because of fluctuation of water level.

2) Case - 2.1 As mentioned in the above table, this case is the most economical. In addition, the following points are distinguished:

- It is possible to take a stable amount of water by means of gate control.
- Much attention must be paid on operating gates at the time of flood to avoid the extension of the inundation area.

3) Case - 2.2 The characteristics of this case are almost the same as the Case - 2.1. However, this case is less economical than the Case - 2.1.

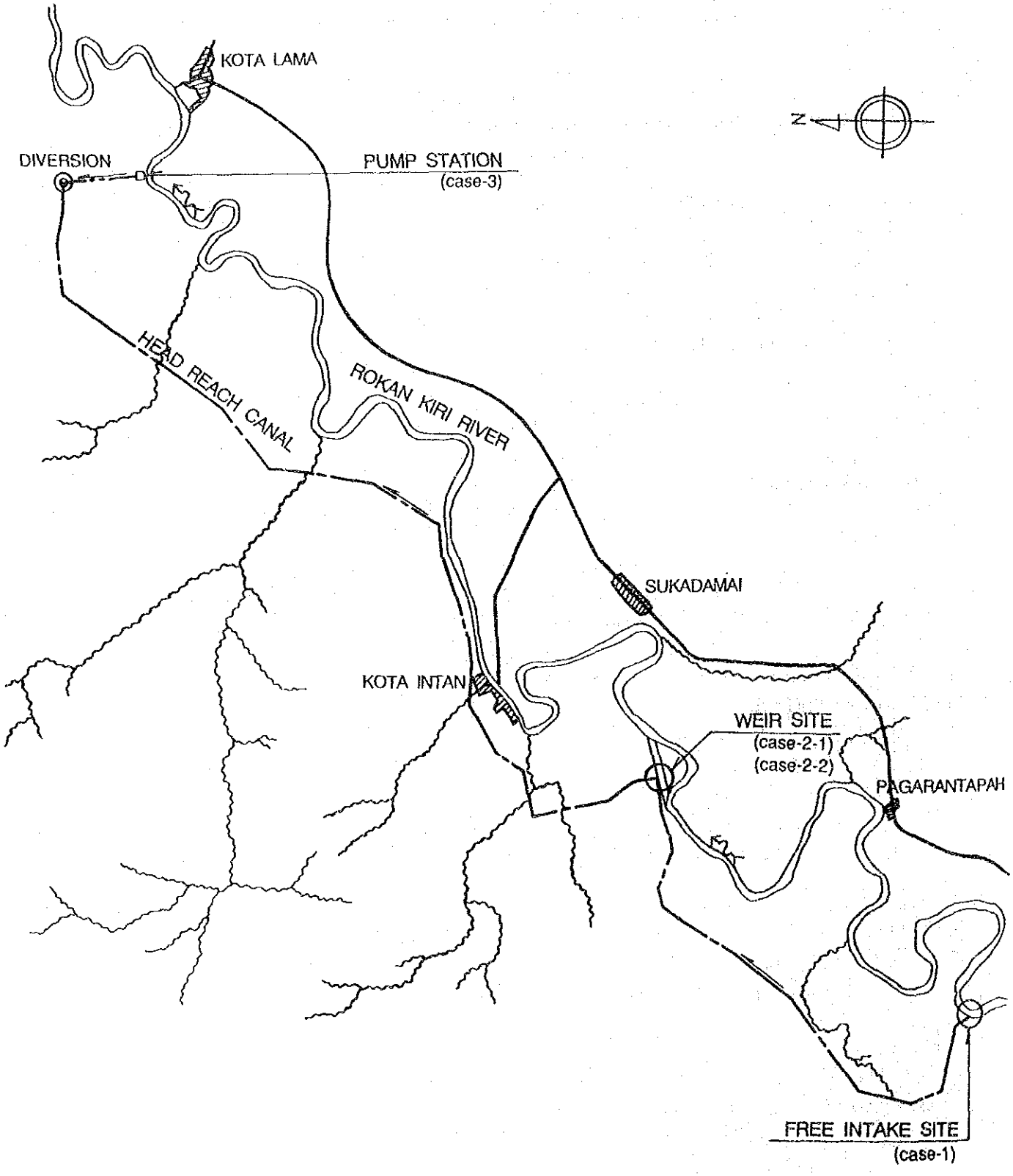
In this case, it is difficult to get spare parts of the rubber dam in Indonesia, when it gets out of order.

4) Case - 3 This case is the most uneconomical as shown in the above table.

The running cost for the diesel engines of pumps is also expensive compared with the other cases.

As a result of the above study, the Case -2.1 is most economical.

LOCATION OF INTAKES FOR ALTERNATIVE PLANNING



3.4 Proposed Project Works

3.4.1 General

In order to achieve the irrigation project in successfully, the construction of the following infrastructures and further improvement of supporting services are required.

a) Construction of irrigation network consisting of a weir, head reach canal, main and secondary canals,

b) Construction of main drainage system,

c) Construction of tertiary network consisting of tertiary and quaternary canals, tertiary and quaternary drains and farm roads,

d) Reclamation of new farm lands,

e) Construction of O & M facilities and provision of O & M equipment, and

f) Further improvement of the present agricultural supporting services.

The irrigation water is diverted by gravity method from weir and conveyed through the head reach canal of 13.0 Km on the left side of the Rokan Kiri river, and then diverted to two(2) main canals for left and right sides of the river. The right main canal crosses the river by a siphon structure.

3.4.2 Weir

The feature of the diversion weir is as follows;

Water source	:	Rokan Kiri river
Location of intake facility	:	about 5 Km upstream from Kp. Kotaintan
Catchment area	:	3,267 Km^2
Elevation of river bed	:	EL.41.70 m
Elevation of gate top	:	EL.46.00 m
Height of gate	:	4.30 m
Width of flood gate	:	24.00 m
Number of flood gate	:	4 nos.

Width of sand flush gate	:	5.00 m
Number of sand flush gate	:	2 nos.
Intake water level	:	45.90 m
Flood discharge (1/100)	:	2,200 m^3/s
Intake	:	Sluice gate (2.0 m x 2 nos.)
Design intake discharge	:	9.35 m^3/s

As to the influence of back water due to the construction of weir, no back water is expected during flood because movable flood gates are employed. In case of normal flow (river discharge is Q = 143.8 m^3/s, annual mean discharge), namely when irrigation water is being taken, effect of back water by weir is estimated at about 9.7 Km from the weir site and no inundation area in the upstream part of the river is considered. This phenomenon is illustrated in Fig.3.6.

3.4.3 Irrigation Canal System

Irrigation canal system up to the tertiary box for tertiary blocks in the project area included a head reach canal, main canals and secondary canals.

1) Head reach canal

Head reach canal with a length of 13.0 Km is constructed between the weir and 1st diversion structure in which left and right main canals are branched off, in order to lead the intake discharge of 9.35 m^3/s in peak time.

The canal is concrete lined trapezoidal section with an inside slope of 1:1.5 and has 4.7 m bottom width and 1.65 m water depth. The longitudinal canal slope is 0.000271.

2) Main canals

The left main canal of 16.1 Km in length is constructed for the irrigation area of 5,485 ha on the left side of the Rokan Kiri river. This canal is designed for the discharge of 8.48 m^3/s at its head.

The right main canal runs for 19.1 Km to irrigate 2,815 ha on the right side of the river and the design discharge at the head of canal is 4.36 m^3/s.

The above main canals are partly concrete lined. The

longitudinal profile of both the canals are illustrate in Fig.3.7.

3) Secondary canals

These secondary canals are branched off from the above mentioned main canals to distribute water to these secondary units of which covering areas are about 100 ha at maximum. Twelve(12) secondary canals with a total length of about 29.5 Km are planned in the project area. These canals basically unlined and trapezoidal shape.

The number of related structures for the head reach canal, main canals and secondary canals are summarized in Table 3.6.

The distribution diagram for main and secondary system is presented in Fig.3.8.

3.4.4 Drainage System

The main drainage network is planned to drain out surplus water in the irrigation area to the Rokan Kiri river by widening small stream in the area and by constructing artificial drainage canals. Number, length and number of related structures of main drainage canals are shown below;

Name of canal	Length (Km)	Bottom width (m)	Top width (m)	Height (m)	Nos. of structures	
					Bridge	Drop
DL-1	1.9	3.50	7.16	1.22	1	1
DL-2	1.8	2.50	4.44	0.97	1	1
DL-3	2.5	3.00	6.48	1.16	1	1
DL-4	3.5	4.50	9.03	1.51	0	0
DL-5-1	5.6	30.00	38.00	2.00	2	1
DL-5-2	5.1	25.00	33.00	2.00	1	0
DL-5-3	2.5	15.00	23.00	2.00	1	0
DL-6	6.1	6.00	10.86	1.62	2	1
DL-7-1	4.4	10.00	18.00	2.00	1	1
DL-7-2	4.9	7.00	12.19	1.73	1	0
DR-1	3.8	4.50	8.94	1.48	0	0
DR-2	4.1	3.50	7.40	1.30	0	0
DR-3	5.5	3.00	6.54	1.18	1	0
DR-4	4.5	5.00	9.65	1.55	1	0
Total	56.2				13	6

3.4.5 Tertiary System

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

The typical layout of tertiary system is shown in Fig.3.9.

3.4.6 Inspection Road

The inspection roads are provided along the head reach canal, main canals and secondary canal with 3.5 m effective width and gravel modeling. The inspection roads are also provided along the main drainage canal by filling the excavated soil from drainage canals with same width as irrigation canals.

3.4.7 Land Reclamation

The clearing works of forest for the first arable farm land for the new transmigration program in the project area will be carried out by the Ministry of Transmigration. The clearing works is made and followed by firing. Uprooting works is made after firing and finally, the rough leveling works is carried out.

The construction of on-farm facilities and farm land including leveling works are principally carried out by farmers themselves under a land development project of the Ministry of Agriculture.

3.4.8 Office and Quarters

Office and quarters are required for the persons to be engaged for the project implementation and for the operation and maintenance of the project facilities. The approximate required number and space of these facilities are estimated as follows;

a) Main office : 1,000 m²
b) Quarters : 1,500 m²
c) Store house : 200 m²

d) Motor pool : 200 m²
e) Site office : 500 m²

3.5 Construction Plan

The construction period is estimated at five(5) years from 1996/97 to 2000/01 taking into account the scale of works, the project economy, etc. and all the costruction for the project is divided into six(6) work divisions. As to the construction of each work division, it is generally desirable to carry out the construction in sequence of drainage canals, head reach canal, main canals, secondary canals and tertiary network in each work division in order to get project benefit as early as possible.

Each work division is generally proposed as shown in the following table and the construction work divisions of the project is shown in Fig.3.10.

Work Division	Main Works	Construction Year
I	Access road (2.5 Km), Gated weir with intake Flood gate : 24 m x 4 nos. Sand flush gate : 5 m x 2 nos. Intake : 1 nos (Left) Sand trap : 1 nos.	1996/97 - 1998/99
II	Head reach canal (13.0 Km) Related structures Bridge : 5 nos. Drainage culvert: 17 nos. Diversion : 1 no. Spillway : 1 no.	1996/97 - 1998/99
III (Left bank)	Main canal (16.1 Km) Secondary canal (4.9 Km) Tertiary network (2,130 ha) Related structures Bridge : 11 nos. Drainage culvert: 15 nos. Diversion & turnout : 19 nos. Spillway : 4 nos. Drop : 4 nos. Check : 3 nos.	1996/97 - 1999/2000
IV (Left bank)	Secondary canal (19.4 Km) Tertiart network (3,355 ha) Related structures Bridge : 10 nos. Drainage culvert: 9 nos. Diversion & turnout : 19 nos. Spillway : 3 nos. Drop : 4 nos. Check : 5 nos.	1997/98 - 2000/01
V (Right bank)	Main canal (19.1 Km) Secondary canal (5.2 Km) Tertiary network (2,815 ha) Related structures Bridge : 11 nos. Drainage culvert: 12 nos. Diversion & turnout : 27 nos. Spillway : 6 nos. Drop : 5 nos. Check : 6 nos. Siphon : 1 no.	1997/98 - 1999/2000
VI (Both banks)	Drainage canal (56.2 Km) Related structures Bridge : 13 nos. Drop : 6 nos.	1996/97 - 1998/99

4. Project Implementation Plan

4.1 Project Implementation Plan

The implementation period planned at seven(7) years months from 1993/94 to 2000/01. Two(2) years from 1993/94 to 1994/95 are the period necessary for survey and investigation, detailed design of weir and irrigation and drainage facilities, preparatory work, tender and contract business, etc.

The construction period is estimated at five(5) years from 1996/97 to 2000/01 taking into account the scale of works, the project economy, etc. and all the construction works for the project is divided into six(6) work divisions. As to the construction of each work division, it is generally desirable to carry out the construction in sequence of drainage canals, head reach canal, main canals, secondary canals and tertiary network in each work division.

The proposed implementation schedule of the project is shown in Fig.4.1.

4.2 Organization for Project Execution

The Directorate General of Water Resources Development(DGWRD) of the Ministry of Public Works would be the executing agency for the implementation of the Lower Roakn Kiri Irrigation Project. DGWRD would be responsible for both the engineering work and the construction works of the project. It would coordinate all activities of the relevant government agencies and regional administrative organizations in connection with the project implementation.

The Public Works in Riau Province would directly coordinate the construction of the project at the provincial level on behalf of the Ministry of Public Works.

In order to attain the project successfully, it is proposed to organize the project executing office under the superintendent of the Directorate Irrigation-II. The main tasks of the project office would be as listed below.

a) Financial arrangement needed for the engineering and construction works of the project.

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

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

d) Coordination along the government authorities concerned with implementation of the project; namely the transmigration office (Kantor Transmigrasi), agricultural office (Dinas Pertanian), estate office, KUD and regional governments.

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

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

The project office during the construction stage will be organized in the project area. The proposed organization structure is presented in Fig.4.2.

4.3 Operation and Maintenance of the Project

After completion of the construction works, the project executing office will be recognized into the O&M office which will be responsible for the operation and maintenance of all facilities, covering the irrigation facilities up to tertiary blocks. The operation and maintenance between the tertiary blocks and terminal facilities will be entrusted to the farmers' water user group (KP2A) and farmers themselves.

The proposed organization structure of the O&M office will have four(4) sections, namely operation section, repair and maintenance section, assistance section and administrative section (see Fig.4.3). The main tasks of these sections are summarized below.

a) Operation section

- Planning of irrigation schedule
- Arrangement of water distribution
- Hydrological measurement
- Data collection and processing

b) Repair and maintenance section

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

c) Assistance section

- Guidance and training to water users' association
- Monitoring and evaluation

d) Administrative section

- Personnel services
- Accounting and cashiering
- General affair services

It is proposed that O&M office be established in these areas in order to execute the smooth and effective water management, otherwise the project area are divided into two(2) areas and water delivery made separately within these areas.

The staff necessary for the O&M office are estimated at 120 persons including water management engineering, hydrologist, mechanics, drivers/operators, accountants, etc.

The O&M equipment that will be required during the O&M stage are bulldozer, motor grader, vehicles, measuring instrument, etc.

The proposed O&M equipment list is as follows;

No.	Equipment	Type	Nos.
1	Backhoe	0.3 m^3	1
2	Bulldozer	6 ton	1
3	Motor Grader	Blade 3 m	2
4	Tire Roller	6-8 ton	1
5	Rammer	80 Kg	4
6	Concrete Mixer	0.2 m^3	1
7	Concrete Vibrator	Dia. 45 mm	2
8	Submersible Pump	11Kv x a50 mm	4
9	Generator	20 KVA	1
10	Dump Truck	4 ton	4
11	Truck with Crane	4 ton	2
12	Jeep (4WD)		6
13	Motor cycle	100 cc	12
14	Micro computer with accessory		2 sets
15	Current meter		2
16	Communication system		2 sets
17	Spare parts		L.S

4.4 Water Users' Association (WUA)

It has been the policy of the Government that O&M of the tertiary and on-farm facilities is the responsibility of the farmers through the water users' associations (WUAs), locally called Perkumpulan Petani Pemakai Air (P3A). The already organized farmers' groups in the Project Area will be converted to WUAs(refer to Fig.4.4).

In view of the need for farmers' involvement from an early stage of the Project, it is essential that formation of WUAs commence during the pre-construction stages. Before completion of the Project facilities, a WUA will be established in each village with technical and operational guidance from the O&M office and the agricultural extension office. In the formation of the WUA, the first step will be to identify the names of probable WUA members based on the provisional field layout of tertiary facilities. The second step will be to hold meetings among concerned farmers to elect group leaders and form executive body for each WUA. After the formation of each WUA, the layout of tertiary and on-farm irrigation and drainage facilities will be finalized.

A WUA is usually established along administrative boundaries which do not necessarily coincide with tertiary unit boundaries,

covers an area of 30 to 100 ha and has 20 to 60 members. In addition to O&M responsibility, WUAs are also responsible for drawing up seasonal programmes for equitable distribution of water within their respective command areas.

5. Cost Estimate

5.1 Conditions

Construction cost required for the development of the project is estimated under the following conditions;

1) Exchange rate : 1.0 US$ = 2,010 Rp.

2) All the construction works is under contract by a contractor with his own construction machinery.

3) Unit cost of the construction works is calculated by the actual cost of materials and labor costs in June 1992.

4) Construction cost consists of portion of foreign currency and local one and each of them includes the following items.

Local currency portion

- Labor force
- Aggregate, gravel and timber
- Fuel, oil, etc. (raw cost)
- Costs of internal transport
- General fee of Indonesian Government during the construction period
- Others

Foreign currency portion

- Reinforcement and structural iron materials
- Iron gate, diesel power generator, motor and other iron works
- Cement excluding raw cost
- Fuel, oil, etc. excluding raw cost
- Cost of the depreciation of construction machinery
- Vehicles required for construction supervision and O&M
- Others

5) A part of the cost for clearing trees and bush is included in the preparatory works.

6) The physical contingency of 5 % of the direct construction cost is given. The price contingency for the foreign and local currency portions are estimated at 3.0 % and 10.0% per

annum respectively.

7) The costs for strengthening of agricultural support services(training cost) is included but costs for facilities for the water users' association and improvement of the social infrastructures are not included in the estimate.

5.2 Cost Estimates

The project cost consist of preparatory costs, direct construction cost, costs of materials and mechanical equipment for operation and maintenance, administrative cost, training cost engineering services cost, contingencies and value added tax. The total project cost is estimated at 62.2 Million US$ consisting of 36.8 Million US$ in foreign portion and 25.4 Million US$ in local portion.

The summary of the project cost is shown in Table 5.1.

In the case that, for the reference, the foreign loan is provided by the OECF's manner, the components of the project cost are US$ 9.3 million of rupiah portion and US$ 52.8 million of loan portion as mentioned in Table 5.3.

5.3 Annual Disbursement Schedule

Annual disbursement schedule is made based on the annual construction plan discussed in Chapter 3.5. The annual disbursement schedule is shown in Table 5.2 and summarized below;

Year	Foreign portion (10^3 US$)	Local portion (10^3 US$)	Total (10^3 US$)
1994/95	779	470	1,249
1995/96	1,352	1,172	2,524
1996/97	5,561	3,616	9,177
1997/98	9,916	6,504	16,420
1998/99	13,723	9,238	22,961
1999/2000	3,890	3,015	6,905
2000/01	1,561	1,367	2,928
Total	36,782	25,382	62,164

6. Project Evaluation

6.1 Overall Benefits

The proposed Project would help achieve several of the agricultural development objectives of the nation as well as Riau province. These include: (a) increase in food crops production to sustain food self-sufficiency; (b) agricultural production increase to meet the demand for domestic manufacturing industries; (c) increase of agricultural productivity and value added of agricultural goods; (d) increase of farmers' income; and (e) rural area development.

Annual incremental production at full development stage of the Project is estimated at 62,200 tons of paddy, and 8,000 tons of palawija crops (e.g. soybeans and groundnuts), valued at Rp 26,370 million at 1992 price level.

The majority of families in the Project Area will enjoy higher levels of income and other benefits. The net annual income of a typical farmer with land holding of 2.0 ha is estimated to increase from Rp 516,800 at present condition to Rp 5,219,500 under with the Project condition as a result of improved agricultural services and irrigation facilities. (Refer to Tables 2.16 and 3.5(1).

The Project will increase farm employment opportunities under the irrigated agriculture system. The farm labour requirement at full development stage is estimated at 2.2 million man-days. Other employment opprtunities will be created for unskilled labour on the Project infrastructural works and operation and maintenance works of the Project facilities. It is estimated that approximately 0.3 million man-days of labours will be required per year during the implementation of the Porject and 2,550 man-days of labours will also be required annually for operation and maintenance of the Project facilities.

Other indirect benefits include stimulation of general economic activity in the region as a result of increased production and incomes, generation of additional trading opportunities and increased opportunities for small business development.

Improved quality of life of the people in the Project Area can be attained through successful implementation of the Project. Homes can be enlarged and improved, and more and better food will

be available. Health and sanitation conditions will be improved. As a result of increase in farm household income, purchases of televisions, radios, motorcycles, and labour saving farm equipment will increase greatly.

6.2 Financial Analysis

6.2.1 Financial Project Costs

Financial Project costs signify the Project costs estimated on the basis of the market prices prevailing in the Project Area. Financial Project costs comprise the costs for: (i) preparatory works, (ii) construction of Project facilities, (iii) land development, (iv) land acquisition, (v) administration, (vi) O&M (operation and maintenance) equipment, (vii) training, (viii) engineering services, (ix) physical contingency, (x) price contingency, and (xi) taxes.

Based on the current market prices as of June 1992, the total costs including physical and price contingencies and taxes are Rp 124,951 million (US$ 62.2 million), comprising Rp 73,931 million (US$ 36.8 million) for the foreign currency portion and Rp 51,020 million (US$ 25.4 million) for the local currency portion (refer to Table 5.1).

Annual disbursement schedule of these costs is presented in Table 5.2.

6.2.2 Farm Budget Analysis

Smallholder farmers in the Project Area are the main beneficiaries with implementation of the Project. In order to assess the impact of the Project on the farmers' income, a farm budget of a representative farmer in the Project Area is prepared under present, future "without the Project (WOP)" and future "with the Project (WP)" conditions (refer to Tables 2.16, 3.5(1) and 3.5(2).

The net annual income of a typical farmer with land holding of 2.0 ha is estimated to increase from Rp 516,800 under present situation to Rp 5,219,500 under WP situation. Net incremental income which is the difference between future annual income between "with" and "without" the project would be Rp 4,648,400.

6.2.3 Finance Plan and Repayment of the Fund

Based on the estimated Project costs, the fund requirement of the Project consists of Rp 73,931 million (US$ 36.8 million) of foreign fund and Rp 51,020 million (US$ 25.4 million) of local fund.

The finance plan mentioned above is estimated on the assumptions that foreign currency portion of the Project costs will be financed by the concessional loan under bilateral aid or international lending arrangement, and the local currency portion of the same will be financed by the Government budget. The foreign loan is assumed to be provided on the conditions of a repayment period of 30 years including 10-year grace period with interest rate of 2.5% per annum. It is also assumed that local portion of the Project costs will be financed by the budget allocation of the Government without any interest and repayment of the principal.

On the basis of the above finance plan, a cash flow statement on the fund requirement and repayment of the interest and principal of the loan has been prepared as shown in Table 6.1.

6.2.4 Cost Recovery of Irrigation O&M

It is generally understood that the water charge will be imposed to the water users when water is released to them and water charges thus collected will be spent for O&M expenditures and repayment of the capital costs of the Project. In Indonesia, however, farmers traditionally do not pay any water charges directly, but contribute indirectly by paying local tax. Although payment of water charges in kind is practiced recently in some parts of Indonesia, it is not common in most parts of Indonesia including Riau province.

With a growing awareness of the need for adequate O&M funding among the Government officials, it is felt urgent to introduce the system of irrigation service fee to recover the O&M cost from the irrigation beneficiaries. In consideration of such Government intention, the prospective irrigation service fee of the proposed Project has been estimated on the basis of annual O&M costs of the Project. The annual O&M costs required for the Project are estimated at Rp 1,874 million which is equivalent to Rp 226,000 (US$ 112) per ha. This corresponds to 4.3 % of the net income (with the Project condition) of a typical farmer in the Project

Area. The irrigation service fee of Rp 226,000 per ha will be recommended as this is within a reasonable range in the capacity to pay of the farmer.

6.3 Economic Analysis

6.3.1 Basic Parameters

The economic analysis is undertaken on the basis of the following basic parameters.

a) Exchange rate: The monetary measurement used for evaluation of costs and benefits is Indonesian Rupiah (RP) as of March 1992. The exchange rate between Rupiah, U.S. Dollars and Japanese Yen are set at US$1.00 = Rp 2,010 based on the official exchange rate as of June 1992.

b) Economic life: Economic life of the Project is assumed to be 30 years.

c) Benefits: Only direct tangible benefits are quantified for the analysis. Indirect benefits are not valued in monetary terms, but assessed in a qualitative manner.

d) Price of paddy: Economic farm gate price of paddy is estimated at Rp 322 per kg. The price is based on the projected 2000 world market price as presented in Table 6.2.

e) Labour cost: A shadow wage rate of 0.8 is applied to the financial farm labour costs.

f) Agricultural development period: A 5-year agricultural development period is assigned. Five equal annual increments in food crops production are assumed.

g) Discount rate for Benefit Cost Analysis: A discount rate of 10% is assumed to be close to the opportunity cost of capital in Indonesia.

h) Price escalation: Price escalation of costs and benefits in the future is assumed to be in the order of magnitude of overall inflation rates. Therefore,

costs and benefits are not escalated in the cash flow streams.

i) Interest: No credit transactions are included in the benefits and costs streams.

6.3.2 Economic Costs of the Project

Economic costs of the Project consist of:

(a) total investment costs of the Project;
(b) plus land development and associated costs;
(c) minus price escalation costs;
(d) minus land acquisition costs;
(e) minus taxes

All the project costs estimated at financial prices have been converted into economic costs using conversion factors. The economic prices of crops are shown in Table 6.3 to Table 6.8. The total economic costs of the Project including physical contingency and land development cost will amount to Rp 79,991 million (US$ 39.8 million) as shown in Table 6.9.

Annual disbursement schedule of economic costs of the Project is presented in Table 6.10.

6.3.3 Economic Benefits

The direct Project benefits are evaluated as the net incremental production values which are derived from the increased agricultural production as a result of provision of irrigation facilities and improved agricultural support services. The net incremental production values are expressed as the difference between net production value under "with the Project (WP)" condition and "without the Project (WOP)" condition. The benefits will arise as a result of production increase after the completion of a part or whole of the Project facilities. Agricultural production is expected to increase at the rate of about 20% per annum, reaching its maximum level at Project Year (PY) 10. Annual incremental benefits at full development stage are estimated at Rp 14,756 million as shown in Table 6.11.

6.3.4 EIRR, B/C and NPV

Benefits and costs streams have been prepared for the benefit cost analysis as shown in Table 6.15. On the basis of the streams, economic indicators in terms of EIRR, B/C ratio and NPV (Net Present Value) have been calculated as follows.

EIRR:	12.0 %	
B/C:	1.18	(discounted at 10%)
NPV:	Rp 10,275 million	(discounted at 10%)

From the viewpoint of economic analysis, it is concluded that the proposed Project is economically feasible as the EIRR exceeds the opportunity cost of capital in Indonesia (10%), B/C ratio is more than 1.0 and NPV indicates the positive value.

6.3.5 Sensitivity Analysis

In order to evaluate further the soundness of the Project to the possible changes of the Project conditions in the future, the sensitivity analysis has been conducted under the following critical conditions.

a) Increased costs due to unforeseeable geological and topographical conditions and higher increase in material costs than expected
b) Decreased benefits due to declined market prices of agricultural products
c) Delay in construction schedule

The results of the tests are presented in Tables 6.15(1) to 6.15(3) and are summarized below.

	Assumptions	EIRR(%)	B/C	NPV(10^6 Rp)
a)	Cost increase by 10%	10.8	1.07	4,507
b)	Benefits decrease by 10%	10.7	1.06	3,480
c)	Two years delay in construction period	10.6	1.06	2,919

6.4 Socioeconomic Impact

6.4.1 Creation of Employment Opportunities

With the implementation of the Project, labour use on farm will increase significantly, from 0.13 million man-days at present to 2.2 million man-days at full development. Returns from on-farm activities will be much more attractive than those from off-farm labour and as a result, off-farm employment opprtunities will be reduced.

Other employment opportunities will be created for surplus rural labour on the Project infrastructural works. It is estimated that 0.3 million man-days of labours will be necessary per year during the construction stage. The Project will generate about 2,550 man-days of employment annually at full development for operation and maintenance of the Project facilities.

6.4.2 Impact on Regional Economy

Villages in the interior part of the Project Area have very poor accessibility due to poor road conditions. The construction of the Project facilities will remove this constraint and will bring these villages into the mainstream of regional economy. As a result, mobility of goods and services will be improved and economic activities in general will be expanded.

General economic activity in and around the Project Area will be activated as a result of increased production and incomes, generating additional trading opportunities, attracting more merchants and encouraging small business development in the area.

6.4.3 Improvement of Living Conditions

The proposed Project will contribute substantially to raising general quality of life as a result of successful implementation of the Project. Impoved quality of life of the people in the Project Area can be attained through improved household incomes accruing from incremental agricultural production. Homes can be enlarged and improved, and more and better food will be available. Health and sanitation conditions will be improved. As a result of increase in household income, purchases of televisions, radios, motorcycles, and labour saving farm equipment will increase greatly.

7. Environmental Impact Assessment

7.1 General

This irrigation development project is planed for the purpose to raise land productivity through increasing paddy production and, as the result, to heighten people's welfare. On the other side, it has possibility to make environmental condition worse and reduce natural resources. Environmental Impact Assessment aims to ensure all positive and negative impacts predicted to occur by the project implementation and to maximize positive impact and remove or minimize negative one, finally.

The Constitution of 1945 (UUD 1945) has provided a base for the regulation and utilization of natural resources so as to increase people's welfare and the benefit of the present and further generation. The General Outline of the State's Course (GBHN) has determined that national development should be not be aimed only at physical welfare or spiritual needs but an equilibrium of both. For the realization of UUD 1945 and GBHN above mentioned, the Act No.4 of 1982 concerning the basic provisions for the management of the living environment and the Government Regulation No.29 of 1986 prescribing the Environmental Impact Assessment procedure have been established. To give the shape to these principals, many laws were decided after then.

The system of Environmental Impact Assessment (AMDAL) in Ministry of Public Works is indicated in Fig.7.1. AMDAL procedure provides many steps corresponding to the activity stage of the project.

The study carried out in this stage is the Preliminary Environmental Information Presentation (PIL) in AMDAL procedure. PIL study is supposed to clarify the image of environmental impact resulting from the project activities and to make recommendation of a further study Environmental Impact Analysis (ANDAL), if it will be required. The purpose of the PIL study are :

- Identification of activities program, mainly those estimated to cause impact.
- Identification of the initial environmental conditions, mainly those estimated to be affected by the impact.
- Prediction and evaluation of important impact on the environment and method of remedy.
- Formulation of recommendation on the approach for the management and monitoring of impacts that may be occur.

7.2 Prediction of Project Impact

The environmental assessment is composed of many items of prediction and evaluation of the environmental impact predicted to be brought about by the implementation of the project.

Environmental components are classified into three categories as follows :

1) Physico-chemical component

- Climate
- Physiography and geology
- Topography
- Land resources
- Quality and quantity of river and well water
- Quality of air

2) Biological component

- Flora and vegetation
- Fauna
- Water biota

3) Socio-economic and cultural component

- Demography
- Social economy
- Socio culture
- Institution
- Facilities and pre-facilities

The project activities are divided into three stages : pre-construction stage, construction stage and operation and maintenance stage. The proposed activities for implementation of the project in each stage are as follows :

1) Pre-construction stage

- Field survey and detailed design
- Earmarking area for the project
- Land acquisition

2) Construction stage

- Mobilization of heavy duty equipment and man power

- Preparation of supporting facilities
- Land clearing for coupure
- Transportation of materials and stockpiled soil
- Weir construction
- Development of irrigation system

3) Operation and maintenance stage

- Operation of weir
- Operation of irrigation system
- Maintenance of weir and its system

Impact prediction of the irrigation project activities was made by a matrix containing interaction between environmental component and activities component.

The predicted positive and negative impacts eventually exerted by various components of the actives proposed for the project were elaborated based on the data collected in the study area and they are identified in Table 7.1.

7.3 Evaluation of Project Impact

7.3.1 Criteria

The basic regulation to evaluate the level of important impact is the Decree of Ministry of Population and Living Environment No.49 of 1987 regarding the guideline of significant impact evaluation. The main components used in impact evaluation are as follows:

- Number of person who will receive impact
- The spreading area of impact
- Duration of impact
- Intensity of impact
- Other component that will receive the impact
- The characteristic of impact cumulation
- Reversibility or irreversibility of impact

Intensity of impact is classified into six categories; less important, fairly important, important, more important, very important and no impact or unknown.

Results of evaluation in each activities stage are shown in Table

7.2 to 7.4 and evaluation and solution of impacts in Table 7.5.

7.3.2 Pre-construction stage

The impacts that may occur in this stage are in the activities of field survey, earmarking area for the project and land acquisition.

(1) Physico-chemical Component

In the pre-construction stage, no impacts are expected to occur owing to the limited activities on the physico-chemical component.

(2) Biological Component

During the pre-construction stage, the activities of field surveys for decision of the weir and canal sites will cause a reduction of biological resources. This is, however, a rather minor negative impact, because the area affected by those activities will be limited

(3) Socio-economic and Cultural Component

In this stage, the environmental component that may receive impact are as follows:

- Land use
- Land property and value
- Society cool
- Livelihood
- Settlement
- People's mobility
- people's attitude to the project

The socio-economic and cultural component is predicted to receive the fairly important negative impact.

7.3.3 Construction stage

In the construction stage, activity components that will cause the impact are mobilization of heavy duty equipment and man power, preparation of supporting facilities, land clearing for

coupure, transportation of materials and stockpiled soil, weir construction and development of irrigation system.

(1) Physico-chemical Component

During the construction stage, the physico-chemical component may receive impact as follows:

- Water quality
- Water flow pattern
- Erosion
- Sedimentation
- Land stability
- Micro climate
- Air quality

Decrease of water quality is predicted to happen as the consequences of increasing water turbidity and the rubbish thrown away to the river. (less to very important)

Erosion and sedimentation around the quarry and weir site is due to the reminder of quarry and clearing vegetation surround it. (important)

Soil stability at the quarry site is predicted to change caused by the exploitation. (less to fairly important)

Negative impact is predicted against the micro climate both in the quarry and weir site, also along the settlement road passed by project vehicles. (fairly to important)

Through the concentrated increase of dust, CO and CO_2, the air quality in the construction stage is predicted to decrease. The decreasing air quality happens in the quarry, weir and irrigation system sites and the settlement passed by vehicle. (fairly important)

(2) Biological Component

During the construction stage, the biological component may receive impact as follows:

- Vegetation
- Wild animals (fauna)
- Water biota
- Cultivated crop

Vegetation around the quarry, weir and irrigation system sites are predicted to be cleared or decreased. (important)

Habitat of several wild animals is predicted to disappear or decrease and closely related with the clearing vegetation and change of land use. (important)

Several number of cultivated crop in the quarry, weir and irrigation system sites will be cut off according to the construction. The crop is closely related with the changes of land function. (fairly important)

Water biota (fishes) are isolated by the weir in the upstream and downstream part. (fairy important)

(3) Socio-economic and cultural component

During the construction stage, the socio-economic component may receive impact as follows:

- Labor force competition
- New settlement
- People's health

The type of negative impact predicted to appear is social jealousy owing to the use of labor from out side of the project area. (fairly important)

On the other hand, the positive important impact on socio-economic and cultural component consists of ground transportation facilities to the weir site and the surroundings, the use of labor and people's income

7.3.4 Operation and maintenance stage

In this stage the project activities predicted to result in impact are the weir and irrigation system operation and maintenance.

(1) Physico-chemical Component

During the operation and maintenance stage, the physico-chemical component that may receive impact as follows:

- Water quality

- Soil fertility
- Sedimentation
- Micro climate

Decrease of water quality will take place caused by the increase of nutrient contents originating from vegetation leftovers. Besides, the waste water quality downstream will decrease because of the increasing use of fertilizers and pesticides on paddy fields. (fairly important)

Sedimentation will take place on the upstream part of Rokan Kiri river. (less important)

The change of micro climate will occur resulting from inundation of weir and clearing of the area. (less important)

(2) Biological Component

During the operation and maintenance stage, the biological component may that receive impact as follows:

- Vegetation
- Water weed
- Water biota

Potentiality of vegetation upstream the weir to be affected is closely related with the inundation. (fairly important)

As a result of decreasing or clearing vegetation protecting erosion and food crops, the land will be flood. (fairly important)

A change in vegetation will take place as the rice fields will become more extensive. Further consequences decreasing of trees is to decrease the available resource of wood for fuel. (less important)

Water weeds in the inundated area will develop rapidly that create negative impact. (fairly important)

Water biota mainly fishes will be limited in their movement because of the separation of the upstream part from the downstream part of the river. (important)

(3) Socio-economic and Socio-cultural Components

During the operation and maintenance stage, the socio-economic component may receive impact as fellows:

- Upstream land use
- Livelihood
- Live pattern
- Transportation cost
- Settlement
- People's attitude to the project

Parameters of means of livelihood, income, facilities and infrastructure of land communications and tourism will be affected by positive impact. (important)

The impact will occur resulting from the change of land use pattern, social mobilization, new dwelling area and public health downstream caused by the decreased of waste water quality. (fairly important)

Environmental quality such as soil, water and air will become worse caused by continuous use of fertilizers and pesticides. (fairly important)

Decreasing of water quality will caused appearance of disease epidemic such as diarrhea, malaria etc. (fairly important)

7.3.5 Environmental Impact on the Project

The environmental component that may affect negative impact on the project is as follows:

- Overlapping of landownership
- Disturbance by wild animals
- The cost of clearing the forests

The overlapping of right to land use on the irrigation system and development area will cause the implementation of project activities to be disturbed. This disturbance may delay the time schedule for implementation. (important)

The development area is still disturbed by elephants wandering through the dwelling area and farmland. This situation may create impact on the irrigation scheme development program. On the other hand, elephants, being wild animals are protected by law. (fairly important)

The large portion of the project area is covered with dense natural forests. So clearing the forests will make the cost of implementation higher. (important)

7.4 Recommendation of Environmental Impact Analysis

Based on the prediction and evaluation of the project impact that may occur, it is recommended to product the further study of Environmental Impact Analysis (ANDAL). The environmental components regarded as requiring further investigation are:

- The number of estimated to be affected by operation of the weir.

- Social tension and grievance that may emerge in relation to the problems of compensation payment, recruitment of work force from other please outside of the project area.

- Rivally between workers from inside and outside the project locations.

- Change of river morphology and increaseof potentiality of erosion and land slide of banks in the borrow area.

- Worsening of air and increase of noisiness during the preparation of construction and implemantation of construction.

- Decrease of quantity of surface and groud water and worsening of water quality caused by turbidity and dirt/debris during construction.

- Worsening of environmental quality (soil, water and air) due to intese use of fertilizers and pesticides.

- Decrease of biological resources potentiality (flora) and migration of wild animal (fauna).

TABLES

Table 2.1 Soil Mapping Unit and their Association

Soil Mapping Unit	Soil Association	Physiography	Topography	Drainage	Left Bank		Right Bank		Total	
					Area(ha)	(%)	Area(ha)	(%)	Area(ha)	(%)
1	Typic Tropodults Typic Dystropepts	Undulating/ Rolling	Slope (3 - 10%)	Moderately well to well	1,744	(7.2)	4,939	(29.1)	6,683	(16.2)
2	Typic Tropodults Typic Dystropepts Humitropepts	Escarpment	Slope (2 - 8%)	Somewhat poorly to Moderately well	1,008	(4.1)	0	(0.0)	1,008	(2.4)
3	Typic Dystropepts Aquic Dystropepts Humitropepts	Terrace	Slope (0 - 2%)	Somewhat poorly	5,484	(22.5)	7,837	(46.2)	13,321	(32.2)
4	Histic Tropaquepts Humitropepts (Tropohemists)	Terrace	Slope (0 - 2%)	Poorly to very poorly	11,390	(46.7)	0	(0.0)	11,390	(27.6)
5	Typic Tropofluvents Aquic Tropofluvents	Alluvial Plain	Slope (0 - 2%)	Somewhat poorly	4,756	(19.5)	4,178	(24.6)	8,934	(21.6)
	TOTAL				24,382	(100.0)	16,954	(100.0)	41,336	(100.0)

Table 2.2 Outline of Villages in the Project Area

Name of Village	Area (ha)	Population (1990)	Household (No.)	Farm Household	Family Size	Farm Population
Old Villages						
Pagaran Tapah	6,858	5,164	1,042	332	4.96	1,645
Kota Lama	23,745	2,296	540	200	4.25	850
Kota Intan	4,800	1,437	359	319	4.00	1,277
Muara Dilam	23,090	2,595	617	576	4.21	2,423
Teluk Sono	18,510	548	133	121	4.12	499
Sub-Total	77,003	12,040	2,691	1,548	4.32	6,694
Percentage (%)		53.3				38.9
New Villages						
Kota Baru	800	1,679	400	400	4.20	1,679
Kota Raya	880	1,868	440	440	4.25	1,868
Muara Jaya	920	1,996	460	460	4.34	1,996
Sub-Total	2600	5,543	1,300	1,300	4.26	5,543
Percentage (%)		24.6				32.2
Transmigration Villages						
SKP-A	380	788	190	190	4.15	788
SKP-B	1,000	1,642	345	345	4.76	1,642
SKP-F	420	812	185	185	4.39	812
SKP-G	790	1,742	400	400	4.36	1,742
Sub-Total	2,590	4,984	1,120	1,120	4.45	4,984
Percentage (%)		22.1				28.9
Total	82,193	22,567 (100%)	5,111	3,968	4.42	17,221 (100%)

Source: (1) Population Census 1990, Riau
(2) Programa Penyuluhan Pertanian, BPP Kota Lama, 1991/92
(3) Monitoring UPT, Department of Transmigration, Bangkinang

Table 2.3 Socioeconomic Conditions of Transmigration Villages

Items	SKP-A	SKP-B	SKP-F	SKP-G
Settlement Year	1988	1988	1988	1988
No. of Household				
Initial	190	345	185	401
Present	190	345	185	400
Population				
Initial	783	1,585	796	1902
Present	788	1,642	905	1812
Origin				
West Java (%)	35.3	36.2	10.8	0
Central Java (%)	26.3	21.7	51.4	74.3
East Java (%)	26.3	22.3	21.6	3.2
Local (%)	12.1	19.7	16.2	22.4
Social infrastructure				
No. of wells	48	68	93	102
Electricity	n.a.	Generator	n.a.	n.a.
Kidergarten	1	0	0	0
No. of pupils	18	0	0	0
Primary school	2	2	1	2
No. of pupils	114	192	122	355
No. of teachers	7	10	10	18
Junior high school	0	0	0	1
No. of pupils	0	0	0	38
Medical service				
Doctor's visit (year)	n.a.	4	n.a.	n.a.
Nurse	1	1	0	1
Health post	0	0	0	1
Market				
Village market	n.a.	120 m2	0	0
Nearest market	Kota Lama	K.Mungkal	n.a.	M. Dilam
Distance to the market	20 km	4.5 km	n.a.	6 km
Household effects				
TV	4	8	4	7
Radio	29	65	57	325
Bicycle	55	98	105	327
Motorcycle	4	7	2	4
Sewing machine	2	3	2	7
Processing and storage				
Rice mill	n.a.	2	0	1
Godown for food crops	1	1	0	1
KUD				
No. of members	0	340	33	379
KUD office	0	0	0	0
Retail shop (kios)	0	0	1	1
Farmer groups				
No. of group	8	14	6	16
No. of members	190	345	175	381

Source: Monitoring UPT, Dept. of Transmigration, 1991

Note: n.a. = data not available

Table 2.4 Working Age Population in the Project Area(1990)

Name of Village	0-9 years old	10 years old and over	Total Population	Share of 10 years old & over
Old Villages 1/				(%)
Pagaran Tapah	1,472	3,692	5,164	71.5
Kota Lama	654	1,642	2,296	71.5
Kota Intan	410	1,027	1,437	71.5
Muara Dilam	740	1,855	2,595	71.5
Teluk Sono	156	392	548	71.5
Sub-Total	3,431	8,609	12,040	71.5
New Villages				
Kota Baru	278	1,401	1,679	83.4
Kota Raya	541	1,327	1,868	71.0
Muara Jaya	466	1,530	1,996	76.7
Sub-Total	1,285	4,258	5,543	76.8
Trans. Villages				
SKP-A	270	518	788	65.7
SKP-B	521	1,121	1,642	68.3
SKP-F	216	596	812	73.4
SKP-G	593	1,149	1,742	66.0
Sub-Total	1,600	3,384	4,984	67.9
Total	6,316	16,251	22,567	72.0

Source: (1) Population Census 1990, Statistics Office, Kampar
(2) Monitoring UPT, Department of Transmigration, Bangkinang, 1990 and 1991

Note: 1/ Age structure was assumed to be the sama as the average of Kunto Darusalam sub-district in 1990.

Table 2.5 Land Ownership in the Project Area (1991)

Unit: No. of Household

Name of Village	Owner Non-Tiller	Owner Tiller	Non-owner Tiller	Land-less	Others	Total
Old Villages						
Pagaran Tapah	151	956	17	18	642	1,784
Kota Lama	18	317	65	21	76	497
Kota Intan	16	209	20	0	63	308
Muara Dilam	15	210	11	0	57	293
Teluk Sono	15	111	0	0	7	133
Sub-Total	215	1,803	113	39	845	3,015
Percentage (%)	7.1	59.8	3.7	1.3	28.0	100.0
New Villages						
Kota Baru	0	400	0	0	20	420
Kota Raya	0	410	0	0	32	442
Muara Jaya	0	320	0	0	5	325
Sub-Total	0	1,130	0	0	57	1,187
Percentage (%)	0.0	95.2	0.0	0.0	4.8	100.0
Trans. Villages 1/						
SKP-A	0	190	0	0	0	190
SKP-B 2/	0	345	0	0	0	345
SKP-F	0	190	0	0	0	190
SKP-G	0	395	0	0	0	395
Sub-Total	0	1,120	0	0	0	1,120
Percentage (%)	0.0	100.0	0.0	0.0	0.0	100.0
Total	215	4,053	113	39	902	5,322
Percentage (%)	4.0	76.2	2.1	0.7	16.9	100.0

Source: Programa Penyuluhan Pertanian, BPP Kota Lama, 1991/92

1/ : Data of BPP Kota Lama on nos. of households are not exactly same as those of Transmigration Office.
2/ : Data on SKP-B are assumed to be the same as those of other transmigration villages.

Table 2.6 Household Income (All Villages)

Unit: Rp

	Area (ha)	Yield (kg/ha)	Prod. (kg)	Price (Rp/kg)	Production (Rp/ha)	Cost (Rp/area)	Gross Margin
Farm Income							
Paddy, lowland	0.087	833	72.4	300	61,540	5,348	16,368
Paddy, upland	0.693	901	624.5	300	47,570	32,971	154,374
Soybeans	0.150	679	101.9	500	51,900	7,785	43,140
Groundnut	0.031	631	19.7	700	101,580	3,169	10,612
Mungbean	0.019	234	4.5	800	97,839	1,888	1,725
Cassava	0.013	631	8.2	700	1,050	14	5,728
Maize	0.113	858	96.7	350	50,800	5,725	28,119
Chili	0.013 (1.1 ha)	409	5.2	2000	170,480	2,182	8,288
Food Crop Income (A)							268,354
Plantation							128,777
Livestock							111,223
Fishery							45,552
Non-Foodcrop Income (B)							285,551
Subtotal (A+B)							553,906
Off-Farm Income							
Trading							123,713
Plantation labour							258,522
Others							77,816
Subtotal							460,051
Total Income :							1,013,957

Source: (1) Farm Economy Survey, 1992
(2) Estimate of the Study Team

Note: 1/ Household income before deducting living expenses

Table 2.7 Household Income (Old Villages)

Unit: Rp

	Area (ha)	Yield (kg/ha)	Prod. (kg)	Price (Rp/kg)	Production (Rp/ha)	Cost (Rp/area)	Gross Margin
Farm Income							
Paddy, lowland	0.321	833	267.7	300	61,540	19,779	60,539
Paddy, upland	0.434	901	391.2	300	47,570	20,655	96,709
Soybeans	0.105	679	71.5	500	51,900	5,465	30,284
Mungbean	0.015	234	3.6	800	97,839	1,487	1,358
Cassava	0.000	631	0.0	700	1,050	0	0
Maize	0.000	858	0.0	350	50,800	0	0
Chili	0.000 (0.9 ha)	409	0.0	2000	170,480	0	0
Food Crop Income (A)							188,891
Plantation							488,084
Livestock							54,105
Fishery							98,197
Non-Foodcrop Income (B)							640,386
Subtotal (A+B)							829,277
Off-Farm Income							
Trading							30,526
Plantation labour							238,842
Others							194,105
Subtotal							463,474
Total Income :							1,292,750

Source: (1) Farm Economy Survey, 1992
(2) Estimate of the Study Team

Note: 1/ Household income before deducting living expenses

Table 2.8 Household Income (New Villages)

Unit: Rp

	Area (ha)	Yield (kg/ha)	Prod. (kg)	Price (Rp/kg)	Production Cost (Rp/ha)	(Rp/area)	Gross Margin
Farm Income							
Paddy, lowland	0.004	833	3.6	300	61,540	265	810
Paddy, upland	0.628	901	565.9	300	47,570	29,879	139,897
Soybeans	0.095	679	64.3	500	51,900	4,915	27,236
Mungbean	0.015	234	3.6	800	97,839	1,487	1,358
Cassava	0.028	631	17.8	700	1,050	30	12,426
Maize	0.159	858	136.6	350	50,800	8,087	39,720
Chili	0.014 (0.94 ha)	409	5.6	2000	170,480	2,353	8,936
Food Crop Income (A)							230,383
Plantation							71,417
Livestock							120,634
Fishery							2,565
Non-Foodcrop Income (B)							194,616
Subtotal (A+B)							424,999
Off-Farm Income							
Trading							153,377
Plantation labour							285,923
Others							89,600
Subtotal							528,900
Total Income :							953,899

Source: (1) Farm Economy Survey, 1992
(2) Estimate of the Study Team

Note: 1/ Household income before deducting living expenses

Table 2.9 Household Income (Trans. Villages)

Unit: Rp

	Area (ha)	Yield (kg/ha)	Prod. (kg)	Price (Rp/kg)	Production (Rp/ha)	Cost (Rp/area)	Gross Margin
Farm Income							
Paddy, lowland	0.000	833	0.0	300	61,540	0	0
Paddy, upland	0.845	901	761.2	300	47,570	40,187	188,162
Soybeans	0.215	679	146.1	500	51,900	11,169	61,892
Groundnut	0.018	631	11.4	700	101,580	1,839	6,156
Mungbean	0.030	234	7.0	800	97,839	2,916	2,663
Cassava	0.000	631	0.0	700	1,050	0	0
Maize	0.096	858	81.9	350	50,800	4,851	23,827
Chili	0.016 (1.2 ha)	409	6.4	2000	170,480	2,677	10,166
Food Crop Income (A)							292,866
Plantation							82,504
Livestock							118,252
Fishery							77,258
Non-Foodcrop Income (B)							278,014
Subtotal (A+B)							570,880
Off-Farm Income							
Trading							119,258
Plantation labour							214,864
Others							48,258
Subtotal							382,380
Total Income :							953,260

Source: (1) Farm Economy Survey, 1992
(2) Estimate of the Study Team

Note: 1/ Household income before deducting living expenses

Table 2.10 Present Land Use in the Survey Area

Present Land Use	Left Bank		Right Bank		Total	
	Area(ha)	(%)	Area(ha)	(%)	Area(ha)	(%)
Primary Forest	11,406	46.8	6,089	35.9	17,495	42.3
Secondary Forest	4,995	20.5	5,306	31.3	10,301	24.9
Bush/Grass Lands	4,225	17.3	1,713	10.1	5,938	14.4
Alang Alang Lands	908	3.7	1,131	6.7	2,039	4.9
Paddy	25	0.1	2	0.0	27	0.1
Upland Crops	1,125	4.6	318	1.9	1,443	3.5
Plantation Area	891	3.7	2,202	13.0	3,093	7.5
Residential Area	807	3.3	193	1.1	1,000	2.4
	24,362	100.0	16,954	100.0	41,336	100.0

Table 2.11 Estimated Present Agricultural Production in the Project Area

Crops	Area(Ha)*	Yeild(t/Ha)**	Production(ton)
Wet Season	1,905		
Wet land paddy			
Irrigated paddy	10	3.1	31.0
Rainfed paddy	17	0.8	13.6
Upland paddy	1,239	0.9	1,115.1
Maize	48	0.9	43.2
Peanut	41	0.6	24.6
Soybean	115	0.7	80.5
Rubber			
planted in 1990	160		
harvested in 1990	275	0.8	220.0
Dry Season	464		
Wet land paddy			
Rainfed paddy	44	0.8	35.2
Upland paddy	68	0.9	61.2
Maize	78	0.9	70.2
Peanut	27	0.6	16.2
Soybean	247	0.7	172.9

Area*: adopted from the statistics fo Programa Penyuluhan Pertanian 1991/92, BPP, Kota Lama

Yield**: The yeilds of wet season was estimated from Farm Economy Survey, 1992, JICA.
The yields of dry season were regarded as same as that of wet season.

Cropping intensity is 124 %.

Note: Agricultural production here is limited to paddy, maize, peanut, soybean, and rubber which are mainly planted in continuously cultivated land, this area is potential irrigable area. On the other hand cassava, sweet potato, mung bean, chili and vagetables are mainly planted in home yard which is difficult to develop for irrigation.

Table 2.12 Farm Inputs and Labour Requirement per hectare for Major Crops -Present-

	Unit	Irrig. Paddy			Lowland Paddy			Upland Paddy			Soybean			Peanut	Maize		
1 Seed	Kg	31			42			40			39			64	28		
2 Fertilizer																	
Urea	Kg	31			65			36			39			13	50		
TSP	Kg	24			58			24			50			6	9		
KCL	Kg	3			0			6			16			0	5		
Organic matter	Kg	0			1120			129			0			79	0		
3 Agrochemicals																	
Insecticides	cc	1470			1530			757			0			609	223		
Rodenticides	g	3.1			0			40			0			0	0		
Herbicides	cc							33			0			0	0		
4 Labour		Own	Hired	Total	Own	Hired	Total	Own	Hired	Total	Own	Hired	Total	Own	Own	Hired	Total
Nursery/Seeding	man-day	2.4	0	2.4	3.7	0	3.7	12.9	6.5	19.4	7.3	4.3	11.6	15.7	5	0.3	5.3
Land Prepar'tn	man-day	37.5	10.4	47.9	56.1	6.9	63	39.5	13.6	53.1	25.7	1.6	27.3	51.8	36.6	0.2	36.8
Transplanting	man-day	16.6	1.3	17.9	14.7	1.7	16.4	0	0	0	0	0	0	0	0	0	0
Ferti.Appli.	man-day	1.9	0	1.9	4.5	0	4.5	1.5	0	1.5	2.8	0	2.8	0	3.1	0.4	3.5
Ag-chemi.Appli.	man-day	4	0	4	3.5	0	3.5	1.9	0	1.9	3.7	0	3.7	3.1	0.8	0	0.8
Weeding	man-day	24.5	1.1	25.6	33.9	1	34.9	26.7	6	32.7	22.3	1.9	24.2	38	10.5	0.7	11.2
Harvesting	man-day	13.7	0.3	14	10.1	0.8	10.9	13.2	6	19.2	9.6	2	11.6	12.4	7.3	0.7	8
Hauling	man-day	1.2	0.1	1.3	1.5	0.2	1.7	1.6	0.3	1.9	1.2	0	1.2	0.2	1.7	0.1	1.8
Thresh/Drying	man-day	11.4	1	12.4	8.1	0.5	8.6	4.7	1	5.7	7.9	0.9	8.8	7.8	17.5	0.1	17.6
Water Control	man-day	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total		113.2	14.2	127.4	136.1	11.1	147.2	102	33.4	135.4	80.5	10.7	91.2	129	82.5	2.5	85
				0			0			0			0				0
5 Animal Power	day	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Source: Farm Economy Survey 1992, JICA
and some figures were adjusted on the basis of the filled survey and interviews.

Table 2.13 Small Scale Plantation Crops, 1990/1991 (April to March)

	Rubber (ton)	Coconut (nut)	Coffee (kg)	Clove (kg)
1 Kota Lama				
Planted Area(Ha)	30.0	1.3	5.0	0.0
Harvested Area(Ha)	60.0	13.0	2.0	6.9
Production	57.5	43,680.0	119.0	88.0
2 Kota Intan				
Planted Area(Ha)	30.0	6.4	5.0	0.0
Harvested Area(Ha)	215.0	9.3	1.9	
Production	165.0	14,170.0	104.5	
3 Muara Diram				
Planted Area(Ha)	0.0	0.0	0.0	0.0
Harvested Area(Ha)				
Production				
4 SKP A				
Planted Area(Ha)	0.0	2.7	0.1	0.0
Harvested Area(Ha)				
Production				
5 SKP F				
Planted Area(Ha)	0.0	8.4	4.0	0.0
Harvested Area(Ha)				
Production				
6 SKP G				
Planted Area(Ha)	0.0	38.4	3.3	0.0
Harvested Area(Ha)				
Production				
7 Kota Baru				
Planted Area(Ha)	5.0	54.6	4.4	11.3
Harvested Area(Ha)		17.0	1.4	4.8
Production		30,780.0	560.0	0.0
8 Kota Raya				
Planted Area(Ha)	18.0	78.8	5.1	16.5
Harvested Area(Ha)		18.0	3.4	7.0
Production		43,235.0	1,005.0	129.0
9 Muara Jaya				
Planted Area(Ha)	76.5	39.1	3.1	9.4
Harvested Area(Ha)		25.0	1.1	0.0
Production		30,325.0	1,185.0	1.2
10 SKP B	na	na	na	na
Total/Average				
Planted Area(Ha)	159.5	229.7	30.0	37.2
Harvested Area(Ha)	275.0	82.3	9.8	18.7
Production	222.5	162,190.0	2,973.5	218.2
Yield per Ha	0.8	1,970.7	303.4	11.7

Source: Programa Penyuluhan Pertania 1991/1992, BPP, Kota Lama

Note: Some figures of production are not equal to the multiplication of area and yield due to rounding.

na: Data not available

Table 2.14 Farm Gate Prices of Agricultural Inputs and Outputs (Market Prices)

Items	Unit	Financial Prices	
		Present (1992)	Future (2000)
Outputs			
Unhusked rice	Rp/kg	300	350
Maize	Rp/kg	350	445
Soybean	Rp/kg	500	425
Groundnut	Rp/kg	700	700
Mungbean	Rp/kg	800	800
Cassava	Rp/kg	50	50
Chilly	Rp/kg	2,000	2000
Inputs			
Rice seed	Rp/kg	500	500
Maize seed	Rp/kg	400	400
Groundnut seed	Rp/kg	1,150	1,150
Soybean seed	Rp/kg	1,150	1,150
Mungbean seed	Rp/kg	1,250	1,250
Cassava	Rp/kg	50	50
Chilly seed	Rp/kg	20,000	20,000
Urea	Rp/kg	220	231
T.S.P.	Rp/kg	280	339
KCl	Rp/kg	280	308
Insecticide	Rp/liter	15,000	15,000
Fungicide	Rp/liter	15,000	15,000
Herbicide	Rp/liter	15,000	15,000
Rodenticide	Rp/kg	4,000	4,000
Human labor	Rp/man-day	3,000	3,000
Animal power with operator	Rp/animal-day	5,000	5,000

Source: (1) Dinas Pertanian Tanaman Pangan, Riau
(2) P. T. Pertani, Riau
(3) DOLOG, Riau
(4) Commodity Price Projections, World Bank, March 1991
(5) Farm Economy Survey, 1992

Table 2.15(1) Crop Budget of Paddy
(1.0 ha - Present Condition)

		Paddy, Irrigated		Paddy, Lowland		Paddy, Upland	
Gross Income (Rp'000)		942.3		249.9		270.3	
Unit Yield (kg/ha)		3141		833		901	
Unit Price (Rp/kg)		300		300		300	
Prodcution Cost	Unit Price	Q'ty	Value (Rp)	Q'ty	Value (Rp)	Q'ty	Value (Rp)
Seed	500	31.0	15500	42.0	21000	40.0	20000
Fertilizers (kg)							
Urea	220	31.0	6820	65.0	14300	36.0	7920
TSP	280	24.0	6720	58.0	16240	24.0	6720
KCL	280	3.0	840	0.0	0	6.0	1680
Organic matter	0	0	0	1120	0	129	0
Pesticides							
Insecticide (lt)	15000	1.47	22050	1.53	22950	0.76	11355
Herbicide (lt)	15000	0.20	3000	0.00	0	0.03	495
Rodenticide (g)	4000	0.00	0	0.00	0	0.04	160
Labour (man-day)							
Family	0	113.2	0	136.1	0	102.0	0
Hired	3000	14.2	42600	11.1	33300	33.4	100200
Animal Power (day)	5000	0.0	0	0.0	0	0.0	0
Sub-total:							
Others (5%)			4877		5390		7427
Prod. Cost Total (Rp'000):			50.09		63.64		48.54
Gross Margin (Rp'000):			892.2		186.3		221.8

Source: Refer to Table 2.4.5 on unit prices.

Table 2.15(2) Crop Budget of Palawija Crops
(1.0 ha - Present Condition)

		Soybeans		Groundnuts		Maize	
Gross Income (Rp'000)		339.5		441.7		300.3	
Unit Yield (kg/ha)		679		631		858	
Unit Price (Rp/kg)		500		700		350	
Prodcution Cost	Unit Price	Q'ty	Value (Rp)	Q'ty	Value (Rp)	Q'ty	Value (Rp)
Seed	1/	39	44850	64	73600	28	11200
Fertilizers							
Urea	220	39	8646	13	2860	50	11000
T.S.P.	280	50	13860	6	1680	9	2520
KCL	280	16	4480	0	0	5	1400
Organic matter	0	0	0	129	0	0	0
Pesticides							
Insecticide	15000	0	0	0.61	9135	0.22	3345
Herbicide	15000	0	0	0.00	0	0.00	0
Rodenticide	4000	0	0	0.00	0	0.00	0
Labour							
Family 2/	0	80.5	0	129.0	0	82.5	0
Hired	3000	10.7	32100	0.0	0	2.5	7500
Animal Power	5000	0.0	0	0.0	0	0.0	0
Sub-total:			103936		87275		36965
Others (5%)			5197		4364		1848
Prod. Cost Total	(Rp'000):		109.13		91.64		38.81
Gross Margin (Rp '000):			230.4		350.1		261.5

Note: 1/ Unit price of each seed (Rp/kg) is as follows:
Soybeans: 1,150; Groundnuts: 1,150; Maize: 400.
2/ Family labour cost is not counted in the production costs.

Source: Unit prices are based on Table 2.4.5.

Table 2.16 Farm Budget (Present Condition)

	Net Household Income (A Typical Model Farm)	
Land holding: 2.0 ha Farm Size: 0.9 ha Area Harvested: 1.12 ha Family Size: 5.0		
	Amount	Share (%)
Gross Income	1,092.7	100
Farm Income		
Paddy, lowland (0.02 ha)	20.5	
Paddy, upland (0.75 ha)	202.7	
Soybeans (0.20 ha)	67.9	
Groundnuts (0.05 ha)	22.1	
Maize (0.10 ha)	34.0	
Crop-Income	347.1	
Other income 1/	285.6	
Sub-total:	632.7	58
Off-farm income		
Trading	123.7	
Plantation labour	258.5	
Others	77.8	
Sub-total:	460.1	42
Expenditures	576.0	
Production cost	51.7	
Living expenses	524.2	
NET HOUSEHOLD INCOME:	516.8	

Source: (1) Farm Economy Survey, 1992
(2) Estimate of the Study Team

Note: 1/ Other income such as income from rubber, coconut livestock and fishery

Table 2.17 Participation Ratio of Farmers to KUD in the Project Area, 1990/1991

Name of Village	No. of KUD	No. of Farmer Group	No. of Farmer Group Members	No. of KUD Members	Participation Ratio (%)
Old Villages					
Pagaran Tapah	1	8	241	54	22.4
Kota Lama	1	10	291	66	22.7
Kota Intan	1	13	329	67	20.4
Muara Dilam	0	0	0	0	0.0
Teluk Sono	0	0	0	0	0.0
Sub-Total	3	31	861	187	21.7
New Villages					
Kota Baru	1	13	400	304	76.0
Kota Raya	1	12	440	326	74.1
Muara Jaya	1	13	382	381	99.7
Sub-Total	3	38	1,222	1,011	82.7
Trans. Villages					
SKP-A	0	8	190	0	0.0
SKP-B	1	14	345	340	98.6
SKP-F	1	6	175	33	18.9
SKP-G	1	16	381	379	99.5
Sub-Total	3	44	1,091	752	68.9
Total	9	113	3,174	1,950	61.4

Source: Programa Penyuluhan Pertanian, BPP Kota Lama, 1991/92

Table 3.1 Proposed Land Allocation in the Project Area

Proposed Land Allocation	Left Bank		Right Bank		Total	
	Area(ha)	(%)	Area(ha)	(%)	Area(ha)	(%)
Existing Transmigration Area (1,120H/H)						
SKP-A(190H/H)			448		448	
SKP-B(345H/H)	814				814	
SKP-G(400H/H)	944				944	
SKP-F(185H/H)	437				437	
Sub-Total	2,195	27.2	448	10.8	2,643	21.7
Area for Old Village People (1,216H/H)						
Teluk Sono (133H/H)	314				314	
Muara Dilam (617H/H)	1,456				1,456	
Kota Lama - 1 (133H/H)	248				248	
Kota Lama - 2 (333H/H)			620		620	
Sub-Total	2,018	25.0	620	15.0	2,638	21.6
New Transmigration Area (2,254H/H)						
New Village - 1 (400H/H)			944		944	
New Village - 2 (380H/H)			898		898	
New Village - 3 (450H/H)			1,062		1,062	
New Village - 4 (345H/H)	814				814	
New Village - 5 (235H/H)	554				554	
New Village - 6 (360H/H)	850				850	
New Village - 7 (84H/H)	198				198	
Sub-Total	2,416	30.0	2,904	70.2	5,320	43.6
Area for the People from Kota Intan	300	3.7	0	0.0	300	2.5
Other Lands (Bad Lands etc.)	1,133	14.1	166	4.0	1,299	10.6
Total	8,062	100.0	4,138	100.0	12,200	100.0

Table 3.2 Proposed Land Use in the Gross Area

	Present Land Use		Proposed Land Use		
	Survey Area	Gross Area	Area to be Developed	Non Development Area	Total Proposed Land Use
Paddy Fields	27	2	5,926	-	5,926
Upland Crops	1,443	637	2,374	-	2,374
Primary Forest	17,495	5,268	-	304	304
Secondary Forest	10,301	3,094	-	751	751
Bush/Grass Lands	5,938	2,325	-	244	244
Alang Alang Lands	2,039	532	-	-	-
Plantation Area	3,093	-	-	-	-
Village Areas	1,000	342	1,720	342	2,062
Right of Way	-	-	539	-	539
Total	41,336	12,200	10,559	1,641	12,200

Table 3.3 Farm inputs and Labour Requirement per hectare for Major Crops -With Project-

	Unit	Irrig. Paddy	Soybean	Peanut	Maize
1 Seed	Kg	30	40	60	30
2 Fertilizer					
Urea	Kg	200	100	50	200
TSP	Kg	100	200	100	75
KCL	Kg	50	50	50	50
Lime	Kg	0	0	300	0
3 Agrochemicals					
Insecticides	cc	3000	3000	2000	2000
Rodenticides	g	100	100	100	100
Fungicides	cc	1000	0	0	0
4 Labour		Total	Total	Total	Total
Nursery/Seeding	man-day	4	15	15	15
Land Prepar'tn	man-day	20	16	16	16
Transplanting	man-day	25	0	0	0
Ferti.Appli.	man-day	4	4	4	4
Ag-chemi.Appli.	man-day	4	3	3	3
Weeding	man-day	30	30	30	30
Harvesting	man-day	40	40	40	40
Hauling	man-day	2	2	2	2
Thresh/Drying	man-day	3	6	10	6
Water Control	man-day	5	4	4	4
Total		137	120	124	120
5 Animal Power	day	20	16	16	16

Remarks:
Farm inputs and labour requirement of the crops have been estimated on the basis of the present inputs and requirement studied through Farm Economy Survey, the recommendation of the Riau agricultural extension office and the similar project.

Table 3.4 Proposed Land Use and Anticipated Crop Production

	Present						Future in Gross Area					
	Survey Area			Gross Area			With Project			Without Project		
	Area (ha)	Yield (t/ha)	Prod'tn (t)	Area (ha)	Yield (t/ha)	Prod'tn (t)	Area (ha)	Yield (t/ha)	Prod'tn (t)	Area (ha)	Yield (t/ha)	Prod'tn (t)
Rainy Season												
Paddy	1,266			548			5,926			548		
Irrigated	10	3.1	31	0	3.1	0	5,926	5.0	29,630	0	3.5	0
Rainfed	17	0.8	14	2	0.8	2	-	-	-	2	0.9	2
Upland	1,239	0.9	1,115	546	0.9	491	-	-	-	546	1.0	546
Secondary Crop*	204	0.7	143	91	0.7	64	2,374	1.6	3,798	91	0.7	64
Sub-total	1,470			639			8,300			639		
Dry Season												
Paddy	116			34			5,926			34		
Irrigated	0		0	0		0	5,926	5.5	32,593	0	3.5	0
Rainfed	44	0.8	35	12	0.8	10	-	-	-	12	0.9	11
Upland	72	0.9	65	22	0.9	20	-	-	-	22	1.0	22
Secondary Crop*	444	0.7	311	339	0.7	237	2,374	1.6	3,798	339	0.7	237
Sub-total	560			373			8,300			373		
Total												
Paddy	1,382		1,260	582		522	11,852		62,223	582		581
Secondary Crop	648		454	430		301	4,748		7,596	430		301

*: Production of secondary crops is estimated in terms of soybean.

Table 3.5(1) Farm Budget(With the Project Condition)

	Net Household Income (A Typical Model Farm)	
Land holding: 2.0 ha Farm Size: 1.75 ha Area Harvested: 3.5 ha Family Size: 5.0		
	Amount	Share (%)
Gross Income	6,381.2	100
Farm Income		
Wet Season Paddy (1.25 ha)	2,187.5	
Dry Season Paddy (1.25 ha)	2,406.3	
Soybeans (0.50 ha x 2)	680.0	
Crop-Income	5,273.8	
Other income 1/	527.4	
Sub-total:	5,801.1	91
Off-farm income		
Trading	580.1	
Plantation labour	0.0	
Others	0.0	
Sub-total:	580.1	9
Expenditures	1,161.8	
Production cost	113.4	
Living expenses	1,048.4	
NET HOUSEHOLD INCOME:	5,219.5	

Source: (1) Farm Economy Survey, 1992
(2) Estimate of the Study Team

Note: 1/ Other income such as income from rubber, coconut, livestock and fishery

Table 3.5(2) Farm Budget(Without the Project Condition)

	Net Household Income (A Typical Model Farm)	
Land holding: 2.0 ha Farm Size: 0.9 ha Area Harvested: 1.12 ha Family Size: 5.0		
	Amount	Share (%)
Gross Income	1,147.1	100
Farm Income		
Paddy, lowland (0.02 ha)	24.5	
Paddy, upland (0.75 ha)	262.5	
Soybeans (0.20 ha)	59.5	
Groundnuts (0.05 ha)	21.0	
Maize (0.10 ha)	34.0	
Crop-Income	401.5	
Other income 1/	285.6	
Sub-total:	687.0	60
Off-farm income		
Trading	123.7	
Plantation labour	258.5	
Others	77.8	
Sub-total:	460.1	40
Expenditures	576.0	
Production cost	51.7	
Living expenses	524.2	
NET HOUSEHOLD INCOME:	571.1	

Source: (1) Farm Economy Survey, 1992
(2) Estimate of the Study Team

Note: 1/ Other income such as income from rubber, coconut, livestock and fishery

Table 3.6 List of Structure

Canal	Length (m)	Number of Structures (nos.)						
		Bridge	D.Culvert	Diversion Turnout	Spillway	Drop	Check	Siphon
HRC	12,973	5	15	1	1	0	0	0
LMC	16,074	8	13	13	4	2	3	0
RMC	19,056	9	11	21	6	4	6	1
Sub-total	35,130	17	24	34	10	6	9	1
LSC1	1,484	0	0	2	0	1	0	0
LSC2	1,304	1	0	1	0	1	0	0
LSC3	2,090	2	2	3	0	0	0	0
LSC4	3,012	1	1	2	0	0	0	0
LSC5	11,951	6	7	13	3	4	5	0
LSC6	1,854	1	0	2	0	0	0	0
LSC7	1,510	1	1	1	0	0	0	0
LSC8	1,113	1	0	1	0	0	0	0
Sub-total	24,318	13	11	25	3	6	5	0
RSC1	1,672	0	0	2	0	1	0	0
RSC2	907	1	0	1	0	0	0	0
RSC3	2,083	1	1	2	0	0	0	0
RSC4	500	0	0	1	0	0	0	0
Sub-total	5,162	2	1	6	0	1	0	0
Total	77,583	37	51	66	14	13	14	1

Table 5.1 Summary of Project Cost

(Unit in Million Rp)

Work Item	Project Cost		
	Foreign Portion	Local Portion	Total
1. Preparatory Work	1,646	705	2,351
2. Irrigation & Drainage Costruction	49,732	15,571	65,303
2.1 Access Road	452	138	590
2.2 Head Works	14,455	4,896	19,351
2.3 Head Reach Canal	6,366	1,950	8,316
2.4 Main Irrigation System(Left)	9,354	2,866	12,220
2.5 Main Irrigation System(Right)	4,398	1,347	5,745
2.6 Drainage System	6,935	2,124	9,059
2.7 Tertiary Networks	7,772	2,250	10,022
3. Land Development Cost	2,681	1,149	3,830
4. O & M Facility Cost	1,225	408	1,633
5. Land Acquisition Cost	-	888	888
6. Administration Cost	-	1,698	1,698
7. Training Cost for WUA	34	15	49
8. Engineering Service	4,702	522	5,224
Sub-Total(1 to 8)	60,020	20,956	80,976
9. Physical Contingency	3,001	1,048	4,049
Sub-Total(1 to 9)	63,021	22,004	85,025
10. Value Added Tax	-	8,503	8,503
Total(1 to 10)	63,021	30,507	93,528
11. Price Contingency	10,910	20,513	31,423
Grand Total(Mill Rp.)	73,931	51,020	124,951
US$ Equivalent(Thousand US$)	36,782	25,383	62,165

Table 5.2 Annual Disbursement Schedule of Financial Cost

Unit in million Rp.

Item	Total Cost			1994/95		1995/96		1996/97		1997/98		1998/99		1999/2000		2000/01	
	F/C	L/C	Total	F/C	L/C	F/C	L/C	F/C	L/C	F/C	L/C	F/C	L/C	F/C	L/C	F/C	L/C
1. Preparatory work	1,646	705	2,351	-	-	1,481	635	165	71	-	-	-	-	-	-	-	-
2. Civil works																	
1) Access road	452	138	590	-	-	-	-	452	138	-	-	-	-	-	-	-	-
2) Head work	14,455	4,896	19,351	-	-	-	-	4,337	1,469	4,337	1,469	5,059	1,714	723	245	-	-
3) Head reach canal	6,366	1,950	8,316	-	-	-	-	1,592	488	2,546	780	2,228	683	-	-	-	-
4) Main irrigation system(Left)	9,354	2,866	12,220	-	-	-	-	-	-	3,742	1,146	3,742	1,146	1,871	573	-	-
5) Main irrigation system(Right)	4,398	1,347	5,745	-	-	-	-	-	-	1,759	539	2,639	808	-	-	-	-
6) Drainage system	6,935	2,124	9,059	-	-	-	-	2,081	637	2,427	743	2,427	743	-	-	-	-
7) Tertiary system	7,772	2,250	10,022	-	-	-	-	-	-	777	225	4,663	1,350	1,554	450	777	225
3. Land development cost	2,681	1,149	3,830				-	-	-	-	-	536	230	938	402	1,206	517
4. O & M facilities	1,225	408	1,633	-	-	-	-	-	-	-	-	490	163	490	163	245	82
5. Land acquisition	-	888	888	-	-	-	311	-	266	-	266	-	44	-	-	-	-
6. Administration	-	1,698	1,698	-	340	-	255	-	255	-	255	-	255	-	255	-	85
7. Training cost for WUA	34	15	49	-	-	-	-	-	-	-	-	10	5	10	5	14	5
8. Engineering services	4,702	522	5,224	1,176	131	705	78	705	78	705	78	705	78	470	52	235	26
9. Phyisical contingency	3,001	1,048	4,049	300	105	300	105	600	210	900	314	600	210	300	105	-	-
Sub-total	63,021	22,004	85,025	1,476	575	2,487	1,383	9,931	3,611	17,194	5,816	23,100	7,429	6,357	2,250	2,477	940
10. Value added tax	-	8,503	8,503	-	205	-	387	-	1,354	-	2,301	-	3,053	-	861	-	342
Sub-total	63,021	30,507	93,528	1,476	780	2,487	1,770	9,931	4,965	17,194	8,117	23,100	10,481	6,357	3,110	2,477	1,281
11. Price contingency	10,910	20,513	31,423	90	164	231	586	1,246	2,304	2,739	4,956	4,483	8,087	1,461	2,951	661	1,465
Total	73,931	51,020	124,951	1,565	944	2,717	2,356	11,177	7,269	19,932	13,073	27,583	18,569	7,818	6,061	3,138	2,747

Table 5.3 Summary of Project Cost
(In case of OECF Loan)

(Unit in Million Rp)

Work Item	Project Cost		
	Loan Portion	Rupiah Portion	Total
1. Preparatory Work	705	1,646	2,351
2. Irrigation & Drainage Costruction	65,303	0	65,303
2.1 Access Road	590	0	590
2.2 Head Works	19,351	0	19,351
2.3 Head Reach Canal	8,316	0	8,316
2.4 Main Irrigation System(Left)	12,220	0	12,220
2.5 Main Irrigation System(Right)	5,745	0	5,745
2.6 Drainage System	9,059	0	9,059
2.7 Tertiary Networks	10,022	0	10,022
3. Land Development Cost	1,915	1,915	3,830
4. O & M Facility Cost	1,633	0	1,633
5. Land Acquisition Cost	-	888	888
6. Administration Cost	-	1,698	1,698
7. Training Cost for WUA	34	15	49
8. Engineering Service	4,702	522	5,224
Sub-Total(1 to 8)	74,292	6,684	80,976
9. Physical Contingency	4,049	0	4,049
Sub-Total(1 to 9)	78,341	6,684	85,025
10. Value Added Tax	-	8,503	8,503
Total(1 to 10)	78,341	15,187	93,528
11. Price Contingency	27,867	3,556	31,423
Grand Total(Mill Rp.)	106,208	18,743	124,951
US$ Equivalent(Thousand US$)	52,840	9,325	62,165

Table 6.1 Financial Cash Flow Statement

Unit : Million Rp.

	Cash Outflow					Cashoutflow			
Project Year	Project Cost	O & M Cost	Loan Interest	Repay-ment	Total Outflow	Foreign Loan	Government Budget	Government Subsidy	Total Inflow
1	2,509	0	39	0	2,548	1,565	944	39	2,548
2	5,073	0	107	0	5,180	2,717	2,356	107	5,180
3	18,446	0	386	0	18,832	11,177	7,269	386	18,832
4	33,005	0	885	0	33,890	19,932	13,073	885	33,890
5	46,152	0	1,574	0	47,726	27,583	18,569	1,574	47,726
6	13,879	1,578	1,770	0	17,227	7,818	6,061	3,348	17,227
7	5,885	1,786	1,848	0	9,519	3,138	2,747	3,634	9,519
8	0	1,874	1,848	0	3,722	0	0	3,722	3,722
9	0	1,874	1,848	0	3,722	0	0	3,722	3,722
10	0	1,874	1,848	0	3,722	0	0	3,722	3,722
11	0	1,874	1,756	3,697	7,327	0	0	7,327	7,327
12	0	1,874	1,663	3,697	7,234	0	0	7,234	7,234
13	0	1,874	1,571	3,697	7,142	0	0	7,142	7,142
14	0	1,874	1,479	3,697	7,049	0	0	7,049	7,049
15	0	1,874	1,386	3,697	6,957	0	0	6,957	6,957
16	0	1,874	1,294	3,697	6,865	0	0	6,865	6,865
17	0	1,874	1,201	3,697	6,772	0	0	6,772	6,772
18	0	1,874	1,109	3,697	6,680	0	0	6,680	6,680
19	0	1,874	1,017	3,697	6,587	0	0	6,587	6,587
20	0	1,874	924	3,697	6,495	0	0	6,495	6,495
21	0	1,874	832	3,697	6,402	0	0	6,402	6,402
22	0	1,874	739	3,697	6,310	0	0	6,310	6,310
23	0	1,874	647	3,697	6,218	0	0	6,218	6,218
24	0	1,874	554	3,697	6,125	0	0	6,125	6,125
25	0	1,874	462	3,697	6,033	0	0	6,033	6,033
26	0	1,874	370	3,697	5,940	0	0	5,940	5,940
27	0	1,874	277	3,697	5,848	0	0	5,848	5,848
28	0	1,874	185	3,697	5,756	0	0	5,756	5,756
29	0	1,874	92	3,697	5,663	0	0	5,663	5,663
30	0	1,874	0	3,697	5,571	0	0	5,571	5,571
Total	124,949	46,471	29,713	73,930	275,063	73,930	51,019	150,114	275,063

Table 6.2 Farm Gate Prices of Agricultural Inputs and Outputs

Items	Unit	Financial Prices		Economic Prices	
		Present (1992)	Future (2000)	Present (1992)	Future (2000)
Outputs					
Unhusked rice	kg	300	350	284	322
Maize	kg	350	445	296	351
Soybean	kg	500	425	675	590
Groundnut	kg	700	700	630	630
Mungbean	kg	800	800	720	720
Cassava	kg	50	50	45	45
Chilly	kg	2,000	2000	1,800	1,800
Inputs					
Rice seed	kg	500	500	450	450
Maize seed	kg	400	400	360	360
Groundnut seed	kg	1,150	1,150	1,035	1,035
Soybean seed	kg	1,150	1,150	1,035	1,035
Mungbean seed	kg	1,250	1,250	1,125	1,125
Cassava	kg	50	50	45	45
Chilly seed	kg	20,000	20,000	18,000	18,000
Urea	kg	220	231	324	343
T.S.P.	kg	280	339	447	512
KCl	kg	280	308	352	375
Insecticide	liter	14,000	14,000	14,000	14,000
Fungicide	liter	14,000	14,000	14,000	14,000
Herbicide	liter	14,000	14,000	14,000	14,000
Rodenticide	liter	4,000	4,000	4,000	4,000
Human labor	man-day	3,000	3,000	2,400	2,400
Animal power with operator	animal-day	5,000	5,000	4,000	4,000

Note: (1) The economic prices of internationally traded goods such as rice, maize, soybeans, fertilizers, etc. are based on IBRD commodity price projections. Refer to Tables 6.3.2 (2) to 6.3.2 (7).

(2) Economic prices for other outputs and inputs such as cassava, groundnuts, etc. are calculated by applying a conversion factor of 0.9 to the financial values.

(3) Shadow wage rate of 0.8 has been applied to financial farm labour costs.

Table 6.3 Economic Price of Rice
(constant 1992 price)

Item	unit	Import Parity	Export Parity	Import Parity	Export Parity
		Present (1992)	Present (1992)	Future (2000)	Future (2000)
FOB Bangkok, 5% broken at constant 1985 price	US$/mt	163	163	190	190
Projected 2000 world market price, constant 1992 price (x 1.623)	US$/mt	265	265	308	308
Quality adjustment, 15%	US$/mt	40	40	46	46
Adjusted price	US$/mt	225	225	262	247
Ocean freight and insurance	US$/mt	25	25	25	25
Border price	US$/mt	250	200	287	222
	Rp' 000/mt	502 (CIF)	402 (FOB)	577 (CIF)	446 (FOB)
Inland transport and handling	Rp' 000/mt	40	40	40	40
Price at Project Area mill	Rp' 000/mt	542	362	617	406
Conversion to paddy (65%)	Rp' 000/mt	352	235	401	264
Transport to/from farm	Rp' 000/mt	10	10	10	10
Farm gate economic price		342	225	391	254
Balanced parity price (Rp' 000/mt):		284		322	

Source: Commodity Price Projections, World Bank, December 1990

Remark: (1) Projected price in 1985 constant dollars has been converted to 1992 price level applying price index of 1.623.
(2) Balanced parity price = Averages of import parity and export parity economic prices

Table 6.4 Economic Price of Soybean (constant 1992 price)

Item	unit	Import Parity	
		Present (1992)	Future (2000)
FOB US Gulf, constant 1985 price	US$/ton	176	150
Projected 2000 world market price, constant 1992 price (x 1.623)	US$/ton	286	243
Ocean freight and insurance	US$/ton	40	40
Border price in U.S. Dollars	US$/ton	326	283
Equivalent value in Rupiah	Rp' 000/ton	655 (CIF)	570 (CIF)
Inland transport and handling	Rp' 000/ton	30	30
Wholesale price	Rp' 000/ton	685	600
Transport to farm	Rp' 000/ton	10	10
Farm gate economic price		675	590

Source: Commodity Price Projections, World Bank, December 1990

Remark: Projected price in 1985 constant dollars has been converted to 1992 price level applying price index of 1.623.

Table 6.5 Economic Price of Maize (constant 1992 price)

Item	unit	Import Parity	
		Present (1992)	Future (2000)
FOB Gulf, constant 1985 price	US$/ton	63	80
Projected 2000 world market price, constant 1992 price (x 1.623)	US$/ton	102	130
Ocean freight and insurance	US$/ton	25	25
Border price in U.S. Dollars	US$/ton	127	155
Equivalent value in Rupiah	Rp' 000/ton	256 (CIF)	311 (CIF)
Inland transport and handling	Rp' 000/ton	30	30
Price at Project Area	Rp' 000/ton	286	341
Transport to farm	Rp' 000/ton	10	10
Farm gate economic price		296	351

Source: Commodity Price Projections, World Bank, December 1990

Remark: Projected price in 1985 constant dollars has been converted to 1992 price level applying price index of 1.623.

Table 6.6 Economic Price of Urea (constant 1992 price)

Item	unit	Export Parity	
		Present (1992)	Future (2000)
FOB N.W. Europe, constant '85 price	US$/ton	114	120
Projected 2000 world market price, constant 1992 price (x 1.623)	US$/ton	185	195
Ocean freight and insurance	US$/ton	19	19
Border price in U.S. Dollars	US$/ton	166	176
Equivalent value in Rupiah	Rp'000/ton	334 (FOB)	353 (FOB)
Inland transport and handling	Rp'000/ton	20	20
Price at Project Area	Rp'000/ton	314	333
Transport to farm	Rp'000/ton	10	10
Farm gate economic price		324	343

Source: Commodity Price Projections, World Bank, December 1990

Remark: Projected price in 1985 constant dollars has been converted to 1992 price level applying price index of 1.623.

Table 6.7 Economic Price of TSP
(constant 1992 price)

Item	unit	Import Parity	
		Present (1992)	Future (2000)
FOB US Gulf, constant '85 price	US$/ton	94	114
Projected 2000 world market price, constant 1992 price (x 1.623)	US$/ton	153	185
Shipping and insurance	US$/ton	40	40
CIF, Sumatra ports	US$/ton	193	225
Equivalent value in Rupiah	Rp'000/ton	387 (CIF)	452 (CIF)
Inland transport and handling	Rp'000/ton	50	50
Price at Project Area	Rp'000/ton	437	502
Transport to farm	Rp'000/ton	10	10
Farm gate economic price		447	512

Source: Commodity Price Projections, World Bank, December 1990

Remark: Projected price in 1985 constant dollars has been converted to 1992 price level applying price index of 1.623.

Table 6.8 Economic Price of KCl (constant 1992 price)

Item	unit	Import Parity	
		Present (1992)	Future (2000)
FOB Vancouver, constant '85 price	US$/ton	65	72
Projected 2000 world market price, constant 1992 price (x 1.623)	US$/ton	105	117
Shipping and insurance	US$/ton	40	40
CIF, Sumatra ports	US$/ton	145	157
Equivalent value in Rupiah	Rp'000/ton	292 (CIF)	315 (CIF)
Inland transport and handling	Rp'000/ton	50	50
Price at Project Area	Rp'000/ton	342	365
Transport to farm	Rp'000/ton	10	10
Farm gate economic price		352	375

Source: Commodity Price Projections, World Bank, December 1990

Remark: Projected price in 1985 constant dollars has been converted to 1992 price level applying price index of 1.623.

Table 6.9 Summary of Economic Project Costs

Unit: Rp. Million

Item	Finacial Cost	Conver-sion Factors	Economic Cost
1. Preparatory Works	2,351	0.90	2,116
2. Civil Works	65,303	0.90	58,773
3. Land Development	3830	0.85	3,256
4. O&M Equipment	1633	0.85	1,388
5. Land Acquisition	888	0.00	0
6. Administration	1,698	0.95	1,613
7. Training Cost for WUA	49	0.85	42
8. Engineering Services	5,224	0.95	4,963
9. Physical Contingency 1/	4,049		3,607
10. Value Added Tax	8503	0.00	0
11. Associated Costs 2/	4980	0.85	4,233
Total Economic Project Cost			79,990

Note: 1/ Physical contingency at 5% for total base cost
2/ On-farm development costs (8,300 ha)

Table 6.10 Annual Disbursement Schedule for Economic Evaluation

Unit: Rp. Million

Item	Total Economic Costs	PY 1	PY 2	PY 3	PY 4	PY 5	PY 6	PY 7
1. Preparatory Works	2,116	635	846	423	212	0	0	0
2. Direct Construction Costs	58,773	0	0	2,939	15,869	23,509	16,456	0
3. Land Development	3256	0	0	0	651	651	1,628	326
4. O&M Equipment	1,388	0	0	0	0	0	695	693
5. Land Acquisition	0	0	0	0	0	0	0	0
6. Administration	1,613	452	242	194	242	290	145	48
7. Training Cost for WUA	42	0	0	0	0	0	21	21
8. Engineering Services	4,963	1,390	744	596	744	893	447	149
9. Physical Contingency	3,607	124	92	208	886	1,267	970	62
10. Associated Costs	4,233	0	0	0	847	847	2,117	423
Total	79,991	2,600	1,924	4,359	19,450	27,458	22,479	1,722

Table 6.11 Annual Incremental Benefits
(at Full Development, Economic Prices)

Net Value of Production under FWO Project

	Paddy, Irrigated	Paddy, Lowland	Paddy, Upland	Soybeans	Groundnut
Yield (ton/ha)	3.5	0.9	1.0	0.7	0.6
Price (Rp/ton)	322,000	322,000	322,000	590,000	630000
Gross Revenue (Rp/ha)	1,127,000	289,800	322,000	413,000	378000
Prod. Cost (Rp/ha)	372,508	452,233	389,094	304,222	431207
Cropped Area ('000 ha)	0	14	568	215	215
Gross Margin (Rp mln)	0	-2.27	-38.11	23.39	-11.44

Sub-Total (A): Rp -28.44 million

Net Value of Production under FW Project

	Paddy, Irrigated		Soybeans	Groundnut
	Wet Season	Dry Season		
Yield (ton/ha)	5.0	5.5	1.6	1.8
Price (Rp/ton)	322,000	322,000	590,000	630,000
Gross Revenue (Rp/ha)	1,610,000	1,771,000	944,000	1,134,000
Prod. Cost (Rp/ha)	627,250	627,250	599,250	583,200
Cropped Area ('000 ha)	5926	5926	2374	2374
Gross Margin (Rp mln)	5823.78	6777.86	818.44	1307.60

Sub-Total (B): Rp 14,727.67 million

Net Value of Production (B-A): Rp 14,756.11 million per year

Table 6.12 Production Cost-FWO Project
(Economic Prices)

Item	Paddy, Irrigated			Paddy, Lowland			Paddy, Upland		
	Q'ty	Price (Rp)	Amount (Rp)	Q'ty	Price (Rp)	Amount (Rp)	Q'ty	Price (Rp)	Amount (Rp)
Seeds (kg)	31.0	450	13,950	42.0	450	18,900	40.0	450	18,000
Fertilizers (kg)									
Urea	31.0	343	10,633	65.0	343	22,295	36.0	343	12,348
TSP	24.0	512	12,288	58.0	512	29,696	24.0	512	12,288
KCL	3.0	375	1,125	0.0	375	0	6.0	375	2,250
Organic matter	0.0	0	0	1120.0	0	0	129.0	0	0
Agrochemicals									
Insecticide (lt)	1.47	14,000	20,580	1.5	14,000	21,420	0.757	14,000	10,598
Rodenticide (g)	3.1	4.0	12	0.0	4.0	0	40	4.0	160
Herbicide (lt)		14,000	0	0.0	14,000	42	0.003	14,000	42
Family Labor									
Nursery	2.4	2,400	5,760	3.7	2,400	8,880	12.9	2,400	30,960
Land preparation	37.5	2,400	90,000	56.1	2,400	134,640	39.5	2,400	94,752
Transplanting	16.6	2,400	39,840	14.7	2,400	35,280	0.0	2,400	0
Fertilization	1.9	2,400	4,560	4.5	2,400	10,800	1.5	2,400	3,552
Pest control	4.0	2,400	9,600	3.5	2,400	8,400	1.9	2,400	4,536
Weeding	24.5	2,400	58,800	33.9	2,400	81,360	26.7	2,400	64,080
Harvesting	15.4	2,400	36,960	11.4	2,400	27,360	14.9	2,400	35,760
Transporting	1.4	2,400	3,360	1.7	2,400	4,080	1.9	2,400	4,560
Threshing/Drying	12.8	2,400	30,720	9.1	2,400	21,840	5.3	2,400	12,720
Water Control	0	2,400	0	0	2,400	0	0	2,400	0
Sub-Total	116.5			138.6			104.6		
Hired Labor									
Nursery	0.0	2,400	0	0.0	2,400	0	6.5	2,400	15,600
Land preparation	10.4	2,400	24,960	6.9	2,400	16,560	13.6	2,400	32,664
Transplanting	1.3	2,400	3,120	1.7	2,400	4,080	0.0	2,400	0
Fertilization	0.0	2,400	0	0.0	2,400	72	0.0	2,400	72
Pest control	0.0	2,400	0	0.0	2,400	48	0.0	2,400	48
Weeding	1.1	2,400	2,640	1.0	2,400	2,400	6.0	2,400	14,328
Harvesting	0.3	2,400	720	0.9	2,400	2,160	6.8	2,400	16,320
Transporting	0.1	2,400	240	0.2	2,400	480	0.3	2,400	816
Threshing/Drying	1.1	2,400	2,640	0.6	2,400	1,440	1.1	2,400	2,640
Water Control	0	2,400	0	0	2,400	0	0	2,400	0
Sub-Total	14.3			11.4			34.4		
Total :			372,508			452,233			389,094

Table 6.13 Production Cost-FWO Project
(Economic Prices)

Item	Soybean			Maize			Groundnut		
	Q'ty	Price (Rp)	Amount (Rp)	Q'ty	Price (Rp)	Amount (Rp)	Q'ty	Price (Rp)	Amount (Rp)
Seeds (kg)	39	1,035	40,365	28.00	360	10,080	63.52	1,035	65,743
Fertilizers (kg)									
Urea	39	343	13,377	50.00	343	17,150	13.08	343	4,486
TSP	50	512	25,600	9.00	512	4,608	6.42	512	3,287
KCL	16	375	6,000	5.00	375	1,875	0	375	0
Organic matter	0	0	0	0	0	0	79.00	0	0
Agrochemicals									
Insecticide (lt)	0	14,000	0	0.22	14,000	3,122	0.61	14,000	8,526
Rodenticide (g)	0	4.0	0	0	4.0	0	0	4.0	0
Herbicide (lt)	0	14,000	0	0	14,000	0	0	14,000	0
Family Labor									
Nursery	7.30	2,400	17,520	5.00	2,400	12,000	15.7	2,400	37,680
Land preparation	25.70	2,400	61,680	36.60	2,400	87,840	51.8	2,400	124,320
Transplanting	0	2,400	0	0.00	2,400	0	0	2,400	0
Fertilization	2.80	2,400	6,720	3.10	2,400	7,440	0	2,400	0
Pest control	3.70	2,400	8,880	0.80	2,400	1,920	3.1	2,400	7,440
Weeding	22.30	2,400	53,520	10.50	2,400	25,200	38.0	2,400	91,200
Harvesting	9.60	2,400	23,040	7.30	2,400	17,520	12.4	2,400	29,760
Transporting	1.20	2,400	2,880	1.70	2,400	4,080	0.2	2,400	480
Threshing/Drying	7.90	2,400	18,960	17.50	2,400	42,000	7.8	2,400	18,720
Water Control	0	2,400	0	0	2,400		0	2,400	
Sub-Total	80.50			82.50			129.00		
Hired Labor									
Nursery	4.30	2,400	10,320	0.30	2,400	720	0	2,400	0
Land preparation	1.60	2,400	3,840	0.20	2,400	480	0	2,400	0
Transplanting	0.00	2,400	0	0	2,400	0	0	2,400	0
Fertilization	0.00	2,400	0	0.40	2,400	960	0	2,400	0
Pest control	0.00	2,400	0	0	2,400	0	0	2,400	0
Weeding	1.90	2,400	4,560	0.70	2,400	1,680	0.32	2,400	768
Harvesting	2.00	2,400	4,800	0.70	2,400	1,680	0	2,400	0
Transporting	0.00	2,400	0	0.10	2,400	240	0	2,400	0
Threshing/Drying	0.90	2,400	2,160	0.10	2,400	240	0	2,400	0
Water Control	0	2,400		0	2,400	0	0	2,400	
Sub-Total	10.70			2.50			0		
Total :			304,222			240,835			392,411

Table 6.14 Production Cost-FW Project
(Economic Prices)

Item	Paddy, Irrigated			Soybean			Groundnut		
	Q'ty	Price (Rp)	Amount (Rp)	Q'ty	Price (Rp)	Amount (Rp)	Q'ty	Price (Rp)	Amount (Rp)
Seeds (kg)	30	450	13,500	40	1,035	41,400	60.00	1,035	62,100
Fertilizers (kg)									
Urea	200	343	68,600	100	343	34,300	50.00	343	17,150
TSP	100	512	51,200	200	512	102,400	100.00	512	51,200
KCL	50	375	18,750	50	375	18,750	50	375	18,750
Organic matter	0	0	0	0	0	0	0	0	0
Lime	0	120	0	0	120	0	300	120	36,000
Agrochemicals									
Insecticide (lt)	3.0	14,000	42,000	3.0	14,000	42,000	2.00	14,000	28,000
Rodenticide (g)	100.0	4.0	400	100.0	4.0	400	100	4.0	400
Herbicide (lt)	1.0	14,000	14,000	0	14,000	0	0	14,000	0
Labor (man-day)									
Nursery/Seeding	4.0	2,400	9,600	15.0	2,400	36,000	15.0	2,400	36,000
Land preparation	20.0	2,400	48,000	16.0	2,400	38,400	16.0	2,400	38,400
Transplanting	25.0	2,400	60,000	0	2,400	0	0	2,400	0
Fertilization	4.0	2,400	9,600	4.0	2,400	9,600	4.0	2,400	9,600
Pest control	4.0	2,400	9,600	3.0	2,400	7,200	3.0	2,400	7,200
Weeding	30.0	2,400	72,000	30.0	2,400	72,000	30.0	2,400	72,000
Harvesting	40.0	2,400	96,000	40.0	2,400	96,000	40.0	2,400	96,000
Transporting	2.0	2,400	4,800	2.0	2,400	4,800	2.0	2,400	4,800
Threshing/Drying	3.0	2,400	7,200	6.0	2,400	14,400	10.0	2,400	24,000
Water Control	5.0	2,400	12,000	4.0	2,400	9,600	4.0	2,400	9,600
Sub-Total	137.0			120.0			124.0		
Animal power (day)	20.0	4,500	90,000	16.0	4,500	72,000	16.0	4,500	72,000
Total :			627,250			599,250			583,200

Table 6.15 Economic Analysis (Base Case)

Unit: Rp million

Proj. Year	Incremental Net Benefit	Incremental Costs			Net Cash Flow	Discount Factor at 10%	Present Value at 10%
		Investment Cost	O & M Cost	Total Cost			
					0.12		
1	0.0	2600.0	0.0	2600.0	-2600.0	0.909	-2364
2	0.0	1924.0	0.0	1924.0	-1924.0	0.826	-1590
3	0.0	4359.0	0.0	4359.0	-4359.0	0.751	-3275
4	0.0	19450.0	0.0	19450.0	-19450.0	0.683	-13285
5	0.0	27458.0	0.0	27458.0	-27458.0	0.621	-17049
6	2951.2	22479.0	836.9	23315.9	-20364.7	0.564	-11495
7	5902.4	1722.0	1174.1	2896.1	3006.4	0.513	1543
8	8853.6	0.0	1199.9	1199.9	7653.7	0.467	3571
9	11804.8	0.0	1199.9	1199.9	10604.9	0.424	4498
10	14756.0	0.0	1199.9	1199.9	13556.1	0.386	5226
11	14756.0	0.0	1199.9	1199.9	13556.1	0.350	4751
12	14756.0	0.0	1199.9	1199.9	13556.1	0.319	4319
13	14756.0	0.0	1199.9	1199.9	13556.1	0.290	3927
14	14756.0	0.0	1199.9	1199.9	13556.1	0.263	3570
15	14756.0	0.0	1199.9	1199.9	13556.1	0.239	3245
16	14756.0	0.0	1199.9	1199.9	13556.1	0.218	2950
17	14756.0	0.0	1199.9	1199.9	13556.1	0.198	2682
18	14756.0	0.0	1199.9	1199.9	13556.1	0.180	2438
19	14756.0	0.0	1199.9	1199.9	13556.1	0.164	2217
20	14756.0	0.0	1199.9	1199.9	13556.1	0.149	2015
21	14756.0	0.0	1199.9	1199.9	13556.1	0.135	1832
22	14756.0	0.0	1199.9	1199.9	13556.1	0.123	1665
23	14756.0	0.0	1199.9	1199.9	13556.1	0.112	1514
24	14756.0	0.0	1199.9	1199.9	13556.1	0.102	1376
25	14756.0	0.0	1199.9	1199.9	13556.1	0.092	1251
26	14756.0	0.0	1199.9	1199.9	13556.1	0.084	1137
27	14756.0	0.0	1199.9	1199.9	13556.1	0.076	1034
28	14756.0	0.0	1199.9	1199.9	13556.1	0.069	940
29	14756.0	0.0	1199.9	1199.9	13556.1	0.063	855
30	14756.0	0.0	1199.9	1199.9	13556.1	0.057	777
	339388.0	79992.0	29608.2	109600.2	0.120		10275

EIRR: 12.0 %
NPV: 10,275 million
B/C: 1.18

Table 6.16(1) Sensitivity Analysis (Cost Increase: 10%)

Unit: Rp million

Proj. Year	Incremental Net Benefit	Incremental Costs			Net Cash Flow	Discount Factor at 10%	Present Value at 10%
		Investment Cost	O & M Cost	Total Cost			
					0.108		
1	0.0	2860.0	0.0	2860	-2860.0	0.909	-2600.0
2	0.0	2116.4	0.0	2116.4	-2116.4	0.826	-1749.1
3	0.0	4794.9	0.0	4794.9	-4794.9	0.751	-3602.5
4	0.0	21395.0	0.0	21395.0	-21395.0	0.683	-14613.1
5	0.0	30203.8	0.0	30203.8	-30203.8	0.621	-18754.2
6	2951.2	24726.9	920.6	25647.5	-22696.3	0.564	-12811.4
7	5902.4	1894.2	1291.5	3185.7	2716.7	0.513	1394.1
8	8853.6	0.0	1319.9	1319.9	7533.7	0.467	3514.5
9	11804.8	0.0	1319.9	1319.9	10484.9	0.424	4446.6
10	14756.0	0.0	1319.9	1319.9	13436.1	0.386	5180.2
11	14756.0	0.0	1319.9	1319.9	13436.1	0.350	4709.3
12	14756.0	0.0	1319.9	1319.9	13436.1	0.319	4281.2
13	14756.0	0.0	1319.9	1319.9	13436.1	0.290	3892.0
14	14756.0	0.0	1319.9	1319.9	13436.1	0.263	3538.2
15	14756.0	0.0	1319.9	1319.9	13436.1	0.239	3216.5
16	14756.0	0.0	1319.9	1319.9	13436.1	0.218	2924.1
17	14756.0	0.0	1319.9	1319.9	13436.1	0.198	2658.3
18	14756.0	0.0	1319.9	1319.9	13436.1	0.180	2416.6
19	14756.0	0.0	1319.9	1319.9	13436.1	0.164	2196.9
20	14756.0	0.0	1319.9	1319.9	13436.1	0.149	1997.2
21	14756.0	0.0	1319.9	1319.9	13436.1	0.135	1815.6
22	14756.0	0.0	1319.9	1319.9	13436.1	0.123	1650.6
23	14756.0	0.0	1319.9	1319.9	13436.1	0.112	1500.5
24	14756.0	0.0	1319.9	1319.9	13436.1	0.102	1364.1
25	14756.0	0.0	1319.9	1319.9	13436.1	0.092	1240.1
26	14756.0	0.0	1319.9	1319.9	13436.1	0.084	1127.4
27	14756.0	0.0	1319.9	1319.9	13436.1	0.076	1024.9
28	14756.0	0.0	1319.9	1319.9	13436.1	0.069	931.7
29	14756.0	0.0	1319.9	1319.9	13436.1	0.063	847.0
30	14756.0	0.0	1319.9	1319.9	13436.1	0.057	770.0
	339388.0	87991.2	32569.0	120560.2	0.108		4507.3

EIRR: 10.8 %
NPV: 4,507.3 million
B/C: 1.07

Table 6.16(2) Sensitivity Analysis (Benefi Decrease:10%)

Unit: Rp million

Proj. Year	Incremental Net Benefit	Incremental Costs			Net Cash Flow	Discount Factor at 10%	Present Value at 10%
		Investment Cost	O & M Cost	Total Cost			
					0.107		
1	0.0	2600.0	0.0	2600.0	-2600.0	0.909	-2364
2	0.0	1924.0	0.0	1924.0	-1924.0	0.826	-1590
3	0.0	4359.0	0.0	4359.0	-4359.0	0.751	-3275
4	0.0	19450.0	0.0	19450.0	-19450.0	0.683	-13285
5	0.0	27458.0	0.0	27458.0	-27458.0	0.621	-17049
6	2656.1	22479.0	836.9	23315.9	-20659.8	0.564	-11662
7	5312.2	1722.0	1174.1	2896.1	2416.1	0.513	1240
8	7968.2	0.0	1199.9	1199.9	6768.4	0.467	3157
9	10624.3	0.0	1199.9	1199.9	9424.4	0.424	3997
10	13280.4	0.0	1199.9	1199.9	12080.5	0.386	4658
11	13280.4	0.0	1199.9	1199.9	12080.5	0.350	4234
12	13280.4	0.0	1199.9	1199.9	12080.5	0.319	3849
13	13280.4	0.0	1199.9	1199.9	12080.5	0.290	3499
14	13280.4	0.0	1199.9	1199.9	12080.5	0.263	3181
15	13280.4	0.0	1199.9	1199.9	12080.5	0.239	2892
16	13280.4	0.0	1199.9	1199.9	12080.5	0.218	2629
17	13280.4	0.0	1199.9	1199.9	12080.5	0.198	2390
18	13280.4	0.0	1199.9	1199.9	12080.5	0.180	2173
19	13280.4	0.0	1199.9	1199.9	12080.5	0.164	1975
20	13280.4	0.0	1199.9	1199.9	12080.5	0.149	1796
21	13280.4	0.0	1199.9	1199.9	12080.5	0.135	1632
22	13280.4	0.0	1199.9	1199.9	12080.5	0.123	1484
23	13280.4	0.0	1199.9	1199.9	12080.5	0.112	1349
24	13280.4	0.0	1199.9	1199.9	12080.5	0.102	1226
25	13280.4	0.0	1199.9	1199.9	12080.5	0.092	1115
26	13280.4	0.0	1199.9	1199.9	12080.5	0.084	1014
27	13280.4	0.0	1199.9	1199.9	12080.5	0.076	921
28	13280.4	0.0	1199.9	1199.9	12080.5	0.069	838
29	13280.4	0.0	1199.9	1199.9	12080.5	0.063	762
30	13280.4	0.0	1199.9	1199.9	12080.5	0.057	692
	305449.2	79992.0	29608.2	109600.2	0.107		3480

EIRR: 10.7 %
NPV: 3,480 million
B/C: 1.06

Table 6.16(3) Sensitivity Analysis
(2 years delay in construction period)

Unit: Rp million

Proj. Year	Incremental Net Benefit	Incremental Costs			Net Cash Flow	Discount Factor at 10%	Present Value at 10%
		Investment Cost	O & M Cost	Total Cost			
					0.106		
1	0.0	2600.0	0.0	2600.0	-2600.0	0.909	-2364
2	0.0	1924.0	0.0	1924.0	-1924.0	0.826	-1590
3	0.0	4359.0	0.0	4359.0	-4359.0	0.751	-3275
4	0.0	9725.0	0.0	9725.0	-9725.0	0.683	-6642
5	0.0	9725.0	0.0	9725.0	-9725.0	0.621	-6038
6	0.0	13729.0	425.0	14154.0	-14154.0	0.564	-7990
7	0.0	13729.0	630.9	14359.9	-14359.9	0.513	-7369
8	2951.2	22479.0	836.9	23315.9	-20364.7	0.467	-9500
9	5902.4	1722.0	1174.1	2896.1	3006.4	0.424	1275
10	8853.6	0.0	1199.9	1199.9	7653.7	0.386	2951
11	11804.8	0.0	1199.9	1199.9	10604.9	0.350	3717
12	14756.0	0.0	1199.9	1199.9	13556.1	0.319	4319
13	14756.0	0.0	1199.9	1199.9	13556.1	0.290	3927
14	14756.0	0.0	1199.9	1199.9	13556.1	0.263	3570
15	14756.0	0.0	1199.9	1199.9	13556.1	0.239	3245
16	14756.0	0.0	1199.9	1199.9	13556.1	0.218	2950
17	14756.0	0.0	1199.9	1199.9	13556.1	0.198	2682
18	14756.0	0.0	1199.9	1199.9	13556.1	0.180	2438
19	14756.0	0.0	1199.9	1199.9	13556.1	0.164	2217
20	14756.0	0.0	1199.9	1199.9	13556.1	0.149	2015
21	14756.0	0.0	1199.9	1199.9	13556.1	0.135	1832
22	14756.0	0.0	1199.9	1199.9	13556.1	0.123	1665
23	14756.0	0.0	1199.9	1199.9	13556.1	0.112	1514
24	14756.0	0.0	1199.9	1199.9	13556.1	0.102	1376
25	14756.0	0.0	1199.9	1199.9	13556.1	0.092	1251
26	14756.0	0.0	1199.9	1199.9	13556.1	0.084	1137
27	14756.0	0.0	1199.9	1199.9	13556.1	0.076	1034
28	14756.0	0.0	1199.9	1199.9	13556.1	0.069	940
29	14756.0	0.0	1199.9	1199.9	13556.1	0.063	855
30	14756.0	0.0	1199.9	1199.9	13556.1	0.057	777
	309876.0	79992.0	28264.3	108256.3	0.106		2919

EIRR: 10.6 %
NPV: 2,919 million
B/C: 1.06

Table 7.1 Matrix of Impact Prediction

Environmental Component	Activity Component	Pre-construction			Construction							Operation and Maintenance				
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Hydrology	-Ground water	-	-	-	-	-	-	-	-	-	X	X	-	-	-	-
	-Surface water	-	-	-	-	-	-	-	-	-	X	X	-	X	-	-
	-Water quality	-	-	-	-	X	-	-	-	-	X	X	X	-	X	-
	-Water quantity	-	-	-	-	-	-	-	-	-	X	X	X	X	-	X
	-Back water	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	-Sedimentation	-	-	-	-	-	-	-	X	-	X	-	-	-	-	-
Cimate	-Air quality	-	-	-	X	X	-	-	-	-	-	-	-	-	X	-
	-Noisiness	-	-	-	X	X	-	-	-	-	-	-	-	-	-	-
	-Temperature	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	-Micro climate	-	-	-	-	-	-	X	X	-	X	-	-	-	-	-
Land	-Erosion/sliding	-	-	-	X	-	-	X	-	-	X	X	-	-	-	-
	-River morphology	-	-	-	-	-	-	-	X	-	X	-	-	-	-	-
	-Land stability	-	-	-	-	X	-	-	-	X	X	X	-	-	-	-
Biology	-Trees	-	-	-	-	X	X	-	X	X	X	-	-	-	-	-
	-Schrubs	-	-	-	-	X	X	-	X	X	X	-	-	-	-	-
	-Farm land	-	-	-	-	-	-	-	X	X	X	X	-	X	-	-
	-Water animal	-	-	-	-	-	-	-	X	-	X	-	-	X	X	-
	-Land animal	-	-	-	-	X	X	-	X	X	X	X	-	-	-	-
Sosio-Economics and Culture	-Opportunity of employmeny	-	-	-	X	X	X	X	X	X	X	X	X	X	-	-
	-Education	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	-Population of mobility	-	X	-	-	-	-	-	-	-	X	-	-	-	-	-
	-Health	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-
	-Income	-	X	-	X	X	X	X		X	X	X	X	X	-	-
	-Social unrest/ tension	X	X	X	-	-	-	-	X	X	X	-	-	X	-	X
	-Social jealousy	-	X	-	-	-	-	-	X	X	X	-	-	X	-	X
	-Compensation	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-
Facility and Pre-facility	-Ground transportation	-	-	-	X	X	-	-	X	X	-	-	-	-	-	-
	-Water transportation	-	-	-	-	-	-	-	X	-	X	-	-	-	-	-

Pre-construction
1. Feasibility study survey and detailed design
2. Earmaking area
3. Land acquisition

Construction
4. Mobilization of heavy duty machine and man power
5. Supporting facilities construction
6. Land clearing at coupure
7. Transportation of materials
8. Weir construction
9. Irrigation system construction

Operation and Management
10. Weir operation
11. Irrigation system operation
12. Maintenance
13. Rice field development
14. The use of agriculture input production
15. Distribution of irrigated water

X : Impact, - : No impact

Table 7.2 Matrix of Impact Evaluation on the Pre-construction Stage

Socio-economic and Cultural							
1	2	3	4	5	6	7	
A	A	B	A	B	A	A	-The number of person to be impacted
B	A	B	A	B	A	A	-The spreading area of impact
A	B	B	B	A	A	A	-The duration of impact
A	A	B	B	A	A	B	-The intensity of impact
B	B	B	B	A	A	A	-The number of other component to be impacted
-	-	-	-	-	-	-	-The characteristic of impact culmulation
B	B	B	B	A	B	B	-Reversibility or irreversibility of impact

Socio-economic and Cultural Component

1. Land use
2. Land property and value
3. Society cool
4. Livelihood
5. Settlement
6. People's mobility
7. People's attitude to the project

A: Less important
B: Fairly important
C: Important
D: More important
E: Very important
-: No impact/ unknown

Table 7.3 Matrix of Impact Evaluation on the Construction Stage

Physico-chemical							Biological				Socio-economics and cultural				
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
C	-	-	-	-	B	B	-	C	B	A	B	A	A	B	-The number of person to be impacted
-	B	A	A	A	B	B	C	C	B	B	C	C	B	C	-The spreading area of impact
A	B	B	B	B	C	C	C	B	B	-	C	B	C	C	-The duration of impact
B	A	B	B	B	A	B	C	B	A	-	B	B	-	C	-The intensity of impact
B	A	-	B	B	-	B	B	B	-	-	B	A	-	B	-The number of other component to be impacted
A	-	-	-	-	B	B	B	B	-	-	B	B	-	B	-The characteristic of impact culmulation
B	-	A	C	A	A	A	A	B	B	-	D	A	A	B	-Reversibility or irreversibility of impact

Physico-chemical component
1. Water quality
2. Water flow pattern
3. Erosion
4. Sedimentation
5. Land stability
6. Micro climate
7. Air quarity

Biological component
8. Vegetation
9. Wild animal (fauna
10. Cultivated crop
11. Water biota

Socio-economic and cultural component
12. Land form
13. Labour competition
14. New setlement
15. People's health

A: Less important
B: Fairly important
C: Important
D: More important
E: Very important
-: No impact/ unknown

Table 7.4 Matrix of Impact Evaluation on the Operation and Maintenance Stage

Physio-chemical				Biology			Socio-economic and cultural						
1	2	3	4	5	6	7	8	9	10	11	12	13	14
-	-	-	B	A	-	-	A	A	A	-	A	B	-
B	-	B	B	B	B	-	B	A	A	-	A	C	-
A	-	C	B	B	D	-	D	A	A	-	-	C	-
A	-	C	B	C	A	-	A	A	A	-	A	C	-
B	B	B	B	B	A	-	-	A	A	-	A	B	-
A	-	B	B	A	A	A	-	A	A	-	-	B	-
A	-	-	C	C	A	A	C	A	A	A	A	B	-

- -The number of person to be impacted
- -The spreading area of impact
- -The duration of impact
- -The intensity of impact
- -The number of other component to be impacted
- -The characteristic of impact culmulation
- -Reversibility or irreversibility of impact

Physico-chemical component
1. Water quality
2. Soil fertility
3. Sedimentation
4. Humidity

Biological component
5. Vegetation
6. Water weed
7. Water biota

Socio-economic and cultural component
8. Upstream land use
9. Livelihood
10. Live pattern
11. Transportation cost
12. Settlement
13. People's health
14. People's attitude to the project

A: Less important
B: Fairly important
C: Important
D: More important
E: Very important

Table 7.5 Environmental Identification Matrix

STAGE	ACTIVITIES POTENTIALLY TO OCCUR THE IMPACT	ENVIRONMENTAL COMPONENTS PREDICTED TO BE IMPACTED	EVALUATION OF IMPACTS	SOLUTION OF IMPACTS
Pre-Construction	1. Field Survey of Feasibility Study	Socio-economic and cultural condition	-Emergence of social unrest/tension -Speculation in the management of land	-Extension and information servise regarding project to people and related offices -Extension services
	2. Land Acquisition	Socio-economic condition	-Emergence of social unrest -Double ownership ot the same plot of land -Appearance of profiteering middleman selling land -Disappointment concerning the process and amount of compensation money	-Give information regarding land acquisition privately -Cooperation with other authority administration of land ownership -Compensation to be given directly to the people/owner -The process and amount of compensation money to be negosiated
Construction	1. Mobilization of Heavy Duty Machine	Settlement	-Increase of air pollution (dust) and noisiness	-Arrangement of implementation -Regulation of the use of vehicles -Regulation of speed of vehicles -Periodic water spraying
		Public road facilities	-Damage of public roads	-Maintaining of road facilities -Regulation of the use of vehicles
	2. Mobilization of Employers	Socio-economic condition	-Emergence of social jealousy -Exchanges of culture	-Recruitment of local workers
	3. Preparatory and Construction of Supporting Facilities	Socio-economic condition	-Emergence of social jealousy	-Recruitment of local workers
		Biological resources	-Decrease of plants at surroundings	-Limitation of cutting trees

STAGE	ACTIVITIES POTENTIALLY TO OCCUR THE IMPACT	ENVIRONMENTAL COMPONENTS PREDICTED TO BE IMPACTED	EVALUATION OF IMPACTS	SOLUTION OF IMPACTS
Construction			-Decrease of wild animal habitat -Migration of wild animal	-Anticipation of new habitat for wild animal -Further study of ANDAL
		Water resources	-Watter polluted by increasing dirt/debris in the river	-Not throwing rubbish and dirt in the river -Private lavatory, bathing and washing facilities
	4. Land Clearing of Coupure	Biological resources	-Decrease of wild animal habitat caused by disappearance of cover plant	-Reforestation of the idle land
			-Migration wild animal to new habitat	-Anticipation of new habitat for wild animal
	5. Transportation of Materials and Stocking Soil	Environmental condition	-Increase of dust concentration in the dwelling area passed by	-Periodic water spraying
			-Increase of noisiness	-Regulation of speed of vehicles
		Land resources	-Change of river morphology and increase of potentiality of erosion/sliding of river banks in the borrow area	-Reforestation for soil conservation at the river banks -Further study of ANDAL
			-Change in landscape due to inundation on borrow pits	-Backing fill the holes and cultivate the idle land
		Biological resources	-Increase of turbidity of river water	-Further study of ANDAL
			-Decrease of wild animal habitat due to clearing trees in borrow area	-Reforestation of the idle land
			-Migration of wild animal	-Anticipation of new habitat for wild animal

STAGE	ACTIVITIES POTENTIALLY TO OCCUR THE IMPACT	ENVIRONMENTAL COMPONENTS PREDICTED TO BE IMPACTED	EVALUATION OF IMPACTS	SOLUTION OF IMPACTS
Construction		Water resources	-Increase of turbidity of river water	-Further study of ANDAL
		Air quality	-Decrease of air quality due to increase noisiness and dust concentration	-Regulation speed of vehicles -Periodic water spraying
		Road network	-Road/bridge damage by project vehicles	-Regulation of the use of vehicles -Road maintaining
	6. Weir Construction	Socio-economic and cultural condition of people	-Emergence of social jealousy -Change of social perception on the project -Interaction of culture and social custom	-Recruitment of local workers -Private information -Use of outside village employment recieved by people
		Water resources	-Dcrease of river water quality caused by increasing pollution	-Provide lavatory, bathing and washing facilities -Not throwing rubbish and dirt in the river
		Air quality	-Increase of noisiness -Increase of CO, dust and co2 concentration	-Further study of ANDAL -Further study of ANDAL
	7. Irrigation System Construction	Socio-economic condition	-Emergence of social jealousy	-Recruitment of local workers
		Land resources	-Change of land use -Increase of erosion potentiality	-Reforestation of the idle land -Reforestation of the idle land

STAGE	ACTIVITIES POTENTIALLY TO OCCUR THE IMPACT	ENVIRONMENTAL COMPONENTS PREDICTED TO BE IMPACTED	EVALUATION OF IMPACTS	SOLUTION OF IMPACTS
		Biological resources	-Disappearance of wild animal habitat due to clearing trees	-Reforestation of the idle land
			-Migration of wild animal	-Anticipation of new habitat for wild animal
		Public roads	-Damage of public transportation facility/road caused by heavy vehicles and heavy duty machines	-Regulation of the use of vehicles
	8. Cutting Trees and Rice Field Development	Biological resources	-Disappearance of vegetation due to develop rice field	-Limitation of cutting trees
			-Wild animal migration (elephant etc.) due to decreasing of habitat	-Anticipation of wild animal habitat (especially for elephant) -Further study of ANDAL
Operation and Maintenance	1. Operation of weir	Biological resources	-The death of trees and crop not resisted to inundation	-Planting swamp trees
			-Migration of wild animal from inundated area	-Anticipation of wild animal habitat especially dangerous kind for people
		Water resources	-Conflict among water users, especially during dry season between agriculture and domestic use	-Regulation of cropping pattern and area in dry season
			-Worsening of water quality caused by rottening plants leftover	-Maintainig and cleaning of upstream parts
			-Distrurbance of environmental condition	-Environmental health care

STAGE	ACTIVITIES POTENTIALLY TO OCCUR THE IMPACT	ENVIRONMENTAL COMPONENTS PREDICTED TO BE IMPACTED	EVALUATION OF IMPACTS	SOLUTION OF IMPACTS
Operation and Maintenance	2. Operation of Irrigation System	Socio-economic and cultural condition	-Change of farming activity pattern from upland field to irrigated rice field	-Giving guidance and extension services
			-Conflict among water users in developing area of irrigation	-Regulation of cropping pattern and area
		Biological resources	-Plant disease epidemy due to monocultural way of farming	-Integrated pest controll i.d : Biological, physical and chemical
		Environmental quality	-Decrease of environmental quality due to the overuse of fertilizers, pesticide	-Application of intensification such as using fertilizer, pesticide, etc.
			-Cutting trees in the forest due to the lack of the wood for fuel	-Reforestation for fuel
	3. Operation and Maintenance of Weir and Irrigation System	Socio-economic condition	-Use of river water disturbed during maintenance of the irrigation system	-Giving information to the people
		Water quality	-Decrease of water quality in the upstream	-Rubbish cleaning in the upstream
		Public health	-Appearance of disease epidemic such as diarrhea, malaria etc. due to decreasing of water quality	-Giving information to the people in using the raw water

FIGURES

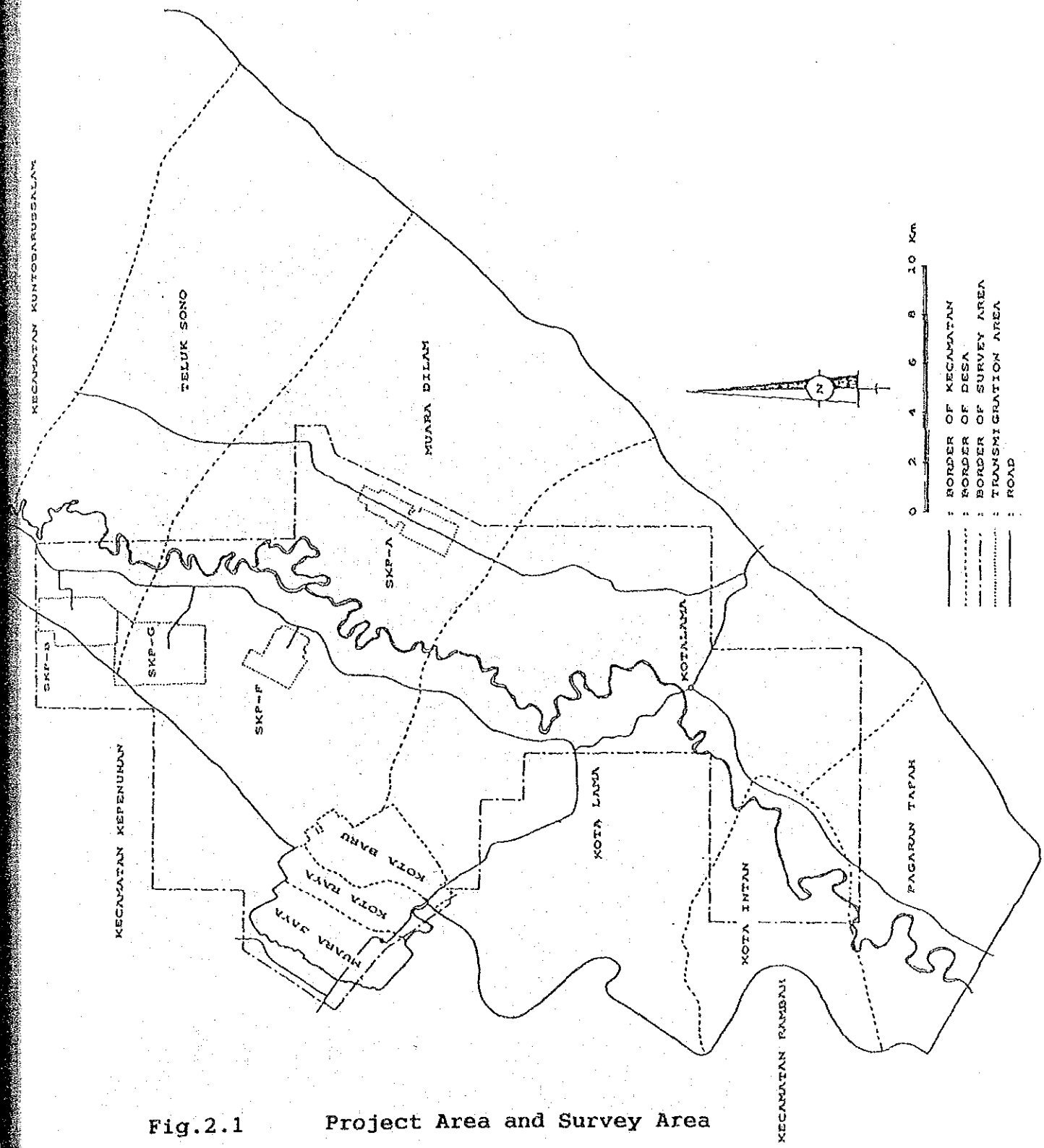


Fig.2.1 Project Area and Survey Area

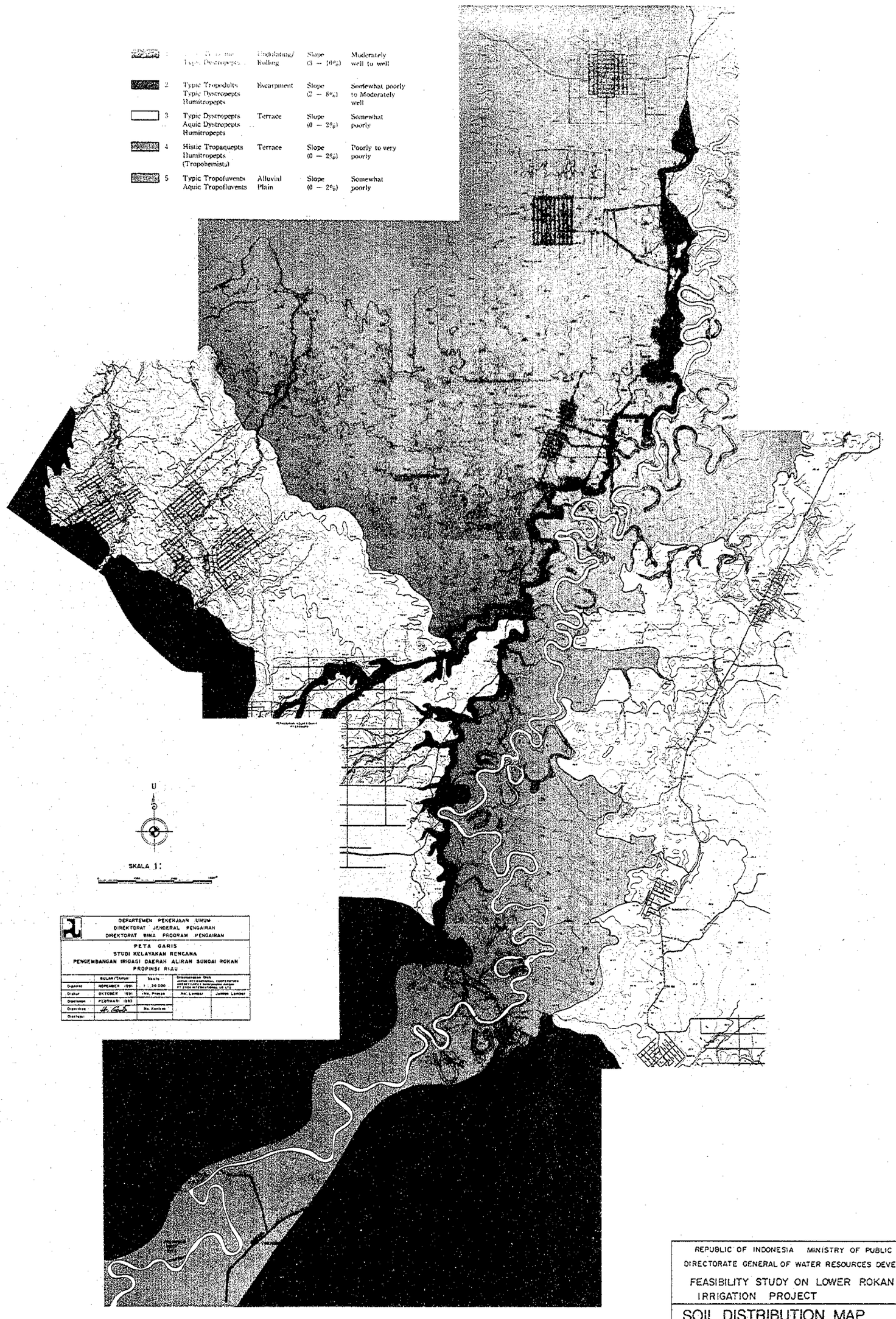


Fig. 2.2 Soil Distribution Map