

*KINGDOM OF THAILAND  
MINISTRY OF AGRICULTURE AND COOPERATIVES  
ROYAL IRRIGATION DEPARTMENT*

**MASTER PLAN STUDY  
ON  
THE WATER MANAGEMENT SYSTEM AND MONITORING PROGRAM  
IN  
THE CHAO PHRAYA RIVER BASIN**

*MAIN REPORT*

*ANNEX-1 METEOROLOGY/HYDROLOGY*

*ANNEX-2 WATER MANAGEMENT PLANNING*

*ANNEX-3 WATER MANAGEMENT MODEL PROJECT*

*ANNEX-4 MONITORING/COMMUNICATION/DATA MANAGEMENT SYSTEM*

*ANNEX-5 IRRIGATION AND DRAINAGE FACILITIES*

*ANNEX-6 LAND USE/AGRICULTURE*

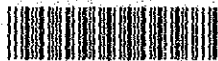
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THE KINGDOM OF THAILAND  
ROYAL IRRIGATION DEPARTMENT

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FINAL REPORT

ANNEX -- 6 LAND USE / AGRICULTURE

JUNR, 1989

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## CHAPTER 1 AGRICULTURAL SECTOR

### 1.1 National Level

#### 1.1.1 Agricultural Land (See Table 1-1 and Figure 1-1)

In 1984, the farm land area was 20,121 thousand hectares and the forest area was 15,151 thousand hectares which was equal to 39.2% and 29.5% of the national area, respectively. Looking at the change in these areas over the past 10 years, the former has increased from 35% to 40%, and the latter has decreased from 40% to 29%, on the contrary. The percentage of forest area in Thailand is extremely low and its increase is urgently required for conservation of land and water. In comparison with other Southeast Asian countries, the percentage of forest area to the respective national land is 66% in Japan, 64% in Indonesia and 40% in Philippines.

Out of the reduction in forest area of 5.77 million hectares, 25.6% or 1.48 million hectares are presumed to be utilized as the cultivated land. The conversion of forest land to upland field especially on slopes is considered one of the main causes of soil erosion in recent years.

The paddy area is 11.99 million hectares, occupying 23.4% of the national land, and has hardly increased over the years. On the other hand, second rice cropping has become possible in certain regions in which irrigation facilities are available. Farm land utilized for fruit trees, vegetables and grassland covers an area of 2.16 million hectares or 4.2% of the national land.

#### 1.1.2 Agricultural production

Table 1-2 shows general agricultural characteristics by Thai geographical region. Previously, Thai agriculture centered on paddy cropping in Central and Northeastern Regions, while the paddy cropping has gradually diversified to cultivation of upland crops, horticultural crops and so on.

Looking at the production volume of the main crops for 1985/86 gives the following figures, 20.26 million tons of paddy, 24.09 million tons of sugarcane, 15.26 million tons of cassava, and 4.93 million tons of maize. These crops are for domestic consumption as well as for export, in addition to natural rubber and coconuts (Refer to Table 1-3).

### 1.1.3 Agricultural Population and Organizations

In 1984, the number of agricultural household in Thailand was 4.75 million and the agricultural population was 33.54 million, showing increasing trend. In comparison with the whole Kingdom, agricultural household accounted for 54.7% of the total, and agricultural population did 64.7%. The increasing trend in agricultural population has created a hindrance to the growth of the rural economy due to lack of employment opportunity.

Agricultural cooperative are established at the district level carrying out purchasing and marketing activities, however, average number of membership does not exceed 17.5% due to their weak financial base.

## 1.2 Present Agriculture in the Basin

### 1.2.1 Crop Husbandry

Table 1-3 can clarify that the Chao Phraya River Basin is playing a vitally important role in Thai agriculture. In particular, wet season paddy cropping occupies about 48 percent and dry season paddy cropping about 84 percent of the national total, respectively. Besides, mungbean, sorghum, and soybean as well are produced in the Basin by nearly 90 percent of the national total. Tables 1-4 and 1-5 indicate average crop production and average cropping intensity in the Study Area, respectively.

### 1.2.2 Irrigated Agriculture

The irrigated farm land ratio is found highest in RID Region 9 followed by Region 7, 1, and 8 in order. In Region 9, however, the irrigated farm land belonging to the Chao Phraya River Basin is only 0.6

percent of the total in the Region. Region 1 provides only small farm land in acreage due to its location in the mountain basin. Under the circumstances, irrigated agriculture has been practised mainly in Region 7 and 8. Consequently, Region 7 blessed with better irrigation conditions than other Regions can produce about 60 percent of the national total of dry season paddy.

#### 1.2.3 Present Conditions of Farm Mechanization in the Basin

The farming machinery used in the Basin is mostly a two-wheels cultivator which is owned at the rate of one cultivator per six farm households. Since, however, the cultivators are unevenly diffused in the Basin, Region 3 and 8 have one machine per four farm households and Region 7 has one per five, whereas Region 1 has one per 16, and Region 2 has one per 14, respectively. And these figures suggest that the farm mechanization has been making a progress in the paddy growing areas. Mechanical threshing has been promoted as well in the Delta, whereas manual works are still practised in the upper reach of the Basin.

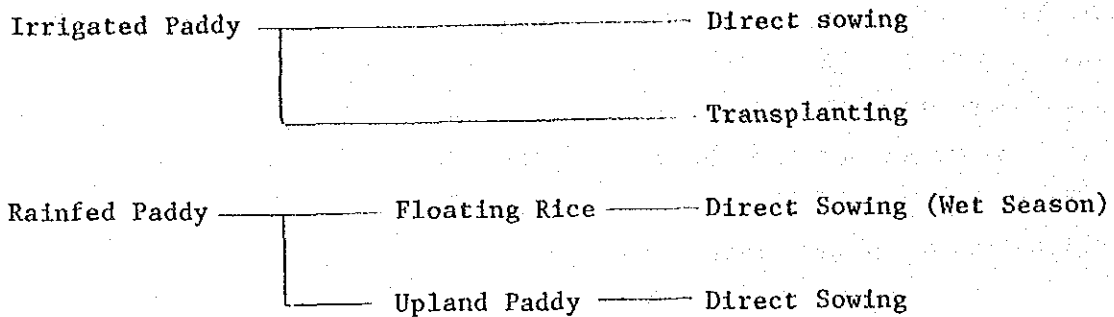
The diffusion rate of irrigation pumps is highest in Region 7 followed by 8 and 3 in order. Generally, the diffusion rate is higher in the lower reach of the Basin, and Region 7 shows the rate as high as one pump unit per three farm households.

#### 1.2.4 Land Holding

One farm household holds about 3.9 ha on an average for the whole Chao Phraya Basin, which are slightly smaller than the national average of about 4.3 ha. The ratio of the owner farmers to the tenant farmers is 7 to 3, although the owner farmers tend to be decreased in number in the lower reach as Nonthaburi, Sumut Prakan, etc.

#### 1.2.5 Paddy Cropping Types

The paddy cropping appears to be different in its method by areas. Followings are the rough descriptions of the cropping methods practised in the Basin.



The paddy cropping in the Area can be roughly divided into two, the irrigated paddy cropping represented by the Chao Phraya Delta and the rainfed paddy cropping which can be further divided into floating rice cropping and upland paddy cropping.

Floating rice is grown mainly in Ayutthaya and its surrounding areas where there chronically happens considerably deep inundation by two to four meters in the wet season. The floating rice was cropped in the area of about 228,300 ha in the year of 1986/87.

Recently, however, the direct sowing has become popular in the Delta for reducing the production cost, but there has been some problem coming up in the water utilization in the dry season because this method requires, much more water than the transplanting method.

The ratio of transplanting to direct sowing is 32 percent to 68 percent for the whole Basin, while transplanting accounts for almost 100 percent in the upper reach of the Basin.

#### 1.2.6 Cropping Pattern

The typical cropping patterns prevailing in the respective RID Regions of the Chao Phraya Basin are illustrated in Figure 1-2. Paddy cropping is a core for each cropping pattern, but there seems to be certain characteristic features observed by areas.



The representative cropping pattern are shown as follows;

	<u>Dry Season</u>	<u>Wet Season</u>	<u>Remarks</u>
Upper Reach (Region 1 & 2)	Garlic	Rice	
	Tobacco	Rice	
	Vegetables	Rice	
	Groundnuts	Rice	Most popular
	Soybean	Rice	
Middle Reach (Region 3)	Rice	Rice	Favourable in irrigation conditions
	Mungbean	Rice	Phechabun, Nakhon Sawan
	Rice	Maize	
	Maize	Maize	Nakhorn Sawan
Lower Reach (Region 7, 8 & 9)	Rice	Rice	
	Mungbean	Vegetables	
	Fruits	Fruits	Rangsit Area

Table 1-1 CHANGING IN LAND USE IN THE WHOLE THAILAND

(Unit: 1,000 ha)

(1) Land Use	Total Land	Forest Land	Paddy Land	Farm Holding Land				Total	Unclassified Land
				Field Crops	Fruits & Tree Crops	Vegetables & Flowers	Others		
1975	51,312	20,922	11,398	3,192	1,666	57	1,641	17,954	12,436
1976	51,312	19,842	11,411	3,418	1,646	57	1,566	18,098	13,372
1977	51,312	18,653	11,440	3,732	1,612	53	1,370	18,207	14,452
1978	51,312	17,522	11,723	3,801	1,668	56	1,383	18,631	15,159
1979	51,312	17,024	11,657	4,041	1,767	50	1,301	18,816	15,472
1980	51,312	16,547	11,770	4,121	1,783	50	1,316	19,040	15,725
1981	51,312	16,094	11,764	4,382	1,826	48	1,387	19,407	15,811
1982	51,312	15,660	11,716	4,686	1,900	55	1,417	19,774	15,878
1983	51,312	15,403	11,782	4,708	1,905	55	1,427	19,877	16,032
1984	51,312	15,151	11,826	4,805	1,930	66	1,423	20,050	16,111

(2) Change of Share (%)	1975	1984
Total Land	100	100
Forest Land	40.9	29.5
Paddy Land	22.2	23.0
Field Crops	6.2	9.4
Fruits & Tree Crops	3.2	3.8
Vegetables & Flowers	0.1	0.1
Others	3.2	2.8
Total Farm Holding Land	34.9	39.1
Unclassified Land	24.2	31.4

Table 1-2 Agricultural characteristics by Regions, 1984

Items	North- Eastern	Northern	Central Plain	Southern	Whole Kingdom
(1) Total Land (1,000 ha)	16,885	16,964	10,390	7,072	51,311
(2) Farm Holding Area (1,000 ha)	8,653	4,535	4,576	2,286	20,050
(3) (2)/(1) x 100 (%)	51.2	26.7	44.0	32.3	39.1
(4) Paddy Land (1,000 ha)	5,927	2,702	2,414	782	11,825
(5) Field Crop Area (1,000 ha)	1,887	1,424	1,471	22	4,804
(6) Fruits/Tree Crop Area (1,000 ha)	105	149	379	1,296	1,929
(7) Vegetable & Flowers (1,000 ha)	17	16	27	6	66
(8) Irrigated Area (1,000 ha)	522	871	1,930	336	3,659
(9) Ratio of Irrigated Area (%)	6.0	19.2	42.2	14.7	18.2
(10) Population (1,000 prs) - 1985	18,061	10,390	16,899	6,437	51,796
(11) Population Density - 1985	107	61	163	91	101
(12) No. of Farm Households	1,975,599	1,256,666	876,080	632,089	4,740,434
(13) Farm Size (ha)	4.38	3.61	5.22	3.62	4.23
(14) Planted Area for Paddy					
Wet season (ha) - 1985/86	4,773	2,136	2,009	592	9,510
Dry season (ha) - 1986	34	70	503	30	637
(15) Paddy Production - 1986					
Wet season (1,000 tons)	7,392	5,101	4,504	933	17,930
Dry season (1,000 tons)	88	249	1,921	76	2,334
(16) Paddy Yield per Hectare (tons/ha)					
Wet season (1985/86)	1.62	2.44	2.28	1.63	1.95
Dry season (1986)	2.57	3.57	3.83	2.51	3.66
(17) Production Cost of Paddy					
1984 - 1985					
Wet season (₪/ha)	4,966	6,324	5,923	5,768	5,537
Dry season (₪/ha)	6,734	9,175	9,709	7,604	9,380
(18) No. of Tractors - 1985					
2 Wheels Tractor	38,790	139,785	172,027	51,480	402,082
4 Wheels Tractor	4,950	9,296	16,082	1,087	31,415
(19) No. of Farm Household/Tractor	50	8	5	13	11
(20) Income (₪/Farm Household) 1982/83					
Farm Income	11,494	20,502	38,529	17,015	19,422
Off-farm Income	12,529	11,451	15,829	20,989	13,961
<u>Total</u>	<u>24,023</u>	<u>31,953</u>	<u>54,358</u>	<u>38,004</u>	<u>33,383</u>
(21) Expenditure (₪/Farm Household)					
- 1982/83					
Household Expense	16,040	19,477	31,422	24,074	20,759
Farm Input Expense	5,748	9,895	21,335	5,612	9,601
<u>Total</u>	<u>21,788</u>	<u>29,372</u>	<u>52,757</u>	<u>29,686</u>	<u>30,360</u>
(22) Disposable Income					
(₪/Farm Household)	2,235	2,581	1,601	8,318	3,023

Table 1-3 Agricultural Situation of the Study Area

	<u>Whole Kingdom</u>	<u>Study Area</u>
1. Land Use		
- Total Land (1,000 ha)	51,311 (100)	19,063 (37)
- Forest Land	15,151 (100)	8,074 (53)
- Cultivable Area (1,000 ha)	18,626 (100)	6,611 (35)
- Ratio of Cultivable Area (%)	36.3	34.7
- Paddy Land (1,000 ha)	11,825 (100)	4,055 (34)
- Field Crops (1,000 ha)	4,805 (100)	1,969 (41)
- Fruit/Tree Crops (1,000 ha)	1,930 (100)	226 (12)
- Vegetable/Flower (1,000 ha)	66 (100)	24 (36)
- Irrigated Area (1,000 ha) - 1984	3,659 (100)	1,951 (53)
- Ratio of Irrigated Area (%)	19.6	29.5
2. Population and Household		
- Total Population (1,000 persons) - 1985	51,796 (100)	21,281 (41)
- Population Density - 1985	100	112
- Total Household (1,000) - 1980	8,460 (100)	3,628 (43)
- No. of Farm Household (1,000) - 1984	4,740 (100)	1,638 (35)
- Agricultural Population (1,000 persons) - 1980	25,903 (100)	8,605 (33)
- Farm size (ha)	4.2	3.9
3. Production		
- Planted Area for Paddy		
Wet season (ha) - 1985/86	9,509,849 (100)	3,273,706 (34)
Dry season (ha) - 1986	637,647 (100)	503,595 (79)
- Paddy Production (1,000 tons)		
Wet season - 1985/85	17,930 (100)	7,837 (44)
Dry season - 1986	2,334 (100)	1,962 (84)
- Maize (1,000 tons) - 1985/86	4,934 (100)	3,107 (63)
- Cassava " - 1986	15,255 (100)	2,105 (14)
- Sugarcane " - 1985/86	24,093 (100)	8,616 (36)
- Mungbean " - "	323 (100)	284 (88)
- Sorghum " - "	404 (100)	342 (85)
- Soybean " - "	309 (100)	270 (87)
- Groundnut " - "	171 (100)	97 (57)

	<u>Whole Kingdom</u>	<u>Study Area</u>
- Cotton (1,000 tons) - 1985/86	102 (100)	57 (56)
- No. of Tractor - 1983		
2-wheel Tractor	474,685 (100)	286,902 (60)
4-wheel Tractor	77,324 (100)	54,644 (71)
- No. of Tractor per ha.	0.03	0.06
4. Land Tenure - 1984	(100)	(100)
- Ownership (1,000 ha)	16,816 (84)	4,682 (73)
- Rented ( " )	3,234 (16)	1,756 (27)
5. No. of Livestock - 1985		
- Buffaloe (1,000 head)	6,250 (100)	1,300 (21)
- Cattle ( " )	4,829 (100)	1,658 (34)
- Swine ( " )	4,224 (100)	1,514 (36)

Table 1-4 Averaged Crop Production in the Study Area (1982 - 1986)

(Unit: tons)

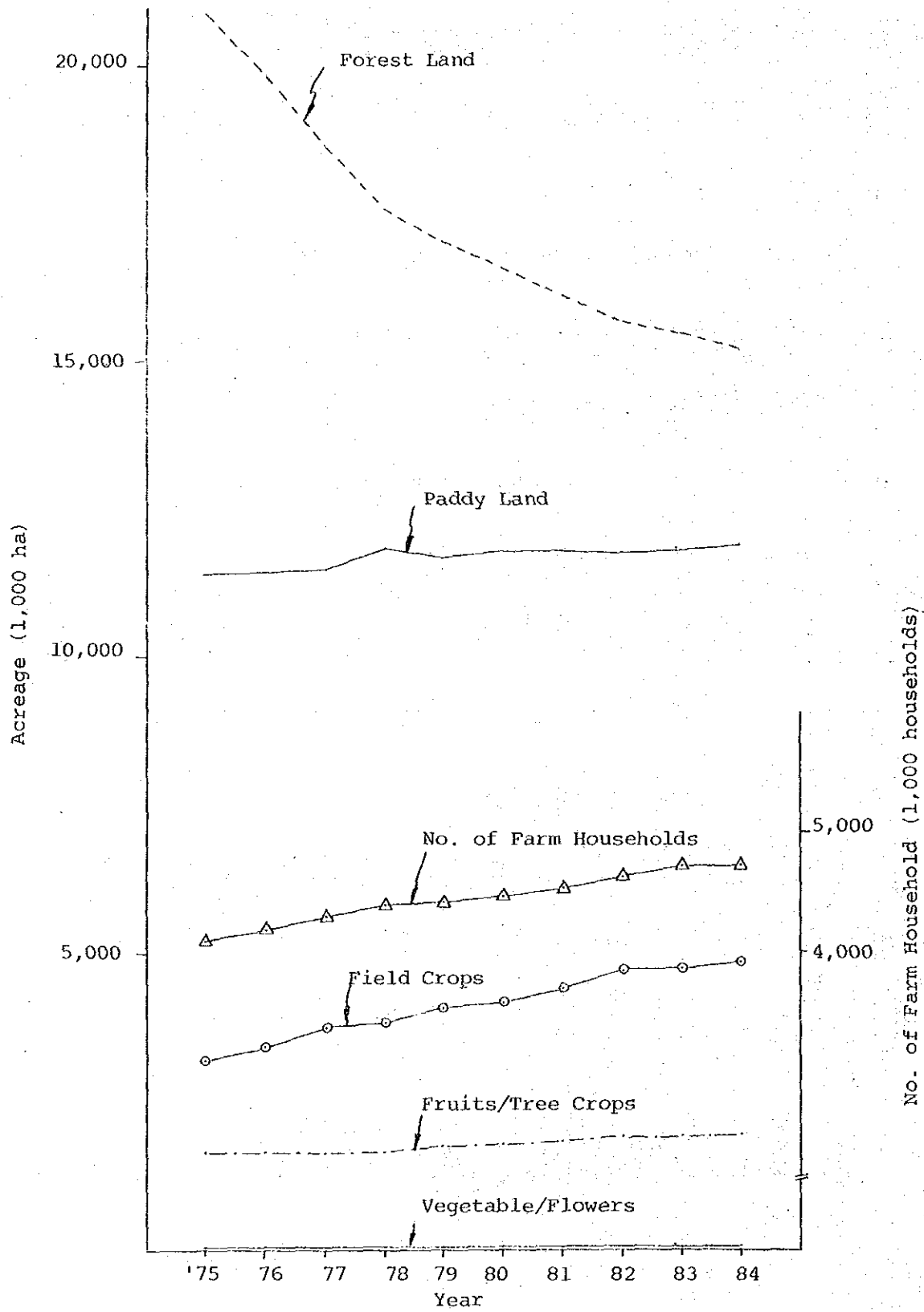
	<u>Paddy (Dry)</u>	<u>Paddy (Wet)</u>	<u>Maize</u>	<u>Cassava</u>	<u>Sugarcane</u>	<u>Mungbean</u>	<u>Sorghum</u>	<u>Soybean</u>	<u>Groundnut</u>	<u>Cotton</u>	<u>Kenaf</u>
1. Upstream											
1.1. Region - 1											
Chiang Mai	18,132	337,580	4,874	-	19,479	318	-	36,911	9,205	-	-
Lamphun	3,738	118,518	815	-	10,044	236	-	1,575	3,821	-	-
Mae Hong Son	2,091	36,608	635	-	-	-	-	2,473	2,950	-	-
Sub-total	23,961	492,706	6,324	-	29,523	554	-	40,959	15,976	-	-
1.2. Region - 2											
Lampang	5,973	153,206	11,620	-	313,487	759	35	2,678	15,774	227	-
Phayao	516	225,296	24,378	2,287	-	971	-	802	6,052	224	-
Phrae	23	111,877	38,951	-	-	4,385	-	6,921	12,668	1,172	-
Nan	2,831	78,831	66,900	-	-	7,455	-	216	16,429	3,294	-
Chiang Rai	36,776	616,935	79,713	101,090	2,396	770	-	2,982	7,446	53	19
Sub-total	44,119	1,184,145	221,562	103,377	315,883	14,340	35	13,599	58,369	5,020	19
Total	68,080	1,676,851	227,886	103,377	345,406	14,894	35	54,558	74,345	5,020	19
2. Midstream											
2.1. Region - 3											
Tak	14,213	32,741	43,946	-	11,988	2,769	3	4,219	2,028	106	-
Sukhothai	18,028	243,471	30,714	-	318,316	34,291	788	57,781	2,303	9,671	-
Uttaradit	14,198	196,287	54,984	-	481,892	12,785	33	10,154	3,081	609	-
Phitsanulok	53,855	487,884	121,688	204,702	123,180	28,014	9	3,309	2,003	139	-
Phetchabun	380	487,883	657,155	2,075	1,410	63,764	41,202	5,626	2,744	14,021	-
Phichit	19,278	429,969	36,498	-	-	16,445	623	-	358	154	-
Kamphaeng Phet	18,820	365,247	92,268	209,692	1,832,616	28,280	370	15,976	891	3,462	24
Nakhon Sawan	33,764	401,311	199,524	89,823	261,814	19,846	44,985	3,753	3,214	5,171	-
Lob Buri	208	1,956	2,723	262	961	141	774	28	12	114	-
Total	172,744	2,646,749	1,239,500	506,554	3,032,177	206,335	88,787	100,846	16,634	33,447	24
3. Downstream											
3.1. Region - 7											
Kamphaeng Phet	1,201	23,314	5,889	66,923	116,975	1,805	24	1,020	57	221	2
Nakhon Sawan	18,116	215,320	107,053	48,194	140,474	10,648	24,136	2,014	1,725	2,775	-
Uthai Thani	3,976	98,774	115,539	129,007	206,066	2,930	7,146	1,029	378	2,512	-
Chai Nat	115,634	285,586	4,285	114,059	180,174	919	855	77	614	6	-
Suphan Buri	289,511	304,040	14,061	161,873	2,307,854	294	3,451	401	540	547	-
Sing Buri	71,688	145,864	-	-	43,623	1,134	-	12	244	-	-
Ang Thong	100,796	146,059	-	-	39,361	861	-	-	-	-	-
Ayutthaya	63,739	166,174	-	-	-	748	-	-	3	-	-
Pathum Thani	70,453	55,340	-	-	-	-	-	-	-	-	-
Nonthaburi	112,902	56,516	-	-	-	-	-	-	-	-	-
Bangkok Metro.	17,007	24,371	-	-	-	-	-	-	-	-	-
Samut Prakan	11,096	14,380	-	-	-	-	-	-	-	-	-
Kanchanaburi	675	4,189	1,457	8,824	197,946	6	414	1,005	20	216	-
Nakhon Pathom	69,942	42,957	-	-	333,030	-	-	-	3	-	-
Samut Sakhon	9,945	15,561	-	-	-	-	-	-	-	-	-
Sub-total	956,501	1,571,445	248,284	528,880	3,545,503	19,345	35,753	5,558	3,584	6,277	2
3.2. Region - 8											
Nakhon Sawan	8,305	98,718	49,081	22,096	64,404	4,882	11,066	923	791	508	-
Chai Nat	20,570	45,991	762	20,286	28,488	164	152	14	109	1	-
Sing Buri	17,365	35,333	-	-	10,567	275	-	2	59	-	-
Ayutthaya	66,341	172,956	-	-	-	779	-	-	-	-	-
Pathum Thani	166,762	130,989	-	-	-	-	-	-	-	-	-
Nonthaburi	12,383	6,210	-	-	-	-	-	-	-	-	-
Lob Buri	34,505	324,002	451,108	43,475	159,140	23,442	128,237	4,584	2,014	18,942	-
Saraburi	24,679	226,635	241,052	76,543	55,335	5,857	22,213	4,615	3,209	4,139	-
Bangkok Metro.	41,840	59,957	-	-	-	-	-	-	-	-	-
Samut Prakan	26,263	34,034	-	-	-	-	-	-	-	-	-
Nakhon Nayok	1,124	18,081	19	1,157	101	-	-	-	1	-	-
Sub-total	420,137	1,152,906	742,022	163,557	318,035	35,399	161,668	10,138	6,183	23,590	-
3.3. Region - 9											
Samut Prakan	11,096	14,380	-	-	-	-	-	-	-	-	-
Chachoengsao	32,941	65,444	505	202,864	53,210	63	-	201	204	22	23
Sub-total	44,037	79,824	505	202,864	53,210	63	-	201	204	22	23
Total	1,420,675	2,804,175	990,811	895,301	3,916,748	54,807	197,421	15,897	9,971	29,889	25
Grand Total	1,661,499	7,127,775	2,458,197	1,505,232	6,294,331	276,036	286,243	171,301	100,950	68,356	68

Source: Agricultural Statistics of Thailand, 1985/86

Table 1-5 Averaged Cropping Intensity in the Study Area (1982 - 1986)

Cultivable Area (1)	Paddy (Ha)		Cassava		Sugar-cane		Mung-bean		Sorghum		Soybean		Ground-nut		Cotton		Kanaf	Vegetable	Fruits/Tree Crops	Total (2)	Cropping Intensity (%) (3)
	(Dry)	(Wet)																			
<b>1. Upstream</b>																					
<b>1.1. Region - 1</b>																					
191,956	5,591	97,527	2,112	-	477	304	31,474	7,017	-	-	20,001	32,110	196,693	101.9							
58,595	1,064	40,071	335	-	237	384	1,403	2,594	-	-	12,917	7,833	66,818	114.0							
21,008	815	12,203	270	-	-	-	2,559	2,348	-	-	3,409	3,264	24,908	148.6							
272,559	7,470	149,801	2,717	-	714	748	35,476	11,959	-	-	35,327	43,207	288,419	105.8							
<b>1.2. Region - 2</b>																					
134,655	2,132	66,827	6,002	-	8,818	1,498	2,248	12,140	375	-	10,989	16,358	129,442	92.1							
136,180	171	56,216	10,157	127	-	1,597	836	4,922	103	-	3,371	6,258	125,945	96.5							
74,735	8	39,484	19,162	-	-	7,320	6,499	9,181	1,215	-	1,730	4,741	89,540	119.5							
90,205	924	32,346	35,079	-	-	11,999	7,052	12,259	6,045	-	5,767	13,463	116,087	128.7							
319,708	12,954	187,619	41,632	-	91	1,101	2,960	5,887	80	-	6,715	15,388	181,611	88.1							
755,483	16,189	424,492	112,032	-	8,909	23,615	44,389	5,898	16	-	26,572	58,215	182,445	98.3							
1,028,042	21,659	574,293	114,749	-	9,622	24,363	49,224	5,898	16	-	54,879	101,422	1,039,844	100.3							
<b>2. Middletown</b>																					
<b>2.1. Region - 3</b>																					
60,191	877	15,492	2,946	-	245	4,585	4,292	1,623	161	-	2,946	6,044	40,713	66.8							
308,999	4,905	112,112	16,051	-	6,881	47,863	49,712	2,551	8,485	-	2,924	21,429	273,498	89.1							
170,102	4,242	29,702	29,925	-	11,372	22,988	7,892	2,568	397	-	4,538	27,648	185,621	109.1							
381,916	13,614	202,892	54,950	19,712	2,542	48,029	14,307	1,652	128	-	6,361	31,249	377,718	98.9							
372,939	5,511	173,756	45,775	15,949	36,772	30,533	13,798	2,662	71	-	1,960	15,867	383,241	97.4							
380,837	5,610	248,843	19,795	-	26,239	685	125	691	125	-	2,711	9,516	313,785	82.4							
364,644	8,838	212,549	84,558	5,796	5,590	30,014	2,801	3,382	91	-	2,865	12,228	413,502	113.4							
2,647	95	885	1,161	-	19	283	26	6	8	-	20	20	3,284	124.1							
554,627	109	183,490	275,955	164	42	101,744	38,339	1,849	13,984	-	5,108	18,394	644,745	116.2							
2,594,902	43,801	1,223,721	531,614	35,240	63,463	332,278	87,163	13,470	29,815	-	29,533	142,392	2,615,607	100.8							
<b>3. Downstream</b>																					
<b>3.1. Region - 7</b>																					
23,805	352	11,091	2,922	992	2,347	3,223	861	45	170	1	125	1,013	23,186	97.4							
195,647	4,742	114,041	43,369	2,110	2,995	16,104	1,502	1,202	2,103	-	-	6,561	222,041	113.5							
119,741	1,143	58,466	55,685	6,344	4,869	5,037	966	398	2,141	-	-	1,129	154,251	128.8							
147,284	30,864	112,730	2,049	7,235	3,467	1,528	83	422	1,103	-	1,103	3,802	165,500	112.4							
56,211	17,708	59,044	-	-	692	1,347	12	180	-	-	356	2,828	76,667	136.4							
82,203	26,180	69,537	-	12,180	673	1,536	-	-	-	-	690	6,696	105,348	128.2							
288,101	73,710	125,400	7,853	-	52,838	670	381	390	573	-	1,243	14,113	291,840	101.3							
106,393	17,643	83,216	702	615	-	1,489	-	2	-	-	395	3,435	106,180	99.8							
8,767	197	2,122	702	-	4,286	9	31	17	180	-	266	331	8,857	101.0							
35,503	18,087	24,381	-	-	-	-	-	-	-	-	562	4,764	47,984	135.2							
37,020	16,817	16,150	-	-	6,968	-	-	3	-	-	1,850	3,924	45,512	120.3							
28,636	26,775	17,627	-	-	-	-	-	-	-	-	2,545	10,156	57,103	199.4							
18,966	6,056	11,791	-	-	-	-	-	-	-	-	940	5,965	24,732	130.5							
10,197	3,455	5,141	-	-	-	-	-	-	-	-	745	3,040	12,381	121.4							
15,435	2,903	6,234	-	-	-	-	-	-	-	-	1,715	3,996	14,848	96.2							
1,174,709	246,632	711,207	115,180	33,176	78,859	31,445	3,856	2,559	5,171	-	14,982	81,753	1,356,460	115.5							
<b>3.2. Region - 8</b>																					
89,699	2,174	52,285	20,800	1,425	1,375	7,383	609	551	964	-	705	3,008	101,799	113.5							
26,195	5,489	20,050	471	1,411	617	272	15	75	1	-	196	676	29,435	112.4							
13,616	4,290	12,849	44	168	448	448	4	44	-	-	86	685	18,573	136.4							
438,538	9,406	146,632	192,410	2,178	3,133	46,811	108,884	1,256	15,077	-	3,256	3,640	537,961	122.7							
232,763	7,123	99,342	105,078	5,380	891	10,513	18,448	2,092	2,930	-	2,069	11,621	269,721	121.1							
110,735	10,353	86,613	-	-	-	1,550	-	2	-	-	-	3,276	110,515	99.8							
84,025	42,812	58,184	-	-	-	-	-	-	-	-	1,320	11,276	113,602	138.2							
3,147	2,942	1,937	-	-	-	-	-	-	-	-	279	1,116	6,274	199.4							
46,661	14,899	29,008	-	-	-	-	-	-	-	-	2,312	14,674	60,893	130.5							
24,136	6,178	12,170	-	-	-	-	-	-	-	-	73	7,197	27,618	114.4							
14,757	450	10,101	-	73	-	-	-	-	-	-	38	581	11,255	76.3							
1,074,272	116,126	529,171	318,766	11,669	6,187	66,977	131,734	4,020	18,972	-	10,753	57,850	1,287,646	119.9							
<b>3.3. Region - 9</b>																					
43,578	10,501	28,344	313	14,505	1,327	100	167	158	21	-	238	3,959	59,652	136.9							
10,197	3,455	5,141	-	14,505	1,327	100	167	158	21	-	238	3,959	59,652	136.9							
53,735	13,956	33,485	313	14,505	1,327	100	167	158	21	-	238	3,959	59,652	136.9							
2,302,156	444,274	1,027,863	434,249	59,330	66,373	98,832	13,242	6,737	24,164	-	26,096	146,602	2,715,625	117.9							
5,925,700	444,274	3,071,877	1,080,622	101,872	159,452	455,163	148,629	76,455	59,877	-	170,238	390,419	6,381,876	107.4							

Figure 1-1 Change in Land Utilization in Thailand



Source: Agricultural Statistics of Thailand, 1985/86



Region: 1 (Chiang Mai)  
 Project Office: Mae Kuang

Transplanting:  
 Broadcasting:  
 Fish Pond:

Wet Season  
 100 %  
 - %

Dry Season  
 100 %  
 - %  
 - ha

Planted Area of Paddy  
 Wet Season 9,600 ha  
 Dry Season 6 ha

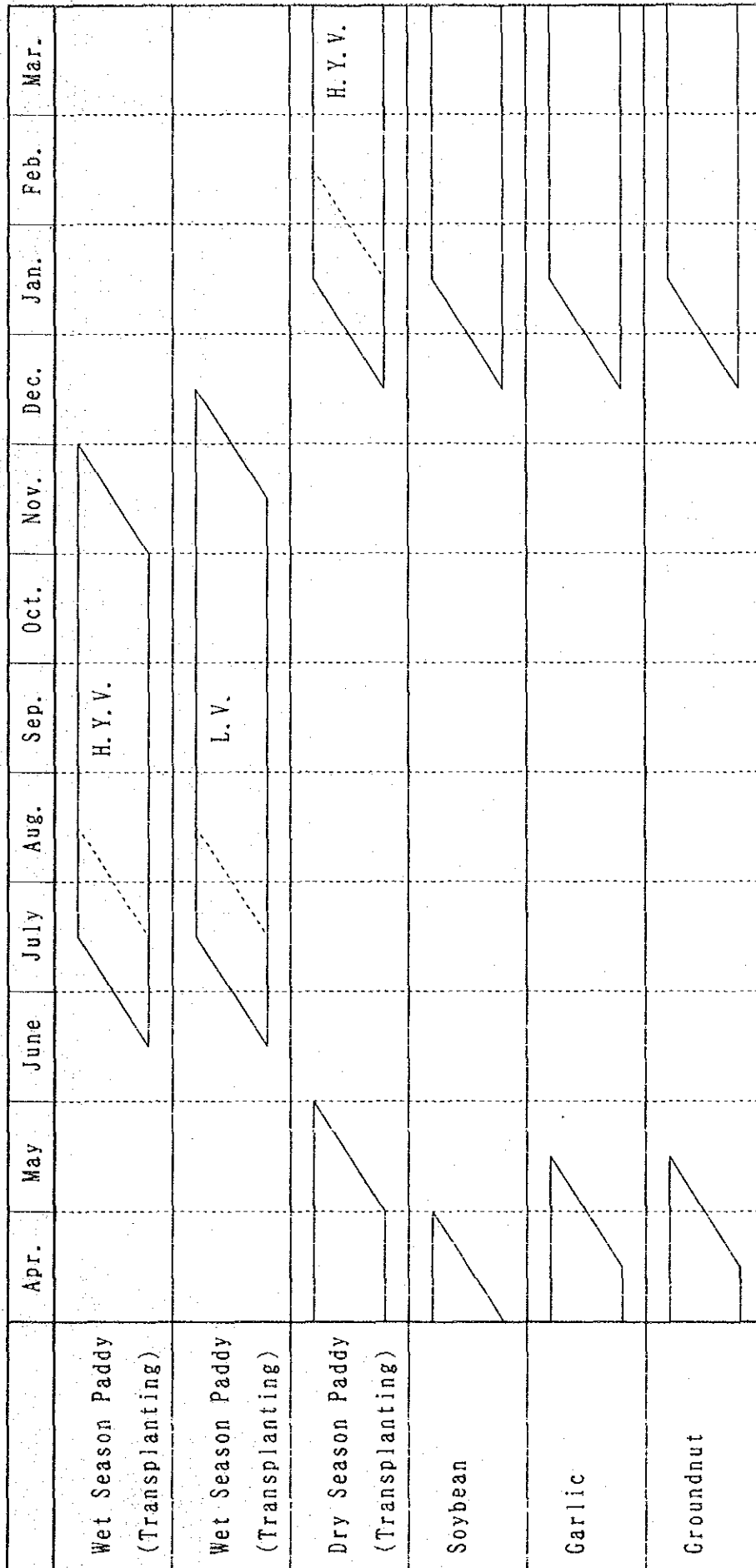


Figure 1-2 TYPICAL CROP ROTATION AT PRESENT (1)

Region: 2 (Lamphang)  
 Project Office: Mac Yom

Wet Season  
 100 %  
 - %

Dry Season  
 100 %  
 - %

Planted Area of Paddy  
 Wet Season 29,790 ha  
 Dry Season 3 ha

Transplanting:  
 Broadcasting:  
 Fish Pond: - ha

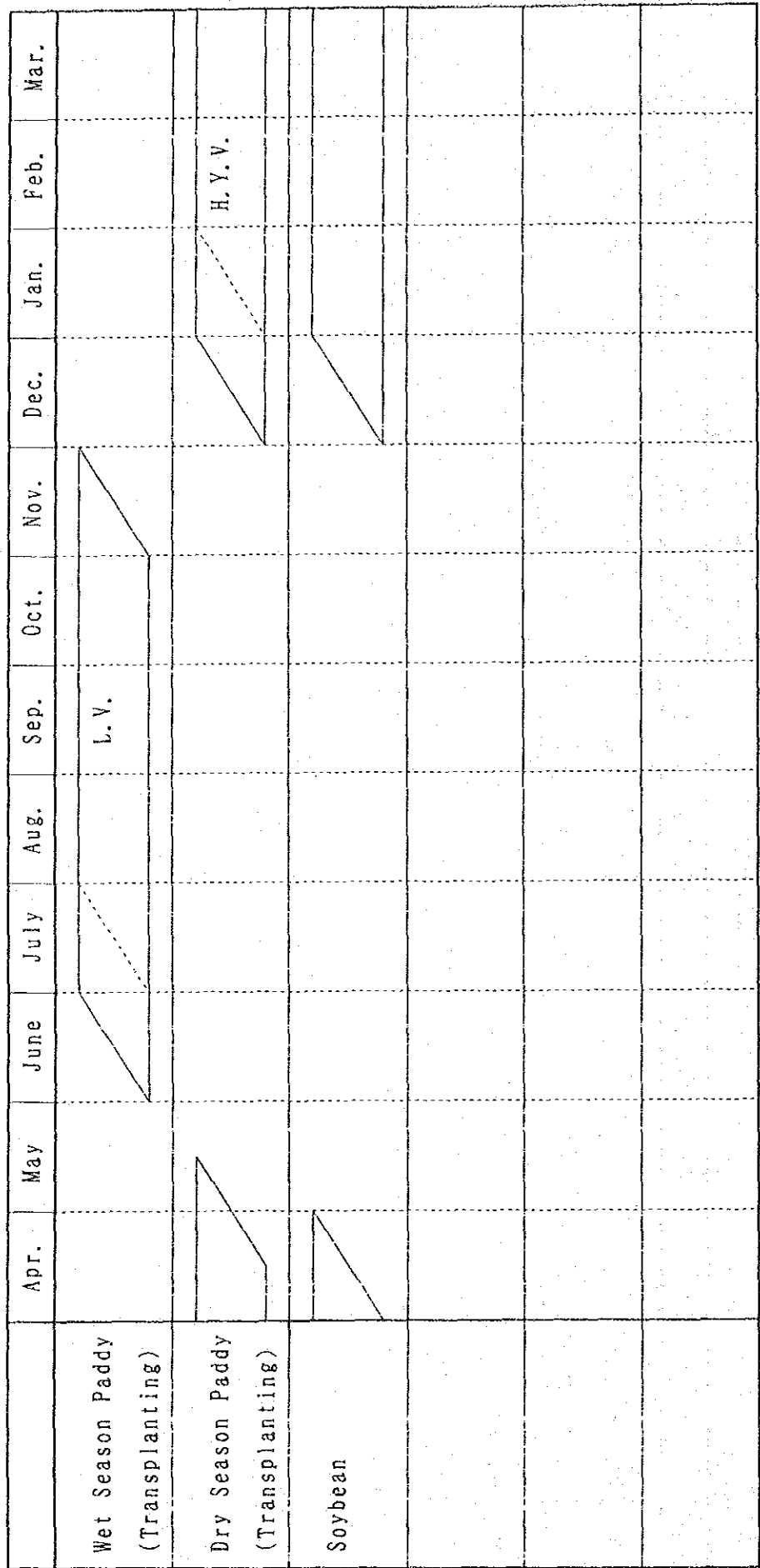


Figure 1-2 TYPICAL CROP ROTATION AT PRESENT (2)

Wet Season: - %  
 Dry Season: 60 %  
 Transplanting: 100 %  
 Broadcasting: 40 %  
 Fish Pond: - ha

Planted Area of Paddy  
 Wet Season: 24,470 ha  
 Dry Season: 1,910 ha

Region: 3 (Phitanulok)  
 Project Office: Dong Setti

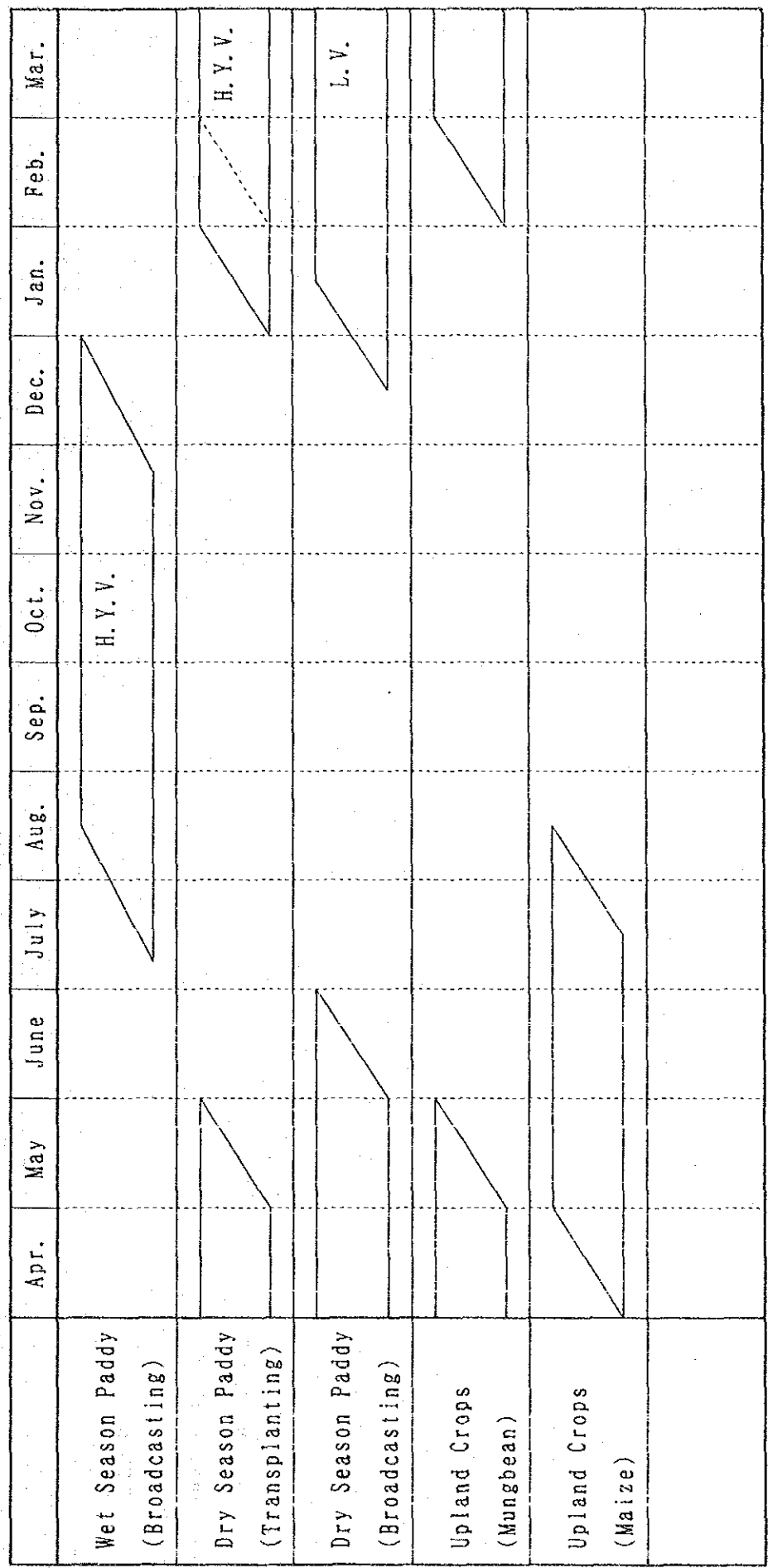


Figure 1-2 TYPICAL CROP ROTATION AT PRESENT (3)

Region: 7 (Chainat)  
 Project Office: Thabole  
 Wet Season: 100%  
 Dry Season: 10%  
 Transplanting: 90%  
 Broadcast: 10%  
 Fish Pond: 26 ha

Planted Area of Paddy  
 Wet Season: 26,790 ha  
 Dry Season: 12,930 ha

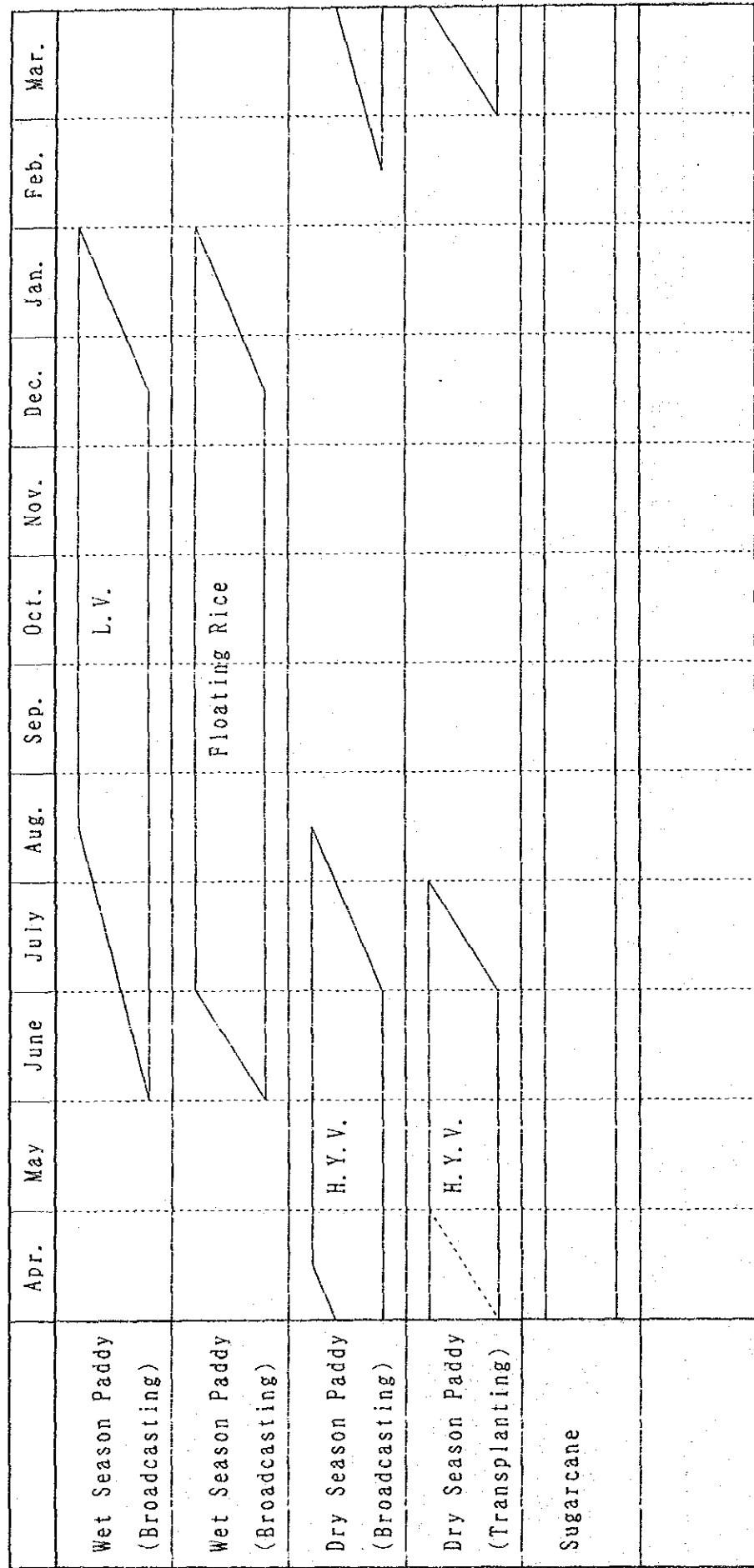


Figure 1-2 TYPICAL CROP ROTATION AT PRESENT (4)

Region: 8 (Lop Buri)

Project Office: Chong Kae

Wet Season

65 %

Dry Season

100 %

Transplanting:

35 %

Broadcasting:

- %

Fish Pond:

- ha

Planted Area of Paddy

Wet Season

36,890 ha

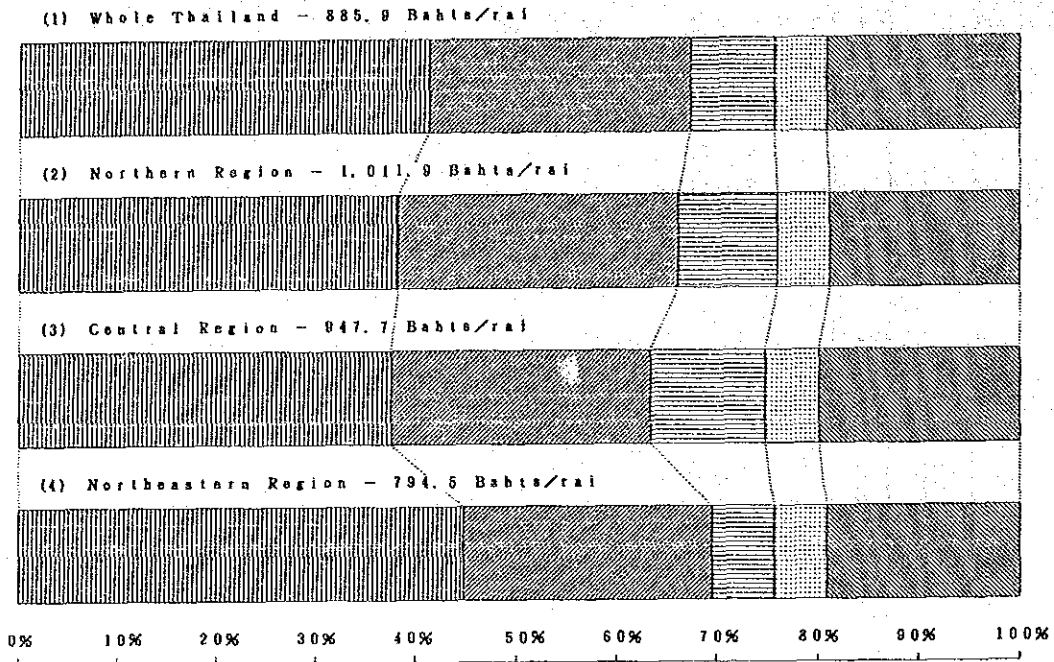
Dry Season

2,870 ha

	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Wet Season Paddy (Broadcasting)					Floating Rice							
Wet Season Paddy (Transplanting)						L.V.						
Dry Season Paddy (Broadcasting)												
Upland Crops (Mungbean & Groundnuts)												

Figure 1-2 TYPICAL CROP ROTATION AT PRESENT (5)

## 1. Wet Season Paddy



## 2. Dry Season Paddy

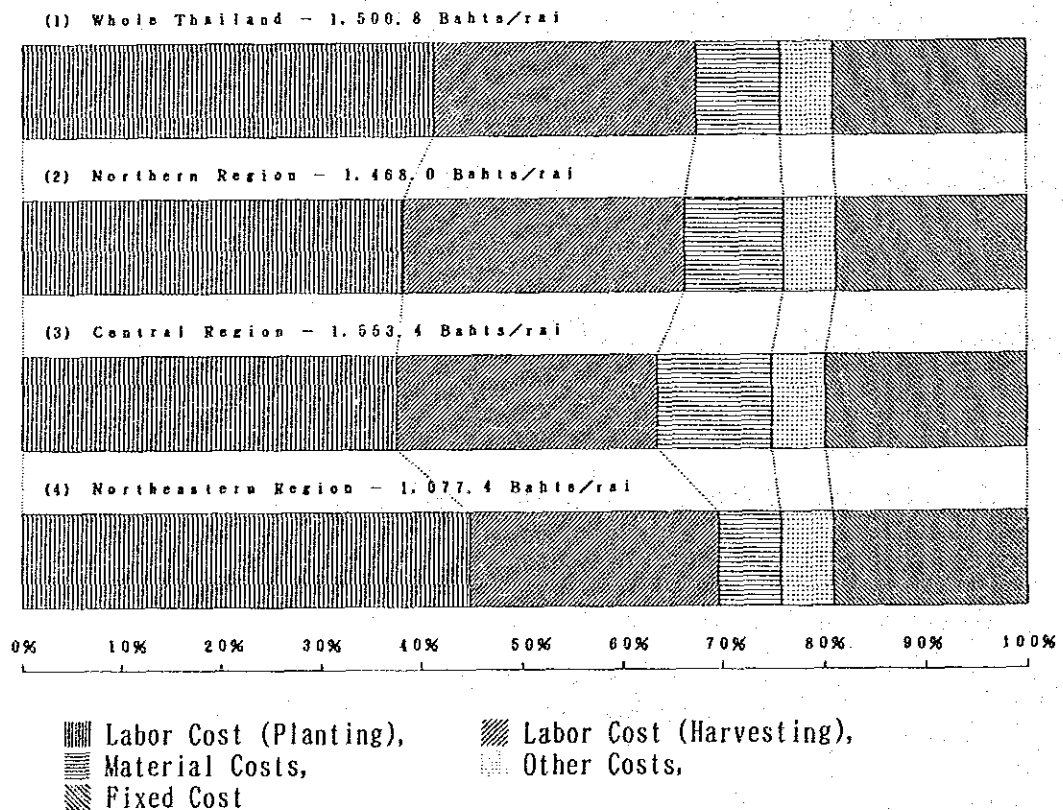


Figure 1-3 PRODUCTION COST OF PADDY (1984/85)

## CHAPTER 2 SOIL AND LAND USE

### 2.1 Soils and Land-form

#### 2.1.1 Soil Map and Mapping Units

The General Soil Map of Thailand (Scale at 1:1,000,000) prepared by the Department of Land Development (DLD) is one of the soil maps covering the Study Area. Since 1970, DLD has adopted Soil Taxonomy developed by the Department of Agriculture of the United States of America. All soil series established in Thailand were placed into the soil families of this classification system. In 1979, the General Soil Map of Thailand was published at a scale of 1:1,000,000. In this soil map, the great groups of Soil Taxonomy were subdivided into soil units by the soil texture and acidity. The soil units and their associations were used as mapping units. A total of 91 mapping units was found in Thailand, 41 out of which were recognized in the Study Area.

#### 2.1.2 Soils and Land-form (See Figures 2-1 and 2-2)

Active and former tidal flats of recent marine and brackish water deposits occur very extensively in the Southern Central Plain. Active tidal flats occupy only a narrow coastal strip which is inundated daily by sea water. The relief is flat and the soils are very poorly drained, gray colored fine clayey textured Saline Hydromorphic Alluvial Soils (Clayey Hydraquents). Part of the soils have high sulfur contents and either extremely acid or potentially acid (Loamy, Clayey Sufaquents), that is, soil reaction becomes extremely acid on oxidation.

The area is for a large part under Mangrove and salt-tolerant shrubs and in places used for fish and shrimp productions.

The vicinity of Bangkok is the main part of the tidal flat. The soils are poorly drained, gray colored Hydromorphic Alluvial Soils with very fine textures (Clayey Trophaquents).

Former tidal flat of older brackish water deposits occupy a large area extending from Ayutthaya to Bang Khen, and Bangkok. Flooding by river water takes place to depths of one meter or more for four to seven months during the rainy season. The soils are somewhat poorly drained, very fine textured Hydromorphic Alluvial Soils (Acid Sulfate Soils)(Clayey Acid Tropaquepts). These soils are characterized by the occurrence of yellow jarosite mottles associated with extremely acid reaction in some part of the profile.

The soils on tidal flats are mainly used for wet land rice and locally are ridged for the cultivation of fruits and vegetables. In a wide zone along the eastern border of the Central Plain, parent materials of the low terraces consist of marl derived clays that are rich in montmorillonite. The soils are very fine textured and crack widely in the dry season. They are identified as Grumsols (Clayey Pelluderts).

Flood plains of recent river alluvium occur along the Chao Phraya River around from Ayutthaya to Phitsanulok and Kamphean Phet. The soils found on higher position of the flood plains are moderately well drained, loamy Alluvial Soils (Loamy Ustifluvents). They are subject to short floods during the rainy season and mainly used for upland and garden crops, orchards.

The soils in depressed position of the flood plains are poorly drained, clayey Hydromorphic Alluvial Soils (Clayey Tropaquepts). In the Central Plain, these soils are flooded to depths of 50 cm or more and usually used for broadcast rice.

Low alluvial terraces of semi-recent and old alluvium occur extensively both sides of flood plains. These terraces have nearly flat relief and consist of higher and lower-lying areas.

The soils of the lower lying area are somewhat poorly drained and flooded by impounded rain water during the rainy season. They are fine loamy to clayey textured Low Humic Gley Soils (Clayey Tropaqualfs, Clayey Paleaquepts). These soils are mainly used for transplanted rice during the rainy season.



The soils of the higher parts are moderately well drained, fine loamy, Non-calcic Brown Soils (Loamy Haplustalfs). They are mostly used for orchards, garden and upland crops.

High alluvial terraces and fans are scattered along the border of the Southern Central Plain. Their relief is undulating and the soils are moderately well drained, loamy textured or skeletal Gray Podzolic Soils (Loamy Paleustalfs, Skeletal Paleustalfs). They are under Dipterocarp forest with some areas cleared for cultivation of some upland crops.

In North Thailand, high terraces and fans occur in all major alluvial basins. The soils on main parts of these lands have undulating relief and are moderately well drained, loamy textured Gray Podzolic Soils (Loamy Paleustults). The soils in higher and well drained areas with undulating or rolling relief, belong to Red Yellow Podzolic Soils (Skeletal Paleustults). Terraces and fans are largely cleared for shifting cultivation of upland crops.

Erosion surfaces and Plateaux occur among the hills and mountains in the middle and upper parts of the Chao Phraya River Basin. Their reliefs are undulating to rolling and the parent materials are from various rocks, such as granit, shale and its metamorphic equivalents, and marl. The soils mainly belong to Red Yellow Podzolic Soils or Reddish Brown Lateritic Soils (Clayey Paleustults, Skeletal Paleustults). Formerly these soils were under forest but at present they are increasingly cleared for cultivation of upland crops and tree crops.

Hills and mountains occupy a considerable part in North Thailand. They are formed in widely variable rocks. Little is known about the soil of these areas. In mapping, they have been mostly mapped as slope complexes or slope phases of soil series. The hills and mountains are mainly under forest, but at present increasingly large areas are being cleared.

## 2.2 Present Land Use (See Figure 2-3)

Most of the Southern Central Plain is in cultivation. The former tidal flats extending from Ayutthaya to Bang Khen, and the lower parts of

river alluvial plain are flooded to depth of 70-80 cm on the average for more 4-7 months during the rainy season. The areas are principally used for broadcast rice. Most of the broadcast rice is sown in early rainy season and the rice plants are grown strong enough by the time floods come in August. On the marine plain along the coast, and the higher parts of alluvial plains and low terraces, rice is mainly transplanted.

In the area where flooding takes place not more than 30 - 50 cm depth for a period ranging from 4 - 5 months during the rainy season. Transplanted rice is planted from June to September and harvested from November to January.

In some areas between Nonthaburi and Bang Len on the western side of Chao Phraya River, two crops per year are grown. Flooding is not very deep in the rainy season and irrigation water can be pumped out of the canal to irrigate the dry season crops. Second crops are planted in March to April and harvested in July or August. Some places on somewhat higher positions, such as natural levee in the Southern Central Plain, are used for upland crops (sugarcane, corn, beans etc.), garden crops and orchards.

Around Bangkok and Thon Buri, man-made ridged soils with deep ditches between the ridges have been constructed. Most of them are used for vegetables and fruit trees, such as chinese cabbage, peas, chillis, tomatoes, durians, mango, various citrus fruits, and coconuts. The water table in these soils is permanently kept at about 70 cm below the top of the soil surface and in the dry season the crops are watered from the ditches. Gardens are surrounded by dikes to prevent flooding in the rainy season.

Mangrove and Nipa forests occur in the active tidal zone along the coast. They are used for charcoal production and thatching. The active tidal area is also used for fish and shrimp productions. On the alluvial plains along the middle stream of the Chao Phraya River, somewhat higher parts are mostly used for upland crops, vegetable gardens and orchards. The lower-lying areas on them with nearly flat relief, are mainly used for cultivation of rice during the rainy season.

The low alluvial terraces contiguous to plains are used for various upland crops (corn, sugarcane, beans), vegetables, and fruit trees (banana, citrus fruits). They are one of the main crop land for upland crops in the Chao Phraya River Basin.

The lower parts of low alluvial terraces are used for transplanted rice during the rainy season.

Hills, mountains, erosion surfaces and high terraces occur mainly in northern part of the Chao Phraya River Basin. They were formerly covered by Dipterocarp and mixed deciduous forests. But nowadays, not a little part of them is cleared for shifting cultivation of upland crops.

### 2.3 Land Use Potentiality (See Tables 2-1 and 2-2, Figure 2-4)

Land use potentiality in the Chao Phraya river basin has been classified on the basis of "General Potential Land Use Map" published by DLD (Department of Land Development) in 1982. The classification of land potential was, comprehensively, made in accordance with land slope, drainability, condition of flood/inundation, soil characteristics, depth of effective soil layer, and fertility. The result shows that the Study area divided into three, namely (1) land suitable for upland crops with good drainability (19.6%), (2) land suitable for paddy (23.5%), and (3) land not suitable for any crops (56.9%) in mainly mountainous region extending RID Region 1, 2 and 3. The land suitable for upland crops extends terraces, especially in Region 3 having two million hectares good for large scale cultivation of maize, sorghum, cotton etc (Refer to Table 2-1).

In Regions 3 and 7, cultivation of cassava is prevailing in sloped lands. Generally the cassava is consecutively grown without any fertilization and plunders soil fertility, resulted in changing the cultivated land to a waste land, therefore, it is desirable to carry out crop rotation with such leguminous crops as groundnuts, soybean, etc.

The land suitable for paddy develops in Region 3, 7, 8 and 9, in which lowlying land with clayey loamy soil extends widely, and these four Regions occupy about 85% of the paddy land in the Study area.

#### 2.4 Present Land Use and Potential

Figure 2-5 indicates comparison between the present land use pattern and the result of study on land potentiality as explained in the previous section 2.3. According to Figure 2-5, those Changwats of Lampang, Lamphun in the Chao Phraya upper basin and Chiang Rai, have potential to increase upland than at present. Similarly, upland can be expanded in Changwats of Tak, Kamphaeng Phet, Phichit, Sukhothai, Uttaradit, Nakhon Sawan in the middle basin, and Uthai Thani, Chainat, Suphan Buri, Sing Buri and Ang Thong in the lower basin.

In Changwats of Ayutthaya and Pathum Thani where an acidic soil is distributed widely, the land suitable for upland crops is hardly available, except introducing the raised bed farming method practised in Rangsit area and the suburbs of Bangkok Metropolis, which requires a quite big amount of investment as well as enough amount of irrigation water during dry season.

#### 2.5 Water Management for Problem Soils

Acid sulfate soils and saline soils occur in concentration in the former tidal flats of the Southern Central Plain in covering an area of about 900,000 ha as main problem soils Thailand (See Figure 2-6).

Acid sulfate soils are the soils with very low pH values resulting from oxidation of sulfide (mainly pyrites) into sulfuric acid and acid sulfates. The main factors affecting the soil pH values are the amount of pyrites and potentially neutralizing components such as carbonates in the brackish water sediments.

Under the monsoon climate, soil acidity in the dry season accelerates the concentration of acid. The accumulated products tend to rise in the soils with groundwater table raised at the beginning of wet season and to increase the adverse chemical conditions for plants growth. In the water management for proper utilization of these potential acid soils, two approaches can be taken as follows.

- (1) To keep groundwater table as high as possible for preventing the existing sulfates from oxidation as well as to reduce the potential acid in the soils to control the acidity of the soils as much as possible, and
- (2) To make the land in question drained and dried well at first so as to oxidize the existing pyrite completely for making acid, and then, to wash out all acid by water.

The soils of the Chao Phraya Delta are of very fine texture and poor in permeability. It is very difficult for these soils to be drained intensively and to remove the acidity, if sufficient fresh water is not available. Therefore, (1) is recommended for the purpose.

One of the practical methods to maintain a high groundwater table in the dry season is the introduction of the second rice cropping under irrigation. This will prevent the development of acid in the subsoils and leach the acid in the top soils. The soil fertility may increase efficiently by liming and applications of nitrogen and phosphates.

In the neighborhood of Bangkok, the soils artificially piled as upland fields with high ridges are used for cultivation of vegetables and fruits trees. In these soils groundwater table is maintained at about 70 cm below the surface and the acid in the piled soils is leached by frequent irrigation through ditches. Such land use technics are very effective in preventing the soil damage and make land used efficiently, if economically available.

Saline and potential acid sulfate soils occur in the tidal swamps along the coast. They will not become acidic as long as the tidal effects are enough to prevent oxidation of soils. Reclamation of these swamps by preventing the sea water intrusion and intensive drainage will lead to strong acidification and salinization of the land. Saline Hydromorphic Alluvial Soils occur on the coast of the western bank of the Chao Phraya River. These soils do not have acidity in drying, but suffer from serious damages by salinization of soils in drying. At present, the tidal swamp areas along the coast are mainly used for productions of mangrove, nipa palm, fish, and shrimp without intensive drainage.

It is not necessary to change the present drainage condition of the land, although to prevent the adverse effects of saline and potential acid sulfate soils. Moreover, the better water management, which should be studied, exploits efficiently fresh water for decreasing the salinity of the land.

Table 2-1 LAND USE POTENTIALITY

(Unit: 1,000 ha)

Suitability	Mapping Unit	Region 1	Region 2	Region 3	Region 7	Region 8	Region 9	Total
Upland Crops	1	40	171	571	296	20	-	1,098
	2	-	-	30	-	3	-	33
	3	69	171	212	47	34	-	533
	4	92	177	978	205	10	-	1,462
	5	12	24	209	17	320	-	582
	Sub-Total	213 (5.7)	543 (11.2)	2,000 (29.8)	565 (28.4)	387 (24.3)	- (0)	3,708 (19.6)
Paddy	6	177	348	1,155	745	624	93	3,142
	7	-	122	350	52	67	-	591
	8	-	-	5	-	-	-	5
	9	-	-	-	238	195	17	450
	10	23	13	118	1	105	-	260
	Sub-Total	200 (5.4)	483 (10.0)	1,628 (24.3)	1,036 (52.0)	991 (62.4)	110 (90.9)	4,448 (23.5)
Unsuitable for Cropping	14	430	895	1,046	150	24	-	2,545
	16	-	-	-	50	17	11	78
	17	-	3	-	-	-	-	3
	18	1	9	18	21	-	-	49
	20	2,873	2,911	2,010	170	171	-	8,135
	Sub-Total	3,304 (88.9)	3,818 (78.0)	3,074 (45.9)	391 (19.6)	212 (13.3)	11 (9.1)	10,810 (56.9)
Total	3,717 (100.0)	4,844 (100.0)	6,702 (100.0)	1,992 (100.0)	1,590 (100.0)	121 (100.0)	18,966 (100.0)	
Water Area		14	12	73	2	-	-	101
Grand Total		3,731	4,850	4,775	1,994	1,590	121	19,067

Note: Mapping unit of 9 and 16 are the problematic soils.

Detailed explanation on mapping unit is given in Table 6.2-1 of Appendix 6.2

Table 2-2 Land Use Potentiality in the Study Area

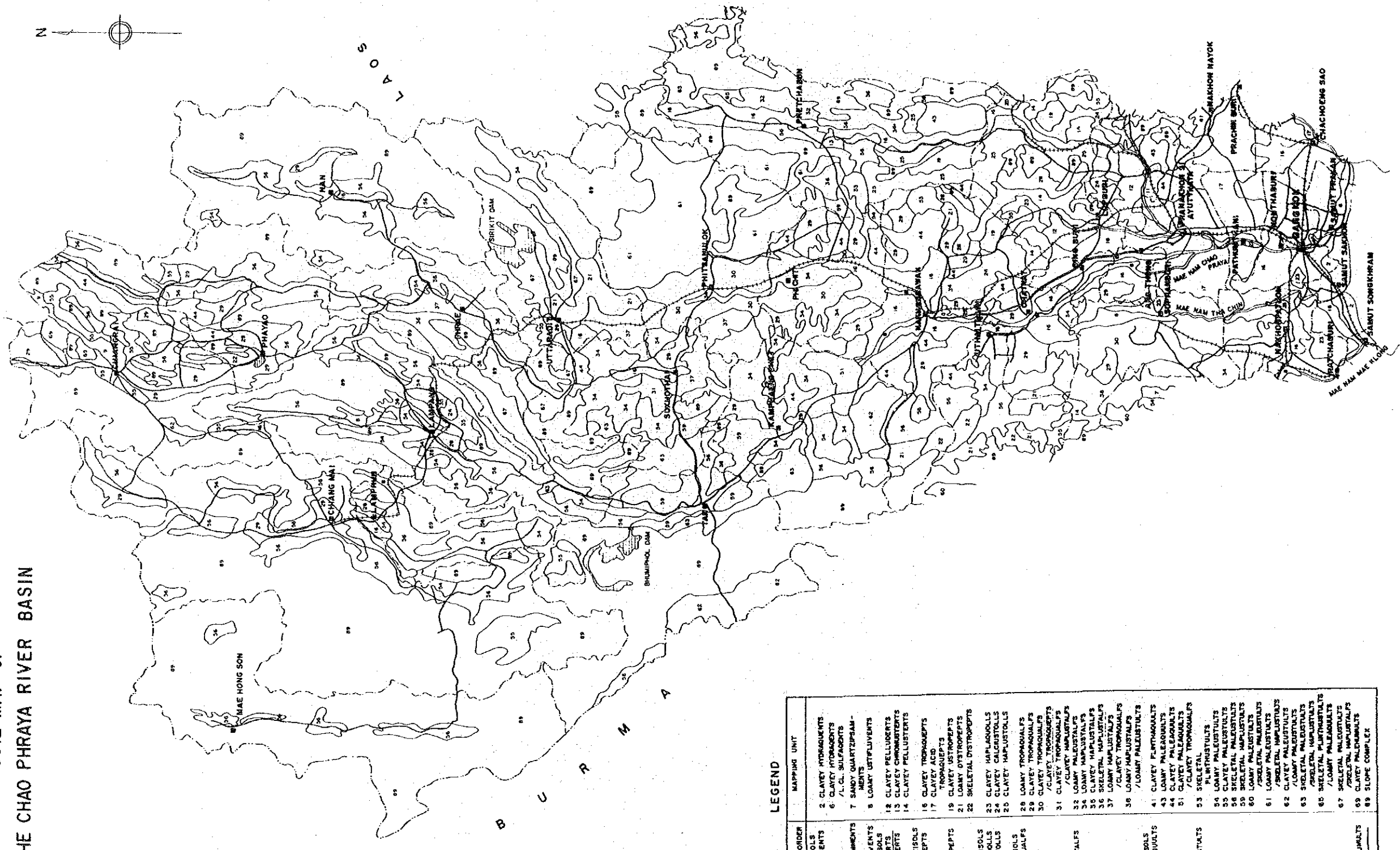
Changwat																(unit: 100 ha)		
	1	2	3	4	5	6	7	8	9	10	14	16	17	18	20	Water Area	Total	
Chiang Mai	125	-	485	375	120	1,455	-	-	-	-	55	2,440	-	-	-	14,920	135	20,110
Lamphun	221	-	205	541	-	315	-	-	-	-	179	1,113	-	-	11	1,925	-	4,510
Mae Hong Son	50	-	-	-	-	-	-	-	-	-	-	747	-	-	-	11,883	-	12,680
Region - 1	396	-	690	916	120	1,770	-	-	-	-	234	4,300	-	-	11	28,728	135	37,300
Chiang Rai	576	-	1,028	197	-	1,705	572	-	-	-	35	778	-	30	-	6,759	-	11,680
Phayao	89	-	184	363	-	829	377	-	-	-	50	1,061	-	-	-	3,377	-	6,330
Lampang	891	-	-	1,041	242	174	194	-	-	-	44	3,659	-	-	87	6,145	53	12,530
Phrae	-	-	215	148	-	597	72	-	-	-	-	2,126	-	-	-	3,382	-	6,540
Nan	149	-	284	20	-	174	-	-	-	-	-	1,325	-	-	-	9,448	70	11,670
Region - 2	1,705	-	1,711	1,769	242	3,479	1,215	-	-	-	129	8,949	-	30	87	29,111	123	48,550
Tak	329	-	1,296	39	-	-	82	-	-	-	-	2,395	-	-	-	7,213	406	11,760
Sukhothai	1,155	-	-	602	-	1,506	225	-	-	-	9	1,754	-	-	-	1,349	-	6,600
Uttaradit	305	-	242	1,425	-	653	-	-	-	-	-	1,582	-	-	-	3,372	261	7,840
Phitsanulok	776	-	-	4,962	-	2,467	33	-	-	-	-	-	-	-	-	2,582	-	10,820
Phatchabun	54	207	23	1,756	1,410	1,687	20	49	-	-	592	2,501	-	-	-	4,371	-	12,670
Phichit	884	-	-	111	-	2,611	747	-	-	-	-	177	-	-	-	-	-	4,530
Kamphaeng Pt.	1,922	-	512	697	-	701	1,001	-	-	-	252	1,699	-	180	-	1,126	-	8,090
Nakhon Sawan	286	89	42	192	671	1,903	1,385	-	-	-	322	347	-	-	-	82	61	5,380
Lop Buri	-	-	2	-	5	24	9	-	-	-	-	-	-	-	-	-	-	40
Region - 3	5,711	296	2,117	9,784	2,086	11,552	3,502	49	-	-	1,175	10,455	-	-	180	20,095	728	67,730
Kamphaeng Pt.	28	-	108	23	-	-	-	-	-	-	-	59	-	-	-	302	-	520
Nakhon Sawan	275	-	147	371	87	751	203	-	-	-	-	492	-	-	-	564	-	2,890
Uthai Tanj	651	-	188	1,141	75	690	269	-	-	-	11	592	-	32	-	641	-	4,290
Chainat	602	-	19	84	-	903	-	-	-	79	-	307	-	65	-	41	-	2,100
Suphan Buri	846	-	7	250	5	2,010	5	-	-	724	-	-	-	-	-	88	15	3,950
Sing Buri	220	-	-	-	-	440	-	-	-	-	-	-	-	-	-	-	-	660
Ang Thong	165	-	-	-	-	805	-	-	-	-	-	-	-	-	-	-	-	970
Ayutthaya	-	-	-	-	-	189	-	-	1,061	-	-	-	-	-	-	-	-	1,250
Pathum Thani	-	-	-	-	-	126	-	-	324	-	-	-	-	-	-	-	-	450
Nonthaburi	-	-	-	-	-	550	-	-	10	-	-	-	-	-	-	-	-	560
Bangkok Metro.	-	-	-	-	-	354	-	-	-	-	-	-	96	-	-	-	-	450
Samut Prakan	-	-	-	-	-	38	-	-	-	-	-	-	192	-	-	-	-	230
Kanchanaburi	168	-	-	177	-	53	41	-	-	-	-	49	-	111	-	61	-	660
Nakhon Pathom	-	-	-	-	-	374	-	-	-	181	-	-	-	-	-	-	-	560
Samut Sakhon	-	-	-	-	-	161	-	-	-	-	-	-	209	-	-	-	-	370
Region - 7	2,955	-	469	2,046	167	7,449	518	-	-	2,379	11	1,499	497	-	208	1,697	15	19,910
Nakhon Sawan	75	33	-	-	557	225	150	-	-	-	64	47	-	-	-	169	-	1,320
Chiant	31	-	-	-	40	220	79	-	-	-	-	-	-	-	-	-	-	370
Sing Buri	34	-	-	-	-	126	-	-	-	-	-	-	-	-	-	-	-	160
Ayutthaya	25	-	-	-	-	621	28	-	-	-	626	-	-	-	-	-	-	1,300
Pathum Thani	-	-	-	-	-	231	-	-	-	-	839	-	-	-	-	-	-	1,070
Nonthaburi	-	-	-	-	-	48	-	-	-	-	12	-	-	-	-	-	-	60
Lop Buri	-	-	289	65	2,157	2,212	-	-	-	-	568	116	-	-	-	753	-	6,160
Saraburi	36	-	48	30	441	1,107	415	-	-	210	421	81	-	-	-	791	-	3,580
Bangkok Metro.	-	-	-	-	-	1,048	-	-	-	-	62	-	-	-	-	-	-	1,110
Samut Prakan	-	-	-	-	-	372	-	-	-	-	-	-	168	-	-	-	-	560
Nakhon Nayok	-	-	-	-	-	28	-	-	-	202	-	-	-	-	-	-	-	230
Region - 8	201	33	337	95	3,195	6,238	672	-	-	1,951	1,053	244	168	-	-	1,713	-	15,900
Samut Prakan	-	-	-	-	-	182	-	-	-	-	-	-	48	-	-	-	-	230
Chachoengsao	-	-	-	-	-	748	-	-	-	165	-	-	57	-	-	-	-	970
Region - 9	-	-	-	-	-	930	-	-	-	165	-	-	105	-	-	-	-	1,200
Total	10,968	329	5,324	14,610	5,810	31,418	5,907	49	4,495	2,602	25,447	770	30	486	81,344	1,001	190,590	
	(5.8)	(0.2)	(2.8)	(7.7)	(3.0)	(16.5)	(3.1)	(0.03)	(2.4)	(1.4)	(13.4)	(0.40)	(0.02)	(0.25)	(42.5)	(0.53)	(100)	

	(Unit: 100 ha)				
	Suitable for Paddy	Suitable for Upland Crops	Unsuitable for Cropping	Water	Total
Region - 1	2,004 (5.4)	2,122 (5.7)	33,039 (88.5)	135 (0.4)	37,300 (100)
2	4,823 (9.9)	5,427 (11.2)	38,177 (78.6)	123 (0.3)	48,550 (100)
3	16,278 (24.0)	19,994 (29.5)	30,730 (45.4)	728 (1.1)	67,730 (100)
7	10,357 (32.0)	5,637 (28.3)	3,901 (19.6)	15 (0.1)	19,910 (100)
8	9,914 (62.3)	3,861 (24.3)	2,125 (13.4)	-	15,900 (100)
9	1,095 (91.3)	-	105 (8.7)	-	1,200 (100)
Total	44,471 (23.3)	37,041 (19.4)	108,077 (56.8)	1,001 (0.5)	190,590 (100)

(Figures 1 - 10, 14, 16, 17, 18, and 20 indicate categories of land use potentiality prepared by DLD)



Figure 2-1 SOIL MAP OF  
THE CHAO PHRAYA RIVER BASIN

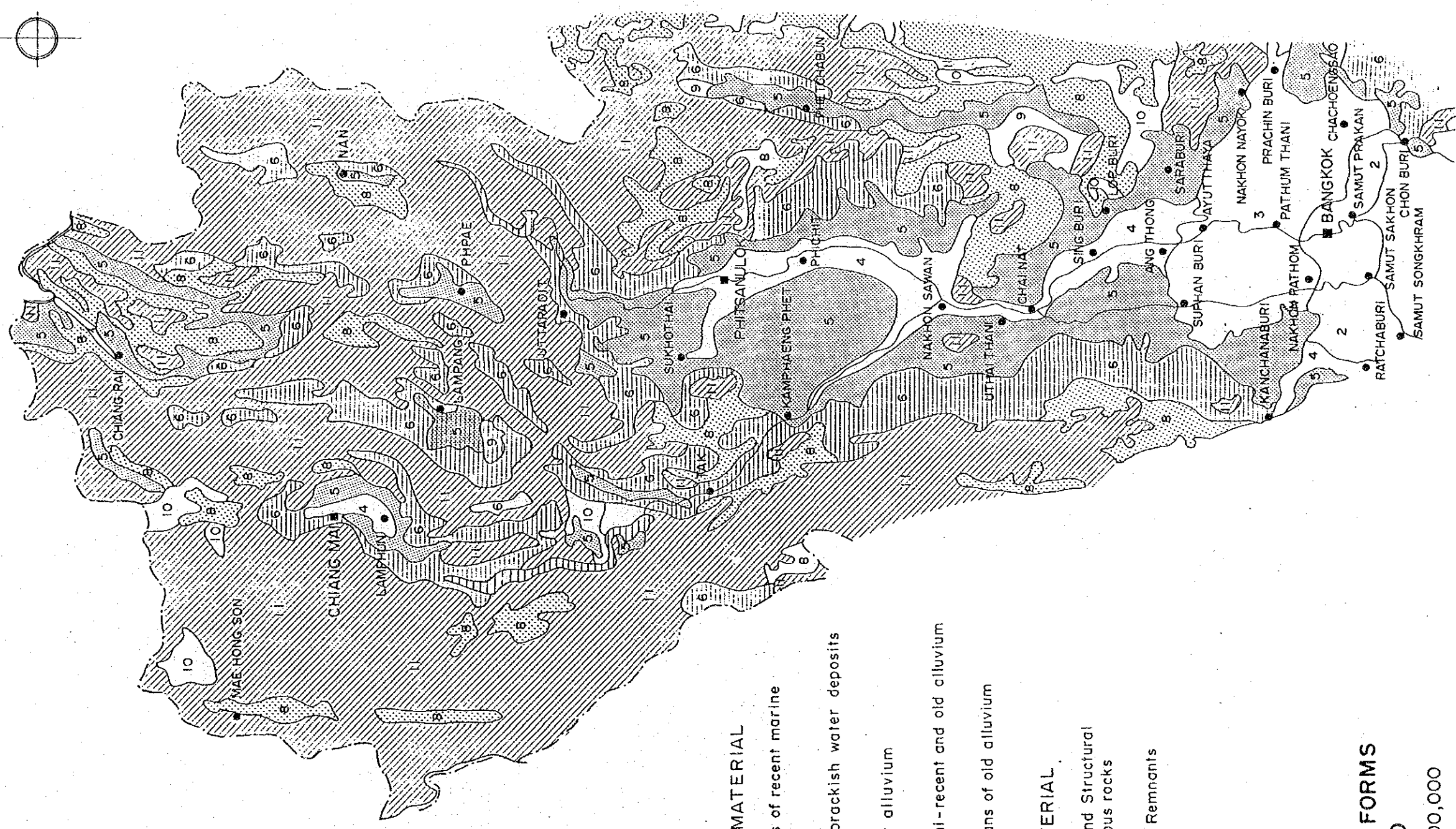


**LEGEND**

ORDER	SUBORDER	MAPPING UNIT
ENTISOLS	ARBUENTS	2 CLAYEY HYDROMENTS
	AGUENTS	6 CLAYEY HYDRAGENTS 7 CL. SULFAGENTS
PSAMMENTS		7 SANDY QUARTZPSAMMENTS
		8 LOAMY USTIFLUVENTS
FLUVENTS		12 CLAYEY PELLUENTS
	VERTISOLS	13 CLAYEY CRUMBSIDENTS 14 CLAYEY PELLUSIDENTS
INCEPTISOLS	ARBUENTS	15 CLAYEY TROPAGUENTS
	AGUENTS	17 CLAYEY ACID TROPAGUENTS
TROPEPTS		19 CLAYEY USTROPEPTS 21 LOAMY OYSTROPEPTS
		22 SKELETAL OYSTROPEPTS
MOLLISOLS	ARBUOLS	23 CLAYEY HAPLARBUOLS
	USTOLS	24 CLAYEY CALCRUSTOLS 25 CLAYEY HAPLUSTOLS
ALFISOLS	ARBUALS	28 LOAMY TROPARBUALS 29 CLAYEY TROPARBUALS 30 CLAYEY TROPAGUALS 31 CLAYEY TROPAGUALS
	USTALS	32 LOAMY HAPLUSTALS 34 LOAMY HAPLUSTALS 35 CLAYEY HAPLUSTALS 36 SKELETAL HAPLUSTALS 37 LOAMY HAPLUSTALS 38 CLAYEY TROPAGUALS 39 CLAYEY TROPAGUALS 40 LOAMY PALLUSTALS 41 LOAMY PALLUSTALS
ULYISOLS	ARBUALS	41 CLAYEY PALMAGUALS 43 LOAMY PALAGUALS 44 CLAYEY PALAGUALS 51 CLAYEY PALAGUALS 7 CLAYEY TROPAGUALS
	USTALS	53 SKELETAL PALMAGUALS 54 LOAMY PALMAGUALS 55 CLAYEY PALMAGUALS 56 CLAYEY PALMAGUALS 58 SKELETAL PALMAGUALS 60 LOAMY PALMAGUALS 61 SKELETAL PALMAGUALS 62 CLAYEY PALMAGUALS 63 CLAYEY PALMAGUALS 64 LOAMY PALMAGUALS 65 SKELETAL PALMAGUALS 66 SKELETAL PALMAGUALS 67 LOAMY PALMAGUALS 68 CLAYEY PALMAGUALS 69 CLAYEY PALMAGUALS
	HUMALS	89 SLOPE COMPLEX

SOURCE : GENERAL SOIL MAP OF THAILAND  
SCALE : 1:1,000,000 (1979)  
DEPARTMENT OF LAND DEVELOPMENT  
BANGKOK

Figure 2-2  
**MAIN LAND FORMS OF  
 THE CHAO PHRAYA RIVER BASIN**



**LEGEND**

- LAND FORMS IN TRANSPORTED MATERIAL**
- 2 Active and Former Tidal Flats of recent marine and brackish water deposits
  - 3 Former Tidal Flats of older brackish water deposits
  - 4 Flood Plains of recent river alluvium
  - 5 Low Alluvial Terraces of semi-recent and old alluvium
  - 6 High Alluvial Terraces and Fans of old alluvium and colluvium

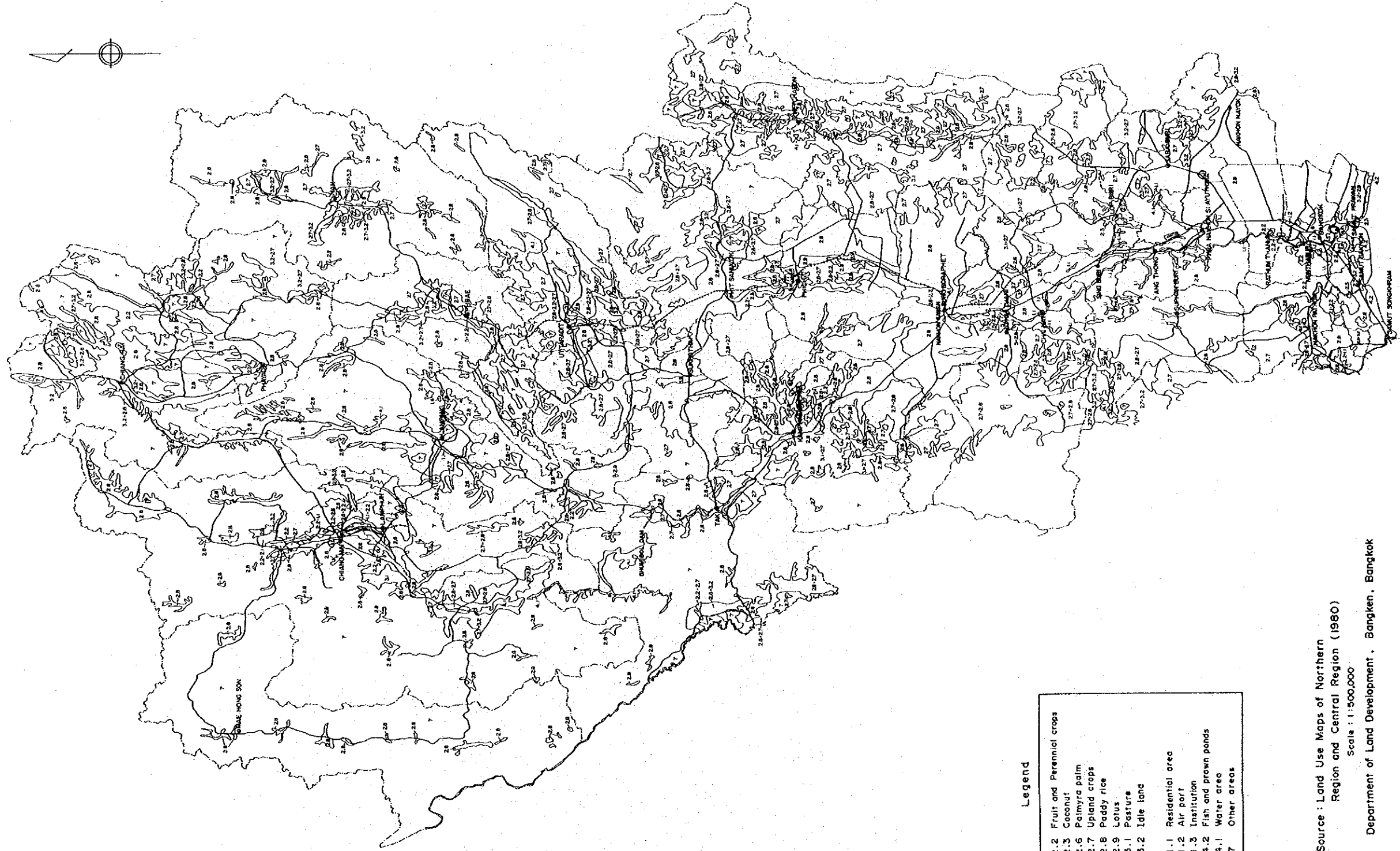
**LAND FORMS IN RESIDUAL MATERIAL**

- 8 Dissected Erosion Surfaces and Structural Plateaux occurring over various rocks
- 9 Lava Plateaux and Volcano Remnants
- 10 Limestone Outcrops
- 11 Hills and Mountains

**SOURCE ; MAIN LAND FORMS  
 OF THAILAND**

SCALE 1 : 2,500,000  
 DLD (1973)

Figure 2-3  
PRESENT LAND USE MAP OF  
THE CHAO PHRAYA RIVER BASIN



Legend

- 2.2 Fruit and Perennial crops
- 2.3 Coconut
- 2.6 Palmyra palm
- 2.7 Upland crops
- 2.8 Paddy rice
- 2.9 Lotus
- 3.1 Pasture
- 3.2 Idle land
- 1.1 Residential area
- 1.2 Air port
- 1.3 Institution
- 4.2 Fish and prawn ponds
- 4.1 Water area
- 7 Other areas

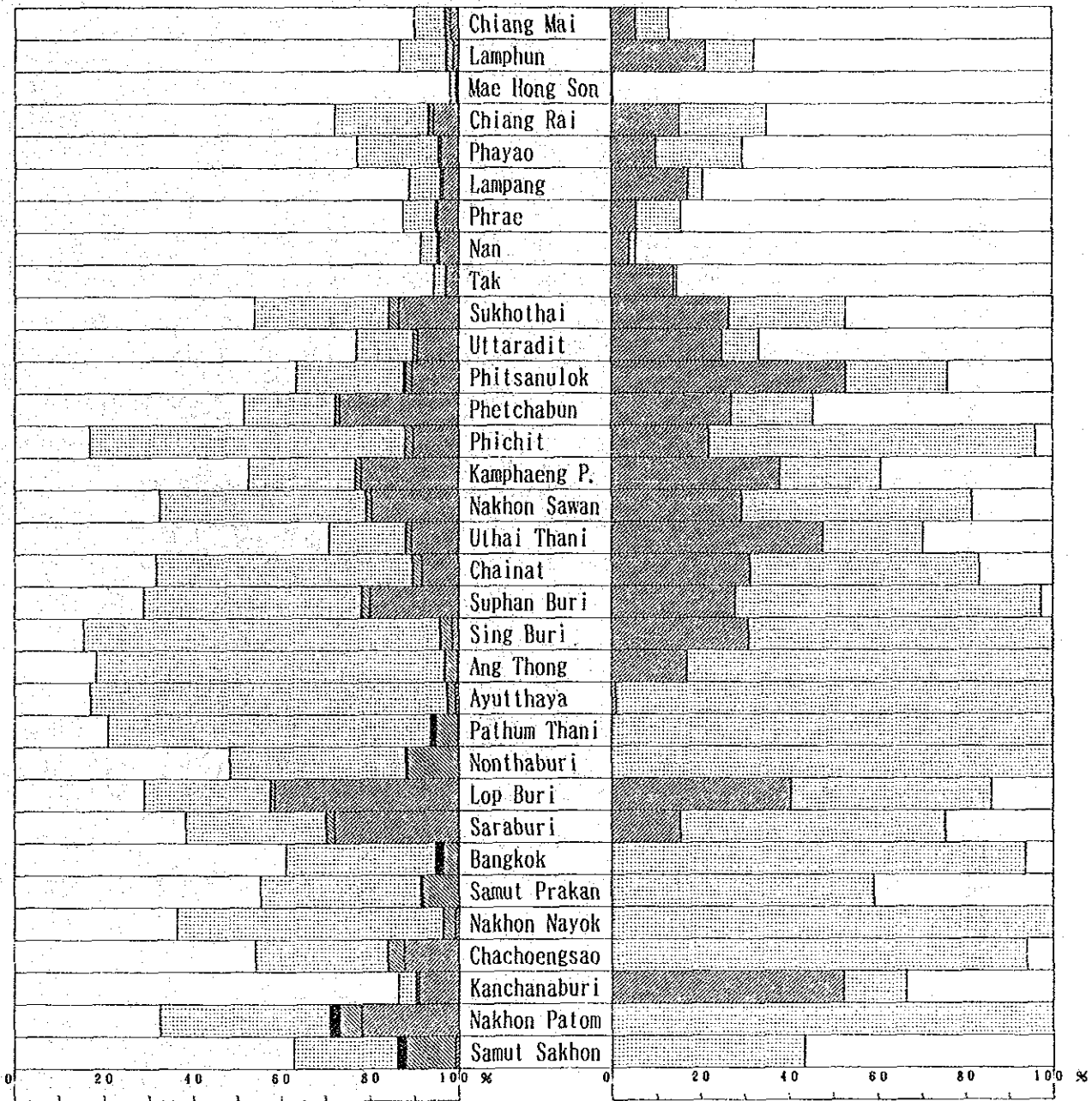
Source : Land Use Maps of Northern  
Region and Central Region (1980)  
Scale : 1:500,000  
Department of Land Development, Bangkok, Bangkok





Present Land Use

Land Use Potentiality



Legend

- ▨ Upland/Field Crop
- ▤ Paddy Land
- ▩ Fruits/Tree
- Vegetable/Flower
- Others

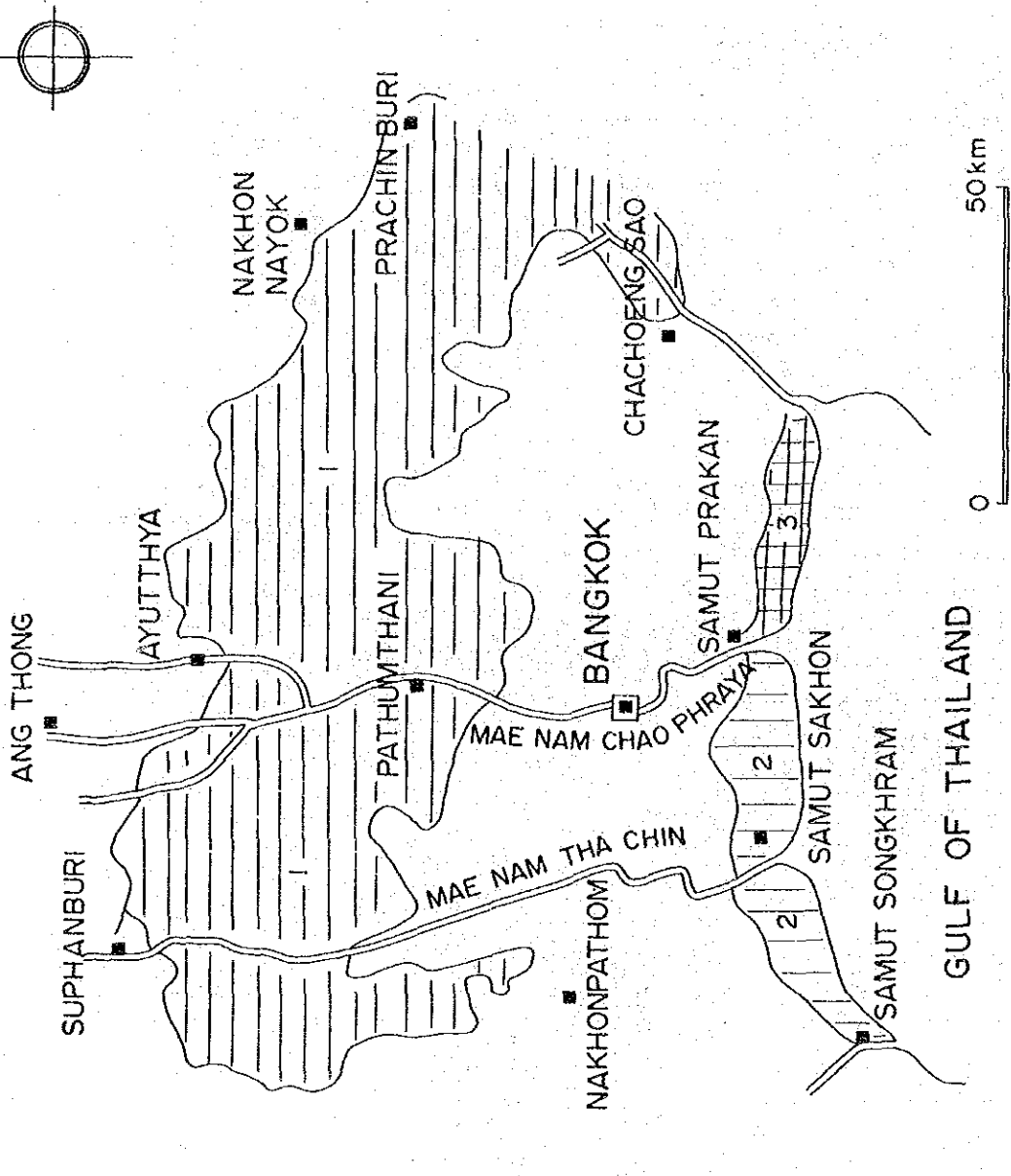
Legend

- ▨ Suitable for Upland Crops
- ▤ Suitable for Paddy
- Unsuitable for Cultivation


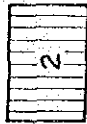

Figure 2-5 PRESENT LAND USE AND LAND USE POTENTIALITY

Figure 2-6

# Problem Soils in the Southern Central Plain



## LEGEND

-  Acid Sulfate Soils
-  Saline Hydromorphic Alluvial Soils
-  1/2 Association

Source :  
General Soil Map of Thailand  
Scale 1 : 1,000,000 (1979)  
D.L.D. Bangkok

## CHAPTER 3 IRRIGATED AGRICULTURE IN CHAO PHRAYA DELTA

### 3.1 Effects of Water Management on Farming

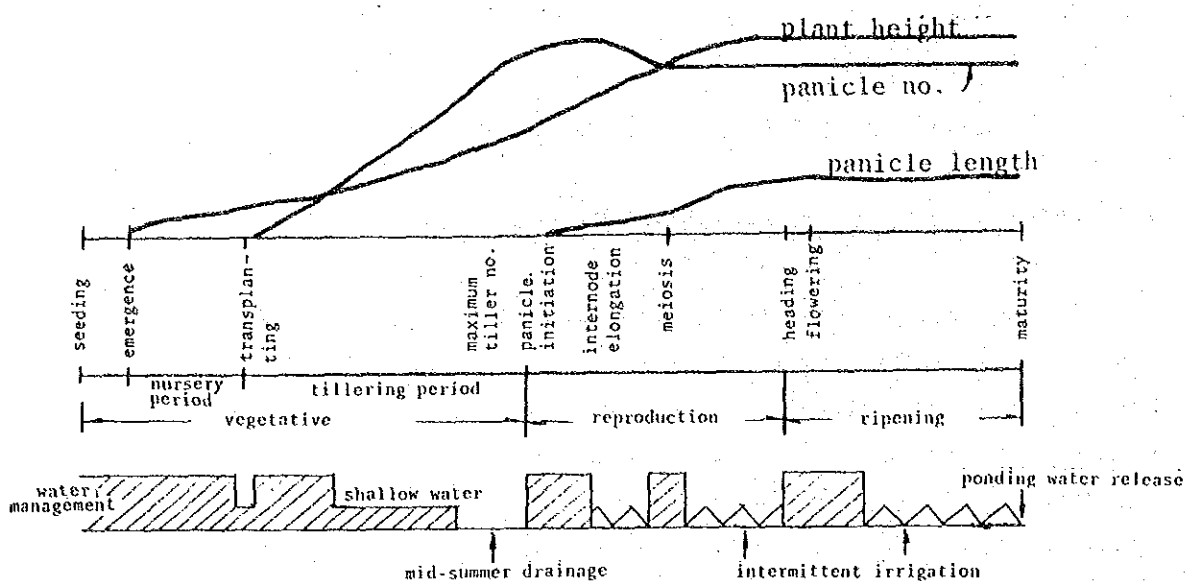
A crop yield suggests the suitability of an irrigation method applied to a certain crop cultivation. Especially in paddy farming, to keep water level suitable to each growing stage from nursery to harvest results in increasing yield as clarified through many kinds of experiments. A little deeper water is necessary immediately after transplanting to urge rooting, and after rooting, water depth should be kept shallow. At non-bearing tillering stage intermittent drainage should be practised for seven to ten days to supply oxygen to soil and then it is suitable to paddy to resume irrigation. For the period of ear-sprouting to heading stage, paddy requires to be supplied with much water and if water supply is not sufficient, yield will be reduced.

Excessively deep water or submergence also adversely affect on paddy growing. Magnitude of damages will be changed by depth, period of submergence, and growing stage. Serious damages could be avoided if paddy is submerged only for about 12 days by 50 percent of paddy height. However, a special attention should be paid to the submergence for the period of meiosis stage to heading stage in which serious damages often occur.

As mentioned above, paddy requires delicate water control according to the growing stages, and therefore, it is desirable to give advices to farmers by agricultural extension staffs on suitable water control at on-farm level by zoneman and farmers themselves.

The following figure shows a sample of water management and growing stage.





Irrigation for fruit trees and upland crops is necessary, especially in the dry season. And sufficient irrigation will result in high yield and good quality. Vegetables require more water than fruit trees. Therefore, planted areas with upland crops are limited in the places which are blessed with irrigation water. Furrow irrigation is generally practised.

### 3.2 Water Management at On-Farm Level

Planting conditions at on-farm level in the areas commanded by project offices are grasped by zonemen who is responsible for the terminal water management of RID. One zoneman covers about 10,000 to 15,500 rai (1,600 - 2,400 ha) and is in charge of making report to Water Master on the weekly basis about crop condition (Refer to Table 6.7-1 of Appendix 6.7).

### 3.3 Plot-to-Plot Irrigation

In Thailand, the paddy fields with land consolidation works are still limited in acreages, and most of the unconsolidated paddy fields are irrigated generally by plot-to-plot irrigation method, and in the plot-to-plot irrigation, the paddy fields in just a position to the canals can take water directly, and then the plots arranged in the downstream of the said first fields closest to the canals shall be irrigated with water flowing down through plots one by one in order. For drainage as well, the fields in the upstream shall be drained first to

eliminate the water to the field in the downstream (See Figure 7-4 of ANNEX 6).

In such plot-to-plot irrigation, the fields in the upstream which can preferentially take water will not be damaged in water shortage, whereas those arranged in the downstream will be damaged. In drainage also, the fields arranged in the downstream will tend to suffer from ill-drainage.

Under such conditions, the successful water control to meet the requirements by growing stages as mentioned in section 3.1 of this chapter, cannot be practised so easily in the plot-to-plot irrigation. It is most desirable, therefore, that the land consolidation projects as well as the establishment of the farmers' organization should be strongly promoted and quite even water distribution is also essential within the unit organizations, at least at the level of each terminal diversion works.

Out of total irrigable area, 1.25 million hectares (See Table 3-2), land consolidation works for only 88,241 hectares have been completed, of which 77,750 hectares are equipped with the intensive method (See Table 3-2 and Figure 3-1).

#### 3.4 Storage Irrigation and Gravity Irrigation

In the Chao Phraya Delta playing the vital role in the Thai agriculture, the irrigation method practised can be roughly divided into two, the gravity irrigation and the storage irrigation prevailing in the downstream areas. Changes of the acreages cropped with paddy in the respective fields in the Delta are shown in Figure 3-1, covering the period between 1974 and 1986. In the wet season, the paddy cropping acreage tends to become larger in the gravity irrigation fields, while in the dry season, larger in the storage irrigation fields. Particularly, in 1980, the drought years, the cropped acreage with paddy in the storage irrigation fields largely exceeded to that in the gravity irrigation fields.

The characteristic features, above all, of the paddy cropping in the storage irrigation areas are that the three projects of Chao Ched Bang Yeehon, Phraya Banlue and Phra Pimol are quite different from the other projects in paddy cropping acreage in the dry season, which is larger than that in the wet season. This is because the above three project areas have been serving as regulating reservoir of the flood water to protect Bangkok Metropolitan Area from submergence and have been drained in delay intentionally to cause the wet season paddy cropping impossible there. The paddy cropping in these areas, therefore, has been practised mainly with the dry season paddy. The areas of the storage irrigation are considered to be a regulating reservoir in future as well.

The examples of the dry season paddy cropping in each area of gravity irrigation and storage irrigation are illustrated in Figures 3-3 and 3-4. As shown in the Figure 3-3, the rotational irrigation has been practised in the right/left bank areas or the upstream/downstream areas by years so as to keep the right and even water distribution for the dry season paddy.

The storage irrigation, contrarily, has been practised only for those farm land located along the canals, and the uneven farm income will be caused by location of the farm land owned by farmers (See Figure 3-4).

### 3.5 Inundation Area and Floating Rice

#### 3.5.1 Inundation Area

##### (1) General condition

Within Chao Phraya Delta, the area expanded South of Ayutthaya is formed by either flood plain or tidal flat, having surface elevation below 2.5 m above MSL and average slope of 1/20,000 - 1/40,000, and is very wide plain as well as farming area.

In this area, annual mean precipitation is about 1,500 mm, most (87%) of which is concentrated during the rainy season from May to October when the southwest monsoon from Indian Ocean is predominant.

Especially, during months of September and October, transition period from the southwest monsoon to the northeast one, monthly rainfall is biggest ranging from 200 mm to 300 mm, due to attack of tropical depression and typhoon taken place in South China Sea.

During the flooding period, discharge of the Chao Phraya River at Nakhon Sawan, conjunction point of Pin and Nan Rivers, is estimated at 3,630 cu.m/s with 1/10 provability. Furthermore, Pasak River having the flood discharge of 520 cu.m/s with the same provability join with Chao Phraya River at near Ayutthaya. On the other hand, it is reported that the flowing capacity of Chao Phraya River through Bangkok and Metropolitan Area is 2,200 cu.m/s which may not cause any flood damage in the area. Although Chao Phraya River branches into Suphan and Noi Rivers at upstream of Chainat Dam, the flowing capacity of the two rivers is quite small in comparison to that of Chao Phraya River. As a consequence, it is no exaggeration to say that the middle and lower part of Chao Phraya Delta has been performing to adjust floods of Chao Phraya River as a kind of retarding basin, in order to protect Bangkok and Metropolitan Area from floods.

## (2) West Bank Delta

Inundation caused by flooding from Chao Phraya River and heavy rainfall in the west bank delta area with average water depth of 70 cm to 80 cm continues for about three months until November and December when water level of Chao Phraya River starts to decrease.

Furthermore, it can be seen that some portion has severer inundation with water depth of 1.0 m to 1.5 m because of road networks constructed recently which has reduced the flowing capacity of inundation.

Although the inundated area is blessed with fertile soil transported by the floods, farmers can grow an ordinary variety of rice even in the area where inundation depth is relatively shallow, and only floating rice where it is quite deep, and hence rice yield per ha during wet season is quite low, ranging from 1 ton to 1.5 tons.

### (3) Lower East Delta

In this area, flood from Pasak River and Nakhon Nayok River and heavy rainfall were drained by a series of pumping station for protecting Bangkok from floods. Since 1983 big flood, as the first stage of urgent flood protection works in Metropolitan Area the green belt has been constructed which separates metropolitan Area and the eastern suburbs of Bangkok.

The green belt was completed end August 1984, having embankment of total length of 76 km, height of 1 m to 1.5 m with several gates of the crossing points with main rivers and channels.

After completion of the green belt, floods and excessive rainfall are forced to flow southerly along the belt in the lower east delta, but total capacity of existing drainage canals, sluiceways and pumping stations could not meet with the drainage requirement, resulted in bringing inundation damages every year. Farmers in this area cope with the situation by growing floating rice or by changing land use pattern from paddy field to fish pond.

#### 3.5.2 Cultivation of Floating Rice

Around Ayutthaya at the central part of the Chao Phraya Delta, the ground elevation is low and those rivers of the Suphan, Pasak, and Noi join the main stream of the Chao Phraya. Under the conditions, the areas have been attacked by abrupt flooding water chronically in the wet season and considerably heavy inundation has lasted up to around December when the water level at the Chao Phraya River begins to decrease. Such chronical heavy inundation areas have been cropped with floating rice which can grow in corresponding to the fluctuating water depth (See Figure 3-5), and the related cropped areas in 1976 and 1986/87 were 182,579 ha and 228,300 ha, respectively (See Tables 3-3 and 3-4, Figure 3-6). Floating rice has been playing an important role for wet season crop husbandry in the areas, where high yielding paddy varieties cannot be grown, although the yielding remains as low as 1.0 to 1.5 tons per hectare. Furthermore, it can be said that the flood water storage in the middle and lower parts of the Delta for a long spell of floating rice

growing (210 - 220 days) serves as regulating the water to prevent Bangkok Metropolitan Area from floods, although resulting in quite low efficiency in land use. And such a vital role will be given to the area in future as well.

### 3.6 Performance of Existing Irrigation Projects

In the Chao Phraya Delta, there exist 25 irrigation projects, of which 14, 10 and 1 are covered by RID Region 7, 8 and 9, respectively, having total irrigable area of approximately 1.25 million hectares (See Table 3-1).

During wet season, about 79% of irrigable area is averagely planted with paddy over the last 13 years, with narrower range between 77% and 80%, on the other hand, dry season paddy planted area fluctuates widely with range between 17% and 43%, depending upon availability of water resources in Bhumibol and Sirikit Dams at the beginning of the Season (See Tables 3-5 and 3-6).

Table 3-1 DISTRIBUTION OF IRRIGABLE AREA IN THE CHAO PHRAYA DELTA

(Unit: ha)

Chang-wat Project	Nakhon Sawan	Chai Nat	Suphan Buri	Sing Buri	Ang Thong	Ayutt-haya	Pathum Thani	Nonth-aburi	Lop Buri	Sara-buri	Bangkok	Samut Prakan	Nakhon Nayok	Chach-engseao	Nakhon Pathom	Samut Sakhon	Total*
1. PT	-	15,411	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15,411
2. TB	-	11,451	17,247	-	-	-	-	-	-	-	-	-	-	-	-	-	28,698
3. SA	-	-	47,678	-	1,122	-	-	-	-	-	-	-	-	-	-	-	48,800
4. DC	-	-	23,112	-	-	-	-	-	-	-	-	-	-	-	-	-	23,112
5. PA	-	-	59,200	-	-	-	-	-	-	-	-	-	-	-	-	-	59,200
6. BO	-	42,807	5,198	10,395	-	-	-	-	-	-	-	-	-	-	-	-	58,400
7. CH	-	835	3,567	27,927	42,345	1,214	-	-	-	-	-	-	-	-	-	-	75,888
8. YM	-	-	-	29,436	4,620	3,204	-	-	-	-	-	-	-	-	-	-	37,260
9. PK	-	-	5,702	-	1,417	25,841	-	-	-	-	-	-	-	-	-	-	32,960
10. BB	-	-	-	-	162	22,910	-	-	-	-	-	-	-	-	-	-	23,072
11. CB	-	-	30,012	-	-	34,948	-	-	-	-	-	-	-	-	-	-	64,960
12. PB	-	-	1,050	-	-	8,540	26,670	14,070	-	-	-	-	-	-	19,670	-	70,000
13. PM	-	-	-	-	-	-	-	22,293	-	-	-	-	-	-	19,532	-	41,825
14. PC	-	-	-	-	-	-	-	-	-	-	20,160	-	-	-	5,440	6,400	32,000
15. MA-KK	14,840	22,618	-	302	-	-	-	-	-	-	-	-	-	-	-	-	37,760
16. CK	5,895	-	-	4,725	-	-	-	-	36,166	-	-	-	-	-	-	-	46,786
17. KT	-	-	-	-	-	7,186	-	-	20,678	7,363	-	-	-	-	-	-	35,227
18. RR	-	-	-	-	-	17,276	-	-	-	12,006	-	-	-	-	-	-	29,282
19. MH	-	4,725	-	23,853	10,898	16,842	-	-	19,890	-	-	-	-	-	-	-	76,208
20. TL	-	-	-	-	-	24,522	-	-	-	13,974	-	-	-	-	-	-	38,496
21. NR	-	-	-	-	-	7,191	65,449	-	-	-	-	-	-	-	-	-	72,640
22. NL	-	-	-	-	-	42,728	-	-	-	-	-	-	-	-	-	-	42,728
23. SR	-	-	-	-	-	-	31,994	-	-	-	15,997	-	25,244	19,233	-	-	92,468
24. KD	-	-	-	-	-	-	-	-	-	-	38,264	41,812	-	4,392	-	-	84,468
25. PO	-	-	-	-	-	-	-	-	-	-	-	18,931	-	62,669	-	-	81,600
Total	20,735	97,847	192,766	96,638	60,564	212,402	124,113	36,363	76,734	31,040	74,241	60,743	25,244	86,294	44,642	6,400	1,249,249

Project: PT:Phonlathep, TB:Thabore, SA:Sam Chuk, DC:Don Chedi, PA:Pho Phraya, BO: Borommathat, CH:Chanasutr, YM:Yangmanee, PK:Phak Hai, BB:Bang Ban  
 CB:Chao Chet-Bang Yihon, PB:Phraya Ban Lu, PW:Phra Phimon, PC:Phasi Charoen, MA-KK:Manorom-Khao Kao, CK:Chong Kae, KT:Koke Kathiem,  
 RR:Roeng Rang, MH:Maharaj, TL:Pasak Tai, NR:Rangsit Nua, NL:Nakhong Luang, SR:Rangsit Tai, KD:Khlong Dan, PO:Phra Ong Chaiyanuchit,

Data Source: \* Water Management Section, O & M Division

Table 3-2 Land Consolidation

<u>Project Name</u>	(Unit : ha)		
	<u>Intensive Area</u>	<u>Extensive Area</u>	<u>Total</u>
Naresuan Dam	-	-	-
Phlai Chumphon	8,464	24,128	32,592
Dong Setthi	208	22,176	22,384
Tha Bua	-	26,944	26,944
Phonlathep	-	-	-
Thabote	-	-	-
Samchook	8,299	-	8,299
Don Chedi	4,246	1,536	5,782
Pho Phaya	-	-	-
Borommathat	24,066	369	24,435
Channasutr	21,689	4,070	25,759
Yang Manee	-	-	-
Phak Hai	-	-	-
Bang Ban	-	-	-
Chao Ched Bang Yihon	-	-	-
Phraya Banlue	-	-	-
Phra Phimon	-	-	-
Phasi Charoen	-	-	-
Manorom	12,509	912	13,421
Chong Khae	-	-	-
Khok Kathiem	6,701	3,844	10,545
Roeng Rang	-	-	-
Maharaj	-	-	-
Pasak Tai	-	-	-
Nakhon Luang	-	-	-
Rangsit Nua	-	-	-
Rangsit Tai	-	-	-
Khlong Dan	-	-	-
Phra Ong Chaiyanuchit	-	-	-
Total	86,182	83,979	170,161
	(77,510)	(10,731)	(88,241)

Note: Figures in parentheses indicate Chao Phraya Delta only.



Table 3-3 AREA UNDER FLOATING RICE BY IRRIGATION PROJECT

(Unit: rai)

	Total Area	Floating Rice Area	
		1976* <sup>1</sup>	1986/87* <sup>2</sup>
1. Phonlathep	95,437	-	-
2. Thabote	160,548	10,950	-
3. Don Chedi	414,809	4,500	14,400
4. Pho Phraya	328,896	82,936	16,010
5. Borommathat	364,965	26,620	27,046
6. Chanasutr	474,767	42,738	86,985
7. Yangmanee	210,321	73,763	138,222
8. Phak Hai	185,173	180,600	199,350
9. Chao Chet-Bang Yihon	405,940	74,400	66,450
10. Phraya Ban Lu	437,503	-	-
11. Phra Phimon	285,563	-	-
12. Phasi Charoen	387,850	-	-
13. Khao Kaeo	39,490	-	-
14. Manorom	192,029	4,000	-
15. Chong Kae	237,946	38,900	39,115
16. Koke Kathiem	193,404	95,425	112,051
17. Roeng Rang	162,662	19,969	66,229
18. Maharaj	421,963	222,147	189,567
19. Nakhon Luang	219,922	125,554	137,878
20. Pasak Tai	N. A.	31,547	26,000
21. Rangsit Nua	454,200	23,526	35,870
22. Rangsit Tai	566,000	1,443	-
23. Bang Ban	144,762	55,300	103,105
24. Khlong Dan	525,000	20,500	168,766
25. Phra Ong Chaiyanuchit	510,000	-	-
26. Nakhon Nayok	N. A.	-	-
27. Sao Hai	35,913	-	-
28. Khlong Prew	91,872	-	-
29. Bang Pakong R. (L. B.)	64,640	-	-
30. Tha Lad	129,797	-	-
31. Phan Thong	18,500	-	-
32. Mae Klong	2,462,953	-	-
33. Phetchaburi	333,064	-	-
34. Phrasitchon	19,160	-	-
Total		1,141,118 (182,579ha)	1,427,044 (228,324ha)

Note: \*<sup>1</sup> Refer to Data provided by Rice Institute  
\*<sup>2</sup> Refer to Data provided by RID O&M Division

Table 3-4 AREA UNDER FLOATING RICE BY CHANGWAT

Name of Changwat	Floating Rice Area (1986/87)		Remarks
	(rai)	(ha)	
C01 Chiang Mai	-	-	
C02 Lamphun	-	-	
C03 Mae Hong Son	-	-	
C04 Chiang Rai	-	-	
C05 Phayao	-	-	
C06 Lamphang	-	-	
C07 Phrae	-	-	
C08 Nan	-	-	
C09 Tak	-	-	
C10 Sukhothai	-	-	
C11 Uttaradit	-	-	
C12 Phitsanulok	-	-	
C13 Phetchabun	-	-	
C14 Phichit	-	-	
C15 Kamphaeng Phet	-	-	
C16 Nakhon Sawan	9,650	1,544	
C17 Uthai Thani	-	-	
C18 Chainat	15,009	2,401	
C19 Suphan Buri	70,506	11,281	
C20 Sing Buri	90,595	14,495	
C21 Ang Thong	203,512	32,562	
C22 Ayutthaya	724,377	115,900	
C23 Pathum Thani	13,703	2,192	
C24 Nonthaburi	-	-	
C25 Lop Buri	107,577	17,212	
C26 Saraburi	23,349	3,736	
C27 Bangkok Metropolis	82,596	13,215	
C28 Samut Prakan	81,621	13,059	
C29 Nakhon Nayok	-	-	
C30 Phrachin Buri	-	-	
C31 Chachoengsao	4,549	728	
C32 Kanchanaburi	-	-	
C33 Nakhon Pathom	-	-	
C34 Samut Sakhon	-	-	
C35 Samut Songkhram	-	-	
C36 Ratchaburi	-	-	
C37 Phetchaburi	N. A.	N. A.	
C38 Prachuap Khiri Khan	N. A.	N. A.	
A15 Agro-Economic Zone 15	N. A.	N. A.	
A16 Agro-Economic Zone 16	N. A.	N. A.	
Total	1,427,044	228,324	

Note: Agro-Economic Zone 15 is composed of Changwat Chon Buri and Rayong  
 Agro-Economic Zone 16 is composed of Changwat Chanthaburi and Trat

Table 3-5 PADDY PLANTED AREA IN THE GREATER CHAO PHRAYA DELTA (1974 - 1986)  
(Wet Season Cropping)

(Unit: ha)

	Irrigable Area	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	Average
1 Phonlathep	15,411	15,411	15,411	15,411	15,411	15,411	15,411	15,411	15,411	15,366	15,411	15,411	15,410	15,360	15,404
2 Thabote	28,698	24,907	25,679	25,709	25,725	25,725	25,828	25,517	25,571	25,004	25,567	28,698	28,698	28,698	26,240
3 Sam Chuk	48,800	42,983	42,105	43,615	43,325	43,216	37,268	44,012	44,367	43,582	42,477	43,761	44,286	43,077	42,929
4 Don Chedi	23,112	21,289	21,401	21,188	21,295	23,030	23,035	23,112	23,112	23,096	22,872	23,112	23,112	23,096	22,519
5 Pho Phraya	59,200	56,103	54,394	54,311	49,746	44,298	41,630	46,482	42,971	38,095	34,336	39,512	31,566	22,361	42,839
6 Borommathat	58,400	58,400	58,400	58,400	58,400	58,400	57,830	58,400	58,400	58,400	58,400	58,294	58,370	55,894	58,153
7 Chanasutr	75,888	75,384	75,271	74,764	74,764	74,560	74,848	74,512	74,292	72,500	70,792	70,770	69,389	75,888	73,672
8 Yangmanee	37,260	30,242	31,115	31,092	31,561	31,064	31,064	31,026	30,123	29,500	29,921	30,152	29,812	29,697	30,490
9 Phak Hai	32,860	31,920	29,372	32,725	32,000	32,307	31,700	32,106	31,218	30,984	29,664	29,224	32,468	31,446	31,318
10 Bang Ban	23,072	-	1,600	1,672	21,533	20,614	22,323	23,072	19,616	19,520	19,920	17,835	18,352	23,072	16,088
11 Chao Chet-Bang Yihon	64,960	50,895	52,415	48,237	42,397	29,862	19,057	9,501	7,651	10,155	15,765	24,024	29,075	20,221	27,630
12 Phraya Ban Lu	70,000	16,098	22,958	4,463	3,314	4,728	4,307	7,985	20,154	17,206	28,080	28,200	45,296	35,760	18,350
13 Phra Phimol	41,825	8,000	9,120	5,600	4,354	6,752	4,880	7,656	16,750	19,920	28,550	33,440	33,024	32,480	16,194
14 Phasi Charoen	32,000	31,976	31,976	31,976	31,976	31,976	23,192	21,528	24,915	23,766	20,999	19,184	13,502	14,162	24,702
Total (Region 7)	611,566	463,608	471,217	449,163	455,761	441,943	412,173	420,320	434,551	427,094	443,354	461,617	472,360	451,712	446,528
15 Manorom/Khao Kao	37,760	36,918	36,604	37,760	37,124	37,124	37,124	36,575	37,124	37,124	37,131	37,760	37,760	37,760	37,222
16 Chong Kae	46,786	36,918	25,506	36,918	36,816	46,786	38,441	38,152	38,001	37,214	36,207	36,604	37,953	34,016	36,887
17 Koke Kathien	35,227	32,867	30,682	32,875	32,174	35,227	27,969	32,888	32,876	32,875	32,875	32,872	32,872	32,875	32,456
18 Roeng Rang	29,282	28,640	24,528	28,640	28,640	28,640	29,282	28,292	28,640	28,640	28,840	28,832	28,840	28,832	28,407
19 Mahara	76,208	75,244	64,051	76,208	76,208	72,286	76,131	76,112	76,200	76,179	76,208	76,128	76,208	61,998	73,782
20 Pasak Tai	38,496	34,624	37,840	38,496	38,496	38,496	38,496	37,875	37,618	32,017	38,128	37,647	37,563	36,640	37,199
21 Rangsit Nua	72,640	67,012	64,781	66,696	62,638	62,638	60,478	57,563	56,893	62,478	57,268	47,501	46,413	45,676	58,310
22 Nakhon Luang	42,728	42,658	42,149	42,558	42,728	40,971	42,602	42,591	42,660	42,548	42,132	41,656	40,303	41,447	42,085
23 Rangsit Tai	92,468	48,000	48,000	48,000	48,000	48,000	84,468	84,468	83,293	84,163	71,448	78,375	79,981	76,700	67,915
24 Khlong Pan	84,468	61,302	66,394	48,982	59,000	58,112	54,061	56,195	45,304	48,729	45,948	48,329	43,769	42,948	52,236
Total (Region 8)	556,063	464,183	440,535	457,233	461,824	468,280	488,702	490,711	478,609	481,967	466,185	465,704	461,662	438,892	466,499
25 Phra Ong Chaiyanuchit	81,600	70,814	70,814	70,814	70,828	58,180	70,814	70,814	70,814	70,814	70,574	70,814	70,814	70,814	69,825
GRAND TOTAL	1,249,249	998,605	982,566	977,210	988,413	968,403	971,689	981,845	983,974	979,875	980,113	998,135	1,004,836	961,418	982,852

Data Source: Water Management Section, O & M Div., RID

Table 3-6

## PADDY PLANTED AREA IN THE GREATER CHAO PHRAYA DELTA (1974 - 1986)

(Dry Season Cropping)

(Unit: ha)

	Irrigable Area	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	Average
1 Phonthathep	15,411	1,801	1,878	2,876	4,044	324	5,037	1,021	6,523	10,703	10,327	11,444	10,277	9,480	5,826
2 Thabote	28,698	3,877	6,079	4,530	9,481	6,338	16,121	757	21,566	20,646	23,764	20,032	21,299	13,568	12,928
3 Sam Chuk	48,800	15,821	21,058	23,295	23,520	13,546	29,296	3,528	26,233	34,807	37,194	29,014	18,312	26,293	22,224
4 Don Chedi	23,112	6,329	9,793	10,028	10,378	9,503	10,058	24	14,114	15,326	15,216	15,232	10,851	13,754	10,816
5 Pho Phraya	59,200	8,433	12,553	16,173	25,547	21,581	34,402	7,826	26,185	38,125	36,498	40,782	38,488	35,925	26,348
6 Boreummatbat	58,400	3,441	4,617	8,456	9,847	11,740	25,893	1,071	29,469	24,723	23,441	21,769	21,804	23,341	16,124
7 Chanasutr	75,888	14,979	18,821	30,713	27,940	12,324	41,846	3,018	39,360	42,140	50,575	30,923	32,117	22,482	28,249
8 Yangmaee	37,260	1,053	1,377	2,218	3,471	614	6,346	292	8,045	6,637	4,483	5,797	6,553	1,981	3,759
9 Phak Hai	32,960	1,040	1,002	1,135	1,120	756	1,472	906	2,336	2,347	1,564	1,688	2,105	1,781	1,481
10 Bang Ban	23,072	-	2,835	2,875	368	1,567	4,277	1,417	3,440	3,216	2,992	3,716	3,680	432	2,375
11 Chao Chet-Bang Yihon	64,960	11,584	12,136	15,067	21,304	20,952	32,698	29,312	31,000	37,229	33,644	36,045	38,903	40,716	27,738
12 Phraya-Ban Lu	70,000	50,315	55,432	63,112	49,066	63,680	67,183	65,282	65,981	64,882	59,571	69,270	56,208	54,050	60,295
13 Phra Phimol	41,825	33,360	35,632	35,536	35,632	35,126	33,444	33,530	34,848	33,344	34,496	34,481	33,740	34,892	34,466
14 Phasi Charoen	32,000	10,880	12,368	17,520	16,485	20,805	15,250	7,606	14,723	14,592	15,856	12,995	11,728	11,315	14,009
Total (Region 7)	611,586	162,913	195,582	233,524	238,203	218,856	323,323	155,590	323,823	348,517	349,621	333,248	306,065	290,010	257,638
15 Manorom/Khao Kao	37,760	1,869	5,381	3,733	9,226	2,858	13,386	280	6,986	8,808	9,926	13,171	12,454	816	6,839
16 Chong Kae	46,786	329	497	370	2,389	2,880	6,914	170	4,539	2,601	2,030	4,827	5,055	4,732	2,872
17 Keke Kathiem	35,227	292	383	537	1,366	1,837	4,090	-	3,012	7,654	4,039	8,476	7,079	4,944	3,862
18 Roeng Rang	29,282	212	466	522	694	856	1,552	-	3,928	1,400	800	1,440	1,920	-	1,061
19 Maharaj	76,208	496	1,548	1,359	1,940	3,810	13,150	90	15,613	18,480	3,975	20,836	3,138	12,592	7,464
20 Pasak Tai	38,496	1,571	1,170	749	761	1,357	4,045	198	5,650	7,469	6,096	6,640	6,656	6,482	3,757
21 Rangsit Nua	72,640	7,828	12,218	10,537	14,765	17,845	18,614	4,111	18,667	23,802	23,094	19,574	22,009	20,238	16,419
22 Nakhon Luang	42,728	184	166	419	1,024	453	1,336	92	1,239	122	130	106	325	367	459
23 Rangsit Tai	92,468	17,100	27,119	37,606	37,884	37,524	49,911	13,630	54,199	51,026	50,832	33,427	30,405	28,063	36,056
24 Khlong Dan	84,468	4,347	6,948	6,985	14,054	13,388	10,431	7,986	25,946	19,759	18,690	22,916	18,497	15,315	14,246
Total (Region 8)	556,063	34,228	55,896	62,867	84,103	82,808	123,429	26,557	139,779	141,121	119,532	131,513	107,548	93,549	82,535
25 Phra Ong Chaiyanuchit	81,600	4,312	12,041	24,274	34,267	37,323	36,551	29,890	39,978	42,484	45,408	49,845	47,916	50,656	34,957
GRAND TOTAL	1,249,249	201,453	253,519	320,655	356,573	333,987	463,303	211,537	503,580	532,122	514,581	514,606	461,529	434,215	395,130

Data Source: Water Management Section, O &amp; M Div., RID

Table 3-7 PERFORMANCE OF THE EXISTING IRRIGATION PROJECT

(1) General Condition

Name of Project	Project Area (ha)	Irrigable Area (ha)	Land Use (ha)			Number of Water Master (No.)	Zone Man (Z.M.)		Floating Rice		Paddy Plant Method (%)	
			Paddy Field	Upland Field	Fruits Tree		Fish Pond	Number (No.)	Coverage (ha/Z.M)	1976 (ha)	'86/87 (ha)	Transplant Wet Dry
1 Phonlathep	16,480	15,411	15,360	-	32	6	8	1,926	-	-	na	na
2 Thabote	34,937	28,698	29,060	-	-	25	16	1,965	1,752	-	na	na
3 Sam Chuk	59,536	48,800	43,077	-	-	-	19	2,568	-	-	30	70
4 Don Chedi	26,000	23,112	23,112	-	-	-	12	1,947	720	2,304	-	100
5 Pho Phraya	66,550	59,200	26,922	-	-	-	36	1,644	13,270	2,561	30	70
6 Borommathai	64,800	58,400	58,274	-	-	-	30	1,947	4,259	4,327	20	80
7 Chanasutr	84,320	75,888	69,066	-	-	-	41	1,749	6,838	13,918	na	na
8 Yangmanee	37,390	37,260	29,704	-	-	88	18	1,870	11,802	22,116	na	na
9 Phak Hai	32,960	32,960	31,736	-	112	310	13	2,343	28,896	31,896	-	100
10 Bang Ban	25,600	23,072	21,553	-	11	35	8	2,740	8,848	16,497	-	100
11 Chao C-B. Y.	70,056	64,960	20,133	99	821	2,376	9	7,218	11,904	10,632	-	100
12 Phraya B. L.	70,000	70,000	28,800	-	2,689	341	9	6,376	-	-	-	100
13 Phara Phim	45,690	41,825	32,480	-	3,596	93	2	2,413	-	-	-	100
14 Phasi Char.	56,000	32,000	14,162	-	7,722	352	6	5,333	-	-	30	70
T t i (Region 7)	690,319	611,586	443,439	99	14,983	3,626	227	2,694	88,289	104,251	-	-
15 Manorom/K. K	42,258	37,760	38,737	-	-	-	3	1,435	640	-	na	na
16 Chong Kae	45,060	46,786	38,128	22	-	-	2	2,122	6,224	6,258	100	35
17 Koke Kathi.	33,299	35,227	32,875	-	-	-	2	2,202	15,268	17,928	100	60
18 Roeng Rang	28,640	29,281	28,832	-	-	-	2	2,662	3,195	10,597	100	60
19 Maharaj	80,448	76,208	76,213	-	173	-	6	1,508	35,544	30,331	10	70
20 Pasak Tai	43,520	38,496	33,440	-	1,336	88	2	2,264	5,047	4,160	40	10
21 Rangsit Nua	71,280	72,640	45,676	-	15,944	701	3	1,772	3,764	5,739	20	80
22 Nakhon Lua	48,295	42,728	41,446	5	248	27	3	1,643	20,089	22,060	60	40
23 Rangsit Tai	90,560	92,468	76,700	347	2,186	25	5	10,274	231	-	10	90
24 Khlong Dan	91,040	82,868	42,951	-	248	15,112	3	16,800	3,280	27,003	10	90
T t i (Region 8)	574,400	554,462	454,998	374	20,135	15,953	31	2,543	93,282	124,076	-	-
25 Phra Ong C.	81,600	81,600	70,814	-	-	10,544	4	5,100	-	-	-	100
Phitsanulok	134,117	106,736	73,920	31,760	2,816	240	12	1,286	-	-	30	70

PERFORMANCE OF THE EXISTING IRRIGATION PROJECT

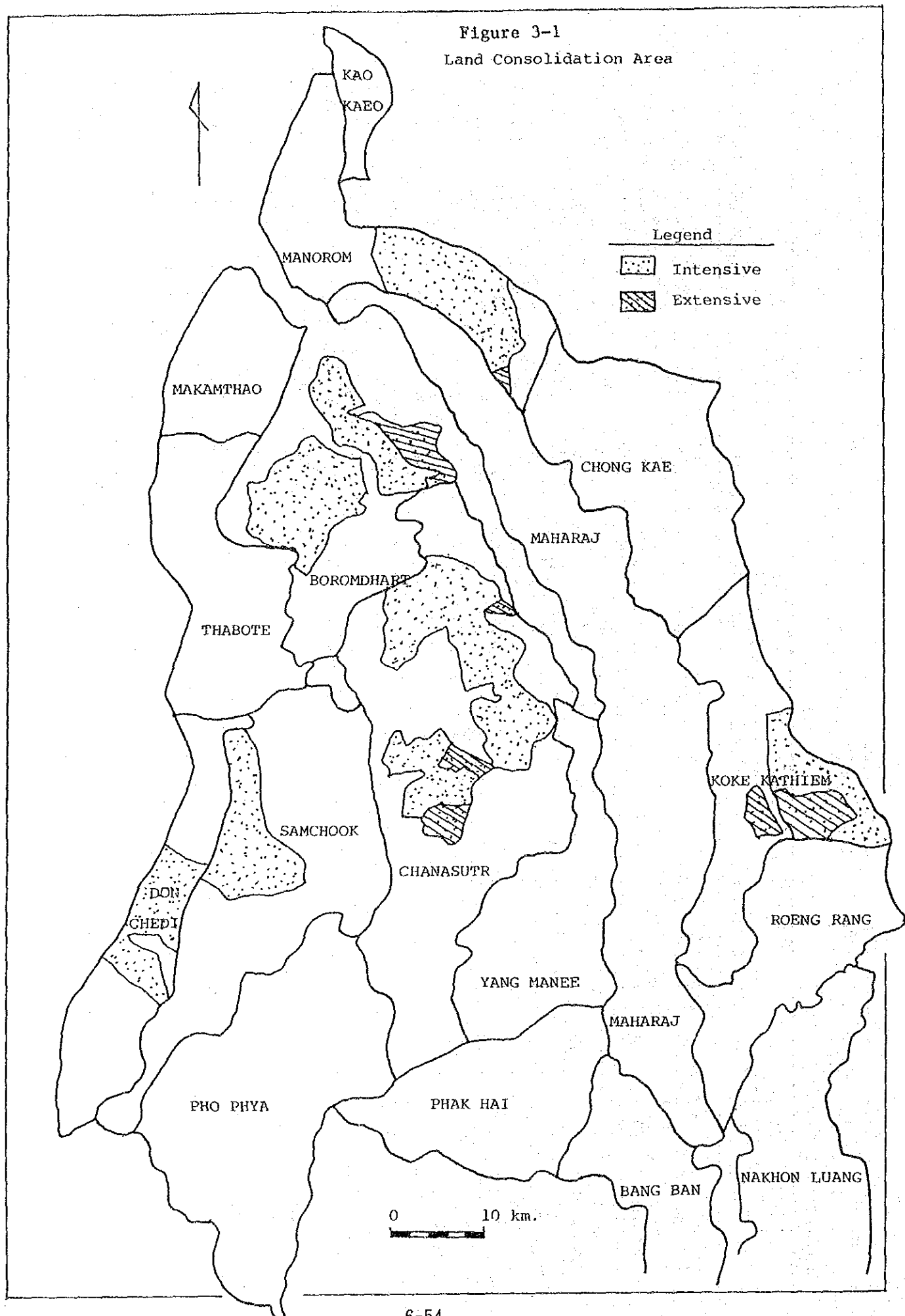
(Unit: Kg/ha)

(2) Paddy Yield

	Dry Season						Wet Season					
	1981/82	1982/83	1983/84	1984/85	1985/86	Average	1981/82	1982/83	1983/84	1984/85	1985/86	Average
	Region - 7											
1 Phonlathep	4, 140	4, 170	4, 090	4, 210	4, 180	4, 160	4, 160	4, 020	3, 950	3, 580	3, 130	3, 770
2 Thabote	4, 540	4, 460	4, 600	4, 920	4, 360	4, 580	4, 580	4, 060	4, 360	4, 210	4, 280	4, 210
3 Sam Chuk	4, 330	4, 280	4, 570	4, 390	4, 390	4, 380	4, 380	3, 760	3, 540	3, 720	3, 860	3, 760
4 Don Chedi	4, 440	4, 560	4, 480	5, 580	4, 470	4, 710	4, 710	3, 710	3, 950	4, 120	4, 350	3, 890
5 Pho Phraya	3, 760	3, 570	4, 340	3, 840	3, 780	3, 860	3, 860	3, 390	3, 160	3, 110	2, 260	3, 040
6 Borommathai	3, 810	3, 960	4, 240	4, 360	4, 380	4, 150	4, 150	3, 890	4, 010	4, 040	4, 090	4, 000
7 Chanasutr	4, 130	4, 490	3, 680	4, 540	4, 100	4, 190	4, 190	3, 850	3, 910	3, 850	3, 710	3, 770
8 Yangmanee	4, 140	3, 910	4, 400	4, 470	4, 440	4, 270	4, 270	3, 790	3, 840	3, 260	3, 360	3, 450
9 Phak Hai	4, 190	3, 570	4, 190	4, 170	3, 990	4, 020	4, 020	2, 500	2, 530	2, 270	2, 540	2, 370
10 Bang Ban	3, 330	3, 780	4, 090	4, 090	3, 740	3, 810	3, 810	2, 380	2, 130	2, 810	3, 660	2, 740
11 Chao Chet-Bang Y.	3, 450	3, 990	3, 990	3, 780	3, 840	3, 810	3, 810	1, 710	2, 330	2, 380	2, 860	2, 100
12 Phraya Ban Lu	4, 410	4, 380	5, 000	4, 660	4, 410	4, 570	4, 570	2, 570	2, 230	2, 630	2, 530	2, 510
13 Phara Phimon	4, 690	4, 910	5, 360	4, 230	4, 250	4, 690	4, 690	2, 620	2, 940	2, 930	3, 390	2, 810
14 Phasi Charoen	3, 190	3, 180	3, 590	3, 290	4, 110	3, 470	3, 470	2, 980	2, 540	2, 970	3, 110	2, 990
Region - 8												
15 Manorom/Khao Kaeo	3, 410	3, 640	840	2, 370	3, 860	2, 820	2, 820	3, 190	3, 960	3, 010	3, 220	3, 330
16 Chong Kae	3, 540	3, 840	4, 930	5, 420	4, 310	4, 410	4, 410	3, 330	4, 390	4, 210	4, 030	3, 900
17 Koke Kathiem	2, 910	3, 000	3, 860	4, 020	3, 810	3, 520	3, 520	3, 640	3, 680	3, 360	3, 490	3, 610
18 Roeng Rang	3, 630	3, 740	3, 750	3, 880	N.A.	3, 750	3, 750	3, 210	3, 030	3, 080	3, 160	3, 150
19 Maharaj	2, 560	2, 590	4, 650	4, 650	4, 080	3, 710	3, 710	3, 240	2, 780	2, 890	2, 720	2, 920
20 Pasak Tai	3, 590	N.A.	4, 500	N.A.	3, 930	4, 010	4, 010	2, 560	3, 380	3, 510	3, 620	3, 210
21 Rangsit Nua	3, 750	3, 780	4, 060	4, 380	4, 190	4, 030	4, 030	2, 640	2, 320	2, 500	2, 530	2, 500
22 Nakhon Lua.	3, 750	3, 780	4, 060	4, 380	3, 750	3, 940	3, 940	2, 560	2, 640	3, 150	3, 130	2, 840
23 Rangsit Tai	3, 030	3, 130	2, 860	2, 740	2, 980	2, 950	2, 950	2, 950	2, 540	2, 890	3, 020	2, 790
24 Khlong Dan	3, 050	2, 600	1, 990	1, 990	2, 000	2, 330	2, 330	2, 810	2, 300	3, 320	3, 180	2, 900
25 Phra Ong Chayanu.	3, 490	3, 430	3, 930	3, 400	2, 560	3, 360	3, 360	3, 580	3, 280	3, 240	3, 360	3, 270
Phitsanulok	3, 250	3, 770	3, 750	4, 070	3, 660	3, 700	3, 700	3, 270	3, 310	3, 620	3, 690	3, 380

Source: hearing from each project office concerned

Figure 3-1  
Land Consolidation Area



(Unit: 1,000 ha)

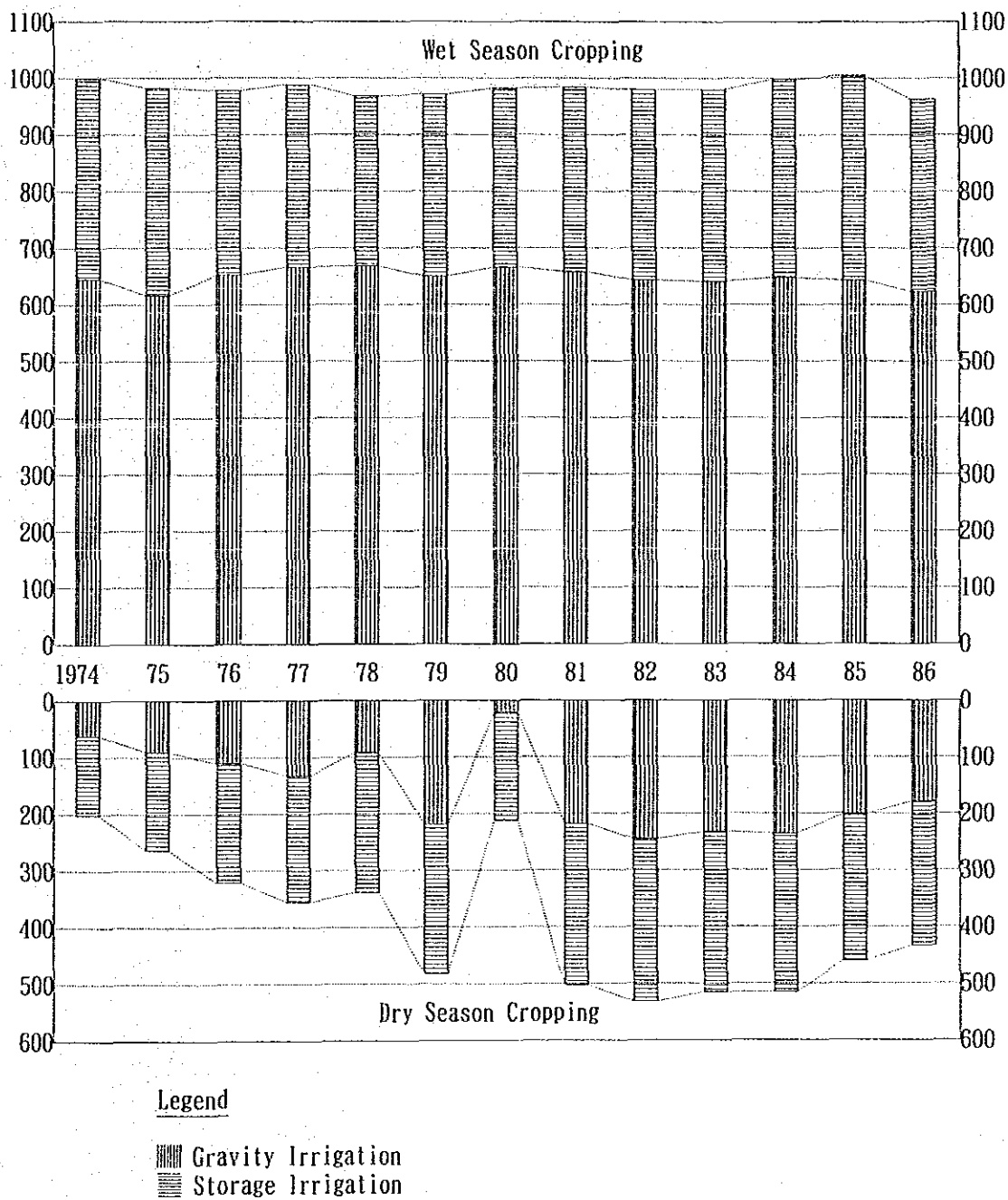
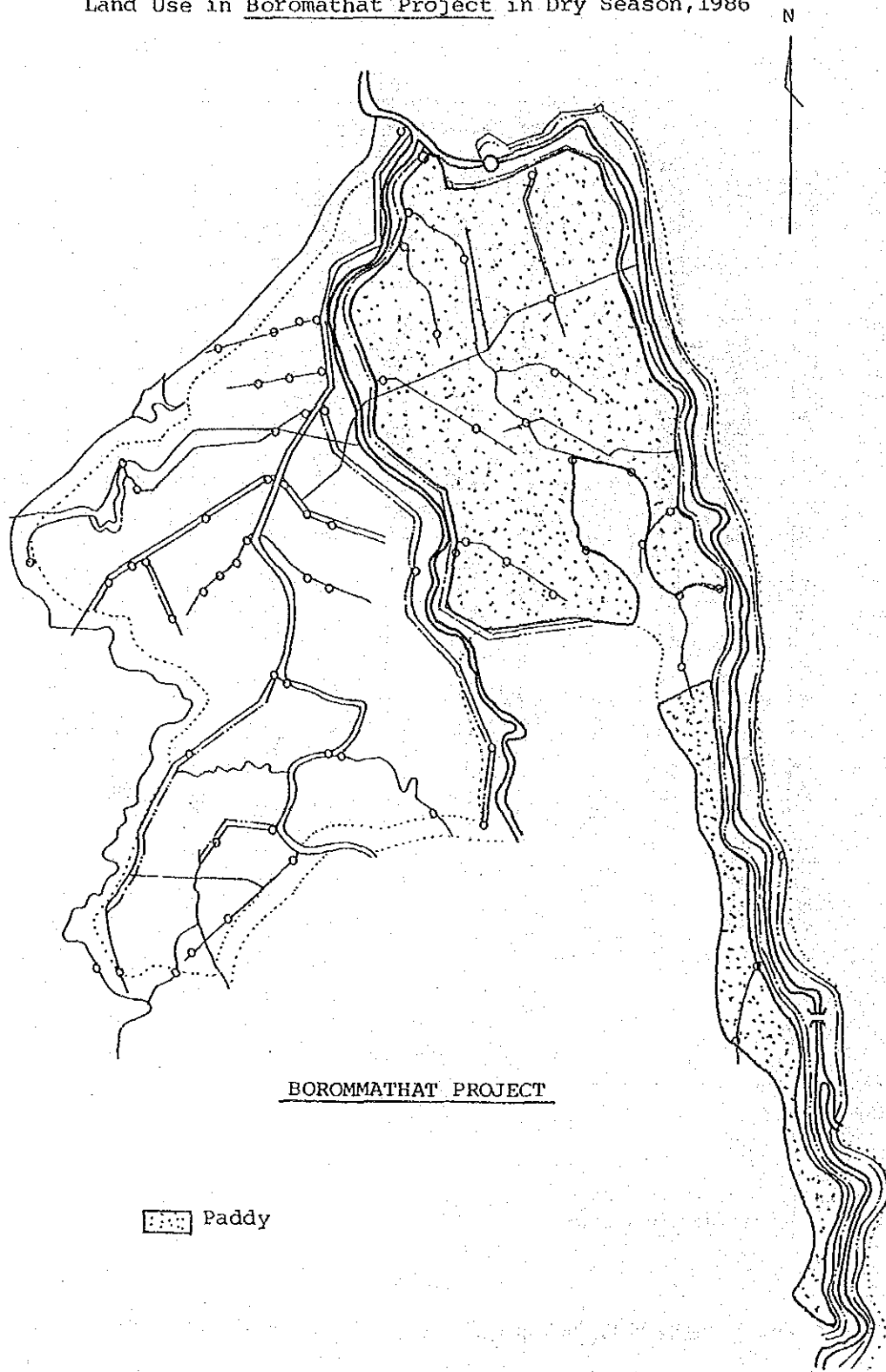


Figure 3-2. PADDY PLANTED AREA BY IRRIGATION METHOD IN CHAO PHRAYA DELTA




Figure 3-3

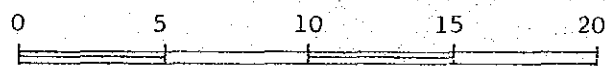
Land Use in Boromathat Project in Dry Season, 1986



BOROMATHAT PROJECT

 Paddy

SCALE



kilometer

Figure 3-4 Land Use in the Rangsit Project in dry season, 1986

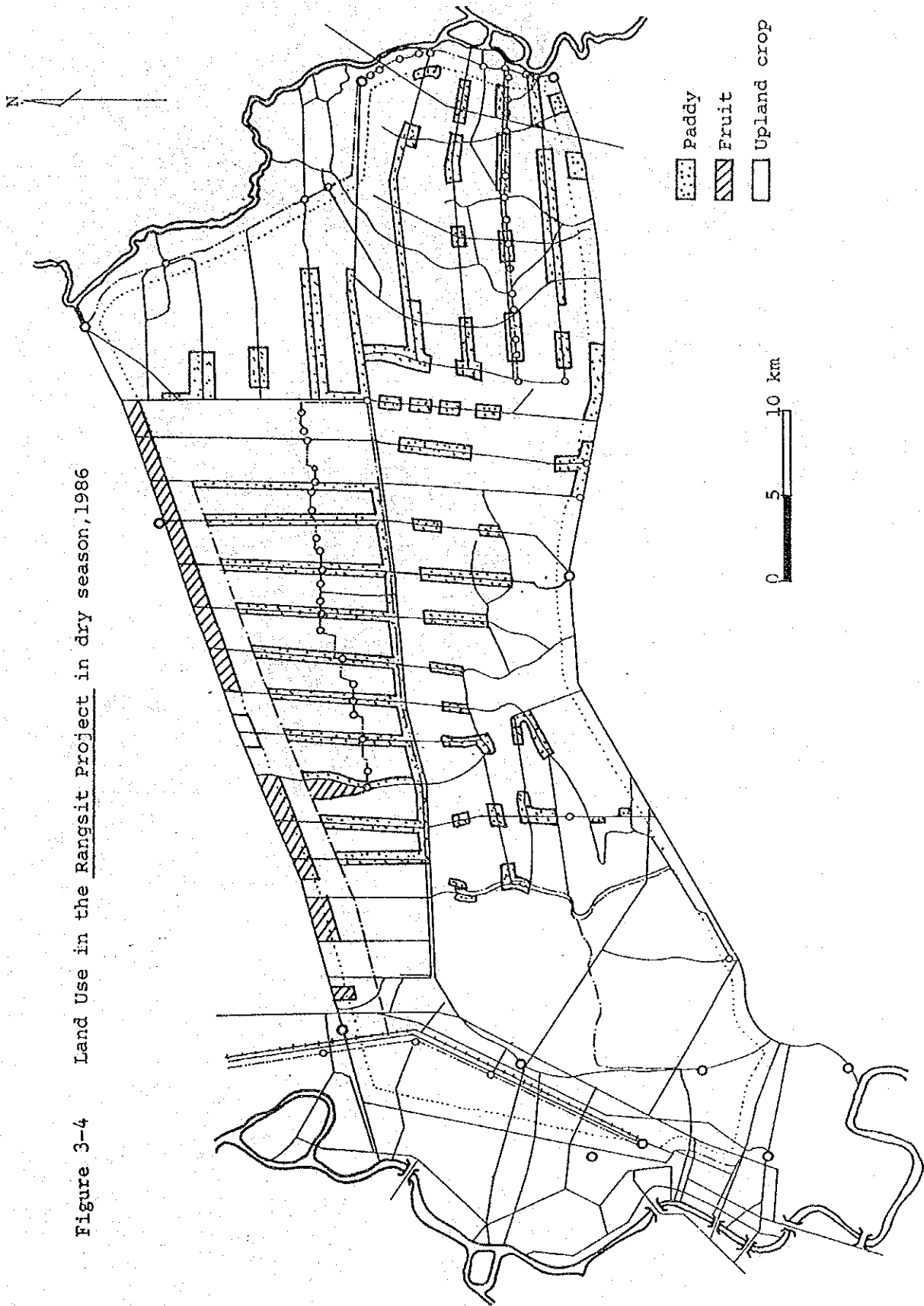
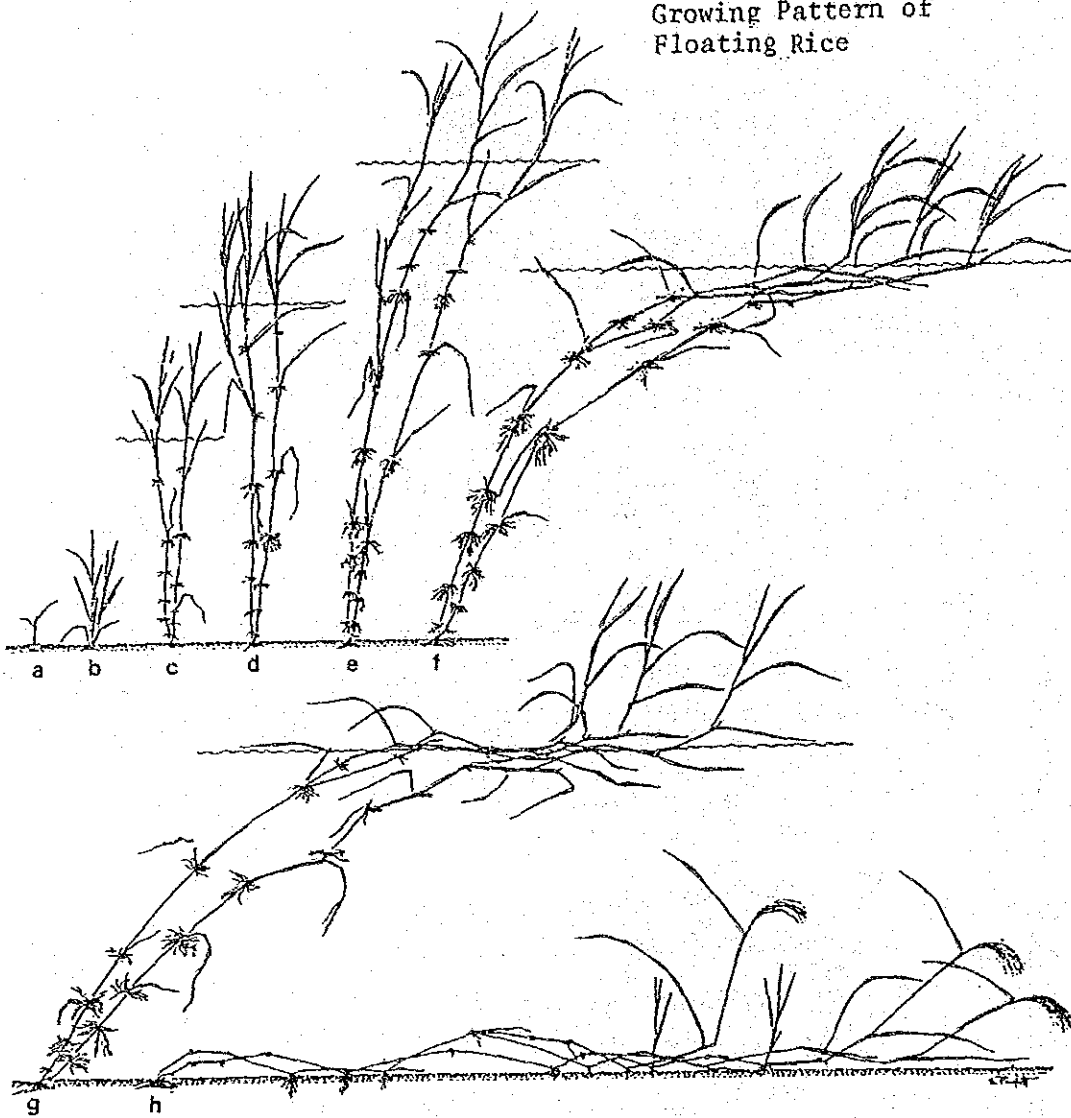


Figure 3-5

Growing Pattern of Floating Rice



Water Level Pattern at Huntra

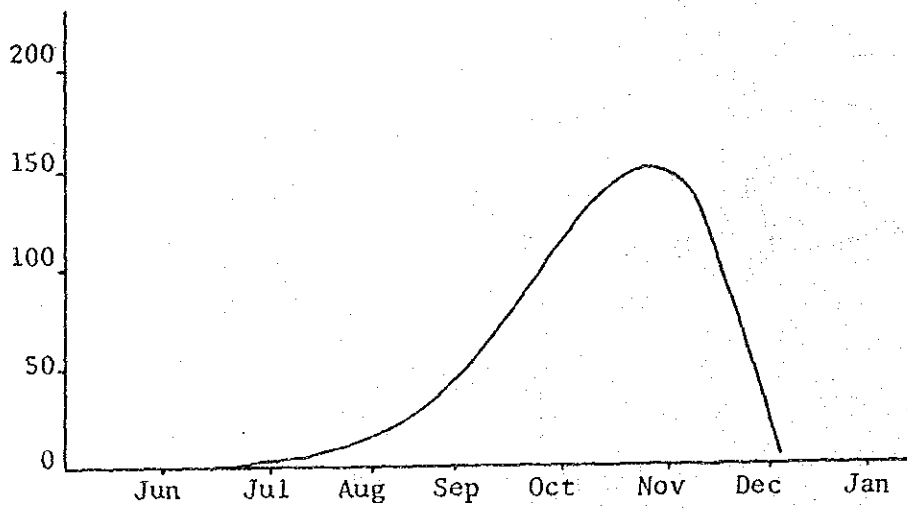
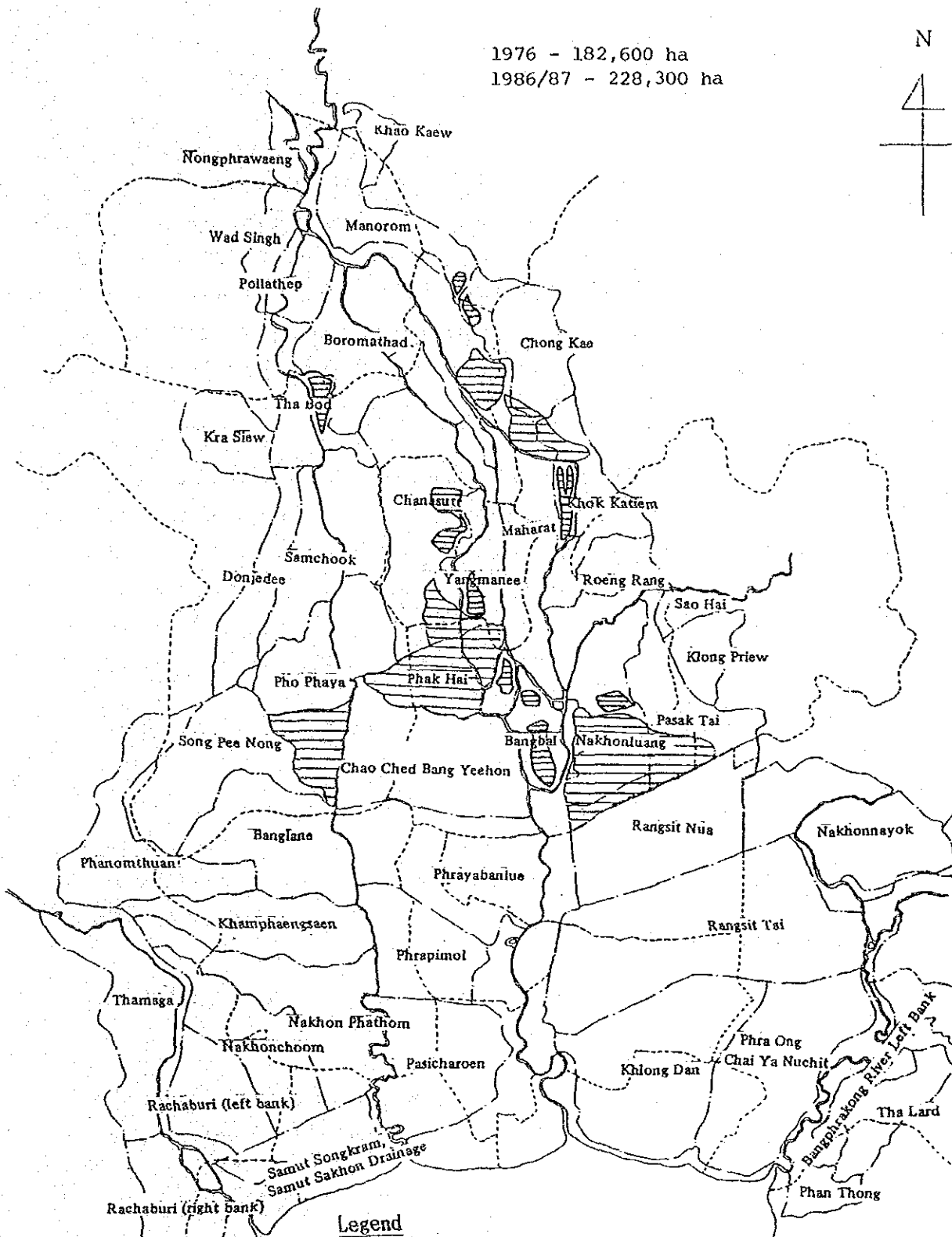
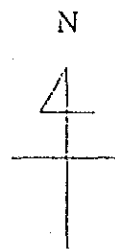


Figure 3-6 DEEP WATER/FLOATING RICE CULTIVATION

1976 - 182,600 ha  
1986/87 - 228,300 ha



**Legend**



Floating Rice/Deep Water  
Rice Area  
(Based on 1976 Data -  
Rice Institute)

0 10 20 km

Deep Water/Floating Rice Area



## CHAPTER 4 CROP DIVERSIFICATION AND ITS CONSTRAINTS

### 4.1 Background

Due to stagnation of rice price in the world market, not only profitability of paddy cropping at farmers' level has been deteriorated, but also share of rice in the Thai export earnings has been decreased. On the other hand, dry season paddy cropping acreage has been increasing in parallel with promotion of constructing irrigation facilities in the basin.

Eventually, available water resources in the basin has become quite tight and marginal. In this regards, it is one of prerequisite to promote crop diversification introducing more crops from viewpoints of efficient and equitable use of irrigation water. In the Sixth National Economic and Social Development Plan, emphasis has been given to promotion of crop diversification.

### 4.2 Objective

By introducing field crops and horticultural crops which demand less irrigation water than paddy, it is planned to increase cropping acreage during dry season as well as to improve overall irrigation efficiency.

### 4.3 Strategy

To carry out crop diversification, following strategies are considered, and optimum strategy shall be selected taking into consideration of various conditions in the objective area.

#### 1) Changes in Land Use Pattern

Paddy field to Upland field

(Ex: Cultivation of vegetables and fruits at the raised bed; See Figure 4-1)

- ii) Rotation from Paddy to Other Crops  
(Provision of irrigation and drainage facilities and land consolidation works are required)

Paddy cropping        -- Field crop cropping  
Field crop cropping -- Field crop cropping

- iii) Double cropping in Paddy Field  
Paddy cropping -- Field crop cropping

#### 4.4 Constraints

At this moment, following constraints on promoting crop diversification in the Study Area are detected;

- i) Soil condition in the delta (Heavy clayey soil)
- ii) Existing irrigation facilities could not meet with introduction of furrow/sprinkler irrigation
- iii) Non-existence of marketing channel for field crops
- iv) Non-existence of farmers' attitude and know-how for field crops which are more risky than paddy

#### 4.5 Prospect

Crop diversification is one of the serious problems that Thai agriculture is now facing difficulty as a result of easing of the international rice market conditions.

In Thailand, the meteorological conditions are not restrictive factors to general crop husbandry as well as paddy cropping, but water and soil conditions are restrictive to crop husbandry.

On top of the above, such a variety of factors and tough problems should be taken into consideration for restrictive matters, as skillfulness of paddy growers, demand and supply balance of products, profitability, marketability home and abroad, processing technology, etc.

In RID Region 1 in the upper reach of the Chao Phraya River, there are many farm plots extending in the mountainous area, although generally small in acreage, and the most intensive farming in the country has been practised with crop diversification with paddy and other crops like vegetables, soybeans tree crops, etc.

The reason why such intensive and diversified cropping is advanced is that the Area is blessed with cool meteorological conditions, and is well-drained farm land which can provide the environment suitable to upland farming.

In the middle and lower reaches, contrarily, slightly ill-drained loamy soils spread widely to be suitable to paddy cropping with undation, but not suitable to upland farming. Under the conditions, the middle and lower reaches of the Chao Phraya Basin have traditionally carrying out the paddy-based agriculture.

The Rangsit Project Area and Suburban Area of Bangkok, however, provide the environment suitable to practise the upland farming with high ridges made for drainage of wetty fields and with some soil improvement materials laid to make furrow irrigation available.

In the Rangsit Nua Area, considerably large scale tree-crops plantations are developed by the aforesaid method to grow fruits, mainly oranges. The total acreage of the tree-crops plantations is about 600 ha in the said area.

This farming method is superior land use technology in practising upland crops with both groundwater table and soils acidation being controlled, although some problems exist in such a high cost in land formation that the small scale local farmers cannot apply this technology.

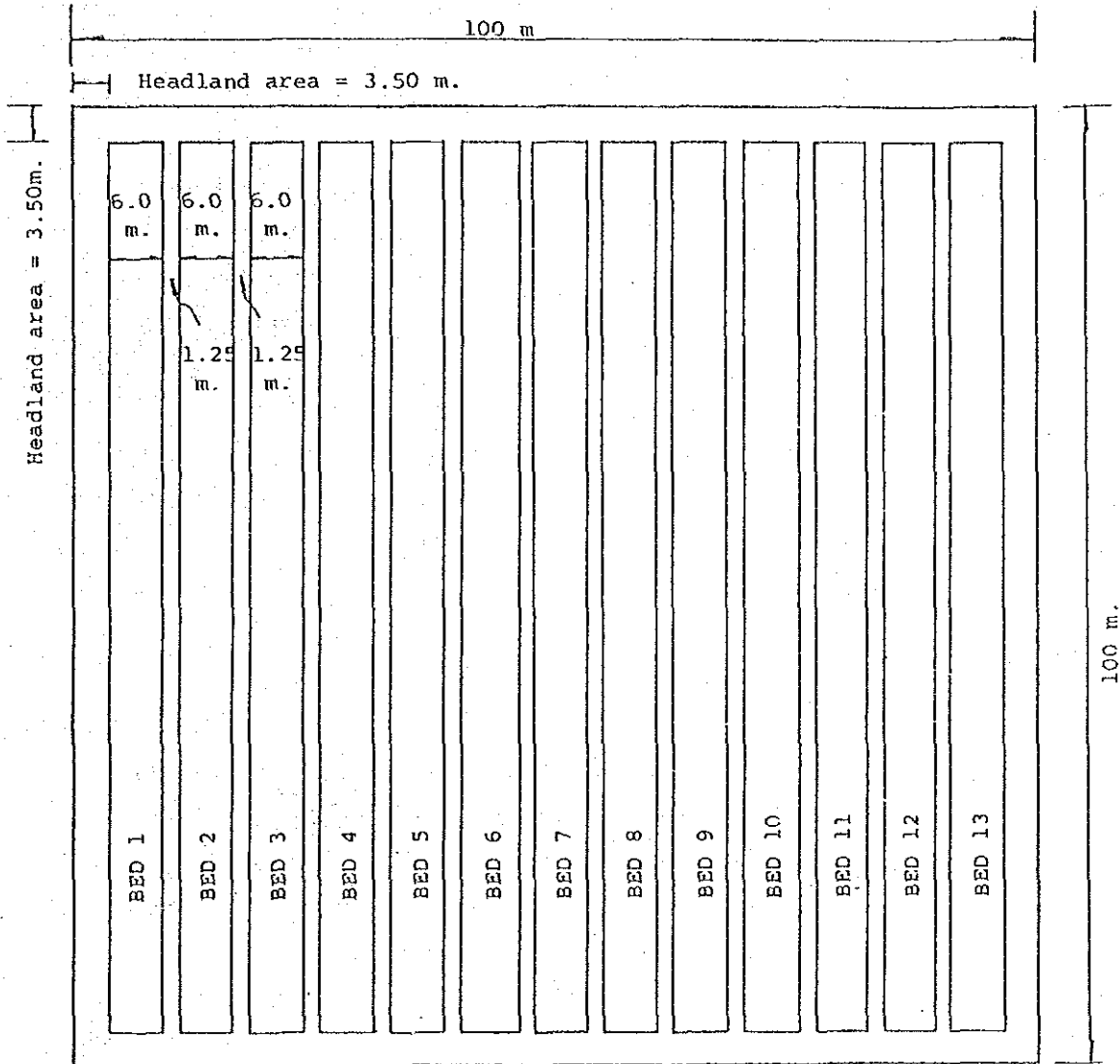
Employment of this method, however, will enable to grow such upland crops as mungbean, sweet corn, long-bean, egg-plant, kale, pumpkin, water melon, cucumber, etc. even in the low-lying swampy land, and the crop diversification will be able to be practised in



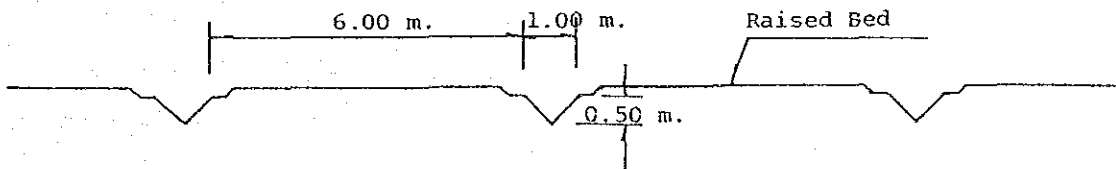
the areas selective with easy water utilization in those areas of Phraya Banlue, Phrapimol, Chao Ched Bang Yihon, etc.

And the crop diversification in the Basin is considered not only dependent upon technical matters but upon operational or managerial matters such as profitability, storage, marketing, and so on.

Figure 4-1 Planting Beds and Ditches (1 Hectare)



Headland area = 3.50 m.  
 Total number of planting beds = 13  
 The length of the planting bed is 93 m.



Raised Bed with Small Irrigation Canal



## CHAPTER 5 PROPOSED CROPPING PATTERN AND FARMING SYSTEM

### 5.1. Crop Diversification and Local Farmers

FAO has a prospect that the international market trend of rice will remain dull at low prices with sufficient supply to meet the import demand and the stocks will be increased in future as well. Under the situation, the Thai farmers have been compelled to turn the farming from rice-majoring farming to multiple crops farming. The Sixth Five-year Development Plan has taken up the crop diversification to encourage the farmers for carrying it out for income increase. And such multiplication of the farm management is a vitally important to solve the problem of population increase.

Figures 5-1 through 5-4 show planted area of selected upland crops in whole Thailand, and Table 5-1 gives planted area of fruits/tree crops and upland crops in 33 Changwats which are related to the Study Area. In addition, Figure 5-5 illustrates provincial concentration of selected fruits production.

It is not easy, however, to persuade the farmers to turn the traditional paddy farming to other diversified crop farming. In addition to such farmers' conservativeness, there are more restrictive factors of soils and irrigation availability adversely working upon the proposed diversification of crops. As for vegetable cropping, unreasonable expansion of the cropping acreages may cause drastic drop and confusion of the market prices in considering the fact that the demand and supply balance of vegetables has been well established in the current market condition.

At present, only those farmers who have much capital to invest can run the large-scale orchard in Rangsit area and shrimp farm ponds in Changwat Supan Buri. For the farmers who have not much capital nor any particular technology can not make crop diversification a multiple farm management so easily in view of instable market prices of the diversified crops.

Consequently, the crop diversification, in considering its natural and socio-economic environment, should be promoted beginning with the large-/medium-scale farmers to show the results to the general farmers, and the furthering effects should be expected to the general farmers through movement by the leading farmers and in due consideration of the potential land use of the Area.

## 5.2. Crops

The Chao Phraya River Basin can be grouped as follows from the viewpoint of the crops husbandry.

<u>RID Regions</u>	<u>Crops</u>
Region 1:	Wet season Paddy, Soybean, Groundnut Garlic, Tobacco, Vegetables, Tree-crops.
Region 2:	Wet Season Paddy, Groundnut, Soybean, Vegetables.
Region 3:	Wet Season Paddy, Maize, Mungbeans, Soybean Sorghum, Cassava, Sugarcane Groundnut.
Region 7:	Wet/Dry Season Paddy, Cassava, Vegetables for Urban Supply, Sugarcane
Region 8:	Wet/Dry Season Paddy, Sorghum, Cassava, Maize, Tree-crops, Vegetables for Urban Supply.
Region 9:	Wet/Dry Season paddy, Cassava.

It can be said that the present land use, as learnt from the above, reflects the different and specific conditions of land and irrigation of the respective Regions.

Consequently, as already pointed out through comparative study of the present and potential land use, there are some Regions having potential for further expansion of the upland cropping land. Fundamentally, however, further development or expansion of upland cropping should be made on the base of the listed crops as above according to potential land use of each Region.

The major crops can be proposed as follows.

- Paddy - The rice export value is largest of all the farm products to keep greatly contributing to the national economy. Regions 7 and 8 are the Major producers of rice of the country.
- Cassava - This is the second largest export crop to paddy, grown in the terrace areas in Region 3, 7, 8 and 9. Since cassava is the exploitative crop which takes soil nutrients excessively to devastate the land, the production expansion is not planned in the Five-year Development Plan in consideration of its cropping limitation.
- Maize - Maize is in the third position of the export items in its amount and the Five-year Development Plan aims to increase its yield. And the production in the Chao Phraya River Basin aims to cover about 45 percent of the national total of this item.
- Sugarcane - The major growers of sugarcane are Region 3 and 7; and since the international market price has been declined, the Five-year Development Plan does not aim to expand the cropping acreage but increase yield.
- Mungbean - Region 3 produces about 64 percent of the national total of mungbean, which has comparatively short growing period and high resistivity to drought, and the export of mungbean has been gradually increasing in the recent year.
- Soybean - Since the axial roots grow relatively deep into the ground, soybean is both drought-resistant and wet-resistant. Region 3 is the main grower of soybean and the dry season cropping is practised almost with soybean in the Region. In cropping year for 1985/86, Thailand produced about 300,000 tons of soybean; however, soybean has been imported from China in the form of food oil because of short supply by domestic production. As the domestic demand is still growing, the Sixth Five-year Plan aims to expand the cropping acreages by 1.4 times as wide as those in 1985/86. In the Chao Phraya Basin, about 82 percent of the national production will be cultivated in future.
- Groundnut - Groundnut is grown in the dry season mainly in Region 2. Since, being relatively resistant to drought, this plant prefers dry sandy sorts, the cultivable land is more limited than that of soybean.

Fruit Crops - Region 1 and 2 are the major fruits growers in the Country.

Recently, as the export of fresh fruits has been increasing, the fruit growers should pay close attention to post-harvest procedures like packing, forwarding, etc. as well as quality improvement.

The crop diversification in the Basin is deemed to be potentially promising in the future.

Although Region 1, 2 and 3 should be reasonably considered as a core of the diversification campaign, further studies, researches and experiments will be necessary for upland crops cultivation in these Region 1 and 2 because of difference in meteorological and soil conditions from the other Regions. In Region 7 and 8, upland crops cultivation can be practised with high ridges provided in the fields in making the better use of comparatively abundant water resources even in the dry season, although more costly than ordinary upland cropping and limited in cropping acreage available.

### 5.3. Cropping Pattern

The Region-wise cropping patterns can be proposed as compiled in Figure 6.5-7 of Appendix 6.5, in taking into consideration the potential land use, experience of the farmers concerned, directions indicated in the Sixth Five-year Plan and some prospectives added. And only the most typical patterns shall be shown in Table 5-2, by selection from crops combinations available.

Table 5-1

Planted Area for Fruits/Tree Crops and Upland Crops (Unit : ha)

Fruits/Tree Crops				Vegetables			
Crops	1980/81 (1)	1984/85 (2)	(2)/(1)	Crops	1980/81 (1)	1985/86 (2)	(2)/(1)
Para Rubber	348	822	2.36	Chilli	20,592	10,378	0.50
Kapok	25,650	18,726	0.73	Bird Pepper	16,997	8,352	0.49
Oil Palm	-	-	-	Ginger	1,118	1,651	1.48
Coffee	4,167	1,988	0.47	Garlic	33,308	26,007	0.78
Pepper	28	-	-	Shallot shoot	11,107	7,890	0.71
Coconut	85,492	73,476	0.86	Chinese Radish	2,844	2,038	0.72
Common Lime	9,880	9,002	0.91	Tomato	4,286	2,597	0.61
Mango	82,681	72,106	0.87	Garden Pea	1,395	696	0.50
Cashew Nut	525	2,072	3.95	Cabbage	4,350	3,761	0.86
Tamarind	22,956	14,884	0.65	Long Cucumber	1,319	731	0.55
Mangosteen	380	354	0.93	Long Yard Bean	6,374	7,015	1.10
Longan	12,990	14,948	1.15	Short Cucumber	9,284	6,491	0.70
Lichee	3,710	5,297	1.43	Angled Loofah	2,141	2,121	0.99
Sapodilla	16,316	10,435	0.64	Bitter Cucumber	746	741	0.99
Langsat	5,329	8,296	1.56	Chinese Cabbage	3,774	3,251	0.86
Longong	1	27	27.00	Lettuce	776	664	0.86
Durian	8,904	6,111	0.69	Leaf Mustard Cabbage	5,001	4,384	0.88
Rambutan	338	332	0.98	Pakchai Chinese	3,551	3,894	1.10
Grape	2,715	2,298	0.85	Chinese Kale	3,918	4,381	1.12
Sugar Apple	11,247	9,729	0.87	Water Conval vulus	2,637	1,512	0.57
Java Apple	2,243	2,380	1.06	Water Spinach	-	2,483	-
Guava	10,408	7,159	0.69	Pumpkin	2,916	2,913	1.00
Jack Fruit	16,259	12,426	0.76	White Gourd	2,061	1,868	0.91
Champedak	28	6	0.21	Taro	2,692	2,059	0.76
Santol	1,526	287	0.19	Baby Corn	-	4,708	-
Tangerin	23,202	31,246	1.36	Onion	-	1,632	-
Sweet Orange Acidless	2,697	1,638	0.62	Multiplier Onion	-	1,824	-
Sweet Orange	1,554	1,578	1.02				
Pomelo	7,126	6,111	0.86				
Neck Orange	28	158	5.64				
Klue Hom	11,403	9,961	0.87				
Klue Nam Wa	59,068	57,768	0.98				
Klue Kai	7,690	6,258	0.81				
Total	436,707	387,924	0.89		143,187	116,042	

Note : Total planted area in 33 changwat concerned to the Study Area.

Source : Department of Agricultural Extension



Table 5-2 Proposed Cropping Pattern

1. Case Study

(Unit : %)

<u>TP</u>	<u>BC</u>	<u>Wet Season</u>		<u>Dry Season</u>
		<u>HYV</u>	<u>LV</u>	<u>HYV</u>
0	100	0	100	100
100	0	100	0	100
80	20	80	20	100
60	40	60	40	100
40	60	40	60	100
20	80	20	80	100
10	90	10	90	100

2. No Change in floating rice area

3. Growing period of paddy could be removable by one month to right or left

4. Study on growing period applied to the dam capacity

Figure 5-1 Planted Area of Soybean

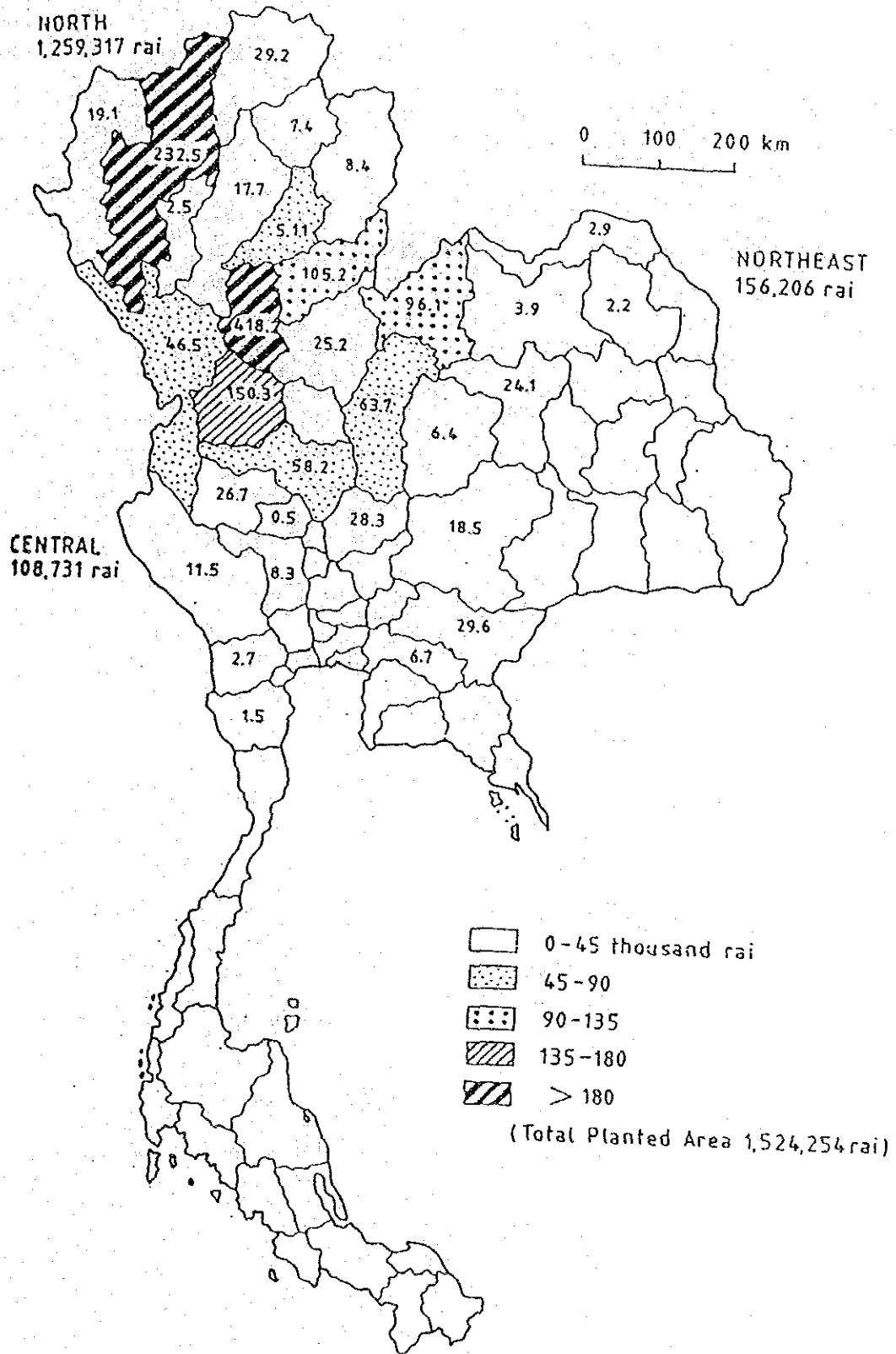


Figure 5-2 Planted Area of Groundnut

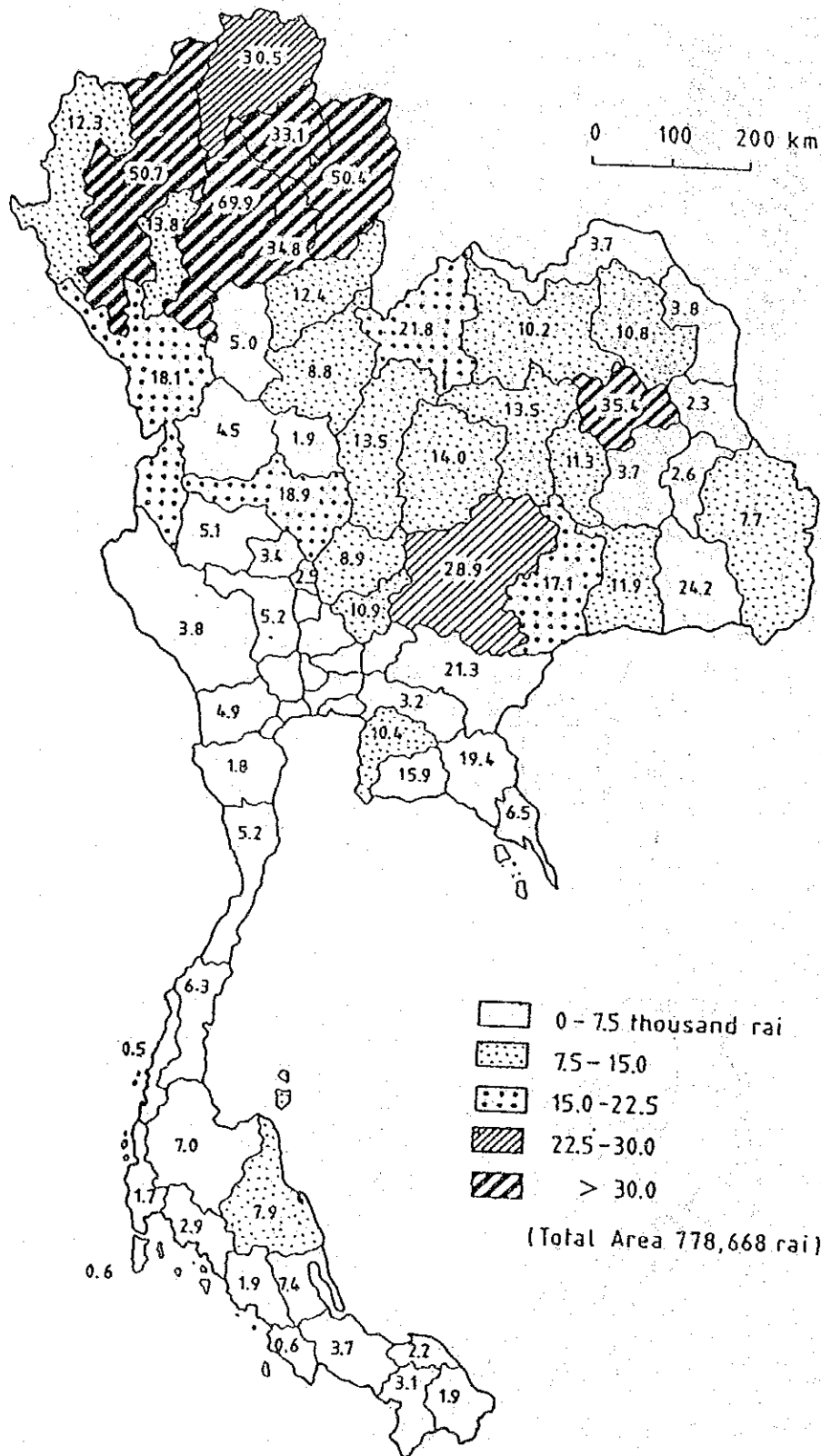


Figure 5-3 Planted Area of Sesame

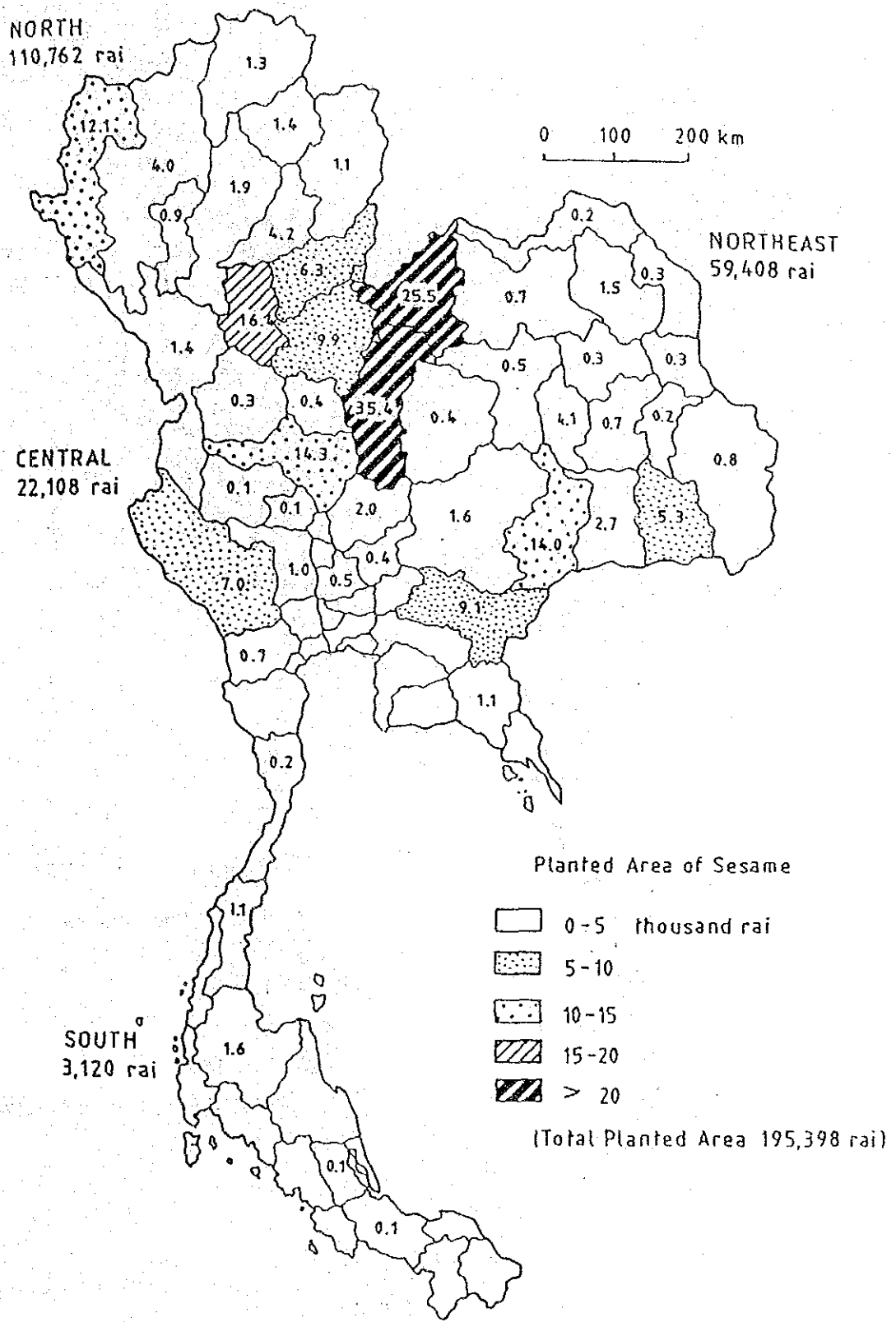


Figure 5-4 Planted Area of Casterbean

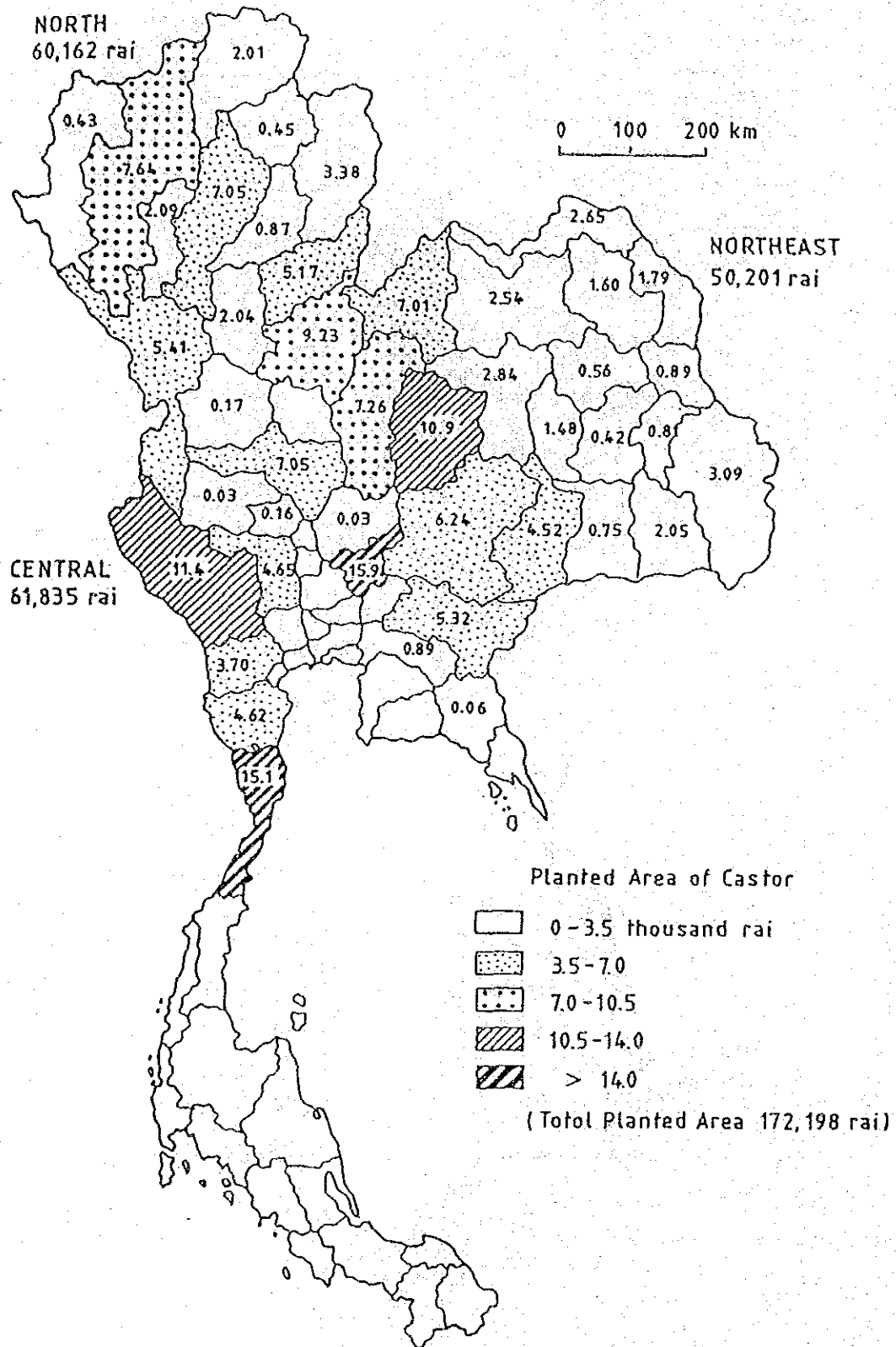


Figure 5-5

Provincial Concentration of Selected Fruit Production

