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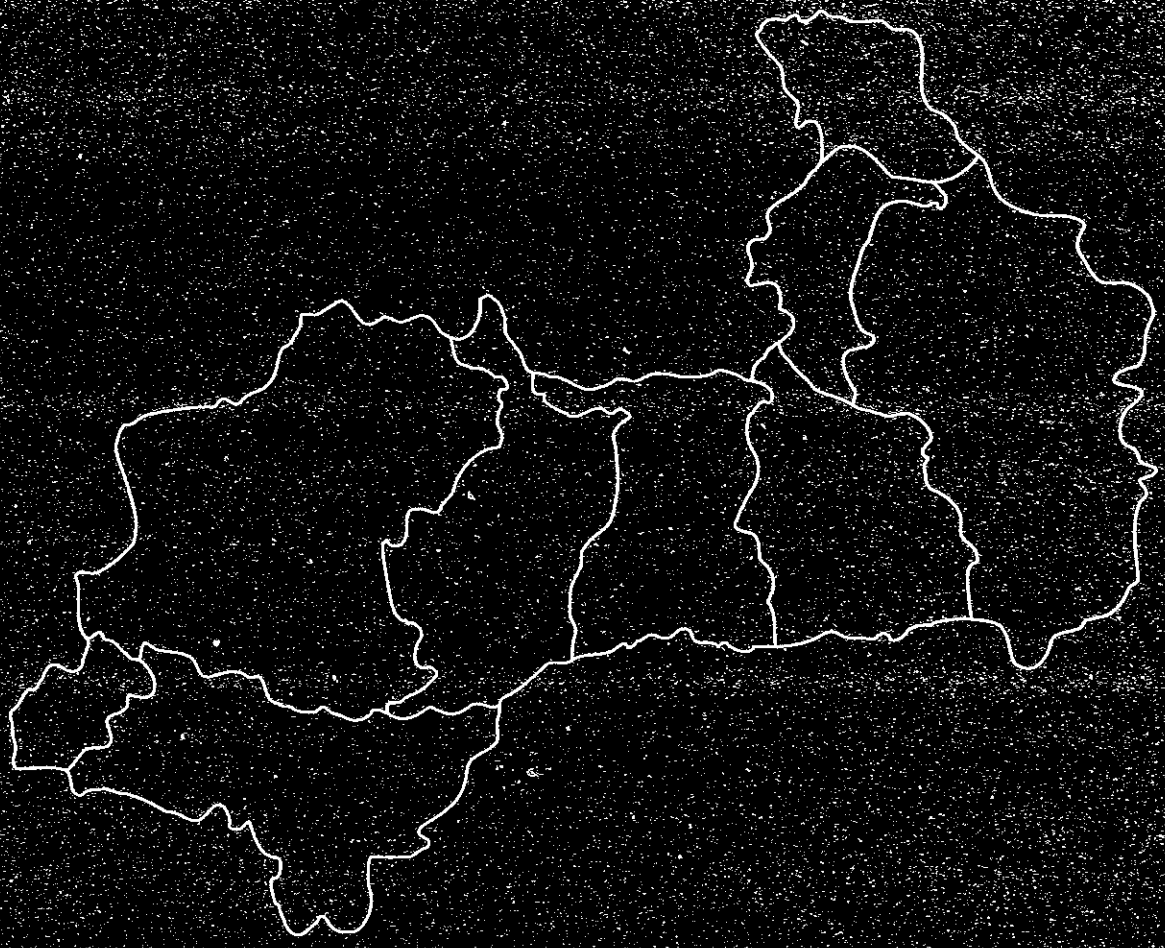
JAPAN INTERNATIONAL COOPERATION AGENCY

THE GOVERNMENT OF THE KINGDOM OF THAILAND
NATIONAL ECONOMIC AND SOCIAL DEVELOPMENT BOARD

THE STUDY ON THE REGIONAL DEVELOPMENT PLAN FOR THE LOWER NORTHEAST AND THE UPPER EAST REGIONS IN THE KINGDOM OF THAILAND

FINAL REPORT



1. Agriculture

September, 1993

NIPPON KOEI CO., LTD.

JAPAN INTERNATIONAL COOPERATION AGENCY

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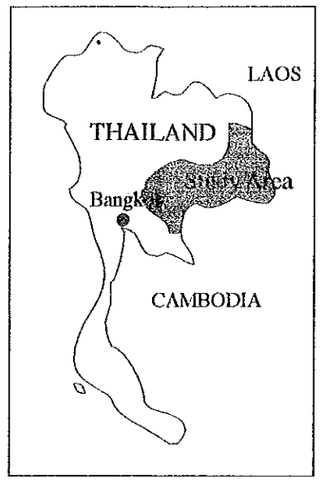

LEGEND

- International Boundary
- Provincial Boundary
- 202 National Highway (Number)
- Railway
- Airport
- National Park
- Major Tourism Attraction

Major City (Population)

- 100,000~500,000
- 50,000~100,000
- 25,000~ 50,000
- 10,000~ 25,000

N

SCALE

0 6.5 32.5 65.0

km

Laos

Khon Kaen

Huai Huat

Mukdahan

Savannakhet

Mukdahan

212

202

Yasothon 202

Amnat Charoen

212

23

Pha Taem

Ubon Ratchatani

217

Warin Chamrap

Phibun Mangsahan

Kaeng Tana

Chon Mek Border Point

Det Udom

Si Sa Ket

Prasart Kamphaeng Yai

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Surin

Bua Yai

202

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Satuk

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Abbreviations

AAT	Airports Authority of Thailand [MOTC]
ADB	Asian Development Bank
AED	Agricultural Extension Department [MOAC]
BAAC	Bank for Agriculture and Agricultural Cooperatives [MOF]
BMA	Bangkok Metropolitan Area
BMR	Bangkok Metropolitan Region
BOB	Bureau of the Budget [OPM]
BOI	Board of Investment [OPM]
BOT	Bank of Thailand
CAO	Changwat Administration Organization [MOIT]
CAT	Communication Authority of Thailand [MOTC]
CDD	Community Development Department [MOIT]
CPD	Cooperatives Promotion Department [MOAC]
CRDP	Coordinating Committee for the Royal Development Projects
DFPOT	Dairy Farming Promotion Organization of Thailand [MOAC]
DOA	Department of Aviation [MOTC]
DOH	Department of Highways [MOTC]
DOLA	Department of Local Administration [MOIT]
DRDC	District Rural (or Regional) Development Committee
DTEC	Department of Technical and Economic Cooperation [OPM]
EGAT	Electricity Generating Authority of Thailand [OPM]
ESBC	Eastern Seaboard Committee [NESDB]
ERTAT	Expressway and Rapid Transit Authority of Thailand [MOIT]
ETOT	Express Transportation Organization of Thailand [MOTC]
FIO	Forest Industry Organization [MOAC]
GCST	Government Cold Storage Organization [MOAC]
IEAT	Industrial Estate Authority of Thailand [MOID]
IFCT	Industrial Finance Corporation of Thailand
IPD	Industry Promotion Department [MOID]
ITD	Internal Trade Department [MOC]
JICA	Japan International Cooperation Agency
JPPCC	Joint Public / Private Consultative Committee [BOI]
LDD	Livestock Development Department [MOAC]
LNE-UE	Lower Northeast - Upper East
LTD	Land Transport Department [MOTC]
MOAC	Ministry of Agriculture and Cooperatives
MO	Marketing Organization [MOIT]
MOC	Ministry of Commerce
MOD	Ministry of Defence
MOE	Ministry of Education
MOF	Ministry of Finance
MOFF	Marketing Organization for Farmers [MOAC]
MOID	Ministry of Industry
MOIT	Ministry of Interior
MOPH	Ministry of Public Health
MOTC	Ministry of Transport and Communications
MOUA	Ministry of University Affairs
MSTE	Ministry of Science, Technology and Environment
NEB	National Environment Board [MSTE]
NESDB	National Economic and Social Development Board [OPM]

NESDC	National Economic and Social Development Committee
NHA	National Housing Authority [MOIT]
NRDC	National Rural (or Regional) Development Committee
OARD	Office of Accelerated Rural Development [MOIT]
OCSC	Office of the Civil Service Commission [OPM]
OECF	Overseas Economic Cooperation Fund (Japan)
OPM	Office of Prime Minister
OPP	Office of Policy and Planning [MOIT]
PDA	Provincial Development Committee
PEA	Provincial Electricity Authority [MOIT]
PRDC	Provincial Regional Development Committee
PRDCC	Provincial Rural (or Regional) Development Coordination Center
PWA	Provincial Waterworks Authority [MOIT]
PWD	Public Works Department [MOIT]
PWO	Public Warehouse Organization [MOC]
RFD	Royal Forest Department [MOAC]
RID	Royal Irrigation Department [MOAC]
SNRDC	Office of the Secretary to the National Rural (or Regional) Development Committee
SRT	State Railway of Thailand [MOTC]
TAT	Tourism Authority of Thailand [OPM]
TCPD	Town and Country Planning Department [MOIT]
TOT	Telephone Organization of Thailand [MOTC]
TRDC	Tambon Rural Development Committee
UNDP	United Nations Development Program
UNIDO	United Nations Industrial Development Organization
USAID	United State Agency for International Development

Abbreviation of Measures

Length

mm	=	millimeter
m	=	meter
km	=	kilometer

Area

ha	=	hectare
km^2	=	square kilometer

Volume

l	=	lit = litre
m^3	=	cubic meter
MCM	=	million cubic meter

Weight

mg	=	milligram
g	=	gram
kg	=	kilogram
t	=	ton = MT = metric ton

Time

sec	=	second
hr	=	hour
d	=	day
yr	=	year

Money

US$	=	U.S. dollar
B	=	Baht

Energy

kcal	=	kilocalorie
J	=	joule
MJ	=	megajoule
HP	=	horsepower
TOE	=	tons of oil equivalent
kW	=	kilowatt
MW	=	megawatt
kWh	=	kilowatt-hour
GWh	=	gigawatt-hour

Others

%	=	percent
°	=	degree
'	=	minute
°C	=	degree Celsius
cap.	=	capita
md	=	man-day
mil.	=	million
no.	=	number
pers.	=	person
PCU	=	passenger car unit
ppb	=	parts per billion

Unit Conversions

1 rai	=	0.16 hectare

CHAPTER 1

AGRICULTURAL POLICIES AND INSTITUTIONS

1.1 Agricultural Policies and Institutions

1.1.1 Main directions of agricultural development

Although agriculture claims a small share (11.5% in 1991) in GDP of Thailand and has been growing at a rate much lower (3.4% per annum during the Sixth Plan period) than the GDP growth, it is still very important in the Thai economy. The agricultural sector employs 64% of the total employment in the Kingdom. It is expected to play an essential role in the socio-economic development of Thailand by providing a firm foundation for an equitable, efficient and sustained growth. As agriculture is basically private sector business, however, the government role is to create the policy and institutional framework and to provide necessary incentives and investments in such areas as infrastructure, research and technology.

Main directions of agricultural development in Thailand in recent years have been the crop diversification, integration with agro-industry, and enhancement of productivity by applying advanceed technology. Efforts will be intensified along these basic directions. Emphasis will be placed on further crop diversification in favor of high value-added and export crops in response to market demand and those crops to be processed domestically to further increase value-added.

Another important dimension for future agriculture seems to be more private sector initiatives and involvement of villagers in all the facets of development activities. The private sector is expected to play a leading role for the provision of agricultural inputs and services. Villagers are expected to be involved in production planning, marketing researches, management of land and water and even minor construction works. For these, villagers need to be better organized.

1.1.2 Seventh plan guidelines

The Seventh plan provides guidelines for agricultural development, emphasizing the enhancement of productivity and high value-added products. They may be summarized below especially in view of the main directions described above.

Land management

A new tax system may be introduced to protect and encourage use of agricultural land. Land use plans should be prepared to guide the provision of basic infrastructure facilities in line with land use types in different localities.

Water management

Collection of water fees should be considered to encourage economic use of irrigation water. Villagers should be involved in planning and management of water facilities.

Research and development

The private sector should be supported to encourage the use of seedlings, plant varieties and animal stocks suited to different localities and socio-economic conditions of people. Dissemination of technical information and provision of support measures for intellectual patents and quality control should be promoted as well as new R and D activities.

Agricultural inputs

Proper use of fertilizer and agro-chemicals should be further promulgated. Laws, regulation and standards should be further clarified or established for the use of veterinary medicines and chemical residues in meat and meat products.

Agricultural credit

Funds to the Bank of Agriculture and Agricultural Cooperatives should be increased, and their activities should be extended to cover credit to small farmers. Fair contract farming arrangements should be encouraged.

Production system

Integrated farming systems suited to local conditions and market demand should be promoted by encouraging farmers to formulate production and marketing plans through extension services. Public and private sector cooperation should be encouraged in acquisition and application of proper inputs and technology for agri-business.

1.2 Agricultural Institutions

Many government agencies and their affiliated institutes/offices are involved in different aspects of agricultural development in Thailand. Their activities are outlined, referring specifically to the Northeast and the Study Area.

1.2.1 Marketing

Several Government organizations are involved in rice marketing such as the Market Organization for Farmers, the Public Warehouse Organization, and the Bank for Agriculture and Agricultural Cooperatives (BAAC). However, more than 98% of the marketed rice is handled by private traders. Roles of the government organizations are price support, direct purchase from rice millers and traders, establishment of public markets and financial support to prevent farmers to sell their rice at low prices especially in harvesting season. These services suffer from limited budget, manpower and facilities.

To expand market outlets for agro-products, a central commodity market was established by BAAC in 1988 at Suphan Buri and the central region. It has been operating well be extending BAAC credit to buyers during peak harvesting seasons. Volume of paddy handled at the market increased from 3,300 ton in 1988 to 180,000 tons in 1991. Participating farmers increased from 519 in 1988 to 39,000 in 1991. Similar markets established in Buri Ram and Si Sa Ket under the guidance of the Internal Trade Department of the Ministry of Commerce did not work well without active participation of traders.

Paddy markets are less developed in the Study Area. Individual farmers depend on middlemen who come and purchase paddy at their farm gates. Marketing systems are reasonably well developed for other major commercial crops in the Study Area such as cassava, kenaf and sugarcane.

1.2.2 Agricultural extension services

Agricultural extension services are insufficient in terms of quantity as well as quality in the study area. There are much room for the development of agricultural extension. An extension worker covers about 1,000, 5,000 and 5,000 farm households for crop husbandry, animal husbandry and fisheries, respectively through approximately 10 contact farmers in the study area. A contact farmer which represents about 150 farms on an average in the study area is visited by an extension worker once every 15 days. There were 653 farmers' groups with about 100,000 members in the study area in 1990/91. The farmers' groups cover about 9% of the total farmers in the study area. Two sub-districts are covered by a respective extension worker on an average. The mobility of extension workers are severely restricted without official vehicles. They have to use their privately owned motor cycles but they are provided with fuel at a rate of about 44 liters (400 Baht) per month. An average basic monthly salary of an extension worker graduated from junior collage, with 2 or 3 years experience is about 5,000 Baht, which is 2,000 to 3,000 Baht lower than for them working in private companies. Common extension workers are junior officials or subordinate officials who are believed to be too young and to have limited practical experiences though they have a basic agricultural training and farmers are reluctant to accept knowledge given by them. Training of the extension workers are centered on rice cultivation but there are increasing demands on technology on others such as vegetables fruit trees, fisheries and animal husbandry.

1.2.3 Agricultural credit

The agricultural credit is not playing major role in the study area. According to the 1988 intercensal survey of agriculture for the northeast, only 35% of the farmers were in debt. An average amount of outstanding loans in 1988 was 1,870 Baht per farm household, of which 15%, 15%, 3%, 21%, 14%, 13% and 19% was covered respectively by BAAC, other financial banks, government agencies, cooperative/farmers' groups, middlemen, money lender and neighborhood relatives/others. Ordinary farmers are very cautious of borrowing money with interests or on collaterals. Only wealthy farmers can afford to take a risk in investment borrowing money from banks even under the unfavorable climate in the study area. Interest rates of institutional loans are 12.5%/year for loan amount of less than 60,000 Baht and 14.5 % for more than 60,000 Baht. Collateral such as land titles or guarantor are required by the institutional loans in most cases.

1.2.4 Agricultural cooperatives

Agricultural cooperative development in the study area has been poor covering only 19% of the farmers in 1990/91. There are 264 agricultural cooperatives with membership of 204,739 in 1990/91, which corresponds to approximately two cooperatives per amphur in most cases. An average size of a cooperative is 776 members per cooperative. Main activities of the cooperatives is credit services. Joint sales or purchasing of agriculture commodities by the cooperatives are rather rare.

Only large and superior cooperatives can afford to manage the joint sales and purchases. Unit service area of a cooperative, i.e. two amphurs, is too big to manage by an organization. Furthest member farmers have to travel about 10 km (80,000 km^2/264 cooperatives, average radius = 9.8 km) to get services of their cooperatives. The cooperative promotion department of the ministry of agriculture and cooperatives are in charge of guidance of cooperative development in Thailand. An active agricultural cooperative has three to five resident officers dispatched from the department. They monitor the activities of the cooperatives not to deviate from the laws or guidelines made by the department. There are no stipulations in the laws or the guidelines for the cooperatives to become independent from the department even when they become financially or administratively viable like private corporations.

1.2.5 Agricultural research

There are many organizations concerned to the agricultural research in Thailand. Among them the Ministry of Agriculture and Cooperatives (MOAC) is the prime organization. Other ministries or or universities also have agricultural research institutes such as the sugarcane institute of the ministry of industry, the tobacco research station of the ministry of finance, Kasetsart University, Khon Kaen University and Chiang Mai University. MOAC has 5 research centers over the country, of which the Northeast Regional Center in Khon Kaen covers the Study Area. Agricultural research is basically conducted by department-wise and commodity-wise. Coordination between departments is weak resulted in duplication in research activities. Farming system researches for increasing farmers' income and market oriented researches are insufficient. Research programs are usually formulated in Bangkok in which it is very difficult to reflect the farmers' needs. When new regional agricultural development projects were started, they usually had to incorporate an agricultural research component in projects to obtain basic crop or animal husbandry information. There are the following agricultural research institutes in the Study Area under the MOAC.

1. Surin rice research station
2. Ubon Ratchathani rice research center
3. Ubon Ratchathani field crop research center
4 Mukdahan field crop experimental station
5. Si Sa Ket horticulture research station
6. Korat sericulture research center
7. Surin sericulture experimental station
8. Si Sa Ket sericulture experimental station
9 Ubon Ratchathani sericulture experimental station
10. Mukdahan sericulture experimental station
11. Buri Ram sericulture experimental station
12. Korat irrigation research station
13. Pak Thongchai forest research station

CHAPTER 2

PRESENT CONDITIONS OF AGRICULTURE IN LNE-UE

2.1 Agricultural Land Use and Holding

(1) Agricultural land use

Farm land

The total farm land is reported to be 5.35 million ha in the Study Area (LNE-UE) in 1988, corresponding to 59.9% of the total land area (Table 2.1). This represents a slight increase from 4.66 million ha in 1982 at the average annual rate of 2.3%. Forest land occupied 15.2% and the remaining 24.8% was unclassified in the Study Area in 1988. Decrease in the unclassified land in 1982-88 corresponds largely in the increase in the farm land, while the land classified as forest did not change much in this period.

The ratio of farm land to the total land area varies widely among the provinces. It is the lowest in Mukdahan at 29.5% where the forest land occupied 35.8% of the total land area. The ratio is high in Yasothon at 80.7% and in Surin at 75.0%. The share of unclassified land is the highest in Mukdahan at 34.7% closely followed by Prachin Buri at 34.6% and it is the lowest in Yasothon at 7.7% followed by 10.6% in Nakhon Nayok.

Land use by crop

Paddy occupied 3.42 million ha in the Study Area or 63.9% of the total farm land in 1988. Various field crops occupied 1.12 million ha or 20.9%, fruit crops 175,000 ha or 3.2%, and vegetables/flowers 48,000 ha or 0.9%. Pasture land was 1.23 million ha or 2.3% of the total farm land, and 359,000 ha or 6.7% were idle in 1988.

Irrigated area in the Study Area increased from 319,000 ha in 1982 to 421,000 ha in 1990 at the average rate of 3.5% per annum. Irrigated area in the Study Area is almost exclusively under paddy. The ratio of irrigated paddy area to the total paddy land area is the lowest in Yasothon below 5%, lower than 10% in Buri Ram, Surin and Si Sa Ket, and the highest in Nakhon Nayok over 70% (Figure 2.1).

(2) Agricultural land holding

The average land holding size of of farmer in the Study Area is 24 rai (3.8 ha) per household in 1988 (Table 2.2). Almost 80% of all the farm holdings in the Study Area are owner-operated (Table 2.3). In Nakhon Nayok and Prachin Buri, the ratios of farm holdings owned by farmers cultivating the lands are lower, and 42.2% and 18.6% of the total farm holdings respectively are rented.

In the Study Area, only 23.5% of villages have villagers having title deeds. Within the national forest reserve area, 6.3% of villages have villagers with title deeds, while 28.1% of villages outside the national forest reserves have villagers possessing title deeds. In the national forest reserves, 75.1% of villages do not have any evidence of tenancy nor land documents. Thus, although the land tenureship does not appear to

be a serious problem from the high ratio of land owners-farm operators, problems do exist in terms of land ownership security. Insecure land tenancy discourages investments to improve land productivity.

2.2 Agricultural Production

(1) Crop cultivation

Harvested area

Paddy is by far the dominant crop in the Study Area with the total harvested area of 2.58 million ha in 1990. Other important crops in terms of harvested area are cassava with 472,000 ha harvested area, maize with 275,000 ha and kenaf with 105,000 ha respectively in 1990 (Table 2.4).

Among the provinces, paddy is dominant in Yasothon, Ubon Ratchathani, Buri Ram, Surin, Si Sa Ket and Nakhon Nayok. In other provinces, other crops are comparatively important as paddy. These are cassava in Mukdahan, cassava and maize in Nakhon Ratchasima and Prachin Buri, and cassava and kenaf in Buri Ram.

Harvested area under different crops has changed significantly in the past decades (Figure 2.2). The area under sugarcane and soybeans has increased significantly, and shallot and garlic were newly established in recent years. The area under cassava, groundnuts and kenaf has slightly increased, while the area under paddy, maize and sorghum has been fluctuating at the similar level respectively. The area under mung bean and cotton has decreased, the latter significantly.

Production and yield

Paddy production dominates the crop production in the Study Area with 3.91 million tons in 1990. Other important crops are cassava with 6.72 million tons, maize with 0.74 million tons, and kenaf with 85,000 tons respectively in 1990 (Table 2.5). Paddy production exceeds cassava production in Yasothon, Ubon Ratchathani, Surin, Si Sa Ket and Nakhon Nayok (Table 2.6).

Crop that have increased their production in the past decade include sugarcane, groundnut and soybeans as well as newly established shallot and garlic. Production of cotton, mung beans and sorghum has decreased.

Yield of sugarcane and soybean has increased but only slightly in the past decade (Figure 2.3). Yield of most other crops has been staying more or less at the same level, including cassava, shallot, paddy, groundnuts, cotton, kenaf, mung bean and sorghum (Figure 2.4).

Paddy yield is the highest in Nakhon Nayok at over 2.0 tons/ha. It is below 2.0 tons/ha in all other provinces in the Study Area (Figure 2.5). Maize yield is increasing except Prachin Buri (Figure 2.6). Cassava yield is declining (Figure 2.7).

Farming technology

Agriculture in the Study Area is characterized by subsistence and tradition-bound farms, of which educational level is rather low. According to the NESDB village socio-economical data base for the northeast in 1991, within people above 6 years

old, only 2% finished higher education than elementary school. Farmers grow the main crop of paddy mainly for self-consumption. Once the required production of paddy for self-consumption is fulfilled, farmers seldom dare to expand production further, which involves higher risk under limited market outlets, unpredictable rainfall, insufficient irrigation water, low agricultural technologies etc.

Technologies applied to agriculture in the Study Area is primitive. Capital intensive farming such as rice cultivation using high-yielding varieties under high input of fertilizers/chemicals, year-round irrigation and intensive agricultural extension services does not been work well under the prevailing rainfed conditions. In respect to rice, farmers grow photoperiod sensitive varieties which have low response to fertilizer application and are generally low in yields. However, this photo period sensitivity is indispensable characteristic to stabilize rice yield under erratic rainfall condition. When transplanting of photoperiod a sensitive variety is delayed due to delayed start of rainy season, seedlings may have to be kept in seed bed for 50 to 70 days, which cause to start tillering in seed bed and lose tillering capacity when transplanted, thus resulting in drastic reduction in yield. On the other hand, photo-sensitive varieties have a longer vegetative period and 60 to 90 days old seedlings continue to tiller after transplanting and give stable yields. Fertilizer application is common practice. According to the 1988 intercensal survey of agriculture for the Northeast about 86% of farmers use fertilizer either chemical or organic forms. However, application amounts of chemical fertilizers is small, only 47 kg/ha in case of rice. Generally speaking farmers do not know the suitable application method on the use of fertilizers. Farm mechanization is rapidly progressing in the Study Area due to labour shortage caused by the increasing job opportunities in non-agricultural sectors. About 34% of farmers use tractors or power tillers in 1988 according to the above- mentioned study. According to the spot surveys by the present study team, more than 90% of farm land in the suburb of Korat is plowed by machine. It is nowadays rare to find farmers cultivating paddy fields by buffaloes near large cities.

Cropping patterns in the Study Area are determined according to four generalized land types: lower paddy land, middle paddy land, upper paddy land and upland (Figure 2.8). The lower paddy land is bunded and planted to long duration lowland paddy rice every year in the wet season. Rice nurseries are also made on the lower paddy land in the early parts of the wet season. Kenaf and vegetables are also planted in this type of land Major problems on the lower paddy land are occasional floods to the rice in the wetter years and temporary water logging pre-rice upland crops. The middle paddy land is also bunded and is the most productive land in the area with relatively well water control and reduced risk of flooding. In most years medium duration rice is grown in this type of land in the wet season often with vegetables, legume or tobacco before and after the rice. The upper paddy land is bunded but planted to short duration paddy rice in only three or four years out of ten with a successful harvest being taken less frequently. This land can be planted with one or two upland crops during the wet season but farmers plant paddy rice whenever possible. Weeds are the severe problems on this land. The uplands consist of unbunded fields. Major crops grown in this type of land are cassava, kenaf, sugar cane, upland rice and legumes such as groundnuts and mungbeans, which are usually grown as monocrops during the rainy season. Major problems of this land are rapid reduction in soil nutrient level, soil erosion and disease buildup in the continuous cropped areas.

(2) Livestock

Livestock population in the Study Area consists of 24.7 million chickens, 264 million ducks, 1.77 million buffaloes, 974,000 cattle, and 721,000 swine (Table 2.7). Population of chicken has increased rapidly in recent years, while buffalo population decreased slightly. Population of cattle and swine has been fluctuating.

Distribution of livestock population varies widely between provinces (Table 2.8). Population of buffalo, cattle and swine is insignificant in Nakhon Nayok with small land area. Buffalo population is the largest in Ubon Ratchathani, and relatively large in the provinces of Surin, Buri Ram, Si Sa Ket and Nakhon Ratchasima under dry climate. Cattle population is the largest in Nakhon Ratchasima, and swine population concentrates in Nakhon Ratchasima and Buri Ram. Chicken population is the largest in Ubon Ratchathani, followed by Nakhon Ratchasima. The three other provinces in the dry central area also have relatively large chicken population.

(3) Fishery

Fishery is not playing significant role in economy in the Study Area. Its importance is mainly for improving the diet of local people as an animal protein source.

The value-added in fishery sector has increased in the Study Area at an average annual rate of 8.1% during 1983-89 (Table 2.9). Two leading provinces are Ubon Ratchathani and Si Sa Ket contributing 25.3% and 24.3% respectively to the total value-added in 1989.

(4) Forestry

Forestry sector has been significant only in Mukdahan, where its share in gross provincial products reached the maximum in 1985 and has rapidly declined since then (Figure 2.9-17). Forest area occupies only about 5% of the total land area in Buri Ram and Surin, and 20 to 25% in Prachin Buri, Nakhon Nayok and Ubon Ratchathani. Mukdahan has the largest share of forest area at 35% of the total land area.

2.3 Agricultural Value-Added

GRDP of the Study Area was 120,999 million baht in 1989 current prices, which was equivalent to 12,239 baht/capita (476 US $/capita). Agricultural GRDP in the Study Area was 31,243 million baht in 1989 covering a small parts of GRDP i.e. 28% of GRDP, in contrast with the large percentage of agricultural population i.e. 85%. The agricultural GRDP of the Study Area from 1983 to 1989 has been stable being at around 10 billion baht/year in 1972 value. In the same period GRDP increased at a rate of 6.1%/year (Figure 2.18). No significant progress was made in the agricultural sector between 1983 and 1989 even with many development endeavors.

Crop production is the largest sector in the agricultural sector covering 64% of the agricultural GRDP followed by livestock production (20%), simple agro-processing (12%), agricultural services (3%) and fisheries (1%) in 1989 (Figure 2.19). Forestry sector is negligibly small in the Study Area from an economic view-point. Average annual growth rates of GRDP between 1983 and 1989 are 1.7%/year for crop production, 7.5%/year for livestock production and 9.8%/year for fishery production in the Study Area.

Paddy, cassava and maize are the main crops in the Study Area generating respectively 42%, 21% and 6% of the crop GRDP in 1989 (Figure 2.20). There is much variation in growth in crop GRDP among related provinces. Mukdahan, Nakhon Nayok and Prachin Buri showed good growth rates of 13.5%/year, 6.8%/year and 6.2%/year respectively on an average between 1983 and 1989 (Figure 2.29). These high growth rates were attributable to increase mainly in harvested area of cassava for Mukdahan, in unit yield of paddy for Nakhon Nayok and in harvested area of maize for Prachin Buri. While, Surin and Buri Ram have negative growth rates of 2.5%/year and 1.7%/year respectively. These decreases were caused by decrease in paddy harvested area for Surin and in paddy harvested area and unit yield for Buri Ram.

2.4 Agricultural Household Income and Expenditure

Agricultural population predominates in the Study Area covering about 85% of the total households in the Study Area. Farmers in the Study Area are poorest in the country. Because of the poor agricultural resources of the Study Area their income is generated mainly from non-farm activities. According to the 1986 household socioeconomic survey by National Statistical Office and to the agricultural statistics of Thailand for crop year 1989/90, the annual net cash income of a farm household with the average family size of 6.5 persons in the northeast region in 1986/87 was 17,910 baht (US $689), which was equivalent to 41% of the national average and to 21% of the income of the corresponding greater Bangkok metropolitan area. About 63% of the farm household net cash income is covered by non-farm cash income. About 69% of the net farm cash income is made by crop cultivation and 31% by animal husbandry (Table 2.10). The most important crop in obtaining cash income is cassava,which covered about 42% of the gross cash income by crop in 1986/87 followed by rice which covered 29%.

The farm household cash income increased by 1.2% per year from 1978/79 to 1986/87, which was far below the corresponding GDP increase i.e.about 8%/year (Figure 2.30). Notwithstanding of many efforts through such as agricultural development projects the annual increment in the net farm household income through farming between 1978/79 and 1986/87 was only 0.7%/year. In term of gross farm income the increment was negative i.e -0.8%/year. Particularly, the cash gross income by crops deceased by 2.4%/year (Figure 2.31). The deficit was made up by mainly livestock/poultry income.

2.5 Recent Agricultural Development Endeavors

The rural development including water resources development has been carried out for about 20 years in the country. Particularly, the northeast region has been given the highest priority in the rural development in the country. Main strategies taken in the respective national development periods can be summarized as follows.

1st.-3 rd (1966-1976) development periods	:	Increase in production and regional income.
4th (1977-1981) development period	:	Fulfillment of villagers' needs
5th (1982-1986) development period	:	Human resources development, particularly of poor people, providing basic human needs.

6th (1987-1992) development period : Peoples' participation in the development, particularly of their communities.

Water shortage has been the main focal point for long time time in the agricultural and rural development in the Study Area. Accordingly, the government tried to develop water resources, large and small, for water supply and irrigation. But, recent trends in the Study Area lie in the construction of small scale water supply facilities such as ponds, reservoirs, wells, weirs and water jars for drinking for human and animals and for irrigation agriculture.

There have been a number of initiative for agricultural development in the Northeast in recent years. Some of them are summarized to give further background and indication for planning the agricultural development the Study Area. A list of on-going agricultural development projects in the Study Area is contained in Appendix.

(1) Northeast Rainfed Agricultural Development Project (NERAD)

This project is a kind of research project and was implemented between 1981 and 1991 with an assistance of USA to increase agricultural production for subsistence and cash income of the poorest farmers in the Northeast establishing in representative districts of the Northeast a replicable program for increasing farm productivity and farm income, particularly among poor farmers in rainfed zones. A comprehensive method was adopted through a farming systems research and extension (FSRE) approach. NERAD consists of 6 components: (1) extension of suitable farming practices in crop husbandry, water utilization, animal husbandry, fish production, sericulture, etc; (2) adaptive research and demonstration; (3) small-scale water resources development; (4) strengthening of agricultural extension activities; (5) support services for the encouragement of community participation in the development activities; (6) monitoring and evaluation.

Lessons learned are :

(a) Problems of rainfed agriculture which are invariably multi-faced and often cannot be addressed by the single-discipline and commodity perspective of individual line agencies or departments.

(b) Analytical tools such as agroecosystems analysis, rapid rural appraisal, preference ranking and transact analysis, are necessary and effective to promote a more flexible, interagency approach to development.

(c) A "problem-pull approach" approach to technology design and testing is necessary for rainfed agriculture in contrast to the "technology-push" approach commonly used in the early green revolution and experienced in relatively well-endowed irrigated conditions. It is cleared that there is no single, miracle technology that will lead to a green revolution under rainfed conditions. The development process in the rainfed agriculture must be small but sustained improvements to the traditional farming system.

(2) Northeast Crops Development Project (NECDP)

This project was implemented in the Northeast rainfed areas between 1985 and 1990 with a financial assistance from EEC. The main objectives were to develop suitable alternative crops to cassava, increase and stabilize the income of cassava farmers, and keep cassava production at an optimum level. Some drought tolerant varieties of sorghum, kenaf, sesame, pigeonpeas and groundnuts were found to be suitable crops for growing before or after rice. Cashew, rubber and fruit trees were also tested.

(3) Esarn Khieo (Greening of the Northeast) program

This program was initiated by the Thai Army-Internal Security Operations Command to relieve the Northeast from drought induced problems by "greening" this region. In 1988, the program was placed under the National Rural Development Program, chaired by the Prime Minister. The five-year allocation of resources for the "Esarn Khieo Implementation Plan, 1988-92" (EKIP) covers forestry, land improvement, irrigation, crop production, livestock and fisheries development and agro-industry as well as rural water supply.

(4) Northeast small-scale irrigation project

The project aimed at rehabilitating seven medium-scale irrigation projects in the Northeast. It started in 1982 with the assistance of USAID. Some early accomplishments of the project include the involvement of farmers in on-farm distribution construction and reactivation of water users association, as well as physical works.

(5) Lam Nam Oon irrigation project

This project aimed at increasing the capacity utilization rate of irrigation water from the Lam Nam Oon dam completed in 1973 and increasing farmers' income from non-traditional crops. Its characteristics include the local institutional involvement in project planning and implementation, a formal coordination framework under a single Project Field Director, and the emphasis on marketing support to involve the private sector.

CHAPTER 3

AGRICULTURAL DEVELOPMENT PLAN

3.1 Objectives and Strategy

(1) Constraints

Marketing and prices

Agricultural economy of the Study Area depends much on international prices of agricultural products such as rice, cassava and maize, which are the main export crops in the country as well as the main crops in the Study Area. In 1990 about 4 million tons of rice corresponding to 36% of the total paddy production in the country and 1.23 million tons of maize corresponding to about 33% of the total production were exported. International prices of these commodities have been declining due to oversupply and protectionism such as domestic production subsidies, import quotas, export subsidies and quality regulations.

Trend of International Prices of Rice and Maize

(US $/ton in 1985 value)

	1970	1980	1985	1988	1989	1990
Rice	394	414	216	217	232	197
Maize	160	119	112	77	81	75

Source : IBRD 1991, Commodity prices and price projection

Recent trends in farm gate prices of crops were stable except vegetables and cotton (Figure 3.1).

Water resources

The Study Area is characterized by savanna climate. An average annual rainfall is about 1400 mm. The rainy season extends from May to October, in which about 80% of the total rainfall concentrates. There are much variation in rainfall amounts and distribution resulting in high frequent droughts . However in the downstream of the Chi river such as Provinces of Yasothon, Ubon Ratchathani and Surin floods occur in almost every year. Floods and poor drainage hinder the development of upland crops such as cassava, maize, pastures, fruit trees and vegetables. Salt water intrusion both up the river and into the groundwater are constraints to agriculture in the downstream of the Bang Pakong river. Due to unfavorable conditions such as flat land, sandy soils and sociological constraints there are a limited number of reservoirs in the Study Area. Irrigation covers only 2.5 million rai(405 thousand ha) in 1988, which is equivalent to 7.6% of the farm land.of the area. According to a

report on the Esarn Khieo Project prepared by Biwater in 1987 within the annual average runoff of 270 mm in the Northeast region 20% is utilized for irrigation, 14 % is evaporated from reservoirs and 75 % is discharged into the Mekong river without utilization. Groundwater resources are mostly contaminated with salts which derives from underlaying salt containing layers.

Soils

Most soils of the Study Area are extremely poor in fertility mainly deriving from sandstone, shale, or silt stone which are inherently low in calcium, potassium, magnesium and phosphorus and organic matter contents and in cation exchange capacity and water holding capacity. There are saline or alkaline soils in the limited areas. Arable land is utilized to the maximum extent and there are little room for further exploitation of land for agricultural production without destroying forest. Unsuitable land for crop production such as steep land and forest reserves are now being encroached by illegal settlers.

Land tenure

The land holding size of farmers in the Study Area is small with an average of 24 rai/household (3.8 ha) in 1988. Owner farmers covered 77% of the total farmers in the Study Area in 1990. However, the land tenancy is growing a big problem in the Study Area due to urbanization. Urban land owners are changing their jobs from farming to non -agricultural occupations. In 1990 tenants and landless laborers covered 13% of the total farm households. In Nakhon Nayok they covered as much as 49% of the total farms including landless laborers in 1990. Insecure land tenancy discourages their investment in soil fertility enrichment such as application of manure to farm land and prevention of soil salinization. They are apt to exploit the soil fertility without application of fertilizers. Agricultural extension services are extended to only land owners.

In the Study Area, only 23.5% of villages have villagers having title deeds. Within the national forest reserve area, 6.3% of villages have villagers with title deeds, while 28.1% of villages outside the national forest reserves have villagers possessing title deeds. In the national forest reserves, 75.1% of villages do not have any evidence of tenancy nor land documents. Without land title deeds, it is virtually impossible for farmers to get agricultural credits which are indispensable for the general farmers to start capital intensive market oriented farming.

Education

Agriculture in the Study Area is characterized by subsistence and tradition-bound farms, of which educational level is rather low. According to the NESDB village socio-economical data base for the northeast in 1991, within people above 6 years old, only 2% finished higher education than elementary school which corresponds to 6 to 12 years old age, 78% finished only elementary school, 18% are studying at elementary school and 1% are illiterate.

According to the data of the Department of Labor on work application of farmers to factories, only 30% of the farmers are eligible to work in factory. Modern farming using farm machinery need skilled farmers such as applicable to factory.

Agricultural support services

Agricultural extension services are insufficient in terms of quantity as well as quality in the Study Area. There are much room for the development of agricultural extension. An government extension worker cover only farmers under a group organized by government. The farmers' groups cover only about 9% of the total farmers in the Study Area. The mobility of extension workers are severely restricted without official vehicles. They have to use their privately owned motor cycles. An average basic monthly salary of an extension worker graduated from junior collage, with 2 or 3 years experience is low of about 5,000 Baht. Common extension workers are believed to be too young and to have limited practical experiences though they have a basic agricultural training and farmers are reluctant to accept knowledge given by them. Training of the extension workers are centered on rice cultivation but there are increasing demands on technology on others such as vegetables fruit trees, fisheries and animal husbandry.

Agricultural cooperative development in the Study Area has been poor covering only 19% of the farmers in 1990/91. Main activities of the cooperatives is credit services. Joint sales or purchasing of agriculture commodities by the cooperatives are rather rare. Only large and superior cooperatives can afford to manage the joint sales and purchases. Unit service area of a cooperative, i.e. two amphoes, is too big to manage by an organization. There are much intervention of government in cooperative operation and no stipulations in the laws or the guidelines for the cooperatives to become independent from the government even when they become financially or administratively viable like private corporations. There are virtually no technical services to cooperatives by the controling agency, i.e. the Department of Cooperative Promotion.

Marketing of agricultural product

The marketing of the agricultural products has serious constraints for the farmers in the Study Area to grow new cash crops and to expand the production particularly for foreign markets. Farmers have little bargaining power with private traders, under limited market outlets, without efficient transportation means, enough working funds for farming/livelihood and accurate and updated market information.

In respect to rice marketing, more than 98% of the marketed rice is handled by private traders. Government intervention in the rice market has not been effective due to mainly limited budgets, man power and facilities.

Local demands of fruits and vegetables are very limited. A small increase in production of these produce cause sharp reduction in prices as demonstrated by passion fruit under the Esarn Kieow program. So there is a wide fluctuation in the prices in a season. There would be more market opportunities outside of the Study Area for these produce but quality control and timely supply of the produce to buyers have are the key for the success.

(2) Objectives

The objectives for agricultural development in LNE-UE, including crop cultivation, livestock and fishery, are established in line with the LNE-UE regional development objectives.

1) To improve sustainability of farmers through such as irrigation development and mixed farming combining crop cultivation and livestock, poultry, fishery and other activities, and on-farm water and land management;

2) To raise income level and create sufficient employment opportunities in rural areas by promoting crop diversification, improving productivity, and expanding marketing outlets in order to minimize the drift of people out of the rural areas; and

3) To promote farmers' organization for efficient production, credit, marketing, input procurement and water and land management.

(3) Strategy

Water resources development

Full utilization of existing water resources through construction of reservoirs, wells and ponds, efficient utilization of the existing irrigation facilities and the promotion of aquaculture in the existing and new reservoirs and ponds will be most effective for the improvement in crop productivity and in sustainability of farmers.

An inventory of existing facilities should be reviewed and updated, and additional water storage should be planned in combination with rehabilitation/improvement of existing facilities by a river basin approach.

Water facilities planned by the river basin approach would call for an integrated operation and management. In particular, farmers need to be organized for on-farm water management. As a prerequisite, farmers should played major role in the planning and implementation of irrigation facilities.

Crop diversification

Higher sustainability will be attained through crop diversification from paddy and cassava to high value-added crops for export and processing in the Study Area such as vegetables and fruit trees of conventional crops, fragrant rice has better export prospect and thus should be encouraged.

Marketing improvement

Marketing of agricultural produce should be improved by establishment of assembly markets and encouragement of joint marketing through cooperatives and farmers' groups. Contract farming is one of the choices of farmers for direct sale of new agricultural products to retailers or agro-industries. Contract farming would provide an additional opportunity to organized farmers to negotiate with large retailers or processors.

Some new crops promising in the Study Area have good export prospects. They include some fruits and flowers. Marketing of these products may be facilitated by the proposed Project Management System (Subsection 6.5.2, Man Report).

Mixed farming

The mixed farming would improve farmers' sustainability by utilizing efficiently available limited land and labor resources. To support various mixed farming systems, provision of agricultural inputs and technical services should be improved. Sericulture, aquaculture in ponds and paddy field and simple agro-processing should be incorporated in the mixed farming as much as possible.

Livestock improvement

Livestock such as dairy cow and pig in the Study Area has much room for expansion due to the rapid growing demands caused by increase in income and the readily available agricultural products such as cassava, rice bran, sugarcane tops, and groundnut leaves in the Study Area. Livestock in the Study Area can be improved through breed improvement, improved feed base, deregulation in marketing, and improvement in veterinary services.

Existing livestock production centers should be activated for breed improvement with improved equipment and facilities and technical cooperation to be provided by international aid organizations. Services should be provided to small livestock farmers at affordable costs.

3.2 Development Targets

(1) Agricultural land development

Potential agricultural land

Land suitability for agriculture has been analyzed by using the GIS and combined with the present land use to clarify potential land development. Results given in subsection 3.3.4 indicate the following potential related to agricultural development.

Potential paddy area, 22,132,000 rai, is smaller than the area presently under paddy, 28,064,000 rai in 1992. This area is comparable to the paddy area in 1988 (21,352,000 rai). The potential area is significantly smaller than the present paddy area in all the provinces except Nakhon Nayok, Prachin Buri and Nakhon Ratchasima. Potential field and tree crops area is 13,685,000 rai, much larger than the area presently under field crops, fruits, vegetables and flowers (8,091,000 rai in 1989). Development area defined as potential area for non-agricultural activities, constitutes 7,602,000 rai. This area is mostly unsuitable for cultivation but can be used as pasture, livestock grazing area or woodland.

Agricultural land development

Given the potentials outlines above, the agricultural land development aims at the following. The total paddy area would be maintained at the 1989 level in the Study Area. Production increase in paddy would therefore be realized by expanding irrigation area and double cropping. Field and tree crops area will be expanded by 2 million rai corresponding to 36% of the potential expansion area. Of the development area, some 800,000 rai or 40% of the total would be devoted to pasture/grazing area to support the boost of livestock production. Also about 5% of the development area or 375,000 rai (60,000 ha) would be developed as commercial forests.

Crop diversification is recommended by the Master Plan in favour of high value-added crops such as fruits and vegetables for seed and processing, grain seed, various oil crop, flowers for export and other horticultural crops. Areas for these crops should be selected from the field and tree crops area identified by the land evaluation (Sector Report on Land Use).

(2) Agricultural value-added

To realize the regional development indicated by the socio-economic framework for balanced development, the agricultural sector value-added would have to increase from 33,900 million bahts in 1989 to 75,800 bahts in 2010 (in 1989 price). Crop cultivation, livestock, fishery and commercial forestry would support this increase as summarized in Table 3.1.

3.3 Development Projects and Support Measures

Groundwater irrigation development

Potential areas for groundwater irrigation have been identified by a GIS analysis, in which the present land use map, the groundwater potentiality map and the land suitability map to crops are overlayed. According to the hydrogeological map of Northeastern Thailand produced by the department of mineral resources, the Project Area has two main productive aquifers i.e. alluvial aquifers along main rivers with the thickness of less than 50 m and with the depth to ground water of less than 10 m, and cemented clastic aquifers found in joints of sandstones, shales and siltstones, with the thickness of 500 m to 2,500 m and the depth to ground water of less than 10 m. But taking water quality into consideration suitable aquifers are identified to be the alluvial aquifers and the Lower Korat group aquifers based on the information from the Chi Basin Water Use Study. Unit command area of a well with a safe water yield is assumed to be 190,000 ton/year per 15 ha mixed cultivation of vegetables, fruit trees, mulberry and fish, based on the said report. Optimum wellfield spacing is assumed to be 1 km. In total, 582,000 ha of land in the Study Area is suitable to groundwater irrigation. Distribution of suitable areas are shown in Figure 3.1. The groundwater would be used for drinking and other human and animal uses. For the accurate measurement of aquifer properties and safe yields of groundwater and for the determination of most suitable design and location of wells, long term monitoring of groundwater tables and quality, seismic tests, surface resistivity surveys and long term constant discharge pumping tests would be necessary. A water balance study using a simulation model would also be effective to determine the safe and sustainable yields of groundwater. Operation and maintenance hold a key for the success. Farmers should participate in planning, operation and management of development schemes. They should bear at least the operation and management costs.

Small reservoir development

Surface water resources have not yet been utilized to the maximum extent. As much as 75% of the runoff in the northeast region is wasted into the Mekong. In respect to the Mun river basin there were 4911 MCM available for storage for irrigation, fishery or domestic water use at Ubon even in 1986 drought taking river maintenance flow of 427 ton/sec into account. Water shortage is one of the biggest problems in the Study Area and the development of reservoirs or ponds has been a

main policy of the rural development by the government. However, existing ponds or small reservoirs are not necessarily utilized to the anticipated extents due to the following problems.

1. wrong siting resulting in insufficient water supply, water salinization, pollution by accumulation of fish feeds and excessive percolation losses etc.
2. poor maintenance resulting in collapse of dikes, accumulation of debris, sand and silt.

Reservoir or pond sites must fill at least the following conditions.

1. within 200 m from the nearest river and canal with their sufficient water supply in wet season by pump or canal, and drainage by pump or gravity in time of needs or in dry season.
2. no inflow nor seepage of saline water into reservoir or pond.
3. low percolation rates of soils in the bottom or bank of reservoir or pond. Sandy soil is not suitable for the construction without water sealing materials.
4. more than 3 m in depth. A plot of more than 1 rai might not be suitable for aquaculture with difficulty in water or fish management.

Communal management of reservoirs or ponds is unsuitable for economic utilization of the facilities without clear power and responsibility for the facilities. Private or cooperative organization would be appropriate for the management.

This project is the construction project of small reservoirs and ponds for multipurposes including irrigation, fresh water aquaculture and domestic water use. Land suitable to small reservoirs and ponds are identified based on the maps on land suitability for small reservoir prepared by the Northeast Agricultural Development Research Center. Target area for the development is the Lower Northeast, which is the most striken area by drought in the Study Area. According to the GIS data base suitable area for the project is estimated at about 1.44 million ha in total; 1.27 million ha for paddy irrigation and 0.17 million ha for irrigation of upland crops and fruit trees (Table 3.2). Exact location of individual sub-projects would have to be decided based on the water availability.

Mixed farming promotion program

This program will provide a package of support measures for farmers to undertake integrated or mixed farming, introducing new crops, varieties and breeds. Extension services and agricultural input will be provided through farmers' groups and cooperatives to individual farmers. Marketing of output will also be conducted through cooperatives and farmers' groups.

A typical case of integrated farming is a traditional combination of rice and fish in paddy fields. Other components include cash crops, vegetables, trees and hedges for fuel, backyard poultry and livestock, and sericulture.

Livestock improvement program

A comprehensive package of measures will be provided under this program to support livestock raising, including breed improvement, disease control, feed

improvement, and arrangements with meat and dairy processors. A few livestock improvement centers will be established to provide these services. Establishment of feed mills will also be supported.

Agricultural cooperative institute project

Farms in the Study Area are too small in size and too isolated to operate efficiently and competitively, and scale merit in the farm cooperation is difficult to be enjoyed by the ordinary farmers. Agricultural cooperative is one of the measures for the small scale farmers to exercise the scale merits of farm operation in an area of farm mechanization, in particular which is progressing under the shortage of farm labours in the time of paddy land preparation and harvesting. Farmers in the Study Area are said to be dislike the collective or organized work and the cooperative movement seems to be far from being popular among farmers. However, there are many examples of splendid agricultural cooperatives in the country according to the finding by the Japanese experts assigned to the agricultural cooperative promotion project in the northeast. The merits of cooperative movement have not been well demonstrated by the government. The farmers would be easily persuaded of the merits of cooperative movement by being shown actual performances of the splendid cooperatives. There are no systematic distribution of information on splendid examples or wisdom accumulated in individual agricultural cooperatives. This institute would become the information center on the agricultural cooperative movement in the country by (1) monitoring individual cooperatives' activities, (2) building data base on experiences of splendid cooperatives, (3) extension of information on cooperatives by publishing cooperative news papers, for example, (4) training of cooperative managers/farmers for efficient farm management and (5) making seminars and workshops on cooperative movement.

Goat bank development project

The health condition of infants in the Study Area is unsatisfactory with their dead rate of 10 per 1000 and malnutrition rate in children under the age of 5 being 1.18%. The malnutrition is caused mainly by shortage of protein. This project is to improve nutritional condition of infants in the Study Area by leasing an adult female goat to a farmer and the farmer will take the offspring free of charge. This system will be the same as the present cattle or buffalo bank.

Floating net cage aquaculture development project

Existing large and medium size reservoirs have not been fully exploited of their resources for fisheries, particularly of aquaculture. Floating net cage fishery is a new technology in Thailand and can be adopted in reservoirs to be constructed in the future as well as existing reservoirs (Figures 3.2 and 3.3). The productivity is very high of about 12,000 pieces (about 20 ton) of fish per ha per year of water surface, (1,000.pieces of fish/cage, 6 cages/ha, 2 turnovers/year). Floating net cage fishery is effectively promoted in Indonesia to accommodate relocated people from submerged area by dams, in fisheries. The relocated people became better well-off by aquaculture than unaffected farmers around the reservoirs. According to the GIS data base there are 102,300 ha of water surface of large and medium size reservoirs and rivers in the Study Area. So 2 million tons of fish could be produced per year by the floating net cage aquaculture in the Study Area.

Agricultural marketing service center project

Marketing improvement is one of the extremely important requisites for the development of the Study Area. Without sound market outlets or channels and reliable and latest market information, agricultural or industrial development could not be successful in the Study Area. There are no systematic collection, analysis and distribution of market information for farmers or cooperatives. There are some market information including marketing reports collected or made for the development of the area, but these information are sometimes written in English or made without coordination of related agencies and used exclusively for public sector. This center will do the following tasks for the contracted organization or personnel.

1) Collection of agricultural market information such as prices, production, quality requirements in foreign as well as domestic markets

2) Market research, promotion and consultancy services for clients

3) Maintenance of market information collected by other public organizations

4) Registration and introduction of buyers, suppliers or producers

5) Market information services for contracted clients through the computer net work

Participatory irrigation system improvement project

In the Study Area there are many irrigation systems in which only major irrigation facilities such as intake weirs, dikes or main canals were constructed and the down stream structures such as farm ditches have not yet constructed. The investment has not yet effectively utilized. If the land acquisition for the structures smoothly implemented, there would be many opportunities to make use of these facilities economically with little additional costs for the on farm structure development. As the sunk costs are not counted as the cost in the economic analysis economic viability of the development would be better than new irrigation projects. Participatory approach, in which beneficiaries participate in each planning, designing, construction and operation stage and share the construction as well as operation costs, is much effective in establishing the sustainable and efficient irrigation systems. Effectiveness of the participatory approach has been well demonstrated in several projects in developing countries such as in the small irrigation development project in the Philippines. In this case irrigation service fee collection efficiency is more than 80% in the newly constructed systems. Irrigation water supply free of charge was the traditional way in irrigation policy in the developing countries, but this policy does not work well in the modern irrigation systems. Many developing countries are changing the policy and started collecting the fees to effectively operate and maintain the irrigation systems. Thailand is still adopting the traditional way resulting in waste of money. The policy prohibiting the collection of irrigation service fees would be the fatal detriment for the improvement and development of irrigation systems in the country. Objective and scientific selection criteria of irrigation development plans for the implementation is the fundamental for the success and fairness of the selected project. Farmers' commitment, preparation of a feasibility report, some cost recovery by beneficiaries, pre-establishment of water users' association, economic/technical soundness of plans, secure of right-of-way, etc are

the prerequisite for qualification of the proposals. This is the pilot action research project to identify the most suitable participatory approach to the irrigation project in Thailand.

Drip irrigation development pilot project

Irrigation is the key for the sustainable and efficient production of crops in the Study Area making the year-round generation of cash from farming possible. Water resources in underground or surface are not endowed sufficiently and drought is the common phenomenon in the Study Area. Drip irrigation is the most efficient irrigation method with small losses in evaporation and percolation. Operation cost is also low by means of low pressure in pipelines and low labour requirements for the operation of the system. Initial investment cost is about 2,000-3,000 US$/ha. Development of the drip irrigation in Thailand is far behind from the other Asian countries as well as middle east countries. In the Philippines and Sri Lanka traditional sprinkler systems are being replaced by the drip irrigation systems because of above-mentioned advantages of the drip irrigation systems. This system is thought to be the most suitable irrigation method for upland crops to the Study Area where water is the most important and precious resource and efficient utilization of it is most desperately required. This project is to monitor the effectiveness of the system in the natural and social conditions of the Study Area and to demonstrate the efficiency and economic advantages of the system to farmers as well as government officials. A preliminary feasibility analysis on this project is found in a separate volume.

On-farm drainage improvement project

The drainage problems is also an important and unnegligible problem in the Study Area. The paddy in the lower paddy fields is most susceptible to flooding. Upland crops and fruit trees in the middle paddy fields are sometimes damaged by water lodging. These problems are caused by excess water in the wet season. In respect to the water requirement of the upland crops and fruit trees in the wet season, water supply is sufficient for the crops. The problem lies in the poor drainage in the wet season. When the drainage is improved by opening drainage canals or construction of polder dikes, low laying areas such as in Surin and Si Sa Ket would become more productive being able to convert paddy cultivation to upland or fruit tree cultivation. According to the GIS data base constructed by the present study team, 4,490,000 ha of the poor drainage areas could be improved by this project making crop diversification more easy. The government is promoting the mixed cropping, in which crop cultivation and aquaculture are combined resulting in more sustainable income in the dry season as well as wet season. This is a kind of drainage project. The Tung Kula Ronghai project is also a kind of drainage improvement project, in which irrigation by water stored in channel and drainage improvement by construction of polder dikes to prevent flooding and intrusion of salty water from up streams are being carried out. These kind projects should be promoted in more comprehensive, systematic ways and in bigger scale in the Study Area. Some salt affected areas in Nakhon Ratchasima province could be improved by preventing salt intrusion by construction of polder dikes.

Grain local assembly markets development project

Marketing system of the agricultural produce has not yet well established in the Study Area. Government supports to farmers have been oriented to production

increase in farmers' level. Producers are widely scattered and have little marketable surpluses. There are virtually no assembly markets. Storage facilities are insufficient in quality. Most of them are owned by farmers. Feeder road system is not well developed. Some of them are impassible in the rainy season. There are no official grading and inspection system. Producers are at the mercy of middlemen or merchants in grading of their products. Grains are marketed in bags and handled mostly by hand. Physical distribution of grains are not so efficient. Even in the market of paddy, which has relatively well developed marketing channels, marketing mechanism has not been well working. Farmers has no bargaining power over the middlemen, who are normally merchants selling commodities, fertilizers, chemicals etc. to their farmers with credit. Prices are arbitrary determined by the middlemen. Generally farmers have to sell major parts of their marketable surplus just after harvest when paddy prices are lowest . Farmers have urgent needs of cash to pay their debts, to purchase farm inputs for the next cropping, to pay family expenses, etc. According to the survey on post harvest practices in Thailand, 1976, by the ministry of agriculture and cooperatives, 34.6% of the paddy produced was marketed within 2-3 months in the Northeast region. To cope with these problems local assembly markets in the major transportation centers in the Study Area will be constructed. The markets would provide the following facilities.and services.to farmers and merchants.

- auction places and services
- cleaning facilities and cleaning services
- weighing machines
- storage silos or godowns and storage services including fumigation
- grading and inspection services
- milling and packing facilities and custom milling and packing services
- loading and unloading services in bulk or in bag
- short term credit services with grains in pledge
- custom clearance services for export
- transportation equipment and their services

Yasothon aquaculture center

This project will extend and expand the efforts made by the United Nations through the Mekong Secretariat. An aquaculture center will be established for breeding, fingerlings production, research and extension. The center may serve not only the Study Area but the entire Lower Mekong basin.

Agricultural audio-visual data base establishment

An effective approach to disseminate information on agriculture development will be to capitalize on farmers' initiative and for the public sector to support farmers in learning themselves through providing wider opportunities for information exchange and education in stead of the government teaches farmers what to grow and how. Considering limit and deficiency of the existing agriculture extension services, it would be more effective and cost-efficient to rely on farmers' initiative than trying to strengthen the existing extension service.

A task force may be created in each region in Thailand, the first one in the Study Area. Ubon Ratchathani will be the base for the task force, as this project would provide software to the planned "Teleport". The task force comprises personnel from the government and NGOs. It will collect information on agricultural development in

the region and establish an audio-visual data base system. Data will be processed and disseminated in various forms to farmers in the Northeast. Individual farmers will have access to the data base at libraries in provincial or district capitals or through mobile services.

Tables

Table 2.1 Land Use by Province in the Study Area, 1988

(Unit: rai)

	NAKHON RATCHASIMA	BURIRAM	UBON RATCHATANI	YASOTHON	MUKDAHAN	SURIN	SISAKET	PRACHIN-BURI	NAKHON NAYOK	STUDY AREA
TATAL AREA	12,808,728	6,451,178	11,816,311	2,601,040	2,712,394	5,077,535	5,524,985	7,473,438	1,326,250	55,791,859
FOREST	1,613,577	373,468	2,432,124	302,539	970,460	212,654	496,953	1,801,573	301,250	8,504,598
FARM LAND	8,832,055	4,209,922	6,235,672	2,099,401	800,759	3,810,576	3,470,158	3,087,051	884,591	33,430,185
HOUSING AREA	133,779	75,161	113,671	30,785	20,324	72,010	66,740	66,307	24,065	602,842
PADDY LAND	3,845,300	3,315,248	4,303,444	1,306,366	357,817	3,153,132	2,697,160	1,611,665	762,249	21,352,381
(IRRIGATED AREA)	690,009	182,045	234,714	43,600	60,992	190,382	171,180	418,087	543,880	2,534,889
FIELD CROP LAND	3,685,441	535,206	528,510	228,664	138,634	244,106	452,588	1,165,005	20,250	6,998,404
FRUIT CROP LAND	348,693	92,524	105,608	93,756	38,394	101,195	135,093	136,051	41,676	1,092,990
VEGETABLE/FLOWER LAND	32,981	12,058	105,608	93,756	2,393	6,636	32,764	12,801	673	299,670
PASTURE LAND	501,200	47,583	24,314	57,366	27,479	26,187	8,324	45,587	28,644	766,684
IDLE LAND	189,395	106,897	1,108,816	358,738	197,548	184,565	70,600	28,102	0	2,244,661
OTHER LAND	95,266	25,245	39,873	20,912	18,170	22,745	6,889	21,533	7,034	257,667
UNCLASSIFIED LAND	2,363,096	1,867,788	3,148,515	199,100	941,175	1,054,305	1,557,874	2,584,814	140,409	13,857,076

Source :" Agricultural Statistics of Thailand", Center of Agricultural Statistics, Ministry of agriculture & Cooperatives

Table 2.2 Land Holding by Number and Area of Households in the Study Area in 1988

	All			under 6 rai		6 - 9.9		10 - 39.9		40 - 139.9		140 and over	
	No.	Area(rai)	Mean	No.	Area	No.	Area	No.	Area	No.	Area	No.	Area
MUKDHAHAN	31,779	534,741	17	3,670	14,438	5,281	37,967	20,758	368,436	2,023	111,226	20	2,674
NAKHON RATCHASIMA	237,523	6,423,590	27	11,484	44,965	17,059	122,043	160,729	3,353,114	46,872	2,588,707	1,379	314,756
YASOTHON	60,878	1,187,009	19	3,963	15,431	7,027	52,228	45,116	887,883	4,746	227,906	26	3,561
UBON RATCHATANI	205,261	4,982,187	24	8,240	19,893	13,974	99,644	149,741	3,118,840	33,077	1,693,944	229	39,857
BURI RAM	160,025	3,698,262	23	13,407	48,078	12,656	88,758	122,677	2,196,768	21,064	1,090,987	221	273,617
SURIN	152,753	3,192,779	21	10,753	44,699	17,299	127,711	107,979	212,639	16,545	868,486	177	25,542
SI SA KET	150,203	2,749,857	18	14,166	54,997	20,490	142,922	102,647	1,911,151	12,858	632,467	42	8,250
NAKHON NAYOK	19,284	693,276	36	1,462	5,015	1,047	8,110	10,521	258,316	6,015	369,642	239	52,193
PRACHIN BURI	79,209	2,808,945	35	2,850	11,702	2,631	20,006	49,403	1,115,142	23,357	1,467,287	968	194,808
TOTAL	1,096,915	26,270,646	24	69,995	259,218	97,464	699,389	769,571	13,422,289	166,557	9,050,652	3,301	915,258
Percent distribution	100	100		6	1	9	3	70	51	15	34	0	3

Source: 1988 Intercensal Survey of Agriculture, National Statistical Office

Table 2.3 Number of Farm Households by Land Tenure in the Study Area in 1988 and 1990

	Owner Farmer		Owner Farmer cum Tenant		Tenant		Casual Labor Only		Total	
	1988	1990	1988	1990	1988	1990	1988	1990	1988	1990
MUKDAHAN	34,770	35,562	995	933	795	886	591	567	37151	37948
Percent distribution	94	94	3	2	2	2	2	1	100	100
NAKHON RATCHASIMA	201,854	207,644	34,105	35,702	21,015	18,756	21,571	25,766	278545	287868
Percent distribution	72	72	12	12	8	7	8	9	100	100
YASOTHON	65,078	67,338	3,556	3,554	1,441	1,418	1,839	1,698	71914	74008
Percent distribution	90	91	5	5	2	2	3	2	100	100
UBON RATCHATHANI	200,781	211,668	7,953	8,185	8,287	6,441	11,585	11,180	228606	237474
Percent distribution	88	89	3	3	4	3	5	5	100	100
BURIRAM	124,059	129,817	25,903	24,991	15,543	14,362	13,173	13,891	178678	183061
Percent distribution	69	71	14	14	9	8	7	8	100	100
SURIN	126,229	137,039	24,493	21,332	12,290	11,003	10,913	7,072	173925	176446
Percent distribution	73	78	14	12	7	6	6	4	100	100
SI SA KET	153,361	161,916	13,439	12,015	9,083	5,526	7,936	6,817	183819	186274
Percent distribution	83	87	7	6	5	3	4	4	100	100
NAKHON NAYOK	7,802	8,302	6,789	6,950	7,922	8,300	5,905	6,285	28418	29837
Percent distribution	27	28	24	23	28	28	21	21	100	100
PRACHIN BURI	69,366	72,799	16,447	15,428	15,024	15,917	15,164	17,104	116001	121248
Percent distribution	60	60	14	13	13	13	13	14	100	100
TOTAL	983,300	1,032,085	133,680	129,090	91,400	82,609	88,677	90,380	1297057	1334164
Percent distribution	76	77	10	10	7	6	7	7	100	100

Source: NESDB Village Level Socio-Economic Data Base

Table 2.4 Crop Harvested Area in the Study Area, 1982-90

(Unit: rai)

	1982	1983	1984	1985	1986	1987	1988	1989	1990
PADDY	15,079,411	14,517,271	16,091,647	16,498,472	17,209,066	16,200,621	14,625,790	16,181,637	16,145,118
MAIZE	1,826,149	1,534,990	1,779,656	1,826,142	2,032,243	1,851,102	1,617,199	1,774,358	1,716,696
CASSAVA	2,459,947	2,249,890	2,732,975	2,642,733	2,327,617	2,628,462	3,039,113	3,236,268	2,952,298
SUGAR CANE	38,368	37,932	52,227	57,698	58,383	60,790	86,250	132,040	148,850
GROUNDNUTS	95,659	84,837	72,898	113,179	114,756	107,687	104,107	113,423	120,133
COTTON	128,568	51,767	58,752	62,911	62,685	43,448	46,721	40,562	30,773
KENAF	527,174	449,350	574,614	455,057	708,532	629,020	479,742	448,314	657,867
MUNG BEAN	84,372	38,370	36,171	53,448	112,368	80,727	66,106	70,664	68,226
SORGHUM	38,772	35,677	33,400	114,184	145,030	51,839	29,819	29,721	31,231
SOYBEANS	8,100	31,442	36,120	32,823	48,076	46,473	77,540	80,650	81,802
SHALLOT						27,335	23,650	27,073	25,511
GARLIC						4,874	5,097	6,435	5,820

Sources: "Agricultural Statistics of Thailand", Center for Agricultural Statistics, Ministry of Agriculture & Cooperatives

Table 2.5 Crop Production in the Study Area, 1982-90

(Unit: ton)

	1982	1983	1984	1985	1986	1987	1988	1989	1990
PADDY	3,102,413	3,104,696	3,882,629	4,147,117	4,528,727	3,951,097	3,427,003	3,874,442	3,910,459
MAIZE	560,164	531,151	601,848	676,385	824,297	676,771	626,466	769,622	736,465
CASSAVA	6,213,623	6,779,117	6,701,307	5,949,897	4,533,866	6,134,346	6,772,016	7,894,710	6,716,639
SUGAR CANE	259,918	264,449	395,619	416,369	435,934	416,547	690,079	1,184,260	1,294,612
GROUNDNUTS	16,895	17,264	15,627	24,874	26,482	23,384	24,024	26,045	24,962
COTTON	21,214	10,590	9,566	11,906	14,706	8,772	9,998	9,971	7,899
KENAF	91,505	73,603	98,949	85,513	127,193	111,038	83,738	90,508	84,518
MUNG BEAN	10,300	4,419	3,362	5,553	10,517	6,211	6,369	7,419	7,707
SORGHUM	6,183	6,353	9,219	31,649	39,812	11,268	5,952	5,524	6,496
SOYBEANS	1,203	4,832	5,171	5,930	8,671	8,812	14,193	16,532	17,653
SHALLOT						58,256	61,585	82,898	63,407
GARLIC						2,143	2,350	3,137	3,563

Sources: "Agricultural Statistics of Thailand", Center for Agricultural Statistics, Ministry of Agriculture & Cooperatives

Table 2.6 Crop Production in the Study Area by Province, 1982-90 (1/12)

		PRODUCTION(TON)								
		1982	1983	1984	1985	1986	1987	1988	1989	1990
MUKDAHAN	PADDY		47744	69057	85933	86017	84152	67400	56876	75713
	MAIZE									
	CASSAVA			25128	36142	41209	80911	173014	237594	203665
	SUGAR CANE		15428	129267	125386	116996	106416	152842	134402	153346
	GROUNDNUTS			72	279	255	174	474	301	633
	COTTON				19	66	41		17	31
	KENAF		2716	3846	1132	2938	2872	2588	4184	3953
	MUNGBEAN				132	186				
	SORGHUM									
	SOYBEANS		6						89	120
NAKHON	PADDY	340731	421887	621558	629711	702889	523652	456196	665600	584865
RATCHASIMA	MAIZE	349344	300964	391598	393234	423299	296638	284731	402405	356806
	CASSAVA	4773063	5034984	4802506	3837392	2954656	3926631	4204709	5097926	4363073
	SUGAR CANE	29425		56244	61750	89832	85899	199961	583634	660475
	GROUNDUTS	6729	3487	2450	4414	6998	5686	5689	6677	6517
	COTTON	9866	6001	4498	4874	7258	4689	3511	3554	3103
	KENAF	8172	14901	18336	13335	26379	17187	13010	14607	14134
	MUNGBEAN	1871	979	1887	2335	4339	2629	3519	3666	5292
	SORGHUM	4626	5277	7265	28186	33155	8340	5111	4709	6496
	SOYBEANS	345	1138	2720	2748	3413	4160	5709	6550	4844
YASOTHON	PADDY	193591	117994	232477	223688	270220	198759	204804	224671	252358
	MAIZE									
	CASSAVA	95390	100625	84890	80805	57806	81771	97853	130064	79549
	SUGAR CANE	28809	28959	25385	28496	26923	11502	18422	9402	2794
	GROUNDNUTS	399	584	470	444	465	1005	625	699	1235
	COTTON									
	KENAF	9012	7061	15805	10825	10154	7611	6262	7724	6375
	MUNG BEAN	1	1		92	128				
	SORGHUM					206				
	SOYBEANS		1							

Table 2.6 Crop Production in the Study Area by Province, 1982-90 (2/12)

		1982	1983	1984	1985	1986	1987	1988	1989	1990
UBON	PADDY	547117	493242	609224	678684	743651	705083	909567	757494	802898
RATCHATHANI	MAIZE	11710	9697	3790	9057	11511	12555	10978	12157	13515
	CASSAVA	112305	118468	130893	289004	192698	287533	311181	296525	232039
	SUGAR CANE									
	GROUNDNUTS	819	836	302	1731	1589	2068	2187	2230	2758
	COTTON	321	666	982	1105	1221	679	405	361	387
	KENAF	29013	21862	22046	20933	28042	23140	18623	17641	17112
	MUNG BEAN	11			108	399	589	154	139	216
	SORGHUM				200	433				
	SOYBEANS		8							
BURIRAM	PADDY	566617	460999	726284	817370	911680	646674	385972	564999	541741
	MAIZE	23284	12115	2519	8572	30754	13619	3449	6328	9520
	CASSAVA	267941	507166	692297	646307	572906	692190	779495	693414	582830
	SUGAR CANE	165827	220062	164723	200737	202183	210498	318854	453026	477997
	GROUNDNUTS	4513	5114	5511	4338	3946	2604	2560	2915	3170
	COTTON									
	KENAF	11065	4189	8833	6024	8210	14253	5666	4133	4685
	MUNG BEAN	23	146	69	233	320	326	131	162	145
	SORGHUM				841	1771	1637			
	SOYBEANS	277	10					157	77	97
SURIN	PADDY	550606	583422	757130	588375	606230	614464	340945	373820	582659
	MAIZE									
	CASSAVA	102382	108000	78259	82105	70818	100856	109602	144118	128402
	SUGAR CANE	31276								
	GROUNDNUTS	2017	992	634	1355	2201	1769	2058	1560	1324
	COTTON									
	KENAF	12340	5612	13704	9346	12881	13910	9530	7658	9303
	MUNG BEAN	52		42	60					
	SORGHUM				105					
	SOYBEANS		19						117	47

Table 2.6 Crop Production in the Study Area by Province, 1982-90 (3/12)

		1982	1983	1984	1985	1986	1987	1988	1989	1990
SISAKET	PADDY	421648	342415	418967	549148	601235	570448	457098	588327	517896
	MAIZE	47970	67252	62574	83092	71562	64703	68556	60161	74167
	CASSAVA	117404	123847	70188	174638	111576	157446	162179	148317	126491
	SUGAR CANE									
	GROUNDNUTS	1239	4868	3721	4197	4902	5326	5174	6420	5007
	COTTON									
	KENAF	21903	17262	14705	19647	26881	19534	17651	20871	18167
	MUNG BEAN	198	70	97	714	1296	1206	1223	1437	
	SORGHUM				463	1153	747	455		
	SOYBEANS	1						77	199	125
	SHALLOT						58256	61585	82898	63407
	GARLIC						2143	2350	3137	3563
PRACHINBURI	PADDY	313947	446821	300344	390397	423570	408831	344308	384975	365697
	MAIZE	126982	141123	141367	182430	287171	289256	258752	288571	281767
	CASSAVA	733559	773813	804576	795094	524394	793266	919742	1135885	990988
	SUGAR CANE								3796	
	GROUNDNUTS	1179	1381	2467	8076	6126	4752	5257	5243	4318
	COTTON	11027	3923	4086	5908	6161	3363	6082	6039	4378
	KENAF			1674	4271	11708	12531	10408	13690	10789
	MUNG BEAN	8144	3195	1267	1879	3849	1461	1342	2015	2054
	SORGHUM	1557	1076	1954	1854	3094	544	386	815	
	SOYBEANS	580	3650	2451	3182	5258	4652	8250	9500	12420
NAKHON NAYOK	PADDY	168156	190172	147588	183811	183235	199034	260713	257680	186632
	MAIZE	874								690
	CASSAVA	11579	12214	12570	8410	7803	13742	14241	10867	9602
	SUGAR CANE	4581					2232			
	GROUNDNUTS		2		40					
	COTTON									
	KENAF									
	MUNG BEAN		28							
	SORGHUM									
	SOYBEANS									

Table 2.6 Crop Production in the Study Area by Province, 1982-90 (4/12)

		1982	1983	1984	1985	1986	1987	1988	1989	1990
STUDY AREA	PADDY	3102413	3104696	3882629	4147117	4528727	3951097	3427003	3874442	3910459
	MAIZE	560164	531151	601848	676385	824297	676771	626466	769622	736465
	CASSAVA	6213623	6779117	6701307	5949897	4533866	6134346	6772016	7894710	6716639
	SUGAR CANE	259918	264449	395619	416369	435934	416547	690079	1184260	1294612
	GROUNDNUTS	16895	17264	15627	24874	26482	23384	24024	26045	24962
	COTTON	21214	10590	9566	11906	14706	8772	9998	9971	7899
	KENAF	91505	73603	98949	85513	127193	111038	83738	90508	84518
	MUNG BEAN	10300	4419	3362	5553	10517	6211	6369	7419	7707
	SORGHUM	6183	6353	9219	31649	39812	11268	5952	5524	6496
	SOYBEANS	1203	4832	5171	5930	8671	8812	14193	16532	17653
	SHALLOT						58256	61585	82898	63407
	GARLIC						2143	2350	3137	3563

Table 2.6 Crop Production in the Study Area by Province, 1982-90 (5/12)

		HARVESTED AREA(RAI)								
		1982	1983	1984	1985	1986	1987	1988	1989	1990
MUKDAHAN	PADDY		179339	308048	316701	320328	295461	308338	304131	322916
	MAIZE									
	CASSAVA			14038	17630	19549	39704	79038	102235	97378
	SUGAR CANE		2856	18183	20845	15791	15705	16740	16716	16911
	GROUNDNUTS			537	1397	2201	1334	2238	1924	3171
	COTTON				208	409	64		196	320
	KENAF		15570	18637	4707	17847	20419	14289	20991	19663
	MUNGBEAN				1639	1629				
	SORGHUM									
	SOYBEANS		44						714	558
NAKHON	PADDY	1736501	1849296	2370052	2437518	2606255	2381737	2305293	2980166	2589192
RATCHASIMA	MAIZE	1262925	1149935	1221748	1127766	1182591	1045039	846022	995636	935480
	CASSAVA	1955476	1624283	1896712	1671338	1540936	1671618	1958807	2079937	1880298
	SUGAR CANE	7422		6818	6663	12835	14052	26986	59591	72019
	GROUNDUTS	32173	16675	11724	23127	28618	24418	23790	30015	28703
	COTTON	45642	30496	20790	29283	29219	24134	16646	11731	10068
	KENAF	69016	103993	98359	78757	154105	122992	80876	74146	68476
	MUNGBEAN	15703	11689	21199	25805	43154	41114	38105	35091	48129
	SORGHUM	32474	28551	25766	98490	116175	41071	26465	25859	31231
	SOYBEANS	3286	5576	13837	15108	18450	21297	26449	31422	24618
YASOTHON	PADDY	944580	689693	981499	988267	1075013	921055	1012741	1045983	1102831
	MAIZE									
	CASSAVA	36232	36565	37827	38830	33495	36877	41889	56871	36975
	SUGAR CANE	3270	6638	5021	5571	4476	2022	2373	1243	308
	GROUNDNUTS	2797	5058	2438	2636	2185	5823	3064	3690	6043
	COTTON									
	KENAF	44761	38405	81368	50101	55829	43845	38187	36783	33938
	MUNG BEAN	33	15		984	2005				
	SORGHUM					1010				
	SOYBEANS		15							

Table 2.6 Crop Production in the Study Area by Province, 1982-90 (6/12)

		1982	1983	1984	1985	1986	1987	1988	1989	1990
UBON	PADDY	3343464	3106744	3406210	3459143	3617286	3622179	3773145	3641957	3673493
RATCHATHANI	MAIZE	45062	18622	11664	21117	25716	27844	22146	26355	29448
	CASSAVA	36223	60552	70179	132510	104927	117977	127533	121776	112903
	SUGAR CANE									
	GROUNDNUTS	4800	6198	1902	10180	7733	11063	10448	10319	12744
	COTTON	1628	3607	5010	6842	7827	1999	2191	1309	1393
	KENAF	163165	124713	134053	118714	174359	152509	115705	109371	106124
	MUNG BEAN	134			1343	5365	6319	1531	1371	1803
	SORGHUM				855	1514				
	SOYBEANS		112							
BURIRAM	PADDY	2307576	2035551	2575291	2583563	2954109	2638229	1794429	2550458	1927591
	MAIZE	75880	28724	9189	22886	81079	36542	11496	20069	28192
	CASSAVA	101867	248575	327534	307972	286372	310090	338029	304396	275234
	SUGAR CANE	22153	28438	22205	24619	25281	28639	40151	54030	59612
	GROUNDNUTS	28236	21347	22700	22906	16746	11613	12743	13684	19003
	COTTON									
	KENAF	62408	33993	63091	35436	48773	71609	34694	24750	273783
	MUNG BEAN	216	1462	764	2259	4000	3666	1600	1781	1453
	SORGHUM				4438	10800	5699			
	SOYBEANS	1216	51					964	487	732
SURIN	PADDY	2537816	2682661	3046478	2388786	2373306	2312819	1494937	1442829	2328907
	MAIZE									
	CASSAVA	49628	41139	32626	43236	34834	49342	51192	62093	62208
	SUGAR CANE	4744								
	GROUNDNUTS	13466	3429	4647	7619	11810	7053	9669	7038	5902
	COTTON									
	KENAF	62536	36870	82057	47314	66224	70267	54057	47863	45149
	MUNG BEAN	565		573	732					
	SORGHUM				456					
	SOYBEANS		94						775	420

Table 2.6 Crop Production in the Study Area by Province, 1982-90 (7/12)

		1982	1983	1984	1985	1986	1987	1988	1989	1990
SISAKET	PADDY	2114339	2000772	1801261	2238733	2175767	2152279	1892056	1996437	2140077
	MAIZE	122065	160698	170331	182919	154954	145619	148754	141790	155803
	CASSAVA	40192	32156	33092	81683	54799	64527	65421	61773	60141
	SUGAR CANE									
	GROUNDNUTS	5855	24093	16760	18122	24149	23176	20508	25171	22871
	COTTON									
	KENAF	125288	95806	87013	103196	147228	105390	100159	93176	76670
	MUNG BEAN	1762	580	940	7103	15434	13750	12784	17107	
	SORGHUM				2338	3010	2478	1355		
	SOYBEANS	17						514	1131	712
	SHALLOT						27335	23650	27073	25511
	GARLIC						4874	5098	6435	5820
PRACHINBURI	PADDY	1474972	1343164	1050914	1506448	1512373	1347066	1386516	1505634	1490931
	MAIZE	318186	177011	366724	471454	587903	596058	588781	590508	565698
	CASSAVA	237168	201698	316354	345693	249257	332165	370565	442495	422736
	SUGAR CANE								460	
	GROUNDNUTS	8332	8022	12190	27062	21314	23207	21647	21582	21696
	COTTON	81298	17664	32952	26578	25230	17251	27884	27326	18992
	KENAF			10036	16832	44167	41989	41775	41234	34064
	MUNG BEAN	65959	24178	12695	13583	40781	15878	12086	15314	16841
	SORGHUM	6298	7126	7634	7607	12521	2591	1999	3862	
	SOYBEANS	3581	25550	22283	17715	29626	25176	49613	46121	54762
NAKHON NAYOK	PADDY	620163	630051	551894	579313	574629	529796	658335	714042	569180
	MAIZE	2031								2075
	CASSAVA	3161	4922	4613	3841	3448	6162	6639	4692	4425
	SUGAR CANE	779					372			
	GROUNDNUTS		15		130					
	COTTON									
	KENAF									
	MUNG BEAN		446							
	SORGHUM									
	SOYBEANS									

Table 2.6 Crop Production in the Study Area by Province, 1982-90 (8/12)

		1982	1983	1984	1985	1986	1987	1988	1989	1990
STUDY AREA	PADDY	15079411	14517271	16091647	16498472	17209066	16200621	14625790	16181637	16145118
	MAIZE	1826149	1534990	1779656	1826142	2032243	1851102	1617199	1774358	1716696
	CASSAVA	2459947	2249890	2732975	2642733	2327617	2628462	3039113	3236268	2952298
	SUGAR CANE	38368	37932	52227	57698	58383	60790	86250	132040	148850
	GROUNDNUTS	95659	84837	72898	113179	114756	107687	104107	113423	120133
	COTTON	128568	51767	58752	62911	62685	43448	46721	40562	30773
	KENAF	527174	449350	574614	455057	708532	629020	479742	448314	657867
	MUNG BEAN	84372	38370	36171	53448	112368	80727	66106	70664	68226
	SORGHUM	38772	35677	33400	114184	145030	51839	29819	29721	31231
	SOYBEANS	8100	31442	36120	32823	48076	46473	77540	80650	81802
	SHALLOT						27335	23650	27073	25511
	GARLIC						4874	5097	6435	5820

Table 2.6 Crop Production in the Study Area by Province, 1982-90 (9/12)

		YIELDS(TON/HA)								
		1982	1983	1984	1985	1986	1987	1988	1989	1990
MUKDAHAN	PADDY	0.00	1.66	1.40	1.70	1.68	1.78	1.37	1.17	1.47
	MAIZE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	CASSAVA	0.00	0.00	11.19	12.81	13.17	12.74	13.68	14.52	13.07
	SUGAR CANE	0.00	33.76	44.43	37.59	46.31	42.35	57.06	50.25	56.67
	GROUNDNUTS	0.00	0.00	0.84	1.25	0.72	0.82	1.32	0.98	1.25
	COTTON	0.00	0.00	0.00	0.57	1.01	4.00	0.00	0.54	0.61
	KENAF	0.00	1.09	1.29	1.50	1.03	0.88	1.13	1.25	1.26
	MUNGBEAN	0.00	0.00	0.00	0.50	0.71	0.00	0.00	0.00	0.00
	SORGHUM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	SOYBEANS	0.00	0.85	0.00	0.00	0.00	0.00	0.00	0.78	1.34
NAKHON	PADDY	1.23	1.43	1.64	1.61	1.69	1.37	1.24	1.40	1.41
RATCHASIMA	MAIZE	1.73	1.64	2.00	2.18	2.24	1.77	2.10	2.53	2.38
	CASSAVA	15.26	19.37	15.83	14.35	11.98	14.68	13.42	15.32	14.50
	SUGAR CANE	24.78	0.00	51.56	57.92	43.74	38.21	46.31	61.21	57.32
	GROUNDUTS	1.31	1.31	1.31	1.19	1.53	1.46	1.49	1.39	1.42
	COTTON	1.35	1.23	1.35	1.04	1.55	1.21	1.32	1.89	1.93
	KENAF	0.74	0.90	1.17	1.06	1.07	0.87	1.01	1.23	1.29
	MUNGBEAN	0.74	0.52	0.56	0.57	0.63	0.40	0.58	0.65	0.69
	SORGHUM	0.89	1.16	1.76	1.79	1.78	1.27	1.21	1.14	1.30
	SOYBEANS	0.66	1.28	1.23	1.14	1.16	1.22	1.35	1.30	1.23
YASOTHON	PADDY	1.28	1.07	1.48	1.41	1.57	1.35	1.26	1.34	1.43
	MAIZE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	CASSAVA	16.45	17.20	14.03	13.01	10.79	13.86	14.60	14.29	13.45
	SUGAR CANE	55.06	27.27	31.60	31.97	37.59	35.55	48.52	47.27	56.70
	GROUNDNUTS	0.89	0.72	1.20	1.05	1.33	1.08	1.27	1.18	1.28
	COTTON	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	KENAF	1.26	1.15	1.21	1.35	1.14	1.08	1.02	1.31	1.17
	MUNG BEAN	0.19	0.42	0.00	0.58	0.40	0.00	0.00	0.00	0.00
	SORGHUM	0.00	0.00	0.00	0.00	1.27	0.00	0.00	0.00	0.00
	SOYBEANS	0.00	0.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 2.6 Crop Production in the Study Area by Province, 1982-90 (10/12)

		1982	1983	1984	1985	1986	1987	1988	1989	1990
UBON	PADDY	1.02	0.99	1.12	1.23	1.28	1.22	1.51	1.30	1.37
RATCHATHANI	MAIZE	1.62	3.25	2.03	2.68	2.80	2.82	3.10	2.88	2.87
	CASSAVA	19.38	12.23	11.66	13.63	11.48	15.23	15.25	15.22	12.85
	SUGAR CANE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	GROUNDNUTS	1.07	0.84	0.99	1.06	1.28	1.17	1.31	1.35	1.35
	COTTON	1.23	1.15	1.23	1.01	0.97	2.12	1.16	1.72	1.74
	KENAF	1.11	1.10	1.03	1.10	1.01	0.95	1.01	1.01	1.01
	MUNG BEAN	0.51	0.00	0.00	0.50	0.46	0.58	0.63	0.63	0.75
	SORGHUM	0.00	0.00	0.00	1.46	1.79	0.00	0.00	0.00	0.00
	SOYBEANS	0.00	0.45	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BURIRAM	PADDY	1.53	1.42	1.76	1.98	1.93	1.53	1.34	1.38	1.76
	MAIZE	1.92	2.64	1.71	2.34	2.37	2.33	1.88	1.97	2.11
	CASSAVA	16.44	12.75	13.21	13.12	12.50	13.95	14.41	14.24	13.23
	SUGAR CANE	46.78	48.36	51.99	50.96	49.98	45.94	49.63	52.40	50.12
	GROUNDNUTS	1.00	1.50	1.52	1.18	1.47	1.40	1.26	1.33	1.04
	COTTON	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	KENAF	1.11	0.77	0.88	1.06	1.05	1.24	1.02	1.04	0.11
	MUNG BEAN	0.67	0.62	0.56	0.64	0.50	0.56	0.51	0.57	0.62
	SORGHUM	0.00	0.00	0.00	1.18	1.02	1.80	0.00	0.00	0.00
	SOYBEANS	1.42	1.23	0.00	0.00	0.00	0.00	1.02	0.99	0.83
SURIN	PADDY	1.36	1.36	1.55	1.54	1.60	1.66	1.43	1.62	1.56
	MAIZE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	CASSAVA	12.89	16.41	14.99	11.87	12.71	12.78	13.38	14.51	12.90
	SUGAR CANE	41.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	GROUNDNUTS	0.94	1.81	0.85	1.11	1.16	1.57	1.33	1.39	1.40
	COTTON	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	KENAF	1.23	0.95	1.04	1.23	1.22	1.24	1.10	1.00	1.29
	MUNG BEAN	0.58	0.00	0.46	0.51	0.00	0.00	0.00	0.00	0.00
	SORGHUM	0.00	0.00	0.00	1.44	0.00	0.00	0.00	0.00	0.00
	SOYBEANS	0.00	1.26	0.00	0.00	0.00	0.00	0.00	0.94	0.70

Table 2.6 Crop Production in the Study Area by Province, 1982-90 (11/12)

		1982	1983	1984	1985	1986	1987	1988	1989	1990
SISAKET	PADDY	1.25	1.07	1.45	1.53	1.73	1.66	1.51	1.84	1.51
	MAIZE	2.46	2.62	2.30	2.84	2.89	2.78	2.88	2.65	2.98
	CASSAVA	18.26	24.07	13.26	13.36	12.73	15.25	15.49	15.01	13.15
	SUGAR CANE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	GROUNDNUTS	1.32	1.26	1.39	1.45	1.27	1.44	1.58	1.59	1.37
	COTTON	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	KENAF	1.09	1.13	1.06	1.19	1.14	1.16	1.10	1.40	1.48
	MUNG BEAN	0.70	0.75	0.64	0.63	0.52	0.55	0.60	0.53	0.00
	SORGHUM	0.00	0.00	0.00	1.24	2.39	1.88	2.10	0.00	0.00
	SOYBEANS	0.37	0.00	0.00	0.00	0.00	0.00	0.94	1.10	1.10
	SHALLOT	0.00	0.00	0.00	0.00	0.00	13.32	16.28	19.14	15.53
	GARLIC	0.00	0.00	0.00	0.00	0.00	2.75	2.88	3.05	3.83
PRACHINBURI	PADDY	1.33	2.08	1.79	1.62	1.75	1.90	1.55	1.60	1.53
	MAIZE	2.49	4.98	2.41	2.42	3.05	3.03	2.75	3.05	3.11
	CASSAVA	19.33	23.98	15.90	14.38	13.15	14.93	15.51	16.04	14.65
	SUGAR CANE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	51.58	0.00
	GROUNDNUTS	0.88	1.08	1.26	1.87	1.80	1.28	1.52	1.52	1.24
	COTTON	0.85	1.39	0.77	1.39	1.53	1.22	1.36	1.38	1.44
	KENAF	0.00	0.00	1.04	1.59	1.66	1.87	1.56	2.08	1.98
	MUNG BEAN	0.77	0.83	0.62	0.86	0.59	0.58	0.69	0.82	0.76
	SORGHUM	1.55	0.94	1.60	1.52	1.54	1.31	1.21	1.32	0.00
	SOYBEANS	1.01	0.89	0.69	1.12	1.11	1.15	1.04	1.29	1.42
NAKHON NAYOK	PADDY	1.69	1.89	1.67	1.98	1.99	2.35	2.48	2.26	2.05
	MAIZE	2.69	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.08
	CASSAVA	22.89	15.51	17.03	13.68	14.14	13.94	13.41	14.48	13.56
	SUGAR CANE	36.75	0.00	0.00	0.00	0.00	37.50	0.00	0.00	0.00
	GROUNDNUTS	0.00	0.83	0.00	1.92	0.00	0.00	0.00	0.00	0.00
	COTTON	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	KENAF	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	MUNG BEAN	0.00	0.39	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	SORGHUM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	SOYBEANS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 2.6 Crop Production in the Study Area by Province, 1982-90 (12/12)

		1982	1983	1984	1985	1986	1987	1988	1989	1990
STUDY AREA	PADDY	1.29	1.34	1.51	1.57	1.64	1.52	1.46	1.50	1.51
	MAIZE	1.92	2.16	2.11	2.31	2.54	2.29	2.42	2.71	2.68
	CASSAVA	15.79	18.83	15.33	14.07	12.17	14.59	13.93	15.25	14.22
	SUGAR CANE	42.34	43.57	47.34	45.10	46.67	42.83	50.01	56.06	54.36
	GROUNDNUTS	1.10	1.27	1.34	1.37	1.44	1.36	1.44	1.44	1.30
	COTTON	1.03	1.28	1.02	1.18	1.47	1.26	1.34	1.54	1.60
	KENAF	1.08	1.02	1.08	1.17	1.12	1.10	1.09	1.26	0.80
	MUNG BEAN	0.76	0.72	0.58	0.65	0.58	0.48	0.60	0.66	0.71
	SORGHUM	1.00	1.11	1.73	1.73	1.72	1.36	1.25	1.16	1.30
	SOYBEANS	0.93	0.96	0.89	1.13	1.13	1.19	1.14	1.28	1.35
	SHALLOT	0.00	0.00	0.00	0.00	0.00	13.32	16.28	19.14	15.53
	GARLIC	0.00	0.00	0.00	0.00	0.00	2.75	2.88	3.05	3.83

Source: "Agricultural Statistics of Thailand", Center for Agricultural Statistics, Ministry of Agriculture & Cooperatives

Table 2.7 Livestock and Poultry Population in the Study Area, 1982-90

	1982	1983	1984	1985	1986	1987	1988	1989	1990
BUFFALOES	1,892,443	1,973,859	2,043,194	2,016,158	2,020,944	2,031,186	1,986,634	1,933,259	1,766,681
CATTLE	745,920	855,959	842,236	840,759	851,346	862,318	874,492	931,709	974,020
SWINE	691,601	683,864	698,714	681,223	682,181	681,414	643,051	694,569	721,168
DUCK	0	0	0	2,157,552	2,378,463	2,369,868	2,955,185	2,580,116	2,643,285
CHICHEN	0	0	0	14,609,337	14,899,853	14,407,751	22,943,624	25,318,540	24,711,571

Source :" Agricultural Statistics of Thailand", Center of Agricultural Statistics, Ministry of agriculture & Cooperatives

Table 2.8 Number of Livestock and Their Distribution in Related Provinces in 1990

KINDS OF LIVESTOCK	NAKHON RATCHASMA	BURIRAM	UBON RATCHATANI	YASOTHON	MUKDAHAN	SURIN	SISAKET	PRACHIN-BURI	NAKHON NAYOK
1.NUMBER									
BUFFALOES	196307	306509	357584	105646	98549	306966	285048	97814	12258
CATTLE	301408	73150	188036	54824	43772	119246	118162	67626	7796
SWINE	241444	142739	69537	15686	19303	91031	58059	72009	11360
DUCK	418571	265252	556729	149099	80993	462670	513738	158461	37772
CHICHEN	4739262	3441238	6730788	1173881	325422	2860002	3080156	1305623	1055199
TOTAL	5896992	4228888	7902674	1499136	568039	3839915	4055163	1701533	1124385
2.DISTRIBUTION									
BUFFALOES	3	7	5	7	17	8	7	6	1
CATTLE	5	2	2	4	8	3	3	4	1
SWINE	4	3	1	1	3	2	1	4	1
DUCK	7	6	7	10	14	12	13	9	3
CHICHEN	80	81	85	78	57	74	76	77	94
TOTAL	100	100	100	100	100	100	100	100	100

Source :" Agricultural Statistics of Thailand", Center of Agricultural Statistics, Ministry of agriculture & Cooperatives

Table 2.9 Value Added from Fresh Water Fisheries in the Study Area, 1983-89, in 1972 Constant Prices

(UNIT :1,000 Baht)

	1983	1984	1985	1986	1987	1988	1989
MUKDAHAN	19,994	22,730	27,469	14,820	12,100	13,302	12,538
NAKHON RATCHASIMA	17,943	17,903	52,677	15,856	21,656	24,013	27,850
YASOTHON	8,242	13,006	1,837	13,064	22,257	25,543	33,513
UBON RATCHATHANI	19,915	45,564	67,692	55,257	61,703	74,612	83,666
BURI RAM	38,056	19,466	36,037	51,954	40,407	37,171	30,681
SURIN	62,407	57,824	42,661	27,043	38,043	42,553	50,270
SI SA KET	25,732	18,111	38,669	30,016	22,017	50,563	80,678
NAKHON NAYOK	9,192	11,193	12,128	3,268	3,636	4,756	5,226
PRACHIN BURI	5,690	2,414	4,496	5,028	8,481	6,068	6,252
TOTAL	207,171	208,211	283,666	216,306	230,300	278,581	330,674

Source: NESDB

Table 2.10 Farm Household Income and Expenditure in the Northeast Region

(Current price)

	1978/79	1982/83	1986/87
1.CASH GROSS INCOME	7631	11494	11020
CROPS	6387	8753	8136
LIVESTOCK/POULTRY	934	2609	2762
OTHERS	310	132	122
2.CASH FARM EXPENDITURE	3550	5748	4356
3.NET FARM CASH INCOME	4081	5746	6664
4.NON-FARM CASH INCOME	6459	12529	11246
5.LIVING CASH EXPEDITURE	8281	16039	14130
6.NET SURPLUS	2259	2236	3780

(1985 constant prices)

	1978/79	1982/83	1986/87
1.CASH GROSS INCOME	12151	12086	10846
CROPS	10170	9204	8008
LIVESTOCK/POULTRY	1487	2743	2719
OTHERS	494	139	120
2.CASH FARM EXPENDITURE	5653	6044	4287
3.NET FARM CASH INCOME	6498	6042	6559
4.NON-FARM CASH INCOME	10285	13175	11069
5.LIVING CASH EXPEDITURE	13186	16865	13907
6.NET SURPLUS	3597	2351	3720

Source :" Agricultural Statistics of Thailand", Center of Agricultural Statistics, Ministry of agriculture & Cooperatives
IMF International Financial Statistics for Constant Price Index(IRRI World Rice Statistics 1990)

Table 3.1 Projection of LNE-UE Agricultural Value-Added

(Unit : 10^6 Bahts in 1989 price)

Subsector	Value-added in 1989	Assumption	Value-added in 2010	Average growth gate (% p.a.)
Crop cultivation				
Paddy	11,313	No net area change, 50% yield increase due to irrigation, double cropping and technological advancement	17,000	1.96
Existing field and tree crops	12,392	No net area change, 30% increase due to yields and changes in crop composition	16,100	
Conversion/activation	-			
Oil crops		400,000 rai, unit VA = 2,000 Baht/rai	800	3.90
Fruits and vegetables		1,600,000 rai, unit VA = 6,750 Baht/rai	10,800	
Subtotal	23,705		44,700	3.07
Livestock	9,172	Threefold increase	28,200	5.49
Fishery	1,023	Threefold increase	3,100	5.42
Commercial forestry	-	60,000 ha for fast growing tree species, unit VA = 6,400 Baht/ha	400	-
Total	33,900		76,400	3.90

Table 3.2 Land Suitability for Reservoir

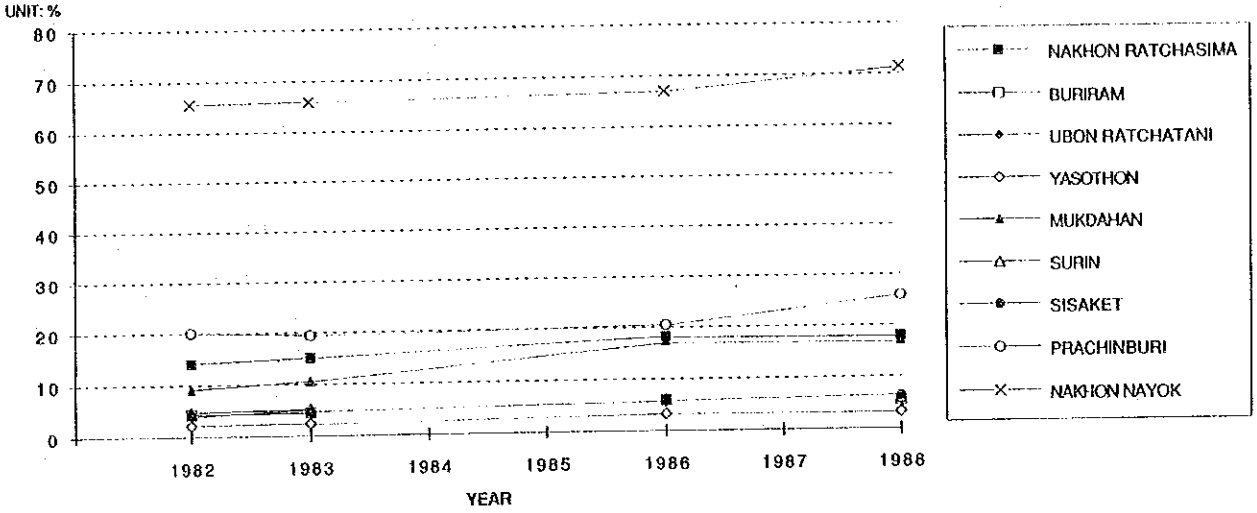
Lower Northeast Unit:ha

Present Land Use	Land Suitability for Reservoir	
	I +II	
	Recommended Land Use	
	Paddy	Upland Crops/ Fruit Trees
(a)Rainfed paddy	1,091,592	137,911
(b)Rainfed field crops	116,371	25,257
(c)Rainfed fruit trees		330
(d)Grass land	499	
(e)Barren land	1,514	
(f)Mixed rainfed paddy and forest	54,524	4,760
(g)Mixed rainfed upland crops and forest	10,225	4,639
Total	1,274,725	172,896

Source : GIS analysis of the present study

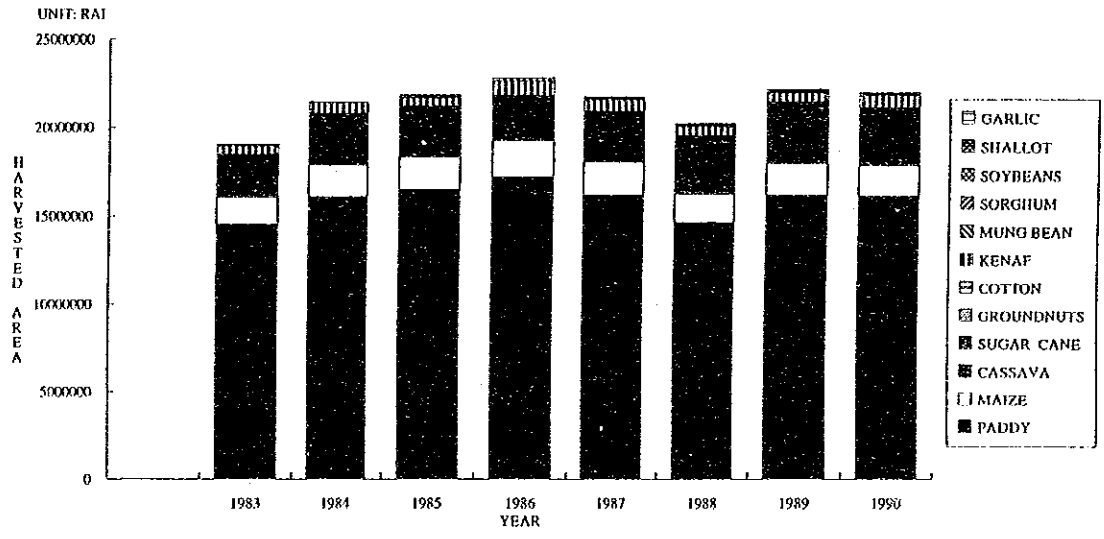
Figures

Figure 2.1 Percentages of Irrigated Area to Paddy Land



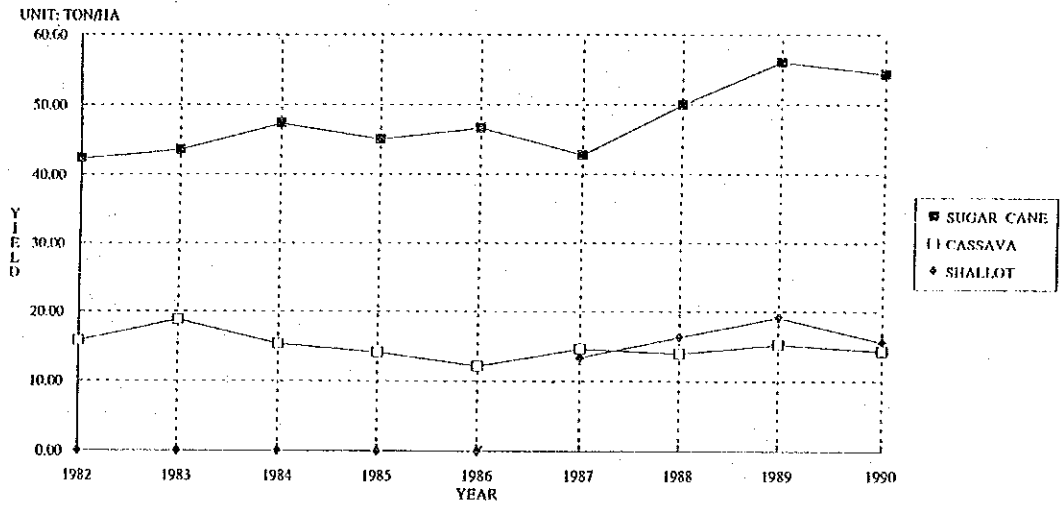
Source: "Agricultural Statistics of Thailand", Center for Agricultural Statistics, Ministry of Agriculture & Cooperatives

Figure 2.2 Crop Harvested Area in the Study Area, 1983-1990



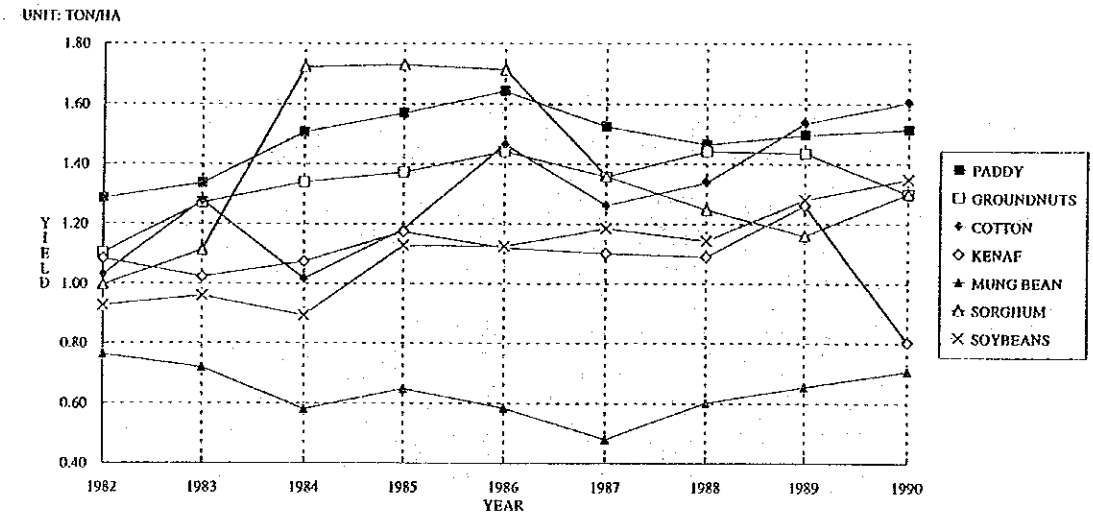
Source: National Economic and Social Development Board, National Account Division

Figure 2.3 Crop Yield in the Study Area (1), 1982-1990



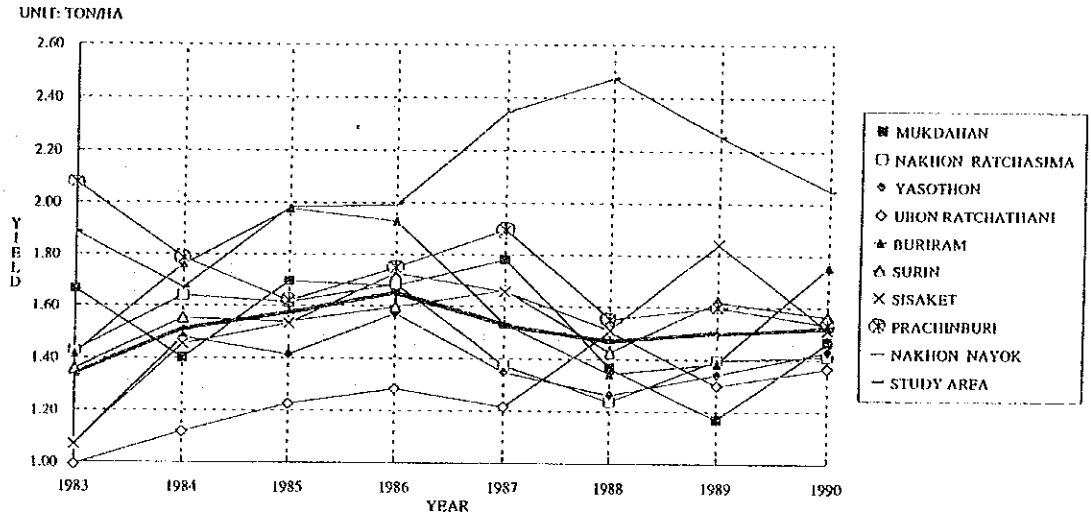
Source: "Agricultural Statistics of Thailand", Center for Agricultural Statistics, Ministry of Agriculture & Cooperatives

Figure 2.4 Crop Yield in the Study Area (2), 1982-1990



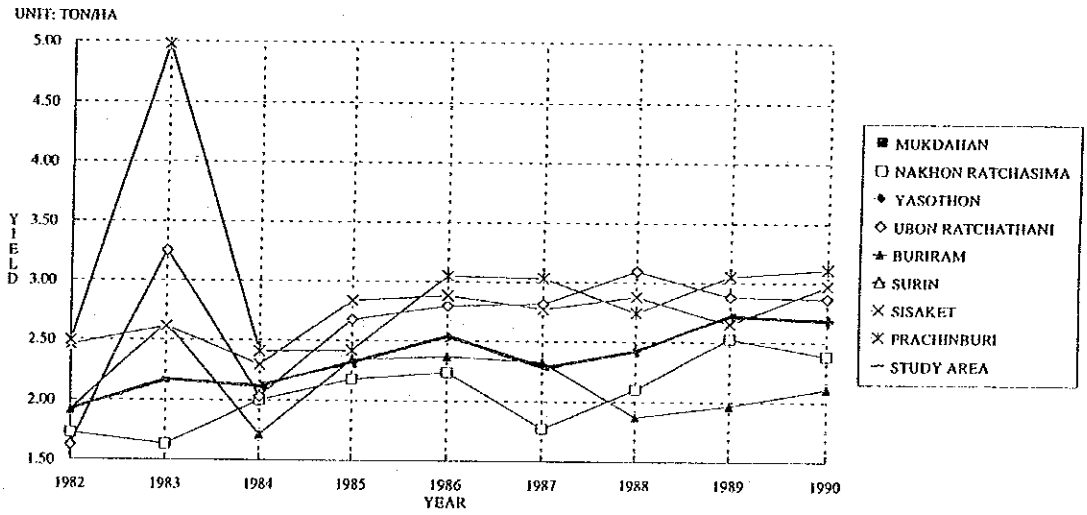
Source: "Agricultural Statistics of Thailand", Center for Agricultural Statistics, Ministry of Agriculture & Cooperatives

Figure 2.5 Paddy Yield in the Study Area, 1983-1990



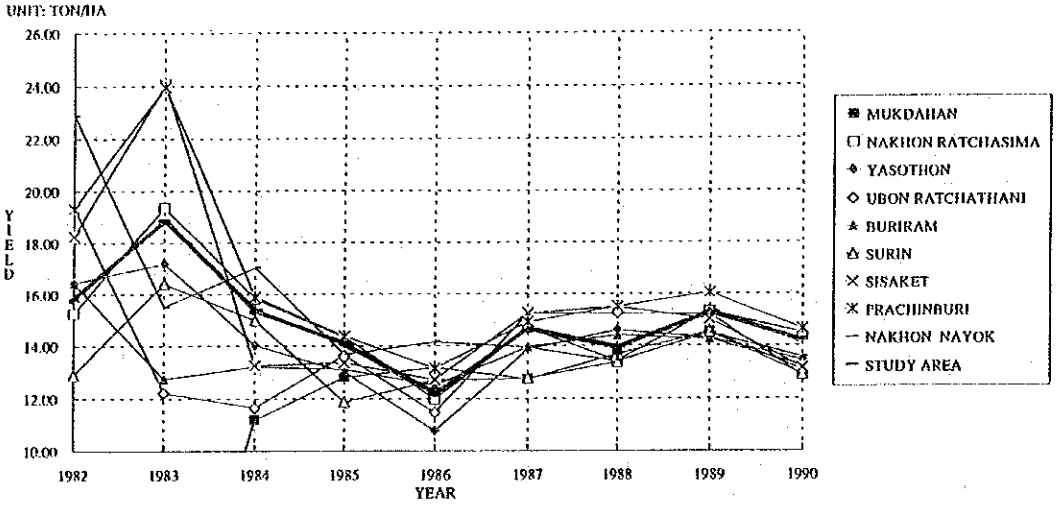
Source: "Agricultural Statistics of Thailand", Center for Agricultural Statistics, Ministry of Agriculture & Cooperatives

Figure 2.6 Maize Yield in the Study Area, 1982-1990



Source: "Agricultural Statistics of Thailand", Center for Agricultural Statistics, Ministry of Agriculture & Cooperatives

Figure 2.7 Cassava Yield in the Study Area, 1982-1990



Source: "Agricultural Statistics of Thailand", Center for Agricultural Statistics, Ministry of Agriculture & Cooperatives

Figure 2.8 Cropping Calendar in the Study Area

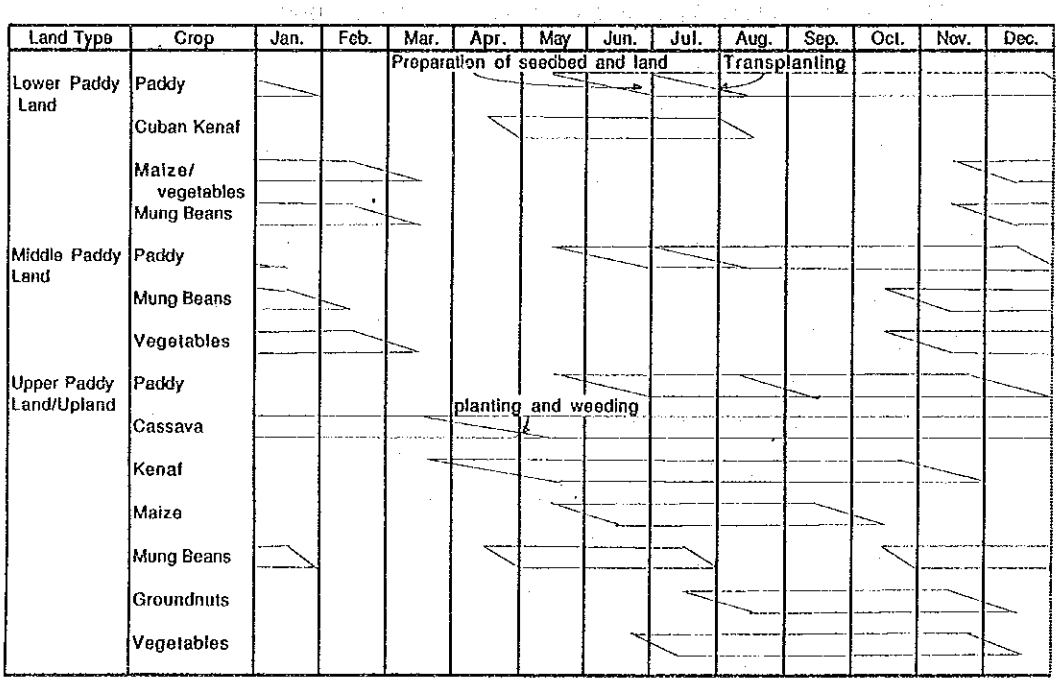
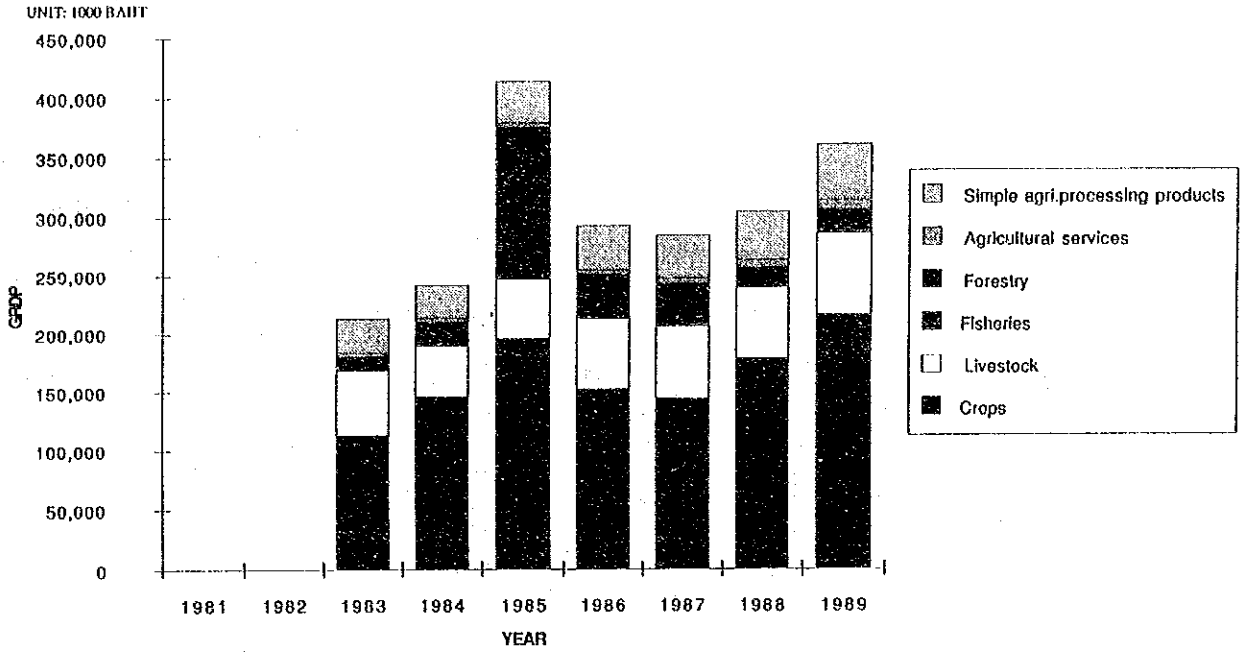
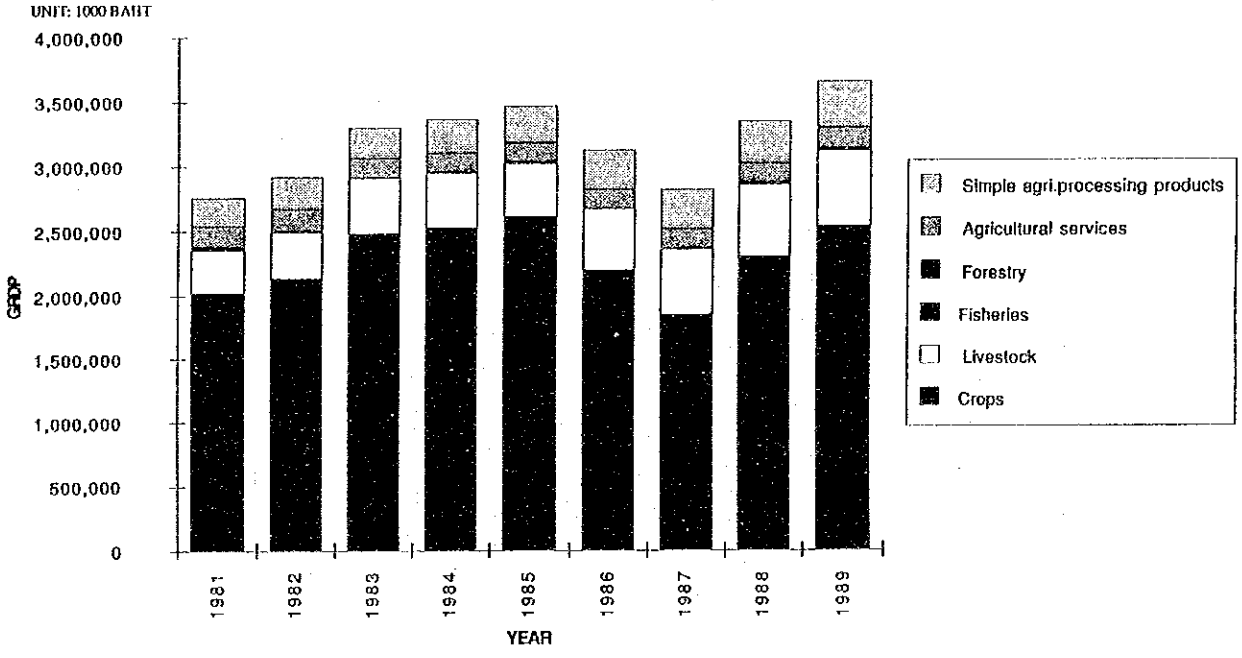


Figure 2.9 Agricultural GRDP at 1972 Constant Prices in Mukdahan, 1983-1989



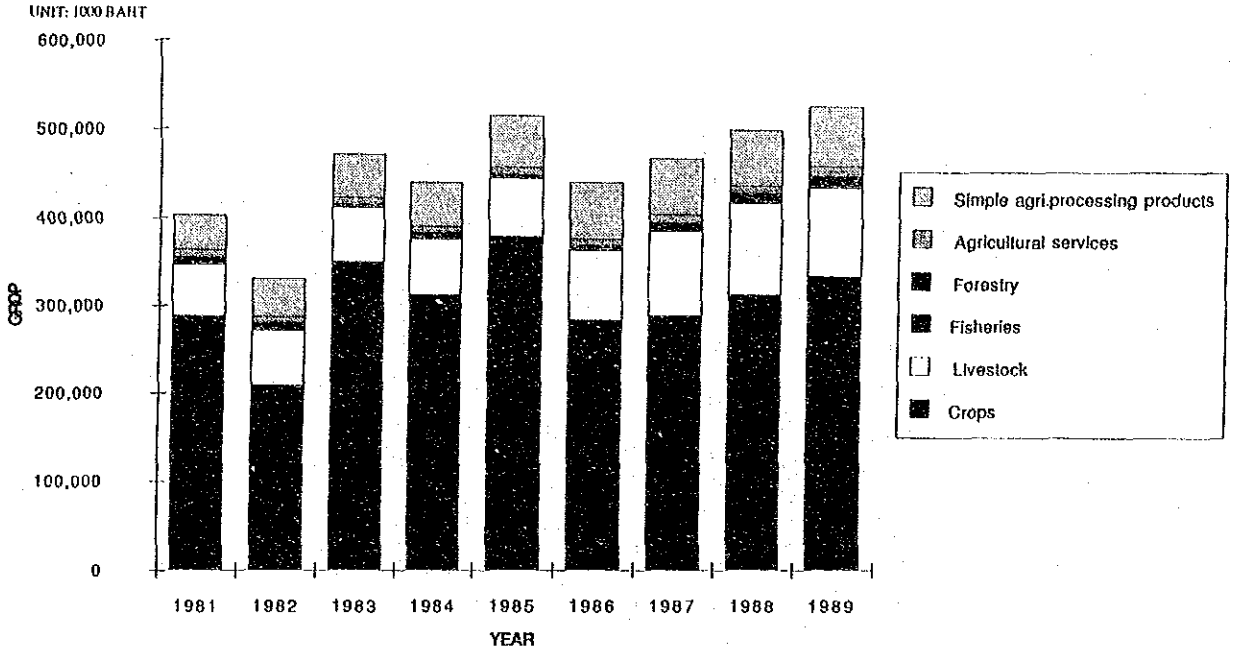
Source: National Economic and Social Development Board, National Account Division

Figure 2.10 Agricultural GRDP at 1972 Constant Prices in Nakhon Ratchasima, 1981-1989



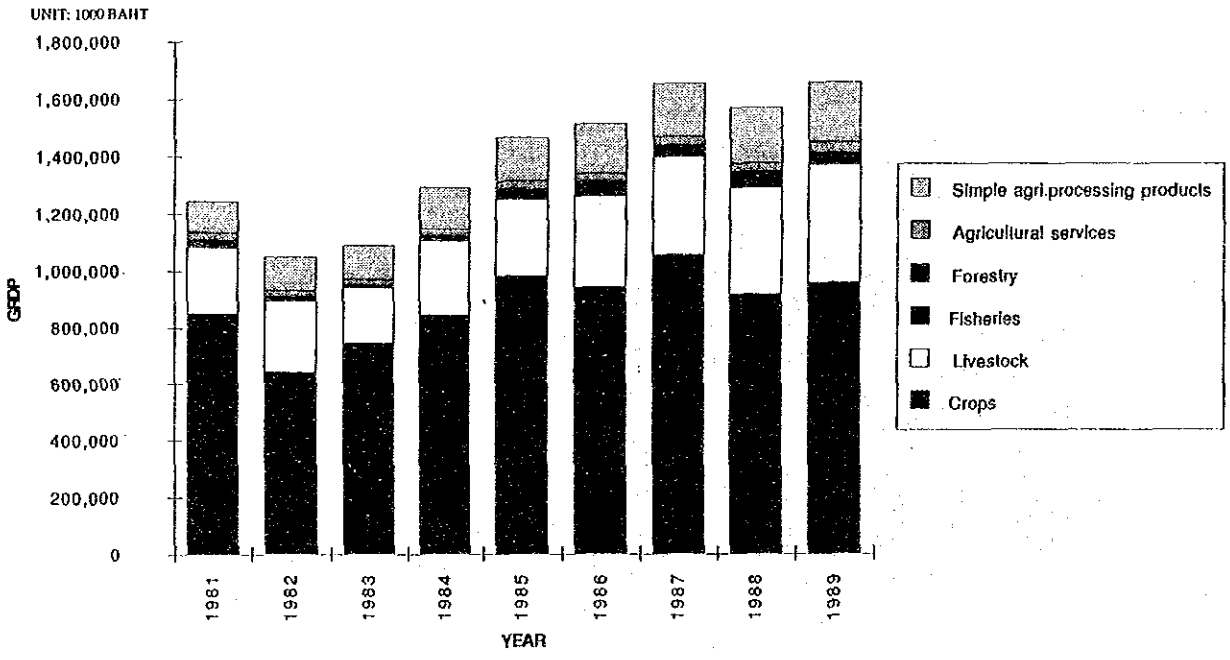
Source: National Economic and Social Development Board, National Account Division

Figure 2.11 Agricultural GRDP at 1972 Constant Prices in Yasothon, 1981-1989



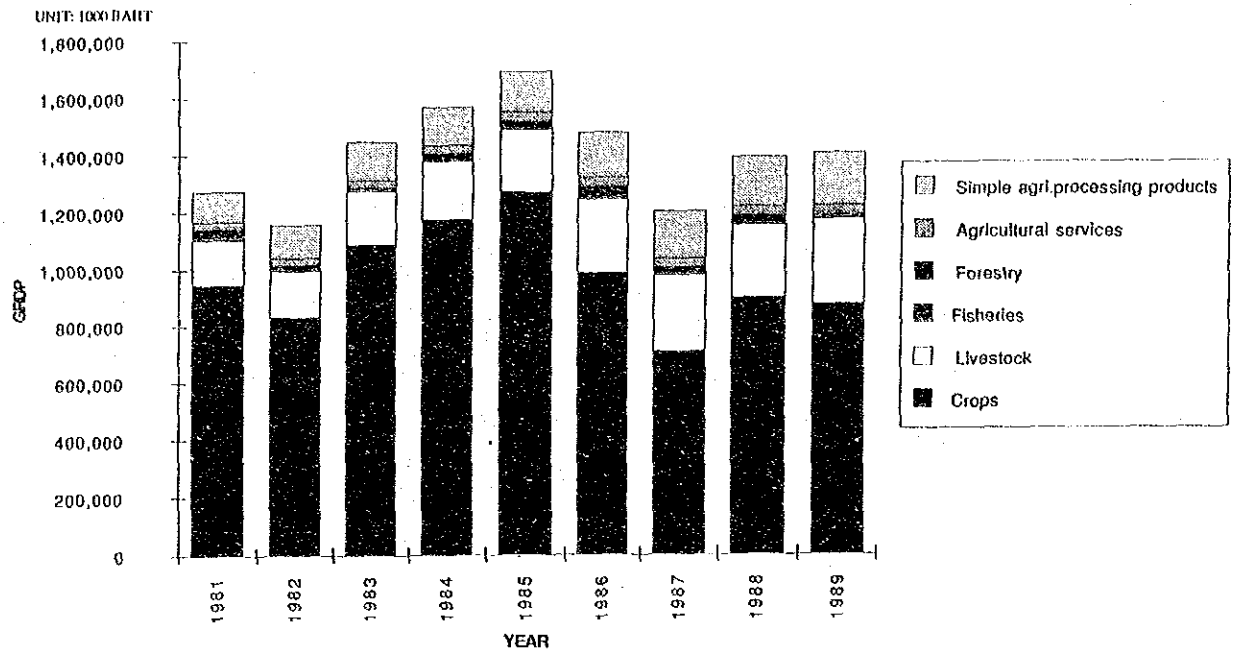
Source: National Economic and Social Development Board, National Account Division

Figure 2.12 Agricultural GRDP at 1972 Constant Prices in Ubon Ratchathani, 1981-1989



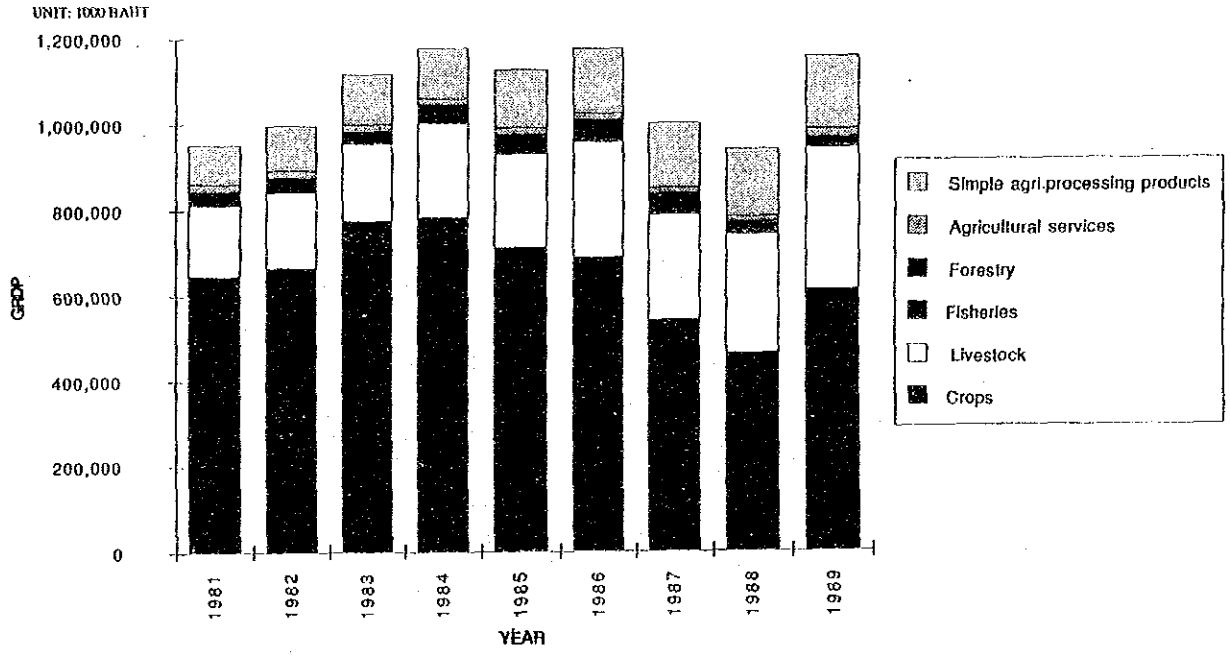
Source: National Economic and Social Development Board, National Account Division

Figure 2.13 Agricultural GRDP at 1972 Constant Prices in Buri Ram, 1981-1989



Source: National Economic and Social Development Board, National Account Division

Figure 2.14 Agricultural GRDP at 1972 Constant Prices in Surin, 1981-1989



Source: National Economic and Social Development Board, National Account Division