and Farm Road Construction a.Increment of dust and noise b.Disturbance to comfort and health of people	a.Soil excavation and compaction b.Transportation of fill materials c.Spoiling of embankment soil	a.To carry out routine watering b.To reduce frequency of transportation during the night and the rainy season c.To provide sufficient traffic signs at the entry of the project area
8. Reservoir Inundation a.Decrement of water quality and quantity b.Decrement of population and growth of aquatic biota (fish, plankton) c.Decrement of soil fertility d.Disturbance of sidat fish migration (Anguila sp.)	a.Water stagnating in reservoir b.Lack of sediment transformed downstream c.Lack of organic matter transported downstream	a.To regulate water released into river

III. Operation Stage

1. Dam / Reservoir Operation a.Decrement of water quality and quantity b.Decrement of aquatic biota growth c.Disturbance to fish migration d.Support fertility of water body e.Disturbance to mangrove growth f.Decrement of fishpond production g.Decrement of water quality within reservoir	a.Damming of river water b.Decrement of river debit c.Disturbance to inundated catchment area d.Increment of tourists	a.To regulated water release into river b.To clean gates routinely, at least four times a year d.To carry out replantation in the catchment area e.To provide signboards forbidding people to litter in the reservoir

Table 7.5.2 (3/3) Environmental Management Plan

Description of Impact	Source of Impact	Environmental Management Plan
2. Reservoir Maintenance a.Increment of turbidity b.Decrement of water quality in reservoir c.Increment of solid waste in reservoir	a.Cleaning of intake gate b.Degradation of the upstream part of Gilirang river c.Tourism	a.To carry out periodic clearing b.To keep replantation trees around the dam c.To protect forests upstream of the Gilirang river d.To provide signboards forbidding people to litter in the reservoir
3. Operation of Irrigation System a.Increment of farmer's income and prosperity b.Increment of national rice stock c.Degradation of river water quality d.Complaint of fishpond farmers e.Increment of aquatic plant in irrigation networks	a.Increment of crop intensity b.Increment of utilization of fertilizer and pesticide c.Decrement of fishpond production	a.To optimize water utilization b.To provide guidance concerning to application of fertilizer and pesticide c.To disseminate information to fishpond farmers not to use irrigation water for their fishponds
4. Irrigation Water Distribution a.Conflict between water users	a.Water not distributed properly b.Water distribution to the irrigation network c.Increment of aquatic plants in the irrigation network	a.To establish a water user association b.To provide intensive guidance to the farmer on irrigation canal maintenance c.To make thorough payment of the irrigation fee d.To clean the irrigation canal of aquatic plants

Table 7.5.3 (1/2) Environmental Monitoring Plan

I. Pre-Construction Stage

Description of Impact	Source of Impact	Environmental Monitoring Plan
1. Land Acquisition a.People's expectation, anxiety and disturbance of safety and public order	a.Unsatisfactory process and amount of compensation b.Resettlement	a.To monitor perception of people to the project b.To monitor people's complaints against land acquisition
2. Resettlement a.Decrement of people's income, health conditions, and complaints	a.Resettlement to new area	a.To monitor people's source and level of income b.To monitor conditions of new location c.To monitor public facilities

II. Construction Stage

1. Air Quality and Noise a.Air quality (dust, CO, SO_2, NOx, dust) and noise	a.Mobilization of heavy equipment b.Land clearing, compaction, and fill c.Excavation of rock, sand, and gravel	a.To monitor air quality b.To monitor level of noise
2. Physiography and Topography a.Physiogrphy and topography modification	a.Excavation of rock, sand, and gravel b.Land clearing c.Dam and irrigation system construction	a.To monitor conditions of the excavation area b.To monitor replantation activities c.To monitor land changes d.To monitor soil in the spoil area
3. Water Quality and Quantity a.River and ground water quality and quantity (total flow, turbidity, and salinity)	a.Reservoir impounding b.Excavation of rock, sand, and gravel c.Land clearing d.Workshop and base camp	a.To monitor river debit and current speed b.To monitor turbidity (dissolved and suspended solids) c.To monitor salinity downstream d.To monitor sediment rate
4. Terrestrial Flora and Fauna a.Land flora and fauna (type/species, density, growth and wild life)	a.Land clearing b.Excavation of rock, sand, and gravel c.Dam construction d.Utilization of heavy equipment	a.To monitor type/species, density growth b.To monitor vegetation growth c.To monitor species and population of wild life
5. Aquatic Biota a.Aquatic biota (diversity index, similarity, growth and migration)	a.Utilization of reservoir b.Increase of turbidity and solid waste	a.To monitor mangrove growth b.To monitor species, growth of fish, plankton and benthos
6. Perception and Social unrest a.People's perception, unrest (social, behavior changes of people residing around project)	a.Restriction of recruitment to local people b.Income of labor	a.To monitor people's complaint and uneasiness b.To monitor the project's role in giving compensation and providing pubic facilities

Table 7.5.3 (2/2) Environmental Monitoring Plan

7. Job Opportunity and Income a.Job opportunity and income	a.Total of local people involved in project activities b.Total of local businesses involved in project activities	a.To monitor people's complaint b.To monitor the number of local people working directly and indirectly in the project b.To monitor people's welfare including labor from outside
8. Public Utility and Infrastructure a.Health and comfort of people (complaint, type of diseases)	a.Increase of dust and noise	a.To monitor people's complaint b.To monitor roads and other damages to facilities c.To monitor traffic jams and number of road accidents d.To monitor types of diseases
9. People's Comfort and Health a.Peaple's comfort and health	a.Increased dust and noise level from vehicles	a.To monitor people's complaint b.To monitor incidence of diseases experienced by local people
10. Health and Safety of Workers a.Health and safety of workers	a.Increase of mosquitoes in base camp b.Lack of health facilities and safety devices c.Lack of worker discipline and capability	a.To monitor type of diseases experienced by worker b.To monitor working equipment and health facilities c.To monitor condition and cleanliness of the base camp d.To monitor waste treatment facilities in the base camp

III. Operation Stage

Description of Impact	Source of Impact	Environmental Monitoring Plan
1. Water quality and quantity a.River water quality and quantity	a.Dam operation b.Irrigation networks operation c.Utilization of fertilizers and pesticides d.Maintenance of intake gate	a.To monitor water debit and flow speed of river b.To monitor dissolved solids and suspended solids of river water c.To monitor water salinity d.To monitor sedimentation level
2. Aquatic Biota a.Aquatic biota (fish, plankton, benthos and mangrove)	a.Increase of water aquatic plants in the reservoir and irrigation canal b.Change of water quality and quantity because of the reservoir operation	a.To monitor species and growth of fish, plankton, and benthos b.To monitor fish migration c.To monitor mangrove growth
3. Conflict among Water Users a.Conflict among water users	a.Water not distributed properly b.Disturbance to irrigation network c.Lack of guidance to water users	a.To monitor people's complaint b.To monitor the number of water user associations and their activities c.To monitor the irrigation canal condition