

FIGURE F-8 RESULT OF CYLINDER INTAKE RATE TEST (NO.2)

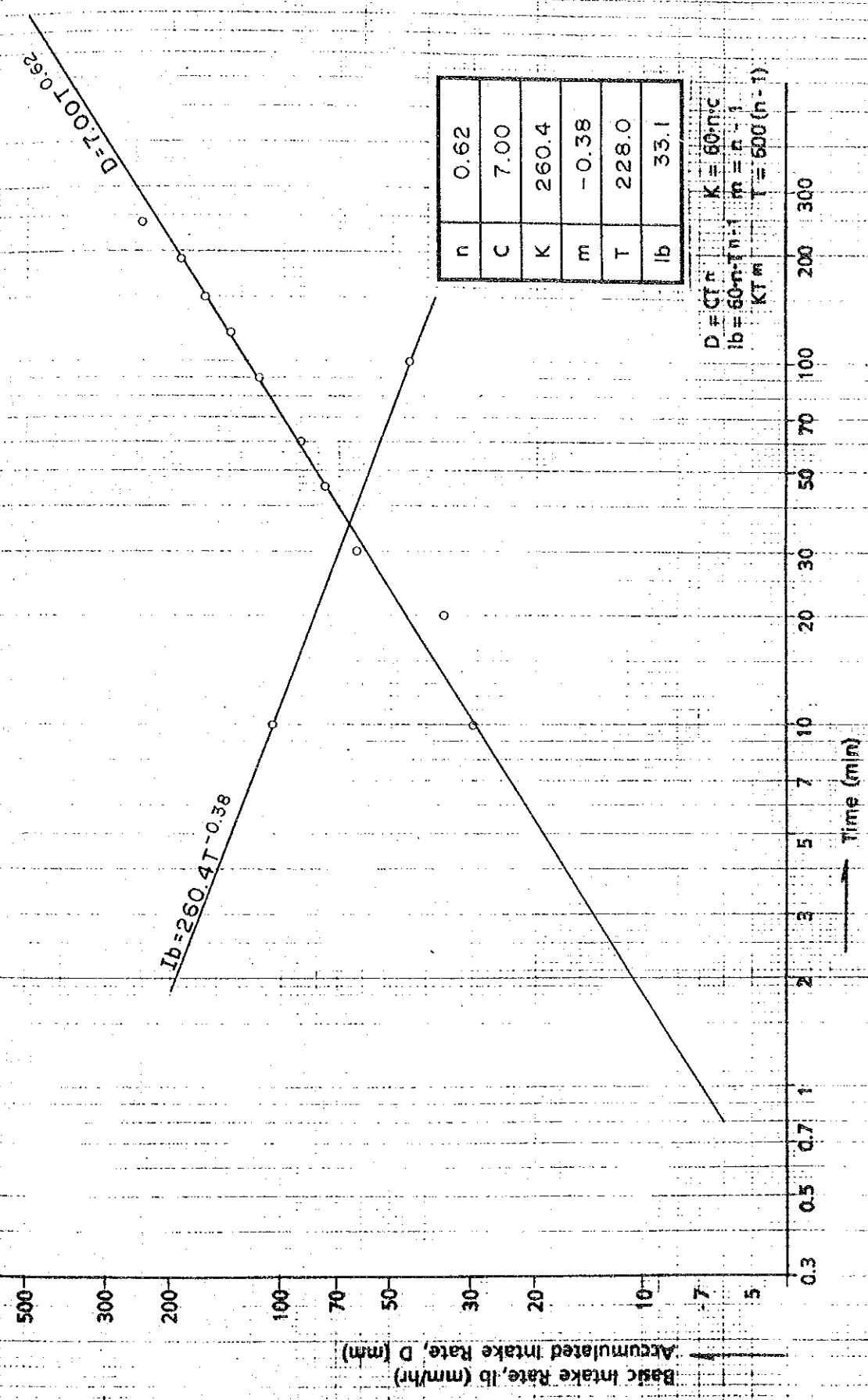


FIGURE F-8 RESULT OF CYLINDER INTAKE RATE TEST (NO. 3)

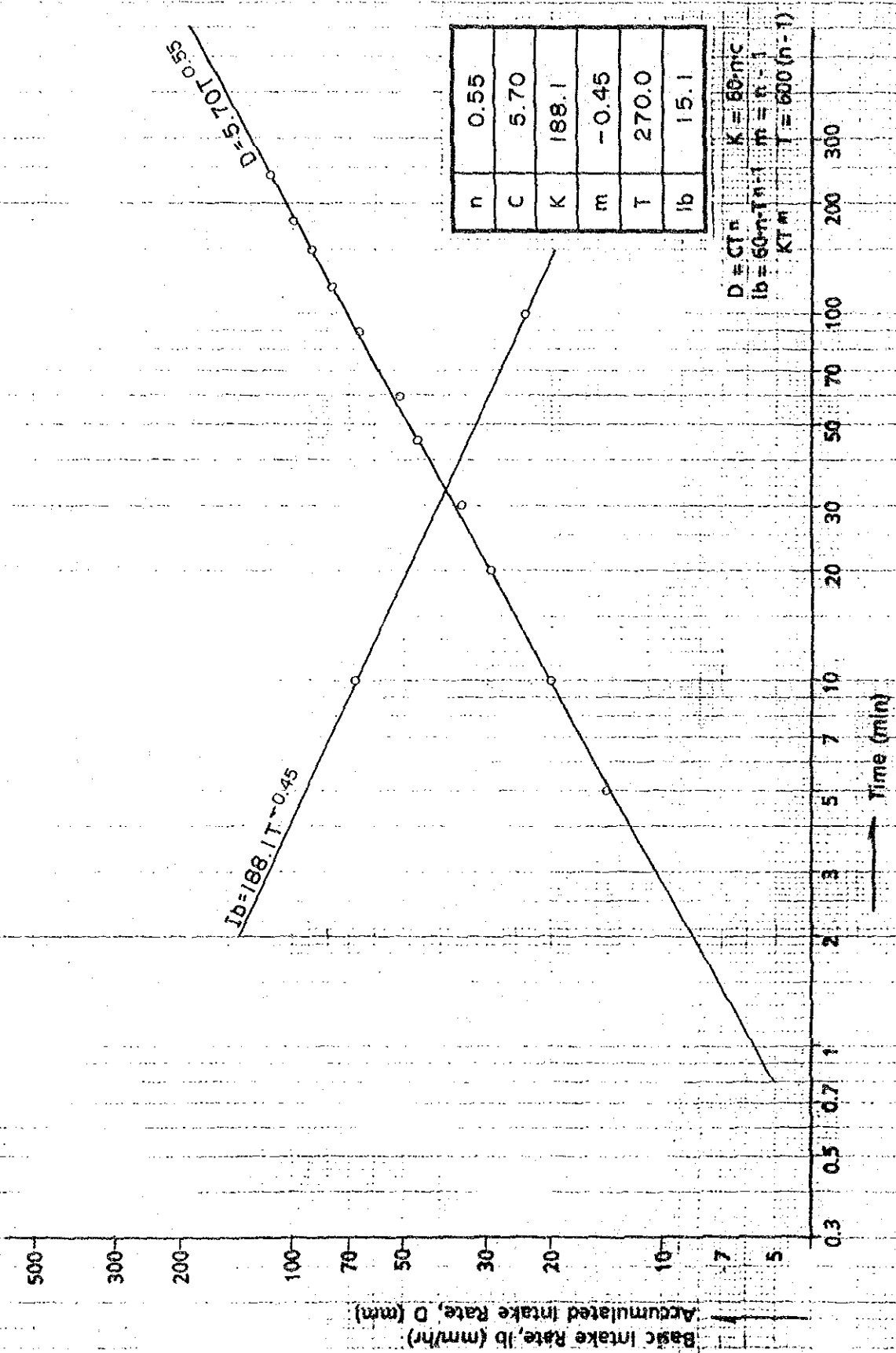


FIGURE F-8 RESULT OF CYLINDER INTAKE RATE TEST (NO.4)

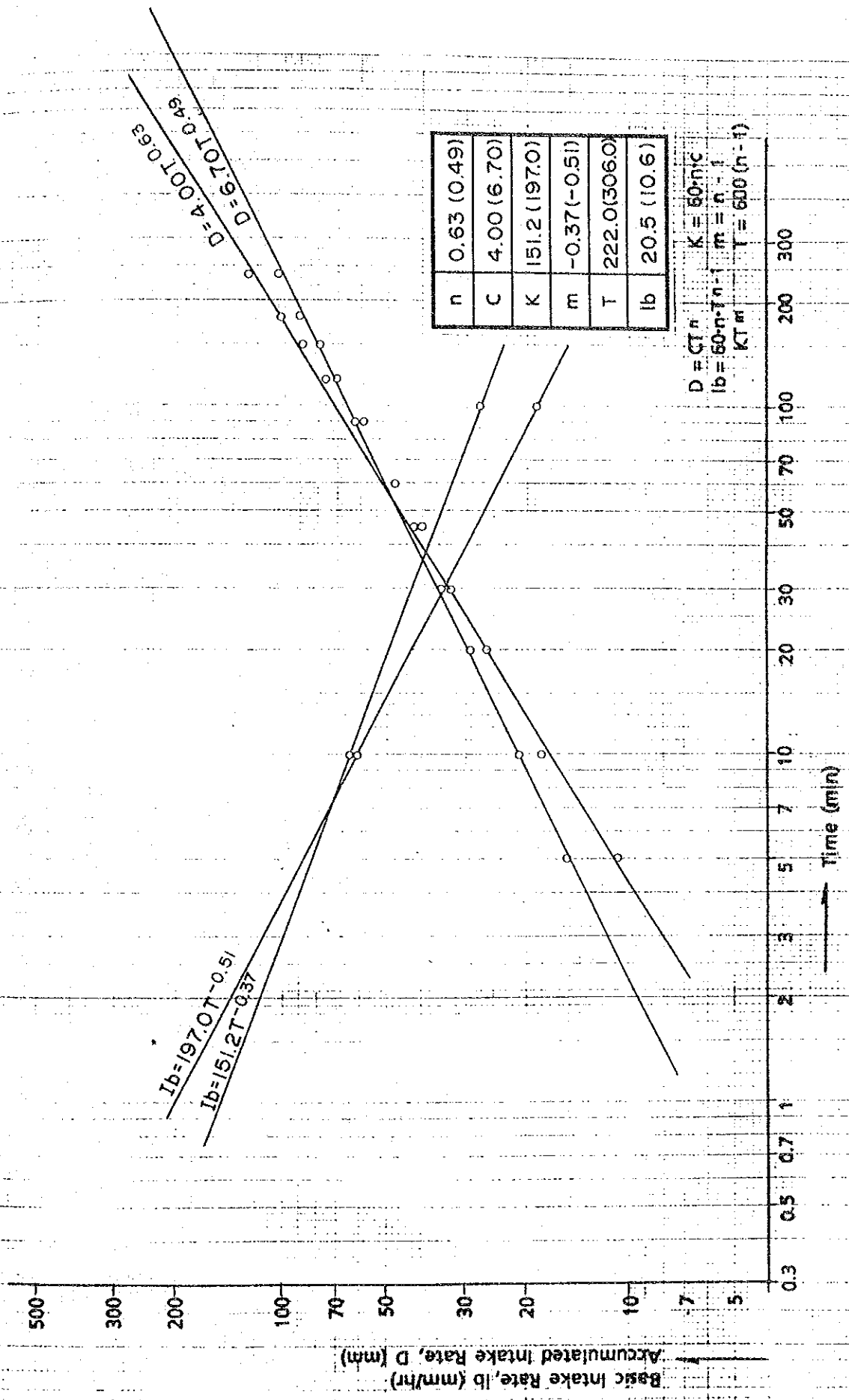
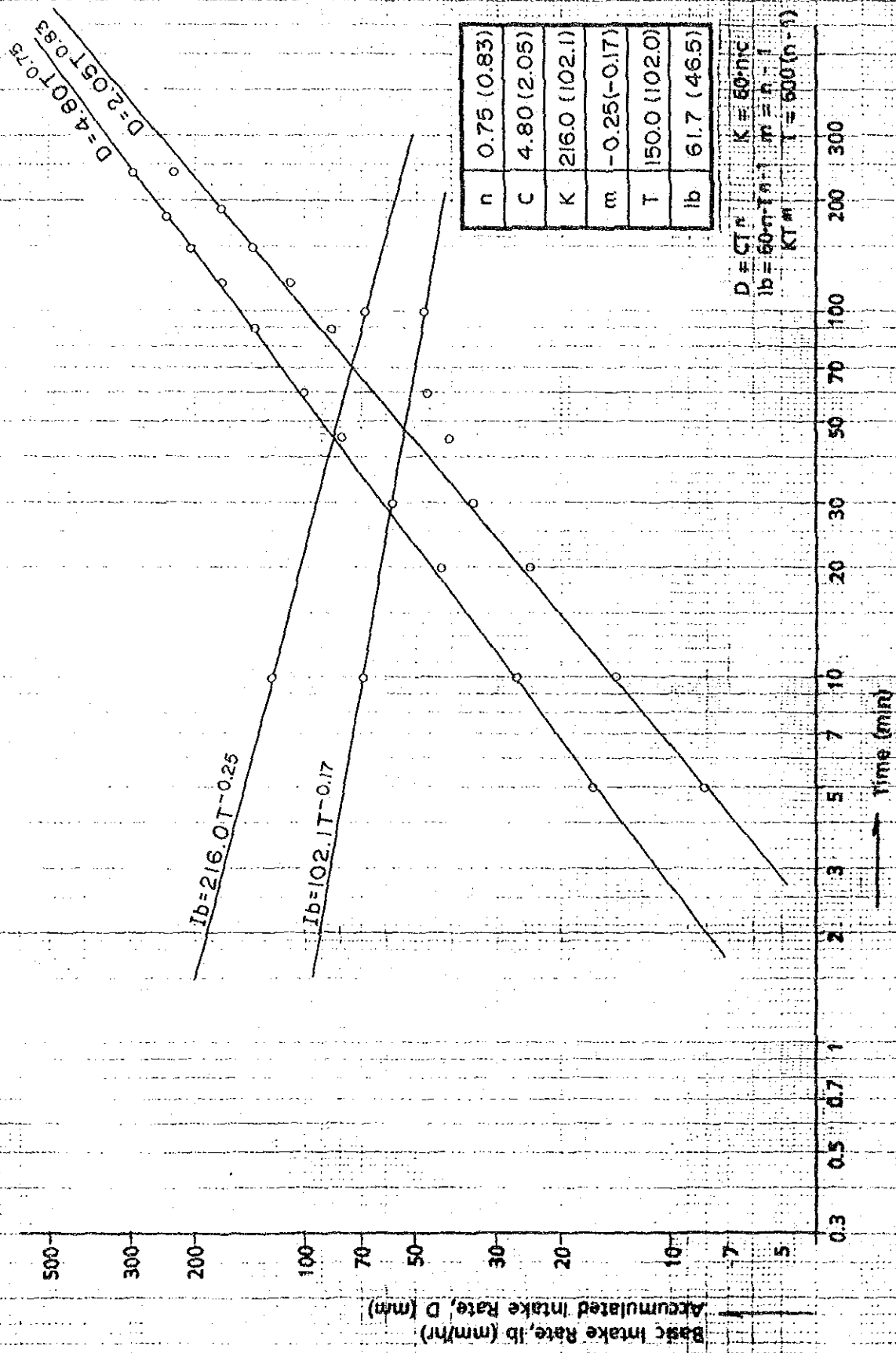


FIGURE F-8 RESULT OF CYLINDER INTAKE RATE TEST (NO. 5)



n	0.75 (0.83)
C	4.80 (2.05)
K	216.0 (102.1)
m	-0.25 (-0.17)
T	150.0 (102.0)
lb	61.7 (46.5)

$D = CT^n$ $K = 60nC$
 $I_b = 60mT^m$ $m = n - 1$
 KT^m $T = 600(n - 1)$

FIGURE F-8 RESULT OF CYLINDER INTAKE RATE TEST (NO. 6)

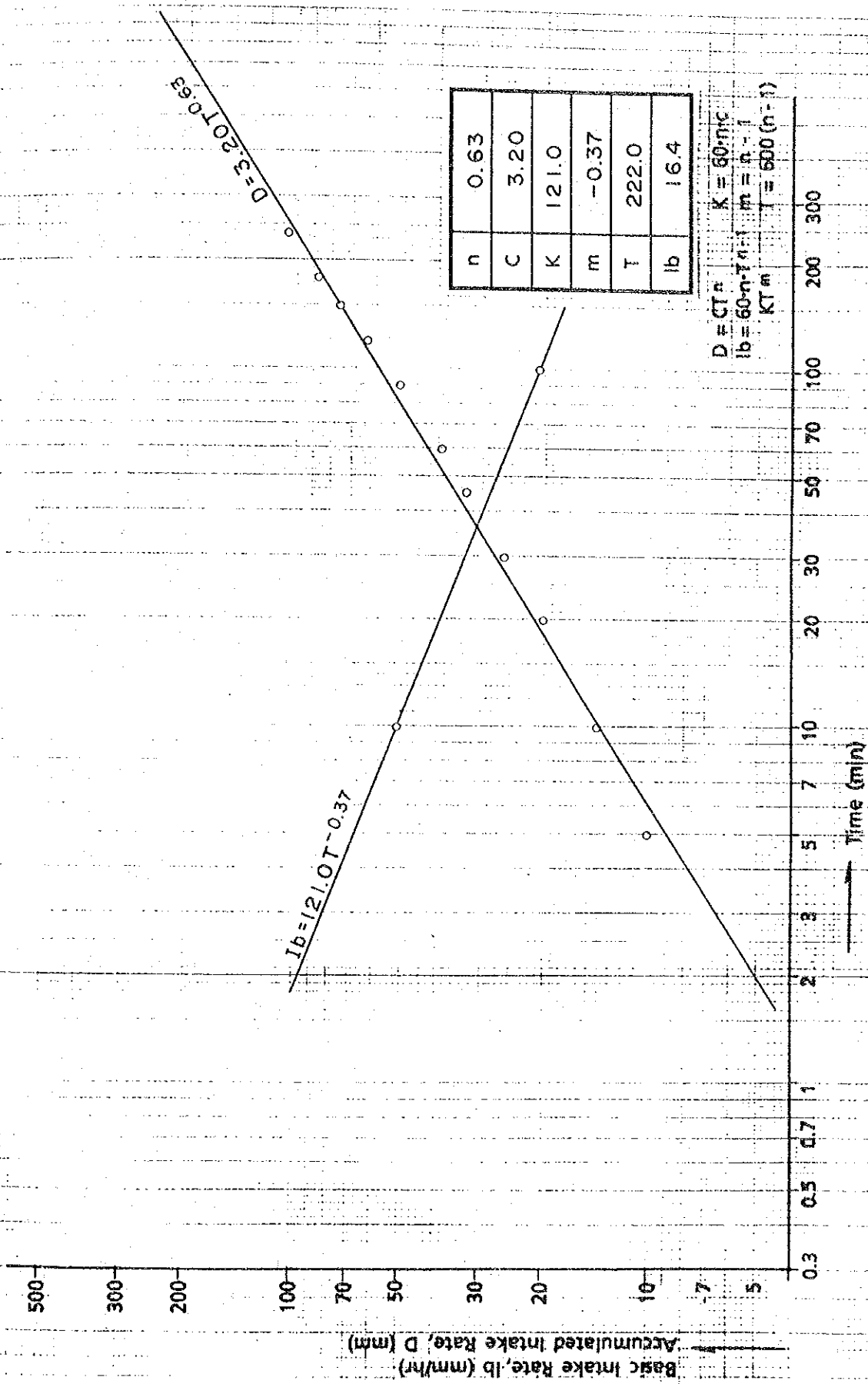


FIGURE F-8 RESULT OF CYLINDER INTAKE RATE TEST (NO.7)

1.3 Pump Operation Hours

The pump operation hours for supplying irrigation and domestic water were analyzed on the 10-day basis by dividing the total diversion water requirement (DWR) by designed pump capacity per unit for the both cases of Type-1 and Type-2 of proposed cropping pattern.

The analyses were made based on the following conditions;

- Diversion water requirement, which corresponds to the cases of normal year with return period of 1/2-year, is of two years' data average of 1962 and 1980.
- Irrigation areas are as follows;

	<u>Plan A-1</u> (ha)	<u>Plan B-1</u> (ha)
Left Bank Area	8,800	-
Right Bank Area	25,200	34,000

- Unit pump capacity in each station is as follows;

	<u>Plan A-1</u> (cu.m/min)	<u>Plan B-1</u> (cu.m/min)
Left Bank Area	88.0	-
Right Bank Area	126.0	127.5

The result of analysis is shown in Table F-29 and Table F-30, and annual operation hours in each alternative plan in case of the proposed cropping pattern of Type-I and Type-II are estimated as follows;

<u>Cropping Pattern</u>	<u>Plan A-1</u> (hr)	<u>Plan B-1</u> (hr)
Type-I	15,485	13,762
Type-II	16,475	14,644

TABLE F-29 ESTIMATION OF PUMP OPERATION HOURS FOR PLAN A-1 AND PLAN B-1
(TYPE-1)
IN RETURN PERIOD OF 1/2-YEAR (TYPE-1)

Month	Average Unit DWR (l/s/ha)	Total DWR				Total Pump Operation Hours			
		Plan A			Plan B	Plan A			Plan B
		AR-1 (cu. m/s)	AR-2 (cu. m/s)	Total (cu. m/s)	B-1 (cu. m/s)	AR-1 (hr)	AR-2 (hr)	Total (hr)	B-1 (hr)
Jan. 1	0.198	1.741	4.985	6.725	6.725	28.5	57.0	85.5	76.0
2	0.195	1.716	4.913	6.628	6.628	28.1	56.1	84.2	74.9
3	0.195	1.716	4.913	6.628	6.628	28.1	56.1	84.2	74.9
Feb. 1	0.188	1.657	4.744	6.401	6.401	27.1	54.2	81.3	72.3
2	0.276	2.426	6.947	9.373	9.373	39.7	79.4	119.1	105.9
3	0.177	1.558	4.462	6.020	6.020	25.5	51.0	76.5	68.0
Mar. 1	0.193	1.700	4.868	6.568	6.568	27.8	55.6	83.4	74.2
2	0.154	1.357	3.886	5.243	5.243	22.2	44.4	66.6	59.2
3	0.171	1.502	4.301	5.803	5.803	24.6	49.2	73.8	65.5
Apr. 1	0.027	0.234	0.670	0.904	0.904	3.8	7.7	11.5	10.2
2	0.045	0.392	1.122	1.514	1.514	6.4	12.8	19.2	17.1
3	0.036	0.314	0.898	1.211	1.211	5.1	10.3	15.4	13.7
May. 1	0.041	0.358	1.025	1.383	1.383	5.9	11.7	17.6	15.6
2	0.030	0.260	0.745	1.005	1.005	4.3	8.5	12.8	11.3
3	0.010	0.090	0.259	0.349	0.349	1.5	3.0	4.5	3.9
Jun. 1	0.091	0.803	2.300	3.103	3.103	13.1	26.3	39.4	35.0
2	0.151	1.332	3.815	5.147	5.147	21.8	43.6	65.4	58.1
3	0.335	2.950	8.449	11.399	11.399	48.3	96.6	144.9	128.7
Jul. 1	0.107	0.940	2.691	3.631	3.631	15.4	30.8	46.2	41.0
2	0.010	0.092	0.264	0.357	0.357	1.5	3.0	4.5	4.0
3	0.000	0.000	0.000	0.000	0.000	0.0	0.0	0.0	0.0
Aug. 1	0.020	0.176	0.503	0.679	0.679	2.9	5.7	8.6	7.7
2	0.203	1.788	5.119	6.907	6.907	29.3	58.5	87.8	78.0
3	0.000	0.000	0.000	0.000	0.000	0.0	0.0	0.0	0.0
Sep. 1	0.000	0.000	0.000	0.000	0.000	0.0	0.0	0.0	0.0
2	0.000	0.000	0.000	0.000	0.000	0.0	0.0	0.0	0.0
3	0.000	0.000	0.000	0.000	0.000	0.0	0.0	0.0	0.0
Oct. 1	0.010	0.084	0.240	0.323	0.323	1.4	2.7	4.1	3.7
2	0.010	0.084	0.240	0.323	0.323	1.4	2.7	4.1	3.7
3	0.030	0.261	0.748	1.009	1.009	4.3	8.5	12.8	11.4
Nov. 1	0.029	0.256	0.733	0.989	0.989	4.2	8.4	12.6	11.2
2	0.030	0.262	0.750	1.012	1.012	4.3	8.6	12.9	11.4
3	0.029	0.258	0.738	0.996	0.996	4.2	8.4	12.6	11.2
Dec. 1	0.202	1.778	5.091	6.869	6.869	29.1	58.2	87.3	77.6
2	0.108	0.953	2.730	3.684	3.684	15.6	31.2	46.8	41.6
3	0.284	2.503	7.167	9.669	9.669	41.0	81.9	122.9	109.2
Total						516.4	1,032.1	1,548.5	1,376.2

Note : 1/ Irrigation area : Plan A-1 Plan B-1
Left Bank Area (AR-1) : 8,800 ha -
Right Bank Area (AR-2) : 25,200 ha 34,000 ha

2/ Pump operation hour = Total water demand (cu. m/sec) x 86,400 /
(Pump capacity per unit (cu. m/min) x 60 min)

3/ Pump Capacity per unit
Left Bank Area (AR-1) : 88.0 cu. m/m -
Right Bank Area (AR-2) : 126.0 cu. m/m 127.5 cu. m/m

TABLE F-30 ESTIMATION OF PUMP OPERATION HOURS FOR PLAN A-1 AND PLAN B-1
(TYPE-2)
IN RETURN PERIOD OF 1/2-YEAR (TYPE-2)

Month	Average Unit DWR (l/s/ha)	Total DWR				Total Pump Operation Hours			
		Plan A			Plan B	Plan A			Plan B
		AR-1 (cu. m/s)	AR-2 (cu. m/s)	Total (cu. m/s)	B-1 (cu. m/s)	AR-1 (hr)	AR-2 (hr)	Total (hr)	B-1 (hr)
Jan. 1	0.208	1.832	5.247	7.080	7.080	30.0	60.0	90.0	80.0
2	0.205	1.806	5.173	6.979	6.979	29.6	59.1	88.7	78.8
3	0.205	1.806	5.173	6.979	6.979	29.6	59.1	88.7	78.8
Feb. 1	0.198	1.744	4.994	6.738	6.738	28.5	57.1	85.6	76.1
2	0.291	2.564	7.342	9.906	9.906	42.0	83.9	125.9	111.9
3	0.188	1.650	4.726	6.376	6.376	27.0	54.0	81.0	72.0
Mar. 1	0.203	1.789	5.123	6.912	6.912	29.3	58.5	87.8	78.1
2	0.162	1.423	4.075	5.497	5.497	23.3	46.6	69.9	62.1
3	0.179	1.571	4.500	6.071	6.071	25.7	51.4	77.1	68.6
Apr. 1	0.027	0.234	0.670	0.904	0.904	3.8	7.7	11.5	10.2
2	0.045	0.392	1.122	1.514	1.514	6.4	12.8	19.2	17.1
3	0.036	0.314	0.898	1.211	1.211	5.1	10.3	15.4	13.7
May. 1	0.041	0.358	1.025	1.383	1.383	5.9	11.7	17.6	15.6
2	0.030	0.260	0.745	1.005	1.005	4.3	8.5	12.8	11.3
3	0.010	0.090	0.259	0.349	0.349	1.5	3.0	4.5	3.9
Jun. 1	0.106	0.936	2.680	3.616	3.616	15.3	30.6	45.9	40.8
2	0.155	1.362	3.900	5.262	5.262	22.3	44.6	66.9	59.4
3	0.347	3.054	8.747	11.801	11.801	50.0	100.0	150.0	133.3
Jul. 1	0.103	0.910	2.605	3.514	3.514	14.9	29.8	44.7	39.7
2	0.026	0.231	0.660	0.891	0.891	3.8	7.5	11.3	10.1
3	0.007	0.064	0.184	0.248	0.248	1.0	2.1	3.1	2.8
Aug. 1	0.042	0.370	1.060	1.430	1.430	6.1	12.1	18.2	16.2
2	0.219	1.926	5.515	7.441	7.441	31.5	63.0	94.5	84.0
3	0.016	0.137	0.392	0.529	0.529	2.2	4.5	6.7	6.0
Sep. 1	0.000	0.000	0.000	0.000	0.000	0.0	0.0	0.0	0.0
2	0.000	0.000	0.000	0.000	0.000	0.0	0.0	0.0	0.0
3	0.000	0.000	0.000	0.000	0.000	0.0	0.0	0.0	0.0
Oct. 1	0.010	0.084	0.240	0.323	0.323	1.4	2.7	4.1	3.7
2	0.010	0.084	0.240	0.323	0.323	1.4	2.7	4.1	3.7
3	0.030	0.261	0.748	1.009	1.009	4.3	8.5	12.8	11.4
Nov. 1	0.029	0.256	0.733	0.989	0.989	4.2	8.4	12.6	11.2
2	0.030	0.262	0.750	1.012	1.012	4.3	8.6	12.9	11.4
3	0.029	0.258	0.738	0.996	0.996	4.2	8.4	12.6	11.2
Dec. 1	0.214	1.879	5.381	7.260	7.260	30.7	61.5	92.2	82.0
2	0.113	0.999	2.860	3.858	3.858	16.3	32.7	49.0	43.6
3	0.301	2.651	7.592	10.243	10.243	43.4	86.8	130.2	115.7
Total						549.3	1,098.2	1,647.5	1,464.4

CHAPTER II. DRAINAGE PLAN

2.1 Estimation of Drainage Modulus for Paddy Field Area

1) Method of Estimating Drainage Modulus

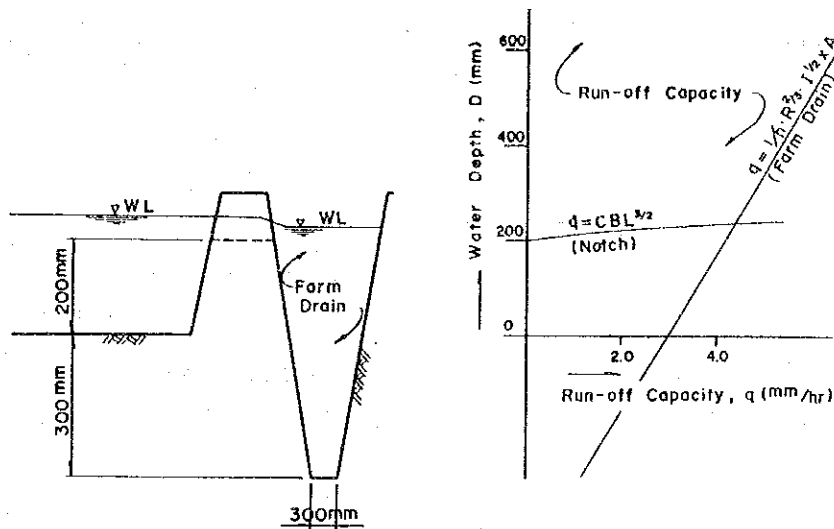
For the estimation of drainage modulus in the paddy field, Ekdahl's method was used. The run-off analysis by the method is explained as follows;

- Paddy field located in a relatively flat area plays a function to store the rain water,
- The stored water in paddy field is discharged through notch provided at each plot to the farm drain, which is a terminal drainage canal at on-farm level.
- Notch and farm drain will control run-off discharge from paddy field to the farm drain.
- The Ekdahl's equation is expressed as shown below, and major dimension of run-off mechanism is indicated in the following figure.

$$1/2 (I_1 + I_2) \times \Delta t - 1/2 (O_1 + O_2) \times \Delta t = S_2 - S_1$$

where;

- I_1 : Inflow at time t_1 (mm/hr)
- I_2 : Inflow at time t_2 (mm/hr)
- O_1 : Outflow at time t_1 (mm/hr)
- O_2 : Outflow at time t_2 (mm/hr)
- S_1 : Field storage at time t_1 (mm/hr)
- S_2 : Field storage at time t_2 (mm/hr)



RUN-OFF MECHANISM IN PADDY FIELD AND RUN-OFF CAPACITY

2) Inflow to Paddy Field

a) Designed Rainfall

There exist six rainfall observation stations in and around the basin. The following table indicates the probable 1-day, 2-day and 3-day consecutive rainfall in the return period of 1/5 and 1/10-years.

Probable Rainfall for Drainage Study

Station	1-Day Rainfall		2-Day Rainfall		3-Day Rainfall	
	1/5	1/10	1/5	1/10	1/5	1/10
Ubon Ratchathani	133.5	154.2	167.2	191.5	194.4	219.3
Phibun Mangsahan	154.8	186.1	193.3	236.9	214.2	259.3
Det Udom	118.5	135.0	148.7	170.3	174.7	198.4
Buntarik	132.0	158.5	168.2	201.1	195.0	229.7
Kantharalak	101.1	118.8	134.7	157.3	161.9	187.2
Nam Yun	117.6	128.8	140.7	159.2	167.5	187.7

As the designed rainfall, 118.5 mm of 1-day rainfall observed at Det Udom is selected for the drainage study, and the following equation was adopted to analyze the hourly distribution for the selected rainfall.

$$R_t = 0.4014 \times t^{0.287} \times R_{24}$$

where; R_t : Hourly rainfall (mm)
 t : Time duration (hr)
 R_{24} : 24 hour rainfall (mm)

According to the application of this application, maximum hourly rainfall is estimated at 47.6 mm/hr in return period of 1/5-year. Thus estimated hourly rainfall was arranged as shown in Table F-31 and Figure F-9.

b) Drainage Modulus

Flood run-off analysis by computing water balance in paddy field was made based on the following conditions;

- Although maximum water level by irrigation water supply is 80 mm, Initial water level in the paddy field is assumed to be 160 mm above field surface, considering the consecutive rainfall before the occurring the designed rainfall of 118.5 mm.
- Therefore, initial rainfall of 40 mm, equivalent to water depth between the height of notch and assumed water level of 160 mm, will be lost as loss of rainfall in the field.

Results of analysis are given in Figure F-9, and the peak run-off discharge of $q = 8.14$ lit/sec/ha, corresponding to the return period of 1/5-year, was decided as drainage modulus for drainage planning in the project.

TABLE F-31 RESULT OF FLOOD RUN-OFF ANALYSIS IN PADDY FIELD

Time	Rainfall	Water Depth	Run-off		Time	Rainfall	Water Depth	Run-off	
			mm/hr	lit/sec/ha				mm/hr	lit/sec/ha
0	0.00	160.0	0.00	0.00	36	239.0	1.46	4.06	
1	1.43	161.4	0.00	0.00	37	237.8	1.39	3.86	
2	1.49	162.9	0.00	0.00	38	236.6	1.33	3.69	
3	1.53	164.5	0.00	0.00	39	235.5	1.26	3.50	
4	1.58	166.0	0.00	0.00	40	234.5	1.21	3.36	
5	1.60	167.6	0.00	0.00	41	233.5	1.16	3.22	
6	1.70	169.3	0.00	0.00	42	232.6	1.11	3.08	
7	1.77	171.1	0.00	0.00	43	231.7	1.07	2.97	
8	1.85	173.0	0.00	0.00	44	230.9	1.02	2.83	
9	1.94	174.9	0.00	0.00	45	230.1	0.99	2.75	
10	2.03	176.9	0.00	0.00	46	229.3	0.95	2.64	
11	2.13	179.1	0.00	0.00	47	228.6	0.91	2.53	
12	2.39	181.4	0.00	0.00	48	227.9	0.88	2.44	
13	2.75	184.2	0.00	0.00	49	227.2	0.85	2.36	
14	3.24	187.4	0.00	0.00	50	226.6	0.82	2.28	
15	4.16	191.6	0.00	0.00	51	226.0	0.79	2.19	
16	5.61	197.2	0.00	0.00	52	225.4	0.77	2.14	
17	10.47	207.6	0.13	0.36	53	224.9	0.74	2.06	
18	47.56	254.1	2.38	6.61	54	224.0	0.70	1.94	
19	7.16	258.9	2.70	7.50	55	223.5	0.68	1.89	
20	4.68	261.0	2.84	7.89	56	223.0	0.66	1.83	
21	3.60	261.9	2.91	8.08	67	222.6	0.64	1.78	
22	2.97	262.1	2.93	8.14	68	222.2	0.62	1.72	
23	2.55	261.9	2.91	8.08	69	221.8	0.61	1.69	
24	2.31	261.4	2.88	8.00	60	221.4	0.59	1.64	
25		258.8	2.69	7.47	61	221.0	0.58	1.61	
26		256.4	2.53	7.03	62	220.6	0.56	1.56	
27		254.1	2.38	6.61	63	220.3	0.54	1.50	
28		252.0	2.24	6.22	64	220.0	0.53	1.47	
29		250.0	2.11	5.86	65	219.7	0.52	1.44	
30		248.1	2.00	5.56	66	219.4	0.51	1.42	
31		246.3	1.89	5.25	67	219.1	0.50	1.39	
32		244.7	1.78	4.94	68	218.8	0.49	1.36	
33		243.2	1.69	4.69	69	218.5	0.48	1.33	
34		241.7	1.62	4.50	70	218.2	0.47	1.31	
35		240.3	1.53	4.25					

Note : 1/ : Designed rainfall is 118.5 mm, corresponding to 1/5-year return period.
 2/ : Initial water level of the field is assumed to be 160 mm above field surface.

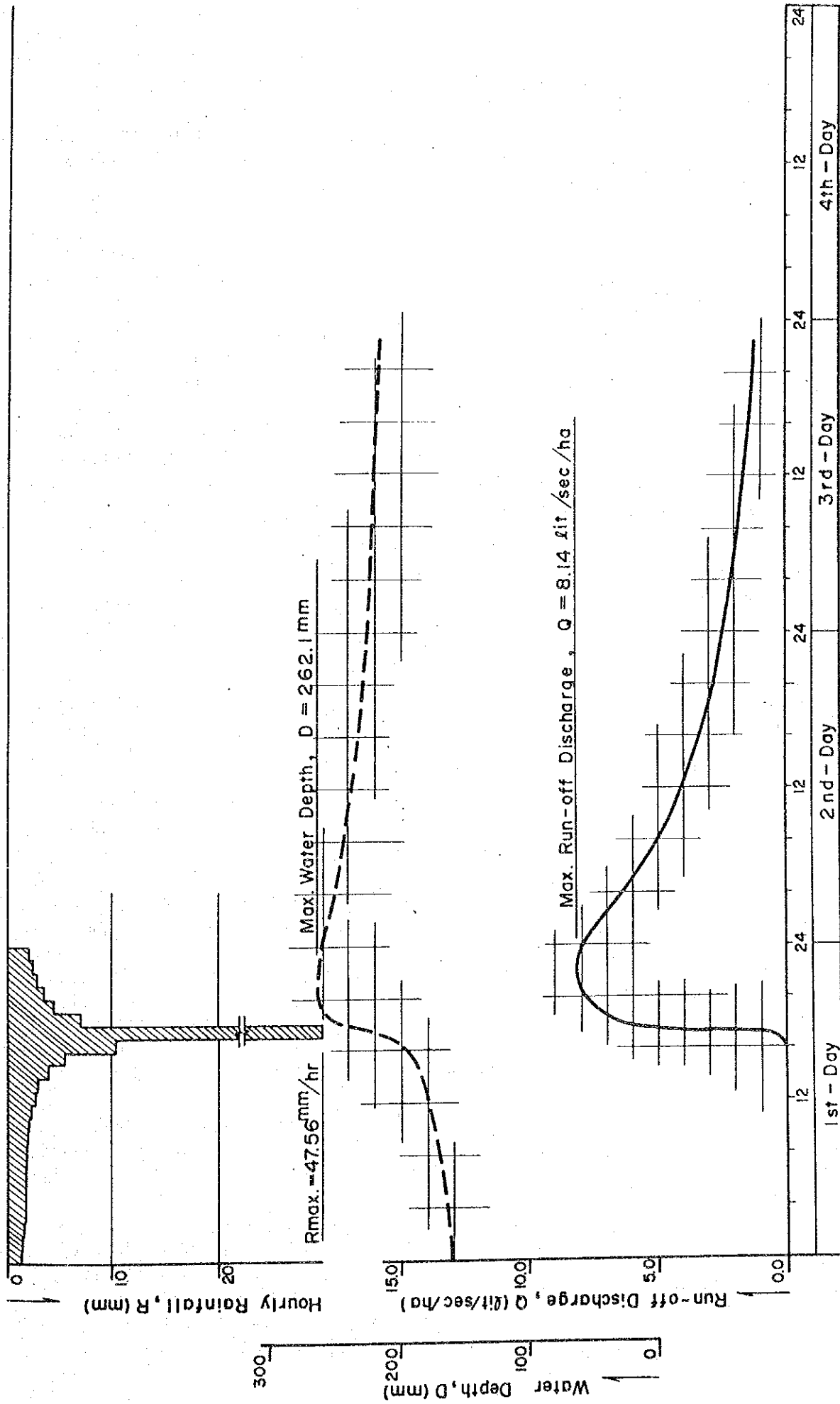


FIGURE F-9 RESULTS OF RUN-OFF ANALYSIS IN PADDY FIELD

ANNEX G. ALTERNATIVE STUDY

ANNEX G. ALTERNATIVE STUDY

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ANNEX G. ALTERNATIVE STUDY

PART-I OVERALL BASIN STUDY

CHAPTER I. SELECTION OF PRIORITY DEVELOPMENT PROJECT

Following data concerning the study on selection of priority development project are attached hereinafter;

- Present conditions of secondary selected project sites
- Project evaluation by B/C ratio (financial)
- Evaluation Criteria for selecting priority project

PART-II (FEASIBILITY STUDY)

CHAPTER II. OPTIMUM PROJECT SCALE

An optimum project scale for the selected priority project was analyzed from technical and economical view points. In connection with this, the subsequent data are attached;

2.1 Water Demand, Water Balance Study and Optimum Project Scale

- Diversion water requirement in the following cases;
 - . Cropping intensity : 110 %
 - . Cropping intensity : 115 %
 - . Cropping intensity : 120 %
- Irrigable area by reservoir normal water level
- Dam and compensation costs by reservoir water level
- Location and schematic diagram of alternative irrigation system

2.2 Project Cost

The project costs in case of alternative plan B-1 was estimated at the feasibility level, and were attached hereinafter;

- Project cost
- Location map of canal system
- Cost estimation of each work items
 - . Pump facilities
 - . Canal systems
 - . On-farm development
 - . Land acquisition

- . Preparation works
- Disbursement schedule of project cost
- Operation and maintenance cost

2.3 Project Benefit and Project Evaluation

The expected project benefits in case of Plan B-1 was estimated, and project evaluation using economic internal rate of return (EIRR) was made. In connection with this, following data are attached;

- Crop production value with/without project
- Benefits from crop production
- Benefit from crop production (economic)
- Incremental benefit
- Project cost
- Disbursement schedule of project cost
- Operation and maintenance cost
- Estimation of economic internal rate of return (EIRR)

TABLE G-1 PRESENT CONDITIONS OF SECONDARY SELECTED PROJECT SITES (1)

Description	Lam Dom Yai(U) (D-7)	Lam Dom Yai(M) (D-23)	Lam Som (D-24)
<p>1) Location</p> <ul style="list-style-type: none"> - Changwat - Amphoe - Tambon - Muban <p>2) Annual Rainfall(mm)</p> <p>3) River</p> <ul style="list-style-type: none"> - Chatchment Area (sq. km) - River - Annual Run-off(R.P=1/5)(MCM) <p>4) Topography of Damsite</p> <ul style="list-style-type: none"> - Elevation of Riverbed (EL.m) - Slope - Vegetation <p>5) Geology and Material</p> <ul style="list-style-type: none"> - Geology - Impermeable Soils for Embankment 	<p>Ubun Ratchathani Nam Yun Dom Pradit Ban Phu Ang 1,356.1</p> <p>281.7 Lam Dom Yai 104.3</p> <p>158.0</p> <p>Well</p> <p>-</p> <p>-</p> <p>Forest No facilities exist. No exist No exist</p> <p>24,200 Sandy loam and loam Paddy and forest</p> <p>1.31 No system exist</p> <p>68.3 6.3 95.5</p> <p>39.9 34.2</p> <p>15.6 51.8</p>	<p>Ubun Ratchathani Nam Yun Dom Pradit Ban Saen Khum 1,356.1</p> <p>395.9 Lam Dom Yai 207.2</p> <p>141.6 1/1,200 Well</p> <p>Fine sand stone interbedded by mud stone, fresh and slightly hard, but permeable. Available, but far from the dam site.</p> <p>Paddy field and open forest No facilities exist. 1 village, 155 houses, 977 habit. 1 temple, 1 school</p> <p>29,600 Sandy loam and loam Paddy, kenaf and forest</p> <p>1.25 No systems exist.</p> <p>69.7 6.2 90.0</p> <p>44.4 32.3</p> <p>14.5 52.1</p>	<p>Ubun Ratchathani Det Udom Kaeng Ban Haul Tak 1,331.3</p> <p>605.9 Lam Som 276.0</p> <p>133.3 1/1,450 Well</p> <p>Unconsolidated deposits deep and wide. Base rock will be fine sand stone/silt stone and permeable. Available, silty clay presents near the site</p> <p>Open forest and orchard No facilities exist No exist No exist</p> <p>4,770 Sandy loam, loam and sand Paddy and forest</p> <p>1.30 No systems exist.</p> <p>82.2 5.4 77.7</p> <p>41.0 35.0</p> <p>26.3 48.3</p>

TABLE G-1 PRESENT CONDITIONS OF SECONDARY SELECTED PROJECT SITES (2)

Description	Huai Ari (D-25)	Lam Dom Yai(L) (D-28)(A)	Lam Dom Yai(L) (D-28)(B)
<p>1) Location</p> <ul style="list-style-type: none"> - Changwat - Amphoe - Tambon - Muban <p>2) Annual Rainfall(mm)</p> <p>3) River</p> <ul style="list-style-type: none"> - Chatchment Area (sq. km) - River - Annual Run-off(R, P=1/5)(MCM) <p>4) Topography of Damsite</p> <ul style="list-style-type: none"> - Elevation of Riverbed (EL.m) - Slope - Vegetation - Geology and Material - Geology <p>5) Impermeable Soils for Embankment</p>	<p>Ubun Ratchathani Det Udom Wa Khaseem Ban Nong Bua Luang 1,521.7</p> <p>228.4 Huai Ari 89.0</p> <p>129.5 1/900 Well, but paddy fields exist.</p> <p>Unconsolidated deposits deep, base rock will be weathered and permeable. Available, silty clay presents on the left bank in the distance of about 1.0 km far from the site</p> <p>Mostly paddy field</p> <p>One RID SSIP and DLD Tank exist. 10 villages, 222 houses, 1,405 hab. 3 temples, 2 schools</p> <p>7.160 Sandy loam and loam Paddy and forest 1.51 No systems exist.</p> <p>87.4 6.6 90.6</p> <p>35.6 31.7</p> <p>7.7 38.1</p>	<p>Ubun Ratchathani Det Udom Klung Top Hu Ban Kham Tao 1,416.0</p> <p>767.6 Lam Dom Yai 487.9</p> <p>125.7 1/5,500 Well, but cassava fields exist.</p> <p>Unconsolidated and residual deposits deep, base rock will be weathered and permeable. Available, silty clay presents near the dam site.</p> <p>About 1,930 ha of paddy field exist. No facilities exist. 324 houses, 1,750 habitants</p> <p>30,970 Loamy sand and sandy loam Paddy, cassava and kenaf 1.38 No systems exist.</p> <p>68.2 6.0 87.9</p> <p>30.3 38.3</p> <p>18.6 52.9</p>	<p>Ubun Ratchathani Det Udom Klung Top Hu Ban Kham Tao 1,416.0</p> <p>533.4 Lam Dom Yai 464.5</p> <p>125.7 1/5,500 Well, but cassava fields exist.</p> <p>Unconsolidated and residual deposits deep, base rock will be weathered and permeable. Available, silty clay presents near the dam site.</p> <p>About 1,930 ha of paddy field exist. No facilities exist. 324 houses, 1,750 habitants</p> <p>25,570 Loamy sand and sandy loam Paddy, cassava and kenaf 1.38 No system exist</p> <p>68.2 6.0 87.9</p> <p>30.3 38.3</p> <p>18.6 52.9</p>

1/ The related Amphoe and Tambon to each project are as follows;

Lam Dom Yai(U) (D-7)

Amphoe Det Udom
Kaeng
Na Khasen
Nong Om
Tung Tueng
Na Kasaeng
Na Charoen
Pa Mong
Na Di
Amphoe Warin Chamrap
Sra Saming
Muang Si Khai
Pho Yai

Lam Dom Yai (D-23)

Amphoe Det Udom
Kaeng
Na Kasem
Nong Om
Tung Tueng
Na Kasaeng
Na Charoen
Pa Mong
Na Di
Amphoe Warin Chamrap
Sra Saming
Muang Si Khai
Pho Yai
Kham Kwang
Tha Chang
That
Sawang
Bung Maleang

Lam Som (D-24)

Amphoe Det Udom
Kut Rua
Amphoe Nam Yun
Khi Lek
Phaibun
Amphoe Kantharalak
Khanun
Kut Salao
Suan Kual

Huai Ari (D-25)

Amphoe Det Udom
Som Sa-at
Na kasaeng
Tha Phosi
Na Charoen
Muang Det
Pa Mong
Na Suang

Lam Dom Yai(L) (D-28)

Amphoe Det Udom
Klang
Phon Ngam
Kham Khrang
Kut Prathai
Na Yia
Top Hu
Kaeng
Tha Pho Si
Muang Det
Amphoe Phibun Mangsahan
Na Pho
Rai Tai
Pho Sai

2/ Farmer's need means the percentage of required development in the level of one(1) corresponding to lower than NESDB standard.

TABLE G-2 PROJECT EVALUATION BY B/C RATIO (FINANCIAL)

Item	Lam Dom Yai (U)	Lam Dom Yai	Lam Som	Huai Ari	Lam Dom Yai (L)	Lam Dom Yai (L)
	(D-7)	(D-23)	(D-24)	(D-25)	(D-28) (A) 1/	(D-28) (B) 2/
A. Project Benefit (million Baht)						
1. Incremental Benefit						
Crops	170.6	212.0	33.6	44.3	207.7	171.5
Fishery	27.2	33.3	5.4	8.1	34.8	28.8
Total	197.8	245.3	39.0	52.4	242.5	200.3
2. Annual Benefit (i=7%) 3/	172.9	214.4	34.1	45.8	211.9	175.1
B. Project Cost (million Baht)						
1. Construction Cost						
Dam and Canal Works	1,628.0	2,243.9	580.7	609.5	2,508.2	2,173.4
Pump Works	460.0	669.1	75.3	82.5	646.8	557.6
Total	2,088.0	2,913.0	656.0	692.0	3,155.0	2,731.0
2. Annual Cost (i=7%)						
Amortization Cost 4/	151.4	211.2	47.6	50.2	228.7	198
Replacement Cost 5/	4.1	5.9	0.7	0.7	5.7	4.9
O/M Cost 6/	20.9	29.1	6.6	6.9	31.6	27.3
Total	176.4	246.2	54.9	57.8	266.0	230.2
C. B/C Ratio (i=7%)	0.98	0.87	0.62	0.79	0.80	0.76

Note : 1/ : Lam Dom Yai (D-28) (A) --- (D-7) + (D-28) + (D-24)
 2/ : Lam Dom Yai (D-28) (B) --- (D-23) + (D-28) + (D-24)

3/ : Full Benefit (F.B) x 0.874 (analysis period : 50 years)

4/ : Construction Cost (C.C) x 0.725

5/ : Pump Cost x 0.0133 (replacement period of pump : 25 years)

6/ : C.C x 1 %

$$\begin{aligned} \text{Annual Benefit} &: \left\{ \frac{1}{5} \times \sum_{n=1}^{n=5} \frac{n}{(1+r)^n} + \frac{1}{(1+r)^5} \times \sum_{n=1}^{n=45} \frac{1}{(1+r)^{45}} \right\} \times \text{F.B} \times \frac{1}{\sum_{n=1}^{n=50} \frac{1}{(1+r)^n}} \\ &= \{1/5 \times 11.747 + 0.713 \times 13.606\} \times \text{F.B} \times 0.0725 = 0.874 \text{ F.B} \end{aligned}$$

Annual Cost

$$\text{Amortization Cost: } \text{C.C} \times \frac{1}{\sum_{n=1}^{n=50} \frac{1}{(1+r)^{50}}} = 0.0725 \text{ C.C}$$

$$\begin{aligned} \text{Replacement Cost : } &\text{Pump Cost} \times \frac{1}{(1+r)^{25}} \times \frac{1}{\sum_{n=1}^{n=50} \frac{1}{(1+r)^{50}}} \\ &= \text{P.C} \times 0.184 \times 0.0725 = 0.0133 \text{ P.C} \end{aligned}$$

TABLE G-3 EVALUATION CRITERIA FOR SELECTING PRIORITY PROJECT

Parameter	Class	Score	Specification
1. Project Economy	A	30	B/C ratio ($i=7\%$) > 1.00
	B	20	1.00 - 0.90
	C	10	0.90 - 0.80
	D	5	< 0.80
2. Scale of Irrigable Area	A	5	> 30,000 ha
	B	3	30,000 - 15,000 ha
	C	1	< 15,000 ha
3. Reservoir Area Conditions	A	5	paddy field less than 300 ha / no household /no existing facility
	B	3	paddy field of 300 - 500 ha / household less than 100 / some facilities
	C	1	paddy field more than 500 ha / more than 100 household
4. Family Income Level	A	5	less than 6,000 Baht/year
	B	3	6,000 - 10,000 Baht/year
	C	1	more than 10,000 Baht/year
5. Soil Suitability	A	5	suitable
	B	3	fairly suitable
	C	1	not suitable
6. Civil Work	A	5	good foundation / available conditions for core material
	B	3	normal
	C	1	bad foundation / difficult for obtaining core material
7. Environment	A	5	least effects on environment
	B	3	normal effect
	C	1	more effects on environment

TABLE G-4 DIVERSION WATER REQUIREMENT IN EACH CROPPING INTENSITY

CROPPING INTENSITY : 110 %

	DRY SEASON UPLAND CROP												3400 ha	UNIT : mm
	WET SEASON PADDY												32750 ha	
	PERENNIAL CROP												1250 ha	
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL	
1961	42.16	40.04	32.77	15.98	5.11	88.93	16.78	1.67	0.00	4.93	8.39	32.69	289.44	
1962	37.35	39.80	28.55	9.24	6.97	77.37	18.45	0.00	0.00	4.93	8.40	37.86	268.92	
1963	37.35	39.80	32.89	15.60	5.24	6.05	0.00	0.00	0.00	4.93	5.06	35.98	182.91	
1964	37.35	39.80	32.74	13.02	0.00	83.50	28.58	0.00	1.78	4.93	6.75	35.98	284.44	
1965	37.35	34.81	37.22	7.64	6.89	5.52	3.37	1.64	10.46	161.57	6.78	37.86	351.11	
1966	37.35	39.80	26.78	12.70	0.00	74.31	1.69	0.00	1.76	96.59	8.40	37.86	337.23	
1967	37.35	39.80	37.48	9.51	5.11	9.26	1.73	1.65	0.00	4.88	8.38	36.21	191.38	
1968	37.35	39.80	36.77	9.53	4.85	3.53	0.00	0.00	0.00	6.82	8.43	36.21	183.28	
1969	37.35	39.80	37.48	11.05	6.65	10.84	3.37	1.64	0.00	3.38	8.34	35.98	195.88	
1970	37.35	39.80	37.48	9.62	6.67	1.23	1.69	0.00	1.78	141.89	8.41	36.00	321.92	
1971	37.35	39.80	37.48	9.51	3.40	1.84	1.69	1.68	1.76	16.90	8.40	37.86	197.66	
1972	37.35	39.80	38.98	8.20	8.43	2.91	1.69	1.61	1.76	3.29	6.86	36.00	186.87	
1973	37.35	39.80	37.48	9.32	1.53	80.12	20.14	0.00	0.00	6.78	8.55	37.83	278.90	
1974	37.35	39.80	27.07	12.58	3.40	2.91	5.20	0.00	3.40	5.12	5.00	37.86	179.71	
1975	35.84	36.43	37.11	10.81	5.05	1.84	5.06	1.64	1.61	3.43	5.04	33.35	177.22	
1976	37.53	40.45	32.42	9.43	3.40	35.66	1.65	0.00	0.00	3.34	6.77	30.87	201.54	
1977	37.35	39.80	31.03	14.46	6.96	48.22	81.65	79.87	0.00	52.20	8.03	37.86	437.42	
1978	37.35	39.80	25.96	11.30	3.40	124.91	146.23	1.64	9.37	123.83	5.11	36.00	564.92	
1979	37.35	39.80	37.48	9.47	5.24	10.75	50.57	37.71	79.56	7.41	11.92	36.00	363.25	
1980	37.35	39.80	38.98	9.21	6.94	22.49	1.81	38.55	0.00	3.49	6.83	35.98	241.43	
1981	37.35	39.80	37.48	8.27	6.85	11.77	3.37	0.00	1.81	6.51	6.75	37.88	197.84	
1982	37.35	39.80	33.18	9.38	8.51	5.26	1.69	0.00	0.00	4.91	6.73	35.98	182.79	
1983	37.35	39.80	37.48	11.05	6.90	4.82	4.98	1.69	198.69	1.76	8.42	35.98	388.91	
1984	37.35	39.80	32.38	12.38	3.61	148.36	74.06	62.12	0.00	3.29	6.85	35.98	456.18	
1985	37.35	39.80	33.18	10.78	3.45	25.31	53.12	0.00	1.68	80.96	7.22	37.84	330.71	
1986	37.35	39.80	33.18	14.17	5.09	10.74	1.69	1.66	1.76	3.40	7.02	37.86	193.71	
1987	37.35	39.80	33.22	16.09	6.85	21.13	1.81	1.64	0.00	4.93	3.37	36.00	202.21	
1988	37.35	39.80	38.98	6.13	3.40	2.20	83.68	39.38	128.41	42.86	8.43	36.21	466.83	
1989	37.35	39.80	28.73	7.95	6.59	28.44	5.06	4.93	22.27	50.69	8.40	37.86	278.07	
1990	37.35	39.80	20.77	9.61	3.48	19.44	0.00	3.29	0.00	5.05	6.87	36.00	181.65	
AVG.	37.47	39.55	33.76	10.80	5.00	32.32	20.69	9.47	15.60	28.83	7.33	36.33	277.14	

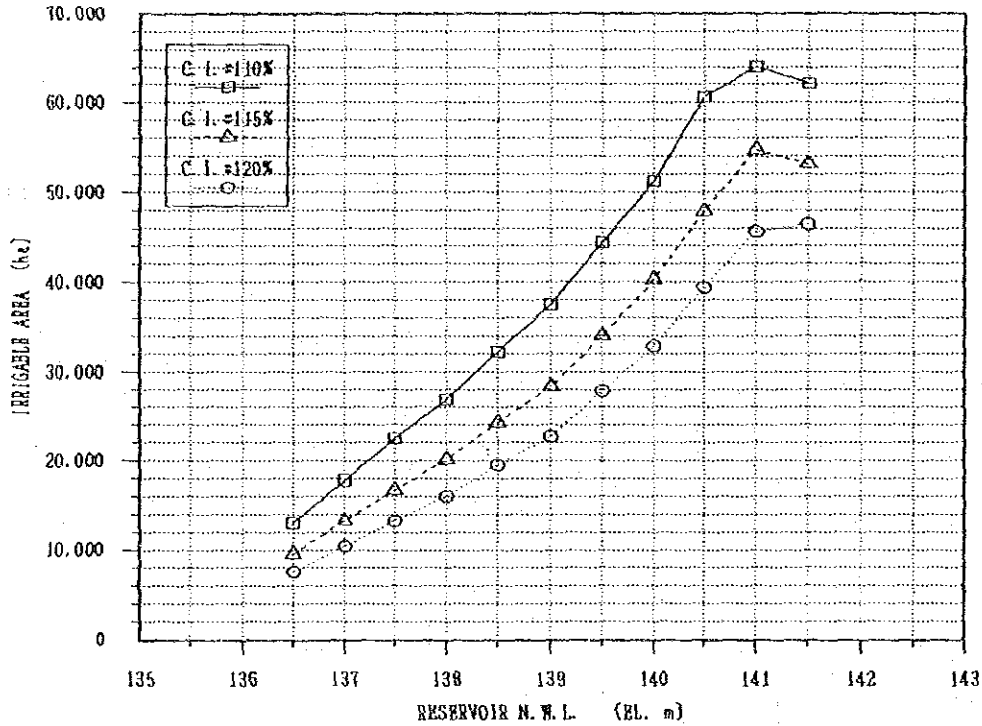
CROPPING INTENSITY : 115 %

	DRY SEASON UPLAND CROP												5100 ha	UNIT : mm
	WET SEASON PADDY												32750 ha	
	PERENNIAL CROP												1250 ha	
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL	
1961	57.98	55.74	43.74	18.45	5.11	88.93	16.78	1.67	0.00	4.93	8.39	44.65	346.36	
1962	50.78	55.38	37.37	9.24	6.97	77.37	18.45	0.00	0.00	4.93	8.40	52.33	321.22	
1963	50.78	55.38	43.93	18.03	5.24	6.05	0.00	0.00	0.00	4.93	5.06	50.45	239.84	
1964	50.78	55.38	43.77	15.37	0.00	83.50	28.58	0.00	1.78	4.93	6.75	50.45	341.30	
1965	50.78	47.90	50.40	7.64	6.89	5.52	3.37	1.64	10.46	161.57	6.78	52.33	495.27	
1966	50.78	55.38	35.67	15.17	0.00	74.31	1.69	0.00	1.76	96.59	8.40	52.33	392.06	
1967	50.78	55.38	50.81	9.51	5.11	9.26	1.73	1.65	0.00	4.88	8.38	50.68	248.19	
1968	50.78	55.38	49.80	9.53	4.85	3.53	0.00	0.00	0.00	6.82	8.43	50.68	239.79	
1969	50.78	55.38	50.81	11.05	6.65	10.84	3.37	1.64	0.00	3.38	8.34	50.45	252.69	
1970	50.78	55.38	50.81	9.62	6.67	1.23	1.69	0.00	1.78	141.89	8.41	50.47	378.73	
1971	50.78	55.38	50.81	9.51	3.40	1.84	1.69	1.68	1.76	16.90	8.40	52.33	254.47	
1972	50.78	55.38	52.15	8.20	8.43	2.91	1.69	1.61	1.76	3.29	6.86	50.47	243.52	
1973	50.78	55.38	50.81	9.32	1.53	80.12	20.14	0.00	0.00	6.78	8.55	52.30	335.70	
1974	50.78	55.38	36.17	15.05	3.40	2.91	5.20	0.00	3.40	5.12	5.00	52.33	234.75	
1975	49.38	50.20	50.38	10.81	5.05	1.84	5.06	1.64	1.61	3.43	5.04	45.55	229.99	
1976	51.04	56.36	43.30	9.43	3.40	35.66	1.65	0.00	0.00	3.34	6.77	42.76	253.73	
1977	50.78	55.38	42.01	16.93	6.96	48.22	81.65	79.87	0.00	52.20	8.03	52.33	494.34	
1978	50.78	55.38	34.55	13.73	3.40	124.91	146.23	1.64	9.37	123.83	5.11	50.47	619.41	
1979	50.78	55.38	50.81	9.47	5.24	10.75	50.57	37.71	79.56	7.41	11.92	50.47	420.06	
1980	50.78	55.38	52.15	9.21	6.94	22.49	1.81	38.55	0.00	3.49	6.83	50.45	298.08	
1981	50.78	55.38	50.81	8.27	6.85	11.77	3.37	0.00	1.81	6.51	6.75	52.35	254.65	
1982	50.78	55.38	44.36	9.38	8.51	5.26	1.69	0.00	0.00	4.91	6.73	50.45	237.44	
1983	50.78	55.38	50.81	11.05	6.90	4.82	4.98	1.69	198.69	1.76	8.42	50.45	445.71	
1984	50.78	55.38	43.19	14.74	3.61	148.36	74.06	62.12	0.00	3.29	6.85	50.45	512.83	
1985	50.78	55.38	44.36	13.13	3.45	25.31	53.12	0.00	1.68	80.96	7.22	52.31	387.71	
1986	50.78	55.38	44.36	16.59	5.09	10.74	1.69	1.66	1.76	3.40	7.02	52.33	250.79	
1987	50.78	55.38	44.48	18.52	6.85	21.13	1.81	1.64	0.00	4.93	3.37	50.47	259.37	
1988	50.78	55.38	52.15	6.13	3.40	2.20	83.68	39.38	128.41	42.86	8.43	50.68	523.49	
1989	50.78	55.38	37.68	7.95	6.59	28.44	5.06	4.93	22.27	50.69	8.40	52.33	330.50	
1990	50.78	55.38	27.64	9.61	3.48	19.44	0.00	3.29	0.00	5.05	6.87	50.47	232.00	
AVG.	50.98	55.00	45.34	11.69	5.00	32.32	20.69	9.47	15.60	28.83	7.33	50.55	332.80	

CROPPING INTENSITY : 120 %

	DRY SEASON UPLAND CROP					6800 ha	CROPPING INTENSITY					UNIT : mm	TOTAL
	WET SEASON PADDY					32750 ha	C.I. = 0.2						
	PERENNIAL CROP					1250 ha							
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
1961	73.81	71.44	54.72	20.91	5.11	88.93	16.78	1.67	0.00	4.93	8.39	56.60	403.28
1962	64.20	70.96	46.19	9.24	6.97	77.37	18.45	0.00	0.00	4.93	8.40	66.80	373.51
1963	64.20	70.96	54.96	20.46	5.24	6.05	0.00	0.00	0.00	4.93	5.06	64.92	296.78
1964	64.20	70.96	54.80	17.73	0.00	83.50	28.58	0.00	1.78	4.93	6.75	64.92	398.16
1965	64.20	60.98	63.58	7.64	6.89	5.52	3.37	1.64	10.46	161.57	6.78	66.80	459.43
1966	64.20	70.96	44.56	17.63	0.00	74.31	1.69	0.00	1.76	96.59	8.40	66.80	446.89
1967	64.20	70.96	64.14	9.51	5.11	9.26	1.73	1.65	0.00	4.80	8.38	65.15	304.99
1968	64.20	70.96	62.83	9.53	4.85	3.53	0.00	0.00	0.00	6.82	8.43	65.15	296.30
1969	64.20	70.96	64.14	11.05	6.65	10.84	3.37	1.64	0.00	3.38	8.34	64.92	309.49
1970	64.20	70.96	64.14	9.62	6.67	1.23	1.69	0.00	1.78	141.89	8.41	64.94	435.53
1971	64.20	70.96	64.14	9.51	3.40	1.84	1.69	1.68	1.76	16.90	8.40	66.80	311.27
1972	64.20	70.96	65.33	8.20	8.43	2.91	1.69	1.61	1.76	3.29	6.86	64.94	300.18
1973	64.20	70.96	64.14	9.32	1.53	80.12	20.14	0.00	0.00	6.78	8.55	66.77	392.51
1974	64.20	70.96	45.27	17.52	3.40	2.91	5.20	0.00	3.40	5.12	5.00	66.80	289.79
1975	62.91	63.97	63.64	10.81	5.05	1.84	5.06	1.64	1.61	3.43	5.04	57.76	282.76
1976	64.54	72.27	54.18	9.43	3.40	35.66	1.65	0.00	0.00	3.34	6.77	54.65	305.92
1977	64.20	70.96	52.99	19.39	6.96	48.22	81.65	79.87	0.00	52.20	8.03	66.80	551.26
1978	64.20	70.96	43.13	16.16	3.40	124.91	146.23	1.64	9.37	123.83	5.11	64.94	673.89
1979	64.20	70.96	64.14	9.47	5.24	10.75	50.57	37.71	79.56	7.41	11.92	64.94	476.86
1980	64.20	70.96	65.33	9.21	6.94	22.49	1.81	38.55	0.00	3.49	6.83	64.92	354.74
1981	64.20	70.96	64.14	8.27	6.85	11.77	3.37	0.00	1.81	6.51	6.75	66.82	311.45
1982	64.20	70.96	55.55	9.38	8.51	5.26	1.60	0.00	0.00	4.91	6.73	64.92	292.10
1983	64.20	70.96	64.14	11.05	6.90	4.82	4.98	1.69	198.69	1.76	8.42	64.92	502.52
1984	64.20	70.96	54.00	17.10	3.61	148.36	74.06	62.12	0.00	3.29	6.85	64.92	569.48
1985	64.20	70.96	55.55	15.47	3.45	25.31	53.12	0.00	1.68	80.96	7.22	66.78	444.71
1986	64.20	70.96	55.55	19.02	5.09	10.74	1.69	1.66	1.76	3.40	7.02	66.80	307.87
1987	64.20	70.96	55.74	20.94	6.85	21.13	1.81	1.64	0.00	4.93	3.37	64.94	316.53
1988	64.20	70.96	65.33	6.13	3.40	2.20	83.68	39.38	128.41	42.86	8.43	65.15	580.14
1989	64.20	70.96	46.63	7.95	6.59	28.44	5.06	4.93	22.27	50.69	8.40	66.80	382.93
1990	64.20	70.96	34.51	9.61	3.48	19.44	0.00	3.29	0.00	5.05	6.87	64.94	282.35
AVG.	64.49	70.46	56.92	12.58	5.00	32.32	20.69	9.47	15.60	28.83	7.33	64.78	388.45

FIGURE G-1 IRRIGABLE AREA BY RESERVOIR NORMAL WATER LEVEL



RESERVOIR N.W.L. (EL. m)		141.5	141.0	140.5	140.0	139.5	139.0	138.5	138.0	137.5	137.0	136.5
RESERVOIR AREA	km ²	58.28	53.22	48.25	43.27	39.06	34.84	29.54	24.24	21.83	19.42	17.00
RESERVOIR TOTAL CAPACITY	MCM	216.46	189.85	163.24	136.63	117.10	97.58	82.81	68.04	58.33	48.62	38.75
RESERVOIR EFFECT. CAPACITY	MCM	204.00	177.38	150.78	124.17	104.63	85.11	70.34	55.57	45.86	36.16	26.28
IRRIGATION AREA (1/5 PROBABILITY)												
CROPPING INTENSITY 110%	ha	62,200	64,000	60,600	51,100	44,400	37,500	32,200	26,900	22,500	17,800	13,000
CROPPING INTENSITY 115%	ha	53,100	54,700	47,800	40,300	34,000	28,300	24,300	20,100	16,700	13,200	9,600
CROPPING INTENSITY 120%	ha	46,400	45,600	39,400	32,000	27,800	22,700	19,500	16,000	13,200	10,400	7,600
IRRIGATION DEMAND (1/5 PROBABILITY)												
CROPPING INTENSITY 110%	MCM	214.37	220.49	208.94	176.68	153.92	130.48	112.48	94.48	79.54	63.58	47.27
CROPPING INTENSITY 115%	MCM	213.16	219.49	192.20	162.53	137.61	115.06	99.24	82.63	69.18	55.33	41.09
CROPPING INTENSITY 120%	MCM	212.61	209.00	181.00	151.21	128.63	105.61	91.16	75.36	62.72	50.07	37.43

TABLE G-5 DAM AND COMPENSATION COSTS BY RESERVOIR WATER LEVEL

Case-I : Overflow Depth of Spillway $h = 1.5$ m

Case	Normal Water Level (EL. m)	High Water Level (EL. m)	Dam Crest Elev. (EL. m)	Reservoir Capacity (MCM)	Wet season Irrigation Area 1/ (1) (ha)	Submerged Area 2/		Cost			
						Paddy Field (ha)	House-Hold (No.)	Const. Cost 3/ (M. B)	Compen. Cost 4/ (M. B)	Total Cost (2) (M. B)	Baht/ha (2)/(1)
I-1	137.0	138.5	140.5	48.62	13,200	1,380	100	231	87	318	24,091
I-2	137.5	139.0	141.0	58.33	16,700	1,550	143	237	99	336	20,120
I-3	138.0	139.5	141.5	68.04	20,100	1,760	230	225	113	338	16,816
I-4	138.5	140.0	142.0	82.81	24,300	1,930	325	224	125	349	14,362
I-5	139.0	140.5	142.5	97.58	28,300	2,160	355	209	139	348	12,297
I-6	139.5	141.0	143.0	117.10	34,000	2,370	430	208	153	361	10,618
I-7	140.0	141.5	143.5	136.63	40,300	2,600	470	209	168	377	9,355
I-8	141.5	143.0	145.0	216.47	53,100	3,220	751	205	210	415	7,815

Case-II : Overflow Depth of Spillway $h = 2.0$ m

Case	Normal Water Level (EL. m)	High Water Level (EL. m)	Dam Crest Elev. (EL. m)	Reservoir Capacity (MCM)	Wet season Irrigation Area 1/ (1) (ha)	Submerged Area 2/		Cost			
						Paddy Field (ha)	House-Hold (No.)	Const. Cost (M. B)	Compen. Cost 4/ (M. B)	Total Cost (2) (M. B)	Baht/ha (2)/(1)
II-1	137.0	139.0	141.0	48.62	13,200	1,550	143	219	99	318	24,091
II-2	137.5	139.5	141.5	58.33	16,700	1,760	230	205	113	318	19,042
II-3	138.0	140.0	142.0	68.04	20,100	1,930	325	203	125	328	16,318
II-4	138.5	140.5	142.5	82.81	24,300	2,160	355	184	139	323	13,292
II-5	139.0	141.0	143.0	97.58	28,300	2,370	430	174	153	327	11,555
II-6	139.5	141.5	143.5	117.10	34,000	2,600	470	171	168	339	9,971
II-7	140.0	142.0	144.0	136.63	40,300	2,820	588	173	183	356	8,834
II-8	141.0	143.0	145.0	189.85	54,700	3,220	751	164	210	374	6,837

Case-III : Overflow Depth of Spillway $h = 2.5$ m

Case	Normal Water Level (EL. m)	High Water Level (EL. m)	Dam Crest Elev. (EL. m)	Reservoir Capacity (MCM)	Wet season Irrigation Area 1/ (1) (ha)	Submerged Area 2/		Cost			
						Paddy Field (ha)	House-Hold (No.)	Const. Cost (M. B)	Compen. Cost 4/ (M. B)	Total Cost (2) (M. B)	Baht/ha (2)/(1)
III-1	137.0	139.5	141.5	48.62	13,200	1,760	230	189	113	302	22,879
III-2	137.5	140.0	142.0	58.33	16,700	1,930	325	180	125	305	18,263
III-3	138.0	140.5	142.5	68.04	20,100	2,160	355	162	139	301	14,975
III-4	138.5	141.0	143.0	82.81	24,300	2,370	430	152	153	305	12,551
III-5	139.0	141.5	143.5	97.58	28,300	2,600	470	144	168	312	11,025
III-6	139.5	142.0	144.0	117.10	34,000	2,820	588	138	183	321	9,441
III-7	140.0	142.5	144.5	136.63	40,300	3,050	680	144	199	343	8,511
III-8	140.5	143.0	145.0	163.24	47,800	3,220	751	154	210	364	7,615

1/: Irrigation area with cropping intensity of 115 %

2/: Paddy field and houses to be submerged by high water level (see Figure 5-1)

3/: Consisting of dam body and spillway costs

4/: Compensation costs for land and houses are estimated based on the following unit cost:

Land : 10,000 Baht/rai

Houses : 12,000 Baht/household

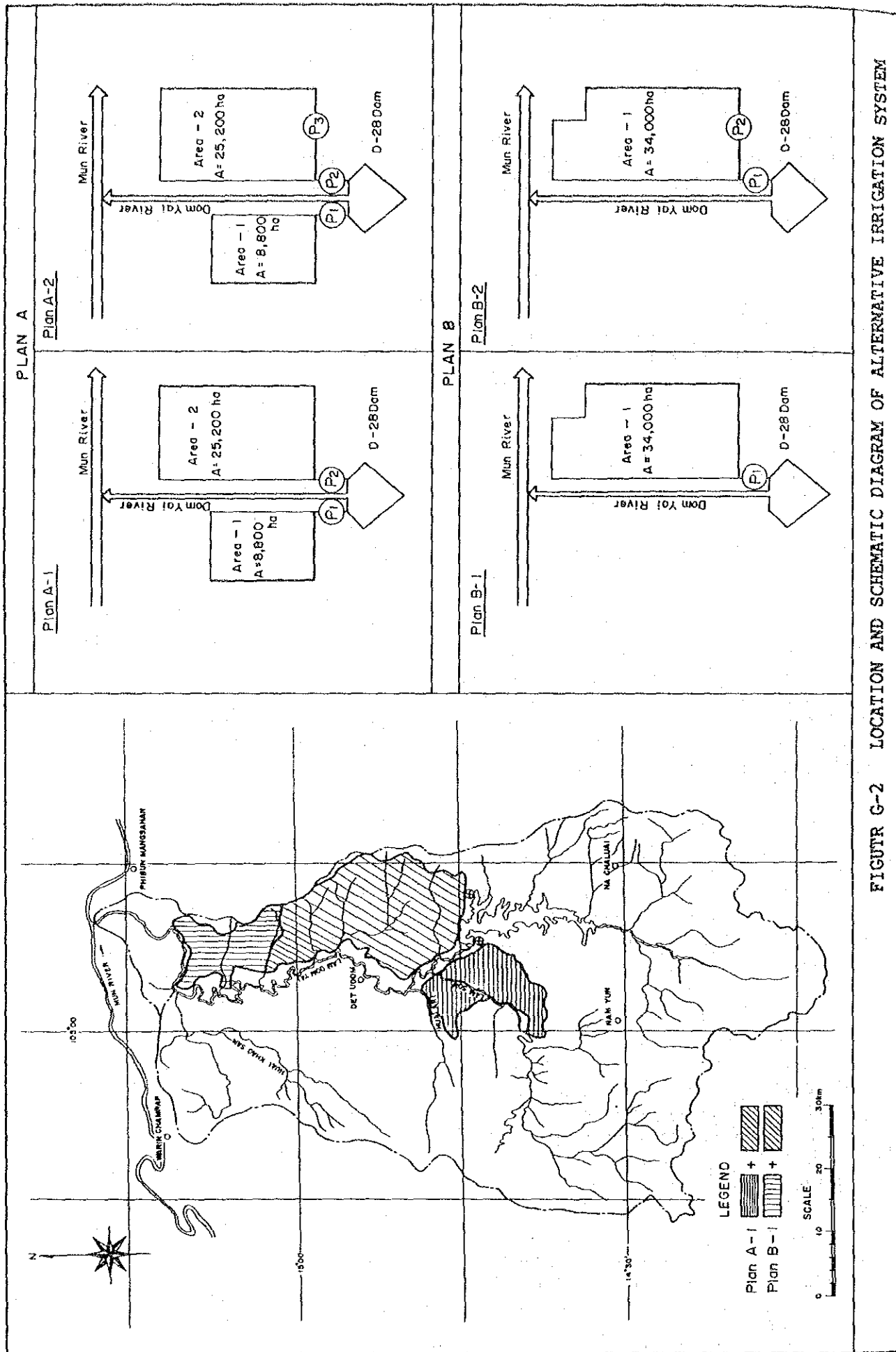


FIGURE G-2 LOCATION AND SCHEMATIC DIAGRAM OF ALTERNATIVE IRRIGATION SYSTEM

TABLE G-6 PROJECT COST

(unit : '000 Baht)

Item	F/C	L/C	Total
1. Civil works			
1.1 Preparatory Works	1,840	18,870	20,710
1.2 Dam Works	150,510	134,580	285,090
1.3 Pump Facilities	632,410	23,650	656,050
1.4 Canal Works	700,710	563,310	1,264,020
1.5 Resettlement Works	28,700	349,900	378,600
Sub-Total	1,514,170	1,090,310	2,604,480
2. On-Farm and Rural Developments			
2.1 On-Farm Facilities	307,150	218,390	525,540
2.2 Community Center	4,990	4,660	9,650
Sub-Total	312,140	223,050	535,190
3. Land Acquisition	-	53,770	53,770
4. Engineering and Administration			
4.1 Consulting Services	97,520	33,620	131,140
4.2 Administration	6,890	14,050	20,940
Sub-Total	104,410	47,670	152,080
5. O & M Equipment	38,440	5,770	44,210
6. Total (1 - 5)	<u>1,969,160</u>	<u>1,420,570</u>	<u>3,389,730</u>
7. Physical Contingencies (10%)	196,920	142,050	338,970
8. Total (6 - 7)	<u>2,166,080</u>	<u>1,562,620</u>	<u>3,728,700</u>
9. Price Escalation	783,710	542,290	1,326,000
10. Grand Total			
With On-Farm and Rural Dev.	<u>2,949,790</u>	<u>2,104,910</u>	<u>5,054,700</u>

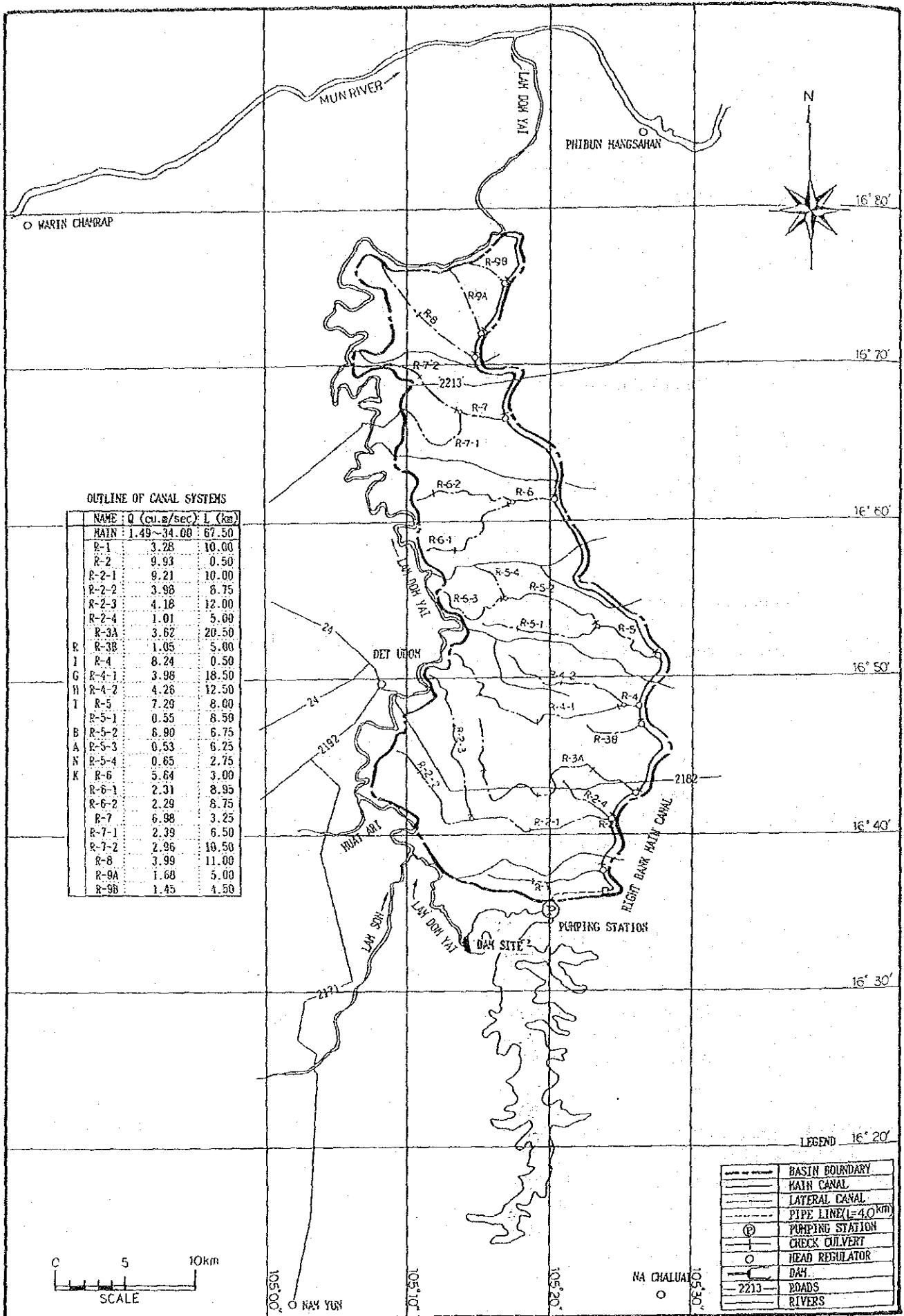


FIGURE G-3 LOCATION MAP OF CANAL SYSTEM

TABLE G-7 PUMP FACILITY COST

Discription	Unit	Q'ty	Unit Cost (B)			Amount ('000 B)		
			F/C	L/C	Total Cost	F/C	L/C	Total Cost
B. Pump Facilities								
1. Right Bank								
- Excavation	cu.m	159,384	13	4	17	2,071	637	2,708
- Embankment	cu.m	6,748	21	10	31	142	67	209
- Riprap	cu.m	23,789	125	288	413	2,974	8,851	9,825
- Concrete Works	cu.m	0,832	2,590	1,110	3,700	22,876	9,804	32,680
- Pump Unit 1000mm	unit	16	33,264,000	0	33,264,000	532,224	0	532,224
- House	sq.m	698	4,000	6,000	10,000	2,794	4,191	6,985
- Substation & Transeformer	L.S		12,930,000		12,930,000	12,930	0	12,930
- Power Cable	km	1	200,200		200,200	200	0	200
- Miscellaneous Works	L.S					28,815	1,078	29,892
Total						605,113	22,620	627,742
3. Overhead, Profit, Tax						27,291	1,021	28,311
Grand Total						632,404	23,649	656,053

TABLE G-8 CANAL SYSTEM COST

Discription	Unit	Q'ty	Unit Cost (B)			Amount ('000 B)		
			F/C	L/C	Total Cost	F/C	L/C	Total Cost
C. Canal								
1. Main Canal								
- Stripping	cu.m	780,275	10	6	16	7,003	4,202	11,204
- Excavation	cu.m	405,577	13	4	17	5,273	1,622	6,895
- Embankment	cu.m	1,593,437	21	10	31	33,462	15,934	49,397
- Drain Filter	cu.m	37,584	53	118	171	1,992	4,435	6,427
- Linig Concrete	cu.m	37,011	864	1,056	1,920	31,978	39,004	71,001
- Laterite	cu.m	245,700	54	126	180	13,260	30,950	44,226
- Sodding	sq.m	464,700	0	22	22	0	10,223	10,223
- Related Structure	L.S					13,946	15,969	29,915
- Miscellaneous Works	L.S					5,346	6,121	11,467
Sub-Total						112,267	120,549	240,816
2. Lateral Canal								
- Stripping	cu.m	1,686,913	10	6	16	16,069	9,641	25,711
- Excavation	cu.m	862,369	13	4	17	11,211	3,449	14,660
- Embankment	cu.m	3,077,179	21	10	31	64,621	30,772	95,393
- Drain Filter	cu.m	72,353	53	118	171	3,835	8,538	12,372
- Linig Concrete	cu.m	65,041	864	1,056	1,920	56,195	68,683	124,879
- Laterite	cu.m	637,200	54	126	180	34,409	80,207	114,696
- Sodding	sq.m	922,150	0	22	22	0	20,207	20,207
- Related Structure	L.S					27,951	33,249	61,200
- Miscellaneous Works	L.S					10,715	12,745	23,460
Sub-Total						225,005	267,652	492,657
3. Pipe Line								
- Pipe Line ϕ 2000*4	m	4,000	83,300	35,700	119,000	333,200	142,800	476,000
Total						670,472	539,001	1,209,473
4. Overhead, Profit, Tax						30,238	24,309	54,547
Grand Total						700,710	563,310	1,264,020

TABLE G-9 ON-FARM DEVELOPMENT COST

Discription	Unit	Q'ty	Unit Cost (B)			Amount ('000 B)		
			F/C	L/C	Total Cost	F/C	L/C	Total Cost
1. On-Farm Development								
- Right Bank	ha	34,000	8,644	6,146	14,790	293,896	208,964	502,860
2. Community Center								
- place	place	57	83,761	78,291	162,052	4,774	4,463	9,237
Total						298,670	213,427	512,097
3. Overhead, Profit, Tax						13,470	9,626	23,096
Grand Total						312,140	223,052	535,193

TABLE G-10 LAND ACQUISITION COST

Discription	Unit	Q'ty	Unit Cost (B)	Total Cost ('000B)
A. Dam				
- Bollow Area	ha	16	47,100	754
B. Pump Facilities				
- Pump Station	ha	0.15	70,300	11
C. Canal				
- Main Canal	ha	258	70,300	18,137
- Lateral Canal	ha	490	70,300	34,447
- Pipe Line	ha	6	70,300	422
Sub-Total				53,006
Total				53,770

TABLE G-11 PREPARATION WORKS

Description	Unit	Q'ty	Unit Rate (Baht)		Amount (' 000 Baht)		
			F/C	L/C	F/C	L/C	Total
1. Project Facility for Construction Supervision							
Main Office	sq. km	400	1,300	3,700	520	1,480	2,000
Staff Residence	sq. km	500	1,500	4,500	750	2,250	3,000
Guest House	sq. km	200	1,300	3,700	260	740	1,000
Equipment Warehouse	sq. km	300	250	750	75	225	300
Furniture	LS			400		400	400
Sub-total					1,605	5,095	6,700
2. Additional Survey and Investigation							
2.1 Reservoir and Dam							
a) Topographic Survey							
- Dam axis and cross section	km	4.9		6,200		30	30
- Temporary diversion channel alignment and cross section	km	3.1		6,200		19	19
- Access road profile and cross section	km	3.0		6,200		19	19
- Bench mark survey	km	5.0		4,800		24	24
b) Geological Investigation							
- Seismic survey for dam-site	m	3,300		90		297	297
- Drilling works							
. Core drilling	m	450		6,200		2,790	2,790
. Permeability test	time	330		1,400		462	462
. Standard penetration test	time	270		1,800		486	486
- Test pit excavation	place	30		1,800		54	54
- Soil laboratory test							
. Physical test	sample	30		13,900		417	417
. Mechanical test	sample	30		13,900		417	417
- Rock test	sample	5		13,900		70	70
Sub-total						5,085	5,085
2.2 Pumping Station							
a) Topographic Survey							
- Plane survey	ha	0.2		1,800		0	0
- Intake canal alignment and cross section	km	1.5		6,200		9	9
- Pipeline alignment and cross section	km	9.0		5,000		45	45
b) Geological Investigation							
- Core drilling	m	30		6,200		186	186
- Standard penetration test	time	15		1,800		27	27
Sub-total						268	268
2.3 Canal Systems							
a) Topographic Survey							
- Strip topographic survey							
. Main canal	km	67.5		18,200		1,229	1,229
. Lateral /sub-lateral canal	km	229.2		18,200		4,171	4,171
b) Geological Investigation							
- Corn penetration test	place	300		300		90	90
- Soil laboratory test	place	60		5,000		300	300
Sub-total						5,790	5,790

Description	Unit	Q'ty	Unit Rate (Baht)		Amount (' 000 Baht)		
			F/C	L/C	F/C	L/C	Total
2.4 Reservoir Area Survey							
- Present land use	m-m	1.0		50,000		50	50
- Population and household	m-m	0.7		50,000		35	35
- Land holding and ownership	m-m	0.7		50,000		35	35
- Public facility	m-m	0.7		50,000		35	35
Sub-total						155	155
2.5 Miscellaneous (10%)					161	1,639	1,800
Total					1,766	18,031	19,797
3. Overhead, Profit and Tax					79	840	919
Grand Total					1,845	18,871	20,716

Additional Survey and Investigation (Plan B-1)

The following additional survey and investigation are proposed to be undertaken during the stage of detailed design;

1) Reservoir and Dam

Topographic Survey

(1) Dam axis and cross section	:	4.9 km
(2) Temporary diversion channel alignment and cross section	:	3.1 km
(3) Access road profile and cross section	:	3.0 km
(4) Bench mark survey	:	5.0 km

Geological Investigation

(1) Seismic survey for dam-site		
- along service spillway	:	900 m
- along dam-axis	:	2,000 m
- on flood plane	:	400 m
Total		3,300 m
(2) Core drilling works		
- on service spillway, 15 m x 2	:	30 m
30 m x 6	:	180 m
- on dam-axis, 15 m x 4	:	60 m
30 m x 6	:	180 m
Total		450 m
- Permeability test	:	270 nos.
Gravity test	:	270 nos
Packer test	:	60 nos
- Standard penetration test		
(3) Embankment materials		
- Test pit excavation	:	30 nos.
- Soil laboratory tests		
Physical test	:	30 nos.
Mechanical test	:	30 nos.
- Rock test for riprap	:	5 nos.
(Specific gravity, water absorption, abrasion tests)		

2) Pumping Station

Topographic Survey

- | | | |
|--|---|--------|
| (1) Topographic survey of pumping site | : | 0.2 ha |
| (2) Intake canal alignment and cross section | : | 1.5 km |
| (3) Pipeline alignment and cross section | : | 9.0 km |

Geological Investigation

- | | | |
|-------------------------------|---|---------|
| (1) Core drilling | : | 30 m |
| (2) Standard penetration test | : | 15 time |

3) Canal Systems

Topographic Survey

Topographic survey of the proposed alignment of main, lateral and sub-lateral irrigation canals should be carried out, and their total length is as follows;

- | | | |
|------------------------------|---|----------|
| (1) Strip topographic survey | | |
| - Main canal | : | 67.5 km |
| - Lateral/Sub-lateral canal | : | 229.2 km |

Geological Investigation

- | | | |
|---------------------------|---|----------|
| (1) Cone penetration test | : | 300 pla. |
| (2) Laboratory test | : | 60 pla. |

4) Reservoir Area Survey

The D-28 reservoir area survey on the following items should be conducted to meet the requirement of compensation subjects by the construction of the dam, of which compensation water level is EL. 140.0 m above mean sea level.

- | | | |
|--|---|----------|
| (1) Present Land use | : | 4,327 ha |
| (2) Population and household | : | 4,327 ha |
| (3) Land holding and ownership | : | 4,327 ha |
| (4) Public facilities as roads, electric line, temples, etc. | : | 4,327 ha |

TABLE G-12 DISBURSEMENT SCHEDULE OF PROJECT COST

Description	1995		1996		1997		1998		1999		Total		
	F/C	L/C	F/C	L/C	F/C	L/C	F/C	L/C	F/C	L/C	F/C	L/C	
1. Civil Works	-	-	1,846	16,871	20,716	-	85,527	53,834	114,037	40,375	85,527	1,945	18,871
1.1 Preparation Works	-	-	-	-	-	45,152	85,527	60,203	114,037	45,152	85,527	1,945	18,871
1.2 Dam Works	-	-	-	-	-	-	158,101	5,912	164,013	474,393	17,737	158,907	134,585
1.3 Pump Facilities	-	-	-	-	-	-	208,264	225,324	585,888	210,213	168,993	632,484	23,643
1.4 Canal Works	-	-	-	-	-	210,213	158,993	379,208	585,888	210,213	168,993	788,718	563,310
1.5 Resettlement Works	-	-	1,845	18,871	20,716	203,975	314,337	510,858	935,088	738,278	332,074	1,514,165	1,090,311
Sub-Total	-	-	1,845	18,871	20,716	203,975	314,337	510,858	935,088	738,278	332,074	1,514,165	1,090,311
2. On-Farm and Rural Development	-	-	-	-	-	93,642	66,916	124,856	60,221	214,877	93,642	66,916	223,052
3. Land Acquisition	-	-	0	26,885	26,885	0	26,885	-	-	-	-	0	53,770
4. Engineering & Administration	19,585	6,724	19,585	6,724	26,238	19,585	6,724	26,238	19,585	6,724	26,238	97,526	33,522
4.1 Consulting Service	19,585	6,724	19,585	6,724	26,238	19,585	6,724	26,238	19,585	6,724	26,238	97,526	33,522
4.2 Administration	-	-	1,378	2,889	4,187	2,886	4,214	6,288	1,378	2,889	4,187	6,088	14,846
Sub-Total	19,585	6,724	20,963	5,534	30,416	21,572	10,938	32,518	20,963	9,534	30,416	184,514	47,668
5. O&M Equipment	-	-	-	-	-	-	-	-	-	38,444	5,767	44,211	5,767
6. Total (1-5)	19,585	6,724	22,728	55,238	78,818	378,183	419,876	788,265	655,495	525,188	1,181,683	931,247	1,420,568
7. Physical Contingencies	1,951	672	2,623	5,528	7,802	37,919	41,988	65,650	52,518	118,188	89,126	41,429	142,857
8. Total (6-7)	21,456	7,397	25,351	60,819	86,610	417,107	460,984	813,932	722,145	577,707	1,270,811	1,023,423	1,563,425
9. Price Escalation	4,553	1,570	6,428	15,618	22,838	126,425	139,724	266,158	259,473	202,775	456,248	392,835	182,607
10. Grand Total	26,009	8,968	34,975	76,437	107,658	543,533	680,708	1,144,241	975,818	788,482	1,766,099	1,373,207	2,048,786

TABLE G-13 OPERATION AND MAINTENANCE COST

<u>Description</u>	<u>Annual Cost</u> (' 000 Baht)		
-Salary and Wage			10,404
- Administration and General Expenditure			1,561
- Pump Operation Cost			17,048
- Equipment Repair & Maintenance Cost			4,421
- Fuel Cost			875
- Office Maintenance Cost			380
Total			<u>34,689</u>

1. Salary and Wage	No. of Staff	Rate (Baht/year)	Total Cost (' 000 Baht)
<u>1.1 Project Office</u>			
Project Manager	1	180,000	180
<u>Administration Branch</u>			
- Administration	1	84,000	84
- Accounting	1	72,000	72
- Material	1	60,000	60
- Security and Labour	4	36,000	144
Sub-total	7		360
<u>Enginnering Branch</u>			
- Budget Planning	1	84,000	84
- Pre-Survey	1	60,000	60
- Design	3	60,000	180
Sub-total	5		324
<u>Water Management Branch</u>			
- Water Distribution Management	2	84,000	168
- Irrigation	2	84,000	168
Sub-total	4		336
<u>Mechanical Branch</u>			
- Vehicles	5	72,000	360
- O & M Machinery	2	72,000	144
- Communication	2	60,000	120
Sub-total	9		624
<u>1.2 Section Office (Five Offices)</u>			
- Chief	5	84,000	420
- Administration	5	72,000	360
- Operation			
Irrigation Technician	10	60,000	600
Gate Tender	65	48,000	3,120
Canal Tender	65	48,000	3,120
- Repairing & Maintenance	20	48,000	960
Sub-total	170		8,580
Total			<u>10,404</u>

	(' 000 Baht)
2. Administration and General Expenditure Cost	
10,404,000 Baht x 0.15	1,561
3. Pump Operation Cost	
14,556 hr x 910 kw x 1.17 Baht/kwh	15,498
Drainage pump in protected area (10%)	1,550
Sub-total	17,048
4. Equipment Repair and Maintenance Cost	
44,211 Baht x 0.10	4,421
5. Fuel Cost	
Heavy equipment	
8.5 Baht/lit. x 20 lit./day x 200 days/year x 6 units	204
Truck	
8.5 Baht/lit. x 20 lit./day x 200 days/year x 15 units	510
Vehicle	
9.0 Baht/lit. x 15 lit./day x 300 days/year x 2 units	81
Motor Bicycle and others (10 %)	80
Sub-total	875
6. Office Maintenance Cost	
Building maintenance cost	
6,700,000 x 4 % / year	268
Office Supplies	112
Sub-total	380

TABLE G-14 CROP PRODUCTION VALUE WITH/WITHOUT PROJECT

1. Crop Production Value With Project						
Crop	Yr.	Yield (kg/ha)	Farmgate Price(B)	Value (B)	Type-I Value(B)	Type-II Value(B)
Paddy	w/o	1,250	4.2	5,250	171,937,500	
	1	1,688	4.2	7,090	232,184,400	457,735,320
	2	2,125	4.2	8,925	292,293,750	457,735,320
	3	2,563	4.2	10,765	352,540,650	457,735,320
	4	3,000	4.2	12,600	412,650,000	457,735,320
	5	3,438	4.2	14,440	472,896,900	457,735,320
Groundnuts	1	1,356	11.7	15,865	54,211,388	68,704,635
	2	1,406	11.7	16,450	56,210,333	68,704,635
	3	1,450	11.7	16,965	57,969,405	68,704,635
	4	1,500	11.7	17,550	59,968,350	68,704,635
	5	1,563	11.7	18,287	62,487,021	68,704,635
Soybean	1	1,150	7.9	9,085	10,193,370	11,079,750
	2	1,175	7.9	9,283	10,414,965	11,079,750
	3	1,200	7.9	9,480	10,636,560	11,079,750
	4	1,225	7.9	9,678	10,858,155	11,079,750
	5	1,250	7.9	9,875	11,079,750	11,079,750
Watermelon	1	20,000	0.9	18,000	6,426,000	8,032,500
	2	21,250	0.9	19,125	6,827,625	8,032,500
	3	22,500	0.9	20,250	7,229,250	8,032,500
	4	23,750	0.9	21,375	7,630,875	8,032,500
	5	25,000	0.9	22,500	8,032,500	8,032,500
Chilli	1	14,125	7.0	98,875	5,042,625	5,578,125
	2	14,500	7.0	101,500	5,176,500	5,578,125
	3	14,875	7.0	104,125	5,310,375	5,578,125
	4	15,250	7.0	106,750	5,444,250	5,578,125
	5	15,625	7.0	109,375	5,578,125	5,578,125
Vegetables (String bean)	w/o	6,875	7.1	48,813	7,468,313	
	1	7,375	7.1	52,363	8,011,463	65,164,688
	2	7,875	7.1	55,913	8,554,613	68,892,188
	3	8,375	7.1	59,463	9,097,763	72,619,688
	4	8,875	7.1	63,013	9,640,913	76,347,188
	5	9,375	7.1	66,563	10,184,063	80,074,688
Fruit (Mango)	w/o					
	1					
	2					
	3					
	4	375	4.0	1,500	1,875,000	46,875,000
	5	2,188	4.0	8,752	10,940,000	46,875,000
	6	3,125	4.0	12,500	15,625,000	46,875,000
	7	6,250	4.0	25,000	31,250,000	46,875,000
	8	6,250	4.0	25,000	31,250,000	46,875,000
	9	6,250	4.0	25,000	31,250,000	46,875,000
	10	6,250	4.0	25,000	31,250,000	46,875,000
11	9,375	4.0	37,500	46,875,000	46,875,000	

2. Crop Production Value Without Project					
Crop	Yr.	Yield (kg/ha)	Farmgate Price(B)	Value (B)	B-I Value(B)
Paddy		1,250	4.2	5,250	156,586,500
Cassava		13,125	0.6	7,875	1,504,125
Kenaf		1,581	4.8	7,589	7,755,754
Vegetables		6,875	7.1	48,813	3,075,188
Fruit		4,675	3.0	14,025	3,337,950

TABLE G-15 PRODUCTION COST

1. Production Cost With Project

Type-I

Crop	Area (ha)	Cost/ha (B)	Total Cost (B)
Paddy	32,750	5,345	175,048,750
Groundnut	3,417	8,046	27,493,182
Soybean	1,122	6,390	7,169,580
Watermelon	357	13,255	4,732,035
Chilli	51	66,298	3,381,198
Vegetables	153	32,073	4,907,169
Fruit	1,250	16,227	20,283,750
Fruit-inv		8,458	10,572,500
TOTAL	39,100		

Type-II

Crop	Area (ha)	Cost/ha (B)	Total Cost (B)
Paddy	31,700	5,345	169,436,500
Groundnut	3,757	8,046	30,228,822
Soybean	1,122	6,390	7,169,580
Watermelon	357	13,255	4,732,035
Chilli	51	66,298	3,381,198
Vegetables	1,203	32,073	38,583,819
Fruit	1,250	16,227	20,283,750
TOTAL	39,440		

2. Production Cost Without Project

Plan B-1

Crop	Area (ha)	Cost/ha (B)	Total Cost (B)
Paddy	29,826	3,605	107,522,730
Cassava	191	6,151	1,174,841
Kenaf	1,022	6,145	6,280,190
Vegetables	63	30,996	1,952,748
Fruit	238	10,140	2,413,320
TOTAL	31,340		

TABLE G-16 BENEFIT FROM CROP PRODUCTION (ECONOMIC)

1. Without Project - Plan B-1 -

Crop	Planted Area (ha)	Production Value (Baht)	Production Cost (Baht)	Net Income (Baht)
Paddy	29,826	156,586,500	107,522,730	49,063,770
Cassava	191	1,504,125	1,174,841	329,284
Kenaf	1,022	7,755,754	6,280,190	1,475,564
Vegetables	63	3,075,188	1,952,748	1,122,440
Fruit	238	3,337,950	2,413,320	924,630
Fallow	4,581	0	0	0
Total	35,921	172,259,516	119,343,829	52,915,687

2. With Project - Type-I

Crop	Planted Area (ha)	Production Value (Baht)	Production Cost (Baht)	Net Income (Baht)
Paddy	32,750	472,896,900	175,048,750	297,848,150
Groundnut	3,417	62,487,021	27,493,182	34,993,839
Soybean	1,122	11,079,750	7,169,580	3,910,170
Watermelon	357	8,032,500	4,732,035	3,300,465
Chilli	51	5,578,125	3,381,198	2,196,927
Vegetables	153	10,184,063	4,907,169	5,276,894
Fruit	1,250	10,940,000	20,283,750	-9,343,750
Total	39,100	581,198,358	243,015,664	338,182,694

2. With Project - Type-II

Crop	Planted Area (ha)	Production Value (Baht)	Production Cost (Baht)	Net Income (Baht)
Paddy	31,700	457,735,320	169,436,500	288,298,820
Groundnut	3,757	68,704,635	30,228,822	38,475,813
Soybean	1,122	11,079,750	7,169,580	3,910,170
Watermelon	357	8,032,500	4,732,035	3,300,465
Chilli	51	5,578,125	3,381,198	2,196,927
Vegetables	1,203	80,074,688	38,583,819	41,490,869
Fruit	1,250	46,875,000	20,283,750	26,591,250
Total	39,440	678,080,017	273,815,704	404,264,313

TABLE G-17 INCREMENTAL BENEFIT

Unit: 1,000 Baht

Year	Crop Benefits	Fishery Benefits	Other Benefits	Minus Benefits	Incremental Benefits
1	36,394	23,784	4,481	918	63,741
2	95,062	28,880	4,759	918	127,783
3	158,382	33,977	5,037	918	196,478
4	213,942	33,977	5,393	918	252,394
5	287,085	33,977	5,714	918	325,858
6	307,006	33,977	5,928	918	345,993
7	326,358	33,977	5,947	918	365,364
8	330,086	33,977	5,966	918	369,111
9	333,813	33,977	6,004	918	372,876
10	337,541	33,977	6,220	918	376,820
11	353,166	33,977	6,220	918	392,445

TABLE G-18 PROJECT COST

Unit: 1,000 Baht

Description	F/C	L/C	Total
1. Civil Works	1,514,165	1,024,892	2,539,057
2. Land Acquisition	0	49,468	49,468
3. Consulting Services	97,526	33,622	131,148
4. Administration	6,888	14,046	20,934
5. O&M Equipment	38,444	5,652	44,096
6. On-farm Cost	312,140	196,286	508,426
7. Total (1-6)	1,969,163	1,323,966	3,293,129
8. Physical Contingencies a/	196,916	132,397	329,313
9. Physical Contingencies b/	165,702	112,768	278,470
10. Grand Total with On-farm Cost	2,166,079	1,456,363	3,622,442
11. Grand Total without On-farm Cost	1,822,725	1,240,448	3,063,174

Note: a/ with On-farm Cost b/ without On-farm Cost

TABLE G-19 DISBURSEMENT SCHEDULE OF PROJECT COST

Unit: 1,000 Baht

1. Grand Total with On-farm Cost						
Item	1st year (1995)	2nd year (1996)	3rd year (1997)	4th year (1996)	5th year (1999)	Total
F/C	21,456	25,000	417,107	722,145	980,372	2,166,080
L/C	7,397	57,208	429,039	537,878	424,843	1,456,364
Total	28,853	82,208	846,146	1,260,023	1,405,215	3,622,444
2. Grand Total without On-farm Cost						
Item	1st year (1995)	2nd year (1996)	3rd year (1997)	4th year (1996)	5th year (1999)	Total
F/C	21,456	25,000	314,101	584,803	877,365	1,822,725
L/C	7,397	57,208	364,264	451,512	360,069	1,240,449
Total	28,853	82,208	678,365	1,036,315	1,237,434	3,063,174

TABLE G-20 OPERATION AND MAINTENANCE COST

Description	Annual Cost (1000 Baht)
1. Salary and Wage	10,404
2. Administration and General Expenditure	1,561
3. Pump Operation Cost	13,467
4. Equipment Repair & Maintenance Cost	4,421
5. Fuel Cost	875
6. Office Maintenance Cost	380
7. Total	31,108

TABLE G-21(1) ESTIMATION OF EIRR (WITHOUT ON-FARM COST)

Year	Project Cost			Total	Incremental Benefits	Return
	Capital	O/M Cost	Replace. Cost			
1	28,853			28,853	0	-28,853
2	82,208			82,208	0	-82,208
3	678,365			678,365	0	-678,365
4	1,036,315			1,036,315	0	-1,036,315
5	1,237,434			1,237,434	0	-1,237,434
6		32,984		32,984	63,741	30,757
7		32,984		32,984	127,783	94,799
8		32,984		32,984	196,478	163,494
9		32,984		32,984	252,394	219,410
10		32,984		32,984	325,858	292,874
11		32,984		32,984	345,993	313,009
12		32,984		32,984	365,364	332,380
13		32,984		32,984	369,111	336,127
14		32,984		32,984	372,876	339,892
15		32,984		32,984	376,820	343,836
16		32,984		32,984	392,445	359,461
17		32,984		32,984	392,445	359,461
18		32,984		32,984	392,445	359,461
19		32,984		32,984	392,445	359,461
20		32,984		32,984	392,445	359,461
21		32,984		32,984	392,445	359,461
22		32,984		32,984	392,445	359,461
23		32,984		32,984	392,445	359,461
24		32,984		32,984	392,445	359,461
25		32,984		32,984	392,445	359,461
26		32,984		32,984	392,445	359,461
27		32,984		32,984	392,445	359,461
28		32,984		32,984	392,445	359,461
29		32,984		32,984	392,445	359,461
30		32,984	532,224	565,208	392,445	-172,763
31		32,984		32,984	392,445	359,461
32		32,984		32,984	392,445	359,461
33		32,984		32,984	392,445	359,461
34		32,984		32,984	392,445	359,461
35		32,984		32,984	392,445	359,461
36		32,984		32,984	392,445	359,461
37		32,984		32,984	392,445	359,461
38		32,984		32,984	392,445	359,461
39		32,984		32,984	392,445	359,461
40		32,984		32,984	392,445	359,461
41		32,984		32,984	392,445	359,461
42		32,984		32,984	392,445	359,461
43		32,984		32,984	392,445	359,461
44		32,984		32,984	392,445	359,461
45		32,984		32,984	392,445	359,461
46		32,984		32,984	392,445	359,461
47		32,984		32,984	392,445	359,461
48		32,984		32,984	392,445	359,461
49		32,984		32,984	392,445	359,461
50		32,984		32,984	392,445	359,461
51		32,984		32,984	392,445	359,461
52		32,984		32,984	392,445	359,461
53		32,984		32,984	392,445	359,461
54		32,984		32,984	392,445	359,461
55		32,984		32,984	392,445	359,461
Total	3,063,174	1,649,200	532,224	5,244,598	18,494,218	13,249,620

EIRR = 8.2%

TABLE G-21(2) ESTIMATION OF EIRR (WITH ON-FARM COST)

Year	Project Cost			Total	Incremental Benefits	Return
	Capital	O/M Cost	Replacc. Cost			
1	28,853			28,853	0	-28,853
2	82,208			82,208	0	-82,208
3	846,146			846,146	0	-846,146
4	1,260,023			1,260,023	0	-1,260,023
5	1,405,215			1,405,215	0	-1,405,215
6		32,984		32,984	63,741	30,757
7		32,984		32,984	127,783	94,799
8		32,984		32,984	196,478	163,494
9		32,984		32,984	252,394	219,410
10		32,984		32,984	325,858	292,874
11		32,984		32,984	345,993	313,009
12		32,984		32,984	365,364	332,380
13		32,984		32,984	369,111	336,127
14		32,984		32,984	372,876	339,892
15		32,984		32,984	376,820	343,836
16		32,984		32,984	392,445	359,461
17		32,984		32,984	392,445	359,461
18		32,984		32,984	392,445	359,461
19		32,984		32,984	392,445	359,461
20		32,984		32,984	392,445	359,461
21		32,984		32,984	392,445	359,461
22		32,984		32,984	392,445	359,461
23		32,984		32,984	392,445	359,461
24		32,984		32,984	392,445	359,461
25		32,984		32,984	392,445	359,461
26		32,984		32,984	392,445	359,461
27		32,984		32,984	392,445	359,461
28		32,984		32,984	392,445	359,461
29		32,984		32,984	392,445	359,461
30		32,984	532,224	565,208	392,445	-172,763
31		32,984		32,984	392,445	359,461
32		32,984		32,984	392,445	359,461
33		32,984		32,984	392,445	359,461
34		32,984		32,984	392,445	359,461
35		32,984		32,984	392,445	359,461
36		32,984		32,984	392,445	359,461
37		32,984		32,984	392,445	359,461
38		32,984		32,984	392,445	359,461
39		32,984		32,984	392,445	359,461
40		32,984		32,984	392,445	359,461
41		32,984		32,984	392,445	359,461
42		32,984		32,984	392,445	359,461
43		32,984		32,984	392,445	359,461
44		32,984		32,984	392,445	359,461
45		32,984		32,984	392,445	359,461
46		32,984		32,984	392,445	359,461
47		32,984		32,984	392,445	359,461
48		32,984		32,984	392,445	359,461
49		32,984		32,984	392,445	359,461
50		32,984		32,984	392,445	359,461
51		32,984		32,984	392,445	359,461
52		32,984		32,984	392,445	359,461
53		32,984		32,984	392,445	359,461
54		32,984		32,984	392,445	359,461
55		32,984		32,984	392,445	359,461
Total	3,622,444	1,649,200	532,224	5,803,868	18,494,218	12,690,350

EIRR = 7.1%

ANNEX H. AGRICULTURE AND AGRO - ECONOMY

ANNEX H. AGRICULTURE AND AGRO - ECONOMY

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I. AGRICULTURE

1.1 Agricultural Conditions

The Lam Dom Yai basin area has been settled and developed from lower to upper-basin by illegal immigrants into national forest, as shown in Figure H-1. These farmers suffer from low productivity under rainfed condition because the water resource for agriculture is extremely limited. The external expansion of farmland through deforestation has been carried out to increase agricultural production among the farmers. This agricultural condition makes the basin a typical single crop paddy area, and agricultural diversification is progressing little. Traditional upland crops like cassava and kenaf are cultivated throughout the basin, but the planted area is limited.

According to the agro-economic survey that sampled 71 farms, most agricultural land lies under rainfed condition. Some dry season crops are observed in areas where irrigation water is available, though this is restricted to small areas. According to the latest data of the National Statistics Office (NSO), second-crop rice occupies 0.2 percent of the total planted area. Land description by source of water is as follows.

Table H-1 Land Description by Source of Water

(Unit: %)

Source of Water	Farms			Cultivated Area		
	Highland	Plains	Lowland	Highland	Plains	Lowland
Rainfed	100.0	100.0	91.6	100.0	100.0	85.7
Pumping 1/	0.0	0.0	4.2	0.0	0.0	10.1
Flooding (River)	0.0	0.0	4.2	0.0	0.0	4.2
Total	100.0	100.0	100.0	100.0	100.0	100.0

Note: 1/ Pumping from natural canal

Data source: Agro-Economic Survey 6/1991

Figure H-3 shows the planted area for major crops in each area. The Lam Dom Yai basin has been the producing district for glutinous rice. Non-glutinous rice characteristically is for commercial use and glutinous rice for self-consumption. Increased production of the local improvement variety Kho Dawk Mali 105, which is non-glutinous with high marketability

and better taste, will be required to increase income from rice selling. This variety of rice, cashew nut, mango and vegetables were selected as recommended crops under the Seventh Development Plan of Ubon Ratchathani province.

1.2 Farming Conditions of Upper, Middle and Lower Basin

The disproportion of farming crops, represented by wet season paddy, restricts agricultural development in the basin. However the farming characteristics are reflected by the natural and social condition of the upper, middle and lower basin in the Lam Dom Yai.

-Upper basin

Small scale farm management is dominated. Due to the natural conditions in the area, upland crop cultivation is the popular current and the crop diversification is also accelerated. Partially, dry season cultivation is carried out. As for the paddy rice cultivation, high yield varieties are diffused and shared the production of glutinous and non-glutinous rices.

-Middle basin

Medium scale farm management is dominated and an average agricultural management scale is the largest in the basin as a whole. Most of farmers are engaged paddy rice cultivation, however, out of 25 percent of farmers tends to diversified farming together with the upland field cultivation. Cropping intensity of the improved local varieties (non-glutinous rice) is high as compared with the upper and lower basins since non-glutinous rice has high marketability and better taste. Moreover, high rate of yield and input use as compared with the other areas reflects the farm income level in the middle basin of the Lam Dom Yai.

-Lower basin

A single crop cultivation of rice with the medium scale farm management is prevailed. However, agricultural production is generally being made under the rainfed and poor soil conditions. Diffusion rate of the high yield varieties is high, however, agricultural productivity in the area is low, and production of glutinous rice which cultivates mainly for the self-sustenance is exceeded than the non-glutinous rice due to poor natural conditions and low utilization of inputs.

Major farming index of the each basin is as follow;

Table H-2 Summary of Farming Situation

<u>I t e m</u>	<u>Upper-Basin</u>	<u>Middle-Basin</u>	<u>Lower-Basin</u>
- Paddy Production			
% of farm household	92.3	100.0	100.0
% of total area	71.9	86.2	96.8
Area per farm household(ha)	3.4	4.9	4.5
-Upland Crops Production			
% of farm household	69.2	25.0	0.0
% of total area	20.4	5.8	0.0
Area per farm household(ha)	1.0	0.3	0.0
Main crops	Malze,Cassava, Kenaf	Cassava Kenaf	
-Planted Area for Paddy (%) 1/			
H Y V 2/	56.3	22.7	56.7
L I V	41.9	57.8	37.1
L V	1.8	19.5	6.2
Non-glutinous rice	46.5	57.8	44.2
Glutinous rice	53.5	42.2	55.8
-Input Utilization for Paddy			
Chemical Materials (Kg/ha)	127.5	145.6	111.9
-do- (Baht/ha)	681.3	798.1	611.3
Pesticide (Baht/ha)	85.0	30.0	10.6

1/ Upper-basin includes upland rice with 1.2 percent of planted area.

2/ HYV: High Yield Varieties LIV: Local Improvement

L V: Local Varieties

Data source: Agro-economic survey 1991.6

1.3 Farmers' Consciousness

Figure H-2 shows farmers' consciousness based on the results of an agro-economic survey. Water shortage is the biggest problem for farmers in the whole basin. Insufficient farmland, crop diseases and lack of funds are reported as other major problems. In the upper basin, farmers' consciousness is dispersed among the problems, but in the middle and lower basin, farmers' consciousness concentrates on specific problems. The market condition of the middle and lower basin is better than that of the upper basin, but lack of water, poor quality of soil and crop diseases have a bad effect on the farming. As uncultivated land is exhausted, external expansion of farmland is difficult for farmers. This is why insufficient farmland is identified as a problem among some farmers. Most farmers of the agro-economic survey dominate the area between 4.2 and 5.1 ha, the same as that in North-East Thailand. After all, increasing land productivity is indispensable to promote preservation of the environment.

1.4 Agricultural Productivity

Present paddy productivity in the basin is extremely low, as described in the main report. Especially, the yield in the upper and lower basin has stagnated. The gross output index for paddy in Table H-3 shows same tendency as the yield index. Figure H-4 makes a comparison between factor inputs and productivity. In the middle basin, much employment labor is used the same as that in the upper basin. In the lower basin, factor productivity is extremely low though inputs, except employment, is on the same level as other basins.

Table H-3 Gross Output Index for Paddy

	Unit	Upper	Middle	Lower	Whole Basin
Yield	Kg/rai	185.00	219.00	167.00	200.00
Price of Product	Baht/kg	3.42	3.59	3.55	3.52
Production Value	Baht/rai	632.70	786.21	592.85	704.00
Gross Output Index		89.87	111.68	84.21	100.00

SOURCE: Agro-Economic Survey 6/1991
National Statistics Office (NSO)

1.5 Agricultural Diversification

The Seventh National Economic and Social Development Plan (1992-1996) suggests an increase of crop yield, improvement of quality, crop diversification, production material support and price control as major methods to improve agricultural income. Especially, emphases are placed on increase of yield and diversification. Increase of the yield of traditional crops, such as rice, cassava, kenaf, etc., will help control external expansion of farmland through deforestation without decreasing production.

Table H-4 shows the present diversification level measured by production value. The production value, except rice, occupies only 5.95 percent of the total. As mentioned above, 69 percent of farmers in the upper basin engaged in upland field cultivation. This diversified farming promotes dispersing the source of income and effective utilization of production resources. According to Figure H-3, upland crops, fruits and vegetables that are cultivated in the upper basin correspond to 23 percent of the total planted area. Heretofore, traditional crops such as cassava, kenaf and jute adapting to extensive agriculture under rainfed condition have been mostly introduced. In the middle and lower basin, where falling behind their diversification requires irrigation water supply in order to extend the cultivation of development crops such as non-glutinous rice, legumes, fruits and vegetable are recommended by the Seventh Development Plan.

Table H-4 Crop Diversification Index

	Unit	Upper	Middle	Lower	Whole Basin
Rice Production	Kg	232,321.00	203,956.00	40,222.00	476,499.00
Price	Baht/Kg	3.42	3.59	3.55	3.52
Value	Baht	794,537.82	732,202.04	142,788.10	1,677,276.48
Maize Production	Kg	10,000.00			10,000.00
Price	Baht/Kg	1.30			1.30
Value	Baht	13,000.00			13,000.00

(To be continued on the next page)

	Unit	Upper	Middle	Lower	Whole Basin
Cassava Production	Kg	122.00	44.00		166.00
(Dry) Price	Baht/Kg	1.55	1.55		1.55
Value	Baht	188.92	68.10		257.02
Kenaf Production	Kg	21,474.00			21,474.00
Price	Baht/Kg	4.12			4.12
Value	Baht	88,472.88			88,472.88
Jute Production	Kg		160.00		160.00
Price	Baht/Kg		5.00		5.00
Value	Baht		800.00		800.00
Ground Production	Kg		467.00		467.00
nut Price	Baht/Kg		7.49		7.49
1/ Value	Baht		3,497.83		3,497.83
Total Production Value		896,199.62	736,567.97	142,788.10	1,783,304.21
Diversification Index (%)		11.34	0.59	0.00	5.95

Note: 1/ During Dry Season.

Diversification Index=Production Value Except Rice/Total Production Value

Source: Agro-Economic Survey 6/1991

1.6 Farm Labor Force

Farming practices in the basin which is mainly carried out by family labor shows striking seasonal fluctuation due to rice cropping on rain fed fields in the wet season. Presently, out of 72 percent of annual human labor requirement is spent on planting from June until July and harvesting from November until December. (Upper basin:71 percent Middle basin:71 percent Lower basin 76 percent) Especially, the middle basin has high labor requirement on July and more than 80 percent of the economically active population is spent. In the upper basin more than 10 percent of it is generally all the year round. Monthly family labor balance by all crops is shown in Figure H-5.

1.7 Livestock and Inland Fishery

The number of livestock is shown in Table H-5. Livestock products in the basin are for family consumption or shipped to the local market. Buffaloes are raised for cultivation labor, which is indispensable for plowing and land preparation. Poultry is a staple item for self consumption and as an income source for farmers. The current feeding amount of swine is small because the raising conditions are harsh. Among farmers, the custom of feeding swine is comparatively low. The agricultural extension office recommended that farmers carry out diversified feeding of large- and small-scale stock. However, ordinary farmers can't respond easily to livestock promotion plans, because it requires a large amount of funds, and there has been a great deal of disease among the animals.

Table H-5 Number of Livestock (1990)

Amphoe	Buffalo	Cattle	Swine	Ducks	Chicken	Geese
Warin Chamrap	15,500	4,326	3,586	38,660	84,795	349
Det Udom	50,117	9,083	9,663	50,062	222,128	507
Phibum Mungsahan	5,514	1,471	782	11,354	34,558	84
Na Chaluai	9,915	2,379	1,214	17,720	34,389	-
Nam Yun	14,884	3,381	6,912	11,046	39,094	345
King A. Samrong	3,637	557	601	4,225	13,584	-
Kantharalak	19,637	2,243	3,871	-	-	-
Total	119,204	23,440	26,629	133,067	428,578	1,285

Data source: Department of Livestock

The north-east region farmers have traditionally obtained fish from their paddy fields. The fish move with the floodwater in the wet season and, when the water level recedes, they are trapped in the paddy field and caught by farmers for self-consumption and sale to local markets. Fresh water fish are not only a staple protein but also an income source for farmers. Fish culture on the self-consumption level is popular with farmers in the basin in addition to that shown in Table H-6. The Seventh National Economic and Social Development Plan emphasizes inland fisheries development on natural water resources.

Table H-6 The Condition of Inland Fishery (1989)

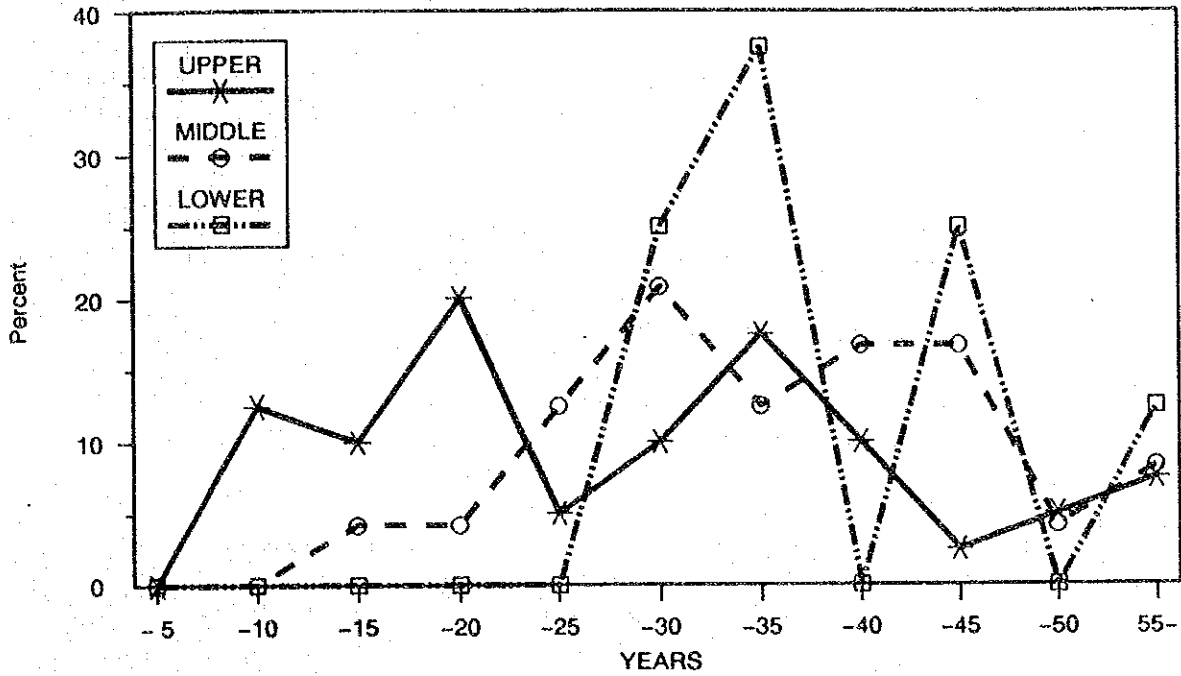
Amphoe	Number of farmers(persons)			Area (ha)		
	Pond	Paddy field	Total	Pond	Paddy field	Total
Warin Chamrap	116	3	119	18.0	30.0	48.0
Det Udom	142	3	145	21.3	0.6	21.9
Phibum Mungsahan	165	17	182	18.5	5.0	23.5
Na Chaluai	9	12	21	2.0	2.1	4.1
Nam Yun	9	5	14	1.6	1.4	3.0
King A. Samrong	13	2	15	1.1	0.2	1.3
Kantharalak 1/	-	-	-	-	-	-
Total/Average	454	42	496	62.5	39.3	101.8
Amphoe	Production (ton)			Yield (Kg/ha)		
Warin Chamrap	73.97	8.76	81.73	4,053.9	292.0	4,345.9
Det Udom	35.70	0.08	35.78	1,676.1	133.3	1,809.4
Phibum Mungsahan	45.23	4.00	49.23	2,444.9	800.0	3,244.9
Na Chaluai	1.07	0.54	1.61	535.0	257.1	792.1
Nam Yun	1.92	0.53	2.45	1,200.0	378.6	1,578.6
King A. Samrong	1.47	0.03	1.50	1,336.4	150.0	1,486.4
Kantharalak 1/	-	-	-	-	-	-
Total/Average	158.36	13.94	172.30	1,874.4	335.2	2,209.5

Note; 1/ Inland fishery in Kantharalak is at self-supply level.

No statistical data.

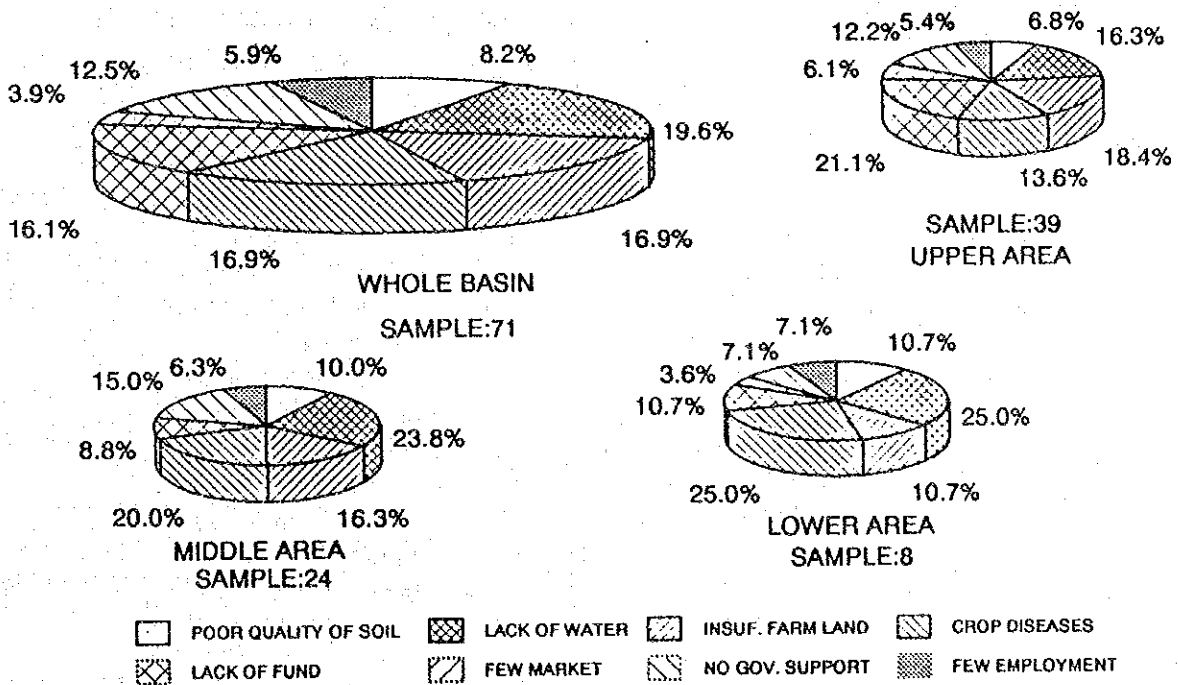
Data source; Statistic personal 1989

Figure H-1 Farm Household Settlement



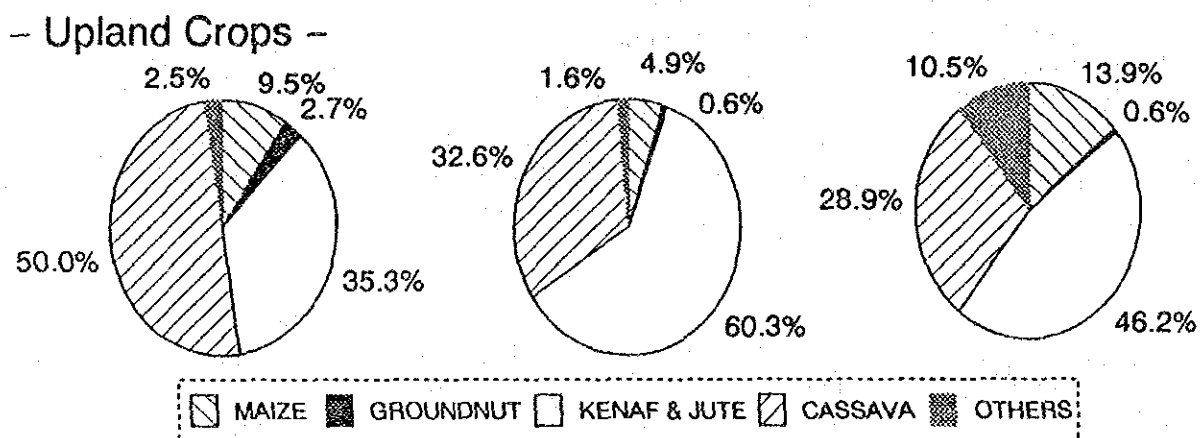
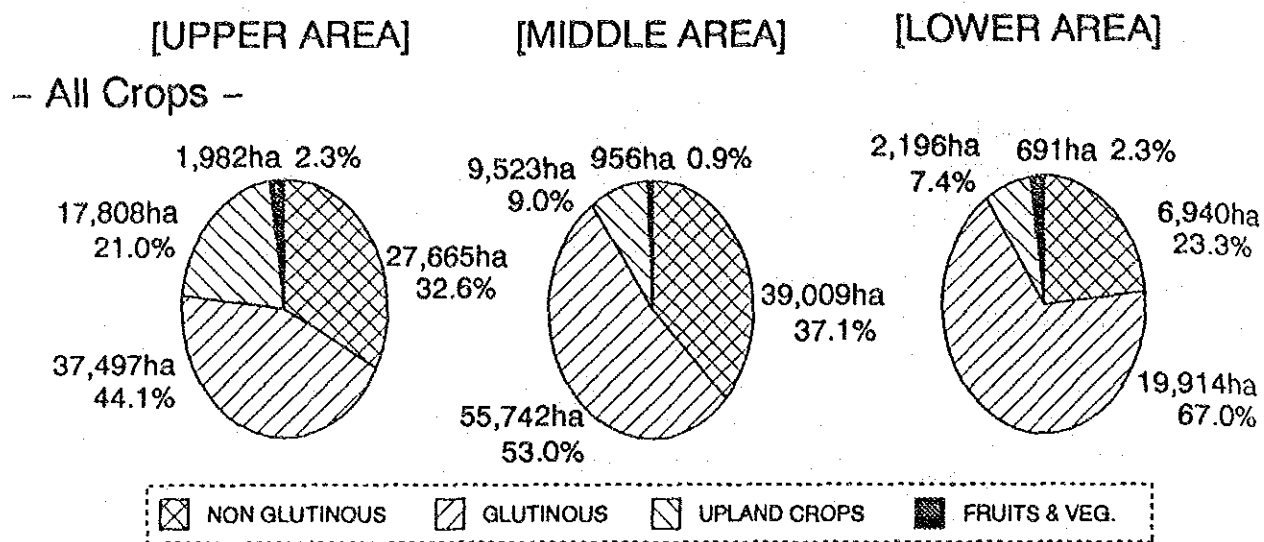
DATA SOURCE: AGRO-ECONOMIC SURVEY 1991.8

Figure H-2 Farming Problem of Farmers
FAIR & EXTREME LEVEL

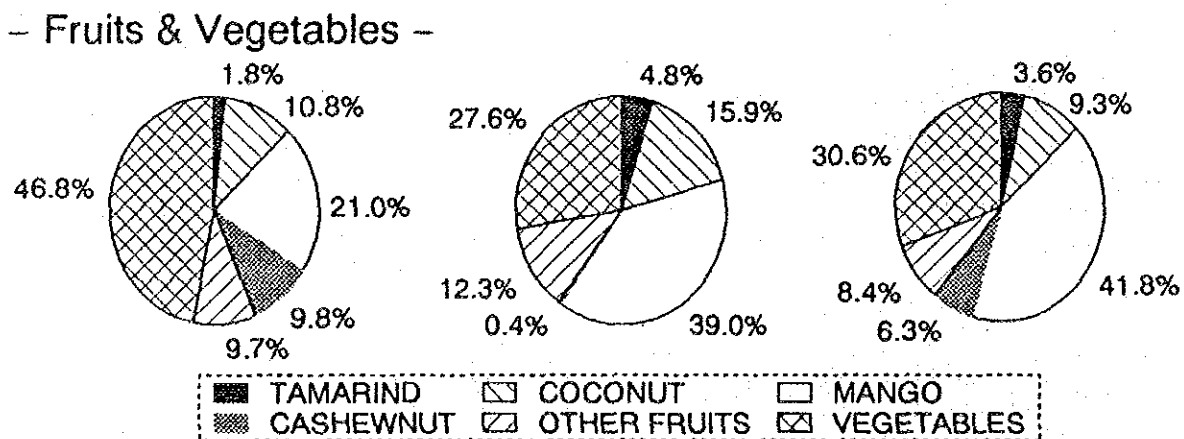


DATA SOURCE: AGRO-ECONOMIC SURVEY 1991.8

Figure H-3 Planted Area for Major Crops



Note: OTHERS include tobacco, sugarcane, sweet potato and sorghum, etc.



Note: OTHER FRUITS include banana, santol, custard apple, bamboo shoot, papaya, longan, pararubber, jackfruits and kapok, etc.

[Amphoe]
 UPPER AREA: Na Chaluai, Nam Yun, Kantharalak
 MIDDLE AREA: Det Udom, King A.Samrong
 LOWER AREA: Warin Chamrap, Phibum Mangsahan

DATA SOURCE: National Statistics Office (1988)

Figure H-4

Farming Situation in the Lam Dom Yai Basin

WHOLE BASIN = 100

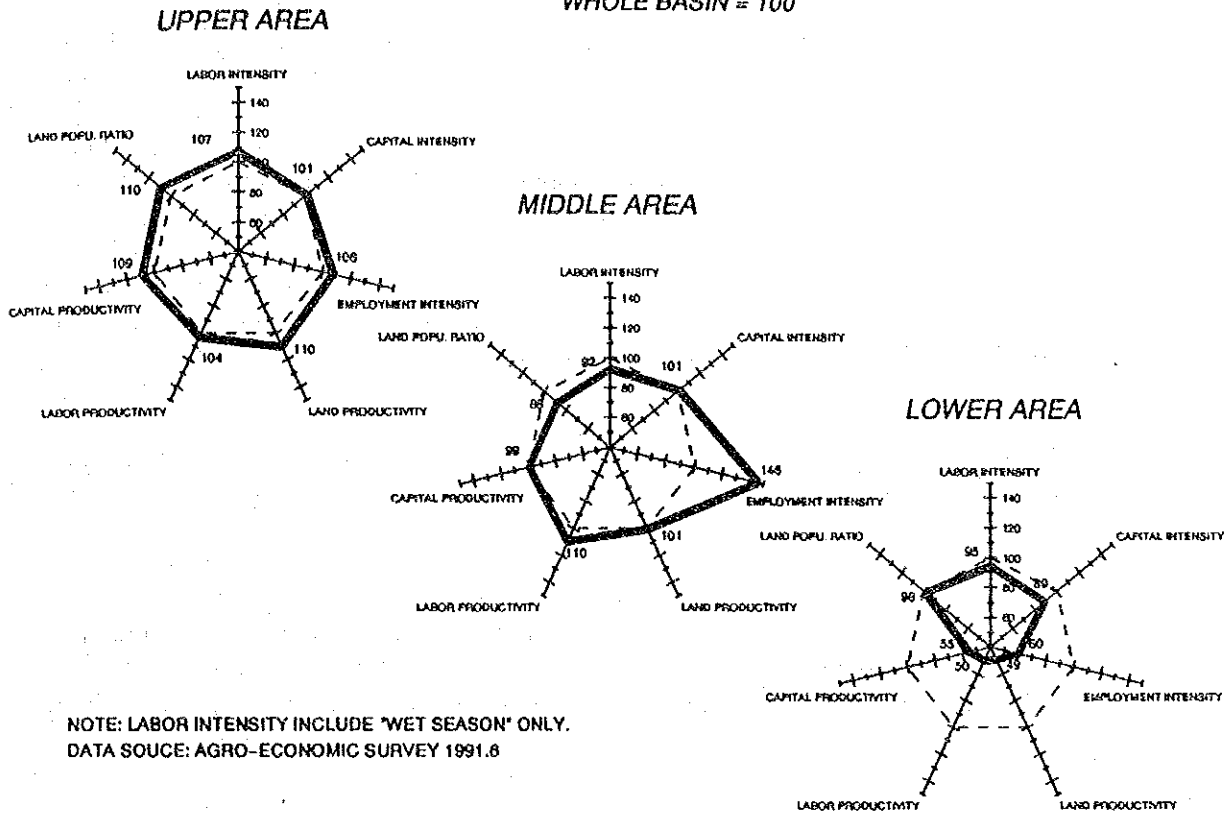
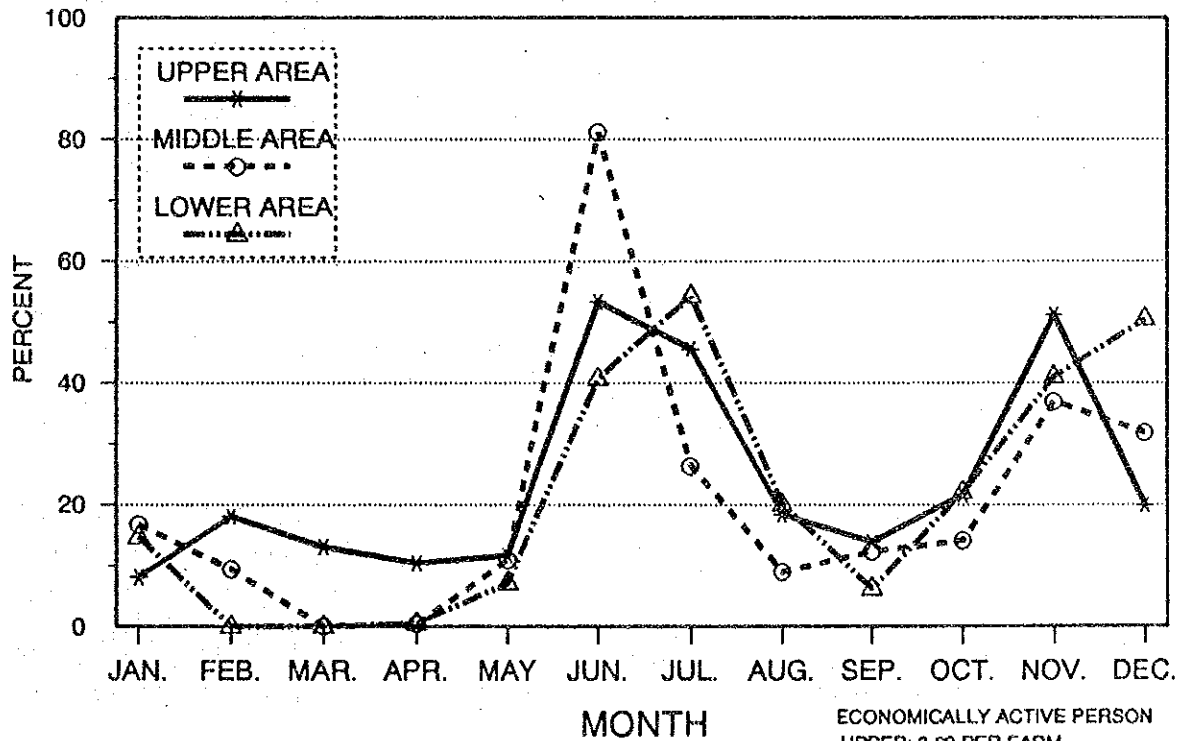


Figure H-5

Family Labour Balance per Farm by All Crops



DATA SOURCE: AGRO-ECONOMY SURVEY 1991.8

II. AGRO-ECONOMY

2.1 Socio-Economic Conditions in the Basin

2.1.1 Socio-Economic Features

The Lam Dom Yai basin is located in the southern part of the Northeast Region of Thailand and occupies the majority of the southwest in Ubon Ratchathani Province and a part of the southeast in Si Sa Ket Province. Gross Provincial Product (1988) at constant 1972 prices of the provinces related to the basin is as follows;

Ubon Ratchathani	:	5,661.0 million Baht (8,545 Baht per capita)
Si Sa Ket	:	3,566.3 million Baht (6,626 Baht per capita)
GDP		512.5 billion Baht (27,179 Baht per capita)

GDP in the related provinces is only one percent and its per capita is also comparatively low as about one third in the Whole Kingdom.

Furthermore, due to the economy in the provinces related to the basin is based on agriculture, the agricultural sector dominates within GDP(1988) and GPP(1988) at constant 1972 prices, as follows;

Ubon Ratchathani	:	1,568.3 million Baht (30% of the GPP)
Si Sa Ket	:	1,400.9 million Baht (35% of the GPP)
GDP	:	86,600.0 million Baht (16% of the GDP)

Major crops produced in the basin are rice(glutinous and non-glutinous), cassava, kenaf, maize and groundnut. As fruit tree crops, mango and cashew nuts are mainly grown. However, the productivity of these crops remains extremely low because of rainfed. Besides, the agro-industry is also undeveloped.

Ubon Ratchathani Province is one of the big production areas of rice and its production amounts for 4.3 percent of the Whole Kingdom. This production is considered to be high among rice production Provinces. Cassava, kenaf and jute are the most important crops in the Northeast Region. Annual production of these crops in the province accounts for 1.4 percent, 11.5 percent respectively of the Whole Kingdom. Also maize is an

important crops of Thailand, but the production in the province is only 0.3 percent of the country. Annual production of groundnuts in the province is 1.7 percent of the national production. The tree crops productions, as cashew nuts and mango, in the province (mainly grown in the basin) are a little.

Administrative division of the basin consists of six Amphoes (District) with 50 Tambons (Sub-District) in Ubon Ratchathani Province and one Amphoe with 8 Tambons in Si Sa Ket Province, as shown in Table H-7. According to the data and information of National Statistical Office and Ministry of Interior, population of the basin is estimated at about 395,000 with 69,000 households. The average size of family is 5.7 persons and the density is 91.7 persons per square kilometer. Farm households occupy 81.3 percent of the total households. Annual growth rate of population is less than 2 percent.

Concerning the rural development, the National Economic Social Development Board (NESDB) prepares the data base on development level in order to establish the order of development priority for rural village in the Whole Kingdom. Viewing this data base, the level in the basin areas is low stage compared with that of the Northeast. (Refer to Table H-8)

2.2 Agro-Economic Condition

2.2.1 Land Ownership

The majority of the land within the basin is covered by the national reserved forest as described in Annex C. Land Use. The considerable forest has been changed to farmland by illegal reclamation. From these circumstances, land registration on the existing land ownership is not arranged except for the urban and its surrounding areas and the area of land reform project.

As the results of the farm survey (71 sample farmers) in the basin, land ownership conditions in the basin are presumed that a difference of these conditions would be very few over the overall basin. Hence the figures are considered as actual land ownership. Because the farms in the basin are considered as small size, in this survey, farm size is

Table H-7 Area and Population by Amphoe and Tambon

Amphoe and Tambon	No. of Area Village (km ²)	Population	No. of Household	Family Size (pn/hh)	Population Density (pn/km ²)	Amphoe and Tambon	No. of Area Village (km ²)	Population	No. of Household	Family Size (pn/hh)	Population Density (pn/km ²)
Ubon Ratchathani Province											
1. A. Warin Chamrap											
W-1 Kham Kwang (Within the Basin)	13	8,233	1,509	5.5	141.9	A. Na Chaluai	13	247	11,428	1,903	6.0
W-2 Khu Muang	10	6,584	1,207	5.5	143.1	N-1 Na Chaluai	8	50	4,932	888	5.6
W-3 Tha Chang (Within the Basin)	12	8,583	1,314	6.5	128.1	N-2 Non Sambun	8	53	4,034	723	5.6
W-4 That	8	6,008	920	6.5	127.8	N-3 Phon Sawan	9	122	7,957	1,444	5.5
W-5 Pho Yai	9	5,417	937	5.8	141.7	N-4 Ban Tum	8	98	5,767	1,015	5.8
W-6 Sra Saming	16	8,416	939	6.7	121.1	N-5 Sok Saeng	7	82	3,645	631	5.7
W-7 Sawang (Within the Basin)	12	10,039	1,578	6.4	144.2	N-6 Non Sawan	53	652	37,823	6,504	5.7
W-8 Bung Maleang (Within the Basin)	9	8,031	1,262	8.4	121.1	Sub-total/Average (Within the Basin)	53	652	37,823	6,504	5.7
W-9 Muang Si Khai	5	4,215	517	5.6	96.0	5. A. Nam Yun	9	124	4,903	885	5.5
Sub-total/Average (Within the Basin)	100	57,082	9,431	6.1	97.1	Y-1 Chong	15	199	10,990	1,867	5.9
81	505	46,723	7,661	6.1	92.5	Y-2 Ta Kao	17	161	9,786	1,613	6.1
2. A. Det Udon											
D-1 Muang Det	22	23,583	3,850	6.1	291.1	Y-3 Yang	14	310	10,074	1,800	5.6
D-2 Na Charoen	8	5,017	751	6.6	91.2	Y-4 Dom Pradit	11	95	5,418	924	5.9
D-3 Tung Tueng	19	11,240	1,723	6.5	113.5	Y-5 Khil Lek	12	94	6,365	938	5.8
D-4 Nong Om	17	9,490	1,578	6.0	128.2	Y-6 Bu Pua	11	114	9,844	1,696	5.8
D-5 Som Sa-at	10	8,577	1,249	6.9	153.2	Y-7 Si Wichien	6	82	4,437	887	6.1
D-6 Kut Prathai	15	9,811	1,427	5.8	49.3	Y-8 Phaibun	8	63	3,914	668	5.9
D-7 Kiang	15	10,408	1,754	5.9	139.6	Y-9 Yang Yai	104	1,252	66,731	11,298	5.9
D-8 Na Suang	17	6,773	1,075	6.3	185.2	Sub-total/Average (Within the Basin)	104	1,252	66,731	11,298	5.9
D-9 Na Suang	12	41	1,328	6.9	95.7	6. King A. Samrong	14	75	4,497	718	6.3
D-10 Na Yia	8	9,186	1,513	5.7	84.9	S-1 Khok Kong (Within the Basin)	13	67	4,047	646	6.3
D-11 Top Hu	14	8,633	1,703	7.1	172.1	S-2 Khok Sawang	8	65	6,900	1,155	6.0
D-12 Tha Pho Si	9	4,973	778	5.6	73.6	Sub-total/Average (Within the Basin)	22	140	11,397	1,873	6.1
D-13 Na Rueng	8	4,591	778	5.6	91.5	Si Sa Ket Province	21	132	10,947	1,801	6.1
D-14 Bus Ngam	13	8,900	1,554	5.7	59.7	7. A. Karharalak	14	95	8,685	1,935	4.5
D-15 Na Khasem	7	4,197	660	6.4	73.6	K-1 Kut Saiao	13	47	12,182	2,640	4.6
D-16 Kham Khrang	8	4,756	872	5.5	103.4	K-2 Bung Malu (Within the Basin)	8	28	7,285	1,584	4.6
D-17 Na Kaseng	11	9,492	1,337	7.1	110.4	K-3 Sang Mek (Within the Basin)	11	87	8,080	3,974	2.0
D-18 Kut Rua	8	4,048	688	5.9	47.1	K-4 Tha Khlo (Within the Basin)	8	60	4,383	2,146	2.0
D-19 Phon Ngam	7	6,157	1,138	5.4	106.2	K-5 Non Samran (Within the Basin)	5	36	3,655	701	5.2
D-20 Ne Di	9	4,973	703	7.1	58.5	K-6 Suan Kua (Within the Basin)	7	61	5,353	1,188	4.5
D-21 Pa Mong	8	3,186	545	5.8	57.9	K-7 Sao Thong Chai (Within the Basin)	9	54	5,305	1,531	4.3
Sub-total/Average (Within the Basin)	245	166,303	26,918	6.2	91.2	K-8 Khanun	10	59	8,079	1,737	4.4
3. Phibun Mangsahan	245	166,303	26,918	6.2	91.2	Sub-total/Average (Within the Basin)	85	540	64,652	16,515	3.9
P-1 Pho Sai (Within the Basin)	13	8,225	1,321	6.2	316.3	Total/Average	640	5,135	424,066	75,994	5.7
P-2 Rai Rai (Within the Basin)	10	6,580	1,057	6.0	313.3	Total/Average (Within the Basin)	594	4,905	395,005	69,149	5.7
P-3 Na Pho (Within the Basin)	7	5,429	956	5.7	77.6						
Sub-total/Average (Within the Basin)	31	20,098	3,355	6.0	143.6						
25	110	16,180	2,696	6.0	147.1						

Data Source: Provincial Data 1980, National Statistical Office and Ministry of Interior
 Note: Total/Average shows Amphoe and Tambon related to the Lam Dom Yai Basin.

Table H-8 Development Level of Amphoe and Tambon

Amphoe and Tambon	Social development			Agricultural development			Water resources		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
(Unit: %)									
Ubun Ratchathani Province									
1. A. Warin Chamrap									
W-1 Kham Kwang	21	13	66	54	32	14	17	0	83
W-2 Khu Muang	14	23	63	48	21	31	70	0	30
W-3 Tha Chang	6	31	63	42	19	39	45	0	55
W-4 That	12	26	62	44	19	37	100	0	0
W-5 Pho Yai	11	29	60	37	23	40	33	12	55
W-6 Sra Sawang	14	30	56	60	10	30	75	0	25
W-7 Sawang	16	28	56	59	32	9	57	0	43
W-8 Bung Maleang	6	32	62	65	19	16	22	2	78
W-9 Muang Si Khai	8	31	61	48	20	32	50	0	50
Average	12	27	61	51	22	28	52	2	47
2. A. Det Udom									
D-1 Muang Det	6	30	64	40	17	43	0	0	100
D-2 Na Charoen	10	30	60	37	32	31	63	0	37
D-3 Tung Jueng	15	35	50	39	27	34	11	0	89
D-4 Nong Om	15	29	56	56	10	34	71	0	29
D-5 Som Srat	5	36	59	31	32	37	40	0	60
D-6 Kut Prathai	22	36	42	68	12	20	100	0	0
D-7 Klang	20	28	52	65	12	23	87	0	13
D-8 Kaeng	22	24	54	55	19	26	94	0	6
D-9 Na Suang	1	31	68	24	49	27	0	0	100
D-10 Na Yia	19	27	54	57	24	19	75	0	25
D-11 Top Hu	25	22	53	50	23	27	37	0	63
D-12 Tha Pho Si	13	34	53	52	21	27	0	0	100
D-13 Na Rueng	2	37	61	36	24	40	0	0	100
D-14 Bua Ngam	37	35	28	33	27	40	100	0	0
D-15 Na Khaseu	43	24	33	32	29	39	57	0	43
D-16 Kham Khirang	14	24	62	53	20	27	88	0	12
D-17 Na Kasang	3	35	62	42	13	45	0	0	100
D-18 Kut Rua	32	18	49	48	16	36	100	0	0
D-19 Phon Ngam	29	29	42	37	21	42	100	0	0
D-20 Na Di	15	35	50	73	5	22	100	0	0
D-21 Pa Mong	16	31	53	41	24	35	0	25	75
Average	17	30	53	46	22	32	53	1	45
3. A. Phibun Mangsahan									
P-1 Pho Sai	17	31	52	54	13	33	31	0	69
P-2 Rai Tai	17	33	50	54	16	30	82	9	9
P-3 Na Pho	19	25	56	50	33	17	50	17	33
Average	18	30	53	53	21	27	54	9	37
Amphoe and Tambon									
4. A. Na Chaiuai									
N-1 Na Chaiuai	22	20	58	51	16	33	43	0	57
N-2 Non Sombun	20	16	64	38	17	45	63	12	25
N-3 Phon Sawan	40	10	50	71	15	14	100	0	0
N-4 Ban Tum	21	24	55	47	24	29	0	0	100
N-5 Sok Saeng	28	22	50	39	12	49	88	0	12
N-6 Non Sawan	49	17	34	53	15	32	100	0	0
Average	30	18	52	50	17	34	66	2	32
5. A. Nam Yun									
Y-1 Chong	19	33	48	41	22	37	71	0	29
Y-2 Ia Kao	21	25	54	45	29	26	73	0	27
Y-3 Yang	29	20	51	46	19	35	88	0	12
Y-4 Dom Pradit	35	26	39	77	8	15	100	0	0
Y-5 Khi Lek	36	26	38	48	31	21	90	0	10
Y-6 Bu Pui	26	22	52	57	13	30	100	0	0
Y-7 Si Wichien	31	18	51	75	13	12	100	0	0
Y-8 Phaibun	40	26	34	57	15	28	100	0	0
Y-9 Yang Yai	40	24	36	65	16	19	100	0	0
Average	31	24	45	57	18	25	91	0	9
6. King A. Samrong									
S-1 Khok Kong	28	27	45	53	12	35	71	8	21
S-2 Khok Sawang	19	30	51	45	14	41	38	24	38
Average	24	29	48	49	13	38	55	16	30
Si Sa Ket Province									
7. A. Kantharalak									
K-1 Kut Salao	10	34	56	52	44	4	50	0	50
K-2 Bung Melu	32	21	47	34	38	28	69	0	31
K-3 Sang Mek	20	33	47	43	26	31	44	6	50
K-4 Tha Khlo	10	23	67	46	42	12	75	0	25
K-5 Non Samran	37	21	42	71	17	12	86	14	0
K-6 Suan Kuai	14	36	50	41	41	18	29	0	71
K-7 Sao Thong Chai	30	30	40	88	15	17	83	0	17
K-8 Khanun	26	25	49	44	36	20	14	0	86
Average	22	28	50	50	32	18	56	3	41
Average of Tambon related to the Basin									
	22	27	51	51	21	26	61	5	34

Data Source: Data Base on Village Level in Rural Area 1989, NESDB
 Note: Development level; 1 = lower than standard
 2 = standard (normal)
 3 = higher than standard

classified into 3 ranks; small(0.04-3.2ha), middle(3.2-6.4ha) and large(6.4ha and over). But it found the maximum size is 12ha. According to the results of the analysis for survey on farms, most the farmers are small-scale farmer and owned land.

Land ownership conditions in the basin are shown in Table H-9 and can be summarized as follows;

(1) Upper basin

This area is a newest settlement area in the basin. At present, the land reform project is being conducted in the right bank area of the Dom Yai River. Small-scale farmers, less than 6.4ha, account for 85 percent and its average land holding is 4.67ha.

(2) Middle basin

About 80 percent of farmers have the land less than 6.4ha and the average land holding is 5.71ha. This area is developed in comparatively early time and Tambon Muang Det, Amphoe Det Udom as a collecting and shipping center of farm products is located in the center of the basin.

(3) Lower basin

The land with sandy soil, as poor soil conditions, stretches for the basin. Following the middle basin area, farmers are settled into this area. Most the farmers have a farmland between 3.2ha and 5.6ha. Average land holding is 4.65ha.

Regarding the status of land holding, the land of most the farmers in the basin is owned land. It founds that some farmers perform their farming to combine rented land with owned land.

Land certificate conditions in the basin by the results of farm survey are tabulated in Table H-10, and the land with title deed is only 3.7 percent.

Table H-9 Land Tenure by Average in the Basin

Item	(Unit: rai)					
	Upper-Basin		Middle-Basin		Lower-Basin	
	No. of Plot	Area	No. of Plot	Area	No. of Plot	Area
Owned Land	2.8	25.79 (4.13 ha)	2.7	31.72 (5.08 ha)	2.9	28.97 (4.68 ha)
Rented Land						
Additional Rent	-	-	-	-	-	-
Rented Only	-	0.10 (0.02 ha)	-	-	-	-
Other farms given to operate free	0.5	2.92 (0.47 ha)	-	3.52 (0.56 ha)	-	-
Other Land						
Co-op. Land	-	-	-	-	-	-
Resettle. Land	-	-	-	-	-	-
Public Land	-	-	-	0.41 (0.07 ha)	0.1	-
Reserved Forest	-	0.38 (0.06 ha)	-	-	-	0.09 (0.01 ha)
Others	-	-	-	-	-	-
Total Area	3.4	29.20 (4.67 ha)	3.3	35.65 (5.71 ha)	3.0	29.06 (4.65 ha)

Data source: Farm household economic survey

Table H-10 Land Certificate for Arable Land(Owned Land) in the Basin

Type of Land Title Document	(Unit: %)			
	Upper-Basin	Middle-Basin	Lower-Basin	Total Area
Title Deed	2.7	2.8	11.2	3.7
Nor Sor 3 Kor	2.0	26.9	48.4	18.5
Nor Sor 3	36.3	42.0	27.1	38.8
Nor Sor 2 (ALRO)	12.8	0.0	0.0	6.3
Sor Kor 1	0.0	3.3	0.0	0.1
Phor Bor Thor 6	33.3	16.9	0.0	21.6
Sor Thor Ko	8.6	0.0	0.0	4.2
No Certificate	4.3	8.1	13.3	6.8
Total	100.0	100.0	100.0	100.0

Data source: Farm household economic survey

Note: Title Document;

Title Deed : who possesses a complete land right certificate.

Nor Sor 3 Kor: who has land right capable of dealing with.

- (whose land has already been surveyed)
- Nor Sor 3 : who has a land right capable of dealing with.
(whose land has only been confirmed in aerophoto)
- Nor Sor 2(ALRO): who has a land right by land reform, but only cultivation and dwelling rights incapable of dealing with.
(whose land is located in the place where land reform has been executed)
- Sor Kor 1 : Who is able to have only cultivation and dwelling rights incapable of dealing with.
(who is obtainable when it is 10 to 15 years after illegal instruction, and the good second generation only is able to apply for Nor Sor 3 in his generation)
- Phor Bor Thor 6: who has only cultivation and dwelling rights incapable of dealing with.
- Sor Thor Ko : who has only cultivation and dwelling rights incapable of dealing with.
- No Certificate : who is an illegal farmer

2.2.2 Valuable Cost and Income of Products

Main farm products produced in the basin are paddy rice (glutinous and non-glutinous), cassava, kenaf, maize, groundnuts, etc. Mango and cashew nuts as tree crops are mainly grown.

Recently, the price of farm inputs is a marked rise (annual rate 5 percent), but an increase of fertilizer and pesticides use is found through a rise in farm products' prices (annual rate 4.2 percent). However, the use of farm inputs is generally low in the basin. Farming in the basin shows the low agricultural productivity through these circumstances combined with severe natural conditions such as water shortage and sandy soil. In fact, these circumstances are reflected to farm income.

Valuable cost and income of major farm products are estimated based on the data and information of OAE, DOAE and farm survey, as shown in Table H-11.

As mentioned above, the low productivity of farming in the basin appears at the yield of crops. In particular the yield of paddy rice is extremely low compared with that of the national level (312 kg/rai=1,950

kg/ha). Production cost (inputs) is also lower than that of the national level (5,705 Baht/rai=35,656 Baht/ha). Deficit in net income includes the human labor cost (non-cash), i.e., its production is materialized by man power.

Table H-11 Valuable Cost and Income of Products

Crop	Yield	Farmgate Price	Gross Income	Variable Cost *1	Fixed Cost *2	Net Income
	(kg/ha)	(B/kg)	(Baht)	(Baht)	(Baht)	(Baht)
Annual Crop						
Paddy	1,250	3.2	4,000	3,694	713	- 407
Cassava	13,125	0.6	7,875	6,799	776	300
Kenaf	1,581	4.8	7,511	6,752	731	28
Maize	2,900	1.3	3,770	2,783	975	12
Groundnuts	1,306	7.1	9,314	8,770	648	- 104
Perennial Crop						
Mango	4,675	3.0	14,025	12,851	742	432
Cashew nuts	881	13.0	11,444	6,452	2,244	2,748

Data source: Farm household economic survey, OAE and DOAE

Note: *1 ... Variable cost: Input materials and labor costs, etc.

*2 ... Fixed cost : Tax and interest, etc.

2.2.3 Farmers' Income and Poverty Distribution

(1) Farmers' Income

Farm household economic survey in the basin has been carried out. The sample farmers (71 farms) surveyed were selected at random in the villages and classified into three areas of the basin such as upper, middle and lower. The average income of each area is shown in Table H-12.

Viewing the results of farm household economic survey, a large number of farmers in the basin are under difficult conditions to maintain a living only farm income as described in the preceding paragraph. The income of off-farm employment is illustrated in Fig. H-6. A disposable income per capita in the basin ranges from 2,700 Baht to 4,700 Baht as considerably low by reflect the low farm income. In living expenses, the

Engel's coefficient indicates; 61.66% in the upper area, 50.16% in the middle area, and 50.31% in the lower area. Propensity to consume in the living expenses shows; 175% in the upper area, 109% in the middle area, and 165% in the lower area.

Table H-12 Average Farmers' Income in the Basin

Item	(Unit: Baht)		
	Upper-Basin	Middle-Basin	Lower-Basin
Cropping Area	26.58 rai (4.25 ha)	32.73 rai (5.24 ha)	28.13 rai (4.50 ha)
Farm Income	29,628	33,911	17,939
Non Farm Income	2,500	8,672	8,538
Gross Income	32,128	42,583	26,477
Production Cost*1	7,371	10,933	6,435
Living Expenses	24,705	24,930	20,875
Net Income	54	6,720	- 833

Data source: Farm household economic survey

Note: *1.... Excluding family labor and non cash material.

(2) Poverty Distribution

From the actual circumstances of the mentioned income, most farmers are belong to low income group. According to the NESDB's report on the poverty, the majority of the poor had been living in rural areas and engaged in agriculture. The poverty incidence was found to be highest in the Northeast and lowest in Bangkok. Poverty incidence (1988/89) at the village level in the Northeast shows 39.87. This figure is considerably high as compared with the Whole Kingdom of 23.67. (Refer to Table H-13) The National Rural Development Center, NESDB, has established the development criteria in rural areas on the national level and prepared the data base on rural development urgency. Socio-economic development conditions in the basin area are shown in Table H-14.

On the other hand, NSO conducts the village survey every year in order to grasp the rural condition. The poverty distribution in the basin has been based on the survey. (Refer to Fig.2-14)

Table H-13 Poverty Incidence between 1975/76 and 1988/89

Region	1975/76	1980/81	1985/86	1988/89
Whole Kingdom	30.02	23.04	29.51	23.67
Northeast	44.92	35.93	48.17	37.45
Villages	48.54	37.92	50.49	39.87
Sanitary districts	24.66	20.81	33.25	20.12
Municipal areas	20.90	17.99	18.67	18.97
All villages	36.16	27.34	35.75	29.43
All sanitary districts	14.76	13.47	18.55	13.18
All municipal areas	12.53	7.51	5.90	6.74
Poverty Line : (Per Capita Household Income/Year)				
	Rural (Village and Sanitary Districts)	Urban (Municipal Areas)		
1975/76	1,981	2,961		
1980/81	3,454	5,151		
1985/86	3,823	5,834		
1988/89	4,141	6,324		

Data source: Urban Poor Upgrading: Analysis of Poverty Trend Oct. 1990, NESDB, TDRI

Table H-14 Comparison of Development Level

(Unit: Percent)

	Social development			Agricultural development			Water resource for agriculture		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
Study Area	21	27	52	50	21	29	58	6	36
Ubon Ratchathani	18	27	55	54	21	25	66	3	31
Northeastern Region	20	29	51	49	24	27	64	3	33
Whole Kingdom	23	23	54	42	25	33	59	5	36

Source: Data Base on village level in rural area 1989, NESDB

Note: Development level;

1 = lower than standard

2 = normal

3 = higher than standard

2.2.4 Marketing Systems of Products

Marketing of farm products in the area deals with village merchants including small transporters, local merchants (middleman), rice millers, and agro-processing factories (jute factory, tapioca factory, peanuts selecting factory, etc.).

(1) Rice

Marketing channel of paddy rice in the area can be illustrated as Fig.H-7, and the flow of marketing is shown in Fig.2-15.

According to a commercial officer of Ubon Ratchathani Province, about 100 percent of non-glutinous rice and a small volume of glutinous rice produced in the area is assumed for marketing. Of the rice for marketing, 50 percent is shipped to the Bangkok market and exporters, and the rest is shipped to local markets in the surrounding Provinces such as Si Sa Ket, Surin, Nakhon Ratchasima and Yasothon. There are three local markets in Ubon Ratchathani Province; Warin Chamrap, Det Udom and Amnat Charoen. Two markets, Warin Chamrap and Det Udom, perform an important role as rice collection centers in the basin.

Rice is shipped to marketing systems by A type of packing as 90 kg sack for paddy (rental sack by middleman) and 100 kg sack for white rice. Price of a sack is 21 Baht as new one.

(2) Upland Crops

Marketing channels of these crops produced in the area are as follows (Refer to Fig.H-8, H-9 and H-10);

Cassava : the factories in the area and the surrounding area buy and collect directly from farmers, besides, the local merchants (middlemen) buy and collect from farmers and are sent it to the factories in Nakhon Ratchasima, Chonburi and Chachoengsao. All of processed one are shipped to Bangkok market and exporters.

Kenaf : the local merchants buy and collect directly from farmers and they send it to a large factory in Nakhon

Ratchasima with bare packing of 50 to 100 kg (dry).
Maize : the local merchants deal with farmers directly and send to feed factories in other areas.
Groundnuts : the village merchants buy and collect directly from farmers and send to two small processing factories (ex-shelling and selecting) in Tambon Muang (urban), Ubon Ratchathani.

(3) Tree Crops

Cashew nuts in the area are grown in the upper-basin of the basin operated by Mah Boon Krong Sirichai Cashew Nuts Co. Ltd., Bangkok, a plantation company. Some large farmers are cultivating at the land which has good soil condition. BAAC assists the farmers in collecting produce for sale to the same company.

In the lower-basin, mango production by small farmers is promoted on a commercial basis under assistance and support by BAAC.

2.2.5 Agricultural Supporting Services

Agricultural supporting services in the basin are conducted by the following agencies:

(1) Ministry of Agriculture and Co-operatives

1) Agricultural Extension Services

The activities of agricultural extension services in the area are carried out based on the National Agricultural Extension Project concept. The organization of the services is shown in Fig.H-11.

On the other hand, Seed Center No. 10: Ubon Ratchathani, Seed Division, Department of Agricultural Extension (DOAE) produces seed of improved varieties of major economic crops such as paddy, groundnuts and soybeans, to help farmers increase their yields. The seed produced distributes the seeds to farmers through Amphoe (District) Agricultural Extension Office, BAAC Field Office and Agricultural Cooperatives. Also,

Plant Protection Center: Ubon Ratchathani, Plant Protection Division, DOAE, is established in the site of Provincial Agricultural Extension Office to help control plant diseases, pests and weeds for farmers.

2) Agricultural Research

Agricultural research of the Department of Agriculture (DOA) in Lower Northeast Thailand is conducted by two centers; Ubon Ratchathani Rice Research Center, key site of the Thai-IRRI Collaborative Project in Thailand, and Ubon Ratchathani Field Crops Research Center.

3) Livestock Promotion

Provincial and Amphoe (District) Livestock Office, Department of Livestock conducts livestock raising promotions, prevention of epidemics and hygiene control for domestic animals. In the area, the Beef Cattle Raising Promotion Project in the Northeast Region, as King's Project, is conducting by Nam Yun District Office in cooperation with the BAAC.

4) Freshwater Fishery Promotion

Ubon Ratchathani Freshwater Fishery Promotion Center, Department of Fisheries, is conducting the promotion and distribution of fry fish, and the extension activities.

5) Marketing Support

Marketing Organization of Farmers (MOF) and Bank for Agriculture and Agricultural Cooperatives (BAAC) carry out the marketing support for farmers. In the area, Ubon Ratchathani Branch, MOF, performs the marketing support for farmers as selling of fertilizer by low price and emergency subsidy for paddy at a sharp decline of price. Det Udom District Branch, BAAC in Tambon Muang Det, Ubon Ratchathani Province performs the support for farmers as marketing co-ordination between farmer and private company, besides, agricultural financing.

6) Agricultural Credit

Agricultural financing services for farmers carries out by the BAAC.

In order to conduct the financing services, the BAAC is promoting the organization of Client Group in each village. (Refer to Table H-15) On the other hand, the BAAC assists the cooperatives' members in agricultural financing through agricultural cooperatives.

The loan condition of the BAAC is tabulated in Table H-16.

Table H-16 BAAC's Loan Conditions

1. Qualification of Farmers	
a. Thai Nationality	
b. 20 years old and over	
c. Occupation is permanent farmer	
d. Farming experience and skill on-farm	
e. Progressive farmer	
f. Never bad client	
g. Trustful and faithful person	
h. Person who has not much debt	
i. Member of farmers' institutions	
2. Loan Conditions	
a. Short term loan	for annual crop farming,
- 12 months	seeds, fertilizer, chemicals, animal feeding, farm equipment, fuel for land preparation, wage for hired labor, fish invest., rented cost, etc.
b. Medium term loan	for land purchase, improvement of
- not more than 3 years	water source for agriculture and tree crop invest., farm machinery, livestock invest., etc.
c. Long term loan	for farm invest. as land improve-
- 10 years to 12 years	ment, land leveling, improvement of water source, tree crop invest., etc.
d. Interest	12.5 percent per annum.
	- for cooperative: 9.5 percent per annum.
	- cooperative's loan condition is the same as BAAC's condition, but only short term loan for member.

Table H-15 BAAC Client Group by Amphoe and Tambon

Amphoe and Tambon		No. of Farm Household(A)	No. of Group	No. of Client(B)	Ratio (B/A)
Ubon Ratchathani Province					
1. A. Warin Chamrap					
W-1 Kham Kwang	1,097	24	323	0.29	
W-2 Khu Muang	840	13	144	0.17	
W-3 Tha Chang	1,044	18	166	0.16	
W-4 That	472	1	5	0.01	
W-5 Pho Yai	898	17	225	0.25	
W-6 Sra Sawing	893	10	105	0.12	
W-7 Saweng	1,375	21	202	0.15	
W-8 Bung Maleang	552	9	102	0.16	
W-9 Muang Si Khai	683	3	31	0.05	
Sub-total	7,954	116	1,303	0.16	
2. A. Det Udon					
D-1 Muang Det	2,354	42	450	0.19	
D-2 Na Charoen	724	20	245	0.34	
D-3 Tung Tueng	1,675	66	804	0.48	
D-4 Nong Om	1,505	49	575	0.38	
D-5 Som Sarat	1,217	41	459	0.38	
D-6 Kut Prathai	1,387	24	307	0.22	
D-7 Kleng	1,573	58	706	0.45	
D-8 Kaeng	1,719	31	347	0.20	
D-9 Na Suang	1,024	21	161	0.16	
D-10 Na Via	1,266	37	460	0.36	
D-11 Top Hu	1,388	36	437	0.31	
D-12 Tha Pho Si	649	9	95	0.15	
D-13 Na Rueng	765	31	207	0.27	
D-14 Bua Ngam	1,459	62	740	0.50	
D-15 Na Khasee	634	15	170	0.27	
D-16 Kham Khrang	625	21	248	0.39	
D-17 Na Kasaeng	1,298	31	410	0.32	
D-18 Kut Rua	680	11	137	0.20	
D-19 Phon Ngam	1,089	15	165	0.15	
D-20 Na Di	649	6	81	0.12	
D-21 Pa Mong	526	3	55	0.10	
Sub-total	24,227	629	7,259	0.30	
3. A. Phibun Mangsahan					
P-1 Pho Sai	1,113	16	193	0.17	
P-2 Rai Tai	925	22	303	0.33	
P-3 Na Pho	836	18	200	0.24	
Sub-total	2,874	56	696	0.24	
Amphoe and Tambon					
4. A. Na Chalusi					
N-1 Na Chalusi	1,558	34	340	0.21	
N-2 Non Soabun	810	20	227	0.28	
N-3 Phon Sawan	704	27	279	0.40	
N-4 Ban Tum	1,332	28	336	0.25	
N-5 Sok Saeng	955	18	208	0.22	
N-6 Non Sawan	533	23	243	0.46	
Sub-total	5,992	150	1,633	0.27	
5. A. Nuea Yun					
Y-1 Chong	841	27	275	0.33	
Y-2 Ta Kao	1,597	75	603	0.50	
Y-3 Yang	1,506	49	555	0.37	
Y-4 Dom Pradit	1,525	41	479	0.31	
Y-5 Khi Lek	860	42	481	0.56	
Y-6 Bu Puai	863	52	632	0.73	
Y-7 Si Wichien	1,077	53	537	0.50	
Y-8 Phaibun	833	12	151	0.18	
Y-9 Yang Yai	495	17	184	0.37	
Sub-total	9,537	368	4,097	0.43	
6. K. A. Saarong					
S-1 Khok Kong	709	14	186	0.26	
S-2 Khok Sawang	1,120	8	169	0.15	
Sub-total	1,829	22	355	0.19	
Si Sa Ket Province					
7. A. Kantharalak					
K-1 Kut Salao	937	59	519	0.54	
K-2 Bung Malu	1,896	58	568	0.30	
K-3 Sang Mek	1,342	32	325	0.24	
K-4 Tha Khlo	745	59	1,361	1.83	
K-5 Non Saaron	754	31	328	0.44	
K-6 Suan Kuai	906	55	551	0.61	
K-7 Sao Thong Chai	1,455	43	402	0.28	
K-8 Khanun	1,254	54	512	0.41	
Sub-total	9,309	391	4,566	0.49	
Total	61,782	1,732	19,909	0.32	

Data Source: BAAC

2.2.6 Farmers' Institution

Farmers' institutions in the area are agricultural cooperatives at the Amphoe level, farmer's group, farm women's club and farm youth club at village (Muban) level.

1) Agricultural Cooperatives

Agricultural cooperatives set up aiming the development of socio-economic conditions in rural areas in order to increase in farm income and improvement of living standard, also development of life quality. In the 7th National Economic and Social Development Plan, the major policy of the cooperative promotion and development is i) increase in members' income, ii) life quality development, iii) cooperative system development, and iv) promotion system development.

2) Farmer's Group, Farm Women's Club and Farm Youth Club(4-H Club)

Amphoe Agricultural Extension Office assists the activities of these groups. Number of group and members by Amphoe is shown in Table H-17.

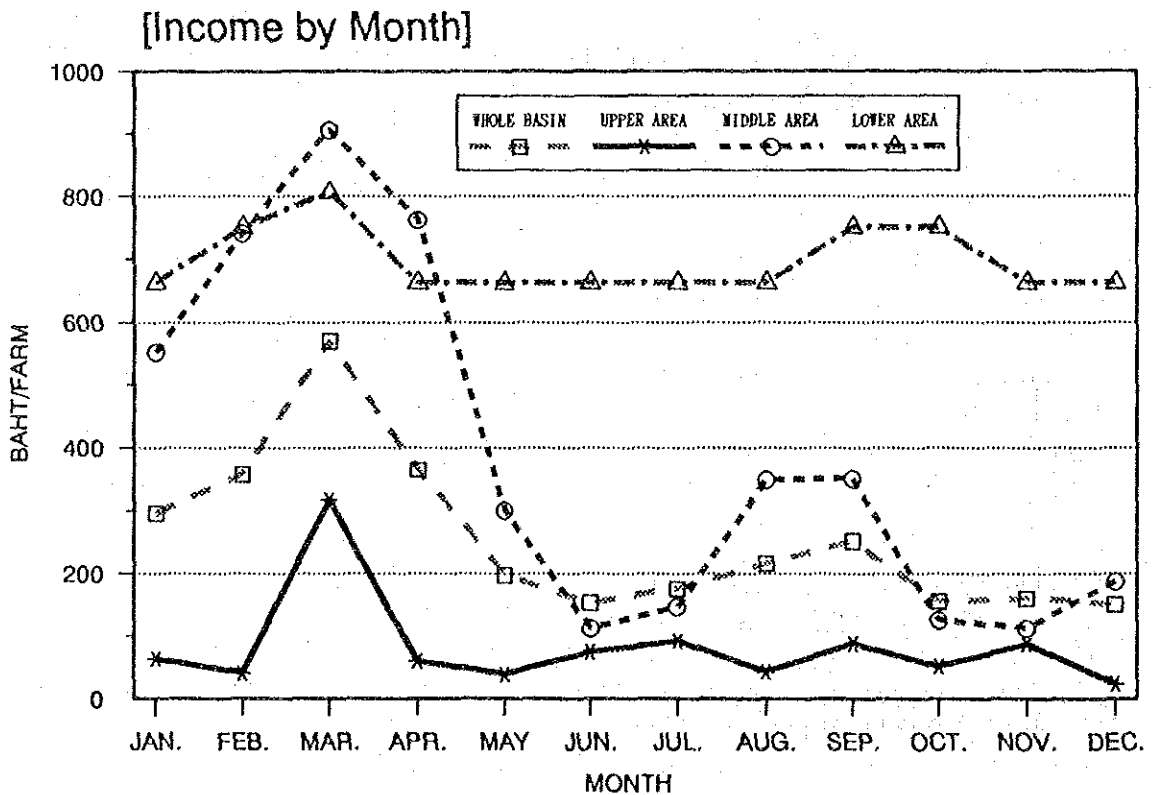
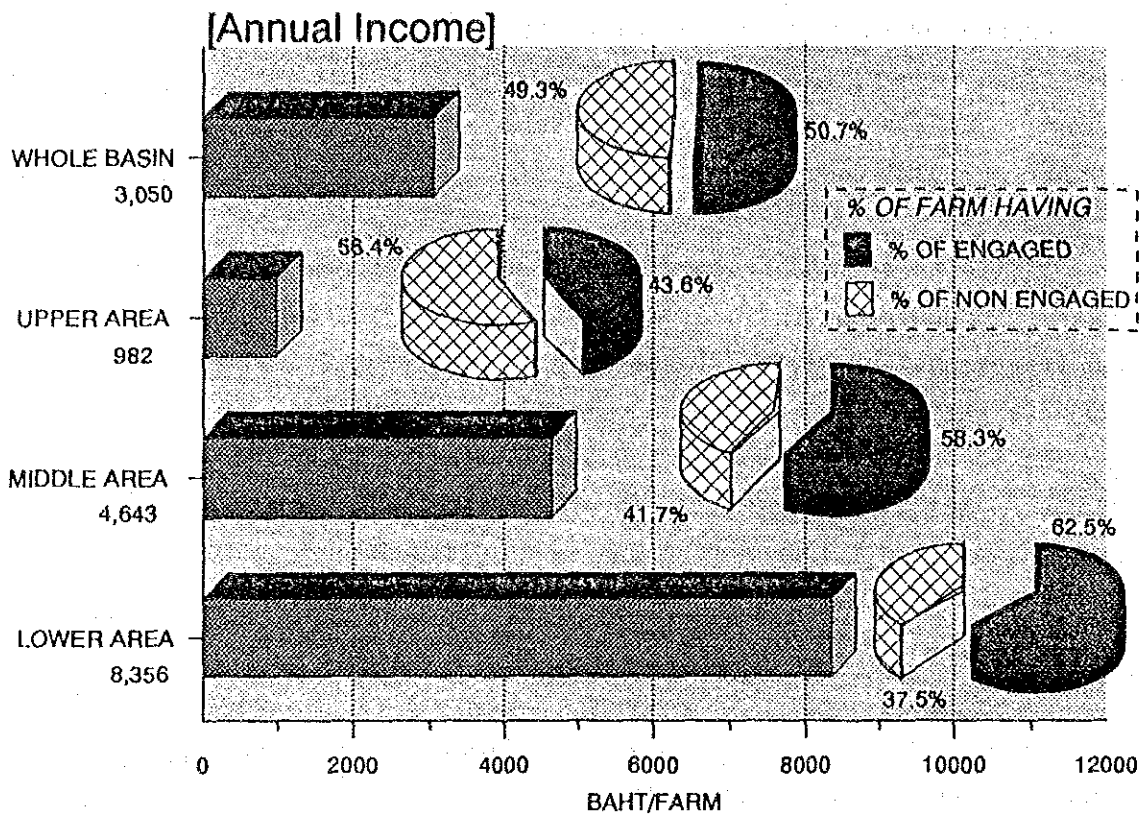
Table H-17 Numbers and Members of Farmer's Group in the Basin

Amphoe	(Unit: Group/Member)		
	Farmer's Group	Farm Women's Group	Farm Youth Group
Ubun Ratchathani Province			
Warin Chamrap	11/1,075	11/231	10/177
Det Udom	10/2,180	9/292	14/350
Phibun Mangsahan	3/ 730	3/ 69	1/ 22
Na Chaluai	3/ 205	5/ 89	7/145
Nam Yun	3/ 273	5/ 94	5/146
Samrong	1/ 104	1/ 30	1/ 22
Sub-total	31/4,567	34/805	38/862
Si Sa Ket Province			
Kantharalak	3/ 627	5/127	3/ 97
Sub-total	3/ 627	5/127	3/ 97

Total	34/5,194	39/932	41/959

Data source: Provincial Agricultural Extension Office, DOAE.

Figure H-6 Total Off-farm Hired Labour Income



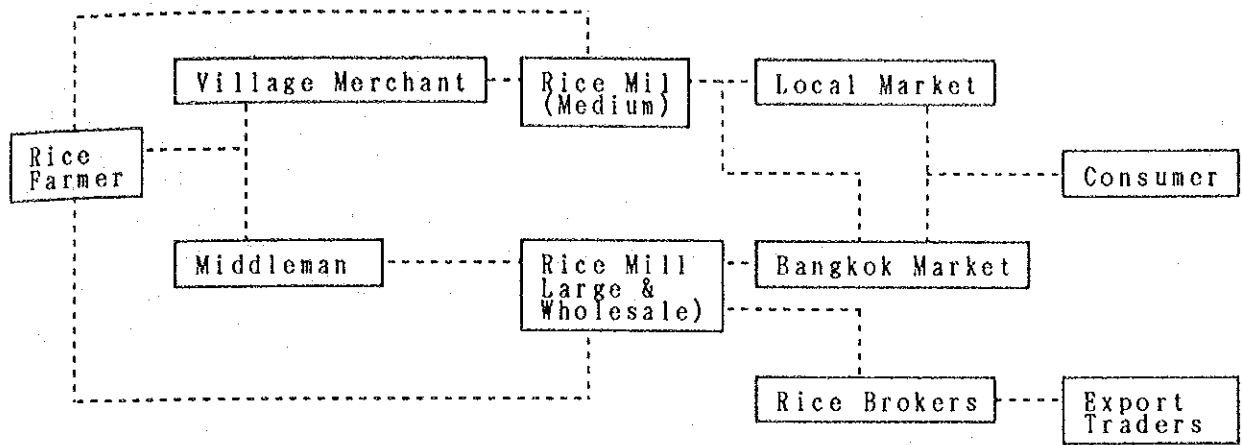


Figure H-7 Marketing Channel of Rice in the Basin

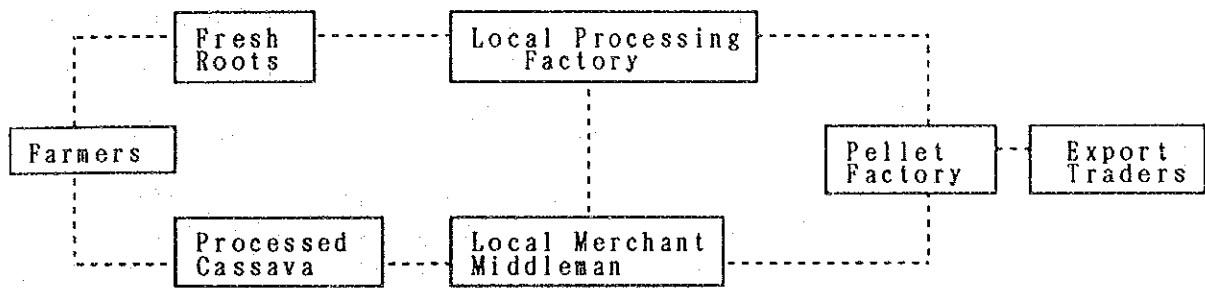


Figure H-8 Marketing Channel of Cassava in the Basin

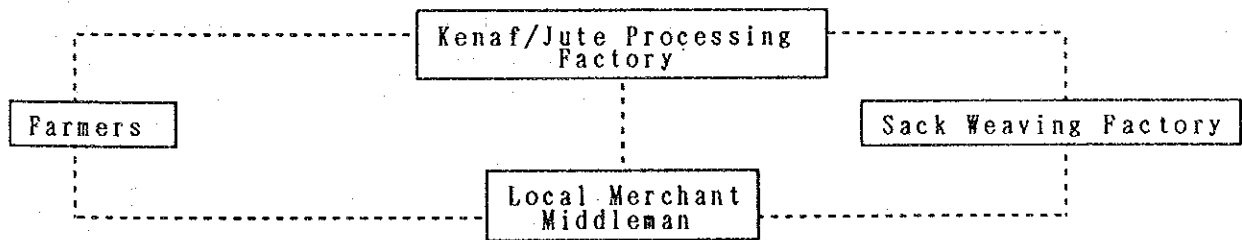


Figure H-9 Marketing Channel of Kenaf in the Basin

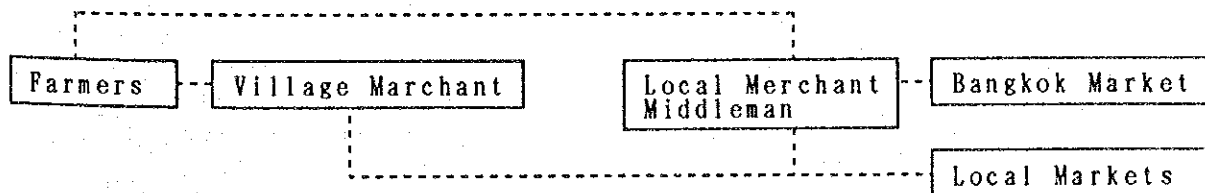


Figure H-10 Marketing Channel of Maize in the Basin

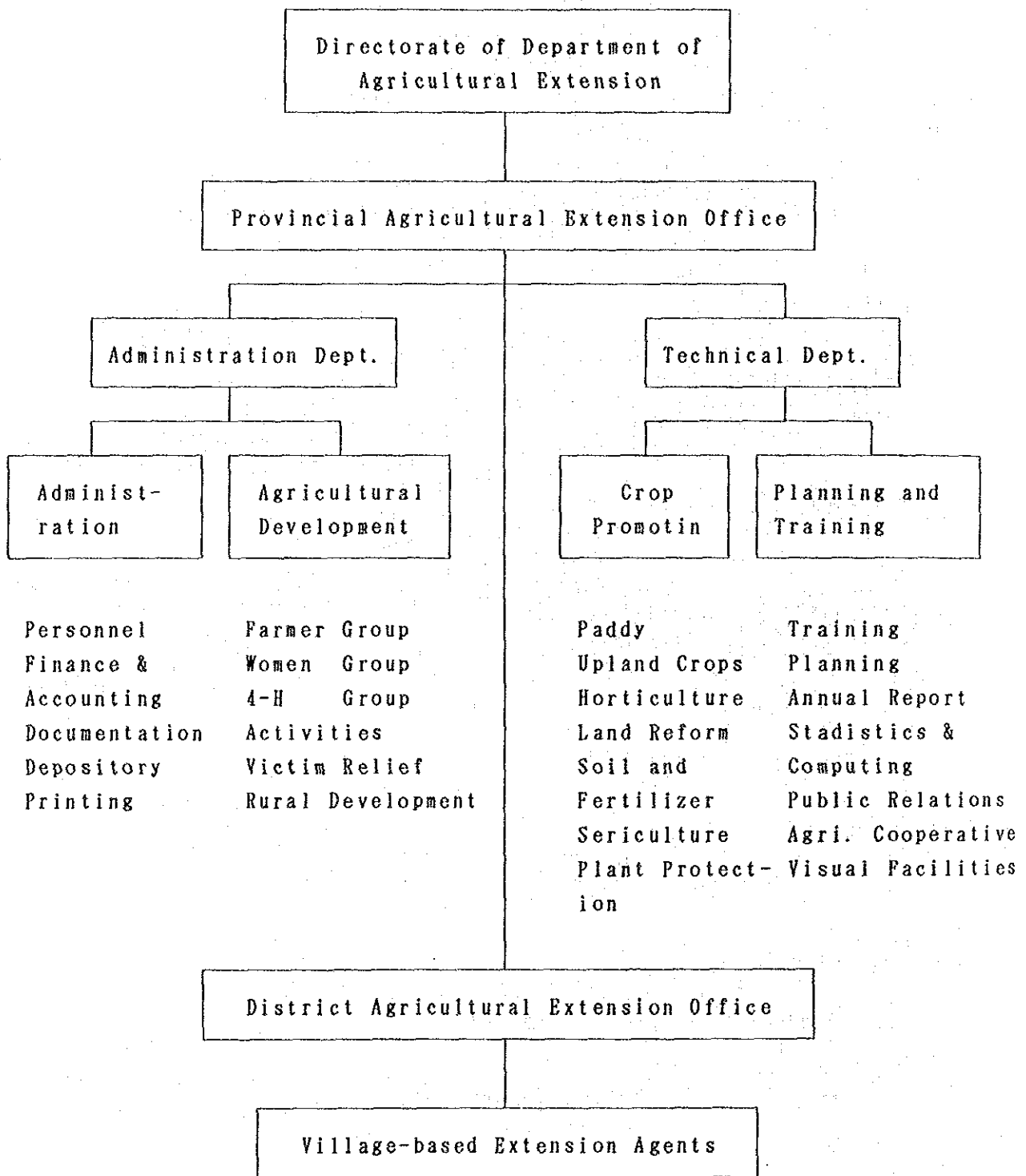


Figure H-11 Organization Chart of Agricultural Extension Services

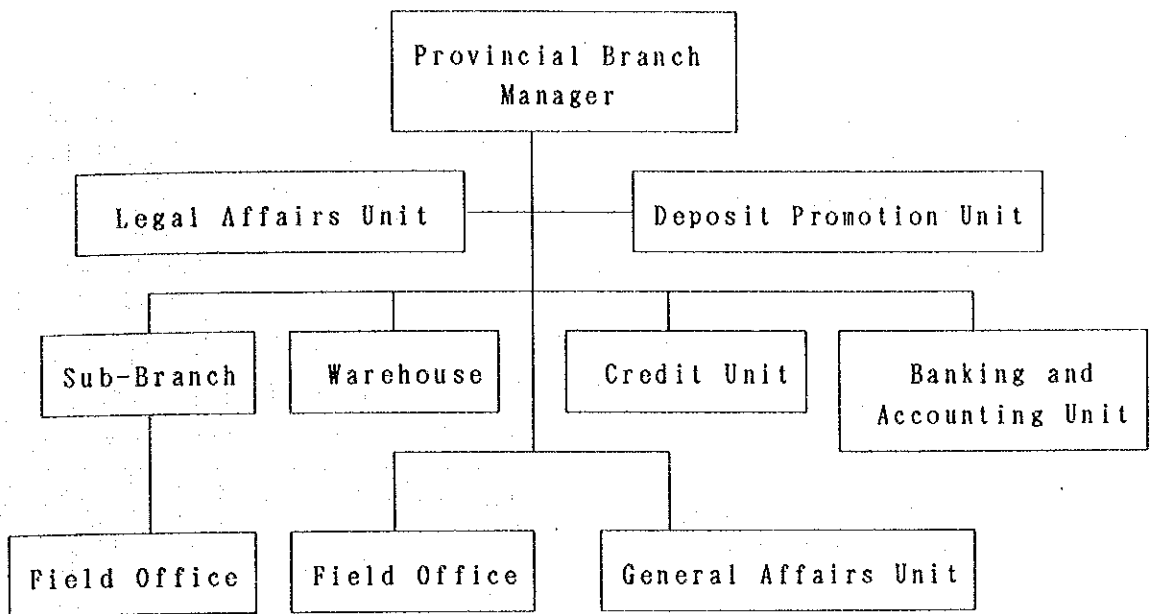


Figure H-12 Organization Chart of Provincial Branch, BAAC

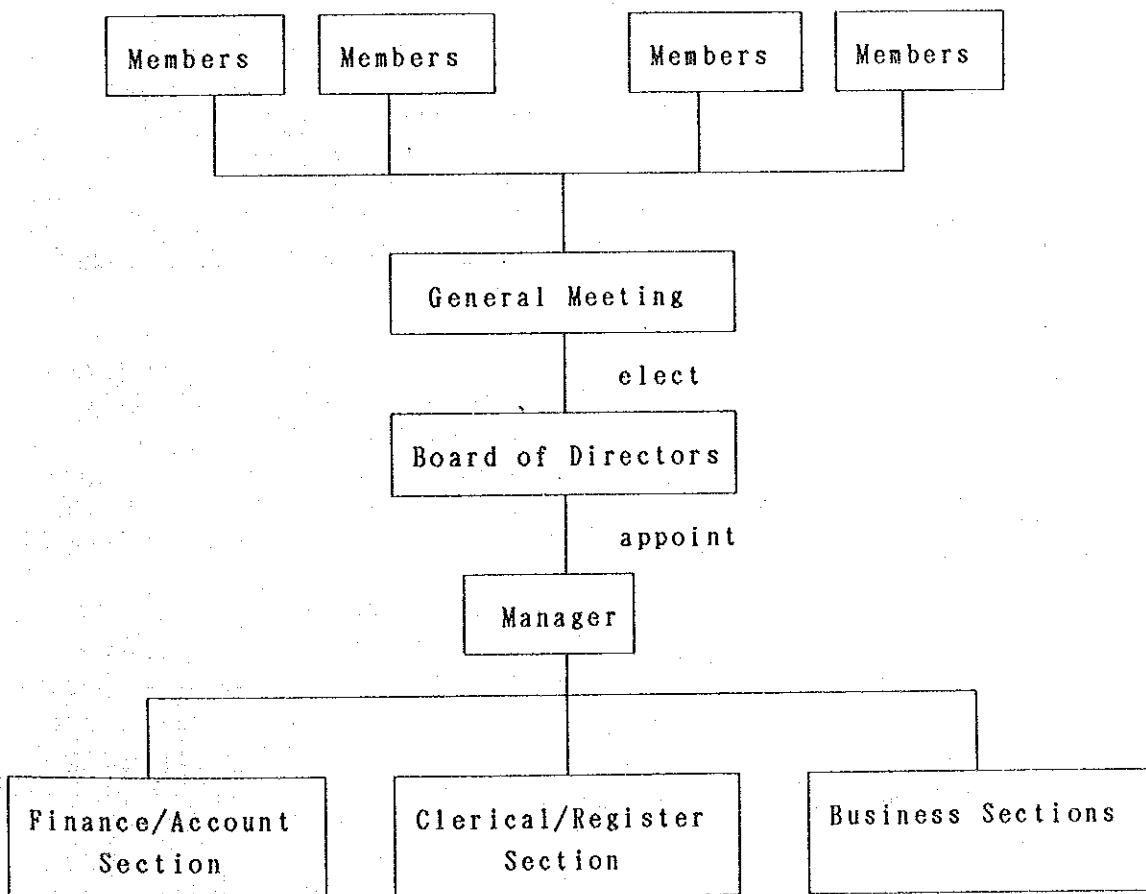


Figure H-13 Organization Chart of Agricultural Cooperatives

III. AGRICULTURE

3.1 Agricultural Condition

The basic farming pattern in the Study Area is single cropping of wet season rice, as described in the main report. According to the farm survey conducted during the field work of the Phase II Study, the farm households in the Study Area can be classified into the upper and lower areas of the right bank and the left bank. Sampled farms were 48, 56 and 48, respectively.

The survey shows in Table H-18 that the planted ratio of glutinous rice is comparatively high. There are many farmers to cultivate traditional upland crops such as cassava and kenaf in the left bank. Some dry season crops such as groundnuts and vegetables are observed in the lower right bank.

Table H-18 Summary of Farming Situation

I t e m	Left Bank	Upper Right Bank	Lower Right Bank
- Paddy Production			
% of farm household	97.92	100.00	100.00
% of total area	77.46	91.96	89.29
Area per farm household(ha)	3.93	4.51	4.29
-Upland Crops Production			
% of farm household	77.08	12.30	35.42
% of total area	17.06	2.15	5.69
Area per farm household(ha)	0.86	0.11	0.27
Main crops(Wet Season)	Cassava Kenaf	Kenaf	Cassava Kenaf
(Dry Season)			Groundnut Soybean Cucumber
-Planted Area for Paddy (%)			
H Y V 1/	65.2	49.8	74.3
L I V	33.1	37.4	24.9

(To be continued on the next page)

I t e m	Left Bank	Upper Right Bank	Lower Right Bank
L V	1.7	12.8	0.8
Non-glutinous rice	36.2	44.4	30.2
Glutinous rice	63.8	55.6	69.8

1/ HYV: High Yield Varieties LIV: Local Improvement

L V: Local Varieties

Data source: Agro-economic survey 11-12/1991

The present yield of paddy is unstable among villages, as shown in Table H-19 and Figure H-14. The Rice Research Center reported paddy yield on the experimental field as follows.

- Variety	Khao Dowk Mali 105 (LIV)
- Transplanting Time	August 8, 1991
- Planting Rate	20 cm x 20 cm
- Amount of Fertilizer Applied	N2: 10.3 Kg/rai P2 O5: 8.0 K2O: 4.0
- Yield Quantity	3,015.6 Kg/ha
- Mixing of Fertilizer	After transplanting 1st 16-16- 8 30 Kg/rai 2nd 16-16- 8 20 3rd 45- 0- 0 10

Figure H-15 shows the result of the yield survey by quadrant sampling in Amphoe Det Udom and Phibun Mangsahan, including the Study Area, in 1991. This survey has been conducted by the Agricultural Extension Office and carried out through 99 survey points. According to its result, the areas where production is more than 3,125 Kg/ha occupy 14 percent of the total survey points. Moreover, it also shows that Khao Dowk Mali 105 of LIV, which has a high marketability, represents a high level of the yield.

At present, one of the causes of the low yield of a photosensitive variety like Khao Dowk Mali 105 is late in transplanting time under rainfed conditions, which makes its growing period short. The supply of irrigation water at the transplanting time gained from the project can

bring a suitable growing period for these varieties. In the future, sustainable increase of the yield can be expected through the increase of agricultural input.

Table H-19 Trend of Paddy Yield

(Unit: kg/ha)

AMPHOE /TAMBON	Left Bank				Right Bank			
	Minimum Level		Max. Level		Minimum Level		Max. Level	
	Non glu.	Glu.	Non glu.	Glu.	Non glu.	Glu.	Non glu.	Glu.
[Det Udom]								
Muang Det								
Som Sa-at	1,146	1,146	2,188	2,115				
Kut Prathal					938	938	3,021	3,125
Klang					979	979	2,854	2,604
Kaeng	938	1,021	2,500	2,500				
Na Yia					938	1,000	3,125	3,125
Top Hu	1,563	1,563	3,333	3,438				
Tha Pho Si	1,094	1,000	1,875	1,875	1,094	1,000	1,875	1,875
Bua Ngam					792	1,000	3,208	2,813
Na Khasem								
Kham Khrang					938	1,000	2,188	1,719
Kut Rua								
Phon Ngam					1,188	1,125	2,656	2,656
[Phibum Mangsahan]								
Rai Tai					896	938	2,104	2,000
Na Pho					1,250	1,250	2,969	2,813
Na Chaluai								
Noen Sambun								
Phon Sawan								
Non Sawan								
[Nam Yun]								
Yang	1,000	1,313	2,604	2,604				
Yang Yai								

Source: National Statistics Office (NSO) 1991

Table H-20 shows total agricultural production and the present diversification level in the Study Area. The left bank is the producing area for rice and traditional upland crops. Especially, kenaf is a main upland crop for this area, raising the diversification index. The upper

right bank falls behind in diversification because single crop cultivation of rice prevails. A small amount of dry season crops are cultivated in the lower right bank. Especially, expansion of the planted area for vegetables can be expected by supplying irrigation water because of the high elasticity of demand.

Table H-20 Crop Diversification Index

	UNIT	Left	Upper Rig.	Lower Rig.	Whole Area
RICE	Production Kg	309,397.00	354,257.00	250,426.00	914,080.00
	Price Baht/Kg	3.42	3.17	3.50	3.34
	Value Baht	1,058,137.74	1,122,994.69	876,491.00	3,053,027.20
Sweet	Production Kg	4,000.00			4,000.00
Corn	Price Baht/Kg	0.93			0.93
	Value Baht	3,720.00			3,720.00
Cassava	Production Kg	84.00		5.00	89.00
(Dry)	Price Baht/Kg	1.10		1.69	1.15
	Value Baht	92.33		8.44	102.07
Kenaf	Production Kg	52,306.00	5,350.00	10,021.00	67,677.00
	Price Baht/Kg	4.76	4.68	5.22	4.77
	Value Value	248,976.56	25,038.00	52,309.62	322,819.29
Jute	Production Kg	3,550.00		2,374.00	5,924.00
	Price Baht/Kg	5.07		3.58	4.48
	Value Value	17,998.50		8,498.92	26,539.52
Ground	Production Kg			771.00	771.00
nut	Price Baht/Kg			7.13	7.13
1/	Value Baht			5,497.23	5,497.23
Soybean	Production Kg			1,000.00	1,000.00
1/	Price Baht/Kg			8.00	8.00
	Value Baht			8,000.00	8,000.00
Cucumber	Production Kg			10,000.00	10,000.00
1/	Price Baht/Kg			3.00	3.00
	Value Baht			30,000.00	30,000.00
Total Production Value		1,328,925.13	1,148,032.69	980,805.21	3,449,705.31
<u>Diversification Index</u>		<u>20.38</u>	<u>2.18</u>	<u>10.64</u>	<u>11.50</u>

Note: 1/ During Dry Season

Diversification Index=Production Value Except Rice/Total Production Value
 Source: Agro-Economic Survey 11-12/1991

Presently, second-crop rice is scarce because of the shortage of irrigation water during the dry season. The main upland crop are cassava and kenaf, which are cultivated all over the Study Area. Vegetables such as onion, corn, cucumber and cabbage are grown as self-supply for farmers. However the proportion of chilli is comparatively high. The main fruit trees are mango, while other fruits such as coconut and tamarind are observed in some areas. The planted area of each crop as agricultural land is shown in Table H-21.

Total cropping intensity of the agricultural land is estimated to be 97.1 percent in the left bank and 87.2 percent in the right bank, as shown bellow.

Table H-22 Planted Area and Ratio for Major Crops

	(Unit:ha)			
	LEFT BANK	%	RIGHT BANK	%
Paddy 1/	11,708.0	81.26	29,835.0	83.06
(To be continued on the next page)				
	LEFT BANK	%	RIGHT BANK	%
Upland Crops	2,124.0	14.74	1,235.0	3.44
Vegetable	23.3	0.16	40.5	0.11
Fruit	135.9	0.94	237.6	0.66
Sub-total	13,991.2	97.10	31,348.1	87.27
Others 2/	592.9		4,580.9	
Agri. Land	14,408.1		35,920.0	

Note: 1/ Include second crop rice

2/ Include fallow

Source: National Statistics Office (NSO) 1991

Table H-21(1) Planted Area for Major Crops

[Paddy]

Unit:ha

AMPHOE	TAMBON	LEFT BANK			RIGHT BANK			TOTAL AREA					
		Area	Non-Glu.	Glu.	Dry Sea.	Area	Non-Glu.	Glu.	Dry Sea.	Area	Non-Glu.	Glu.	Dry Sea.
Det Udom	D1. Muang Det	869	418	450	16					869	418	450	16
	D5. Som Sa-at					4,413	2,264	2,149		4,413	2,264	2,149	
	D6. Kut Prathai					3,676	1,540	2,136		3,676	1,540	2,136	
	D7. Kiang												
	D8. Kaeng	3,314	1,541	1,772	160					3,314	1,541	1,772	160
	D10. Na Yia					2,585	1,248	1,338		2,585	1,248	1,338	
	D11. Top Hu	5,396	2,614	2,782						5,396	2,614	2,782	
	D12. Tha Pho Si	989	252	738		640	160	480		1,629	412	1,218	
	D14. Bua Ngam					2,019	520	1,499		2,019	520	1,499	
	D15. Na Khasem					4,184	2,166	2,018		4,184	2,166	2,018	
	D16. Kham Khrang												
Phibum	D18. Kut Rua					3,019	1,577	1,442		3,019	1,577	1,442	
	D19. Phon Ngam					5,377	1,891	3,486	6	5,377	1,891	3,486	6
	P2. Rai Tai					3,912	1,415	2,497	4	3,912	1,415	2,497	4
Mangsaban	P3. Na Pho												
	Na Chauai*N2. Noen Sambun												
	*N3. Phon Sawan												
Nam Yun	*N6. Non Sawan												
	Y3. Yang	965	480	485						965	480	485	
	Y9. Yang Yai												
T O T A L		11,532	5,305	6,227	176	29,826	12,780	17,046	9	41,357	18,085	23,272	185

Source: National Statistics Office (NSO) 1991

Table H-21(2) Planted Area for Major Crops

[Upland Crops]

AMPHOE	TAMBON	LEFT BANK				RIGHT BANK				TOTAL AREA						
		Cassava	Kenaf	Maize	Bean	Other	Cassava	Kenaf	Maize	Bean	Other	Cassava	Kenaf	Maize	Bean	Other
Det Udom	D1. Muang Det	16	43			26										
	D5. Som Sa-at															
	D6. Kut Prathai								4							
	D7. Klang						48	264		2						2
	D8. Kaeng	220	579		8											
	D10. Na Yia						3	121		3						3
	D11. Top Hu	298	614													
	D12. Tha Pho Si	51	77			32	11	27								32
	D14. Bua Ngam							6								6
	D15. Na Khasem															
	D16. Kham Khrang						34	29								29
	D18. Kut Rua															
	D19. Phon Ngam															
Phibum	P2. Rai Tai						76	376		1						4
Mangsahan	P3. Na Pho						16	103								
Na Chaluai	*N2. Noen Sambun						2	42		3						5
	*N3. Phon Sawan															
	*N6. Non Sawan															
Nam Yun	Y3. Yang	160														
	Y9. Yang Yai															
TOTAL		745	1,318	0	8	58	191	1,022	5	9	8	936	2,336	5	17	66

Unit:ha

Source: National Statistics Office (NSO) 1991

Table H-21(3) Planted Area for Major Crops

[Vegetables & Fruits]

AMPHOE	TAMBON	LEFT BANK VEGETABLE AREA			RIGHT BANK VEGETABLE AREA			LEFT BANK FRUIT AREA			RIGHT BANK FRUIT AREA			TOTAL VEGETABLE AREA			TOTAL FRUIT AREA							
		Chilli	Onion	Corn	Other	Chilli	Onion	Corn	Other	Mango	Coconut	Other	Mango	Coconut	Other	Chilli	Onion	Corn	Other	Mango	Coconut	Other		
Det Udon	D1. Muang Det	0.8		0.8		2.1	0.2								0.8		0.8					1.6		
	D5. Som Sa-at								1.6	4.5	2.7				2.1	0.2						4.5	1.6	38.4
	D6. Kut Prathai						1.3		8.3	37.1	2.1				1.3	1.3	2.4					37.1	8.3	10.2
	D7. Kiang																							
	D8. Kaeng	5.9	0.2	1.4	5.0	0.3			0.5	0.3	0.3				5.9	0.2	1.4	5.0				41.6	10.4	37.1
	D10. Na Yia														0.3		0.5	0.3				3.2	0.5	
	D11. Top Hu	1.6		1.9	1.3										1.6		1.9	1.3				28.3	3.7	6.4
	D12. Tha Pho Si	1.8		0.3	1.2										1.8		0.3	1.2				4.8	0.5	3.7
	D14. Bua Ngam					0.5			0.5	2.1					0.5			2.1				2.1	0.5	
	D15. Na Khaem					3.5	0.3			4.6	0.3				3.5	0.3		4.6				4.6		0.2
	D16. Kham Khrang																							
	D18. Kut Rua																							
	D19. Phon Ngam					12.2	0.8	1.3		8.5	3.5	1.3			12.2	0.8	1.3					48.0	58.1	58.1
Phibum	P2. Rai Tai					2.6	1.0			3.4	2.2				2.6	1.0						3.4	0.2	0.2
Mangsaen	P3. Na Pho					0.2									0.2									
Na Chalusi	*N2. Noen Sambun																							
	*N3. Phon Sawan																							
	*N6. Non Sawan																							
Man Yun	Y3. Yang																							
	Y9. Yang Yai																							
TOTAL		10.1	0.2	4.5	8.5	21.3	3.5	4.5	11.2	70.6	59.0	108.0	31.4	3.7	9.0	19.7	145.8	73.6	154.1					

Source: National Statistics Office (NSO) 1991

3.2 Farm Labor Force

The agro-economic survey shows that average family size is 5.55 persons in the upper right bank, 5.23 in the lower right bank and 6.83 in the left bank. The farm labor force of a farm household is estimated at 3.69 persons, 3.92 persons and 4.39 persons, respectively, while the animal labor force over two years of age is estimated at 2.36 head, 2.85 head and 2.77 head per farm household, respectively. The monthly labor requirement under the condition above is shown in Figure H-16. Assuming 25 days per month for human labor, an estimated 15 days and 30 days of animal labor are required for land preparation of nursery and paddy fields respectively.

Presently, the labor balance restricts the land preparation and transplanting period from June to July and harvesting in November. Labor input for rainfed agriculture shows a remarkable fluctuation based on weather condition. The farming is mainly carried out by the family labor force because utilization of hired labor is limited during the labor peak period. Some animal labor is used for upland crops, but the labor requirement of animals is estimated by transplanting rice, which is the most labor intensive crop in the Study Area.

3.3 Farming Condition

Tables H-23 to H-25 are analyzed based on the result of the agro-economic survey. Table H-23 shows the intensity of factor inputs. In the lower right bank, labor intensity during the dry season is high because of some vegetable cultivation, though utilization of employment labor is not common. Table H-24 shows the productivity of each production factor.

Table H-23 Intensity of Factor Inputs

	UNIT	Left	Upper Rig.	Lower Rig.	Whole Area
- Labor Intensity per rai					
Wet Season	Mandays	13.65	11.37	11.73	12.18
Dry Season	Mandays			25.83	25.83
Through the year	Mandays			37.56	38.01
- Capital Intensity 1/					
Capital Input	Baht	5,206.44	3,436.63	4,110.01	4,325.42
Farming Area	Rai	31.10	30.68	30.04	30.87
Capital Intensity	Baht/rai	167.41	112.02	136.82	140.12
- Employment Labor Intensity					
Hired Labor Cost	Baht	1,007.67	1,106.41	316.32	916.22
Farming Area	Rai	31.10	30.68	30.04	30.87
Employment Labor Intensity	Baht/rai	32.40	36.06	10.53	29.68

Note: 1/ consists of seed, fertilizers, chemical, fuel/lubric and hired machine.

Source: Agro-Economic Survey 11-12/1991

Table H-24 Productivity of Production Factors

	UNIT	Left	Upper Rig.	Lower Rig.	Whole Area
- Land Productivity					
Net Agri. Production	Baht	20,972.57	14,025.51	13,539.01	16,367.07
Farming Area	rai	31.10	30.68	30.04	30.87
Land Productivity	Baht/rai	674.36	457.15	450.70	530.19
- Labor Productivity					
Net Agri. Production	Baht	20,972.57	14,025.51	13,539.01	16,367.07
Labor Input	Wet Seas. Mandays	412.66	328.31	334.74	356.99
	Dry Seas. Mandays			5.38	1.61
Through the year	Mandays	412.66	328.31	340.12	358.60
Labor Productivity	Baht/Manday	50.82	42.72	39.81	45.64

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	UNIT	Left	Upper Rig.	Lower Rig.	Whole Area
- Capital Productivity 1/					
Net Agri. Production	Baht	20,972.57	14,025.51	13,539.01	16,367.07
Capital Input	Baht	5,206.44	3,436.63	4,110.01	4,325.42
Capital Productivity	Baht	4.03	4.08	3.29	3.78

Note: 1/ consists of seed, fertilizers, chemical, fuel/lubric and hired machine.

Source: Agro-Economic Survey 11-12/1991

The cultivation of groundnut and cucumber requires adequate inputs of chemical fertilizer as shown in Table H-25. The utilization of chemical fertilizer has been increased gradually. On the other hand, to increase soil fertility, the input of compost or green manure is indispensable. Presently, some farmers in the Study Area make use of manure for paddy only. Pesticide use during the wet season is of small amount in the right bank. Herbicide use is not reported among the sample farmers in the Study Area.

Table H-25 Utilization of Farming Inputs

	UNIT	Left	Upper Rig.	Lower Rig.	Whole Area	
- Seed use						
Rice	Glutinous	Kg/rai	5.20	5.20	4.60	5.00
	Non-glutinous	Kg/rai	5.10	4.70	4.60	4.80
Upland	Cassava	Kg/rai	997.10		2,890.90	1,180.90
Crops	Kenaf/Jute	Kg/rai	1.50	1.20	1.50	1.50
	Groundnut	Kg/rai			18.30	18.30
	Soybean	Kg/rai			7.50	7.50
	Cucumber	Kg/rai			0.50	0.50
- Chemical Fertilizer use						
Rice	Glutinous	Kg/rai	13.90	14.30	15.60	15.10
	Non-glutinous	Kg/rai	18.10	13.90	15.70	16.60
Upland	cassava	Kg/rai	23.70	16.70	30.00	24.60
Crops	Kenaf/Jute	Kg/rai	21.80		19.30	20.70
	Groundnut	Kg/rai			62.50	62.50
	Soybean	Kg/rai			37.50	37.50
	Cucumber	Kg/rai			83.30	83.30

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