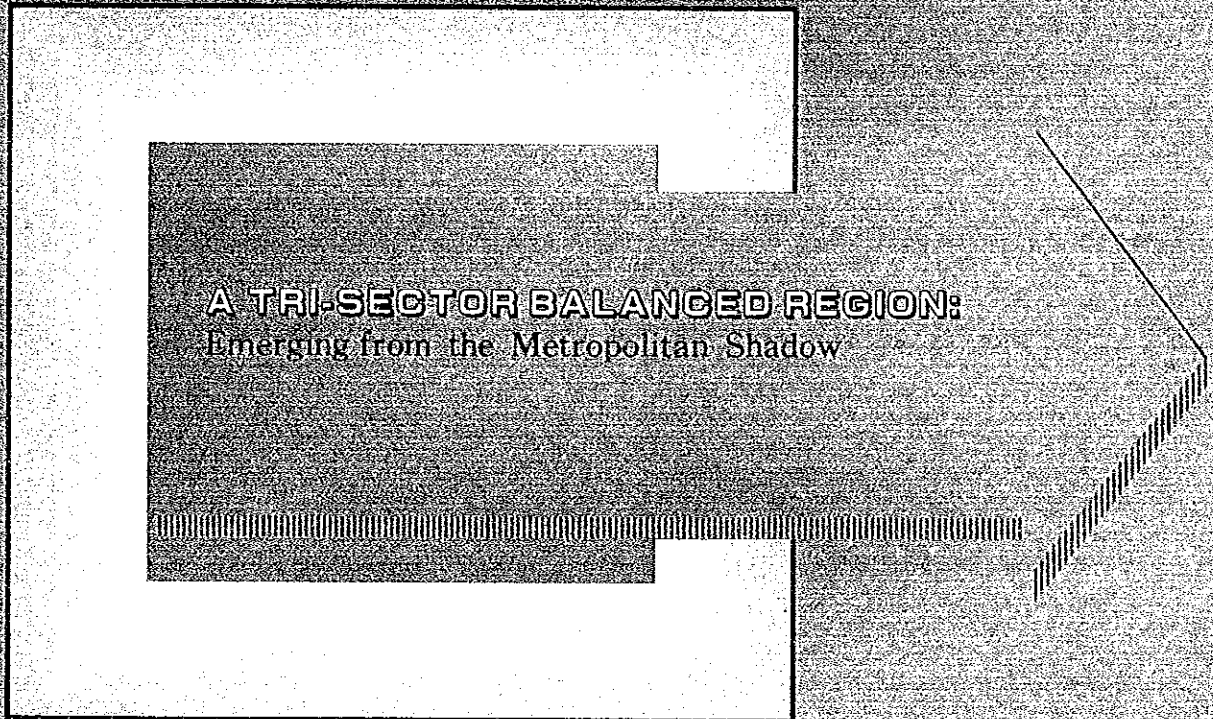No. 202

THE ROYAL THAI GOVERNMENT
NATIONAL ECONOMIC AND SOCIAL DEVELOPMENT BOARD

UPPER CENTRAL REGION STUDY

SECTOR REPORT Vol. 11:
LANDSAT ANALYSIS

A TRI-SECTOR BALANCED REGION:
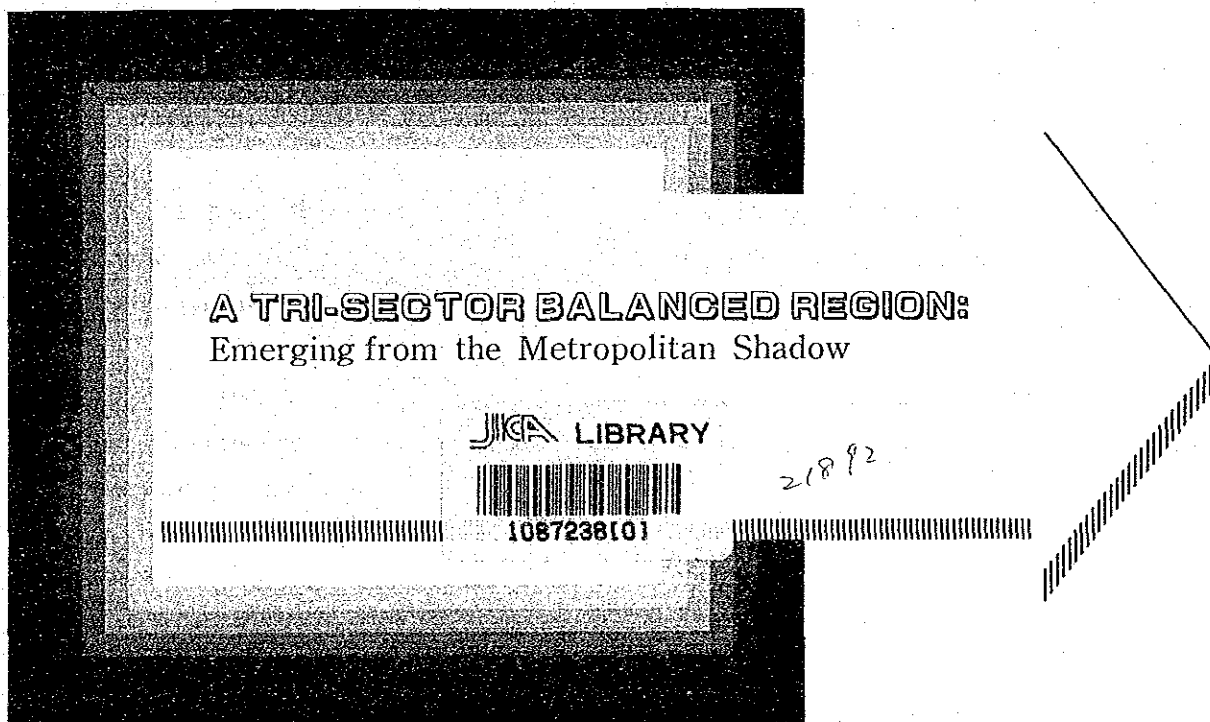Emerging from the Metropolitan Shadow

FINAL REPORT NOVEMBER 1990

JAPAN INTERNATIONAL COOPERATION AGENCY

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THE ROYAL THAI GOVERNMENT
NATIONAL ECONOMIC AND SOCIAL DEVELOPMENT BOARD

UPPER CENTRAL REGION STUDY

SECTOR REPORT Vol. 11:
LANDSAT ANALYSIS

A TRI-SECTOR BALANCED REGION:
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PREFACE

In response to a request from the Government of the Kingdom of Thailand, the Japanese Government decided to conduct the Upper Central Region Study and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Thailand a study team headed by Mr. Jinichiro Yabuta, and composed of members from International Development Center of Japan and Pacific Consultants International Inc., from December 1988 to July 1990.

The team held discussions with concerned officials of the Government of the Kingdom of Thailand, and conducted field surveys. After the team returned to Japan, further studies were made and the present report was prepared.

I hope that this report will contribute to the promotion of development in the said region and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Kingdom of Thailand for their close cooperation extended to the team.

November 1990

Kensuke Yanagiya
President
Japan International Cooperation Agency

ACKNOWLEDGEMENT

agriculture, development against environmental considerations, and urban development against rural development. Bearing this in mind, the Study Team recommends improvements in conventional development administration, with a focus on water resource management, environmental management, and urban management.

The Study Team acknowledges that its study has been guided by many past studies, such as the Bangkok Metropolitan Region Study by the National Economic and Social Development Board (NESDB), the Upper Central Region Planning Study by the Department of Town and Country Planning, the Road Development Study in the Central Region by the Japan International Cooperation Agency (JICA), and the Rural Industries and Employment in Thailand Study by The Thailand Development Research Institute. In preparing this report, the team was supported by the staff of the NESDB, other central ministries, and local authorities in the UCR throughout its stay in Thailand for nearly fourteen months. Equally important, the team benefited a great deal from cooperation extended by the officers in charge and the advisory committee members of the JICA and other concerned agencies of the Government of Japan. The team also wishes to recognize with gratitude the contributions of the participants in the National Seminar on the Upper Central Region Development: Policies and Programs, held on 28 and 29 July 1990 in Jomtien, Chonburi, to the wide-ranging discussions on the proposals contained in the draft final report of the Study Team.

We wish to add that we sincerely hope that this report will provide an important basis for planning and implementation in the Upper Central Region of Thailand.

November 20, 1990

Jinichiro Yabuta
Study Team Leader
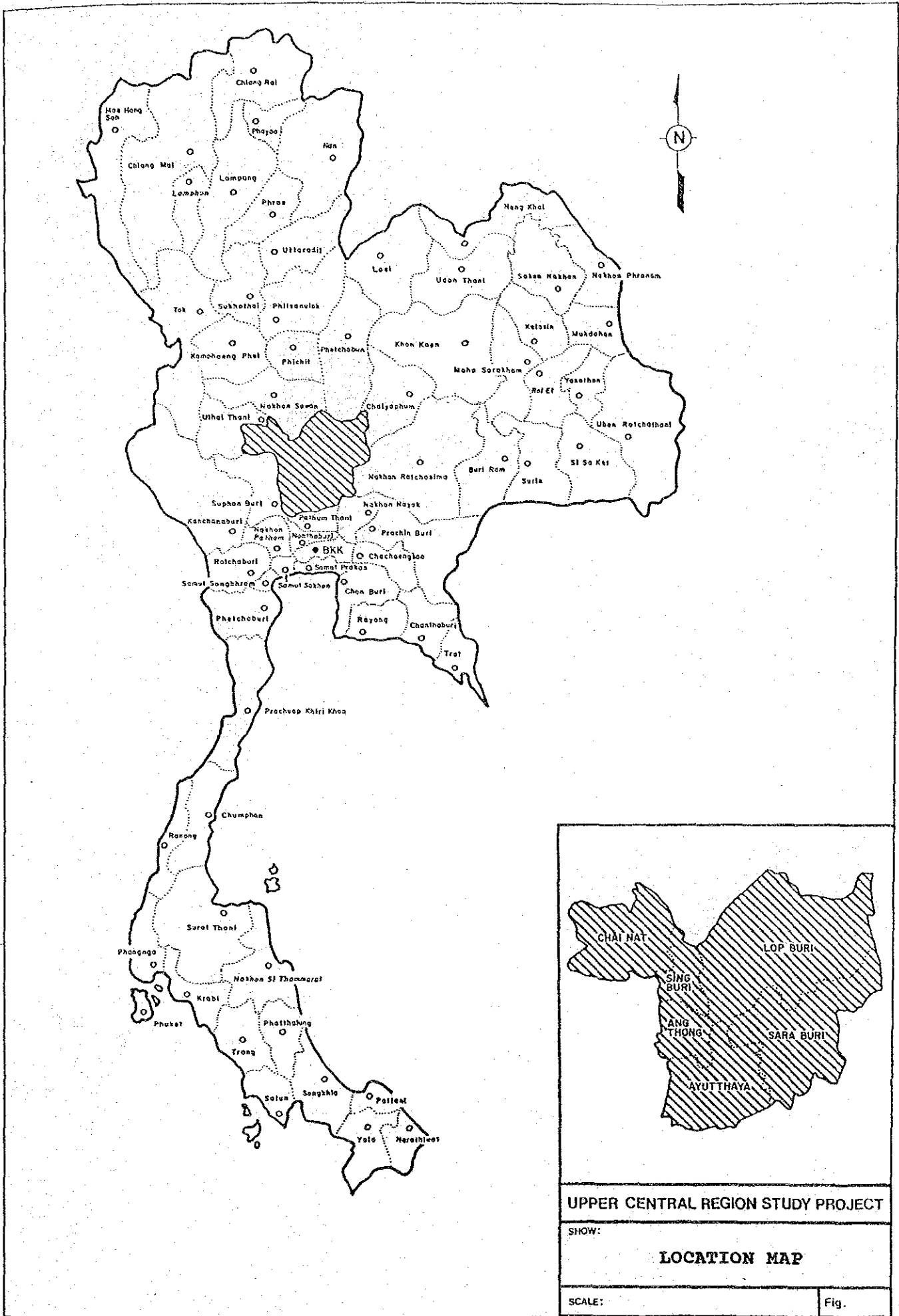
UPPER CENTRAL REGION STUDY PROJECT

SHOW:

LOCATION MAP

SCALE:

Fig.

LEGEND:

○ CHANGWAT LOCATION

• AMPHOE LOCATION

——•—— CHANGWAT BOUNDARY

——·—— AMPHOE BOUNDARY

UPPER CENTRAL REGION STUDY PROJECT

SHOW:

ADMINISTRATIVE BOUNDARY
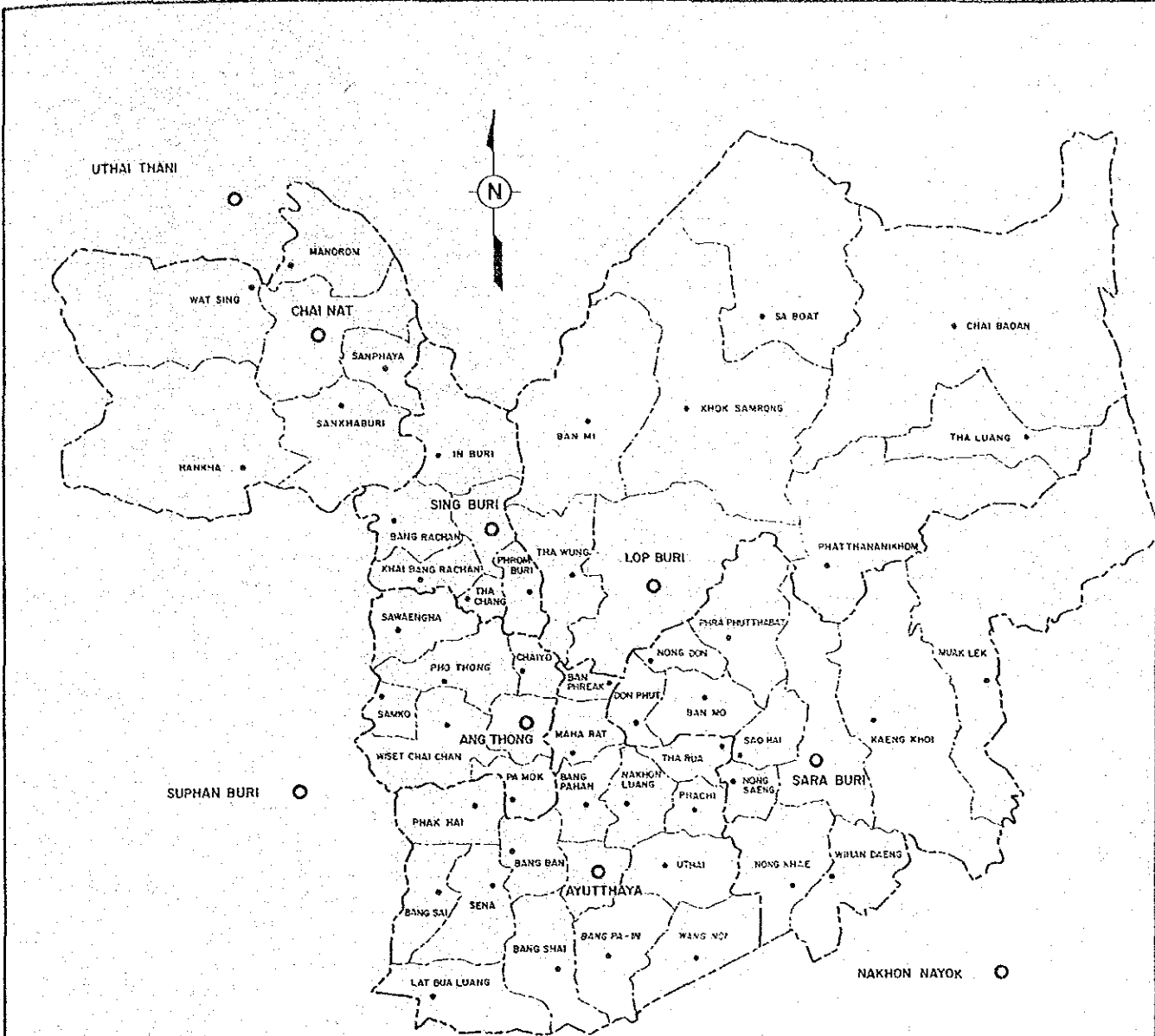OF STUDY AREA

SCALE: Fig.

A Summary :
Policies and Strategies

Upper Central Region Development

Why Upper Central Region (UCR)

Toward the year 2010, Thailand will have to get through the challenges of :
(1) shifting export-led to domestic market-based growth,
(2) balancing development and environment, and
(3) smoothly transitioning rural to urban employment.

In the national space, these challenges call particularly for :
(1) decentralizing the capital region systematically, and
(2) strengthening the linkages between ESB, SSB and other parts of the country, and
(3) sustaining strategic agricultural and forestry space.

Under these national perspectives, it is the UCR that potentially plays a combined role of :
(1) National Food Supply Center,
(2) Subnational Distribution Center, and
(3) A New Inland Industrial Base,

if this region can overcome :
(1) the presently unstable rural sector,
(2) the weak urban sector, and
(3) consequent regional out-migration.

The UCR is at a crossroads between a tri-sector (agriculture, industry and services) balanced region or a mere transit region over-ridden by sporadic external industrial investments.

Development Policies & Strategies

Objectives of the UCR development are :
1. Maintaining and restoring the ecological environment,
2. Deepening and widening of regional economy, and
3. Enhancing regional human resource base to support the two objectives above.

Recommended policies and strategies are thus as follows:
Agriculture
1. Strengthen capability and willingness of rice farmers,
2. Rehabilitate upland agricultural environment, and
3. Promote linkages between production, processing and market.
Industry
1. Build-up, step-by-step, an industrial development core at Sara Buri,
2. Intensify agro-industrial linkages within the UCR,
3. Foster local entrepreneurship of potential business men, and
4. Control rapidly dispersing industries in Ayutthaya.
Services
1. Develop secondary order centers
2. Develop extensive urban, technological and managerial supporting services at sub-regional urban centers,
3. Strengthen hierarchical system of agricultural distribution, processing and transport network, and
4. Promote tourism especially at Ayutthaya, Lop Buri and Chai Nat.
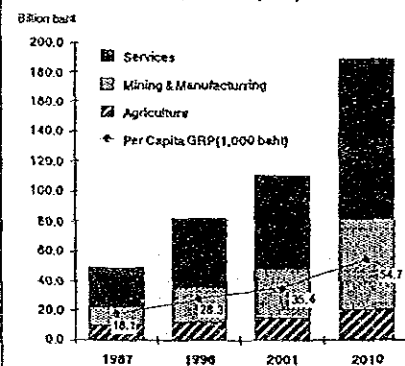
Development Target

Economic Growth: Toward 2010, it is targeted that per capita GPP growth of the UCR will be accelerated up to that of national average growth rate, 5% p.a. The GPP growth rate will be 6.1% p.a. toward 2010, and sector growth rates are: Agriculture : 1.3%; Manufacturing : 7.0%; and Services : 6.3%.

Population Growth: Population is targeted to growth at a rate of 1.0% so that the targeted per capita GPP will be attained. It will be 3.46 million in 2010, compared with 2.74 million in 1987.

Urbanization: Urban population will increase at a 2.5% growth rate, compared with 1.1% p.a between 1981 and 1987. The urban population ratio will be 37.2% in 2010.

Employments: Additional 421 thousand job opportunities will newly be created, and a total will be 1.9 million in 2010. The employments in both manufacturing and service sectors shall increase by 568 thousand, while that in agriculture sector will decrease by 147 thousand.

Production Framework (GRP) in the UCR

Billion baht

- Services
- Mining & Manufacturing
- Agriculture
- Per Capita GRP(1,000 baht)

1987   1996   2001   2010

Profile of Upper Central Region

The Upper Central Region (the UCR) consists of 6 Changwats: Ayutthaya, Sara Buri, Ang Thong, Sing Buri, Lop Buri and Chai Nat, having the population of about 2.7 million and the area of 16,6 thousand sq. km. The UCR is located in the Chao Phraya River Basin Area, an agricultural (particularly rice) advanced region in the Kingdom, and environmentally sensitive.

The UCR is on a frontage of the expanding Bangkok economy, and has been pressured by urbanization and industrialization. Thus, the UCR is a pioneer to the national challenge of agro-industrial coexistence by widening and deepening the UCR economy. For the second generation development of the Thai economy, the UCR's gateway function would be more significant.

Agricultural Diversification and Agro-Industrial Linkage

In order to stabilize income of the farmers, being the leading players in sustaining agricultural and ecological environment, a must is the agricultural diversification at the farmer level. With good access to the expanding and diversifying market in Bangkok, the agricultural diversification should be supported by the intensified linkages among crop production, livestock and processing networks as well as by the improved urban and transport infrastructures.

Industrialization for A New Industrial Base

The country will call in the UCR a strong magnet as (1) one of the centers to facilitate deconcentration of Bangkok, (2) a means to prevent extensive industrial pollution and agro-industrial conflicts, (3) a base to attain agro-processing agglomeration, and (4) an inland supporting base for the Eastern Sea-Board to maximize its spread effect.

Sara Buri offers the best seat of this magnet. Local infrastructure, urban and human resource development should be integrated in timely response to ongoing and forthcoming national projects.

Gateway as A Subnational Distribution Center

The UCR is situated at the gateway of Bangkok to the North and Northeast Regions. In other wards, the UCR is in a best position to make use of development in other regions. In addition to traditional concentration of agricultural products, new transport and energy infrastructure inputs will boost various industrial and business opportunities.

Integrated Urbanization and Service Sector Encouragement

Urban and service sector encouragement is strategic to regional development especially in the UCR in order to (1) support externally dependent and thus unstable rural sector, (2) provide nonagricultural job opportunities for decelerating out-migration to Bangkok and (3) offset a missing link existing between foreign-investment-led industrial expansion and regional economic development.

Of particular importance are to meet Basic Urban Needs (BUNs), encourage local entrepreneurship and improve goods distribution functions in selected urban centers at regional level.

Human Resource Development

Focusing on (1) Middle level manpower for industries, (2) Community leaders for environmental management and (3) potential local entrepreneurs.

Environment and Water Resources Management

Special importance lies in (1) keeping the Chao Phraya River clean and conserving flood retarding areas for the survival of Bangkok and (2) maximizing water use efficiency and rehabilitating upland soils for the UCR's agriculture of national importance to be maintained. High priority should be given to (1) the integrated management of water and land use for two river basins of Chao Phraya and the Pasak and (2) the strengthened institutions at not only central but local levels to explore environmental control.

Implementation & Development Management Systems

Unlike the regional development triggered by intensive central government investments, the UCR development will need not only central initiative but effective management particularly at the local level. Of particular importance are (1) local planning system to meet the cross-boundary expansion of urban and industrial activities, (2) institutional measures to realize the scale of economy in urban services and (3) strengthened financial base of local authorities so as to encourage local initiatives in public investments and business promotion.

Macro-Spatial Framework

To assure effective economic links between major urban centers centering on Bangkok and the Eastern Sea-Board functions, a well organized macro-spatial network is necessary. The UCR may be situated in the Suburban Agro-Industrial Belt.
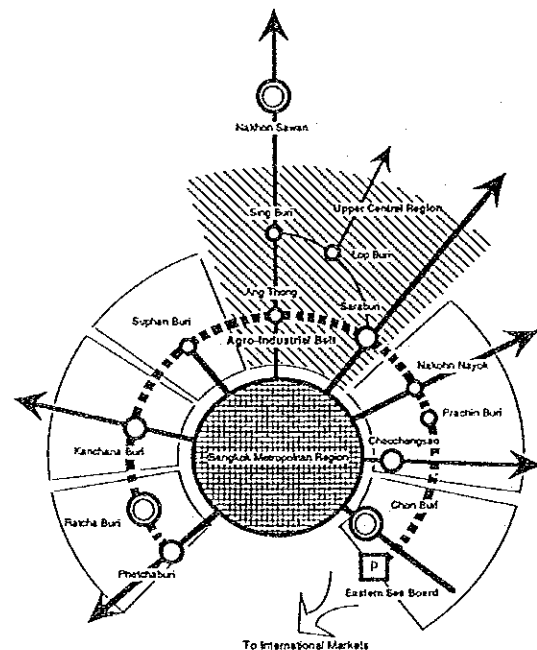
Human Settlement System

Sub-regional system with a urban center hierarchy should be formulated as a basis of regional development. This system assure relations between urban functions and their hinterland activities.
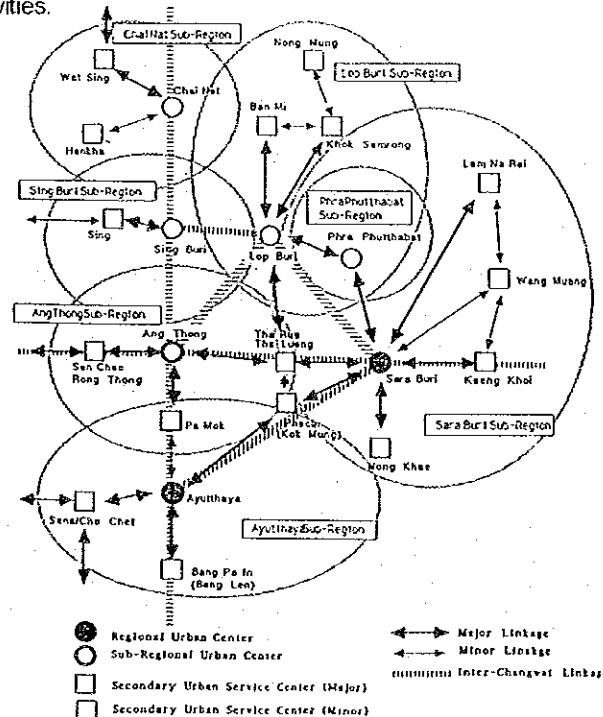
Appropriate Land Use

A clear-cut land use zoning system is essential for a balanced development with an appropriate use of natural environmental resources.
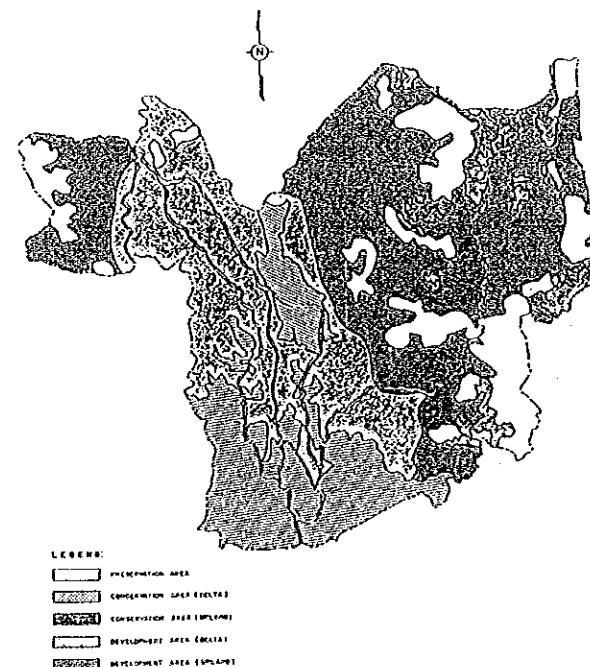
Greater Sara Buri Industrial Core (GSIC) Development

The GSIC development is recommended to receive the potential activities for industrialization and urbanization, being a new inland industrial basis linking with the sea-board development.

Development Strategies & Phasing

	1996	2001	2010
	Short-Term	**Medium-Term**	**Long-Term**

National Development

Economy

Export-led Industrialization Back-supported by Regional Economy	Expanding Development Opportunities All Over the Country	Domestic Market Based Economic Diversification

Strengthening Human Resource Base

Space

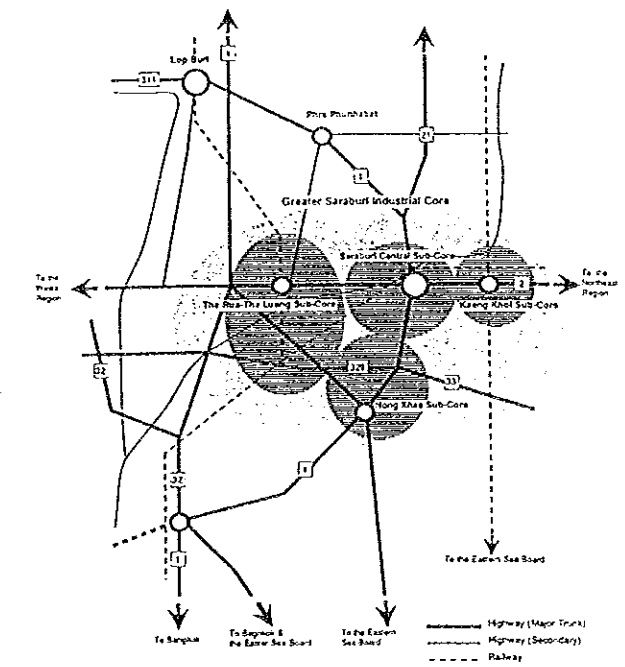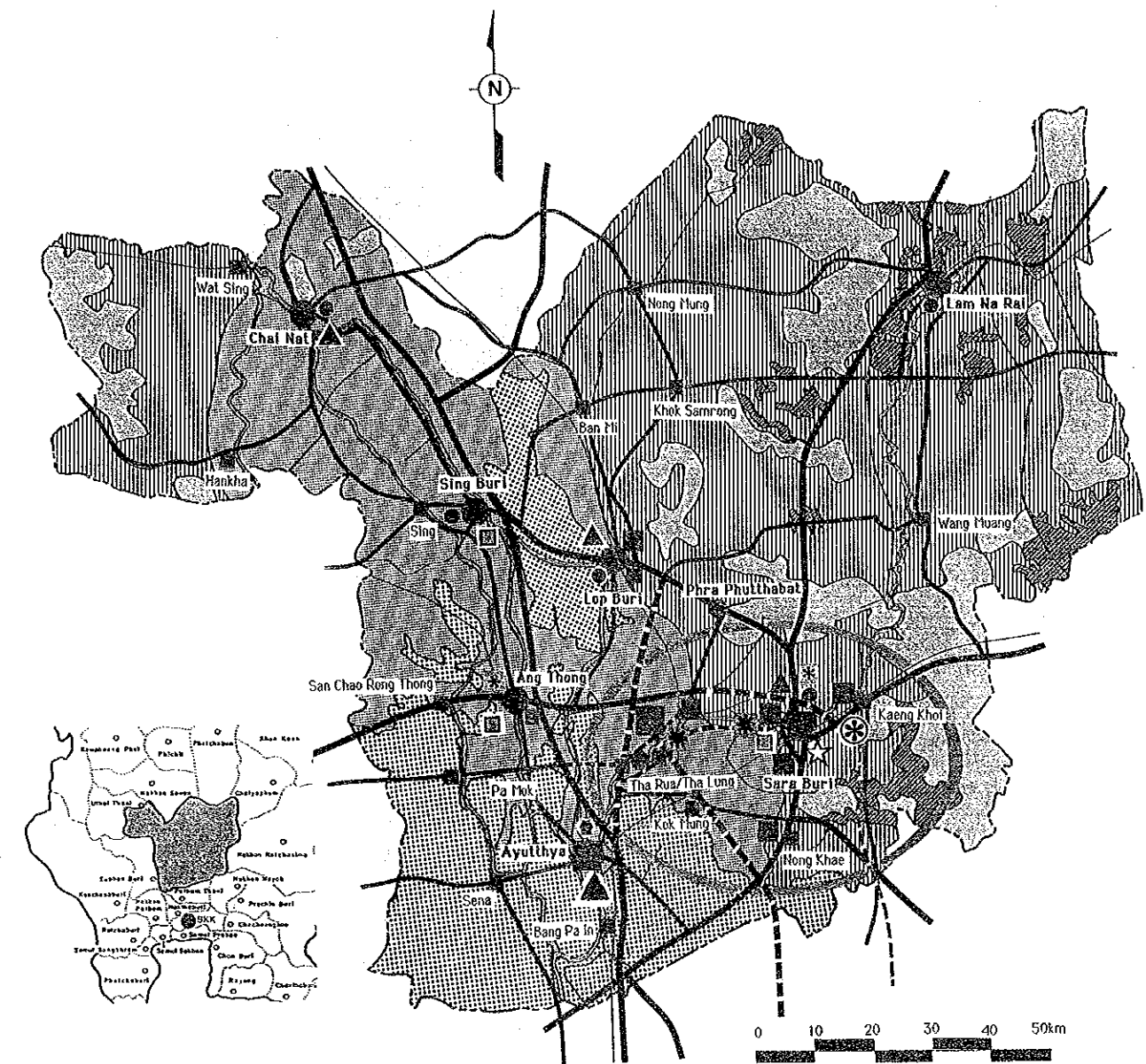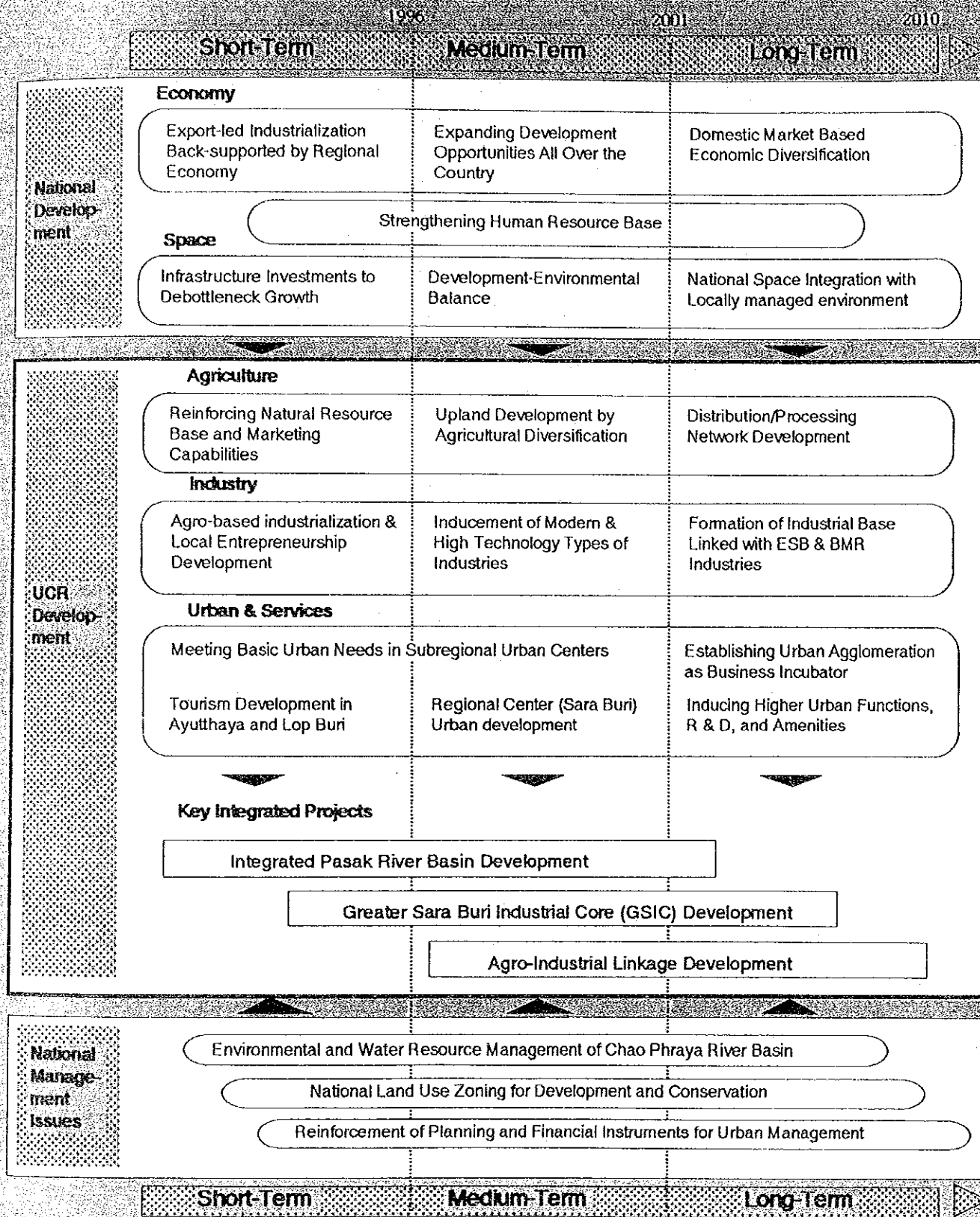| Infrastructure Investments to Debottleneck Growth	Development-Environmental Balance	National Space Integration with Locally managed environment

UCR Development

Agriculture

Reinforcing Natural Resource Base and Marketing Capabilities	Upland Development by Agricultural Diversification	Distribution/Processing Network Development

Industry

Agro-based industrialization & Local Entrepreneurship Development	Inducement of Modern & High Technology Types of Industries	Formation of Industrial Base Linked with ESB & BMR Industries

Urban & Services

Meeting Basic Urban Needs in Subregional Urban Centers		Establishing Urban Agglomeration as Business Incubator
Tourism Development in Ayutthaya and Lop Buri	Regional Center (Sara Buri) Urban development	Inducing Higher Urban Functions, R & D, and Amenities

Key Integrated Projects

Integrated Pasak River Basin Development

Greater Sara Buri Industrial Core (GSIC) Development

Agro-Industrial Linkage Development

National Management Issues

Environmental and Water Resource Management of Chao Phraya River Basin

National Land Use Zoning for Development and Conservation

Reinforcement of Planning and Financial Instruments for Urban Management

Short-Term	**Medium-Term**	**Long-Term**

Legend

Land Use Zoning
- Development Area (Delta)
- Conservation Area (Delta)
- Development Area (Upland)
- Conservation Area (Upland)
- Preservation Area

Human Settlement Center
- Regional Urban Center
- Sub-Regional Urban Center
- Secondary Major Center

Transportation & Energy
- Arterial Road (Existing)
- Arterial Road (Proposed)
- Collector Road (Existing)
- Collector Road (Proposed)
- Railway (Existing)
- Railway (Planned)
- Goods Distribution Center
- Inter-Modal Transport Facilities (Container Yard & Inland Depot)
- Energy Center

Industrial and Urban Facilities
- Industrial Estates
- Agro-industrial Park
- Business Incubator Center
- Agro-Tech Center
- Handicraft Promotion Center
- Wholesale Food Market
- Higher Educational Facility
- Regional Medical Center
- Regional Tourism Center
- Tourism Promotion Areas
- Greater Sara Buri Industrial Core

General Development Plan 2010 in the Upper Central Region

LIST OF FINAL REPORTS

(This volume is indicated by [   ].)

Executive Summary

Master Plan Report

Sector Reports:

Vol. 1	Spatial Framework and Network for Development
Vol. 2	Urban Management
Vol. 3	Environmental Management
Vol. 4	Water Resource Management, Agricultural Development and Land Use Management
Vol. 5	Industrial Development
Vol. 6	Distribution and Marketing
Vol. 7	Energy
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Vol. 9	International and National Economic Environment
Vol. 10	Human Resource Development
➡ Vol. 11	Landsat Analysis

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LIST OF ABBREVIATIONS USED

CCT	Computer Compatible Tape
GCP	Ground Control Points
MSS	Multi-Spectral Scanner
NRCT	National Research Council of Thailand
TM	Thematic Mapper
UCR	Upper Central Region
UTM	Universal Transverse Mercator

1. LANDSAT DATA ANALYSIS

Image Processing of the Landsat Data was performed to identify the changes which have taken place in the use of land during the dry season. Flooded areas during the rainy season in the Upper Central Region (UCR) were also identified.

1.1 Materials

Satellite Data

Computer Compatible Tapes (CCT) of Landsat-5 TM data (Dry Season)
-    Path 129 Row 50 acquired on December 09, 1987
-    Path 130 Row 50 acquired on January 17, 1988

Computer Compatible Tape (CCT) of Landsat-5 MSS data (Rainy Season)
-    Path 129 Row 50 acquired on November 4, 1986

The UCR images were compiled from two separate Landsat-5 scenes, shown in Fig. 1.1.

Other Materials

Topographic Maps at scales of 1:50,000 and 1:250,000.

Equipment

-    Meridian Image Analysis System
     (National Research Council of Thailand : NRCT)
-    RIPS Image Analysis System
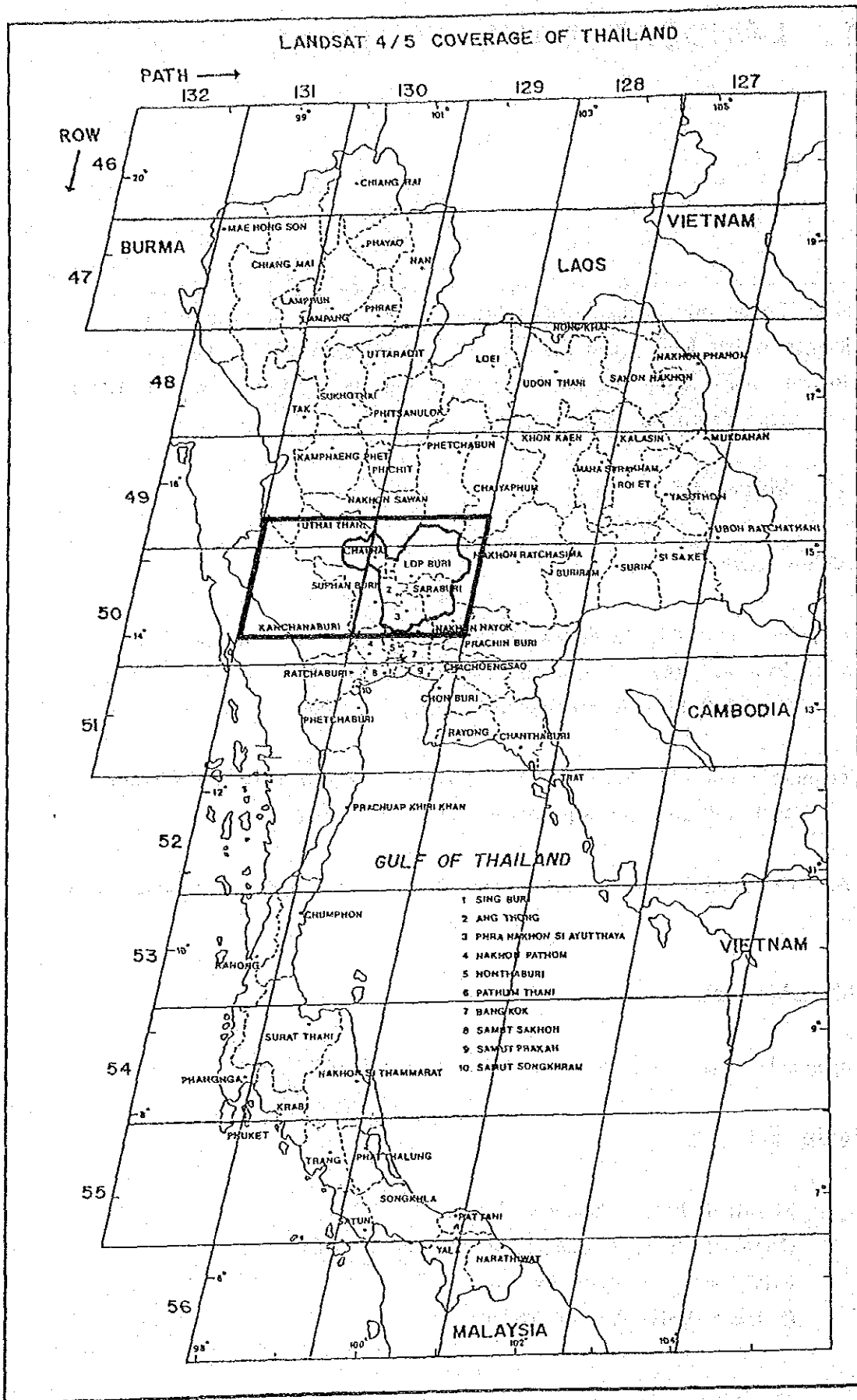   (Science University of Tokyo)

Fig. 1.1 Study Area Shown in Landsat Coverage Map

1.2 Process

Image processing flow of Landsat TM Data is shown in Fig. 1.2. Details of each processing are as follows:

Geometric   Correction

The geometric error of the satellite image is generally rectified by registering the image with Ground Control Points (GCPs) from a standard cartographic projection such as the Universal Transverse Mercator projection (UTM).

Correction of the Thematic Mapper (TM) image was made on the original data using GCPs as shown in Fig. 1.3. A Cubic Convolution Interpolation Technique was used to register each pixel with a particular point of the UTM map at a scale of 1:50,000.

Registration

The geometric error of the Multi-Spectral Scanner (MSS) image was rectified by registering it with the corrected TM images. Three GCPs were used to create a model and Cubic Convolution Interpolation Technique was used in the same manner as for the TM image.

Land-coverage   Classification

To obtain landuse in the study area, TM data were classified by using Band-2, 3, 4 and 5. The Maximum Likelihood Algorithm was employed to perform this classification. The classifier executes this algorithm by finding values for the pixel population mean and standard deviation based on known "training areas". This training can be either "supervised" or "unsupervised" classification. In this study, the supervised method was applied.

Post-classification

The 26 classes of TM data acquired on December 9,1987 were grouped into 11 classes, while the 27 classes of the data acquired on January 17, 1988 were grouped into 10 classes. A "filtering" technique was used to group scatter
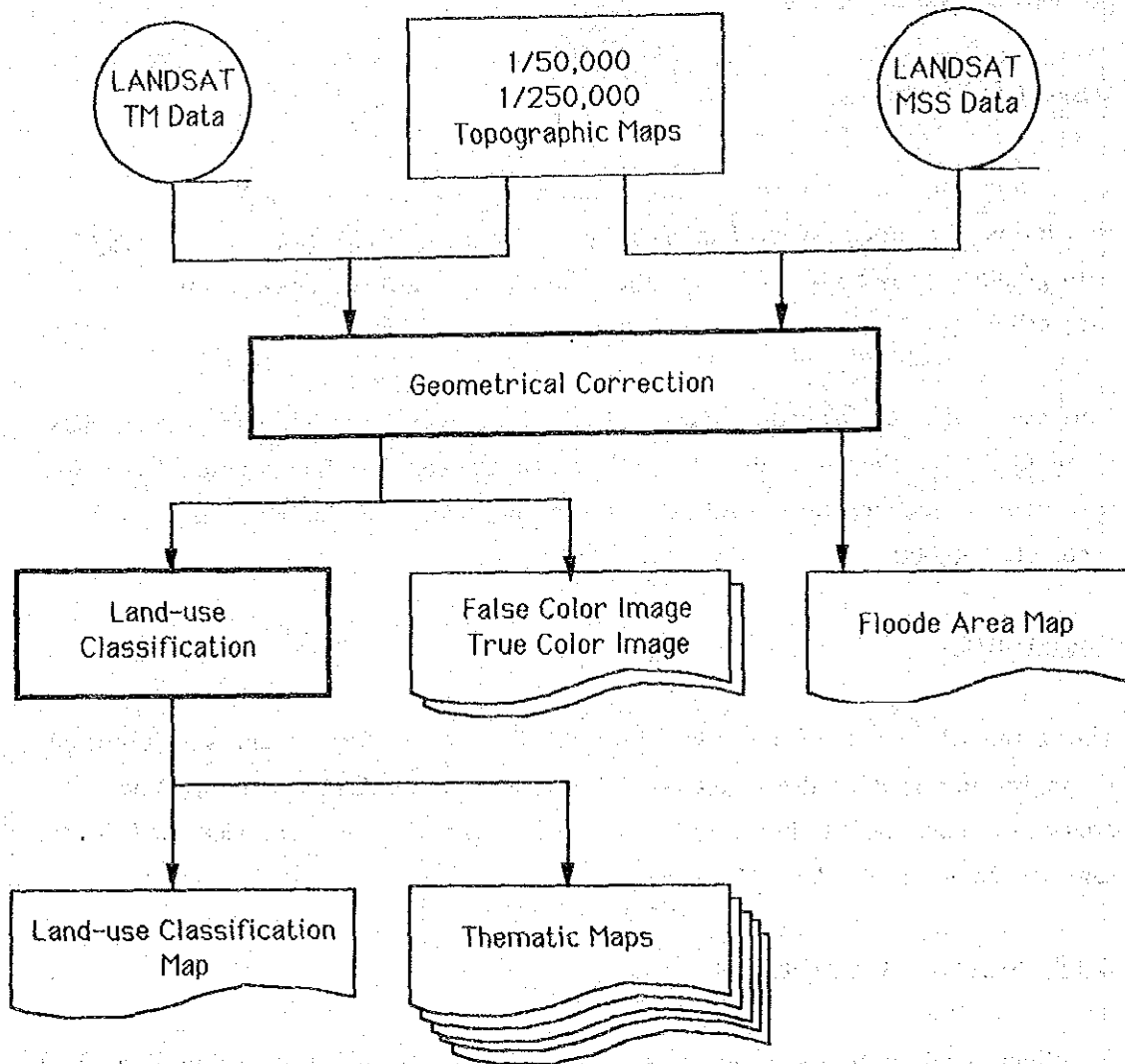
3

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┌─────────┐      ┌──────────────────┐      ┌─────────┐
│ LANDSAT │      │     1/50,000     │      │ LANDSAT │
│ TM Data │      │    1/250,000     │      │ MSS Data│
└─────────┘      │ Topographic Maps │      └─────────┘
                 └──────────────────┘
                          │
                 ┌──────────────────┐
                 │ Geometrical Correction │
                 └──────────────────┘
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Geometrical Correction

Land-use
Classification

False Color Image
True Color Image

Floode Area Map

Land-use Classification
Map

Thematic Maps

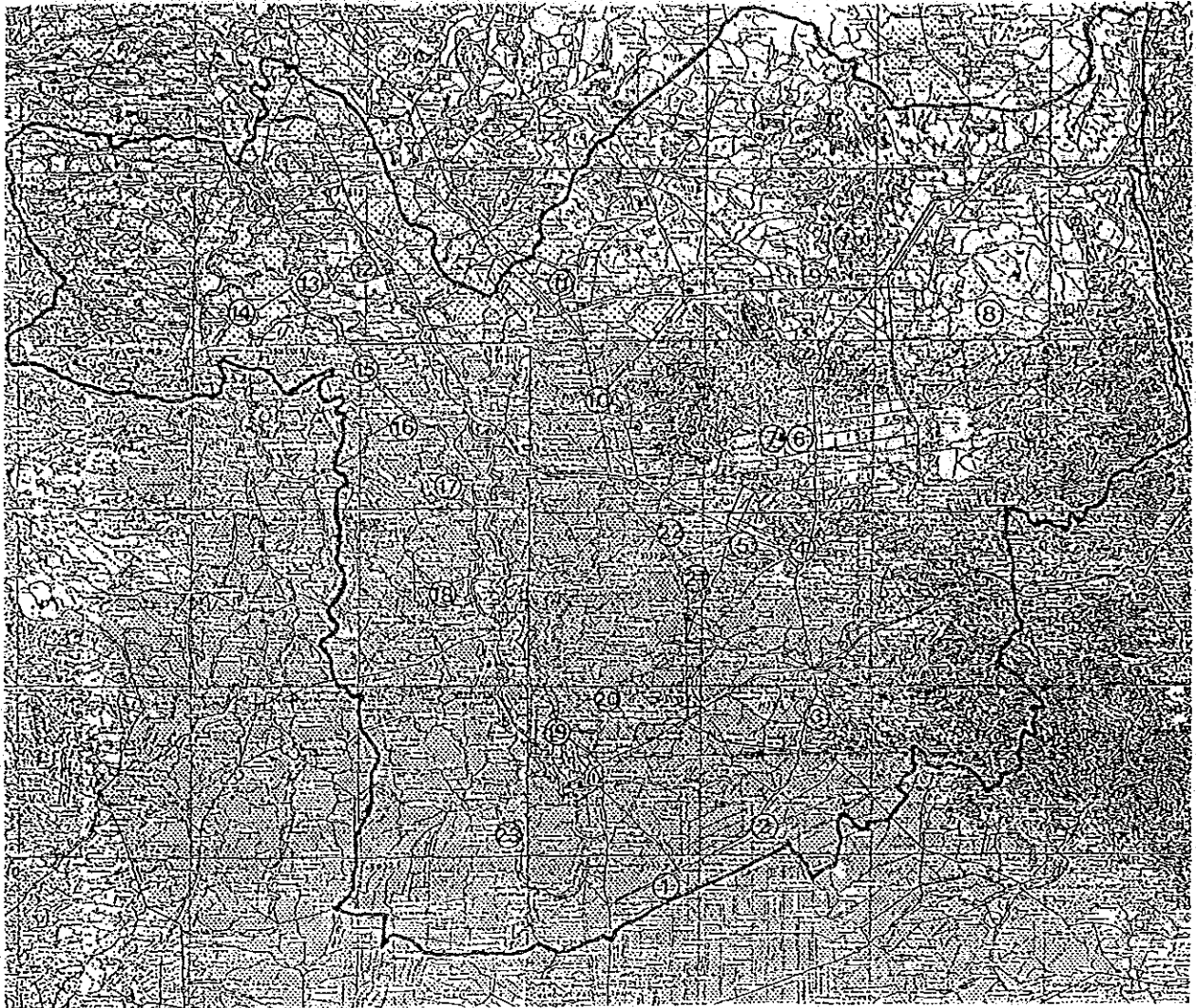**Fig. 1.2   Landsat Data Analyzing Flow**

4

Fig. 1.3 Map of Study Area with Location of Ground Truth Data

pixels into a particular class for smoothing. The result of this classification was presented in the form of a thematic map of the training area, and the area of each class was calculated from the pixel count.

(1 pixel = 29.99 x 29.99 Sq.m.)

Flooded Area Classification

To identify the flooded area in the UCR, during rainy season, the water area in the MSS image was classified.

The "Thresholding" technique was used to segment land and water areas in the Landsat MSS Band-7. And then, the "density slice" method was used to change the intensity value of the water area. The extent of the flooded area was found to be 1,435.931 Sq. km. (calculated from the pixel count).

Thematic Maps

Classified TM Data from Landsat-5 in the dry season were filed in the computer so as to be used as the database for the UCR study. Different kinds of thematic maps were created using this data-base to show the distribution of selected items. These thematic maps can be overlaid on the topographic map as shown in chapter 2.