(2) Unit drainage discharge

Unit drainage discharge is calculated with rational formula:

$$Q = 0.2778 \cdot f \cdot r \cdot A$$

where, Q : peak flood rate (m^3/sec)

f : runoff coefficient 0.40

r : rainfall intensity 17 mm/hr

A : catchment area (km^2)

Runoff coefficient values are: Park: 0.30, Rubber farm: 0.45, Jungle: 0.35, Bare earth: 0.75 in accordance with DID's Procedure No.1 Table 4-2. Therefore, runoff coefficient value of 0.40 is set for farmland in this master plan.

$$Q = 0.2778 \times 0.40 \times 17 \times A(km^2)$$

$$= 1.889 \times A(km^2) m^3/sec$$

$$= 0.007645 \times A(acre) m^3/sec$$

3-2 Drainage canal section

Drainage canal sections are studied for paddy and upland fields in the area in accordance with the unit drainage discharge.

Table VI-7 Drainage Discharge

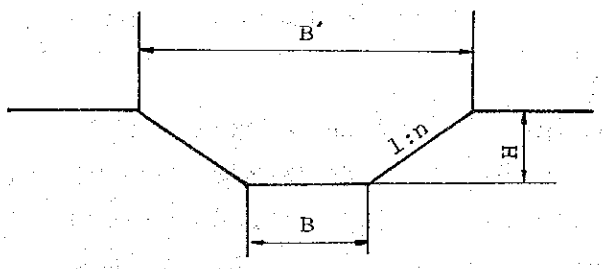
Item	Catchment area	Discharge
Paddy field		
a) Field drain	200m x 400m = 8.0 ha	0.151 m^3/sec
b) Secondary canal	400 x 800 =32.0	0.604
c) Main canal	2,000 x1,600 =320.0	6.045
Upland field		
a) Field drain (Peat soil)	40 x 200 = 0.8	0.015
Field drain (Clay soil)	80 x 200 = 1.6	0.030
b) Secondary canal	200 x 800 =16.0	0.302
c) Main canal	2,000 x1,600 =320.0	6.045

(1) Drainage canal section

The hydraulic calculation of drainage canal is based on the Manning's Formula. The minimum bottom width is set at 50 cm. The canal sections on paddy and upland fields are shown in Table VI-8.

Table VI-8 Drainage Canal Section (1)

Item	Soil type	Discharge (m^3/S)	B (m)	B' (m)	H (m)	S	A (m^2)	V (m/s)	Q (m^3/S)
Paddy field									
a) Field drain	Peat	0.151	0.50	2.50	0.50	1:2.0	0.750	0.315	0.236
b) Field drain	Clay	0.151	0.50	1.50	0.50	1:1.0	0.500	0.305	0.152
c) Secondary canal	Peat	0.604	1.50	3.90	0.60	1:2.0	1.620	0.396	0.642
d) Secondary canal	Clay	0.604	2.00	3.20	0.60	1:1.0	1.560	0.420	0.655
Upland field									
a) Field drain	Peat	0.015	0.30	0.90	0.30	1:1.0	0.180	0.217	0.039
b) Field drain	Clay	0.030	0.30	0.90	0.30	1:1.0	0.180	0.217	0.039
c) Secondary canal	Peat	0.302	0.50	2.90	0.60	1:2.0	1.02	0.349	0.356
d) Secondary canal	Clay	0.302	0.80	2.00	0.60	1:1.0	0.840	0.361	0.303



Manning's roughness coefficient: 0.03 (Earth canal)

Surface slope: 1/2,000

Main drainage canal

The main drainage canal leads discharge from the secondary canal into the trunk drainage canal. Cross section is studied according to catchment area and classified into A, B and C.

Main drainage canal	Catchment area	Discharge
Type A	500 ha	9.45 m^3/s
Type B	1,000	18.89
Type C	2,000	37.78

Table VI-9 Drainage Canal Section (2)

Item	Soil type	Dis-charge (m^3/s)	B (m)	B' (m)	H (m)	S	A (m^2)	V (m/s)	Q (m^3/s)
Main canal									
a) Type A	Peat	9.45	2.50	10.50	2.00	1:2.0	13.00	0.81	10.55
b) Type A	Clay	9.45	4.00	8.00	2.00	1:1.0	12.00	0.86	10.34
c) Type B	Peat	18.89	3.50	13.50	2.50	1:2.0	21.25	0.95	20.26
d) Type B	Clay	18.89	5.50	10.50	2.50	1:1.0	20.00	1.02	20.31
e) Type C	Peat	37.78	6.00	18.00	3.00	1:2.0	36.00	1.12	40.48
f) Type C	Clay	37.78	8.00	14.00	3.00	1:1.0	33.00	1.18	39.05

The above mentioned canal sections are summarised in Table VI-10.

Trunk drainage canal

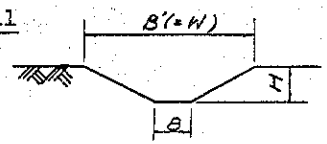
Trunk drainage canals connect main canals to existing rivers. The hydraulic calculation of trunk drainage canal is based on the Manning's Formula. The canal sections are shown in Table VI-11.

Table VI-10 Drainage and Irrigation Canals

(per meter)

Item		Soil type	B_m	B'_m	H_m	N	b_m	b'_m	h_m	n	W_m	Excavation	Embankment	Remarks
Drainage Paddy field	Field drain	Peat	0.50	2.50	0.50	1:2.0	-	-	-	-	2.50	0.75	0	
		Clay	0.50	1.50	0.50	1:1.0	-	-	-	-	1.50	0.50	0	
	Secondary canal	Peat	1.50	3.90	0.60	1:2.0	-	-	-	-	3.90	1.62	0	
		Clay	2.00	3.20	0.60	1:1.0	-	-	-	-	3.20	1.56	0	
Drainage Upland field	Field drain	Peat Clay	0.30	0.90	0.30	1:1.0	-	-	-	-	0.90	0.18	0	
	Secondary canal	Peat	0.50	2.90	0.60	1:2.0	-	-	-	-	2.90	1.02	0	
		Clay	0.80	2.00	0.60	1:1.0	-	-	-	-	2.00	0.84	0	
Drainage Paddy & upland field	Main canal A type	Peat	2.50	10.50	2.00	1:2.0	-	-	-	-	10.50	13.00	0	
		Clay	4.00	8.00	2.00	1:1.0	-	-	-	-	8.00	12.00	0	
	Main canal B type	Peat	3.50	13.50	2.50	1:2.0	-	-	-	-	13.50	21.25	0	
		Clay	5.50	10.50	2.50	1:1.0	-	-	-	-	10.50	20.00	0	
	Main canal C type	Peat	6.00	18.00	3.00	1:2.0	-	-	-	-	18.00	36.00	0	
		Clay	8.00	14.00	3.00	1:1.0	-	-	-	-	14.00	33.00	0	
Irrigation Paddy field	Field canal	Peat Clay	0.30	0.90	0.30	1:1.0	0.30	0.75	0.15	1:1.0	1.80	0.07	0.14	
	Secondary canal	Peat Clay	0.30	1.10	0.40	1:1.0	0.30	0.90	0.20	1:1.0	2.10	0.10	0.20	
	Main canal	Peat Clay	0.50	1.70	0.60	1:1.0	0.30	1.20	0.30	1:1.0	2.90	0.24	0.36	

Drainage Canal



Irrigation Canal

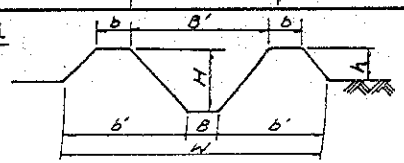


Table VI-11 Trunk Drainage Canal (1)

Canal No.	Length	Catchment area	Drainage discharge	Dishcarge rate for calculation	Slope	Section of proposed canal			Flowing water sectional area	Existing river	Excavation per meter
						Base width	Depth	Slope gradient			
	(m)	(ha)	(m^3/s)	(m^3/s)		(m)	(m)		(m^2)		(m^3)
2-1	5,500	9,233	174.41	174,41	1/2,000	38.0	3.0	1:1.0	123.00	o	61.50
2-2	2,500	3,404	64.30	64,30	2,000	14.0	3.0	1:1.0	51.00	o	25.50
2-3	5,000	2,906	54.89	27.45	2,000	5.5	3.0	1:1.0	25.50		25.50
3-1	5,000	3,083	58.24	29.12	2,000	6.0	3.0	1:1.0	27.00		27.00
4-1	4,200	2,344	44.28	22.14	1,000	2.5	3.0	1:1.0	16.50	o	8.25
5-1	2,100	1,284	24.25	24.25	2,000	8.0	2.0	1:3.0	28.00		28.00
5-2	3,800	2,409	45.51	22.76	2,000	7.0	2.0	1:3.0	26.00		26.00
7-1-1	9,700	3,854	72.80	36.40	2,000	8.0	3.0	1:3.0	33.00	o	16.50
7-2-1	1,300	5,717	107.99	107.99	2,000	20.0	3.0	1:3.0	87.00		87.00
7-2-2	5,600	3,099	58.54	29.27	2,000	1.0	3.0	1:3.0	30.00		30.00
7-2-3	1,700	2,136	40.35	40.35	2,000	4.0	3.0	1:3.0	39.00		39.00
7-2-4	1,400	4,015	75.84	75.84	2,000	12.0	3.0	1:3.0	63.00	o	31.50
7-2-5	4,800	1,606	30.34	15.17	2,000	2.5	3.0	1:1.0	16.50		16.50
7-2-6	1,500	1,927	36.40	36.40	2,000	3.0	3.0	1:3.0	36.00	o	18.00
7-3-1	9,500	18,981	358.55	358.55	2,000	75.0	3.0	1:3.0	252.00	o	126.00
7-3-2	3,100	6,713	126.81	126.81	2,000	24.0	3.0	1:3.0	99.00		99.00
7-3-3	2,200	3,580	67.63	67.63	2,000	11.0	3.0	1:3.0	60.00		60.00
7-3-4	6,900	1,798	33.96	16.98	2,000	4.5	2.0	1:3.0	21.00		21.00
7-3-5	3,100	963	18.19	9.10	2,000	1.0	2.0	1:3.0	14.00		14.00
7-3-6	5,000	6,986	131.97	131.97	2,000	25.0	3.0	1:3.0	102.00	o	51.00
7-3-7	1,400	4,288	81.00	81.00	2,000	14.0	3.0	1:3.0	69.00		69.00
7-3-8	4,100	1,445	27.30	13.65	2,000	2.0	3.0	1:1.0	15.00		15.00
7-4-1	5,600	2,939	55,52	27.76	2,000	1.0	3.0	1:3.0	30.00		30.00
7-4-2	5,100	3,452	65.21	32.61	2,000	2.0	3.0	1:3.0	33.00		33.00
7-5-1	5,900	7,741	146.23	146.23	2,000	28.0	3.0	1:3.0	111.00		111.00
7-5-2	5,000	3,067	57.94	57.94	2,000	8.0	3.0	1:3.0	51.00		51.00
7-5-3	4,100	1,735	32.77	16.39	2,000	4.0	2.0	1:3.0	20.00		20.00

(Sub-total) (115,100)

Table VI-11 Trunk Drainage Canal (2)

Canal No.	Length	Catchment area	Drainage discharge	Discharge rate for calculation	Slope	Section of proposed canal			Flowing water sectional area	Existing river	Excavation per meter
						Base width	Depth	Slop gradient			
	(m)	(ha)	(m^3/s)	(m^3/s)		(m)	(m)		(m^2)		(m^3)
8-1	1,800	351	6.63	6 63	1/1,000	1.5	2.0	1:1.0	7.00	o	3.50
9-1	8,500	4,432	83.72	83.72	1,000	13.0	3.0	1:1.0	48.00	o	24.00
11-1	3,800	2,826	53.38	26.69	1,000	3.5	3.0	1:1.0	19.50	o	9.75
14-1	8,000	5,941	112.23	56.12	2,000	8.0	3.0	1:3.0	51.00		51.00
15-1	3,100	13,843	261.49	261.49	800	36.0	3.0	1:1.0	117.00	o	58.50
15-2	5,200	12,012	226,91	226,91	800	32.0	3.0	1:1.0	102.00	o	51.00
15-3	5,000	9,282	175.34	175.34	800	24.0	3.0	1:1.0	81.00	o	40.50
17-1	2,400	2,714	51.26	25.63	2,000	1.0	3.0	1:3.0	30.00		30.00
18-1	4,100	1,124	21.23	10.62	2,000	1.0	2.0	1:3.0	14.00		14.00
19-1	2,500	1,300	24.56	12.28	2,000	2.0	3.0	1:1.0	15.00		15.00
20-4-1	3,600	1,761	33.27	33.27	2,000	2.5	3.0	1:3.0	34.50		34.50
20-5-1	6,900	4,100	77.45	77.45	2,000	12.5	3.0	1:3.0	64.50		64.50

(Sub-total) (54,900)

Total 170,000

VII. PROJECT COST

VII-1 General

The project cost is estimated using figures provided by KETENGAH, DID and governmental departments on unit prices and costs as of 1979.

Physical contingency of the cost estimate is 7.5% of direct cost. Price contingency is calculated for each year of the construction period. Price contingency is 5.0%. The price contingencies is, therefore, calculated assuming this rate for the initial year and the incremental rates for the ensuring years as follows:

	1st year	2nd year	3rd year	4th year	5th year
Inflation Rate (%)	5.0	10.3	15.8	21.6	27.6

6th year	7th year	8th year	9th year	10th year
34.0	40.7	47.7	55.1	62.9

11th year	12th year	13th year
71.0	79.6	88.6

VII-2 Project Cost

The project cost consist of (i) cost for the civil works including land reclamation and the construction of the setller's houses, (ii) cost for the facilities of sericulture, (iii) cost for the facilities of livestock rearing, (iv) cost for the construction of the technical service center.

The reclamation cost is calculated on the basis of VI-1-2, reclamation plan.

The total cost for the development is M$488 million. The cost for unit area is M$6,718 per acre. Table VII-1 shows the breakdown of the cost.

Table VII-1 Breakdown of the Project Cost

(Unit: M$10^3)

Item	Work unit No.1			Work unit No.2			Work unit No.3			Total		
	F.C.	L.C.	Sub-total	F.C.	L.C.	Sub-total	F.C.	L.C.	Sub-total	F.C.	L.C.	Total
Civil works	111,478	74,319	185,797	29,459	19,640	49,099	23,678	15,785	39,463	164,615	109,744	274,359
Cooperative rearing houses for young silk worms	6,228	4,152	10,380	3,114	2,076	5,190	1,038	692	1,730	10,380	6,920	17,300
Livestock facilities	2,880	1,920	4,800	1,080	720	1,800	600	400	1,000	4,560	3,040	7,600
Technical center	600	400	1,000	-	-	-	600	400	1,000	1,200	800	2,000
Sub-total	121,186	80,791	201,977	33,653	22,436	56,089	25,916	17,277	43,193	180,755	120,504	301,259
Engineering services	6,059	4,039	10,098	1,682	1,122	2,804	1,295	864	2,159	9,036	6,025	15,061
Physical contingency	9,088	6,060	15,148	2,524	1,682	4,206	1,943	1,296	3,239	13,555	9,038	22,593
Price contingency	45,541	30,360	75,901	23,713	15,808	39,521	20,069	13,379	33,448	89,323	59,547	148,870
Sub-total	60,688	40,459	101,147	27,919	18,612	46,531	23,307	15,539	38,846	111,914	74,610	186,524
Total	181,874	121,250	303,124	61,572	41,048	102,620	49,223	32,816	82,039	292,669	195,114	487,783
(Unit cost per acre)			(6,264)			(7,800)			(7,418)			(6,718)

F.C. : Foreign currency

L.C. : Local currency

Table VII-2 Annual Cost of the Proejct

(Unit: M$)

Item	Total cost	1st year	2nd year	3rd year	4th year	5th year	6th year	7th year	8th year	9th year	10th year	11th year	12th year	13th year
Work Unit No. 1	303,126,537	10,603,820	10,022,351	23,704,259	35,945,560	40,255,663	44,267,472	48,960,982	42,747,611	34,555,167	12,063,652			
Work Unit No. 2	102,621,949						3,757,965	4,597,183	11,377,412	12,249,467	23,229,368	27,489,380	19,921,174	
Work Unit No. 3	82,041,652							3,038,687	3,169,786	12,299,226	14,556,982	16,324,853	21,140,337	11,511,781
Total	487,790,138	10,603,820	10,022,351	23,704,259	35,945,560	40,255,663	48,025,437	56,596,852	57,294,809	59,103,860	49,850,002	43,814,233	41,061,511	11,511,781
Sericulture center	27,690,373	1,027,950	1,233,154	4,615,903	5,291,545	5,086,263	5,341,374	5,094,184						
Grand-total	515,480,511	11,631,770	11,255,505	28,320,162	41,237,105	45,341,926	53,366,811	61,691,036	57,294,809	59,103,860	49,850,002	43,814,233	41,061,511	11,511,781

Unit cost per acre: M$6,718

(including sericulture center: M$7,099)

Table VII-3 Annual Cost of the Work Unit No.1

(Proposed development acreage: 48,390 are)

(Unit: M$)

Item	Total cost	1st year	2nd year	3rd year	4th year	5th year	6th year	7th year	8th year	9th year	10th year
Trunk drainage canals	13,904,381		1,738,060	2,085,650	2,085,650	2,085,650	2,085,650	2,085,650	1,738,071		
Trunk roads	11,286,190			1,410,790	1,692,920	1,692,920	1,692,920	1,692,920	1,692,920	1,410,800	
Land reclamation	160,606,976		4,218,450	10,533,420	21,483,564	23,092,710	26,152,060	27,431,793	22,291,975	18,674,114	6,728,890
Sub-total	185,797,547		5,956,510	14,029,860	25,262,134	26,871,280	29,930,630	31,210,363	25,722,966	20,084,914	6,728,890
Rearing houses for silkworms	10,380,000		2,076,000	4,152,000	2,076,000	2,076,000					
Livestock facilities	4,800,000		120,000	160,000	160,000	400,000	800,000	1,160,000	1,200,000	640,000	160,000
Technical center	1,000,000		300,000	700,000							
Total	201,977,547		8,452,510	19,041,860	27,498,134	29,347,280	30,730,630	32,370,363	26,922,966	20,724,914	6,888,890
Engineering services	10,098,877	10,098,877									
Physical contingency	15,148,316		633,938	1,428,140	2,062,360	2,201,046	2,304,797	2,427,777	2,019,222	1,554,369	516,667
Price contingency	75,901,797	504,943	935,903	3,234,259	6,385,066	8,707,337	11,232,045	14,162,842	13,805,423	12,275,884	4,658,095
Total	101,148,990	10,603,820	1,569,841	4,662,399	8,447,426	10,908,383	13,536,842	16,590,619	15,824,645	13,830,253	5,174,762
Grand-total	303,126,537	10,603,820	10,022,351	23,704,259	35,945,560	40,255,663	44,267,472	48,960,982	42,747,611	34,555,167	12,063,652

Unit cost per acre: M$6,264

Table VII-4 Annual Cost of the Work Unit No.2

(Proposed development acreage: 13,155 acre)

(Unit: M$)

Item	Total cost	6th year	7th year	8th year	9th year	10th year	11th year	12th year
Trunk drainage canals	2,758,900		551,780	827,670	827,670	551,780		
Trunk roads	2,235,464			447,093	670,639	670,639	447,093	
Land reclamation	44,104,690		1,329,630	3,534,870	4,410,470	10,604,600	14,107,010	10,118,110
Sub-total	49,099,054		1,881,410	4,809,633	5,908,779	11,827,019	14,554,103	10,118,110
Rearing houses for silkworms	5,190,000		1,038,000	2,076,000	1,038,000	1,038,000		
Livestock facilities	1,800,000		120,000	280,000	400,000	400,000	400,000	200,000
Total	56,089,054		3,039,410	7,165,633	7,346,779	13,265,019	14,954,103	10,318,110
Engineering services	2,804,452	2,804,452						
Physical contingency	4,206,679		227,956	537,423	551,008	994,876	1,121,558	773,858
Price contingency	39,521,764	953,513	1,329,817	3,674,356	4,351,680	8,969,473	11,413,719	8,829,206
Total	46,532,895	3,757,965	1,557,773	4,211,779	4,902,688	9,964,349	12,535,277	9,603,064
Grand-total	102,621,949	3,757,965	4,597,183	11,377,412	12,249,467	23,229,368	27,489,380	19,921,174

Unit cost per acre: M$7,800

Table VII-5 Annual Cost of the Work Unit No.3

(Proposed development acreage: 11,059 acre)

(Unit: M$)

Item	Total cost	7th year	8th year	9th year	10th year	11th year	12th year	13th year
Trunk drainage canals	1,921,351		384,270	576,400	576,400	384,281		
Trunk roads	1,647,566			329,580	494,200	494,200	329,586	
Land reclamation	35,894,953		966,100	4,958,644	6,616,095	7,376,168	10,419,985	5,557,961
Sub-total	39,463,870		1,350,370	5,864,624	7,686,695	8,254,649	10,749,571	5,557,961
Rearing houses for silkworms	1,730,000		346,000	692,000	346,000	346,000		
Livestock facilities	1,000,000			120,000	280,000	280,000	200,000	120,000
Technical center	1,000,000		300,000	700,000				
Total	43,193,870		1,996,370	7,376,624	8,312,695	8,880,649	10,949,571	5,677,961
Engineering services	2,159,693	2,159,693						
Physical continugency	3,239,540		149,728	553,246	623,452	666,049	821,218	425,847
Price contingency	33,448,549	878,994	1,023,688	4,369,356	5,620,835	6,778,155	9,369,548	5,407,973
Total	38,847,782	3,038,687	1,173,416	4,922,602	6,244,287	7,444,204	10,190,766	5,833,820
Grand-total	82,041,652	3,038,687	3,169,786	12,299,226	14,556,982	16,324,853	21,140,337	11,511,781

Unti cost per acre: M$7,418

Table VII-6 Annual Construction Cost of the Sericultural Facilities

(Unit: M$)

Item	Total cost	1st year	2nd year	3rd year	4th year	5th year	6th year	7th year
Sericulture center	1,040,000		1,040,000					
Sericulture sub-center	1,700,000			340,000	680,000	340,000	340,000	
Raw silk reeling mill	16,840,000			3,368,000	3,368,000	3,368,000	3,368,000	3,368,000
Sub-total	19,580,000		1,040,000	3,708,000	4,048,000	3,708,000	3,708,000	3,368,000
Engineering services	979,000	979,000						
Physical contingency	1,468,500	-	78,000	278,100	303,600	278,100	278,100	252,600
Price contingency	5,662,873	48,950	115,154	629,803	939,945	1,100,163	1,355,274	1,473,584
Sub-total	8,110,373	1,027,950	193,154	907,903	1,243,545	1,378,263	1,633,374	1,726,187
Total	27,690,373	1,027,950	1,233,154	4,615,903	5,291,545	5,086,263	5,341,374	5,094,184

Table VII-7 Schedule of the Farmland Development

(Unit: acre)

Item	Development acreage	1st year	2nd year	3rd year	4th year	5th year	6th year	7th year	8th year	9th year	10th year	11th year	12th year	13th year
Work Unit No. 1	acre													
Paddy field	6,615				630			4,135	310	310	1,240			
Upland field	22,407			200	774			10,293	1,558	8,710	872			
Mulberry field	3,800							2,000		1,500	300			
Grassland	5,400			225				675	1,350	2,250	900			
Fish pond	490				50			290	25	25	100			
Total	38,712			425	1,444			17,393	3,243	12,795	3,412			
Work Unit No. 2														
Paddy field	2,005												2,005	
Upland field	4,584												4,584	
Mulberry field	1,750												1,750	
Grassland	2,025												2,025	
Fish pond	160												160	
Total	10,524												10,524	
Work Unit No. 3														
Paddy field	2,070									310		310		1,450
Upland field	4,752									376	1,030	252	1,655	1,439
Mulberry field	750												250	500
Grassland	1,125											225		900
Fish pons	150									25		25		100
Total	8,847									711	1,030	812	1,905	4,389
Grand-total	58,083			425	1,444			17,393	3,243	13,506	4,442	812	12,429	4,389

Table VII-6 Annual Direct Reclamation Cost

(Unit: M$)

Work unit	Swamp No.	Development acreage	Farmland acreage	1st year	2nd year	3rd year	4th year	5th year	6th year	7th year	8th year	9th year	10th year	11th year	12th year	13th year	14th year	Total-cost
		acre	acre															
	7-3	11,741	9,393		2,207,750	4,415,500	8,831,000	11,038,750	11,038,750	6,623,273								44,155,023
	S12	531	425		407,190	950,110												1,357,300
	7-2	10,000	8,000		1,603,510	3,207,020	6,414,050	8,017,560	8,017,560	4,810,550								32,070,250
	8	855	684			929,900	2,169,789											3,099,689
	9	950	760			1,030,890	2,405,425											3,436,315
	7-4	10,176	8,141				1,663,300	3,326,610	4,989,910	8,316,520	8,316,520	6,653,233						33,266,093
1	7-5	3,193	2,554					475,100	950,200	2,613,040	2,613,040	2,850,601						9,501,981
	11	1,725	1,380					234,690	469,390	1,173,470	2,816,335							4,693,885
	2	1,125	900						277,500	1,248,750	1,248,750							2,775,000
	3	2,625	2,100						408,750	817,500	3,270,010	3,678,770						8,175,030
	S11	389	311							281,150	656,013							937,163
	4	815	652							828,690	1,933,617							2,762,307
	5	1,765	1,412							229,790	459,580	2,068,110	1,838,315					4,595,795
	7-1	2,500	2,000							4,89,060	978,110	3,423,400	4,890,575					9,781,145
Total		48,390	38,712		4,218,450	10,533,420	21,483,564	23,092,710	25,152,060	27,431,793	22,291,975	18,674,114	6,728,890					160,606,976
	14	8,030	6,424							1,329,630	2,659,270	2,659,270	7,977,800	7,977,800	3,988,900			26,592,670
2	15	5,125	4,100								875,600	1,751,200	2,626,800	6,129,210	6,129,210			17,512,020
Total		13,155	10,524							1,329,630	3,534,870	4,410,470	10,604,600	14,107,010	10,118,110			44,104,690
											738,030	1,722,057						
	17	655	524								228,070	532,177						2,460,087
	S20	234	187									829,790	1,936,190					760,247
	18	975	780									338,690	1,524,110	1,524,118				2,765,980
3	19	1,015	812									251,810	587,565					3,386,918
	S24	313	250									357,790	715,580	2,146,750	3,935,705			839,375
	20-4	2,381	1,905									926,330	1,852,650	3,705,300	6,484,280	5,557,961		7,155,825
	20-5	5,486	4,389															18,526,521
											966,100	4,958,644	6,616,095	7,376,168	10,419,985	5,557,961		35,894,953
Total		11,059	8,847															
Grand-total		72,604	58,083		4,218,450	10,533,420	21,483,564	23,092,710	26,152,060	28,761,423	26,792,945	28,043,228	23,949,585	21,483,178	20,538,095	5,557,961		240,606,619

Table VII-9 Cost Estimate of the Land Reclamation (1)

(Unit: M$)

Swamp No.	Unit	2. DURIAN			3. KUBANG			S-11			4. PENGHULU DIMAN		
Soil units		Rd			Rd			Rd			Gd		
Proposed development acreage	acre			1,125			2,625			389			815
Number of settlements	numbers			112			289			39			122
Cost Estimate		Unit price	Q'ty	Amount	Unit price	Q'ty	Amount	Unit price	Q'ty	Amount	Unit price	Q'ty	Amount
Cutting	acre	M$ 175	120	21,000	175	1,800	315,000			-	175	100	17,500
Uprooting	acre	390	120	46,800	390	1,800	702,000			-	390	100	39,000
Land reclamation													
(paddy field)	acre			-	2,502	310	775,620			-	2,502	310	775,620
(upland field)	acre	2,299	225	517,275	2,299	415	954,085	2,299	86	197,714	2,299	317	728,783
(mulberry field)	acre						-			-			-
(grassland)	acre	2,299	675	1,551,825	2,299	1,350	3,103,650	2,299	225	517,275			-
(fish pond)	acre			-	10,854	25	271,350			-	10,854	25	271,350
Irrigation facilities	acre			-		310	161,000			-		310	161,000
Soil improvement	acre	9	900	8,100	127	2,100	266,700	9	311	2,799	127	652	82,804
Sub-total				2,145,000			6,549,405			717,788			2,076,057
Settler's houses	household	4,500	112	504,000	4500	289	1,300,500	4,500	39	175,500	4,500	122	549,000
Public facilities				126,000			325,125			43,875			137,250
Sub-total				630,000			1,625,625			219,375			686,250
Total				2,775,000			8,175,030			937,163			2,762,307
Unit cost per acre				2,466			3,114			2,409			3,389

Table VII-9 Cost Estimate of the Land Reclamation (2)

(Unit: M$)

Swamp No.	Unit	5. TOK PAKIR			7-1 JERANGAU			7-2 JERANGAU			7-3 JERANGAU		
Soil units		Oes			Gd			Gd.Odd			Gdd.Odd		
Proposed development acreage	acre			1,765			2,500			10,000			11,741
Number of settlemtns	numbers			185			460			1,566			1,951
Cost Estimate		Unit price M$	Q'ty	Amount	Unit price	Q'ty	Amount	Unit price	Q'ty	Amount	Unit price	Q'ty	Amount
Cutting	acre	175	250	43,750	175	1,045	182,875	175	5,900	1,032,500	175	7,101	1,242,675
Uprooting	acre	390	250	97,500	390	1,045	407,550	390	5,900	2,301,000	390	7,101	2,769,390
Land reclamation													
(paddy field)	acre			-	2,502	1,240	3,102,480			-	2,620	4,135	10,833,700
(upland field)	acre	2,326	512	1,190,912	2,299	360	827,640	2,326	7,000	16,282,000	2,326	3,293	7,659,518
(mulberry field)	acre			-	2,299	300	689,700	2,326	1,000	2,326,000	2,326	1,000	2,326,000
(grassland)	acre	2,299	900	2,069,100			-			-	2,299	675	1,551,825
(fish pond)	acre			-	10,854	100	1,085,400			-	10,854	290	3,147,660
Irrigation facilities	acre			-		1,240	644,000			-		4,135	2,147,000
Soil improvement	acre	109	1,412	153,908	127	2,000	254,000	165	8,000	1,320,000	160	9,393	1,502,880
Sub-total				3,555,170			7,193,645			23,261,500			33,180,648
Settler's houses	household	4,500	185	832,500	4,500	460	2,070,000	4,500	1,566	7,047,000	4,500	1,951	8,779,500
Public facilities				208,125			517,500			1,761,750			2,194,875
Sub-total				1,040,625			2,587,500			8,808,750			10,974,375
Total				4,595,795			9,781,145			32,070,250			44,155,023
Unit cost per acre				2,603			3,912			3,207			3,760

Table VII-9 Cost Estimate of the Land Reclamation (3)

(Unit: M$)

Swamp No.	Unit	7-4 JERANGAU			7-5 JERANGAU			S-12			8. TELEMBOH		
Soil units		Odd			Odd.Oed.Gd			Gd			Gd		
Proposed development acreage	acre			10,176			3,193			531			855
Number of settlements	numbers			1,590			492			58			128
Cost Estimate		Unit price M$	Q'ty	Amount	Unit price	Q'ty	Amount	Unit price	Q'ty	Amount	Unit price	Q'ty	Amount
Cutting	acre	175	6,911	1,209,425	175	833	145,775			-	175	500	87,500
Uprooting	acre	390	6,911	2,695,290	390	833	324,870			-	390	500	195,000
Land reclamation													
(paddy field)	acre			-			-			-	2,502	310	775,620
(upland field)	acre	2,326	7,141	16,609,966	2,326	1,154	2,628,204	2,299	200	459,800	2,299	349	802,351
(mulberry field)	acre	2,326	1,000	2,326,000	2,326	500	1,163,000			-			-
(grassland)	acre			-	2,299	900	2,069,100	2,299	225	517,275			-
(Fish pond)	acre			-			-			-	10,854	25	271,350
Irrigation facilities	acre			-			-			-		310	161,000
Soil improvement	acre	182	8,141	1,481,662	158	2,554	403,532	127	425	53,975	127	684	86,868
Sub-total				24,322,343			6,734,481			1,031,050			2,379,689
Settller's houses	household	4,500	1,590	7,155,000	4,500	492	2,214,000	4,500	58	261,000	4,500	128	576,000
Public facilities				1,788,750			553,500			65,250			144,000
Sub-total				8,943,750			2,767,500			326,250			720,000
Total				33,266,093			9,501,981			1,357,300			3,099,689
Unit cost per acre				3,269			2,975			2,556			3,625

Table VII-9 Cost Estimate of the Land Reclamation (4)

(Unit: M$)

Swamp No.	Unit	9. PERDAH			11. PAK SABAH			14. MENGKUANG			15. BUNGKUS		
Soil units		Gd			Gd.Ge.Odd			Gd.Ge.Ods			Ge		
Proposed development acreage	acre			950			1,725			8,030			5,125
Number of settlements	numbers			140			205			1,344			797
Cost Estimate		Unit price M$	Q'ty	Amount	Unit price	Q'ty	Amount	Unit price	Q'ty	Amount	Unit price	Q'ty	Amount
Cutting	acre	175	650	113,750	175	400	70,000	175	3,200	560,000	175	3,700	647,500
Uprooting	acre	390	650	253,500	390	400	156,000	390	3,200	1,248,000	390	3,700	1,443,000
Land reclamation													
(paddy field)	acre	2,502	310	775,620			-	2,502	1,240	3,102,480	2,502	765	1,914,030
(upland field)	acre	2,299	425	977,075	2,299	930	2,138,070	2,326	2,484	5,777,784	2,299	2,100	4,827,900
(Mulberry field)	acre			-			-	2,326	1,250	2,907,500	2,299	500	1,149,500
(grassland)	acre			-	2,299	450	1,034,550	2,299	1,350	3,103,650	2,299	675	1,551,825
(fish pons)	acre	10,854	25	271,350			-	10,854	100	1,085,400	10,854	60	651,240
Irrigation facilities	acre		310	161,000			-		1,240	644,000		765	397,000
Soil improvement	acre	127	760	96,520	103	1,380	142,140	94	6,424	603,856	109	4,100	446,900
Sub-total				2,648,815			3,540,760			19,032,670			13,028,895
Settler's houses	household	4,500	140	630,000	3,500	205	922,500	4,500	1,344	6,048,000	4,500	797	3,586,500
Public facilities				157,500			230,625			1,512,000			896,625
Sub-total				787,500			1,153,125			7,560,000			4,483,125
Total				3,436,315			4,693,885			26,592,670			17,512,020
Unit cost per acre				3,617			2,721			3,311			3,416

Table VII-9 Cost Estimate of the Land Reclamation (5)

(Unit: M$)

Swamp No.	Unit	17. CHABANG			S-20			18. KEMASIK			19. KIJAL		
Soil units		Oes			Gd			Odd			Oed.Gh		
Proposed development acreage	acre			655			234			975			1,015
Number of settlements	numbers			101			31			130			137
Cost Estimate		Unit price M$	Q'ty	Amount	Unit price	Q'ty	Amount	Unit price	Q'ty	Amount	Unit price	Q'ty	Amount
Cutting	acre	175	250	43,750	175	234	40,950	175	190	33,250	175	260	45,500
Uprooting	acre	390	250	97,500	390	234	91,260	390	190	74,100	390	260	101,400
Land reclamation													
(paddy field)	acre	2,620	310	812,200			-			-	2,502	310	775,620
(upland field)	acre	2,326	189	439,614	2,299	187	429,913	2,326	780	1,814,280	2,326	252	586,152
(mulberry field)	acre			-			-			-			-
(grassland)	acre			-			-			-	2,299	225	517,275
(fish pond)	acre	10,854	25	271,350			-			-	10,854	25	271,350
Irrigation facilities	acre			161,000			-			-		310	161,000
Soil improvement	acre	127	524	66,548	127	187	23,749	145	780	113,100	133	812	107,996
Sub-total	acre		310	1,891,962			585,872			2,034,730			2,566,293
Settler's houses	household	4,500	101	454,500	4,500	31	139,500	4,500	130	585,000	4,500	137	616,500
Public facilities				113,625			34,875			146,250			154,125
Sub-total				568,125			174,375			731,250			770,625
Total				2,460,087			760,247			2,765,980			3,336,918
Unit cost per acre				3,755			3,248			2,836			3,287

Table VII-9 Cost Estimate of the Land Reclamation (6)

(Unit: M$)

Swamp No.	Unit	S-24			20-4 IBOK			20-5 IBOK		
Soil units		Gh			Odd			Odd.Ods		
Proposed development acreage	acre			313			2,381			5,486
Number of settlements	numbers			41			375			864
Cost Estimate		Unit price M$	Q'ty	Amount	Unit price	Q'ty	Amount	Unit price	Q'ty	Amount
Cutting	acre			—	175	570	99,750	175	1,300	227,500
Uprooting	acre			—	390	570	222,300	390	1,300	507,000
Land reclamation										
(paddy field)	acre			—				2,620	1,450	3,799,000
(upland field)	acre	2,326	250	581,500	2,326	1,655	3,849,530	2,326	1,439	3,347,114
(mulberry field)	acre			—	2,326	250	581,500	2,326	500	1,163,000
(grassland)	acre			—			—	2,299	900	2,069,100
(fish pond)	acre			—			—	10,854	100	1,085,400
Irrigation facilities	acre			—			—		1,450	753,000
Soil improvement	acre	109	250	27,250	154	1,905	293,370	163	4,389	715,407
Sub-total				608,750			5,046,450			13,666,521
Settler's houses	household	4,500	41	184,500	4,500	375	1,687,500	4,500	864	3,888,000
Public facilities				46,125			421,875			972,000
Sub-total				230,625			2,109,375			4,860,000
Total				839,375			7,155,825			18,526,521
Unit cost per acre				2,681			3,005			3,377

Table VII-10 Reclamation Cost for 320 ha

(Unit: M$)

Item	Paddy field		Upland field	
	Peat soil area	Clay soil area	Peat soil area	Clay soil area
Land clering	400,000	400,000	400,000	400,000
Land leveling	160,000	160,000	-	-
Drainage canal	119,248	103,472	107,314	93,256
Irrigation canal	85,328	38,752	-	-
Road	803,672	803,672	852,360	852,360
Related structure	504,124	472,948	479,837	472,808
Total	2,072,372	1,978,844	1,839,511	1,818,424
Unit cost per acre	2,620	2,502	2,326	2,299

Table VII-11 Paddy Field Reclamation Cost for 320 ha

(Unit:M$)

Works	Unit	Quantity	Unit Price	Total
1. Peat Soil Area				
Land clearing	ha	320	1,250	400,000
Leveling	ha	320	500	160,000
(Sub-total)				560,000
Drainage				
Field drain	m	16,000	1.95	31,200
Secondary canal	m	8,000	4.22	33,760
Main canal A type	m	1,600	33.93	54,288
(Sub-total)				119,248
Irrigation				
Field canal	m	32,000	1.64	52,480
Secondary canal	m	8,000	2.35	18,800
Main canal	m	3,200	4.39	14,048
(Sub-total)				85,328
Road				
Farm road	m	16,800	18.30	307,440
Branch road	m	8,800	56.39	496,232
(Sub-total)				803,672
Total				1,568,248
2. Clay Soil Area				
Land clearing	ha	320	1,250	400,000
Leveling	ha	320	500	160,000
(Sub-total)				560,000
Drainage				
Field canal	m	16,000	1.30	20,800
Secondary canal	m	8,000	4.07	32,560
Main canal A type	m	1,600	31.32	50,112
(Sub-total)				103,472

(Unit:M$)

Works	Unit	Quantity	Unit Price	Total
Irrigation				
Field canal	m	32,000	0.74	23,680
Secondary canal	m	8,000	1.06	8,480
Main canal	m	3,200	2.06	6,592
(Sub-total)				38,752
Road				
Farm road	m	16,800	18.30	307,440
Branch road	m	8,800	56.39	496,232
(Sub-total)				803,672
Total				1,505,896

Table VII-12 Upland Field Reclamation Cost for 320 ha

(Unit: M$)

Works	Unit	Quantity	Unit Price	Total
1. Peat Soil Area				
Land clearing	ha	320	1,250	400,000
Drainage				
Field drain	m	8,000	0.46	3,680
Secondary canal	m	16,000	2.66	42,560
Main canal A type	m	1,800	33.93	61,074
(Sub-total)				107,314
Road				
Farm road	m	9,600	18.30	175,680
Branch road	m	12,000	56.39	676,680
(Sub-total)				852,360
Total				1,359,674
2. Clay Soil Area				
Land clering	ha	320	1,250	400,000
Drainage				
Field drain	m	4,000	0.46	1,840
Secondary canal	m	1,600	2.19	35,040
Main canal A type	m	1,800	31.32	56,376
(Sub-total)				93,256
Road				
Farm road	m	9,600	18.30	175,680
Branch road	m	12,000	56.39	676,680
(Sub-total)				852,360
Total				1,345,616

Table VII-13 Cost Estimate of Civil Works

(Unit: M$)

Works	Unit	Quantity	Unit Price	Total
1. Trunk Roads				
Work Unit No.1 (R1 - R14)	km	155.5	72,580	11,286,190
Work Unit No.2 (R15 - R17)	km	30.8	72,580	2,235,464
Work Unit No.3 (R18 - R23)	km	22.7	72,580	1,647,566
Total				15,169,220
2. Trunk Drainage Canals				
Work Unit No.1	m^3	5,327,350.0	2.61	13,904,381
Work Unit No.2	m^3	1,057,050.0	2.61	2,758,900
Work Unit No.3	m^3	736,149.0	2.61	1,921,351
Total				18,584,632
3. Fish pond (per 0.5 acre)				
Excavation	m^3	1,902.0	2.61	4,964
Embankment	m^2	115.75	4.00	463
Total				5,427
4. Irrigation Facilities (per 310 acre)				
Pump station (ϕ350, 60PS)	set	1		80,000
Pipe line (ϕ450)	m	1,000	81.00	81,000
Total				161,000

Table VII-14 Cost Estimate of the Rearing Houses

(Unit: M$)

Works	Unit	Quantity	Unit Price	Total
1. Cooperative rearing house for young silkworms				
Equipment	set	1		30,000
Building	m^2	180	100	18,000
Total				48,000
2. Rearing house for grawn silkworms				
Building	m^2	100	50	5,000
Total				5,000
(Work Unit No.1)				
Cooperative rearing house for young silkworms	room	60	48,000	2,880,000
Rearing house for grown silkworms	room	1,500	5,000	7,500,000
Total				10,380,000
(Work Unit No.2)				
Cooperative rearing house for young silkworms	room	30	48,000	1,440,000
Rearing house for grown silkworms	room	750	5,000	3,750,000
Total				5,190,000
(Work Unit No.3)				
Cooperative rearing house for young silkworms	room	10	48,000	480,000
Rearing house for grown silkworms	room	250	5,000	1,250,000
Total				1,730,000

Table VII-15 Cost for Soil Inprovement

Swamp No.	Soil units	Lime requirement		Cost for soil imprvement M$/acre
		Analytical value on $Caco_3$	Multiplied by field factor 3	
1	Rd	150	450 kg/ha	9.00
2	Rd	150	450	9.00
3	Gd	2,100	6,300	127.00
4	Gd	2,100	6,300	127.00
5	Oes	1,800	5,400	109.00
6	Rd	150	450	9.00
7-1	Gd	2,100	6,300	127.00
7-2	Gd, Odd	2,730	8,190	165.00
7-3	Gdd, Odd	2,640	7,920	160.00
7-4	Odd	3,000	9,000	182.00
7-5	Odd, Oed, Gd	2,610	7,830	158.00
8	Gd	2,100	6,300	127.00
9	Gd	2,100	6,300	127.00
10	Ge	1,800	5,400	109.00
11	Gd, Ge, Odd	1,700	5,100	103.00
13	Odd	2,400	7,200	145.00
14	Gd, Ge, Ods	1,550	4,650	94.00
15	Ge	1,800	5,400	109.00
16	Ge	2,100	6,300	127.00
17	Oes	2,100	6,300	127.00
18	Odd	2,400	7,200	145.00
19	Oed, Gh	2,200	6,600	133.00
20-1	Gd	2,100	6,300	127.00
20-2	Ge	1,800	5,400	109.00
20-3	Oed, Gd	2,200	6,600	133.00
20-4	Odd, Ods	2,550	7,650	154.00
20-5	Odd	2,700	8,100	163.00

Table VII-16 Cost Estimate of the Sericultural Facilities (1)

(Unit: M$)

Works	Unit	Quantity	Unit Price	Total
1. Sericulture center				
Equipment	set	1		500,000
Building				
Main building	m^2	500	300	150,000
Rearing reseach room	m^2	200	300	60,000
Silkworm egg production room	m^2	200	300	60,000
Disease reseach room	m^2	100	300	30,000
Pebrine inspection room	m^2	200	300	60,000
Egg refrigeration and artificial hatchery room	m^2	100	300	30,000
Work room	m^2	500	300	150,000
Sub-total				540,000
Total				1,040,000
2. Sericulture Sub-centers				
Equipment	set	1		100,000
Building				
Main building	m^2	300	200	60,000
Silkworm egg production	m^2	200	200	40,000
Pebrine inspection room	m^2	100	200	20,000
Egg refrigeration and artifical hatchery room	m^2	100	200	20,000
Work room	m^2	500	200	100,000
Sub-total				240,000
Total				340,000

Table VII-16 Cost Estimate of the Sericultural Facilities (2)

(Unit: :M$)

Works	Unit	Quantity	Unit Price	Total
3. Raw silk reeling mill				
Equipment				
Reeling machines	set	35	300,000	10,500,000
Cocoon cooking machines	set	5	180,000	900,000
Rewinding machines	set	30	60,000	1,800,000
Dryers	set	10	60,000	600,000
Assorting machines, Boiler	set	5	150,000	750,000
Others	set	5	50,000	250,000
Sub-total				14,800,000
Building				
Main office building	m	200	200	40,000
Plant	m	1,000	200	2,000,000
Sub-total				2,040,000
Total				16,840,000

VIII. ECONOMIC JUSTIFICATION AND FINANCIAL ANALYSIS

VIII-1 Basic Assumptions for the Economic Internal Rate of Return (EIRR)

1-1 Basic assumptions are as follows.

Price of Farm Products/Inputs

Major farm products are rice, soybean, coffee, groundnut, various vegetables and fruits. Of these products, rice is considered international trading goods and the price is based on projected 1981 international price of IBRD. International price of U.S.$370 per mpt. for rice was used. The prices of other farm products have been based on domestic prices. The price of fertilizers have also been based on domestic prices. Wages are based on local market rates and family labour is included in the calculation of labour cost.

Intensity of Land Use

At full development, with adequate water control better drainage, soil improvement and farm mechanization, it is estimated that the cropping intensity in the paddy farms will be 160% while that of upland will be 120% on an average.

Crop Yield

With the Project, the yield of rice is estimated to be 1.44 m.t./acre in case of monsoon season improved rice, and 1.52 m.t./acre in case of off-season improved rice. These yields were projected on the basis of available data from the existing irrigated areas and the local experiment stations of MARDI.

Agricultural Development Period

After completion of the project, it is expected that full agricultural development will take further five years. During this period a comprehensive programme on extension, farm mechanization, water management, and marketing will be implemented and the yield and crop intensity will gradually increase year by year up to the full development in the fifth year after the project construction is started.

Economic Life of the Project

The economic life of the project is assumed at 50 years after completion of the project taking into consideration services and physical life of major engineering structures of the project and the previous standard for similar projects.

Economic Cost

This means the total investment cost of the agricultural development, both foreign and local, excluding interests during the construction period and price escalation. O & M cost and residual value of machinery were excluded in this study.

The direct tangible economic benefits of the project are estimated at the difference between the net value of crop, livestock, pisciculture and sericulture production "with" and "without" the project. Indirect and non-quantifiable benefits are not included in the economic analysis.

Economic Internal Rate of Return (EIRR)

Based on the above assumptions, the EIRR has been calculated at 14.0% for the Work Unit No. 1, 14.8% for the Work Unit No. 2 and 16.7% for the Work Unit No. 3 respectively.

Life Period of Project

In estimating economic internal rate of return, life period of the project must be set as one of the important matters. Generally, it is in advisable to extend the life of the project beyond 50 years, not only because the uncertainties involved would much greater, but also because the present value of the future benefits and costs beyond 50 years would be too small to make any real difference in the final result. In the master plan study, however, the life period of 50 years was applied because this master plan is a lont-term one for the period of 1981 - 2000.

IX. OTHERS

IX-1 Sericulture

1-1 Sericultural facilities

(1) Cooperative rearing house for young silkworms

Silkworms of the first stage of instar larva through the third stage will be reared in cooperative houses. One cooperative rearing house will be established for every 25 farmers and 100 in total for the entire project. The starting rearing capacity of a house will be 100 boxes of silkworm eggs at a time.

A house will contain a rearing room, a mulberry leaf storage, and an administration office in a total area of 180 m^2.

The following tools will be required:

Tools	Dimension	Quantity
Rearing box	180 x 90 x 15 cm	100 boxes
Rearing net	90 x 60 cm	200 nets
Leaf storage basket		20 baskets
Sterilizer		1 set

(2) Rearing house for grown silkworm

One sericultural farmer will be equipped with one rearing room with a total area of 100 m^2 to rear and mount silkworm of the fourth stage through the fifth stage. The standard rearing capacity will be five boxes of eggs at a time. Equipment required is as follows:

Rotary frame:	45 sets
Hair remover:	1 set
Rearing nets:	40 nets

(3) Sericultural center

Facilities	Quantity	Area
		(m^2)
Main building	1	500
Rearing research room	1	200
Silkworm egg production room	1	200
Disease research room	1	100
Pebrine inspection room	1	200
Egg refrigeration and artificial hatchery room	1	100
Work room	5	100
(One mulberry field management room, three storage rooms and a garage)		
Mulberry testing field		15(acres)
Equipment	1 set	

(4) Sericultural sub-center

Five sub-centers will be established in the master plan area having the following facilities:

Facilities	Quantity	Area
		(m^2)
Main building	1	300
Silkworm egg production	1	200
Pebrine inspection room	1	100
Egg refrigeration and artificial hatchery room	1	100
Work room	5	100
(One mulberry field management room, three storage rooms and a garage)		
Mulberry testing field		15(acres)
Equipment	1 set	

(5) Station for the reproductive silkworm eggs

The station produces F_2 hybrid eggs on the basis of imported F_1 to distribute them to farmers through sub-centers.

9,000 boxes will be produced at a time with starting rearing capacity of 90 boxes.

The station will be equipped with the following facilities:

Facilities	Quantity	Area
		(m^2)
Egg and male moth refrigeration room	1	50
Egg raising room	1	250
Incubation room	1	50
Equipment	1 (set)	

(6) Raw silk reeling mill

Only one centralized mill will be built consisting of five buildings to accommodate a total of 35 sets of reeling machines on completion of the mill. One building will be equipped with seven sets of reeling machines.

The following facilities will be provided:

Facilities	Quantity	Area
		(m^2)
Main office building	1	200
Plant	5	2,000

Detailed facilities of one plant

Reeling machines:	7 sets	x 150 m^2	=	1,000 m^2
Cocoon cooking machines:	1	x 50	=	50
Rewinding machines:	6 sets	x 80	=	480
Dryers:	2	x 100	=	200

Assorting machine:	1	x 50	=	50
Boiler:	1	x 50	=	50
Cocoon storage:	1	x 150	=	150

The annual maximum capacity of the processing of cocoons and of the production of raw silk will be 1,780 and 302.5 tons respectively.

Types and the numbers of equipment required are as follows:

Equipment	Number of sets		Unit price
		(set)	(M$)
Reeling machines	7 sets	x 5 = 35	300,000
Cooking machines	1 set	x 5 = 5	180,000
Rewinders	6	x 5 = 30	60,000
Dryers	2	x 5 = 10	60,000
Assorting machine	1	x 5 = 5)	
Boiler	1	x 5 = 5)	150,000
Skeining machine	1	x 5 = 5)	
Booking machine	1	x 5 = 5)	
Others		5	50,000

1-2 Annual plan for facilities construction

Annual plan for facilities construction is as follows:

Items	1st year	2nd year	3rd year	4th year	5th year	6th year	7th year
Sericultural center (1)	1						
Sub-centers (5)		1	2	1	1		
Station for the reproductive silkworm eggs (1)		1					
Raw silk reeling mill (5 buildings)		1	1	1	1	1	
Young silkworm rearing house (100 houses)	20	40	20	20			
Grown silkworm rearing rooms (2,500 rooms)	500	1,000	500	500			

IX-2 Estimation of Anticipated Unit Crop Yield

1. In evaluating an irrigation development project, the unit crop yield is estimated on the basis of the present situation, the result on research and study of crop production, the conditions of climate, soil, water, etc. and others. Also in the study of the Bukit Bauk Pilot Project, the anticipated unit crop yield was estimated taking into account the peat soil as well as the above-said conditions.

2. The unit yield of paddy is expected to increase gradually in parallel with the increase of land productivity and attain the maximum yield on the seventh year after completion of the Pilot Project. The anticipated unit paddy yield during the build-up period is presented in the below table.

Table IX-1 Anticipated Unit Yield of Paddy

(Unit: ton/acre)

	Build-up Period											
	1st[1/]	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th
Improved Paddy												
Monsoon season				0.72	0.76	0.94	1.02	1.21	1.15	1.30	1.37	1.44
Off-season					0.81	0.99	1.08	1.28	1.32	1.37	1.44	1.52
Local Paddy												
Monsoon season				0.69	0.72	0.75	0.78	0.81	0.85	0.89	0.96	1.00

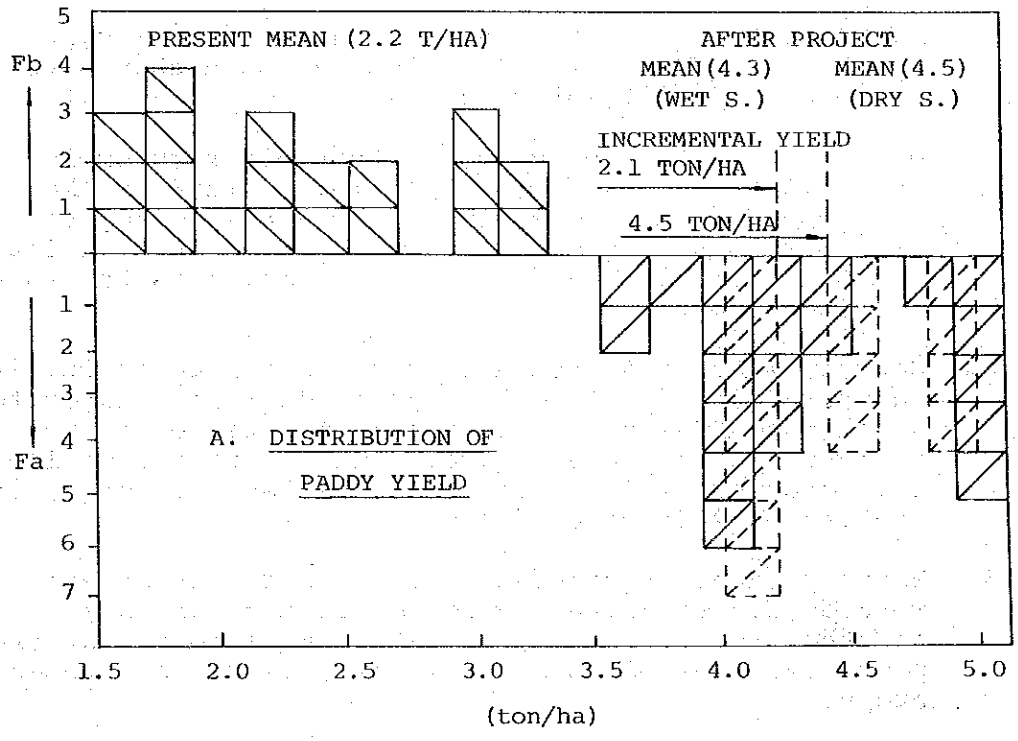
3. According to the latest data [2/], the yield position of paddy before and after project is illustrated in Fig. A. The upper half of the figure exhibits that: 1) yield level of rainy season paddy before project is 2.2 tons per ha on an average fluctuating from a little over 1.5 tons/ha to about 3.2 tons/ha, 2) this yield level will be raised to as high as 4.3 tons/ha after project, and 3) a yield level of 4.5 tons/ha has been planned for dry season paddy on an average. These figures indicate that the increase of yield is about 4.5 tons/ha in paddy for dry season crop as there has been practically no cultivation practiced before, whilst it is only 2.1 tons/ha rainy season.

1/: Means 1981/82 when the construction is assumed to be commenced.

2/: Obtained from Mr. Nakahara, Ex-ADB officer.

4. Difficulty of paddy cultivation in peat soil area is mentioned in the report. However, paddy cultivation in peat soil area is considered possible as far as the reclamation is conducted smoothly and adequately. Assuming that paddy cultivation is possible, agricultural development plan on the Bukit Bauk Pilot Project was established as seen in the report. Practically, the paddy cultivation is to be tested in the proposed demonstration farm.

Fig. IX-1 Paddy Yields and Production Cost



Labor Requirements

1. Average number of family labor forces was estimated to be 2.6 persons (husband, wife and son) per household. The reason is as below.

   a. Settlement will be conducted during 1982/83 to 1983/84 at latest. In accordance with the selection criteria, the proposed settlers are limited to married men of 25 in average ages.

   b. In 1991/92 the agricultural production will reach the maximum level on the basis of which the farm budget is calculated.

   c. In 1991/92 average ages of settlers' children will be 17 to 20 years old. Such a youth should be one of the family labor forces.

   d. It is realistic to assume that non-farm employment will at least grow at the similar rate as the population increase even in the Pilot Project. In this study, however, it was assumed that at least one child within farm family remains as the farm successor.

2. Monthly labor requirements by crops for paddy cultivation farms were estimated on the basis of family labor forces as shown in Table A. As seen in the table, in May shortage of labor forces takes place. Such shortages will be solved by supplying hired seasonal laborers or in collaboration with other farmers.

3. Monthly labor requirements for upland crop estate farms were estimated excluding common estate farm activities, in other words, limited to labor requirement for crop production. Table B shows monthly labor requirements by crops.

4. In the proposed estate farms, the farming practices will still require considerable manpower even though some kinds of farm machineries are introduced different from paddy cultivation farms. The labor requirements per year for the operation of the estate farms are estimated at about 115,000 man-days including 113,465 man-days for crop production in case of upland crop estate farm and about 55,000 man-days including about 4,000 man-days for fruit production in case of livestock estate farm. These requirements will be provided by about 300 permanent family for the upland crop estate farm and about 160 permanent family for livestock estate farm.

Table IX-2 Monthly Labor Requirement by Crops Upland Crop Estate Farm

(Unit: man-day)

Crops	Acreage (acre)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Total
Vegetables														
Tomato	0.5		4	6	12	6	8	8	8					52
Chilies	0.5			5	7	13	7	15	15	15	15	10		102
Watermelon	0.5				4	6	12	10	8	8	8			48
Onion	0.5						4	5	11	10	10	10	10	60
Fruits														
Pineapple	4	12	8	4	9	9	8	7	6	8	7	4	6	88
Total (A)	6	12	12	15	32	34	39	45	48	41	32	24	16	350
Workable days 1/		24	22	24	23	24	23	24	24	23	24	23	24	282
Family labor force 2/ (B)		62.4	57.2	62.4	59.8	62.4	59.8	62.4	62.4	59.8	62.4	59.8	62.4	733.2
Difference (B-A)		50.4	45.2	47.4	27.8	28.4	20.8	17.4	14.4	18.8	30.4	35.8	43.4	383.2

1/: Excluding national holidays, sundays, rainy days.
2/: Calculated assuming that average number of available family labor forces is 2.6 persons per household.
3/: Limited to labor requirements for crop production. The remaining labor forces will be supplied for the common estate farm activities, i.e., collection of harvested products, transport to cannery, works in cannery, sending works of crop products to market, etc.

Table IX-3 Monthly Labor Requirement by Crops Paddy Cultivation Farmer

(Unit: man-day)

Crops	Acreage (acre)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Total
Paddy														
Improved														
Main season	1	2	9								12	17	2	42
- do -	1	2	2	9								12	17	42
Off-season	1				12	17	3	3	9					44
- do -	1					12	17	3	3	9				44
- do -	1				12	17	3	3	9					44
Local														
Main season	1	14	1	1	5	6							8	35
Upland Crops														
Chilies	1			10	15	25	15	30	30	30	30			185
Fruits	0.35	2	2	2	2	2	2	2	2	2	2	2	2	24
Other vegetables														
Cucumber	0.5			5	6	13	5	10	4					43
Long beans	0.5	7	6	5							5	6	10	39
Total (A)	8.35	27	20	32	52	92	45	51	57	41	49	37	39	542
Workable days 1/		24	22	24	23	24	23	24	24	23	24	23	24	282
Family labor force 2/ (B)		62.4	57.2	62.4	59.8	62.4	59.8	62.4	62.4	59.8	62.4	59.8	62.4	733.2
Difference (B-A)		35.4	37.2	30.4	7.8	-29.6 3/	14.8	11.4	5.4	18.8	13.4	22.8	23.4	191.2

1/: Excluding national holidays, sundays, rainy days, etc.

2/: Calculated assuming that average number of available family labor forces is 2.6 persons per household.

3/: Shortage of labor forces will be solved by supplying hired seasonal labor forces or in collaboration with other farmers.

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