Phase III (2002 ~ 2010)

- Advanced urban facilities will be provided in major urban centers (higher order services and various amenity facilities).
- A comprehensive information center or "Teleport" will be established.
- Solid waste disposal and wastewater treatment facilities will be introduced to secondary towns.

2) Projects to meet the projected demand

From the existing infrastructure conditions outlined above and utility demands due to the Master Plan, project needs are clarified. Sewerage system installation and solid waste disposal site development are required for larger urban centers with 100% treatment capacity. ISDN-based telecommunication service is also expected. Basic infrastructure for industrial development, such as access roads, water supply, electricity will be needed.

3.3 Institutional Strengthening

3.3.1 Land use planning

There are few national level land use guidelines that would provide planning input at local level. Some national level guidelines are executed by line agencies with no local coordination. Presently, the Town and Country Planning Department of Ministry of Interior has been formulating general plans for municipalities. This general plan contains land development policies and future land use plan.

However, locational setting and controls of large scale industries or housing developments are implemented by national line agencies without any reference to the general plan. Practically, there is no local control over urban development activities. Therefore, for effective planning control, the short-term emphasis would have to be placed on coordination between national line agencies as well as between local line agencies.

The regional office of NESDB will have this coordination responsibilities and provide technical assistance to the provincial and municipal planners. Involvement of planning consultant firms is also effective for making land use plans.

Planning staff of municipal and provincial administrations are mainly recruited from central government agencies. Training of local staff is essential

3.3.2 Project formulation and implementation

For the IUD programme, a set of component projects should be formulated in a mutually consistent way. A task force consisting of related national agencies, NESDB, provincial and municipal administrations should be set up under the mayor or the governor. Project implementation by respective agencies should be monitored by NESDB in cooperation with provincial and municipal administrations.

3.3.3 Institutional strengthening

Planning capacity in terms of staff and finance is quite small in any local government. The total resources available to local administration will not be sufficient to meet the urgent development needs. Local administrations need additional resources.

An immediate short-term measure that the government can take is to increase the proportion of funds transferred to local administrations under the "non-specific" category as opposed to those which are earmarked for specific projects.

In the medium-term, new measures are needed to strengthen the local administrations financially. Proposals vary from increasing the rates for the existing local taxes (mostly property and business taxes), and improving collection efficiency, to introducing new taxes (ex. land development tax), and transferring some of the revenue from existing taxes from the central to local governments.

On source of additional revenue is pricing of local utilities. Improvements in these could be achieved by transferring the central government owned assets (i.e. main works for water supply) to local governments.

Other measures may include the following.
- improvement of tax collection efficiency,
- introducing new taxes,
- capturing the increase in value of real estate due to government infrastructure investments, and
- raising loans by local authorities.

4. Outline Project Formulation of Nakhon Ratchasima Integrated Urban Development Programme

4.1 Land Use Plan

4.1.1 Existing land use plan

1) Background of the 1989 general plan of Nakhon Ratchasima city

City Planning Office (Department of Town and Country Planning Ministry of Interior) had set up revised Nakhon Ratchasima General Plan in 1988. New planning area is 264.9 km^2, or 165,565 rai. Target year of this plan is set at the year of 2009. Expected population is about 537,300 people, equivalent to a 3.4% growth per year over 20 year period.

This planning area covers four communities, namely Nakhon Ratchasima municipality Muang, Jau Hau sanitary district, Kham Ta-le Sau sanitary district, Khok Kruad sanitary district, and some tambon areas around the city.

2) Objectives of the General Plan

Two main development objectives are indicated in this plan.

(i) To encourage Nakhon Ratchasima city to be a centre of various public services and high level education for both Nakhon Ratchasima province and the Northeast region

(ii) To be a centre of market, goods transport services, warehouses, industrial sources of Northeast region and export industries by linking to Bangkok and ESB industrial areas

3) Land use policy in the General Plan

There are a number of development constraints for expansion of the community in Nakhon Ratchasima city. Southern part of the city is occupied by the Military Zone, and the north side is occupied by the low level land with canals.

Under the geographical constraints, the city can expand only in the northeastern direction and the western direction along bith sides of Mittraphap road.

4) Land use plan in the General Plan

Future land use for Nakhon Ratchasima is planned for 11 types of land use categories. The land use map produced by the General Plan is shown in Figure 5.

4.1.2 Master Plan Framework for Nakhon Ratchasima Urban Center

1) Nakhon Ratchasima population target

In the Master Plan framework set by the Study Team, the target population of Nakhon Ratchasima urban centre will be expected to be one million by 2010. The city will accommodate nearly four times of present population in and around the present city area. Nakhon Ratchasima city boundary will naturally be expanded in the future.

2) Expected functions of Nakhon Ratchasima urban center

(i) Characteristics and expected functions of Nakhon Ratchasima urban center are as follows:

- the regional centre with multiple functions related to industry and trade,
- one of the places for industrial relocation from BMR,
- designated as a Greater Nakhon Ratchasima Industrial Centre Development Zone, and
- Suranaree University of Technology as the major center for higher education for science and technology fields.

(ii) Proposed projects in the Master Plan

- Commerce and Industry Plaza Complex
- Automobile Test Course
- Regional Truck Terminal
- Regional Industrial Modernization Model Project
- Agricultural Marketing Network Development

Proposed projects except Automobile Test Course Project are recommended to locate within the urban area.

Figure 5 Existing Land Use Plan (1989 Nakhon Ratchasima General Plan)

4.1.3 Proposed modification

For making an appropriate land use plan in line with the Master Plan framework, existing land use plan should be modified and adjusted. Some modification criteria are shown below.

1) Separation of intra-and inter-urban traffics as much as practical,
2) Preservation of historical, cultural and religious areas,
3) Proper location of parks, recreational areas and greenery,
4) Avoidance of possibility to create mixed industrial residential zones, and
5) Minimization of investment and operation and maintenance costs for utilities.

A future land use plan of Nakhon Ratchasima modified according these criteria are shown in Figure 9.

4.2 Proposed Projects

4.2.1 Water supply project

1) Background

Supply of piped-water in municipality and surrounding areas is under the responsibility of Provincial Waterworks Authority of Thailand (PWA). At present, drinking water supply is for 100% of local households in the municipal area including its surrounding areas. Production capacity is 90,000 m^3/day.

A rapid economic growth and accelerated urbanization in the municipality is anticipated in the following decades. Accordingly increase of water supply capacity and construction of additional reticulation pipes will be needed to satisfy increasing water demand by communities and business.

2) Project outline

The purpose of this project is to supply sufficient water to the communities including commercial and industrial users. Assuming population size in 2001 as 500,000 ~ 600,000, present production capacity of 90,000 m^3/day must be expanded upto 135,000 m^3/day by 2001.

Another water filtration plant (61,000 m^3/day) together with pumping facility, tanks and other related facilities have to be installed during Phase II (1997 ~ 2001) period.

3) Implementing agency

A task force committee consisting of national line agencies, NESDB, provincial and municipal administration is recommended to be set up under the supervision of the governor.

Project implementation by respective agencies should be monitored by the task force committee organized by NESDB.

4) Project costs

- expansion of water supply reticulation pipes (Phase I & II)	120	million baht
- pump plants, tanks, etc. (Phase I & II)	90	million baht
- water filtration plant (61,000 m^3/day) (Phase II)	60	million baht
Total	270	million baht

5) Schedule

This project should be continually carried out in accordance with urban expansion in Phase I through III.

4.2.2 Sewerage and drainage project

1) Background

An urban sewerage system exists only in Nakhon Ratchasima municipality in the Study Area. There are oxidation ponds with total capacity of 675,240 m^3. It can treat 32,000 m^3/day of wastewater.The wastewater treatment system covers 300 rai (48 ha) in total.

In 1992, nearly half of households in the municipality can drain their wastewater into near trenches for drainage after treatment at their septic tanks. Other wastewater through their septic tanks is directly drained down to the canals, rivers or rice fields near the roads.

Water drainage pipes are installed along regional arterial roads and main and secondary roads in urban area are poorly maintained.

2) Project outline

Lack of sewerage and drainage system in the community disturbs city environment and health condition of community population. Immediate actions for expansion of sewerage and drainage infrastructure are required for improving and upgrading the community's living standard.

Presently, wastewater treatment capacity is sufficient due to the limited service area. However, during the Phase II period, another treatment plant will have to be installed for treatment of increased wastewater amount and service area expansion in the communities.

For covering 100% service area for the community by 2001, it is assumed that 55,000 m^3/day (70% expansion of present capacity) has to be treated .

3) Implementing agency

Same arrangement as the water supply project.

4) Project costs

- water drainage improvement (installation) (Phase I & II)		
pipes 15 million baht/year	8 years	120 million baht
ditches 10 million baht/year	8 years	80 million baht
- second wastewater treatment plant (1 unit) (Phase II)		30 million baht
Total		230 million baht

5) Schedule

Phase I through III

4.2.3 Solid waste disposal project

1) Background

The municipality has now about 300 rai area for solid waste and garbages discarded by the communities, located in Tambon Khok Kruad 14 km away from the municipality. This disposal site was developed in 1988 with the expected life of 20 years.

The method of disposal is dumping solid wastes on to the ground and burning them. This method has problems in causing aesthetic problems, contaminating groundwater, and creating air pollution and odor problem.

Presently, 70% of solid wastes by the community in the municipal area is collected. This amounts to 33,068 tons/year. Municipality holds about 40 garbage trucks (1992) for garbage collection. However, due to the rapid urbanization in the municipality, shortage of garbage disposal collection capacity has been becoming a serious issue.

2) Project outline

The target is 100% collection of community disposal. It is estimated that by 2001, the amount of community disposal will be 4 times larger at about 150,000 tons/year. The municipality will have to purchase 150 new garbage trucks (including replacement) for 150,000 tons/year collection and develop a new disposal site at a suitable location in surrounding areas by 2001.

3) Implementing agency

Same arrangement as the water supply project

4) Project costs

- purchasing of new garbage trucks (Phase I to II) 150 trucks (50 for replacement, 100 for new purchase) 0.8 million/car	120 million baht
- Development of new disposal site (Phase II)	20 million baht
Total	140 million baht

5) Schedule

Phase I through III

4.2.4 Electrification project (public lighting)

1) Background

One gas turbine power plant with 14 MW is operating in Nakhon Ratchasima area. It is, however, recommended to improve or replace the existing system with the co-generation system for increasing its efficiency.

Nakhon Ratchasima municipality has 100% electrification rate in its jurisdiction. However, municipality has still lacks public electricity to supply lighting during the night time and insufficient supply capacity for covering the public electricity or lighting to small streets or areas in the outer areas of the municipality.

2) Project outline

This project is to increase public lighting on the streets for avoiding traffic accidents and increasing pedestrian safety during the night time.

3) Implementing agency

Same arrangement as the water supply project

4) Project costs

- installation of public lighting 5 million/year	40	million baht
- new co-generating system (EGAT responsibility)	-----	
Total	40	million baht

5) Schedule

Phasing I through III

4.2.5 Telecommunications projects

1) Background

The number of telephone subscribes indicates a very poor service level even in urban areas. In 1989, the average number of telephones per 100 residents was 2.6 in the kingdom, and 16.2 in Bangkok. Study Area's average was only 0.6 lines per 100 population.

2) Project outline (Detail in Sector Report on Telecommunications: Section 2.14)

The purpose of this project is to accelerate the increase of public telephone lines as well as private ones in the community.

The targets in telecommunications development are as follows.
- to install telephone lines in every tambon
- to establish mobile telephone system in all nine provinces
- upgrading the telephone service quality

3) Implementing agency

The Telephone Organization of Thailand (TOT) (with IUD task force committee)

4) Projects costs

(to be estimated)

5) Schedule

Phase I through III

4.2.6 Urban roads project

1) Background

Urban roads within the Nakhon Ratchasima city area is not well developed in terms of surface and network. Regional roads such as route no.2, no.205 and no.224 were constructed as city outer roads with high standards. However, new community areas have been already expanding beyond those regional roads and traffic congestions are already taking place at the intersections causing noise and air pollutions problems.

In "old city" area occupying the eastern side of the city, roads are relatively well developed in a grid pattern. On the other hand, western area which has been urbanized lately has not developed such a road network. Only three east-west roads are developed upto near Nakhon Ratchasima railway station. Road along the north-south axises in this area are crooked and narrow with surface and ditches poorly maintained.

2) Project outline

The purposes of this project are to rehabilitate urban road condition and to reduce adverse environmental impacts caused by traffic such as noise and air pollution. Improvement of pedestrian sidewalks and road surfaces, installation of traffic lights, and rearrangement of intra- and inter-road network (widening of community roads, construction of by-pass or fly-over roads, etc.) will be included in this project.

3) Implementing agency

IUD task force committee

4) Project costs

- traffic lights installation (20 points) 0.6 million baht/unit Phase I : 10 places, Phase II 10 paces	12	million baht
- intra-roads improvements (with pedestrian side walks) 30 million /year	340	million baht
- underpass : 1 place (Phase II)	50	million baht
- fly-over for railway truck : 1 place (Phase II)	35	million baht

- by-pass construction (25 km)
  (Phase II) 15 million/km) (concrete without drainage) 375 million baht
  Total 812 million baht

5) Schedule

- intra-roads improvements (Phase I through III)
- under-pass and fly-over (Phase II)
- by-pass road (Phase I through III)

4.2.7 Regional industries modernization project

1) Background

The existing and planned industrial estates are basically planned to serve large manufacturing enterprises. Small industries that need to locate close to urban areas are presently located in the built-up areas. Their expansion is constrained and they may be harmful to their immediate surroundings. They should be located in selected areas with a concentration of small industries.

2) Project development (Detail in Sector Report on Industry : Section 6.9)

The project has the dual objectives. The one is to modernize the existing small and medium scale industries located in the built up areas. The second is to improve urban environment by elimination of problematic mixed land use and will allow the municipality to utilize the left out space for public facilities as neighborhood parks etc. which will also lead to attracting people to the region.

Such industries as automotive repair, food processing, metal plating, and textile bleaching and dyeing will be target industries for relocation.

3) Implementating agency

Leading agency will be Ministry of Industry, DID/DIW, IEAT, IFCT within the framework of IUD task force committee.

4) Project costs

16 million baht

5) Schedule

Phase I

4.2.8 Regional truck terminal project

1) Background

Nakhon Ratchasima city has already played important roles as a distribution center in the Study Area and Northeast region. The dominance of Nakhon Ratchasima in commodity distribution will continue as the city is located in a strategic position in the Northeast.

2) Project outline (Detail in Sector Report on Transportation : sub-section 5.4.5)

The roles and functions of truck terminal are conceived as follows.

- improvement of transportation conditions
- modernization and realization of trucking industries
- systematization of terminals
- proper combination of sub-systems

3) Implementing agency

Public-private joint venture guided by IUD task force committee

4) Project costs

42 million baht (35 berths)

5) Schedule

Phase II

4.2.9 Commercial and industry plaza complex project

1) Background

At present, provision of parts and office supplies and maintenance services in the Study Area mainly depends upon Bangkok. A rapid development of Nakhon Ratchasima as a regional center needs this kind of facility, especially for export oriented manufacturers and business and professional services industries.

In response to expansion of demand in the Study Area, the company shall grade up the roles and functions of the branches in Nakhon Ratchasima. In fact, the expansion of demand is foreseeable since some manufacturers in the Suranaree Industrial Zone have already started their operation in Nakhon Ratchasima.

2) Project outline (Detail in Sector Report on Trade and Distribution : sub-section 1.4.3)

This project should be implemented as a public-private joint venture. The plaza complex will accommodate offices of traders, suppliers and distributors with stock of essential parts and office supplies and maintenance personnel, public information and one-stop service center for investors, etc.

3) Implementing agency

The operators are private enterprises guided by IUD task force committee. As for public information and one-stop service center for investors, the Ministry of Commerce, the Ministry of Industry and BOI can provide services and facilities.

4) Project costs

25 million

5) Schedule

Phase II

4.2.10 Agricultural marketing network development project

1) Background

Most provinces in the Study Area already have a plan to establish central commodity markets. At present there are a few central markets in the Study Area, but some of them are not active. The reasons for this include: (a) the farmers can not afford transportation cost, (b) farmers can not adjust to grading of crops, and (c) rice mills or traders do not participate actively. To develop a mechanism to ensure a smooth operation is the key.

2) Project outline (Detail in Sector Report on Trade and Distribution : sub-section 1.4.1)

The project will establish central commodity markets in provincial and district centers with agricultural marketing services centers and local assembly markets.

3) Implementing agency

The operator of a market network is basically a private enterprise. The Internal Trade Department (Ministry of Commerce) can promote this project through offering more incentives.

4) Project cost

The cost will vary depending on the size and the level of services in market facilities and location.

Area size : 48 rai 250 million baht

5) Schedule

Phase I

4.2.11 Other related projects

1) Housing rehabilitation projects (illegal settlement areas) (Phase I & II)
10 buildings : 6 million/building 60 million baht

2) City beautification programme (Phase I & II)
(tree plantation programme) 56 million baht

3) Amusement parks development projects (Phase I & II)
13 places : 1.5 million/year 19.5 million baht

4) New housing development projects (Phase I & II)
65 buildings : 10 million/building 650 million baht

Total 785.5 million baht

5. Project Costs and Funding

5.1 Nakhon Ratchasima Integrated Urban Development Programme

(1) Proposed project sand costs

Costs of proposed projects have been roughly estimated and phased as summarized below. The total costs are 792 million bahts in Phase I and 1,819 million bahts in Phase II.

(Unit : million baht)

	Proposed Projects	Phase I (1994 ~ 1996)	Phase II (1997 ~ 2001)	Total
1.	Water supply project	70.0	200.0	270.0
2.	Sewerage and drainage project	75.0	155.0	230.0
3.	Solid waste disposal project	14.4	125.6	140.0
4.	Electricity supply project (public lighting)	15.0	25.0	40.0
5.	Telecommunications project	-	-	-
6.	Urban roads project	96.0	716.0	812.0
7.	Regional industries modernization model project	16.0	-	16.0
8.	Regional truck terminal project	-	42.0	42.0
9.	Commercial and industry plaza complex project	-	25.0	25.0
10.	Agricultural marketing network development project	250.0	-	250.0
11.	Other projects	255.5	530.0	785.5
	Total	**791.9**	**1,818.6**	**2,160.5**

(2) Additional costs

Additional costs are incurred for improving the municipal management.

- Consulting service fee for land use planning and urban management project

  Due to the limited capacity of planning staff in the local administration, private consulting firms should be involved in the Integrated Urban Development Programme for effective and efficient plan preparation, projects development and cooperative management of the projects.

  It is assumed that the consulting service fee for above initial works will be, at least, around 5 million baht.

- Computer system development for improved urban management

  For an integrated urban development programme, it is necessary to set up an integrated urban management system for monitoring the on-going projects carried out by various agencies in the communities. A

computerized urban management system should be developed in the local administration office. Costs for the system development will be about 15 million baht.

5.2 Indicative Investment Schedule for the IUD Program

Indicative investment schedules for the IUD programme by designated urban centers are shown below with a tentative development schedule.

(Unit : million baht)

Urban Center	Phase I	Investment Costs	Phase II (1997 ~ 2001)	Investment Costs
1. Nakhon Ratchasima IUD	Project formulation and implementation	800	Implementation	1,800
2. Ubon Ratchathani IUD	Project formulation	400	Implementation	2,000
3. Mukdahan IUD	Project formulation	200	Implementation	1,000
4. Aranyaprathet IUD	Project formulation	200	Implementation	1,000
5. Buri Ram/Surin	Project formulation	200	Implementation	1,600
6. Five other urban centers	-		Project formulation	750

5.3 Funding Options

There are two types of investment funding options for the IUD program excluding the case of revenue transfer from the central government to local governments. One is to collect a new development tax from the community, such as planning tax, public utility tax or land use tax. This tax is similar to the fixed property tax, but smaller in amount, and collected together with the property tax. The rationale behind this tax is that urban residents should pay an additional tax, since they receive a number of uncountable fringe benefits as a result of public investments.

The other option is that the central government permits local government to raise local loans for the purpose of development expenditure. Local government can invest raised fund on urgent and profitable public projects immediately.

Gains from public lotteries issued by the local government may also be another option for fund raising.

Figure 6 Outline Map of Nakhon Rachashima Muang Municipality (with General Plan Boundary)

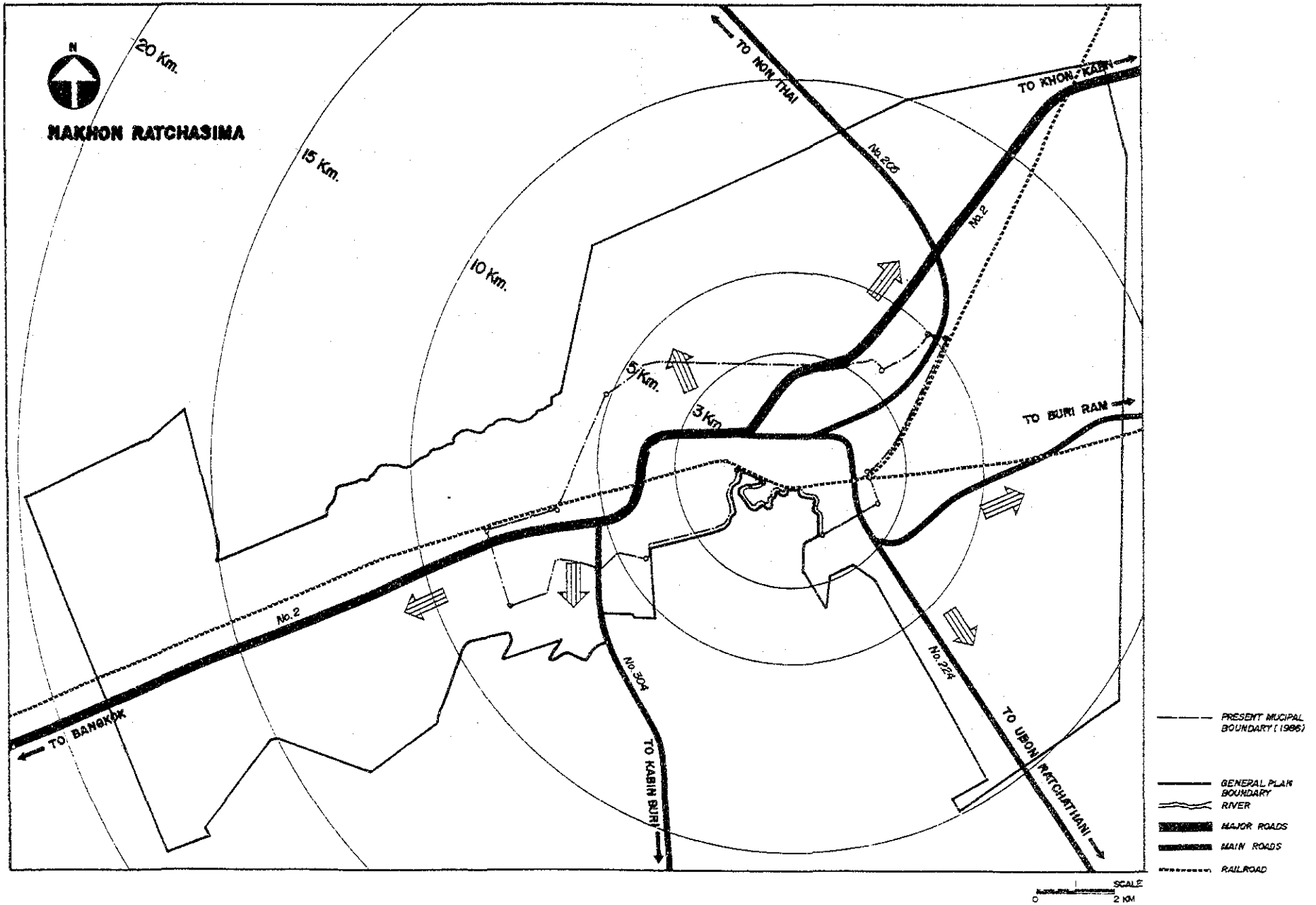


Figure 7 Map of Existing Land Use Plan (1989 General Plan)

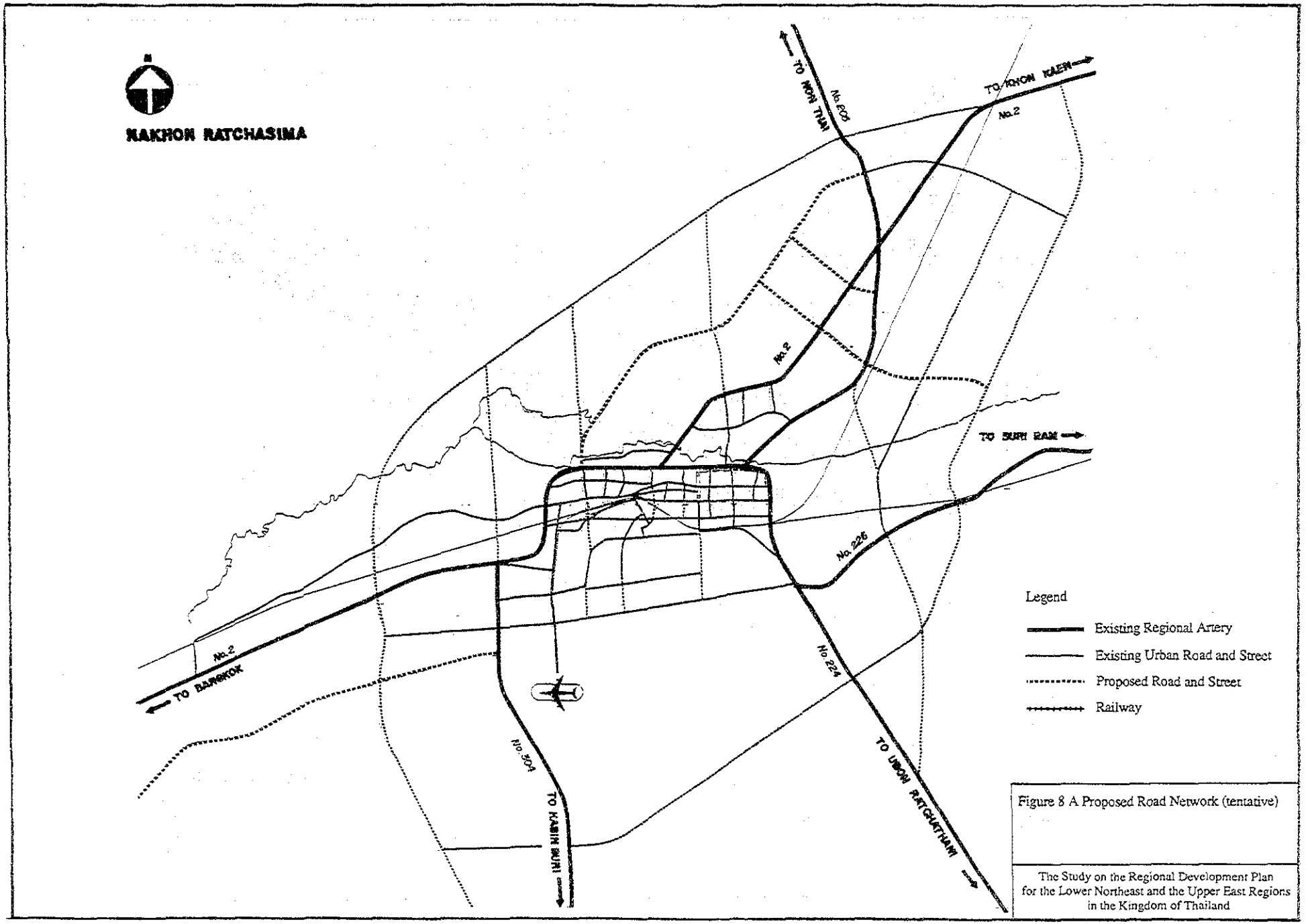
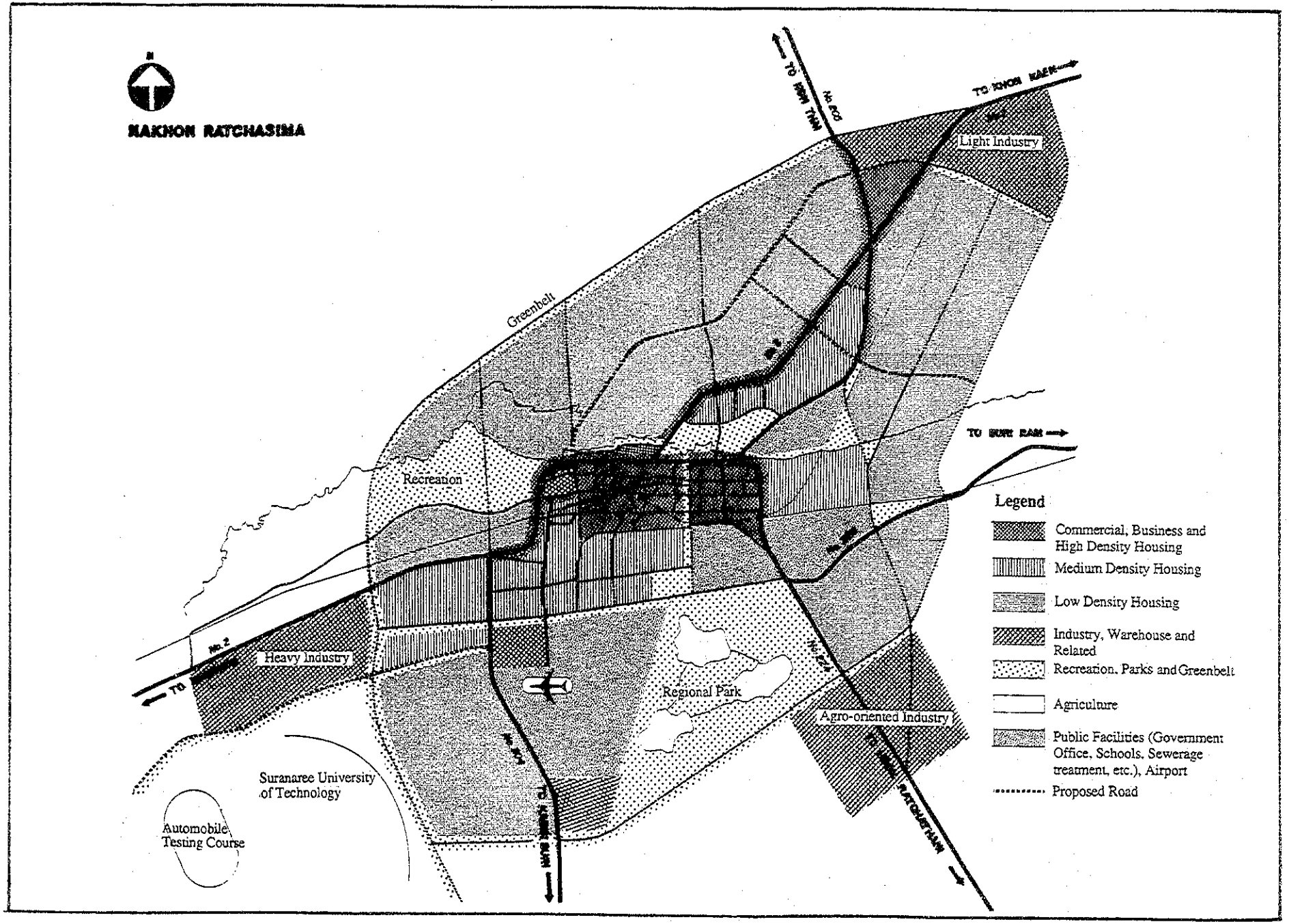


Figure 8 A Proposed Road Network (tentative)

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

Figure 9 A Proposed Land Use Zoning (Conceptual Map) (Tentative)



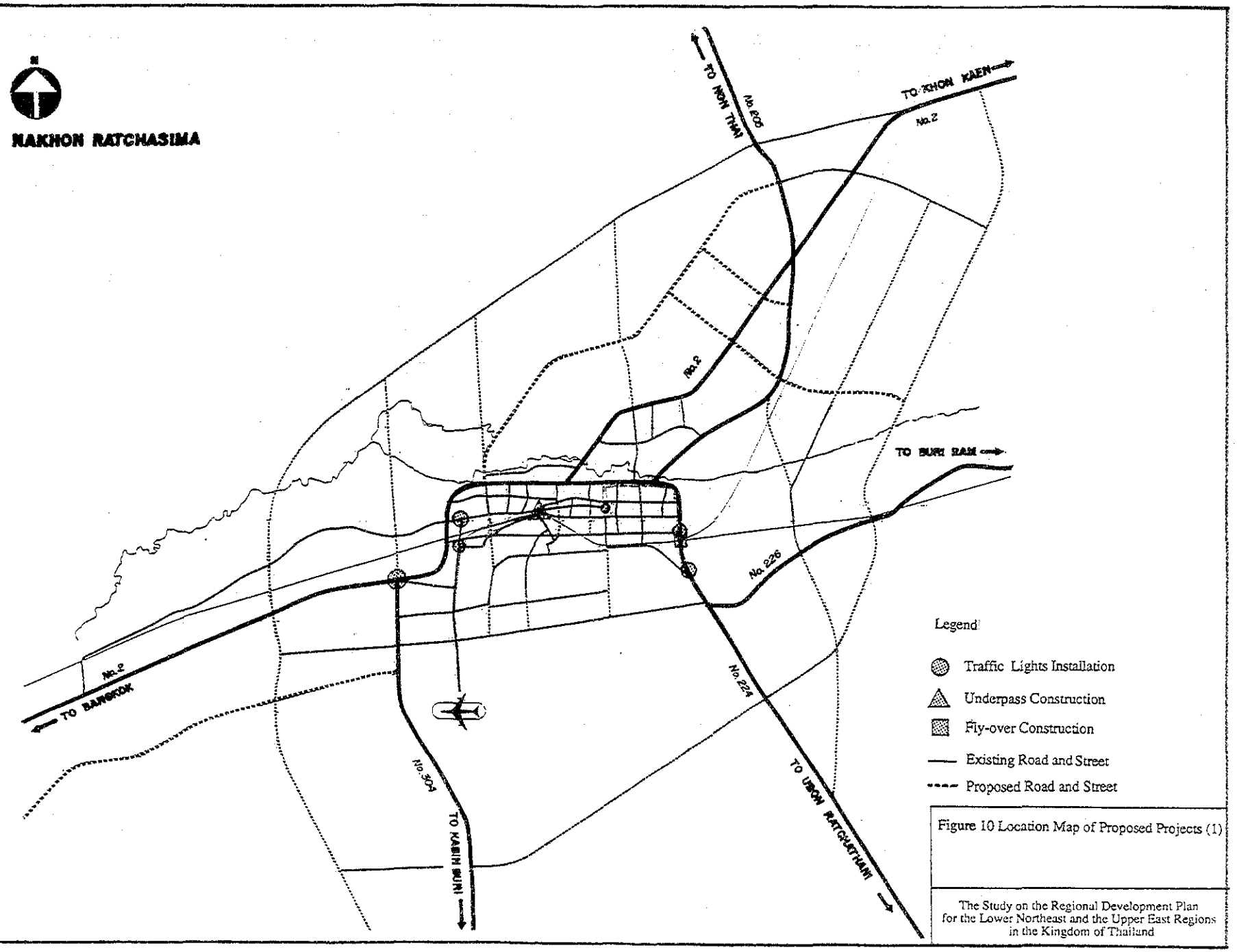


Figure 10 Location Map of Proposed Projects (1)

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

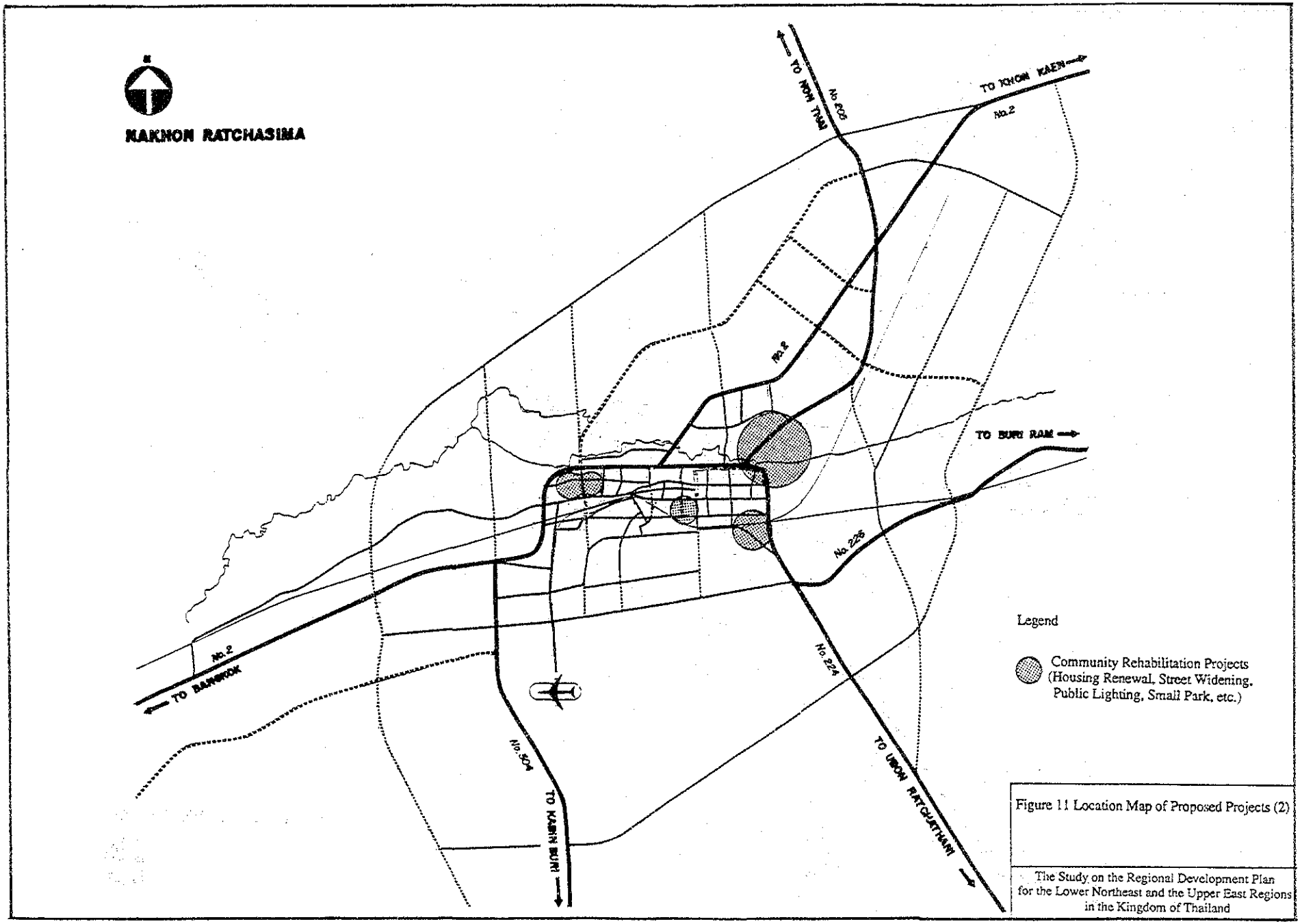


Figure 11 Location Map of Proposed Projects (2)

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

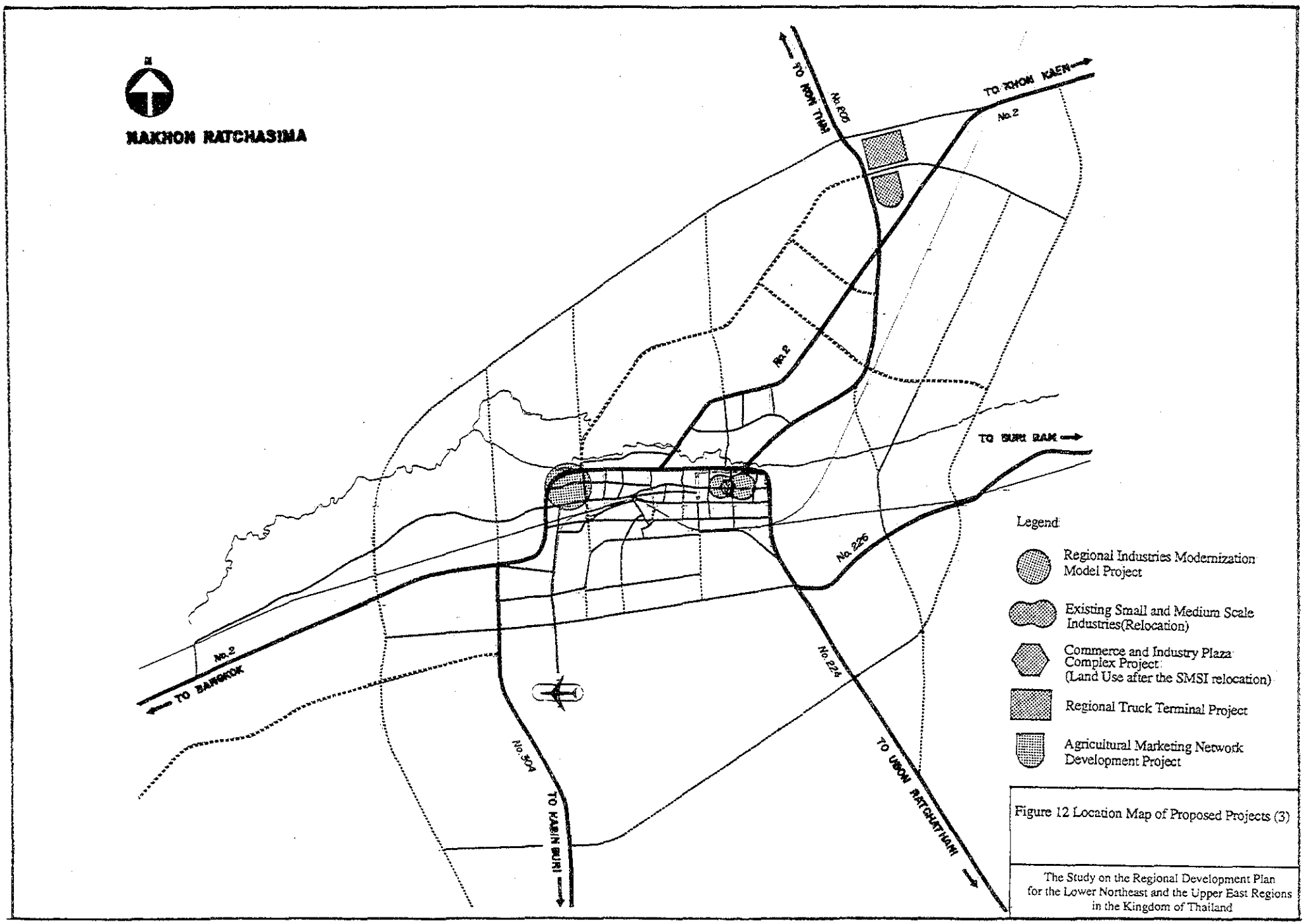


Figure 12 Location Map of Proposed Projects (3)

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

4. Drip Irrigation Development

Drip Irrigation Development

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Drip Irrigation Development

1. Background

(1) Irrigation in LNE-UE

Need for irrigation

Most parts of the LNE-UE regions are under savannah climate with an average annual rainfall of about 1,4000 mm. The rainfall is highly variable both seasonally and annually. During the rainy season from May through October, more or less 90% of annual rainfall occurs in a typical year. Droughts are frequent and often extended.

Under such climate, significant increase in agricultural production cannot be expected without irrigation especially during the dry season. Year round cultivation is essential not only to boost agricultural production but also to minimize soil erosion by vegetation cover and to reduce seasonal labour outmigration causing various social problems.

Existing irrigation and constraints

Irrigation in the LNE-UE regions is still quite limited, despite efforts by the government and local people. Irrigated areas are almost exclusively under paddy and cover only 12% of the paddy field.

There exist many dams and ponds in LNE-UE for irrigation purposes. Existing irrigation storage capacity is 2,474 million m^3 in total, consisting of 1,935 million m^3 by large/medium dams, 466 million m^3 by small dams and 92.4 million m^3 by public ponds (Table 1). Due to topographic conditions, water storage in large scale is difficult. Potential storage sites by dams will be practically exhausted by the completion of the on-going Phanom Dong Rek water resources development project. Only remaining means of storage would be by small ponds.

Development of small public ponds is increasingly more important not only due to lack of large storage sites by dams but also for social and environmental reasons. Large-scale irrigation development often causes resettlement of people in dam and reservoir areas, destruction of forests, extinction of species, and other problems. Moreover, such large scale irrigation development sometimes does not produce expected outcomes due to inadequate on-farm development, improper water management, or simply over-sizing of facilities.

Irrigation by small public ponds, however, also faces many problems. Typical problems are summarized from a monitoring report of the new village development program and the EC/BAAC agricultural credit project.

1) Unsuitable sites for ponds in sandy or salty soil without any access to river nor connected to canals resulting in insufficient water supply, water salinization, excessive seepage losses, pollution by fish feed or organic matters, and other problems; locating ponds in area of high groundwater table in the rainy season causes ripping-off of plastic sheet covers from the bottom soil.

2) Poor maintenance due to lack of budget, failure to collect user charges, and non-existence of management organization; collapse of dikes, accumulation of debris, sand and silt, and breaking of plastic covers are sometimes caused.

3) Lack of back support in the face of severe droughts such as supplementary water supply from reservoirs by RID.

4) Inappropriate pond design characterized by shallow depth less than 3 m, steep slopes of banks, no compaction on bottoms and sides of the pond, no drainage outlet, and over-sizing for proper operation such as for aquaculture.

5) No detailed planning nor feasibility analysis in advance.

6) No systematic monitoring nor post-evaluation on the performance of ponds.

Irrigation potentials and directions

Remaining potential of surface water has been estimated at this time to be 2,408 million m^3 (Table 2). This is a conservative estimate, but still almost as large as the existing irrigation storage capacity. However, conflicts in water use are becoming more and more serious with domestic use, requirements for animals, and industrial purposes. Large scale irrigation development is unlikely.

Main directions for irrigation development in the LNE-UE regions are the following:

1) effective utilization of existing irrigation facilities by rehabilitation, integration and proper management,
2) small scale development by ponds and by groundwater,
3) establishment of less water intensive crops ----- upland crops rather than paddy, and
4) introduction of less water intensive irrigation technology such as drip irrigation.

(2) Project opportunities

Master Plan strategy

Crop diversification in favour of high value-added crops is an important strategy to transform the LNE-UE regional economy according to the Master Plan. More promising crops identified are various oil crops, fruits and vegetables, and seed for grains and vegetables. These crops are suited to sandy and skeletal soil widespread in the LNE-UE regions. Most of these types of crops would expand opportunities for agro-processing industries, livestock development, and other related activities.

The Northeast Poor Farmer's Scheme under the EC/BAAC Agricultural Credit Project has demonstrated that irrigation is one of indispensable means for successful fruits and vegetable development in the region. Some oil crops and vegetables are particularly suited to drips irrigation, a technology relatively less developed in the kingdom. Wide application of drip irrigation may induce industries to manufacture related equipment and materials.

Small pumping reservoirs development

Storage of water in large scale is difficult generally in LNE-UE and particularly on the Korat plateau. As mentioned above, potential storage sites by dams will be exhausted by the on-going Phanom Dong Rek project.

The Master Plan has introduced a new concept of small pumping reservoirs development. The basic concept of a small pumping reservoir is to link it with a river system. This will allow better utilization of excess river water during the rainy season to store in large volume. Water quality would be better than the case of utilizing surface run-offs. It may also allow the release of water to the downstream when there is an excess.

Critical for the formulation of small pumping reservoirs development project is selection of sites in relation to river systems. Within the master planning, 30 promising sites have been identified in the nine LNE-UE provinces. These reservoirs would be utilized for various purposes, depending on the locations and storage volume.

Aquaculture

Inland fish production in the LNE-UE is estimated at about 25,700 ton per year, equivalent only to 2.7 kg per person as shown in Table 3. As transportation system of fresh water fish is substantially not developed this amount is equal to consumption. This is too small compared to the national average consumption of about 23 kg per person. Fish is the most important source of protein for the rural people in the LNE-UE regions. There are great potentials in demands of fish.

Main problems in the fresh water aquaculture in the LNE-UE regions are (1) insufficient water bodies particularly of perennial ones, (2) insufficient supply of fingerlings, (3) improper design of fish pond, (4) high prices of fish feeds, (5) insufficient extension services and (6) no cold storage nor processing facilities.

Use of small public ponds or small pumping reservoirs would present an opportunity to expand aquaculture production. To overcome some problems listed above, an aquaculture center will be established in Yasothon according to the Master Plan for breeding, fingerlings production, research and extension. Relatively large reservoirs will be effectively utilized for floating cage net aquaculture development, a relatively new technology in Thailand, as also recommended by the Master Plan.

Groundwater exploration

Groundwater is used throughout the LNE-UE regions primarily for domestic purposes in rural areas and industrial purposes in a few major urban centers. The Master Plan recommends further exploration of groundwater resource. Low pressure application for drip irrigation makes this technology particularly adaptable to groundwater as sources of irrigation water.

2. The Project

(1) Objectives

The prime objective of the project is to increase farm income of people in the LNE-UE regions by expanding new crops and aquaculture. A secondary objective is to establish drip irrigation as a new mode of irrigation in LNE-UE to produce various oil crops and vegetables as a main course of crop diversification. Another objective is to improve the diet of local people by increasing fish production by aquaculture, including application of floating cage net technology. Side effects may include inducement of manufacturing industries for equipment, materials and input for drip irrigation and new aquaculture technology.

(2) Components

The project consists of the following components:

1) Development of water sources ----- small pond, small pumping reservoir or groundwater,
2) Introduction of drip irrigation system with application device for water, fertilizer and chemicals,
3) Agricultural credit by BAAC,
4) Establishment of a joint public-private committee in each province to plan, implement and manage the project,
5) Farmers' involvement and commitment throughout the project cycle: planning for sub-projects, construction, maintenance, cost recovery, marketing and information exchange through existing or new farmers' organizations; a feasibility report and farmers' organization should be a prerequisite to project initiation; at least 10% of construction costs would have to be borne by beneficiaries in the form of cash or labor contribution to construction works, and
6) Establishment of marketing outlet to traders or processors.

(3) Project area

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. According to the GIS data base constructed for the Master Plan, area suitable for irrigation development 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. Breakdowns of the suitable areas by present land use and by recommended land use are shown in Table 4.

Distribution of the suitable areas by province are shown in Figures 1 through 7. Exact location of individual sub-projects would be decided based mainly on the water and arable land availability .

3. Organization and Management

(1) Beneficiaries

Agribusiness firms, agricultural cooperatives, individual farmers or farmers' groups with sufficient arable land, suitable sites for ponds or groundwater extraction and strong entrepreneurship will be able to join the project.

(2) Project management

The project will be executed by the initiative and entrepreneurship of the private sector such as agribusiness firms, cooperatives, and farmers' groups with technical and financial assistance from the public sector. The existing centralized system would not work well due to lack of entrepreneurship: no financial incentives for risk takings, no bankruptcy, slow response to markets etc. A decentralized organization will be newly established and operated for the project execution in the initial stage of about seven years and thereafter will be dissolved. This organization, i.e. a project management office (PMO), will consist of temporary staff such as those from consulting firms and will play catalytic role for the development by training local leaders and by establishing appropriate production, marketing and management system for promising crops and fresh water fish. PMO will consist of the administrative section, production section, marketing section and training section under the project manager and the co-manager. PMO operation will be supervised by the steering committee to be made of representatives from related public agencies, farmers' groups and agribusiness societies. The leading public agency for the project supervision will be BAAC or the Ministry of Interior. Other agencies such as the Department of Agriculture, the Office of Agricultural Economics, the Department of Agricultural Extension, the Department of Fisheries, the Irrigation Department and the Ministry of Commerce will be consulted whenever it becomes necessary.

Communal management of ponds and other key facilities is unsuitable for economic utilization of the facilities without clear power and responsibility for the facilities. Private, farmers' groups or cooperative organization would be appropriate for the management.

(3) Agricultural researches and extension

In respect to new crops, breeds, or species, appropriate production systems i.e., technically sound and economically/socially viable technology packages, have not yet been well developed in most cases. Adaptive experiments would inevitably be necessary to develop or identify suitable technology packages. According to information from the team leader of the EC fruit/vegetables development project for the Northeast, the production has more problems than the marketing of fruits and vegetables. Low productivity or insect pests/diseases are the main problems in the production. Once existing or developed technology packages of particular crops or fish species are proved to be effective, these packages will be extended to farmers through extension workers to be employed by the project or existing credit/ technology distribution system of BAAC. Existing agricultural extension workers or research scientists of the Ministry of Agriculture and Cooperatives might not be available nor accountable for the project, because they have their own jobs with almost full loads and no extra time and budgets could allocated to the project. The development will be made step by step from experiments to demonstration pilot farms and common farmers.

(4) Agricultural credits

Agricultural credits for the project will be given to agribusiness firms, agricultural cooperatives, farmers' groups and individual farmers through BAAC. Individual farmers will be given credit principally in kind and under collective responsibility of their farmers' groups. Farmers usually have problems in handling cash lent under intensive temptation of consumer goods. Credit management including farm inputs supply, technology transfer and loan repayment will also be made by farmers groups with nominal financial incentives. They will closely monitor the consumption of credit in-kind and frequently visit loanees for the repayment.

4. Production Plan

(1) Selection of crops and fish species

Crops

The LNE-UE Master Plan strategy is to promote crop diversification in favour of high value-added crops and those to be processed within the regions. Particularly promising are various oil crops, fruits and vegetables. Initially, emphasis should be placed on those crops successfully cultivated in LNE-UE or under the similar climatic conditions. More promising fruits and vegetables include Irish potatoes, mango, baby papaya, grapes, oranges, pomelo, durian, asparagus, rambutan, pineapple, guava, onion and mangosteen. In addition to corn, groundnut and sunflower already introduced in the regions, other oil crops should be experimented such as safflower, rapeseed and soybean.

Fish

Domestically popular species of fresh water fish should be selected for the project, as there are high demands. They include cat fish, sneak head fish, climbing fish, tilapia, local carp, Chinese carp, cinnib carp and small mud carp.

(2) Water requirements

Crop water requirements for most oil crops and vegetables are in the range of 300-800 mm per crop season. Assuming an average crop water requirement of 500 mm, and irrigation efficiency of 85%, the field water requirement is calculated to be 588 mm. In this calculation, effective rainfall is not taken into account for conservative estimate.

Pan evaporation in Nakhon Ratchasima is typically 1,870 mm/year. Assuming pan coefficient is 75%, pond evaporation is calculated to be 1,403 mm. Taking account of seepage losses, the total loss from the pond is taken to be 1,500 mm.

The maximum effective water depth of the pond is taken to be 4.0 m. Allowing for evaporation and seepage losses, the total pond depth is 5.5 m. The total water requirement of 5,880 m^3 to irrigate a unit ha under the selected corps would make the pond surface area 1,470 m^2 with 4.0 m depth. The total evaporation and seepage loss from this unit pond would be 2,205 m^3. Thus the total water consumed for this module would be 8,100 m^3.

If groundwater is used as the water source, the total water requirements to irrigate a unit has is just 5,880 m^3. Assuming a pumping rate of 30 l/min for 15 hours per days, a medium size well would yield 2,430 m^3 over three month period. Thus two or three wells can satisfy the total water requirement.

(3) Irrigation facilities

Sites for ponds or reservoirs should satisfy the following conditions.

1) location within 200 m from the nearest river or existing canal with sufficient supply of water in the rainy season and ease of drainage by pump or gravity as necessary,
2) no inflow nor intrusion of saline water,
3) low percolation rates of soil at the bottom or bank; water sealing materials required for ponds in sandy soil, and
4) depth of at least 3.0 m.

Drip irrigation system will be introduced to grow oil crops and vegetables. With this system, most suitable input combination is assured by the supply of fertilizer and chemicals as well as water through the water distribution system even in sandy or saline soil.

If aquaculture is also introduced, surface area of ponds may not exceed 1.0 rai for conventional methods. If larger ponds or reservoirs are used as water sources, a separate pond may be provided for aquaculture. Floating cage net culture can be introduced in large water bodies.

(4) Irrigation area

According to the Master Plan, 400,000 rai of land will be developed for oil crops by the year 2010. Additional area to be devoted to fruits and vegetables would be 2 million rai, of which 400,000 rai is assumed to be used for vegetables.

If ponds are used exclusively for water sources, the total area of ponds would be 18,800 ha. Existing public ponds may be effectively converted to use for the project to reduce the requirement for new ponds. Groundwater will also be extensively used. Thus the pond area to be newly developed may be much smaller than calculated above.

5. Marketing Plan

(1) Organization

Agribusiness firms might probably have expertise in marketing and have probably constructed market channels. Cooperatives and farmers' groups usually have problems in marketing. Special assistances for the marketing of fruits and vegetables will be given in the project to these groups. Existing wholesale and retail markets, agro-processing factories, middlemen and foreign markets will be the targets of market outlets. Large supermarkets and department stores in major cities would be most attractive market outlets of high quality and high value-added fruits and vegetables to be produced in the project. Some own retail shops, cold storages, pre-cooling facilities, refrigerated trucks and simple processing equipment as well as grading and packing machines might have to be introduced gradually in the project

when establishment of own market systems is proved to be more profitable than relying on existing market system.

In the case of oil crops, contract farming arrangements may be made between farmers and processors. Institutional mechanism for the Complete Cycle Project may be applied.

(2) Market information

There are no systematic collection, analysis and distribution of comprehensive market information for farmers or cooperatives. There are some official market information systems but are usually used exclusively for the public sector. PMO will construct a data base on agricultural information on fruits, vegetables, oil crops and fresh water fish fulfilling the following tasks for the participated agri-firms, cooperatives, farmers' groups and individual farmers:

1) collection of information related to prices, production, quality requirements in foreign as well as domestic markets including information collected by other public organizations,
2) market research, promotion and consultancy services for clients,
3) registration and introduction of buyers, suppliers or producers, and
4) market information services for contracted clients through the project computer network.

(3) Market promotion

The market promotion for oil crops, fruits and vegetables to be produced in the project will be attained by the distribution of advertising leaflets to buyers, overseas personnel activities by a contracted consulting firm and publicity promotion through mass media.

6. Financial Viability

(1) Construction costs

To estimate construction costs for the project, a module system is assumed for a unit ha of irrigation area. A pond is assumed as a water source for this system, having the dimension of 40 m x 40 m with 5.5 m depth to store 8,800 m^3, more than sufficient to satisfy the water requirement for 1.0 ha under oil crops or vegetables.

Construction costs for the pond of this dimension are estimated as followed.

Excavation cost : 8,800 m^3 x 50 baht/m^3 = 440,000 baht
Sodding cost : (46 m x 46 m - 40 m x 40 m) x 60 baht/m^2 = 30,960 baht

Construction cost of a drip irrigation system including pump cost is estimated at 44,000 baht/ha. The total construction cost of this module system becomes 514,960 baht.

If this module system is extended to cover the entire project area of 128,000 ha, the total project cost would be about 66,000 million baht. This may be considered the maximum. In reality, existing ponds will be utilized as much as possible. Groundwater will be used extensively. Costs of groundwater systems would vary widely,

depending among others on ratio of successful wells and yields. On an average, however, costs of groundwater systems should be at least competitive with costs of pond systems.

(2) Revenue

It is assumed that the module system is used for vegetable growing and fishery. Net income from vegetable growing is assumed to be 6,000 baht/rai or 37,500 baht/ha. Prices of telapia and carp are in the range of 30-40 baht/kg and 40-44 baht/kg, respectively. Assuming net benefit of 30 baht/kg and 10 ton/ha yield for a three month period, the annual revenue would be 44,100 baht from water area of 1,470 m^2.

(3) Financial viability

Based on the estimated costs and revenue, a cash flow table has been prepared as shown in Table 5. In the table, operation and maintenance cost is shown to be 3,000 baht/year, estimated based on three persons working for 10 days each at 100 baht/day/person. From the table, financial internal rate of return is calculated to be 14.0%.

Construction costs for the pond and drip irrigation system may be financed by a loan. If the interest rate of loan is assumed at 10% and repayment period 19 years, the net farm surplus will be about 17,000 baht/ha/year.

7. Recommendation

The drip irrigation development project is essential to increase farm income substantially by crop diversification in favour of high value-added crops. Farmers would have to be convinced to convert from traditional crops to new crops. Given the initial investment requirements, it is necessary to improve the credit-worthiness of small farmers. The prerequisite for this is to upgrade land ownership and provide full title security.

Another essential condition is to establish market outlets. One way is to establish contract farming arrangements between farmers and processors by using the institutional mechanism for the Complete Cycle Project. In further developing the project, farmers in respective project areas should be involved in a group as well as local administrations and relevant central government agencies.

The farmers' group would receive technical training related to new crops and drip irrigation, procure credit and equipment, and negotiate with traders and processors.

Tables

Table 1 Existing Irrigation Water Supply Capacity in LNE-UE

Province	Irrigation Storage Capacity			Total	Irrigation Area [ha]	Unit Water Supply
	Public Ponds	Large/Medium Scale Dams	Small Scale Dams	(10^6 m^3/year)		(m^3/m^2/year)
Prachin Buri	16.4	249.3	77.4	343.1	68,703	0.50
Nakhon Nayok	21.4	325.3	101.0	447.7	89,671	0.50
N. Ratchasima	14.3	770.0	45.6	830.0	117,713	0.71
Buri Ram	9.6	238.9	57.0	305.4	30,622	1.00
Surin	8.3	95.6	45.6	149.5	29,321	0.51
Si Sa Ket	6.7	81.7	46.3	134.7	25,588	0.52
U. Ratchathani	10.1	100.8	44.8	145.6	41,772	0.35
Yasothon	3.2	17.5	34.9	55.6	7,541	0.70
Mukdahan	2.4	54.6	13.3	70.3	9,997	0.70

Table 2 Comparison between Water Demand and Potentials

(million m^3/year)

Province	Existing Irrigation Water Storage Capacity	Water Demand for Human & Animal Use (2010)	Water Potentials	
			Surface Water	Groundwater
Nakhon Nayok	448	7	44	39
Prachin Buri	343	34	268	51
Nakhon Ratchasima	830	149	280	72
Buri Ram	305	57	534	49
Surin	141	51	285	27
Si Sa Ket	135	51	138	54
Ubon Ratchathani	146	101	662	143
Yasothon	56	24	106	26
Mukdahan	70	20	91	11

Table 3 Annual Production of Fish in LNE-UE (1989-91)

(Unit : tons)

Province	Production	Province	Production
Surin	3,068	Korat	632
Prachin Buri	5,155	Si Sa Ket	13,200
Mukdahan	122	Ubon Ratchathani	499
Buri Ram	1,115	Nakhon Nayok	958
Yasothon	972	Total	25,721

Source: Department of Fishery

Table 4 Area Suitable for Irrigation by Pond/Reservoir

Lower Northeast (Unit : ha)

Present Land Use	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	0	330
(d) Grass land	499	0
(e) Barren land	1,514	0
(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

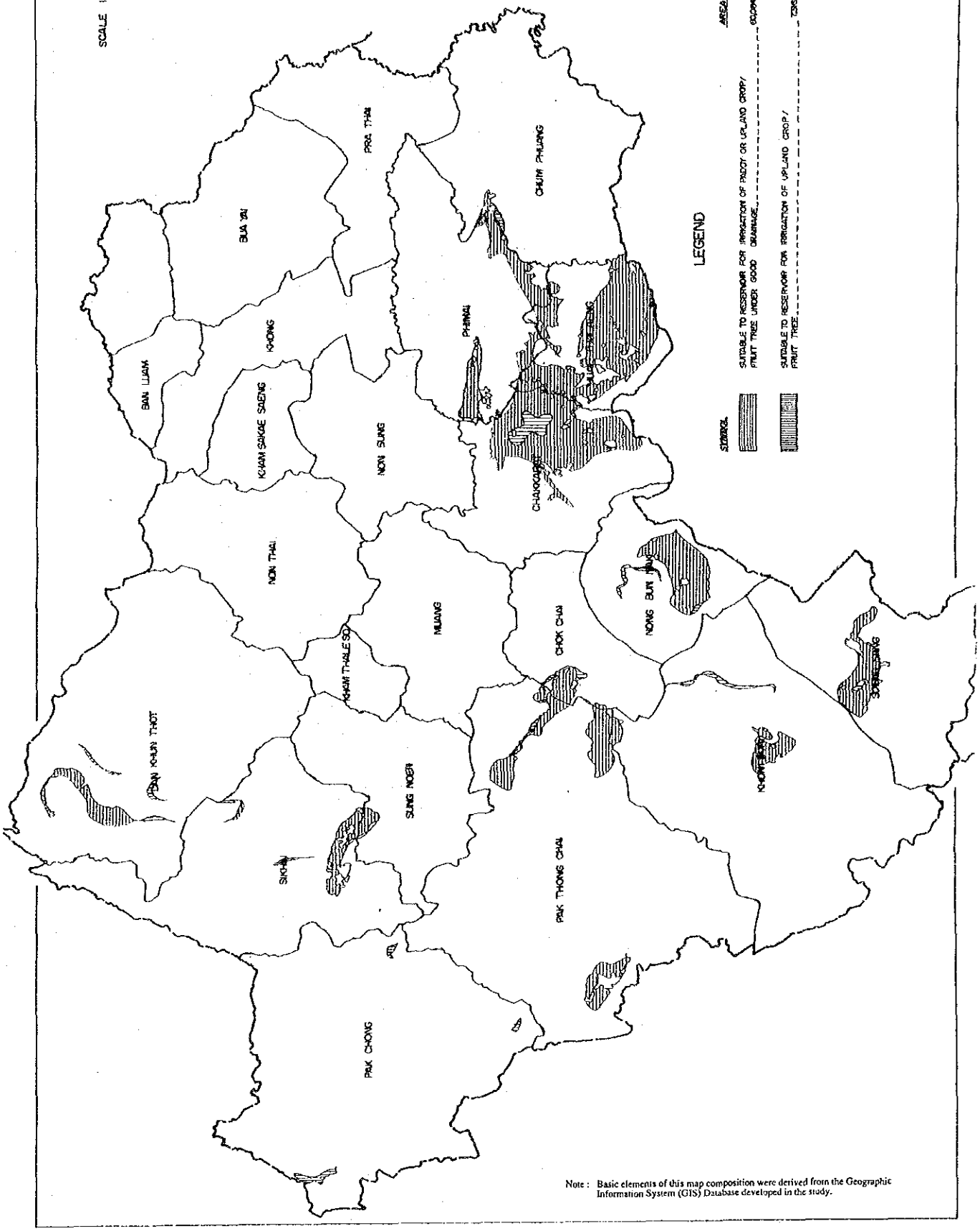
Table 5 Cash Flow of Drip Irrigation Development and IRR Calculation

Year	Construction Costs	O&M Costs	Total Revenue	Net Cash Flow
1	514,960			-514,960
2		3,000	81,600	78,600
3		3,000	81,600	78,600
4		3,000	81,600	78,600
5		3,000	81,600	78,600
6		3,000	81,600	78,600
7		3,000	81,600	78,600
8		3,000	81,600	78,600
9		3,000	81,600	78,600
10		3,000	81,600	78,600
11		3,000	81,600	78,600
12		3,000	81,600	78,600
13		3,000	81,600	78,600
14		3,000	81,600	78,600
15		3,000	81,600	78,600
16		3,000	81,600	78,600
17		3,000	81,600	78,600
18		3,000	81,600	78,600
19		3,000	81,600	78,600
20		3,000	81,600	78,600
IRR				14.00%

Figures

Figure 1

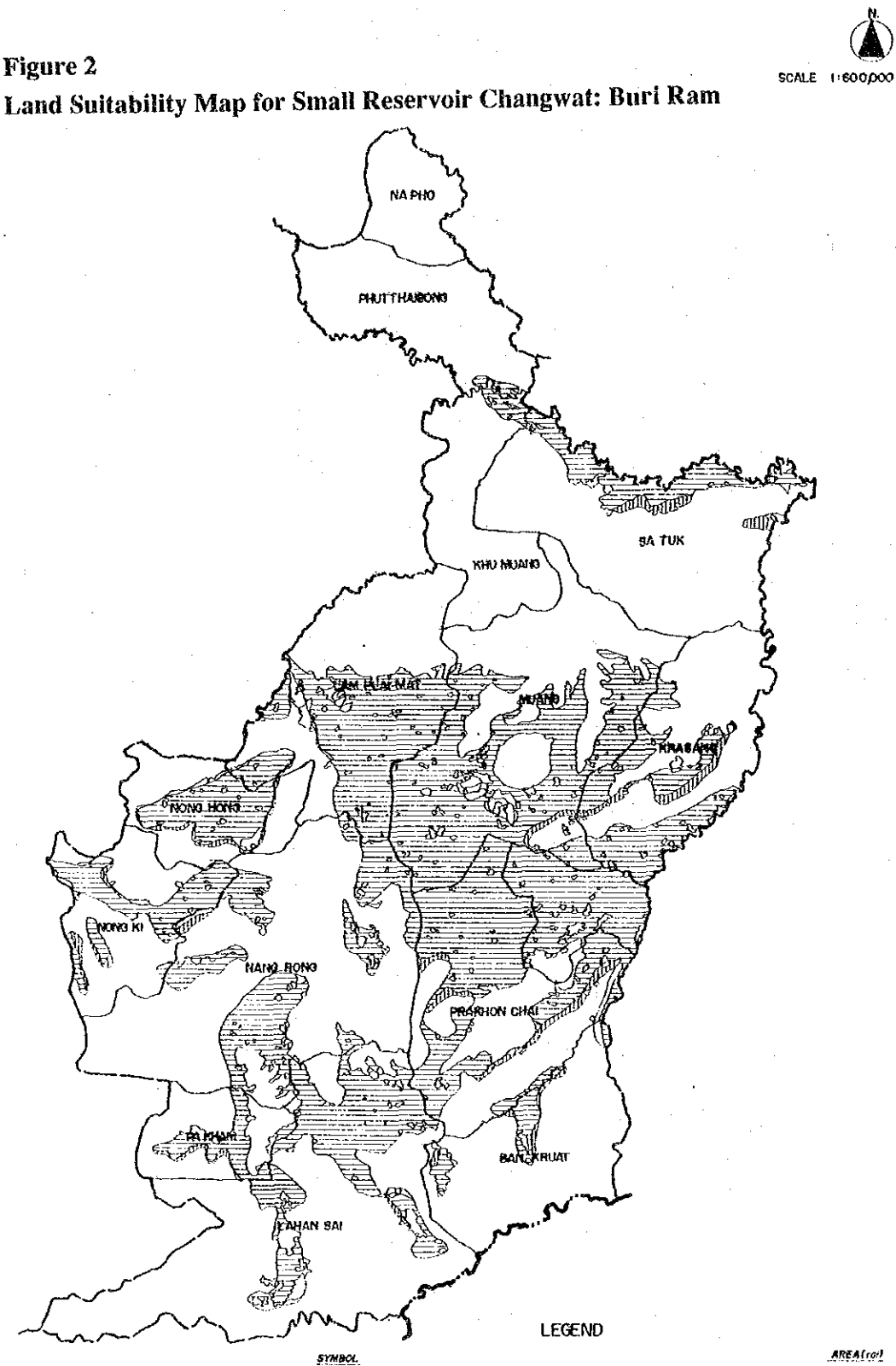
Land Suitability Map for Small Reservoir Changwat: Nakhon Ratchasima



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

Figure 2

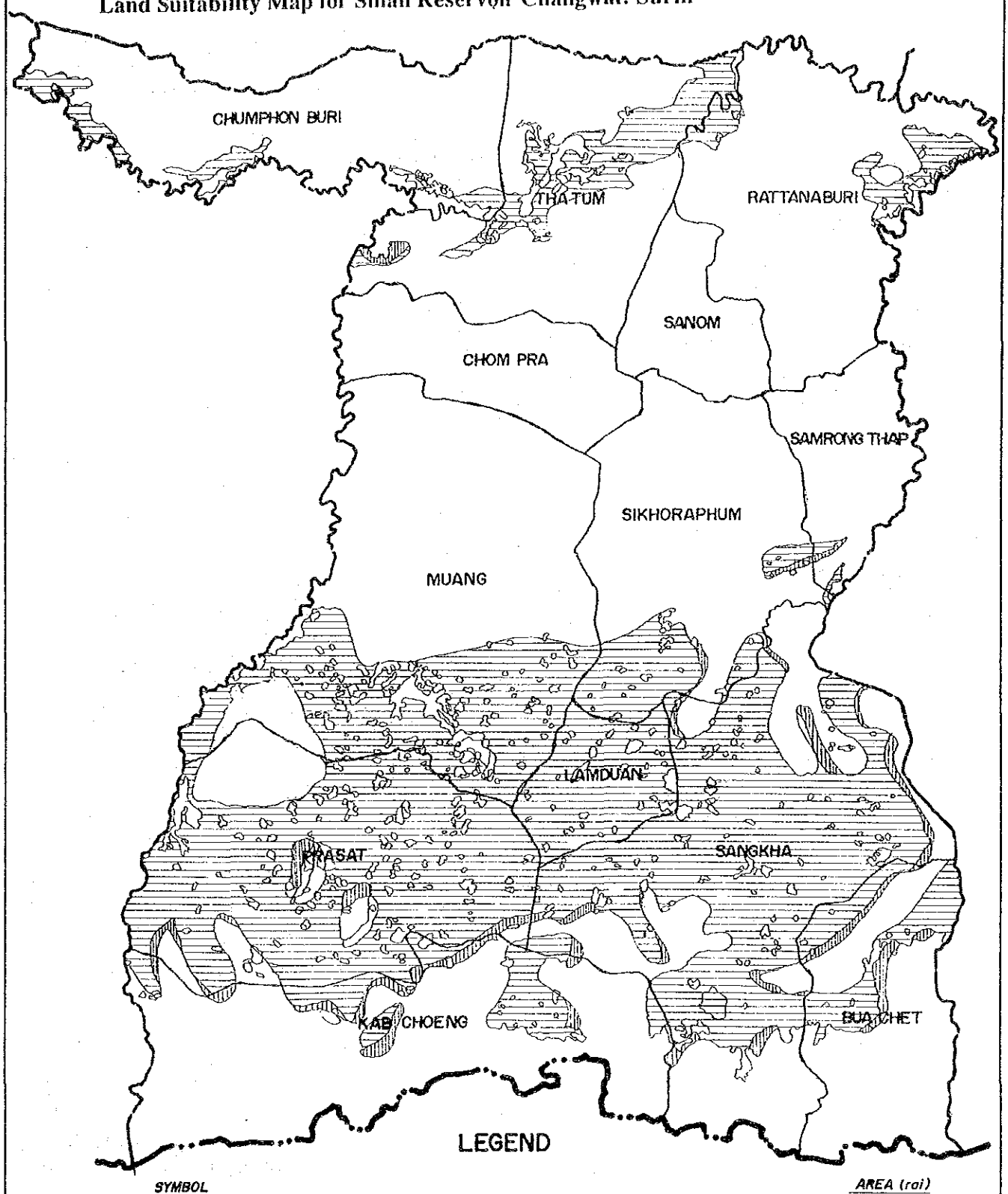
Land Suitability Map for Small Reservoir Changwat: Buri Ram



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

Figure 3

Land Suitability Map for Small Reservoir Changwat: Surin



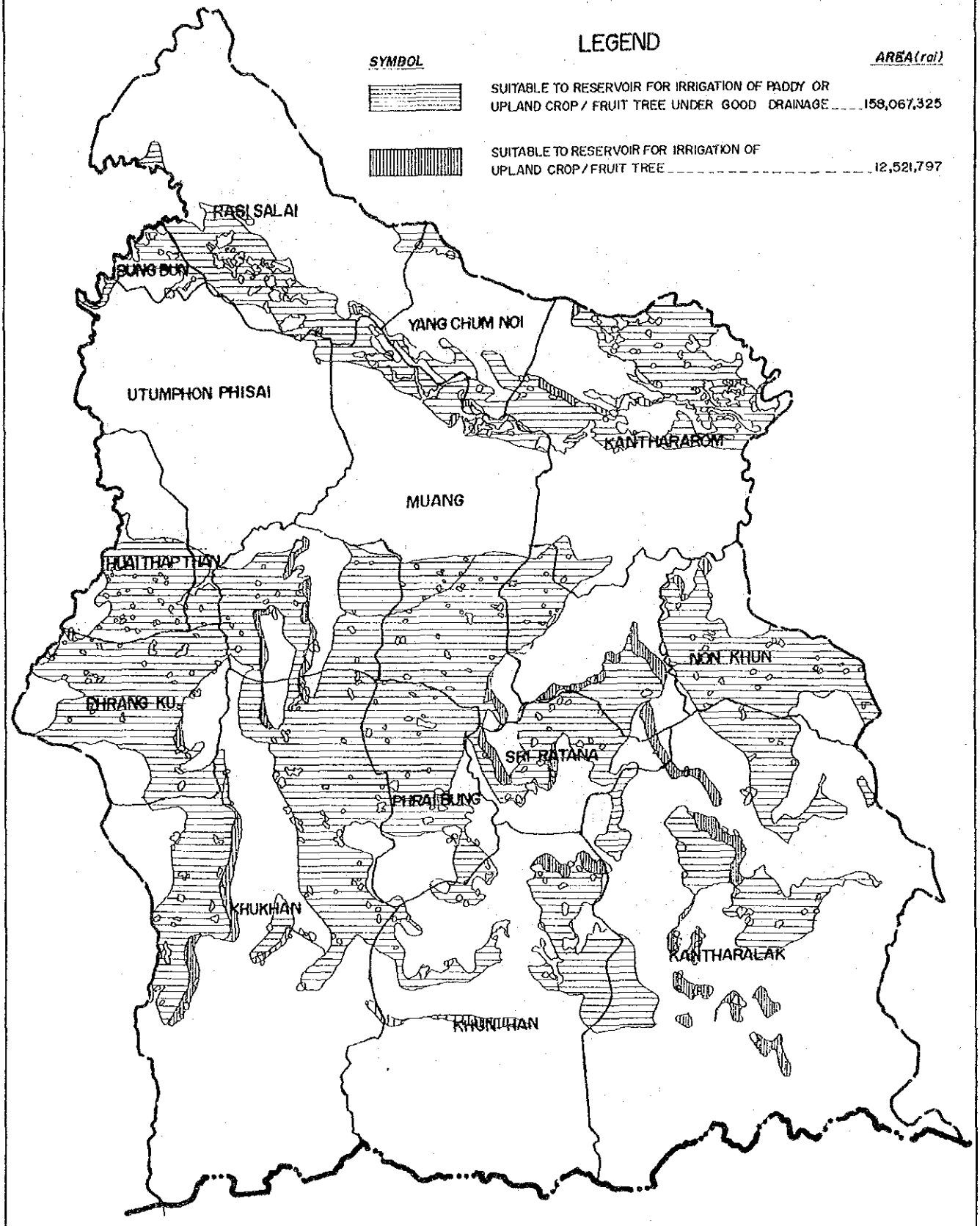
Note : Basic elements of this map composition were derived from the Geographic Information System (GIS) Database developed in the study.

N.

SCALE 1:600,000

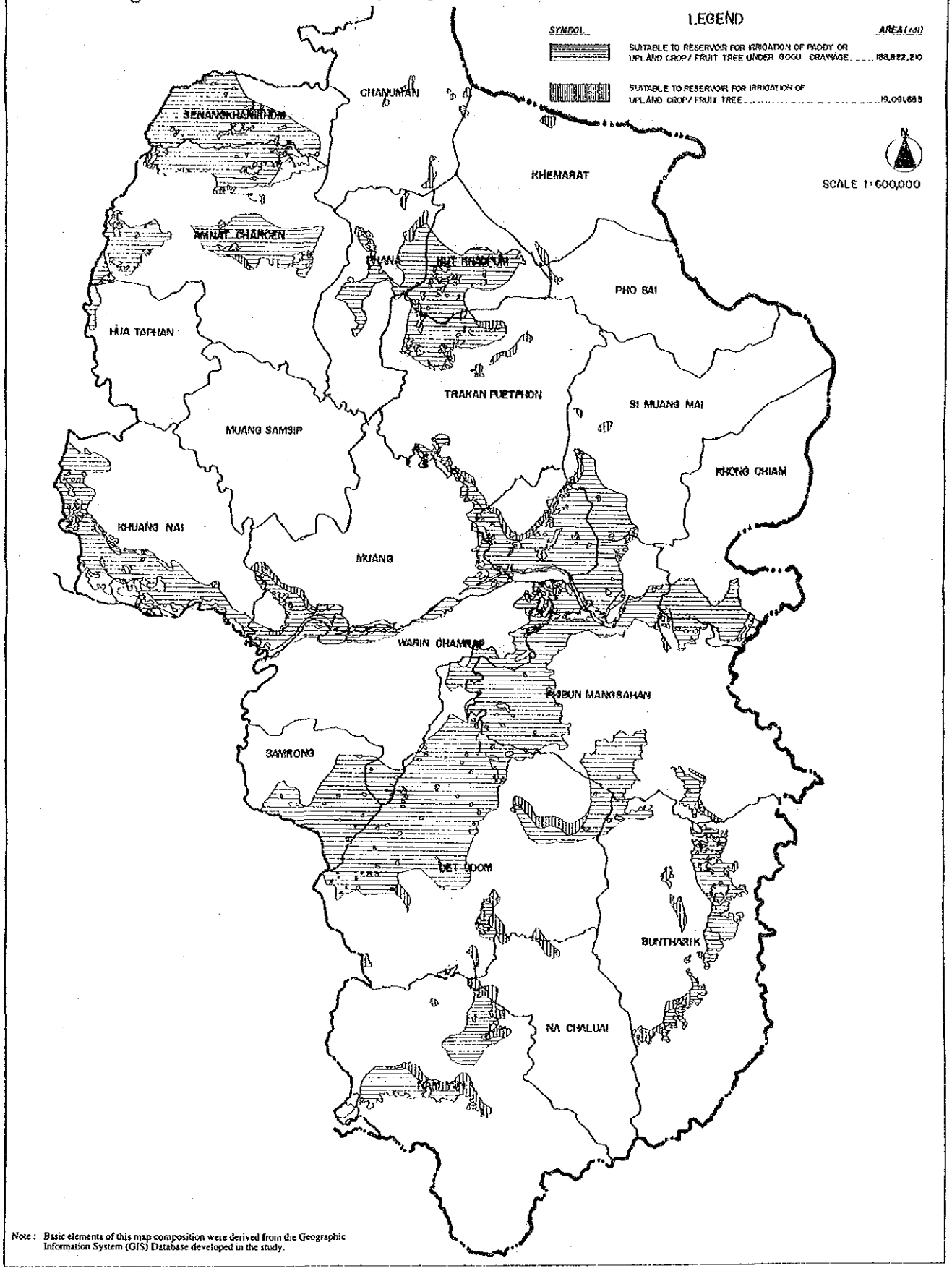
Figure 4

Land Suitability Map for Small Reservoir Changwat: Si Sa Ket



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

Figure 5 Land Suitability Map for Small Reservoir Changwat: Ubon Ratchathani



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

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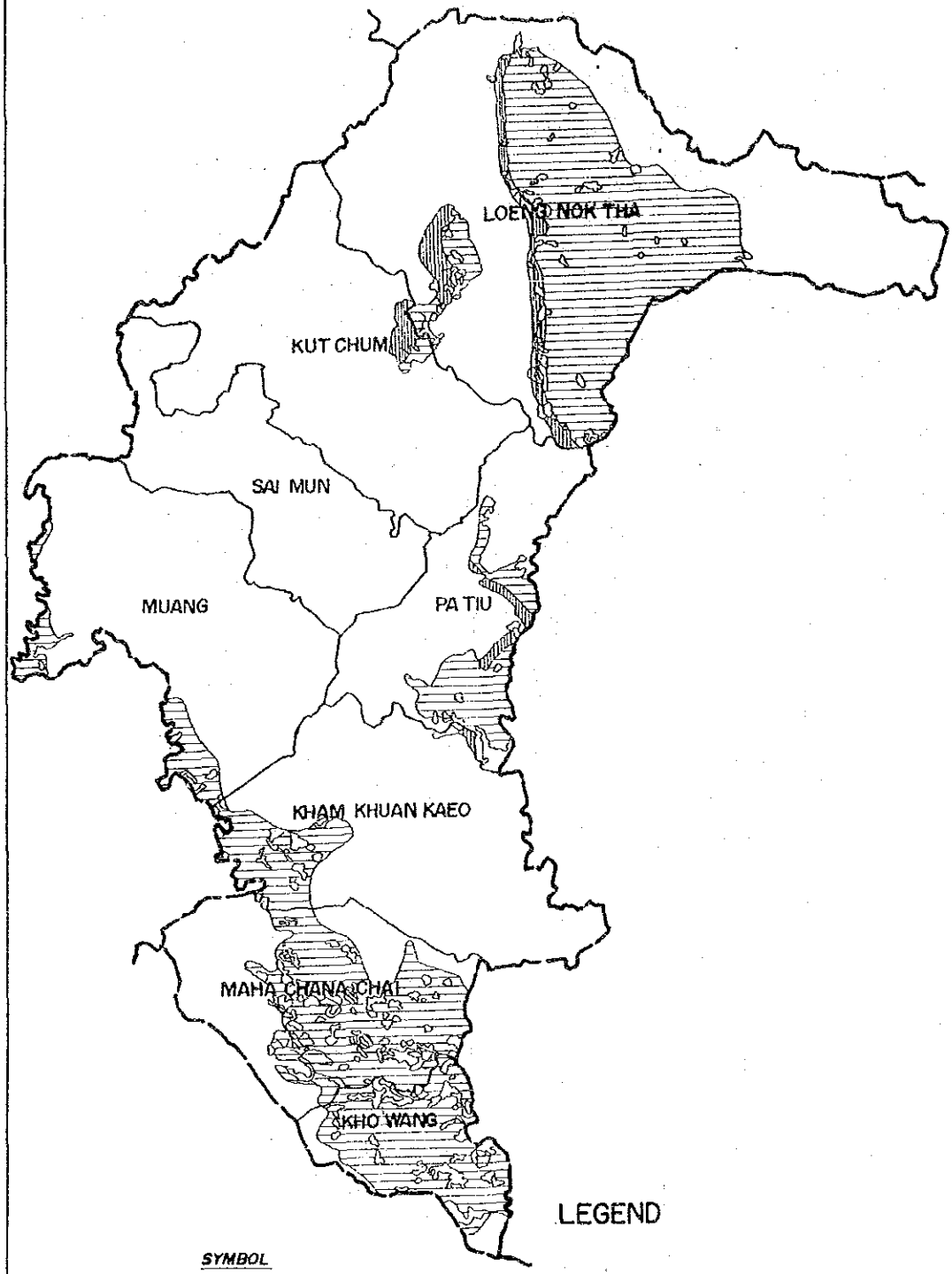
SCALE 1:600,000

Figure 6

Land Suitability Map for Small Reservoir Changwat: Yasothon



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

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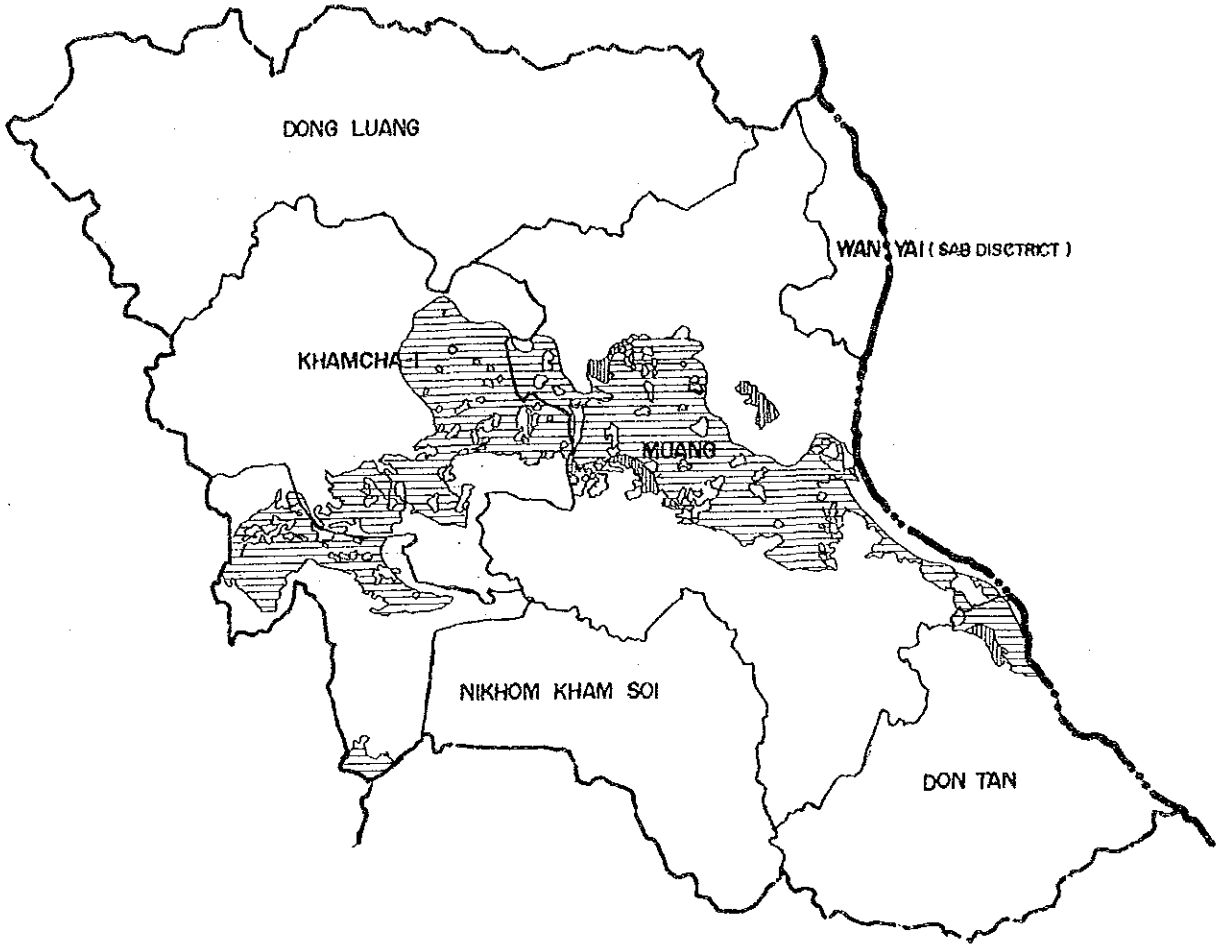
SCALE 1:600,000

Figure 7

Land Suitability Map for Small Reservoir Changwat: Mukdahan



LEGEND

SYMBOL		AREA (rai)
	SUITABLE TO RESERVOIR FOR IRRIGATION OF PADDY OR UPLAND CROP/ FRUIT TREE UNDER GOOD DRAINAGE	28,807,583
	SUITABLE TO RESERVOIR FOR IRRIGATION OF UPLAND CROP/ FRUIT TREE	1,425,826

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

5. Dairy Industry

PRIVATE SECTOR INVESTMENT OPPORTUNITIES
DAIRY INDUSTRY

List of Tables

PRIVATE SECTOR INVESTMENT OPPORTUNITIES
DAIRY INDUSTRY

1. Overview

a) Characteristics of the Northeast Region

This region has over a third of Thailand's population (19 million people in 1990) and 33% of land area. It is the least developed region of the Kingdom. Per capita income was only 37% of the national average in 1990.

The region is traditionally a source of migrant labor for industrial enterprises in Bangkok Metropolitan area and abroad. A salient characteristic of the migration from this region is the almost permanently seasonal nature of this migration: few migrants permanently settle in Bangkok and other areas of seasonal employment. The bulk of migrants return to their homes - at least part of the year. As a result, the population of the region has grown at about the same rate as that of Thailand despite low relative incomes.

The low incomes in the region are due to a combination of reliance on agriculture, and limited agricultural potential. The latter derives from reliance on rainfed agriculture, limited rainfall and its uneven distribution within the year, and problematic soil characteristics (particularly saline soil due to prevalence of salt rocks).

Non-agricultural employment and income opportunities are extremely limited. Industry accounted for 15% of regional income. Manufacturing was largely confined to rice and cassava milling, production of concrete products, and simple repairs for the motor vehicles.

Agricultural production, is also heavily concentrated in few products with limited growth prospects. Paddy occupied 64% of agricultural land. Almost all of the rest was in cassava, maize, kenaf, and sugarcane. Fruit and vegetables, other food and feed grain, and oil seed production is extremely limited.

Two of the major crops in the region, furthermore, are likely to face major price problems in the future. In addition to the declining trend of the international rice prices, Thailand will face increasing competition from Indochina countries who have low production costs. This is likely to result in falling paddy prices for Thai farmers.

Most of Thai cassava output is produced in the Northeast. Thai cassava farmers have benefited from substantial subsidies of European Community (EC) over the last ten years. This is likely to end over the next five years as a result of EC reforms of the Common Agricultural Policy, and ongoing GATT negotiations.

Despite these problems, Thai government is committed to increase the incomes in Northeast and reduce the income gap between this region and the rest of the Kingdom. As a part of these efforts, the government has prepared a Regional Development Master Plan for a region including seven provinces of the Lower Northeast (Nakhon Ratchasima, Buri Ram, Si Sa Ket, Surin, Mukdahan, Yasothon and Ubon Ratchathani) and two provinces of the Upper East Region (Nakhon

Nayok and Prachin Buri). As a part of the Master Plan Studies, detailed case studies were prepared three papers presented in this report (dairy, meat processing and animal feed) to identify the possibilities for private sector investments in agro-industries. They provide a framework within which detailed feasibility studies of individual investments may be conducted by interested investors.

b) Development Prospects in the Lower Northeast

The government will attempt to develop the Northeast region through three policy instruments. One; it will promote industrialization of the region; two, the region will receive priority in infrastructure development to support industrialization and intensive agriculture; and finally, agriculture will be diversified through a combination of promoting productivity, agro-industry development, support services, and by taking advantage of new possibilities for trading with neighboring Indochina countries.

The future industrialization of the region is based on a combination of promoting Bangkok based companies to relocate to the Lower Northeast and support of local entrepreneurs. The relocation from Bangkok is already happening in Nakhon Ratchasima. Further growth will be channeled into Ubon Ratchathani by a combination of promotional measures and strengthening its links with the Eastern Seaboard by building new highways.

Agro-industries are projected to be a major component of industry. They will continue to exploit export marketing opportunities, will serve the national market with livestock products, and will be based on a diversified and efficient agricultural base.

Livestock is projected to play a major role in the future agricultural development of the Northeast. The region already has a major share of cattle and pig population. In the case of cattle, however, productivity is very low and the quality of beef output is very poor-making it suitable for processing into some traditional meat products only.

Two-third of the present cattle herd is buffalos and is kept primarily for draft purposes. The cattle herd consists of local breeds which are not milked at all. Due both to the breed and extensive farming practices, both the meat yield and the quality is very poor. As a result, Thailand has had to rely on imports to serve the tourist trade and the high income Thai domestic demand for high quality beef.

Domestic milk production in Thailand is confined to few integrated dairy operations. The annual output of these enterprises and small village units is around 150,000 tons of milk, with over 600,000 tons of milk equivalent imported (mostly as milk powder) to meat the domestic demand.

Demand for good quality beef and milk is estimated to increase by around 10% per annum while production has grown much less rapidly. The proportion of domestic demand met through local production has thus remained low.

Thailand is noted to have international comparative advantage in both milk and meat production. This derives from low cost labor, suitable climate, and rich agricultural resource base.

Poultry sector is already well developed and is primarily export oriented. Pig raising meats the bulk of domestic red meat demand. Beef sector is the least developed due both the supply constraints and to limited demand resulting from consumer preferences and religious reasons. The demand for beef, however, has grown rapidly in recent years.

The introduction of UHT milk with a long shelf life, government promotional programs and the change in dietary habits have led to a substantial growth in milk and dairy product consumption. This sector is expanding rapidly. The growth in production of finished animal feed has largely been in response to that of poultry and pig raising. Its future growth is expected to rely largely on that of red meat (presently dominated by pig meat) and dairying.

c) Prospects for Private Sector Investments

A key constraint to the development of both beef and dairy sectors is government regulations on slaughterhouses. This, in turn, has prevented the development of the meat processing industry which heavily relies on supplies from illegal slaughters. These regulations are now being modified to encourage private sector to take over the meat processing sector.

The development of dairy and beef industry will require a parallel growth in animal feed industry to provide formula feeds. It will also require a change in the cropping pattern-away from rainfed paddy and cassava to production of forages. The technical and financial feasibility of such a change has already been demonstrated in two dairy enterprises in the Lower Northeast region and through government sponsored research trials.

There are thus substantial investment opportunities for the private sector to invest in beef, dairy, and feed production in the Study Area This could be combined (integrated) with production of formula feeds and primary production (dairying and fattening) to various degrees depending on the investor characteristics. Government input supplying (particularly credit) and technical service agencies could also be brought into such an integrated production unit.

Given the present market environment, and the sophistication in processing technology, two recommended priority areas of investment are formula feed and dairy production. Dairy products will find a ready market through import substitution. The market prospects for formula feed are also attractive. There one substantial opportunities for replacing grains fed directly by formula feeds. The male calf output of the dairy enterprises will provide the stock for fattening for the meat processing enterprises.

The formula feeds are presently produced in Nakhon Ratchasima province of the Lower Northeast only. The two plants in this province, furthermore, are operating near full capacity and additional investment in formula feed production would be required even in that province.

A related development is the production and processing of oil seeds. This would provide the protein ingredients of formula feeds. The oil industry, however, is unlikely to develop in the short term. The protein ingredients (presently mostly soybean, groundnut, and sunflower cake/past) can be transported over long distances and there is, as yet, no proven oil seed crop that may be grown

competitively in the Northeast. Thailand is also presently self-sufficient in oil production and the small incremental demand can be met by increased production of palm oil.

The abundance of low cost, easily trainable, labor force, the relatively large regional market and opportunities for trade with Indochina countries present opportunities in fruit and vegetable processing as well. There already is an established canning industry based on a combination of baby corn, asparagus, bamboo shoots, and mushrooms for exports. Some specialized vegetables (onion, garlic, ginger and eggplants) are presently grown for exports in the Study Area. Similar new projects can be undertaken profitably in the region. The impetus for such projects needs to originate from foreign importers as the major bottleneck is export marketing.

In the case of fruits, there is a ready regional market. The region is deficient in fruit production at present and the incremental supplies will be absorbed by the fresh market with which processors can not compete as the fresh market can almost always pay higher prices. Substantial growth in production can occur only in the long term as most fruit trees have a gestation period of 6 to 8 years. For the short-term, fruit processing may be undertaken in small units sharing the machinery in dairy plants. Such an integration would be needed in any case if the dairy plants produce flavored milk.

2. Dairy Sector in Thailand

Modern dairy production is a new activity in Thailand. Thai local breed of cows is not milked at all. All of the present milk production in Thailand come from cross breeds.

Government breed improvement programs have utilized, at different times, all of the available options: purebred cows have been imported to provide a local nucleus; local cows have been artificially inseminated with purebred bulls to produce crossbreeds; and finally, the government has provided selected crossbreed bulls to the villages for natural insemination.

The government efforts at breed improvement are noted to have been successful in upgrading the local cattle with Brashman cross-breeds for meat production. The improvement for dairy production, in contrast, is in its infancy. Out of a total cattle population of 6.8 million in 1992, only around 110,000 are reported to be dairy cross-breeds. The number of such cows milked is around 50,000, producing 150,000 tons of raw milk per annum.

The present emphasis for breed improvement is on artificial insemination (AI), though imports also continue. The success rate at the first, the subsequent two and inseminations is very low. This has adverse effects on herd composition (too few milking cows and too many unproductive animals in the herd) and probably reduces the average milk yield per cow milked by over extending the lactation period.

A more efficient strategy may be to rely on stock from nucleus farms who would have better AI performance. To build the nucleus farms, Thailand imported pregnant heifers. These are given to farmers who are supplied with credit from the Bank of Agriculture and Agricultural Cooperatives (BAAC). Imports are undertaken by both the government and private companies. The number of imported cattle has fallen

sharply in 1992: beef cattle imports of 14,884 in 1991 have declined to 6,879 in 1992. The purebred cow imports were very small: 180 in 1992, compared with over 5,000 in 1986-87.

The Ministry of Agriculture does not seem to be overly concerned with the fall in imports of breeding stock. The size of the domestic herd is now believed to be large enough to provide the nucleus for breed improvement. It is estimated that the existing farms can supply up to 10,000 pregnant heifers a year to the dairy farms to be newly established.

The purchase of milk produced by the dairy enterprises is guaranteed by the government. Initially, the raw milk was procured by plants owned by Dairy Farming Promotion Organization (DPO) of Thailand. At present, there are also private dairy plants who purchase fresh fluid milk.

In 1992, domestic production supplied around 20% of total domestic consumption. The rest is met by imported milk powder which is reconstituted into fresh milk. This reconstituted milk is much cheaper than products based on local supplies. To protect the local dairy farmers, the government allows imports of milk powder only as a proportion of local raw milk purchases (Section b below).

The private sector has become dominant in Thai dairy industry as it has grown. Initially, the industry was domnated by the three plant owned by DPO: {in Muak Let (Saraburi), Chiang Mai, and Pranburi (Prachuap Khiri Khan)}. Now there are 23 private and cooperative dairy plants in Thailand. There are also 12 small dairy units in Agricultural Colleges and 11 in vocational schools. The total number of dairy plants is thus 48 as of end of 1992.

a) Domestic Raw Milk Production

The milk production in Thailand was negligible until 1980. Total domestic production was 27,000 tons in 1982.This had increased to 70,000 tons in 1987, 119,000 tons in 1989 and to 130,000 in 1990. The estimated 1992 production is between 150,000 to 200,000 tons.

The share of DPO and its member farmers in national production has declined gradually and stood at around 25% in 1992. Four other large processors (Foremost, C.P.-Maji, and Chok Chai) control around 40% the market. This concentration will increase with two large expansion projects underway.

The domestic raw milk was supplied from 8,275 dairy farms with a total of 44,450 cows and a total herd of 101,266 cattle. The milk production per cow milked was 2.9 ton/year which is reasonably high by international standards.

b) Consumption

Statistics on domestic consumption are derived from availability: adding imports to domestic production and subtracting exports. These estimate indicate that the total domestic consumption was around 750,000 tons in 1992.

Imported milk powder is reconstituted and processed into UHT milk. To protect the domestic dairy production, the government allowed diary plants to import a ton of

powder for each 10 tons raw milk procured domestically. This ratio has now been changed to 1 in 20.

The bulk of domestic milk consumption is in fresh liquid form. The preferred marketing form is tetrapack boxes of 250 grs. The initial packing in plastic bags has largely disappeared due to the ease of handling and longer shelf life of UHT milk, though this is considerably more expansive than pasteurized milk.

The present market product mix is estimated to be as follows (in milk equivalent):

Condensed milk	27%	Milk powder	17%
Pasteurized milk	12%	Cultured products	5%
UHT milk	21%	Other dairy products	18%

c) Processing Capacity

As of the end of 1992, the capacity of dairy plants for processing raw milk was around 1,000 tons/day. These plants have a further capacity of around 4,000 tons/day, fresh milk equivalent, for reconstituting milk powder. The existing plants are able to supply the domestic market. The capacity constraint is in raw milk processing. The present raw milk production will allow an industry average capacity utilization of 70%. This is a high average ratio considering that some plants operate at around 50% capacity utilization.

Further, it wold be necessary to supply the fresh liquid milk market out of the local raw milk. These three demand components of dairy products (condensed, pasteurized and UHT milk) correspond to 60% of total consumption or 450,000 tons/annum. The pasteurized and UHT milk demand alone is 33% of total consumption or 250,000 tons in 1992. The existing capacity of 300,000 is barely sufficient to meet this demand, and it is this segment of the market that is growing most rapidly.

It is not clear why the present UHT milk packaging is too small and is in the 250 grs. range. This increases the unit costs of packaging (which is more expansive than the raw milk it contains), prices and depresses consumption. The pasteurized milk demand is reportedly very strong partly because of this, and partly due to transparency of its packaging.

The size of the domestic market could grow even beyond the projected levels if the industry could supply the milk at lower prices. This would include emphasizing pasteurized milk and marketing in larger packages to reduce costs.

Although the domestic market for dairy products is expected to grow rapidly (around 10% per annum) in the near future, per capita consumption will still remain low compared with other countries. Thailand's estimated per capita consumption of 13.5 kgs. is only one-third of corresponding figure in Malaysia.

d) Exports

Although Thailand is a net importer of dairy products, it also exports some fresh liquid milk to neighboring countries. In 1990, 10,000 tons of milk were exported. The two principal markets for milk exports were Laos and Burma. Such trade is likely to expand in the future as border trade increases. The average prices in these border markets are considerably above the domestic prices.

Occasional re-export opportunities are also fully exploited. Imported milk powder is sweetened or flavored and re-exported.

3. Production Potential in the Study Area

a) Present Processing Capacity

The Study Area includes seven provinces of the Lower Northeast stretching along the Cambodian and Laotian borders and include Nakhon Ratchasima, Surin, Si Sa Ket, Buri Ram, Ubon Ratchathani, Mukdahan and Yasothon. Two provinces of Upper East (Nakhon Nayok and Prachin Buri) are also included.

At present, there are two dairy plants in the Study Area and both are located south of Nakhon Ratchasima (in Pak Chong and Muak Lek). The plant in Pak Chong has a rated capacity of 100 tons fresh milk/day, and the one in Muak Lek 120 tons/day. The plant in Pak Chong is operating at 70% of its capacity and the one in Muak Lek at full capacity. Their total liquid milk production in 1992 was around 57,000 tons.

In addition to these two plants, there are two dairy production centers in the Study Area. The two agricultural colleges in Buri Ram and Si Sa Ket have a processing plant of one ton/day to produce pasteurized milk. Farmers in these two provinces purchased dairy cows in 1992 to enable both of these plants to operate at full capacity.

b) Regional Consumption

Information on total or per capita milk consumption in the Study Area is not available. A rough estimate of the magnitude of regional demand can be made. The population of the nine provinces was 9.1 million in 1990. The Master Plan Study for the area projects the population of these nine provinces to increase to 13.4 million in 2010. Assuming the same per capita consumption as the national average, the size of the potential regional market would be 149,600 tons of fresh milk equivalent (projected population of 13.4 million x per capita consumption of 11.2 kgs/capita/annum).

Furthermore, a substantial part of the projected population will live in urban areas where per capita consumption of dairy products is much higher. The urban population in 1990 was around one million in and is projected to increase to 4.5 million in year 2010. Nakhon Ratchasima and Ubon Ratchathani are projected to become the major regional sub-centers as shown below:

Projected population in the Study Area

	Urban	Rural (in 000)	Total Population
Nakhon Nayok	200	192	391
Prachin Buri	650	719	1,369
Nakhon Ratchasima	1,700	1,905	3,605
Ubon Ratchathani	1,000	1,639	2,639
Buri Ram	300	1,261	1,561
Surin	250	1,154	1,404
Si Sa Ket	150	1,229	1,379
Yasothon	120	492	612
Mukdahan	180	221	401
Total	4,550	8,811	13,361

c) Present and Projected Supply Deficit

The two dairy plants located in the Lower Northeast supply half of the present regional consumption. The rest is partly met by plants located in the Central Region and Bangkok, while a substantial part of the regional demand is presently unmet.

At full capacity, these two plants would provide 70,000 tons of fresh milk equivalent. The present regional deficit is sufficient to absorb the output of two new plants. Half of this could be met by the on-going expansion of the Chok Chai farm in Pak Chong as a joint venture with a Japanese company. The existing plants of DPO and Chock Chai and the plant under construction will all complete for milk supplied by farmers around Pak Chong and Nakhon Ratchasima. A plant to be established in Ubon Ratchathani will not only have a ready market, but will also have a strong locational advantage to receive milk from it hinterland which includes Si Sa Ket, Mukdahan and Yasothon.

d) Production of Raw Milk

One reason for the increasing can centration of processing plants in Pak Chong is the availability of raw milk from dairy farms in its immediate vicinity. A plant locating east of Nakhon Ratchasima will have no supply of raw milk. The farmers will not establish dairy farms unless there is a market (plant) nearby.

One mechanism for promoting dairying in areas without a milk plant is to establish a milk collection center. These centers could be located within a distance of 200 kms of the processing plant. Milk inspected and cooled in these centers is trucked to the plant in tanks that need not to have coolers.

As yet, there are few dairy enterprises in the Study Area whose output the plant would purchase. The existing farms in Nakhon Ratchasima have supply agreements with Chock Chai Farm and the DPO plant. It would be difficult for the new plant to compete for this milk.

In the medium to long-term, the company will promote dairying around its plants and independent farmers will supply the required raw milk. For the short-term, the plant would have to rely on milk from two sources. One is DPO itself. It does provide fresh milk from its collection centers for a fee of 80 satang above what it pays the dairy farmers. The second source is imported milk powder to be re-constituted. The

quantity of milk powder the company will be allowed to import depends on the amount of fresh milk it purchases domestically.

Some dairy farms have supplemented their milk procurement by establishing their own dairy farms. This may be done if the company owns large tracks of agricultural land. Production of forages for one dairy cow (two heads of cattle when replacement heifers/calves and dry cows are taken into account) requires 4 rai of land under rainfed conditions and 0.5 rai if the land is irrigated under the climate/agronomic conditions in the Lower Northeast.

The proposed plant would require 100 tons of raw milk/day. Assuming that one-third of this is met by local procurement and the rest is re-constituted milk powder, the plant would require 30 tons/day of raw milk/day. For the first year of operation, it may be sufficient to work at around 40% capacity utilization requiring around 10 tons of raw milk/day. With the present Thai levels of productivity, this corresponds to the output of 1,250 cows requiring around 6,000 rai of land under rainfed conditions.

Aside from large land and investment requirements of establishing a dairy farm of its own, the company's production costs are likely to exceed the market price of raw milk. Establishment of such a central farm, therefore, is not recommended. Arrangements should be made to procure this fresh milk from DPO regardless of cost. Two other sources are the dairy farms being developed in Si Sa Ket and Buri Ram.

Many small farms of around 10 cows per farm could be established immediately by making a contract with the BAAC. Under these arrangements, the Bank will finance the farmers to build the cow sheds and purchase stocks. Contacts with Livestock Development Department of the Ministry of Agriculture would facilitate the importation of pregnant heifers for the dairy farms, and technical/veterinary services to the farmers - including farmer training. At present, the BAAC requires that some of these technical service costs should be born by the processing company.

Another source of dairy stock is DPO. DPO purchases female calves and heifers from the farmers. It resells these after rearing in its farm in Nakhon Ratchasima. At present, it can supply up to 2,000 pregnant heifers a year. It also provides veterinary services and guarantees a minimum level of productivity for the stock it supplies.

4. Prices

The present relative prices in Thailand make both dairy farming for the farmers and milk processing highly profitable. Additional work on changes in these relative prices is needed to assess the long-term viability of the project in the light of Thailand's international comparative advantage.

Neither the government guaranteed minimum purchase price of raw milk, nor that of the final products appear to have changed between 1982-1987 (Table 1). The raw milk price of 6.55 baht/kg in 1982 was 6.59 baht in 1987 (average farmgate price). The final product prices have been equally stable.

In an effort to increase farmers' income, the government increased the guaranteed minimum price by one baht in October 1992. The prices given for February 1993 (Table 1) largely reflect this one time correction.

a) Input Prices

Both dairy feed and raw milk prices are presently controlled by Thai government. The feed price control in unlikely to continue in the medium term. The raw milk price appears to be established above the free market levels as the processors who purchase local milk are given access to highly subsidized imported milk powder.

The dairy feed prices were established at 4,200 baht/ton in February 1993. This is the ex-factory selling price. Factories provide a small margin for their dealers out of this price.

The basic price for the local raw milk is 7,500 baht/ton. Additional premiums are paid to the farmers if the fat/solid content of milk exceeds specified minimum levels. The farmers also receive a premium if their herd is disease free as some of these diseases may be transmitted to the consumers. These premiums amount to 50 satang per liter.

These are prices paid at the factory or milk collection centers. The farmers have to bear transport costs to these points. The collection system, however, is fairly efficient and trucking costs are around 500 to 1,000 baht per farmer per month. The cost per liter is thus negligible (less than 10 satang for an average farmer with 5 cows milked).

At these prices, dairying appear to be highly profitable. Ministry of Agriculture estimates the total cost per liter of milk to vary between 5.03 baht to 5.76 depending on the farm type. This includes the opportunity cost of all capital involved and farmer's own labor. Concentrates is the largest cost item accounting for 45 to 50% of all costs, followed by opportunity cost of capital employed at around 25% of total costs. The return to farmers would be over 30% when all costs are included.

Dairy farming would seem to be highly profitable provided that farmers maintain certain levels of production per caw, and the milk produced can be marketed. The sale of male calues would provide an additional income if the meat processing industry is promoted simutenously.

For the processing plant, the raw material cost only partly derives from the price of raw milk. For the medium term at least, most of plant's raw material will be imported milk powder. The ex-factory price of this (if imported through a dealer) was 52 baht/kg in February 1993.

The imported milk powder is the equivalent of 8 to 10 kgs. of raw milk. The corresponding cost for the raw milk equivalent would thus be 5.8 baht/liter compared with 8 baht/liter for domestic fresh milk. Based on national parameters of 150,000 tons local production and 750,000 total consumption, imported powder based milk to domestic milk purchase ratio would be 5 liters from imported powder to one liter local procurement.

This, of course, is very different from the government regulation which requires that plants purchase 2 liters for every liter equivalent imported. The industry seem to have found ways to avoid this regulation. The regulation can not be implemented in any case under the prevailing conditions. The present macro balance of local production and imports is 1 to 6 while government requirement is 1 to 20.

Considering the rapid growth of domestic production, a safe assumption would be that the plant will utilize 2 liters equivalents of imports for every liter purchased from farmers. The weighted average cost of milk will be 6.5 baht/liter.[1)]

There will be additional costs to the plant of the milk is purchased at milk collection centers. The cost of staff at the collection center, energy and trucking is normally born by the plant.

b) Output Prices

The ex-factory price of UHT milk (in tetrapack boxes of 250 grs. each) was 19.2 baht/kg in February 1993. The details of processing costs and operating margins are presented in Section V. The retail prices of pasteurized milk in plastic containers were similar or slightly higher. The ex-factory price, however, was slightly lower due to the higher marketing margins for pasturized compared with UHT milk. This is due to higher marketing cost of distributing pasturized milk and risk of spoilage if not sold within a week.

The relatively high pasteurized milk prices are also affected by the deficiencies in the marketing (cold) chain and the long distance between plants and markets. A plant with an efficient distribution system could supply pasteurized milk at around half the price of UHT milk and dominate the fluid milk market. This would be case at least in the immediate hinterland of the factory.

c) Accounting Prices

All future costs and revenues are calculated in constant 1993 baht prices. No allowance is made for inflation or price contingencies. This is considered reasonable as the same price adjustment which applies to the inputs will also effect the outputs: they are likely to fall or increase in the same direction by similar margins.

Adjustments, however, must be made for inflation when calculating the real costs of interest for the loan financing. The rates assumed for that purpose is inflation (over the project life) of 6% per annum, and interest costs of 14% per annum with interest paid once at the end of the year. The real interest cost under this assumption is 7.5% per annum. The interest cost of 14% used in this pre-feasiblity study, therefore, overstimates the actual costs.

5. Production Unit and Investment Costs

The proposed plant will have a rated capacity of 100 tons/day. It is unlikely that the actual production will reach this level at full capacity utilization. A tentative level of full capacity utilization is set at 80 tons/day; 365 days/year (29,200 tons/annum at fuel capaciity utilization).

The plant is assumed to start with a relatively low level of capacity utilization (20%) and will reach 80% capacity utilization after 4 years (Section V). Despite these low levels, it is recommended that the full capacity be built at the beginning.

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1) The actual cost of reconstituting imported powder is even lower as it requires no processing for pasteurizing. This, however, is disregarded. The operating costs are calculated by assuming that the plant will process all the milk it requires.

It is technically possible to build up to the terminal capacity in units of 20 tons each. This, however, will double the investment cost of machinery and will lead to significantly higher operating costs. These costs will outweight the capital costs of investment with low capacity utilization during the initial period.

a) Output Composition

For the dairy plant, profit margins tend be highest in fresh fluid milk and other fresh products (yoghurt, ice cream). Cheese production basically regulates fluctuations in demand and supply. Given the large deficit in the regional market and the scarcity of fresh milk, all of the plant's output is planned for pasteurized, and UHT milk.

b) Investment Requirements

A tentative estimate of investment requirements of such a plant are given below. These figures will be revised after detailed process/machinery investigations being undertaken as a part of this Study are completed.

The adjustments in fixed capital requirements, however, will only have a minor impact on project profitability. This is due to the estremely favorable capital/output ratios. Unlike the manufacturing averages of between 4 to 5 in Thailand in 1992, the capital requirement for producing a unit of output is around 0.4 : at fuel capacity utilization the plant produces an output of 560 million baht, with a total capital investment of 245 million baht.

The key determinant of project's viability is the relative prices between inputs and outputs. As an industry average, raw milk accounts for 50% of production costs for UHT milk and 70% for pasturized milk. Together with packaging, the two account for 85% in UHT milk and 81% in pasturized milk.

The share of variable costs, given in the table above, is slightly higher because interest costs are excluded. Including interest costs would result in a cost structure similar to the industry averages.

		Investment requirements in 000 Baht		
		Local costs	Imports	Total costs
I	Fixed Investments			
	a) Land	20,000	-	20,000
	b) Building	30,000	-	30,000
	c) Machinery	35,000	60,000	95,000
	d) Utilities	15,000	5,000	10,000
II	Installation, know how, test run	10,000		10,000
III	Design, supervision, and start-up expenses	5,000	5,000	10,000
IV	Permanent working capital (PWC)	67,000	-	67,000
	Total	182,000	70,000	252,000

Permanent working capital is required primarily to finance stocks of packaging materials. The cost of these materials per kg. of fresh milk varies significantly depending on the size of package. In 1993, the cost of the tetrapack box was 5.7 baht per liter if packaged in units of 200 grs. (cc.). This declined to 3.57 baht per liter

in the case of one liter boxes. The average price of a plastic bag for one liter of pasturized milk was 3 bahts. For this study, a simple average of 4.3 baht/liter is assumed as the cost of packaging.

The plant is assumed to have in storage its packaging materials for three months. The additional 10 million baht included in the permanent working capital should be sufficient to finance other operating expanses.

The milk powder is presently imported by dealers. It is assumed that they would provide the same terms as the plant provides to its buyers, so that the two would cancel each other out. Therefore, no provision is made for stocks of imported milk powder.

The terms on which milk products are sold is not known, so no provision is made for that. In case of credit terms of one month, for example, the plant would need an additional 128 million baht in permanent working capital. The milk is purchased from the farmers against cash. Considerable savings in operative capital can be made of accounts were settled with the farmers on a monthly basis.

c) Physical Volume of Inputs and Outputs

For the medium term, the bulk of the raw material is milk powder. An average figure (1 to 9) is assumed for physical conversion of powder into milk. There will be an increase in the quantity of plant's output if it produces drinking yoghurt, because over half of this is water added to yoghurt. Yoghurt itself would have a ratio of slightly less than one-to-one with milk.

6. Economic and Financial Viability

a) Investment Phasing

The planning, construction and test run phases of this project will be completed over a 12 months period. This will be followed by actual production with the following levels of capacity utilization and investment scheduling.

Year	0	1	2	3	4	5
Capacity utilization (%)	-	20	40	60	80	80
Raw milk procurement (tons/annum)	-	7,300	14,600	21,900	29,200	29,200
Investment						
a) Fixed investment (million baht)	170.0	15.0	-	-	-	-
b) PWC (incremental)	-	17.0	17.0	17.0	16.0	-

b) Cash Flow

The variable production costs per ton of output sold are given below. These constitute 93% of total production costs. The fixed costs are depreciation, project administration, and interest charges on the bank loans.

Variable production costs (baht/ton)

Milk	6,500
Packaging Materials	4,300
Electricity/Water	600
Labor	1,200
Maintenance	200
Other	400
Total Variable Cost	13,200

All labor costs are included in variable costs except for management and clerical staff. A part of the labor costs are in the nature of fixed costs, but sufficient information is not available for a break down.

The total project costs are given below together with project revenues. Revenues are equal to the value of production. Changes in stocks are disregarded, though they should be included at the cost of production.

Project Revenues and Expenditures (Million Baht)

Year	0	1	2	3	4	5
1. Fixed Expenditures						
Investment and permanent working capital	170.0	32.0	17.0	17.0	16.0	-
Variable costs	-	96.4	192.7	289.1	385.4	385.4
Fixed costs						
- Depreciation	-	13.0	14.0	14.0	14.0	14.0
- Administration	-	6.0	8.0	10.0	12.0	12.0
Total expenditures	170.0	147.4	231.7	330.1	427.4	411.4
2. Project revenues (sales)	-	140.2	280.3	420.5	560.6	560.6
3. Net cash flow	-170.0	-7.4	48.6	90.4	133.2	149.2
4. Cumulative cash flow	-170.0	-177.4	-128.8	-38.4	94.8	244.0
5. Cumulative cash flow	-187.8	-203.1	-180.5	-86.5	50.4	203.2

The raw (4) above shows the cumulative financing requirements, including both equity and loans. The last raw is constructed by assuming 75% loan financing, payment of interest at the end of year, including the investment period, at 14%, but excluding repayment of the principal.This last raw is indicative of the kind of grace period required by the project loan. It indicates that the project could start to repay the principal after 36 months from initiation.

The total financing requirements are considerably lower than the simple sum of fixed investments and permanent working capital requirements given in section IV-b above. This basically derives from the projects profitability. Even in year-1, the project generates an operating profit of 37.8 million baht which could be used to finance the increase in permanent working capital requirements due to higher capacity utilization. The other reason for the difference is the gradual increase in working capital over a four-year period.

Including the interest charges in the cash outflow and adjusting for the profits generated within the year (they become available during the following year), the total financing requirement would be 245 million baht. Additional safety margins derive from the use of depreciation allowances.

c) Project Profitability

The funds generated by the project and expenditures for 15 years of project operations are shown in Table 2. It is not necessary to separately specify the sources of funds and repayment of the principal for the calculation of project profitability (Internal Rate of Return, IRR) as a whole.The basic IRR is 47.1% for the cash flow schedules discussed above.

The timing of infusion of loan, interest and repayment of the principal are separately shown in Table 2. The return to equity is 72.5%.

Further refinement would need to be made after the machinery and their effective life is specified. The costs of machinery replacement will be added to the cash out-flow schedule.

The working capital is liquidated at the end of 15 years and added to the cash inflow schedule.The land is also liquidated at its purchase value.

No allowance is made for corporate taxes. This is due to the proposed investment's eligibility for privileges from the Board of Investment (BOI). These privileges effectively exempt the company from corporate income taxes as discussed below.

d) Impact of Investment Incentives on Project Profitability

All seven provinces of the Lower Northeast are eligible for the highest level of incentives (Zone 3). This provides eligibility for a diverse set of incentives to potential foreign investors including a) foreign exchange transfers, b) protection against nationalization or government controls or subsidies that may lead to unfair competition, and c) the right to employ foreign nationals.

Regardless of ownership, the Board of Investment (BOI) privileges short cut the administrative procedures for setting up business in Thailand. This includes registration as well as various permits and licenses required for the factory.

A different set of incentives increase the profitability of the investment by tax and duty reductions. The machinery needed for the plant will be imported largely duty free, though this would vary for different machinery and import duties of up to 10% may be imposed.

As a result of incentives, most promoted investments pay no corporate taxes for up to 8 years, and a reduced rate of taxes for 5 years after that. This is done by granting corporate tax exemption for 6 to 8 years, extendable for another 5 years; double deduction from taxable income of costs of transport, water and electricity; and deduction of 25% of costs of installation and construction of infrastructure facilities from taxable income.

For the component of output exported, the company will also be allowed to import raw and essential materials for a period of 5 years after the commencement of operations. For exports, the company will also be allowed to deduct 5% of the increase in the volume of incremental exports (the change over the previous year).

All of these incentives are available for dairy production. Given Thailand's large deficit, no exports are foreseen. The company will thus not benefit from the export

related incentive. This will only have a marginal impact on company's profitability as it would pay the full cost (including import duties) on some imported packaging materials.

Unlike most other encouraged activities, there appear to be no limits on minimum Thai share holding, implying that the company can be totally freign owned. The minimum investment capital requirement is 5 million baht.

The investment incentive has no locational restrictions as long as it uses local fresh fluid milk. Although the BOI has additional requirements for granting privileges, these are not always enforced and may be waived on a case by case basis. These refer to the company having a nucleus dairy farm and assurances of the supply of raw milk. This last may require the company to have contractual relationships with the farmers for part of its raw milk requirements.

Tables

Table 1 Price of Raw Milk and Retail Prices Major Dairy Products

	1982	1987	Feb. 1993
Raw Milk [1)]	6.55	6.59	8.0
Sweetened condensed milk (8% fat) [1)]	24.56	24.56	36.5
Unsweetened condensed milk	21.89	21.89	
Sterilized milk	44.83	44.83	
Pasteurized milk	15.55	15.55	24.0
UHT milk	22.00	22.00	24.0
Full cream milk powder	95.00	120.00	

1) Raw milk is the farmgate price. All others are retail prices. The basic raw milk price is 7.5 baht/liter. Additional premiums result in an effective farmgate price of 8 baht/liter.

Source: Office of Agricultural Economics (Ministry of Agriculture and Cooperatives) for the period 1982-1987. The 1993 prices are those observed in Nakhon Ratchasima. The prices vary by brand. Those presented are medium values.

Table 2 Cash Flow Schedules (Million Baht) for the Dairy Plant

	Return to Total Project		Return to Equity		Loan Servicing		Net Cash Flow	
Years	Cash Out 1)	Cash In 2)	Cash Out	Cash In	Interest Payment	Repayment of Principal	Case (1)*	Case (2)*
0	170.0		42.5		17.8		-170.0	-42.5
1	134.4	140.2	121.2	114.5	25.7		5.8	-6.7
2	217.7	280.3	217.7	228.6	25.7	26.0	62.6	10.9
3	316.1	420.5	316.1	372.4	22.1	26.0	104.4	56.3
4	413.4	560.6	413.4	516.2	18.4	26.0	147.2	102.8
5	397.4	560.6	397.4	519.8	14.8	26.0	163.2	122.4
6	397.4	560.6	397.4	523.4	11.2	26.0	163.2	126.0
7	397.4	560.6	397.4	527.1	7.5	26.0	163.2	129.7
8	397.4	560.6	397.4	528.5	3.9	27.7	163.2	131.1
9	397.4	560.6	397.4	560.6			163.2	163.2
10	397.4	560.6	397.4	560.6			163.2	163.2
11	397.4	560.6	397.4	560.6			163.2	163.2
12	397.4	560.6	397.4	560.6			163.2	163.2
13	397.4	560.6	397.4	560.6			163.2	163.2
14	397.4	560.6	397.4	560.6			163.2	163.2
15	397.4	607.0	397.4	607.0			209.6	209.6
IRR							0.4714	0.7250

1) The same schedule as total expenditures given in section VI-C, but excluding depreciation.
2) The same schedule as revenues in section VI-C, but also includeing loan proceeds.
* Case (1) is return to total investment, and Case (2) return to owners' equity.

6. Meat Processing Industry

PRIVATE SECTOR INVESTMENT OPPORTUNITIES
MEAT PROCESSING INDUSTRY

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PRIVATE SECTOR INVESTMENT OPPORTUNITIES
MEAT PROCESSING INDUSTRY

1. Overview

a) Characteristics of the Northeast Region

This region has over a third of Thailand's population (19 million people in 1990) and 33% of land area. It is the least developed region of the Kingdom. Per capita income was only 37% of the national average in 1990.

The region is traditionally a source of migrant labor for industrial enterprises in Bangkok Metropolitan area and abroad. A salient characteristic of the migration from this region is the almost permanently seasonal nature of this migration: few migrants permanently settle in Bangkok and other areas of seasonal employment. The bulk of migrants return to their homes - at least part of the year. As a result, the population of the region has grown at about the same rate as that of Thailand despite low relative incomes.

The low incomes in the region are due to a combination of reliance on agriculture, and limited agricultural potential. The latter derives from reliance on rainfed agriculture, limited rainfall and its uneven distribution within the year, and problematic soil characteristics (particularly saline soil due to prevalence of salt rocks).

Non-agricultural employment and income opportunities are extremely limited. Industry accounted for 15% of regional income. Manufacturing was largely confined to rice and cassava milling, production of concrete products, and simple repairs for the motor vehicles.

Agricultural production, is also heavily concentrated in few products with limited growth prospects. Paddy occupied 64% of agricultural land. Almost all of the rest was in cassava, maize, kenaf, and sugarcane. Fruit and vegetables, other food and feed grain, and oil seed production is extremely limited.

Two of the major crops in the region, furthermore, are likely to face major price problems in the future. In addition to the declining trend of the international rice prices, Thailand will face increasing competition from Indochina countries who have low production costs. This is likely to result in falling paddy prices for Thai farmers.

Most of Thai cassava output is produced in the Northeast. Thai cassava farmers have benefited from substantial subsidies of European Community (EC) over the last ten years. This is likely to end over the next five years as a result of EC reforms of the Common Agricultural Policy, and ongoing GATT negotiations.

Despite these problems, Thai government is committed to increase the incomes in Northeast and reduce the income gap between this region and the rest of the

Kingdom. As a part of these efforts, the government has prepared a Regional Development Master Plan for a region including seven provinces of the Lower Northeast (Nakhon Ratchasima, Buri Ram, Si Sa Ket, Surin, Mukdahan, Yasothon and Ubon Ratchathani) and two provinces of the Upper East Region (Nakhon Nayok and Prachin Buri). As a part of the Master Plan Studies, detailed case studies were prepared (dairy, meat processing and animal feed) to identify the possibilities for