

CHAPTER 4

AGRICULTURE

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4.1 Agricultural Development Policy

4.1.1 The 8th National Development Plan

In the past, Thailand's economy underwent rapid growth and the national economic and social development concept was based largely on the acceleration of economic growth. However, the rapid economic growth resulted in little benefits for rural areas, and the standard of living of rural people remains poor. In views of this, the development concept under the 8th plan has been adjusted from growth-oriented to people-centered development. Therefore, the 8th plan emphasizes on fostering and promoting regional and rural development so as to reduce the number of rural poor and to shift economic activities from urban to rural areas. In this way, more employment opportunities can be created in rural areas. This concept aims at promoting stable and sustainable economic growth and empowering the people to play a greater participatory role in the development process, in order to create an equitable distribution of benefits.

Regarding the agricultural development under the implementation of the 8th plan, it will aim at increasing farmer income, maintaining the economic stability of the agricultural sector and supporting the overall economic growth of the country. The main objectives of agricultural development can be summarized as follows:

- To maintain the capacity for competitiveness of agricultural commodities in the world market by increasing production efficiency, and improving the quality of produce to satisfy market demand;
 - To conserve natural resources through sustainable development; and
 - To develop human resources and farmers' organizations and to upgrade standard of living leading to better quality of life.
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4.1.2 Revision of the 8th National Development Plan

Thailand has been experiencing an acute economic crisis since July 1997. In order to minimize the impact on society and steer the country to economic recovery, the Government decided to review and revise the 8th plan aiming at a sound economic structure for future development under prevailing conditions. The original concept, objectives and strategies laid out in the 8th plan are to be applied during its revision. The principal guidelines for the revision of the 8th plan can be identified as follows:

- To adjust the macro-economic framework and to maintain economic stability;
- To formulate guidelines for human and social development leading to minimize the economic impact on the population;
- To accelerate the restructuring of the economy in order to lay a sound and stable economic foundation; and
- To formulate the restructuring of administration and management systems for national development.

4.1.3 Economic Policy and Measures of MOAC

The MOAC reviewed and made some revisions to the Ministerial Action Plan under the 8th Plan. In connection with this matter, MOAC also proposed an economic policy set to address the economic crisis. The Government and the Cabinet gave its approval in March 1998.

MOAC revised the Action Plan during the implementation of the 8th Plan, by specifying a new economic policy devised to harmonize with the current economic condition. The key elements of the economic policy by MOAC may be summarized as follows:

(1) Philosophy of Agricultural Development

- Develop quality of life.
- Produce in order to compete and harmonize with natural resources and environment.

(2) Objectives of Agricultural Development

- Maintain the capacity for competitiveness of agricultural commodities in the world market.
- Conserve natural resources through sustainable development.
- Strengthen human resources and farmers' organizations.

(3) Target of Agricultural Development

Unit: %/year

Production Sector	Target of 8 th Plan	
	Before revision	After revision
Agriculture	2.9	3.0
Crops	2.7	2.7
Livestock	2.8	2.8
Fishery	4.0	2.5
Forest	7.7	-12.0
Services and processed products	2.7	5.0

(4) Important Matters of the Policy

- Maintain the growth rate of agricultural sector and increase farmer income.
- Raise the capacity for competitiveness of agricultural commodities
- Accelerate local production of agricultural commodities to substitute for imports and to increase export of agricultural produce.
- Adjust the agricultural system to cope with job creation in the rural areas in order to absorb laid-off labor.

The Economic Policy and Measures drawn up by MOAC under the revised 8th Plan are summarized in Table 4.1.

Table 4.1 Economic Policy and Measures by MOAC under the Revised 8th Plan

Items	
1.	Policy on agriculture restructuring (a) Stipulation of large specific agricultural areas with emphasis on production that connect to complete the circuit of marketing and processing for agro-industry of important agricultural commodities. (b) Reduction of risk for small-scale farmers.
2.	Policy on increasing production efficiency and reducing production cost (a) Research and appropriate technology development including biotechnology of crops, livestock and fishery. (b) Implementation of Champion Product Pilot Project on the part of MOAC. (c) Expansion of production base to secure sufficient raw materials for the agro-industry by negotiating with neighboring countries. (d) Purchase of modern farm machinery or increased allocation of budget for technological research and development (up to 10% of MOAC budget).
3.	Policy on quality improvement and processing (a) Stipulation of exporting agricultural commodities emphasizing on one stop service. (b) Encourage and support farmers who are members of various organizations to play a vital role in controlling and promoting production and marketing activities. (c) Research and development for quality control (d) Promotion of safe and natural production methods for domestic consumption and for export to

	specific markets.
Items	
4.	<p>Policy on restructuring of MOAC</p> <p>(a) Restructuring of administrative work of MOAC to facilitate an integrated service, efficient natural resource conservation and restoration.</p> <p>(b) Reduction of official participation at Tambon level by decentralizing authority to local organizations.</p>
5.	<p>Policy on savings in the rural areas</p> <p>(a) Mobilize savings of agricultural cooperatives, farmer groups and other rural savings groups.</p>
6.	<p>Policy on fertilizer and chemical compounds</p> <p>(a) Management measures for efficient utilization of chemical fertilizers and other chemical compounds.</p> <p>(b) Utilization of solid waste and agricultural by-products by the private sector to produce organic fertilizer and bio-fertilizer and other agricultural inputs.</p>
7.	<p>Policy on management of forest, land, water and coastal resources as well as biodiversity</p> <p>(a) Measures for land provision and land distribution as well as for problems on cultivated land.</p> <p>(b) Management of conservation areas and protection of preservation areas.</p> <p>(c) Conservation and restoration of ecological system of deteriorated coastal areas.</p> <p>(d) Development of natural resources suitable for conserving tourism and promoting agro-tourism.</p> <p>(e) Development potential of irrigated land for efficient production including addressing the problem of environmental pollution.</p>
8.	<p>Policy on preparation in response to global climate change</p> <p>(a) Prevention of effects of natural disasters and provision of appropriate assistance to farmers.</p> <p>(b) Food security to avoid the natural effects of disaster.</p> <p>(c) Restoration of occupation and livelihood after natural disasters.</p>
9.	<p>Policy towards the 21st century</p> <p>(a) Conduct a survey to come up with an inventory of living things in Thailand, including a database system to manage natural resources.</p> <p>(b) Follow up, solving, and negotiate trade barrier problems not relevant to taxation.</p>

The Ninth National Economic and Social Development Plan is now being drafted. Major issues of the Ninth Plan will be on: 1) restructuring the national economic structure to be more competitive and robust in the international market; 2) strengthening local economies by maximum utilization of public investment; and 3) materializing efficient and equitable resource distribution to alleviate socioeconomic disparities among regions. These directions, needless to say, are relevant to and in line with development issues for the Study Area.

4.2 Present Agricultural Conditions

4.2.1 Cropped Area and Crop Production

Generally, the major crops cultivated in the Study Area are paddy, cassava and sugar cane, while the minor crops in terms of planted area are groundnut, soybean, kenaf and vegetables and fruit trees.

According to the harvested area, in 1997/98 crop-year, paddy accounted for the largest acreage among major crops in the Study Area with total harvested area of 3.83 million rai or 49% of total farmland, followed by cassava, sugar cane, groundnut and kenaf. The acreage of sugar cane and cassava is concentrated in two provinces, Mukdahan and Kalasin, where sugar-mills and cassava processing mills have been established. The breakdown of cropped area, according to five major crops in the Study Area, is shown below:

Table 4.2 Harvested Area of Major Crops

Crops	Unit: rai					
	Nakhon Phanom	Mukdahan	Sakon Nakhon	Kalasin	Total	% of total Farmland
Rice (Major & secondary rice)	810,026	396,967	1,393,334	1,229,328	3,829,655	49.00
Cassava	23,261	103,045	83,050	288,363	497,719	6.37
Sugar cane ^{1/}	9,660	70,599	11,515	63,844	155,618	2.00
Groundnut	6,056	6,065	11,888	19,210	43,219	0.55
Kenaf	891	7,564	12,493	6,906	27,854	0.36
Farmland	1,568,097	819,127	2,964,401	2,462,561	7,814,186	

Source: Agricultural Statistics of Thailand: Crop Year 1997/98, OAE
^{1/} Planted Area

Cropped area of major crops has changed significantly in the past decades as shown in Table 4.3 and Figure 4.1 to Figure 4.6. The acreage of cassava has decreased significantly in every province in the Study Area, while the area of sugar cane has increased especially in Kalasin and Mukdahan. Generally, the cropped area of paddy and groundnut has been fluctuating from year to year due to weather conditions. With regard to paddy production, in dry and wet seasons, it yielded the highest crop production in the Study Area with 1.15 million tons in crop year 1997/98, or about 13% of total paddy production in the Northeast; cassava and sugar cane accounted for 12% and 7.5% respectively, as shown in Table 4.4.

Major rice is entirely cropped in the rainy season; glutinous rice production accounts for approximately 80% of total production in Mukdahan and Kalasin, while glutinous

rice production in Nakhon Phanom ranges from 60% to 70%. High quality varieties recommended by DOAE, such as RD6, RD15, aromatic rice (Hom Mali 105), etc., are planted in the Study Area. The average rice yields in the four provinces of the Study Area in 1997 were 293 kg/rai and 462 kg/rai for major and secondary rice respectively. Among the four provinces in the Study Area, Kalasin has the highest paddy yield and planted area of secondary rice owing to its large-scale irrigation facilities.

Cassava has been widely cultivated in the upland areas of the Study Area. In crop year 1997/98, Kalasin had the highest harvested area of 288,363 rai. Local varieties and Rayong 1 are most popular; the average yield in the Study Area amounted to about 2.1 tons/rai. Yield of cassava has decreased but only slightly. Generally, the cassava-cultivated areas tend to gradually decrease under the program of restructuring the system of agriculture production (refer to Figure 4.3). However it will continue to be the main rain-fed crop in the upland areas of the Study Area, because it is suitable for infertile soil and drought condition, and it is easy to cultivate.

Table 4.3 Major Production and Yield in the NBR, 1988- 1998

Province	Year	Minor Rice			Sesam Rice			Cassava			Sugarcane			Groundnuts			Kemp		
		Harvested Area 1,000 rai	Production 1,000 Ton	Yield kg/rai	Harvested Area 1,000 rai	Production 1,000 Ton	Yield kg/rai	Harvested Area 1,000 rai	Production 1,000 Ton	Yield kg/rai	Harvested Area 1,000 rai	Production 1,000 Ton	Yield kg/rai	Harvested Area 1,000 rai	Production 1,000 Ton	Yield kg/rai	Harvested Area 1,000 rai	Production 1,000 Ton	Yield kg/rai
Nakhon Phanom	1988	1,034.8	206.4	199	8.3	3.6	430	95.5	187.0	1,957	1.5	12.8	8,500	2.3	0.4	190	2.5	0.5	207
	1989	1,031.4	212.3	206	6.1	2.3	374	100.3	216.3	2,156	0.4	2.8	7,339	3.0	0.6	197	4.4	0.8	182
	1990	928.2	213.7	230	3.6	1.4	383	96.8	208.9	2,158	0.2	1.9	10,000	3.7	0.7	187	4.0	0.8	194
	1991	890.9	201.4	226	5.6	1.4	258	69.6	133.7	1,920	5.1	60.4	11,798	2.6	0.5	186	4.4	1.1	242
	1992	778.4	235.2	302	4.9	1.7	341	47.6	95.4	2,064	9.5	95.9	10,048	2.7	0.5	200	4.8	1.0	210
	1993	852.3	235.9	277	7.9	2.8	357	46.1	1,903	1,903	12.3	72.9	5,926	3.0	0.6	201	2.8	0.7	250
	1994	864.1	251.9	292	6.8	2.4	345	45.6	86.8	1,903	7.5	48.7	6,481	3.3	0.6	185	2.3	0.5	220
	1995	818.2	229.3	280	15.2	4.9	323	30.5	52.6	1,726	8.5	77.5	9,135	4.2	0.9	212	1.8	0.4	211
	1996	793.9	234.8	296	13.8	5.4	389	25.9	51.1	1,972	16.6	142.4	8,574	5.8	1.2	208	0.7	0.2	273
	1997	778.8	241.3	310	13.7	7.1	520	22.1	41.0	1,944	9.8	82.9	8,460	5.7	1.3	224	1.1	0.2	220
Mukdahan	1988	789.0	204.2	259	21.1	7.0	331	23.3	40.0	1,720	9.7	80.9	8,380	6.1	1.4	230	0.9	0.2	244
	1989	307.3	66.9	218	1.1	0.5	484	79.0	173.0	2,189	16.7	152.8	9,139	2.3	0.5	212	14.3	2.6	181
	1990	302.6	56.3	186	1.5	0.6	390	102.2	237.6	2,324	16.7	134.4	8,040	1.9	0.3	156	21.0	4.2	199
	1991	318.6	80.6	253	1.7	0.6	321	97.4	203.7	2,091	16.9	153.3	9,068	3.2	0.6	200	19.7	4.0	201
	1992	325.8	99.8	306	0.7	0.2	299	96.4	197.0	2,044	22.2	225.4	10,173	2.9	0.5	180	20.1	4.2	210
	1993	308.8	99.5	322	0.7	0.3	379	110.1	232.4	2,111	30.8	285.4	9,266	6.0	1.3	221	13.3	2.5	186
	1994	266.0	76.6	288	0.4	0.1	345	113.1	240.9	2,130	42.2	183.8	4,356	5.7	1.3	222	8.8	1.8	210
	1995	371.7	102.8	277	1.0	0.5	454	102.6	212.7	2,073	49.5	384.5	7,774	4.6	1.0	217	10.7	2.4	224
	1996	370.2	108.4	293	0.1	0.0	293	90.7	186.0	2,128	72.3	574.8	7,952	7.0	1.5	217	8.8	1.9	217
	1997	362.0	95.2	263	0.3	0.1	502	104.4	214.3	2,053	65.7	518.9	7,897	7.1	1.6	232	8.0	2.2	270
Sakon Nakhon	1988	395.5	101.2	256	1.5	0.4	262	103.0	214.8	2,085	70.6	593.0	8,399	6.1	1.4	232	7.6	1.9	252
	1989	1,493.1	322.0	216	16.2	5.6	346	149.8	332.1	2,217	5.3	38.7	7,343	9.9	2.1	212	17.0	2.7	158
	1990	1,571.4	388.2	247	14.5	5.0	345	147.6	340.7	2,308	4.7	42.2	8,970	9.7	1.8	181	6.1	1.1	185
	1991	1,936.5	513.4	265	8.7	2.4	277	134.7	281.5	2,090	3.7	31.2	8,392	10.6	2.1	196	8.9	1.1	189
	1992	1,618.6	486.0	300	13.3	6.0	451	142.4	289.9	2,036	7.7	69.8	9,119	10.7	2.5	233	11.4	2.3	205
	1993	1,398.0	380.2	272	8.1	2.5	315	149.6	293.2	1,959	8.3	73.8	8,863	10.0	2.5	233	13.2	2.4	184
	1994	1,630.4	448.8	275	8.9	0.3	367	149.4	328.4	2,198	11.7	48.2	4,113	10.2	1.9	191	10.4	2.0	192
	1995	1,567.9	427.1	272	4.0	1.4	338	152.6	324.0	2,124	12.9	81.6	6,344	10.8	2.3	213	15.5	3.0	191
	1996	1,544.5	415.2	269	2.3	0.7	326	137.2	262.7	1,914	15.9	138.4	8,426	13.5	3.0	224	14.2	3.4	243
	1997	1,544.0	393.5	225	4.6	1.6	344	123.7	262.7	2,026	18.2	161.1	8,869	13.1	3.2	245	9.3	2.2	234
Kalasin	1988	1,377.2	413.9	301	16.1	6.3	391	83.1	184.0	2,215	11.5	95.5	8,296	11.9	2.6	219	12.5	1.5	224
	1989	1,173.0	322.1	275	15.1	7.2	480	464.3	1,044.1	2,249	7.8	61.7	7,876	27.0	5.7	212	27.6	4.6	167
	1990	1,093.5	331.3	303	44.3	23.4	529	498.3	1,150.0	2,308	5.7	48.6	8,510	38.1	9.0	235	15.6	2.5	256
	1991	1,098.8	311.0	283	58.0	34.1	587	452.8	945.9	2,089	6.2	54.8	8,786	31.6	6.5	207	14.5	3.9	236
	1992	1,171.9	346.8	296	81.0	44.9	554	454.1	925.0	2,037	13.6	153.2	11,305	32.5	6.4	197	14.1	2.8	202
	1993	1,028.2	311.2	303	122.3	67.6	552	419.3	902.5	2,153	25.1	272.2	10,858	30.3	6.5	213	7.3	1.4	188
	1994	1,149.3	379.0	330	133.4	63.5	476	408.3	881.8	2,160	56.9	352.0	6,187	19.5	3.9	201	6.2	1.2	190
	1995	1,147.5	344.1	300	5.0	1.8	357	385.1	812.9	2,111	31.4	234.3	8,106	19.4	4.6	240	7.7	1.6	203
	1996	1,100.8	336.2	305	66.4	32.6	492	363.9	676.2	1,858	45.6	408.9	8,959	20.0	4.2	212	8.4	2.0	241
	1997	1,220.0	413.3	338	90.6	48.5	515	362.7	745.0	2,054	57.4	527.5	9,196	21.6	4.6	212	7.6	1.8	233
1998	990.7	335.2	338	109.3	52.1	477	359.6	783.2	2,178	57.7	501.5	8,687	21.2	4.6	219	7.9	1.8	228	
1998	1,064.4	342.2	321	164.9	80.4	488	288.4	622.0	2,157	63.8	531.6	8,326	19.2	4.4	231	6.9	1.6	229	

Source: Agricultural Statistics of Thailand.

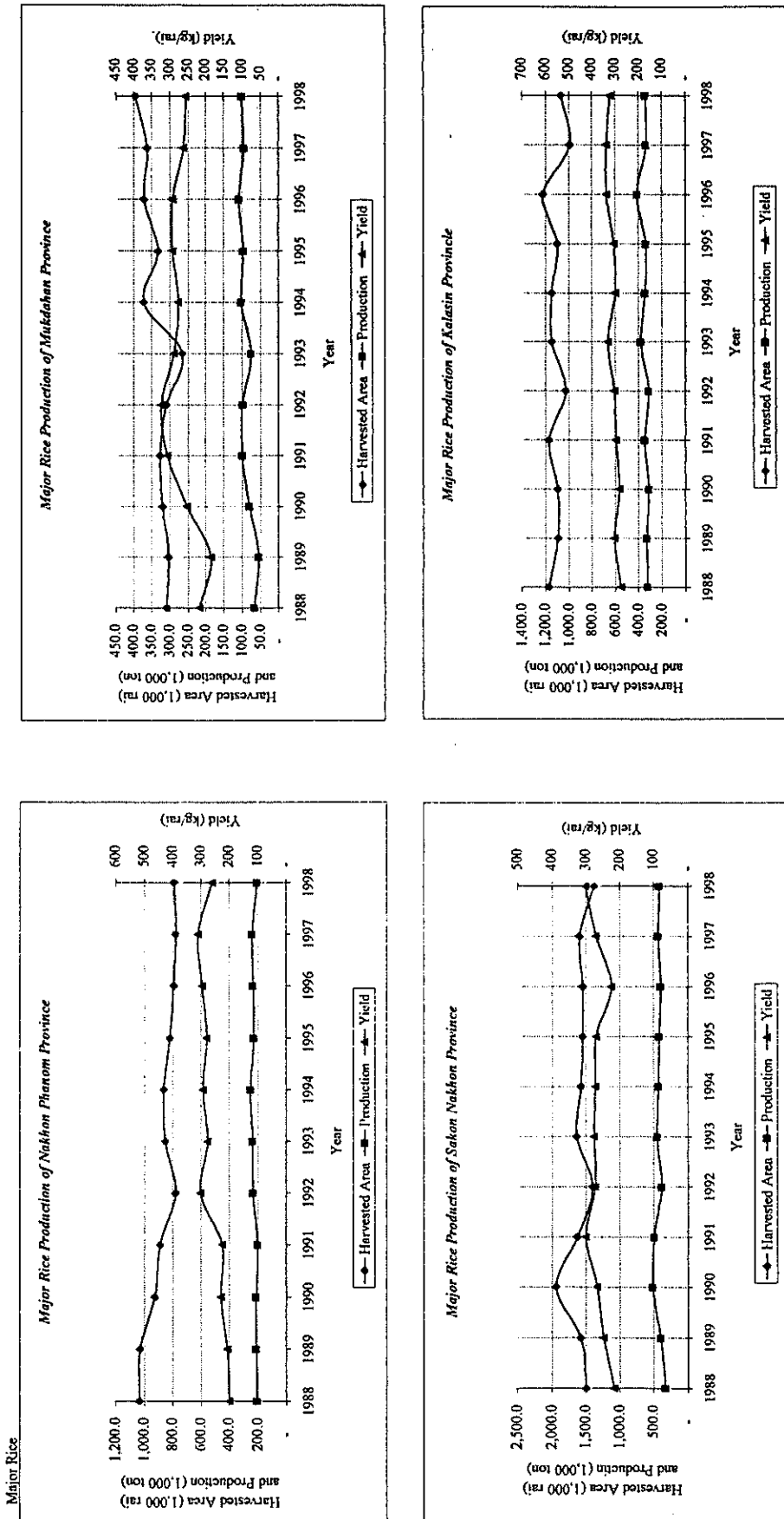


Figure 4.1 Major Rice Production 1988-1998

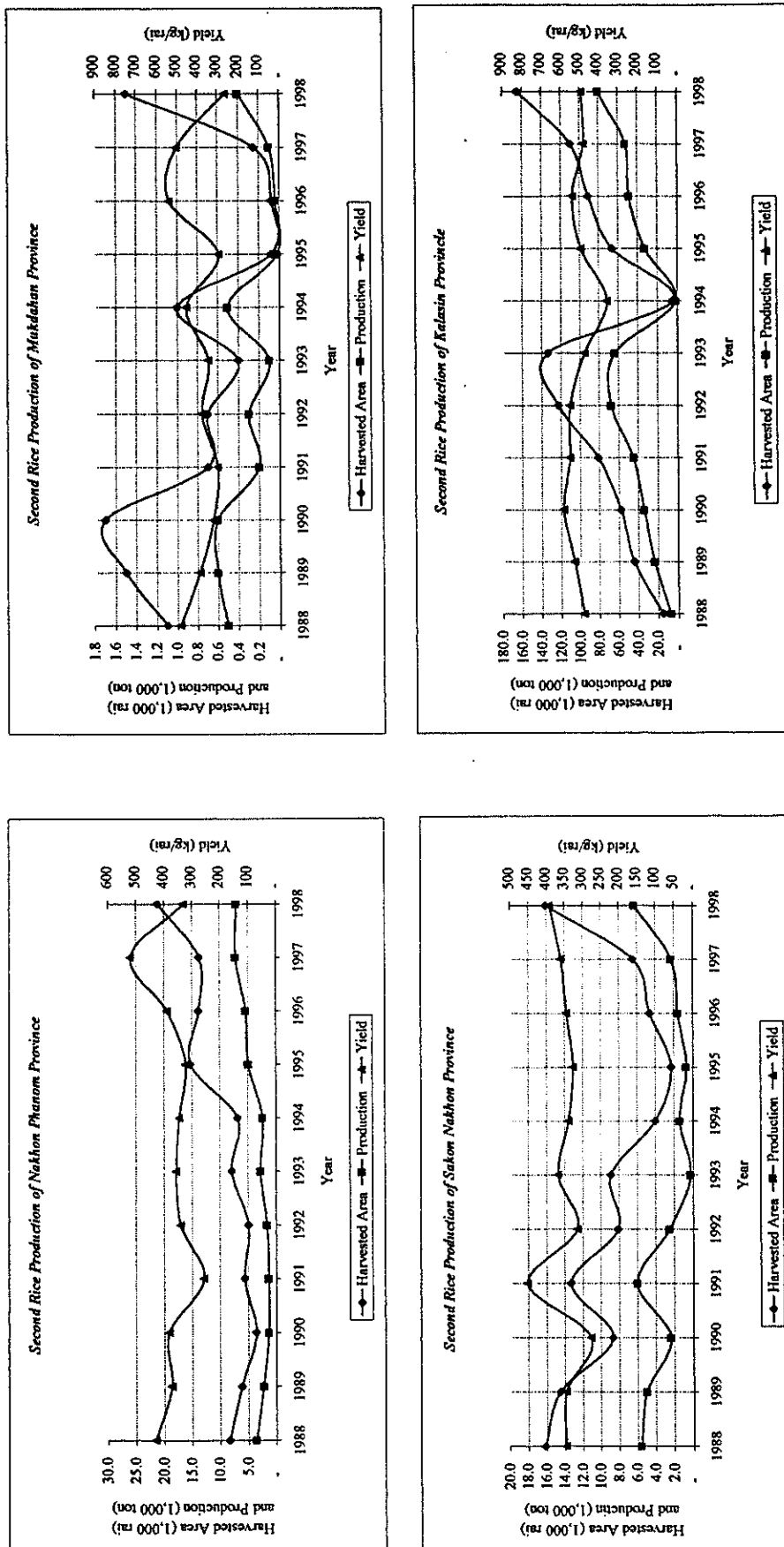


Figure 4.2 Second Rice Production 1988- 1998

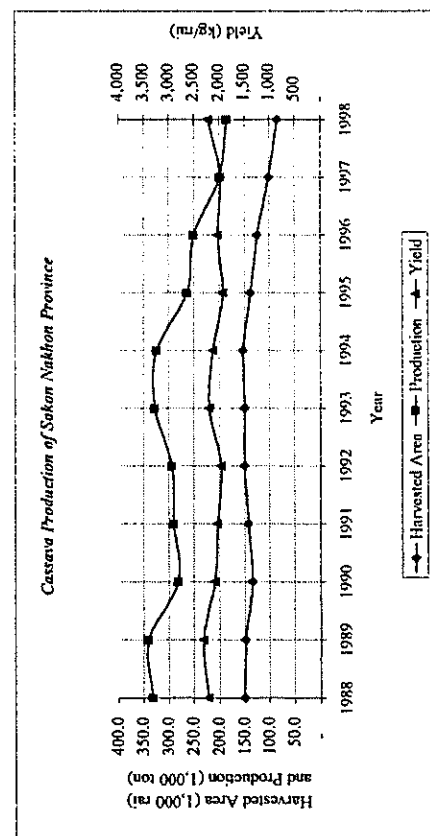
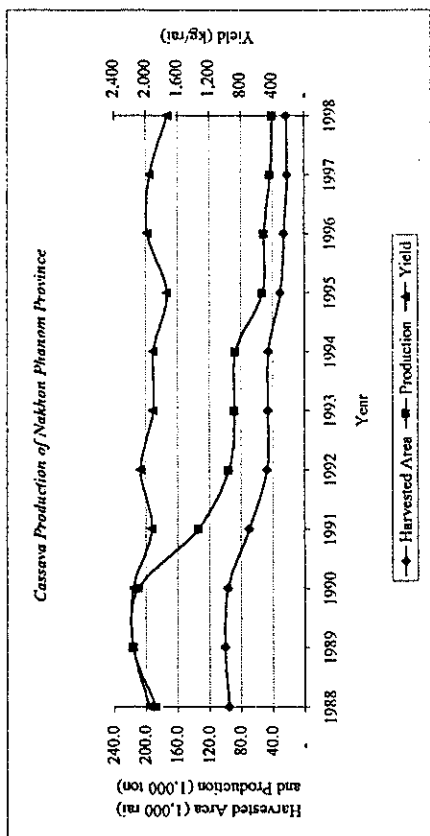
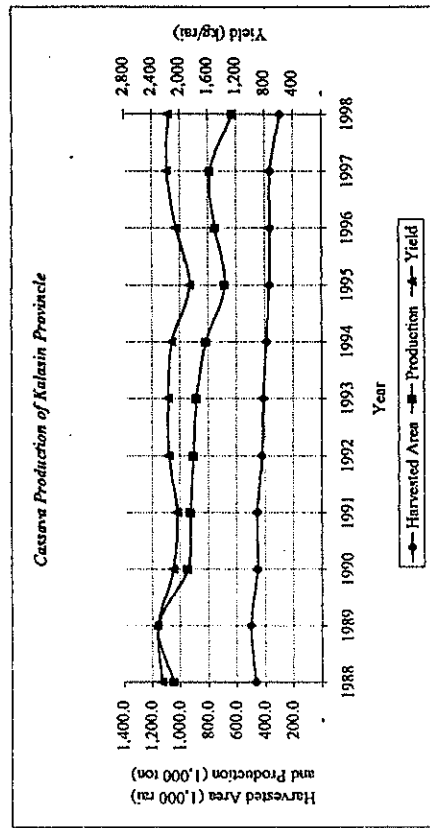
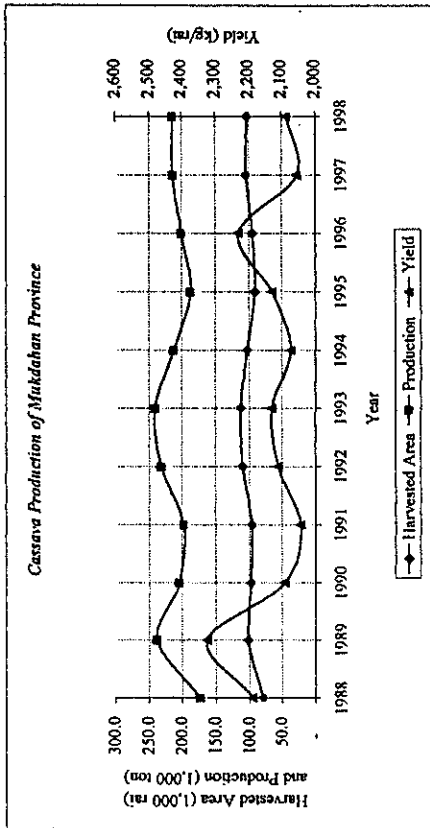


Figure 4.3 Cassava Production 1988- 1998

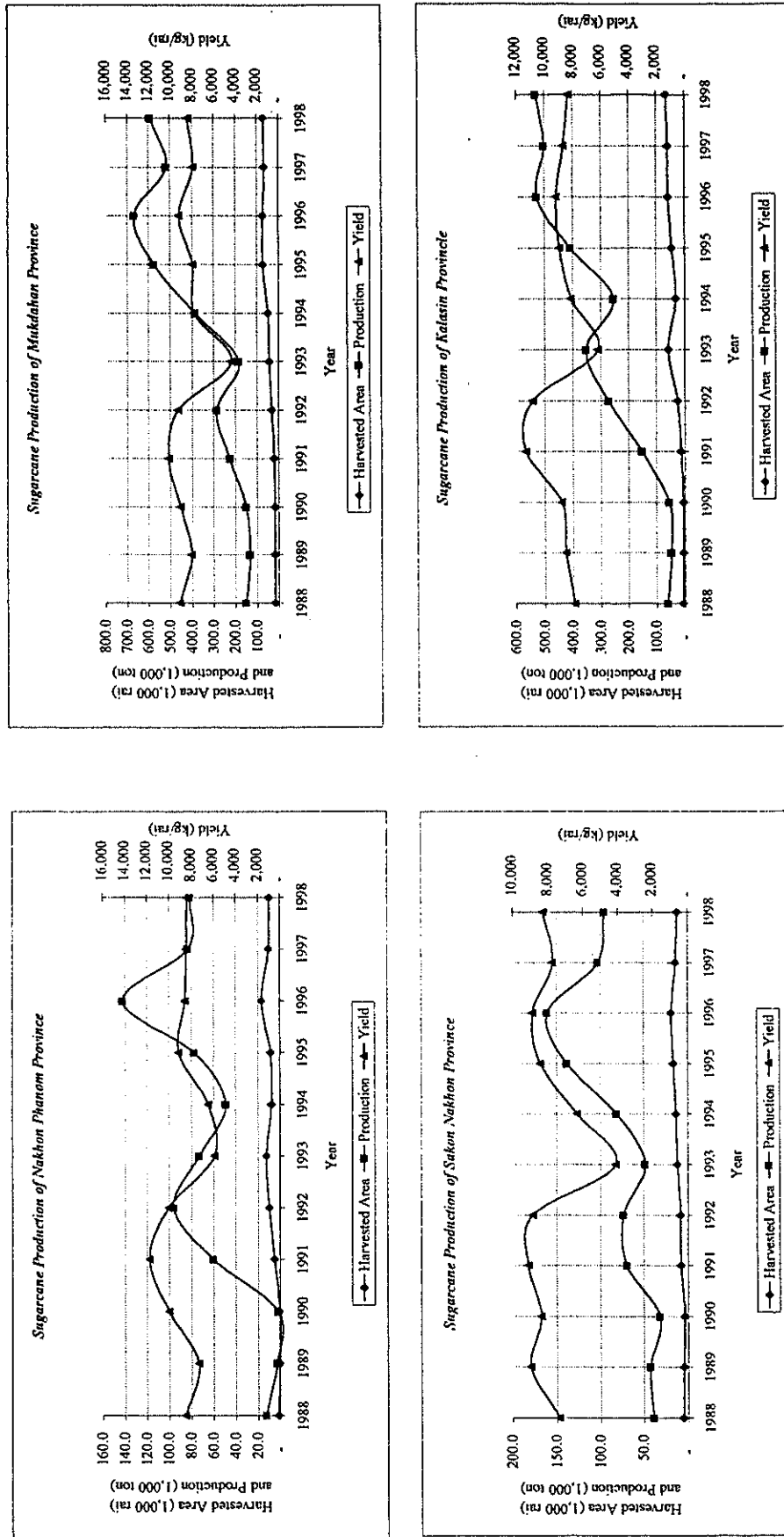


Figure 4.4 Sugarcane Rice Production 1988- 1998

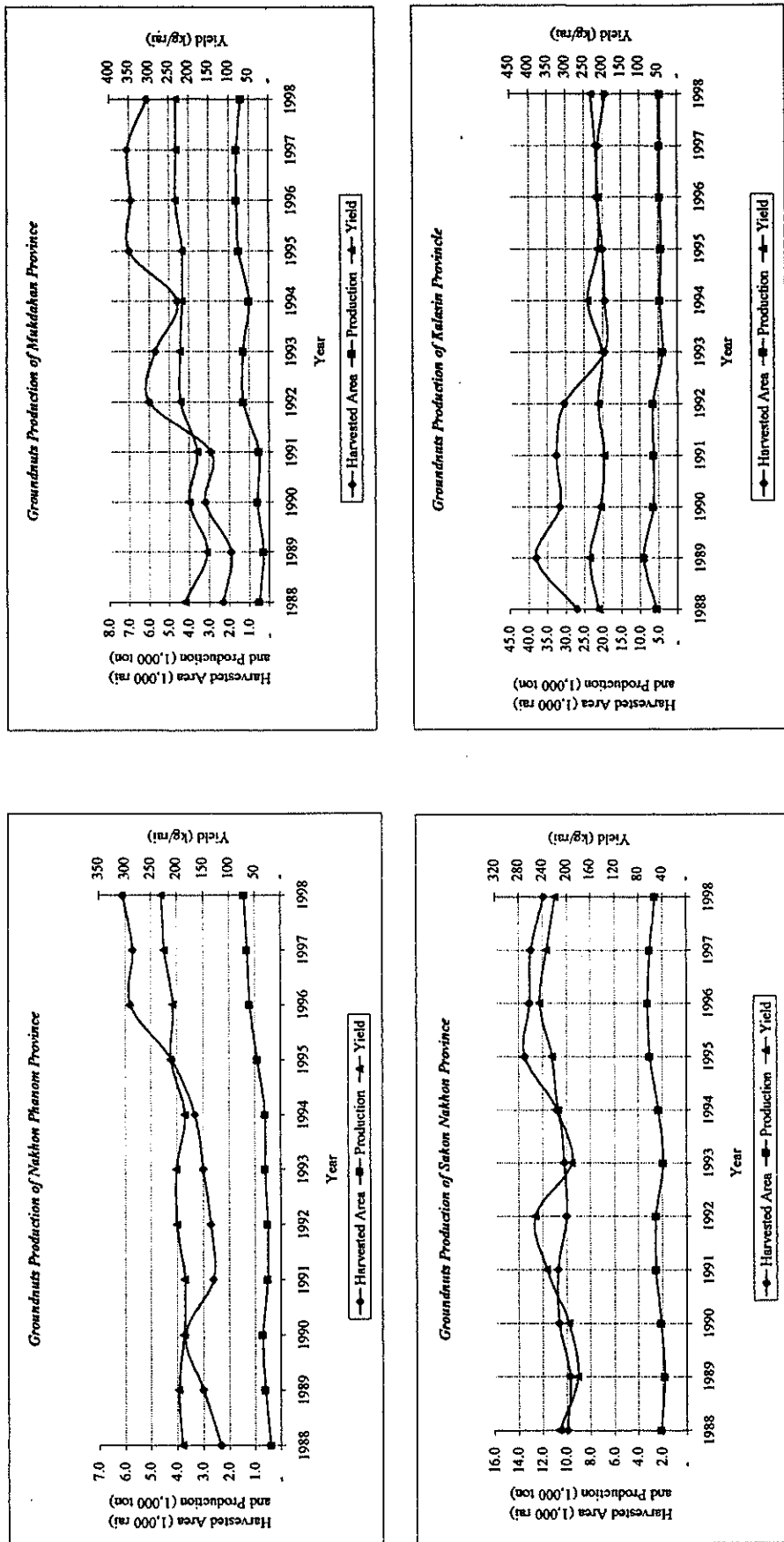


Figure 4.5 Groundnut Rice Production 1988- 1998

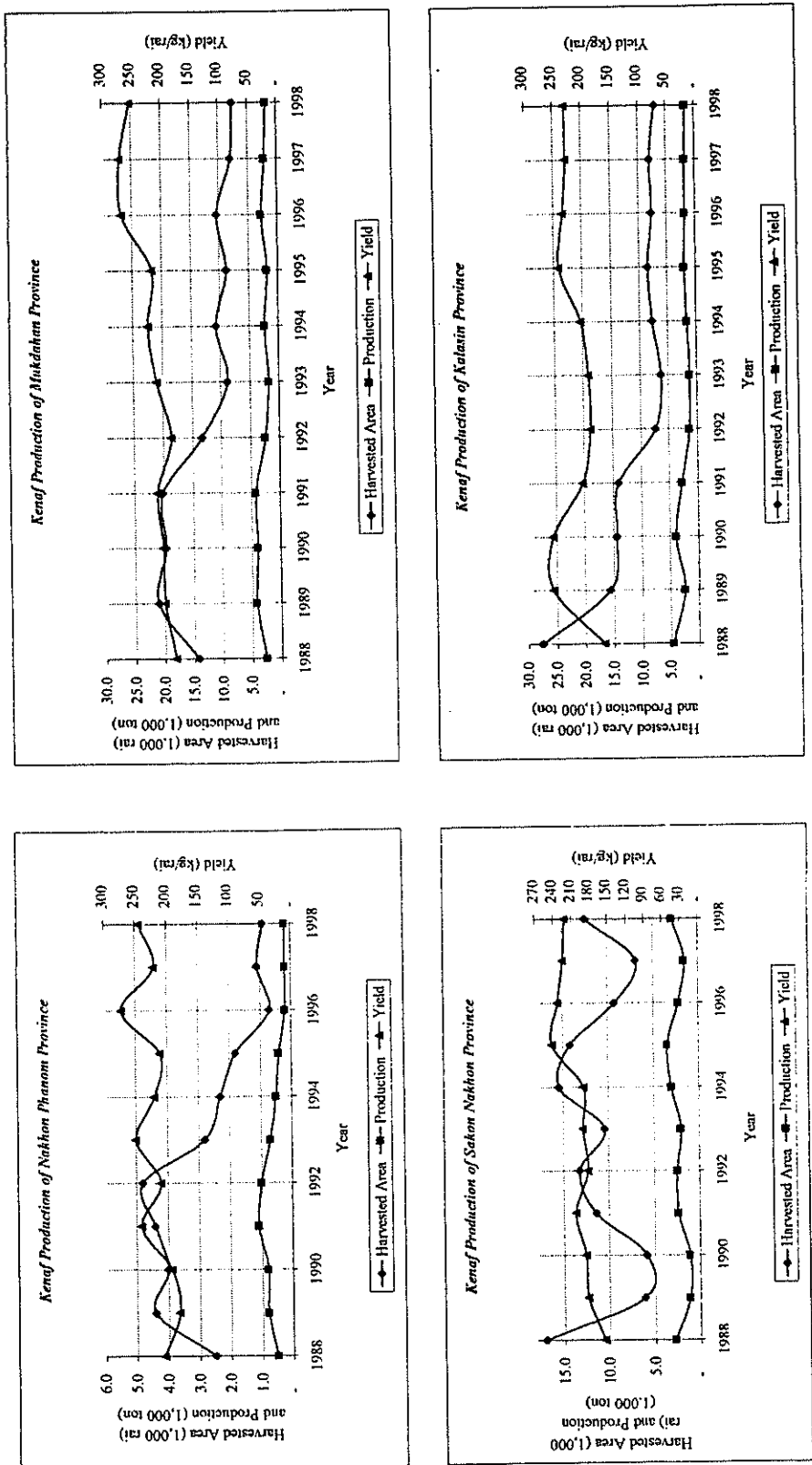


Figure 4.6 Kenaf Rice Production 1988-1998

Table 4.4 Harvested Area, Production and Yield of Major Crops (Crop Year 1997/98)

Province	Major Rice			Second Rice			Cassava		
	Harvested Area, rai	Production Ton	Yield kg/rai	Harvested Area, rai	Production Ton	Yield kg/rai	Harvested Area, rai	Production Ton	Yield kg/rai
Nakhon Phanom	788,972	204,207	259	21,054	6,963	331	23,261	40,009	1,720
Mukdahan	395,512	101,176	256	1,455	381	262	103,045	214,849	2,085
Sakon Nakhon	1,377,188	413,903	301	16,146	6,315	391	83,050	183,956	2,215
Kalasin	1,064,426	342,159	321	164,902	80,424	488	288,363	621,999	2,157
Study Area	3,626,098	1,061,445	293	203,557	94,083	462	497,719	1,060,813	2,131
Northeast	30,861,783	8,633,595	280	473,853	209,668	442	3,844,822	8,869,801	2,307

Province	Sugarcane			Groundnut			Kenaf		
	Harvested Area, rai	Production Ton	Yield kg/rai	Harvested Area, rai	Production Ton	Yield kg/rai	Harvested Area, rai	Production Ton	Yield kg/rai
Nakhon Phanom	9,660	80,946	8,380	6,056	1,391	230	891	217	244
Mukdahan	70,599	592,987	8,399	6,065	1,410	232	7,564	1,905	252
Sakon Nakhon	11,515	95,527	8,296	11,888	2,603	219	12,493	2,767	221
Kalasin	63,844	531,595	8,326	19,210	4,446	231	6,906	1,584	229
Study Area	155,618	1,301,055	8,361	43,219	9,850	228	27,854	6,473	232
Northeast	2,055,199	17,354,139	8,444	177,678	42,286	238	369,265	84,882	230

Source: Agricultural Statistics of Thailand: Crop Year 1997/98.

Regarding upland crops especially sugar cane and cassava, transplanting of young shoots is done manually. In some areas, rice and cassava are harvested through the cooperation of small groups of neighbors in the village. As to application of fertilizers on major crops, farmers usually use single or compound chemical fertilizers and a limited amount is used. Pest/disease control is seldom practiced except a portion of vegetable, cash crops and fruit trees fields.

4.2.3 The Calendar of Major Crops

Generally, the main crops in the Study Area may be divided into three types. These are crops which are cultivated mainly in the rainy season such as rain-fed rice and corn, crops to be mainly cultivated in the dry season after harvesting the major rice, and crops to be cultivated throughout the year, such as sugar cane and cassava.

The calendar of annual crops is slightly different by locality, depending on weather conditions, availability of water for agriculture and the readiness of farmers. However, the calendar of major crops in large-scale irrigation projects will follow the irrigation schedule of those projects. In rain-fed areas, when there is drought or a dry spell at the period of seed- bed preparation or transplanting, the farmers have to wait for rainfall, and eventually actual cropping calendar will be delayed. The calendar of major crops is illustrated as follows.

4.2.4 Livestock Breeding

In the past, buffaloes played a vital role in agriculture, because farmers relied on its physical power for paddy cultivation, such as land preparation and threshing. In some areas, oxen were also used in crop cultivation. Now, economically important livestock are buffaloes, cattle, swine, chicken and duck. Regarding draught animals, it is taken over by big tractors and hand tractors. Only poor farmers who cannot afford owning or hiring tractors for their crop cultivation still keep buffaloes for farm labor. Most of livestock are raised for additional family income as well as for household consumption, as in the case of chicken and swine. Only a few raise cattle, swine and chicken on a commercial scale.

Livestock population in the Study Area in 1985, 1995 and 1998 (Table 4.5) varies between provinces. Sakon Nakhon province occupied the highest number of cattle and chicken, while in 1998 buffalo population was the largest in Nakhon Phanom and swine population was relatively large. Table 4.6 presents number of livestock by Amphoe in the Study Area in 1998.

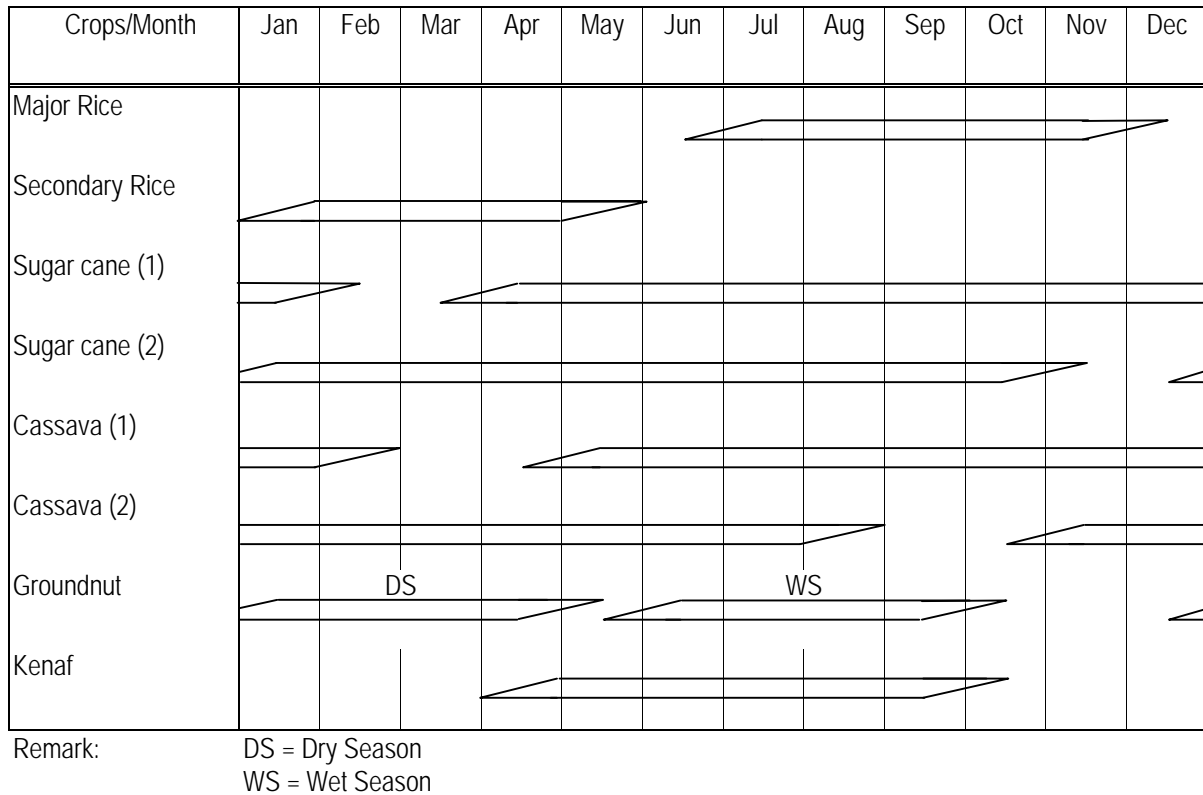


Figure 4.7 Calendar of Major Crops in the Study Area

Generally, the buffalo population is rapidly decreasing not only in the Study Area but also in the whole country. For example, the head of buffaloes in 1985, 1995 and 1998 were 793,800, 587,500, and 242,500 respectively. From 1985-1995, their numbers decreased by 26%; from 1995-1998, the decline was a staggering 58.72%. In 1998, the total population of buffaloes in the area amounted to 15% of the region, while the total number of buffaloes in the Northeast occupied about 80% of the whole country. As a matter of fact, buffaloes in the whole Kingdom have declined year after year in parallel with the decreasing demand for draught animals, which have been substituted by farm machinery.

On the other hand, the population of cattle has been fluctuating, due largely to the price of meat and feeds. During the period 1985-1995, the number of population continuously increased at 12.83% but during 1995-1998 it decreased 26.75%.

In general, the population of swine and duck in the Study Area has been increasing year after year since 1985. Nowadays, duck farmers are knowledgeable about commercial breeds. The Muscovy duck is the most popular in the area.

Table 4.5 Livestock Population in the NBR: 1985-1998

Unit : 10³ heads

Province	Buffaloes				Cattle				Swine						
	1985	1995	1998	% of Change		1985	1995	1998	% of Change		1985	1995	1998	% of Change	
				95-85	98-95				95-85	98-95				95-85	98-95
Nakhon Phanom	206.2	151.3	85.1	-26.62	-43.75	109.2	77.9	58.3	-28.66	-25.16	45.9	44.1	44.7	-3.92	1.36
Mukdahan	96.5	83.9	39.2	-13.06	-53.28	35.7	52.7	47.1	47.62	-10.63	24.9	21.6	38.3	-13.25	77.31
Sakon Nakhon	254.7	195.3	71.7	-23.32	-63.29	119.1	142.3	98.1	19.48	-31.06	50.6	50.5	40.4	-0.20	-20.00
Kalasin	236.4	157.0	46.5	-33.59	-70.38	69.6	103.5	72.2	48.71	-30.24	22.1	40.1	45.9	81.45	14.46
Study Area	793.8	587.5	242.5	-25.99	-58.72	333.6	376.4	275.7	12.83	-26.75	143.5	156.3	169.3	8.92	8.32
Northeast	4,428.8	3,213.1	1,614.9	-27.45	-49.74	1,726.3	2,686.2	2,097.8	55.60	-21.90	1,093.6	1,291.3	1,688.6	18.08	30.77

Province	Duck				Chicken					
	1985	1995	1998	% of Change		1985	1995	1998	% of Change	
				95-85	98-95				95-85	98-95
Nakhon Phanom	85.5	142.9	195.2	67.13	36.60	1,182.8	1,531.0	966.9	29.44	-36.85
Mukdahan	35.6	70.4	160.0	97.75	127.27	394.5	792.4	677.6	100.86	-14.49
Sakon Nakhon	138.3	230.8	253.5	66.88	9.84	1,071.0	2,283.9	1,416.4	113.25	-37.98
Kalasin	270.0	262.9	195.0	-2.63	-25.83	805.9	712.7	950.1	-11.56	33.31
Study Area	529.4	707.0	803.7	33.55	13.68	3,454.2	5,320.0	4,011.0	54.02	-24.61
Northeast	4,687.7	5,119.1	5,261.1	9.20	2.77	24,292.5	34,570.3	38,176.6	42.31	10.43

Source : Department of Livestock

Table 4.6 Number of Livestock by Amphe in the NBR

Livestocks by Amphoe in Nakhon Phanom : 1998

Unit: Heads

Province and Amphoe	Type of Livestocks					
	Cattle	Buffaloes	Duck	Chicken	Geese	Swine
Total	58,332	85,123	195,243	966,913	1,863	44,735
Muang Nakhon Phanom	5,709	10,979	17,579	238,347	268	10,128
Tha Uthen	3,369	9,932	36,187	52,582	153	2,651
That Phanom	4,274	4,935	10,483	70,278	46	9,447
Na Kae	9,367	10,226	33,219	153,031	38	1,958
Na Wa	5,687	4,801	12,129	53,755	50	4,159
Ban Phaeng	1,395	1,993	7,365	44,107	79	696
Pla Pak	6,765	9,141	22,412	70,175	151	6,144
Phone Sawan	3,801	7,167	5,985	26,069	123	2,249
Reuu Nakhon	5,346	8,078	5,412	101,025	440	1,790
Si Songkhram	7,329	12,963	16,783	68,147	279	3,801
Na thom	3,464	2,688	24,764	34,470	234	722
K.A. Wang Yang	1,826	2,220	2,925	54,927	2	990

Source: Statistical Reports of Changwat Nakhon Phanom, 1999 Edition, NSO

Livestocks by Amphoe in Mukdahan: 1998

Unit: Heads

Province and Amphoe	Type of Livestocks					
	Cattle	Buffaloes	Duck	Chicken	Geese	Swine
Total	47,083	39,166	160,048	677,603	-	38,328
Muang Mukdahan	13,097	15,247	21,604	210,111	-	15,426
Don Tan	9,354	3,118	10,000	47,493	-	3,139
Kham Cha I	8,665	6,908	51,101	197,620	-	13,186
Dong Luang	5,614	4,528	6,303	24,466	-	360
Nikhom Kham Soi	3,429	4,003	8,731	81,459	-	2,003
Wan Yai	1,870	3,446	47,415	71,355	-	2,624
Nong Soong	5,054	1,916	14,894	45,099	-	1,590

Source: Statistical Reports of Changwat Mukdahan, 1999 Edition, NSO

Livestocks by Amphoe in Sakon Nakhon: 1998

Unit: Heads

Province and Amphoe	Type of Livestocks					
	Cattle	Buffaloes	Duck	Chicken	Geese	Swine
Total	122,268	82,472	245,393	1,422,926	1,808	36,415
Munag Sakon Nakhon	17,052	10,626	29,755	179,284	145	4,461
Kusuman	5,655	3,545	6,705	12,900	80	1,080
Kut Bak	7,137	4,417	4,796	4,043	31	658
Kham Ta Kla	5,247	3,091	9,693	66,427	15	1,034
Khok Si Suphan	5,955	3,869	10,099	132,985	7	5,679
Charoen Sin	4,394	2,875	10,555	65,354	22	1,178
Tao Ngoi	6,026	2,334	3,965	30,342	22	342
Nikhom Nam Un	4,416	1,287	1,669	31,727	9	622
Ban Muang	4,833	4,028	14,034	74,834	106	1,510
Phanna Nikhom	10,553	6,039	14,355	136,464	180	2,299
Phang Khon	4,809	2,762	12,299	64,326	149	1,493
Phone Na Kaew	6,943	2,394	17,965	46,956	130	2,195
Phu Phan	3,321	1,855	6,217	62,954	53	936
Wanon Niwat	13,747	10,573	31,446	162,009	216	3,477
Waritchaphum	4,454	4,177	7,421	103,731	243	1,477
Sawang Daen Din	4,839	9,505	30,789	138,933	272	3,466
Song Daow	2,555	2,376	8,533	40,162	114	632
Akat Annuai	10,332	6,719	25,097	69,495	14	3,876

Source: Statistical Reports of Changwat Sakon Nakhon, 1999 Edition, NSO

Livestocks by Amphoe in Kalasin: 1998

Unit: Heads

Province and Amphoe	Type of Livestocks					
	Cattle	Buffaloes	Duck	Chicken	Geese	Swine
Total	72,425	46,532	195,013	950,038	1,696	45,904
Muang Kalasin	7,398	1,709	11,516	89,637	66	3,116
Kamalasai	2,371	1,166	18,817	61,540	300	4,668
Kushinarai	8,062	5,436	24,241	150,594	292	6,369
Khao Wong	2,686	2,745	3,197	21,115	45	1,548
Kham Muang	9,026	3,248	9,922	58,704	10	2,005
Tha Khantho	1,876	1,478	7,210	22,499	19	696
Na Mon	3,367	1,821	7,249	24,205	18	3,260
Yang Talat	6,818	3,716	6,998	43,719	-	3,150
Rong Kham	1,911	2,180	12,705	44,470	-	1,515
Somdet	5,378	6,163	11,032	80,377	346	2,686
Sahatsakhan	4,845	2,340	12,952	79,685	66	3,225
Nong Kung Si	4,686	3,352	13,666	70,262	112	2,345
Huai Phung	2,236	1,094	3,086	51,573	52	808
Huai Mek	2,989	3,011	6,899	27,011	-	2,956
K.A. Khong Chai	956	692	11,494	24,268	54	2,718
K.A. Don Chan	1,636	1,396	8,142	28,037	148	1,153
K.A. Na Khu	4,451	3,595	7,526	46,095	59	2,252
K.A. Sam Chai	1,733	1,390	18,361	26,247	109	1,434

Source: Statistical Reports of Changwat Kalasin, 1999 Edition, NSO

Regarding production techniques of husbandry, beef cattle is feed mainly with natural grasses in the grassland or paddy field after harvesting on their own with little supplementary diet from owners. Swine breeding farms use rice bran and chips of vegetables but some of them feed blended concentrates. For chickens, most of them are local breed, while ducks are all Muscovy. Poultry's raising is mainly conducted in the area and they are fed around farmhouses and in fields.

The Department of Livestock Development (DLD) is directly responsible for livestock promotion and extension. In addition, there are other government agencies involved in livestock promotion, such as the Cooperative Promotion Department (CPD), the Dairy Farming Production Organization of Thailand and the National Security Command. Overall, the extension service in livestock is a task of the Provincial Livestock Office with the cooperation of concerned agencies, i.e. DOAE, CPD and the Livestock Extension Division of DLD.

At present, there are three livestock breeding stations in the Study Area, two stations in Sakon Nakhon and one station in Nakhon Phanom, with a total of 56 Insemination Units in the area. Furthermore, there is one Nutrition Station in each province of the Study Area, taking care of pasture, forage crop legume seed and concentrates.

For the private sector, they have a very mild involvement in large animals but significant in small animals and fowls, i.e. commercial swine farm, commercial broiler

farm and some laying hen farms. In general, swine and fowls are well undertaken by the private sector.

4.2.5 Inland Fishery

In the past, fish was caught mainly in streams, creeks, natural ponds or swamps, and for some people fishing was their livelihood. Lately, the quantity of fish in natural water sources has been gradually decreasing because of over-fishing. This may be the main reason why fish culture has been introduced into the Study Area.

Fish is obtained from two activities: fishing in natural and man-made water sources, and fish culture. The major fishing grounds in the Study Area are natural water bodies, i.e. rivers, canals and swamps. There are also many reservoirs in the large-scale, medium-scale and small-scale irrigation projects.

In 1996, fish production from aquaculture in the Study Area accounted for 7,363 tons, or 45%, of total production, while the production from fish catch produced about 9,001 tons, or 55%. Most of fish productions are consumed in the area because the supply does not yet satisfy the demand.

Fish is normally raised by means of artificial pond culture, or floating net cage culture. Cage culture is carried out generally in the main rivers or large reservoirs, such as the Mekong River, Chi River, Lam Pao River, and Lam Pao and Nam Un reservoirs. At present, fish culture by floating net cage in the Mekong River has been popularized in Mukdahan, while cage culture has been found in the Lam Pao River and reservoir, Kalasin province, with total production of nearly 251 tons in 1998.

The common freshwater fish that are being cultured in the Study Area are tilapia, Sepat Siam, local carp, catfish, snake-head and common carp; however, tilapia, which is herbivorous, is the most popular species. These fishes are mostly for household consumption and some of them are sold in the local market. Commercial scale shrimp farming has been found in Lam Pao Irrigation Project, Kalasin province, with total production of about 700 tons in 1998.

Table 4.7 presents freshwater fish production in the Study Area in 1998, by number of households engaged in the activity, number of ponds, area and number of fish catch. Total freshwater fish accounted nearly 11,000 tons and Sakon Nakhon had the highest fish production of around 5,300 tons, followed by Nakhon Phanom.

Table 4.7 Freshwater Culture Households, Number of Ponds, Area and Inland Fishery Catch in the NBR in 1998

	Pond Culture			Inland Fishery Catch (ton)
	Household No.	Pond No.	Area (rai)	
Nakhon Phanom	19,292	20,152	23,147	3,885
Mukdahan	8,581*1	8,573	15,788	943
Sakon Nakhon	7,660	9,366	11,805	5,344
Kalasin	5,682	6,892	6,965	829
Total	41,216	44,983	57,705	11,001

Source: Statistical Reports of Changwat, NSO, 1999 edition

*1 Date in 1997

Fish handling and processing facilities in the Study Area and its adjacent areas are quite adequate. There are some ice plants for preserving some high value species. Local villagers also carry out traditional fish processing, such as salting, smoking and fermenting. Among these, fermenting is the most popular in the area.

For researches and extension activities, the institutes who have conducted research on fishery are Kasetsart University, Khon Kaen University and the Department of Fisheries. Some researches have also been conducted in the fisheries stations in the Study Area. In general, a number of researches regarding inland fisheries have been conducted on both catch and agricultural fisheries.

In the past, the average fish production in the Study Area has been decreasing and this may be due to over-fishing. It is clear that to increase fish production from wild fish is difficult due to many factors, such as water pollution, fish migration and water control. Although the production from freshwater fish culture in the Study Area has been increasing every year during the last five years, the production is not enough to meet the increasing demand. Hence, future development trend should put emphasis on agriculture.

4.2.6 Agricultural Extension Services

The Department of Agricultural Extension (DOAE) has the major responsibility for extension services and transfer of technical know-how on crop production to farmers. Under the head office of the DOAE with 12 divisions and 6 regional offices, the Northeastern Regional Agricultural Extension office exists at Khon Kaen, which is responsible for coordination, transfer of technical know-how to provincial and district agricultural extension officers, and work supervision of provincial offices in the region.

The DOAE has Provincial Agricultural Extension Offices (PAEO) in every province and Amphoe Agricultural Extension Office (AAEO) in all districts throughout the country. PAEO is composed of four branches, i.e. administration, planning, Extension and Production Development, and Pest Control and Eradication. PAEO is primarily

responsible for the promotion of crop production, encouraging the formation of farmer groups, training of farmers in group units by using demonstration farms and training facilities, and also the coordination of agricultural extension and development in the province. Each PAEO has a manpower of approximately 20 persons.

Under the PAEO, Amphoe Agricultural Extension Office is responsible for extension work at field level with each office comprising approximately 10-15 workers. There are three branches in AAEO, namely, Administration, Farmer's Organization Development, and Promotion of Crop Production. Agricultural extension agents (Tambon extension worker) are assigned in each sub-district (Tambon). In general, the ratio of Tambon extension worker to farm families is about 1:1,000. The work of Tambon extension workers follows a training and visit system, in which the workers visit each village in their sub-district. The agricultural extension agents work under the supervision of the Promotion of Crop Production branch, AAEO.

The Provincial Livestock Office and Provincial Fishery Office implement extension services for livestock and fisheries respectively.

Generally, the number of extension workers and specific technical expertise at the field level are insufficient, especially in the field of horticulture. Regarding the transfer of modern technology to farmers, the education background of farmers are mostly rather low; hence, farmers will take a long time to adapt themselves to new farming technologies and new farm management concepts which are essential in future agricultural production. For improvement of extension services, at present, DOAE is undergoing some changes in agricultural extension services—from being the sole promoter of agricultural activities to providing farming alternatives to farmers based on their needs and consistent with local conditions and market demand in each area.

4.2.7 Agricultural Credit

At present, major credit institutions for farmers in the Study Area are BAAC and agricultural cooperatives. Informal lenders are also available through middlemen, relatives, moneylenders and others in the neighborhood. They provide short-term loans to farmers at high interest rates. Farmers usually use this type of loan to bridge the cash flow of their agricultural or lifestyle activities.

Among the agricultural credit financiers, BAAC plays a key role in lending money to farmers. The basic types of loan are summarized as follows:

- Short-term loans for agricultural production with repayment period of 12 months.
- Medium-term loans for investment in agricultural assets, such as purchase of farm machinery and investment for raising livestock, with repayment period of 3 years.
- Long-term loans for refinancing old debts and for investment in agriculture with repayment period of 15 years.

- Cash credit loans which are short-term credit lines and very convenient for established BAAC client farmers.

The popular agricultural credit through BAAC is short-term loans; a farm borrows 15,000 – 30,000 baht on average. The Bank lends money, not exceeding 30,000 baht, at a basic interest rate of 12% to individual clients and at a basic interest rate of 9% to farmers' organizations.

Aside from the regular lending services, BAAC also provides lending operation in line with the government's special development projects. For example, BAAC will provide a long-term loan with a low interest rate of 5% and a repayment period of 15 years to farmers in the Study Area who apply for Kor Por Lor program. This loan is incorporated in the specific development projects to promote the agricultural restructuring program. BAAC is able to provide loans at interest rates lower than the basic interest rates because the government subsidizes the difference in the interest.

In 1999, the number of BAAC branches in the 4 provinces is as follows: 4 branch offices in Nakhon Phanom, 3 branches in Mukdahan, 8 branches in Sakon Nakhon and 8 branches in Kalasin. Approximately 312,800 farm households received loans through BAAC amounting to around 4,662 million baht as shown in Table 4.8.

Table 4.8 Lending Operation, BAAC

Province	Individual Client Farmers		Agricultural Cooperatives		Farmer Associations		Total	
	No. (Families)	Disbursement 10 ⁶ baht	No. (Families)	Disbursement 10 ⁶ baht	No. (Families)	Disbursement 10 ⁶ baht	No. (Families)	Disbursement 10 ⁶ baht
Nakhon Phanom	41,684	547.9	16,262	77.4	10	-	57,956	625.3
Mukdahan	29,362	388.9	12,237	28.9	32	-	41,631	417.8
Sakon Nakhon	80,507	1,277.1	23,943	212.1	-	-	104,450	1,489.2
Kalasin	76,978	1,757.5	31,811	372.7	-	-	108,789	2,130.2
Total	228,531	3,971.4	84,253	691.1	42	-	312,826	4,662.5

Source : BAAC Annual Report, 1999

4.2.8 Farmers' Organizations

Farmers' organization is one of the important elements for the success of agricultural development. It can provide a link among farmers and also between government agencies and farmers. Furthermore, farmers' organizations will create the negotiating power of the farmers themselves for their occupational management. At present, farmers' organizations in the Study Area can be classified under several models

promoted by various government agencies. The major farmers' organizations involved in agriculture may be summarized as follows:

(1) Cooperative Systems

This is an ultimate goal of farm institutions. At present, there are six major kinds of cooperatives, namely, Agricultural Cooperatives, Land Settlement Cooperatives, Fishery Cooperatives, Consumers Cooperatives, Thrift and Credit Cooperatives, and Service Cooperatives. Among these, Agricultural Cooperatives are district level cooperatives and they are the largest kind. All kinds of cooperatives are promoted by the Cooperative Promotion Department, MOAC.

(2) Farmers' Groups

Farmers' Groups are promoted by DOAE to improve the farmers' agricultural productivity and to develop their leadership performance. In addition, DOAE is also promoting Farmers' Housewives Groups and Farmers' Groups in a specific occupation at village level, e.g., vegetable growers' group, fruit growers' group. This is to strengthen the farmers' activities and to improve their productivity in accordance with a specified product.

(3) Water Users' Organizations

Water Users' Organizations are mainly organized by RID and CPD to create better water operation and maintenance of irrigation systems. At present, Water Users' Organizations can be classified into three kinds, namely, Water Users' Groups, Water Users' Associations, and Water Users' Cooperatives. Among these, Water User's Groups are the largest kind in the RID irrigation project and DEDP pumping projects.

Taking the figures of year 1998 for Nakhon Phanom and Mukdahan and 1999 figures for Sakon Nakhon and Kalasin for illustration, Agriculture Cooperatives in the Study Area have the largest members of nearly 225,000, or 50%, of total farm households, and a far second is Farmers Groups at about 44,870 members as shown in Table 4.9.

Generally many of the existing farmers' organizations are not strong enough, due to little self-reliance, lack of capable leaders and insufficient technical and financial support. Therefore, there are very few organizations in operation that are successful.

Table 4.9 Major Farmer's Organization in the NBR

	Agricultural Cooperatives		Farmer's Group		Farmer's Housewives Group		Young Farmer's Group	
	NO.	Member	NO.	Member	No.	Member	No.	Member
Nakhon Phanom	58	55,521	97	8,003	380	9,986	210	3,950
Mukdahan	31	34,204	36	4,933	106	3,678	73	1,496
Sakon Nakhon	39	101,097	54	4,981	424	12,446	53	1,172
Kalasin	44	34,165	167	26,958	235	7,580	160	3,495
Total	172	224,987	354	44,875	1,145	33,690	496	10,113

Source: Basic Data of Nakhon Phanom and Mukdahan in 1998,
Sakon Nakhon and Kalasin in 1999,
Provincial Agricultural and Cooperatives Office

4.2.9 Agricultural Research and Experiment Stations

There are several organizations involved in agricultural research and experimental activities in Thailand. MOAC has the major role in agricultural research, but the other ministries such as the Ministry of Industry and the Ministry of Finance are dealing with sugar cane research and tobacco research respectively. Aside from the government agencies, universities, and the private sector have also conducted agricultural research. Among the government organizations, DOA, DOF, LDD, DLD and RFD are key agencies in agricultural research and experiment stations. The major types of research centers and experiment stations in the Study Area are summarized as follows:

Activity	Responsible Agency	Location
Rice Research Center	DOA	SKN
Field Crop Experiment Station	DOA	MKD, KS, SKN
Sericulture Experiment Station	DOA	MKD, SKN
Horticultural Experiment Station	DOA	NP
Freshwater Fisheries Station	DOF	MKD, NP, SKN
Livestock Breeding Station	DLD	SKN, NP
Forage Crop Stations	DLD	MKD, NP, SKN
Land Development Station	LDD	MKD, NP, SKN

Note: SKN = Sakon Nakhon KS = Kalasin
NP = Nakhon Phanom MKD = Mukdahan

In 1982, His Majesty the King initiated the establishment of Phu Phan Royal Development Study Center at Tambon Huai Yang, Amphoe Muang in Sakon Nakhon Province. This center is involved in the study and experiment on appropriate integrated agricultural development for the Northeastern Region. The center provides a complete "one-stop service" where people can actually see and learn various fields, such as agriculture and animal husbandry, soil improvement and soil erosion control, irrigation work, agricultural extension and training and cottage industry. Besides the activities at the Study Center, the extension and demonstration services of this center have been expanded to other provinces, such as Amphoe Khao Wong in Sakon

Nakhon, Nam Kam Basin Development Project in Nakhon Phanom, and Huai Bang Sai Irrigation Project in Mukdahan. For education in agriculture at the university level in the Study Area, the new campus of Kasetsart University has been established at Tambon Chieng Krue, Amphoe Muang in Sakon Nakhon, which began to conduct activities at the new campus in 2000. At present, there are three faculties: Natural Resources and Agro-Industry, Science and Engineering and Liberal Art and Management Technology. In general, it is clearly seen that Sakon Nakhon has more agricultural research work and experiments than the other provinces in the Study Area.

4.2.10 Rubber Plantation

Rubber has long been one of Thailand's economic crops. At present about 12 million rai are covered by rubber plantation in the country, most of which are in 14 southern provinces. However, the planted areas have been gradually concentrated in five provinces in the east and 17 provinces in the northeast, while the total area is maintained at 12 million rai.

Interest in rubber planting in the northeast has been occurring for the past 20 years. Rubber Research Institute of the Department of Agriculture discovered eight rubber trees of an old variety planted by a farmer in Nakhom Khamsoi district, Mukdahan province, and they could produce latex from these trees. From this point the Institute came up with an idea that rubber may have been grown productively in northeastern provinces, especially those near Mekong River. It then started up studies and experiments in rubber planting in the region in 1978 (Rubber Planting Observation in Northeastern Thailand) in Nongkhai, Buriram and Surin provinces. The experiments revealed that after the rubber tree had reached an age of 6.5 years, its growth rate became slower than the tree planted in the south. However, growth rate in rainy season of the trees in both regions was not much different. The variety that gave the highest growth was Tjir 1, followed by PE 28 / 59 and RRM 600.

In 1992 the European Community (EC) gave aid to Thailand under the Cassava Production Reduction Project with Rubber Development in the Northeast Pilot Project in land reform areas in six provinces. Under this project 24,750 rai were planted.

The distribution per province is given below:

Nongkhai	13,300	rai
Udon Thani	5,000	rai
Nong Bua Lampoo	2,200	rai
Nakhon Phanom	2,000	rai
Sakon Nakhon	1,125	rai
Loei	1,125	rai

The duration of the above mentioned project is 8.5 years between May 1992 and December 2000. The main purpose is to test the feasibility of producing rubber with appropriate management in the northeast. If this pilot project showed a good

possibility, implementation would be expanded in larger areas. Activities of the pilot project include farmer training, rubber planting, planted area inspection, rubber farmer groups establishment and rubber marketing system development. The main executing agencies are ALRO, DOA, DOAE, BAAC, and Office of Rubber Plantation Aid Fund. ALRO is the administrative agency responsible for providing planting areas and project farmers.

Nowadays rubber is grown in all 19 provinces of the northeast. From statistics of the Rubber Research Institute in 1998, there were 348,082 rai planted to rubber in the northeast; Nongkhai had the largest area with a share of 24%, followed by Burirum (12%) and Udon Thani (8.50%). For the four provinces in the Study Area, Sakon Nakhon and Nakhon Phanom have 18,534 and 17,735 rai and ranked 7 and 8, respectively. Kalasin and Mukdahan have 14,659 and 14,147 rai and ranked 9 and 11, respectively.

The Agricultural Census of 1993 revealed that high yield clone was mostly used in the planted area of the four provinces in the Study Area. Farm holdings of majority of rubber growers in those provinces ranged from 10 to 59 rai, with those having 10-19 rai accounting for 12%-20%, 20-39 rai, for 40%-43% and 40-59 rai, for 19%-22%.

Total planted area, yielded and un-yielded area production and yield of latex of each province in the Study Area are presented below.

Table 4.10 Planted Area, Production and Yield of Para Rubber in the Study Area, 1997

Province	Planted Area (rai)			Production (Ton)	Yield (kg/rai)
	Yield area	Un-yielded area	Total		
Nakhon Phanom ^{1/}	782	20,581	21,363	206	263
Mukdahan	573	8,330	8,903	184	322
Sakon Nakhon	6,072	17,763	23,835	1,973	325
Kalasin	738	12,414	13,152	178	240
Study Area	8,165	59,088	67,253	2,541	311

Source: Statistical Reports of Nakhon Phanom, Mukdahan, Sakon Nakhon and Kalasin, NSO

^{1/} : 1998 data

To have the country rubber development with a clear direction, the Natural Rubber Policy Committee has established a strategy of rubber development with a complete circle within a five year period (1999-2003) that stipulates strategies and measures for production, rubber latex industry, rubber wood industry, rubber marketing, and rubber enterprise management.

In the production channel there is an important measure to limit the country's total planted area within 12 million rai. The criteria are that the new expanded area be equal to the reduced area in the old plantation, and that the low productive area of 300,000 rai be substituted by oil palm with aid from the government sector.

4.2.11 Fruit Trees

In the four provinces in the Study Area, there are several kinds of fruits. Among the varieties are mango, longan tamarind, banana, lychee, pomelo and jackfruit.

Table 4.11 presents fruit production in the Study Area in crop year 1997/98. From the table it is apparent that mango, banana, tamarind, longan, jackfruit, guava, papaya and pomelo are mostly grown. In the Study Area, the two important varieties of banana are Kluay Nam Wa and Kluay Hom. The most common variety is Kluay Nam Wa.

Mango, one of the most popular and common fruits in the area, is widely grown and it can grow in many types of soils. The Kaew variety is mainly prepared as mango preserves, while some other popular varieties such as Kaew Saway, Nam Dawk Mai and Okrong are eaten fresh.

The provinces having the highest number of fruit varieties is Nakhon Phanom, followed by Sakon Nakhon. Orchard cultivation was practiced in Nakhon Phanom a long time ago. At present, rambutan is only grown in Nakhon Phanom occupying about 40 rai. Lychee is grown in two provinces, Nakhon Phanom and Sakon Nakhon, but Nakhon Phanom is the largest lychee producer in the area. For longan production, Sakon Nakhon occupied the largest planted area with 5,337 rai; second is Nakhon Phanom.

In conclusion, there is a clear increasing tendency in the Study Area of areas planted to major fruits, such as mango, tamarind, banana and longan. According to the results of 1993 agricultural census, the planted area of mango, tamarind, banana and longan accounted for 27,347 rai, 15,565 rai, 6,951 rai and 1,009 rai respectively. In 1997, the Study Area had 106,691 rai, 52,686 rai, 44,182 rai and 9,252 rai of mango, tamarind, banana and longan respectively.

Table 4.11 Harvested Area of Major Fruits Trees, Production and Yield in the NBR

Province	Nakhon Phanom (1998/99)					Mukdahan (1997/98)				
	Yielded Area (rai)	Unyielded Area (rai)	Total Area (rai)	Production (Ton)	Yield (kg/rai)	Yielded Area (rai)	Unyielded Area (rai)	Total Area (rai)	Production (Ton)	Yield (kg/rai)
Banana	12,068	1,478	13,546	47,439	3,931	5,941	2,462	8,403	10,359	1,744
Sweet Banana	880	379	1,259	4,105	4,665	-	-	-	-	-
Sugar Apple	358	744	1,102	202	564	-	-	-	-	-
Tamarind	5,323	5,054	10,377	2,888	543	7,896	12,902	20,798	4,913	622
Common Lime	582	899	1,481	39	67	21	122	143	2.42	115
Coconut	3,485	1,749	5,234	5,522	1,585	573	8,330	8,903	184	321
Mango	11,464	6,314	17,778	7,993	697	9,395	14,995	24,390	5,310	565
Cashew Nut	639	139	778	77	121	670	115	785	71	106
Papaya	1,290	624	1,914	2,339	1,813	568	415	983	1,618	2,849
Longan	276	2,935	3,211	12	43	-	-	-	-	-
Pomelo	6	4,156	4,162	5	833	-	-	-	-	-
Jack Fruit	-	-	-	-	-	498	785	1,283	8,867	17,805
Rambutan	12	27	39	6	500	-	-	-	-	-
Durian	-	10	10	-	-	-	-	-	-	-
Gandana	50	3	53	82	1,640	-	-	-	-	-
Sapodilla	146	508	654	99	678	-	-	-	-	-
Lychee	287	354	641	46	160	-	-	-	-	-
Guava	197	276	473	187	949	-	-	-	-	-
Tangerine	-	43	43	-	-	-	-	-	-	-
Grape	-	15	15	-	-	-	-	-	-	-

Province	Sakon Nakhon (1997/98)					Kalasin (1997/98)				
	Yielded Area (rai)	Unyielded Area (rai)	Total Area (rai)	Production (Ton)	Yield (kg/rai)	Yielded Area (rai)	Unyielded Area (rai)	Total Area (rai)	Production (Ton)	Yield (kg/rai)
Banana	5,349	1,931	7,280	8,746	1,635	14,301	652	14,953	27,137	1,898
Sweet Banana	1,563	178	1,741	3,750	2,399	-	-	-	-	-
Sugar Apple	3,231	1,662	4,893	2,016	624	4,111	842	4,953	2,456	597
Tamarind	9,421	6,821	16,242	4,597	488	3,212	2,057	5,269	1,152	359
Common Lime	1,317	1,521	2,838	487	370	1,883	696	2,579	436	232
Coconut	2,647	1,482	4,129	2,538	959	4,403	2,988	7,391	4,408	1,001
Mango	24,495	13,415	37,910	18,420	752	16,729	9,884	26,613	7,120	426
Cashew Nut	-	-	-	-	-	214	-	214	43	201
Papaya	1,759	1,375	3,134	3,958	2,250	3,382	462	3,844	6,370	1,884
Longan	851	4,486	5,337	407	478	76	628	704	63	829
Pomelo	168	673	841	122	726	63	201	264	22	349
Jack Fruit	1,054	1,108	2,162	2,817	2,673	2,284	2,388	4,672	7,008	3,068
Rambutan	-	-	-	-	-	-	-	-	-	-
Durian	-	-	-	-	-	-	-	-	-	-
Gandana	150	99	249	75	500	-	-	-	-	-
Sapodilla	57	477	534	24	421	193	371	564	69	358
Lychee	70	224	294	40	571	-	-	-	-	-
Guava	73	180	253	139	1,904	161	27	188	55	342
Tangerine	-	-	-	-	-	-	-	-	-	-
Grape	-	-	-	-	-	-	-	-	-	-

Source: Statistical Reports of Changwat Nakhon Phanom, Mukdahan, Sakon Nakhon and Kalasin; NSO. 1998 and 1999 Edition.

A number of researches and extension activities regarding orchard cultivation have been conducted in Phu Phan Royal Development Center, Sakon Nakhon and Horticulture Experiment Station, Nakhon Phanom province. According to the results of study, the trials revealed that some new high value fruits such as mangosteen and rambutan can be grown at Phu Phan Royal Development Center and Nakhon Phanom Horticultural Experiment Station.

4.3 Irrigation Development

4.3.1 General Background

In general, there are considerable fluctuations in wet season rice yields because the rainfall pattern is very variable. Irrigation development can be used as an important measure to improve this situation by supplementary irrigation in the wet season and some dry season irrigation.

RID has been developing a large gravity irrigation project in the Northeastern Region since 1939. Storage reservoirs are essential to irrigation development in the Northeast because of the region's variable rainfall and long dry season. In the past irrigation investments have been dominated by large-scale projects. Today medium- and small-scale projects account for the majority of construction budget on new projects.

According to RID, irrigation projects are classified into three categories by size, namely, Large-scale Irrigation Project (LSIP), Medium-scale Irrigation Project (MSIP) and Small-scale Irrigation Project (SSIP). The project classification may be summarized below.

- a) Large-scale Irrigation Project

Storage Capacity	>	100 MCM
Reservoir Surface	>	15 km ²
Irrigation Area	>	80,000 rai
Construction Period	>	5 years

- b) Medium-scale Irrigation Project

Storage Capacity	10-100 MCM
Construction Period	1-5 years

- c) Small-scale Irrigation Project (SSIP)

Construction Period	>	1 year
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At present, there are many government agencies involved in irrigation development, but only three agencies, namely, EGAT, RID and DEDP are directly involved in construction of large- and medium-scale projects. For small irrigation projects, there are 16 government agencies involved in construction of this type of project. RID is responsible for design, construction, operation and maintenance of all large- and medium-scale projects which include main and secondary canal systems. For operation and maintenance of tertiary systems or on-farm works, these are normally undertaken by the water users.

Development of small-scale irrigation project (SSI) in the Northeast started in 1976. The project type of SSIP can vary from a small excavated pond to a sizeable weir and small reservoir. Farm pond is the another form of small-scale project, which provides water for agricultural use at the farm level.

The basic concept of SSIPs is that they are built upon the request of farmers and transferred to local communities after completion of the project. Furthermore, farmers themselves carry out operation and maintenance of facilities. In the past, the major purposes of SSIP were to solve or lessen the difficulty of the villagers in remote rural areas in terms of water use for year-round domestic water use, and to secure irrigation water for at least one crop in the rainy season. In recent years, the Government has promoted farm pond development in the rain-fed area for water resource development at the farm level throughout the country.

Pumping irrigation schemes have been developed along the main river in the Northeast by DEDP since 1965. Typically a pumping irrigation project consists of an electrically operated pump with concrete-lined main canal systems serving an area about 3,000 rai per unit. However, RID also has pumping irrigation schemes which are mobile and diesel driven for supplementary irrigation during drought period.

4.3.2 Irrigation in the Study Area

Existing irrigation projects in the Study Area by province are summarized in Table 4.12. As shown in this table, the irrigation ratio is approximately 17%. Kalasin occupied the highest ratio of 20.28%, followed by Sakon Nakhon, 17.94%, and the smallest ratio belongs to Mukdahan. There are two large-scale projects in Sakon Nakhon, namely, Nam Un Project with storage capacity of 520 MCM and the irrigable area of 185,800 rai, and Nam Phung Dam by EGAT with storage capacity of around 165 MCM for hydropower generation. In Kalasin, there is also one large-scale irrigation project, Lam Pao, with total irrigable area of 314,300 rai and storage capacity of 1,430 MCM.

Table 4.12 Irrigation Projects in the NBR

	Farm Land (1000 rai)	RID Large and Medium Scale Project			RID Small Scale Project			DEDP Pumping Project		Total Irrigation Area (Rai)	Irrigation Ratio (%)
		NO.	Capacity (MCM)	Area (rai)	NO.	Capacity (MCM)	Area (rai)	NO.	Area (rai)		
Nakhon Phanom	1,568.1	24	57.75	49,173	126	25.58	50,548	74	105,660	205,381	13.10
Mukdahan	891.1	14	79.86	37,368	88	14.65	30,025	30	37,930	105,323	12.86
Sakon Nakhon	2,964.4	30	725.53	328,000	168	74.41	162,438	34	41,430	531,868	17.94
Kalasin	2,462.6	19	1,543.93	387,100	185	14.18	58,598	41	53,790	499,488	20.28
Total	7,814.2	87	2,407.07	801,641	567	128.82	301,609	179	238,810	1,342,060	17.17

Remark: *1 1995 Farm Land from Agricultural Statistics of Thailand

Source: 1. Provincial Irrigation Office, NP, MKD, SKN and KS
2. Provincial Agricultural and Cooperatives Office, NP, MKD, SKN and KS

At present the total irrigable area of large-scale projects serve about 37% of the irrigated area in the Study Area, while the irrigated area under the medium-scale projects is 301,541 rai, or 22%, and the irrigated area of small-scale projects is also approximately 22%.

Two large-scale irrigation projects, Nam Un and Lam Pao, comprise a storage dam and associated gravity irrigation systems served by a main canal, a secondary canal and a tertiary canal or on-farm works. For medium-scale projects, most of them are supplied by storage reservoirs but a few are run-off-river projects.

Aside from the RID irrigation projects, DEDP carried out electric pumping irrigation projects along the perennial rivers, such as the Mekong River, Chi River, Lam Pao River etc. Among the four provinces in the Study Area, Nakhon Phanom has the highest irrigable area under DEDP pumping irrigation projects with nearly 106,000 rai, or about 51%, of total irrigation area in the province, followed by Kalasin at 43,790 rai. While the least pumping irrigation area is in Mukdahan.

For agro-industry development, large-scale irrigation projects play a key role of raw material suppliers. The Nam Un Irrigation Project has been promoting agricultural produce in the dry season as raw material to feed agro-industry for a long time now. Table 4.13 shows a summary of planted area, number of farmers and investors for agro-industry in Nam Un irrigation project, crop year 1987/88 – 1998/99 and Table 4.14 shows the dry season crops in the Lam Pao Irrigation Project, crop year 1987 – 2000.

Table 4.13 Summary of Planted Area, Number of Farmers and Investors for Agro-Industry in Nam Un Irrigation Project

Unit: rai

Crop Year	No. of Investor	No. of Farmer	Planted Area (rai)				Value (Million Baht)
			Seed	Processing	Fresh	Total	
1987/88	9	1,256	891	118	89	1,098	11.93
1988/89	8	3,269	2,504	363	1,571	4,438	52.12
1989/90	11	6,065	4,883	1,694	545	7,122	63.34
1990/91	9	7,302	4,650	3,599	62	8,311	136.27
1991/92	8	5,374	3,949	2,853	940	7,742	116.83
1992/93	8	6,500	5,104	1,269	571	6,944	184.08
1993/94	10	3,472	1,953	2,365	86	4,404	91.80
1994/95	11	3,337	1,552	3,513	24	5,089	86.18
1995/96	10	3,394	2,274	7,306	6	9,586	156.68
1996/97	11	2,050	1,993	2,127	-	4,120	84.24
1997/98	9	2,500	2,484	1,782	-	4,266	117.47
1998/99	10	4,830	3,251	4,389	-	7,640	228.67

Source: Nam Un Irrigation Project

Table 4.14 Dry Season Crops in lam Pao Irrigation Project

Unit: rai

Year	Second Rice	Field Crop	Vegetable	Fish/Shrimp Pond	Total	% of Project Area
1987	1,077	17,683	2,275	2,095	23,130	7.36
1988	15,827	22,726	5,097	3,200	46,850	14.91
1989	43,497	34,589	3,654	2,791	84,531	26.90
1990	108,007	29,513	4,138	2,094	143,752	45.74
1991	91,735	25,356	3,668	2,054	122,813	39.08
1992	113,940	20,199	3,439	1,081	138,659	44.12
1993	132,795	17,083	2,557	1,943	154,378	49.12
1994	209	2,552	488	170	3,419	1.09
1995	65,597	14,278	2,525	2,675	85,075	27.07
1996	107,194	14,101	3,198	3,952	128,445	40.87
1997	108,666	8,922	2,177	4,728	124,493	39.61
1998	159,355	7,057	2,120	4,478	173,010	55.05
1999	2,055	2,863	1,284	2,151	8,353	2.66
2000	157,543	8,135	2,042	4,658	172,378	54.85

Source: O&M Section, Lam Pao Irrigation Project

Note: Project Area = 314,300 rai

In regard to dry season crops in irrigation project, the acreage of dry season crops is based on available water in the reservoir at the end of wet season and water allocation policy. MOAC and RID estimates water budget for all purposes and the target of dry season crop is set in accordance with available water. The planted area and target of dry season crops in the Study Area, crop year 1999/2000 is shown in Table 4.15.

In the past, large investments have been spent for the development of irrigation and drainage systems with on-farm development works in the Study Area. However, those developments are not yet sufficient to satisfy needs of villagers.

Table 4.16 presents major on-going, medium-scale irrigation projects in the Study Area. There are 4 on-going projects in Sakon Nakhon, 2 projects in Nakhon Phanom and 1 project in Kalasin. The total benefit area of these on-going projects is approximately 97,020 rai. However, the construction of distribution system of Nam Kam Basin development project is not yet included in the implementation schedule.

**Table 4.15 Planted Area and Target of Dry Season Crops in the NBR
(Nov. 1, 1999 – Apr. 30, 2000)**

Province	Second Rice			Field Crop			Vegetable			Total of Dry Season Crop	Target	% of Variation	
	RID	DEDP	Others	RID	DEDP	Others	RID	DEDP	Others				
													Total
Nakhon Phanom	-	1,222	24,941	2,529	2,192	19,776	24,497	134	2,523	22,292	24,949	87,300	-13.4
Mukdahan	-	188	-	1,817	2,230	7,905	11,952	751	1,069	2,969	4,789	17,600	-3.8
Sakon Nakhon	4,398	538	9,434	9,262	1,300	7,410	17,972	3,830	2,325	30,050	36,205	65,200	5.1
Kalasin	158,855	4,000	-	10,870	1,881	10,900	23,651	2,203	523	7,758	10,484	149,400	31.9
Study Area	163,253	5,948	34,375	24,478	7,603	45,991	78,072	6,918	6,440	63,069	76,427	319,500	12.1

Source: Progress Report on Dry Season Crops by Province
(as of Nov. 1, 1999 to Apr. 30, 2000), DOAE

Table 4.16 On-going Medium Scale Irrigation Projects

Name of Project	Huai Pla Hang River basin Development	Huai Hin Cha Nan Yai Reservoir	Lam Pa Yang (Upper) River basin Development	Huai Ka Chur Reservoir	Nam Kam Basin Development		
					Ban Nong Bung Diversion Gate	Ban Na Kham Diversion Gate	Ban Na Ku Diversion Gate
1. Location : Latitude Longitude Amphoe Province	17° 15' 00" N 103° 34' 35" E Varichaphum Sakon Nakhon	48 QVE 375 - 216 5243 I Kusuman Sakon Nakhon	48 QVD 230 - 418 5842 IV Khao Wong Kalasin	17 04' 44" N 103 43' 54" E Kud Bak Sakon Nakhon	391794 5842 I Na Kae Nakhon Phanom	48 QVD 498750 5942 IV Na Kae Nakhon Phanom	
2. Water Source	Huai Pla Hang	Huai Hin Cha Nan Yai	Lam Pa Yang	Huai Ka Chur	Nam Kam	Nam Kam	
3. Project Description	2 Diversion Structures 3 Weirs	Earth Dam	Earth Dam Pipe line system	Zone Type Dam	Diversion Gate	Diversion Gate	Water distribution system Water distribution system
4. Implementation Schedule							
Start Year	1997	1997	1994	1996	1995 ↓ 1997	1996 ↓ 1998	
Complete Year	2000	2000	2001	2000	2000	1997	
5. Implementing Agency	RID	RID	RID	RID	RID	RID	
6. Type of Project	Flood Protection Irrigation	Irrigation	Irrigation Flood Protection	Irrigation	Pumping Irrigation Flood Protection	Pumping Irrigation Flood Protection	Pumping Irrigation Flood Protection
7. Benefit area (Rai)	10,000	5,300	14,600	16,500	14,100	25,510	
8. Storage Capacity (MCM)	53.6	4.6	3.5	10.2	3.1	8.75	
9. Project cost (Million Baht)		88		200	350	203.54	

Source : RID, Regional office No. 5

↓ Not include distribution systems

4.4 Agricultural Development Plan

4.4.1 Development Opportunities and Constraints

The NBR Study Area consists of the provinces of Nakhon Phanom, Mukdahan, Sakon Nakhon and Kalasin, which will hold the East-West Transport Corridor of the GMS. Therefore, some items of development opportunities and constraints in agricultural development will concern other Indochina countries. The major items that should be considered in examining planning directions can be outlined as follows:

(1) Opportunities

Indochina East-West Corridor and 2nd Mekong International Bridge

The Mekong sub-regional economic cooperation will result in expanding various sorts of development potentials. Efficient and stable linkages with other Indochina countries and domestic regions, which are secured by the Indochina East-West Corridor and the AFTA trade agreement, create more opportunities to produce higher value-added agricultural products through efficient marketing and processing.

Demands for Food Variety

Modernization and westernization of people's life style as well as economic growth likely change people's dietary habits. This greatly affects a demand pattern of agricultural commodities, for instance, demand for carbohydrate, will be less, while that for protein and vegetables will be more. In addition, people's food preference will be more varied, resulting in varying demands on agricultural commodities. The agricultural sector will be transformed to produce various kinds of products. This situation provides a great opportunity to diversify agriculture.

Raw Material Suppliers for Agro-Industry

The Study Area has a potential area for producing raw materials for agro-industry, such as sugar cane, cassava, para rubber, corn, tomatoes and vegetables. Furthermore, it can expand production base into Lao PDR, a neighboring country, for procurement of raw materials to continuously feed the agro-industry.

Water Resources Development

Four provinces in the Study Area have high potential for water resources management and development. There are many perennial rivers such as the Mekong River, Chi River, Lam Pao River, Lam Nam Un River, Nam Song Khram River, Nam Khum River, and the average annual rainfall in the Study Area is higher

region. Apart from the rivers, there are also three large-scale reservoirs, Lam Pao, Nam Un and Nam Phung, and the largest natural swamp in the Northeastern Region, Nong Han in Sakon Nakhon. Therefore, there is more potential of additional water resources development for agriculture and fish culture.

(2) Constraints

Table 4.17 Major Development Constraints and Planning Considerations

Constraints	Planning Considerations
1. Marketing	
1.1 Declining price of traditional commodity crops such as rice, cassava, sugar cane etc.	<ul style="list-style-type: none"> a) Restructuring agricultural production in line with domestic market and world market demand. b) Promote agro-industry based on the agricultural products of diversified cropping and integrated farming.
1.2 Insufficient updates on market information especially at village level	<ul style="list-style-type: none"> a) Formulate a system to inform farmers of present demand and prices of agricultural products. b) Establish a systematic and effective collaboration among the relevant government agencies.
1.3 Limited market outlets and little bargaining power of farmers	<ul style="list-style-type: none"> a) Promote an effective marketing channel between farmers and traders or government agencies, such as BAAC and the Marketing Organization for Farmers. b) Provide supporting services for marketing facilities, such as collecting and loading warehouses, marketing centers, searching for new markets, facilitating border trade and exporters.
1.4 Insufficient quality control	<ul style="list-style-type: none"> a) Provide supporting services for post-harvest facilities, such as selecting and grading, drying machines, etc.
2. Natural Constraints	
2.1 Soils are infertile	<ul style="list-style-type: none"> a) Applications of green manure techniques, organic compost and crop diversification. b) Introduce soil conservation techniques on sloping sandy soils.
2.2 Rainfall is poorly distributed seasonally and rapid runoff in the wet season result in insufficient water sources in dry season.	<ul style="list-style-type: none"> a) Storage dam construction in high potential water resources area and farm pond development on rain-fed agricultural land should be considered. b) Efficient use of water resources for agriculture and improvement of irrigation efficiency.
3. Agricultural Supporting Services	
3.1 There is insufficient agricultural extension services in terms of quantity and quality of farm products	<ul style="list-style-type: none"> a) Disseminate relevant knowledge about integrated farming covering crops, fishery, livestock and updated marketing information through selective media. b) Establish a technology transfer center at Tambon level and provide periodic visits by extension agents. c) Encourage and assist the farmers to formulate annual and seasonal farm plans and farm accounts.
3.2 Inadequate training services for farmers and trainers to increase their ability.	<ul style="list-style-type: none"> a) Provide training courses to farmers in various fields to increase their farming ability and encourage the private sector to take part in formulating training courses. b) Expand both formal and informal training courses.

Constraints	Planning Considerations
3.3 Inadequate agricultural credit at low interest rates.	<ul style="list-style-type: none"> a) Increase the lending capacity of BAAC and agricultural cooperatives to cope with future development project requirements. b) Encourage private financial institutions to arrange various credits with appropriate interest rates to help farmers. c) Easy access to agricultural credit should also be considered. d) Encourage development of the management of all types of village revolving fund for optimum use.
4. Farmers' Organizations	
4.1 There are very few successful farmers' organizations due to lack of leaders with proper management capabilities and experience in business and marketing activities.	<ul style="list-style-type: none"> a) Promote training and development of administration and management capabilities of leaders of farmers' organizations. b) Promote systematic and effective collaboration between various relevant local organizations at the village level. c) Encourage the private sector to participate in farmers' organization development.
4.2 Inadequate government budget or community funds to support farmers' organizations.	a) Establishment of community funds and low interest rate agricultural credit to support the activities of farmers' organizations.
4.3 Lack of appropriate laws and regulations.	a) Amendment of relevant laws and regulations to facilitate the operation of farmers' organizations.
5. Agro-processing Industry	
5.1 Instability and lower quality of raw materials	<ul style="list-style-type: none"> a) Encourage the private sector to assist farmers by providing necessary farm input, technology, information service and marketing under contract farming system. b) Provide intensive extension services for agro-processing crops especially for production efficiency and improvement of product quality. c) Encourage production base expansion into neighboring countries for procurement of raw materials. d) Promote agricultural zones for production of raw materials.
5.2 Inadequacy of know-how on producing new varieties of crop for the processing industry	<ul style="list-style-type: none"> a) Provide relevant training courses to farmers involved in agro-industry. b) Encourage the private sector to play a greater role in technology transfer. c) Formulate intensive consultation and disseminate knowledge about new varieties of crop for agro-industry.
5.3 Immature contract farming management	<ul style="list-style-type: none"> a) Establish coordinating committee to deal with policy planning, coordination and supervision among the relevant parties, i.e., public sector investors, and farmers. b) Promote development of administration and management in contract farming system for farmers. c) Consider laws or regulations concerning contract farming.

4.4.2 Objectives

The objectives for agricultural development in the NBR Study will conform to the Regional Development Master Plan with linkage to the cross border region of Lao

PDR across the Mekong River. By this, the main objectives of the agricultural development related to the Study will be as follows:

- To increase production efficiency, improve the quality of produce to satisfy market demand and develop a linked agro-industry;
- To conserve natural resources through sustainable agriculture; and
- To develop and strengthen farmers' capability and farmers' organizations for diversification to more appropriate farming systems.

4.4.3 Strategies

To accomplish the development objectives, the major strategies will be as follows:

- Improve marketing of agricultural produce through crop diversification in line with market demand and quality control, and provide various types of market outlets and supporting services for marketing facilities.
- Increase farmers' capability and opportunity for development of integrated agricultural production through diversification to more appropriate farming systems, e.g., crop diversification, integrated farming, and agro-forestry.
- Enhance productivity in agro-industry by encouraging the acquisition and transfer of know-how on high-yielding plant varieties, high quality animal stock, and quality improvement of raw materials, and ensure stability.
- Emphasize proper development and management of natural resources, forest, land and water to serve as agricultural production base. Water resources development should be implemented on the basis of the river basin approach and farmer participation in all stages of implementation.
- Promote all necessary agricultural supporting services and technical know-how for diversification to appropriate farming systems and marketing improvement.

4.4.4 Development Plan

(1) Agricultural Marketing Development, via the Following:

- Formulate systematic and effective measures for provision of updated market information involving price, quantity, quality and characteristics of each produce needed in the market to farmers or farmers' organizations.
- Develop marketing outlets or channels in all forms, such as central market, wholesale marketing center, collecting and loading warehouse, and forward market of specific commodities.
- Promote contract farming and joint investment in agro-industry between farmers' group and entrepreneurs in agri-businesses, together with provision of more opportunity to farmers for negotiating with investors.

- Amendment of relevant laws and regulations to facilitate border trade businesses and exporters.

(2) Development of Diversification Production Structure from Mono- cropping System to Crop Diversification or Integrated Farming System.

At present, the diversification production structure from primary agricultural produce to higher value-added products in line with the local conditions, farmers' needs and market demand together with processing for agro-industry is the main policy of the MOAC. Restructuring of agricultural production is a means of increasing and promoting the stability of farm incomes. It can be achieved through crop diversification program in irrigation areas and integrated farming system in the rain-fed areas. Nowadays, integrated farming, including the new theory initiated by His Majesty, the King, is the most popular practice of sustainable agriculture. In restructuring agricultural production, farmers should have greater flexibility in shifting from mono-cropping system to other appropriate farming systems and then final decision would come from farmer themselves with active information and technical support from the relevant agencies. In order to achieve a successful diversification production structure for agriculture, the necessary measures are summarized as follows:

- Encouraging farmers to switch to crop diversification or integrated farming and all of basic infrastructure, i.e., irrigation systems down to the farm level, and road networks, must be adequately provided.
- For high-potential irrigated areas, stipulating large-scale specific agricultural areas with emphasis on more diversified production that connect to domestic and/or international market and modern agro-processing industries of important agricultural commodities. In order to achieve the above mentioned objective, the government should provide an opportunity to foreign investors or private-sector participation in market-oriented problem goods, and all of necessary supporting services to both farmers and entrepreneurs.
- For small farm holdings in rain-fed areas, integrated agriculture or mixed farming is highly recommended, consisting of mixed crop growing, fishery activity, and livestock raising, as well as the new theory of integrated agriculture initiated by His Majesty. In the system each activity will essentially support one another.
- Providing active information, extension services and training including appropriate technology on alternative agriculture activities.
- Subsidizing farmers with low interest loans and providing assistance in marketing to farmers that adopt the production-restructuring program.

Finally, an area of sustainable agriculture by agricultural restructuring in the direction of organic and integrated farming should be expanded.

(3) Increasing Production Efficiency and Reducing Production Cost through the Following:

- Promote inter-disciplinary research and appropriate technology development emphasizing new plant varieties, post harvesting technology, animal stock, new aquatic species which are suitable for the locality, market demand and farmer benefit.
- Accelerate plan for efficient use of chemical fertilizer and chemical compound through the combined use of organic and chemical fertilizer as well as natural pest control method.
- Support the expansion of necessary agricultural inputs for agricultural restructuring by promoting high quality of plant seedlings, animal stock and stock of aquatic species.
- Study on the feasibility of using Lao PDR, a neighboring country, as production base for raw materials of agro-processing industries.
- Expand irrigated areas with on-farm development works and better water management.

(4) Quality Improvement and Agro-processing Development via the Following:

- Promote research and development for quality control and setting quality standards, particularly agricultural production for exporting and agro-processing.
- Establish industrial product standards and health standards, especially level of chemical residues for agricultural products in line with international standards.
- Encourage and support the private sector and farmers' organizations to play a vital role in post-harvest activities, controlling quality and standard of agricultural products and their processed products to meet international standards.
- Upgrade the capabilities of farmers in quality improvement by providing training and technology transfer to farmers for new commodities, with emphasis on inspection, grading, testing mechanism and packing.

(5) Accelerate Water Resources Development and Management to Enhance Crop Diversification or Integrated Farming System, via the Following:

- Improve or rehabilitate existing irrigation projects of various scales, particularly large- and medium-scale irrigation projects under the RID and DEDP pumping irrigation project, to achieve their full benefit and to better manage and maintain project facilities.
- Develop water sources and irrigation systems of various scales, even down to the

farm level, in compliance with surface water resources potential and agricultural development plan. While the area is scarce in surface water resources, a small water storage or farm pond should be developed based on the new theory of integrated agriculture initiated by His Majesty.

- Groundwater should be developed at the micro scale, such as micro irrigation system by shallow wells, within their safe yield.
- Encourage a water users' organization to take charge of water management and maintenance of projects particularly at the farm level, with more efficient use of water and appropriate irrigation practices.
- Develop water demand and pricing system for irrigation water and encourage replacement of dry season paddy with high-value and low-water-requirement crops.

(6) Improve the Capabilities of Farmers' Organizations under Agricultural Diversification to Favor Higher Value Crops and Agro-processing, as Follows:

- Encourage farmers to adopt integrated farming or sustainable farming practices and provide farming alternatives according to their needs and consistent with local conditions and market demand in each area.
- Provide necessary production inputs to facilitate agricultural restructuring, such as certified seeds, livestock breeds, fingerlings, and long-term soft loans at a reasonable rate of interest.
- Promote training and development of administration and management capability for members and leaders of farmers' organizations by organizing training courses in production know-how, marketing, managerial skills, business and general administration.
- Strengthen existing farmers' groups and promote the establishment of farmers' groups under the same specific productions, i.e. sugar cane growing, vegetable plantation, cattle, poultry raising, etc. Furthermore, encouraging women's groups and youth groups to play more roles in agricultural development.
- Encourage the private sector to support and participate in building the capacity of farmers' organizations.

(7) Livestock Development

According to the Statistic Division, FAO, 1996, per capita annual meat and offal consumption between 1982-84 and 1992-94 in Thailand increased from 18.7 kg to 22.1 kg, respectively. Generally, the number of buffaloes decreased rapidly and population of cattle has been fluctuating also. Therefore, a comprehensive plan for

livestock development in the Study Area should be carried out with emphasis on meat, milk and other products. The key issues for livestock development are as follows:

- Improve forage and grassland management and make full use of cassava fields as grassland or forage field for providing high quality feed to cattle and buffaloes.
- Foster training and transfer of dairy technology to dairy farm members through the dairy cooperatives.
- Promote cattle farming and high-quality calves raising.
- Establish a technical cooperation among the neighboring countries on animal disease control, diagnostic techniques and animal movement control.
- Develop a mechanism for trade in livestock across the border, with effective animal disease control.

(8) Improving Natural Resources Management Related to Agricultural Development.

In order to conserve natural resources to serve as basis for sustainable agricultural production, with increasing production, and to minimize negative environmental impact, emphasis should be placed on the following key issues:

- Develop potential of irrigated areas for an efficient agricultural production including prevention of deterioration of land as a result of improper land use, farming practice and irrigation practices.
- Encourage farmers to use organic fertilizer with chemical fertilizer to preserve soil condition and application of pesticides will be integrated into natural control method.
- Promote sustainable and ecologically sound farming systems together with soil, water and forest conservation programs, through conservation farming, soil and water management and structural measures approach.
- Develop and support program for conservation of farmland adjacent to forest reserved area by provision of more opportunities for villagers of these zones to participate actively in the forest conservation activities and adopt conservation farming and agro-forestry with native species.
- Promote water quality control especially in farmland and prevent the spread of pollution, which affects the quality of natural water resources.

(9) Post-Harvest Handling Development

The major crops in the Study Area are paddy, cassava and sugar cane. Other crops such as vegetables and fruits are mostly for domestic consumption, but vegetables and some field crops are cultivated in some areas of large-scale irrigation projects for processing under a contract-farming basis.

Regarding the present post-harvesting practices by farmers, rice harvesting, threshing, drying and milling are conducted by contract or hired labor. Harvesting cassava is done by the farmer himself and sometimes with hired labor. After harvesting, traders or middlemen buy and transport them to their warehouses and to flour factories or have the cassava sliced and dried before transporting them to a pellet factory. Sugar cane is generally harvested by the farmer himself with help from relatives and hired labor. Harvested sugar cane is immediately loaded onto a truck to be transported to sugar factories. At present, the typical post-harvest handling for other crops such as vegetables and fruits are not found in the Study Area.

In the future, the agricultural development is expected to focus on marketable products, both fresh and processed products for domestic and foreign market with good quality. Some agricultural products such as vegetables and fruits perish within a weak; hence, poor post-harvest handling results in high losses and also reduces shelf life. On the other hand, good quality products can be sold at a high price. In order to improve quality of agricultural products for export and agro-processing industry, providing support for post-harvest handling is deemed necessary. However, it should be considered that post-harvest handling and marketing of products is conducted smoothly and systematically when the market volume of products is sufficient. Furthermore, the post-harvest systems vary between crops. For new development plans, post-harvest handling for rice, vegetables, fruits and some field crops should be considered.

For post-harvest handling development, the necessary actions are summarized as follows:

- Promote inter-disciplinary research and appropriate development in post-harvesting technology and set quality standards of agricultural products for exporting and agro-processing.
- Encourage the private sector and farmers' organizations to conduct and play a vital role in post-harvest activities.
- Provide support for the introduction of equipment and facilities. First of all, it is necessary to provide better transportation facilities in and around the production areas. When the handling volume of products increases, the farmer or farmers' organization may need some equipment and facilities, such as threshing machine, combine harvester, drying machine, grading and cleaning equipment as well as warehouse and packing facilities. In general, for equipment and facilities to be introduced, simple, reasonably priced, compact and unsophisticated equipment and facilities should be considered for easy operation and maintenance. Advice and suggestion about the selection of equipment and facilities should be provided based on the above mentioned concepts.
- Promote a systematic up-to-date marketing information and effective marketing

channel. Systematic handling should be considered for timely selling according to market demand. Planting and harvesting patterns should be created and improved periodically by establishing a feedback system concerning the linkage of market information, quality standards, demand and prices.