Table IV-21 FARM INPUTS REQUIREMENTS AT PRESENT (1/2)

		Wet Land Paddy			Dry Land Paddy		
1) Seeds	(kg/ha)			29			38
2) Fertilizers							
- Urea	(kg/ha)			91			63
- T.S.P.	(kg/ha)			12			44
- KCl	(kg/ha)			4			11
3) Agro-chemicals							
- Insecticides/ Fungicide	(l/ha)			2.4			1.6
- Herbicides	(l/ha)			0.2			0.3
4) Labor Force(man-day)		Owend	Hired	Total	Owend	Hired	Total
- Land Preparation		12	5	17	24	5	29
- Nursery		1	0	1	0	0	0
- Seeding		1	0	1	15	3	18
- Transplanting		4	16	20	0	0	0
- Fertilizing		4	0	4	3	0	3
- Weeding		13	10	23	15	6	21
- Spraying		2	2	4	2	0	2
- Harvesting		15	19	34	20	5	25
Total		52	52	104	79	19	98
5) Animal Power	(day)	Owend	Hired	Total	Owend	Hired	Total
- Land Preparation		5.6	4.0	9.6	3.0	2.0	5.0
- Nursery		0.2	0.4	0.6	0.0	0.0	0.0
Total		5.8	4.4	10.2	3.0	2.0	5.0

		Maize			Groundnuts		
1) Seeds	(kg/ha)			28			31
2) Fertilizers							
- Urea	(kg/ha)			51			20
- T.S.P.	(kg/ha)			30			13
- KCl	(kg/ha)			9			0
3) Agro-chemicals							
- Insecticides/ Fungicide	(l/ha)			1.0			1.2
- Herbicides	(l/ha)			0.3			0.1
4) Labor Force(man-day)		Owend	Hired	Total	Owend	Hired	Total
- Land Preparation		25	4	29	16	3	19
- Nursery		0	0	0	0	0	0
- Seeding		12	2	14	7	9	16
- Transplanting		0	0	0	0	0	0
- Fertilizing		5	0	5	1	0	1
- Weeding		17	3	20	12	8	20
- Spraying		2	0	2	2	0	2
- Harvesting		21	5	26	14	10	24
Total		82	14	96	52	30	82
5) Animal Power	(day)	Owend	Hired	Total	Owend	Hired	Total
- Land Preparation		2.5	1.1	3.6	7.6	2.5	10.1
- Nursery		0.0	0.0	0.0	0.0	0.0	0.0
Total		2.5	1.1	3.6	7.6	2.5	10.1

Table IV-21 FARM INPUTS REQUIREMENTS AT PRESENT (2/2)

	Soybeans			Green Beans		
1) Seeds (kg/ha)			27			25
2) Fertilizers						
- Urea (kg/ha)			39			4
- T.S.P. (kg/ha)			53			5
- KCl (kg/ha)			14			2
3) Agro-chemicals						
- Insecticides/ Fungicide (l/ha)			2.6			1.0
- Herbicides (l/ha)			0.0			0.0
4) Labor Force(man-day)	Owend	Hired	Total	Owend	Hired	Total
- Land Preparation	27	4	31	22	1	23
- Nursery	0	0	0	0	0	0
- Seeding	12	2	14	3	2	5
- Transplanting	0	0	0	0	0	0
- Fertilizing	3	0	3	1	0	1
- Weeding	22	7	29	9	1	10
- Spraying	3	2	5	2	0	2
- Harvesting	16	7	23	11	4	15
Total	83	22	105	48	8	56
5) Animal Power (day)	Owend	Hired	Total	Owend	Hired	Total
- Land Preparation	2.2	5.8	8.0	2.9	0.4	3.3
- Nursery			0.0	0.0	0.0	0.0
Total	2.2	5.8	8.0	2.9	0.4	3.3

	Cassava		
1) Seeds (piece/ha)			10,000
2) Fertilizers			
- Urea (kg/ha)			0
- T.S.P. (kg/ha)			0
- KCl (kg/ha)			0
3) Agro-chemicals			
- Insecticides/ Fungicide (l/ha)			0.0
- Herbicides (l/ha)			0.0
4) Labor Force(man-day)	Owend	Hired	Total
- Land Preparation	19	3	22
- Nursery	0	0	0
- Seeding	0	0	0
- Transplanting	13	2	15
- Fertilizing	0	0	0
- Weeding	8	4	12
- Spraying	0	0	0
- Harvesting	19	2	21
Total	59	11	70
5) Animal Power (day)	Owend	Hired	Total
- Land Preparation	0.8	0.3	1.1
- Nursery	0.0	0.0	0.0
Total	0.8	0.3	1.1

Table IV-22 HARVESTED AREA, PRODUCTION AND UNIT YIELD OF MAIN CROPS IN THE STUDY AREA

Crops	Wet Season			Dry Season			Total		
	1986	1987	Average	1986	1987	Average	1986	1987	Average
Harvested Area (ha)									
Lowland Paddy	92	112	102	-	-	-	92	112	102
Upland Paddy	648	904	776	701	143	422	1,349	1,047	1,198
Maize	361	150	255	499	187	343	860	336	598
Groundnuts	69	55	62	139	93	116	208	148	178
Soybeans	215	85	150	356	120	238	571	205	388
Green Beans	50	16	33	66	63	64	116	78	97
Cassava	159	102	131	108	102	105	267	204	236
(Total)	(1,594)	(1,423)	(1,509)	(1,863)	(706)	(1,287)	(3,462)	(2,129)	(2,796)
Production (tons)									
Lowland Paddy	275	290	283	-	-	-	275	290	283
Upland Paddy	738	1,135	937	661	237	449	1,398	1,372	1,385
Maize	479	186	333	533	323	428	1,012	509	761
Groundnuts	48	62	55	115	86	100	163	148	155
Soybeans	126	70	98	254	102	178	381	172	276
Green Beans	29	12	21	38	42	40	67	55	61
Cassava	304	1,337	820	289	1,360	824	592	2,697	1,645
Unit Yield (tons/ha)									
Lowland Paddy	3.0	2.6	2.8	-	-	-	3.0	2.6	2.8
Upland Paddy	1.1	1.3	1.2	0.9	1.7	1.1	1.0	1.3	1.2
Maize	1.3	1.2	1.3	1.1	1.7	1.2	1.2	1.5	1.3
Groundnuts	0.7	1.1	0.9	0.8	0.9	0.9	0.8	1.0	0.9
Soybeans	0.6	0.8	0.7	0.7	0.9	0.7	0.7	0.8	0.7
Green Beans	0.6	0.8	0.6	0.6	0.7	0.6	0.6	0.7	0.6
Cassava	1.9	13.1	6.3	2.7	13.3	7.8	2.2	13.2	7.0

Remark: The crop production in Rantau Kasai village was estimated on the basis of information from village chief, because of no data was available. According to the information from village chief, main crops in this village are upland paddy and rubber. Crops such as maize, groundnuts, vegetables and fruits have been cultivated in home yard, but production of these crops is negligible.

Source: Programa Penyuluhan Pertanian 1987/1988-1988/1989, Balai Penyuluhan Pertanian (BPP) - Dalu-Dalu, Departemen Pertanian Kab. Kampar.

Table IV-23 CROP PRODUCTION OF VEGETABLES AND PERENNIAL CROPS IN THE STUDY AREA

Crops		1986	1987	Average
Harvested Area				
Long Beans	(ha)	26.0	35.4	30.7
Cowpea	(ha)	12.3	14.2	13.3
Long Chilly	(ha)	20.5	36.8	28.7
Patchouli Plant	(ha)	*	1.5	1.5
Orange	(ha)	28.0	31.8	29.9
Rambutan	(ha)	59.0	78.0	68.5
Banana	(ha)	12.0	13.8	12.9
Coconut	(ha)	*	17.9	17.9
Coffee	(ha)	*	5.2	5.2
Papaya	(ha)	*	10.7	10.7
Pineapple	(ha)	13.5	14.4	14.0
Rubber	(ha)	500.0	500.0	500.0
(Total)	(ha)			(733.3)
Production				
Long Beans	(Bundle)	8,578	9,505	9,040
Cowpea	(tons)	6.9	14.6	10.8
Long Chilly	(tons)	10.0	38.8	24.4
Patchouli Plant	(tons)	*	0.3	0.3
Orange	(tons)	24.5	18.5	21.5
Rambutan	(tons)	55.4	65.5	60.5
Banana	(Bunch)	4,400	3,270	3,840
Coconut	(tons)	*	5.4	5.4
Coffee	(tons)	*	0.5	0.5
Papaya	(Pieces)	*	191,700	191,700
Pineapple	(tons)	16,200	14,400	15,300
Rubber	(tons)	100.0	100.0	100.0
Unit Yield				
Long Beans	(Bundle/ha)	330	270	290
Cowpea	(tons/ha)	0.6	1.0	0.8
Long Chilly	(tons/ha)	0.5	1.1	0.9
Patchouli Plant	(tons/ha)	*	0.2	0.2
Orange	(tons/ha)	0.9	0.6	0.7
Rambutan	(tons/ha)	0.9	0.8	0.9
Banana	(Bunch/ha)	370	240	300
Coconut	(tons/ha)	*	0.3	0.3
Coffee	(tons/ha)	*	0.1	0.1
Papaya	(Pieces/ha)	*	17,920	17,920
Pineapple	(tons/ha)	1,200	1,000	1,090
Rubber	(tons/ha)	0.2	0.2	0.2

Source: Programa Penyuluhan Pertanian 1987/1988-1988/1989, Balai Penyuluhan Pertanian (BPP) - Dalu-Dalu, Departemen Pertanian Kab. Kampar.

Table IV-24 FARMGATE PRICES OF FARM INPUTS AND OUTPUTS IN THE STUDY AREA (AS OF AUG. 1988)

(Unit: Rp)

1) Farm Outputs		
Rice	(kg)	650
Paddy *1	(kg)	210
Maize *1	(kg)	175
Groundnuts*1	(kg)	680
Soybeans *1	(kg)	500
Green beans *1	(kg)	600
Cassava	(kg)	50
Rubber	(kg)	750
Chilly	(kg)	1,000
2) Seed		
Paddy	(kg)	220
Maize	(kg)	210
Groundnuts	(kg)	1,000
Soybeans	(kg)	640
Green beans	(kg)	680
Cassava *2	(picec)	2
Chilly	(kg)	1,000
3) Fertilizers		
Urea	(kg)	135
T.S.P.	(kg)	135
KCl	(kg)	135
4) Agro-chemicals		
Insecticide	(liter)	5,000
Fungicide	(liter)	5,000
Herbicide	(liter)	5,000
Rodenticide	(kg)	5,000
5) Hired Labor*3	(man-day)	
Land preparation		2,000
Nursery preparation		2,000
Seeding		1,500
Transplanting of paddy		1,500
Fertilizing		1,500
Weeding		1,500
Spraying		1,500
Harvesting/Drying		2,000
6) Others		
Hired animal	(day)	3,000
Milling charge	(kg)	31
Transportation cost of crops		
SKP-E - Dalu-Dalu:	(kg)	30
Dalu-Dalu - Pasirpangarayan:	(kg)	15

Remarks:
- *1 Farm gate price of dry grain.
- *2 No data was available. The price was estimated at Rp 2/picec.
- *3 Including 2 times of meal.

Sources:
- (1) Perkembangan Harga Komoditi Tanaman Pangan Tahun 1987, Dinas Pertanian Tanama Pangan, Propinsi Riau, 1988.
- (2) Harga Pesticida Bersubsidi Surat Direksi PT Pertani (Persero) No 1976 Sap/01.21, Juli 1988.
- (3) Buku Pedoman, Pengadaan Pangan / Palawija, Departemen Koperasi, 1987/1988.
- (4) Results of farm interview survey.

Table IV-25 CROP BUDGET PER HECTARE - PRESENT CONDITION

		Unit Price (Rp)	Wet Land Paddy Q'ty	Wet Land Paddy Value (Rp)	Dry Land Paddy Q'ty	Dry Land Paddy Value (Rp)	Maize Q'ty	Maize Value (Rp)	Groundnuts Q'ty	Groundnuts Value (Rp)	Soybeans Q'ty	Soybeans Value (Rp)	Green Beans Q'ty	Green Beans Value (Rp)	Cassava Q'ty	Cassava Value (Rp)
I. Gross Income																
1) Unit Yield	(ton/ha)		2.8		1.2		1.3		0.9		0.7		0.6		7.0	
2) Unit Price	(Rp/ton)		210,000		210,000		175,000		680,000		500,000		600,000		50,000	
3) Gross Income	(Rp)		588,000		252,000		227,500		612,000		350,000		360,000		350,000	
II. Production Cost																
1) Seed	(kg)	- *1	29	6,400	38	8,400	28	5,900	31	31,000	27	17,300	25	17,000	10,000	20,000
2) Fertilizers																
- Urea	(kg)	135	91	12,300	63	8,500	51	6,900	20	2,700	39	5,300	4	500	-	-
- T.S.P.	(kg)	135	12	1,600	44	5,900	30	4,100	13	1,800	53	7,200	5	700	-	-
- KCl	(kg)	135	4	500	11	1,500	9	1,200	-	-	14	1,900	2	300	-	-
3) Agro-chemicals																
- Insecticides	(ltr.)	5,000	2.4	12,000	1.6	8,000	1.0	5,000	1.2	6,000	2.6	13,000	1.0	5,000	-	-
- Herbicides	(ltr.)	5,000	0.2	1,000	0.3	1,500	0.3	1,500	0.1	500	-	-	-	-	-	-
4) Labor	(man-day)															
- Land Preparation		2,000	17	34,000	29	58,000	29	58,000	19	38,000	31	62,000	23	46,000	22	44,000
- Nursery		2,000	1	2,000	-	-	-	-	-	-	-	-	-	-	-	-
- Seeding		1,500	1	1,500	18	27,000	14	21,000	16	24,000	14	21,000	5	7,500	15	22,500
- Transplanting		1,500	20	30,000	-	-	-	-	-	-	-	-	-	-	-	-
- Fertilizing		1,500	4	6,000	3	4,500	5	7,500	1	1,500	3	4,500	1	1,500	21	-
- Weeding		1,500	23	34,500	21	31,500	20	30,000	20	30,000	29	43,500	10	15,000	12	18,000
- Spraying		1,500	4	6,000	2	3,000	2	3,000	2	3,000	5	7,500	2	3,000	-	-
- Harvesting		2,000	34	68,000	25	50,000	26	52,000	24	48,000	23	46,000	15	30,000	21	42,000
5) Animal Power	(day)	3,000	10.3	30,900	5.0	15,000	3.6	10,800	10.1	30,300	8.0	24,000	3.3	9,900	1.1	3,300
6) Others (5%)				12,300		11,100		10,300		10,800		12,700		6,800		7,500
Total				259,000		233,900		217,200		227,600		265,900		143,200		157,300
III. Net Income				329,000		18,100		10,300		384,400		84,100		216,800		192,700

*1 Unit price of seed (Rp/kg)

Paddy:	220	Groundnuts:	1,000	Green beans:	680
Maize:	210	Soybeans:	640	Cassava (Rp/piece):	2

Table IV-26 FARM BUDGET - PRESENT CONDITION

(Unit: Rp)

Item	With Subsidy	Without Subsidy*1
I. Gross Income	736,700	736,700
Farm Income	385,700	385,700
- Wet land paddy	17,600	17,600
- Dry land paddy	98,300	98,300
- Maize	43,200	43,200
- Groundnut	36,700	36,700
- Soybeans	45,500	45,500
- Grean beans	10,800	10,800
- Cassava	28,000	28,000
- Others *2	105,600	105,600
Off-farm Income *3	351,000	351,000
II. Gross Outgoing	731,700	953,000
Production Cost	69,900	69,900
- Seed	10,800	10,800
- Fertilizers	11,200	11,200
- Agro-chemicals	7,600	7,600
- Hired laborers *4	30,800	30,800
- Hired animal *4	6,200	6,200
- Others *5	3,300	3,300
Living Expenses	661,800	883,100
- Food expenses		
Rice	198,400	381,700
Other foods	253,400	291,400
- Other living expenses	210,000	210,000
III. Net Reserve (I-II)	5,000	-216,300

Remarks:
*1 Exclude subsidy from the WFP Project (FAO).
*2 Include incomes from livestock raising and crops cultivated in home yard.
*3 Off-farm income was estimated as follows.

- Wages from works at other farms	37,000
- Wages from non-farm works, remmitance, etc.	314,000
Total	351,000

*4 Exclude farming costs for family labor and owned animal.
*5 Minor farm tools, equipment, rice bags, etc.
Source: Farm interview survey (September 1988).

Table IV-27 PRESENT CONDITION OF LAND RECLAMATION IN TANJUNG MEDAN SKP-C AND SKP-D (1/2)

(Unit: ha)

	Transmigration Area				Outside Trans-migration Area	Total
	LU I*1	Para Land LU II*2	Sub-Total	House Yard		
SKP-C: DU						
1) Initially Allocated Area	570	430	1,000	143	-	1,143
2) Reclaimed Area	570	121	691	143	-	834
3) Land Use						
- Paddy field (Wet land)	-	-	-	-	21	21
- Upland field	141	121	262	-	190	452
- Grass land (alang-alang)	429	-	429	-	-	429
- Forest	-	309	309	-	-	309
SKP-C: DK-II						
1) Initially Allocated Area	400	300	700	100	-	800
2) Reclaimed Area	315	185	500	100	-	600
3) Land Use						
- Paddy field (Wet land)	52	16	68	-	-	68
- Upland field	-	169	169	-	128	297
- Grass land (alang-alang)	263	-	263	-	-	263
- Forest	85	115	200	-	-	200
SKP-C: DK-III						
1) Initially Allocated Area	400	300	700	100	-	800
2) Reclaimed Area	273	51	324	90	-	414
3) Land Use						
- Paddy field (Wet land)	-	16	16	-	-	16
- Upland field	75	35	110	-	279	389
- Grass land (alang-alang)	198	-	198	-	-	198
- Forest	127	249	376	10	-	386
SKP-C: DK-IV						
1) Initially Allocated Area	400	300	700	100	-	800
2) Reclaimed Area	215	150	365	100	-	465
3) Land Use						
- Paddy field (Wet land)	8	-	8	-	-	8
- Upland field	-	-	-	-	291	291
- Grass land (alang-alang)	207	150	357	-	-	357
- Forest	185	150	335	-	-	335
SKP-D: DU						
1) Initially Allocated Area	582	437	1,019	146	-	1,165
2) Reclaimed Area	582	70	652	146	-	798
3) Land Use						
- Paddy field (Wet land)	58	-	58	-	-	58
- Upland field	270	70	340	-	-	340
- Grass land (alang-alang)	254	-	254	-	-	254
- Forest	-	367	367	-	-	367

Table IV-27 PRESENT CONDITION OF LAND RECLAMATION IN TANJUNG MEDAN SKP-C AND SKP-D (2/2)

(Unit: ha)

	Transmigration Area				Outside Trans-migration Area	Total
	LU I	Farm Land LU II	Sub-Total	Home Yard		
SKP-D: DK-I						
1) Initially Allocated Area	256	192	448	64	-	512
2) Reclaimed Area	256	150	406	64	-	470
3) Land Use						
- Paddy field (Wet land)	7	-	7	-	-	7
- Upland field	57	150	207	-	-	207
- Grass land (alang-alang)	192	-	192	-	-	192
- Forest	-	42	42	-	-	42
SKP-D: DK-II						
1) Initially Allocated Area	433	325	758	108	-	866
2) Reclaimed Area	275	150	425	108	-	533
3) Land Use						
- Paddy field (Wet land)	12	-	12	-	-	12
- Upland field	182	150	332	-	-	332
- Grass land (alang-alang)	81	-	81	-	-	81
- Forest	158	175	333	-	-	-
TOTAL						
1) Initially Allocated Area	3,041	2,284	5,325	761	-	6,086
2) Reclaimed Area	2,486	877	3,363	751	-	4,114
3) Land Use						
- Paddy field (Wet land)	137	32	169	-	21	190
- Upland field	725	695	1,420	-	888	2,308
- Grass land (alang-alang)	1,624	150	1,774	-	-	1,774
- Forest	555	1,407	1,962	-	-	1,962
PROPORTIONAL EXTENT (%)						
1) Initially Allocated Area	100.0	100.0	100.0	100.0	-	100.0
2) Reclaimed Area	81.7	38.4	63.2	98.7	-	67.6
3) Land Use	100.0	100.0	100.0	-	-	-
- Paddy field (Wet land)	4.5	1.4	3.2	-	-	-
- Upland field	23.8	30.4	26.7	-	-	-
- Grass land (alang-alang)	53.4	6.6	33.3	-	-	-
- Forest	18.3	61.6	36.8	-	-	-

Remark: The area of home yard consists of farmers houses and their home garden, and the public area was excluded from this table.
LU I: Lahan Usaha I LU II: Lahan Usaha II

Sources: (1) Allocated and reclaimed areas:
Laporan Bulanan, Kantor Departemen Transaigrasi Kab. Kampar, April 1988.
(2) Land Use:
Prograna Penyuluhan Pertanian 1988/1989, BPP Dalu-Dalu, Departemen Pertanian Kab. Kampar, April 1988.
(3) The land use in each village was estimated by the survey team, based on the results of field survey and interview survey to village chief.

Table IV-28 SOCIAL CONDITION IN THE STUDY AREA

		SKP-C				SKP-D			Sub Total	Rantau Kasai	Total
		DU	DK-II	DK-III	DK-IV	DU	DK-I	DK-II			
No. of farm household *1		571	378	386	367	582	254	433	2,971	100	3,071
Initial settlement		616	400	400	400	600	259	512	3,187	100	3,287
Re-settlement		55	30	34	50	44	14	28	255	-	255
Spontan		67	19	12	23	65	27	28	241	-	241
Outgo		167	71	60	106	127	46	135	712	-	712
Farm population *1		2,790	1,820	1,990	2,010	2,690	1,150	2,180	14,630	470	15,100
Occupation before settlement											
Farmer	(%)	100	90	87	99	86	94	*	93	100	93
Non-farmer	(%)	-	10	13	1	14	6	*	7	-	7
Native province											
Jakarta	(%)	3.9	6.3	-	-	-	-	-	1.5	-	1.5
West Jawa	(%)	36.2	-	37.5	57.8	13.2	-	29.3	26.1	-	25.3
Central Jawa	(%)	23.4	73.3	44.8	-	-	55.2	12.5	25.8	-	25.0
DIY	(%)	-	6.0	-	12.0	12.2	4.2	17.4	7.7	-	7.5
East Jawa	(%)	30.7	12.5	-	-	68.0	24.7	31.3	27.3	-	26.5
Local	(%)	5.8	1.9	17.7	30.2	6.6	15.9	9.5	11.6	100.0	14.2
Social infrastructure											
Electric supply		1+3kW	7.5kW	1+7.5kW	0.5kW	3kW	3kW	2kW	28.5kW	-	28.5kW
Water supply		Well	Well	Well	Well	Well	Well	Well		Well	
Primary school		2	1	1	1	1	1	1	8	1	9
No. of pupils		500	300	280	330	520	220	420	2,570	130	2,700
No. of teachers		13	8	6	6	13	6	7	59	6	65
Junior high school		1	-	-	-	-	-	1	2	-	2
No. of pupils		150	-	-	-	-	-	240	390	-	390
No. of teachers		15	-	-	-	-	-	10	25	-	25
Medical services											
Clinic		-	-	-	-	-	-	1	1	-	1
No. of doctor		-	-	-	-	-	-	1	1	-	1
No. of nurse		-	-	-	-	-	-	2	2	-	2
Mail post		-	-	-	-	-	-	-	-	-	-
Market		1	-	-	-	1	1	1	4	-	4
Home facilities and goods											
Television		13	4	3	4	15	2	5	46	7	53
Radio/recorder		87	42	31	76	346	57	161	800	80	880
Bicycle		327	115	107	44	450	161	457	1,661	80	1,741
Motorcycle		17	5	3	5	15	4	8	57	11	68
Processing and storage facilities											
Rice mill	(No.)	4	1	-	-	3	-	1	9	1	10
Godown *2	(No.)	2	1	1	1	1	1	1	8	-	8
Drying floor	(No.)	12	-	4	9	148	6	17	196	-	196
Farm machinery											
Plow	(No.)	115	12	10	19	118	8	14	296	-	296
Hand sprayer	(No.)	95	47	66	59	83	89	86	525	-	525
Thresher	(No.)	26	12	4	12	35	4	13	106	-	106

Remarks: *1 As of June 1988.
*2 Floor space of a godown averages 60m2.

Sources: (1) Programa Penyuluhan Pertanaian 1988/1989, BPP Dalu-Dalu.
(2) Laporan Buran Juni 1987 - Juni 1988, Kantor Departemen Transmigrasi, Kabupaten Kampar.
(3) Data and information obtained from village chief and transmigration offices located in each transmigration village.

Table IV-29 LAND ALLOCATION AND GOVERNMENT SUBSIDY TO TRANSMIGRANTS

1) Land to be allocated — 2.00 ha/KK*3
   - Farm land : Lahan Usaha I*1 — 1.00 ha/KK
   : Lahan Usaha II*2 — 0.75 ha/KK
   - Home yard — 0.25 ha/KK

2) House — 1 unit/KK

3) Farm inputs

		Packet A	Packet B	Packet C
- Seeds/Seedlings				
Paddy	(kg/KK)	30	30	-
Maize	(kg/KK)	5	-	-
Beans	(kg/KK)	12	-	-
Vegetables	(kg/KK)	12	-	-
Cassava	(Stick/KK)	2,000	-	-
Fruit trees	(hill/KK)	10	-	-
- Urea + T.S.P.	(kg/KK)	300	300	300
- Insecticides	(lit./KK)	2.75	2.75	2.75

4) Farm tools and equipment such as hoe, crowbar, plow, chopping knife, axe, saw, hooked stick, etc. — 1 unit/KK

5) Food stuff (12 months after settlement)

- Rice	: Husband	17.5 kg/KK/month
	: Wife	10.0 kg/KK/month
	: Children	7.0 kg/KK/month
- Salt fish		5.0 kg/KK/month
- Salt		2.0 kg/KK/month
- Sugar		3.0 kg/KK/month
- Food oil		3.0 kg/KK/month
- Kerosine		8.0ltr/KK/month
- Soap		1.0 kg/KK/month

6) Clothes: Uniform (1 shirt + 1 trouser) from the Transmigration Office at original place.

7) Cooking utensils such as pot, frying pan, kettle, etc.

Remarks: *1 Farm land to be reclaimed by the Government.
*2 Farm land to be reclaimed by the transmigrants themselves.
*3 KK = Family

Source: Hak dan Kewajiban Transmigran Umum, Direktorat Jenderal Transmigrasi, 1981.

Table IV-30 PROPOSED LAND USE

(Unit: ha)

	Present Land Use		Proposed Land Use		
	Study Area	Project Area	Area to be Developed	Non Development Area	Total
Paddy fields					
Irrigated	-	-	7,300	-	7,300
Rainfed	190	180	-	-	-
Upland field*1*4	2,410	2,120	-	-	-
Perennial crop fields	500	400	5,480 *5	400	5,880
Grass lands	2,600	2,240	-	-	-
Forest	21,800	14,630	-	3,470	3,470
Right of way*2	-	-	800	-	800
Village Areas*1*3	1,610	1,400	2,120 *6	1,400	3,520
Others	590	430	-	430	430
Total	29,700	21,400	15,700	5,700	21,400

Remarks:
*1 Farm land and village area of DK-IV, SKP-C were excluded topographically from the Project area.
*2 Includes canal, farm road, etc. (10 % of gross irrigable area)
*3 Includes area of public facilities.
*4 Includes the farm lands of Rantau Kasai.
*5 Area allocated to the transmigrants and re-settlements.
7,300 families x 0.75 ha = 5,480 ha
*6 Villages of new transmigrants.
Home yard: 4,230 families x 0.25ha = 1,060ha
Public area: 4,230 families x 0.25ha = 1,060ha
Total 2,120ha

Table IV-31 CROP BUDGET PER HECTARE FOR PALAWIJA - IMPROVED FARMING

	Unit Price (Rp)	Maize Q'ty	Maize Value (Rp)	Groundnuts Q'ty	Groundnuts Value (Rp)	Soybeans Q'ty	Soybeans Value (Rp)	Green Beans Q'ty	Green Beans Value (Rp)	Chillies Q'ty	Chillies Value (Rp)
I. Gross Income											
1) Unit Yield (ton/ha)			3.5		1.2		1.2		1.2		1.5
2) Unit Price (Rp/ton)			175,000		680,000		500,000		600,000		1,000,000
3) Gross Income (Rp)			612,500		816,000		600,000		720,000		1,500,000
II. Production Cost											
1) Seed (kg)	- *1	30	6,300	60	60,000	30	19,200	30	20,400	1	1,000
2) Fertilizers											
- Urea (kg)	135	200	27,000	50	6,800	100	13,500	100	13,500	150	20,300
- T.S.P. (kg)	135	75	10,100	100	13,500	200	27,000	200	27,000	200	27,000
- KCl (kg)	135	50	6,800	-	-	50	6,800	50	6,800	50	6,800
- Lime (kg)	100	-	-	300	30,000	-	-	-	-	-	-
3) Agro-chemicals											
- Insecticide (liter)	5,000	2.0	10,000	2.0	10,000	3.0	15,000	2.0	10,000	3	15,000
- Fungicides (liter)	5,000	-	-	-	-	-	-	-	-	-	-
- Rodenticide (kg)	5,000	0.1	500	0.1	500	0.1	500	0.1	500	-	-
4) Labor (man-day)											
- Land Preparation	2,000	30	60,000	20	40,000	30	60,000	30	60,000	30	60,000
- Nursery	2,000	-	-	-	-	-	-	-	-	10	20,000
- Seeding	1,500	15	22,500	15	22,500	15	22,500	15	22,500	2	3,000
- Transplanting	1,500	-	-	-	-	-	-	-	-	40	60,000
- Fertilizing	1,500	6	9,000	8	12,000	6	9,000	6	9,000	8	12,000
- Weeding	1,500	20	30,000	20	30,000	20	30,000	20	30,000	60	90,000
- Spraying	1,500	3	4,500	3	4,500	3	4,500	2	3,000	5	7,500
- Harvesting	2,000	35	70,000	40	80,000	30	60,000	30	60,000	80	160,000
- Water management and others	1,500	6	9,000	4	6,000	6	9,000	7	10,500	10	15,000
5) Animal Power (day)	3,000	4.0	12,000	10.0	30,000	8.0	24,000	8.0	24,000	10.0	30,000
6) Others (5%)			13,900		17,300		15,100		14,900		26,400
Total			291,600		363,100		316,100		312,100		554,000
III. Net Income			320,900		452,900		283,900		407,900		946,000

*1 Unit price of seed (Rp/kg)

Maize:	210	Soybeans:	640	Chilly:	1,000
Groundnuts:	1,000	Green beans:	680		

*2 Total labor requirement (man-day)

Maize:	115	Soybeans:	110	Chilly:	245
Groundnuts:	110	Green beans:	110		

Remarks:

1. The farm inputs and labor requirements of palawija crops were estimated on the basis of existing farming practices with reference to the recommendation of agricultural extension office in Riau Province.
2. The crop budgets for palawija crops were analyzed in order to make the studies on alternative cropping patters and selection of crops to be introduced in the Project area. Yields of crops were estimated under the following assumptions:
   1) The soils in the study area have the constraints to the cultivation of palawija crops. For these limitations, no consideration was paid to the estimation of yields, on the assumption that the advanced practices with improved varieties will be established at the proposed pilot farm in the future.
   2) The solar radiation in the Project area is relatively low. For the estimation of yields at the area under such climatic conditions, there is no literature to refer to about it. Therefore, the yields in the area were assumed at 90 % of these normal yields.

Table IV-32 FARM INPUTS AND LABOR REQUIRMENTS PER HECTARE FOR PADDY - WITH PROJECT

		Wet Season	Dry Season
1) Seed	(kg/ha)	30	30
2) Fertilizers			
- Urea	(kg/ha)	200	200
- T.S.P.	(kg/ha)	100	100
- KCl	(kg/ha)	50	50
3) Agro-chemicals			
- Insecticides	(l/ha)	3.0	3.0
- Fungicides	(l/ha)	1.0	1.0
- Rodenticides	(kg/ha)	0.1	0.1
4) Labor	(man-day/ha)	135	135
- Land Preparation		25	25
- Nursery		4	4
- Seeding		1	1
- Transplanting		25	25
- Fertilizing		6	6
- Weeding		25	25
- Spraying		4	4
- Harvesting		40	40
- Water management and others		5	5
5) Animal Power	(day)	10.0	10.0

Remarks:

1. Agricultural extension office in Riau Province has the recommendation of farming practices for each crop (see 2). The farm inputs and labor requirements of paddy under with project were estimated on the basis of existing farming practices with reference to this recommendation.

2. Anjuran Teknologi Produksi Tanaman Pangan Th. 1982: Propinsi Riau, Directorat Jenderal Pertanian Tanaman Pangan, Direktorat Bina Produksi, September 1982.

Table IV-33 FARM INPUTS AND LABOUR REQUIREMENT PER HECTARE
FOR RUBBER - WITH PROJECT

Tree Crop Year	(Unit)	1	2	3	4	5	6	7	8	9	10	11<
Land Clearing	(Rp 1,000)	366	-	-	-	-	-	-	-	-	-	-
Rubber Stumps	(Nos.)	500	50	-	-	-	-	-	-	-	-	-
Seeds of Cover Crop	(kg)	20	-	-	-	-	-	-	-	-	-	-
Fertilizers												
- Urea	(kg)	50	150	180	180	250	250	250	250	250	250	250
- T.S.P.	(kg)	620	100	150	150	200	200	200	200	200	200	200
- KCl	(kg)	50	80	100	100	100	100	150	150	150	150	150
- Rock Phosphate	(kg)	500	-	-	-	-	-	-	-	-	-	-
- Kiserite	(kg)	0	30	30	30	30	30	30	30	30	30	50
Agro-chemicals	(Rp 1,000)	16	15	18	15	15	15	58	58	58	58	58
Water Pump	(Rp 1,000)	6	6	6	6	6	6	9	9	9	9	9
Harbicides	(liter)	2	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Tools and Equipment	(Rp 1,000)	3	3	3	3	3	108	3	3	3	3	3
Family Labour	(man-day)	267	105	73	47	31	31	107	187	187	187	187
Hired Labour	(man-day)	-	-	-	-	-	-	-	-	-	-	-

Remarks: (1) Cultivation of rubber is carried out under rainfed condition.
(2) Rubber development in the Project area would be implemented along with SSDP which has been executed by the Ministry of Transmigration.

Source: Second Stage Development Programme, Feasibility Studies and Detailed Engineering - WPP: XII/Pasir Pangarayan, Province: Riau, Annex-2/2, Directorate General of Settlement Preparation, Ministry of Transmigration, February 1988.

Table IV-34 LABOR BALANCE STUDY

(Farm Size: 1.75 ha) (Unit: person/day/ha)

Year		Available Labour Force	Wet Season Paddy	Dry Season Paddy	Palavija				Rubber	Total	Balance
					Maize	Groundnuts	Soybeans	Green Beans			
Harvested Area (ha)			(1.00)	(0.42)	(0.193)	(0.193)	(0.097)	(0.097)	(0.75)	(1.75)	
JAN	(1)	2.13	0.38	-	-	-	-	-	0.56	0.94	1.19
	(2)	2.13	0.38	-	-	-	-	-	0.56	0.94	1.19
	(3)	2.13	0.35	-	-	-	-	-	0.56	0.91	1.22
FEB	(1)	2.13	1.01	-	-	-	-	-	0.56	1.57	0.56
	(2)	2.13	1.01	-	-	-	-	-	0.56	1.57	0.56
	(3)	2.13	0.73	-	-	-	-	-	0.56	1.29	0.84
MAR	(1)	2.13	0.69	0.33	-	-	-	-	0.56	1.58	0.55
	(2)	2.13	0.69	0.33	0.09	0.06	0.05	0.04	0.56	1.82	0.31
	(3)	2.13	0.69	0.62	0.10	0.06	0.05	0.04	0.56	2.12	0.01
APR	(1)	2.13	-	0.62	0.14	0.11	0.08	0.05	0.56	1.56	0.57
	(2)	2.13	-	0.45	0.18	0.14	0.10	0.05	0.56	1.48	0.65
	(3)	2.13	-	0.47	0.18	0.14	0.10	0.06	0.56	1.51	0.62
MAY	(1)	2.13	-	0.19	0.19	0.14	0.11	0.06	0.56	1.25	0.88
	(2)	2.13	-	0.19	0.09	0.08	0.06	0.02	0.56	1.00	1.13
	(3)	2.13	-	0.21	0.09	0.08	0.05	0.02	0.56	1.01	1.12
JUN	(1)	2.13	-	0.19	0.04	0.03	0.03	0.01	0.56	0.86	1.27
	(2)	2.13	-	0.19	0.05	0.03	0.03	0.01	0.56	0.87	1.26
	(3)	2.13	-	0.19	0.05	0.03	0.03	0.01	0.56	0.87	1.26
JUL	(1)	2.13	-	0.46	0.12	0.03	0.07	0.03	0.56	1.27	0.86
	(2)	2.13	-	0.44	0.12	0.03	0.07	0.03	0.56	1.25	0.88
	(3)	2.13	-	0.44	0.12	0.03	0.07	0.03	0.56	1.25	0.88
ACT	(1)	2.13	-	0.44	0.12	0.11	0.06	0.03	0.56	1.32	0.81
	(2)	2.13	-	-	0.08	0.11	0.04	0.02	0.56	0.81	1.32
	(3)	2.13	-	-	0.08	0.10	0.04	0.02	0.56	0.80	1.33
SEP	(1)	2.13	-	-	-	0.10	-	-	0.56	0.66	1.47
	(2)	2.13	-	-	-	0.08	-	-	0.56	0.64	1.49
	(3)	2.13	-	-	-	0.08	-	-	0.56	0.64	1.49
OCT	(1)	2.13	0.53	-	-	-	-	-	0.56	1.09	1.04
	(2)	2.13	0.53	-	-	-	-	-	0.56	1.09	1.04
	(3)	2.13	0.98	-	-	-	-	-	0.56	1.54	0.59
NOV	(1)	2.13	0.98	-	-	-	-	-	0.56	1.54	0.59
	(2)	2.13	1.26	-	-	-	-	-	0.56	1.82	0.31
	(3)	2.13	1.30	-	-	-	-	-	0.56	1.86	0.27
DEC	(1)	2.13	0.80	-	-	-	-	-	0.56	1.36	0.77
	(2)	2.13	0.80	-	-	-	-	-	0.56	1.36	0.77
	(3)	2.13	0.38	-	-	-	-	-	0.56	0.94	1.19
Peak Labor Requirement			1.30	0.62	0.19	0.14	0.11	0.06	0.56	2.12	-

Remarks: Family labor force (person/family) 2.50 Efficiency 0.85
Farm size (ha/family) 1.75 Available labor force (person/ha) 2.13

Table IV-35 MARKETING ANALYSIS FOR RICE IN THE PROJECT AREA

		2000	2005
1) Marketable Surplus in the Project Area			
- Total paddy production	(ton)	52,000	52,000
(Wet season)	(ton)	(36,500)	(36,500)
(Dry season)	(ton)	(15,500)	(15,500)
- Waste and seeds*1	(ton)	4,400	4,400
- Total rice supply*2	(ton)	32,400	32,400
- Per-capita consumption*3	(kg)	140	140
- Population*4		18,700	20,000
- Total demand in the Project area	(ton)	2,600	2,800
- Marketable surplus	(ton)	29,800	29,600
2) Deficit in the whole country*5	(ton)	500,000	1,100,000
3) Deficit in Riau Province			
- Total paddy production*6	(ton)	554,000	606,000
- Waste and seeds*1	(ton)	47,100	51,500
- Total rice supply*2	(ton)	344,700	377,100
- Per-capita consumption*3	(kg)	140	140
- Population*7	(million)	4.22	4.96
- Total demand in Riau Province	(ton)	590,800	694,400
- Rice deficit	(ton)	246,100	317,300
4) Percentage to marketable surplus in the Project area			
- Whole country	(%)	6.0	2.7
- Riau province	(%)	12.1	9.3

*1 8.5 % of paddy production
*2 Milling recovery rate: 68 %
*3 140 kg/year
*4 For the population growth in the Project area, no data is available. It is assumed at 1.8-1.4 %/year, based on the national population growth.
1988-2000: 1.8 %/year 2000-2005: 1.4 %/year
*5 Forecast by SFCDP (see Sub-section 2.1.3 (3)).
*6 The production of paddy in 2000 and 2005 was forecasted on the basis of the following past trend.

Year		Ton	Year		Ton
1974	(1)	302,820	1980	(7)	313,550
1975	(2)	319,280	1981	(8)	323,110
1976	(3)	289,210	1982	(9)	356,970
1977	(4)	319,180	1983	(10)	370,550
1978	(5)	325,890	1984	(11)	403,380
1979	(6)	330,910	1985	(12)	437,930

$y = 273430 + 10400x$ $r = 0.86$

*7 Population growth : 3.3 %/year

Table IV-36 NUMBER OF TRANSMIGRANTS AND RESETTLERS

Transmigration Area/Village	Present Condition				With Project			
		Reclaimed Area				Area to be Allocated		
	KK*1 (No.)	I*2 (ha)	II*2 (ha)	Total (ha)	KK*4 (No.)	I*4 (ha)	II*4 (ha)	Total (ha)
1) Resettlement	2,970	1,701	606	2,307	2,970	2,970	2,230	5,200
SKP-C: DU*3	570	-	-	-	570	570	428	998
DK-II	378	315	185	500	380	380	285	665
DK-III	386	273	51	324	390	390	293	683
DK-IV*3	367	-	-	-	370	370	278	648
SKP-D: DU	582	582	70	652	580	580	435	1015
DK-I	254	256	150	406	250	250	188	438
DK-II	433	275	150	425	430	430	323	753
2) Rantau Kasai	100	-	-	100	100	100	75	175
3) New Transmigration		-	-	-	4,230	4,230	3,170	7,400
Total	3,070	1,701	606	2,407	7,300	7,300	5,475	12,775

Remarks: *1 KK: Family *2 I: Lahan Usaha I, II: Lahan Usaha II
*3 The existing farm lands in DU and DK-IV, SKP-C are excluded topographically from the irrigation area.
*4 Rounded figures.

Note: The number of resettlers and their farm lands to be allocated under the future with project were estimated on the basis of the figures of families and reclaimed area as of 1988.

Table IV-37 PUBLIC FACILITIES PROVIDED BY THE GOVERNMENT

Facilities	Per One Village		Total	
	Unit (No)	Space*1 (m2)	Unit (No)	Space*1 (m2)
- Transmigration Office	1	160	9	1,440
- Extension Office	1	160	9	1,440
- Post Office	1	80	9	720
- Clinic	1	160	9	1,440
- Houses for Officials *2	10	50	110	5,500
- Village Meeting Hall	1	300	9	2,700
- Primary School	1	480	9	4,320
- Junior High School			9	4,320
- Cooperative Office	1	160	9	1,440
- Storehouse	1	160	9	1,440
- Religious Building	1	L.S.	9	
- Market	1	400 *3	9	3,600
Total*1				24,760

*1 Floor space (except for the yard of market). *3 Area of yard.
*2 Include 20 houses of teachers of junior high school.

Table IV-38 CROP BUDGET PER HECTARE FOR PADDY - WITH PROJECT

		Unit Price (Rp)	Paddy (Wet Land) Wet Season Q'ty	Wet Season Value (Rp)	Dry Season Q'ty	Dry Season Value (Rp)
I. Gross Income						
1) Unit Yield	(ton/ha)			5.0		5.0
2) Unit Price	(Rp/ton)			210,000		210,000
3) Gross Income	(Rp)			1,050,000		1,050,000
II. Production Cost						
1) Seed	(kg)	220	30	6,600	30	6,600
2) Fertilizers						
- Urea	(kg)	135	200	27,000	200	27,000
- T.S.P.	(kg)	135	100	13,500	100	13,500
- KCl	(kg)	135	50	6,800	50	6,800
- Lime	(kg)	100	-	-	-	-
3) Agro-chemicals						
- Insecticides	(liter)	5,000	3.0	15,000	3.0	15,000
- Fungicides	(l/ha)	5,000	1.0	5,000	1.0	5,000
- Rodenticides	(kg)	5,000	0.1	500	0.1	500
4) Labor*1	(man-day)					
- Land Preparation		2,000	25	50,000	25	50,000
- Nursery		2,000	4	8,000	4	8,000
- Seeding		1,500	1	1,500	1	1,500
- Transplanting		1,500	25	37,500	25	37,500
- Fertilizing		1,500	6	9,000	6	9,000
- Weeding		1,500	25	37,500	25	37,500
- Spraying		1,500	4	6,000	4	6,000
- Harvesting		2,000	40	80,000	40	80,000
- Water management and others		1,500	5	7,500	5	7,500
5) Animal Power	(day)	3,000	10.0	30,000	10.0	30,000
6) Others (5%)				17,100		17,100
Total				358,500		358,500
III. Net Income				691,500		691,500

*1 Total labor requirement (man-day/ha):
Wet season paddy 135
Dry season paddy 135

Table IV-39 CROP BUDGET PER HECTARE FOR RUBBER - WITH PROJECT

(Unit: Rp 1,000)

Tree Crop Year	1	2	3	4	5	6	7	8	9	10	11
1) Gross Income											
- Unit Yield (kg/ha)	-	-	-	-	-	400	600	750	850	950	1,050
- Unit Price (Rp/kg)	680	680	680	680	680	680	680	680	680	680	680
- Gross Income (Rp 1,000)	-	-	-	-	-	272	408	510	578	646	714
2) Gross Outgoing											
Land Clearing	366	-	-	-	-	-	-	-	-	-	-
Rubber Stumps	175	18	-	-	-	-	-	-	-	-	-
Seeds of Cover Crop	60	-	-	-	-	-	-	-	-	-	-
Fertilizers - Urea	7	20	24	24	34	34	34	34	34	34	34
- T.S.P.	84	14	20	20	27	27	27	27	27	27	27
- KCl	7	11	14	14	14	14	20	20	20	20	20
- Rock Phosphate	39	-	-	-	-	-	-	-	-	-	-
- Kiserite	-	9	9	9	9	9	9	9	9	9	15
Agro-chemicals	16	15	18	15	15	15	58	58	58	58	58
Water Pump	6	6	6	6	6	6	9	9	9	9	9
Harbicides	60	15	15	15	15	15	15	15	15	15	15
Tools and Equipment	3	3	3	3	3	108	3	3	3	3	3
Labour	401	158	110	71	47	47	161	281	281	281	281
Others (5%)	61	13	11	9	9	14	17	23	23	23	23
Total	1,285	282	290	186	179	289	353	479	479	479	485
3) Net Income	(1,285)	(282)	(230)	(186)	(179)	(17)	55	31	99	167	229

Tree Crop Year	12	13	14	15	16	17	18	19	20	21	22<
1) Gross Income											
- Unit Yield (kg/ha)	1,100	1,150	1,250	1,300	1,400	1,450	1,450	1,350	1,300	1,250	1,250
- Unit Price (Rp/kg)	680	680	680	680	680	680	680	680	680	680	680
- Gross Income (Rp 1,000)	748	782	850	884	952	986	986	918	884	850	850
2) Gross Outgoing											
Land Clearing	-	-	-	-	-	-	-	-	-	-	-
Rubber Stumps	-	-	-	-	-	-	-	-	-	-	-
Seeds of Cover Crop	-	-	-	-	-	-	-	-	-	-	-
Fertilizers - Urea	34	34	34	34	34	34	34	34	34	34	34
- T.S.P.	27	27	27	27	27	27	27	27	27	27	27
- KCl	20	20	20	20	20	20	20	20	20	20	20
- Rock Phosphate	-	-	-	-	-	-	-	-	-	-	-
- Kiserite	15	15	15	15	15	15	15	15	15	15	15
Agro-chemicals	58	58	58	58	58	58	58	58	58	58	58
Water Pump	9	9	9	9	9	9	9	9	9	9	9
Harbicides	15	15	15	15	15	15	15	15	15	15	15
Tools and Equipment	3	3	3	3	3	3	3	3	3	3	3
Labour	281	281	281	281	281	281	281	281	281	281	281
Others	23	23	23	23	23	23	23	23	23	23	23
Total	485	485	485	485	485	485	485	485	485	485	485
3) Net Income	263	297	365	399	467	501	501	433	399	365	365

Source: Second Stage Development Programme, Feasibility Studies and Detailed Engineering - WPP: XII/Pasir Pangarayan, Province: Riau, Annex-2/2, Directorate General of Settlement Preparation, Ministry of Transmigration, February 1988.

Table IV-40 CROP BUDGET PER HECTARE FOR PALAWIJA CROPS (TRADITIONAL CULTIVATION) - WITH PROJECT

		Maize		Groundnuts		Soybeans		Green Beans	
I. Gross Income									
1) Unit Yield	(ton/ha)		1.3		0.9		0.7		0.6
2) Unit Price	(Rp/ton)		175,000		680,000		500,000		600,000
3) Gross Income	(Rp)		227,500		612,000		350,000		360,000
	Unit Price (Rp)	Q'ty	Value (Rp)	Q'ty	Value (Rp)	Q'ty	Value (Rp)	Q'ty	Value (Rp)
II. Production Cost									
1) Seed	(kg)	- *1	28	5,900	31	31,000	27	17,300	25	17,000
2) Fertilizers									
- Urea	(kg)	135	51	6,900	20	2,700	39	5,300	4	500
- T.S.P.	(kg)	135	30	4,100	13	1,800	53	7,200	5	700
- KCl	(kg)	135	9	1,200	-	-	14	1,900	2	300
3) Agro-chemicals									
- Insecticides	(ltr.)	5,000	1.0	5,000	1.2	6,000	2.6	13,000	1.0	5,000
- Herbicides	(ltr.)	5,000	0.3	1,500	0.1	500	-	-	-	-
4) Labor	(man-day)									
- Land Preparation		2,000	29	58,000	19	38,000	31	62,000	23	46,000
- Nursery		2,000	-	-	-	-	-	-	-	-
- Seeding		1,500	14	21,000	16	24,000	14	21,000	5	7,500
- Transplanting		1,500	-	-	-	-	-	-	-	-
- Fertilizing		1,500	5	7,500	1	1,500	3	4,500	1	1,500
- Weeding		1,500	20	30,000	20	30,000	29	43,500	10	15,000
- Spraying		1,500	2	3,000	2	3,000	5	7,500	2	3,000
- Harvesting		2,000	26	52,000	24	48,000	23	46,000	15	30,000
5) Animal Power	(day)	3,000	3.6	10,800	10.1	30,300	8.0	24,000	3.3	9,900
6) Others (5%)				10,300		10,800		12,700		6,800
Total				217,200		227,600		265,900		143,200
III. Net Income				10,300		384,400		84,100		216,800

*1 Unit price of seed (Rp/kg)

Maize:	210
Groundnuts:	1,000
Soybeans:	640
Green beans:	680

Table IV-41 FARM BUDGET - WITH PROJECT

(Farm Size: 1.75 ha) (Unit: Rp 1,000)

Item	With Palawija*1		Without Palawija*1	
	With Rubber	Without Rubber	With Rubber	Without Rubber
I. Gross Income	2,817	2,179	2,586	1,948
Farm Income	2,466	1,828	2,235	1,597
- Wet season paddy	1,050	1,050	1,050	1,050
- Dry season paddy	441	441	441	441
- Palawija *1	231	231	-	-
- Rubber	638	-	638	-
- Others *2	106	106	106	106
Off-farm Income	351	351	351	351
II. Gross Outgoing	1,384	1,234	1,335	1,186
Production Cost	501	351	452	303
- Seed	20	20	9	9
- Fertilizers	72	72	67	67
- Agro-chemicals	33	33	29	29
- Hired laborers *3	173	173	153	153
- Hired animal *3	21	21	17	17
- Production cost of rubber *3	136	-	136	-
- Others *4	46	32	41	28
Living Expenses *5	883	883	883	883
- Food expenses				
Rice	382	382	382	382
Other foods	291	291	291	291
- Other expenses	210	210	210	210
III. Net Reserve (I-II)	1,433	945	1,251	762

Remarks:
*1 Palawija crops are cultivated traditionally by the farmers. (See Fig, IV-3)
*2 Include income from livestock and crops cultivated in home yard.
*3 Exclude farming costs for family labor and owned animal.
*4 Production cost for crops cultivated in home yard, raising cost of livestock, minor farm tools, rice bags, IPEDA tax, etc.
*5 Exclude subsidy from the WFP Project (FAO).

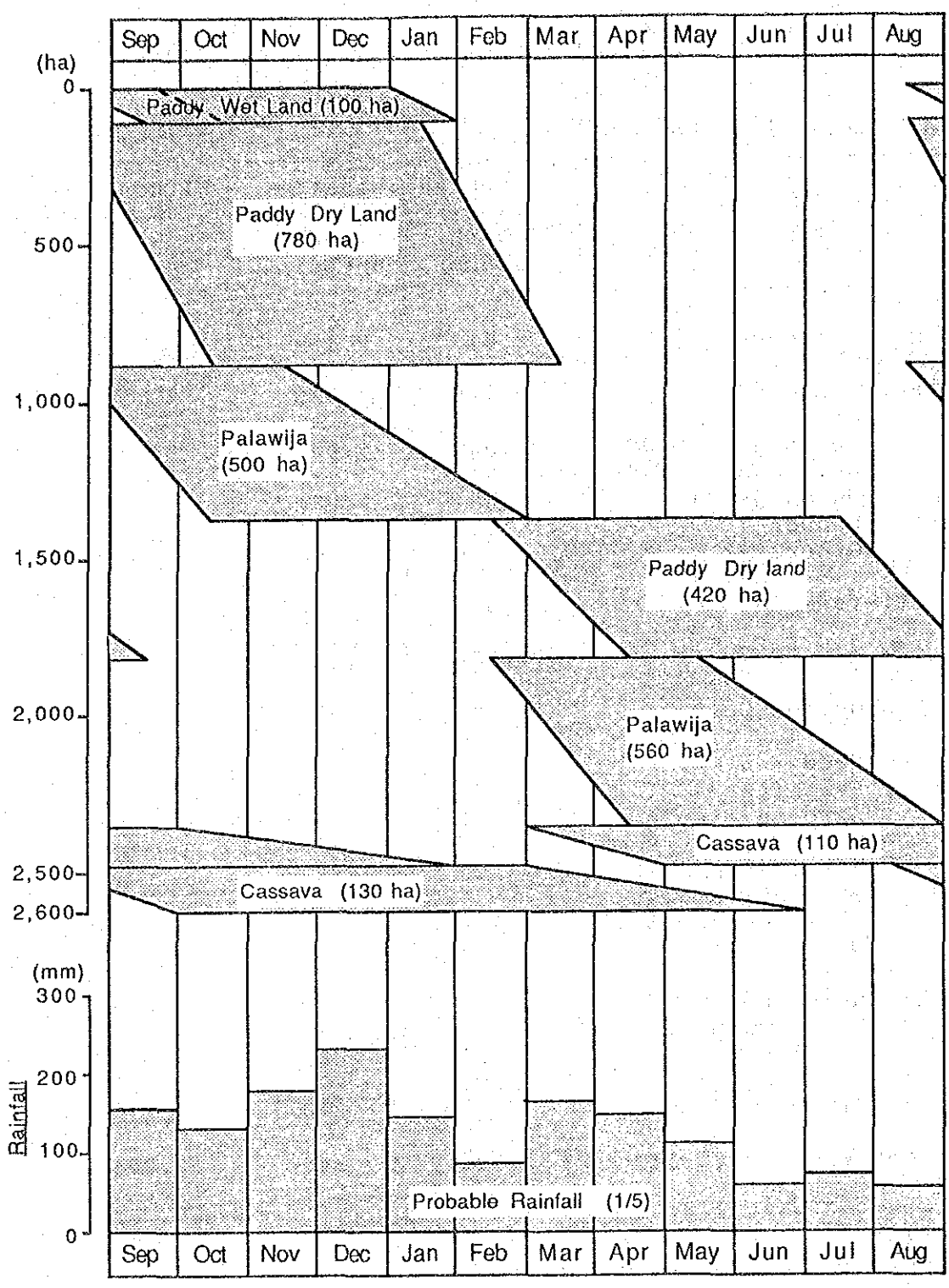
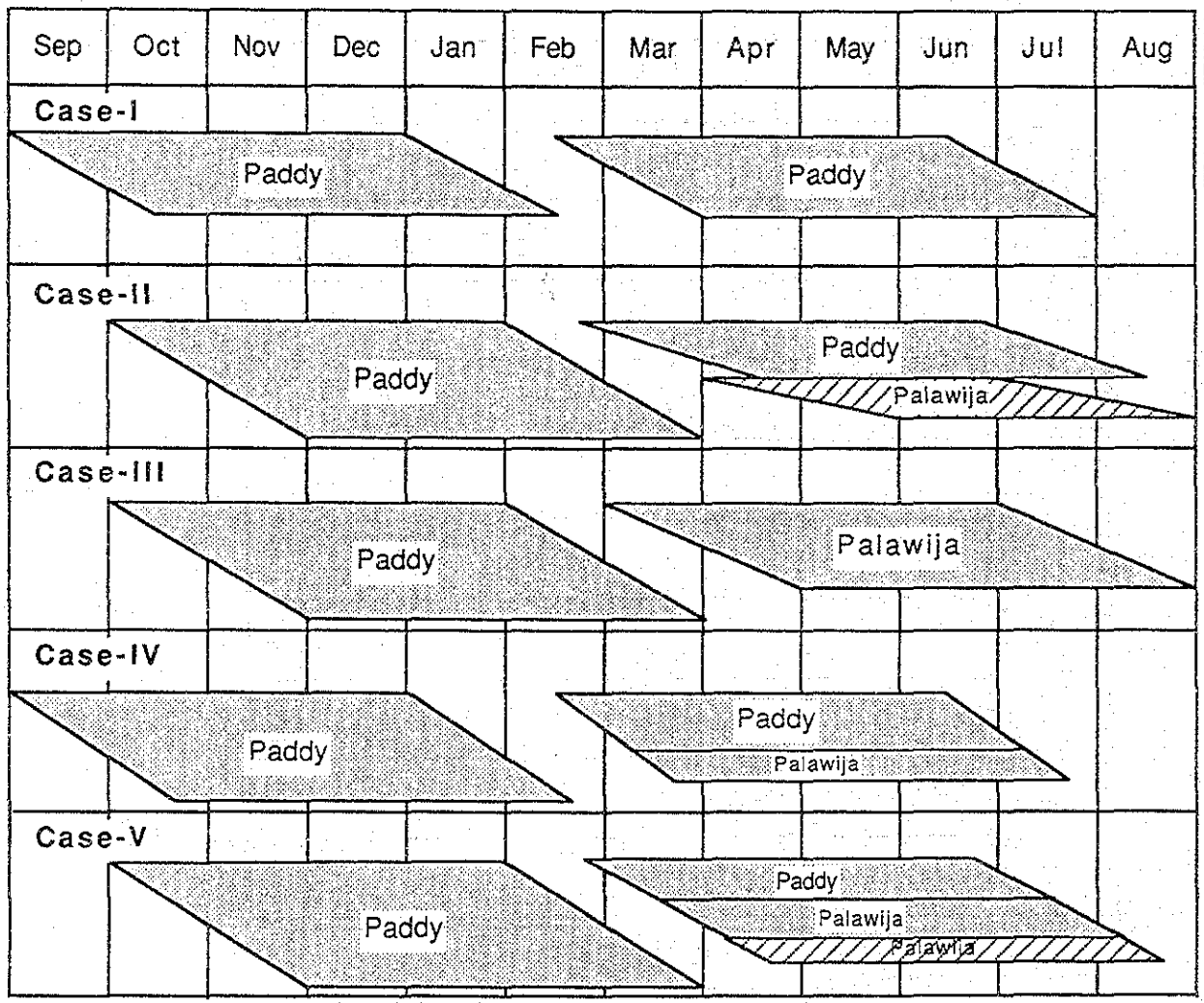


Fig. IV-1 Present Cropping Pattern

Unit : Crop Area : ha
Div. Water Req. : lit./s/ha



	Wet	Dry	
	Paddy	Paddy	Palawija
Case-I	4,500	4,500	-
	1.43	1.45	-
Case-II	7,300	3,100	2,700
	1.23	1.54	0.32
Case-III	7,300	-	5,800
	1.28	-	0.21
Case-IV	6,100	3,050	2,750
	1.43	1.78	0.21
Case-V	7,300	2,400	3,400
	1.28	1.54	0.32

Fig. IV-2 Alternative Cropping Pattern

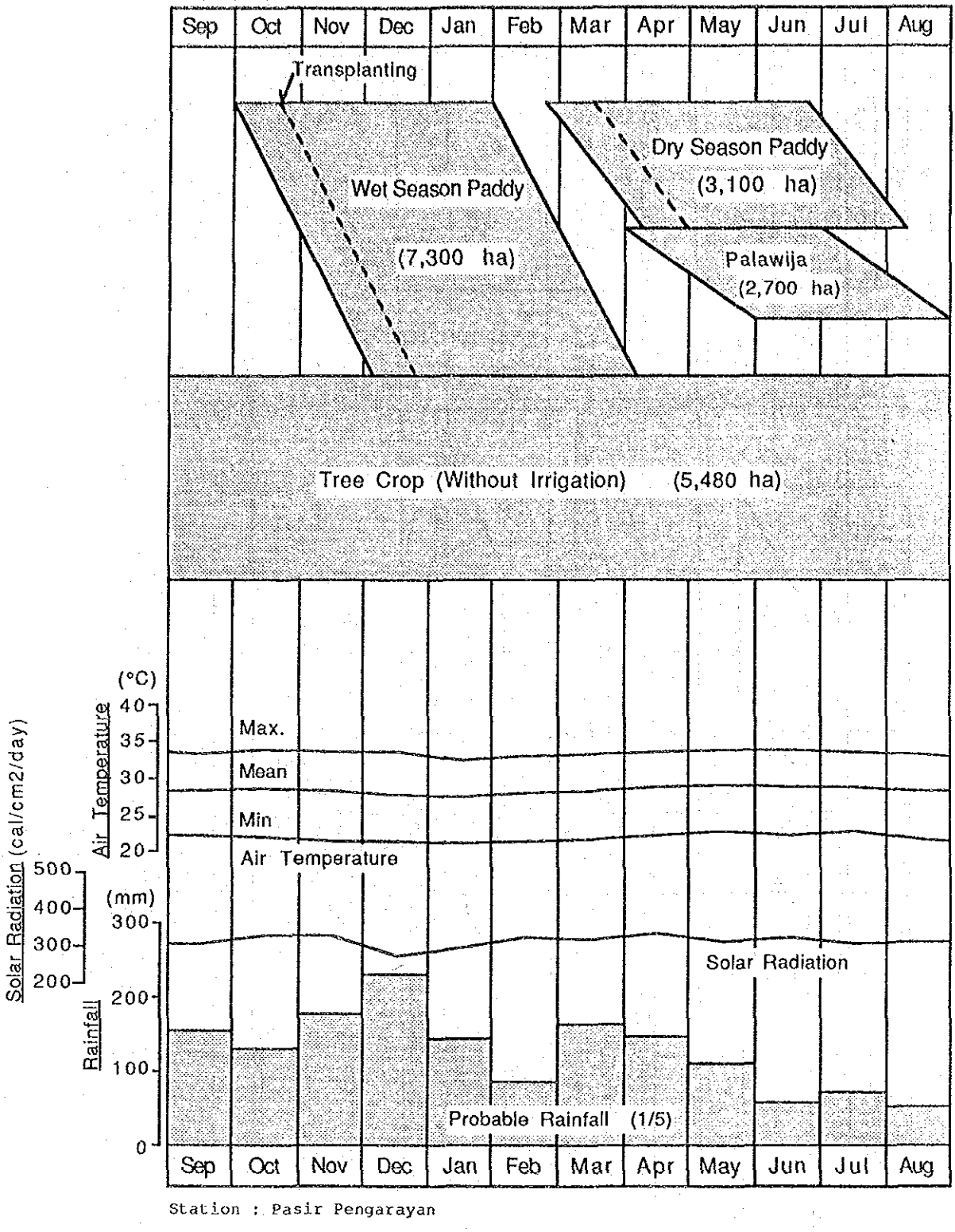


Fig. IV-3 Proposed Cropping Pattern

APPENDIX V

IRRIGATION AND DRAINAGE

CHAPTER 1. GENERAL

1.1 Topographic Condition

The Kumu river originates from the hilly area in the North Sumatra Province, in which the peak elevation is 280 m, runs to the northeast on the center of the study area, joins the Mahato Kiri river, a tributary of the Kumu river at the downstream part (Kuara Mahato), then become Lubuk river and then the Rokan Kanan river. After that, the river joins the Rokan Kiri river and pours into the Malaka strait as the Rokan river.

The total length of the river from the origin to the Malaka strait is estimated at about 260 Km. The study area is located on the both sides of the Kumu river about 240 to 270 km far from the estuary.

The left side area for the Study is terrace and alluvial plain and has a long stretch about 10 Km in the broad part and about 30 Km in length between the Kumu river and the Mahato Kiri and the Mahato rivers. The elevation of the above area gradually changes from 75m to 15m to the direction of northeast and the slope of the ground is averagely about 1 to 700 to the north east. In the left side area of the Kumu river, the Sitarus river, a tributary of the Kumu river runs about 20 Km in almost parallel with the Kumu river and the lower part between the Sitarus river and the Kumu river forms alluvial plain with about 1.5 Km width.

On the other hand, the right side area of the Kumu river has ground slope of about 1 to 700 similar to the left side area. The Hitam river which is an adjacent river to the Kumu river, flows about 12 Km to 20 Km far from the Kumu river in the south. However, the area between the both rivers forms swamp except the higher part with the width of 5 to 6 Km along the Kumu river.

The catchment area of the proposed weir is estimated at 540 Km^2. Out of this, 475 Km^2 belongs to the North Sumatra Province. The catchment area in the North Sumatra Province has the highest part with elevation of 280 m and is hilly and undulatated area with the specific height of 40 m to 100 m.

The study area consists of about 20,000 ha of the left side of the Kumu river and about 10,000 ha on the right and the elevation of its irrigable area is planned to be 20 m to 59 m. The acreage and slope at each elevation of the study area is estimated using the existing topographic maps (scale : 1 to 5,000, covering area : 220 Km^2) and the new maps contracted by JICA in this time (Scale : 1 to 5,000 covering area : 90 Km^2) as follows :

Table V-1 ACREAGE AND SLOPE AT EACH ELAVATION IN THE STUDY AREA

GROUND ELEVATION (M)	PLAN A (LEFT BANK)			PLAN B (LEFT BANK & RIGHT BANK)					
				LEFT SIDE			RIGHT SIDE		
	ACREAGE	ACCUMULATED ACREAGE	SLOPE	ACREAGE	ACCUMULATED ACREAGE	SLOPE	ACREAGE	ACCUMULATED ACREAGE	SLOPE
	ha	ha		ha	ha		ha	ha	
15 - 20	248	248		15	15				
20 - 25	1,038	1,286	1 : 250	206	221	1 : 250			
25 - 30	1,250	2,536	1 : 200	716	937	1 : 200			
30 - 35	1,664	4,200	1 : 250	1,083	2,020	1 : 250			
35 - 40	3,219	7,419	1 : 900	2,298	4,318	1 : 900	8965		
40 - 45	3,531	10,950	1 : 1000	2,375	6,693	1 :1000			
45 - 50	3,033	13,983	1 : 600	1,664	8,357	1 : 600			
50 - 55	2,461	16,444	1 : 500	1,020	9,377	1 : 500		8,965	
55 - 60	1,054	17,498	1 : 250	916	10,293	1 : 250	896	9,861	
60 - 65	993	18,491	1 : 400	756	11,049	1 : 400			
65 - 70	1,069	19,560	1 : 550	472	11,521	1 : 550	174		
70 - 75	191	19,751		14	11,535			10,035	

(From map scale 1/25000)

1.2 Existing Irrigation and Drainage System

Irrigation plan is not included in the transmigration projects in the study area. Rain-fed paddy is cultivated at some lower places in the study area.

There are small scale irrigation projects planned by the Provincial Office around DK-V of SKP-D in the downstream part of the study area, and diversion weirs with the width of about 10 m and canal are now under construction. Actually however the projects are not progressed because of the difficulty of the budget and no paddy fields development is found at present. The water sources for the above projects are small rivers, namely the Muruk river and Megumpal river, the tributaries of the Kumu river.

At present, the excavation for drainage canal with the width of 1.0 m and the depth of 0.5 m to 1.0 m is carried out by transmigrants at some places in swampy area.

Small drainage canals in the study area are inundated for two or three days due to the influence of back water of the Kumu river after continuous precipitation.

The afore-mentioned Second Development Program for the transmigration area aims at improving the drainage conditions of ground surface and farm land as one of the strengthening works for the transmigration area and plans the construction of main and secondary drainage canals. Almost all of them are planned around home yard of transmigrants, but the coordination between the above works and irrigation projects will be required in the future to avoid the duplicated works.

The biggest irrigation and drainage project in the neighbourhood of the study area is the Kaiti-Samo Irrigation Project getting the IBRD loan which is located about 6.0 Km in the south of Pasir Pengarayan. Out of the planning area of 1.500 ha, 640 ha is operated as technical irrigation area. The project has a plan to construct two (2) diversion weirs at the Kaiti river and the Samo river, to change the catchment area and to irrigate the transmigration area that is, Pasir Pengarayan SKP-A. The construction of the weir on the Samo river and canals were completed and that of the weir at the Kaiti river is scheduled to be completed within this fiscal year.

1.3 Area to be developed

When the areas for development are to be delineated, it is necessary to take the following factors into consideration.

(1) Location and intake water level of intake facility
(2) Water availability and diversion water requirement
(3) Land suitability
(4) Planning household of transmigrants, distributed area for paddy cultivation per household and land use plan.

A point for the special consideration to be given in reference to (1) is that as the intake water level is heightened, long sub-embankment to the weir is needed and the flooding area in the upstream of the weir largely spreads and influences to the North Sumatra Province.

As for the above matter, (2), it is considered to supply additionally the discharge from the Mahato river in the case of the shortage of discharge of the Kumu river, but the additional weir plan on the Mahato river will be considered as a next phase development plan. The elevation of river bed on the Mahato river is considerably lower than that on the Kumu river. The river bed elevation of 55.0 m on the proposed weir site on the Kumu river is about 5.0 Km far from the border of the Project area, but the location with the same elevation on the Mahato river is about 16.5 Km far from the Project area. Moreover, the canal from that location to the Project area must cross five (5) tributaries of the Mahato river. Therefore, the construction of the supplemental weir on the Mahato river becomes costly and also it will be difficult to operate and maintain the weir because of the remote place. In addition, transmigration to the left side of the Mahato river has been planned by the Province.

With regard to the item (3), it is considered that the flooding areas along small rivers, influenced by the back water of the Kumu river during the flood are excluded from proposed farm land, and the land for paddy and other food crops will be secured with priority and then the land for perennial crops and tree crops such as rubber, oil palm, etc will be taken.

With reference to the item (4), taking distributed area for paddy cultivation per household as 1.00 ha and taking the plan of the provincial office into consideration, the transmigration scheme, road plan and land use plan will be studied.

1.4 Approach to the Project

As studied in Appendix I, the discharge at the proposed weir site for the project is estimated at 15.5 m3/S on monthly average discharge and 8.9 m3/S on monthly average discharge of the 1 in 5 year probability, and irrigable area for paddy is estimated at about 8,000 ha.

The study area consists of about 20,000 ha on the left side of the Kumu river and about 10,000 ha on the right side and the area benefited by the Project should be selected at the area with high investment effect as much as possible.

At present, the transmigrants in the study area have settled on the both sides of the Kumu river and the benefited area is generally selected as the following 3 plans.

Plan A : the case that only the left side area is developed
Plan B : the case that the both side areas are developed
Plan C : the case that the areas with good land capability are developed only for existing transmigrants

The area of each plan is estimated as follows :

Plan	Location	Gross Area	Net Irrigable Area
A	Left side	19,700 ha	7,300 ha
	Right side	-	-
	Total	19,700 ha	7,300 ha
B	Left side	11,400 ha	4,500 ha
	Right side	10,000 ha	2,800 ha
	Total	21,400 ha	7,300 ha
C	Left side	4,800 ha	1,900 ha
	Right side	5,300 ha	2,100 ha
	Total	10,100 ha	4,000 ha

CHAPTER 2. STUDY ON DEVELOPMENT PLAN

2.1 Alternative Study on Irrigation Area

Selection of benefited area is studied about 3 cases of plan A, B and C described in the clause 1.4, Chapter 1.

The control point elevation of the benefited area for each plan is selected as follows:

Plan A : The elevation, 55.0 m at the highest farm land near SKP-C, DK-IV

Plan B : Left side : the same as Plan A
Right side : the elevation, 56.0 m at the highest farm land in SKP-C, DK-II

Plan C : Left side : almost the same as Plan A
Right side : almost the same as Plan B

(1) Location of weir

A weir to the Project area is proposed at a certain place within about 10 km on the Kumu river from Kota Bangun near the upstream part of the Project area to the confluence with the Marbi river near the boundary to the North Sumatra Province.

As a result of the field reconnaissance and the study by the available topographical maps, the following two (2) places are proposed for comparative study on the weir site.

i) Upstream site : at the place about 2.4 Km in the downstream from the confluence with the Marbi river

ii) Downstream site : at the place about 4.1 Km further in the downstream from the upstream site

In order to compare the above sites, the conditions on the existing line of the Kumu river, river elevation, location of tributaries, sub-weir at the both sides and its possible height, temporary by-path space for construction in the case of Coupure method and others were studied.

The conditions of the both sites are described in 4.1.2, but the general conditions are as follows :

Item	Upstream Site	Downstream Site
River bed elevation	57.4 m	55.1 m
Width of river	30.0 m	35.0 m
Catchment area	520 Km^2	540 Km^2
Flood discharge (in 100 year probability)	620 m^3/S	640 m^3/S
Width of weir	48 m	50 m
Length of weir and sub-weir		
Elevation 65 m	480 m	560 m
Elevation 70 m	670 m	850 m

The results of the comparative study on the above two (2) plans are as follows:

i) The weir at the upstream site has small height and width, but the flood influences to the North Sumatra side because the flood water level is about 80 cm higher than the downstream one.

ii) The canal from the upstream site to the Project area has about 4.4Km longer in distance and must pass five (5) high land which needs deep excavation from 11.5 m to 20.0 m in depth and the construction cost becomes bigger.

iii) From technical, economical, operation and maintenance points of views, the downstream weir becomes better as shown in 4.1.2.

Therefore, the location of the weir for the Project was decided at the downstream site.

(2) Water availability and water requirement

As a result of the study described in the Appendix-I, clause 2.1.1, discharge of the Kumu river was estimated by tank model method as follows:

RIVER DISCHARGE ESTIMATED

(Unit: m^3/s)

Month	Downstream Site (CA = 540 Km2)		
	Monthly Average Discharge	1/5 Probable Average Discharge	Planning 10 days Min. Discharge
Jan.	20.5	11.9	8.84
Feb.	13.6	7.5	7.03
Mar.	16.8	9.2	8.42
Apr.	16.2	9.1	7.66
May.	13.6	8.3	6.30
Jun.	9.6	5.5	3.55
Jul.	9.2	5.2	4.67
Aug.	11.6	4.6	4.46
Sept.	16.5	9.3	7.38
Oct.	16.1	8.6	7.69
Nov.	18.4	10.8	9.27
Dec.	29.2	17.4	16.43
Yearly	15.5	8.9	-

The peak diversion water requirement in the wet season was estimated at 1.28 l/s/ha in 3.3 and the total irrigable area is generally estimated at 7,300 ha from the above river discharge.

(3) Height of weir and elevation of benefited area

With reference to the Plans A, B and C as described in 1.4, the required head loss from the control point in the benefited area to the weir site is respectively calculated as follows :

Table V-2 COMPARISON OF TOTAL HEAD LOSS

Unit : m

Plan	Location	Canal Length	Dis-charge	Slope	Convey-ance Loss	Other Losses	Total Loss
		m	m^3/s		m	m	m
A	Left	12,100	9.34	1/5.300	2.28	0.65	
		2,500	7.98	1/5.200	0.48	0.20	
		1,040	7.98	1/5.200	0.20	0.15	
	Total	15,640			2.96	1.00	3.96
B	Left	2,650	9.34	1/5,300	0.50	0.30	
		9,050	7.38	1/5,100	1.77	0.35	
		3,200	4.80	1/4,300	0.74	0.20	
		740	3.39	1/3,900	1.19	0.15	
	Total	15,640			3.20	1.00	4.20
	Right	2,650	9.34	1/5,300	0.50	0.30	
		9,310	4.58	1/4,100	2.27	0.50	
		150	4.59	1/1,163	0.30	-	
	Total	12,110			3.07	0.80	3.87
C	Left	2,650	5.12	1/4,300	0.62	0.30	
		12,990	3.12	1/3,800	3.42	0.51	
	Total	15,640			4.04	0.81	4.85
	Right	2,650	5.12	1/4,300	0.62	0.30	
		8,850	3.44	1/3,900	2.27	0.50	
		150	3.44	-	0.30	-	
	Total	11,650			3.19	0.80	3.99

Taking the required elevation at the fields as the elevation of the field plus 0.60m, the required elevation of weir is respectively estimated as follows:

Plan	Location	Elevation of Field	Canal Loss	Distribu-tion Loss	Intake Loss	Elevation of Weir
		m	m	m	m	m
A	Left	GH 55.0	3.96	0.60	0.10	EL 59.66
B	Left	GH 55.0	4.20	0.60	0.10	EL 59.90
	Right	GH 56.0	3.87	0.60	0.10	EL 60.57
C	Left	GH 55.0	4.85	0.60	0.10	EL 60.55
	Right	GH 56.0	3.99	0.60	0.10	EL 60.69

The required elevation of weir becomes in the following order.

Plan C > Plan B > Plan A

In the case of plan C, the required elevation of the weir becomes higher because of smaller canal discharge and steeper canal slope, and it will result in the small investment effect. Therefore, Plan A or Plan B will be selected.

(4) Topography of the Project area

The covering area by the existing topographic map on a scale of 1 to 5,000 is 22,100 ha in total including the area for linking canal and the mapping area in this time is 9,000 ha. Therefore, the total covering area by the topo-maps amounts to 31,100 ha.

Out of these areas, the irrigable area of which the ground slope is less than 5%, excluding non-irrigable area such as home yard, river course, steep land, etc. in the Project area, is estimated contour by contour as shown in Table V-3.

The Table V-3 shows that 185 ha of land is averagely distributed by one meter from 54 m to 57 m for the Plan A (left side), 110 ha for the Plan B (left side) and 200 ha for the Plan B (Right side), and net irrigable area increases about 74 ha for the Plan A by the elevation of one meter taking a ratio, 40% of net to gross into account, 44 ha for the Plan B (Left side) and 80 ha for the Plan B (Right side).

Table V-3 TOPOGRAPHIC CONDITION OF GROUND SLOPE

Division		Plan A		Plan B			
Slope	Elevation	Area	Accumulated Area	Left Side		Right Side	
				Area	Accumulated Area	Area	Accumulated Area
Less	m	ha	ha	ha	ha	ha	ha
than 5%	- 54	13,645	13,645	7,742	7,742	6,322	6,322
" Slope	54 - 55	190	13,835	130	7,872	274	6,596
"	55 - 56	184	14,019	140	8,012	198	6,794
"	56 - 57	183	14,202	160	8,172	139	6,933
"	57 - 58	164	14,366	136	8,308	161	7,094
"	58 - 59	196	14,562	176	8,484	81	7,175
"	59 - 60	151	14,713	134	8,618	80	7,255
"	60 - 61	200	14,913	154	8,772	94	7,349
"	61 - 62	136	15,049	81	8,853	18	7,367
"	62 - 63	136	15,185	106	8,959	8	7,375
More than 5% and land over 63 m		4,485	19,670	2,448	11,407	2,660	10,035

(from map scale 1/5,000)

(5) Land suitability

a. In the case of Plan A.

Attention is paid to the following points;

- The low land between the Kumu river and the Sitalas river (about 1.0 - 2.7 Km wide) and the low-land along the Mahato river are suitable for both paddy and upland cultivations.

- The land higher than the above area, which has sandy soil distributing in circular shape, is unsuitable for paddy field, but may be used for upland field

- The land with poor drainage condition is dotted in the Project area, but can be used for paddy field.

b. In the case of Plan B

- The area in the left side of the Plan B is the same as the Plan A

- The land in the right has many parts with poor drainage, and a lot of unsuitable land for upland field.

The area classified by soil and the suitability to the crop are shown as in the following table.

Table V-4 LAND SUITABILITY

Classification	Left side	Right side	Total	Paddy	Upland
	ha	ha	ha		
1st	4,030	850	4,880	S	S
2nd	9,790	3,590	13,380	S	S
3rd	560	-	560	S	N
4th	830	2,740	3,570	S	N
5th	4,810	2,430	7,240	N	S
Total	20,020	9,610	29,630		

(S: Suitable, N: Not Suitable)

(6) Number of household of transmigrant and distributed area

Special attention is paid to the following matters:

The existing transmigration village (SKP-C, DK-I) in which 245 households have already settled is located at the higher part more than elevation of 70 m and far from proposed paddy field area. This village will have to manage mainly upland cultivation. It is possible to develop paddy field of net 73 ha in the upstream part along the Kumu river, but this part is 4.5 Km to 6.5 Km far from DK-I and is excluded from the Project because the distributed field per one household becomes too small.

DU and DK-IV in SKP-C located in the highest part more than 63 m can find paddy field area comparatively near the villages (about 5-6 Km far from the village). Therefore, these villages can run irrigation farming in the lower area, while the higher area near the village is kept for tree crop farming.

The area of which the ground slope is 1/8 - 1/20 will be used for perenial crop farming.

The following table shows the highest elevation of the benefited areas, necessary distributed area, households of transmigration, net irrigable area, etc. of the plan A and Plan B.

Plan	Elevation of Benefited Area	Distribution Area	Number of Household	Net Irrigable Area	Ratio of Paddy Field
A left	< 55.0m	13,800 ha	7,300	7,300 ha	53%
B left	< 55.0m	7,900	4,500	4,500	57
B right	< 56.0m	6,800	2,800	2,800	41

Remarks : (i) Average alloted area per household is 2.25 ha in total adding average public land, 0.25 ha to the official alloted area 2.00 ha per household.

(ii) Net paddy field per household is proposed to 1.00 ha.

(iii) Possible total number of household for transmigration can be obtained dividing total distribution area by 2.25 ha.

(iv) Net irrigation area can be obtained multiplying 1.00 ha to the number of households.

(v) Ratio of paddy field is obtained dividing net irrigation area by distribution area.

(7) Flooding water level at proposed weir site

Flooding area arises in the upstream of the water source facility due to the installation of the area. Each flooding area corresponding to each flood water level is shown as follows and in Fig. V-1.

Flooding Water Level	Total Flooding Area	Flooding Area in North Sumatera
m	ha	ha
WS 60	59	5
WS 61	105	5
WS 62	165	10
WS 63	240	20
WS 64	340	29
WS 65	460	39
WS 66	585	60
WS 67	525	90
WS 68	890	120
WS 69	1.075	155
WS 70	1.310	185

(8) Result of study

As result of the studies up to the previous item, it is found that the project has following features.

a. Provided that a weir is equipped in the Riau Province, the site is proposed in the downstream of the confluence between the Kumu river and the Marbi river and its elevation of river bed is less than 58.3m

b. From a technical point of view for fluctuation of ten days discharges of the Kumu river which is water source, irrigable area is estimated at 7,300 ha.

c. Possible highest elevation in the benefited area to be irrigated by the weir is 55.0m near DK-IV and the elevation at the upstream part connected with it becomes 57.3 m for the Plan A, and that is 55.3 m near DK-IV and 58.2 m at the upstream part in the left side and 56.0m at DK-II in the right side for the Plan B.

d. In the above case, the irrigable area is estimated at 7,300 ha in the left side for the Plan A, and 4,500 ha in the left side and 2,800 ha in the right side for the Plan B.

e. The irrigable area increases 44 ha to 80 ha with every one meter between 54m to 57m of the ground elevation. It simply means that the area of 0.6% to 1.0% increases as a whole and even if the elevation of the weir is heightened, irrigable area does not increase so much.

f. The inundated area due to the installation of a weir appears from the elevation of 59.70 m in the case of the Plan A and 60.60m in the Plan B in the North Sumatra Province and the inundated area is estimated at 20 ha in the Plan A and 28.5 ha in the Plan B respectively

g. Comparison of Plan A and Plan B

i The Plan A is an irrigation development project only in the left side of the Kumu river.

ii From the viewpoints of water availability of the Kumu river, it is possible for the plan A to provide the area for new transmigration settlement of 5,680 households in the left side.

iii While, the plan B can provide the area for that of 4,230 households in total consisting of 2,880 in the left side and 1,350 in the right side.

iv The plan A needs bigger cost for new transmigration than the plan B because the number of households is bigger by 1,450 for the plan A.

v The plan A has lower height of a weir about 0.9 m in comparison with the plan B, and therefore the flood water level becomes lower and the inundated area to the North Sumatra province becomes decreases by 8.5 ha.

vi In the case that only the left side area is developed, it is necessary to pay attention to the selection of the land for paddy fields because the sandy land spreads from lower part to middle part.

vii The transmigration project in the project area forms one unit including the both side areas of Kumu river in both SKP-C and SKP-D.

viii In the case of the plan A, it becomes impossible to give supplemental irrigation to 1,450 households which have already transmigrated in the rigth side area of the Kumu river even in the future because of almost no other water source for the area.

ix The plan A bears inequality in one community dividing it in two.

The item v only is favourable to the plan A and all other items show advantages of the plan B in the above results of studies. The plan B is adopted for the Project.

Therefore, the scale of the Project is proposed as follows:

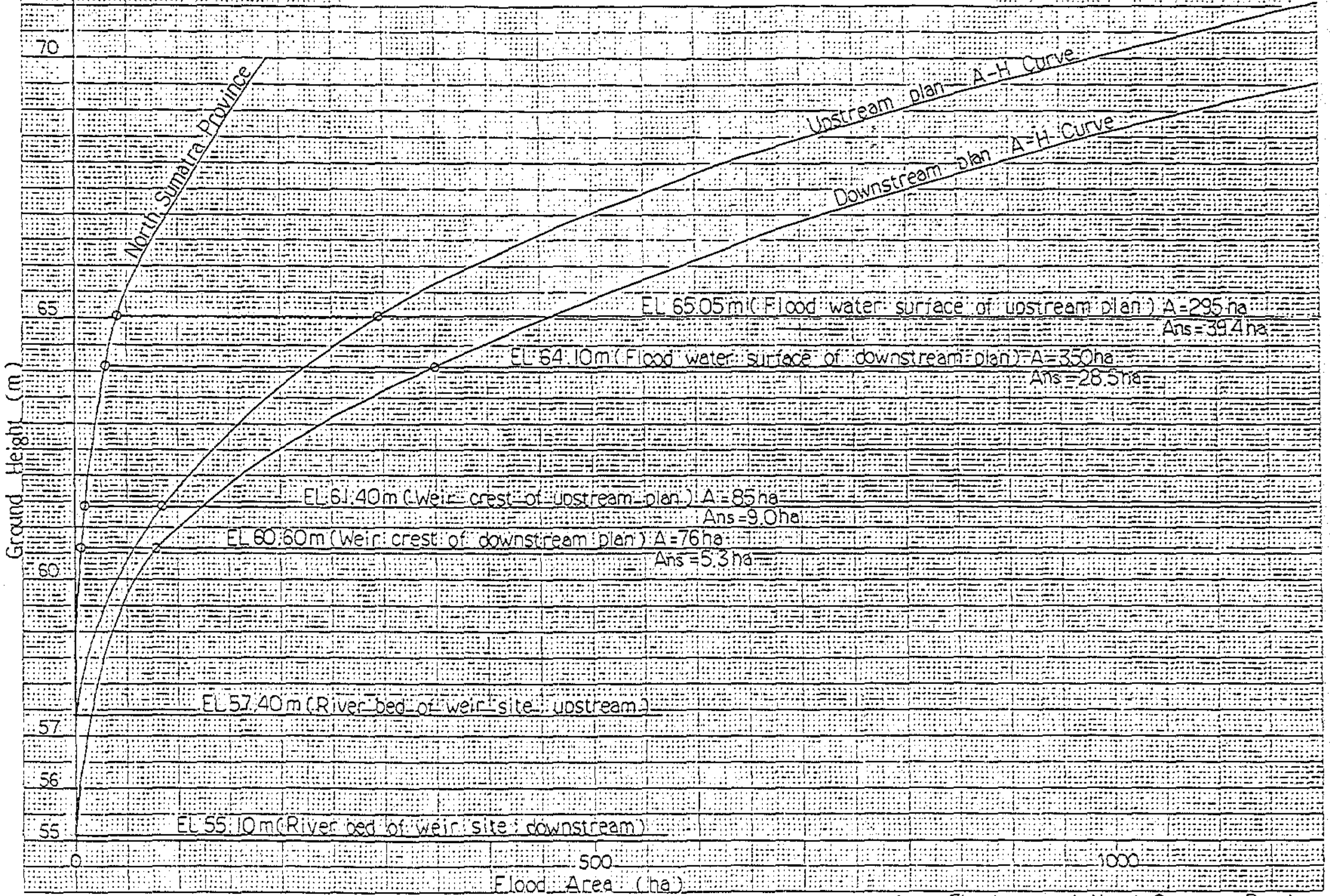
Net irrigation area : Left side 4,500 ha
Right side 2,800 ha
Total 7,300 ha

Number of households of transmigration;

Left side	: Existing householdss	1,620
	New households	2,880
Right side	: Existing households	1,450
	New households	1,350
Total		7,300

Site of Weir : Downstream site
Height of fixed weir : 5.5 m
Flood water level (1/100) : 64.10 m
Total inundated area : 350 ha
in the North Sumatra : 28.5 ha

Fig.V-1 Flood Area at Proposed Weir Site



Ans : Flood area of North Sumatra Province

Table V-5 PLANNING LAND USE OF THE PROJECT AREA (PLAN A&B)

Plan	Place	Area of land		Transmi-grants households	Gross paddy	Perenial crop	Home-yard	Public land	Other	Total
		Condition	Area							
			ha	KK	ha	ha	ha	ha	ha	ha
A	Left	<GH55m,<5%slope	13,835	5,681	7,940	3,400	1,200	1,200	95	13,835
	bank	GH55m-GH58m,<5%	531	-	170	300	-	-	61	531
		>GH58m,<5%slope	2,065	-	-	550	-	-	1,515	2,065
		River &>5%slope	2,619	-	-	1,025	215	215	1,164	2,619
		Home yard &								
		public land	620	1,252	-	-	310	310	-	620
		SKP-C,DK-IV	410*	367	-	200	100	110	-	410
		Total	20,080	7,300	8,110	5,475	1,825	1,835	2,835	20,080
B	Left	<GH55m,<5%slope	7,872	2,881	4,830	1,750	600	600	92	7,872
	bank	GH55m-GH58m,<5%	436	-	170	250	-	-	16	436
		>GH58m,<5%slope	1,015	-	-	500	-	-	465	1,015
		River &>5%slope	1,464	-	-	625	115	115	609	1,464
		Home yard &								
		public land	620	1,252	-	-	310	310	-	620
		SKP-C,DK-IV	410*	367	-	200	100	110	-	410
		Sub total	11,817	4,500	5,000	3,375	1,125	1,135	1,182	11,817
	Right	<GH56m,<5%slope	6,794	1,349	3,110	1,800	240	240	1,404	6,794
	bank	>GH56m,<5%Slope	449	-	-	300	-	-	149	449
		River &>5%slope	832	-	-	-	70	70	692	832
		Home yard &								
		Public land	780	1,451	-	-	390	390	-	780
		Consession area	1,180	-	-	-	-	-	1,180	1,180
		Sub total	10,035	2,800	3,110	2,100	700	700	3,425	10,035
		Total	21,852**	7,300	8,110	5,475	1,825	1,835	4,607	21,852

Note; * is outside of the project area.

** Project area : 21,852-410=21,400 ha.

Table V-6 PROPOSED TRANSMIGRATON PLAN (PLAN-B)

Location	Division	Name of Unit	House Hold		
			Already Settled	New	Total
			KK	KK	KK
Left Bank	SKP-C	DU	570		570
	SKP-C	DK-IV	367		367
	SKP-D	DU	582		582
	Spon-	Rantau			
	taneous	Kasai	100		100
	New	DK-6		600	600
	New	DK-7		400	400
	New	DK-8		400	400
	New	DK-9		600	600
	New	DK-10		480	480
	New	DK-11		401	401
	Sub Total		1,619	2,881	4,500
Right Bank	SKP-C	DK-II	378		378
		DK-III	386		386
	SKP-D	DK-I	254		254
		DK-II	433		433
	New	DK-12		600	600
	New	DK-13		400	400
	New	DK-14		349	349
	Sub Total		1,451	1,349	2,800
Total			3,070	4,230	7,300

2.2 Alternative Plan

The basic framework of the afore-mentioned development plan for the project is to install a weir on the Kumu river, to irrigate low land and to make double cropping a year mainly for paddy. To get the above plan, the following three cases were compared as described in 2.1.

Plan A : the case that only the left side area is developed
Plan B : the case that the both side area are developed
Plan C : the case that the areas with good land capability are developed only for existing transmigrants

As a result of the comparative study, the plan B is adopted for the project as stated in 2.1.(8).

However, other alternative plan may be taken as an optimum plan for the project by studying others ways to make it possible to take much more water stably. The followings are these alternative plans for the Project.

(1) Dam plan in the upstream of the Kumu river

This is a plan to construct a dam at further upstream part on the Kumu river than the proposed weir site which is located 3.5 Km far from Kota Bangung. It may be difficult to realize the plan from an administrative point of view because the benefited area of the Project is located in the Riau province and the upstream part of the catchment area of the Kumu river belongs to the North Sumatra Province.

The Kumu river belongs to the Riau province up to the confluence with Marbi river, a tributary of the Kumu river, which is located about 10 Km in the upstream from Kota Bangung, and up to the confluence with the Geringing river about 6.5 Km in further upstream from the above point, the boundary is the Kumu river of which the left side belongs to the North Sumatra province. The upstream of the Kumu river from the above confluence with the Geringing river belongs to the North Sumatra.

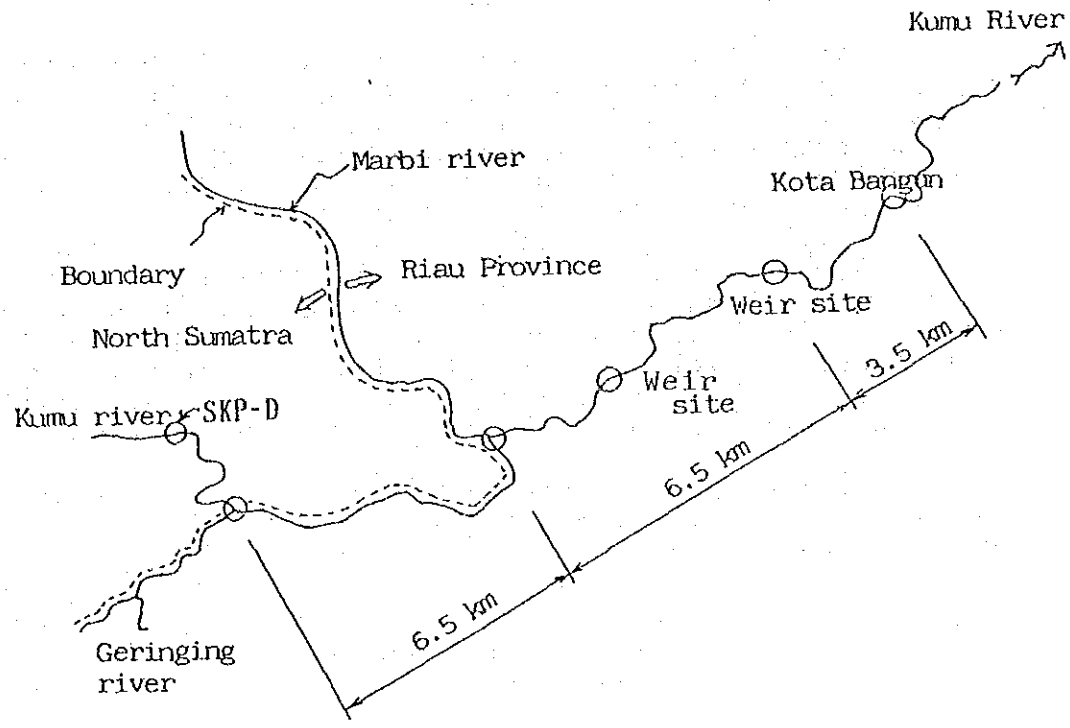


Fig.V-2 Location of Weir Sites

There is a transmigration area consisting of five (5) units (WPP IXb) in the North Sumatra Province Shibuhuan, SKP D Ujung Batu),which is located about 7.6 Km in the upstream from the confluence with the Marbi river. The bed elevation of the Kumu river at this point is seen at 65m to 66m in accordance with the topo-map at a scale of 1 to 5,000 and the ground elevation of the transmigration area is from 70m to 120m.

On the other hand, the geological investigation shows that the river bed at this point has gravel layer of 1 to 6.5m in depth and the aluvial of 5.0m to 7.5m in depth is deposited at the both sides of the river. The base rock for dam is found at Batu Lempung in the downstream, but this rock has big permeability of which coefficient is within 1.035×10^{-3} to 6.44×10^{-4} in accordance with the drilling survey,although it has enough bearing capacity. Therefore, the site has improper geology for dam.

(2) Supplemental weir plan from the Mahato river

This plan is not adopted as described in 1.3 at this development stage.

(3) Weir plan with effective storage

The Kumu river has the catchment area of 540 Km^2, but the run-off is fast and the river discharge has a trend to be strongly influenced by rainfalls. As it is desirable to assure stable intake discharge as a water source facilities for irrigation, it is considered of 1 to 2m in water depth by equipping movable gate on the fixed weir.

At present, the flood discharge is estimated at 640 m^3/s on a hundred year probability. Provided that the overflow depth is 3.5m using the above figure, the width of the abovbe movable weir will become 45.0m. This plan, however, has difficulties in the increase of construction cost, complicated operation and maintenance, structure, etc.

By the above-mentioned study, the scale of weir can be applied lower in height than the existing river banks in normal water in this plan.

2.3 Alternative Study on Irrigation Efficiency

It is very difficult to have effective irrigation for water saving on irrigation development in new land reclamation and transmigration areas. It is found the case of 0.5 in overall irrigation efficiency in Jawa island where the development has been advanced.

As a case study of the efficiency in this project, the calculation of rough cost estimation and of internal rate of returns is carried out by the following four (4) cases.

CASE-A	Overall Irrigation Efficiency	0.50
CASE-B	"	0.55
CASE-C	"	0.60
CASE-D	"	0.65

(1) Net Field Requirement (NFR)

Net field requirement (NFR) is comon in all the cases, and the maximum value is as follows. Table V-7 shows each five day's NFR in wet and dry season using the effective rainfall value from 1 in 5 years probability.

Season	Occurance date	Max. NFR
		mm/day
Wet Paddy	1st 10 days of Nov.	6.1
Dry Paddy	3rd 10 days of Mar.	7.3

(2) Diversion Requirement (DR)

Diversion requirement (DR) in each case is also shown in Table V-7 and maximum annual diversion requirement is summerized as below.

Case	Maximum DR	
	Wet	Dry
	ℓ/s/ha	ℓ/s/ha
A	1.41	1.69
B	1.28	1.54
C	1.18	1.41
D	1.09	1.30

(3) Maximum Irrigable Area

As the result of study of river discharge and irrigation requirement, irrigable area for paddy is as follows in each case.

(Unit: ha)

CASE	I.E	Max.Irrigable Area		Planning Area	
		Wet	Dry	Wet	Dry
A	0.50	6,758	2,958	6,700	2,900
B	0.55	7,440	3,256	7,400	3,200
C	0.60	8,110	3,550	8,100	3,500
D	0.65	8,720	3,817	8,700	3,800

The above cropping partern is Golongan method, starting from Feb-26 & Mar-11 in dry season, and Oct-1, Oct-16 & Nov-1 in wet season.

The calculation of the maximum area of Case-B is shown in Table V-8, V-9 and V-10 as a reference.

(4) River discharge and Diversion Requirement

As river discharge is constant and maximum irrigable area is objected in each case. Diversion requirement is almost constant.

The relation among river discharge, intake quantity and responsibility water discharge to downstream is shown in Table V-11 and Fig. V-3.

(5) Project cost and Internal Rate of Return in Rough Estimation

Rough estimation of project cost and internal rate of return is summarized below as a result of the study.

The Table V-12 shows the items of rough cost estimation.

	Case-A	Case-B	Case-C	Case-D
Irrigation Efficiency	0.50	0.55	0.60	0.65
Irrigable Area (ha)				
Wet	6,700	7,400	8,100	8,700
Dry	2,900	3,200	3,500	3,800
Project Cost (10^3US$)	39,963	43,020	46,051	47,716
I.R.R (%)	12.4	12.7	12.7	12.9
B/C	1.29	1.32	1.32	1.35

And project cost per ha. exempted land acquisition and price escalation contingency is as follows.

	Case-A	Case-B	Case-C	Case-D
Per ha cost (US$)	4,338	4,223	4,123	3,985

(6) Planning Irrigation Efficiency

IRR of each case is almost same with 12%, and higher grade group is Case B, C and D.

As the result of consideration of condition of soil texture, new land reclamation, total cost and new transmigration household etc. Case-B is adopted in this project. But responsibility water discharge to downstream at weir point should not be below than 0.10 m^3/s in a dry season.

Table V-7 NFR & DR AT EVERY IRRIGATION EFFICIENCY (1/4)

	NFR (mm/day)				DR, IE=0.65 (l/s/ha)				DR, IE=0.60 (l/s/ha)			
	Oct 1	Oct16	Nov 1	Mean	Oct 1	Oct16	Nov 1	Mean	Oct 1	Oct16	Nov 1	Mean
Oct 1	7.7	-	-	2.6	1.37	-	-	0.46	1.49	-	-	0.50
2	7.7	-	-	2.6	1.37	-	-	0.46	1.49	-	-	0.50
3	7.8	-	-	2.6	1.39	-	-	0.46	1.50	-	-	0.50
4	7.8	7.8	-	5.2	1.39	1.39	-	0.93	1.50	1.50	-	1.00
5	6.6	7.7	-	4.8	1.18	1.37	-	0.85	1.27	1.49	-	0.93
6	6.6	7.7	-	4.8	1.18	1.37	-	0.85	1.27	1.49	-	0.93
Nov 1	4.7	6.8	6.8	6.1	0.84	1.21	1.21	1.09	0.91	1.31	1.31	1.18
2	4.7	5.7	6.8	5.7	0.84	1.01	1.21	1.01	0.91	1.10	1.31	1.10
3	4.8	5.7	6.8	5.8	0.85	1.01	1.21	1.03	0.93	1.10	1.31	1.12
4	3.7	4.8	6.8	5.1	0.66	0.85	1.21	0.91	0.71	0.93	1.31	0.98
5	3.2	3.2	4.2	3.5	0.57	0.57	0.75	0.62	0.62	0.62	0.81	0.68
6	3.1	3.2	4.2	3.5	0.55	0.57	0.75	0.62	0.60	0.62	0.81	0.68
Dec 1	3.6	1.5	2.6	2.6	0.64	0.27	0.46	0.46	0.69	0.29	0.50	0.50
2	2.4	2.6	2.6	2.5	0.43	0.46	0.46	0.45	0.46	0.50	0.50	0.48
3	2.0	2.1	2.2	2.1	0.36	0.37	0.39	0.37	0.39	0.41	0.42	0.41
4	2.0	3.2	1.0	2.1	0.36	0.57	0.18	0.37	0.39	0.62	0.19	0.41
5	4.0	2.9	3.0	3.3	0.71	0.52	0.53	0.59	0.77	0.56	0.58	0.64
6	4.0	2.9	3.0	3.3	0.71	0.52	0.53	0.59	0.77	0.56	0.58	0.64
Jan 1	4.5	3.5	4.7	4.2	0.80	0.62	0.84	0.75	0.87	0.68	0.91	0.81
2	3.4	4.6	3.5	3.8	0.61	0.82	0.62	0.68	0.66	0.89	0.68	0.73
3	4.3	5.7	4.6	4.9	0.77	1.01	0.82	0.87	0.83	1.10	0.89	0.95
4	3.3	5.6	4.6	4.5	0.59	1.00	0.82	0.80	0.64	1.08	0.89	0.87
5	3.9	5.4	6.6	5.3	0.69	0.96	1.18	0.94	0.75	1.04	1.27	1.02
6	2.4	5.2	6.6	4.7	0.43	0.93	1.18	0.84	0.46	1.00	1.27	0.91
Feb 1	1.5	4.2	7.0	4.2	0.27	0.75	1.25	0.75	0.29	0.81	1.35	0.81
2	1.5	4.2	5.9	3.9	0.27	0.75	1.05	0.69	0.29	0.81	1.14	0.75
3	0	2.7	6.0	2.9	-	0.48	1.07	0.52	-	0.52	1.16	0.56
4	0	1.6	4.4	2.0	-	0.28	0.78	0.36	-	0.31	0.85	0.39
5	0	1.5	4.2	1.9	-	0.27	0.75	0.34	-	0.29	0.81	0.37
6	-	0	2.6	0.9	-	-	0.46	0.16	-	-	0.50	0.17
Mar 1	-	0	0.9	0.3	-	-	0.16	0.05	-	-	0.17	0.06
2	-	0	0.9	0.3	-	-	0.16	0.05	-	-	0.17	0.06
3	-	-	0	-	-	-	-	-	-	-	-	-
4	-	-	0	-	-	-	-	-	-	-	-	-
5	-	-	0	-	-	-	-	-	-	-	-	-

Table V-7 NFR & DR AT EVERY IRRIGATION EFFICIENCY (2/4)

	NFR (mm/day)				DR, IE=0.55 (l/s/ha)				DR, IE=0.50 (l/s/ha)			
	Oct 1	Oct16	Nov 1	Mean	Oct 1	Oct16	Nov 1	Mean	Oct 1	Oct16	Nov 1	Mean
Oct 1	7.7	-	-	2.6	1.62	-	-	0.55	1.78	-	-	0.60
2	7.7	-	-	2.6	1.62	-	-	0.55	1.78	-	-	0.60
3	7.8	-	-	2.6	1.64	-	-	0.55	1.81	-	-	0.60
4	7.8	7.8	-	5.2	1.64	1.64	-	1.09	1.81	1.81	-	1.20
5	6.6	7.7	-	4.8	1.39	1.62	-	1.01	1.53	1.78	-	1.11
6	6.6	7.7	-	4.8	1.39	1.62	-	1.01	1.53	1.78	-	1.11
Nov 1	4.7	6.8	6.8	6.1	0.99	1.43	1.43	1.28	1.09	1.57	1.57	1.41
2	4.7	5.7	6.8	5.7	0.99	1.20	1.43	1.20	1.09	1.32	1.57	1.32
3	4.8	5.7	6.8	5.8	1.01	1.20	1.43	1.22	1.11	1.32	1.57	1.34
4	3.7	4.8	6.8	5.1	0.78	1.01	1.43	1.07	0.86	1.11	1.57	1.18
5	3.2	3.2	4.2	3.5	0.67	0.67	0.88	0.74	0.74	0.74	0.97	0.81
6	3.1	3.2	4.2	3.5	0.65	0.67	0.88	0.74	0.72	0.74	0.97	0.81
Dec 1	3.6	1.5	2.6	2.6	0.76	0.32	0.55	0.55	0.83	0.35	0.60	0.60
2	2.4	2.6	2.6	2.5	0.51	0.55	0.55	0.53	0.56	0.60	0.60	0.58
3	2.0	2.1	2.2	2.1	0.42	0.44	0.46	0.44	0.46	0.49	0.51	0.49
4	2.0	3.2	1.0	2.1	0.42	0.67	0.21	0.44	0.46	0.74	0.23	0.49
5	4.0	2.9	3.0	3.3	0.84	0.61	0.63	0.69	0.93	0.67	0.69	0.76
6	4.0	2.9	3.0	3.3	0.84	0.61	0.63	0.69	0.93	0.67	0.69	0.76
Jan 1	4.5	3.5	4.7	4.2	0.95	0.74	0.99	0.88	1.04	0.81	1.09	0.97
2	3.4	4.6	3.5	3.8	0.72	0.97	0.74	0.80	0.79	1.06	0.81	0.88
3	4.3	5.7	4.6	4.9	0.90	1.20	0.97	1.03	1.00	1.32	1.06	1.13
4	3.3	5.6	4.6	4.5	0.69	1.18	0.97	0.95	0.76	1.30	1.06	1.04
5	3.9	5.4	6.6	5.3	0.82	1.14	1.39	1.12	0.90	1.25	1.53	1.23
6	2.4	5.2	6.6	4.7	0.51	1.09	1.39	0.99	0.56	1.20	1.53	1.09
Feb 1	1.5	4.2	7.0	4.2	0.32	0.88	1.47	0.88	0.35	0.97	1.62	0.97
2	1.5	4.2	5.9	3.9	0.32	0.88	1.24	0.82	0.35	0.97	1.37	0.90
3	0	2.7	6.0	2.9	-	0.57	1.26	0.61	-	0.63	1.39	0.67
4	0	1.6	4.4	2.0	-	0.34	0.93	0.42	-	0.37	1.02	0.46
5	0	1.5	4.2	1.9	-	0.32	0.88	0.40	-	0.35	0.97	0.44
6	-	0	2.6	0.9	-	-	0.55	0.19	-	-	0.60	0.21
Mar 1	-	0	0.9	0.3	-	-	0.19	0.06	-	-	0.21	0.07
2	-	0	0.9	0.3	-	-	0.19	0.06	-	-	0.21	0.07
3	-	-	0	-	-	-	-	-	-	-	-	-
4	-	-	0	-	-	-	-	-	-	-	-	-
5	-	-	0	-	-	-	-	-	-	-	-	-

Table V-7 NFR & DR AT EVERY IRRIGATION EFFICIENCY (3/4)

	NFR (mm/day)			DR, IE=0.65 (l/s/ha)			DR, IE=0.60 (l/s/ha)		
	Feb 26	Mar 11	Mean	Feb 26	Mar 11	Mean	Feb 26	Mar 11	Mean
Feb 6	8.2	-	4.1	1.46	-	0.73	1.58	-	0.79
Mar 1	6.5	-	3.3	1.16	-	0.59	1.25	-	0.64
2	6.5	-	3.3	1.16	-	0.59	1.25	-	0.64
3	6.6	6.6	6.6	1.18	1.18	1.18	1.27	1.27	1.27
4	5.6	6.6	6.1	1.00	1.18	1.09	1.08	1.27	1.18
5	6.8	7.8	7.3	1.21	1.39	1.30	1.31	1.50	1.41
6	5.8	7.8	6.8	1.03	1.39	1.21	1.12	1.50	1.31
Apr 1	5.5	6.6	6.1	0.98	1.18	1.09	1.06	1.27	1.18
2	5.5	6.6	6.1	0.98	1.18	1.09	1.06	1.27	1.18
3	3.9	4.9	4.4	0.69	0.87	0.78	0.75	0.95	0.85
4	5.0	4.9	5.0	0.89	0.87	0.89	0.96	0.95	0.96
5	5.5	5.5	5.5	0.98	0.98	0.98	1.06	1.06	1.06
6	6.6	4.5	5.6	1.18	0.80	1.00	1.27	0.87	1.08
May 1	6.1	6.2	6.2	1.09	1.10	1.10	1.18	1.20	1.20
2	6.1	6.1	6.1	1.09	1.09	1.09	1.18	1.18	1.18
3	6.4	7.5	7.0	1.14	1.34	1.25	1.23	1.45	1.35
4	7.4	6.4	6.9	1.32	1.14	1.23	1.43	1.23	1.33
5	7.0	6.0	6.5	1.25	1.07	1.16	1.35	1.16	1.25
6	6.9	6.0	6.5	1.23	1.07	1.16	1.33	1.16	1.25
Jun 1	6.2	7.4	6.8	1.10	1.32	1.21	1.20	1.43	1.31
2	6.0	7.4	6.7	1.07	1.32	1.19	1.16	1.43	1.29
3	5.0	8.1	6.6	0.89	1.44	1.18	0.96	1.56	1.27
4	5.0	7.0	6.0	0.89	1.25	1.07	0.96	1.35	1.16
5	3.1	7.3	5.2	0.55	1.30	0.93	0.60	1.41	1.00
6	2.0	5.3	3.7	0.36	0.94	0.66	0.39	1.02	0.71
Jul 1	1.8	4.8	3.3	0.32	0.85	0.59	0.35	0.93	0.64
2	0	2.9	1.5	0	0.52	0.27	0	0.56	0.29
3	0	1.8	0.9	0	0.32	0.16	0	0.35	0.17
4	0	1.8	0.9	0	0.32	0.16	0	0.35	0.17

Table V-7 NFR & DR AT EVERY IRRIGATION EFFICIENCY (4/4)

	NFR (mm/day)			DR, IE=0.55 (l/s/ha)			DR, IE=0.50 (l/s/ha)		
	Feb 26	Mar 11	Mean	Feb 26	Mar 11	Mean	Feb 26	Mar 11	Mean
Feb 6	8.2	-	4.1	1.73	-	0.86	1.90	-	0.95
Mar 1	6.5	-	3.3	1.37	-	0.69	1.50	-	0.76
2	6.5	-	3.3	1.37	-	0.69	1.50	-	0.76
3	6.6	6.6	6.6	1.39	1.39	1.39	1.53	1.53	1.53
4	5.6	6.6	6.1	1.18	1.39	1.28	1.30	1.53	1.41
5	6.8	7.8	7.3	1.43	1.64	1.54	1.57	1.81	1.69
6	5.8	7.8	6.8	1.22	1.64	1.43	1.34	1.81	1.57
Apr 1	5.5	6.6	6.1	1.16	1.39	1.28	1.27	1.53	1.41
2	5.5	6.6	6.1	1.16	1.39	1.28	1.27	1.53	1.41
3	3.9	4.9	4.4	0.82	1.03	0.93	0.90	1.13	1.02
4	5.0	4.9	5.0	1.05	1.03	1.05	1.16	1.13	1.16
5	5.5	5.5	5.5	1.16	1.16	1.16	1.27	1.27	1.27
6	6.6	4.5	5.6	1.39	0.95	1.18	1.53	1.04	1.30
May 1	6.1	6.2	6.2	1.28	1.30	1.30	1.41	1.44	1.44
2	6.1	6.1	6.1	1.28	1.28	1.28	1.41	1.41	1.41
3	6.4	7.5	7.0	1.35	1.58	1.47	1.48	1.74	1.62
4	7.4	6.4	6.9	1.56	1.35	1.45	1.71	1.48	1.60
5	7.0	6.0	6.5	1.47	1.26	1.37	1.62	1.39	1.50
6	6.9	6.0	6.5	1.45	1.26	1.37	1.60	1.39	1.50
Jun 1	6.2	7.4	6.8	1.30	1.56	1.43	1.44	1.71	1.57
2	6.0	7.4	6.7	1.26	1.56	1.41	1.39	1.71	1.55
3	5.0	8.1	6.6	1.05	1.70	1.39	1.16	1.88	1.53
4	5.0	7.0	6.0	1.05	1.47	1.26	1.16	1.62	1.39
5	3.1	7.3	5.2	0.65	1.54	1.09	0.72	1.69	1.20
6	2.0	5.3	3.7	0.42	1.12	0.78	0.46	1.23	0.86
Jul 1	1.8	4.8	3.3	0.38	1.01	0.69	0.42	1.11	0.76
2	0	2.9	1.5	0	0.61	0.32	0	0.67	0.35
3	0	1.8	0.9	0	0.38	0.19	0	0.42	0.21
4	0	1.8	0.9	0	0.38	0.19	0	0.42	0.21

Table V-8 MAXIMUM IRRIGABLE AREA FOR CASE STUDY

CASE- B FOR WET PADDY

MONTH		RIVER DIS. M3/S	WATER REQ. L/S/HA.	IRRI.AREA HA.	
JAN.	1	15.67	0.88	17806.8	
	2	11.17	1.03	10844.7	
	3	8.84	1.12	7892.9	
FEB.	1	7.13	0.88	8102.3	
	2	7.03	0.61	11524.6	
	3	8.42	0.40	21050.0	
MAR.	1	9.74	0.06	162333.0	
	2	9.48	0.00	0.0	
	3	8.42	0.00	0.0	
APR.	1	7.66	0.00	0.0	
	2	10.79	0.00	0.0	
	3	8.79	0.00	0.0	
MAY.	1	9.10	0.00	0.0	
	2	9.44	0.00	0.0	
	3	6.30	0.00	0.0	
JUN.	1	7.26	0.00	0.0	
	2	5.63	0.00	0.0	
	3	3.55	0.00	0.0	
JUL.	1	4.93	0.00	0.0	
	2	4.67	0.00	0.0	
	3	6.04	0.00	0.0	
AUG.	1	4.83	0.00	0.0	
	2	4.57	0.00	0.0	
	3	4.46	0.00	0.0	
SEP.	1	7.38	0.00	0.0	
	2	10.31	0.00	0.0	
	3	10.22	0.00	0.0	
OCT.	1	10.03	0.55	18236.4	
	2	8.11	1.09	7440.4	Min.
	3	7.69	1.01	7613.9	
NOV.	1	10.21	1.28	7976.6	Max.
	2	9.27	1.22	7598.4	
	3	12.86	0.74	17378.4	
DEC.	1	16.52	0.55	30036.4	
	2	16.43	0.44	37340.9	
	3	19.15	0.69	27753.6	

CASE- B FOR DRY PADDY

MONTH		RIVER DIS. M3/S	WATER REQ. L/S/HA.	IRRI.AREA HA.	
JAN.	1	15.67	0.00	0.0	
	2	11.17	0.00	0.0	
	3	8.84	0.00	0.0	
FEB.	1	7.13	0.00	0.0	
	2	7.03	0.00	0.0	
	3	8.42	0.86	9790.7	
MAR.	1	9.74	0.69	14115.9	
	2	9.48	1.39	6820.1	
	3	8.42	1.54	5467.5	Max.
APR.	1	7.66	1.28	5984.4	
	2	10.79	1.05	10276.2	
	3	8.79	1.18	7449.2	
MAY.	1	9.10	1.30	7000.0	
	2	9.44	1.47	6421.8	
	3	6.30	1.37	4598.5	
JUN.	1	7.26	1.43	5076.9	
	2	5.63	1.39	4050.4	
	3	3.55	1.09	3256.9	Min.
JUL.	1	4.93	0.69	7144.9	
	2	4.67	0.19	24578.9	
	3	6.04	0.00	0.0	
AUG.	1	4.83	0.00	0.0	
	2	4.57	0.00	0.0	
	3	4.46	0.00	0.0	
SEP.	1	7.38	0.00	0.0	
	2	10.31	0.00	0.0	
	3	10.22	0.00	0.0	
OCT.	1	10.03	0.00	0.0	
	2	8.11	0.00	0.0	
	3	7.69	0.00	0.0	
NOV.	1	10.21	0.00	0.0	
	2	9.27	0.00	0.0	
	3	12.86	0.00	0.0	
DEC.	1	16.52	0.00	0.0	
	2	16.43	0.00	0.0	
	3	19.15	0.00	0.0	

Table V-9 MAXIMUM IRRIGABLE AREA FOR WET PADDY (IE=0.65)

No	Commencement Date of Puddling	Period of Puddling Preparation	Max. Water Requirement	Max. Irrigation Area	Remarts
		(days)	(l/s/ha)	(ha)	
1	Aug.16	45	1.67	2,736	
2	Sep. 1	45	1.28	5,765	
3	Sep.16	45	1.37	6,702	
4	Sep.21	45	1.37	6,702	
5	Sep.26	45	1.39	5,834	
6	Oct. 1	45	1.39	5,834	
7	Oct. 6	45	1.39	5,613	
8	Oct.11	45	1.39	5,613	
9	Oct.16	45	1.39	5,613	
10	Oct.21	45	1.37	5,613	
11	Oct.26	45	1.37	5,613	
12	Nov. 1	45	1.25	5,704	
13	Nov. 6	45	1.26	5,658	
14	Nov.16	45	1.32	5,325	
15	Nov.21	45	1.32	5,325	
	Golongan				
16	2+3,Sep.1,Sep.16		1.21	7,306	
17	3+6,Sep.16,Oct.1		1.37	6,238	
18	6+9,Oct.1,Oct.16		1.39	5,834	
19	9+12,Oct.16,Nov.1		1.21	7,130	
20	12+14,Nov.1,Nov.16		1.21	5,858	
21	13+15,Nov.6,Nov.21		1.21	5,809	
22	2+3+4		1.25	6,758	
23	3+6+9		1.26	6,436	
24	4+7+10		1.25	6,152	
25	5+8+11		1.25	6,152	
26	6+9+12,Oct.1,Oct.16,Oct.21		1.09	8,720	Adopted
27	7+10+13		1.09	7,835	
28	9+12+14		1.09	6,922	

Table V-10 MAXIMUM IRRIGABLE AREA FOR DRY PADDY (IE=0.65)

No	Commencemet date of Puddling	Nos, Unit/ Golongan	Puddling	Max	Max Area	Remarts
		(Nos)	(days)	(l/s/ha)	(ha)	
1	Feb 26	3	45	1.46	5,040 ※	
2	Mar 1	3	45	1.30	3,776 ※	
3	Mar 11	3	45	1.44	2,730	
4	Mar 16	3	45	1.46	2,649	
5	Apr 1	3	45	1.55	2,290	
6	1+3, Feb 26, Mar 11	3	45	1.30	3,817	Adopted
7	2+4, Mar 1, Apr 1	3	45	1.34	3,114	
8	4+5, Mar 16, Apr 1	3	45	1.45	2,448	
9	Mar 1	3	30	1.67	4,731 ※	
10	Mar 16	3	30	1.89	2,367	
11	9+10, Mar 1, Mar 16	3	30	1.72	3,817	
12	Mar 1	2	30	1.67	4,331 ※	
13	Mar 16	2	30	1.89	2.500	
14	12+13, Mar 1, Mar 16	2	30	1.67	3.586	

Note; Simple pattern can not be adopted because of a short period after 1st paddy to beginning of 2nd paddy.

Table V-11 RIVER DISCHARGE & DIVERSION REQUIREMENT FOR CASE STUDY

WET IRRIGABLE AREA- 7400 HA.
DRY IRRIGABLE AREA- 3200 HA.

CASE- .55

MONTH		RIVER DIS. M3/S	DIVERSION REQ. M3/S	SURPLUS DIS. M3/S
JAN.	1	15.67	6.51	9.16
	2	15.67	5.92	9.75
	3	11.17	7.62	3.55
	4	11.17	7.03	4.14
	5	8.84	8.29	0.55
	6	8.84	7.33	1.51
FEB.	1	7.13	6.51	0.62
	2	7.13	6.07	1.06
	3	7.03	4.51	2.52
	4	7.03	3.11	3.92
	5	8.42	2.96	5.46
	6	8.42	4.16	4.26
MAR.	1	9.74	2.65	7.09
	2	9.74	2.65	7.09
	3	9.48	4.45	5.03
	4	9.48	4.10	5.38
	5	8.42	4.93	3.49
	6	8.42	4.58	3.84
APR.	1	7.66	4.10	3.56
	2	7.66	4.10	3.56
	3	10.79	2.98	7.81
	4	10.79	3.36	7.43
	5	8.79	3.71	5.08
	6	8.79	3.78	5.01
MAY.	1	9.10	4.16	4.94
	2	9.10	4.10	5.00
	3	9.44	4.70	4.74
	4	9.44	4.64	4.80
	5	6.30	4.38	1.92
	6	6.30	4.38	1.92
JUN.	1	7.26	4.58	2.68
	2	7.26	4.51	2.75
	3	5.63	4.45	1.18
	4	5.63	4.03	1.60
	5	3.55	3.49	0.06
	6	3.55	2.50	1.05

CASE- .55

MONTH		RIVER DIS. M3/S	DIVERSION REQ. M3/S	SURPLUS DIS. M3/S
JUL.	1	4.93	2.21	2.72
	2	4.93	1.02	3.91
	3	4.67	0.61	4.06
	4	4.67	0.61	4.06
	5	6.04	0.00	6.04
	6	6.04	0.00	6.04
AUG.	1	4.83	0.00	4.83
	2	4.83	0.00	4.83
	3	4.57	0.00	4.57
	4	4.57	0.00	4.57
	5	4.46	0.00	4.46
	6	4.46	0.00	4.46
SEP.	1	7.38	0.00	7.38
	2	7.38	0.00	7.38
	3	10.31	0.00	10.31
	4	10.31	0.00	10.31
	5	10.22	0.00	10.22
	6	10.22	0.00	10.22
OCT.	1	10.03	4.07	5.96
	2	10.03	4.07	5.96
	3	8.11	4.07	4.04
	4	8.11	8.07	0.04
	5	7.69	7.47	0.22
	6	7.69	7.47	0.22
NOV.	1	10.21	9.47	0.74
	2	10.21	8.88	1.33
	3	9.27	9.03	0.24
	4	9.27	7.92	1.35
	5	12.86	5.48	7.38
	6	12.86	5.48	7.38
DEC.	1	16.52	4.07	12.45
	2	16.52	3.92	12.60
	3	16.43	3.26	13.17
	4	16.43	3.26	13.17
	5	19.15	5.11	14.04
	6	19.15	5.11	14.04

Fig.V-3 Ten Days River Discharge and Diversion Discharge of Paddy for Case Study

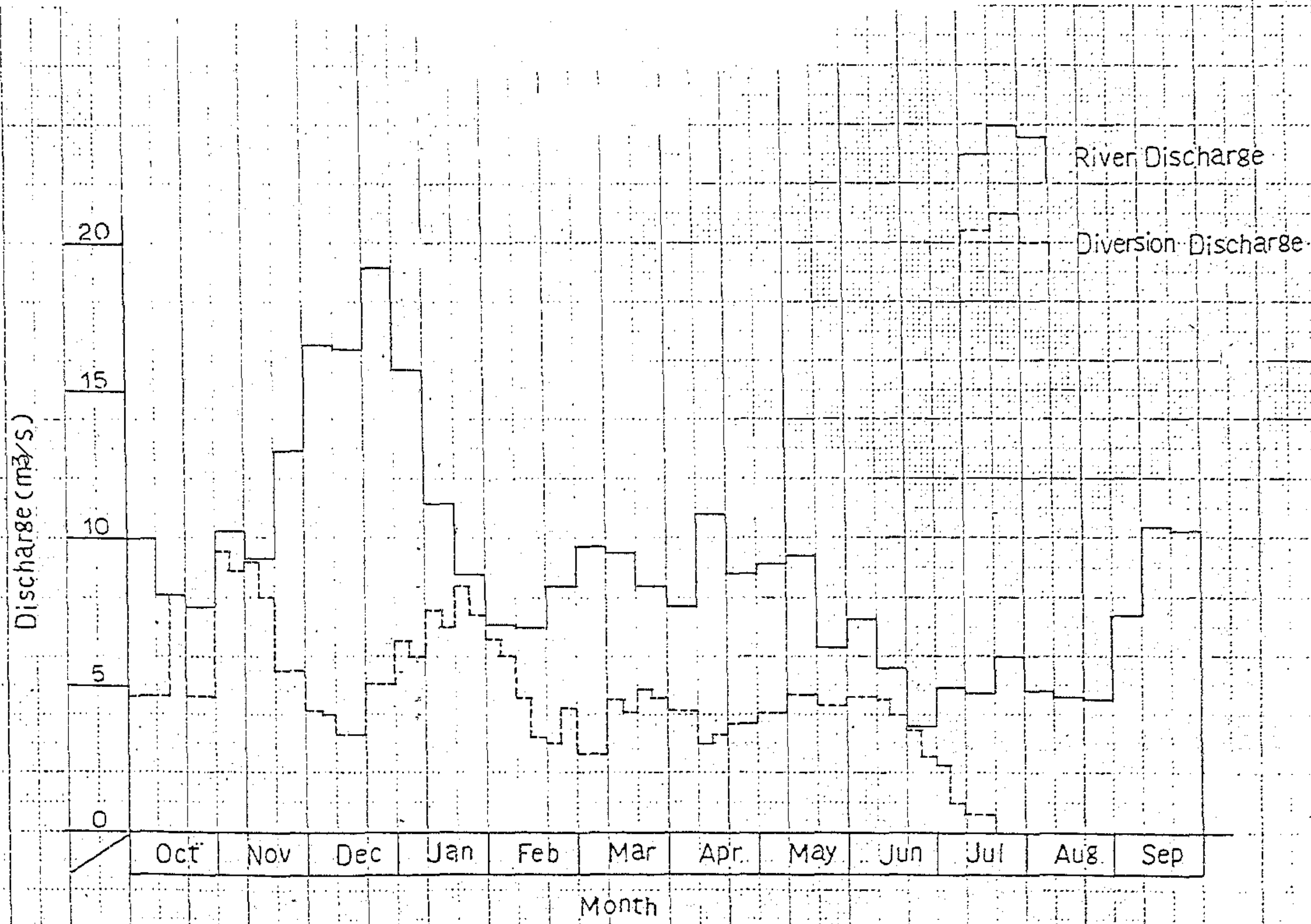


Table V-12 COMPARISON OF PROJECT COST IN ROUGH ESTIMATION

(Unit 1,000 US $)

Items		CASE- A	CASE- B	CASE- C	CASE- D
1. Preparatory Expenses		302	333	365	392
2. Main Civil Work		23,192	24,919	26,614	27,590
2.1 Head work	(Div-I)	2,495	2,495	2,495	2,495
2.2 Link Canal	(〃)	647	647	647	647
2.3 Main & Secondary Canal	(Div-II)	4,148	4,148	4,099	4,073
2.4 〃	(Div-III)	3,989	4,037	4,054	4,120
2.5 〃	(Div-IV)	1,687	2,309	3,145	3,064
2.6 〃	(Div-V)	3,091	3,461	3,664	4,004
2.7 〃	(Div-VI)	2,426	2,546	2,667	2,858
2.8 Tertiary System		4,709	5,276	5,843	6,329
2.9 Pilot farm		-	-	-	-
3. Land Compensation Cost		180	180	180	180
4. Administration Cost		603	666	729	783
5. Engineering Service		3,575	3,839	4,098	4,248
6. Physical Contingency		1,392	1,497	1,600	1,659
Total		29,244	31,432	33,584	34,851
7. Price Contingency		10,719	11,588	12,467	12,865
Project Cost Grand Totl		39,963	43,020	46,051	47,716

CHAPTER 3 IRRIGATION WATER REQUIREMENT

3.1 Planning ten days discharge

The Kumu river shows bigger monthly average discharge in comparison with the planning irrigation area, but also big fluctuation in the range of monthly discharges and ten days discharges. In addition, effective storage is not expected for the Project because the type of water source facility is proposed to be a weir. Therefore, planning ten days discharges are estimated by the following method for the sake of safety to the Project.

(i) The average of ten days discharges for 19 years is calculated every period and the ratio of each average value is used as a pattern of ten days discharges for every month.

(ii) The monthly discharge of the 1 in 5 years probability is calculated every month.

(iii) Planning ten days discharges are obtained in proportion to the ratio of ten days discharges to the above monthly discharge of the 1 in 5 years probability.

The above calculation result is compiled as shown in Table V-15.

3.2 Cropping Pattern and Crop Coefficient

a. Cropping pattern

It is necessary to study comparatively variety, meteorological condition, possible river discharge, etc. to decide growing period of low land paddy. In this report, cropping pattern has been studied adopting IR-64 which has been prevailing in Indonesia and upland crops such as peanuts, soybeans and maize are studied for supplemental irrigation.

Taking into consideration that average monthly rainfalls are smaller in June to August and shown a trend to become also smaller in February, and there are two wet seasons, that is, bigger rainy season in December to January and smaller rainy season in March to April, it is possible to apply double cropping of law land paddy.

The following combinations of cropping pattern are studied to confirm the water availability and to decide the scale of irrigation area.

Type -A Paddy - Paddy
Type -B Paddy - Polowijo
Type -C Paddy - Paddy/Polowijo

As to the polowijo crop, soybeans, maize and peanuts are chosen for dry season crops.

b. Crop coefficients for rice and Polowijo

The crop coefficients for rice and polowijo as given in Table V-13 will be used on the basis of Irrigation system Design, KP-01.

Table V-13 CROP COEFFICIENT FOR RICE AND POLOWIJO

Crop		Rice	Soybeans	Maize	Peanuts
Growth period days		100	90	90	120
Month	5 Days				
1st	1	1.1	0.5	0.5	0.5
	2	1.1	0.5	0.5	0.5
	3	1.1	0.5	0.5	0.5
	4	1.1	0.75	0.59	0.51
	5	1.1	0.75	0.59	0.51
	6	1.1	0.75	0.59	0.51
2nd	1	1.1	1.0	0.96	0.66
	2	1.05	1.0	0.96	0.66
	3	1.05	1.0	0.96	0.66
	4	1.05	1.0	1.05	0.85
	5	1.05	1.0	1.05	0.85
	6	1.05	1.0	1.05	0.85
3rd	1	1.05	0.82	1.02	0.95
	2	1.05	0.82	1.02	0.95
	3	0.95	0.82	1.02	0.95
	4	0.95	0.45	0.95	0.95
	5	0.95	0.45	0.95	0.95
	6	0	0.45	0.95	0.95
4th	1	0			0.95
	2	0			0.95
	3				0.95
	4				0.55
	5				0.55
	6				0.55

3.3 Irrigation Water Requirement

Irrigation water requirement is estimated using the meteorological data at Pasir Pengarayan.

i) Evapotranspiration

Crop evapotranspiration is obtained using modified Penman method as follows:

Table V-14 TEN DAYS EVAPOTRANSPIRATION

Period	Evapotranspiration	Period	Evapotranspiration	Period	Evapotranspiration
	mm		mm		mm
Jan. 1	34	May 1	41	Sep. 1	40
2	35	2	42	2	40
3	38	3	45	3	40
Feb. 1	39	Jun. 1	40	Oct. 1	42
2	40	2	41	2	40
3	33	3	42	3	43
Mar. 1	38	Jul. 1	41	Nov. 1	38
2	42	2	38	2	40
3	48	3	42	3	37
Apr. 1	42	Aug. 1	40	Dec. 1	35
2	43	2	41	2	34
3	42	3	42	3	36

(Remarks : Latitude; $1^{o}15'$ North)

The detailed calculation is shown in the Table V-16 and Table V-17.

ii) Effective Rainfall

Effective rainfall for rice, is asseemed by the following equation using observed rainfall data for 19 years from 1970 to 1988 at Pasir Pengarayan. (See Table V-18)

$$Re = 0.7 \times Rm$$

Where Re : Effective rainfall in mm/month
Rm : Monthly rainfall of the 1 in 5 years probability in mm/month

Planning ten days effective rainfall is distributed in proportion to the ratio of ten days rainfall to the above monthly rainfall of the 1 in 5 years probability.

The effective rainfall for polowijo is determined for monthly period and is related to monthly rainfall of 1 in 2 years probability and the average monthly crop evapotranspiration. (Refer to Irrigation Design standards, KP-01)

iii) Percolation

The percolation rate for irrigation planning in the project area will be assumed to be 3 mm/day referring to the value observed in the UWAI Irrrigation Project and Ranah Singkuang Irrigation Project at Bankinan, Kampar.

The value observed in the UWAI project was 1.8 mm/day to 2.1 mm/day during Apr. 1985 to Aug. 1985 and in Ranah Singkuang was 1.0 mm/day during Oct. 1986 to Jan. 1987.

iv) Land Preparation Requirement

In general, peak water requirement becomes smaller as making puddling period longer. The lag of puddling period depends on labour force and water availability even if using rotational system. For the peroject, the period of land preparation is taken to be 45 days. However the study of 30 days will be added for dry season rice to make irrigation period shorter and to supply stable diversion discharge from the weir considering the lowest river discharge during last 10 days of June. (See Table V-19 and V-20)

The irrigation requirement at field level is calculated by the method of Van de Goor and Zijlstra as follows.

Condition :

Presaturation requirement	for Wet paddy	:	S= 275 mm
"	for Dry paddy	:	S= 275 mm
Land preparation period		:	T= 45 days
Percolation		:	P= 3.0 mm/day

$$IR = M.e^{k} / (e^{k} - 1)$$

where :

IR : Irrigation requirement at field level, mm/day
M : Water requirement to compensate for evaporation and percolation of the fields already saturated. M = Eo + P
Eo : Open water evaporation taken at 1.1 x ETo during land preparation, mm/day
ETo : Evapotranspiration by the mofified Penman method, mm/day

K : M.T/S

S : Presaturation requirement from below items

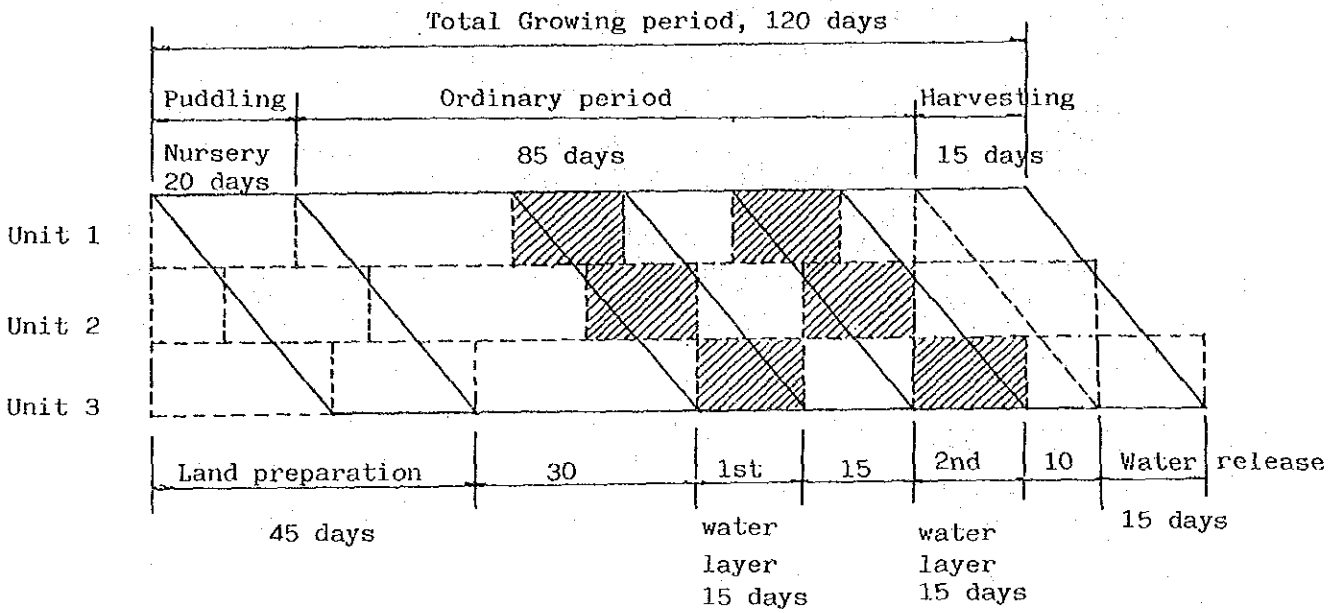
. Required water depth above soil surface after puddling	:	150 mm
. Saturation requirement	:	90 - 140mm (mean 115 mm)
. Nursury requirement	:	5 mm
. Losses	:	5 mm
	S =	275 mm

V) Water Layer replacement

According to the Indonesian Design Standard, 2 replacements, each of 50mm (3.3 mm/day for 1/2 month) at about 1 month and 2 months after transplanting for fertilizer application.

A schematilized cropping pattern with the layer replacement is shown in Table V-21 and as below.

Model of Paddy Cultivation



Remark : 1. Rectangular shapes show actual farming period at each unit

2. Inclined line is representative farming period for one block of Golongan.

3. Time lag of planting is 25 days for one block of Golongan.

vi) Irrigation efficiency

The irrigation efficiencies are given as follows. (See Chapter 1, clause 2.3)

For paddy fields	: Overall	55%
For polowijo	:	50%

vii) Results of calculation

From the above mentioned figure, the water requirements for paddy and polowijo are summarized Table V-22, and 24 and the results of combination pattern of each crop are shown in Fig IV-2, and IV-3 in the Appendix IV.

3.4 Diversion Requirement

Diversion requirements of wet paddy, dry paddy and upland crops as supplemental irrigation are shown in Table V-26.

Irrigation area of Table V-27 is as follows:

Wet season paddy : 7,300 ha
Dry season paddy : 3,100 ha
Upland crops : 2,700 ha

As to the irrigable area of upland crops, the following consideration is adopted.

Objective number of people in downstream up to the confluence of Mahato river; 20,000 person
Necessary living water ; Qd

$$Qd = 20,000 \text{ person} \times 140 \text{ l/day/person} \div 86,400 \text{ sec}$$
$$= 0.003 \text{ m}^3/\text{s}$$

River discharge in last 10 days of June; $Q_1 = 3.55 \text{ m}^3/\text{s}$
Diversion discharge for dry paddy ; $Q_2 = 3.38 \text{ m}^3/\text{s}$
Available discharge for polowijo ; Q_3

$$Q_3 = Q_1 - Q_2 - Qd = 0.14 \text{ m}^3/\text{s}$$

Diversion water requirement of polowijo; Q_p

$$Q_p = 0.05 \text{ l/s/ha} \times 2,700 \text{ ha} = 0.14 \text{ m}^3/\text{s}$$

However, in the case of minimum responsibility water discharge to downstream is 0.10 m^3/sec, the irrigation water of polowijo will be shorten as below.

$$Q_1 - (Q_2 + Q_3) = 3.55 - (3.38 + 0.14)$$
$$= 0.03 < 0.10 \text{ m}^3/\text{s}$$

Therefore, irrigation should be considered to be a supplemental irrigation against upland crops during the period of last 10 days of June.

Table V-15 PLANNING TEN DAYS DISCHARGE

Month	10 days	Average Ten Days Discharge	1/5 Probable Monthly Discharge	Planning Ten Days Discharge
Jan.	1	27.18 m^3/s	m^3/s	15.67 m^3/s
	2	19.38		11.17
	3	15.33		8.84
	Average	20.63	11.89	11.89
Feb.	1	12.94		7.13
	2	12.76		7.03
	3	15.27		8.42
	Average	13.66	7.53	7.53
Mar	1	17.80		9.74
	2	17.32		9.48
	3	15.38		8.42
	Average	16.83	9.21	9.21
Apr.	1	13.68		7.66
	2	19.26		10.79
	3	15.69		8.79
	Average	16.21	9.08	9.08
May	1	17.39		9.10
	2	18.03		9.44
	3	12.04		6.30
	Average	15.82	8.28	8.28
Jun.	1	12.67		7.26
	2	9.84		5.63
	3	6.20		3.55
	Average	9.57	5.48	5.48

Month	10 days	Average Ten Days Discharge	1/5 Probable Monthly Discharge	Planning Ten Days Discharge
Jul.	1	8.62 m^3/s	m^3/s	4.93 m^3/s
	2	8.16		4.67
	3	10.56		6.04
	Average	9.11	5.21	5.21
Aug.	1	12.18		4.83
	2	11.51		4.57
	3	11.23		4.46
	Average	11.64	4.62	4.62
Sep.	1	13.12		7.38
	2	18.33		10.31
	3	16.17		10.22
	Average	16.54	9.30	9.30
Oct.	1	18.77		10.03
	2	15.17		8.11
	3	14.39		7.69
	Average	16.11	8.61	8.61
Nov.	1	17.42		10.21
	2	15.82		9.27
	3	21.15		12.86
	Average	18.10	10.78	10.78
Dec.	1	27.64		16.52
	2	27.49		16.43
	3	32.04		19.15
	Average	29.06	17.37	17.37

Table V-16 TEN DAYS CLIMATOLOGICAL DATA

	Temperature	Rel.Humidity	Sunshine dur.	Wind Vel.
J 1	26.9	81	33	0.40
A 2	26.5	80	38	0.41
N 3	26.7	82	37	0.44
F 1	27.0	81	43	0.44
E 2	27.2	83	46	0.44
B 3	27.2	82	49	0.44
M 1	27.3	82	38	0.43
A 2	27.3	82	49	0.45
R 3	27.8	82	51	0.44
A 1	28.3	81	48	0.41
P 2	28.4	82	50	0.41
R 3	28.1	82	50	0.36
M 1	28.4	82	51	0.39
A 2	28.7	82	52	0.37
Y 3	28.6	80	50	0.44
Y 1	28.0	82	53	0.39
U 2	28.9	79	56	0.40
N 3	28.2	77	59	0.39
J 1	28.6	77	54	0.42
U 2	27.4	79	47	0.39
L 3	28.4	80	47	0.41
A 1	27.5	76	48	0.43
U 2	28.0	77	49	0.38
G 3	27.6	78	45	0.44
S 1	27.7	80	43	0.39
E 2	27.8	78	44	0.40
P 3	27.3	76	44	0.41
O 1	27.9	79	50	0.43
C 2	27.6	79	44	0.39
T 3	27.6	81	41	0.36
N 1	27.5	80	44	0.39
O 2	27.0	80	51	0.41
V 3	27.3	80	42	0.41
D 1	27.2	79	40	0.34
E 2	27.0	82	36	0.36
C 3	26.9	82	33	0.39

Table V-17 CONSUMPTIVE WATER USE OF CROP BY MODIFIED PENMAN METHOD (1/2)

*** CONSUMPTIVE WATER USE OF CROP BY MODIFIED PENMAN METHOD *** (1)

ITEM	JAN.			FEB.			MAR.			APR.			MAY.			JUN.		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
DATA:																		
LATITUDE:1°15'																		
TEMPARATURE (°C)	26.9	26.5	26.7	27.0	27.2	27.2	27.3	27.3	27.8	28.3	28.4	28.1	28.4	28.7	28.6	28.0	28.3	28.5
REL. HUMIDITY (%)	81	80	82	81	83	82	82	82	82	81	82	82	82	82	80	82	79	77
SUN DURATION (%)	33	38	37	43	46	49	38	49	51	48	50	50	51	52	50	53	56	59
WIND VELOCITY (M/S)	0.40	0.41	0.44	0.44	0.44	0.44	0.43	0.45	0.44	0.41	0.41	0.36	0.39	0.37	0.44	0.39	0.40	0.39
CALCULATION:																		
1. F(TAI)/100	9.21	9.16	9.18	9.22	9.24	9.24	9.26	9.26	9.32	9.38	9.39	9.35	9.39	9.43	9.42	9.34	9.38	9.40
2. DELTA*100/L.HEAT	2.68	2.63	2.65	2.70	2.72	2.72	2.74	2.74	2.81	2.88	2.90	2.85	2.90	2.94	2.93	2.84	2.88	2.91
3. SAT.VAPOUR PRESS.	26.59	25.97	26.28	26.75	27.07	27.07	27.22	27.22	28.03	28.86	29.03	28.53	29.03	29.54	29.37	28.36	28.86	29.20
4. GAMMA+DELTA	2.05	2.02	2.03	2.06	2.07	2.07	2.08	2.08	2.12	2.16	2.17	2.15	2.17	2.20	2.19	2.14	2.16	2.18
5. WATER VAPO.PRESS.	21.54	20.78	21.55	21.67	22.47	22.20	22.32	22.32	22.98	23.38	23.80	23.39	23.80	24.22	23.50	23.26	22.80	22.48
6. F(TDP)	0.113	0.119	0.113	0.112	0.105	0.107	0.106	0.106	0.101	0.098	0.094	0.098	0.094	0.091	0.097	0.099	0.102	0.105
7. PWS-PWZ	5.05	5.19	4.73	5.08	4.60	4.87	4.90	4.90	5.05	5.48	5.23	5.14	5.23	5.32	5.87	5.10	6.06	6.72
8. RF(U2)	0.123	0.124	0.127	0.127	0.127	0.127	0.126	0.127	0.127	0.124	0.124	0.119	0.122	0.120	0.127	0.122	0.123	0.122
9. GAMMA*EVAPORAT.	0.62	0.64	0.60	0.65	0.58	0.62	0.62	0.62	0.64	0.68	0.65	0.61	0.64	0.64	0.75	0.62	0.75	0.82
10. SHORT WAVE ANGOT.	8.46	8.46	8.46	8.79	8.79	8.79	8.91	8.91	8.91	8.71	8.71	8.71	8.31	8.31	8.31	8.05	8.05	8.05
11. ASH*F(IR)	0.346	0.366	0.362	0.385	0.397	0.409	0.366	0.409	0.416	0.405	0.412	0.412	0.416	0.420	0.412	0.424	0.436	0.448
12. SHORT WAVE RAD.	2.93	3.10	3.06	3.38	3.49	3.60	3.26	3.64	3.71	3.53	3.59	3.59	3.46	3.49	3.42	3.41	3.51	3.61
13. F(M)	0.57	0.60	0.60	0.64	0.65	0.67	0.60	0.67	0.69	0.67	0.68	0.68	0.69	0.69	0.68	0.70	0.72	0.74
14. LONG WAVE RAD.	0.59	0.65	0.62	0.66	0.63	0.66	0.59	0.66	0.65	0.62	0.60	0.62	0.61	0.59	0.62	0.65	0.69	0.73
15. NET RADIATION	2.34	2.45	2.44	2.72	2.86	2.94	2.67	2.98	3.06	2.91	2.99	2.97	2.85	2.90	2.80	2.76	2.82	2.88
16. DELTA*NET RAD.	6.27	6.44	6.47	7.34	7.78	8.00	7.32	8.17	8.60	8.38	8.67	8.46	8.27	8.53	8.20	7.84	8.12	8.38
17. DELTA*NET.R.+G*EA	6.89	7.08	7.07	7.99	8.36	8.62	7.94	8.79	9.24	9.06	9.32	9.07	8.91	9.17	8.95	8.46	8.87	9.20
18. EO (MM/DAY)	3.36	3.50	3.48	3.88	4.04	4.16	3.82	4.23	4.36	4.19	4.29	4.22	4.11	4.17	4.09	3.95	4.11	4.22
19. EO (MM/10DAY)	34	35	38	39	40	33	38	42	48	42	43	42	41	42	45	40	41	42
20. EO (MM/MONTH)			107			112			128			127			128			123

Table V-17 CONSUMPTIVE WATER USE OF CROP BY MODIFIED PENMAN METHOD (2/2)

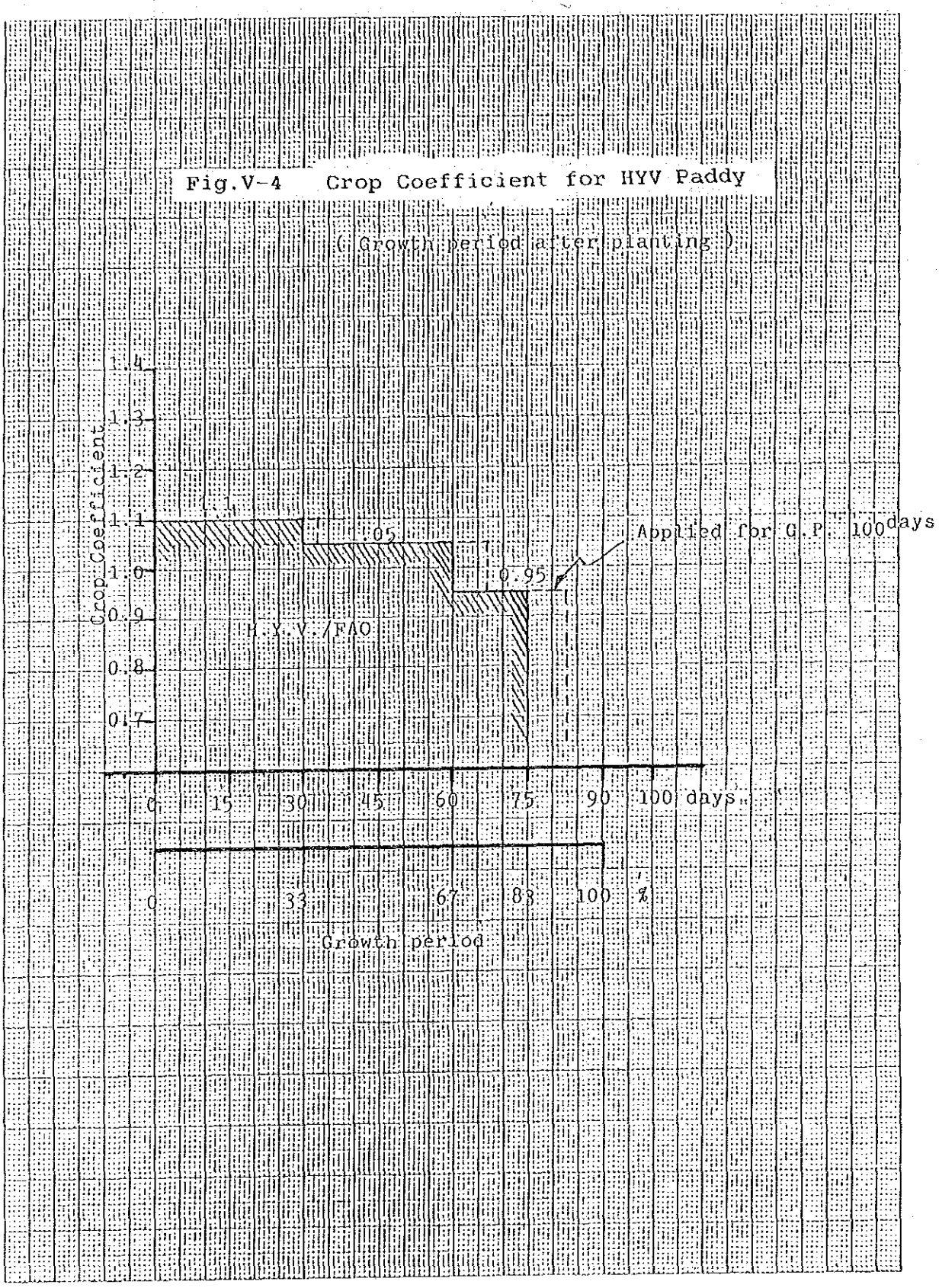
*** CONSUMPTIVE WATER USE OF CROP BY MODIFIED PENMAN METHOD *** (2)

ITEM	JUL.			AUG.			SEP.			OCT.			NOV.			DEC.		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
DATA:																		
LATITUDE:1°15'																		
TEMPARATURE (°C)	28.6	27.9	28.2	27.5	28.0	27.6	27.7	27.8	27.3	27.9	27.6	27.6	27.5	27.0	27.3	27.2	27.0	26.9
REL. HUMIDITY (%)	77	79	80	76	77	78	80	78	76	79	79	81	80	80	80	79	82	82
SUN DURATION (%)	54	47	47	48	49	45	43	44	44	50	44	41	44	51	42	40	36	33
WIND VELOCITY (M/S)	0.42	0.39	0.41	0.43	0.38	0.44	0.39	0.40	0.41	0.43	0.39	0.36	0.39	0.41	0.41	0.34	0.36	0.39
CALCULATION:																		
1. F(TAI)/100	9.42	9.33	9.37	9.28	9.34	9.29	9.31	9.32	9.26	9.33	9.29	9.29	9.28	9.22	9.26	9.24	9.22	9.21
2. DELTA*100/L.HEAT	2.93	2.82	2.87	2.77	2.84	2.78	2.79	2.81	2.74	2.82	2.78	2.78	2.77	2.70	2.74	2.72	2.70	2.68
3. SAT.VAPOUR PRESS.	29.37	28.20	28.69	27.55	28.36	27.71	27.87	28.03	27.22	28.20	27.71	27.71	27.55	26.75	27.22	27.07	26.75	26.59
4. GAMMA+DELTA	2.19	2.13	2.16	2.10	2.14	2.11	2.11	2.12	2.08	2.13	2.11	2.11	2.10	2.06	2.08	2.07	2.06	2.05
5. WATER VAPO.PRESS.	22.61	22.28	22.95	20.94	21.84	21.61	22.30	21.86	20.69	22.28	21.89	22.45	22.04	21.40	21.78	21.39	21.93	21.80
6. F(TDP)	0.104	0.107	0.101	0.118	0.110	0.112	0.106	0.110	0.120	0.107	0.110	0.105	0.109	0.114	0.111	0.114	0.109	0.110
7. PWS-PWZ	6.76	5.92	5.74	6.61	6.52	6.10	5.57	6.17	6.53	5.92	5.82	5.26	5.51	5.35	5.44	5.68	4.82	4.79
8. RF(U2)	0.125	0.122	0.124	0.126	0.121	0.127	0.122	0.123	0.124	0.126	0.122	0.119	0.122	0.124	0.124	0.117	0.119	0.122
9. GAMMA*EVAPORAT.	0.85	0.72	0.71	0.83	0.79	0.77	0.68	0.76	0.81	0.75	0.71	0.63	0.67	0.66	0.67	0.66	0.57	0.58
10. SHORT WAVE ANGOT.	8.12	8.12	8.12	8.47	8.47	8.47	8.77	8.77	8.77	8.77	8.77	8.77	8.51	8.51	8.51	8.32	8.32	8.32
11. ASH*F(IR)	0.428	0.401	0.401	0.405	0.409	0.393	0.385	0.389	0.389	0.412	0.389	0.377	0.389	0.416	0.381	0.373	0.358	0.346
12. SHORT WAVE RAD.	3.48	3.26	3.26	3.43	3.46	3.33	3.38	3.41	3.41	3.61	3.41	3.31	3.31	3.54	3.24	3.10	2.98	2.88
13. F(M)	0.71	0.66	0.66	0.67	0.67	0.65	0.64	0.64	0.64	0.68	0.64	0.62	0.64	0.69	0.63	0.62	0.59	0.57
14. LONG WAVE RAD.	0.70	0.66	0.62	0.73	0.69	0.68	0.63	0.66	0.71	0.68	0.65	0.60	0.65	0.73	0.65	0.65	0.59	0.58
15. NET RADIATION	2.78	2.60	2.64	2.70	2.77	2.65	2.75	2.75	2.70	2.93	2.76	2.71	2.66	2.81	2.59	2.45	2.39	2.30
16. DELTA*NET RAD.	8.15	7.33	7.58	7.48	7.87	7.37	7.67	7.73	7.40	8.26	7.67	7.53	7.37	7.59	7.10	6.66	6.45	6.16
17. DELTA*NET.R.+G*EA	9.00	8.05	8.29	8.31	8.66	8.14	8.35	8.49	8.21	9.01	8.38	8.16	8.04	8.25	7.77	7.32	7.02	6.74
18. EO (MM/DAY)	4.11	3.78	3.84	3.96	4.05	3.86	3.96	4.00	3.95	4.23	3.97	3.87	3.83	4.00	3.74	3.54	3.41	3.29
19. EO (MM/10DAY)	41	38	42	40	41	42	40	40	40	42	40	43	38	40	37	35	34	36
20. EO (MM/MONTH)			121			123			120			125			115			105

Table V-18 PLANNING TEN DAYS EFFECTIVE RAINFALL FOR PADDY

Period	Average Rain fall	1/5 Probable Monthly Rainfall	Effective Rain fall	Period	Average Rain fall	1/5 Probable Monthly Rainfall	Effective Rain fall
Jan.1	92.4		42	Jul.1	42.6		15
2	69.6		32	2	35.2		13
3	55.7		25	3	59.9		21
Total	217.7	141.1	99	Total	137.7	70.4	49
Feb.1	60.9		22	Aug.1	49.0		13
2	53.1		20	2	46.8		12
3	52.5		20	3	52.8		14
Total	166.5	88.8	62	Total	148.6	55.9	39
Mar.1	77.6		39	Sep.1	69.8		33
2	80.8		41	2	77.2		37
3	64.8		33	3	78.3		38
Total	223.2	161.3	113	Total	225.3	154.7	108
Apr.1	68.1		31	Oct.1	71.5		30
2	85.8		38	2	65.9		27
3	68.4		31	3	73.9		31
Total	222.3	143.1	100	Total	211.3	125.4	88
May 1	55.1		24	Nov.1	76.0		36
2	50.5		22	2	78.2		37
3	61.6		27	3	105.2		50
Total	167.2	104.0	73	Total	259.4	175.6	123
Jun.1	54.2		20	Dec.1	115.9		54
2	35.0		13	2	121.8		57
3	25.7		9	3	111.3		52
Total	114.9	59.6	42	Total	349.0	232.3	163
				Grand Total	2,443.1	1,512.2	1,059

Fig.V-4 Crop Coefficient for HYV Paddy



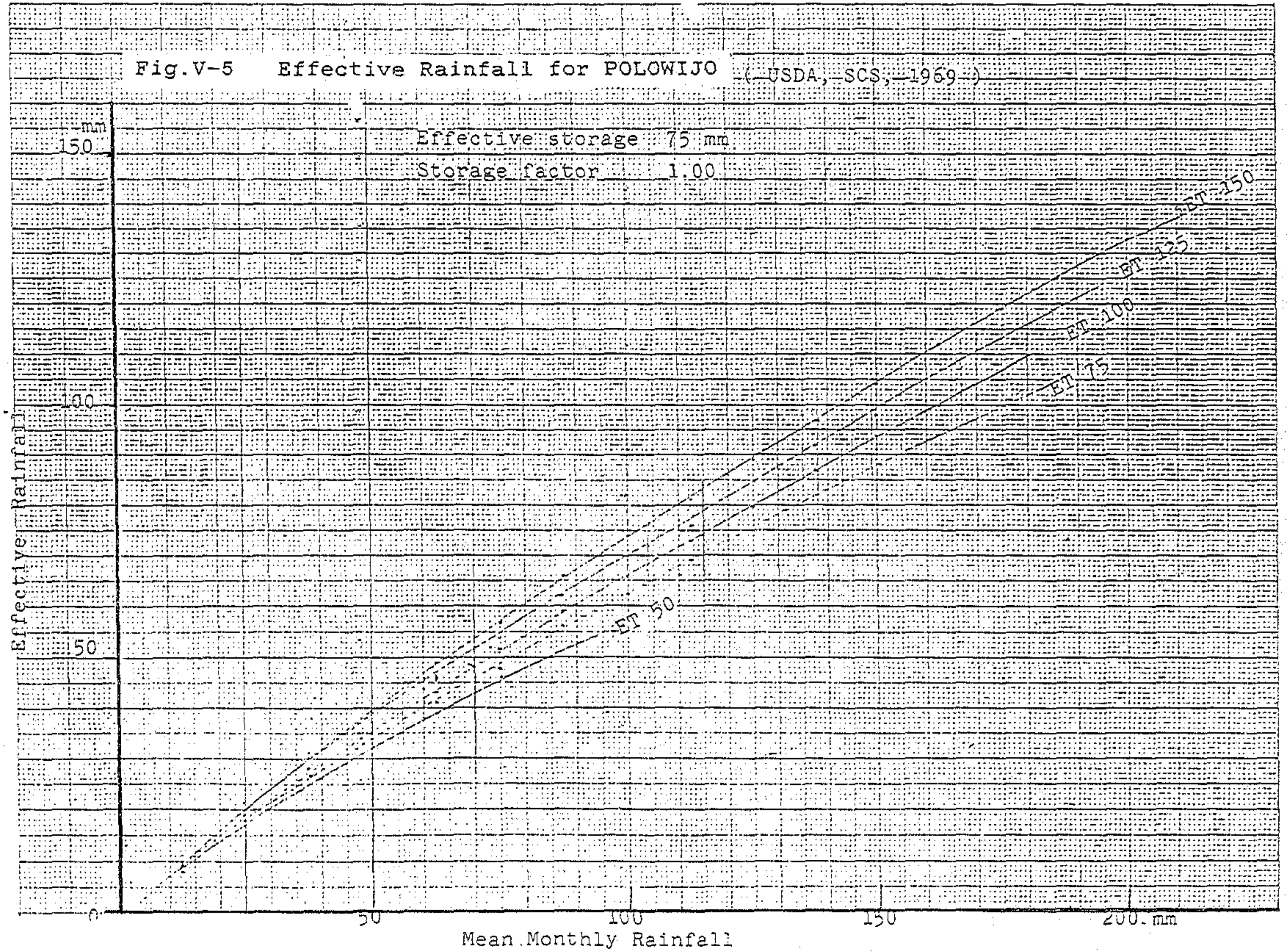


Fig.V-5 Effective Rainfall for POLOWIJO (USDA, SCS, 1969)

Table V-19 PUDDLING WATER REQUIREMENT FOR T 45 DAYS

Period	ETo mm/d	Eo mm/d	P mm/d	M mm/d	k	$M*e^k$	e^k-1	IR_{275} mm/d	Remarks
(1)	(2)	(3)	(4)	(5) 3+4	(6)	(7)	(8)	(9) 7/8	(10)
Jan.1	3.4	3.7	3.0	6.7	1.096	20.048	1.992	10.064	
2	3.5	3.9	3.0	6.9	1.129	21.339	2.093	10.195	k=(M*T)/S
3	3.5	3.9	3.0	6.9	1.129	21.339	2.093	10.195	
Feb.1	3.9	4.3	3.0	7.3	1.195	24.116	2.304	10.467	T= 45 days
2	4.0	4.4	3.0	7.4	1.211	24.841	2.357	10.539	S= 275 mm
3	4.2	4.6	3.0	7.6	1.244	26.368	2.469	10.679	
Mar.1	3.8	4.2	3.0	7.2	1.178	23.385	2.248	10.402	
2	4.2	4.6	3.0	7.6	1.244	26.368	2.469	10.679	
3	4.4	4.8	3.0	7.8	1.276	27.942	2.582	10.822	
Apr.1	4.2	4.6	3.0	7.6	1.244	26.368	2.469	10.679	
2	4.3	4.7	3.0	7.7	1.260	27.146	2.525	10.751	
3	4.2	4.6	3.0	7.6	1.244	26.368	2.469	10.679	
May.1	4.1	4.5	3.0	7.5	1.227	25.582	2.411	10.611	
2	4.2	4.6	3.0	7.6	1.244	26.368	2.469	10.679	
3	4.1	4.5	3.0	7.5	1.227	25.582	2.411	10.611	
Jun.1	4.0	4.4	3.0	7.4	1.211	24.841	2.357	10.539	
2	4.1	4.5	3.0	7.5	1.227	25.582	2.411	10.611	
3	4.2	4.6	3.0	7.6	1.244	26.368	2.469	10.679	
Jul.1	4.1	4.5	3.0	7.5	1.227	25.582	2.411	10.611	
2	3.8	4.2	3.0	7.2	1.178	23.385	2.248	10.402	
3	3.8	4.2	3.0	7.2	1.178	23.385	2.248	10.402	
Aug 1	4.0	4.4	3.0	7.4	1.211	24.841	2.357	10.539	
2	4.1	4.5	3.0	7.5	1.227	25.582	2.411	10.611	
3	3.9	4.3	3.0	7.3	1.195	24.116	2.304	10.467	
Sep.1	4.0	4.4	3.0	7.4	1.211	24.841	2.357	10.539	
2	4.0	4.4	3.0	7.4	1.211	24.841	2.357	10.539	
3	4.0	4.4	3.0	7.4	1.211	24.841	2.357	10.539	
Oct.1	4.2	4.6	3.0	7.6	1.244	26.368	2.469	10.679	
2	4.0	4.4	3.0	7.4	1.211	24.841	2.357	10.539	
3	3.9	4.3	3.0	7.3	1.195	24.116	2.304	10.467	
Nov.1	3.8	4.2	3.0	7.2	1.178	23.385	2.248	10.402	
2	4.0	4.4	3.0	7.4	1.211	24.841	2.357	10.539	
3	3.7	4.1	3.0	7.1	1.162	22.649	2.196	10.334	
Dec.1	3.5	3.9	3.0	6.9	1.129	21.339	2.093	10.195	
2	3.4	3.7	3.0	6.7	1.096	20.048	1.192	10.064	
3	3.3	3.6	3.0	6.6	1.080	19.435	1.945	9.992	

Table V-20 PUDDLING WATER REQUIREMENT FOR T 30 DAYS

Period	ETo mm/d	Eo mm/d	P mm/d	M mm/d	k	$M*e^k$	e^k-1	IR_{275} mm/d	Remarks
(1)	(2)	(3)	(4)	(5) 3+4	(6)	(7)	(8)	(9) 7/8	(10)
Jan.1	3.4	3.7	3.0	6.7	0.731	13.917	1.077	12.900	
2	3.5	3.9	3.0	6.9	0.753	14.651	1.123	13.000	k=(M*T)/S
3	3.5	3.9	3.0	6.9				13.000	
Feb.1	3.9	4.3	3.0	7.3	0.796	16.182	1.217	13.300	T= 30 days
2	4.0	4.4	3.0	7.4	0.807	16.585	1.241	13.400	S= 275 mm
3	4.2	4.6	3.0	7.6	0.829	17.412	1.291	13.500	
Mar.1	3.8	4.2	3.0	7.2	0.785	15.785	1.192	13.200	
2	4.2	4.6	3.0	7.6				13.500	
3	4.4	4.8	3.0	7.8	0.851	18.268	1.342	13.600	
Apr.1	4.2	4.6	3.0	7.6				13.500	
2	4.3	4.7	3.0	7.7	0.840	17.836	1.316	13.600	
3	4.2	4.6	3.0	7.6				13.500	
May.1	4.1	4.5	3.0	7.5	0.818	16.995	1.266	13.400	
2	4.2	4.6	3.0	7.6				13.500	
3	4.1	4.5	3.0	7.5				13.400	
Jun.1	4.0	4.4	3.0	7.4				13.400	
2	4.1	4.5	3.0	7.5				13.400	
3	4.2	4.6	3.0	7.6				13.500	
Jul.1	4.1	4.5	3.0	7.5				13.400	
2	3.8	4.2	3.0	7.2				13.200	
3	3.8	4.2	3.0	7.2				13.200	
Aug 1	4.0	4.4	3.0	7.4				13.400	
2	4.1	4.5	3.0	7.5				13.400	
3	3.9	4.3	3.0	7.3				13.300	
Sep.1	4.0	4.4	3.0	7.4				13.400	
2	4.0	4.4	3.0	7.4				13.400	
3	4.0	4.4	3.0	7.4				13.400	
Oct.1	4.2	4.6	3.0	7.6				13.500	
2	4.0	4.4	3.0	7.4				13.400	
3	3.9	4.3	3.0	7.3				13.300	
Nov.1	3.8	4.2	3.0	7.2				13.200	
2	4.0	4.4	3.0	7.4				13.400	
3	3.7	4.1	3.0	7.1	0.775	15.411	1.171	13.200	
Dec.1	3.5	3.9	3.0	6.9				13.000	
2	3.4	3.7	3.0	6.7				12.900	
3	3.3	3.6	3.0	6.6	0.720	13.559	1.054	12.900	

Table V-21 LAND PREPARATION PERIOD, CROP FACTOR AND WATER LAYER REPLACEMENT

Month	5 days period	c_1	c_2	c_3	LP area	c	Crop area	WLR_1 mm/d	WLR_2 mm/d	WLR_3 mm/d	Mean WLR mm/d
1	2	3	4	5	6	7	8	9	10	11	12
1st	1	LP	LP	LP	1						
	2	LP	LP	LP	1						
	3	LP	LP	LP	1						
	4	LP	LP	LP	1						
	5	1.1	LP	LP	2/3	1.1	1/3				
	6	1.1	LP	LP	2/3	1.1	1/3				
2nd	1	1.1	1.1	LP	1/3	1.1	2/3				
	2	1.1	1.1	LP	1/3	1.1	2/3				
	3	1.1	1.1	LP	1/3	1.1	2/3				
	4	1.1	1.1	1.1		1.1	1				
	5	1.1	1.1	1.1		1.1	1	3.3			1.1
	6	1.05	1.1	1.1		1.08	1	3.3			1.1
3rd	1	1.05	1.1	1.1		1.08	1	3.3	3.3		2.2
	2	1.05	1.05	1.1		1.07	1		3.3		1.1
	3	1.05	1.05	1.1		1.07	1		3.3		1.1
	4	1.05	1.05	1.1		1.07	1			3.3	1.1
	5	1.05	1.05	1.05		1.05	1	3.3		3.3	2.2
	6	1.05	1.05	1.05		1.05	1	3.3		3.3	2.2
4th	1	0.95	1.05	1.05		1.02	1	3.3	3.3		2.2
	2	0.95	1.05	1.05		1.02	1		3.3		1.1
	3	0.95	0.95	1.05		0.98	1		3.3		1.1
	4	0	0.95	1.05		1.00	2/3			3.3	1.1
	5	0	0.95	1.05		1.00	2/3			3.3	1.1
	6	0	0	0.95		0.95	1/3			3.3	1.1
5th	1	0	0	0.95		0.95	1/3				
	2	0	0	0.95		0.95	1/3				
	3			0		0					
	4			0		0					
	5			0		0					

Table V-22 RESULTS OF WATER REQUIREMENT FOR PADDY

Wet Paddy	NFR (mm/day)				DR, IE=0.55 (l/s/ha)			
	Oct 1	Oct16	Nov 1	Mean	Oct 1	Oct16	Nov 1	Mean
Oct 1	7.7	-	-	2.6	1.62	-	-	0.55
2	7.8	7.8	-	5.2	1.64	1.64	-	1.09
3	6.6	7.7	-	4.8	1.39	1.62	-	1.01
Nov 1	4.7	6.8	6.8	6.1	0.99	1.43	1.43	1.28
2	4.8	5.7	6.8	5.8	1.01	1.20	1.43	1.22
3	3.2	3.2	4.2	3.5	0.67	0.67	0.88	0.74
Dec 1	3.6	1.5	2.6	2.6	0.76	0.32	0.55	0.55
2	2.0	3.2	1.0	2.1	0.42	0.67	0.21	0.44
3	4.0	2.9	3.0	3.3	0.84	0.61	0.63	0.69
Jan 1	4.5	3.5	4.7	4.2	0.95	0.74	0.99	0.88
2	4.3	5.7	4.6	4.9	0.90	1.20	0.97	1.03
3	3.9	5.4	6.6	5.3	0.82	1.14	1.39	1.12
Feb 1	1.5	4.2	7.0	4.2	0.32	0.88	1.47	0.88
2	0	2.7	6.0	2.9	-	0.57	1.26	0.61
3	0	1.5	4.2	1.9	-	0.32	0.88	0.40
Mar 1	-	0	0.9	0.3	-	-	0.19	0.06

Dry Paddy	NFR (mm/day)			DR, IE=0.55 (l/s/ha)		
	Feb 26	Mar 11	Mean	Feb 26	Mar 11	Mean
Feb 3	8.2	-	4.1	1.73	-	0.86
Mar 1	6.5	-	3.3	1.37	-	0.69
2	6.6	6.6	6.6	1.39	1.39	1.39
3	6.8	7.8	7.3	1.43	1.64	1.54
Apr 1	5.5	6.6	6.1	1.16	1.39	1.28
2	5.0	4.9	5.0	1.05	1.03	1.05
3	6.6	4.5	5.6	1.39	0.95	1.18
May 1	6.1	6.2	6.2	1.28	1.30	1.30
2	6.4	7.5	7.0	1.35	1.58	1.47
3	7.0	6.0	6.5	1.47	1.26	1.37
Jun 1	6.2	7.4	6.8	1.30	1.56	1.43
2	5.0	8.1	6.6	1.05	1.70	1.39
3	3.1	7.3	5.2	0.65	1.54	1.09
Jul 1	1.8	4.8	3.3	0.38	1.01	0.69
2	0	1.8	0.9	0	0.38	0.19

Table V-23 WATER REQUIREMENT FOR PADDY (OCT.1 & MAR.11)

(Wet:Oct.1 , Dry:Mar.11)

Period	ETo mm/d	P mm/d	Re mm	WLR mm/d	LP Area	ETc (LP) mm/d	Crop Area	Mean c.f	ETc (c) mm/d	NFR (LP) mm/d	NFR (c) mm/d	NFR Total mm/d	DR l/s/ha
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10) 2*9	(11) (7-4)*6	(12) 10+3-4*8	(13) 11+12+5	(14) 13/(0.55*8.64)
Oct.1	4.2	3.0	3.0		1	10.7				7.7		7.7	1.62
2	4.0	3.0	2.7		1	10.5				7.8		7.8	1.64
3	3.9	3.0	2.8		2/3	10.5	1/3	1.1	4.3	5.1	1.50	6.6	1.39
Nov.1	3.8	3.0	3.6		1/3	10.5	2/3	1.1	4.2	2.3	2.4	4.7	0.99
2	4.0	3.0	3.7		1/3	10.5	2/3	1.1	4.4	2.3	2.5	4.8	1.01
3	3.7	3.0	5.0	1.1			1	1.1	4.1		2.1	3.2	0.67
Dec.1	3.5	3.0	5.4	2.2			1	1.08	3.8		1.4	3.6	0.76
2	3.4	3.0	5.7	1.1			1	1.07	3.6		0.9	2.0	0.42
3	3.3	3.0	4.7	2.2			1	1.05	3.5		1.8	4.0	0.84
Jan.1	3.4	3.0	4.2	2.2			1	1.02	3.5		2.3	4.5	0.95
2	3.5	3.0	3.2	1.1			1	0.98	3.4		3.2	4.3	0.90
3	3.5	3.0	2.3	1.1			2/3	1.0	3.5		2.8	3.9	0.82
Feb.1	3.9	3.0	2.2				1/3	0.95	3.7		1.5	1.5	0.32
2	4.0	3.0	2.0				0	0	0		0	0	0
3	4.2	3.0	2.5				0	0	0		0	0	0
Mar. 1	3.8	3.0	3.9										
2	4.2	3.0	4.1		1	10.7				6.6		6.6	1.39
3	4.4	3.0	3.0		1	10.8				7.8		7.8	1.64
Apr.1	4.2	3.0	3.1		2/3	10.7	1/3	1.1	4.6	5.1	1.5	6.6	1.39
2	4.3	3.0	3.8		2/3	10.8	2/3	1.1	4.7	2.3	2.6	4.9	1.03
3	4.2	3.0	3.1		1/3	10.7	2/3	1.1	4.6	2.5	3.0	5.5	1.16
May 1	4.1	3.0	2.4	1.1			1	1.1	4.5		5.1	6.2	1.30
2	4.2	3.0	2.2	2.2			1	1.08	4.5		5.3	7.5	1.58
3	4.1	3.0	2.5	1.1			1	1.07	4.4		4.9	6.0	1.26
Jun.1	4.0	3.0	2.0	2.2			1	1.05	4.2		5.2	7.4	1.56
2	4.1	3.0	1.3	2.2			1	1.05	4.2		5.9	8.1	1.70
3	4.2	3.0	0.9	1.1			1	1.02	4.1		6.2	7.3	1.54
Jul.1	4.1	3.0	1.5	1.1			2/3	1.0	4.1		3.7	4.8	1.01
2	3.8	3.0	1.3	1.1			1/3	0.95	3.6		1.8	1.8	0.38
3	3.8	3.0	1.9						0		0	0	0
Aug.1	4.0	3.0	1.3					0	0		0	0	0
2	4.1	3.0	1.2										
3	3.9	3.0	1.3										
Sep.1	4.0	3.0	3.3										
2													
3													

Table V-24 WATER REQUIREMENT FOR POLOWIJO

Period	Crop factor			Crop area	c mean	ETo	ETc	Re	NFR	DR
	Soybean	Peanut	Maize			mm/d	mm/d	mm/d	mm/d	l/s/ha
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8) 6*7	(9)	(10)8 -9)*5	(11) 10/(0.5*8.64)
Apr.1	0.50			1/3	0.50	4.2	2.1	4.1	0	0
2	0.75			1/3	0.75	4.3	3.2	4.1	0	0
3	0.75			1/3	0.75	4.2	3.2	4.1	0	0
May.1	1.00	0.50		2/3	0.75	4.1	3.1	3.3	0	0
2	1.00	0.51		2/3	0.76	4.2	3.2	3.3	0	0
3	1.00	0.51		2/3	0.76	4.1	3.1	3.3	0	0
Jul.1	0.82	0.66	0.50	1	0.66	4.0	2.6	2.4	0.2	0.05
2	0.82	0.85	0.59	1	0.63	4.1	2.7	2.4	0.3	0.07
3	0.45	0.85	0.59	1	0.63	4.2	2.6	2.4	0.2	0.05
Jun.1		0.95	0.96	2/3	0.96	4.1	3.9	2.9	0.7	0.16
2		0.95	1.05	2/3	1.00	3.8	3.8	2.9	0.6	0.14
3		0.95	1.05	2/3	1.00	3.8	3.8	2.9	0.6	0.14
Aug.1		0.95	1.02	2/3	0.99	4.0	4.0	3.1	0.6	0.14
2		0.95	1.02	2/3	0.99	4.1	4.1	3.1	0.7	0.16
3		0.95	0.95	2/3	0.95	3.9	3.7	3.1	0.4	0.09

Table V-25 MAXIMUM IRRIGABLE AREA FOR WET & DRY PADDY (1/2)
(IRRIGATION EFFICIENCY 0.55)

No	Commencement Date of Puddling	Period of Puddling Preparation	Max. Water Requirement	Max. Irrigation Area	Remarks
		(days)	(l/s/ha)	(ha)	
1	Aug.16	45	1.98	2,257	
2	Sep. 1	45	1.52	4,789	
3	Sep.16	45	1.62	5,601	
4	Sep.21	45	1.62	5,601	
5	Sep.26	45	1.64	4,884	
6	Oct. 1	45	1.64	4,884	
7	Oct. 6	45	1.64	4,685	
8	Oct.11	45	1.64	4,685	
9	Oct.16	45	1.64	4,685	
10	Oct.21	45	1.62	4,685	
11	Oct.26	45	1.62	4,685	
12	Nov. 1	45	1.47	4,782	
13	Nov. 6	45	1.49	4,718	
14	Nov.16	45	1.56	4,442	
15	Nov.21	45	1.56	4,442	
	Golongan				
16	2+3,Sep.1,Sep.16	〃	1.43	6,114	
17	3+6,Sep.16,Oct.1	〃	1.62	5,201	
18	6+9,Oct.1,Oct.16	〃	1.64	4,884	
19	9+12,Oct.16,Nov.1	〃	1.43	5,957	
20	12+14,Nov.1,Nov.16	〃	1.43	4,880	
21	13+15,Nov.6,Nov.21	〃	1.43	4,846	
22	2+3+6	〃	1.48	5,640	
23	3+6+9	〃	1.49	5,375	
24	4+7+10	〃	1.48	5,128	
25	5+8+11	〃	1.48	5,128	
26	6+9+12,Oct.1,Oct.16,Nov.1	〃	1.28	7,348	Adopted
27	7+10+13	〃	1.28	6,509	
28	9+12+14	〃	1.28	5,762	

Table V-25 MAXIMUM IRRIGABLE AREA FOR WET & DRY PADDY (2/2)
(IRRIGATION EFFICIENCY 0.55)

No	Commencemet date of Puddling	Nos, Unit/ Golongan	Puddling	Max	Max Area	Remarks
		(Nos)	(days)	(l/s/ha)	(ha)	
1	Feb 26	3/1	45	1.73	4,217 ※	
2	Mar 1	3/1	45	1.54	3,080 ※	
3	Mar 11	3/1	45	1.70	2,240	
4	Mar 16	3/1	45	1.73	2,183	
5	Apr 1	3/1	45	1.83	1,885	
6	1+3, Feb 26, Mar 11	3/2	45	1.54	3,165	Adopted
7	2+4, Mar 1, Mar 16	3/2	45	1.58	2,555	
8	4+5, Mar 16, Apr 1	3/2	45	1.71	2,017	
9	Mar 1	3/1	30	1.97	3,921 ※	
10	Mar 16	3/1	30	2.23	1,949	
11	9+10, Mar 1, Mar 16	3/1	30	2.03	3,136	
12	Mar 1 "	2/1	30	1.97	3,590 ※	
13	Mar 16	2/1	30	2.23	2.053	
14	12+13, Mar 1, Mar 16	2/2	30	1.97	2.948	

Note; Simple pattern can not be adopted because of a short period after 1st paddy to beginning of 2nd paddy.

Table V-26 COMPARISON OF DIVERSION REQUIREMENT

Period	1	2	3	4	5	(1+2)/2	(2+3)/2	(3+4)/2	(4+5)/2	(2+3+4)/3	(3+4+5)/3
SEP. 1	1.52	—	—	—	—	0.76	—	—	—	—	—
2	1.43	1.43	—	—	—	1.43	0.72	—	—	0.48	—
3	1.20	1.41	—	—	—	1.31	0.71	—	—	0.47	—
OCT. 1	1.20	1.62	1.62	—	—	1.41	1.62	0.81	—	1.08	0.54
2	1.20	1.43	1.64	1.64	—	1.32	1.54	1.64	0.82	1.57	1.09
3	1.18	1.18	1.39	1.62	—	1.18	1.29	1.51	0.81	1.40	1.00
NOV. 1	1.20	0.99	0.99	1.43	1.43	1.10	0.99	1.21	1.43	1.14	1.28
2	0.99	1.22	1.01	1.20	1.43	1.11	1.12	1.11	1.32	1.14	1.21
3	0.86	0.65	0.67	0.67	0.88	0.76	0.66	0.67	0.78	0.66	0.74
DEC. 1	0.72	0.74	0.76	0.55	0.55	0.73	0.75	0.66	0.55	0.68	0.62
2	0.36	0.65	0.42	0.67	0.46	0.55	0.54	0.55	0.57	0.58	0.52
3	0.46	0.59	0.84	0.61	0.63	0.53	0.72	0.73	0.62	0.68	0.69
JAN. 1	0.15	0.55	0.95	0.97	0.99	0.35	0.75	0.96	0.98	0.82	0.97
2	—	0.44	0.90	1.20	0.97	0.22	0.67	1.05	1.09	0.85	1.02
3	—	0.27	0.82	1.14	1.39	0.14	0.55	0.98	1.27	0.74	1.12
FEB. 1	—	—	0.32	0.88	1.47	—	0.16	0.60	1.18	0.40	0.89
2	—	—	—	0.57	1.26	—	—	0.29	0.92	0.19	0.61
3	—	—	—	0.32	0.88	—	—	0.16	0.60	0.11	0.40
MAR. 1	—	—	—	0.19	0.06	—	—	0.10	0.13	0.06	0.08
2	—	—	—	—	—	—	—	—	—	—	—
3	—	—	—	—	—	—	—	—	—	—	—

* Case 3+4+5 is adopted for wet paddy

Table V-27 RIVER DISCHARGE,DIVERSION REQUIREMENT & SURPLUS WATER

MONTH	RIVER DISCHARGE m3/s	DIVERSION REQUIREMENT							SURPLUS WATER m3/s
		WET PADDY 7,300ha m3/s		DRY PADDY 3,100ha m3/s		UPLAND CROP 2,700ha m3/s		TOTAL m3/s	
		q	Q	q	Q	q	Q	ΣQ	
JAN. 1	15.67	0.88	6.42					6.42	9.25
2	11.17	1.03	7.52					7.52	3.65
3	8.84	1.12	8.18					8.18	0.66
FEB. 1	7.13	0.88	6.42					6.42	0.71
2	7.03	0.61	4.45					4.45	2.58
3	8.42	0.46	1.39	0.86	2.67			4.05	4.37
MAR. 1	9.74	0.06	0.44	0.69	2.14			2.58	7.16
2	9.48	0	0	1.39	4.31			4.31	5.17
3	8.42	0	0	1.54	4.77			4.77	3.65
APR. 1	7.66			1.28	3.97	0		3.97	3.69
2	10.79			1.05	3.26	0		3.26	7.54
3	8.79			1.18	3.66	0		3.66	5.13
MAY. 1	9.10			1.30	4.03	0		4.03	5.07
2	9.44			1.47	4.56	0		4.56	4.88
3	6.30			1.37	4.25	0		4.25	2.05
JUN. 1	7.26			1.43	4.43	0.05	0.14	4.57	2.69
2	5.63			1.39	4.31	0.07	0.19	4.50	1.13
3	3.55			1.09	3.38	0.05	0.14	3.52	0.03
JUL. 1	4.93			0.69	2.14	0.16	0.43	2.57	2.36
2	4.67			0.19	0.59	0.14	0.38	0.97	3.70
3	6.04			0	0	0.14	0.38	0.38	5.66
AUG. 1	4.83			0	0	0.14	0.38	0.38	4.45
2	4.57					0.16	0.43	0.43	4.14
3	4.46					0.09	0.24	0.24	4.22
SEP. 1	7.38							—	7.38
2	10.31							—	10.31
3	10.22							—	10.22
OCT. 1	10.03	0.55	4.02					4.02	6.02
2	8.11	1.09	7.96					7.96	0.15
3	7.69	1.01	7.37					7.37	0.32
NOV. 1	10.21	1.28	9.34					9.34	0.87
2	9.27	1.22	8.91					8.91	0.36
3	12.86	0.74	5.40					5.40	7.46
DEC. 1	16.52	0.55	4.02					4.02	12.65
2	16.43	0.44	3.21					3.21	13.22
3	19.15	0.69	5.04					5.04	14.11

CHAPTER 4 IRRIGATION AND DRAINAGE PLAN

4.1 Intake Facilities

4.1.1 General

The Study area for the Project is about 30,000 ha in total consisting of 20,000 ha located between the Kumu & Mahato rivers in the left side of the Kumu river and 10,000 ha in the right side. The weir is proposed as the intake facility for the irrigation to the Project area.

4.1.2 Study on the location

In view of water elevation, the site of weir to be the intake facility of this project can be considered at a certain place of the Kumu river within about 10 Km from Kota Bangung near the upstream part of the Project area to the confluence with the Marbi river near the boundary to the North Sumatra Province.

As a result of the field reconnaissance and the study by the available topographical maps, two (2) weir sites are compared taking the following points into consideration.

(1) Factors to select the site

- Line of existing river
- River bed elevation, and shape and elevation of the both sides
- Location and condition (catchment area) of tributaries
- Geological condition
- Construction method by temporary diversion channel or Coupure method
- As a rule, the weir shall not be installed in the North Sumatra side

(2) Comparative sites

- Upstream site : at the place about 2.4 km in the downstream from the conflunce with the Marbi river.
- Downstream site : at the place about 4.1 km further in the downstream from the upstream site.

Fig.V-6 Longitudinal Illustlation of ROKAN River

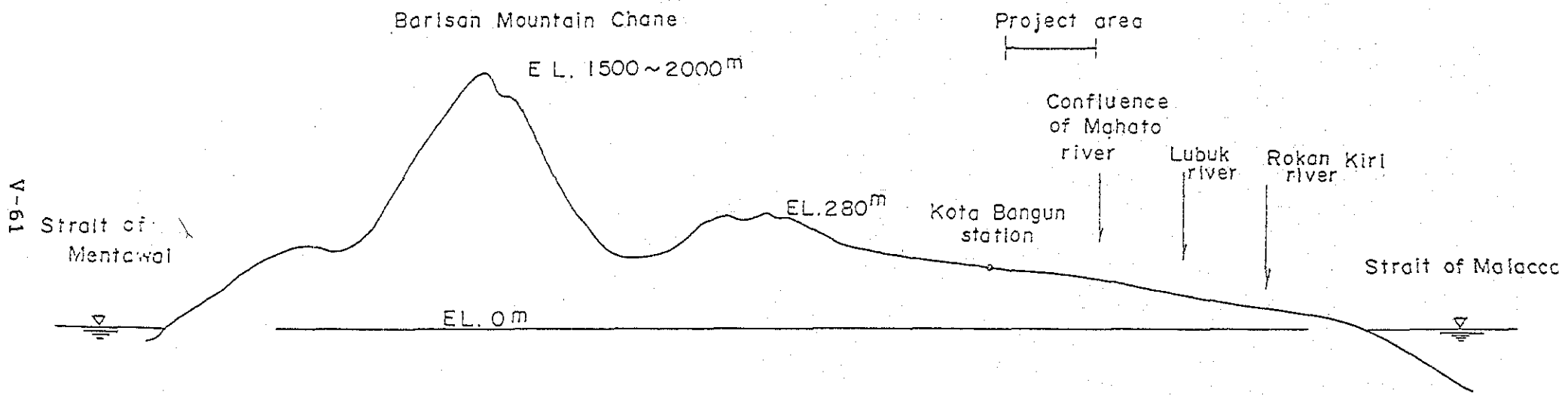


Fig.V-7 Map of Proposed Weir Sites

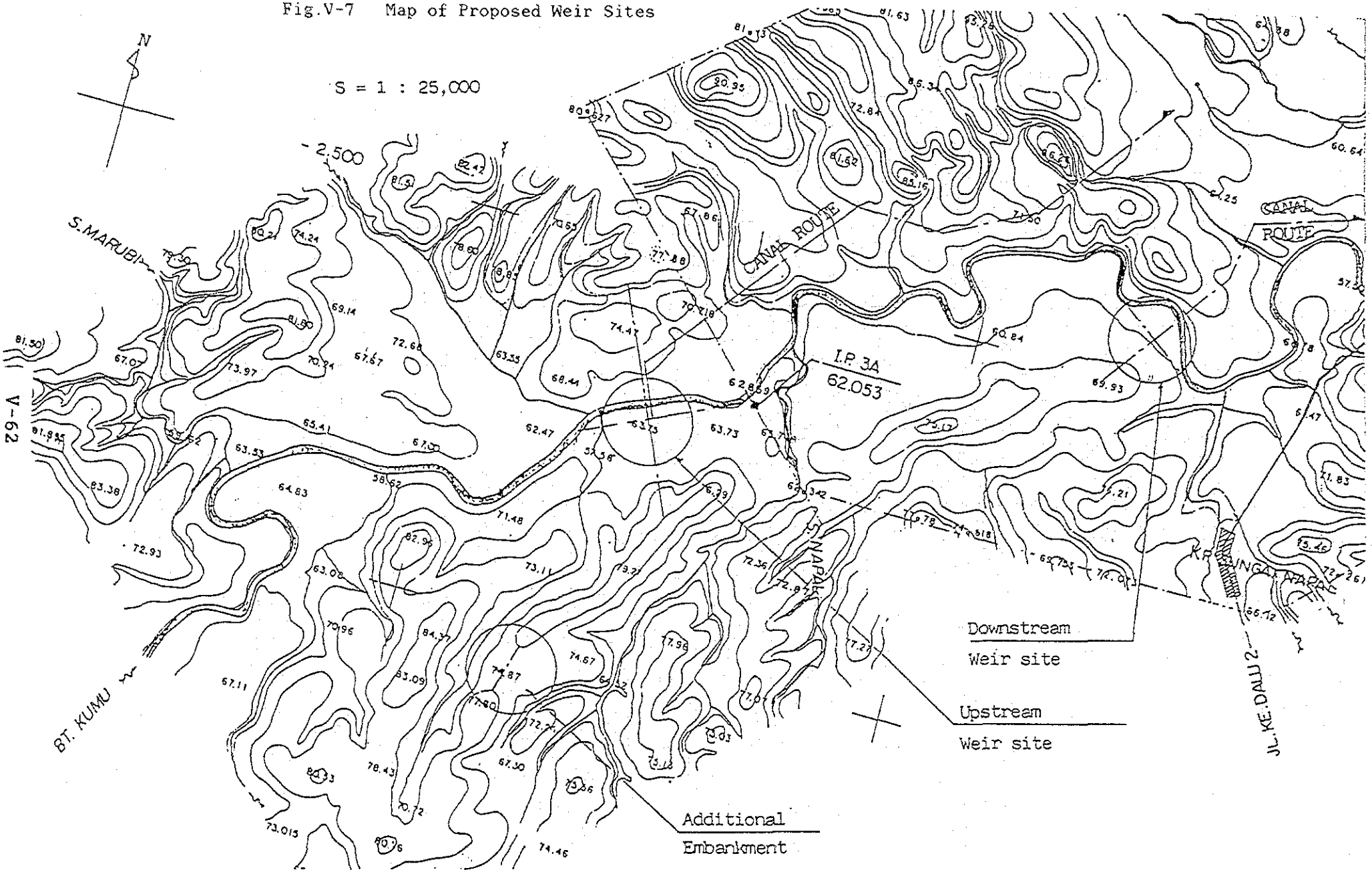
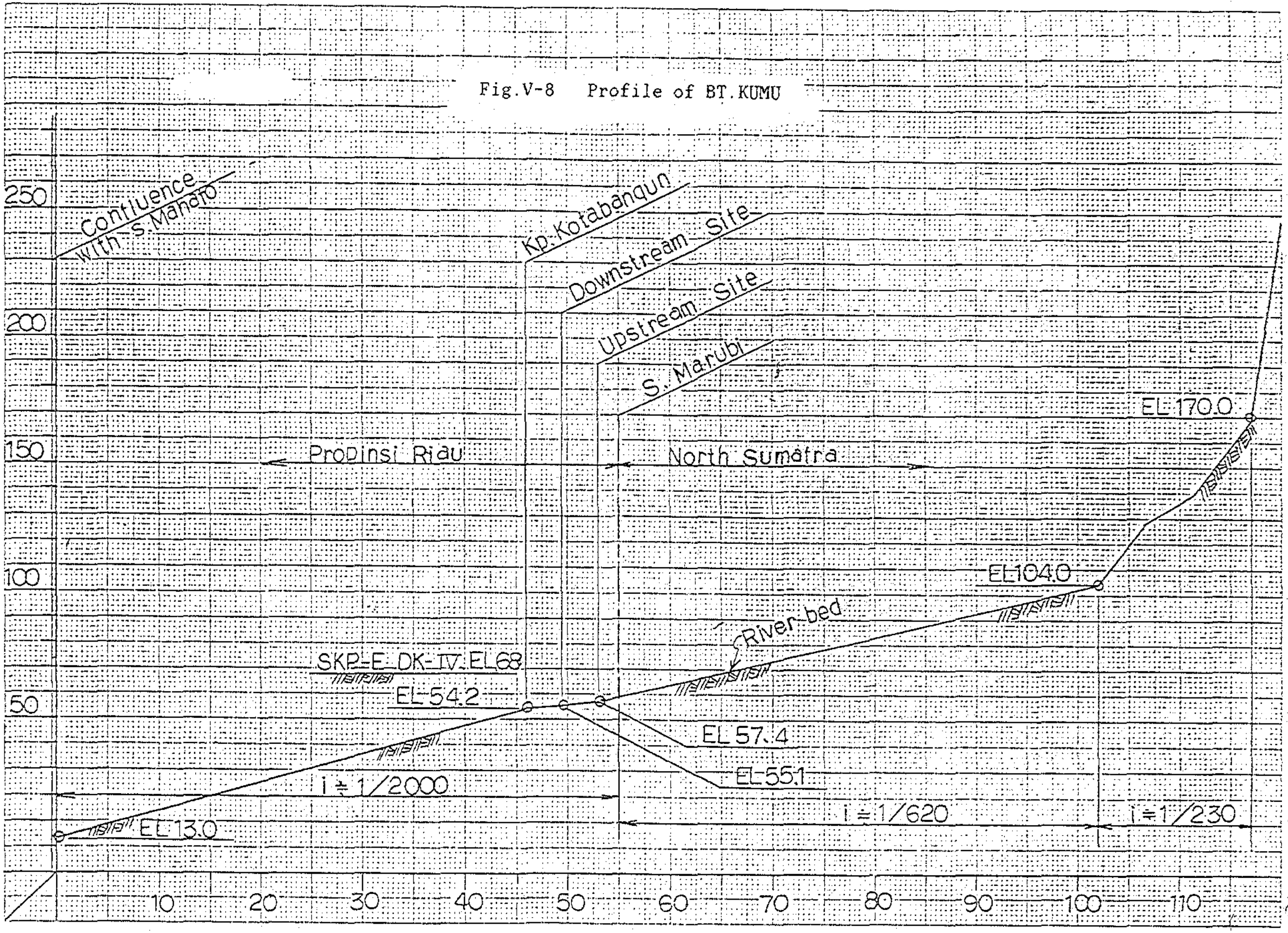


Fig.V-8 Profile of BT.KUMU



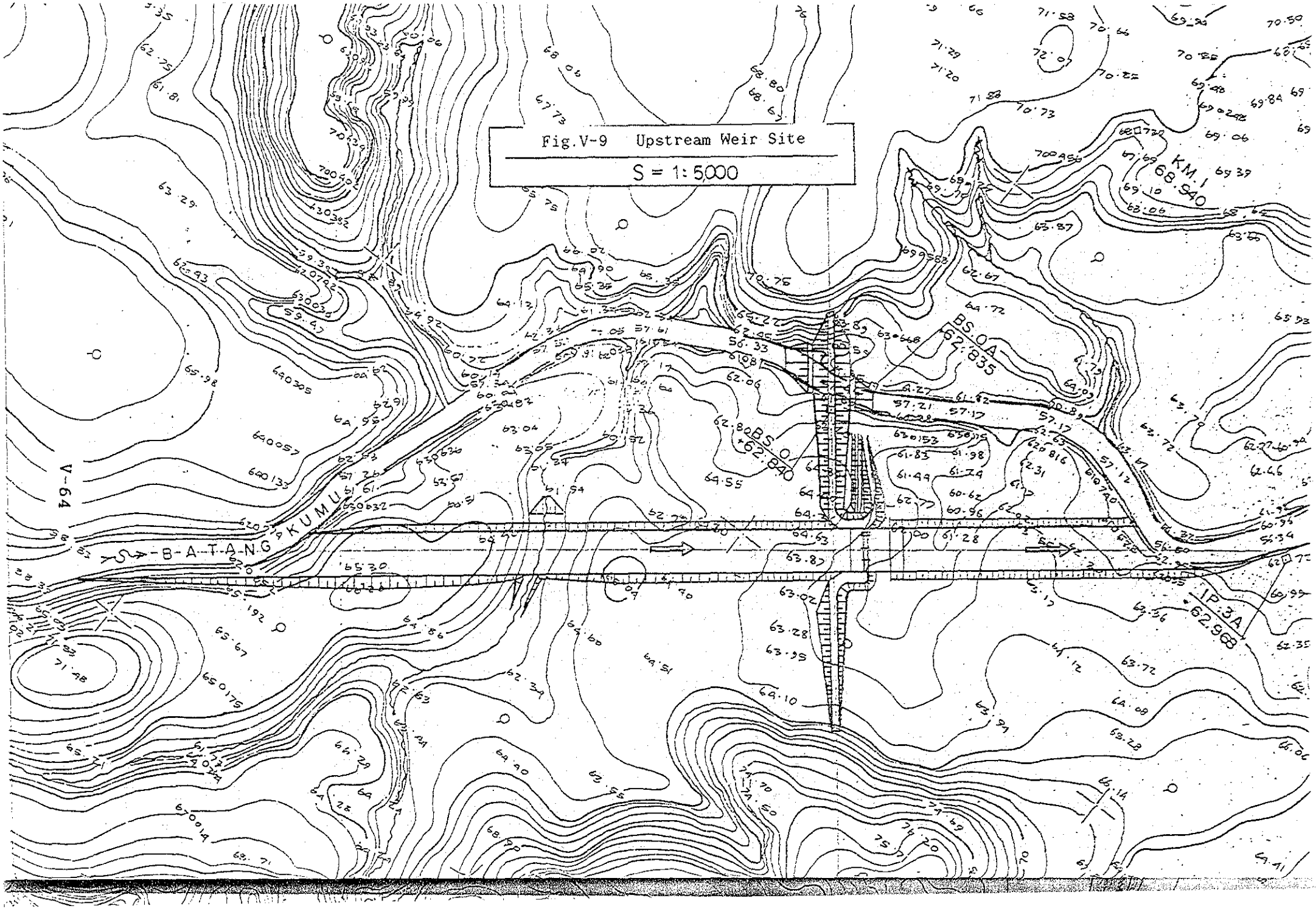


Fig.V-9 Upstream Weir Site

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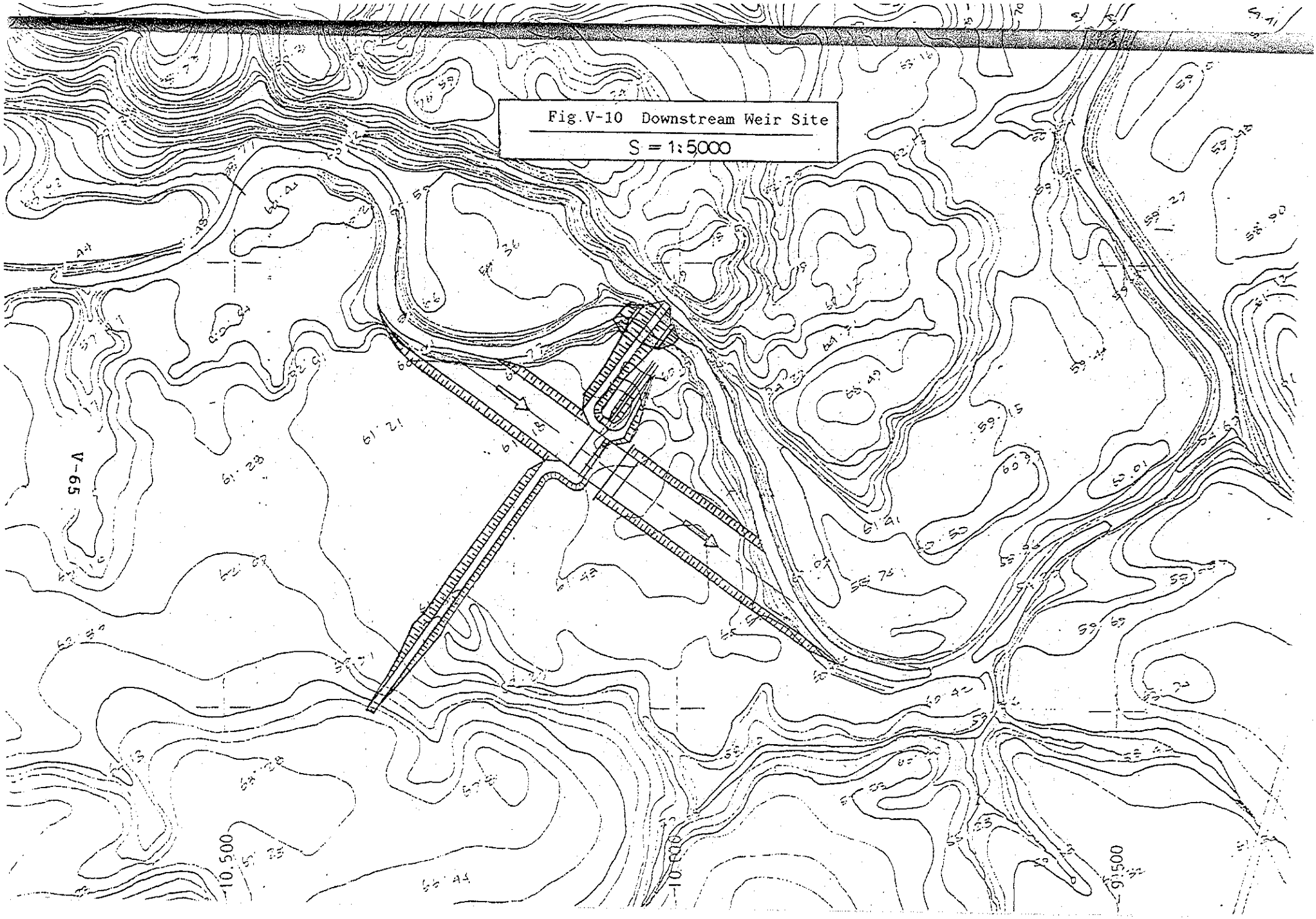

Fig.V-10 Downstream Weir Site

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