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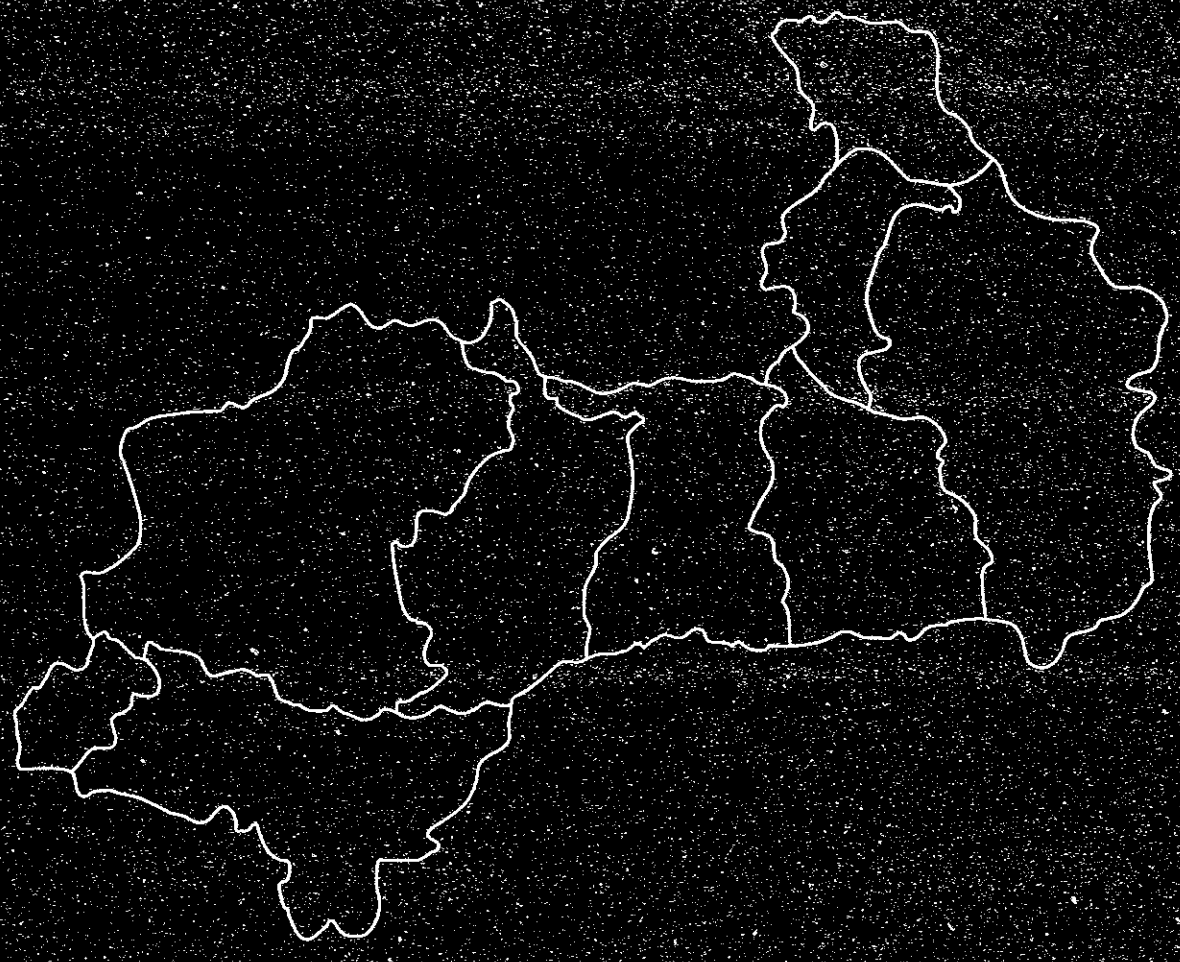
JAPAN INTERNATIONAL COOPERATION AGENCY

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

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

FINAL REPORT



9. Transportation

September, 1993

NIPPON KOEI CO., LTD.

JAPAN INTERNATIONAL COOPERATION AGENCY

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LEGEND

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

Major City (Population)

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

N

SCALE

0 6.5 32.5 65.0

km

Laos

Khon Kaen

Bua Yai

Phimai

Satuk

Buri Ram

Nakhon Ratchasima (Khorat)

Sung Noen

Sikhiu

Dan Kwian

Pak Tong Chai

Chok Chai

Nang Rong

Prakhon Chai

Prasat

Surin

Si Sa Ket

Prasart Kamphaeng Yai

Warin Chamrap

Ubon Ratchatani

Phibun Mangsahan

Kaeng Tana

Chon Mek Border Point

Det Udom

Kamralak

Phu Chong Nayoi

Khao Phra Viharn

Pha Taem

Yasothon

Amnat Charoen

Mukdahan

Huai Huat

Savannakhet

Phanom Rung

Muang Tam

Pak Chong

Khao Yai

Wang Takrai N.P.

Tha Plan

Nakhon Nayok

Prachin Buri

Kabin Buri

Sa Kaeo

Aranyaprathet

Bangkok Metropolitan Region

Eastern Seaboard

Phnom Penh

Cambodia

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

Location Map of Study Area

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

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Abbreviations

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

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

Abbreviation of Measures

Length

mm	=	millimeter
m	=	meter
km	=	kilometer

Area

ha	=	hectare
km^2	=	square kilometer

Volume

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

Weight

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

Time

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

Money

US$	=	U.S. dollar
B	=	Baht

Energy

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

Others

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

Unit Conversions

1 rai	=	0.16 hectare

THE DEVELOPMENT STUDY ON THE LOWER NORTHEAST AND UPPER EAST REGIONS

SECTOR REPORT

-TRANSPORTATION-

INTRODUCTION

The Thai government requested the Japanese government for technical cooperation to prepare an action oriented development plan for a geographic area that is considered strategically important in the light of her development policies. The Study Area is defined as seven provinces in the Northeast, Nakhon Ratchasima, Buri Ram, Surin, Si Sa Ket, Ubon Ratchathani, Yasothon and Mukdahan, and two provinces in the East, Prachin Buri and Nakhon Nayok, and called collectively the Lower Northeast and Upper East (LNE-UE) regions.

In this study, development objectives, strategy and measures were examined by sector. Sector works were coordinated through a number of staff meeting as well as daily cooperative works among different sectors. This is a sector report on transportation, one of such collabrative works.

The remaining part of this report is organized in the following way. Chapter 1 contains a quick review of present transport policies in Thailand. In Chapter 2, existing conditions of transportation are stated and existing problems in transportation clarified. Contents of Chapter 3 are the review of existing transport plans related to the Study Area. Chapter 4, 5 and 6 are the main part of this study.

Contents of Chapter 4 are roughly divided into two part. Firstly, problems in transportation which should be improved are identified through the analysis of problem structure composed of three main factors, the existing problems, trend of traffic demand and existing transport plans in the Study Area. Secondly, the objectives of the traffic condition improvements are set and subjects for development strategy are identified based on the results of the preceding sections and chapters above.

In chapter 5, concept of network formation in the Study area, and design policy of transport network are proposed. Road, railway and air transport projects are proposed with consideration of options and priorities. Of which, projects of high priority or importance are further developed in this Chapter.

In Chapter 6 principles of staged transport improvement are established in accordance with the spatial development framework of the Study Area and projects/programs are shown with a tentative schedule.

CHATTER 1

PRESENT TRANSPORT POLICIES IN THAILAND

1.1 Main Direction of Transport Development in Thailand

The transportation sector in Thailand has become increasingly important as the Thai economy has continued to grow. This sector not only supports other sectors but, in general, is also a significant contributor to the broad service sector in terms of value added and employment. The service sector, in turn, claims the largest share as the economy improves.

Basically, three directions have been pursued in recent years for the development of the transport sector in Thailand: increased efficiency, equity of inter-regional balance, and overall environmental quality. These goals are expressed in the Seventh Plan in the following way:

1) Provision of efficient transportation services to support economic growth and to enhance international competitiveness;
2) Dispersion of development benefits to regions for better quality of life of the people by using the transport sector; and
3) Promotion of safety and environmental health related to transportation.

Efficiency improvements would include the integration of transport service networks, improvement of management and operation of public agencies involved in transport services, and readjustment of pricing structures and regulations. All of these items would also contribute to the equity of regional development. The degree of success in this aspect would depend mainly on the availability of investment funds and other resources, including personnel, as well as careful planning and prioritization. Thus, an increased role of the private sector is called for in the provision of transport infrastructure and services.

1.2 Seventh Plan Guidelines

The Seventh Plan provides more specific guidelines for transport development in the near future. Those having some relevance to the Study Area may be summarized as follows:

1.2.1 Transport system

1) To speed up construction of alternative routes bypassing central parts of large urban areas;
2) To enforce restrictive measures and organize traffic to reduce use of private passenger vehicles and encourage mass transit use;
3) To construct public truck depots in appropriate locations for transport of goods in city areas;
4) To improve organizational structures and operations to encourage more efficient supervision and coordination for solving traffic problems; and
5) To promote public- and private-sector cooperation to alleviate environmental problems caused by the traffic situation.

1.2.2 Land transport

1) To develop networks of inter-urban expressways or limited access highways to enhance efficiency of transport system and contribute to dispersion of benefits to the regions;
2) To develop transportation by road, high-speed rail and pipeline to meet the requirements of new economic zone development; and
3) To develop road and rail networks to respond to the demand of the expanding industrial and agricultural sectors by linking sources of raw materials, production units and consumers.

1.2.3 Air transport

1) To promote Thailand to become the air transportation center of the Southeast Asian region through:

    i) enhancement of capacity of the existing international airports and related facilities;
    ii) improved efficiency of air services by seeking cooperation from neighboring countries and adequately linking air traffic control systems to ensure maximum safety;
    iii) encouragement of air travel into Thailand for tourism; and
    iv) development of cargo transport system linking air and other modes of transport for import and export cargoes.

2) To increase efficiency in planning, administration, management and investment methods through the formulation of long-term plans, organizational restructuring and establishment of training institutes related to air transport.

CHAPTER 2

EXISTING CONDITIONS OF TRANSPORTATION IN LNE-UE

2.1 Transportation System

The Study Area (LNE-UE) is served by roads, railways and airports. The area does not have a port as it is landlocked nor an international airport. Access to an international airport and a port is via Bangkok, yet ports in the E.S.B. are becoming increasingly important. The overall transportation network for the Study Area is shown in Fig.2.1.

The transportation network within the Study Area comprises a well-developed road system serving most parts of the area and a railway system connecting six out of nine provincial capitals in the area to the BMA. The only inter-regional artery serving the Study Area is a road from the BMA to Nong Khai (Route No. 2) passing through the northwestern corner of Nakhon Ratchasima.

The Study Area has a fairly sufficient east-west artery passing through the middle of the area. This artery consists first of the road from the BMA to Nakhon Ratchasima (Route No. 2), the road connecting Nakhon Ratchasima, Buri Ram, Surin and Si Sa Ket (Route No. 226), the road from Si Sa Ket to Ubon Ratchathani (Route No. 222), and the road leading from Ubon Ratchathani to the border with Laos (Route No. 217). These routes are supplemented by the railway serving these five provincial capitals and also by the alternative road connection between Nakhon Ratchasima and Ubon Ratchathani (Route No. 224 and Route No. 24). These two east-west roads are inter-connected with roads from the provincial capitals (Routes No. 218, No. 219, No. 214, No.220 and No. 221).

The road connection between the Northeast and the East is rather limited. The main road is Route No. 304 coming from Chachoengsao, passing through Prachin Buri to Nakhon Ratchasima, where it connects to Route No. 2 heading further Northeast.

There are three routes of Asian Highways that pass through the Study Area. The Asian Highways system was advocated by ESCAP for people to be able to travel by car between Europe and Southeast Peninsular countries via Burma, Bangladesh, India, Nepal, Pakistan, Afghanistan, Iran, Iraq and Turkey. Six routes pass through Thailand and are classified into two standards (i.e. Primary highway and Secondary Highway). The ones which pass through the Study Area are the following:

Route A-1 (Primary Highway)

- Starts from Burmese border at Mae Sot District ; passes Tak, Nakhonsawan Bang Pa-In intersection, Hinkong and Nakhon Nayok to the Cambodian border at Aranyaprathet for a total length of 703 km. of paved road.

Route A-12 (Primary Highway)

- Starts from Hingkong ; passes Sara Buri, Nakhon Ratchasima,Kohn Kaen, Udon Thani and Nong Khai for a total length of 522 km. of paved road.

Route A-14 (Secondary Highway)

- Starts from Tak ; passes Sukhonthai, Pitsanulok, Lom Sak, Chum Phae, Khon Kaen, Ban Phai, Maha Sarakham, Roi Et, Yasothon and Ubon Ratchathani; and crosses Laotian border at Chong Mek for a total length of 870 km. of paved road.

All of these routes utilize existing national highways. All of the Asian Highways in Thailand have been completed according to ESCAP's plan (completed in 1978) with even higher standard than expected. The width of carriageways on each route is not less than 6 m.

The State Railway of Thailand operates the Northeastern and the Eastern lines of single track to serve the Study Area. The Northeastern line serves the five provincial capitals of Nakhon Ratchasima, Buri Ram, Surin, Si Sa Ket and Ubon Ratchathani. This line branches off at Nakhon Ratchasima to serve major towns further northeast such as Khon Kaen, Udon Thani and Nong Khai. The Eastern Line passes through Chachoengsao, Prachin Buri and Kabin Buri to reach the border town of Aranyaprathet. The line then extends into Cambodia, but no service is available at present.

Daily air services are available from Bangkok to Nakhon Ratchasima and Ubon Ratchathani. Both airports are military airports, but they provide commercial service as well. Another airport with the potential for international flights is under construction in Buri Ram.

2.2 Transport Demand

2.2.1 Inter-regional transport

Passenger traffic between the Northeast and the BMR was about 7,200,000 trips in both direction. Bus was the dominant inter-regional transport means and carried over 60% of the passengers between the Northeast and the BMR with 3.2% made up by rail and by air. Transport by air is minor but rapidly increasing (Table 2.1).

Freight traffic between the Northeast and the BMR was 6,757,000 tons to the BMR and 7,225,000 tons from the BMR. Road transport carried 96.8% of the freight from the Northeast to the BMR with the remaining 3.2% made up by rail. Of the freight from the BMR to the Northeast, 91.5% was transported by road and the rest (8.5%) by rail. Transport by air was negligible. (Table 2.2).

2.2.2 Border crossing transport

The Northeast Region has an extensive border with Laos, mostly along the Mekong River except along the eastern boundary of Changwat Ubon Ratchathani where there is a land border for 100 kilometers. Four border crossings are now open not only for truck traffic but also for travelers under normal customs and immigration procedures. Nong Khai, located approximately 20 kilometers from Vientiane, is the most important crossing in terms of both passenger and freight traffic. The other two crossings, Mukdahan and Chongmek, are located in this Study Area, but have smaller traffic volumes than Nong Khai.

Mukdahan

Mukdahan is a potentially important crossing, with the second largest city in Laos (Savannakhet) located on the other side of the border and an important Vietnamese seaport (Da Nang) connected by a 400-kilometer-long road. The Mukdahan crossing was opened for passenger traffic in June 1989, but only 200 persons have been crossing in each direction per day. Data on freight movement across the border during the six-month period from April to September 1989 show an average of 12 ferry trips and 60 large trucks (with some empty when returning) per day in each direction.

Chongmek

In March 1989, the crossing between Thailand and Laos at Chongmek was opened to both passenger and freight traffic. The crossing is by land at this point, with the Mekong River located approximately 25 kilometers within Laos territory. Pakse, a relatively large town by Lao standards, is located on the other side of the river. In October 1989, approximately 93 persons per day crossed the border at Chongmek, with 48 crossing from Laos into Thailand and 45 from Thailand into Laos. Approximately 56% of the crossings were made by citizens of Laos, 37% by Thais, and 7% by those of other nationalities (mostly Europeans).

Freight movements along the border crossings are also relatively significant. Approximately 2,905 tons were transported from Thailand to Laos (68% of the total) in October 1989, including 241 tons originally from other countries to Laos via Thailand. An additional 1,369 tons (32%) were transported in the other direction, from Laos to Thailand. (Fig 2.2)

2.3 Road Transport

2.3.1 Existing conditions

(1) Road length, density and network

The road network in the Northeast under the jurisdiction of the Department of Highways (DOH) is 12,980 km. Of the DOH road length within the Northeast, 78.9% is paved. This is slightly higher than the national average of 75.5% in 1991.

The road density in terms of the DOH road length per unit land area is lowest in the Northeast at 0.08 km/km^2 in 1991. This density is 0.23 km/km^2 in the BMR and ranges between 0.09 and 0.13 in other regions with a national average of 0.10 km/km^2. The road density including all roads, however, is the highest in the Northeast at 0.39 km/km^2 in 1991 except for the BMR.

DOH road lengths and densities in the Study Area are given by province and region in Table 2.3 and 2.4.

As outlined above, the road network in the Study Area serves most of the area and inter-connects most major urban centers and provides access to arterial roads (Fig.2.1). The only major exceptions are relatively weak links between the capital cities in the Eastern region and the capital cities in the central, eastern and northeastern parts of the Northeast(Fig.2.3 and Fig.2.4).

(2) **Institutions related to roads**

a) Institution related to highways

The Department of Highways is responsible for the construction, administration and maintenance of Special Highways, National, Provincial and Concession Highways for the purpose of national development in the fields of transportation, economics, education, administration as well as defence.

b) Institutions related to local roads

Ministry of Interior

- The Public Works Department (PWD)
  The Public Works Department (PWD) is a department within the Ministry of Interior responsible for the planning and construction of public works, and it has the following objectives:

  - To relieve the central budget since the Changwat Administration Organizations (CAOs) must support 20% of the budget.
  - To distribute project implementation with the CAOs.
  - To achieve a national balance in the construction, rehabilitation and maintenance of rural roads, national highways and provincial highways.

There are three PWD programs for rural road development:

- Rural Road Construction Project (RRCP)

This project is to improve accessibility from rural areas in only 38 changwats. The budget is from the Department of Local Administration (DOLA). Program implementation is carried out by the PWD. The projects are carried out in junction with the Changwat Administrative Organizations (CAOs) in the construction of roads which are limited only to laterite road construction.

- Public Utilities Project (PUP)

This program started in 1989 to construct roads in rural areas which are more developed than areas eligible for RRCP programs. Contractors are hired for the actual construction, which is usually laterite, but may be bitumen when the traffic is greater than 200 ADT.

- Labor-Based Construction Project (LBCP)

This program was established in 1984 and is intended for the construction of roads but emphasizes employment creation. The program is designed only for designated "poverty areas" which are in north and northeast Thailand. For this project local workers are hired to work with relatively primitive equipment in the construction of low-standard local roads under the supervision of PWD engineers.

- Office of Accelerated Rural Development (ARD)

The primary emphasis of ARD's activities is on infrastructure development such as rural roads and water supply. ARD started operations in six changwats in the

northeastern region and expanded by 1974 to include changwats considered to be politically sensitive. In 1992, ARD expanded its operations to 72 changwats. ARD has become a general purpose rural road development agency for the first time, but its contributions will not be distributed equally over the nation for a while due to its primary emphasis in only 38 changwats. A total of 31,296 km of road has been constructed by ARD. In 1992, 4,916 million bahts was spent for rural roads.

- Local governments and their sub-divisions

Local governments which may be involved in rural local road development are the Changwat Administrative Organizations (CAOs), amphoe, tambons and mubans. In all cases it is the CAOs which implement programs. Municipalities and sanitary districts are responsible for urban local roads. A fund from the national budget is allocated to the changwats for changwat development projects such as the provision and maintenance of water works, roads, and other small-scale public facilities. The CAOs and the subsidiary governments are also charged with maintaining rural roads which were developed by other rural road development agencies but turned over to them.

Ministry of Transport and Communications

- Department of Highways (DOH)

DOH involvement in local road development takes place through what is called "minimum maintenance" roads.

Some of the rural local roads developed by the rural road development agencies are transferred to DOH. These are the roads with significantly large traffic volumes that are considered necessary to be upgraded to national or provincial highway standards and maintained by DOH. Roads transferred to DOH but awaiting upgrading due to budgetary and other constraints are called "minimum maintenance" roads, and DOH is responsible for their maintenance.

c) Special categories

Ministry of Agriculture and Cooperatives

- Royal Irrigation Department (RID)

Since 1955, RID has maintained the policy that all canal construction should be associated with road construction because of the need for irrigation systems. Based on this policy, rural road construction is carried out in three sections within the RID.

- Agricultural Land Reform Office (ALRO)

ALRO was established in 1977 to administer land reforms according to the Agricultural Land Reform Act of 1975. ALRO can use three programs through which rural roads may be developed as part of its land reform programs: the Basic Infrastructure Development (BID) program, the Rural Infrastructure Development (RID) program and the Land Consolidation Works (LCW) program.

Among those, the BID program provides significant rural road development. Three types of roads developed through the BID program are main roads (6 m wide),

secondary roads (4 m wide) and service roads. About 10.3% of all main roads and 13.5% of programs are proposed by the Provincial Land Reform Office (PLRO).

Ministry of Interior

- Community Development Department (CDD)

The CDD is the government's most direct and widespread link with the rural population. The CDD's objectives are to promote changes in both the physical conditions and the customary practices in the rural communities in order to increase the general well-being. Its role in building and maintenance is limited to helping villagers build relatively small, low quality roads, including many of the so-called "tambon" roads. And, the CDD has a more direct role in administering a large part of the New Village Development Program (NVDP), where a more planned road-building effort replaces the usual ad hoc construction projects.

- Self-Help Land Settlement Division (SHLSD)

This agency is part of the PWD. Road building has been a major contribution of the SHLSD.

Ministry of Defence

- National Security Command (NSC)

The NSC operates two agencies that build roads, its Engineering Division and the Mobile Development Units. The Engineering Division builds roads normally in militarily sensitive areas, although it may build roads for civil purposes. Mobile Development Units are designed to project a positive governmental presence in remote and isolated villages that are susceptible to communist guerilla attacks or propaganda.

(3) Transport vehicles

The number of different types of transport vehicles are summarized by province in the Study Area in Table 2.5. As seen from the table, other than bicycles and motorcycles, light trucks and mini-trucks dominate all other vehicles in provinces. Public transport vehicles in Nakhon Ratchasima and Ubon Ratchathani are compared in Table 2.6. with those in other regional cities. Nakhon Ratchasima has a relatively high number of buses and mini-buses, and Ubon Ratchathani has the highest number of taxis.

(4) Road traffic

Arterial, collector and provincial roads of DOH are summarized in Table 2.7. Average daily traffic (ADT) on artery and some collector roads is also given. These major roads are classified by ADT and illustrated in Fig.2.5.

The road with the heaviest traffic is the Route No. 2 from the BMR via Nakhon Ratchasima to Khon Kaen and further northeast. The ADT exceeds 45,000 in the section between Muaklek on the western border of the Study Area and the city of Nakhon Ratchasima.

Other roads having more than 10,000 ADT are Route No. 212 from Ubon Ratchathani to Amnat Charoen, Route No. 33 from Nakhon Nayok via Prachin Buri to Aranyaprathet, Route No. 205 from Nakhon Ratchasima to Nong Bua Khok, Route No. 319 from Prachin Buri to the South and Route No. 226 from Lam Plaimat via Buri Ram to Surin.

(5) Bus services

Bus is the main means for catering passenger transport by highways. Three kinds of bus service are offered in the study area, catering inter-regional, inter-provincial and intra-provincial passenger transportation. The number of routes and average length of route by region are shown in Table 2.9.

Over the five-year period from 1980 to 1985, the bus fleet for Categories 2,3 and 4 excluding small vehicles has grown by 3.9 percent per year. Although the LTD has control over the number of buses obtaining licenses, increases in fleet size and associated services are generally made as demand warrants them. In the provinces, services provided by local buses and mini-buses typically carry passengers from rural communities to the local urban centers and to small adjacent towns. Daily origin destination person trips by bus are summarized in Table 2.10.

Local bus and mini-bus services carry small amounts of freight, mainly agricultural products.

Areas that function as bus terminals are the streets adjacent to markets and local business centers or outside the offices.

Table 2.11 shows that there are significant differences in the level of trip making by region. Trip rates in the regions reasonably accessible to Bangkok show levels 2 or 3 times that of the Northeast. The level of trip making of the Northeast is extremely low, with an average of about 5.6 regional trips/year/person. This low value indicates that a large proportion of the population in the Study Area travels infrequently or not at all by bus.

2.3.2 Existing problems

Arterial roads

As a method for evaluating the present road network and determinating network improvements, a "circuity factor" was adopted. This method involved comparing the shortest possible travel time based on a 80 km/hr design speed on a National Highway between two points with the theoretical travel time based on travelling at the same speed along a straight line. The changwat centers, Bangkok CBD and E.S.B. were the points used in this calculation. Dividing the actual shortest travel time by the minimum theoretical travel time produces the "circuity factor", a number always greater than 1.0.

According to the results of this analysis, the most serious problems of the highway network are between E.S.B. and remote sequestered changwat centers.(Fig.2.6)

One obvious way to evaluate the conditions of local roads is to look at local road network density in terms of the number of road kilometers per square kilometer in the study area and compare it to other regions in Thailand. The network densities of

rural roads are shown in Fig.2.7. The study area is served by local roads at a sufficient standard except for Prachin Buri.

Another evaluation method is to simply determine the service level of access to land or facilities which local roads provide for, considering the fundamental function of local roads. As part of an effort to have a nationwide system of information for planning rural development, an information management system was established under the supervision of NESDB called the National Rural Development Cooperation Center (NRDCC). Under this agency, a detailed survey was conducted, which contains the most comprehensive information currently available that can be used for evaluating local transport throughout the Study Area. The results are shown in Tables 2.12 through 2.17. Out of 11,855 villages (muban) in the Study Area, 449 are deprived of light-bus services and 1,637 are not served during the rainy season. Light-bus services are infrequent in 5,052 villages. On average, over 10 % of all amphoes in the Study Area lack bus service. Among the amphoes with bus service, 2.9% do not have bus service during the rainy season. Clearly, road improvements are necessary in the Study Area.

2.4 Railways

2.4.1 Existing conditions

(1) Railway network and services

The northeast line of the State Railway of Thailand (SRT) in the Study Area refers specifically to the following sections (Fig.2.8).

a) (Bangkok -) Muaklek - Pak Chong - Nakhon Ratchasima - Lam Plaimat - Buri Ram - Surin - Sikhoraphum - Si Sa Ket - Ubon Ratchathani

b) Nakhon Ratchasima - Bua Yai junction (- Ban Phai - Khon Kaen - Udon Thani - Nong Khai)

The eastern line of SRT in the Study Area refers to the following.

c) (Bangkok - Chachoengsao -) Prachin Buri - Prachatkham - Kabin Buri - Aranyaprathet.

Travel time between Bangkok and Nakhon Ratchasima is six to six-and-a-half hours for ordinary trains, about five hours for rapid trains, and four to four- and-a-half hours for express, diesel trains. There are a few services each day to the Northeast that pass through the Bua Yai junction rather than through Nakhon Ratchasima. Travel time between Bangkok and Prachin Buri is two-and-a-half to three hours by diesel train.

(2) Institutions related to railway

All inter-city trains in the country are operated by the State Railway of Thailand(SRT), a wholly government-owned enterprise.

SRT has been operating in the red every year since 1979, and the operating ratio was 110.02 in 1990. Overall revenues made up by the passenger fares (63%) and freight tariffs (28%). The remaining 9% came from other revenue sources (Tables 2.18, 2.19 and Fig. 2.9).

Passengers trains are grouped into three separate categories based on distance of travel:

1) Express or Rapid	Long-distance trains
2) Ordinary	Medium- to long-distance trains
3) Commuter	Short-distance trains

Freight trains are grouped into two categories based on operating characteristics:

1) Conventional	Cars carrying various cargo
2) Unit	Train dedicated to a single commodity

(3) Rail passengers and freight

Annual passenger traffic in the Northeast has remained steady at around 13,500,000 passengers in recent years. Passenger trips made within the Northeast dominant all other rail passenger traffic related to the Northeast with 7,195,000 passengers in 1989, accounting for about 70% of all the outgoing or incoming passengers (Table 2.20 and Fig.2.10).

Freight traffic in the Northeast has shown increase from 1,025,000 tons in 1986 to 1,286,000 tons in 1989. Inter-regional freight traffic volumes show that freight traffic within the Northeast is insignificant share compared to all freight traffic related to the Northeast. Freight traffic volumes were 344,000 tons outgoing and 937,000 tons incoming in 1989. The main outgoing commodities are agricultural products and incoming ones are petroleum products and cement.

2.4.2 Existing problems

A "circuity factor", mentioned earlier with respect to highways, was also adopted here. Basic travel time was assumed to be 40 km/hr for existing train operations. For the evaluation of rail network, changwat centers and the Bangkok CBD and E.S.B. were set as the network nodal points. Dividing the actual shortest travel time by the minimum theoretical travel time results in the "circuity factor", a number greater than 1.0.

Compared to the road network, the railway network is more constrained due to the conventional radial pattern. According to the results of this circuity factor determination, the network needs to be improved at the linkages between E.S.B. and Prachin Buri and remote sequestered changwat centers along the northeastern line. Sparsely populated areas and relatively stagnant activities in LNE-UE prevented the formation of dense networks and the demographic characteristics necessary for convenient use of the railway.

Both the northeastern line and the eastern line experience the severe train delays along some segments of the lines. As a result, travel times fluctuate considerably, and therefore scheduled operations are not being practiced. The existing operational bottlenecks in the rail network are shown in Fig 2.11.

A number of problems regarding the railway facilities includes the following:

<u>The northeastern line</u>

This line is plagued with gradient and curvature problems between Kaeng Khoi and Pak Chong which cause both low hauling capacity and line capacity problems.

Between Ban Phachi and Kheng Khoi, there are additional line capacity problems on long distance passenger trains and freight trains.

The eastern line

This line is suffering from similar problems as the northeastern line.

2.5 Air Transport

2.5.1 Existing conditions

There are a number of airports throughout the Kingdom. Basic data on 25 major airports in Thailand are summarized in Table 2.22, including the international airports of Bangkok, Phuket, Chiang Mai and Hat Yai. The airline network in Thailand is shown Fig.2.12.

The national government plays a dominant role in the regulation and operation of the Thai civil aviation system. This control is exerted by six key aviation-related organizations within the Ministry of Transport and Communications. Three of these organizations are state enterprises under the Ministry's administration, two are departments within the Ministry, and one is an advisory board to the Ministry. The domestic carrier, Thai Airways International (TG), is a state enterprise and operates a wide range of domestic services almost exclusively.

Only two airports in the Study Area receive regular commercial flights from Bangkok. Average daily commercial flight departures are 1.5 from Nakhon Ratchasima and 1.0 from Ubon Ratchathani.

The Nakhon Ratchasima Royal Thai Air Force Base, located five kilometers south of the city of Nakhon Ratchasima, is a major Royal Thai Air Force (RTAF) base. Commercial facilities at the airport are operated by the DOA. Airfield facilities are used jointly by RTAF and Department of Aviation (DOA). Commercial air service at the airport is provided by Thai Airways, with jet flights to/from Bangkok and Ubon Ratchathani. The runway length is 2,743 m.

Ubon Airport is also a Royal Thai Air Force base; located two kilometers east of the town of Ubon Ratchathani. The DOA operates a commercial passenger terminal at the airport, located on the northeast side of the runway. The runway is 3,000 m in length and is jointly used for commercial and military operations (Table 2.23).

Number of passengers and amount of freight handled at these airports are summarized below (Table 2.24).

2.5.2 Existing problems

A useful method of evaluating the relative position of the various airports derives from the assumption that overlap in the effective service areas should be minimized. Such a methodology was employed in creating a regional road map of LNE-UE on which surface time contours were constructed, assuming average speeds for different classes of roads (Fig 2.13).

The resulting contours reflected the service areas of the airports, as well as the areas that are not within one hour of scheduled air service. In the LNE-UE, contours

follow major roads, overlap is limited, and lack of service is most evident between Ubon Ratchathani and Nakhon Ratchasima.

Currently, these airports only accommodate narrow-body jets because they do not have sufficient facilities to handle wide-body jet operations. If service by a larger commercial aircraft is initiated, even very infrequently, these airports' facilities would need to be enlarged.

At present, military agencies play an important role in the operation of the commercial airport system. However, commercial-military conflicts over runway capacity and utilization at these airports should not be an issue, since commercial operations are so limited in number. Security and land access issues will need further consideration.

2.6 Inland Water Transport

2.6.1 Existing conditions

Inland waterways in the LNE-UE are not utilized for the transport of goods or passengers at present except along the Mekong River.

Almost all rivers in LNE-UE are not navigable by the lighters currently used in river transport.

Regarding the utilization of rivers within the LNE-UE, the priority is given to irrigation, electric power generation and drinking water supply.

The international Mekong River functions with the IndoChina countries as a travel route. Despite a series of rapids, regular navigation services are provided on the Mekong River between Cambodia and Laos. The impassible section of the river at the Khone Falls at Cambodia-Laos border was overcome by a transshipment service by rail.

Navigation beyond Savannakhet southwards is interrupted by a number of rapids in the vicinity of Khemarat. At present, only very small boats ply the Mekong River between Savannakhet and Pakse. Goods to and from Pakse are shifted to the road. Fifty-ton boats can operate during the rainy season from Pakse to Moulapamok. Local navigation is possible year-round for small boats (8 tons). Many years ago, boats up to 300 tons in capacity plied the Mekong River between Pakse and Hinak. Gradually, waterway services in this area declined in direct proportion to the progress made by the Saigon roads and Thai railway to Nong Khai.

Traffic along the main sections of the Mekong River are shown in Table 2.25 and Fig.2.14. In the the Study Area, the volume of downstream waterborne transport was 8,000 tons per year in 1990 and that for upstream was 3,000 tons.

2.6.2 Existing problems

Port facilities and access roads to the river ports of the Mekong River are poor. However, problems in river transport along the Mekong River have not emerged apparently because of relatively light transport demand.

CHAPTER 3

EXISTING TRANSPORT PLANS

3.1 Road Transport

3.1.1 Approved projects

The Seventh Plan provides a list of projects with expected starting dates between 1992 and 1996, to be added to the overall DOH programme of work. Included in the Plan are 14.7 thousand kms. of route length and 38 interchange/flyover locations. Table 3.1 provides the inventory figures, costs and implementation schedules of the projects in the Plan related to LNE-UE. Fig 3.1 through 3.3 show the financially significant projects.

3.1.2 Planned projects

The following are some relevant road construction proposals in the Study Area:

Motorways

Motorways are recognized internationally as a special class of highways. They are built to higher standards than other roads, with full control of access and the provision of service and rest areas. They also may have restrictions on use. High average speeds and ease of driving are the two prime characteristics associated with motorways.

The toll highways development study in the Kingdom of Thailand was conducted by JICA from 1990 to 1991. This study proposed that a nationwide motorway network of 4,300 km should be developed for the future progress and prosperity of Thailand by 2010. Out of these motorways, three routes are proposed in this Study Area. They are the route from BMA passing through Nakhon Ratchasima to Ubon Ratchatani along the considered east-west artery, the route from Chon Buri through Nakhon Ratchasima to Nong Khai along the existing Route 304 and Route 2, the route from BMA to Aranyaprathet along the existing Route 35 (Table 3.2, Fig.3.4).

The Expressway & Rapid Transit Authority of Thailand (ETA) is also considering inter-urban expressways as part of its Fourth Stage Expressway System. The major routes under consideration are Bangkok - Nakhon Ratchasima and Bangkok - E.S.B. These routes are similar to DOH toll highways in terms of linkage. It is important that the network be well coordinated. Both DOH and ETA have the legal capacity to develop inter-urban motorways. However, there is no mechanism for coordinating their plans (Table 3.3, Fig.3.5).

Second Thai-Lao Bridge (Mukdahan - Savannakhet)

A feasibility study was completed under the technical assistance programme of the Asian Development Bank. Thai standards for primary highways (7 m in width) will apply to the design of the bridge. The second phase, devoted to detailed design, was to start in 1991 and construction will take place during the period from 1993-1996.

As for the site, the alternative located at Thakhek and Nakhon Phanom lies along Asian Highway A 15, whereas sites around Mukdahan and Savannakhet are merely terminal points of connection roads. The beginning point of the future corridor between Laos and Vietnam giving way to Vinh and the port of Cua Lo will be either Thakek by way of RN.12 or further upstream the Mekong River by way of RN 8A. The shortest route from Bangkok to Da Nang is through Pakse where construction of another bridge is recommended. Building a bridge at either site depends on regional transport development (Fig.3.6).

3.2 Railways

3.2.1 Approved projects

Projects approved in the Seventh Plan are currently fixed. The new line construction between Kaeng Khoy and Khlong Sip Kao is approved together with other projects in E.S.B. The construction of new line between Kaeng Khoy and Khlong Sip Kao will make it possible to reduce the travelling time between North or Northeastern region by by-passing the BMR and E.S.B. And it also contribute the enhancement of the railway capacity.

Budget secured plan for the fiscal year 1992 includes sub-plan for the transportation improvement in E.S.B. of 1266 mil.baht and sub-plan for improvement of efficiency and safety of railway of 12 mil. baht.

Table 3.4 shows the significant projects related to LNE-UE.

3.2.2 Planned projects

SRT has a programme of potential new lines related to LNE-UE. The new line from Bua Yai to Tha Uthen (416 km) was proposed in SRT's five-year programme as of 1990 and is shown Fig 3.7.

Surveys on the railway network in the Northeastern region were undertaken in 1989 by Engineering Consulting Firms Association (ECFA), Japan, in which the feasibility of new lines proposed by the State Railway of Thailand were studied. The proposed new lines were :

- Ubon Ratchathani - Chongmek (70 km)
- Nakhon Ratchasima - Eastern Seaboard (approximately 245 km)

At present new feasibility study on railway network in Northeastern region is planned to start in 1993 by SRT.

Bangkok-Phnom Penh-Ho Chi Minh City railway

According to an agreement signed by Cambodia and Thailand in 1989, reconstruction of 48 km of track from Serei Sophon to Poipet, the border point, and construction of a new railway bridge at Poipet are envisaged. As part of the policy to develop transport links with neighboring countries, Thai authorities reportedly have started making preparations to open the rail link with Cambodia. This link would contribute to the strengthening of the tourism network in LNE-UE in the mid-term future.

The extension of the railway from Phnom Penh over 200 km. to Ho Chi Minh City would not only develop trade between Cambodia and Vietnam but also boost trade and commerce between Thailand and southern Vietnam via Phnom Penh.

3.3 Air Transport

3.3.1 Approved projects

Projects approved in the Seventh Plan are presented in Table 3.5. Construction of Buri Rum Airport project was approved by the national cabinet in 1989. According to the DOA budget plan, Buri Ram Airport construction is to be completed in 1994. At present, a new site for Buri Ram Airport is under review since the previous one is associated with environmental problems and did not pass the review of National Environmental Board. Currently the candidate site of new airport is being looked for within the Krasang Amphoe just located in the middle of the way beween Buri Ram and Surin. And site selection study is planned to be carried out in 1993 by DOA. The Ubon Ratchathani Airport development project is also listed.

3.3.2 Planned projects

The Airport System Master Plan in Thailand (ASMPS) has been undertaken by the Airport Authority of Thailand.

Proposed scenarios for developing the Thai airport system are presented Fig.3.8. These plans are based on both the allocation of operational responsibilities and roles played in the aviation network for the respective airports.

International flights will be operated by at least the first six airports in the primary group below; the first four already have international service, and international service is assumed to begin at Ubon and resume at Chiang Mai.

proposed group classification of airports

-Primary group
Bangkok International;
Phuket, Hat Yai, U-Taphao, and possibly Ubon;
Chiang Mai, Chiang Rai, Nam Phong, and Surat Thani.
-Secondary group
all others with commercial air service(15 airports);
Hua Hin, given its new air service;
Buri Ram - Surin and/or Mae Sariang (assuming regular commercial air services are provided at these airports).
Service to these points will be direct from Bangkok, non-stop or via intermediate points.
-Tertiary group
Samui;
Krabi (unless it develops as a significant facility in conjunction with the Southern Seaboard project);
Ranong.

With the exception of a limited number of flights between Chiang Mai and Phuket and possibly to U-Taphao, the domestic service pattern will be radial from Bangkok. Most airports are already constructed and maintained by a private operator, and new tourist-based airports are envisioned to operate similarly.

Intended improvements of two existing airports in LNE-UE are the following:

Nakhon Ratchasima

DOA has given consideration to the concept of developing a separate commercial facility not within military control but with continued joint use of the existing runway. This is the same concept being pursued at Ubon Ratchatani and Udon Thani. A possible location for such a facility would be in the northeast corner of the military base, the part of the base which is closest to the city.

Ubon Ratchathani

The DOA foresees a future role for the airport as a gateway to IndoChina. The DOA has budgeted several ambitious development projects for commercial facilities at the airport over the next few years. The program centers on lengthening and widening the runway and creating a completely new passenger terminal and apron on non-military land on the southeast side of runway, allowing access that does not pass through areas controlled by the military (Table 3.6).

3.4 Inland Water Transport

In 1990 the Mekong Secretariat began to study the role of the Mekong River in regional and sub-regional transport development. The following are the roles of the Mekong River as proposed in the interim report, presented in 1991.

The Mekong River, while an obstacle for east-west traffic and a waterway subject to seasonal flooding, is a gateway to seaports for land-locked countries, a cheap mode of transport, a transport means for industrial and mining products, a source of potential tourism promotion and a non-polluting, low-energy consuming mode of transport.

Proposed projects in the interim report are listed below.

- High-priority projects
    * Hydrographic surveys of the Bassac River
    * Installation of navigation aids on the Mekong River
    * Navigation training in Laos
- Second-priority projects
    * Development of waterborne transport on the Mekong River between China, Laos and Thailand in cooperation with China's Yunnan Province
    * Construction of one 300 ton twin-screw, self-propelled cargo barge for the Mekong River downstream of Vientiane as part of a pilot project
    * Integrated transport study of the Mekong delta area

The evolution of the role of the Mekong River in transport development will depend mainly upon the six riparian countries' policies and time frames in the implementation of the large development schemes.

CHAPTER 4

MAJOR TRANSPORT PLANNING ISSUES IN LNE-UE

4.1 Trends of Traffic Demand

4.1.1 Progress in developing highly mobile society

Expansion of the activities and trip-making

Expansion of activities and trip-making concern both people and commodities.

A number of factors that would bring about increased trip generation are foreseen such as follows.

- increased proportion of younger generation who are most mobile, with higher income,
- industrial development leading to market expansion and resultant increase in commodity flows and traffic demand.

Travel time will become even more important than ever in this circumstance. Greater demand for high-speed transport network should be dealt with developing and expanding advanced high-speed transport modes.

4.1.2 Internationalization of traffic

Expansion of border trade

Thailand is expected to play a major role in supporting Indochina's economic rehabilitation as the new gateway to this area. LNE-UE, located at a strategic point, well play a key role in this regard. Among various needs, transportation facilities will be most urgently needed to strengthen ties with the Indochina countries in trade and other activities.

Expansion of tourism

LNE-UE is endowed with a number of potential touristic resources. These potentials could be most effectively tapped by planning international tourism circuits linked with neighboring Indochina countries. Transport means that would benefit tourists in time and cost saving will be needed to promote tourism development along this direction.

4.1.3 Changes in modal split

Shift to Road transport

The importance of road transport for goods movement will become greater in the future, as road transport has the advantage of convenience in terms of quick delivery and collection of commodities.

Regarding person trips, specialization of travel mode with respect to trip purpose and length will occur in the long run. It is expected that the share of transport by motor vehicles will expand for all trip purposes considering the widespread use of motor vehicles and its convenience. In LNE-UE, factors such as the unprofitability of public transport, expected increase in income level and scattered settlement pattern will facilitate the modal shift to private motor vehicles.

4.2 Problem Identification

4.2.1 Spatial development plan in LNE-UE

The spatial development plan of the Study Area proposed in the regional master plan (refer to the Main Report) is summarized below and shown in Fig.4.1.

i) Development axes

- East-west development axis
- Main north-south development axis
- Alternative north-south axis

ii) Urban centers

- Major urban centers
  Nakhon Ratchasima (regional center with multiple functions)
  Ubon Ratchatani (sub-regional center encompessing Si Sa Ket and Yasothon)

- Secondary urban centers
  Surin
  Buri Ram (tourism center)
  Prachin Buri (industrial center)

- Others
  Mukdahan (border trade and tourism center)
  Aranyaprathet (border trade and tourism center)
  Nakhon Nayok (science and technology center)

4.2.2 Problems identification

Problems almost always emerge from imbalance between transport demand and supply of infrastructure. The problems in the transport sector were identified focussing on the existing problem as well as foreseen trends in transport demand and transport infrastructure improvements. Transport problems identified in LNE-UE are summarized and shown in Figure 4.3.

4.3 Major Transport Planning Issues in LNE-UE

4.3.1 Objectives of traffic condition improvements

The objectives of traffic condition improvements in the Study Area are following:

Provision of affordable transport for the poor

The fundamental objective is to provide a range of services affordable to the vast majority of the population in LNE-UE. A desirable target is that services should be widely available and affordable to almost all households across all the income level segments..

Improvement of transport service in rainy season

Some amphoes in LNE-UE still lack bus services during the rainy season due to the inferior conditions of essential local roads. During this season these impassable roads become a great obstacle for carrying out all types of activities, both personal and work-related in the affected amphoes.

The transport service during the rainy season should, therefore, be improved to ensure normal economic and other types of activities.

Improvement of pedestrian safety

For making comfortable personal and work-related trips, it is desirable that separate roads be used for transport mode to function most efficiently. However, mainly because of budget constraints, roads designated for special use can hardly be found in LNE-UE. Expecially, pedestrians are forced to walk along the arterial roads on which trucks and passenger vehicles travel at widely different speeds. As a result, pedestrians are easily exposed to the dangers of traffic accidents. The improvement of pedestrian safety is also an important issue in traffic condition improvements.

Formation of efficient arterial network

For the growth of the LNE-UE region where villages, towns and cities are widely dispersed, an efficient network formation is indispensable for the Study Area to connect neighboring urban centers and serve small towns and villages. A well-coordinated combination of different transport means should be achieved, especially between highways and airports, considering the increasing importance of the high-speed network formation in the future .

Rerouting of traffic

In LNE-UE it is sometimes observed that through-traffic and internal traffic are mixed in urban areas. This situation limits the activities of the respective urban area and lowers the travelling speeds of through-traffic. Through-traffic and internal traffic largely differ in trip purpose and length. Rerouting of traffic having different characteristics is essential for enhancing convenience for users and sound urban development.

4.3.2 Subjects for development strategy

The main purpose for improving transport infrastructure in the Study Area, in the light of development strategy, are to expand market activities and establish a tourism network. To achieve these goals, the geographical disadvantages of LNE-UE must be overcome, and development axes should be formulated.

Formation of development axes

As shown in the spatial development plan, three development axes are proposed in LNE-UE. As is generally known, the transport system is a significant factor affecting industrial development. The proposed development axes are envisioned as a new formation or reinforcement of the existing transport axes. Each transport means, such as highway, motorway, railway and airway, is expected to manage specific traffic demand suitable for respective characteristics of each mode. Therefore, in order to form the development axes, it is desirable that different transport modes are provided and integrated. The arrangement of duplicate networks by different modes would be extremely efficient for overall transport stability.

Designed inducement of urbanization

Land use planning and transport planning should be coordinated in the regional development planning process. One can not function without the other. In LNE-UE, where no major industries exist, it would be more reasonable to formulate a transport plan from the point of view of stimulating economic activities through transport infrastructure provision rather than as a countermeasure to deal with the existing traffic demand.

With this in mind, two different approaches can be envisaged to encourage urbanization in conjunction with development axes development. One would be to plan new urban areas such as manufacturing zones, residential zones, trade zones, etc, along the development axes. The other would be to encourage the expansion of existing urbanized areas in major centers in LNE-UE.

Expansion of the market

Three geographical constraints hinder the improvement of economic-related communications between LNE-UE and other regions. One is the Khao Yai mountains lying between LNE-UE and BMR and ESB. The second is the Mekong River at the Laos border, and the third is a mountain range lying along the Cambodian border. As LNE-UE is located relatively distant from Bangkok, economic-related communications between LNE-UE and Bangkok have been historically limited for long. The development of industries in BMR has not spread to the LNE-UE, and earning differentials between the two areas have been increasing. Improved accessibility to Bangkok, ESB., Laos, Cambodia, and other nearby countries will help surmount these disadvantages and result in narrowing earnings differentials.

The target would be to place the LNE-UE in the physical range within which people can make a one-day round trip to and from Bangkok and ESB. This would be possible through the formation of high-speed network including highways, motorways and airports. Despite the utility of geographical constraints from the point of view of defense, carefully planned gateways to Indochina would become increasingly important to secure smooth flow of people and commodities between LNE-UE and the Indochina countries.

Accessibility to the BMR and ESB is emphasized as the development strategy for boosting economic activities in LNE-UE. Regarding freight transport, the main commodities would be agricultural, forestry and mining products supplied to BMR and ESB. Improvement of accessibility to the BMR and ESB. would be the

fundamental condition necessary to activate the industries in LNE-UE. Furthermore, in terms of international commodity flow, if arteries passing through the LNE-UE region are established, new international transport corridors (namely BKK(ESB) - LNE-UE - Laos - Vietnam and BKK(ESB) - LNE-UE - Cambodia - Vietnam) will be formed. These corridors would contribute to the expansion of markets in LNE-UE as well as in Bangkok and ESB.

Similarly, the tourism network with links to domestic Khmer ruins (i.e, in Thailand) as well as Siem Riep in Cambodia or central Vietnam would be created by the development mentioned above.

CHAPTER 5

OPTIONS AND PRIORITIES FOR TRANSPORT DEVELOPMENT

5.1 Emphasis in the LNE-UE Study

The transportation network in any region substantially influences spatial development by affecting the location of economic activities and settlement pattern. Options and priorities for transport development in the Study Area are dicussed according to their perceived effects on future regional development.

Aiming at the realization of the development of LNE-UE according to the envisaged scenario, projects should be planned as concrete measures to pursue perceived development and in a flexible manner not constrained by the existing plans.

5.1.1 Concept of network formation

Need to cater for residents' daily activities

Basic demands for transport from residents in all districts should be satisfied. Therefore, transport networks should be arranged corresponding to the range of daily activities of an area's residents. Good access to the Changwat center, the core town of the districts, from each district should be provided with reasonable travel times.

Modal split in the Study Area by trip purpose is presented in Table 5.1. For intra-regional transport for both person and freight, road transport plays an important role. Air transport is important in meeting inter-regional and international transport needs.

Contribution to the specified utilization of transport means

In general, each transport mode or means corresponds to its own suitable transport demand because of the characteristics of transport means. Therefore, relationships between various transport modes depend on transport demand. As the economy develops, transport means will also improve and function for specialized traffic demand. For network formation in the long run, realization of the specified utilization of transport means corresponding to various traffic demands should be taken as the basic idea for transport planning.

Need to cater for industrial development

In accordance with the development strategy of agro-industry and labor-intensive industry, network formation to ensure the flow of materials, products and people is essential. Basically these industries will be developed along the arterial roads, paying attention to productivity factors such as connections with major markets and natural resources. The effects caused by transport infrastructure improvements are presented in Fig.5.1.

Need to activate border trade

Laos, Cambodia and Vietnam are large markets for the products of Thailand, and procurement of materials and labor has been possible due to the favorable, recent turn of political events. International network formation to encourage border trade is the basic idea here.

Expansion of influence area of Bangkok, ESB. and S.S.B.P.

The tendency to depend heavily on road transport for goods movement is expected to intensify in the future. With the condition that an arterial high-speed network be provided, it is likely that not only industries which prefer locations near natural resources but also high-tech industries will develop in LNE-UE seeking relatively low labour cost and low construction costs. The provision of an arterial high-speed network will contribute not only to develop or relocate the industries but also to promote regional industrial specialization. In this sense, to expedite the expansion of the influence area of Bangkok and ESB. or S.S.B.P will be beneficial for LNE-UE.

Activation of tourism

A future transport network will have to develop integrating tourism network, both domestic and international. Tourists destinations in LNE-UE, located distant from each other, should be effectively linked with each other as well as with the major touristic resources in the neighboring countries such as Ankor Wat in Cambodia.

5.1.2 Design policy

Formation of random access network

From the following points of view, it is desirable to form a random access network as a long-term objective in LNE-UE:

i) to utilize the existing network
ii) to follow the improvements with developed communications
iii) to establish a self-supporting system

The concept of a random access network is shown in Fig.5.2.

An urban system is supposed to be composed of a number of centers and their surrounding areas, each with its own specializations and comparative advantages (Fig.5.3). The relationships between rural and urban areas make up complex rural-urban fields of activities. To solve the existing problems in LNE-UE, the promotion of industries is the primary measure for the moment. This strategy of network formation, emphasizing the development axes, is necessary in order to induce the previously mentioned potential economic influences of Bangkok or ESB. Accordingly, network formation in LNE-UE should be envisioned considering the realization of a random access network in the long term.

Formation of multi-transport axis

Air transport is sensitive to the change in climate, whereas road transport is relatively reliable with a change in climate. Arrangement of the road network to airports that carry out the role of alternative airports in case of emergency improves the reliability

of a high-speed transport network. The network reliability is enhanced through the formation of multiple networks in case of interruption of a specific linkage by traffic accident, natural disaster, or other cases. It is essential to include multiple and complex axes for improving and enhancing transport stability, and reinforcement in forming a network. These multi-axes should be formed in accordance with the tree development axes/areas of the Master Plan (Figure 5.4).

Formation of international transport network

From the viewpoint of international trade and tourism promotion, the formation of an international network should be considered. Although there are sensitive political issues, the economic activities in Thailand require international transport with neighboring countries to a high degree.

Considering its advantage in terms of location with respect to Cambodia, Laos and Vietnam, the transport network in LNE-UE should be proposed from the view point of international network formation. A careful plan should be developed so that coordination with relevant transport projects in other countries, especially those in Indochina, could be achieved in LNE-UE.

Realization of intermodal transport network

Good coordination of intermodal transportation should be realized. The coordination of air transport and highways in network formation is especially significant in order not to diminishing the merits of reduced travel time by air.

Expansion of potential action area

For an equitable distribution of benefits from economic development, it is necessary to ensure accessibility to the growth centers, strategic core cities and Bangkok and ESB. within a fixed standard of time. One-day round trips to Bangkok and ESB. from LNE-UE for face-to-face communications are the desirable and essential standard for evaluation of network. Table 5.2 presents this desirable standards for inter-city travel times. To meet this standard and the envisioned urban system, bypass roads and direct linkages between neighboring core cities should be developed.

5.1.3 Necessary linkages

The principle linkages for industrial development in the Study Area are between the flows of labor force, materials, products, and various information such as marketing and technical assistance. As for the inter-regional commodity flow, cargo flows are generated and attracted in the main industrial zones within the Study Area, BMR and ESB. The main direction of the flows of materials and industrial goods related to the Study Area are the following:

a) material base in LNE-UE - industrial zones within LNE-UE - area of consumption (LNE-UE/BMR/foreign countries)

b) material base in neighboring countries - industrial zones within LNE-UE - area of consumption (LNE-UE/BMR/foreign countries)

c) material base in neighboring countries - industrial zones within LNE-UE (half-finished goods) - BMR/ESB. - area of consumption (LNE-UE/BMR/foreign countries)

d) material base in foreign countries - BMR/ESB (half-finished goods) - industrial zones within LNE-UE - area of consumption (LNE-UE/BMR/foreign countries)

Although freight movement would mainly depend on land transport, it is likely that some high-value goods would be exported by air (Fig.5.4).

The main direction of business travel related to the LNE-UE including information, would be centered around the research and development (R&D) core in Nakhon Nayok and Nakhon Ratchasima, other R&D cores in LNE-UE and BMR/ESB.(Fig.5.5).

The Study Area contains ancient Khmer ruins and places of archaeological, historical, and religious interest, but it lacks significant tourist attention. For domestic tourists, itineraries combining visit to the Khmer ruins, national parks, and border towns from the tourism-center city of Buri Ram are assumed.

Potentially, the most attractive tourism resources in the Study Area are the major attractions in Cambodia, Laos and Vietnam. The envisioned tourism circuits are the following:

a) integrated Khmer tourism circuit
Links with Cambodia (Aranyaprathet - Angkor Wat, Surin - Siem Reap)

b) hinterland tourism along Laos Border
Links with Laos (Ubon Ratchathani - Laos, Mekong River)

c) integrated tourism network with Vietnam's coastal area
Links with Vietnam (Aranyaprathet - Cambodia - Vietnam's coastal area, Mukdahan - Savannakhet - Vietnam's coastal area, Ubon Ratchathani - Laos - Vietnam's coastal area)

The directions of tourism linkages are shown in Fig.5.6.

Linkages among urban clusters, BMR and ESB. should be formed to improve connections. Linkages between urban areas and surrounding areas should be strengthened to expand the service areas of urban centers (Fig.5.7).

The deficient linkages at each service area are clarified through the analysis are shown in Fig.5.8 and 5.9. The directions of linkage formation at each geographical level are listed below.

a) Changwat Level

- Linkages to improve accessibility to the urban/rural centers

To ensure an adequate level of accessibility for all parts of LNE-UE to/from urban/rural centers.

- Linkages beyond the major urbanized areas

  To improve the flow of through-traffic in large cities.

b) Regional Level

- Linkage to improve travel between major points

  To improve linkages between changwat centers by upgrading existing roads and constructing new roads. The sections between Yasothon and Si Sa Ket, Yasothon and Mukdahan, and Buri Ram and Prachin Buri, particularly, need new high-grade linkages (Fig 5.10).

c) Inter-regional Level

- Linkages to connect Bangkok with LNE-UE

  To strengthen the connections between Bangkok and LNE-UE, especially sequestered areas of the LNE-UE through the establishment of a high-speed network.

- Linkages to connect ESB. with LNE-UE

  To connect ESB. with LNE-UE through the establishment of new multi-modal linkages (Fig.5.11).

d) International Level

- Linkages to connect Laos & north Vietnam with LNE-UE

  To improve the border crossing network with Laos and north Vietnam and activate economic exchanges between Bangkok, ESB., LNE-UE and neighboring countries to help develop the LNE-UE.

- Linkages to connect Cambodia and south Vietnam with LNE-UE

  To improve the border crossing network with Cambodia and south Vietnam and activate the economic exchanges and tourism between Bangkok, ESB., LNE-UE and neighboring countries to help develop the LNE-UE (Fig.5.12).

5.1.4 Direction of modal split

Regarding commodity flow, since goods for final consumption usually need to be transported quickly, highways are commonly used as the transport means for these commodities. Other types of transport such as plane, ship, and train hardly become alternative for road transport.

Regarding person trips, specialized utilization of transport means can be supposed; that is, long-distance trips depend on the air transport, middle-distance trips rely on railway and short-distance trips by road transport. However, it can be said that the possibility of these modes complementing or competing with each other is relatively high.

Generally, it is expected that specialization of trips by mode, according to trip characteristics, will progress in the future.

The road network in the Study Area (LNE-UE) is well developed. Road coverage is fairly extensive and the conditions of major roads are generally good. It is clear that roads will continue to be the primary mode of transport for both inter- and intra-regional transportation in LNE-UE.

In the future it is probable that the importance of road transport will grow even larger. However, an increase in the number and use of private vehicles expected in the future will diminish the transport share of bus.

The railway system in the Study Area is well maintained and is operated by SRT. The roles of railway transport will probably increase in the future for both passengers and freight. If the present quality of rail track is maintained, travel time can be significantly reduced with electrification and improved telecommunication system. Improvement of the existing railway system, such as double tracking, will also help reduce travel time. These improvements would make rail transport more competitive with road transport for relatively long-distance passenger trips and bulk commodity flows.

Air transport would certainly become more important for tourism and other passenger travel purposes.

5.2 Conceived Transport Projects in LNE-UE

5.2.1 Regional artery roads

The existing arterial roads in the Study Area lead from the BMR to Nakhon Ratchasima and further into the Northeast and from Chachoengsao to Kabin Buri and Nakhon Ratchasima. The road from Chachoengsao via Nakhon Ratchasima to Khon Kaen may be regarded as a north-south artery, although it directly serves only the western part of the Study Area.

A new regional arterial road may be required to serve the eastern and northeastern parts of the Study Area. Important considerations in establishing a new regional arterial road include the need for (i) an alternative connection between the Northeast and the East, (ii) better connection with the ESB., and (iii) better services to promote border trade.

Among the proposed projects listed below, high priority should be given to the new regional arterial road considering that this road does not have any existing alternative roads, unlike other proposed projects, and it would play an important role in the overall network in LNE-UE and further the development of LNE-UE.

(1) ESB to Mukdahan Highway (Secondary North-South Axis)

Description

This road would connect the ESB. with LNE-UE passing through the planned Buri Ram International Airport and Mukdahan, and expected to reach Da Nang, a deep seaport in Vietnam, through Savannakhet, the second-largest city in Laos. This road should be an ordinary highway or motorway and serve as a new artery.

Objectives

1) to expand the influence area of ESB.
2) to form the development axis of LNE-UE.
3) to surmount the circuity problems between ESB. and LNE-UE.
4) to construct the shortest possible route from ESB. to Cambodia.

Project costs

Construction cost of the New Indochina Gateway road with two lanes including land acquisition for additional two lane construction was estimated at 8,660 million baht. Construction cost for additional two lanes was estimated at 9,740 million baht. Construction cost of the ESB - Sa Kaeo link with two lanes including land acquisition for additional two lane construction was estimated at 2,600 million baht.

Subjects

This road can be conceived as the development axis in LNE-UE connecting it to ESB. This axis links the major cities and industrial areas in LNE-UE. The construction of a new railway was previously proposed for the portion of this linkage between Nakhon Ratchasima and ESB. However, southward from Route 34 this road would be near the existing arterial road between ESB. and Nong Khai, the primary North-South Development axis. There may be an over-investment problem with the coexistence of these two roads.

Although the shortest route from Bangkok to Da Nang in Vietnam is the route via Ubon Ratchathani, this route is not well developed at present. Accordingly, the issue of which route would become the main route to Vietnam by land depends on road improvements in other countries.

(2) New Mekong ("Rainbow") bridge

Description

The regional artery (ESB. to Mukdahan Highway) can be extended further through Laos and all the way to Vietnam, a bridge between Mukdahan and Suwannakhet is a natural choice for alternative crossing over the Mekong.

Objectives

1) to expand the influence area of ESB.
2) to form the development axis of LNE-UE.

Project cost

The construction costs of the bridge has been estimated at 570 million baht. The total project cost would reach to 820 million baht, if the approach roads, related function facilities and something are included.

Subjects

The feasibility study has already been carried out by the Danish and local consultants in cooperation with the National Energy Administration of Thailand and Ministry of Communication, Transport, Post and Construction of Laos making use of Asian Development Bank fund. The report of the study showed the difficulty in terms of viability. The careful and detailed study including the effects on the spatial and economic activities to be induced in Thailand shoud be necessary for the progress of this project.

(3) ESB to Nong Khai Highway/Motorway (Primary North-South Axis)

Description

This road would connect the ESB. with Nong Khai just grazing LNE-UE.The Highway is expected to extend further to Vientiane, the capital of Laos. This road is expected to form the primary axis together with the proposed new rail line between Nakhon Ratchasima and ESB.

Objectives

1) to expand the influence area of ESB.
2) to form the development axis of LNE-UE linking the major cities and both existing and planned industrial areas
3) to surmount the circuity problems between ESB. and LNE-UE without passing through the Bangkok Metropolitan Area.
4) to realize a high-speed network.

Project cost

Project cost for the section between Chon buri and Nakhon Ratchasima of the motorway was estimated at 27,300 million baht. The section between Nakhon Ratchasima and Nong Kahi was estimated at 24,700 million baht. Total cost was estimated at about 52,000 million baht. The construction cost within the Study Area was estimated at 24,200 million baht.

Subjects

As the alignment is envisaged to pass through the Khao Yai National Park, there would be a conflict between this development and environmental protection efforts. Another feasibility problem would be very high construction costs because of the necessity for providing tunnels to pass through the mountainous district.

(4) BMR to Ubon Ratchathani Motorway (East-West Axis)

Description

This road would connect the BMR with Ubon Ratchathani passing through the middle of LNE. This road is expected to extend further to Da Nang, the deep seaport in Vietnam, via Laos.

This road should be a motorway to form a part of the high-speed network linking Nakhon Ratchasima, Buri Ram, Surin, Si Sa Ket and Ubon Ratchatani, the major cities in LNE.

This road will function as a component of a comprehensive transport axis together with the existing railway (northeastern line), Route Nos. 24, 222, and 226 running alongside and Nakhon Ratchasima, Buri Ram and Ubon Ratchathani Airports.

At present, the existing road is served by the Mekong River at Pakse in Laos and is not well developed in the mountainous area between Laos and Vietnam. However, a new bridge across the Mekong River is curently being investigated by ADB.

Objectives

1) to expand the influence area of BMR.
2) to form the development axis of LNE-UE linking the major cities and both existing and planned industrial areas.
3) to ensure circumstances needed for diverse activities.
4) to surmount the disadvantageous location of the LNE-UE and activate exchanges.
5) to construct the shortest road from BMR to Da Nang.

Project cost

Project cost for the section of motorway between Nakhon Ratchasima and Ubon Ratchathani of some 300 km was estimated 27,430 million baht. The section between Outer Bangkok Ring Road and Nakhon Ratchasima was estimated 24,700 million baht. Total cost for motorway was estimated about 52,130 million baht. The construction cost within the Study Area was estimated at 40,400 million baht.

Subjects

The alignments proposed by DOH and ETA are different. ETA's alignment is Bangkok and Nakhon Ratchasima. A study on alignments and connections with ETA's express network should be carried out.

(5) BMR to Aranyaprathet Highway/Motorway (East - West Axis)

Description

These roads would connect the BMR with Aranyaprathet passing through the middle of of UE. The highway is expected to extend further to Ho Chi Minh in Vietnam via Cambodia.

These roads would make up the high-speed network linking Bangkok, Nakhon Nayok and Aranyaprathet, the major cities in UE. These roads are expected to form the comprehensive transport axis together with the existing railway (eastern line).

Objectives

1) to expand the influence area of BMR and ESB.
2) to form the development axis of LNE-UE linking the major cities and both existing and planned industrial areas.

3) to construct the shortest route from ESB. to Cambodia and Vietnam in cooperation with the newly proposed road between ESB. and Mukdahan.
4) to activate border trade.

Project cost

Project cost for motorway was estimated at 24,700 million baht. The construction cost within the Study Area cost 20,000 million baht.

Subjects

Because the route length in Thailand is relatively short, the reduction of travel times caused by the construction of a motorway would not be expected excessively. Therefore, it seems that there would be a feasibility problem.

(6) Improvement of Route No.24 (East - West Axis)

Description

Dual carriageways are proposed between divergings points at Route No. 2 and Ubon Ratchathani to function as the arterial road for freight transport in coordination with industrial development. The section between Nakhon Ratchasima and Nong Khai will be implemented by 1996 according to DOH Seventh plan.

Objectives

1) to form the development axis in LNE-UE.
2) to provide an artery for freight traffic.

Project cost

Project cost for was estimated at 5,200 million baht.

Subjects

The improvement of this road, a catalyst for development, is intended to be preceding infrastructure provision. Therefore, a detailed study would be necessary to verify this project's feasibility.

(7) Route No.226 Bypass at Surin

Description

Bypasses are already planned or provided for Route No.226 at each changwat center city in LNE-UE except Surin. A bypass at Surin enhances the functions of Route No.226.

Objectives

1) to improve the service provided by Route No. 226.
2) to form the development axis in LNE-UE.

Project cost

Project cost for was estimated 40 million baht.

Subject

Well-planned integration with urban planning in Surin will be necessary.

5.2.2 Rural access

Some 4 % of the villages in the Study Area do not have satisfactory access from larger cities or arterial roads. The situation becomes worse during the rainy season. Considering the problems of erosion and intense rainfall, repair and maintenance are just as important as new rural road construction. Improvements and proper maintenance of rural roads would expand the market for agricultural produce from the villagers' point of view, and expand the raw material base from the processors' point of view. In addition to these economic incentives, a system may be established to repair and maintain rural roads by self-help efforts of villagers through the provision of basic equipment, technology, and trainning.

Among the proposed projects listed below, high priority should be given to the road maintenance system.

(1) Si Sa Ket to Yasothon Highway

Description

This road would connect Si Sa Ket with Yasothon. This road should be a P-1 or P-2 highway (National Highway), which would serve current traffic and allow for future improvements.

This road is expected to directly link two changwat centers.

Objectives

1) to improve the circuity between Si Sa Ket and Yasothon.
2) to improve the random access network in LNE-UE.
3) to more efficiently rearrange diverse activities.

Project cost

Project cost for was estimated at 315 million baht.

Subjects

Feasibility of this road is dubious because the demand for traffic is expected to be relatively small.

(2) Road maintenance system

Description

Road maintenance funds that can be more directly obtained by local governments should be expanded.

A self-help method should be established through the provision of basic equipment, technology, and training.

Objective

1) to strengthen the road maintenance system so that maintenance requirements would be adequately met.

Subjects

Procurement of funds would be the most essential and difficult issue.

5.2.3 Road transport

Rearrangement of bus routes will be necessary in response to the development strategy in LNE-UE. Nakhon Ratchasima, Ubon Ratchathani, Buri Ram, and Surin are expected to be core cities in the sub-region. The bus service network should be newly systematized to emphasize the centralization of these cities.

The existing system of privately donated terminals often leads to inconveniently located terminals. Bus route re-allocation should be practiced in coordination with urban redevelopment for effective and efficient use of urban facilities.

Also regional truck terminal facilities will have a favorable effect on the rationalization of freight transport.

However, from the view of development strategy in LNE-UE, these projects will not play as significant a role as arterial roads in terms of promoting regional development.

(1) Regional truck terminals

Description

Truck terminals should be provided with basic facilities such as berths, platforms and temporary storage areas.

Nakhon Ratchasima and Ubon Ratchathani would be locations for regional truck terminals to serve the Study Area adequately.

Objective

1) to improve the freight transport capacity and operations in the region.
2) to serve as regional centers for receiving, sorting, and delivering general cargoes to consignees brought from Bangkok.
3) to manage the picking up, sorting and loading of locally manufactured products for shipment on line-haul heavy trucks bound for Bangkok.

Project cost

The construction cost will vary depending on the size of the truck terminal facilities and location Supposing the moderate size for the regional public truck terminal, total investment cost is roughly estimated at 45 million baht for one truck terminal. Consequently it will cost 90 million baht in total.

Subjects

The feasibility of regional truck terminals depends on the volume of commodity flows in the region.

5.2.4 Railway transport

From Bua Yai junction to Nakhon Phanom, new railway construction has been authorized by SRT. Other conceivable projects are transportation capacity improvements of existing railways and new line construction between Nakhon Ratchasima and ESB. The new railway would have more strategic importance for the LNE-UE.

(1) Nakhon Ratchasima to ESB railway

Description

This railway would directly connect LNE-UE with ESB without passing through Bangkok.

The alignment is envisaged to be along Route 304.

Objectives

1) to form the primary North-South Development axis together with the proposed motorway.
2) to improve the circuity between ESB and LNE-UE to receive the associated benefits from a direct connection.
3) to extend the economic market area of ESB including IndoChina countries, especially considering that the railway extension would be realized.

Project cost

The construction cost of the section between Nakhon Ratchasima and Kabin Buri of 130 km with double track was estimated at 5,720 million baht. The railway improvement of the section between Kabin Buri and Khlong Sip Kao for double track was estimated at 1,800 million baht. Total project cost within Study Area was estimated at 7,340 million baht.

Subjects

As the alignment is envisaged to pass through the Khao Yai National Park, careful countermeasures will be necessary for environmental protection.

Passage through mountainous areas by tunnelling would significantly increase construction costs.

(2) Surin to Nakhon Phanom railway

Description

This line would relieve the outer part of the existing railway catchment area in LNE by connecting Surin of the northeastern line with Nakhon Phanom via Mukdahan.

This line partially coincides with the line already planned in the ten-year programme as of 1992 by SRT.

This line is expected to function with Mekong River transport.

Objectives

1) to relieve regions not served with railway transport, such as Mukdahan and Yasothon.
2) to activate Thailand's border trade with Laos and Vietnam.
3) to extend the market area of ESB and Bangkok, and neighboring countries, in conjunction with new railway development in Laos.
4) to formulate the multi-transport axis.

Project cost

The construction cost of the section between Surin and Loi Et with single track was estimated at 2,860 million baht. The section within the Study area have a distance of some 65 km and cost 1,430 million baht.

Subjects

Because the railway will be aligned along the border, Laos, Vietnam and Yunnan in China are regarded as potential areas to benefit from this new system. There is a possibility of transshipment between the Mekong River transport and the railway. It would be necessary first to establish a base for transshipment.

(3) Transportation capacity improvements of northeastern line

Description

The northeastern line, especially between Bangkok and Nakhon Ratchasima, is expected to perform better through electrification, adoption of automatic signalling and telecommunication system, as well as by construction of double track. This line is expected to extend further to Vietnam's coast in the future.

Objectives

1) to intensify the East-West Development axis by improving capacity and travel speed,
2) to improve the inter-relationships among various transport modes through specialization to accommodate suitable traffic demand.

Project cost

The total project costs would be 9,200 million baht, excluding cost of the section within Central Region. The project cost from the BMR to Ubon Ratchathani reaches to 12,600 million baht.

And the extension of northeastern line having a distance of some 80 km will cost additional 1,800 million baht.

Subjects

Although the construction of double tracking has a big effect on increasing transportation capacity compared to electrification, construction costs, the most decisive factor,may be higher.

In the case of electrification, construction costs include those for transformer substations and electric cables installation. Further improvements in the of signaling system and telecommunication system and , reconstruction of bridges and tunnels may be necessary. In the case of double tracking, new bridges and significant land acquisition may be necessary. Detailed feasibility studies should be undertaken prior to the implementation.

(4) Inland container depot

Description

An inland container depot is the international cargo distribution center located inland of the country which has the customs clearance function. The inland container depot with this function enables traders and transporters to convert both the domestic cargo to international cargo and international cargo to domestic cargo for the consistent cargo transportation. It is desirable for an inland container depot to include a container freight station and loading and unloading facility (Figure 5.14). Nakhon Ratchasima and Ubon Ratchathani would be location for inland container depots.

Objectives

1) to activate the border and international trade by land in the Study Area,
2) to facilitate the launching of the industries expecting export and import into the Study Area.

Project cost

Assuming the land are of 9 ha, the construction cost was estimated at 85 million baht per facility. Total project cost was estimated at 190 million baht.

Subjects

The feasibility of inland container depots depends on the volume of cargo flows in the region. Wide-ranging cooperations and assistances by customs, port authorities, local administrative offices and related authorities are indispensable for the project implementation.

5.2.5 Air transport

The basic concepts of air transport development are to eliminate inconvenienes associated with areas having poor air transport service and to promote the development axis in coordination with other transport modes.

(1) Local air transport network

Description

A local air service network should be established to enable one-day roundtrips to Bangkok and ESB. and to formulate a tourism network by air. The first step would be enabling current flight services to make additional stops instead of confining them to only roundtrips. Additional airports with heliports or short runways could also be opened for regular services. Additional airports are envisaged at Aranyaprathet, Nakhon Nayok and Mukdahan, but their feasibility is questionable.

The network should be expanded in steps to connect with neighboring countries.

Objectives

1) to build the comprehensive transport axis,
2) to expand the service area of the high-speed network,
3) to build a tourism network by air,
4) to ensure the accessibility to the tourism spot not accessible by land.

Project cost

The construction cost of Buri Ram/Surin airport assuming land area of 500 ha and 2,500 m runway was estimated at about 500 million baht. Supposing land area of 170 ha and 1,500 m runway as the small scall local airport, total investment cost is roughtly estimated at 170 million baht. Consequently it will reach to 400 million bahts in total.

Subjects

In the long term, the role of air transport will be clarified along with the improvement of the interrelationships among the different transport modes. Buri Ram Airport and Ubon Ratchathani Airport will be more important. An essential prereguisite to make a new international airport feasible is the establishment of the local air services network connected directly to neighbouring countries.

On the other hand, Nakhon Ratchasima Airport is expected to lose its advantageous travel time with progress of the high-speed network by non-air modes. Its role is also expected to diminish, because of the establishment of competitive alternatives such as private cars and bus services on motorways. The assignment of the catchment area to each airport and the network formation should be studied.

5.2.6 Inland water transport

Since the development of the Mekong River depends on the political situation, the priority of Mekong River transport projects is relatively low.

(1) Mekong River transport

Description

The Mekong River may be considered as an important artery in Laos, Cambodia, China and south Vietnam. To make the most of the Mekong River as a transport means, the river ports transshipment facilities and other transport developments should be encouraged for barge navigation.

Objectives

1) to utilize the Mekong River as the less energy-consuming transport means and an efficient transport mode for Indochina countries.
2) to activate border trade between Thailand, Laos and China.
3) to utilize the abundant materials produced in Laos and China with relatively low transport costs.
4) to offer a tourism circuit across the border.

Subjects

As the Mekong River is an international river, its utilization depends on sensitive political conditions.

The expectation of the Mekong River as a transport mode depends on the extent of international industrial specialization and international markets in the future. Thailand is not likely to highly utilize the Mekong River as a transport mode considering its distribution of industries.

5.3 Options and Priorities for Transport Development

5.3.1 Issues related to options and priorities

The transportation network in any region significantly influences spatial development of the region by affecting the location of economic activities, settlement pattern and associated activities. Options and priorities for transport development in the Study Area are discussed in terms of their perceived effects on future regional development.

Development issues related to options are conceived as follows:

a) classification of main roads serving central part of the Study Area
b) classification of major airports in LNE-UE
c) railway alignment between central part of the Study Area and ESB

5.3.2. Consideration of options and priorities

The development issue concerns the relative importance of the extent to which the roads and railway should be modified for the east-west artery. An important issue is the determination of which route (Route No. 226 - No.222 or Route No. 24) should become the main road serving the central part of the Study Area. Determination in this issue would affect not only the spatial development pattern in the Study Area, but also the urbanization pattern of cities along the artery.

In this study, assuming that an axis composed of various transport modes and specialized transport means would encourage progress in the long term, expansion of each function of each transport mode is regarded as the main development issue at present. As for the emphasis to put importance on which route as a main road, it would be proper to assume that Route No. 24 function as the main route for freight traffic because of its advantages such as low utilization of land along the road at present and its high-quality design standards. On the other hand, the corridor along Route No 226 - No. 222 connecting large cities and passing through densely inhabited urban areas has the potential to be developed as part of the high-speed network taking advantage of its proximity to large cities. This corridor should accommodate both road-based person travels and a railway in the future.

A key issue related to the increased role of air transport for tourism and other passenger travel purposes is a major port of entry in the Study Area. At least three alternatives are available: existing airports at Nakhon Ratchasima and Ubon Ratchathani and a new airport at Buri Ram. Buri Ram has the advantage of its central location and good access to several major tourist attractions, but it may be a medium to long term option. Ubon Ratchathani is located at an advantageous position with respect to distances to neighboring countries and sufficient distance from Bangkok, which are the important conditions for an international airport.

As the railway is indispensable for the formation of multi-transport axis, it is desirable for new development corridor between ESB. and Mukdahan passing through central part of th Study Area to include the new railway. Two alternative new railway alignments are conceived for this concept; the one is the new line construction between Nakhon Ratchasima and ESB. along the existing National Highway Route No.304 and the other is the line between Buri Ram/Surin and ESB. Comparing these two alternatives, the latter matches the regional artery development concept, but will have to depend on smaller traffic demand than the former. The former alternative, though not quite compatible with the regional artery cencept, will connect ESB. not only with LNE region but also more directly with Vientiane in Laos and is expected to take much more traffic demand. It would be more reasonable to adopt the new line between ESB. and Nakhon Ratchasima from the views of feasibility and network formation.

The conceptual transport master plan in LNE-UE is shown in Figure 5.15.

5.4 Action Oriented Project Proposals

Of all the projects planned conceived already by implementing agencies and newly formulated, the following are selected for the action-oriented development plan:

1) Regional artery establishment (new Indochina gateway road),
2) New Mekong bridge,
3) Railway improvement,
4) Rural road maintenance system, and
5) Regional truck terminals.

A preliminary feasibility analysis on the regional artery establishment projects is contained in a separate volume. Detailed profiles of other projects are provided in the following.

Some actions should be taken for these projects during Phase I as indicated by the master Plan, as they constitute the "core" projects. Other regular projects will be implemented as planned by respective implementing agencies.

5.4.1 New Mekong ("Rainbow") Bridge

(1) Background

The Mekong River is the world's twelfth largest river in terms of annual flow volume as well as length. It originates in Tibet and has a total length of 4,200 km.

In the Mukdahan/Savannakhet area the Mekong river is 800-1,500 meters wide. Over a five-year period the maximum high water level is about 13 meters above low water level, and in this situation the water flow reaches about 31,800 cubic meters per second.

From the point where the Mekong leaves China until it reaches the sea, there is no bridge or other permanent link across the river. However, a bridge between Vientiane (Laos) and Nong Khai (Thailand) is under construction, financed by the Australian International Development Assistance Bureau.

Five border crossings are open between Thailand and Laos at present, of which four are located along the Mekong river. One road border crossing exists at Chongmek on the road from Ubon Ratchathani to Pakse.

Improving relations between the two countries during the recent years is likely to result in an increase in the international trade across the Laos-Thailand border. The expected increase following the proposed bridge will provide an important stimulus for production and development in the Study Area in cooperation with the proposed new regional artery. In particular, the increased trade and traffic flows would contribute to accelerated development of this region resulting in improved access to new markets and sources of a broader range of production inputs.

(2) Project development

The new bridge should be connected with new regional artery road. Accordingly, site selection of the new bridge should be studied taking account of the compatibility with the new regional artery road alignment.

The activities undertaken at the border crossing are supposed to be immigration, customs, health and quarantine, toll collection, and highway change-over. Traffic in Thailand drives on the left side of the road, while traffic in Laos drives on the right side of the road. Consequently a change-over facility have to be provided, and should be located within a close distance from the rest of the border crossing facilities.

According to the existing standard and criteria used in Thailand and in Laos as well as relevant international standards, the following design standards and criteria are assumed.

- design speed	120km./hr
- width of carriage way	7.00m or more
- Width of shoulders	2.50m

The geometrical requirements for the bridge design are assumed as follows.

- The vertical navigation clearance in the main navigation span shall be minimum 10 m above the 15-years recurrence high water level.
- The soffit of the superstructure shall be located minimum 0.5 m above the 100-year recurrence high water level.
- The bridge approaches shall pass above the existing roads along the river banks with a vertical clearance of 5.0 m.

(3) Implementing agencies

The bridge will be located partly in Laos and partly in Thailand.

There are several possible ways for the bridge to be legally owned after its completion, such as:

a) joint ownership of the complete structure,
b) ownership divided between Laos and Thailand with each country owing half of the bridge up to the center of the structure, and
c) ownership by a third party such as the Mekong Committee .

It should be noted that the agreements about many bridges over international rivers make no comment about the ownership of the bridge. Nevertheless, formal agreement about the ownership should be made, which emphasizes the spirit of peace and friendship. The legal ownership of the bridge is a matter for Thailand and Laos. Subject to the precedent agreement upon the northern bridge between Vientiane (Laos) and Nong Khai (Thailand), it is proposed that New Mekong ('Rainbow") bridge be owned by a Mekong Bridge(s) Authority (MBA). MBA would periodically report to the Interim Mekong Committee, and would operate under an agreement by the Thailand and Laos governments.

(4) Project viability

Project cost

The construction costs of the bridge has been estimated at 570 million bahts by the Danish and local consultants in cooperation with the National Energy Administration of Thailand and Ministry of Communication, Transport, Post and Construction of Laos making use of Asian Development Bank fund.

The total project cost would reach to 820 million bahts, if the approach roads and related function facilities are included.

Project benefit

The primary benefits expected to accrue from the proposed bridge would be the savings resulting from reduced cross-river costs and capital costs, including waiting time at ferry terminals, saved future ferry operating costs and capital costs and diverted and generated traffic, following normalization of relations between the countries.