		Rp.	Rp.
2.	Farming expense		
	Hired labours & cows	7,740	9,110
	Seeds	5,900	5,610
	Fertilizers	4,690	14,350
	Agri. chemicals	540	1,100
	Miscellaneous	6,380	8,110
	Total	25,250	38,280
3.	Other expense		
	IPEDA Tax	5,080	4,900
	Interest of Credit	-	1,710
	Other fee	290	290
	Total	5,370	6,900
4.	Net farm income	283,470	302,450
5.	Non-farm income	29,000	-
6.	Family living expense	290,270	274,580
7.	Payment capacity	22,200	27,870

2.5.2. Irrigation and Drainage Systems.

(1) Irrigation System.

The project area has paddy fields of 18,500 ha. The paddy field consists of the technical irrigation area of 3,000 ha, the semi-technical irrigation area of 1,500 ha, the non-technical irrigation of 2,500 ha and the rain-fed area of 11,500 ha.

The water sources for the irrigation in the area mostly depend on the discharge of the Ular river, although a little amount of water in the streams flowing down through the area has been used as supplemental.

There are fourteen intake facilities along a distance of about 32 km between Serbajadi Bridge and the estuary of the Ular river. All the intake facilities except a pumping station for PNP VI Adolina are being used for the irrigation of the paddy field and have recently been constructed or rehabilitated after 1970 as shown in Table 2-5.

The existing irrigation area of 7,000 ha is divided into nine irrigation blocks by the existing canal network with thirteen intakes. The length of the existing main irrigation canals and secondary canals totals 33.9 km and 168.9 km, respectively. However, the existing canals are almost deterio-

Table 2-5 Existing Intake Facilities

Name	Location	Site	Completion year	Authorities concerned	Type	Size of intake structure (gate width × number)	Bed elevation of intake	Irrigation area		Control at gate operation	Remarks
								Wet season	Dry season		
	km					m	EL(m)	ha	ha		
Pulau Gambar	+22.5	Right	1965	P.U.Province	Free intake	Concrete 1.00×2	43.66	1,200	800	Sektor L. Pakam	
Swadaya	+19.7	Right	1976	P.U.Kabupaten	Free intake	Concrete 1.20×1	39.30			P.U.Kabupaten	Supplementary intake for Pulau Gambar area
S. Bulun	+19.0	Right	1975	P.U.Kabupaten	Free intake	Concrete 1.20×3	38.49	400	-		Project INPRES INPRES (Constructed by the budget from the President)
Timbang Deli	+14.3	Left	1975	P.U.Province	Free intake	Concrete 0.75×2	32.60	400	400	Sektor L. Pakam	
Perbaungan	+ 9.6	Right	1960	P.U.Province	Free intake	Concrete 1.20×4	25.56	1,950	1,800	P.U.Province	Rehabilitated in 1975
Sumber Rejo	+ 3.1	Left	1970	P.U.Kabupaten	Free intake	Concrete 1.00×4	17.63	800	100	Sektor L. Pakam	Rehabilitated in 1975 by the Ular River Project, now under P.U. Province
Bendang	+ 0.2	Right	Before 1935	P.U.Province	Free intake	Concrete φ0.80×2	13.12	1,000	900	Sektor L. Pakam	Rehabilitated in 1974 by the Ular River Project
Adolina	- 0.2	Right	1976	Public	Pump station	Yanmer TS 60mm pipe φ4"×2	no data	-	-	Public	Constructed by PNP VI ADOLINA
Singosari (2 places)	- 2.6 - 3.2	Right	1970	P.U.Kecamatan	Syphon	(I) Steel pipe φ100×12 (II) Steel pipe φ100×8	no data	100	-	Farmer	
Ramonia	- 4.7	Left	1967	P.U.Province	Free intake	Concrete 1.20×3	7.73	1,100	500	Sektor L. Pakam	
Wonosari (3 places)	- 6.0 - 7.0	Right	1974	P.U.Kecamatan	Free intake	(I) Concrete pipe φ500×3 (II) Concrete pipe φ500×1 (III) Concrete pipe φ500×1	no data	50	-	Farmer	
Total								7,000	4,500		

rated by silting and scouring. The water distribution system in the area generally exhibits the complicated canal network due to the dual-purpose of irrigation and drainage.

The density of the existing farm ditches is approximately 20 m/ha in the technical and the semi-technical irrigation areas. There exist no farm ditches in the non-technical irrigation area and the rain-fed area. The density of these farm ditches is not adequate so as the supply irrigation water equitably on farm.

Fig.2-8 shows the existing irrigation system in the project area.

(2) Drainage.

Eight natural rivers and drainage canals totaling about 250 km play important roles in the existing drainage system of the project area at present.

In the area, there are two different drainage conditions. One is the plantation area and the other is non-plantation area. In general, the plantation area has well-developed and well-maintained drainage systems, but the non-plantation area has poor drainage conditions due to shortage of carrying capacities of natural rivers and drainage canals, constrictions formed by bridges and culverts on the national highway and the national railway, and sand dunes formed on the coastal zone.

One of the most important problems on drainage system is the existence of dual-purposed canals used for both irrigation and drainage.

Farm drains have not been developed over the entire area. The density of the drainage system on farm is about 20 m/ha in the technical and the semi-technical irrigation areas, and almost none in the non-technical irrigation area and the rain-fed area. These are not enough to drain off heavy rain and excess irrigation water.

Fig.2-9 shows the existing drainage system in the project area.

2.5.3. Agricultural Support System.

(1) BIMAS Program and WUD.

In Indonesia, basic administrative unit is the village headed by village chief who is elected from among the villagers. The village chief has the responsibility of agricultural development in the rural area as well as health and welfare, public education of the inhibitants.

Supplies of the agricultural inputs, on the other hand, are

primarily made through the establishment of agricultural co-operatives which have been promoted in rural area by the Government since 1945 when the Co-operative Act was enacted. However the movement of co-operatives has not been well organized yet, mainly because of weakness in management.

In order to improve such stagnant condition of the co-operatives, the Government introduced a merged co-operative of several villages so called BUUD/KUD.

Meanwhile, for the provision of a package of agricultural inputs to the farmers, the agricultural intensification program so called BIMAS and INMAS has been promoted by the Government since 1968. For further development of BIMAS Program, the Government has initiated to organize a Village Unit (WUD) with one Field Extension Worker, Village Unit BRI, retailer/shop and BUUD/KUD, as the lowest executive unit of the Program since 1973.

In the project area, there are 25 WUD's, with 12 KUD's and 4 Village Units BRI in 1977. Average paddy field and number of farm household per WUD in the project area are 738 ha and 786 farm households respectively.

Although all villages in the project area are covered by this system, it is too varied among the village units in number of villages and farmers, and area of irrigated paddy field.

(2) Water Management.

In the project area, there are 14 intakes along the Ular river, of which six are constructed and managed by the Provincial Government, five by the District Government and one by PNP and two by farmers groups.

The operation and maintenance of the irrigation facilities up to the secondary canals on the Ular river is under the responsibility of Deli-Serdang District Office of Provincial Public Works, however daily works are only limitted to the said 6 intakes and related secondary canals and not well carried out at present. Mainly because, there is no tertiary canal system completed and no interest of the farmers who could'nt get the irrigation water whenever they need because of shortage of water especially down stream of the canal.

Although the Water User's Association (P3A) in the Project area has been formally organized in each village as sub-branch of the Village Agricultural Corporation Association (BMTD) and District, Sub-District and Tertiary Irrigation Committees have also been set up at each level already, the activities of these organizations are not fully running yet.

Operation and maintenance of the existing intake facilities are carried out partially by each foreman by own way at present. There is no record concerned about daily discharge, distributed

Fig. 2-8 Existing Irrigation System

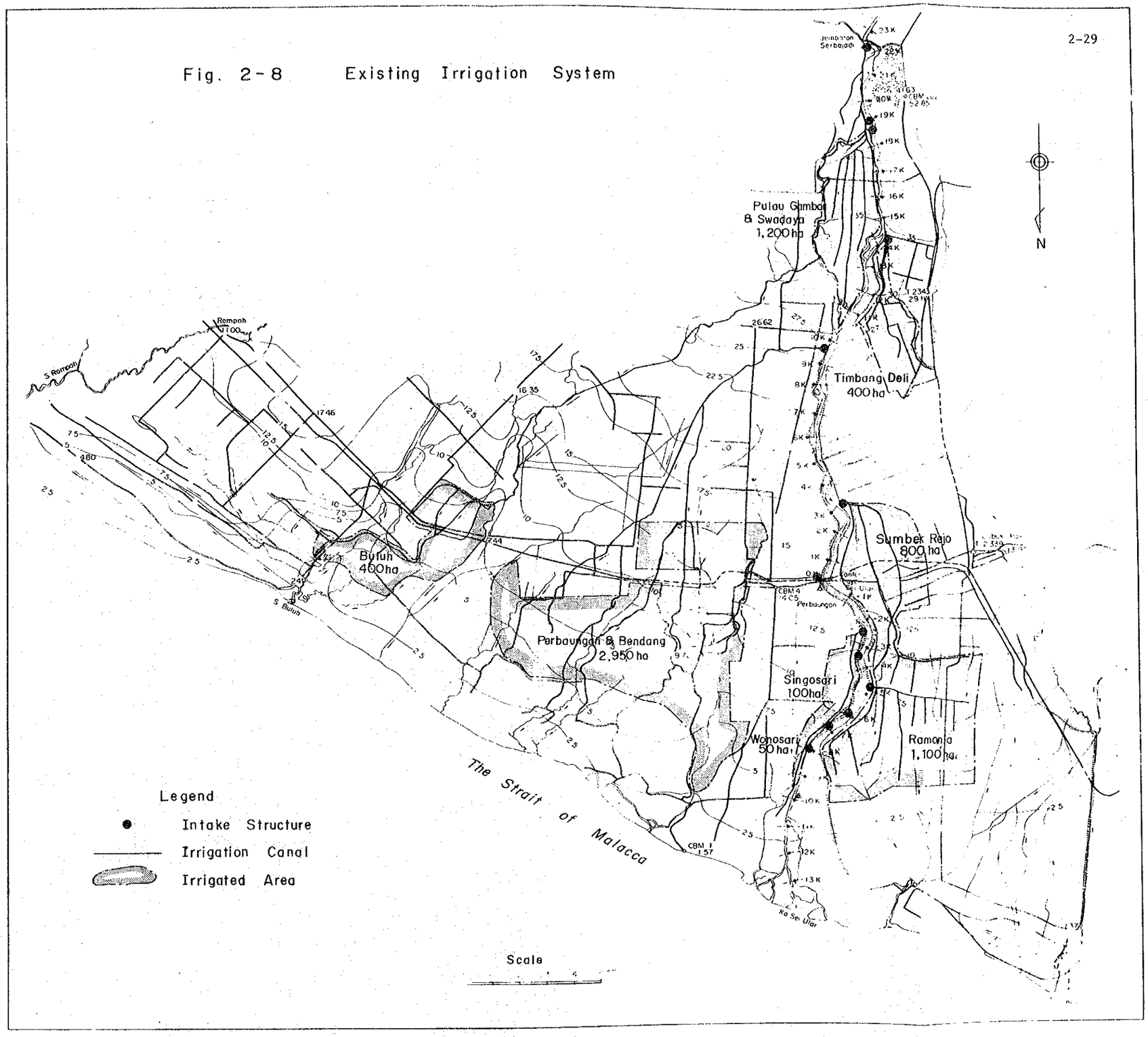
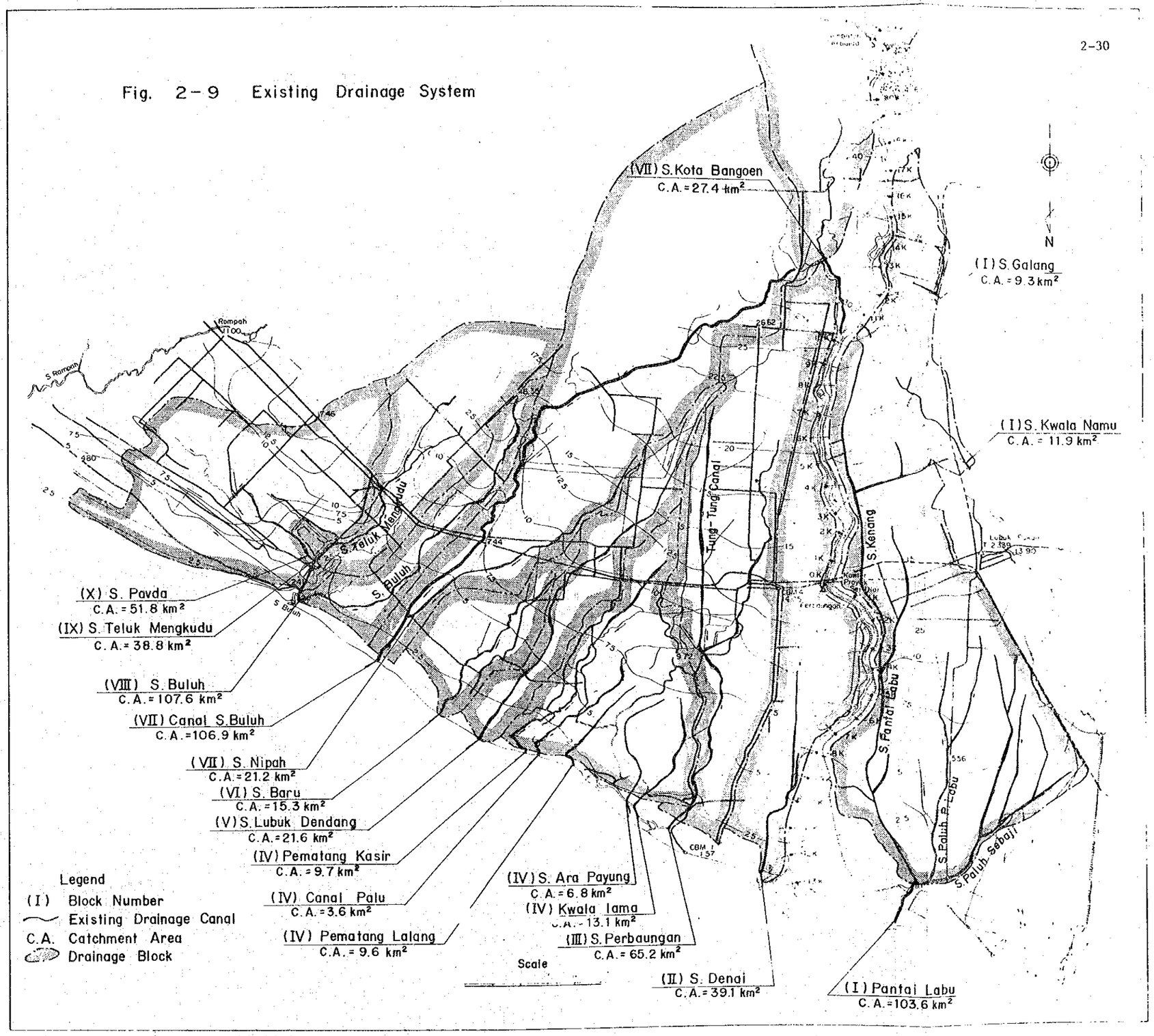


Fig. 2-9 Existing Drainage System



area as well as planting calendar in any intake place. Even the well organized Water User's Association, it is hardly to realize more than 60 % of participation of the farmers for maintenance cooperation activities so called "Gotong Royon".

(3) Research and Extension Services.

Agricultural research work in Indonesia is undertaken by the Central Research Institute of Agriculture (CRIA) at Bogor in Java. One of the five branch research stations is located in West Sumatra, that is only one branch research station of CRIA in whole Sumatra Island. Therefore, it is hardly expected that the Extension Workers in the project area advice timely to the local farmers with the most suitable cultivation method based on the local natural conditions.

In recognition of these situation, the Ministry of Agriculture of Central Government intends to establish a branch research station of CRIA in North Sumatra. It is expected to commence the construction since April in 1978 with five years construction period. The proposed site of the branch research station is located at Lubuk Pakam Sub-District.

Since 1974, Agricultural Extension Service in Indonesia has been strengthened with establishment of the Agency for Agricultural Education, Training and Extension as one of the extraministerial bureaus under the Ministry of Agriculture.

At the same time, the Government intended to establish an Agricultural Development Center in each Province and several Rural Extension Centers in rural areas. The main function of the former is adaptation test of new recommended agricultural techniques and that of the later is a base camp for extension activities in rural area.

The primary policy for this development program of Agricultural Extension Service was to promote and accelerate the extension education activities on field level by separating with general agricultural administrative services.

In Deli-Serdang District, two Subject-Matter Specialists would assist and advice 16 Extension Supervisors (PPM), of which 14 would be stationed at 7 Rural Extension Center in 1978. Two Extension Supervisors staying at Rural Extension Center assist and advice 9 Field Extension Workers (PPL) on an average. Each Field Extension Worker covers one Village Unit, three villages, 740 ha of paddy field and 786 farm households on an average, which are more intensive than the average of Province.

Together with the consolidation of the extension system, the extension program has also been strengthened. Every Field Extension Worker is requested to visit the key farmer in each working area (16 working area makes one Village Unit), four days a week and two working areas a day. According to this program, a key

farmer would contact ten progressive farmers and each progressive farmer would influence twenty farmers, then finally one Field Extension Worker may affect 3,200 farmers totally.

(4) Agricultural Credits.

The Indonesian People's Bank (BRI) is the main source of institutional credit to agriculture at present. At Medan, there is a Regional Office of BRI. In the project area, loan service is carried out through four branch offices of BRI with including 5 village Units outside of the project area.

The bank is authorized to finance BIMAS package credit for qualified individual farmers. The loan condition for BIMAS is fixed on amount of loan by the kind of package with 1 % per month of interest rate and 7 months of loan period.

In the project area, the BIMAS loan has been steadily increased on loan amount and number of renders as mentioned in detail in Volume II Study Report.

(5) Agricultural Input Supply.

Distribution of chemical fertilizers in North Sumatra Province is handled by four enterprises, of which two are private and two are govermental.

Agricultural inputs are sold to seven Distributors at Medan, then redistributed to Sub-Distributors at the District level. Sub-Distributors provide the necessary amount of agricultural inputs to the retailers and/or Village Unit Co-operatives (KUD) at the local level.

In the project area, chemical fertilizer application has already become common and the amount has achieved about 150 kg/ha of Urea and 50 kg/ha of TSP for paddy cultivation on irrigated area at present.

(6) Seed Multiplication and Distribution.

The stock seeds of recommended varieties of paddy are produced at the Provincial Seed Center and distributed to 12 seed stations managed by the District Agricultural Office and many registered seed growers.

The extension certified seeds produced and/or collected from seed growers by the Seed Stations are distributed to the farmers through KUD's according to the BIMAS Program.

One of the 12 Seed Stations in North Sumatra is located at Lubuk Pakam Sub-District in the project area. The Seed Station is growing recommended improved varieties of paddy such as IR32 and IR36. The yield is 6 ton per hectars both in dry and wet seasons at the Station.

The improved seeds required for 37,000 ha of irrigated paddy field at the full development stage of the project is estimated at about 185 tons annually under the seed renewal system of 5 year interval. The necessary hectarage of seed multiplication farms in future including seed grower's farm will be about 15 ha. This would be attained without any difficulties by adequate management of existing seed multiplication and distribution system.

CHAPTER III

FLOOD CONTROL PLAN

3.1. General.

As mentioned previously, the stretch of river channel extending from -12.25 km toward upstream to +22.65 km was taken as the object of planning for improvement. The stretch from -12.25 km to the river mouth was put out of planning because, in our judgement too, this stretch is located in a too swampy area to fix a low-water channel.

The capacity of the existing river channel is not enough for carrying the design discharge 800 m^3/s. Therefore, to meet this discharge, improvement of the river channel was planned in line with the conclusion of the Overall Plan Study.

An area located upstream of the confluence (near the distance-mark 10 km) of Pulau Gambar Canal (S. Kotabangun) and the main stream of the Ular river was selected as a candidate site for retarding basin because the right-side levee of the Ular river at the confluence is not closed yet. Since this area is playing an important role in rice production, an artificial retarding basin system was studied on the principle that a part of a flood discharge of the Ular river shall be led to this basin overtopping a deversoir to be constructed on the right-side levee of the Ular which will protect this basin. The result of the study indicated that this system is not economically profitable compared with the flood control system without artificial retarding basin.

In consequence, it was decided to confine both the flood discharges of the Ular river and S. Kotabangun respectively within their own levees. For planning the treatment of the confluence of S. Kotabangun and the Ular river, a study was made on three alternatives of open-levee system, enclosing-levee system and gate system. Comparison of the three alternative plans indicated that the enclosing-levee system with a sluice is economically profitable.

In conclusion, levee system was adopted as flood control measure for both the Ular river and S. Kotabangun.

General principles taken in planning the improvement are as follows.

a. In planning new alignment of the river channel, high regard shall be paid to the existing ones.

b. The width between new levees shall be set at 250 m as standard.

c. In case the width between the existing levees is enough, the

levees shall be used by heightening or widening at need.

d. Necessary carrying capacity shall be secured by excavation and/or dredging works together with by building new levees or strengthening the existing levees.

e. The total spans of the railway and highway bridges are assumed to be left as they are after the completion of the present rebuilding works.

f. The enclosing-levee system shall be adopted as the treatment of the confluence of the Ular river and S. Kotabangun.

g. In designing cross sections of the Ular river, attention shall be paid to the water level of intake.

For planning the alignment of the river channel, were used the topographical maps on a scale of 1/10,000 which were provided by the JICA. For planning cross sections of the river channel, were used (1) 106 cross sections which were surveyed at intervals of 250 m and drawn by the JICA Surveying Team in 1977 over a stretch of about 35 km upstream from the river mouth except a stretch of about 10 km upstream from the highway bridge and (2) the cross sections which were surveyed at intervals of 1 km and drawn by the JICA Surveying Team in 1976 over a stretch of about 10 km upstream from the highway bridge on the occasion of the Overall Plan Study. For examining the stability and procedure of embankment, were used the results of soil survey that was conducted by the Soil Survey Group of the Study Team in 1977.

3.2. Design Discharge and Water Level.

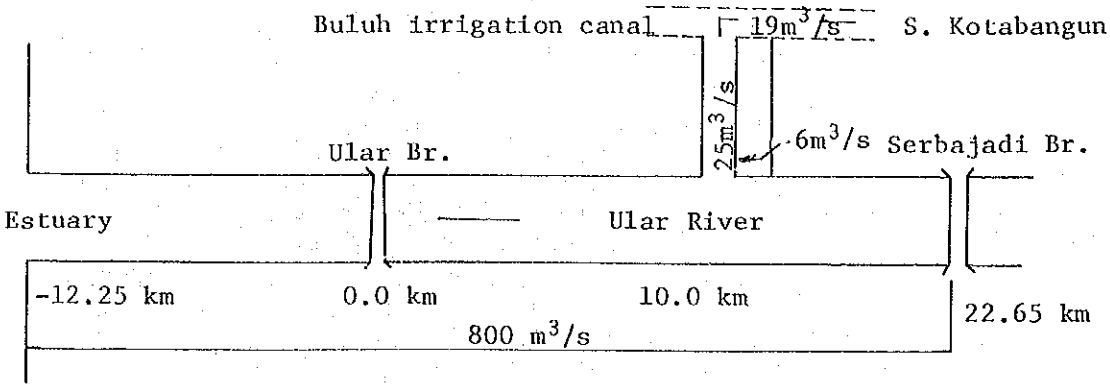
A discharge of 800 m^3/s was adopted as the basic design discharge at a point of Serbajadi Bridge in accordance with the conclusion of the Overall Plan Study conducted by the JICA in 1978. The recalculation made in the present study proved that the return period of the discharge 800 m^3/s is at a level of 30 years likewise the conclusion obtained in the Overall Plan Study.

As it was concluded that the river channel of the Ular should be improved without artificial retardation of flood by use of the lower Pulau Gambar area, it was decided to apply the design discharge of 800 m^3/s to the whole stretch of the Ular from Serbajadi Bridge to the lower end of the channel.

Concerning S. Kotabangun, the peak discharge before diversion at Sennah was estimated at 19 m^3/s as mentioned later in a paragraph of drainage system. Adding 6 m^3/s of a runoff from the remaining area to this discharge 19 m^3/s, the discharge 25 m^3/s was adopted as the design discharge of S. Kotabangun at its confluence with the Ular river.

Thus the discharge allocation adopted in the present study is as follows.

Fig. 3-1 Discharge Allocation



To meet this discharge allocation, improvement plan of the river channel including levees was made as follows.

a. The levees located between 0.0 km and 10.0 km were already rebuilt on the occasion of the Urgent Flood Control Project. Therefore, the alignment of these levees shall be left as they are, but only heightening of the levees was planned so as to meet the design discharge. In this stretch, the standard river width was set at approximatedly 250 m.

b. On the stretches downstream from 0.0 km and upstream from 10.0 km, new levees or heightening of levees were planned respectively at the river width of 260 m and 250 m considering to utilize the existing levees or natural banks as much as possible.

c. The existing levee located on the left side of the stretch upstream from 10.0 km was planned to be heightened and strengthened and connected with a hill located near 15.0 km.

d. On the right side between 10.0 km and 19.0 km, a new levee was planned and the levee located between 19.0 km and 22.65 km was planned to be heightened.

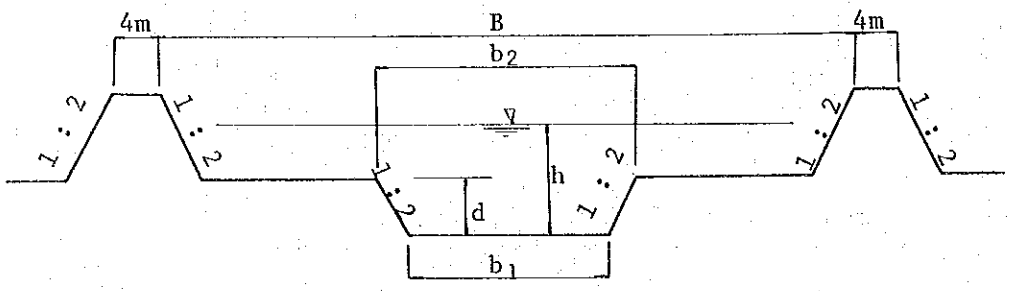
e. On the left side of the stretch from 0.0 km to -7.5 km, the existing levee was planned to be heightened, and a new levee was planned on the from -7.5 km to -12.25 km.

f. On the right side of the stretch from 0.0 km to -12.5 km, the existing levee located between 0.0 km and -2.5 km was planned to be heightened and a new levee was planned from -2.5 km to -12.5 km.

The fixed alignments of levees including those on Pulau Gambar Canal (S. Kotabangun) are shown in Fig.2-5. The design elevation of low-water and high-water channels and the design freeboard (0.8 m) were fixed following the principle taken on the occasion of the Overall Plan Study. The cross sections shown

below were adopted as standard also in accordance with the Overall Plan, and their stability was confirmed based on the

Fig. 3-2 Standard Cross Section



	d (m)	h (m)	b_1 (m)	b_2 (m)	B (m)
-12.25 to -10.75 km	1.2	3.07	85.5	90.3	260
-10.75 to -5.75 +159 m	1.2	3.00	76.0	80.8	260
-5.75 to 2.00 +159 m +204 m	1.2	2.95	69.2	74.0	250
2.00 to 10.00 +204 m +343 m	1.2	2.95	65.2	70.0	250
10.00 to 19.00 +343 m	1.2	2.89 to 2.79	70.0	74.8	250
19.00 to 22.65			Existing		

Results of soil survey. It was planned to coat the levees located from -12.25 km to 0.0 km with cohesive soil 0.5 m in thickness and the levees located from 0.0 km to 22.65 km with cohesive soil 0.3 m in thickness.

For calculation of design high-water level to be produced by the design discharge 800 m^3/s on condition of the above-mentioned features of the river channel, the coefficient of roughness and the high-water level at the lower end of the river channel were set as follows.

In consideration of the present condition of river channel including both the major and minor beds and the level of practical maintenance in future, the following Manning's coefficients of roughness were adopted for design, where n_1 is coefficient of roughness for low-water channel and n_2 is coefficient of roughness for high-water channel.

$n_1 = 0.028$ and $n_2 = 0.060$ for -12.25 km to 0.00 km.

$n_1 = 0.030$ and $n_2 = 0.060$ for 0.00 km to 22.65 km.

At the lower end of the stretch for improvement, -12.25 km, a stage-discharge curve was drawn by uniform-flow calculation. On this curve, a water level corresponding the design discharge 800 m^3/s was read at 3.46 m UP. On the other hand, calculation was made of a water level which will appear at the point -12.25 km on condition of 800 m^3/s and a river width of 200 m by use of the non-uniform flow method starting from the sand bar located at the real river mouth which is about 1.5 km downstream from the lower end of the river. Comparison of the two water levels showed that the former is a little higher than the latter. From the viewpoint of safety, the former value 3.46 m UP was adopted as the design water level at the lower end of the river.

The design high-water level fixed based on the calculation by the non-uniform flow method is shown in Fig.3-3 together with the design longitudinal profiles of the low-water and high-water channel beds and the tops of levees. Some typical cross-sections are shown in Fig.3-4.

Revetment works were planned at some places where levees are critical due to erosion at river banks. The locations of revetment works totaling 1,800 m are shown in Fig.2-5.

With regard to Pulau Gambar Canal (S. Kotabangun), improvement was planned over a stretch of 2 km extending from the confluence with the Ular river up to the spillway at Sennah. Out of the stretch 2 km, the lower reaches of about 0.8 km from the confluence require back-water levees for confining the back-water from the Ular river. The cross section of this canal was planned in such a way that a discharge of 20 m^3/s out of the design discharge 25 m^3/s can be carried by the low-water channel providing for the future.

Some typical cross-sections are shown in Fig.3-5 and the design longitudinal profile is shown in Fig.3-6.

A calculation of sediment discharge was made for conjecturing the tendency of change in river bed after the completion of river channel improvement. In general, a river bed is mainly formed by bed load and change in river bed is also mainly affected by bed load. As it seems to be the same in the case of the Ular river, attention was paid to only bed load in this case.

The sediment discharge was calculated by applying the Sato-Kikkawa-Ashida formula* to a stretch from -12.25 km at its lowe end to 22.75 km a little downstream of Serbajadi Bridge which covers the stretch for river improvement. In this calculation, the grain size of sediment was assumed at 1.15 mm in average diameter based on the Overall Plan Study.

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* See page 204, "Formulas in Hydraulics" published by the Japan Society for Civil Engineers, in 1971.

Fig 3 - 3 Design Longitudinal Profile (Ular River)

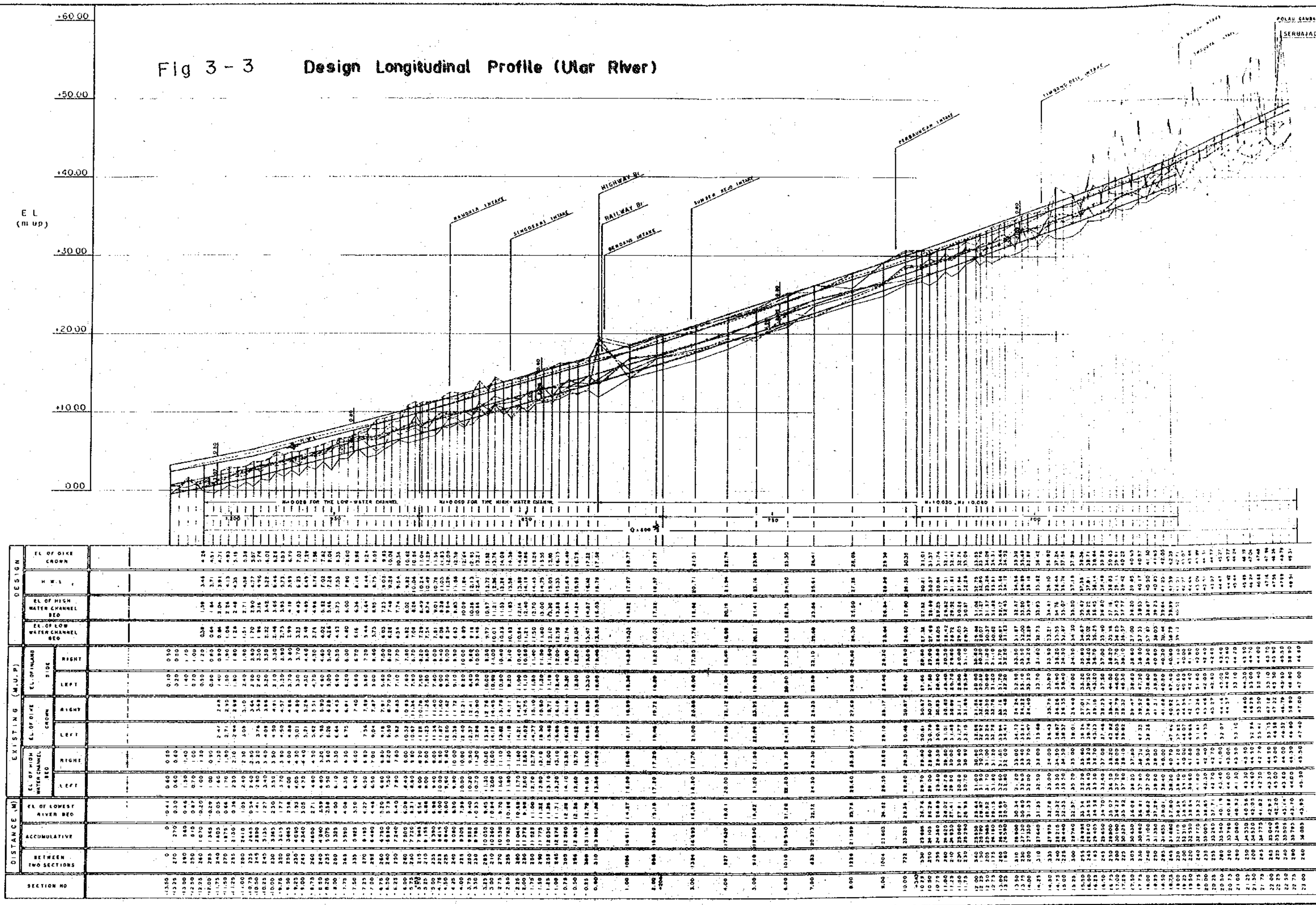
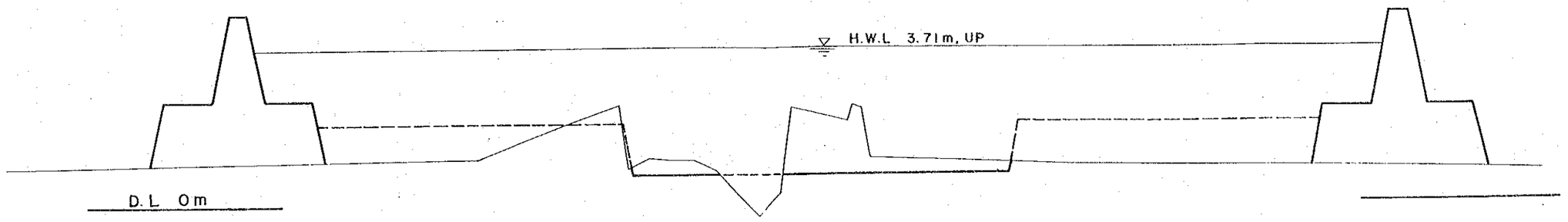


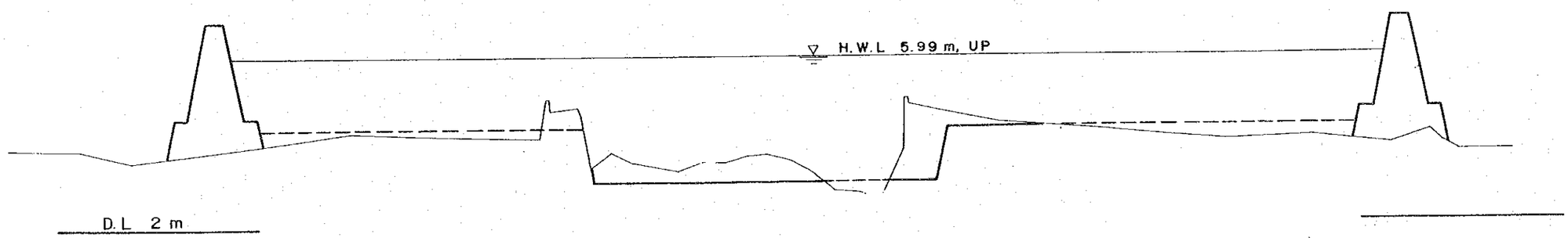
Fig. 3-4 Typical Cross - Section (Ular River)

Scale ; V = 1/100
H = 1/1000

No. - 12.00 k



No. - 9.50 k



No. - 6.50 k

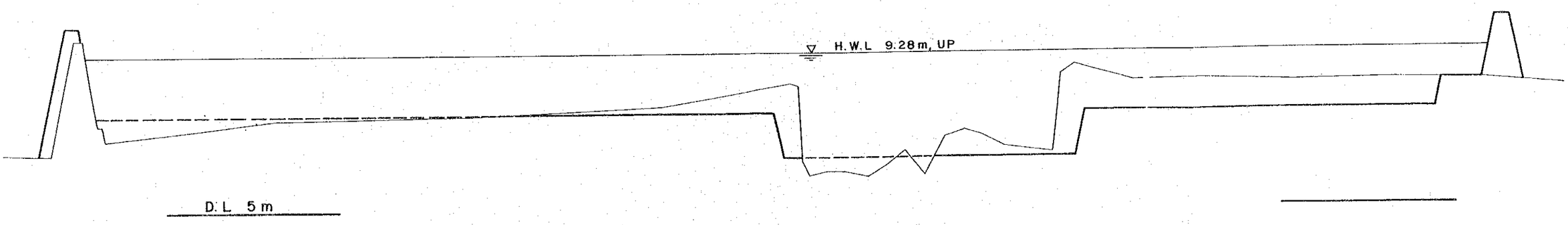
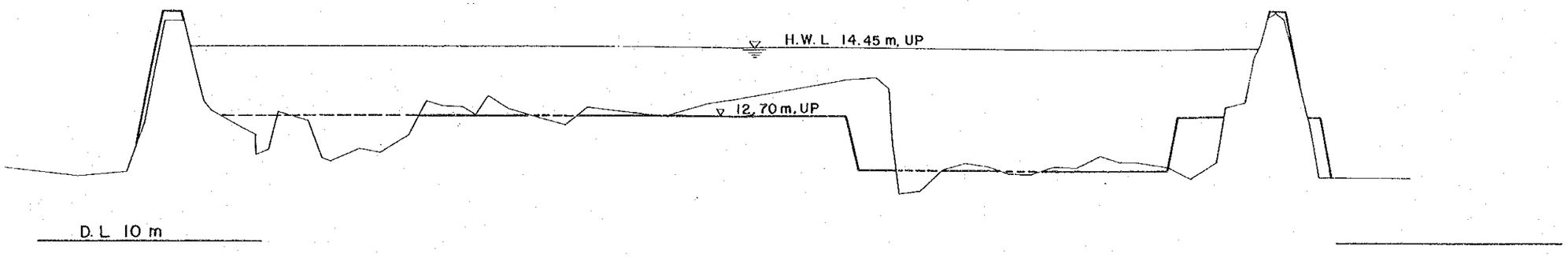


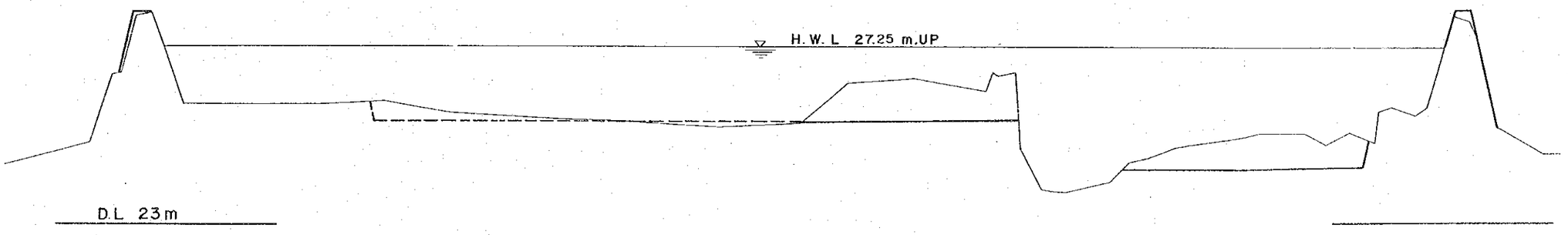
Fig. 3-4 Typical Cross-Section (Ular River)

Scale ; V = 1/100
H = 1/1000

No. -1.75 k



No. 8.00 k



No. 11.50 k

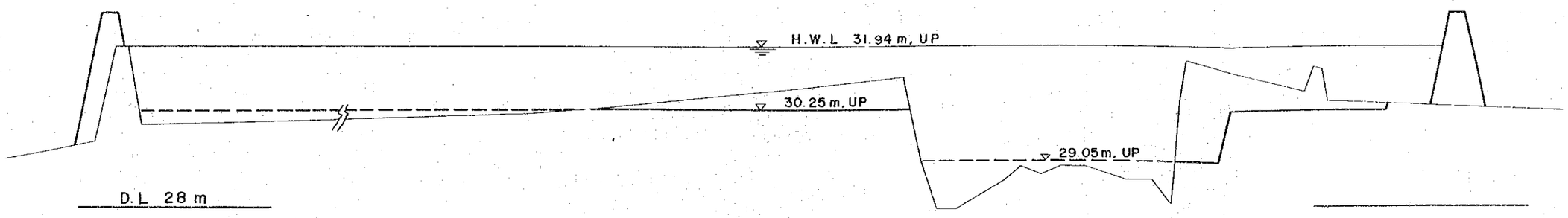


Fig. 3-5 Typical Cross-Sections of Pulau Gambar Canal

Scale ; 1/200

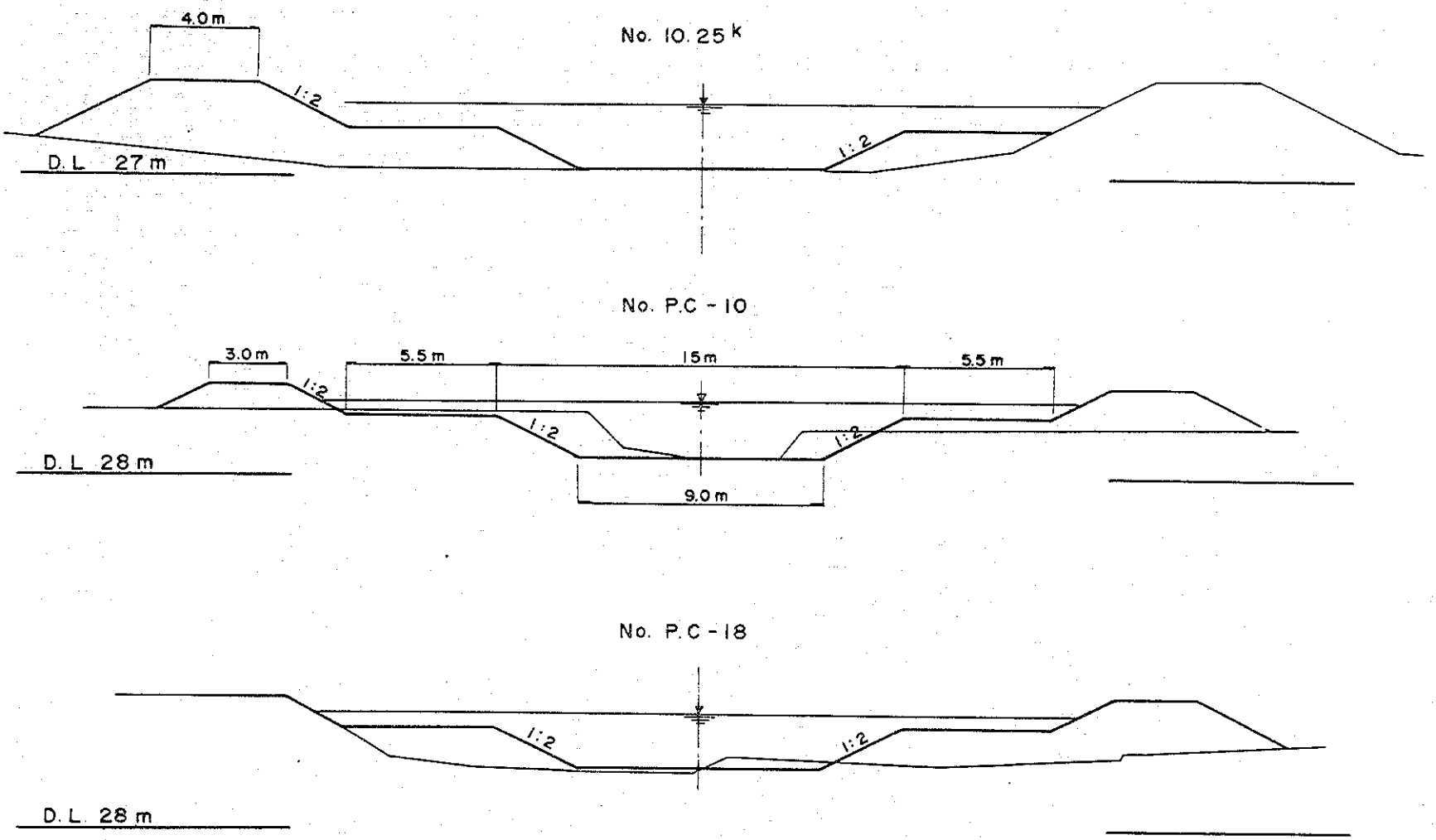
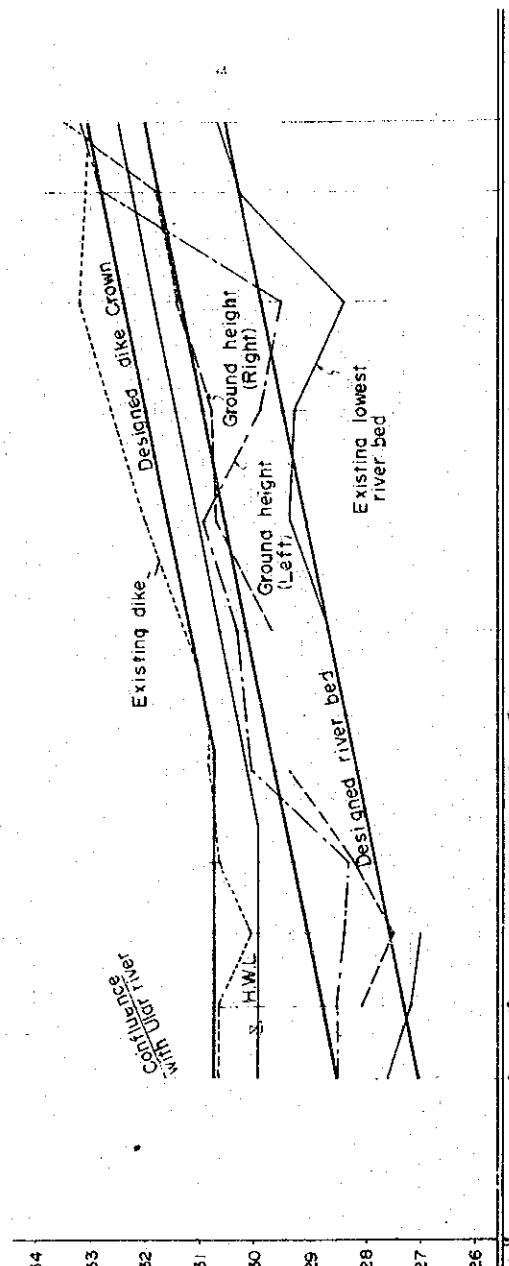


Fig. 3-6 Design Longitudinal Profile of Pulau Gambar Canal



Section No.	Distance (m)		Design (m, UP)				
	Between two sections	Cumulative	El. of low water channel bed	El. of high water channel bed	H.W.L	El. of dike Crown
PC-19	260	3500	30.51	32.01	32.51	33.11
PC-18	400	3240	30.25	31.75	32.25	32.85
PC-16	400	2840	29.85	31.35	31.85	32.45
PC-14	400	2440	29.45	30.95	31.45	32.05
PC-12	400	2040	29.05	30.55	31.05	31.65
PC-10	110	1640	28.65	30.15	30.65	31.25
11.50	200	1530	28.54	30.04	30.54	31.14
11.25	205	1330	28.34	29.84	30.34	30.94
11.00	335	1125	28.14	29.64	30.14	30.75
10.75	260	790	27.80	29.30	29.95	30.75
10.50	270	530	27.54	29.04	29.95	30.75
10.25	260	260	27.27	28.77	29.95	30.75
10.00 +300m	0	0	27.01	28.51	29.95	30.75

The calculation has clarified that the river channel of the Ular would remarkably be improved from the viewpoint of sedimentation by reason that the non-uniformity of sediment transport along the existing river channel would almost be eliminated by the expected river improvement works. However, the river channel would have a tendency that the sediment transport in the upstream reaches would be a little larger than those in the downstream reaches. This tendency may need some dredging works for the maintenance of the low-water channel.

3.3. Proposed River Improvement Works.

The levees to be improved or newly constructed and the proposed revetments are shown in Fig.2-5. The works for the proposed improvement are as follows.

a. Ular river.

Dredging works ; from -12.25 to 19.00 km; length = 31,040 m.,

Excavation works ; from -11.25 to 19.00 km; length = 29,980 m.

Embankment works are listed in the following table.

	Left Side		Right Side	
	New levee	Heightening	New levee	Heightening
- 12.25 km to - 11.25 km	1,060 m	-	1,060 m	-
- 11.25 km to - 7.5 km	3,795 m	-	3,795 m	-
- 7.5 km to - 2.5 km	-	4,860 m	4,860 m	-
- 2.5 km to 0.0 km	-	2,720 m	-	-
0.0 km to 10.0 km	-	9,820 m	-	2,720 m
10.0 km to 15.0 km	-	5,115 m	5,115 m	9,820 m
15.0 km to 19.0 km	-	-	3,670 m	-
19.0 km to 22.65 km	-	-	-	3,545 m
Total length	4,855 m	22,515 m	18,500 m	16,085 m

Revetment works ; total length = 1,800 m.

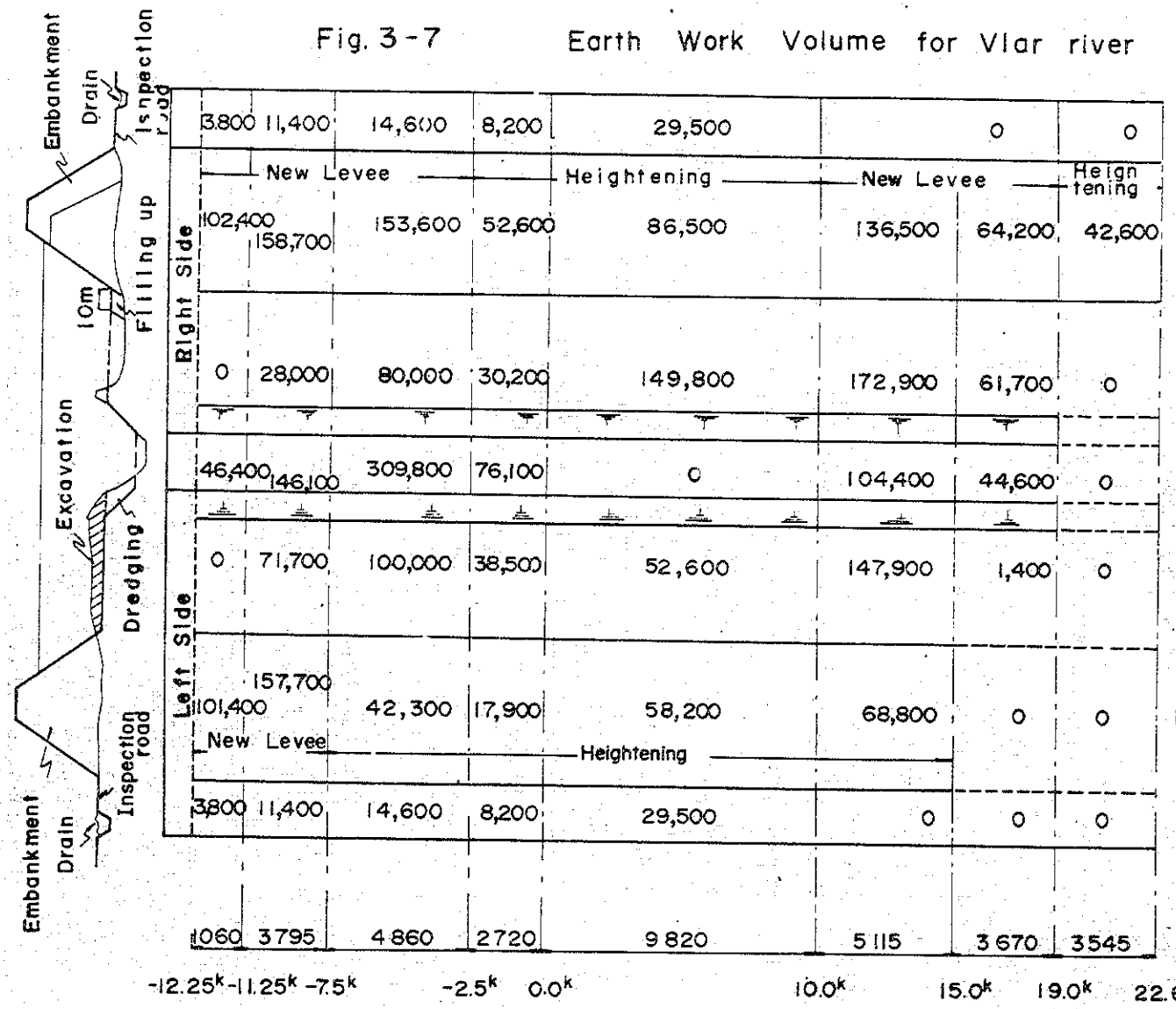
b. Pulau Gambar Canal.

Excavation works ; length = 3,500 m.

Embankment works ; length = 3,500 m.

The quantity of earth works were estimated based on the above-mentioned lengths and proposed cross sections. These are shown in Fig.3-7. The total quantity of works are summarized as follows.

Fig. 3-7 Earth Work Volume for Vlar river



								Total
Right Side	3,800	11,400	14,600	8,200	29,500	0	0	Drain : 67,500 m³
	102,400	158,700	153,600	52,600	86,500	136,500	64,200 42,600	Embankment : 797,100 m³
	0	28,000	80,000	30,200	149,800	172,900	61,700 0	Excavation : 522,600 m³
	46,400	146,100	309,800	76,100	0	104,400	44,600 0	Dredging : 727,400 m³
Left Side	0	71,700	100,000	38,500	52,600	147,900	1,400 0	Excavation : 412,100 m³
	101,400	157,700	42,300	17,900	58,200	68,800	0 0	Embankment : 446,300 m³
	3,800	11,400	14,600	8,200	29,500	0	0 0	Drain : 67,500 m³
	1060	3795	4860	2720	9820	5115	3670 3545	Distance : 34,585 m³

a. Ular river.

Dredging works	:	727,400 m^3
Excavation works	:	934,700 m^3
Embankment works	:	1,243,400 m^3
Drain works	:	135,000 m^3
Revetment works	:	1,800 m^3

b. Pulau Gambar Canal.

Dredging works	:	5,600 m^3
Embankment works	:	95,200 m^3
Sluice	:	1 place

3.4. Land Acquisition and Compensation.

The usual way of land acquisition was proposed for land necessary for executing the construction works of the low-water channel and levees. However, for land necessary for the high-water channels, a way of compensation per unit area was proposed because it seems to enable to avoid changeability of cost compared with the way of compensation per tree. As for the houses to be moved, the usual way of compensation was proposed.

The area of land to be acquired or compensated for the river improvement works was measured by use of the topographic map drawn in 1977 on a scale of 1/10,000.

3.5. Network of Hydrological Observation Stations and Communication Stations.

As mentioned in 2.3.3 and 2.3.4, since 1972, the Ular River Project Office has installed 17 recording rain-gage stations and 14 ordinary rain-gage stations in and around the Ular river basin and 6 recording water-level gage stations together with ordinary staff gages on the main stream of the Ular. These stations are shown in the Ular river basin map given at the beginning of the report. Besides these, the DPMA has a climatologic station at Silinda since 1975. For the purpose of obtaining discharge rating curves, there are 3 gaging stations, at Pulau-Tagor (Serbajadi Bridge), Ular Bridge and Bandar Tiga.

In the present study as well as the study of Overall Plan, no correlation was found between rainfall and runoff. The final purpose of rain-gage stations is to catch areal and time distribution of rainfall in order to grasp the runoff mechanism of the basin. From this viewpoint, the density of distribution of the existing rain-gage stations seems to be still thin. Asarain-gage

station only catches a point rainfall, the representativity of rain-gage stations must be reviewed further continuously.

According to some data in Japan, /1 it seems to be necessary to install one rain-gage station per area smaller than 50 km^2. From this viewpoint, it is recommendable to set at least two more recording rain-gage stations, say, at Tiga Juhar and Serbajadi. After these recording rain-gage stations have additionally been set, observation of rainfall and discharge should be continued for some period by use of all the rain-gages and the water-level gages until it is made clear whether the present density of distribution of hydrological gages is sufficient or not. In making the analyses, special attention must be paid to the tropical characteristics of behavior of rainfall and the relation between the topography and rainfalls.

In 1978, the JICA Study Team for the Overall Plan proposed to set additionally 8 recording water-level-gage stations, among which the following 5 stations are not installed yet.

Balapulung on the Buaya river (near the bridge).

Sipinggan on the Buaya river (no bridge).

Mabar on the Buaya river (near the bridge).

Negeri Dolok on the Karai river (near the bridge).

Esperance on the Ular river (no bridge).

Therefore, it is recommendable to set these stations as soon as possible. If these stations have been added, the analysis of runoff will fairly be improved and at the same time, it will serve to supply informations of floods. During the analyses, study also must be made of the density of distribution of gaging stations which will serve for supplying data on water levels or charges to be used for the future flood warning and forecasting.

The present flood information system is as follows.

a. If water level at the Bandar Tiga station has become higher than 2.0 m on the graduations of the staff gage, information is soon sent to the Ular River Project Site Office at Perbaungan by VHF radio telephone.

b. For the above purpose, 3 persons are standing by at the Bandar Tiga station for 24 hours.

c. The above information is soon sent to the military, the police, the district government and the PNP under circumstances.

d. On receiving information, necessary activities are commended for flood fighting.

e. For the above purpose, 5 persons are standing by for 24 hours

/1: Accuracy of areal rainfall and the number of rain-gage stations Doboku Gijutsu Shiryo (Civil Engineering Report), Vol.16-12, 1974.

at the Ular River Project Site Office at Perbaungan.

f. The above information is soon sent to the Ular River Project Office in Medan.

In order to improve the present system of communication between the Ular River Project Office and the observation stations, it is recommendable to set the following VHF radio stations.

VHF-radio stations at Serbajadi Bridge, Bandar Tiga and Perbaungan Site Office.

3 VHF-radio mobile stations.

At present, only simple information can be made, as mentioned above, on occured floods because of insufficient distribution of rain-gage stations and gaging stations. This project expects to strengthen the networks of the stations, which will serve for the establishment of flood-forecasting and warning system in the future. However, in order to establish the system, it is necessary to reinforce the study on analysis of the relations between rainfalls and runoffs as well as the relations between water levels or discharges studying the suitability of distribution of the stations on the one hand and strengthening the communication system for transmitting the informations on hydrologic data on the other hand.

CHAPTER IV

IRRIGATION AND DRAINAGE IMPROVEMENT PLAN

4.1. General.

The production of foodstuff, with emphasis on rice, in Indonesia is still insufficient to meet regional or national demand due to rapid increase of population and of per-capita consumption of rice.

Plan for improvement of irrigation and drainage is formulated to eliminate many constraints against rice production in the project area and to increase rice production under introduction of improved irrigation farming.

Plan for improvement of irrigation and drainage is principally a part of the overall plan for improvement of the Ular river, hence it is not considered to divert the discharge of the Ular river to any basins of other rivers and vice versa. The project area has no room to be newly reclaimed and, in estate lands, crop diversification to paddy faces some difficulties under the present situation. Consequently, the existing paddy field of 18,500 ha becomes the objective area for plan of irrigation and drainage improvement, and this plan will focus its attention on a work to convert the existing paddy field to technical irrigation area to promise double cropping of paddy per year instead of the present low rate of double cropping of paddy.

Water sources for irrigation will entirely depend on the Ular river which is sufficient in discharge throughout the year. From this point of view, no construction of reservoir for irrigation purpose is needed as mentioned in the Overall Plan Study.

There are two ways in the irrigation plan. One is to provide irrigation water through the existing intakes as much as possible and the other is to provide it through a new weir which may be constructed at the upper reaches of Serbajadi Bridge unifying the existing intakes. The construction of a new weir will require much amount of fund and furthermore the change of the existing irrigation system which will occurs from the unification of the existing intakes will exert a serious influence upon the existing social condition. On the other hand, most of the existing intakes have recently been constructed or rehabilitated after 1970 and it will be able to provide economically sufficient irrigation water if only some improvements of the existing intakes are made or small intakes are supplementary installed.

It should be consequently planned that irrigation water be drawn from the existing intakes as much as possible.

4.2. Agricultural Development Plan.

4.2.1. Cropping Pattern.

After the implementation of construction of irrigation and drainage facilities, all the paddy field in the project area will be turned to technical irrigation area. The land use in the area is expected to become more intensive with the introduction of year-round irrigation farming.

Under these conditions, double cropping of paddy per year will be applied to the project area in due consideration of the demand-supply conditions at the national and regional levels, profitability of paddy and strong farmer's intention for cultivating double cropping of paddy. The proposed cropping pattern in the project area is shown in Fig.4-1.

In framing cropping pattern, agronomic attention was paid to the increase in photosynthetic efficiency of paddy in order to increase rice production. It is also considered to use effectively natural rainfall at the puddling periods when much irrigation water is required.

Polowijo crops will not be cultivated in the project because all the cultivation area can be improved for more profitable use through paddy cultivation.

Multi-cropping index in the project will rise to 2.0 from present 1.3.

4.2.2. Farm Inputs and Farming Practices.

Proper application of fertilizers and chemicals is most essential for aull exploitation of agricultural potential under irrigation farming.

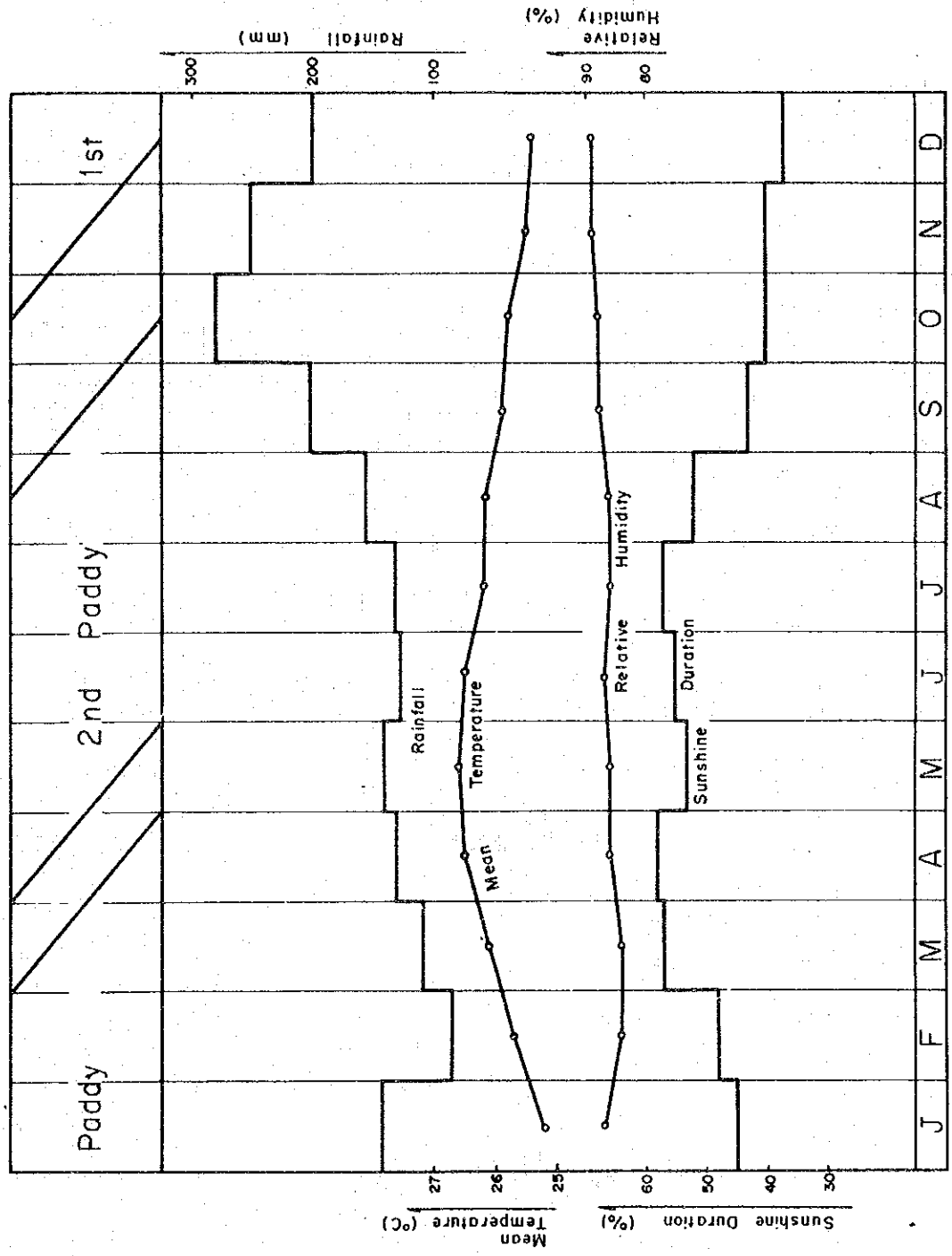
The estimated total fertilizer requirements on with-project condition are 250 kg of urea and 100 kg of triple super phosphate per ha per crop. The estimated total chemical requirements are 4 ℓ of chemicals such as Furadan, Sumithion, Nogos, etc. per ha per crop.

Split application of urea and joint prevention of plant diseases will be applied to the project. Proper water management is also important in order to attain the target yield of paddy.

It is expected, on the other hand, that there will be no substantial change in farm input requirement on without-project condition except some increase of fertilizer inputs.

Details in farm inputs and proposed farming practice are explained in Volume II Study Report.

Fig. 4 - 1 Proposed Cropping Pattern



4.2.3. Anticipated Yield and Agricultural Production.

As mentioned in Section 2.5, "Present condition of agriculture", the present crop yield is low, mainly because of low level of farm inputs and improper water control. Substantial increase in crop production is not expected without improvement of irrigation condition and introduction of proper irrigation farming.

An introduction of the improved and advanced irrigation farming as recommended, however, will help raise the present low crop yield year after year on with-project condition. The expected yield of crops is estimated on the basis of the results of the experiments made in the provincial seed center in Tanjung Morawa, International Rice Research Institute and Bogor Agricultural Experimental Station as well as the data on well-irrigated land in the project area.

The yield will increase gradually from year to year and will attain its maximum in and after the seventh year after the introduction of improved irrigation farming. The anticipated unit yields and production are summarized in Table 4-1. Details in crop yields are explained in Volume II Study Report.

Table 4-1 Crop Yields and Production in Future Without and With Project

	Without Project			With Project		
	Area (ha)	Unit yield (t/ha)	Production (t)	Area (ha)	Unit yield (t/ha)	Production (t)
Rainy season paddy						
rainfed area	14,000	3.3	46,200			
irrigated area	4,500	4.0	18,000	18,500	4.5	83,250
Dry season paddy						
irrigated area	4,500	4.0	18,000	18,500	4.5	83,250
Polowijo crops						
cassave	654	11.9	7,800	-		
peanuts	170	1.09	190	-		
soybeans	80	0.95	80	-		

4.2.4. Marketing and Price Prospects.

Indonesia is still rice import country. Recently, around one million tons of rice are imported every year in Indonesia. Considering the growth rate of population, per capita consump-

tion and the increase rate of rice production, the shortage of rice in Indonesia will continue to some extent.

North Sumatra Province is also affected by the shortage of rice. Annually, about 100,000 tons of rice were imported. It is estimated from the study of forecast of demand-supply condition of rice for the period of 1980 to 2000 that the shortage of rice will continue in the future and will reach 238,000 tons at least and 1,045,000 tons at maximum in 2000. Details are explained in Vol.III Study Report.

A large part of the additional production of about 80,000 tons of paddy from the project would be marketed in domestic market in Indonesia, as the substitute of import rice.

The economic farm gate price for paddy is estimated at Rp.65,000 per ton on the basis of the international market price taking into consideration the transportation, processing and other costs and expenses as follows.

Rice Price Estimation for Economic Evaluation of the Project

	US$/t	Rp./t	Rp./t
International market price FOB Bangkok	270		112,050
Transportation cost (Bangkok-Belawan)	10	4,150	116,200
Handling charge & warehouse charge (handling charge Rp.1,000, warehouse charge Rp.10/day × 60 days = Rp.600)		1,600	117,800
Transportation cost (Belawan-Medan)		2,600	120,400
Processing cost			
a. Package & handling charge		6,000	114,400
b. Milling charge		2,500	111,900
c. Selling price of paddy (b. × 0.6)			67,140
Transportation and broker's margin		2,500	64,640
Farm gate price			64,640
			(65,000)

For the farm-budget analysis, Rp.70,000 per ton for IR varieties and Rp.75,000 per ton for local varieties are taken as the farm gate price of paddy based on the present market flow in North Sumatra in 1977.

4.3. Irrigation Plan.

4.3.1. Water Sources.

Irrigation water will entirely be supplied from the Ular river. The records of discharge at the Serbajadi station are available for the irrigation plan as described in 2.3.4,(2).

Irrigation plan is usually formulated on the basis of drought discharge of a probability 1 in 5 years in Indonesia. However, the records at the Serbajadi station are only for three and a half years from Aug., 1971 to Dec., 1974 and no distinct correlation is found between the river discharge and areal rainfall. It is said that the discharge in 1972 was a minimum in recent years.

In this study, therefore, the ten-day discharge system using all past records of discharge for three and a half years was adopted to formulate the irrigation plan.

Fig. 4-2 shows the relation of the ten-day discharge and the total diversion requirement, and suggests that the Ular river has comparatively sufficient discharge for supplying irrigation water.

4.3.2. Irrigation Water Requirement.

As there were are no data available on the consumptive use of water for the crop, the irrigation water requirement was estimated on the basis of climatic and soil conditions as follows.

i) Calculation of the consumptive use of water for the crop by using the modified Penman method,

ii) Assessment of percolation loss,

iii) Deduction of effective rainfall from the summation of the amounts obtained in the item 1) and ii),

iv) Assessment of net irrigation water as the summation of the amounts obtained in the item iii) and farm waste, and

v) Estimation of diversion water requirement by summing the amounts obtained in the item iv) and conveyance loss.

The maximum diversion requirement was thus estimated at 1.12 ℓ/sec per ha and 20.7 m^3/s for the total irrigable area of 18,500 ha based on the proposed cropping pattern of double cropping of paddy per year.

4.3.3. Irrigation System.

It was planned that the existing irrigation facilities would be utilized as much as possible for the irrigation plan. Upon the comparative study among the six alternative diversion

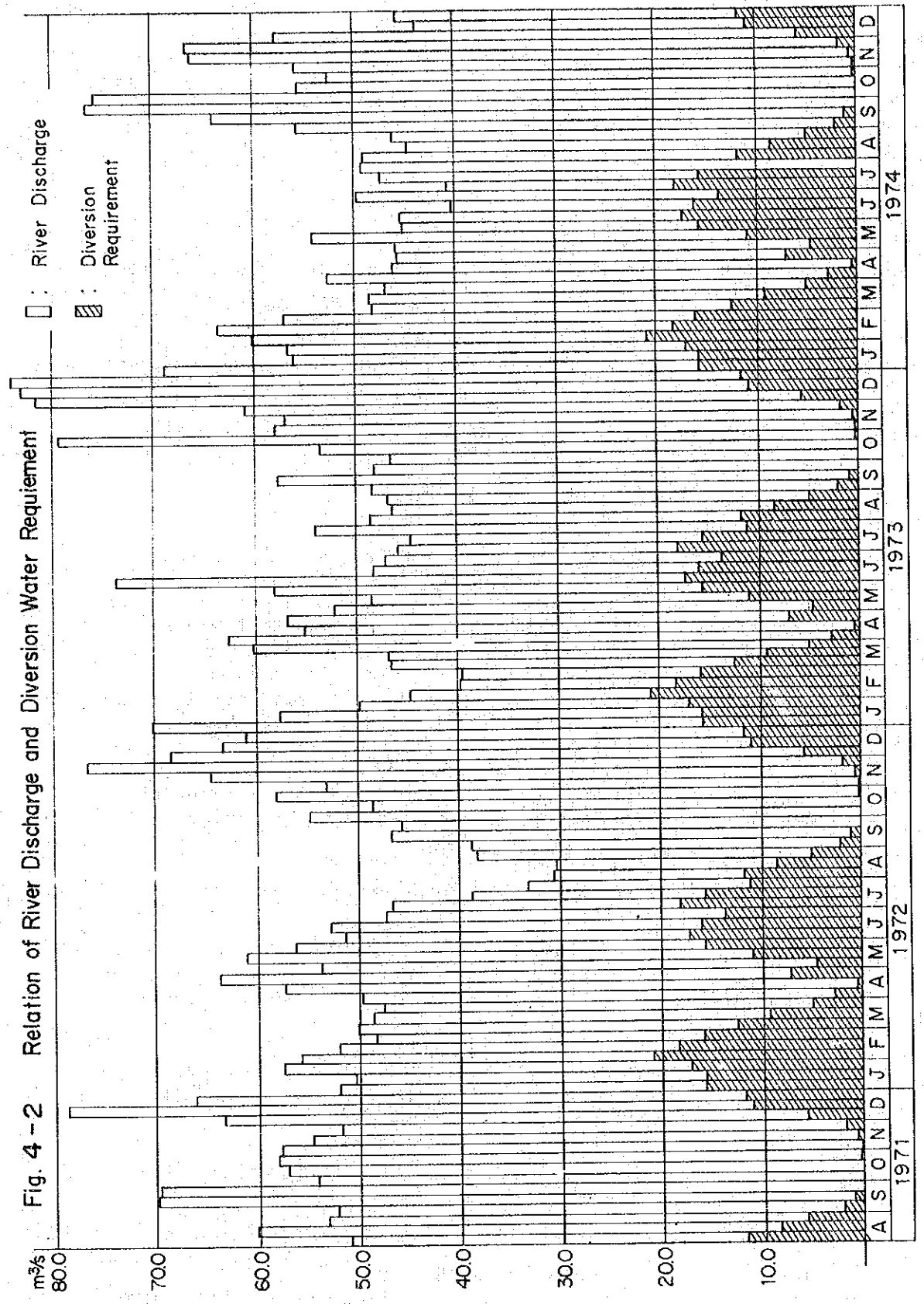


Fig. 4-2 Relation of River Discharge and Diversion Water Requirement

systems, the most economical system was selected for the project area totaling 18,500 ha.

(1) Intake and Settling Basin.

Three intakes will be improved or newly constructed. Timbang Deli Intake will be improved by only enlarging the width of the existing intake. As for Sumber Rejo Intake, one supplementary intake will be newly constructed at 1.1 km upstream of the existing intake. Singosari Intake will newly be constructed unifying the existing five small intakes. The remaining intakes of Pulau Gambar, Swadaya, Buluh, Perbaungan, Bendang and Ramonia have no necessity for improvement.

Settling basins will newly be constructed in some distances in the upstream of the successive canals at each intake.

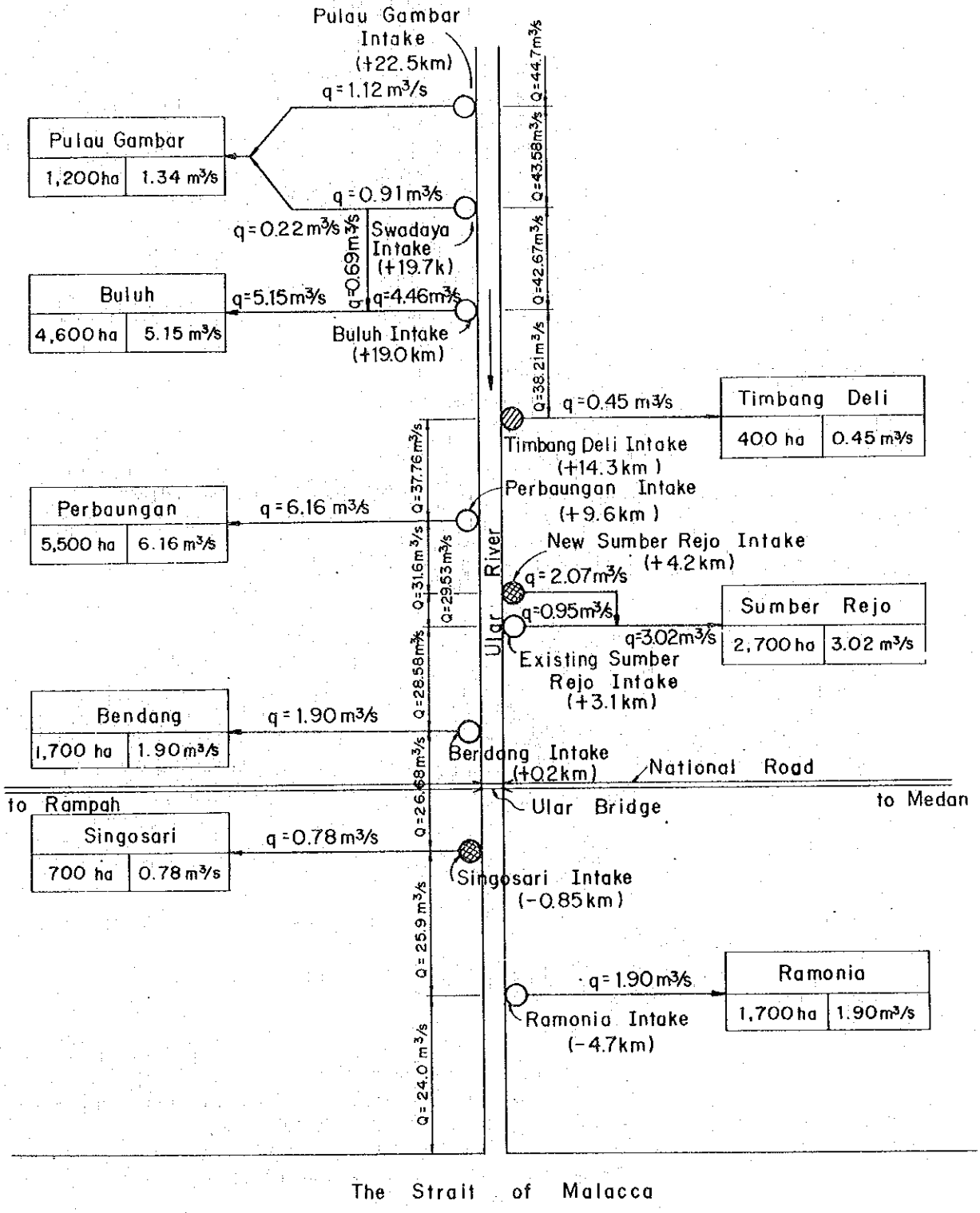
(2) Irrigation canal.

The proposed area of 18,500 ha for irrigation improvement is divided into eight irrigation blocks by canal networks with ten intakes as shown in Table 4-2, and Fig.4-3 shows the diagram of irrigation water distribution system from the Ular river during the first ten days of February when the intakes will take the maximum discharge of 20.7 m^3/s in total. Most existing irrigation canals in the project area will be improved, and the non-technical irrigation area and rain-fed area will have to be provided with new irrigation canals. The irrigation water diverted from the main canals will be led by the secondary canals to the minimum service unit area of 150 ha in principle. Fig.4-4 shows the proposed irrigation system in the project area.

Table 4-2 Irrigation Blocks in the Project Area

Block	Area (ha)	Intake
Pulau Gambar	1,200	Pulau Gambar and Swalaya
Buluh	4,600	Buluh
Timbang Deli	400	Timbang Deli (improved)
Perbaungan	5,500	Perbaungan
Sumber Rejo	2,700	Sumber Rejo and new supplementary one
Bendang	1,700	Bendang
Singosari	700	Singosari (new)
Ramonia	1,700	Ramonia
Total	18,500	

Fig. 4-3 Diagram of Irrigation Distribution System



Note : ○ : Intake not to be improved
▨ : Intake to be improved
▩ : Intake to be newly constructed

Q : Planning river discharge
q : Intake discharge

4.4. Drainage Plan.

4.4.1. Drainage Water Requirement.

The surface drainage discharge was estimated by use of the PROSIDA method. According to the method, the surface discharge from agricultural lands is obtained as a sum of runoff from paddy fields and runoff from drainage areas comprising villages, roads and non-agricultural lands. The rain water stored in the paddy fields can be drained within 4 days at the maximum duration of drainage. Therefore, the drainage discharge from one drainage basin is estimated according to the ratio of paddy fields and other areas.

The peak drainage discharge varies from 5.1 m^3/sec per 500 ha to 64.7 m^3/sec per 10,000 ha according to the variation of total drainage area and the ratio of paddy fields and other areas.

4.4.2. Drainage System.

The drainage basin demarcated at 55,000 ha is divided into ten blocks. Each block has more than several drainage units. The proposed drainage system is shown in Fig.4-5. Natural rivers and the existing drainage canals will be utilized as much as possible.

The drainage water from the drainage area which has the minimum service size of several hundred hectares will be led by the secondary drainage canals to the main drainage canals.

The collector drains will be improved or newly constructed for carrying the excessive water especially in the eastern part of the project area along the national highway and railway.

4.5. Proposed Irrigation and Drainage Work.

4.5.1. Intake and Settling Basin.

Out of the ten intakes, three intakes will be improved or newly constructed. The principal dimensions of the three intakes are shown in Table 4-3.

Ten settling basins will newly be constructed in some distances in the upstream of the successive canals to prevent sand from entering into the irrigation canals. The grain size of sands to be settled is assumed at 0.25 mm in diameter. Based on the hydraulic calculations, the principal dimensions are decided as shown in Table 4-4.

4.5.2. Irrigation Canal.

The design discharges for main and secondary canals are

Fig. 4-4 Plan of Irrigation System

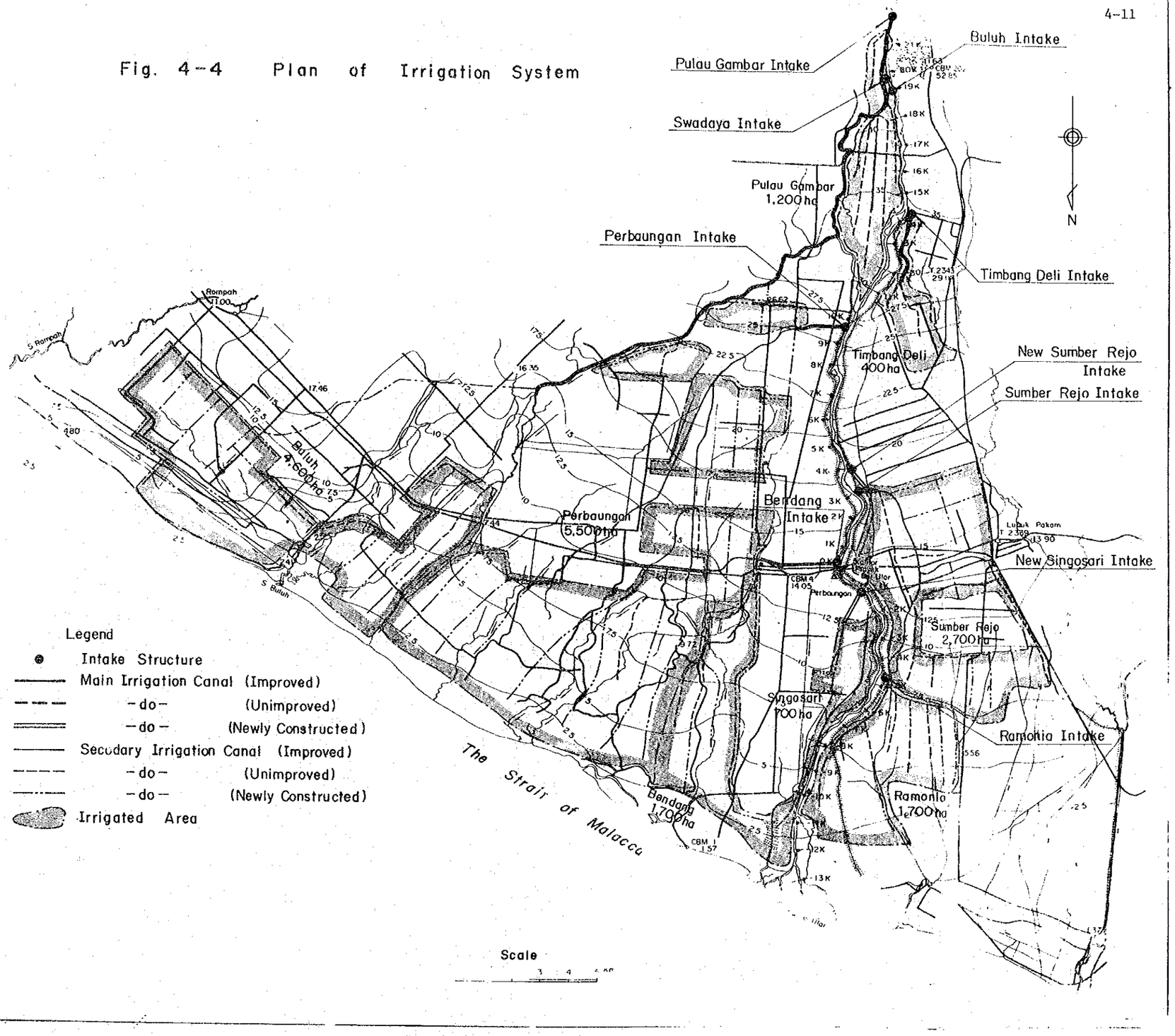


Fig. 4-5 Plan of Drainage System

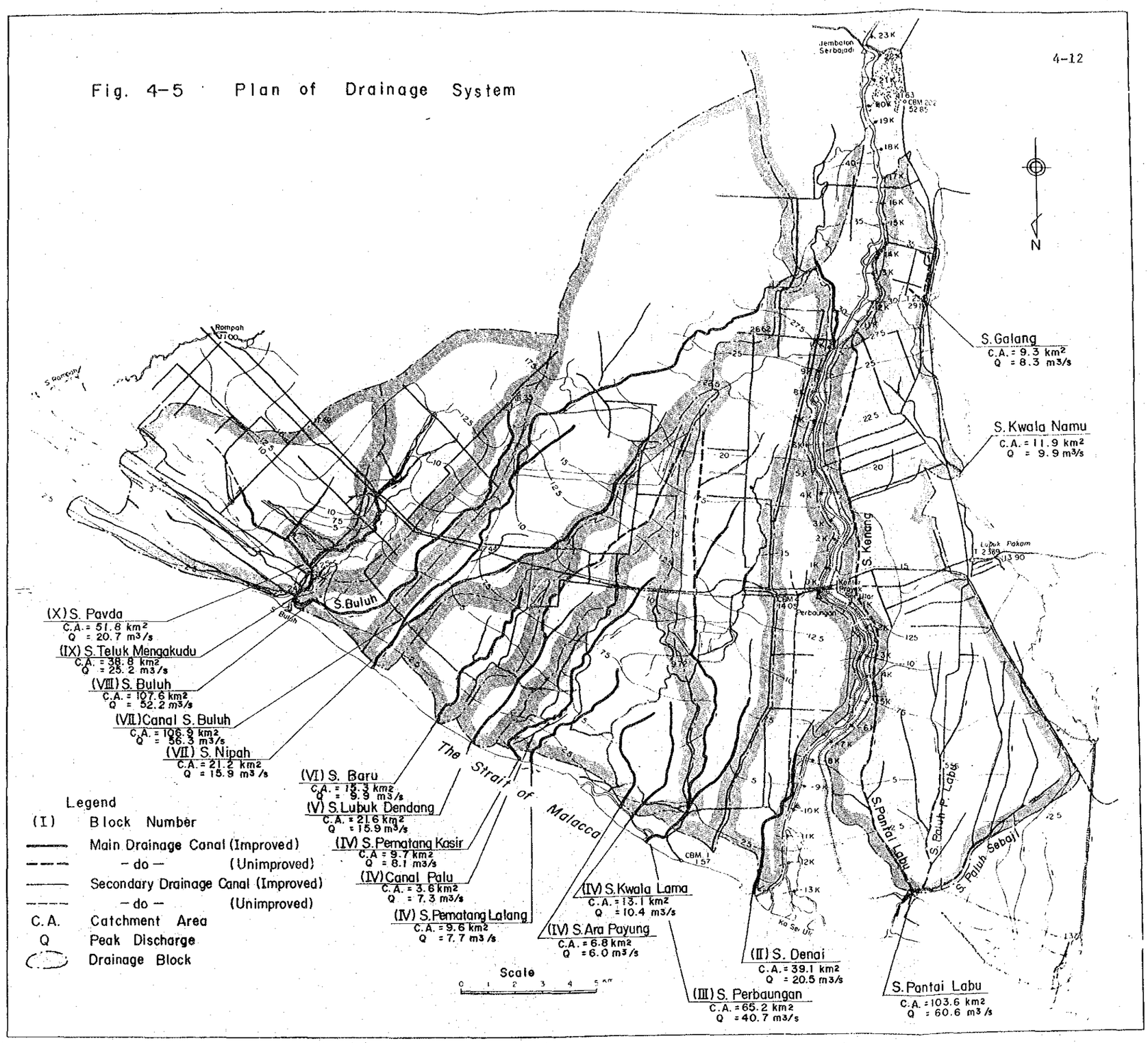


Table 4-3 Proposed Intakes

Name of Intake	Width of Intake	Type of Intake gate
Timbang Deli	0.75 m × 4 bays	Sluice gate
Singosari	1.0 × 2	Sluice gate
Supplementary Sumber	1.2 × 3	Sluice gate

Table 4-4 Proposed Settling Basins

Name of Intake	Effective water depth	Effective length	Effective width
Pulau Gambar	2.10 m	16.0 m	3.6 m
Swadaya	1.70	13.0	3.6
Buluh	2.45	19.0	12.0
Timbang Deli	1.60	12.0	2.2
Perbaungan	2.50	19.0	16.4
New Sumber Rejo	2.30	18.0	6.0
Existing Sumber Rejo	2.00	15.0	3.2
Bendang	2.40	18.0	5.4
Singosari	1.80	14.0	3.0
Ramonia	2.20	17.0	5.8

decided on the basis of the calculated water requirement. The profiles of canals are determined in consideration of topographical conditions and hydraulic requirements.

Preliminary design of the canals is prepared based on the following conditions:

i) Type of canal : unlined earth canal with trapezoidal section of 1:1 inside slope except new canal in the plantation area, where concrete lining canal is proposed.

ii) Maximum velocity : less than 0.6 m /sec in the earth canal and less than 1.5 m /sec in the concrete lining canal.

Total length of main canals is 36.5 km consisting of 20.4 km to be improved, 13.5 km not to be improved and 2.6 km to be newly constructed, while total length of secondary canals is 327.4 km consisting of 51.5 km to be improved, 117.4 km not to be improved and 158.5 km to be newly constructed.

4.5.3. Drainage Canal.

The profiles of canals are determined in consideration of topographical conditions and hydraulic requirement of drainage water. Preliminary design of drainage canal is prepared based on the following conditions.

i) Type of canal : excavated earth canal with trapezoidal section of 1:1 inside slope.

ii) Maximum velocity : less than 0.9 m/sec.

Total length of main canals is 195.1 km including 125 km to be improved, while total length of secondary canals is 136.3 km to be improved. Collector drains totaling 18 km will be improved or newly excavated.

4.5.4. Related Structures.

(1) Irrigation.

Since main and secondary irrigation canals cross tributaries, canals, roads and railway thereunder at some places or thereover at other places, it will be necessary to construct the crossing structures such as siphons, aqueducts and bridges. In addition, water measuring devices and check gates will be provided for distribution of the irrigation water. Provision of drop works will also be needed to prevent erosion at inside slopes of the canals.

(2) Drainage.

Since the drainage canals cross at some places under or over the roads and railway, concrete bridge and steel girder bridge will be constructed. Drop structures will also be needed to keep non-scouring velocity in the canals. In addition, in order to prevent the salt intrusion occuring in some places at the time of extraordinary high tide, flap gates will be provided.

The proposed number of these structures are summarized in Table 4-5.

Table 4-5 Proposed Delated Structures

Name of structures	To be left as it is	To be improved	Newly constructed	Total
Irrigation				
Syphon	2	4	55	61
Aqueduct	7	6	24	37
Bridge	11	11	4	26
Spill way	-	5	-	5
Conduit	1	1	1	3
Main diversion work	1	7	3	11
Secondary diversion work	9	24	33	66
Check gate	-	-	6	6
Drop	3	13	25	41
Drainage				
Bridge	-	-	16	16
Drop	-	-	29	29
Flap gate	-	-	11	11

4.5.5. Farm Ditch, Farm Drain and Farm Road.

For equitable distribution of water, increase in the productivity of the soil, proper water management and effective farming practices, the density of on-farm works is proposed as follows taking into consideration the present conditions of the farm blocks.

Farm ditch: 20 m/ha in technical and semi technical irrigation area.

40 m/ha in non-technical irrigation and rainfed area.

Farm drain: 20 m/ha in technical and semi technical irrigation area.

40 m/ha in non-technical irrigation and rain-fed area.

Farm road: 15 m/ha in technical and semi-technical irrigation area.

30 m/ha in non-technical irrigation and rain-fed area.

The total length of the proposed farm ditches, farm drains and farm roads is 600 km, 600 km and 450 km, respectively.

4.6. Land Acquisition and Compensation.

The usual way of land acquisition was applied to land necessary for irrigation/drainage works, and calculation was made based on the sizes of the land deemed appropriately necessary for intakes, settling basins and irrigation/drainage canals including related structures, classifying into irrigated area, rain-fed area, plantation area and swampy area. As for trees in the plantation area houses in the project area, compensation system was adopted.

Table 4-6 shows the details of land acquisition and compensation for irrigation and drainage works.

Table 4-6 Land Acquisition and Compensation.

Description	Land				Tree		House
	Irri-gated area	Rain-fed area	Plant-ation area	Swampy area	Oil Palm	Rubber	
Irrigation	ha	ha	ha	ha	No.	No.	No.
Pulau Gambar	1.8	-	-	-	-	-	-
Buluh	2.0	10.7	10.9	-	2,894	1,860	-
Timbang Deli	0.6	-	-	-	-	-	-
Perbaungan	6.7	12.3	2.3	-	631	360	-
Sumber Rejo	2.5	5.8	1.0	-	371	-	-
Bendang	2.3	1.6	-	-	-	-	-
Singosari	0.6	2.2	1.3	-	482	-	-
Ramonia	2.5	1.3	-	-	-	-	-
Sub-total	19.0	43.9	15.5	-	4,378	2,220	-
Drainage							
S. Perbaungan	11.6	22.0	-	3.4	-	-	85
Canal S. Buluh	25.4	50.0	38.0	7.6	5,100	14,500	24
S. Buluh	5.1	8.0	2.1	8.3	300	780	16
S. Teluk mengkudu	6.8	11.0	-	-	-	-	5
S. Pavda	-	4.4	-	-	-	-	60
S. Denai, Paluh Babi	4.0	7.7	3.3	1.5	1,220	-	-
Kwala Lawa, Pematang Kasih	8.0	16.3	6.8	3.1	2,520	-	-
S. Sijenggi, L. Sabah	4.0	7.7	3.3	1.5	1,220	-	-
S. Baru, S. Mayang	3.0	5.5	2.4	1.1	890	-	-
Sub-total	67.9	132.6	55.9	26.5	11,250	15,280	190
Grand Total	86.9	176.5	71.4	26.5	15,628	17,500	190

CHAPTER V

CONSTRUCTION PLAN

5.1 General

5.1.1 Basic Line of Construction Plan.

(1) Execution System and Period of Construction Works.

In the present study, two alternative plans were studied for planning the execution of construction works. One is a plan that the Government procures the required equipment other than the existing ones available for this project and lends all of them to contractors, and the contractors carry out the works by use of them. The other one is a plan that the Government lends to contractors some existing equipment available for this project and the contractors carry out the works by use of the borrowed equipment and other major equipment procured by themselves. For the sake of simplicity, we call the former "equipment-lending system" and the latter "full-contracting system". These two systems were studied and compared, and the latter system is proposed in this study.

As for the period of construction, two plans were taken into consideration; one is a 7-year plan that consists of five years for execution of main civil works and more than one year for preparation prior to the execution of works, and the other is a 5-year plan that consists of three years for execution of works and more than one year for preparation. These two plans were studied, but the 7-year plan was adopted.

In conclusion, the 7-year construction plan on the full-contracting system is described in this report.

(2) Workable days and working hours.

It was assumed that the construction works will be commenced at the beginning of April of 1980 and completed by the end of March of 1985 without suspension even in the rainy season. But, since earth work is affected by rainfall, workable days within a year for executing earth work were estimated by month by use of the rainfall records obtained at the Sungai Putih and Kwala Namu stations. In this case, days which had rainfall of more than 10 mm/day were regarded as waiting days for earth work. Workable days are shown in the following table.

Table 5-1 Workable Days in a Year

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Waiting days	5	7	6	5	7	9	7	9	16	16	12	7	106
Sundays and holidays	6	5	6	5	5	5	4	5	6	4	6	6	63
Total non-workable d,	11	12	12	10	12	14	11	14	22	20	18	13	169
Workable days	20	16	19	20	19	16	20	17	8	11	12	18	196

Working hours were assumed as follows:

a. Two 8-hour shifts per day were assumed for civil works, and net operation hour of equipment for the civil works was estimated at 10 hours in a day except excavation and dredging works in the low-water channel.

b. Two 8-hour shifts per day were assumed for excavation works in the low-water channel and net operation hour of equipment for the works was estimated at 14 hours in a day.

c. Two 8-hour shifts per day were assumed for dredging works in the low-water channel, and net operation hour of equipment for dredging works was estimated at 12 hours in a day.

(3) Existing Equipment Available, for the Project.

It was confirmed that the existing equipment available to this project are those shown in Table 5-2, by checking the year of purchase and the operation hours in the past of the existing equipment procured on the occasion of the Urgent Flood Control Project and by examining their life times and operation hours to be considered until March 1980.

5.1.2 Preparatory Works.

(1) Transportation Road and Access Roads.

The existing asphalt-paved road with a width of about 6 m which starts from Belawan, runs through the city of Medan and the town of Lubuk Pakam and across the project area will serve for transportation. This is a trunk road for the project. The existing non-paved road except some parts such as Pulau Gambar area and upper reaches from No.19 km is also available to this project as an access road to the work area branching from the trunk road. It is required, however, that small bridges built on these existing roads shall be improved so as to enable the transportation and some new access

roads shall be built to secure the transportation of equipment and regular traffic.

Table 5-2 List of Transferable quipment

No.	Name of equipment	Capacity	Q'ty.	Remaining workable hour (in total)	Transfer
1	Swamp bulldozer	12 t	2	1,493 hr	Flood Control
2	- do -	7 t	3	4,655	- do -
3	Loader (dragshovel)	1.3 m^3	3	7,433	- do -
4	Dragline	0.6 m^3	1	2,787	- do -
5	Back hoe	0.3 m^3	2	4,687	- do -
6	Amphibious dredger	40 m^3/hr	1	4,027	- do -
7	Dump truck	6 t	12	10,866	- do -
8	Ordinary truck	4.5 t	3	4,043	2-Flood Control 1-Irrigation
9	Grease car	6 t	1	5,400	Irrigation
10	Hydraulic truck crane	10 t	1	5,285	Flood Control
11	Service car	1 t	3	3,596	2-Flood Control 1-Irrigation
12	J e e p	6 persons	4	10,589	2-Flood Control 1-Irrigation
13	Diesel generator	45 KVA	1	2,966	Flood Control
14	- do -	30 KVA	1	510	- do -

(2) Offices and Quarters

The existing offices located in Medan and the project site should be provided for designing and supervision of construction works. Termporary branch offices are required to be set at several places for supervision of the works. The yard of the existing site office will be used for storing and handling the existing equipment. Construction quarters for supervision personnel are required to be built in the yard of the site office according to the stage of construction. The existing repair shop will be used as it is.

Power supply and water supply to quarters must be provided in addition to the existing ones in the case of full-contracting system.

Communication measures to be used exclusively for implementation of the project must be provided during the period of construction.

(3) Topographic survey

Topographic surveying and soil survey are required for carrying out the detailed design and the supervision.

(4) Clearing and other works

Clearing works must be executed at the sites of embankment and excavation, and some other temporary works will be needed.

5.2 Execution Plan of Flood Control Works

5.2.1 Execution Plan for the Ular River

The main works for improvement of the Ular river were shown in Fig. 3-7 and are summarized as below.

Dredging	:	727,400 m^3
Excavation	:	934,700 m^3
Embankment	:	1,243,400 m^3
Revetment	:	1,800 m
Drains	:	135,000 m^3

Dredging works will be executed by using amphibious dredgers and amphibious soft-terrain excavators. Dredged materials will be used for embankment which will be carried out by means of building small dikes or temporarily storing them in a spoil bank. The soil stored in the temporary spoil bank will be moved to the final spoil place, embankment sites, depressions as are located at the foot of levees or inspection roads by use of backhoes and dump trucks or swamp bulldozers at need.

Excavation will be executed by use of swamp bulldozers and backhoes to form high-water channel bed. Excavated soils will be transported and dumped to embankment sites nearby, depressions or inspection-road sites by use of swamp bulldozer or backhoes and dump trucks.

Embankment will be made with the materials hauled from excavation sites nearby, transported from the temporary spoil banks or excavated in borrow pits and transported. Forming of levees will be executed by use of bulldozers, vibrating rollers, vibrating plate compactors and manpower. Excess soil after supply to embankment will be used for filling depressions or banking inspection roads.

For revetment works, vibrating pile driver attached to amphibious excavator will be employed.

The drains to be built on the landside of embankment will be executed by manpower.

5.2.2 Execution Plan for Pulau Gambar Canal (S. Kotabangun).

The main works for improvement of Pulau Gambar Canal (S. Kotabangun) are as follows:

Dredging	:	5,600 m^3
Embankment	:	95,200 m^3
Sluice	:	1 place

Dredging will be executed by use of amphibious soft terrain excavators. Embankment will be executed with soils hauled from borrow pits nearby or transported from temporary spoil bank of the Ular river improvement works, and the works will be carried out by bulldozers, vibrating rollers, vibrating compactors and manpower.

5.3 Execution Plan of Irrigation/Drainage Improvement Works

In irrigation/drainage improvement works, major construction works consist of those of intakes, settling basins, irrigation and drainage canals, farm ditches and farm roads. Quantity of the works are summarized as follows:

(1) Intakes

a.	Construction of new intakes	:	2 places
b.	Improvement of the existing intakes	:	1 place
c.	Construction of settling basins	:	10 places
d.	Excavation	:	12,240 m^3
e.	Embankment	:	4,980 m^3
f.	Reinforced concrete works	:	2,280 m^3

(2) Irrigation canals

a. Improvement of the existing canals

Main canals	:	20.4 km
Secondary canals	:	51.5 km

b. Construction of new canals

Main canals	:	2.6 km
Secondary canals	:	158.5 km

c. Excavation : 391,920 m^3

d. Embankment : 244,340 m^3

e. Concrete lining : 6,310 m^3

(3) Drainage canals

a. Improvement of the existing canals

Main canals : 125 km

Secondary canals : 136 km

Collector drains : 18 km

b. Excavation

Main canals : 1,900,000 m^3

Secondary canals : 499,000 m^3

Collector drains : 70,000 m^3

(4) On-farm works

a. Farm ditches : 600 km

b. Farm drains : 600 km

c. Farm roads : 450 km

Allocation of construction power or machinery power and manpower was assumed as follows:

(1) Irrigation improvement works

a. Intakes, settling basins, main canals and new canals in plantation area.

Excavation and embankment : 70% by machinery and 30% by manpower

b. Secondary canals

Excavation and embankment : 25% by machinery and 75% by manpower

c. Farm ditches, farm drains and farm roads : 100% by manpower

(2) Drainage improvement works

a. Main drainage canals

Excavation	:	60% by machinery 40% by manpower

b. Secondary drainage canals

Excavation	:	100% by manpower

The excavation of canals by machinery will be executed with draglines, backhoes and amphibious soft terrain excavators. The embankment of irrigation canals will be carried out with materials excavated from canals by use of bulldozers, vibrating rollers, slope compactors and manpower. The excavated materials from drainage canal will be stored in spoil bank on both sides of the canals by using swamp bulldozers and manpower.

5.4 Construction schedule

The construction schedule proposed for the 7-year plan is given in Fig. 5-1.

(1) Flood Control Works

The construction schedule for flood control works was planned based on the following assumptions.

a. The detailed design will be commenced in January in 1979 and completed by the end of March 1980.

b. Immediately after the completion of the detailed design, the construction works will be started, and they will be completed in five years by March 1985.

The proposed sequence of works of the 7-year plan is as follows from the technical and economic point of view.

1980/81	A half of the stretch from -7.5 km to -2.5 km.
1981/82	The remaining half of the stretch from -7.5 km to -2.5 km and one-third of the stretch from 10.0 km to 15.0 km.
1982/83	Two-thirds of the stretch from 10.0 km to 15.0 km and the stretch from -2.5 km to 0.0 km.
1983/84	The stretch from -11.25 km to -7.5 km and the stretch from 0.0 km to 10.0 km.
1984/85	The stretch from -12.25 km to -11.25 km, the stretch from 15.0 km to 22.65 km, Pulau Gambar Canal and revetment works 1,800 m in length.

Fig. 5 - 1 Construction Schedule for Flood Control and Irrigation / Drainage Improvement Component (7-Year Plan)

Description	1978/79	1979/80	1980/81	1981/82	1982/83	1983/84	1984/85
	10 11 12 1 2 3	4 5 6 7 8 9 10 11 12 1 2 3	4 5 6 7 8 9 10 11 12 1 2 3	4 5 6 7 8 9 10 11 12 1 2 3	4 5 6 7 8 9 10 11 12 1 2 3	4 5 6 7 8 9 10 11 12 1 2 3	4 5 6 7 8 9 10 11 12 1 2 3
Flood Control Component							
1. Detailed design.							
2. Land acquisition and Conpensation							
3. Civil work							
a. Preparatory work.							
b. Dredging and excavation.							
c. Embankment and drains							
d. Revetment.							
e. Sluice							
4. Engineering and administration.							
Irrigation / Drainage Improvement Component							
1. Detailed design.							
2. Land acquisition and compensation.							
3. Civil work							
a Preparatory work.							
b. Irrigation work.							
c. Drainage work.							
d. On-farm work.							
4. Engineering and administration.							

(2) Irrigation Improvement Works

The construction schedule for irrigation/drainage improvement works was planned under same assumptions as the flood control works mentioned previously.

The area 18,500 ha proposed for irrigation improvement is divided into eight areas, and the sequence of the works for the eight areas was proposed as follows from the technical and economical point of view.

1980/81	Sumber Rejo and Ramonia areas.
1981/82	Bendang, Pulau Gambar areas and one-third of Perbaungan area.
1982/83	The remaining two-thirds of Perbaungan area.
1983/84	Two-thirds of Buluh area.
1984/85	The remaining one-third of Buluh area, Singosari and Timbang Deli areas.

Table 5-3 shows the sequence of areas to be dealt with according to the schedule mentioned above.

(3) Drainage Improvement Works

The proposed sequence of drainage improvement works is as follows:

1980/81	Pantai Labu Canal, Sungai Denai and a half of Sungai Perbaungan.
1981/82	A half of Sungai Perbaungan, Kuala Lama Canal, one-fifth of Lubuk Bendang, one-fifth of Sungai Baru and one-tenth of Canal S. Buluh.
1982/83	Four-fifths of Lubuk Bendang, four-fifths of Sungai Baru and four-fifths of Canal S. Buluh.
1983/84	Four-tenths of Canal S. Buluh, three-tenths of Sungai Buluh and two-tenths of Sungai Telukmengkudu.
1984/85	One-tenth of Canal S. Buluh, Sungai Pavda, seven-tenths of Sungai Buluh and eight-tenths of Sungai Telukmengkudu.

Table 5-3 Sequence of Construction by Area (Irrigation)

Construction year	Area	Existing condition			Develop double cropping (ha)
		First cropping		Second cropping (ha)	
		Irrigated (ha)	Rain-fed (ha)		
1980/81	Sumber Rejo	800	1,900	100	2,700
	Ramonia	1,100	600	500	1,700
	Sub-total	1,900	2,500	600	4,400
1981/82	Bendang	1,000	700	900	1,700
	Pulau Gambar	1,200	-	800	1,200
	Perbaungan (1/3)	650	1,180	600	1,830
	Sub-total	2,850	1,800	2,300	4,730
1982/83	Perbaungan (2/3)	1,300	2,370	1,200	3,670
1983/84	Buluh (2/3)	270	2,800	-	3,070
1984/85	Buluh (1/3)	130	1,400	-	1,530
	Singosari	150	550	-	700
	Timbang Del	400	-	400	400
	Sub-total	680	1,950	400	2,630
	Total	7,000	11,500	4,500	18,500

CHAPTER VI

ORGANIZATION AND MANAGEMENT

6.1 Present Organization

The flood control works of the Ular river are at present managed under an organization which was established as Ular River Urgent Flood Control Project (hereinafter referred to as Urgent Project) on the occasion of commencement of the Urgent Project. The office of the Urgent Project is still located in Medan for management, and the site office is located in Perbaungan near the Ular highway bridge for supervision of construction works.

At present, however, the Urgent Project deals with not only the construction works for urgent flood control but also the maintenance of completed part of the river channel improvement works. In addition, as mentioned in paragraph 3.5 of Chapter III, flood information is dealt with by the Urgent Project.

The existing river structures on the Ular have been operated and managed by three organizations; one is the Urgent Project, another is Deli/Serdang District Service (Seksi Deli/Serdang) under the control of the Public Works Service of North Sumatra Province and other is the PNP. As a part of maintenance work for the river channel, the Urgent Project has been trying to plant low-height vegetation on the major beds because usual plant regrows very rapidly if they are left as they are after they were once cut.

The existing irrigation facilities in the project area have been managed by two organizations; one is Public Works Service of North Sumatra Province and the other is the District administration.

The Public Works Service of North Sumatra Province is responsible for giving services of operation and maintenance to the areas commanded by Pulau Gambar, Perbaungan and Timbang Deli Intakes through the Subdivisions under the control of the Public Works Service and to the areas commanded by Sumber Rejo, Bendang and Ramonia Intakes through Deli/Serdang District Service (Seksi Deli/Serdang).

The District administration is responsible for the operation and maintenance of the areas commanded by Swadaya and Buluh Intakes. Besides, for the operation of irrigation facilities, Irrigation Committees have been organized respectively at the levels of District, Subdistrict and the tertiary irrigation block.

6.2 Organization for Implementation of Project

The Ministry of Public Works and Electric Power will entirely be responsible for implementation of the project, and necessary

consultations will made to the organizations concerned. On this occasion, the present organization for the Urgent Project will be developed to the new project of Ular River Flood Control and Improvement of Irrigation Project. For implementing the project, an organization indicated in Fig. 6-1 is proposed.

The Directorate General of Water Resources Development will be the executing agency for the project. The Directorate of Rivers under the control of the Directorate General of Water Resources Development will take charge of coordination with all the relevant government agencies and regional administrative organizations in implementing the project.

The project manager will be appointed by the Ministry to take all the responsibilities to the Ministry for implementing the project properly. The vice-project manager will be appointed to support the project manager and the site manager will be appointed to take charge of supervision of the execution of works.

The staffs will support the project manager in execution of detailed survey, design and planning, preparation of tender documents and specifications for civil works, preparation of tender documents and specifications for equipment, materials and spare parts if necessary and land acquisition. The site engineers and the project staffs will support the site manager in supervision of construction works.

As the staffs of the Urgent Project are now experienced in river improvement field, this function must be utilized efficiently in executing the improvement works. As for the irrigation and drainage field, however, not only the existing function of the Urgent Project is utilized as much as possible, but also the function will have to be strengthened in the organization.

Foreign consultants will have to be employed to assist the implementation of the project including the field of detailed design and supervision. The organization therefore is also indicated in Fig. 6-1.

6.3 Organization for Operation and Maintenance

An organization shown in Fig. 6-2 is proposed for managing the facilities constructed or improved by the project.

The management of the flood control facilities will be entrusted by the Ministry to the provincial government. For maintaining the carrying capacity of the high-water channel, special attention will be paid because plants will grow very rapidly. In connection with the operation and maintenance of the irrigation and drainage facilities, the existing organization of irrigation committees would be maintained.

Fig. .6-1 Organiation Chart for Implementation of the Project

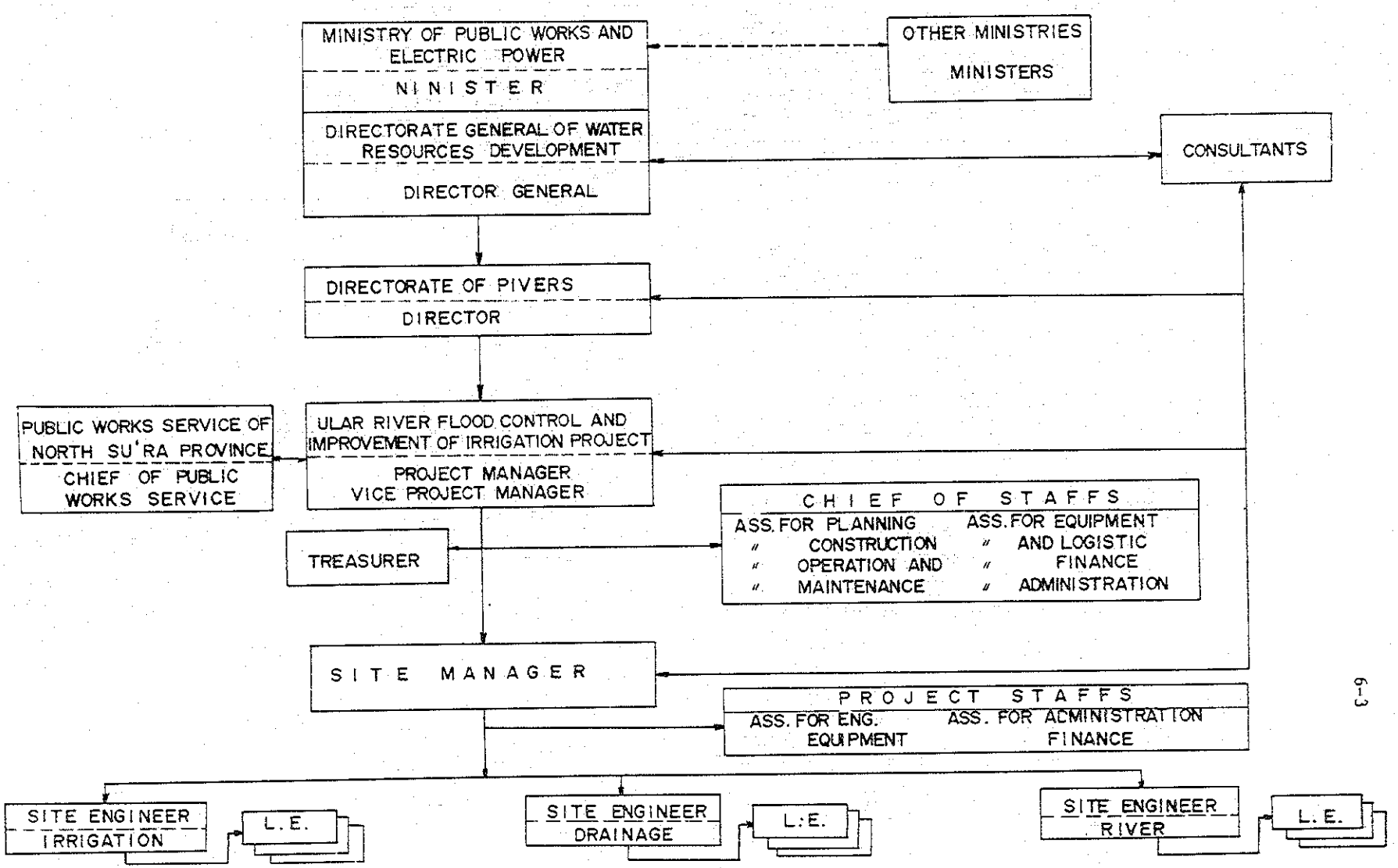
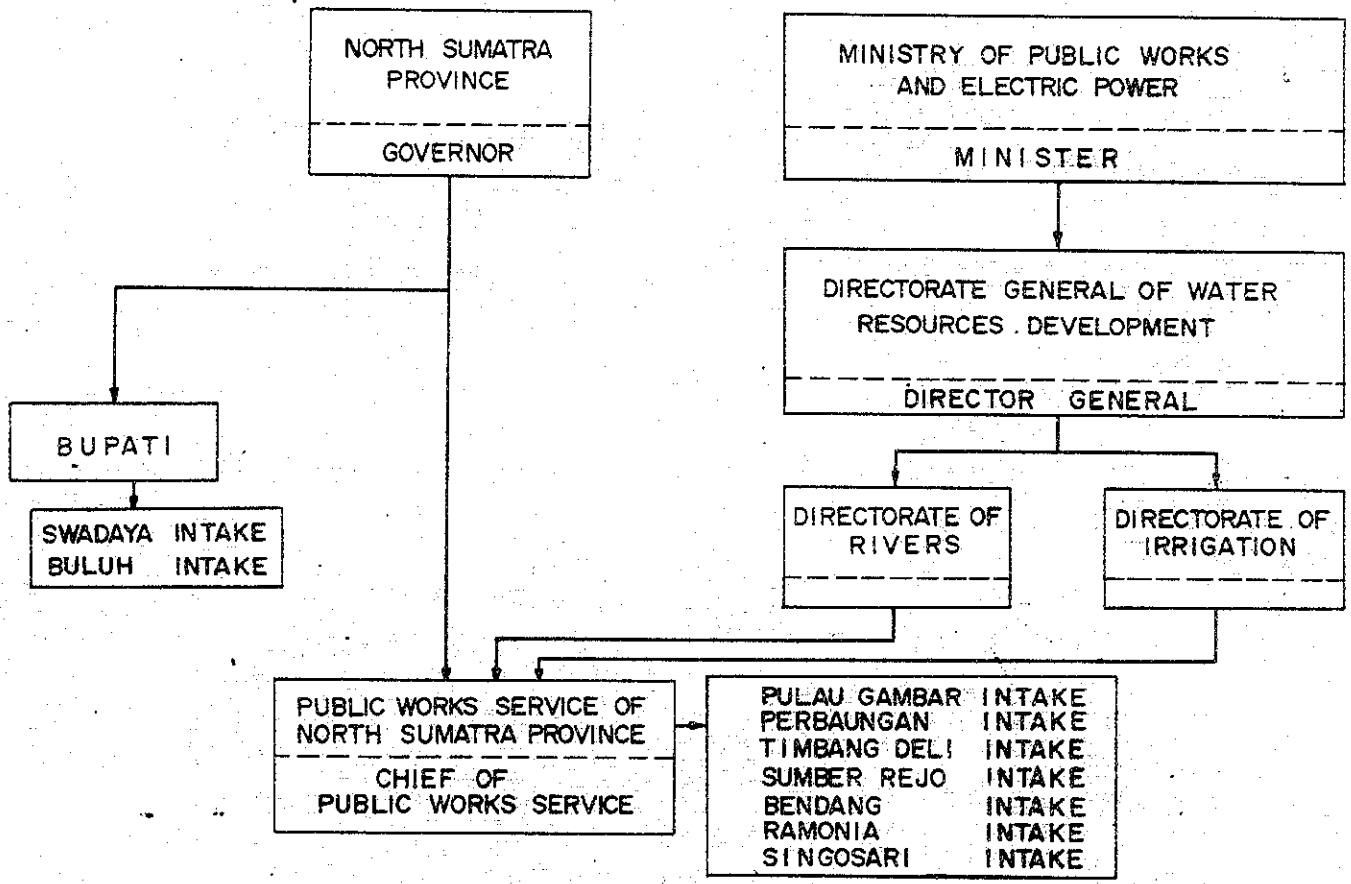


Fig. 6-2 Organization Chart for Administration and Operation after Completion of Project



6.4 Agricultural Support System

It is strongly recommended to establish the Agricultural Development Center (ADC) in and around the project area as early as possible. The existing Provincial Seed Center located at Tanjung Morawa in Deli/Serdang District would be proposed to be reorganized into ADC having the functions of experiment and training at provincial level in addition to the current function of seed multiplication.

On the proposed ADC, at least three subject-matter specialists will be appointed to assist, advise and train the Field Extension Workers (PPL) as well as undertake the adaption tests and/or trails of recommended varieties, new irrigation farming and plant protection methods in and around the project area.

The present number of 7 Rural Extension Centers in the project area would be reasonable but not sufficient in facilities. The necessary supplemental facilities would also be supplied in order to facilitate extension activities effectively and efficiently for the successful implementation of the project.

Other organizations of agricultural support system such as BRI, P.N. Pertani and P.T. Pusri could be improved by themselves following the development stages of the project.

CHAPTER VII

COST ESTIMATE

7.1 General

The cost of the project is composed of the costs required for construction and those required for operation, maintenance and replacement. The construction costs are composed of those required for land, civil works, engineering and administration and contingency. The costs for civil works are composed of depreciation and operation cost of construction equipment, cost for spare parts including those for the existing equipment, labor cost, cost for materials, cost for technicians and other cost for contractors. The cost for engineering and administration includes the cost for foreign consultants.

The construction cost of the project was estimated dividing the project into the two components of flood control and irrigation/drainage improvement. All the costs were calculated on the following assumptions and at the 1977-price.

a. The execution of works is carried out based on the full-contracting system mentioned in the previous paragraph 5.1.1,(1).

b. The construction schedule is mentioned in the previous paragraph 5.4.

c. The major part of construction equipment and their spare parts are prepared and borne by contractors. Some existing equipment available for this project are lent to the contractors by the Government and the maintenance including procurement of necessary spare parts is made by the contractors during the period of use of equipment.

The estimated costs were classified into two portions of local and foreign currency. The costs in foreign currency portion were counted in US Dollars. The following conversion rates were used.

US$ 1 = Rp 415 = ¥241.

The local currency portion is composed of cost for land acquisition and compensation, cost for domestic labor, cost for materials, cost for engineering and administration of the executing agency including costs for foreign consultants such as per diem and general expenses in the site, other costs such as those for contractors and contingency. Construction materials except rain gages, water-level gages and radio telephones were planned to be procured at local markets.

The foreign currency portion is composed of cost for construction equipment on the basis of depreciation estimated at CIF price at Belawan and life of equipment, cost for spare parts for construction

equipment including spare parts for the existing equipment available for the project, special materials such as observation instruments (rain gages and water-level gages) and communication instruments (radio telephones), cost for technicians for execution of the works, cost for foreign consultants including costs for procuring instruments for survey and laboratory use and cars required on the occasion of detailed design and supervision and contingency. The cost for foreign consultants' services consists of remuneration and out-of pocket expenses for the leader of consultants, surveying engineers, civil engineers, hydrologists, design engineers for river and irrigation/drainage, construction engineers, staffs for general affairs and other specialists.

7.2 Construction Cost

The cost for land acquisition and compensation was estimated based on the unit prices for similar works in this area and the area required for this project as described in the previous paragraphs 3.4 and 4.6. The estimated costs for land acquisition and compensation are shown in Table 7-1 for the flood control component and Table 7-2 for the irrigation/drainage component.

The costs for civil works were estimated based on quantity of works which were obtained in the paragraphs 3.3 and 4.5 and unit costs which were estimated from costs required for labor, materials, depreciation of equipment, spare parts, technicians for execution, operation of equipment and contractor's cost. The cost for operation of equipment includes operator, fuel and consumables.

The adopted unit prices of labor and materials are shown in Tables 7-3 and 7-4. The major construction equipment to be used for both the flood control and irrigation/drainage improvement works are listed in Table 7-5 together with the description of hourly depreciation cost and life time. Spare parts in this table are those which are required for a machine during its life time including overhaul and minor repair, and the percentage (%) is a ratio of cost for spare parts to the cost for purchase of the machine. The unit operation costs used in this estimation are shown in Table 7-6 classifying them into the two portions of local and foreign currency.

The unit costs for major different types of work were thus estimated from operation of equipment and unit operation cost. Table 7-7 gives the unit costs employed for the cost estimate of civil works in the flood control component and Table 7-8 gives the unit costs employed for the cost estimate of civil works in the irrigation/drainage improvement component.

The preparatory work in the civil work is composed of such works as transportation roads, access roads, office and quarters, topographic survey and clearing. Table 7-9 shows the preparatory work for flood control and Table 7-10 the preparatory work for

Table 7-1 Cost for Land Acquisition and Compensation
(Flood Control)

1977-price

Stretch	Land												House		Others	Total
	Paddy		Other productive		Unproductive		Swamp		Residential		Sub-total					
	Area (ha)	Cost (10^3Rp)	Area (ha)	Cost (10^3Rp)	Area (ha)	Cost (10^3Rp)	Area (ha)	Cost (10^3Rp)	Area (ha)	Cost (10^3Rp)	Area (ha)	Cost (10^3Rp)	(nos)	Cost (10^3Rp)	(10^3Rp)	(10^3Rp)
Left side																
-12.25 km to -11.25 km	10.5	4,725	0	0	3.3	660	0	0	0.6	900	14.4	6,285	5	750	371	7,406
-11.25 km to -7.5 km	24.2	10,890	9.4	2,820	2.3	460	7.7	1,155	1.7	2,550	45.3	17,875	11	1,650	1,278	20,803
-7.5 km to -2.5 km	44.9	20,205	0	0	1.1	220	7.3	1,095	0.6	900	53.9	22,420	9	1,350	1,246	25,016
-2.5 km to 0.0 km	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.0 km to 10.0 km	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10.0 km to 15.0 km	26.4	11,880	10.5	3,150	38.1	7,620	0	0	0	0	75.0	22,650	0	0	1,948	24,598
15.0 km to 19.0 km	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19.0 km to 22.65 km	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pulau Gambar	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sub-total	106.0	47,700	19.9	5,970	44.8	8,960	15.0	2,250	2.9	4,350	188.6	69,230	25	3,750	4,843	77,823
Right side																
-12.25 km to -11.25 km	8.7	3,915	0	0	6.8	1,360	0	0	0	0	15.5	5,275	2	300	294	5,869
-11.25 km to -7.5 km	38.4	17,280	7.7	2,310	2.7	540	0	0	0.2	300	49.0	20,430	2	300	1,356	22,086
-7.5 km to -2.5 km	32.9	14,805	6.7	2,010	7.1	1,420	0	0	1.4	2,100	48.1	20,335	10	1,500	1,144	22,979
-2.5 km to 0.0 km	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.0 km to 10.0 km	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10.0 km to 15.0 km	22.5	10,125	1.8	540	18.6	3,720	0	0	2.5	3,750	45.4	18,135	29	4,350	1,933	24,418
15.0 km to 19.0 km	38.7	17,415	8.9	2,670	0	0	0	0	3.0	4,500	50.6	24,585	10	1,500	1,486	27,571
19.0 km to 22.65 km	2.8	11,260	5.0	1,500	0	0	0	0	0	0	7.8	2,760	22	3,300	1,088	7,148
Pulau Gambar	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5,106	5,106
Sub-total	144.0	64,800	30.1	9,030	35.2	7,040	0	0	7.1	10,650	216.4	91,520	75	11,250	12,407	115,177
Total	250.0	112,500	50.0	15,000	80.0	16,000	15.0	2,250	10.0	15,000	405.0	160,750	100	15,000	17,250	193,000

Table 7-2 Cost for Land Acquisition and Compensation (Irrigation/Drainage)

1977-price

Name of Area	Irrigated Area		Rainfed Area		Plantation Area		Swampy Are		Oil palm		Rubber		House	Others	Total
	Area (ha)	Cost (10^3Rp)	Area (ha)	Cost (10^3Rp)	Area (ha)	Cost (10^3Rp)	Area (ha)	Cost (10^3Rp)	No.	Cost (10^3Rp)	No.	Cost (10^3Rp)	(10^3Rp)	(10^3Rp)	(10^3Rp)
1. Irrigation work															
a. Pulau Gamber and Swadaya area	1.8	900	-	-	-	-	-	-	-	-	-	-	-	-	900
b. S. Buluh area	2.0	1000	20.7	6210	10.9	5450	-	-	2894	18090	1860	4190	-	-	34,940
c. Timbang Deli area	0.6	300	-	-	-	-	-	-	-	-	-	-	-	-	300
d. Perbaungan area	6.7	3350	12.3	3690	2.3	1150	-	-	631	3940	360	810	-	-	12,940
e. Sumbar Rejo area	2.5	1250	5.8	1740	1.0	500	-	-	371	2320	-	-	-	-	5,810
f. Bendung area	2.3	1150	1.6	480	-	-	-	-	-	-	-	-	-	-	1,630
g. Singosari area	0.6	300	2.2	660	1.3	650	-	-	482	3010	-	-	-	-	4,620
h. Ramonia area	2.5	1250	1.3	390											1,640
Sub total	19.0	9500	43.9	13170	15.5	7750	-	-	4378	27360	2220	5000	-	-	62,780
2. Drainage work															
a. S. Perbaungan	11.6	5800	22.0	6600	-	-	3.4	340	-	-	-	-	33860	14120	60,720
b. Canal S. Buluh	25.4	12700	50.0	15000	38.0	19000	7.6	760	5100	31880	14500	32630	4670	35340	151,980
c. S. Buluh	5.1	2550	8.0	2400	2.1	1050	8.3	830	300	1880	780	1760	4140	4430	19,040
d. S. Teluk Mengkudu	6.8	3400	11.0	3300	-	-	-	-	-	-	-	-	970	2330	10,000
e. S. Pavdo		0	4.4	1320	-	-	-	-	-	-	-	-	19140	6200	26,660
f. S. Denai, Paluk Babi	4.0	2000	7.7	2310	3.3	1650	1.5	150	1220	7630	-	-	-	4170	17,910
g. Kwala Lama, Pematang Kasih	8.0	4000	16.3	4890	6.8	3400	3.1	310	2520	15750	-	-	-	8590	36,940
h. S. Sijenggi, L. Sabah	4.0	2000	7.7	2310	3.3	1650	1.5	150	1220	7630	-	-	-	4170	17,910
i. S. Baru, S. Mayang	3.0	1500	5.5	1650	2.4	1200	1.1	110	890	5560	-	-	-	3040	13,060
Sub total	67.9	33950	132.6	39780	55.9	27950	26.5	2650	11250	70330	15280	34390	62780	82390	354,220
Total	86.9	43450	176.5	52950	71.4	35700	26.5	2650	15628	97690	17500	39390	62780	82390	417,000

Table 7-3 Unit Price of Labor (8-hour work per day)

1977-price

	Description	Unit price
a.	Foreman	: Rp 1,000
b.	Skilled labor	: " 750
c.	Semi skilled labor	: " 600
d.	Common labor	: " 500
e.	Operator	: " 1,500
f.	Mechanic	: " 1,500
g.	Driver	: " 1,200
h.	Carpenter	: " 800

Table 7-4 Unit Price of Materials

1977-price

	Description	Unit	Price
a.	Cement	ton	Rp 40,000
b.	Steel bar (19 mm)	ton	" 350,000
c.	Log (6 m x 9 cm)	m^3	" 75,000
d.	Aggregate (20 to 40 mm)	m^3	" 4,500
e.	Aggregate (sand)	m^3	" 3,000
f.	Light oil	l	" 25
g.	Petrol	l	" 70
h.	Engine oil (diesel)	l	" 650
i.	Grease (multi-purpose)	kg	" 900
j.	Gear oil	l	" 1,000

Table 2-5 Hourly Depreciation Cost of Equipment and Spare Parts

Equipment (a)	1977-price CIF Belawan (1977-prices) (b) (US$)	Hourly depreciation cost (c) (US$/hr)	Spare parts (b) × % (%)	Life-time of equipment (hours)
Bulldozer, swamp-15 t	87,137	12.07	92	6,500
Bulldozer, swamp-12 t	66,390	9.19	92	6,500
Backhoe, swamp, 0.5 m^3	62,241	8.62	64	6,500
Dragline, swamp, 0.6 m	66,390	7.97	64	7,500
Amphibious dredger, w/pipe	373,444	28.01	68	12,000
Amphibious soft terrain excavator, 0.4 m^3	107,884	14.94	68	6,500
Dump truck, 4 × 4, 6 t	18,672	2.80	72	6,000
Vibrating roller, 2.5 t	11,203	1.68	68	6,000
Vibrating roller, 1 t	6,224	0.85	68	6,000
Vibrating plate compactor for soil, 50kg	830	0.12	56	6,000
Vibrating pile driver/extractor, 15 kw	12,864	1.40	68	8,000
Portable concrete mixer, 0.3 m	9,959	1.38	56	6,500

Notes: Spare parts are those which are required for a machine during its life time and include overhaul and minor repair.

Percentage (%) in the column of Spare parts is a ratio of cost for spare parts to the cost for purchase of a machine.

Table 7-6 Unit Operation Cost (Full-contracting System; 7-year Plan)

1977-price

Equipment	Hourly capacity (m^3/hr)	Unit operation cost L.C. Labor, etc (Rp/m^3)	L.C. Consumable material (Rp/m^3)	F.C. Equipment and spare part ($/$m^3$)	F.C. Technician ($/$m^3$)
1. Amphibious dredger	30	53	56	1,719	0.032
2. Amphibious soft terrain excavator	25	38	35	1,049	0.022
3. Bulldozer swamp-12t					
a. Long distance excavation	35	22	18	0.531	0.013
b. Short distance excavation	50	15	12	0.372	0.009
c. Spreading	70	11	9	0.266	0.007
4. Bulldozer swamp-15t					
a. Long distance excavation	35	22	24	0.697	0.013
b. Short distance excavation	50	15	17	0.488	0.009
c. Spreading	70	11	12	0.349	0.007
5. Backhoe, swamp, 0.5 m	30	18	18	0.492	0.011
6. Dragline	30	17	21	0.498	0.010
7. Drump truck,4×4, 6t					
a. L = 1 km	8	20	120	0.630	0.013
b. L = 3 km	5	32	192	1,008	0.020
c. L = 5 km	3.5	46	274	1,440	0.029
d. L = 10 km	2.5	64	384	2,016	0.040
8. Vibration roller 1t	13	36	28	0.115	0.022
9. Vibration roller 2.5t	20	24	28	0.148	0.015

Equipment	Hourly capacity (m^3/hr)	Unit operation cost			
		L.C.		F.C.	
		Labor, etc (Rp/m^3)	Consumable material (Rp/m^3)	Equipment and spare part ($/m^3$)	Technician ($/m^3$)
10. Vibration plate tamper	2.6	62	56	0.077	0.038
11. Vibration pile driver	3 pcs/hr	313 Rp/pcs	288 Rp/pcs	0.817 $/pcs	0.187 $/pcs
12. Excavation	-	440	50	-	0.265

Table 7-7 Unit Cost of Flood Control Works
(Full-Contracting System;
7-year plan)

1977-price

Description	Unit	Unit cost L.C (Rp/m^3)	Unit cost F.C ($/$m^3$)	Total (Rp/m^3)
1. Dredging				
a. Amp. dredger (to emb. direct)	m^3	109	1,751	836
b. Amp. dredger (to emb. by bull. backh. and DT-3km)	m^3	399	3,721	1,943
c. Amp. dredger (to emb. by bull. backh. and DT-5km)	m^3	495	4,162	2,222
d. Amp. dredger (to spoil bank by full, backh. and DT-1km & bull)	m^3	337	3,651	1,852
e. Amp. dredger (to spoil bank by bull)	m^3	131	2,066	988
f. Amp. excavator (to emb. by bull.)	m^3	116	1,698	821
g. Amp. excavator (to emb. by bull. backh. and DT-1km)	m^3	279	2,656	1,381
2. Excavation				
a. Bulldozer (to emb. direct)	m^3	43	0.627	303
b. Bulldozer (to emb. by backh. and DT-1km)	m^3	206	1,585	865
c. Bulldozer (to emb. by backh. and DT-3km)	m^3	290	1,970	1,108
d. Bulldozer (to emb. by backh. and DT-5km)	m^3	386	2,411	1,387
e. Bulldozer (to emb. by backh. and DT-10km)	m^3	514	2,998	1,758

Description	Unit	Unit cost L.C (Rp/m^3)	F.C ($/$m^3$)	Total (Rp/m^3)
f. Bulldozer (to emb. by backh. and DT-1km & bull.)	m^3	228	1,900	1,017
3. Embankment				
a. Com. by V & T and sod.	m^3	228	0.285	346
b. Com. by V & T & bull. for 1/2 of volume and sod.	m^3	240	0.443	424
c. Comp. by V & T & bull and sod.	m^3	250	0.600	499
d. Amp. dredger	m^3	349	2,194	1,260
4. Revetment	m	26,600	6,774	29,411 Rp
5. Drains	m^3	490	0.265	600

Notes : a. b. c. d. e. f. are types of works.

Amp. dredger	= Amphibious dredger
Emb.	= Embankment
Bull.	= Bulldozer
Backh.	= Backhoe
DT-1 km	= Dump track 1 km
DT-3 km	= Dump track 3 km
DT-5 km	= Dump track 5 km
Amp. excavator	= Amphibious terrain excavator
DT-10 km	= Dump track 10 km
Com.	= Compaction
V	= Vibration roller
T	= Vibration tamper
Sod.	= Sodding

Table 7-8 Unit cost of Irrigation/Drainage Improvement Works
(Full-contracting System; 7-year Plan)

1977-price

Item	Unit	Unit Cost L.C.	Unit Cost F.C.	Remarks
1. Irrigation canal				
a. Excavation by machinery	m^3	84	1.16	Bachhoe ($0.5m^3$), swamp bulldozer (12t)
b. Excavation by man-power (A)	m^3	246	0.10	
c. Excavation by man-power (B)	m^3	466	0.18	
d. Embankment by machinery	m^3	357	0.78	Dump Truck (6t), vibrating roller (1t), vibrating plate compactor (50kg)
e. Embankment by man-power (A)	m^3	328	0.09	
f. Embankment by man-power (B)	m^3	588	0.17	
2. Drains				
a. Excavation by machinery (A)	m^3	88	1.11	Dragline ($0.6m^3$), swamp bulldozer (12t)
b. Excavation by machinery (B)	m^3	84	1.16	Backhoe ($0.5m^3$), swamp bulldozer (12t)
c. Excavation by machinery (C)	m^3	129	1.83	Amphibious excavator ($0.4m^3$ swamp bulldozer (12t)
d. Excavation by man-power (A)	m^3	325	0.17	
e. Excavation by man-power (B)	m^3	580	0.28	
3. Reinforced concrete	m^3	21,517	2.76	Port concrete mixer ($0.3m^3$ concrete vibrator (30ϕmm)
4. Plain concrete	m^3	18,044	2.76	Port concrete mixer ($0.3m^3$ concrete vibrator (30ϕmm)
5. Form	m^2	9,054	0.43	
6. Reinforcement bar	ton	375,311	3.90	
7. Stone masonry	m^3	23,829	1.68	

Table 7-9 Cost of Preparatory Work for Flood Control (Full-contracting System, 7-year Plan)

1977-price

Description	Estimated cost		
	L.C. (1,000 Rp)	F.C. (US$)	Total (1,000 Rp)
1. Access road	147,936	308,887	276,124
2. Clearing	78,587	164,090	146,685
3. Others	11,042	23,054	20,609
4. Total	237,565	496,031	443,418

Table 7-10 Cost of Preparatory Work for Irrigation/ Drainage Improvement (Full-contracting System, 7-year Plan)

1977-price

Description	Estimated cost		
	L.C. (1,000 Rp)	F.C. (US$)	Total (1,000 Rp)
1. Office and quarters	23,000	0	23,000
2. Temporary work	117,000	180,000	197,000
3. Survey cost	55,000	0	55,000
4. Total	195,000	180,000	275,000

irrigation/drainage improvement. The miscellaneous work in the civil work includes the cost required for construction of rain-gage stations, water-level-gage stations and VHF-radio stations.

The engineering and administration cost was assumed at about 20% of the sum of the costs for land acquisition and compensation and civil works. The contingency was assumed at 15% of the sum of the costs for land, civil works and engineering and administration.

In conclusion, the construction cost for the flood control component was estimated at Rp 4,414,000,000 except price escalation, consisting of Rp 1,655,000,000 of local currency portion and US$6,648,000 (equivalent to Rp 2,759,000,000) of foreign currency portion at the 1977-price. The cost is shown in Tables 7-11 and 7-12. The construction cost for the irrigation/drainage component was estimated at Rp 8,546,000,000 except price escalation, consisting of Rp 6,437,000,000 of local currency portion and US$5,083,000 (equivalent to Rp 2,109,000) of foreign currency portion at the 1977-price. The cost shown in Tables 7-13 and 7-14.

The annual construction cost was estimated at the 1977-price based on the construction schedule mentioned in 5.4 Tables 7-15 and 7-16 show the annual construction cost for the flood control component and Tables 7-17 and 7-18 show the annual construction cost for the irrigation/drainage component. All the costs do not include price escalation during the construction period.

7.3 Operation, Maintenance and Replacement Cost

The maintenance cost for the flood control facilities after the completion of the project, including clearing works on the major beds, maintenance of low water channel by dredging and operation and maintenance of sluice, was assumed at Rp 25,000,000 per year at the 1977-price.

The operation and maintenance cost for the irrigation and drainage facilities after the completion of construction was assumed at Rp 88,000,000 at the 1977-price including those foroperation and maintenance of the intakes, maintenance of the approach canals and setting basins by dredging, maintenance of the irrigation canals, operation and maintenance of the related irrigation structures, maintenance of the drainage canals, operation and maintenance of the related drainage structures, and maintenance of the farm ditches, the farm drains and the far roads.

The amount of operation and maintenance cost in the irrigation and drainage sector during the construction period was assumed to be proportional to the area developed. The annual disbursement schedule of the operation and maintenance cost for the irrigation and drainage facilities is shown below.

Table 7-11 Construction Cost for Flood Control Component (1); (Full-contracting System, 7-year Plan)

1977-price

Description	Cost		
	L.C. (10^3Rp)	F.C. (US$)	Total (10^3Rp)
1. Land acquisition and compensation	193,000	-	193,000
2. Civil work	1,052,763	4,515,151	2,926,551
a. Preparatory	237,565	496,031	443,418
b. Dredging	121,551	1,567,232	771,953
c. Excavation	124,901	1,077,620	527,114
d. Embankment	339,500	863,312	697,774
e. Revetment	47,880	12,193	52,940
f. Drains	66,147	35,781	80,996
g. Sluice	26,000	45,643	44,942
h. Miscellaneous	115,367	354,610	262,530
3. Engineering and administration	193,348	1,265,783	718,648
4. Contingency	215,867	867,140	575,730
Total	1,654,978	6,648,074	4,413,929

Notes : L.C. denotes local currency. F.C. denotes foreign currency.

The cost does not include price escalation during the construction period.

Engineering and administration include an amount of US$ 159,883 as the cost for procuring instruments and cars.

Table 7-12 Construction Cost for Flood Control Component (2); (Full-contracting System, 7-year Plan)

1977-price

Description	L.C. (1,000 Rp)	F.C. (US$)	Total (1,000 Rp)
1. Land	193,000	-	193,000
2. Civil work	1,052,763	4,515,151	2,926,551
a. Labor, etc. (including technician)	397,030	232,574	493,548
b. Materials	665,733	128,631	709,115
c. Depreciation of equipment	-	2,786,065	1,156,217
d. Spare parts	-	1,367,881	567,671
3. Engineering and administration	193,348	1,265,783	718,648
a. Instrument for survey and laboratory use	-	83,000	34,445
b. Cars	-	76,883	31,906
c. Engineering and administration	193,348	1,105,900	652,297
4. Contingency	215,867	867,140	575,730
Total	1,654,978	6,648,074	4,413,929

Notes : L.C. denotes local currency. F.C. denotes foreign currency.

The cost does not include price escalation during the construction period.

F.C. of Materials is the cost required for rain gages, water-level gages and radio telephones.

F.C. of Labor is the cost for foreign technicians.

Table 7-13 Construction Cost for Irrigation/Drainage (2)
(Full-contracting System)

1977-price

Item	Local Currency (10^3Rp)	Foreign Currency (US$)	Total (10^3Rp)
1. Land acquisition and compensation expenses	417,000	-	417,000
2. Civil work	4,551,030	2,947,350	5,774,180
a. Preparatory work	195,000	180,000	269,700
b. Irrigation work	1,480,060	356,320	1,627,933
c. Drainage work	1,103,340	2,069,590	1,962,220
d. On-farm work	1,387,500	-	1,387,500
e. Miscellaneous work	385,130	341,440	526,827
3. Engineering and administrative expenses	629,470	1,472,290	1,240,470
4. Contingency	839,630	662,950	1,114,754
Total	6,437,130	5,082,590	8,546,404

Notes: The cost does not include price escalation during the construction period.

Engineering and administration include an amount of US$ 94,791 as the cost for procuring instruments and cars.

Table 7-14 Construction Cost for Irrigation/Drainage Component (2); (Full-contracting system, 7-year Plan)

1977-price

Description	L.C. (1,000 Rp)	F.C. (US$)	Total (1,000 Rp)
1. Land acquisition and compensation	417,000	-	417,000
2. Civil work	4,551,030	2,947,350	5,774,180
a. Labor, etc. including technicians	2,397,850	478,120	2,596,270
b. Material	2,153,180	-	2,153,180
c. Equipment	-	1,554,447	645,095
d. Spare part	-	914,733	379,635
3. Engineering and administration	629,470	1,472,290	1,240,470
a. Instrument for survey and laboratory use	-	38,410	15,940
b. Cars	-	56,381	23,398
c. Engineering and administration	629,470	1,377,499	1,201,132
4. Contingency	839,630	662,950	1,114,754
Total	6,437,130	5,082,590	8,546,404

Notes : L.C. denotes local currency. F.C. denotes foreign currency.

The cost does not include price escalation during the construction period.

Table 7-15 Annual Construction Cost for Flood Control Component (1) (Full-contracting System; 7-year Plan)

1977-price

Description	1st 1978/79		2nd 1979/80		3rd 1980/81		4th 1981/82		5th 1982/83		6th 1983/84		7th 1984/85		Total	
	L.C. (10^3Rp)	F.C. ($)	L.C. (10^3Rp)	F.C. ($)	L.C. (10^3Rp)	F.C. ($)	L.C. (10^3Rp)	F.C. ($)	L.C. (10^3Rp)	F.C. ($)	L.C. (10^3Rp)	F.C. ($)	L.C. (10^3Rp)	F.C. ($)	L.C. (10^3Rp)	F.C. ($)
1. Land acquisition and compensation	0	0	47,995	0	49,016	0	0	0	42,889	0	53,100	0	0	0	193,000	0
2. Civil work	0	0	0	0	104,314	745,041	164,817	920,869	179,243	912,736	283,973	987,792	320,416	948,713	1,052,763	4,515,151
a. Preparatory work	0	0	0	0	23,632	70,336	38,437	105,098	41,338	103,898	56,661	110,038	77,497	106,661	237,565	496,031
b. Dredging	0	0	0	0	32,955	389,384	38,696	460,693	23,044	295,324	16,258	253,211	10,598	168,620	121,551	1,567,232
c. Excavation	0	0	0	0	8,621	81,139	26,415	224,231	39,672	337,033	34,057	320,968	16,136	114,249	124,901	1,077,620
d. Embankment	0	0	0	0	22,795	32,174	39,647	67,954	51,419	113,641	111,984	218,673	113,655	430,870	339,500	863,312
e. Revetment	0	0	0	0	0	0	0	0	0	0	0	0	47,880	12,193	47,880	12,193
f. Drains	0	0	0	0	7,153	3,869	7,154	3,870	8,036	4,347	40,080	21,681	3,724	2,014	66,147	35,781
g. Sluice	0	0	0	0	0	0	0	0	0	0	0	0	22,800	53,354	22,800	53,354
h. Miscellaneous	0	0	0	0	9,158	168,139	14,468	59,023	15,734	58,493	24,933	63,221	28,126	60,752	92,419	409,628
3. Engineering and administration	16,559	238,723	66,236	315,360	22,110	142,340	22,110	142,340	22,111	142,340	22,111	142,340	22,111	142,340	193,348	1,265,783
4. Contingency	2,484	35,809	17,135	47,304	26,316	133,107	28,039	159,481	36,636	158,261	53,878	169,520	51,379	163,658	215,867	867,140
5. Total	19,043	274,532	131,366	362,664	201,756	1,020,488	214,966	1,222,690	280,879	1,213,337	413,062	1,299,652	393,906	1,254,711	1,654,978	6,648,074

Table 7-16 Annual Construction Cost for Flood Control Component (2) (Full-contracting System; 7-year Plan)

1977-price

Description	1st 1978/79		2nd 1979/80		3rd 1980/81		4th 1981/82		5th 1982/83		6th 1983/84		7th 1984/75		Total	
	L.C. (10^3Rp)	F.C. ($)	L.C. (10^3Rp)	F.C. ($)	L.C. (10^3Rp)	F.C. ($)	L.C. (10^3Rp)	F.C. ($)	L.C. (10^3Rp)	F.C. ($)	L.C. (10^3Rp)	F.C. ($)	L.C. (10^3Rp)	F.C. ($)	L.C. (10^3Rp)	F.C. ($)
1. Land acquisition and compensation	0	0	47,995	0	49,016	0	0	0	42,889	0	53,100	0	0	0	193,000	0
2. Civil work	0	0	0	0	104,314	745,041	164,817	920,869	179,243	912,736	283,973	987,792	320,416	948,713	1,052,763	4,515,151
a. Equipment	0	0	0	0	0	398,102	0	594,949	0	586,860	0	610,060	0	596,093	0	2,786,065
b. Spare parts	0	0	0	0	0	195,457	0	292,104	0	288,133	0	299,522	0	292,665	0	1,367,881
c. Consumable materials	0	0	0	0	65,304	128,631	107,093	0	114,813	0	150,458	0	218,065	0	655,733	128,631
d. Labor, etc including technician	0	0	0	0	39,010	22,851	57,724	33,816	64,430	37,743	133,515	78,209	102,351	59,955	397,030	232,574
3. Engineering and administration	16,559	238,723	66,236	315,360	22,110	142,340	22,110	142,340	22,111	142,340	22,111	142,340	22,111	142,340	193,348	1,265,783
4. Contingency	2,484	35,809	17,135	47,304	26,316	133,107	28,039	159,481	36,636	158,261	53,878	169,520	51,379	163,658	215,867	867,140
5. Total	19,043	274,532	131,366	362,664	201,756	1,020,438	214,966	1,222,690	280,879	1,213,337	413,062	1,299,652	393,906	1,254,711	1,654,978	6,648,074
	132,974		281,872		625,259		722,382		784,414		952,417		914,611		4,413,929	$\times 10^3$Rp

Notes: The cost does not include price escalation during the construction period.

Engineering and administration include an amount of US$ 159,883 as the cost for procuring instruments and cars.

Table 7-17 Annual Construction Cost for Irrigation/Drainage Component(1) (Full-contracting System; 7-year Plan)

1977-price

Description	1978/79		1979/80		1980/81		1981/82		1982/83		1983/84		1984/85		Total	
	L.C. (10^3Rp)	F.C. ($)	L.C. (10^3Rp)	F.C. ($)	L.C. (10^3Rp)	F.C. ($)	L.C. (10^3Rp)	F.C. ($)	L.C. (10^3Rp)	F.C. ($)	L.C. (10^3Rp)	F.C. ($)	L.C. (10^3Rp)	F.C. ($)	L.C. (10^3Rp)	F.C. ($)
1. Land acquisition and compensation expenses	0	0	86,080	0	106,020	0	73,780	0	0	98,060	53,060	0	0	0	417,000	0
2. Civil work	0	0	14,348	15,820	908,144	567,029	822,659	557,530	802,053	545,979	1,048,187	732,082	955,629	528,910	4,551,030	2,947,350
a. Preparatory work	0	0	13,650	12,600	87,750	81,000	23,400	21,600	23,400	21,600	23,400	21,600	23,400	21,600	195,000	180,000
b. Irrigation work	0	0	0	0	296,860	48,660	264,490	58,490	281,600	62,760	342,770	113,680	294,340	72,730	1,480,060	356,320
c. Drainage work	0	0	0	0	127,586	371,936	158,395	413,078	149,773	398,598	322,504	512,512	345,082	373,466	1,103,340	2,069,590
d. On-farm work	0	0	0	0	319,000	0	306,670	0	279,330	0	270,670	0	211,830	0	1,387,500	0
e. Miscellaneous work	0	0	698	3,220	76,948	65,433	69,704	64,362	67,960	63,021	88,843	84,290	80,977	61,114	385,130	341,440
3. Engineering and and administrative expenses	39,220	211,591	91,500	467,199	99,750	158,700	99,750	158,700	99,750	158,700	99,750	158,700	99,750	158,700	629,470	1,472,290
4. Contingency	5,883	31,739	28,790	72,453	167,088	108,860	149,429	107,435	149,982	105,703	180,150	133,618	158,308	103,142	839,630	662,950
Total	45,103	243,330	220,718	555,472	1,281,002	834,589	1,145,618	823,665	1,149,855	810,382	1,381,147	1,024,400	1,213,687	790,752	6,437,130	5,082,590

Table 7-18 Annual Construction Cost for Irrigation/Drainage Component(2) (Full-contracting System; 7-year Plan)

unit: L.C. = 1,000Rp
F.C. = US$

	1978/79		1979/80		1980/81		1981/82		1982/83		1983/84		1984/85		Total	
	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.	F.C.	L.C.	F.C.
1. Land acquisition and compensation	-	-	86,080	-	106,020	-	73,780	-	98,060	-	53,060	-	-	-	417,000	-
2. Civil work	-	-	14,348	15,820	908,144	567,029	822,659	557,530	802,063	545,979	1,048,187	732,082	955,629	528,910	4,551,030	2,947,350
a. Equipment and spare parts	-	-	-	15,820	-	509,293	-	475,827	-	473,294	-	598,164	-	396,832	-	2,469,230
b. Material	-	-	5,380	-	416,960	-	359,592	-	368,588	-	515,320	-	487,340	-	2,153,180	-
c. Labor etc and technician	-	-	8,968	-	491,184	57,736	463,067	81,703	483,475	72,685	532,867	133,918	468,289	132,078	2,397,850	478,120
3. Engineering and administration	39,220	211,591	91,500	467,199	99,750	158,700	99,750	158,700	99,750	158,700	99,750	158,700	99,750	158,700	629,470	1,472,290
4. Contingency	5,883	31,739	28,790	72,453	167,088	108,860	149,429	107,435	149,982	105,703	180,150	133,618	158,308	103,142	839,630	662,950
5. Total	45,103	243,330	220,718	555,472	1,281,002	834,589	1,145,618	823,665	1,149,855	810,382	1,381,147	1,024,400	1,213,687	790,752	6,437,130	5,082,590
	146,085		451,239		1,627,356		1,487,439		1,486,164		1,806,273		1,541,848		8,546,404	10^3Rp

Notes: The cost does not include price escalation during the construction period.

The cost for engineering and administration includes an amount of US$ 94,791 as the cost for procuring instruments and cars.

Annual Disbursement Schedule of Operation and Maintenance Cost for Irrigation and Drainage Facilities

unit: million Rp

	1980/81	1981/82	1982/83	1983/84	1984/85	1986/87	after 86/87
O.M. cost		21	43	61	76	88	88

The cost required for replacing the facilities for irrigation and drainage within the period of project life was assumed mainly for the gates. Their life year was assumed at 30 years. Since the civil works for the irrigation and drainage improvement are planned to be carried out for the period of 1980/81 through 1984/85, the replacement will be carried out over the five years extending from 2010/11 to 2014/15. The total amount of the cost for replacement was estimated at Rp 90,000,000. As there is no necessity for counting the second replacement by reason that it is beyond the period of project life, the annual disbursement schedule of the replacement cost during the said five years will be as follows.

Annual Disbursement Schedule of Replacement Cost

unit: million Rp

	2010/11	2011/12	2012/13	2013/14	2014/15
Replacement cost	30	14	13	13	20

CHAPTER VIII

ECONOMIC EVALUATION

8.1. General.

The project is composed of the two components of flood control and irrigation/drainage improvement. The following four alternative plans were studied on the way of implementation of the project.

(1) Seven-year construction plan on full-contracting system.

(2) Seven-year construction plan on equipment-lending system.

(3) Five-year construction plan on full-contracting system.

(4) Five-year construction plan on equipment-lending system.

The economic analysis was made on each alternative plan classifying it into three categories of flood control, irrigation/drainage improvement and the entire project. As the result of the analysis, the 7-year plan on full-contracting system has been selected as the most feasible one. In this chapter, therefore, description will be made only on the economic evaluation of the 7-year plan on full-contracting system.

The economic cost and benefit were given at the 1977-price excluding such transfer costs as tax, duty, subsidy and interest. The rate of tax was assumed as shown below based on the Tax Ordinance of Indonesia.

a. Rate of income tax : 10% of income.
   This rate was applied to wage and salary of local staff and employee.

b. Rate of sales tax : 5% of market price.
   This rate was applied to equipment, materials, spare parts and other goods to be procured locally.

The project was planned to commence at the beginning of January 1979 fiscal year and completed at the end of the 1984/85 fiscal year, and the 1978/79 fiscal year was taken as the base year for economic analysis. The economic life of the project was assumed at 50 years after the completion of construction works.

8.2. Economic Cost.

The construction costs given in Chapter VII as the foreign currency portion do not include any import duty, sales tax and other transfer costs. But the construction costs given in Chapter VII as

the local currency portion include some transfer costs. Therefore, the transfer costs were deducted from them.

As a result, the total economic cost of capital to be invested to the construction works was estimated at Rp 12,434 million consisting of Rp 7,566 million as the local currency portion and US$ 11,731,000 (equivalent to Rp 4,868 million) as the foreign currency portion. Among the total economic cost, the economic cost for the flood control component is Rp 4,318 million consisting of Rp 1,559 million as the local currency portion and US$6,648,000 (equivalent to Rp 2,759 million) as the foreign currency portion and the economic cost for the irrigation/drainage component is Rp 8,116 million consisting of Rp 6,007 million as the local currency portion and US$5,083,000 (equivalent to Rp 2,109 million) as the foreign currency portion. These amounts are summarized in Table 8-1.

Table 8-1 Economic Construction Cost of the Project

Unit : Million Rp

Year after base year	Fiscal year	Full-contracting system		
		Flood control	Irrigation & drainage	Total
1	1978/79	131	142	273
2	1979/80	276	441	717
3	1980/81	616	1,543	2,159
4	1981/82	708	1,410	2,118
5	1982/83	769	1,411	2,180
6	1983/84	928	1,713	2,641
7	1984/85	890	1,456	2,346
Total		4,318	8,116	12,434

The economic operation and maintenance cost for the flood control component was estimated at Rp 22 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 5 million for 1981/82, Rp 9 million for 1982/83, Rp 13 million for 1983/84 and Rp 17 million for 1984/85 assuming that they would be given in ratio of the invested partial construction cost to the total construction cost (Table 8-2).

Table 8-2 Economic Operation and Maintenance Cost of the Project

Unit : Million Rp

Year after base year	Fiscal year	7-year plan		
		Flood control	Irrigation & drainage	Total
4	1981/82	5	18	23
5	1982/83	9	37	46
6	1983/84	13	52	65
7	1984/85	17	65	82
8	1985/86	22	76	98
⋮	⋮	⋮	⋮	⋮
55	2032/33	22	76	98
56	2033/34	22	76	98
57	2034/35	22	76	98
Total		1,144	3,972	5,116

Table 8-3 Economic Replacement Cost for Gates of Irrigation Facilities

Unit : Million Rp

Year after base year	Fiscal year	Replacement cost
33	2010/11	28
34	2011/12	13
35	2012/13	12
36	2013/14	12
37	2014/15	19