Table 2.11 Problem Soils in Study Area (Area in Rai)

Province	Acid Sulphate	Saline	Saline Associations	Sandy	Sandy Associations	Skeletal	Skeletal Associations	Total of all Associated Soils
Nakhon Nayok	677,290	0	0	0	0	53,164	0	0
Prachin Buri	425,761	0	0	71,623	76,913	1,100,516	46,055	122,968
Nakhon Ratchasima	0	399,855	36,084	392,058	272,537	987,338	152,514	461,135
Buri Ram	0	33,554	0	76,570	227,247	227,218	1,024	261,825
Surin	0	103,064	0	187,266	11,547	26,658	312,100	323,647
Si Sa Ket	0	0	0	534,651	166,533	351,464	15,521	182,054
Ubon Ratchathani	0	6,370	0	1,570,132	804,147	364,209	1,958,331	2,762,478
Yasothon	0	24,978	0	166,649	321,121	20,709	15,820	336,941
Mukdahan	0	0	0	0	0	91,114	13,137	13,137
Study Area	1,103,051	567,821	36,084	2,998,949	1,880,045	3,222,390	2,514,502	4,464,185
	percentage of total province area							
Nakhon Nayok	50.22	0.00	0.00	0.00	0.00	3.94	0.00	0.00
Prachin Buri	5.85	0.00	0.00	0.98	1.06	15.12	0.63	1.69
Nakhon Ratchasima	0.00	3.09	0.28	3.03	2.11	7.63	1.17	3.55
Buri Ram	0.00	0.53	0.00	1.21	3.64	3.61	0.56	4.21
Surin	0.00	1.87	0.00	3.40	0.21	0.48	5.67	5.88
Si Sa Ket	0.00	0.00	0.00	9.65	3.01	6.35	0.50	3.50
Ubon Ratchathani	0.00	0.05	0.00	13.42	6.87	3.11	16.73	23.60
Yasothon	0.00	0.99	0.00	6.51	12.54	0.82	1.39	13.15
Mukdahan	0.00	0.00	0.00	0.00	0.00	3.50	0.54	0.54
Study Area	1.98	1.02	0.06	5.40	3.37	5.78	4.63	8.00

Source: GIS Database of JICA Study Team

Table 2.12 Present Landuse in Sandy Soil Areas (Areas in Rai)

Province / Present Landuse	Nakhon Nayok	Prachin Buri	Nakhon Ratchasima	Buri Ram	Surin	Si Sa Ket	Ubon Ratchathani	Yasothon	Mukdahan
Irrigated Fields	0	0	881	0	0	0	0	0	0
Paddy Fields	0	13,811	111,844	57,748	101,346	475,963	1,183,984	121,664	0
Field Crops	0	15,168	246,768	13,135	37,125	9,049	13,031	7,377	0
Pasture & Grass Land	0	0	524	0	1,169	370	1,342	3,873	0
Fruits & Trees Areas	0	0	841	0	0	0	156	4,996	0
Forest	0	6,686	6,455	1,194	37,000	13,473	180,303	1,924	0
Reforestation Area	0	0	6,742	0	431	567	155	0	0
Encroached Forest	0	6,115	647	1,186	3,663	7,480	7,939	0	0
Water Bodies	0	0	6,513	647	219	3,446	19,991	278	0
Barren Land	0	0	0	0	0	0	1,846	0	0
Built up Areas	0	714	7,288	2,660	6,313	17,210	30,962	9,392	0
Mixed Paddy & Forest	0	29,129	0	0	0	5,299	103,984	3,275	0
Mixed Field Crop & Forest	0	0	3,555	0	0	1,794	26,439	13,870	0
Total	0	71,623	392,058	76,570	187,266	534,651	1,570,132	166,649	0
	percentage of respective province total areas								
Irrigated Fields	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Paddy Fields	0.00%	0.19%	0.86%	0.92%	1.84%	8.59%	10.11%	4.75%	0.00%
Field Crops	0.00%	0.21%	1.91%	0.21%	0.67%	0.16%	0.11%	0.29%	0.00%
Pasture & Grass Land	0.00%	0.00%	0.00%	0.00%	0.02%	0.01%	0.01%	0.15%	0.00%
Fruits & Trees Areas	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.20%	0.00%
Forest	0.00%	0.09%	0.05%	0.02%	0.67%	0.24%	1.54%	0.08%	0.00%
Reforestation Area	0.00%	0.00%	0.05%	0.00%	0.01%	0.01%	0.00%	0.00%	0.00%
Encroached Forest	0.00%	0.08%	0.00%	0.02%	0.07%	0.14%	0.07%	0.00%	0.00%
Water Bodies	0.00%	0.00%	0.05%	0.01%	0.00%	0.06%	0.17%	0.01%	0.00%
Barren Land	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.02%	0.00%	0.00%
Built up Areas	0.00%	0.01%	0.06%	0.04%	0.11%	0.31%	0.26%	0.37%	0.00%
Mixed Paddy & Forest	0.00%	0.40%	0.00%	0.00%	0.00%	0.10%	0.89%	0.13%	0.00%
Mixed Field Crop & Forest	0.00%	0.00%	0.03%	0.00%	0.00%	0.03%	0.23%	0.55%	0.00%
Total	0.00%	0.98%	3.03%	1.21%	3.40%	9.65%	13.42%	6.51%	0.00%

Source: GIS Database of LNE-UE Project

Table 2.13 Present Landuse in Skeletal Problem Soil Areas (Areas in Rai)

Province / Present Landuse	Nakhon Nayok	Prachin Buri	Nakhon Ratchasima	Buri Ram	Surin	Si Sa Ket	Ubon Ratchathani	Yasothon	Mukdahan
Irrigated Fields	0	0	3,717	0	0	0	73,762	0	0
Paddy Fields	51,119	115,159	96,637	76,658	0	0	0	14,140	8,074
Field Crops	0	474,727	672,743	138,088	0	0	50,571	0	3,791
Pasture & Grass Land	0	3,207	5,412	7	1,200	0	1,507	0	0
Fruits & Trees Areas	0	534	1,699	0	0	0	0	0	37,732
Forest	0	46,071	127,223	0	14,391	309,915	183,016	4,292	41,381
Reforestation Area	0	22,321	314	0	0	4,430	352	0	0
Encroached Forest	0	23,261	60,808	3,429	2,219	37,119	6,701	562	14
Water Bodies	0	1,759	3,660	1,661	239	0	7,112	0	0
Barren Land	0	1,941	2,466	0	0	0	19,465	0	0
Built up Areas	2,045	13,498	10,465	7,376	609	0	21,723	954	0
Mixed Paddy & Forest	0	398,038	1,173	0	8,000	0	0	762	0
Mixed Field Crop & Forest	0	0	1,021	0	0	0	0	0	122
Total	53,164	1,100,516	987,338	227,219	26,658	351,464	364,209	20,710	91,114
	percentage of respective province total areas								
Irrigated Fields	0.00%	0.00%	0.03%	0.00%	0.00%	0.00%	0.63%	0.00%	0.00%
Paddy Fields	3.79%	1.58%	0.75%	1.22%	0.00%	0.00%	0.00%	0.56%	0.31%
Field Crops	0.00%	6.53%	5.20%	2.19%	0.00%	0.00%	0.43%	0.00%	0.15%
Pasture & Grass Land	0.00%	0.04%	0.04%	0.00%	0.02%	0.00%	0.01%	0.00%	0.00%
Fruits & Trees Areas	0.00%	0.01%	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%	1.45%
Forest	0.00%	0.63%	0.98%	0.00%	0.26%	5.60%	1.56%	0.17%	1.59%
Reforestation Area	0.00%	0.31%	0.00%	0.00%	0.00%	0.08%	0.00%	0.00%	0.00%
Encroached Forest	0.00%	0.32%	0.47%	0.05%	0.04%	0.67%	0.06%	0.02%	0.00%
Water Bodies	0.00%	0.02%	0.03%	0.03%	0.00%	0.00%	0.06%	0.00%	0.00%
Barren Land	0.00%	0.03%	0.02%	0.00%	0.00%	0.00%	0.17%	0.00%	0.00%
Built up Areas	0.15%	0.19%	0.08%	0.12%	0.01%	0.00%	0.19%	0.04%	0.00%
Mixed Paddy & Forest	0.00%	5.47%	0.01%	0.00%	0.15%	0.00%	0.00%	0.03%	0.00%
Mixed Field Crop & Forest	0.00%	0.00%	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Total	3.94%	15.14%	7.63%	3.60%	0.48%	6.35%	3.11%	0.82%	3.50%

Source: GIS Database of LNE-UE Project

Table 2.14 Erosion Hazard Soils of the Study Area (Area in Rai)

Province	Erosion Hazard Soils		Erosion Hazard Soil Associations	
	Area in Rai	%	Area in Rai	%
Nakhon Nayok	71,422	5.30	0	0.00
Prachin Buri	1,304,597	17.93	76,913	1.06
Nakhon Ratchasima	3,255,760	25.14	1,505,753	11.62
Buri Ram	1,221,674	19.40	2,199,315	34.90
Surin	1,450,352	26.30	738,716	13.42
Si Sa Ket	1,038,040	18.70	345,164	6.23
Ubon Ratchathani	4,242,556	36.26	1,382,627	11.82
Yasothon	787,586	30.75	359,398	14.03
Mukdahan	1,490,193	57.30	50,870	1.96
Study Area	14,862,180	26.64	6,658,756	11.94

Source: GIS Database of JICA Study Team

Table 2.16 Areas Affected by Soil Erosion in Thailand

Category	Soil Loss (ton/rai/year)	Area (million rai)	Land Use
Very Slight	0.01-1.00	119	forest, paddy
Slight	1.01-5.00	90	forest, rubber, orchards, paddy
Moderate	5.01-20.00	26	rubber, orchards, field crops, forest + field crops
Severe	20.01-100.00	43	rubber, orchards, field crops, forest + field crops, shifting cultivation
Very severe	100.01-966.65	39	field crops, forest + shifting cultivation
Others		4	coastal area, mangrove forest, shrimp farms etc.
Total		321	

Source : Thailand Natural Resources Profile, TDRI, 1987

Table 2.15 Present Landuse in Erosion Hazard Soil Areas (Areas in Rai)

Province / Present Landuse	Nakhon Nayok	Prachin Buri	Nakhon Ratchasima	Buri Ram	Surin	Si Sa Ket	Ubon Ratchathani	Yasothon	Mukdahan
Irrigated Fields	0	0	58,331	0	0	0	92,871	0	0
Paddy Fields	0	0	684,113	484,933	868,851	187,645	1,837,024	320,979	313,425
Field Crops	0	354,327	1,788,467	594,198	207,928	250,093	156,390	134,547	355,900
Pasture & Grass Land	94	1,768	0	0	0	0	1,655	401	147
Fruits & Trees Areas	0	28,851	13,546	12,158	33,924	30,269	15,855	6,429	11,786
Forest	70,038	241,945	203,566	13,611	224,115	254,508	1,176,861	128,924	533,031
Reforestation Area	0	44,813	102,669	24,229	45,734	12,392	1,569	14,428	0
Encroached Forest	1,280	69,869	150,696	29,807	31,453	69,486	55,716	1,466	73,692
Water Bodies	0	6,527	32,913	12,542	17,135	46,902	60,888	3,000	8,155
Barren Land	0	2,294	3,360	0	253	8,204	80,332	0	2,378
Built up Areas	10	39,166	133,061	50,196	3,776	144,437	115,752	19,699	14,612
Mixed Paddy & Forest	0	515,037	17,904	0	8,555	16,492	417,097	69,914	68,925
Mixed Field Crop & Forest	0	0	67,134	0	8,628	17,612	230,546	87,799	108,142
Total	71,422	1,304,597	3,255,760	1,221,674	1,450,352	1,038,040	4,242,556	787,586	1,490,193
	percentage of respective province total areas								
Irrigated Fields	0.00%	0.00%	0.45%	0.00%	0.00%	0.00%	0.79%	0.00%	0.00%
Paddy Fields	0.00%	0.00%	5.29%	7.70%	15.78%	3.39%	15.71%	12.53%	12.05%
Field Crops	0.00%	4.87%	13.81%	9.43%	3.78%	4.52%	1.34%	5.32%	13.69%
Pasture & Grass Land	0.01%	0.02%	0.00%	0.00%	0.00%	0.00%	0.01%	0.02%	0.01%
Fruits & Trees Areas	0.00%	0.40%	0.10%	0.19%	0.62%	0.55%	0.14%	0.25%	0.45%
Forest	5.19%	3.33%	1.57%	0.22%	4.10%	4.59%	10.05%	5.09%	20.50%
Reforestation Area	0.00%	0.62%	0.79%	0.38%	0.83%	0.22%	0.01%	0.57%	0.00%
Encroached Forest	0.09%	0.96%	1.16%	0.47%	0.57%	1.25%	0.48%	0.06%	2.83%
Water Bodies	0.00%	0.09%	0.25%	0.20%	0.31%	0.85%	0.52%	.0.12%	0.31%
Barren Land	0.00%	0.03%	0.03%	0.00%	0.00%	0.15%	0.69%	0.00%	0.09%
Built up Areas	0.00%	0.54%	1.03%	0.80%	0.07%	2.61%	0.99%	0.78%	0.56%
Mixed Paddy & Forest	0.00%	7.08%	0.14%	0.00%	0.16%	0.30%	3.56%	2.76%	2.65%
Mixed Field Crop & Forest	0.00%	0.00%	0.52%	0.00%	0.16%	0.32%	1.97%	3.47%	4.16%
Total	5.30%	17.93%	25.14%	19.40%	26.30%	18.70%	36.26%	30.75%	57.30%

Source: GIS Database of LNE-UE Project

Table 2.17 Surface Water Resources Classification and Standards

	Parameter	Units	Max. Allowance by Class				
			1	2	3	4	5
1	Temperature	℃	n'	n'	n'	n'	-
2	pH value	-	n	5-9	5-9	5-9	-
3	Dissolved oxygen	mg/l	n	6	4	2	-
4	BOD (5 days, 20°C)	mg/l	-	1.5	2.0	4.0	-
5	Colifirm Bacteria						
	- Total Coliform	MPN/100 ml	-	5,000	20,000	-	-
	- Fecal Coliform	"	-	1,000	4,000	-	-
6	NO_3-N	mg/l	n	---------	5.0	---------	-
7	NH_3-N	"	n	---------	0.5	---------	-
8	Phenols	"	n	---------	0.005	---------	-
9	Cu	"	n	---------	0.1	---------	-
10	Ni	"	n	---------	0.1	---------	-
11	Mn	"	n	---------	1.0	---------	-
12	Zn	"	n	---------	1.0	---------	-
13	Cd	"	n	0.005*	0.05**	---------	-
14	Cr (Hexavalent)	"	n	---------	0.05	---------	-
15	Pb	"	n	---------	0.05	---------	-
16	Hg (total)	"	n	---------	0.002	---------	-
17	As	"	n	---------	0.01	---------	-
18	CN	"	n	---------	0.005	---------	-
19	Radioactivity						
	- Gross	Becquerel/l	n	---------	0.1	---------	-
	- Gross ß	"	n	---------	1.0	---------	-
20	Pesticides (Total)	mg/l	n	---------	0.05	---------	-
	- DDT	µg/l	n	---------	1.0	---------	-
	- BHC	"	n	---------	0.02	---------	-
	- Dieldrin	"	n	---------	0.1	---------	-
	- Aldrin	"	n	---------	0.1	---------	-
	- Heptachlor & Heptachlor epoxide	"	n	---------	0.1	---------	-
	- Endrin	"	n	---------	none	---------	-

Note: n = Natural
n' = Natural but changing not more than 3°C
* = When water hardness is not more than 100 mg/l as Ca CO_3
** = When water hardness is more than 100 mg/l as Ca CO_3
*** = Water Quality Classification in the following page.

Table 2.17 Surface Water Resources Classification and Standards (continued)

Water Quality Classification Classifications	Condition and Benefical Usages
Class 1	Extra clean fresh surface water resources useful for: (1) conservation, not necessary to pass through water treatment processes; require only ordinary process for pathogenic destruction. (2) ecosystem conservation where basic living organisms can breed naturally.
Class 2	Very clean fresh surface water resources useful for (1) consumption which requires only ordinary water treatment process before use (2) aquatic organism conservation (3) fishery development (4) recreation
Class 3	Medium clean fresh surface water resources useful for: (1) consumption but has to pass through an ordinary treatment process before use (2) agriculture
Class 4	Fairly clean fresh surface water resources useful for: (1) consumption but require special water treatment process before use (2) industry (3) other activities
Class 5	The resources which are not classified in class 1-4 and useful for: (1) navigation

Source: Laws and Standards on Pollution Control in Thailand, ONEB, July 1989

Table 2.18 Water Quality Data in Main River During 1987 to 1990

Main River	Standard Value			1987			1988			1989			1990		
	DO (mg/l)	BOD (mg/l)	Total Coliform (MPN/100ml)	DO (mg/l)	BOD (mg/l)	Total Coliform (MPN/100ml)	DO (mg/l)	BOD (mg/l)	Total Coliform (MPN/100ml)	DO (mg/l)	BOD (mg/l)	Total Coliform (MPN/100ml)	DO (mg/l)	BOD (mg/l)	Total Coliform (MPN/100ml)
Nakhon Nayok River (1)	4	2	20,000	2.7	1.2	4,000	0.8	1.1	4,307	1.8	1.0	60,000	1.7	1.0	53,000
Prachin Buri River (2)	6	1.5	5,000	4.0	1.0	5,000	1.8	1.0	5,000	4.0	1.2	95,000	3.0	0.7	40,000

Notes: (1) Water quality class 3
(2) Water quality class 2
Calculated value of DO at P_{20}, BOD at P_{80} and Coliform Bacteria at P_{80}

Source: National Environment Board

Table 2.19 Location of Water Quality Sampling Stations along Mun River (NEB; 1991-92 Water Quality Monitoring)

Station No.	Location
1	Khong Chiam, Ubon Ratchathani
2	Phibun Mungsaharn, Ubon Ratchathani
3	Muang, Ubon Ratchathani
4	Intersection Chi-Mun; Warin Chamrap, Ubon Ratchathani
5	Kantrarom, Si Sa Ket
6	Muang, Si Sa Ket
7	Rasislai, Si Sa Ket
8	Tatoom, Surin
9	Satuk, Surin
10	Koomuang, Buri Ram
11	Chumphuang, Nakhon Ratchathani
12	Pimai, Nakhon Ratchathani
13	Muang, Nakhon Ratchathani
14	Kamtalaysor, Nakhon Ratchathani
15	Sikhieu, Nakhon Ratchathani

Source: National Environment Board

Table 2.20 Location of Water Quality Sampling Stations along Chi River (NEB; 1991-92 Water Quality Monitoring)

Station No.	Location
1	Ban Nonyan - Nong Sang, Kueng Nai, Ubon Ratchathani
2	Behind Wat Ban Kaeng, Kueng Nai, Ubon Ratchathani
3	Mahachanachai, Yasothon
4	Muang, Yasothon
5	Selaphum, Roi Et
6	Ban Tatoogna, Muang, Mahasalakarm
7	Wat Ban Din Dum, Muang, Mahasalakarm
8	Kosumpisai, Mahasalakarm
9	Ban Thapra, Muang, Khon Kaen
10	Munjakeeree, Khon Kaen
11	King Amphur, Kaeng Sanamnang, Nakhon Ratchasima
12	Amphur Ban Kwao, Chaiyaphum

Source: National Environment Board

Table 2.21 Flooded Areas in Lower Mun River Basin

Area	Years												Average			
	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	12 years		4 years	
													Normal	Weighted	Normal	Weighted
1. Total areas flooded (1,000 ha)																
Num Mun between Ban Bun Bao and Tha Tum	25.3	10.4	24	33.4	10.8	4	16.7	28	31.4	42	18	35.8	23.28	24.05	31.35	29.07
Lam Phlapphla upstream of highway 214	5.4	5.5	3.6	7.1	1.2	5.1	7.5	6.6	6	17.3	5.6	9.1	6.67	6.88	6.90	6.41
Lam Sieo Yai upstream of highway 214	10.9	13.9	8.8	7.7	18.1	10.9	21.3	22.7	16.3	14.2	10.7	13.2	14.06	13.80	12.02	11.55
Lam Phlapphla confluence	5.3	2.4	5.4	8	2.9	0.9	3.5	6.3	5.7	9.3	5.1	8	5.23	5.34	6.75	6.23
Lan Sieo Yai confluence	15.2	6.5	13.4	21.8	4.5	12.2	13.7	22.9	18.7	28.6	14.1	21.4	16.08	17.12	19.27	17.72
Sub-total area upstream of Rasi Salai (I)	62.1	38.7	55.2	78	37.5	33.1	62.7	86.5	78.1	111.4	53.5	87	65.32	67.19	76.29	70.98
Num Mun between Rasi Salai and Sisaket (II)	8.1	1.9	8.6	13.2	0.3	0.2	5.9	12.2	9.7	16.3	7.9	13.3	8.13	8.18	11.07	9.90
Nam Mun between Sisaket and Chi confluence	5.1	2.2	3.1	7.4	0	0.4	3.8	6.9	5.5	14.9	4.7	8.1	5.17	5.44	6.52	5.90
Nam Chi confluence	12.6	11	10.9	13	6.9	10.7	12.3	12.7	14	21.5	11.9	15	12.71	12.85	13.65	13.30
Nam Mun downstream of Ubon Ratchathani	8.6	7.9	8	9.3	3.9	7.1	9	8.9	10	11.9	8.4	10.2	8.60	8.45	9.52	9.37
Sub total area downstream of Si Sa Ket (III)	26.3	21.1	22	29.7	10.8	18.2	25.1	28.5	29.5	48.3	25	33.3	26.48	26.74	29.69	28.57
Grand total (I+II+III)	96.5	61.7	85.8	120.9	48.6	51.5	93.7	127.2	117.3	176	86.4	133.6	99.93	102.11	117.05	109.45
2. Cultivated areas flooded (1,000 ha)																
Num Mun between Ban Bun Bao and Tha Tum	6.8	1.3	6.2	11.9	0.9	0.1	3.3	8.4	10.4	17.3	3.3	13.1	6.92	7.37	10.55	9.14
Lam Phlapphla upstream of highway 214	4.5	4.4	2.9	5.3	1.1	4.2	6.1	5.2	5.1	14.7	4.3	7.2	5.42	5.60	5.52	5.20
Lam Sieo Yai upstream of highway 214	7.3	9.8	6.4	6	11.8	6.6	14.2	15.8	9.3	8.7	7.8	10.4	9.51	9.26	8.25	7.95
Lam Phlapphla confluence	0.5	0.6	0.7	1.8	0.1	0.3	0.6	0.9	0.6	2.9	0.5	1.7	0.93	0.96	1.15	91.00
Lan Sieo Yai confluence	2.2	0.9	1.4	5	0.2	5.7	3.5	5.6	3.5	8.9	1.8	4.3	3.58	4.06	3.75	3.14
Sub total area upstream of Rasi Salai (I)	21.3	17	17.6	30	14.1	16.9	27.7	35.9	28.9	52.5	17.7	36.7	26.36	27.25	29.22	26.34
Num Mun between Rasi Salai and Sisaket (II)	3.6	0.5	4.2	5.8	0.1	0.1	2.3	5.4	4.5	7.4	3.4	5.9	3.61	3.64	4.95	4.44
Nam Mun between Sisaket and Chi confluence	1.6	0.2	0.8	2.8	0	0	1	2.5	1.9	7.9	1.5	3.1	1.94	2.18	2.35	2.04
Nam Chi confluence	2.3	1.8	1.8	2.5	0.5	1.6	2.2	2.3	2.8	5.1	2.1	3	2.33	2.38	2.65	2.54
Nam Mun sownstream of Ubon Ratchathani	1.3	1.1	1.2	1.5	0.3	0.9	1.5	1.4	1.6	1.9	1.3	1.6	1.30	1.25	1.50	1.46
Sub total area downstream of Si Sa Ket (III)	5.2	3.1	3.8	6.8	0.8	2.5	4.7	6.2	6.3	14.9	4.9	7.7	5.57	5.81	6.50	6.04
Grand total (I+II+III)	30.1	20.6	25.6	42.6	15	19.5	34.7	47.5	39.7	74.8	26	50.3	35.54	36.70	40.67	36.82

Source : Mekong Secretariat

Table 2.22 Areas Subjects to Flooding in 1978 and 1980

(Unit : square kilometer)

Province & Amphoe	Total Area	Flooded Area	
		1978	1980
Yasothon			
1. Muang	454	117	27
2. Kham Khuan Kaeo	638	18	
3. Maha Chana Chai	455	189	
4. Kho Wang	150	150	
Subtotal	1,697	474	27
Si Sa Ket			
1. Yang Chum	660	18	
2. Khan Thara Rom	1,001	261	
Subtotal	1,661	279	
Ubon Ratchathani			
1. Khuang Nai	783	233	
2. Muang	939	14	
Subtotal	1,722	247	

Source : Chi Basin Water Use Study Flood Studies, Report, RID, 1988

Table 2.23 Number of Holdings Reporting the Use of Fertilizers in the North-Eastern Region

Type of Fertilizers	Number of Holdings					
	1978		1978		1988	
	nos.	%	nos.	%	nos.	%
1. Total No.of Holdings	166,172	100.00	1,899,365	100.00	2,179,562	100.00
2. Holdings that do not Use Fertilizers	589,517	35.50	513,114	27.00	306,938	14.10
3. Holdings that Use fertilizers :	1,070,655	64.50	1,386,251	73.00	1,872,624	85.90
a) Only Inorganic Fertilizers	312,837	18.80	339,868	17.90	521,374	23.90
b) Only Organic Fertilizers	233,799	14.10	225,527	11.90	153,688	7.10
c) Both Types of Fertilizers	524,019	31.60	820,856	43.20	1,197,562	54.90

Source : Intercensal Survey of National Statistics Office, 1988

Table 2.24 Number of Holdings that Use Fertilizers by Type of Fertilizers and by Size of Holding, 1988

Size of Holding (rai)	Total No. of Holdings	No. of Holdings Not Using Fertilizer	No. of Holdings - Using Fertilizers			
			Inorganic only	Organic only	Both Types	Total
All Size	2,179,562	306,938	521,374	153,688	1,197,562	1,872,624
<6	157,201	36,390	33,049	19,396	68,366	120,811
6-9.9	224,634	37,575	54,632	17,542	114,885	187,059
10-39.9	1,493,807	201,725	358,774	95,807	837,501	1,292,082
40-139.9	296,549	30,261	73,231	19,938	173,119	266,288
>140	7,371	987	1,688	1,005	3,691	6,384

Source : Intercensal Survey of National Statistics Office, 1988

Table 2.25 SO_2 Emission in Northeast Region (by Sector & Year)

(Unit: ton/year)

Sector	1991	2011
Industry	11,549 (33.88%)	30,398 (50.51%)
Agriculture	8,236	7,511
Res. & Comm.	639	628
Transportation	13,665	21,642
Power Generation	1	2
Refineries	0	0
Total	34,089	60,181

Source: 'The Greening of Thai Industry: Producing More and Polluting Less', TDRI 1990 year end conference

Table 2.26 Number of Manufacturing Enterprises in Provinces of Study Area in 1989

		Nakhon Nayok	Prachin Buri	Nakhon Ratchasima	Buri Ram	Surin	Si Sa Ket	Ubon Ratchatani	Yasothon	Mukdahan	Study Area
I	Food Processing	112	837	3,328	2,567	1,767	2,560	1,946	598	64	13,779
	Rice Mills	97	430	2,330	2,302	1,685	2,415	1,873	564	37	11,733
	Casava Mills	0	328	802	222	39	98	30	22	10	1,551
	Meat Products	0	4	32	2	3	0	2	0	2	45
	Milk Products	4	3	19	4	1	11	4	1	4	51
	Flour & Grain Mills (Exe. Rice)	2	17	35	3	11	20	10	3	3	105
II	Textiles	1	1	43	1	1	1	1	1	0	50
III	Wood & Furniture	1	6	9	1	9	2	4	4	10	46
IV	Pulp & Paper	0	2	0	1	0	1	3	0	0	7
V	Chemicals & Chem Prods.	2	4	28	0	3	2	11	1	1	52
VI	Non-Metalic Prods.	16	48	95	37	46	23	49	20	19	353
VII	Engineering Industries	13	67	271	29	53	3	172	14	18	640
VIII	Prec. Mach. & Others	20	28	134	21	36	6	66	10	17	338
	Total	178	1,023	3,951	2,671	1,927	2,697	2,269	653	134	15,413

Table 2.27 Biochemical Oxygen Demand (BOD) Load to Major Rivers in Thailand, 1986

River Name	DO of River (mg/l)	Std. DO (mg/l)	No.of Factories a/	Flow 1,000 cu.m. (Per Year)	BOD Load (Tons/Yr)	70% Cost of Treatment b/ (Million b.)	Treatment Residual BOD (Tons/Yr)
Bang Pakong	4	-	135	13,997	86,761	60.73	26,028
Chao Phraya	0.3	2	351	53,224	81,426	57.00	24,428
East Coast Gulf	-	-	123	16,345	80,427	56.30	24,128
Mun	3	-	84	7,350	75,867	53.11	22,760
Thachin	< 2	2	376	166,757	56,033	39.22	16,810
Mae Klong	> 4	-	22	47,741	48,910	34.24	14,673
Ping	-	-	17	125,087	30,254	21.18	9,076
Nan	-	-	19	101,866	21,819	15.27	6,546
Chi	-	-	82	18,015	19,106	13.37	5,732
Klong	-	-	55	1,532	7,091	4.96	2,127
Prachin Buri	-	-	27	281	4,618	3.28	1,385
Wang	-	-	13	1,517	3,719	3.60	1,110
Yom	-		5	102	296	0.21	89
Kok	-		2	18	55	0.04	16
Total			1,311	553,832	516,382	362.51	154,908

Note : a/ This amount of load covers only factories under monitoring scheme of the Department of Industrial Works.
b/ Assuming cost of treatment = 1000 baht ton

Sourve : Department of Industrial Works, Office of the National Environment Board, 1986
Department of Health, 1986

Table 2.28 Number of Top Five Hazardous-Waste Producing Industries in Provinces of Study Area in 1989

Province	Type of Industry					
	Basic Metal	Fabricated Products	Transport Products	Electrical Machinery	Chemical Products	Total
Nakhon Nayok	0	5	21	1	2	29
Prachin Buri	0	9	35	4	4	52
Nakhon Ratchasima *	2	54	180	8	5	249
Buri Ram	0	7	24	0	0	31
Surin	1	14	45	0	0	60
Si Sa Ket	0	0	2	0	1	3
Ubon Ratchathani						
Yasothon	0	4	11	0	0	15
Mukdahan	0	2	23	0	0	25

* Nakhon Ratchasima ranks 5th among provinces in the country generating hazardous wastes.

Note : Hazardous waste generating potential ranging system and grouping of industries based on hazardous nature of waste specified in the "Source".

Source : "The Greening of Thai Industry : Producing More and Polluting Less", TDRI 1990 Year End Conference.

Table 3.1 Soil Types and Recommended Land Use (1/3)

Type of Soil	General Description of Soils	Recommended Land Use	Major Management Required
	AREAS WITH SOILS SUITED FOR UPLAND CROPS IN LOW RAINFALL ZONE		
1.	Deep nearly level to gently sloping, moderately well to well drained, medium to fine textured soils with moderate fertility.	Permanent agricultural land: very suitable for 4 variety of upland crops, vegetables and fruit trees: suggested crops and maize, sorghum, cotton, tobacco, beans, nuts, sugar cane and castor bean.	Need ordinary management practices to maintain soil fertility and structure : irrigation is required for continuous cultivation of various upland crops.
2.	Deep gently sloping, moderately well to well drained, fine textured soil with moderate to high fertility and consisting mainly of montmorillonite clay.	Permanent agricultural land generally suitable for upland crops and fruit trees but choice of crops may be limited due to unfavorable surface texture (very sticky clay); suggested crops are corn, cotton, sorghum and beans.	Need proper cultivation and suitable fertilizer application: application of trace element may be required for some crops such as beans
3.	Deep gently sloping to strongly sloping well to moderately well drained, fine textured soils with low or moderately low fertility.	Permanent agricultural land; suitable for large variety of upland crops and fruit trees; suggested crops are corn, sorghum, cotton, castor bean, sugar cane and beans.	Require proper fertilizer application and conservation practices such as contour tillage planting and terracing; (drought may occur during period of little rainfall in the rainfed area).
4.	Deep gently sloping to strongly sloping, well to moderately well drained, medium to coarse textured soils with low fertility.	Permanent agricultural land; generally suitable for upland crops and fruit trees but choice of crops may be limited; suggested crops are kenaf, beans, nuts, cassava, water melon, sugar cane and pineapple.	In addition to proper fertilization and good management measures to maintain soil fertility and structure, one or more special conservation practices such as contour tillage planting and terracing are required; (drought commonly occurs during periods of little rainfall in growing season of rainfed area).
5.	Shallow to moderately deep, gently sloping to moderately sloping, well to moderately well drained fine of medium textured soils with moderate fertility and high organic matter content in the surface.	Suitable for growing cultivate crops but choice of crops may be limited; suggested crops are maize, sorghum, cotton and beans.	Need ordinary management including fertilizer application to maintain soil fertility and structure; proper conservation practices are required on moderately sloping soils.
	AREAS WITH SOILS SUITED FOR PADDY (WET LAND) RICE		
6.	Deep, level, poorly drained clayey low to moderately to low fertility	Best suited for wet land rice in the rainy season; with irrigation multiple crops of rice, vegetables or other upland crops can be grown.	Ordinary fertilizer application and irrigation to maintain productivity, irrigation suitable variety of rice.
7.	Deep, level, poorly drained clayey low to moderately to low fertility	Well suited for wet-land rice in the rainy season with irrigation multiple crops of rice vegetables or other upland crops can be grown.	Proper fertilizer application irrigation and improved variety of rice.

Table 3.1 Soil Types and Recommended Land Use (2/3)

Type of Soil	General Description of Soils	Recommended Land Use	Major Management Required
8.	Shallow to moderately deep, level, poorly drained, gravelly soils that include areas with lateritic outcrops.	Can be used for growing wet-land rice in the rainy season under suitable management.	Require intensive work and high investment to cultivated land; proper fertilizer application is necessary.
9.	Deep level poorly drained, extremely acid clayey soils	Wet-land rice under proper management is suggested.	Proper fertilizer application especially N and P with lime, irrigation, improved variety of rice.
10.	Deep, level to nearly level, poor drainage, medium textured or loamy soil with low to moderate fertility.	Well suited for wet land rice in the rainy season; with irrigation multiple crops of rice, vegetables or other upland crops can be grown.	Suitable fertilizer application; irrigation improved variety of rice (drought may occur during period of little rainfall in the rainfed area).
11.	Deep level to nearly level, poorly drained, medium textured or loamy soils of high salt content.	Generally suited for wet-land rice in the rainy season but may be risky due to high concentration of slat in soil during period of insufficient water supply.	Adequate irrigation system to supply enough water in the growing season; proper fertilizer application.
	AREAS WITH SOILS SUITED FOR TREE CROPS IN HIGH RAINFALL ZONE		
12.	Deep, gently sloping to strongly sloping moderately well to well drained, fine textured or clayey soils with low to moderately low fertility and of the humid zone.	Best suited for various kinds of fruit trees (durian, rambutan, langsat, orange, mangosteen etc.) beverage crops (coffee) industrial oil crops (oil palm coconut) and rubber	Fertilizer application to maintain soils fertility; erosion control on sloping soils such as cover crops, terracing contour cropping, etc.
13.	Deep, to moderately deep gently sloping to strongly sloping, moderately well to well drained soils with low fertility and of humid zone.	Well suited for many kinds of fruit trees, beverage crops, industrial oil crops and rubber.	Proper fertilizer application; use of erosion control practices such as cover crops, terracing contour cropping, etc.
	AREAS WITH SOILS GENERALLY UNSUITED FOR CULTIVATED CROPS		
14.	Shallow to very shallow, moderately sloping to steep, well to moderately well drainage gravelly soils including areas with laterite or bedrock near the surface.	Generally not suited for cultivated crops with ordinary management practices; best suited for pasture and woodland.	Special conservation practices are required on sloping soils; fertilizer application and proper cultivation practices are required.
15.	Shallow, gently sloping to steep, moderately well to well drained; gravelly soils of the humid zone including areas with bedrock, laterite or stone near the surface.	Generally suited for rubber and pasture best suited for woodland.	Proper fertilizer application, well prepared growing pit; use of erosion control practices such as cover crops, terracing, contour cropping etc.

Table 3.1 Soil Types and Recommended Land Use (3/3)

Type of Soil	General Description of Soils	Recommended Land Use	Major Management Required
16.	Muddy soils on tidal flat prolonged deep flooding, regular flooding by sea water.	Not suited for any commercial crops, better maintained for woodland (mangrove) production or construction of shrimp and fish ponds in local areas.	Extensive improvement if being converted into cultivated land.
17.	Peat and muck soils, prolonged deep flooding.	Not suited for any crops; although reclamation has been made, choice of crops in limited.	Reclamation entails costly inputs especially for drainage control and fertilizer application.
18.	Deep, gently sloping, excessively drained sandy soils on beach or sandy terrace.	Not suited for cultivated crops except for pasture; but where water supply is adequate, water melon and other vegetables can be produced; on beach area coconut is well adapted.	Proper fertilizer application; irrigation or water conservation.
19.	Deep, gently sloping, excessively drained sandy soils with spodic horizon that occurs within 100 cm. from the soils surface; usually forming on beach ridges or sand bars.	Generally not suited for any crops due to limitation caused by spodic horizon except for pasture, but water melon, pine apple and cashew nut may be grown if adequate water supply is available.	Proper fertilizer application; water conservation is required if attempts to grow crops are made.
20.	Shallow to deep, well to excessively drained, rolling to very steep soils of the hills and mountains.	Not suited for any commercial crops, suited for woodland or establishment of watershed protective vegetation.	Not recommended to convert into cultivated land because it required very high input which will have impact on the environment.

Source: Legend - Regional Land Use Potential Maps of DLD

Table 3.2 Land Use Potential of the Study Area (Area in Rai)

Province \ Land Potential	Protected Forests	Paddy	Field crops/ Tree crops	Unsuitable for cultivation	Water bodies	Total
Nakhon Nayok	11,450	870,000	31,600	420,682	1,250	1,334,982
Prachin Buri	1,354,861	2,092,142	2,640,625	1,187,500	0	7,275,128
Nakhon Ratchasima	1,560,782	4,661,235	5,576,923	1,108,253	61,964	12,969,157
Buri Ram	253,950	3,580,403	1,954,670	508,326	11,596	6,308,945
Surin	81,149	4,115,960	1,018,640	245,787	31,184	5,492,720
Si Sa Ket	502,681	3,186,232	1,131,160	677,306	24,110	5,521,489
Ubon Ratchathani	1,421,635	3,738,239	4,203,972	2,141,481	190,441	11,695,768
Yasothon	76,858	1,443,841	1,022,822	16,106	0	2,559,627
Mukdahan	938,645	397,186	1,221,653	18,373	1,894	2,577,751
Total	6,202,011	24,085,238	18,802,065	6,323,814	322,439	55,735,567
	percentage distribution					
Nakhon Nayok	0.86%	65.17%	2.37%	31.51%	0.09%	100.00%
Prachin Buri	18.62%	28.76%	36.30%	16.32%	0.00%	100.00%
Nakhon Ratchasima	12.03%	35.94%	43.00%	8.55%	0.48%	100.00%
Buri Ram	4.03%	56.75%	30.98%	8.06%	0.18%	100.00%
Surin	1.48%	74.93%	18.55%	4.47%	0.57%	100.00%
Si Sa Ket	9.10%	57.71%	20.49%	12.27%	0.44%	100.00%
Ubon Ratchathani	12.16%	31.96%	35.94%	18.31%	1.63%	100.00%
Yasothon	3.00%	56.41%	39.96%	0.63%	0.00%	100.00%
Mukdahan	36.41%	15.41%	47.39%	0.71%	0.07%	100.00%
Total	11.13%	43.21%	33.73%	11.35%	0.58%	100.00%

Source: GIS Database of Present Study

Table 3.3 Land Use Evaluation

Potential Land Use \ Present Land Use	Irrigated Land	Paddy	Field Crops	Fruit and Tree Areas	Pasture and Grass Land	Forest	Reforest-ation Areas	Encroached Forests	Water Bodies	Barren Land	Mixed Paddy and Forest	Mixed Field Crop and Forest
1.1 Protected Forests	2	2	2	2	2	1	2	2	1	2	2	2
2.1 Paddy	3	3	3	3	3	1	2	2	1	3	5	5
2.2 Field Crops and Tree Crops	4	4	4	4	4	1	2	2	1	4	5	5
2.3 Unsuitable for Cultivation but can be Pasture/Livestock Grazing Area or Woodland	5	5	5	5	5	1	2	2	1	5	5	5

Legend: (1) Protected Area
(2) Reforestation Area
(3) Intensive Paddy Cultivation Area
(4) Intensive Field Crop and Tree Crop Cultivation Area
(5) Land Area for Development

Table 3.4 Land Use Development Zones (All Areas in '000 Rai')

Land Zone / Province	Protected Areas	Reforestation Areas	Paddy Cultivation Areas	Field & Tree Crops	Development Areas	Total
Nakhon Nayok	413	6	850	52	3	1,324
Prachin Buri	1,590	547	1,760	1,852	1,525	7,274
Nakhon Ratchasima	1,720	790	4,484	4,666	1,237	12,897
Buri Ram	492	238	3,619	1,584	370	6,303
Surin	378	106	3,982	782	259	5,507
Si Sa Ket	726	120	3,077	988	628	5,539
Ubon Ratchathani	2,952	441	2,885	2,390	3,040	11,708
Yasothon	290	30	1,273	681	287	2,561
Mukdahan	1,053	297	193	649	408	2,600
Total	9,614	2,575	22,123	13,644	7,757	55,713
	percentage of respective total province areas					
Nakhon Nayok	31.19%	0.45%	64.20%	3.93%	0.23%	100.00
Prachin Buri	21.86%	7.52%	24.20%	25.46%	20.97%	100.00
Nakhon Ratchasima	13.34%	6.13%	34.77%	36.18%	9.59%	100.00
Buri Ram	7.81%	3.78%	57.42%	25.13%	5.87%	100.00
Surin	6.86%	1.92%	72.31%	14.20%	4.70%	100.00
Si Sa Ket	13.11%	2.17%	55.55%	17.84%	11.34%	100.00
Ubon Ratchathani	25.21%	3.77%	24.64%	20.41%	25.97%	100.00
Yasothon	11.32%	1.17%	49.71%	26.59%	11.21%	100.00
Mukdahan	40.50%	11.42%	7.42%	24.96%	15.69%	100.00
Total	17.26%	4.62%	39.71%	24.49%	13.92%	100.00

Source: GIS Analysis of Present Study

Table 4.1 Existing and Planned Industrial Estates in the Study Area

Industrial Estate	Site (From BKK)	Year of Completion	Area (Rai) *		Capital (Bt. Million)	Estimated Price ** (Bt./Rai)	Remarks
			Total	Available			
1 Suranaree Industrial Zone	Muang, Nakhon Ratchasima 260 Kms/Northeast						Promoted by BOI
Phase I - General Industrial Zone		1988	530		110	90,000	
Phase II - General Industrial Zone			1,500	1,500	390	900,000-1,000,000	
2 (forming)	Muang, Nakhon Ratchasima 300 Kms/Northeast	1990					Promoted by BOI
- General Industrial Zone			1,600	1,600	255	forming	
3 Prachin Buri Industrial Park Project	Kabin Buri, Prachin Buri 170 Kms/Northeast						Promoted by BOI
- General Industrial Zone		1191	1,768	1,768	335	forming	
4 Kabin Buri Industrial Zone	Kabin Buri, Prachin Buri 160 Kms/East						Promoted by BOI
- General Industrial Zone		1995	1,900	1,900	476	forming	
5 Prosperity I.E.	Srimahaphoe, Prachin Buri						Promoted by BOI
- Export Processing Zone	125 Kms/East						
- General Industrial Zone		1997	3,000	3,000	2,138	forming	
6 Ubon Ratchathani		n.a.	3,048	3,048	25	forming	Promoted by BOI

* Rai = 0.4 Acres

** The Eastimated Price may be changed later

Source : Information and Promotion Service Division, Industrial Estate Authority of Thailand

Table 4.2 Development Plans in the Study Area by Sectoral Base

Type of Sectors / Name of Area(s)	General Development Characteristics	Industrial Sector	Distribution and Trade Sector	Telecommunication Sector	Agricultural Sector
1 **Nakhon Ratchasima Area** Core Zone : Nakhon Ratchasima Area Related Towns : Pak Chong, Si Khiu, Sung Noen, Chok Chai, Nong Ki, Bua Yai, Phimai	• (N.R) : Metal Working & Machinery Industry Promotion Core Zone ○ Small & Medium Enterprise Dev. Area (Industries, Commerce & Distribution Oriented) ○ Livestock Dairy Products Dev. Area (Fresh)	• (N.R) : Metal Working Ind., Transportation Machinery Ind., Electrical Machinery Ind., Export Oriented Ind., Local Resource Based Ind. • (P.C) : Agro-Industry • (Phimai) : Chemical Ind.	• (N.R) : Regional Truck Terminal • (N.R) : Agricultural Export/ Processing Centre • (N.R) : Industrial Parts Trade & Distribution Centre ○ To set up or revive Central Commodity Market (Muang Municipality Area)	(U.R) : To establish teleport Centre ○ To build telecommunication links between the boundary ○ To start variety of telecommunications service such as: i) Agricultural Information System ii) Rain Fall and Water Level Telemetering iii) Medical Treatment Information System iv) Telemeter VAN System v) Tourism Information System	"Common Projects or Not Specify the Areas" ○ Groundwater Irrigation Development Project ○ Small Reservoirs Development Project ○ Agricultural Cooperative Institute Project ○ Goat Bank Development Project ○ Floating Net Cage Aquaculture Development Project ○ Agricultural Marketing Service Centre Project ○ Participatry Irrigation Imporvement Project ○ Drip Irrigation Development Project ○ On-Farm Drainage Improvement Project ○ Grain Local Assembly Market Development Project
2 **Buri Ram & Surin Areas** Core Zone : Buri Ram City Related Towns : Surin City, Sa Tuk, Nang Rong, Prakhon Chai, Prasat	• (B.R) : Food Supply Core Zone (Fresh canned & bottled goods) • (Surin) : Cottage Industry (Silverware, etc.) Devlopment Core Zone ○ Agro-Processing & Cottage Ind. Promotion Area	"Common Projects or Not Specify the Areas" ○ Agro-Industries ○ Handicraft Industries ○ Elecurical Machinery Industries ○ Local Resource Based Industries	○ To set up or revive Central Commodity Market (Muang Municipality Area)		
3 **Ubon Ratchathani Area** Core Zone : Ubon Ratchathani City Related Towns : Si Sa Ket City, Phibun Mangsahan, Det Udom	• (U.R) : High-Tech Small & Medium Industry Promotion Core Zone (Precision Machinery related) • (U.R) : Inland Port (Airport Oriented Import & Export) Development Core Zone ○ Agro-Processing & Consumer Related Goods Industry Development Area	• (U.R) : Agro-Industries, Consummer Related Ind., Metal Working Ind.	• (U.R) : Regional Truck Terminal • (U.R) : Agricultural Export/Processing Centre • (U.R) : Industrial Parts Trade & Distribution Centre • (U.R) : Border Trade Centre ○ Central Commodity Market		
4 **Mukdahan & Yasothon Areas** Core Zone : Mukdahan City Related Towns : Yasothon City, Amnat Charoen	• (M.D) : Border Trade & In-Bond Programme Promotion Core Zone (Precision Machinery related) ○ Livestock & Pond Fish Processing Development Area (Fresh canned & bottled goods)		• (M.D) : To improve Border Trade Market Facilities • (M.D) : Border Trade Centre ○ Central Commodity Market		
5 **Prachin Buri & Nakhon Nayok Areas** Core Zone : Prachin Buri City Related Towns : Nakhon Nayok, Kabin Buri	• (P.B) : Hinterland Industry Core Zone ○ High-Tech Industry Research & Development Area (Science & Technology Promotion Area)	• (P.B) : Consumer Related Ind., Export Oriented Industries • (N.N) : Consumer Related Ind.	○ Central Commodity Market		
6 **Aranyaprathet Area** Core Zone : Aranyaprathet Related Towns : Sa Kaeo	• (A.P) : Border Trade & In-Bond Programme Promotion Core Zone ○ Middle Industrial Technology Development Area		• (A.P) : To improve Border Trade • (A.P) : Border Trade Centre ○ Central Commodity Market		

• Project areas are not specified

Table 4.3 Characterization of Major Urban Center and Clustering (1/2)

Major Urban Centers	Characterization and Priority	Other Urban Centers
Nakhon Ratchasima	Regional center with multiple functions; location of labour-intensive, footloose industry; secondary tourism center; priority includes urban infra-structure to serve industries, urban land use plan and water resources development/management	Pak Chong, Sikhiu, Sung Noen, Chok Chai, Pak Thong Chai (Bua Yai) Phimai
Ubon Ratchathani	Sub-regional center with multiple functions; future location of teleport; development of its hinterlands is the key	Warin Chamrap, Det Udom, Phibun Mangsahan
Si Sa Ket	Secondary agro-industrial center complementing Ubon Ratchathani specialized in livestock	Kantralak
Surin	Community urban growth center; center of handicrafts and rural industries; priority includes the link with the ESB and water resources development for diversified agriculture	Prasat
Buri Ram	Community urban growth center; future tourism center; priority includes better water management and beautification of the city, tourism areas and their access roads	Prakhon Chai, Nang Rong, Satuk

Table 4.3 Characterization of Major Urban Center and Clustering (2/2)

Major Urban Centers	Characterization and Priority	Other Urban Centers
Prachin Buri	Community urban growth center; alternative site for industries to be relocated from the BMA; center for fruits and vegetable processing; priority includes flood control and increased water supply	Kabin Buri
Nakhon Nayok	Controlled urban growth center; future science and technology center; priority includes flood control, enhancement of urban functions and effective land use control	
Aranyaprathet	Controlled urban growth center; center for border trade and base for Indochina tourism; priority includes urban infrastructure and water supply	Sa Kaeo
Mukdahan	Border trade center; future connection to Laos and Vietnam through a new bridge over the Mekong; priority includes improvement of transport infrastructure	Amnat Charoen
Yasothon	Secondary trade center located an the crossroads; aquaculture center; priority includes the improvement of road links with its hinterland	

Table 4.4 Problems Encountered by Muang Municipality Offices in the Survey

Problems Encountered by MMO	Priority	1	2	3	4	5	Total	Point Rank
	Weighted point	5	4	3	2	1		
1) Lack of pipe water		4	-	-	1	-	22	(4)
2) Poor conditions of road surface		4	2	-	1	1	31	(2)
3) Disposal of garbage system		-	4	1	4	-	27	(3)
4) Water drainage system		1	2	5	1	2	32	(1)
5) Poor linkage of road system		-	-	-	-	-	-	
6) Lack of electricity		-	1	-	-	-	4	
7) Lack of public electricity system		-	-	1	1	1	4	
8) Lack of agricultural products market		-	-	-	-	1	1	
9) Poor public health services		-	-	1	-	1	4	
10) Lack of jop opportunity		-	-	-	-	1	1	
11) Poor sanitary market		-	-	-	-	1	1	
12) Poor fire distinguisher system		-	-	-	-	-	-	
13) Poor conditions of agricultural land		-	-	1	-	-	5	(5)
14) Waste water treatment system		-	-	-	-	-	2	
15) Public land encrochers		-	-	-	-	-	-	
16) Other, including slaughter house environmental problems, public part traffic		-	-	-	1	1	1	
Total		9	9	9	9	9	135	

Source : Survey

Table 4.5 Problems Encountered by Tambol Municipality Offices in the Survey

Problems Encountered by TMO	Priority / Weighted point	1 / 5	2 / 4	3 / 3	4 / 2	5 / 1	Total	Point Rank
1) Lack of pipe water		6	1	-	-	-	34	(1)
2) Poor conditions of road surface		1	2	2	2	-	23	(3)
3) Disposal of Garbage System		-	1	3	1	1	16	(4)
4) Water Drainage System		1	3	1	3	-	26	(2)
5) Poor linkage of road system		-	-	-	-	-	-	
6) Lack of electricity		-	1	-	-	-	4	
7) Lack of Public Electricity System		-	1	1	-	-	7	(5)
8) Lack of Agricultural Products market		-	-	-	-	1	1	
9) Poor Public Health Services		1	-	-	-	-	5	
10) Lack of Job Opportunity		-	-	1	1	-	5	
11) Poor sanitary market		-	-	-	1	1	3	
12) Poor Fire Distinguisher System			-	-	-	-	-	
13) Poor conditions of Agricultural Land		-	-	-	-	-	-	
14) Waste Water Treatment System		-	-	1	-	2	5	
15) Public Land Encrochers		-	-	-	-	-	-	
16) Others, including slaughter house environmental problems, public part traffic		-	-	-	1	4	6	
Total		9	9	9	9	9	135	

Source: Survey

Table 4.6 Development Needs Calculated from the Weighted Pointed According to Priorities

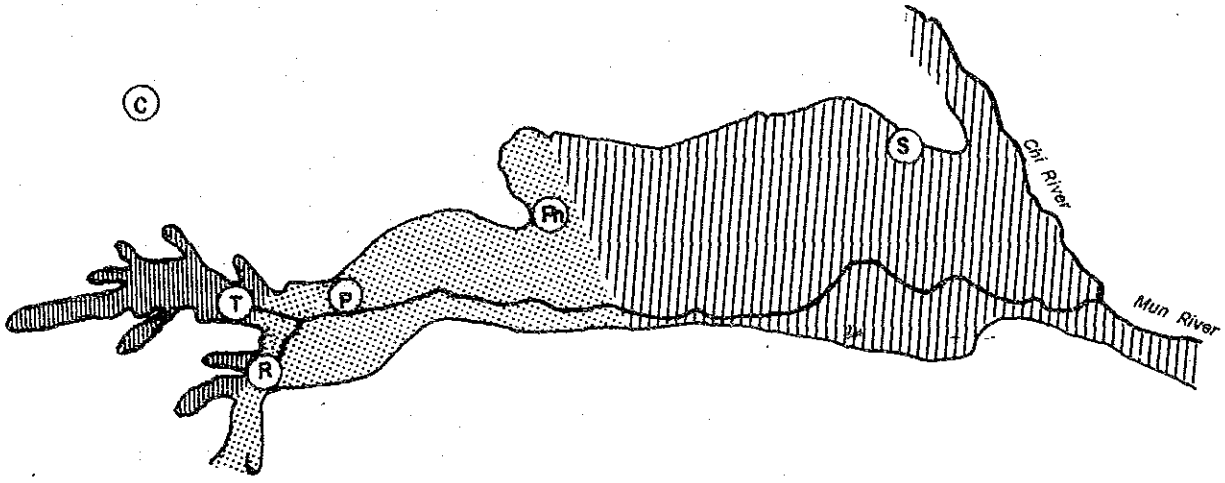
Development Needs	Tambol Municipality Offices	Muang Municipality Offices	Ranking
1) Drinking water & utility water	34	17	3
2) Improvement of road conditions in the designated area	33	25	1
3) Provision of electricity and public utility	16	10	4
4) Public health services	8	3	8
5) Water drainage system	23	31	2
6) Waste water treatment	10	13	5
7) Land settlement programme	4	5	9
8) Sanitary market	-	1	13
9) Local market for agricultural product	-	4	14
10) Creat jobs (setting up industrial plants)	-	5	10
11) Garbage disposal system	5	13	6
12) Provide irrigation system	-	-	-
13) Financial support	3	-	2
14) Others (fire distinguisher, residential area, parking area, park, determine the boundaries)	5	8	7

Source: Survey

Table 5.1 Proposed Land Utilization in 2010 (All Area in '000 Rai')

Province	Protected Areas	Paddy Cultivation Areas	Field Crops	Economic Forests			Total	Other Landuse
				From Tree Crops Area	From Refores-tation Area	From Deve-lopment Area		
Nakhon Nayok	413	850	52	0	6	0	6	3
Prachin Buri	1,590	1,760	1,852	431	547	410	1,388	1,115
Nakhon Ratchasima	1,720	4,484	4,666	645	790	649	2,084	588
Buri Ram	492	3,619	1,584	315	238	200	753	170
Surin	378	3,982	782	275	106	100	481	159
Si Sa Ket	726	3,077	988	277	120	277	674	351
Ubon Ratchathani	2,952	2,885	2,390	585	441	892	1,918	2,148
Yasothon	290	1,273	681	128	30	128	286	159
Mukdahan	1,053	193	649	130	297	130	557	278
Total	9,614	22,123	13,644	2,786	2,575	2,786	8,147	4,971
	Percentage of Respective Total Province Areas							
Nakhon Nayok	31.19	64.20	3.93	0.00	0.45	0.00	0.44	0.22
Prachin Buri	21.86	24.20	25.46	5.93	7.52	5.64	19.08	15.33
Nakhon Ratchasima	13.34	34.77	36.18	5.00	6.13	5.00	16.16	4.56
Buri Ram	7.81	57.42	25.13	5.00	3.78	3.17	11.95	2.70
Surin	6.86	72.31	14.20	5.00	1.92	1.82	8.73	2.89
Si Sa Ket	13.11	55.55	17.84	5.00	2.17	5.00	12.17	6.34
Ubon Ratchathani	25.21	24.64	20.41	5.00	3.77	7.62	16.38	18.35
Yasothon	11.32	49.71	26.59	5.00	1.17	5.00	11.17	6.21
Mukdahan	40.50	7.42	24.96	5.00	11.42	5.00	21.42	10.69
Total	17.26	39.71	24.49	5.00	4.62	5.00	14.62	8.92

Figures



Hill Area

Valley Area

Basin Area (Thung Kula Ronghai)

C Chaiyaphum

T Non-Thai

R Nakhon Ratchasima

P Phimai

Ph Phutthaisong

S Suwannaphum

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Figure 2.1

Three Salitnity Areas in the Mun River Drainage

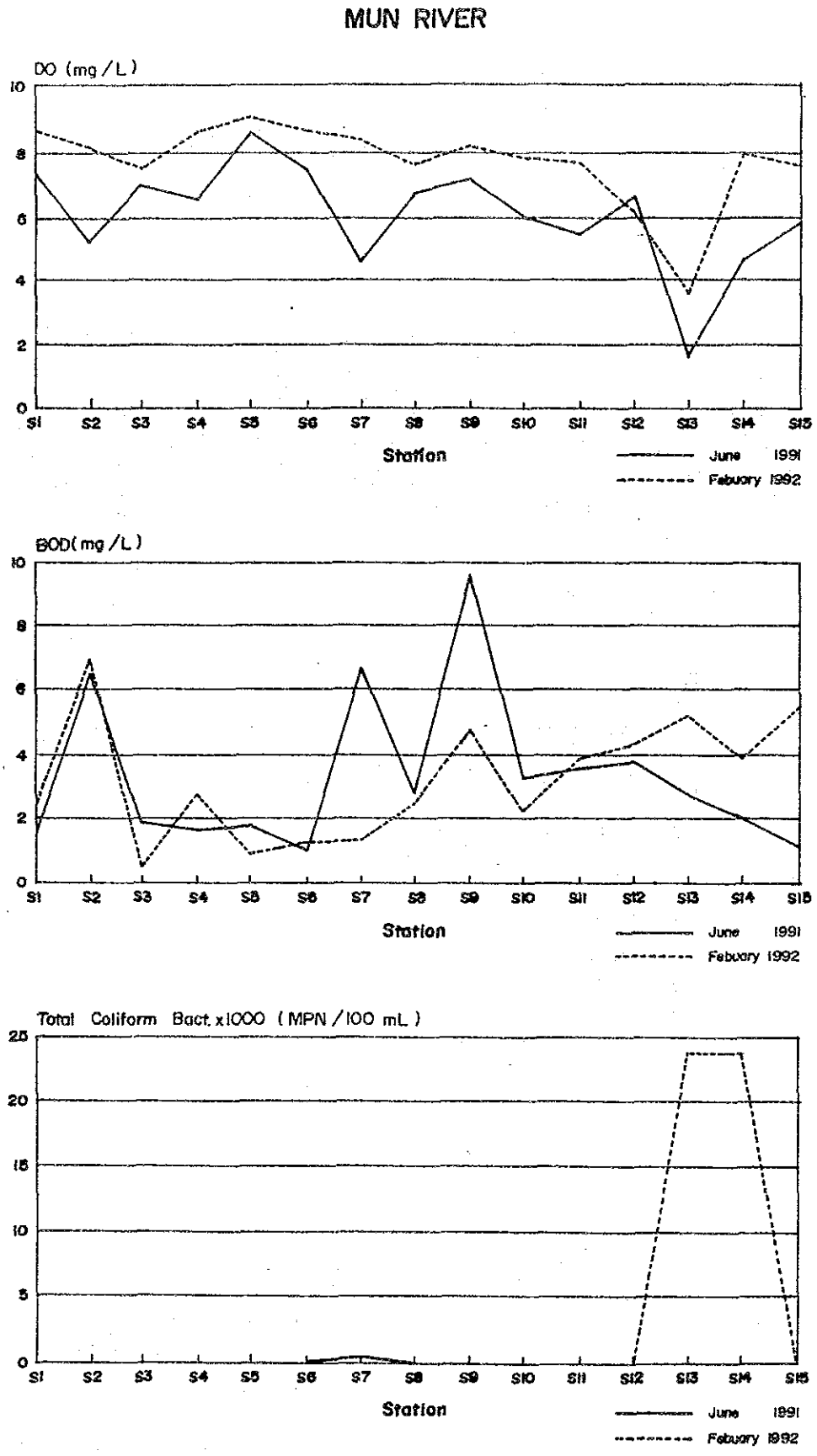


Figure 2.2 BOD, DO and Total Coliform Bacteria in Mun River, 1991-92
Source: National Environment Board

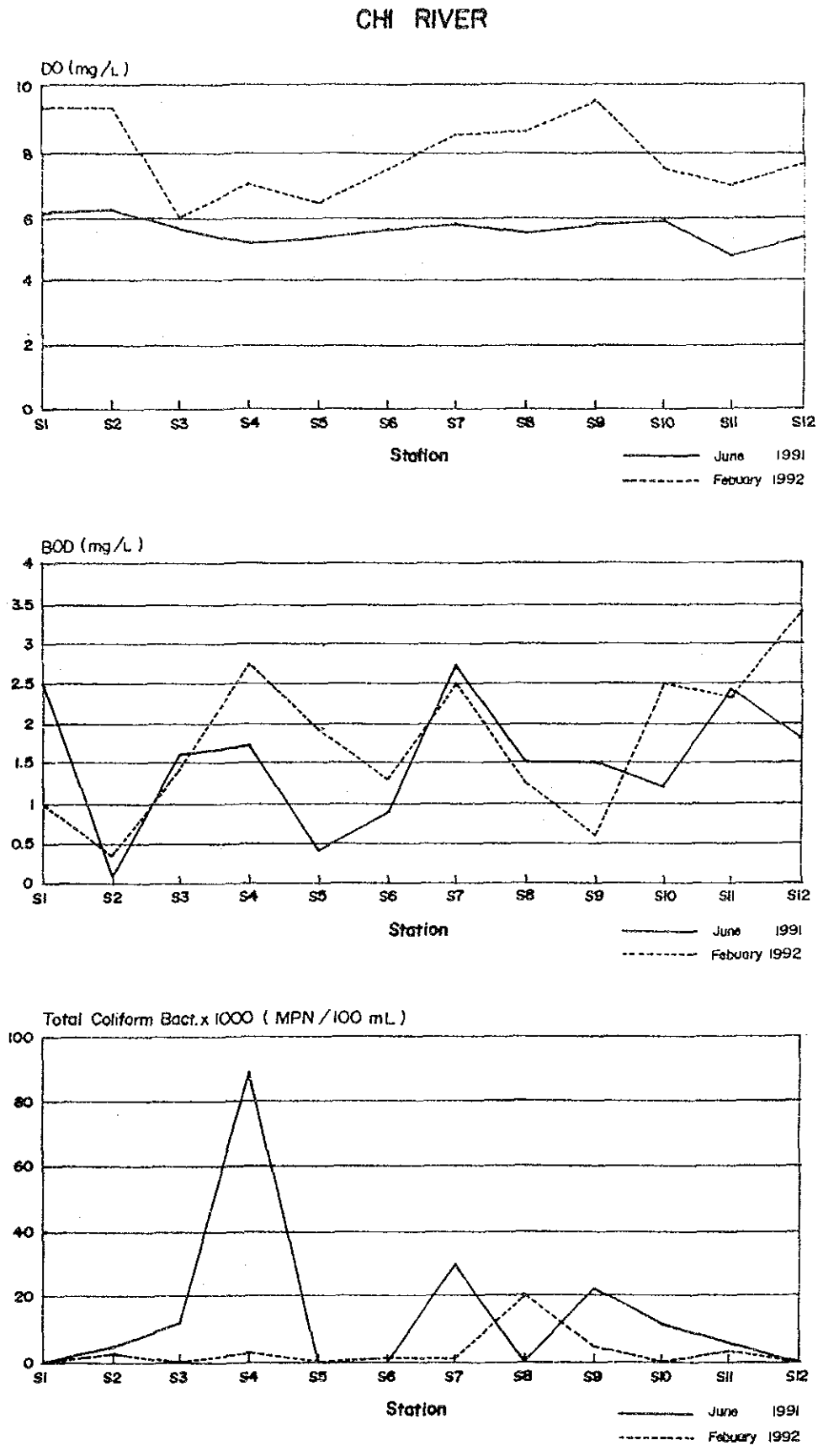
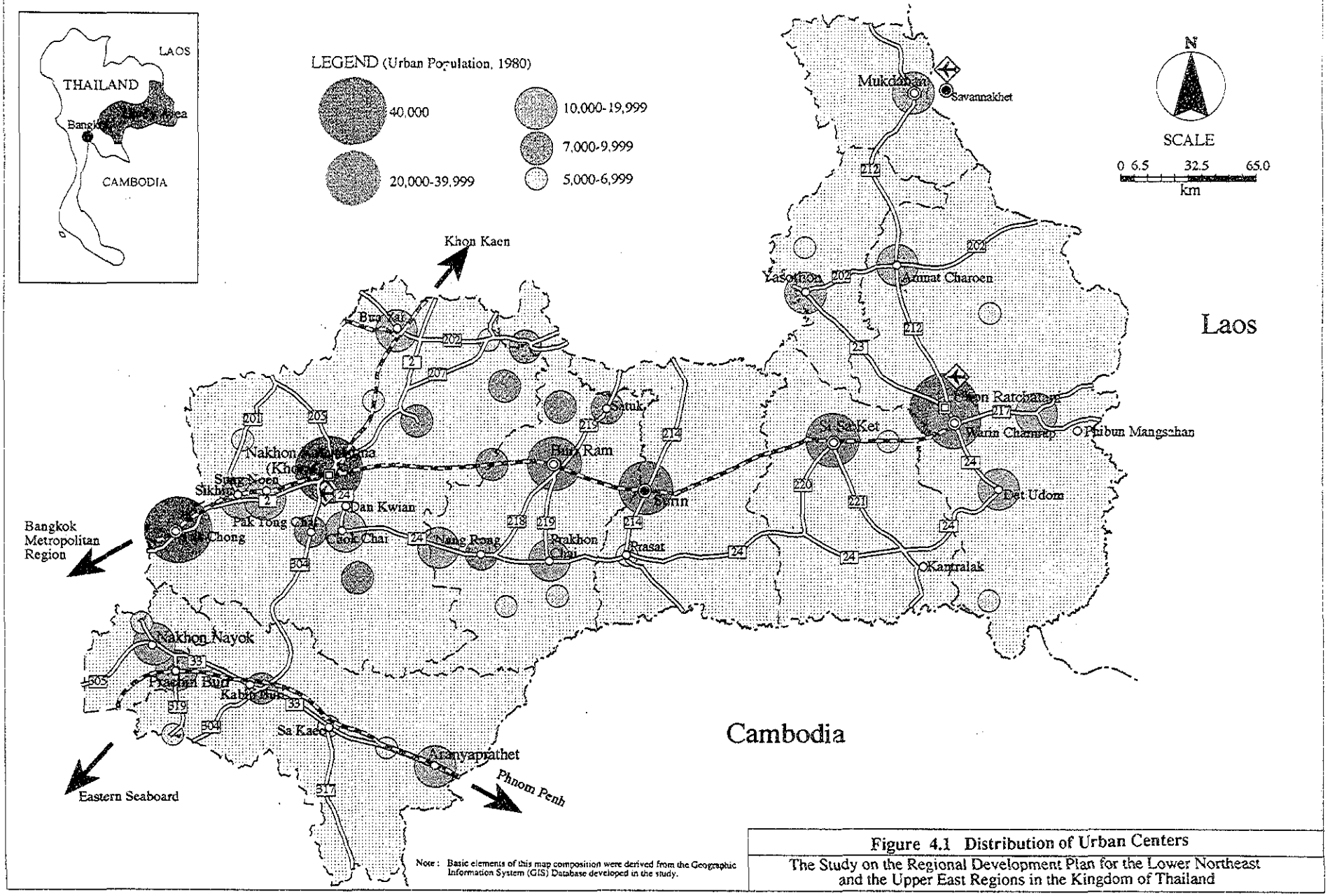


Figure 2.3 BOD, DO and Total Coliform Bacteria in Chi River, 1991-92
Source: National Environment Board



Note : Basic elements of this map composition were derived from the Geographic Information System (GIS) Database developed in the study.

Figure 4.1 Distribution of Urban Centers

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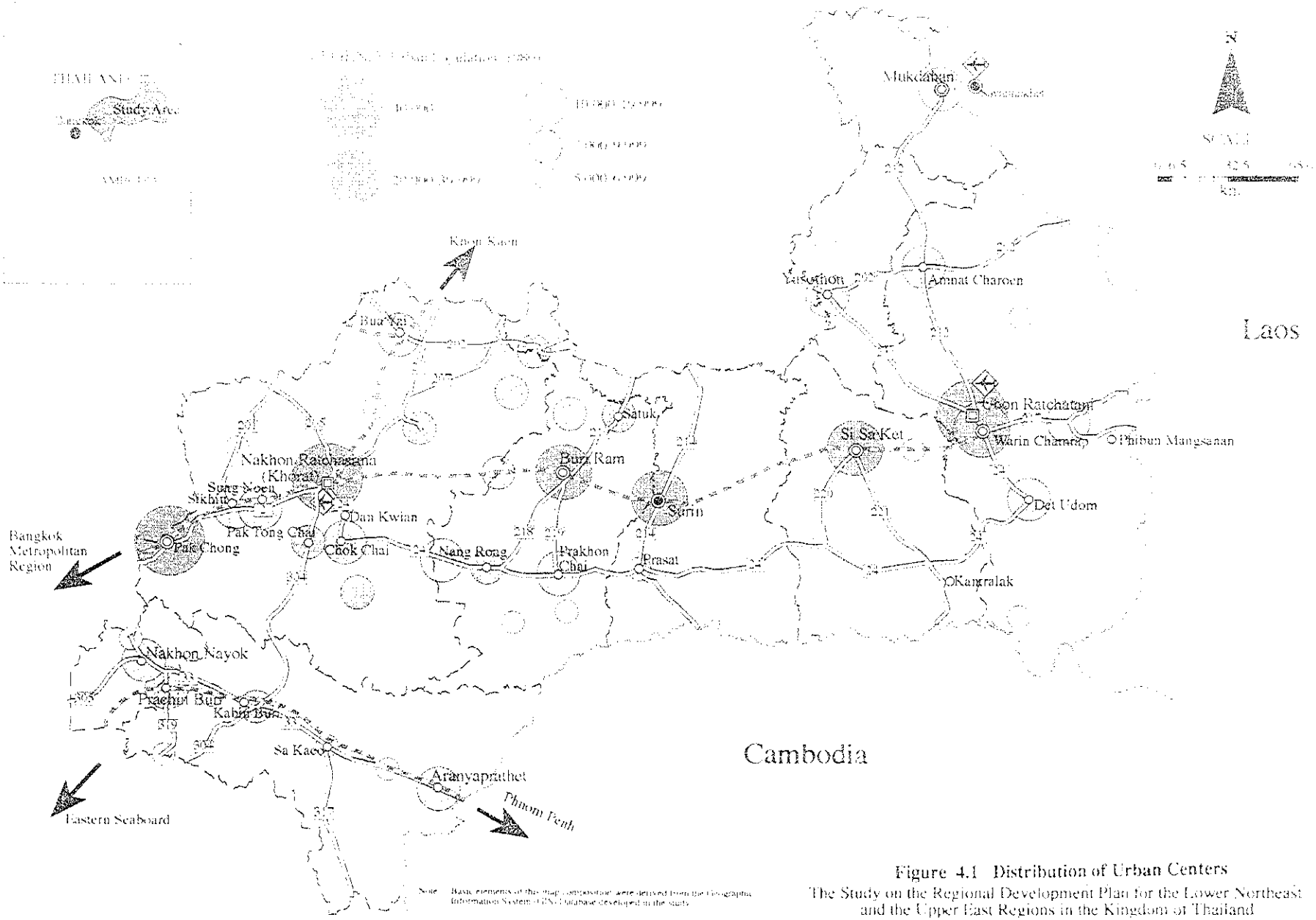
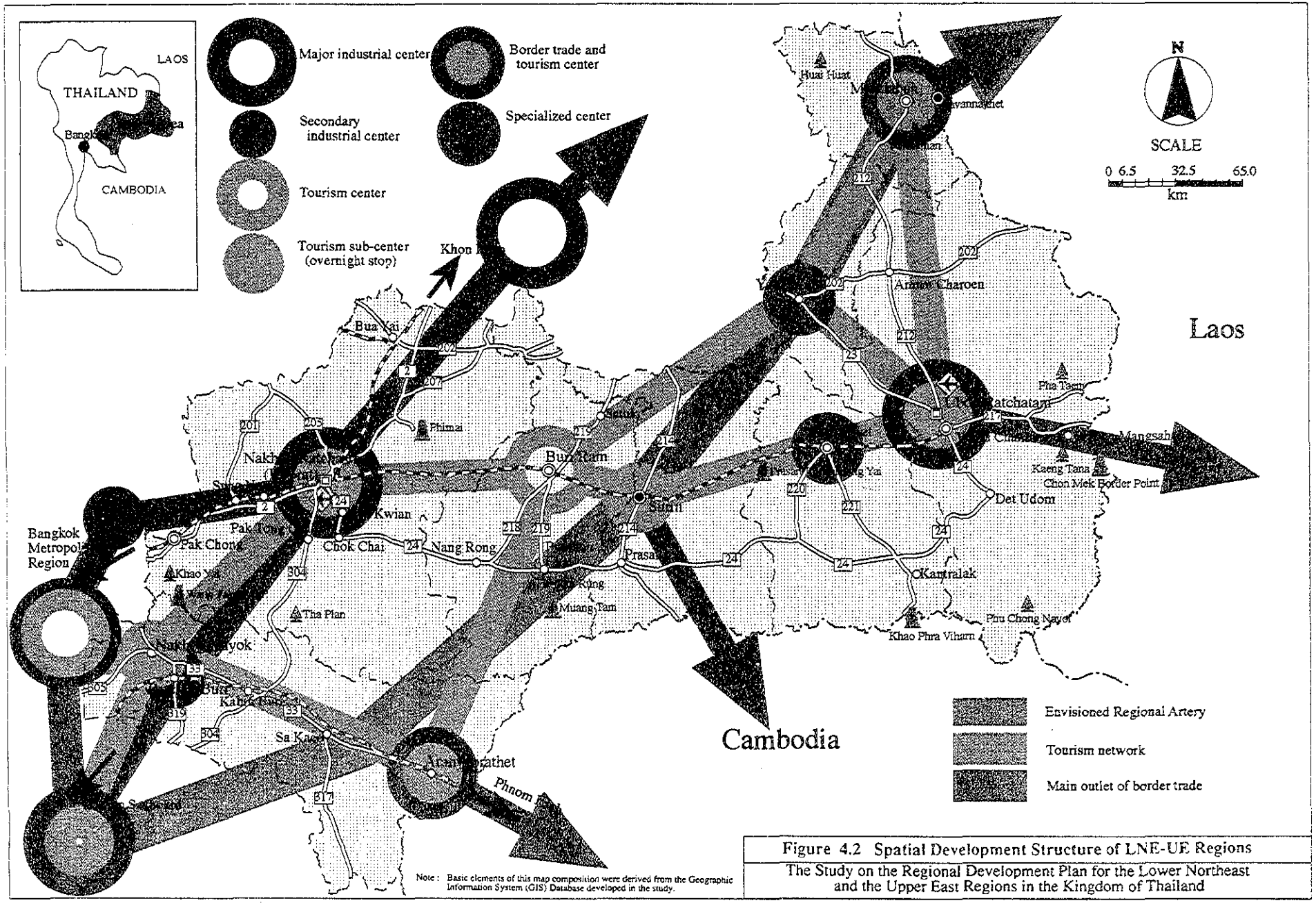


Figure 4.1 Distribution of Urban Centers
The Study on the Regional Development Plan for the Lower Northeast and the Upper East Regions in the Kingdom of Thailand



Note : Basic elements of this map composition were derived from the Geographic Information System (GIS) Database developed in the study.

Figure 4.2 Spatial Development Structure of LNE-UE Regions

The Study on the Regional Development Plan for the Lower Northeast and the Upper East Regions in the Kingdom of Thailand

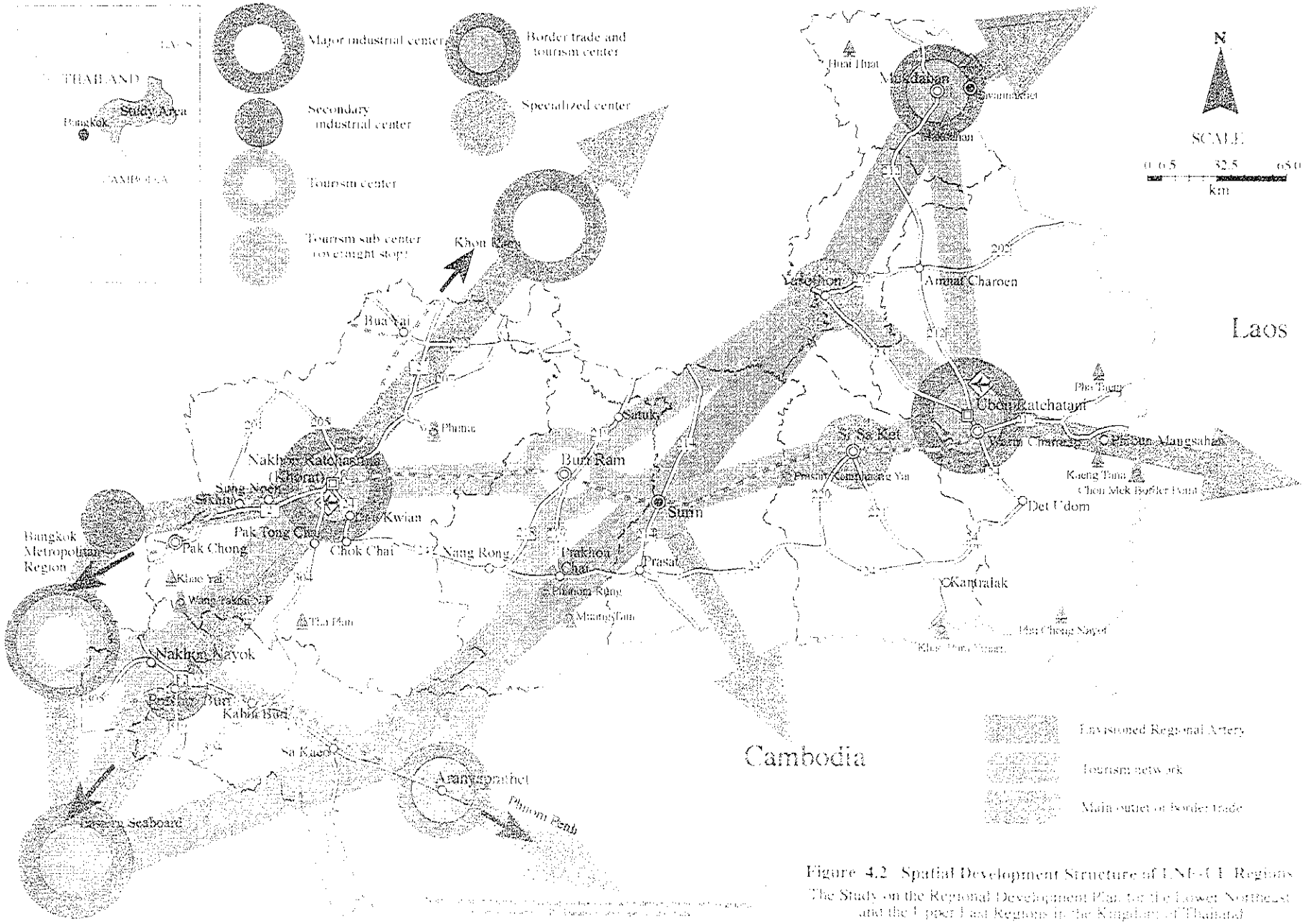


Figure 4.2 Spatial Development Structure of LNE-UE Regions

The Study on the Regional Development Plan for the Lower Northeast and the Upper East Regions in the Kingdom of Thailand

APPENDICIES

A Profiles of proposed projects for achieving targeted development

B Projects completed, on-going or proposed in Study Area and Thailand related to natural resources and environment

C References/Bibliography

D Maps

APPENDIX A

Profiles of Proposed Projects for Achieving Targeted Development

Project Code No., LE-1

Project Title: Problem Soil Management and Soil Erosion Prevention

Location: All provinces of lower north east and upper east Thailand Study Area

Executing Agency: Land Development Department (LDD) in the Ministry of Agriculture and Cooperatives

Objectives: To formulate plans for management of problem soils and minimization of soil erosion in the study area leading to sustainable productive use of land.

Project Description:

The project will consist of the following tasks to be carried out in parallel with one another.

1. To prepare a comprehensive inventory of problem soils and erosion hazard soils using a Geographic Information System (GIS).

2. Do a comprehensive review of earlier studies, carry out additional surveys and establish pilot projects covering all types of problem soils and soil erosion problems in different land use categories. Study to determine problems associated with various kinds of problem soils and soil erosion losses would be done in order to determine suitable land use alternatives well suited to local conditions. Studies to determine ways and means of reclaiming and rehabilitating areas exhausted by various kinds of problem soils will be done. Soil erosion losses would be determined in various kinds of land use by field surveys and tests.

3. Elaborate means of transmitting the technology for improved problem soil management and minimization of soil erosion losses. The importance of local communities and NGOs, as well as benefits derived by free dessimination of ideas between all groups involved would be considered.

4. Formulation of guidelines for future policy making in problem soil and soil erosion research, development, and management for the Study Area.

Project Duration: Three years

Cost: Undetermined

Timing: Urgent, Seventh Plan

Priority: High

Comments:

1. The present study used a GIS to map and determine existing land use in major problem soil types (acid sulphate, saline, sandy and skeletal), and erosion hazard soil types in the study area. The analysis was at the regional level and groupings of problem soil groups and erosion hazard soils were simplified. Nevertheless, they are an excellent basis to commence more detailed mapping and analysis using a GIS. This would then facilitate tasks 2, 3, and 4 listed under project description above.

2. The mapping component using a GIS in this project could become a sub-project under the Land Information System Development Project.

Project Code No., LE-2

Project Title: Fragrant wood afforestation program

Location: Reforestation areas in the provinces Buriram, Surin, Si Sa Ket, Ubon Ratchathani, Yasothon and Mukdahan

Executing Agency: Royal Forestry Department in cooperation with NGO groups

Objectives: Formulate an attractive agro-forestry and agro-industrial alternative in line with national and regional goals of economic forestry development and economic development

Project Description:

1. Study to determine tree species suited to water and soil conditions of the Study area.

2. Do a feasibility study to examine international market prospects of fragrant wood.

3. Identify areas for pilot implementation.

4. Formulate a comprehensive implementation program with active local participation and involvement of NGOs.

Project Duration: 1 year for the Feasibility study. Pilot scale implementation and monitoring in a phased manner over several years.

Project cost: Undetermined

Timing and priority: Urgent, within Seventh Plan Period

Comments:

1. Many species of fragrant woods exist which:

   (a) are suitable to soil and water conditions of North East Thailand.
   (b) can earn economic profits in the international market. Huge demand exist for fragrant woods in East and South Asian countries, Middle East countries, and European countries for various purposes.

2. The study would lead to determination of an alternative agro-forestry crop help in economic upliftment of local communities by offering them a good income earning opportunity, and help in meeting national economic forest targets as well as regional economic development targets.

3. Involvement of local communities and NGOs is vital right from project inception. A participatory approach needs to be adopted. Benefits must trickle

down to the local population living in the reforestation sites. The local communities become the principal participants and undertakers of the project, with help, guidance and assistance, both technical and financial, from governmental and non-governmental agencies.

4. This project could be a sub-project of the economic reforestation project.

Project Title: Development of a Regional Environmental Monitoring System and Linking it with a Geographic Information System (GIS)

Location: All provinces

Executing Agency: Office of National Environmental Board (ONEB) in cooperation with NESDB, RFD and LDD

Objectives:

1. To establish a regional Environmental Monitoring and Evaluation Database System (EMEDS) for the LNE-UE region. The EMEDS would provide a common basis for carrying out EIAs of individual projects. It would enable storage, manipulation, archiving, processing and presentation of environmental and socio-economic data by computer techniques.

2. To link the EMEDS with a GIS to enable detailed environmental assessment and analysis on a geographic basis.

3. To implement the EMEDS and GIS developed in one of the provinces - say Nakhon Ratchasima.

Project Description:

The project will involve the following tasks that will be carried out in parallel with one another:

(1) Review of existing data and study reports. This will lead to identification of existing and foreseen problems and the clarification of needs for additional data collection.

(2) Review of existing organization and institutions.

(3) Supplemental surveys.

(4) Determination of monitoring indices for various environmental aspects. Four main environmental parameters will be focussed on. These are:

   (a) Physical resources including physico-chemical effects on water and soils,
   (b) Ecological resources including the biological effects on fisheries and aquatic life.
   (c) Value for human use including the impact on agriculture and land use and the impact of agro-chemicals, and
   (d) Quality of life with emphasis on socio-economic aspects.

(5) Design of the EMEDS.

(6) Development of a GIS to enable geographic spatial queries and analysis of the designed EMEDS.

(7) Establishment of the EMEDR and GIS in one of the study area provinces say Nakhon Ratchasima province. Training of personnel would also be included for facilitating transfer of technology.

Timing and Priority: Very urgent, very high priority

Cost and Financing:

Comments:

1. The urgency in addressing natural resources and environmental management issues in Thailand and particularly in the LNE-UE region is recognized. For sustainable use of natural resources, environmental conditions need to be integrated into the planning process itself. For proper enforcement of laws and regulations promulgated for environmental protection, baseline information on environmental and natural resources parameters is necessary. This information needs to be collected on a regular basis, to determine changes and effects on the environment. This process of environmental data collection, storage and analysis is best done by the development of a EMEDS.

2. There is always a geographic dimension to environmental assessment. Spatial queries as to where a problem is present and what is the spatial extent of the area it is affecting need to be known. The development of a GIS and linking it to the EMEDS would enable geographic analysis and mapping of environmental issues. Environmental assessment and modelling would be greatly facilitated. This in turn would help authorities involved in environmental control and enforcement to have sound, reliable and effective information.

3. The GIS sub-component of this project could form a sub-project under the Land Resources Information System Development Project.

Project Code No., LE-4

Project Title: Green Wedge

Location: Buri Ram, Surin provinces

Executing Agency: Royal Forestry Department

Objectives:

1. To improve the quality of life of local inhabitants in the zone through development of a reforested natural environment.

2. To improve the conditions for eater resource management to benefit drinking water supply and irrigation.

3. To improve the natural environs of tourist attractions of Khao Phanom Rung Historical Park, Muang Tam and Tam Miang sites.

4. To province a refreshing natural environment for development of a new Elephant Park as a tourist attraction.

Project Description:

(1) Development of a reforestation program covering selected districts in central and southern parts of the provinces.

(2) Design and implementation of an educational program for affected populations to improve their water consumption habits.

(3) Urban beautification of Buri Ram City, Nang Rong.

(4) Preparation of a riverside location as an elephant habitat to accommodate the Elephant Park.

Timing and Priority: Seventh and Eighth Plans

Cost and Financing: Public Source

Comments:

Coordination with the Green Isan project is essential. Also, the possibility of improving any of the ancient ponds and canals in the zone for modern use for purposes of beautification, irrigation or water storage, will be explored. Success of this project will lead to its application in other parts of Thailand (or Indochina) as a pilot project.

Project Code No., LE-5

Project Title: Economic Reforestation Program

Location: Reforestation areas targeted for economic forests in all provinces

Executing Agency: RFD in cooperation with ONEB and LDD

Objectives: To formulate a comprehensive reforestation program with multiple objectives in line with provincial and national economic forestation targets.

Project Description:

The project will involve the following tasks which will be carried out in parallel with one another.

(1) Review of existing data and study reports. This would lead to identification of purposes and needs for reforestation - for agro-industrial needs, fuel wood needs of general population and other community needs. Relevant sub-projects would be formulated.

(2) Review of existing organization and institutions and all concerned groups.

(3) Formulation of comprehensive reforestation plan with multiple objectives including cost benefit analysis for various groups involved . Establishment of forestry villages.

(4) Implementation of formulated plan in the established forestry villages in a phased manner.

Timing: Urgent, implementation in a phased manner during 7th National Plan period

Duration required for study and implementation: 5 years.

Cost and Project Financing: undetermined

Comments:

1. The project has considerable benefits. It will help prevention of encroachment of Protected Forests and will generate considerable income generating opportunities.

2. The project will help to tackle the social environmental problem of occupancy of national forestry reserves and will adopt a participatory approach with active involvement of local communities and NGO groups to work in coordination with governmental agencies. The project will lead to establishment of forestry villages which will be self sustaining and which in the long run become the backbone of agro-industrial development of the study area.

3. The fragrant wood reforestation program project could eventually be a sub-project under this project.

Project Code No., LE-6

Project Title: Protected area buffer zone program

Location: Around Protected area (existing natural forests and water bodies) identified in all provinces of LNE-UE region

Executing Agency: Royal Forestry Department in cooperation with ONEB, LDD and NGO group(s).

Objectives:

1. To formulate a comprehensive land use plan in a 5 km buffer zone around Protected Areas and to determine ways of implementing it, giving protection of adjacent natural forest and top priority.

2. Promote a sense of environmental consciousness while improving the quality of life and standard of living of villagers living in villages within the buffer zone.

3. Formulate plans to promote local community and private sector involvement in forest resource protection by determining and defining roles, responsibilities and inter-relationships of various groups and institutions involved in environmental management.

4. Implement the plan around Khao Yai National Park.

Project Description:

The project involves the following tasks carried out in parallel with one another:

1. Review of existing data, study reports, institutions and policies. This will lead to identification of existing and foreseen problems and clarification of needs for additional data collection..

2. Conduct necessary supplemental surveys.

3. Formulate comprehensive land use plans in the 5 km buffer zone area around Protected Areas.

4. Formulate plans for implementation of formulated land use plans with identification of roles and responsibilities of all groups concerned. This is in order to maximize the villager's participation in the planning, implementation and management of activities at the village level, so that a sense of consciousness is created for environmental conservation in the village community. The establishment of a local institution or Environmental Protection Society (EPS) would be central to this plan.

5. Implement the plans in villages around the Khao Yai National Park in a phased manner.

Timing and Priority: Very urgent, very high

Cost and Financing:

Comments:

1. Natural forest resources in Thailand and particularly in the LNE-UE region have decreased significantly. Protection of remaining forest resources from any further encroachment is vital. Villagers living near the natural forests encroach upon the forests as a result of economic necessity. Inappropriate land use due to practice of wrong farming techniques on steep slopes adjacent to natural forest areas has also resulted in severe soil erosion and land degradation. In view of this, it is essential to carry out the proposed study which recognizes all dimensions of the problem of forest encroachment.

2. Understanding and defining the role of local communities in forest protection is vital for the success of this project. The proposed idea of creation of EPS at the village level is to instill ideas of forest protection and conservation at the grass roots level. NGOs would serve as intermediateries and advisors and would provide project guidance in cooperation with governmental agencies.

3. The success of a NGO group Population and Community Development Association (PDA) with headquarters in Bangkok in a 'Rural Development for Conservation Project' in about seven villages in Pak Chong district of Nakhon Ratchasima province adjoining Khao Yai national Park should be carefully noted and studied. EPS at the village level have been established under this project and have been very successful in instilling environmental conservation and natural forest protection principles to local communities.

Project Code No., LE-7

Project Title: Land Information System (LIS) Development using GIS

Location: All provinces of LNE-UE region

Executing Agency: NESDB in coordination with the Land Development Department, and other agencies

Objectives: To formulate the structure and plan for a LIS using GIS for the LNE-UE study area and implement the LIS in one of the study area provinces.

Project Description:

(1) Study existing institutions, policies, and data available related to land resources for the study area.

(2) Formulate the structure and concept plan for the LIS to be designed and created using a GIS. The LIS would be designed to facilitate easy data retrieval and to serve the purpose of availability of spatial information for sound land use planning as per national and regional land policies. The LIS would be made up of various independent sub-systems like base maps, public utility database (tap water, electricity, sewerage etc.), land ownership database, property value database, soil property and natural resources database, land allocation database, forestry database, socio-economic database etc.

(3) Select one of the provinces of the study area say Nakhon Ratchasima for a demonstration project to design and formulate the LIS in detail and implement it.

(4) Include a training program for a selective number of officials for technology transfer related to GIS.

Timing: Urgent, 7th National Plan period

Duration required for study and implementation: 1 year.

Cost and Project Financing: undetermined

Comments:

1. Once a national land policy is defined, for land use planning an up-to-date accurate land information database system is essential. This LIS would contain the following types of data: size, boundaries, area, use, geographical condition, soil properties, water resources, names and addresses of land holders, value, and other necessary information. The LIS would facilitate the use of information to analyze problems, make decisions and specify land policies.

2. The Seventh National Plan guidelines call for development of natural resource databases for the various regions of the country using advanced technology

such as GIS. The value of GIS has been clearly demonstrated in the present JICA study. A comprehensive land resources database covering 17.3 % of the country has been developed using GIS. Sufficient reason and baseline information now exists for urgent implementation of the proposed project.

Project Code No., LE-8

Project Title: Eastern Greenbelt Parks Development Plan

Location: Saraburi, Nakhon Nayok, Nakhon Ratchasima and Prachin Buri

Executing Agency: Land Development Department, Town and Country Planning and National Parks Division

Objectives: Formulation of a master plan to guide development in the east-west belt extending from Saraburi to the Cambodian border which includes the Dongrek Range and constitutes a valuable natural reserve.

Project Description:

(1) To cover the National Parks of Khao Yai, Tha Plan, Pang Sida and the proposed one along the Cambodian border (Tha Phraya District of Prachin Buri).

(2) To develop preservation and development guidelines reflecting the optimal framework to meet objectives of environmental preservation, wildlife management, recreational usage by the Thai population, sustainable economic activities such as hunting or agriculture, protection of antiquities, national security in border regions, and other objectives.

(3) To review and develop new legislation needed to improve management of park resources and enforcement of usage.

(4) To evaluate the need for redesignation (as national forest, reserve, sanctuary status) of any areas now designated as national parklands.

(5) The role of the private sector in park improvement and management will be defined.

Timing: Urgent, 7th National Plan period

Duration required for study and implementation: 5 years.

Cost and Project Financing: undetermined

Comments:

1. Because of the coming opening of Cambodia which will bring increased traffic and development to this region, and because of proposed highway and dam projects, completion of this study is urgent.

2. Inclusion of all these four parks is biologically and functionally logical since together these four areas constitute a coherent natural region focused on a continuous mountain range.

3. There are plans for major infrastructure construction (roads and possibly a dam) in the region and these must be coordinated with this plan.

APPENDIX B

Projects Completed, On-going or Proposed in Study Area and Thailand Related to Natural Resources and Environment

1. The Esarn Khieo Project since 1988, under the National Rural Development Coordination Center.

   Comments: The five year allocation of resources approved for the "Esarn Khieo Implementation Plan (1988-92)" indicates that 89% of all incremental public funds are allocated to new irrigation development and water supply (58% and 31%, respectively). Emphasis was on water resources development as the program itself was realized in response to critical drought conditions in the Northeast. The FY89 national budget includes 7% of total planned incremental funding for the five-year Esarn Khieo program (B1-3 billion out of a total B19.3 billion). The B1-3 billion of incremental FY89 funds are primarily for irrigation (61%), household water supply (9%) and reforestation (13%).

2. RTG/World Bank, Study on Conservation Forest Area Demarcation, Protection and Occupancy (Proposed).

3. UNDP/World Bank, Pre-investment Study on Forestry and Woodfuel in the Northeast (Completed 1989).

4. Asian Development Bank, Study on Commercial Tree Farm Development (Completed November 1989).

5. Project on Protection of Conservation Forest (National Parks and Wildlife Preserves) and Critically Derided Head Watersheds through the Royal Forestry Department.

   Comment: A Japanese Technical Assistance Grant has been approved and work is on-going in the Study covering all of Thailand.

6. World Bank/RTG, A Master Plan for Land Reform, (Supported by the World Bank's Agricultural Land Reform Project); On-going.

   Comments: Project aims are to further support already alienated forest areas by the provision of basic infrastructure through the Agricultural Land Reform Office combined with farmer-financing support through the World Bank for Agriculture and Agricultural Cooperatives, and the concurrent provision of productive and income enhancing activities.

7. Population and Community Development Association (PDA), Community Afforestation Project (CAP) in the provinces Khon Kaen, Mahasarakham, and Buri Ram in Northeast Thailand, On-going; Phase 3 : April 1, 1991 - September 31, 1994.

   Comments: 1. CAP aims to re-afforest project villages located in Thailand's Northeast region. Budget allocated is B8 million obtained from German Agro Action (GAA) and B3.48 million generated locally. By

promoting the indispensable role forests contribute to ecological balance and recognizing the ways goods and services of forestry products directly affect the lives of rural villagers, CAP will contribute to changing villager's attitudes and behaviors towards forests and forested lands. CAP will contribute to village re-afforestation by creating and contributing to a village fund and by holding regular training sessions for villagers regarding trees essential contribution to ecological health. Access to inexpensive credit (village fund) will help to dissuade villagers from using forests and forest products to augment their incomes, in effect, releasing some of the pressures that exist on the village's tree stands.

2. This project must be carefully studied as it is being implemented by a NGO group at the village level. In 7 years of implementation and currently moving towards phase 3 completion, 86 villages conducted planting activity and 86 village Forestry Committees were formed. 39 villages cut down trees for economic benefits (Benefits Sharing). Benefits Sharing averaged B17,604 per village, and ranged from B2,660 to B54,000 per village.

APPENDIX C

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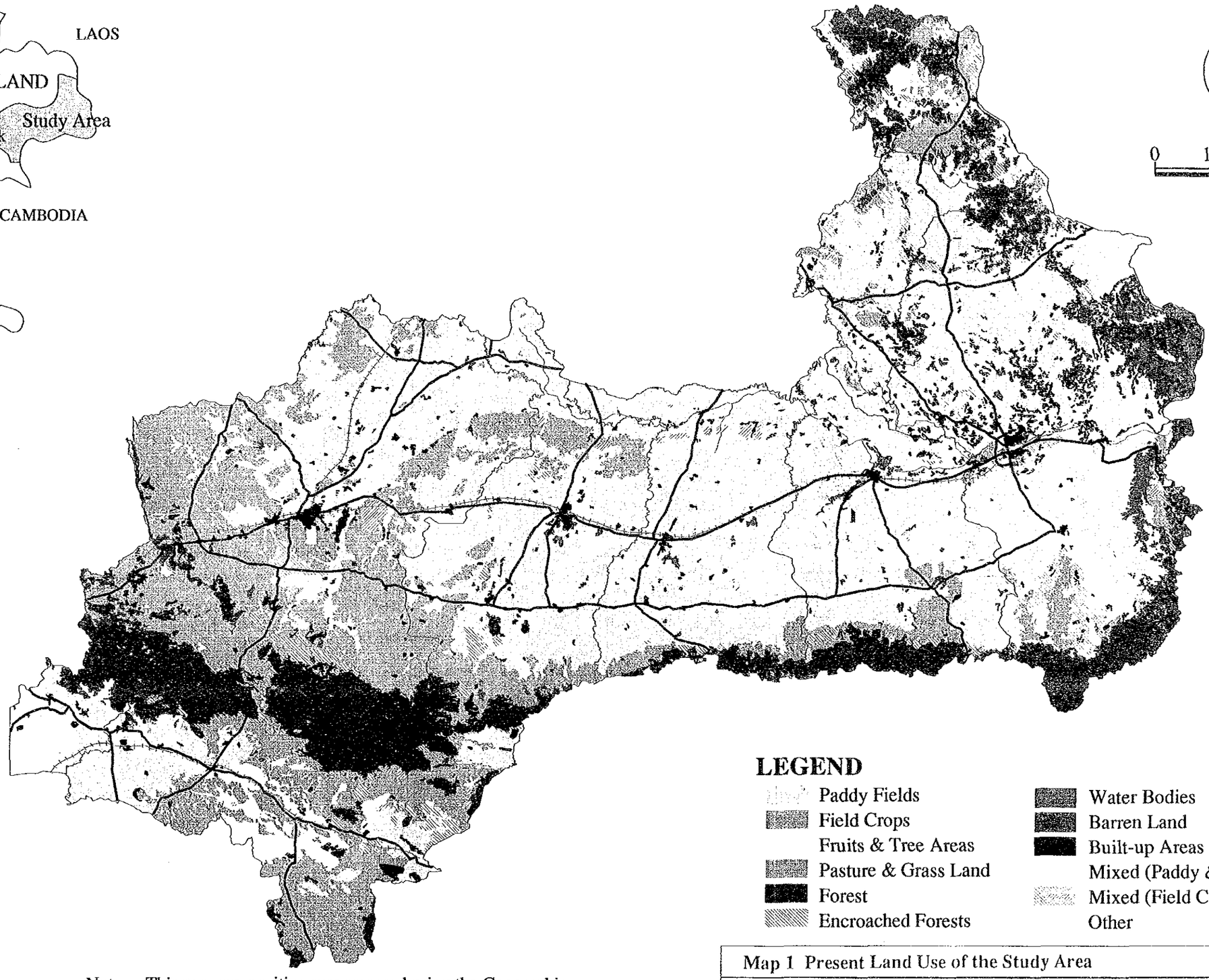
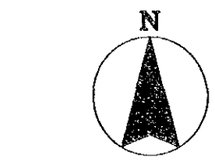
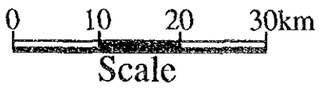
APPENDIX D

MAPS







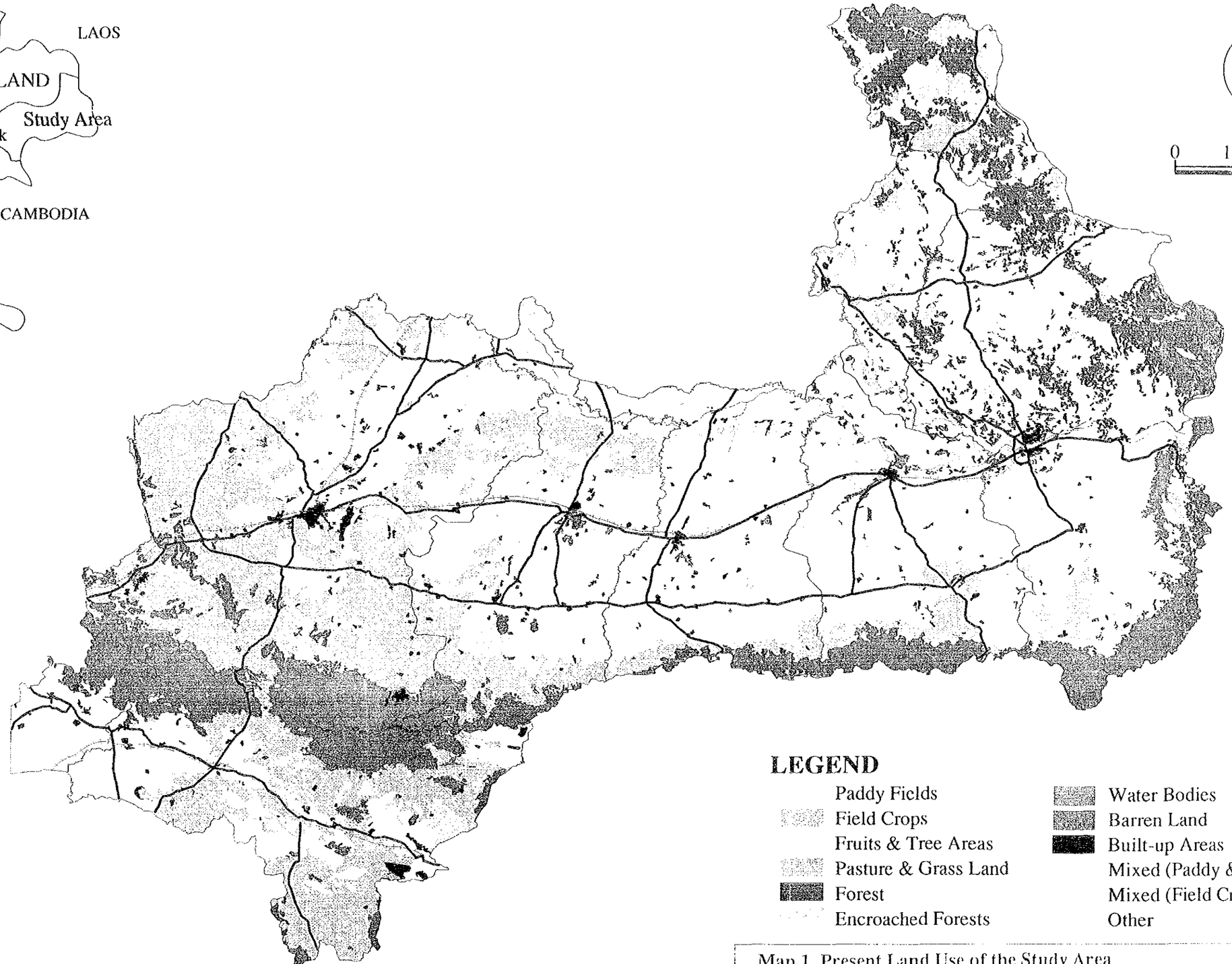
LEGEND

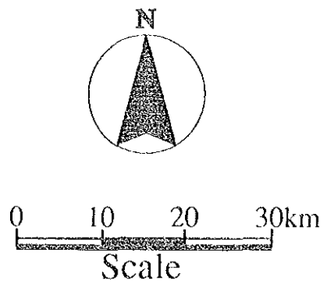
- Paddy Fields
- Field Crops
- Fruits & Tree Areas
- Pasture & Grass Land
- Forest
- Encroached Forests
- Water Bodies
- Barren Land
- Built-up Areas
- Mixed (Paddy & Forest)
- Mixed (Field Crops & Forest)
- Other

Note : This map composition was prepared using the Geographic Information System (GIS) Database developed in the study.

Map 1 Present Land Use of the Study Area

The Study on the Regional Development Plan for the Lower Northeast and Upper East Regions in the Kingdom of Thailand





LEGEND

- Paddy Fields
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- Mixed (Field Crops & Forest)
- Other

Note : This map composition was prepared using the Geographic Information System (GIS) Database developed in the study.

Map 1 Present Land Use of the Study Area

The Study on the Regional Development Plan for the Lower Northeast and Upper East Regions in the Kingdom of Thailand

Note : This map composition was prepared using the Geographic Information System (GIS) Database developed in the study.

Problem Soils

Legend

- Saline and Sodic Soils.
- Sandy and Textured Soils.
- Skeletal Soils.
- Acid Sulphate.
- Associated Soils.

- Amphoe Boundaries
- Major Roads
- Railroads
- Major Rivers

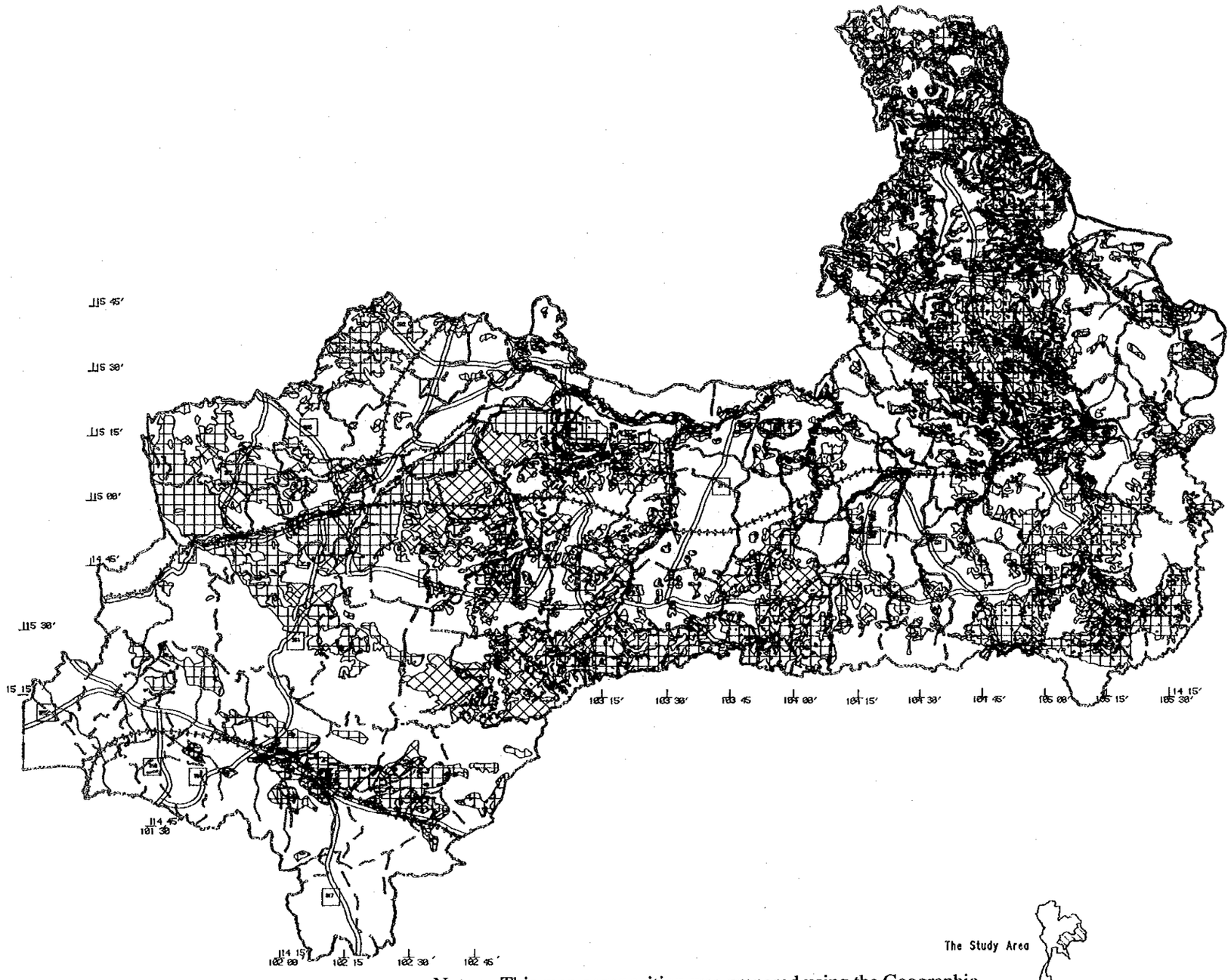
0 17 85

Kilometers

N

The Study on the Regional Development Plan for the Lower Northeast and the Upper East Regions in the Kingdom of Thailand

Map 2
Problem Soils in the Study Area



Note : This map composition was prepared using the Geographic Information System (GIS) Database developed in the study.

Erosion Hazard Soils

Legend

- Erosion and Hazard Soils.
- Associated Soils.

- Amphoe Boundaries
- Major Roads
- Railroads
- Major Rivers

0 17 85

Kilometers

N

The Study on the Regional Development Plan for the Lower Northeast and the Upper East Regions in the Kingdom of Thailand

Map 3
Erosion Hazard Soils in the Study Area