

The economic operation and maintenance cost for the irrigation/drainage component was estimated at Rp 76 million per annum throughout the project life in and after 1985/86, and the operation and maintenance cost during the construction period was estimated at Rp 18 million for 1981/82, Rp 37 million for 1982/83, Rp 52 million for 1983/84 and Rp 65 million for 1984/85 on the same assumption as that for the flood control component.

The economic operation and maintenance cost of the project thus amounts to Rp 98 million per annum in and after 1985/86 as a sum of the above two components.

The economic cost for replacement of the gates of intakes is given in Table 8-3 for the period from 2010/11 through 2014/15.

8.3. Economic Benefit.

8.3.1. Definition of Benefit.

The benefit of the project was estimated classifying the project into three categories of flood control component, irrigation/drainage component and the project.

Benefit that will arise from the flood control is mainly given as effects of decrease in damages caused by flood. In the present study, evaluation in monetary term can be made on the effects on public facilities, buildings, household effects, paddy, plantation and upland crops, business activities and transportation. On the other hand, the benefit of irrigation and drainage improvement is defined as a difference between with and without project conditions concerning primary profits to be produced from crops.

The benefit of the project will accrue immediately after the implementation of construction. The benefit of the flood control component will increase in proportion to the degree of completion of the construction and is expected to attain to its maximum in the 1985/86 fiscal year. On the other hand, the benefit of the irrigation/drainage improvement component is expected to increase linearly year by year after the implementation of construction and to attain to its maximum in the 7th year after the completion of construction.

8.3.2. Flood Damage.

(1) Flood-Damage Survey.

The Ular river had big floods in the past. The peak discharge was 865 m³/s, 610 m³/s, 540 m³/s and 430 m³/s in order of magnitude. The amounts of damages caused by these floods were surveyed first in the Feasibility Study for the Urgent Flood Control Project in 1970/71 and then in the Overall Plan Study in 1976/77. In the former study,

the survey was mainly made of the damages to estate crops, paddy and public facilities based on the informations collected by the DPU and some data on submergence depth obtained in the inundated area. In the latter study, the damages to buildings and household effects were newly surveyed in addition to those to public facilities and agricultural crops based on the informations collected by subdistricts and the data on the properties obtained by the Team.

A partial revision was made of the said amounts of the damages based on a newly drawn topographic map of 1/10,000. To estimate flood damages, the economic data in the present were applied by reason of lack of data available for forecasting. The area of inundation caused by the biggest flood discharge in the past, 865 m³/s in 1954, was estimated at approximately 25,000 ha stretching over about 100 villages in 4 subdistricts.

Table 8-4 shows the breakdown of inundated area estimated with regard to each flood discharge of 865 m³/s, 610 m³/s and 540 m³/s. The area inundated by the 1973-Jan-flood of 430 m³/s could not be estimated owing to lack of data except that the area of inundated paddy fields was estimated at about 1,000 ha and the amount of damage was estimated only to public facilities. In the case of the flood of 430 m³/s, therefore, the damages to other items were estimated on the assumption that a proportional relation holds between damages to paddy or public facilities and damages to items other than the said two.

(2) Flood Damage on the Present Conditions.

The total flood damages to public facilities, buildings and household effects, paddy, palm oil and rubber, facilities in the plantation, upland crops and losses due to suspension of business activities and interruption of transport were estimated at Rp 6,196 million, Rp 4,017 million, Rp 1,853 million and Rp 695 million corresponding to each flood discharge of 865 m³/s, 610 m³/s, 540 m³/s and 430 m³/s on the assumption that the Urgent Project is not implemented but the inundated area has the present economic potential. These are shown in Table 8-5. The flood damages corresponding to each discharge of 800 m³/s, 600 m³/s and 400 m³/s were estimated by interpolation of the above four values, and it was assumed on the basis of the study in Chapter II that there would occur no flood damage in case of a discharge of 200 m³/s and below.

The flood damages in consideration of the effect of the Urgent Project were estimated by reducing the flood damages corresponding to a discharge of 600 m³/s and below to half. The estimated damages are Rp 6,050 million, Rp 1,840 million, Rp 255 million and Rp 0 corresponding to each flood discharge of 800 m³/s, 600 m³/s, 400 m³/s and 200 m³/s. These are shown in Table 8-6.

Table 8-4 Inundated Area

(A) Flood Discharge: 540 m³/s.

Land use	Inundated depth	Unit: Ha					Total
		0.00	0.50	1.00	1.50	over	
		-	-	-	-	-	
		0.49	0.99	1.49	1.99	2.00	
Oil palm		950	500	400	430	140	2,420
Rubber		130	130	10	0	0	270
Paddy		1,420	1,340	870	630	400	4,660
Upland crops		240	70	30	0	0	340
Town		40	40	10	0	0	90
Others		600	450	400	360	110	1,920
Total		3,380	2,530	1,720	1,420	650	9,700

(B) Flood Discharge: 610 m³/s.

Land use	Inundated depth	Unit: Ha					Total
		0.00	0.50	1.00	1.50	over	
		-	-	-	-	-	
		0.49	0.99	1.49	1.99	2.00	
Oil palm		1,950	1,700	1,400	840	440	6,330
Rubber		150	110	50	10	0	320
Paddy		1,550	1,190	770	660	300	4,470
Upland crops		220	110	30	0	0	360
Town		200	130	50	10	0	390
Others		690	530	300	300	210	2,030
Total		4,760	3,770	2,600	1,820	950	13,900

(C) Flood Discharge: 865 m³/s.

Land use	Inundated depth	Unit: Ha					Total
		0.00	0.50	1.00	1.50	over	
		-	-	-	-	-	
		0.49	0.99	1.49	1.99	2.00	
Oil palm		2,100	1,900	1,750	1,310	550	7,610
Rubber		330	350	190	100	0	970
Paddy		2,670	2,770	2,310	1,650	800	10,200
Upland crops		230	220	30	0	0	480
Town		210	130	50	10	0	400
Others		1,550	1,750	1,930	590	490	5,210
Total		7,090	7,120	5,260	3,660	1,820	24,950

(3) Increase in Flood Damage in the Case of "With Irrigation/Drainage Improvement and Without Flood Control".

In the case of "with irrigation/drainage improvement and without flood control", the following increase in damage will be considered.

a. Increase in flood damage to paddy due to alteration in yield.

An unit yield of 3.6 t/ha was applied to the estimation of flood damage to paddy on the present condition. But in this case, another unit yield of 4.5 t/ha must be used as the yield is expected to increase to 4.5 t/ha by the improvement. Accordingly the increase in flood damage is estimated as shown in Table 8-7 taking account of the effect of the Urgent Project by the same manner as mentioned above.

b. Increase in flood damage to agricultural facilities such as intakes and canals to be constructed newly.

In the present study, it is planned to construct two intakes newly and improve one intake. These three intakes were assumed to suffer flood damage from a discharge beyond about 600 m³/s taking account of the effect of the Urgent Project. The estimated increase in damage is Rp 19 million (Table 8-7).

A record shows that the rate of flood damage to canals was about 14% of the total length of canals in the flooded area. Based on this rate, it was assumed that the new canals would suffer flood damage over a length of 12 km, 5 km and 4 km corresponding to each discharge of 865 m³/s, 610 m³/s and 540 m³/s. The estimated increase in flood damage on this assumption is shown in Table 8-7.

c. Decrease in production of paddy due to damages to canals and intakes.

It was assumed in consideration of the effect of the Urgent Project that six intakes including the above-mentioned three would suffer damages from a flood discharge beyond about 600 m³/s.

The area in which the production of paddy is affected by damages to the intakes at a flood discharge of 865 m³/s and the area in which the production of paddy is affected by damages to canals at each discharge of 865 m³/s, 610 m³/s, 540 m³/s and 430 m³/s were respectively estimated based on the planned irrigation system with the said intakes in the former case and the planned canal systems for irrigation/drainage improvement and the past flooded area corresponding to each of the above four flood discharges in the latter case. The decrease in production of paddy was estimated on the assumption that (1) those paddy fields which are irrigated by the said canals will return to rain-fed fields for one year owing to damages to the canals and (2) those paddy fields which are irrigated by the said intakes will also return to rain-fed fields owing to damages to the intakes and need 3 years for restoration at an annual constant rate.

Table 8-5 Flood Damage by Discharge without Urgent Project and Irrigation/Drainage Improvement

I t e m	Flood discharges (m ³ /S)			
	865	610	540	430
(1) Public facilities	278	88	194	67
(2) Houses and household effects	4,469	3,053	1,090	455
(3) P a d d y	577	232	251	54
(4) Palm oil and rubber	442	334	165	53
(5) Facilities in plantation	55	55	21	10
(6) Upland crops	32	22	19	4
(7) Suspension of business activities	268	183	63	27
(8) Interruption of traffic	75	50	50	25
T o t a l	6,196	4,017	1,853	695

Table 8-6 Flood Damages by Discharge in the Present Situation

Unit: Million Rp

Discharge (m ³ /S)	Return period (year)	Flood damage (10 ⁶ Rp)
200	1	0
400	2	255
600	8	1,840
800	33	6,050

Table 8-7 Increase in Flood Damage in Case of "with Irrigation/Drainage Improvement and without Flood Control"

Unit: Million Rp

I t e m	Flood discharge (m ³ /S)			
	865	610	540	430
A. Public facilities				
a. Intakes	19	0	0	0
b. Canals	36	16	13	0
c. Sub-total	55	16	13	0
B. Paddy				
a. Due to increase in yield	144	58	31	7
b. Due to damages agricultural facilities	9,417	899	628	119
c. Sub-total	9,561	957	659	126
C. T o t a l	9,616	973	672	126

The estimated amount of production decrease is Rp 9,417 million, Rp 899 million, Rp 628 million and Rp 119 million corresponding to the said past flood discharges. These are shown in Table 8-7.

The total of increases in flood damage to paddy in case of "with irrigation/drainage improvement and without flood control" thus works out at Rp 9,561 million, Rp 957 million, Rp 659 million and Rp 126 million respectively corresponding to the said past floods. These are also shown in Table 8-7.

The estimated increase in flood damages to paddy and those which accrue from new construction or improvement of intakes and canals is shown in Table 8-8 with regard to a range of discharge varying from 1,200 m³/s to 200 m³/s which is regarded as an innocuous discharge.

(4) Average Annual Flood Damage on the Present Conditions.

The average annual flood damage on the present conditions is given by integrating the flood damages obtained by discharge. The amount of damage worked out at Rp 830 million. This is shown in Table 8-10. This value is used later as average annual economic benefit by flood control.

(5) Average Annual Flood Damage in the Case of "With Irrigation/ Drainage Improvement and Without Flood Control".

Similar integration was performed with regard to flood damage to paddy based on the flood damage given in Table 8-8 dividing it into two parts of "below 800 m³/s" and "above 800 m³/s". It worked out at Rp 856 million consisting of production decrease by Rp 832 million due to flood damage to intakes and canals and damage increase by Rp 24 million due to alteration in yield. These are summarized in Table 8-9.

Increase in the average annual damage to intakes and canals to be newly constructed or improved was calculated in a similar way with regard to two cases of discharge of 800 m³/s and below and above 800 m³/s. It worked out at Rp 6 million and Rp 1 million respectively. These are also shown in Table 8-9.

The increase in average annual flood damage to paddy and to intakes and canals in the case of "with irrigation/drainage improvement and without flood control" was thus estimated at Rp 863 million consisting of Rp 616 million for discharge of 800 m³/s and below and Rp 247 million for discharge of above 800 m³/s.

Therefore, the average annual flood damage in the case of "with irrigation/drainage improvement and without flood control" was thus estimated at Rp 1,446 million by adding Rp 830 million given in Table 8-10 to Rp 616 million given in Table 8-9.

Table 8-8 Increase in Flood Damages to Paddy and to Intakes and Canals to be Constructed newly in Case of "with Irrigation/Drainage Improvement and without Flood Control"

Unit: Million Rp

Flood discharge (m ³ /s)	Flood damages to paddy		Flood damages to intakes and canals
	Due to alternation in yield (3.6 ton/ha to 4.5 ton/ha) (1)	Due to damages of intakes and Canals (2)	
200	0	0	0
400	3	103	0
600	54	860	16
800	128	7,246	43
1,000	165	9,417	47
1,200	183	9,417	48

Table 8-9 Increase in Average Annual Flood Damage to Paddy and Intakes and Canals to be Constructed newly in Case of "with Irrigation/Drainage Improvement and without Flood Control"

Unit: Million Rp

Flood discharge (m ³ /s)	Average annual flood damage				Total
	To paddy		Sub & canals total	To intakes & canals	
	(1)	(2)			
200 to 800	20	590	610	6	616
over 800	4	242	246	1	247
Total	24	832	856	7	863

- (1): Flood damage to paddy to difference between 4.5 ton/ha and 3.6 ton/ha.
 (2): Decrease in production of paddy due to flood damages to intakes and canals.

Table 8-10 Average Annual Flood Damage without Flood Control

Unit: Million Rp

Description	Average annual benefit
(1) without irrigation & drainage project conditions	830
(2) with irrigation & drainage project conditions	1,446

8.3.3. Benefit of Flood Control Component.

The amount of Rp 830 million which is the average annual damage due to flood discharge of 800 m³/s and below will be given as the average annual benefit of the flood control when it is implemented with the design discharge of 800 m³/s. This benefit will accrue every year throughout the project life of 50 years after the completion of construction. The partial benefit that will accrue during the construction period can be estimated assuming that it is given in a ratio of the invested construction cost to the total construction cost (Table 8-15).

8.3.4. Benefit of Irrigation and Drainage Component.

Most of the paddy field in the project area is at present under insufficient seasonal irrigation in some part and rain-fed in another part. Consequently the percentage of paddy cropping in dry season is restricted to less than 25%. Furthermore, unit yield of paddy crop remains in low level due to improper water control as well as in sufficient farm management. The project will provide perennial irrigation water throughout the year and proper drainage of excess water to the entire project area and will thereby promise to provide the base for a major increase in rice yield and production.

The benefit of irrigation/drainage improvement will come out immediately after the implementation of the construction of irrigation and drainage facilities and is expected to increase linearly year by year and attains to its maximum of Rp 3,139 million in and after the 7th year after the completion of irrigation and drainage facilities. This is shown in Tables 8-11 and 8-12.

Taking account of the flood damage mentioned previously, the net annual benefit of the irrigation and drainage improvement is estimated at Rp 2,276 million by subtracting the flood damage of Rp 863 million from Rp 3,139 million. Further, the benefits expected for each year during the building period were given as shown in Tables 8-13 and 8-15, assuming that the benefit after deduction of the flood damage is given by multiplying 0.725 ($= 2,276 \times 10^6 / 3,139 \times 10^6$) by benefit before deduction of the flood damage.

8.3.5. Benefit of the Project.

As mentioned previously, the net annual benefit of the irrigation and drainage improvement was given by subtracting the average annual flood damage amounting to Rp 863 million from the production benefit due to the irrigation and drainage improvement. Of the above flood damage, the damage due to flood discharge of 800 m³/s and below was estimated at about Rp 616 million as shown in Table 8-9. Such a damage is to be eliminated in case the flood control work is executed. The eliminated damage will be given as an increase in benefit by the implementation of flood control works.

Table 8-11 Annual Economic Irrigation Benefit in the Full Stage

	(1)	(2)	(3)	(4)	(5)=3x4	(6)	(7)	(8)=6x7	(9)=5 - 8
	Area (ha)	Unit yield (t/ha)	Total production (ton)	Unit price (Rp/t)	Gross income (10 ⁶ Rp)	Input area (ha)	Unit production cost (Rp)	Gross out go (10 ⁶ Rp)	Primary profit (10 ⁶ Rp)
Without I/D Impr. control									
Paddy					5,343			2,084	3,259
Rainfed	14,000(w)	3.3	46,200	65,000	3,003	14,000	82,000	1,148	1,855
Irrigated area	4,500(w)	4.0	18,000	65,000	1,170	4,500	104,000	468	702
	4,500(D)	4.0	18,000	65,000	1,170	4,500	104,000	468	702
Other Crops (1)					127			33	94
Cassava	654	11.9	7,800	12,250	95	654	35,000	23	72
Peanuts	170	1.09	190	127,230	24	170	47,000	8	16
Soybeans	80	0.95	80	97,910		80	30,000	2	6
T o t a l					5,470			2,117	3,353
With I/D Impr. control					10,822			4,330	6,492
Paddy					5,411			2,165	3,246
Irrigated area	18,500(w)	4.5	83,250	65,000	5,411	18,500	117,000	2,165	3,246
	18,500(D)	4.5	83,250	65,000	5,411	18,500	117,000	2,165	3,246
Other crops					0			0	0
Cassava	-	-	-	-	-	-	-	-	-
Peanuts	-	-	-	-	-	-	-	-	-
Soybeans	-	-	-	-	-	-	-	-	-
T o t a l					10,822			4,330	6,492
Benefit									3,139 (2)

Notes: (1) 2nd crops to be cultivated in the rain-fed area after harvesting of 1st paddy (west season paddy).
 (2) 6,492 x 10⁶ - 3,353 x 10⁶
 I/D means irrigation and drainage.

Table 8-12 Economic Irrigation and Drainage Benefit in
Building-up Period in the Project Area

Unit : Million Rp

1st ⁽¹⁾	2nd ⁽²⁾	3rd ⁽³⁾	4th	5th	6th	7th	8th
0	119	327	608	989	1,438	1,887	2,335
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9th	10th	11th	12th				
2,605	2,908	3,070	3,139				

- (1) At the end of 1st year, implementation of 7,300 ha for Sumber Rejo, Ramonia, Bendang and Pulau Gambar areas will be finished.
- (2) At the end of 2nd year, implementation of 7,000 ha for Perbaungan and Buluh (1/3) area will be finished.
- (3) At the end of 3rd year, implementation of 4,200 ha for Buluh (2/3), Singosari and Timbang Deli areas will be finished.

Accordingly, the average annual benefit of the present project, which has been planned to implement both the flood control and the irrigation/drainage improvement at the same time, amounts to Rp 3,722 million in total, adding the increase in benefit of Rp 616 million to the sum of the flood control benefit of Rp 830 million and the irrigation/drainage benefit of Rp 2,276 million.

The increase in benefits expected in each year during the building-up period was given through two steps; firstly the estimation of benefit expected for the irrigation/drainage improvement during its building-up period and then the estimation of benefit expected for the flood control during its construction period (Tables 8-14 and 8-15).

8.3.6. Intangible Benefit.

The benefits described above are tangible ones which are comparatively easy to count in monetary term. Besides these, there would be the following intangible benefits.

In the flood control sector, the implementation of the project will produce such good results as decrease in diseases due to improvement of the environment and stabilization of the people's livelihood due to protection from menace of flood. In the sector of irrigation/drainage improvement, the intensive and extensive farming planned in the project will foster trade in agricultural inputs and the production increase in rice will encourage commercial millings and improvement of the distribution system of rice.

As a result, the impact of the project will lead to expansion of commercial activities, increase in opportunity of employment, improvement of living conditions of inhabitants and increase in incomes of the people in the project area and its neighborhood.

8.4. Comparison of Cost and Benefit.

The cost-benefit analysis was made for each of the flood control component, the irrigation/drainage component and the project. The calculated internal rate of return (IRR), benefit-cost ratio (B/C) and net present value (B - C) are given in Table 8-16.

As is evident from the table, the benefit exceeds the cost in the two components as well as in the project in case the discount rate is assumed at 12% and the value of IRR indicates a good rate as high as 20% in the project, 18% in the flood control component and 17% in the irrigation and drainage component. It can be said from these results that the project is economically feasible. The fact that the value of IRR of the project is larger than any of those of the components is by reason that the increase in flood damage in case of "with irrigation/drainage improvement without flood control" has been added as benefit.

Table 8-13 Annual Economic Benefit of Irrigation and Drainage Improvement without Flood Control

Description	Fiscal year													Unit : Million Rp
	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87	1987/88	1988/89	1989/90	1990/91	1991/92	.....	2034/35
1. Irrigation/drainage benefit excluded flood damage (%)	119 (3.79)	327 (10.42)	608 (19.37)	989 (31.51)	1,438 (45.81)	1,887 (60.11)	2,335 (74.39)	2,665 (84.90)	2,908 (92.64)	3,070 (97.80)	3,139 (100)	.....	3,139 (100)
2. Flood damage	33	90	167	272	395	519	642	733	799	844	863	.....	863
3. Irrigation drainage benefit in case of "without flood control"	86	237	441	717	1,043	1,368	1,693	1,932	2,109	2,226	2,276	.....	2,276

Table 8-14 Increase in Average Annual Economic Benefit of Flood Control in Building-up Period of Irrigation and Drainage Improvement

Description	Fiscal year													Unit : Million Rp
	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87	1987/88	1988/89	1989/90	1990/91	1991/92	.....	2034/35
1. Irrigation/drainage benefit (%)	119 (3.79)	327 (10.42)	608 (19.37)	989 (31.51)	1,438 (45.81)	1,887 (60.11)	2,335 (74.39)	2,665 (84.90)	2,908 (92.64)	3,070 (97.80)	3,139 (100)	.....	3,139 (100)
2. Increase in flood damage	23	64	119	194	282	370	458	523	571	602	616	.....	616
3. Completion rate of flood control works (%)	23.56	39.93	57.70	79.28	100	100	100	100	100	100	100	.....	100
4. Increase in benefit of flood control	5	46	69	154	282	370	458	523	571	602	616	.....	616

Table 8-15 Average Annual Economic Benefit of the Project in 7-year Plan

Unit: Million Rp

Year after base year	Flood control		Irrigation/Drainage Improvement		Increase (1) in benefit		Project		Total (10)
	Benefit (1)	Salvage value (2)	Benefit (4)	Salvage value (5)	Total (3)	Total (6)	Benefit (8)=(1)+(4)+(7)	Salvage value (9)=(2)+(5)	
4	196	-	86	-	196	86	287	-	287
5	331	-	237	-	331	237	594	-	594
6	479	-	441	-	479	441	989	-	989
7	658	247	717	242	905	959	1,529	489	2,018
8	830	-	1,043	-	830	1,043	2,155	-	2,155
9	830	-	1,368	-	830	1,368	1,368	-	1,368
10	830	-	1,693	-	830	1,693	2,981	-	2,981
11	830	-	1,932	-	830	1,932	3,285	-	3,285
12	830	-	2,109	-	830	2,109	3,510	-	3,510
13	830	-	2,226	-	830	2,226	3,658	-	3,658
14	830	-	2,276	-	830	2,276	3,722	-	3,722
:	:	:	:	:	:	:	:	:	:
:	:	:	:	:	:	:	:	:	:
:	:	:	:	:	:	:	:	:	:
57	830	-	2,276	-	830	2,276	3,722	-	3,722
Total	43,164	247	111,996	242	43,411	112,238	185,326	489	185,813

(1: Increase in benefit means decrease in flood damage to be deducted from benefit of the irrigation/drainage improvement.

Table 8-16 Cost-benefit Analysis of the Project

Description	IRR (%)	Benefit-cost ratio(B/C)				Net present value (B-C)			
		Discount rate				Discount rate			
		10%	12%	15%	20%	10%	12%	15%	20%
					(10 ³ Rp)	(10 ³ Rp)	(10 ³ Rp)	(10 ³ Rp)	
Project	20	2.23	1.82	1.40	0.98	10,518	6,398	2,756	-90
Flood control	18	1.79	1.50	1.21	0.90	2,282	1,331	484	-183
Irrigation/ drainage	17	1.94	1.57	1.19	0.82	5,336	2,946	874	-676

8.5. Sensitivity Analysis.

Sensitivity has been examined only in regard to IRR because the sensitivity analyses of benefit-cost ratio and net present value are expected to give the same result as that of IRR. For examining the sensitivity, increase and/or reduction in cost and/or benefit were adopted as variables. Table 8-17 shows the increase and/or decrease in IRR corresponding to increase and/or reduction in cost and/or benefit by 10%, 20% and 30%.

It is found from the results given in the table that the value of IRR of the project exceeds 12% even if the cost should go up by 20% or the benefit come down by 20%. Further, even in case of the most pessimistic assumption that the cost should go up by 20% and at the same time the benefit should come down by 20%, IRR of the project attains to a pretty good value as high as 14%. This means that the project is economically sound. The similar features are seen in the two components of the project.

Furthermore, some examinations were made on the sensitivity of two major elements of price of paddy and yield of paddy which may have a big influence upon the value of IRR.

a. Price of Paddy.

In the present study, Rp 65 per kg has been applied as the price of paddy. This is the farm-gate price which has been derived from the international price of paddy at the 1977-price. This price of paddy however varied between about Rp 35 and about Rp 130 per kg since 1970. Such a fluctuation in the price may also expected in the future.

If the price of paddy is assumed at Rp 35 per kg as a pessimistic condition, the benefit of the project will be reduced by about 35% and IRR will work out at 12%. This result indicates that there is no room for doubt of economic viability of the project.

On the contrary, if the price of paddy is assumed at Rp 130 per kg as an optimistic condition, the benefit of the project will be increased by about 75% and IRR will work out at 25%.

International price of paddy has generally taken an upward tendency for the long period of time. It seems therefore that the price of paddy will be an optimistic element rather than a pessimistic one.

b. Yield of Paddy.

In the present study, the yield of paddy per ha in the dry season has been assumed to be the same as the wet season paddy. However, if the yield of paddy per ha in the dry season is assumed at 80% of that in the wet season as assumed in the Overall Plan Study, the benefit of the irrigation/drainage component will be reduced by about 25% which

Table 8-17 Sensitivity of IRR of 7-year Plan on Full-contracting System

(A) Project

Benefit \ Cost		Reduction (%)			0	Increase (%)		
		-30	-20	-10		10	20	30
Reduction (%)	-30	20	18	16	15	14	13	12
	-20	22	20	18	17	15	14	13
	-10	24	22	20	18	17	16	15
0 (over 25)		24	21	20	18	17	16	
Increase (%)	10 (over 25)	25	23	21	20	18	17	
	20 (over 25)	25	23	21	20	18	17	
	30 (over 25)	25	23	21	20	18	17	

(B) Flood control

Benefit \ Cost		Reduction (%)			0	Increase (%)		
		-30	-20	-10		10	20	30
Reduction (%)	-30	18	16	14	13	12	11	10
	-20	21	18	16	15	13	12	11
	-10	23	20	18	16	15	14	13
0 (over 25)		23	20	18	17	15	14	
Increase (%)	10 (over 25)	25	22	20	18	17	15	
	20 (over 25)	24	22	20	18	17	15	
	30 (over 25)	24	22	20	18	17	15	

(C) Irrigation and drainage

Benefit \ Cost		Reduction (%)			0	Increase (%)		
		-30	-20	-10		10	20	30
Reduction (%)	-30	17	16	14	13	12	11	10
	-20	19	17	16	14	13	12	12
	-10	21	19	17	16	15	14	13
0		22	20	19	17	16	15	14
Increase (%)	10	24	22	20	19	17	16	15
	20 (over 25)	23	21	20	18	17	16	
	30 (over 25)	25	23	21	20	18	17	

will reduce the value of IRR of the project to 15 or 16%. However, all the values of IRR exceed 12% even if the above-mentioned pessimistic assumption should be applied. The economic feasibility of the project is therefore justifiable from the viewpoint of fluctuation of yield of paddy.

8.6. Farm Budget.

In order to make an economic evaluation from the farmer's point of view, the farm budget was analyzed with respect to two types of owner farmers in the project area. Type I mentioned in Table 8-18 is a representative farmer in non-technical irrigated paddy field area and Type II is that of technical irrigated paddy field area.

As shown in Table 8-18, the gross farm income, the gross farm expenses, the net farm income and the reserve or capacity to pay of each type of farmers were worked out on each condition of "without the project" and "with the project".

It is seen from the results given in the table that the reserve of the farmer on the condition of "with the project" would mount up to about 17 times in case of Type I and more than 6 times in case of Type II of that on the condition of "without the project". Therefore, it can be said that the project is quite beneficial for the farmers in the project area.

Table 8-18 Future Annual Budget on Typical Owner Farmer

Description	Type I (1.45 ha)		Type II (1.00 ha)	
	Without project	With project	Without project	With project
<u>Farm size description (ha)</u>				
Irrigated paddy field	-	1.34	0.45	0.95
Rainfed paddy field	1.34	-	0.5	-
Upland	0.11	0.11	0.05	0.05
Family size (person)	5.55		5.25	
<u>Gross farm income (Rp)</u>	354,290	858,040	387,830	604,790
Intensive paddy (Wet season)	-	422,100	126,000	299,250
Intensive paddy (Dry season)	-	422,100	126,000	299,250
Non-intensive paddy	331,650	-	123,750	-
Upland crops	22,640	13,840	12,080	6,290
<u>Farming expense (Rp)</u>	45,330	132,260	54,890	93,470
Hired labours & cows	9,230	24,030	10,800	16,950
Seeds	6,560	10,790	6,020	7,470
Fertilizers	18,760	65,660	24,330	46,550
Agrichemicals	3,030	12,730	4,320	9,030
Miscellaneous	7,750	19,050	9,420	13,470
<u>Other expense (Rp)</u>	5,370	16,280	6,900	11,210
Tax	5,080	9,570	4,900	6,450
Interest of credit	-	5,900	1,710	4,180
Other fees	290	810	290	580
<u>Net farm income (Rp)</u>	303,590	709,500	326,040	500,110
<u>Non farm income (Rp)</u>	31,000	-	-	-
<u>Family living expense (Rp)</u>	310,580	310,580	293,790	293,790
<u>Payment capacity (Rp)</u>	24,010	398,920	32,250	206,320

CHAPTER IX
FINANCIAL ASPECTS

9.1. Required Fund.

The fund required for the implementation of the project was estimated on the following assumptions.

- a. The escalation in price was assumed at 18% per year for the local currency portion and 10% per year for the foreign currency portion taking account of the rate of rise in prices for the last 5 years.
- b. The annual interest during the construction period was assumed at 3% of capital to be invested in foreign currency and assumed to be disbursed in local currency.

The total fund of the project was estimated at Rp 27,270 million, which consists of Rp 19,589 million in the local currency portion and US\$18,508,000 (equivalent to Rp 7,681 million) in the foreign currency portion including price escalation and annual interest during the construction period. These are summarized in Table 9-1.

Among the total fund, the fund required for the flood control component was estimated at Rp 8,754 million consisting of Rp 4,359 million in the local currency portion and US\$10,590,000 (equivalent to Rp 4,395 million) in the foreign currency portion, and the fund required for the irrigation/drainage component was estimated at Rp 18,516 million consisting of Rp 15,250 million in the local currency portion and US\$7,918,000 (equivalent to Rp 3,286 million) in the foreign currency portion. These are summarized in Table 9-2.

9.2. Disbursement Schedule.

The schedule of annual disbursement of the fund mentioned above was planned as shown in Table 9-2.

Table 9-1 Fund Required for 7-Year Plan on Full-Contracting System

Description	Flood control		Irrigation & drainage			Total		
	LC (10 ⁶ Rp)	FC (10 ³ \$)	LC (10 ⁶ Rp)	FC (10 ³ \$)	Total (10 ⁶ Rp)	LC (10 ⁶ Rp)	FC (10 ³ \$)	Total (10 ⁶ Rp)
Construction cost	1,655	6,648	4,414	6,437	5,082	8,092	11,730	12,960
Land acquisition	193	-	193	417	-	610	-	610
Labor	397	233	494	2,492	478	2,889	711	3,184
Equipment	-	2,786	1,156	-	1,554	-	4,340	1,801
Spare parts	-	1,368	568	-	915	-	2,283	948
Materials	656	129	709	2,247	-	2,903	129	2,956
Administration	193	1,265	718	441	1,472	634	2,737	1,770
Contingency	216	867	576	840	663	1,056	1,530	1,691
Price escalation	2,311	3,942	3,947	8,476	2,836	10,787	6,778	13,600
Interest ^{/1}	393	-	393	317	-	710	-	710
T o t a l	4,359	10,590	8,754	15,230	7,918	19,589	18,508	27,270

^{/1}: Interest for foreign currency portion during the construction period.

Table 9-2 Disbursement Schedule for 7-Year Plan on Full Contracting System

Description	1978/79		1979/80		1980/81		1981/82		1982/83		1983/84		1984/85		Total									
	LC (10 ⁶ Rp)	FC (10 ³ Rp)	LC (10 ⁶ Rp)	FC (10 ³ Rp)	LC (10 ⁶ Rp)	FC (10 ³ Rp)	LC (10 ⁶ Rp)	FC (10 ³ Rp)	LC (10 ⁶ Rp)	FC (10 ³ Rp)	LC (10 ⁶ Rp)	FC (10 ³ Rp)	LC (10 ⁶ Rp)	FC (10 ³ Rp)	LC (10 ⁶ Rp)	FC (10 ³ Rp)	LC (10 ⁶ Rp)	FC (10 ³ Rp)						
Flood control	26	302	151	191	441	374	358	1,357	921	465	1,788	1,207	716	1,955	1,528	1,216	2,301	2,171	1,387	2,446	2,402	4,359	10,590	8,754
Construction cost	19	275	133	131	363	282	202	1,020	625	215	1,222	722	281	1,213	785	413	1,300	952	364	1,255	915	1,655	6,648	4,414
Price escalation	3	27	14	51	78	83	130	337	270	202	566	437	362	742	670	702	1,001	1,118	861	1,191	1,355	2,311	3,942	3,947
Interest ^{/1}	4	-	4	9	-	9	26	48	-	48	73	-	73	101	-	101	132	-	132	393	-	-	-	393
Irrigation & drainage	56	267	167	320	674	600	2,131	1,110	2,592	2,261	1,207	2,782	2,688	1,305	3,229	3,808	1,815	4,561	3,966	1,540	4,605	15,230	7,918	18,516
Construction cost	45	243	166	221	556	452	1,281	834	1,627	1,145	824	1,487	1,150	810	1,486	1,381	1,024	1,806	1,214	791	1,542	6,437	5,082	8,546
Price escalation	8	24	18	87	118	136	824	276	935	1,075	383	1,234	1,481	495	1,686	2,348	791	2,676	2,653	749	2,964	8,476	2,836	9,653
Interest ^{/1}	3	-	3	12	12	12	26	41	-	41	57	-	57	79	-	79	99	-	99	317	-	-	-	317
T o t a l	82	569	318	511	1,115	974	2,489	2,467	3,513	2,726	2,995	3,969	3,404	3,260	4,757	5,024	4,116	6,732	5,353	3,986	7,007	19,589	18,508	27,270

^{/1} : Interest for foreign currency portion during the construction period.

LIST OF APPENDICES INCLUDED IN VOLUME III SUPPORTING REPORT

- APPENDIX A Terms of Reference for Feasibility Study of Ular River Flood Control and Improvement of Irrigation Project, July 1977.
- APPENDIX B Letter of Mr. K. Ichikawa, First Secretary of Embassy of Japan, dated October 6, 1977.
- APPENDIX C Scope of Work for Feasibility Study of Ular River Flood Control and Improvement of Irrigation Project, September 1977.
- APPENDIX D Note of Meeting on Draft Final Study Report for Overall Ular River Improvement Project and Inception Report for Feasibility Study of Ular River Flood Control and Improvement of Irrigation Project, signed on November 14, 1977.
- APPENDIX E Letter of Submission of Inception Report. Inception Report on Feasibility Study of Ular River Flood Control and Improvement of Irrigation Project, November 1977.
- APPENDIX F Record of Meeting in Medan for Feasibility Study of Ular River Flood Control and Improvement of Irrigation Project, signed on December 21, 1977.
- APPENDIX G Record of Meeting in Medan for Feasibility Study of Ular River Flood Control and Improvement of Irrigation Project, signed on January 18, 1978.
- APPENDIX H Note of Meeting on Feasibility Study of The Ular River Flood Control and Improvement of Irrigation Project, signed on February 4, 1978.
- APPENDIX I Letter of Receipt of Equipment, dated January 30, 1978.
- APPENDIX J Letter of Sending Additional Data.
- APPENDIX K Letter of Additional Comments.
- APPENDIX L Letter of Question to Additional Comments.
- APPENDIX M Bibliography and Data.