

JAPAN INTERNATIONAL COOPERATION AGENCY(JICA)  
AGRICULTURAL LAND REFORM OFFICE(ALRO), MOAC  
THE KINGDOM OF THAILAND

**THE FEASIBILITY STUDY  
ON  
THE INTEGRATED AGRICULTURE DEVELOPMENT  
IN  
THE AGRICULTURAL LAND REFORM AREAS  
IN  
THE UPPER NORTHEASTERN REGION  
THE KINGDOM OF THAILAND**

**FINAL REPORT**

**MAIN REPORT**

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**JULY, 1998**

**SANYU CONSULTANTS INC.**

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## PREFACE

*In response to the request from the Government of Thailand, the Government of Japan decided to conduct a feasibility study on the Integrated Agriculture Development in the Agricultural Land Reform Areas in the Upper Northeastern Region and entrusted the study to Japan International Cooperation Agency (JICA).*

JICA sent to Thailand a study team headed by Mr. Hiroshi Moriyama, Sanyu Consultants Inc., four times between December 1996 to May 1998.

The team held discussions with the officials concerned of the Government of Thailand, and conducted field surveys at the study area. 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 the project 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 Thailand for their close cooperation extended to the team.

July, 1998



Kimio Fujita

President

Japan International Cooperation Agency

Mr. Kimio Fujita  
President,  
Japan International Cooperation Agency,  
Tokyo, Japan

**Letter of Transmittal**

Dear Mr. Fujita

We have a pleasure to submit to you the Final Report of the Feasibility Study on the Integrated Agriculture Development in the Agricultural Land Reform Areas in the Upper Northeastern Region of the Kingdom of Thailand. This report contains the advice and suggestions of the authorities concerned of the Government of Japan and your Agency, as well as the formulation of the above-mentioned development plan. The advice and suggestions made by the officials of Agricultural Land Reform Office(ALRO) and other governmental agencies of the Kingdom of Thailand in the course of the study are also included in this report.

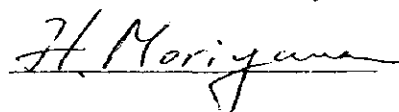
This study has been carried out for 35 Land Reform Areas(LRAs), where have about 221 thousand ha of land in total and are located in the four provinces of Khon Kaen, Maha Sarakam, Mukdahan and Sakhon Nakhon in the Upper Northeastern Region, and includes the formulation of basic development plan for 35 LRAs, the classification of these LRAs into development categories, selection of priority areas, a feasibility study for the priority areas, the provision of guideline for formulating a development plan, etc.

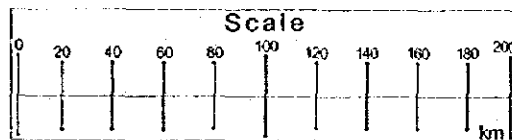
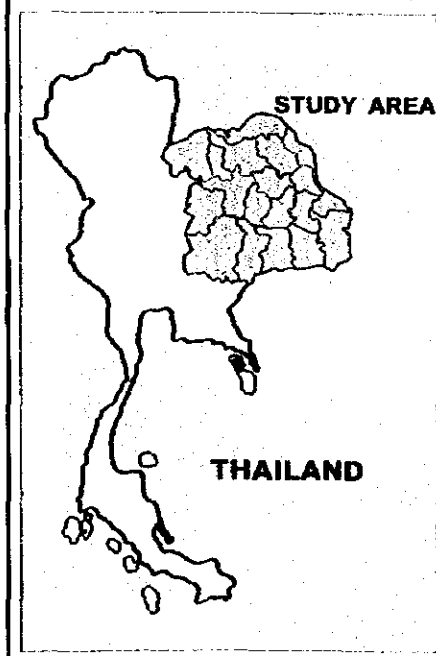
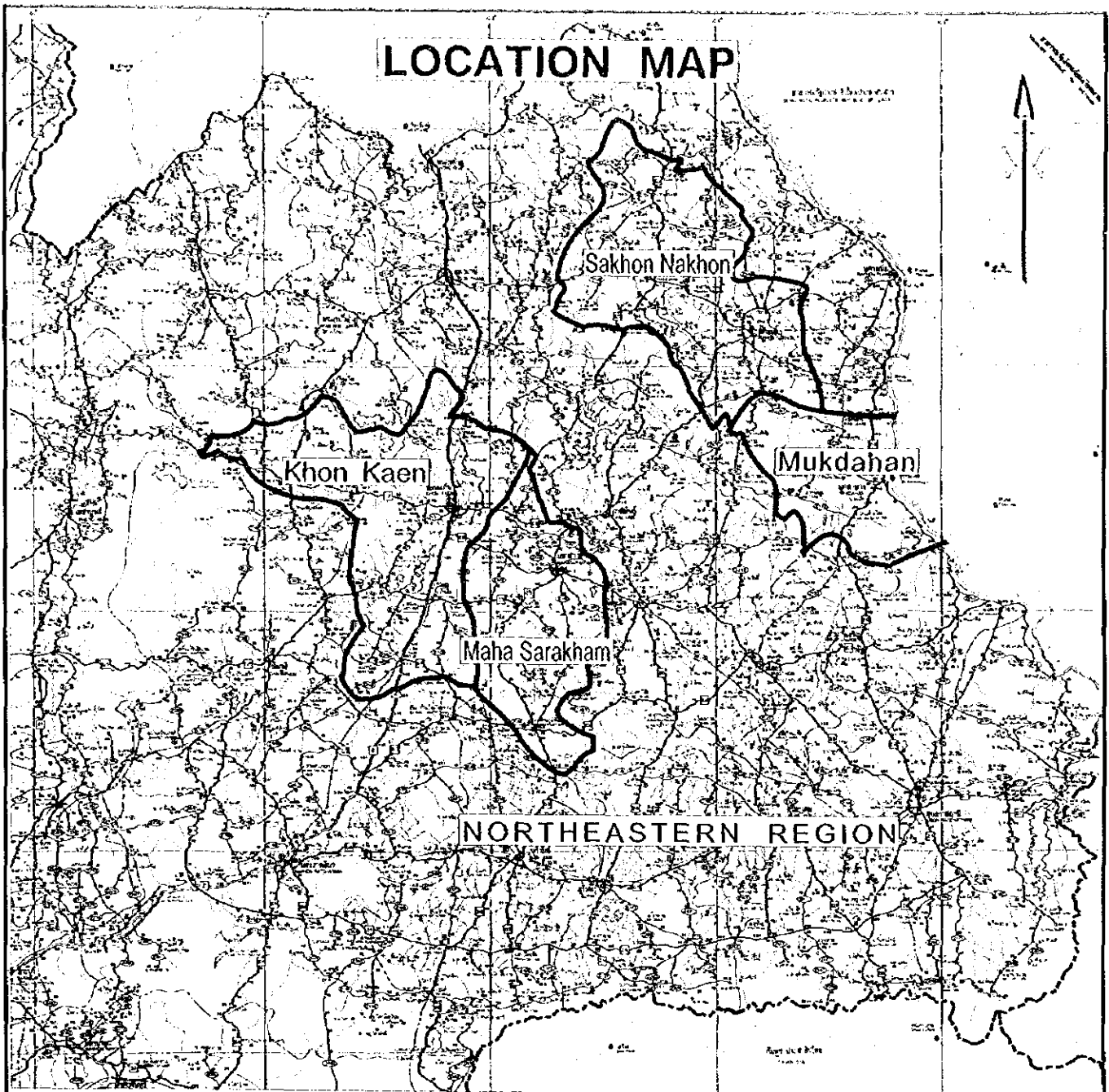
In the LRAs in the Upper Northeastern Region, it is possible to conduct multiple cropping if irrigation water is available. However, the potential for water resources development is very low due to only a few storage damsites, etc. and more than 90% of farmland in the LRAs remain as rainfed area, where even supplementary irrigation during the rainy season is unavailable, even after water resources development has been implemented to the maximum possible extent. In order to secure water for agriculture for such rainfed areas, Thai Government has been supplying a farm pond of 1,200 m<sup>3</sup> storage capacity to every farm family without cost. The proposed development plan aims at promoting farm pond based integrated farming in most LRAs of rainfed and both diversified cropping and integrated farming in a few irrigated LRAs.

We wish to take this opportunity to express our sincere gratitude to your Agency, the authorities concerned of the Government of Japan and the Embassy of Japan for the Kingdom of Thailand. We also wish to express our deep gratitude to the officials concerned of the Government of Thailand for the close and cordial cooperation and assistance extended to us during this study.

Very truly yours,

Hiroshi MORIYAMA  
Team Leader, JICA Study Team



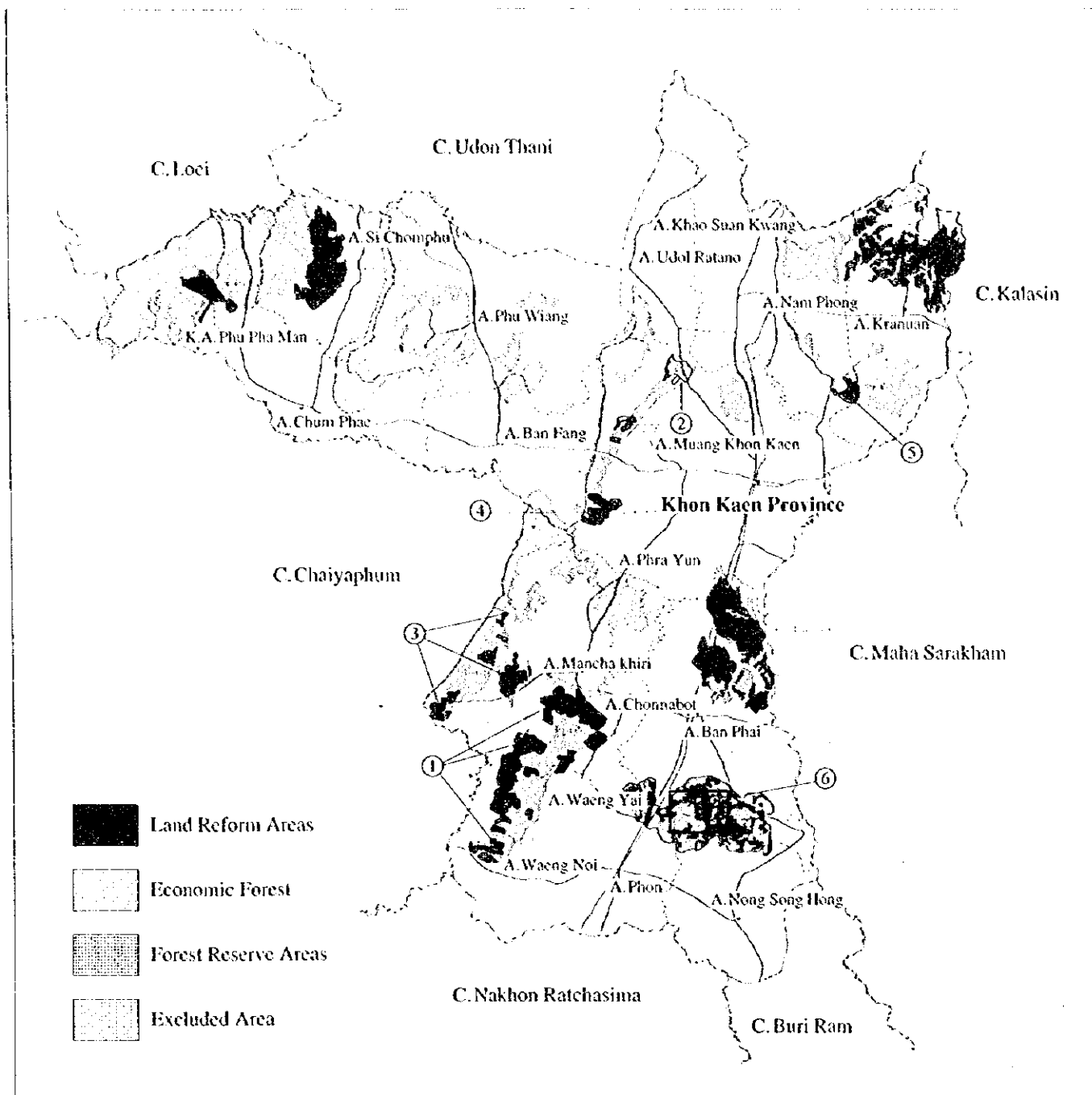


#### ACREAGE OF THE STUDY AREA

Province	Whole Province		Study Area		
	Total Area (ha)	Farm Land (ha)	Nos. of LRAs	Total Area (rai)	Farm Land (ha)
Khon Kaen	1,088,640	667,520	6	267,920	42,870
Maha Sarakham	529,120	428,960	10	218,610	34,970
Sakhon Nakhon	960,480	449,120	7	420,750	67,320
Mukdahan	433,920	130,240	12	479,270	76,680
<b>Total</b>	<b>3,012,160</b>	<b>1,675,840</b>	<b>35</b>	<b>1,386,550</b>	<b>221,840</b>

Unit of area : 1 rai = 0.16 ha

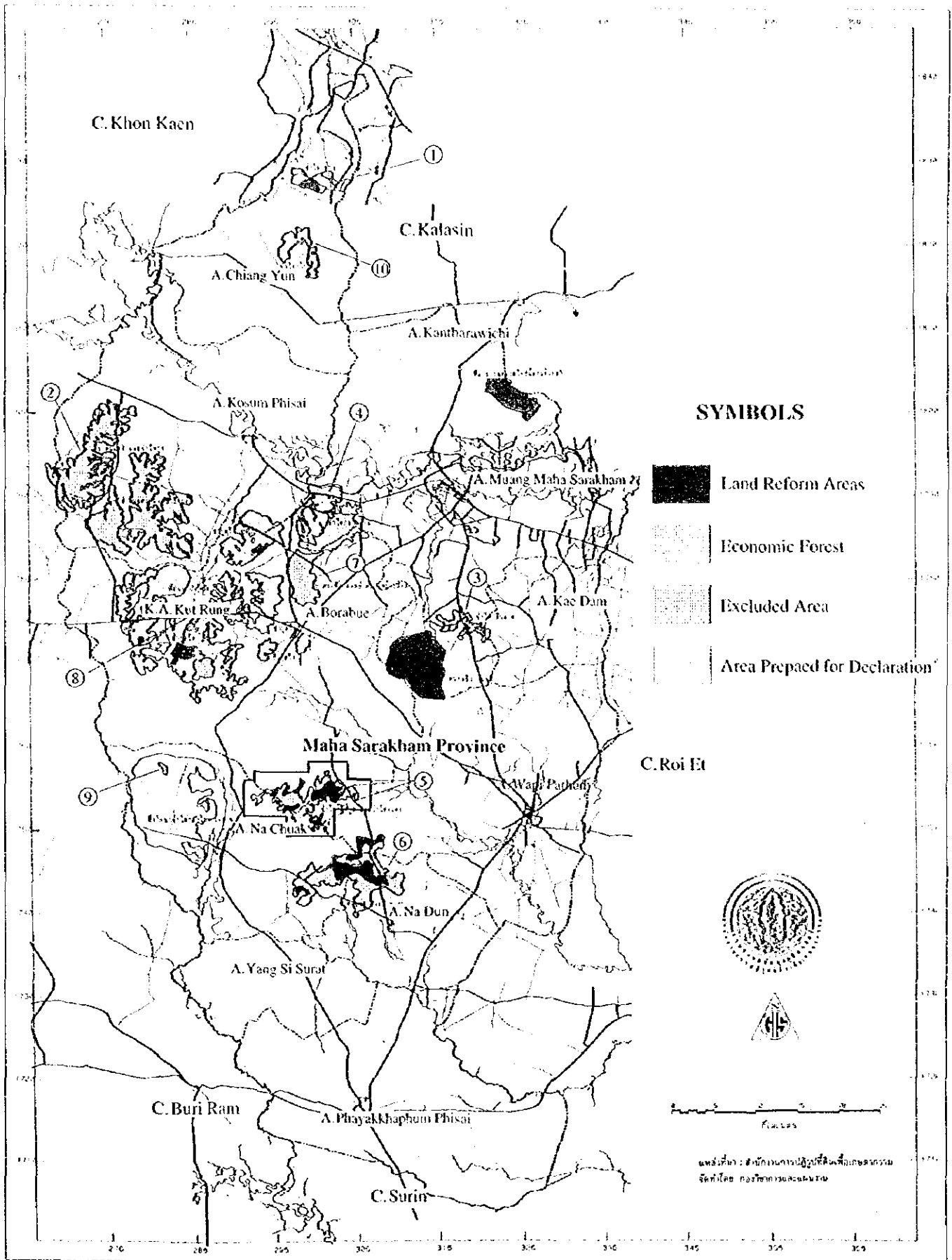
## DETAILED LOCATION MAP (KHON KAEN)



Priority Area : No.6 area, Non Nam Baeng Forest

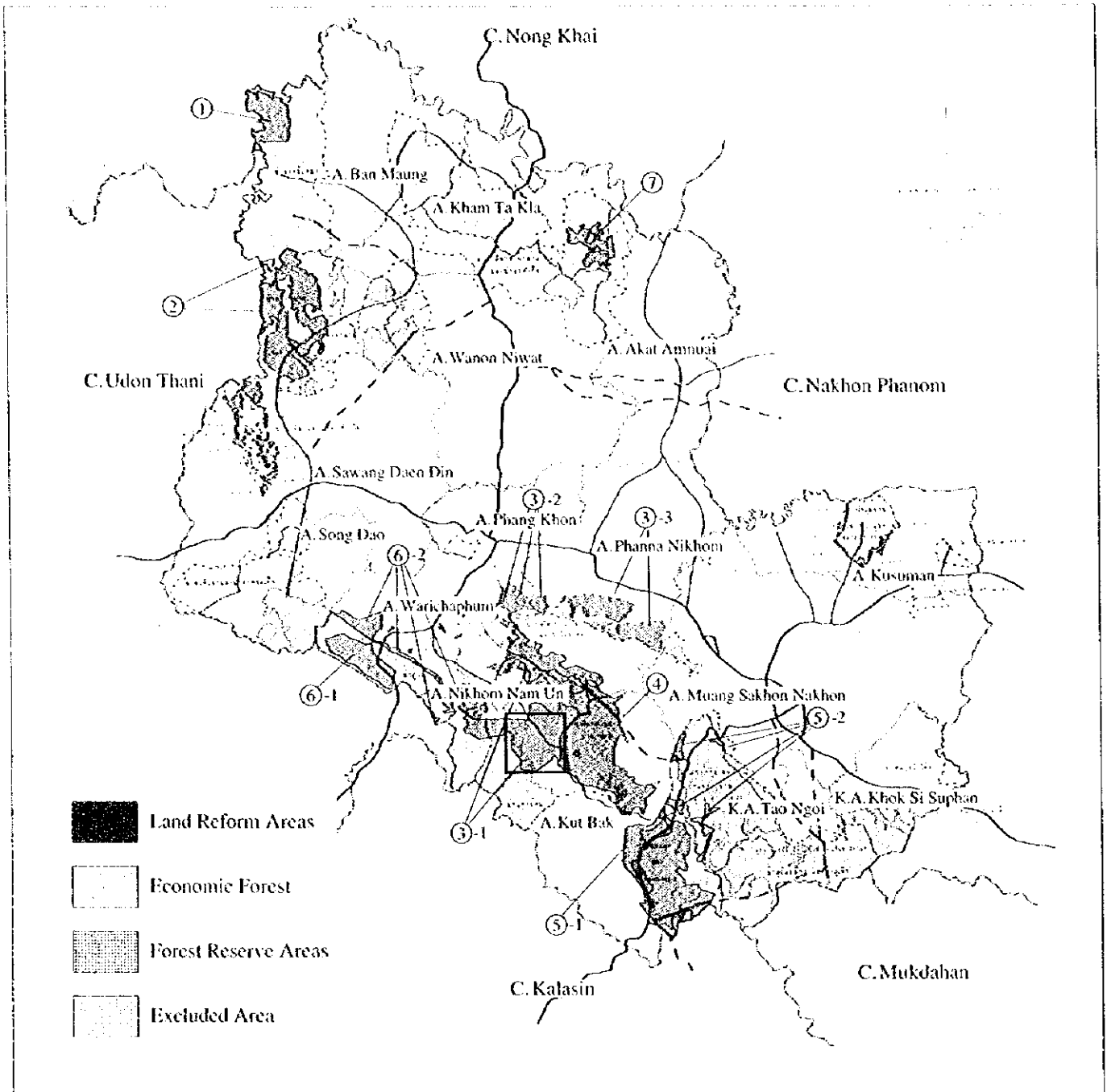


# DETAILED LOCATION MAP (MAHA SARAKHAM)



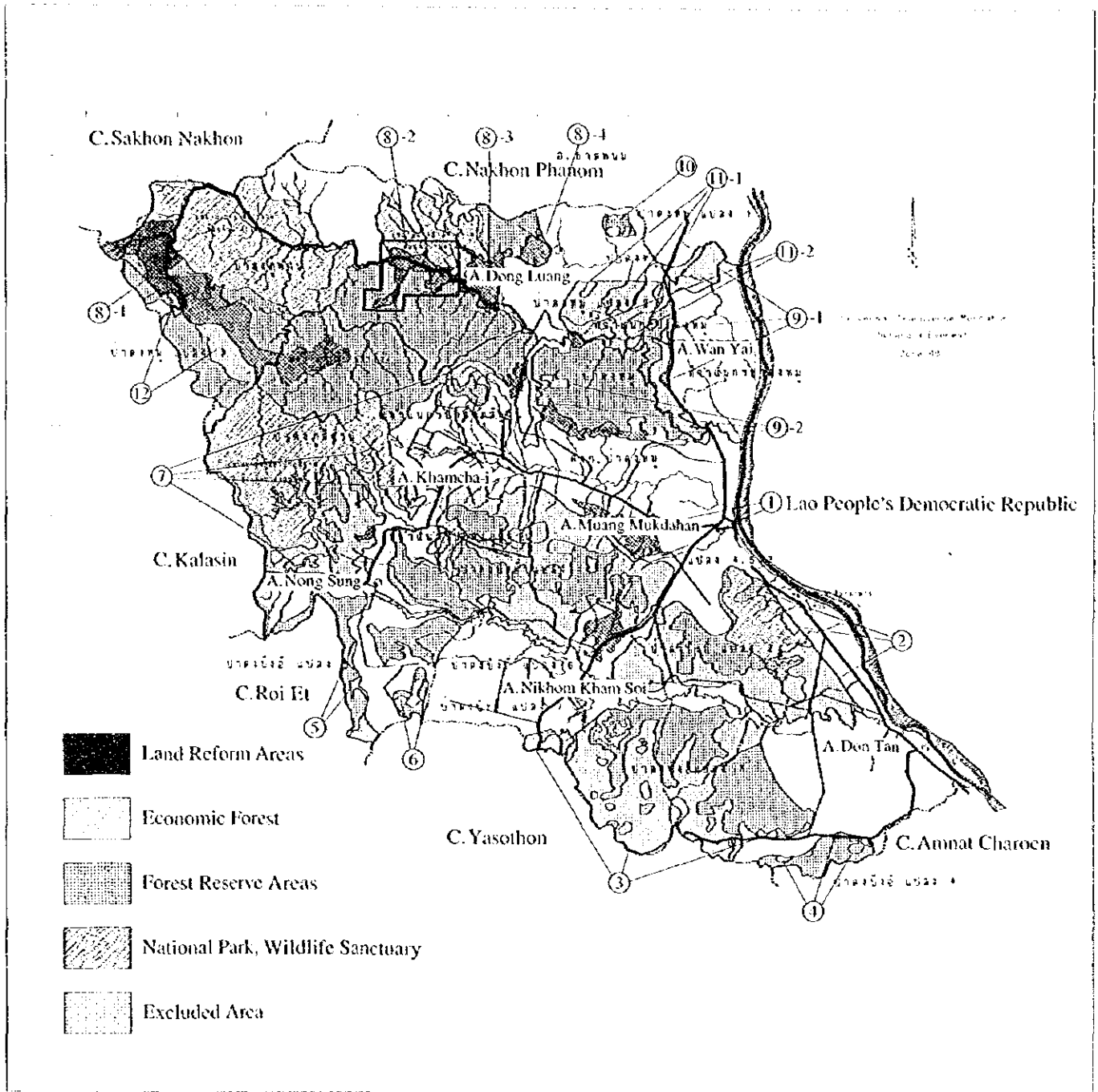
Priority Area : No. 5 area Khok Phuk Kut and Pong Daeng Forest

## DETAILED LOCATION MAP (SAKHON NAKHON)



Priority Area : No. 3-1 area Kut Hai Na-Nai Non Udom Forest

# DETAILED LOCATION MAP (MUKDAHAN)



Priority Area : No. 8-2 area Dong Phu Phan Forest

**PHOTOGRAPH OF THE STUDY AREA**



**Village in the Study Area**



**Cassava Field**



**Paddy Field**



**Vegetable Cultivation on a  
Farm Land with Farm Pond**



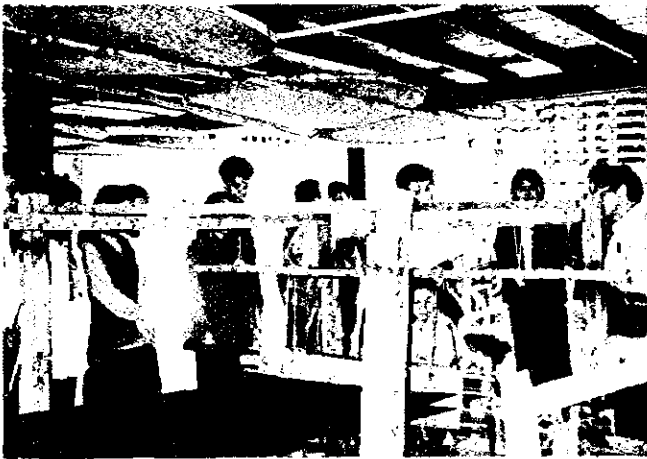
**Irrigation by using a Watering Pot**



Ecological Farming



Community Forest



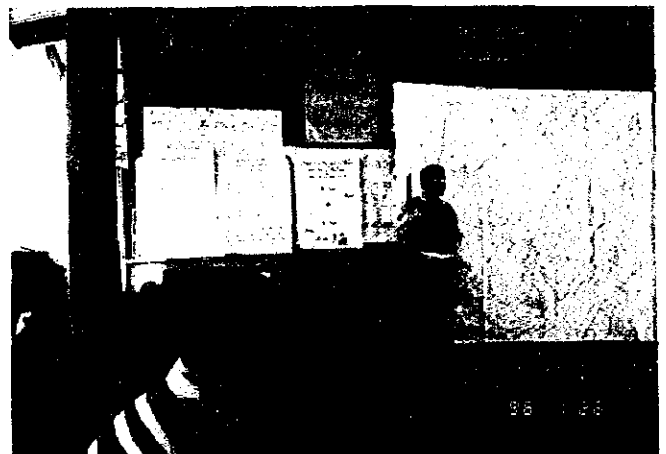
Silk Weaving



A Public Market  
(Amphoe Kut Bak, Sakhon Nakhon Province)



Kichen in a Farmhouse



Project Explanation to Farmers

### ACREAGE OF STUDY AREA

Province	Forest Name	Initial Stage (Nov/96)		Reviewed (05/June/97)				
		(rai)	(ha)	Revision	Forest to LRA	(rai)	(ha)	Differ (ha)
<b>Khon Kaen</b>		<b>273,518</b>	<b>43,763</b>			<b>267,920</b>	<b>42,866</b>	<b>-897</b>
① KK 1	Phu Ra-ngam	68,123	10,900	reviewed	only A	67,640	10,822	-78
② KK 2	Sawathi	15,375	2,460	reviewed	only A	14,130	2,261	-199
③ KK 3	Khok Luang (Plot 3)	19,700	3,152	reviewed	only A	18,370	2,939	-213
④ KK 4	Khok Talat Yai	11,450	1,832	reviewed	only A	11,740	1,878	46
⑤ KK 5	Dong Sam	6,525	1,044	reviewed	only A	6,250	1,000	-44
⑥ KK 6	Non Nam Baeng	152,343	24,375	reviewed	A & E	149,790	23,966	-409
<b>Mabarakham</b>		<b>213,864</b>	<b>34,218</b>			<b>218,610</b>	<b>34,977</b>	<b>759</b>
① MHS 1	Khok Khao	1,613	258	reviewed	a part of A	2,640	422	164
② MHS 2	Din Daeng and Wang Kung	69,747	11,160	revised	whole E	59,690	9,550	-1,610
③ MHS 3	Khok Hin Lard	2,275	364	revised	whole E	3,080	493	129
④ MHS 4	Khok Kham Poom	10,625	1,700	revised	whole E	9,510	1,522	-178
⑤ MHS 5	Khok Phuk Kut and Pong Daen	12,050	1,928	revised	A & E	18,200	2,912	984
⑥ MHS 6	Nong Khu and Na Dun	20,065	3,210	revised	A & E	29,790	4,766	1,556
⑦ MHS 7	Don Ken and Nong Ya Prong	10,937	1,750		whole E	10,940	1,750	0
⑧ MHS 8	Kut Rang	80,402	12,864	revised	A & E	79,620	12,739	-125
⑨ MHS 9	Khok Sum Rong and Pro Pan	388	62	revised	whole E	310	50	-12
⑩ MHS 10	Khok Rai	5,762	922	revised	whole E	4,830	773	-149
<b>Mukdahan</b>		<b>458,233</b>	<b>73,318</b>			<b>479,270</b>	<b>76,683</b>	<b>3,365</b>
① MKD 1	Dong Bung-I (Plot 1)	109,055	17,449	revised	whole E	103,580	16,573	-876
② MKD 2	Dong Bung-I (Plot 2)	56,292	9,007	revised	whole E	75,840	12,134	3,127
③ MKD 3	Dong Bung-I (Plot 3)	103,958	16,633	revised	whole E	106,490	17,038	405
④ MKD 4	Dong Bung-I (Plot 4)	1,387	222	revised	whole E	1,860	298	76
⑤ MKD 5	Dong Bung-I (Plot 5)	6,450	1,032	revised	whole E	6,030	965	-67
⑥ MKD 6	Dong Bung-I (Plot 7)	700	112		whole E	700	112	0
⑦ MKD 7	Dong Phu Si Than	47,150	7,544	revised	whole E	47,020	7,523	-21
⑧ MKD 8	Dong Phu Phan	64,800	10,368	revised	whole E	59,420	9,507	-861
⑨ MKD 9	Dong Mu	43,529	6,965	revised	whole E	52,240	8,358	1,393
⑩ MKD 10	Dong Mu (Plot 1)	1,281	205	revised	whole E	1,180	189	-16
⑪ MKD 11	Dong Mu (Plot 2)	11,394	1,823	revised	whole E	13,430	2,149	326
⑫ MKD 12	Dong Mu (Plot 3)	12,237	1,958	revised	whole E	11,480	1,837	-121
<b>Sakon Nakhon</b>		<b>416,144</b>	<b>66,583</b>			<b>420,750</b>	<b>67,320</b>	<b>737</b>
① SKN 1	Dong Mo Thong	24,600	3,936	revised	only A	22,810	3,650	-286
② SKN 2	Dong Pha Lat	36,775	5,884	revised	only A	43,580	6,973	1,039
③ SKN 3	Kut Hai, Na-Nai, Non Udom	139,813	22,370	revised	A & E	120,110	19,218	-3,152
④ SKN 4	Khok Phu and Na Mong	87,700	14,032	revised	A & E	86,520	13,843	-189
⑤ SKN 5	Dhong Chomphu Phan and Dong Kachoe	69,350	11,096	revised	most E & Military Area	89,240	14,278	3,182
⑥ SKN 6	Phu Wong	40,956	6,553	revised	most of E	45,290	7,246	693
⑦ SKN 7	Dong I- Bang, Dong Kham Phu and Dong Kham Kang	16,950	2,712	revised	only A	13,200	2,112	-600
<b>Grand Total</b>	<b>35</b>	<b>1,361,759</b>	<b>217,882</b>			<b>1,386,550</b>	<b>221,846</b>	<b>3,964</b>

(Note) Area of each LRA was reviewed by a digitizer by Research and Planning Division, ALRO.

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## ABBREVIATION AND GLOSSARY

### I) Agencies ( \* : State Enterprise)

ADRC	Agricultural Development Research Center in the Northeast of Thailand
ALRO	Agricultural Land Reform Office, MOAC
ARD	Office of Accelerated Rural Development, MOI
BAAC	Bank for Agriculture and Agricultural Cooperatives
CDD	Community Development Department, MOI
CPD	Cooperatives Promotion Department, MOAC
DANCED	Danish Cooperation for Environment and Development
DLD	Department of Land Development, MOAC
DEDP	Department of Energy Development and Promotion, MOSTE
DMR	Department of Mineral Resources, MI
DOA	Department of Agriculture, MOAC
DOAE	Department of Agricultural Extension, MOAC
DOF	Department of Fisheries, MOAC
DOH	Department of Highways, MTC
DOI	Department of Health, MPH
DOL	Department of Livestock Development, MOAC
DOLA	Department of Local Administration, MOI
EGAT	Electricity Generating Authority of Thailand
FAO	Food and Agriculture Organization of the United Nation
*FIO	Forest Industry Organization, MOAC
JICA	Japan International Cooperation Agency
JIRCAS	Japan International Research Center for Agricultural Services
MASU	Mobile Agricultural Service Unit, MOAC
MD	Meteorological Department, MTC
MI	Ministry of Industry
MOAC	Ministry of Agriculture and Cooperatives
MOC	Ministry of Commerce
MOE	Ministry of Education
*MOF	Marketing Organization of Farmers, MOAC
MOI	Ministry of Interior
MOSTE	Ministry of Science, Technology and Environment
MPH	Ministry of Public Health
MTC	Ministry of Transport and Communications
NEB	National Environmental Board
NESDB	Office of National Economic and Social Development Board, PMO
NGOs	Non-Governmental Organizations
NSO	National Statistic Office
OAE	Office of Agricultural Economics, MOAC
OEPP	Office of Environmental Policy and Planning, MOSTE
ONEB	Office of the National Environmental Board
PAEO	Provincial Agricultural Extension Office
*PEA	Provincial Electricity Authority, MOI
PLRO	Provincial Land Reform Office
PMO	Prime Minister's Office
*PWA	Provincial Waterworks Authority, MOI

PWD	Public Works Department, MOI
REX	The Reforestation and Extension Project in the Northeast of Thailand (JICA's On-going Project)
RFD	Royal Forestry Department, MOAC
RID	Royal Irrigation Department, MOAC
TDRI	Thai Development Research Institute

## 2) Other Abbreviations

GDP	Gross Domestic Product
GRP	Gross Regional Product
GPP	Gross Provincial Product
HYV	High Yield Variety
LV	Local Variety
EIRR	Economic Internal Rate of Return
B/C	Benefit Cost Ratio
NPV	Net Production Values
KWH	Kilowatt Hour
MW	Mega Watt
F.C	Foreign Cost
L.C	Local Cost
FY	Fiscal Year
C.I.F	Cost, Insurance and Freight
F.O.B	Free on Board
O/M	Operation and Maintenance
HWL	High Water Level
NWL	Normal Water Level
LWL	Low Water Level
EL	Elevation Above Mean Sea Level
MSL	Mean Sea Level
LSIP	Large-Scale Irrigation Project
MSIP	Medium-Scale Irrigation Project
SSIP	Small-Scale Irrigation Project
JICA Study Team	JICA Study Team assigned to the Study
LRA(s)	Land Reform Area(s)
KK	: Khon Kaen LRA
MHS	: Maha Sarakham LRA
MKD	: Mukdahan LRA
SKN	: Sakhon Nakhon LRA

## 3) Glossary

Phak	Region
Changwat	Province
Muang	Capital of Province
Amphoe	District
Tambon	Sub-District

Muban	Village
Mac Nam	Large River
Nam	A Medium-size river
Lam	A small river
Kwae	A tributary of a river
Huai	A rivulet

#### 4) Units of Measurements

B	baht
mm	millimeter
cm	centimeter
m	meter
km	kilometer
sq.cm(or cm <sup>2</sup> )	square centimeter
sq.m(or m <sup>2</sup> )	square meter
sq.km(or km <sup>2</sup> )	square kilometer
rai	unit of land measurement = 0.16 ha
, lit	liter
cu.m	cubic meter
cms	cubic meter per second
MCM	million cubic meter
lit/sec	liter per second
m/sec	meter per second
ppm	part per million
pH	potential of hydrogen
EC	electric conductivity
g	gram
kg	kilogram
ton, t	metric ton
sec	second
min	minute
hr	hour

#### 5) Exchange Rate

1US dollar = 25 baht = 110 Yen



## **SUMMARY**



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## **1. INTRODUCTION**

### **1-1. Background of the Study**

The Agricultural Land Reform Office (ALRO) has been undertaking agricultural land reform in accordance with the Agricultural Land Reform Act, B.E 2518 (1975), to enable landless farmers to have their own land for cultivation and to improve their living standards. The implementation of agricultural land reform is categorized as three main activities, namely; "land provision", "land distribution", and "development".

Since 1975, 35.4 million rai of public land and 0.4 million rai of private land were designated as Land Reform Areas (LRAs), and 8.3 million rai have been allocated to about 455,000 households. ALRO intends to distribute at least 1.8 million rai (100,000 household) each year.

As to development, ALRO undertakes infrastructure development such as provision of water resources, roads, small irrigation facilities, etc. as well as income generation and the restructure of agricultural production. Other activities such as agricultural extension and credit, public health, etc. remain the responsibilities of other government agencies, and ALRO plays a coordinating role in this regard. The development of LRAs has been continuing since 1975 though most LRAs are still found in less-developed poor areas.

ALRO recognized the necessity of formulating a master plan for integrated agriculture development in LRAs in order to meet the increasing number of requests for early implementation of the development projects. In the preparation of the master plan, due consideration should be given to actual problems confronted by rural people with different natural and socio-economic backgrounds. In this context, ALRO has decided to implement the study by dividing all LRAs into several regions covering the whole country.

As the initial stage of the implementation of the study, top priority has been given to LRAs in the four provinces of Khon Kaen, Maha Sarakham, Mukdahan and Sakon Nakhon in the Upper Northeastern Region, the poorest region, where about 1.38 million rai (221 thousand ha) of land were transferred to ALRO for the implementation of agricultural land reform.

### **1-2. Objectives of the Study**

The objectives of the Study are:

- 1) To confirm the existing conditions and constraints, to select priority areas (Phase-I), and to conduct a feasibility study for the priority areas in each development category (Phase-II).
- 2) To establish guidelines consisting of Guidelines (1) for classification of the areas into development categories and selection of priority areas, and Guidelines (2) for formulating

a development plan for each category.

- 3) To carry out, in the course of the Study, technology transfer to Thai counterpart personnel concerned.

### **1-3. Rural Development Policy**

The rural development strategies during the implementation of the Eighth National Economic and Social Development Plan (1997-2001) can be identified as follows:

- 1) Strengthening the community for the development of human potential, which will subsequently result in the development of the economy, culture, family and community values of rural people.
- 2) Restructuring agricultural practice so that more options for occupational development are available to farmers while this restructuring can, at the same time, support the conservation and rehabilitation of natural resources and the environment.
- 3) Decentralization program of growth to the regions and rural areas aiming at job creation for, and income distribution to, rural people in the regions and rural areas.
- 4) Development of natural resources and conservation and rehabilitation of the environment as a source of livelihood and well being for rural people in the pertinent regions.

The development plan of LRAs will conform with this policy and will be formulated in consideration of existing conditions of LRAs and farmers' needs.

### **1-4. Agricultural Land Reform**

The implementation of agricultural land reform by ALRO is categorized as three main activities, namely; "land provision", "land distribution", and "development".

#### **1) "Land Provision" and "Land Distribution"**

Since 1975, 35.4 million rai of public land and 0.4 million rai of private land were designated as Land Reform Areas (LRAs). ALRO intends to distribute at least 1.8 million rai (100,000 households) each year.

#### **2) Development**

The development of LRAs by ALRO will be divided into two main activities as shown below:

##### **a) Infrastructure Development:**

Infrastructure development within LRAs by ALRO is carried out by the Engineering

Division and includes provision of water resources, roads, small irrigation facilities, etc.

b) **Income generating activities and restructuring of agricultural production:**

These activities include construction of farm ponds for integrated farming, establishment of cooperatives, etc. and will be mainly carried out by the Land Reform Operation Division and the Land Reform Financing Division.

Other activities such as provision of provincial highways, medium-and large-scale irrigation facilities, agricultural extension, credit, etc. will be implemented by other governmental agencies.

### 1-5. **Role and Responsibility of ALRO**

The Agricultural Land Reform Office (ALRO) has been undertaking agricultural land reform as mentioned above. In the case that development activities to be implemented by other governmental agencies are included in integrated agricultural development projects in LRAs, ALRO will coordinate with the other agencies who have direct responsibility for those activities. Its role as coordinating agency is one of the most important functions of ALRO in developing LRAs.

ALRO currently has 1,184 staff in its central office organized into eight administrative units. The annual budget for fiscal year 1996 is as shown below;

<b>Annual Budget (1996)</b>	
	(million baht)
1. Government Budget	843,200
2. MOAC	74,300
3. ALRO	2,166 (100%)
- Preparation & Administration	605 (28%)
- Land Distribution	872 (40%)
- Infrastructure Development	526 (24%)
- Income Generation, etc.	108 (5%)
- Special Projects	55 (3%)

## **2. THE STUDY AREA**

### **2-1. Field Survey and Data Collection**

In this Study, the existing conditions of each LRA and the development constraints are analyzed based on the results of field survey and social assessment by the Study Team, a Kor Chor Chor Survey carried out once every two years by the National Rural Development Committee, etc.

## 2-2. Population, Land Distribution and Land Use

The Study Area covers 35 LRAs, and its population, number of household, acreage of the Study Area and existing status of land distribution are as follows:

**Population, Number of Household, etc.**

Province	Number of LRAs	Number of Amphoes related	Population	Number of Household	Study Area (rai)	Distributed Area (rai)	Pending Area (rai)
Khon Kaen	6	12	61,400	12,280	268,000	185,000	83,000
Maha Sarakham	10	8	59,500	12,360	219,000	15,000	204,000
Sakhon Nakhon	7	6	129,900	25,980	421,000	416,000	5,000
Mukdahan	12	12	142,100	28,420	479,000	73,000	406,000
Total	35	38	392,900	79,040	1,387,000	689,000	698,000

About 50 % of the Study Area have been distributed to landless farmers. Most of LRAs in Sakhon Nakhon and Mukdahan are not distributed yet due to delay of cadastral survey, check of ownership, etc. Most of LRAs belong to 1 or 2 Amphoes but some LRAs belong to 5 Amphoes. Average land holding is about 20 rai (3.2 ha).

Most LRAs are farm land consisting of paddy field and upland field (cassava, sugarcane, others, etc.) and the land use of each province is summarized below:

**Land Use of the Study Area**

(unit : rai)

Land	Khon Kaen	Maha Sarakham	Sakhon Nakhon	Mukdahan	Total
Paddy Field	40,900	33,310	96,690	103,860	274,760
Upland Field	222,100	181,550	312,670	366,530	1,082,850
- Cassava	151,210	157,410	274,580	205,410	788,610
- Sugarcane	57,740	12,560	17,620	137,600	225,520
- Vegetable, etc.	13,150	11,580	20,470	23,520	67,720
Farm Land (Total)	263,000	214,860	409,360	470,390	1,357,610
Road and Others	4,920	3,750	11,390	8,880	28,940
Grand Total	267,920	218,610	420,750	479,270	1,386,550

## 2-3. Topography and Soil

The Study Area is located mostly in higher locations in the region, such as on the isolated lower hills in Maha Sarakham; at the foot of high ranges in Khon Kaen; and in the high ranges in Mukdahan and Sakhon Nakhon. Consequently, the topography of LRAs in the latter two provinces is steeper than in the others. The fact that there is a few storage dam sites in the Study Area is the most essential factor to prevent development of irrigated agriculture.

Major soils in the Study Area are 5S (Sandy Quartzipammments, Upland 5S = 241,000 rai and Lowland 5S = 54,000 rai), 30L (Loamy Paleaquults, 202,000 rai) and 33L (Loamy Paleustults, 828,000 rai) and those soils cover about 96 % of the Study Area.



## 2-4. Meteorology and Hydrology

The Study Area is in the Asian monsoon zone, which is characterized by a clear classification of climate with a rainy season from May to October and a dry season. Annual rainfall amounts to approximately 1,000 mm - 1,200 mm in Khon Kaen and Maha Sarakham and 1,300 mm - 1,700 mm in Mukdahan and Sakhon Nakhon, of which about 90 per cent falls in the rainy season, and the remainder falls in the dry season without any effect on crop growth. This means that dry season farming is very difficult for the areas not having a storage reservoir. Effective rainfall during the rainy season is estimated to be 700 mm - 900 mm, however, rainfall fluctuates seasonally and yearly, and dry spells are occurred frequently. Therefore, supplementary irrigation is necessary for paddy rices cultivation for its stable and increased production. Runoff coefficients are estimated at 25 - 30 per cent.

Annual mean monthly temperatures vary from 22 in January to 30 in April. Annual evaporation amounts to approximately 1,630 mm - 1,930 mm.

## 2-5. Agriculture and Agricultural Production

### 1) Major Crops and Agricultural Production

The trend of agricultural production in the Study Area is different from that of the areas other than LRAs due to difference of topography, soil condition, status of farm household economy, etc. The major crops cultivated in the Amphoes related to the Study Area are as follows:

**Major Crops cultivated in the Amphoes related to the Study Area** (unit : %)

Province	Paddy	Cassava & Sugarcane	Grassland	Other Crops
Khon Kaen	56 - 81	10 - 37 459	1 - 4	a few fruits, vegetables
Maha Sarakham	68 - 93	2 - 25 248	1 - 2	a few fruits, vegetables
Sakhon Nakhon	42 - 83	2 - 39 233	1 - 5	a few fruit, vegetables
Mukdahan	28 - 65	19 - 52 226	3 - 12	a few fruit, vegetables

Note : Figures in parentheses are planted areas shown in 1,000 ha.

The paddy production is not sufficient for people lived in LRAs but it is easy to buy it from the areas adjacent to the Study Area. Shortage of paddy is estimated at about 34,000 ton. The planted areas and production of major crops in the Study Area are shown below :

### Planted Area and Production of Major Crops in the Study Area

Crops	Planted Area (rai)	Yield (kg/rai)	Production (ton)
Paddy	274,760	245	67,300
Cassava	788,610	2,000	1,577,200
Sugarcane	225,520	8,500	1,916,900

Three major crops in the Study Area, paddy, cassava and sugarcane, are cultivated as mentioned below:

All of rice is the rainy season rice, and glutinous rice production accounts for 80 % of the total rice production and non-glutinous rice production for the rest 20 %. High quality varieties recommended by DOAE such as RD6, RD15, etc. are used in many paddy fields and broadcast sowing recommended for rainfed areas is becoming more popular in the Study Area. The average paddy yields are 160 - 320 kg/rai for the Study Area. The paddy production varies from year to year due to the fluctuation of amount of the annual rainfall. The maximum difference of paddy production over a 4-year period from 1991 to 1994 reaches about 30 %.

Cassava has been cultivated widely in the upland areas of the Study Area, capable of growing on the poorest soils, in drought conditions, easy to cultivate. The cassava cultivated areas tend to decrease gradually under implementation of the program for restructuring agricultural production system aiming at the reduction of cassava field by 15 % of the current level. It will continue to be the main rainfed crop in the upland areas of the Study Area for many years to come, because its profitability per unit acreage is comparable to that of paddy.

Sugarcane is planted on a contract-farming basis and its profit per rai is almost twice as much as the profit obtainable from paddy or cassava cultivation. Sugarcane is only a reliable cash crop in the Study Area as the price is guaranteed by the Government.

## 2) Livestock

Major livestock kept by four provinces concerned constitutes cattle, buffaloes, swine, duck and chicken.

### Major Livestock in Four Provinces

(unit : head)

Province	Beef + Dairy Cattle	Buffaloes	Swine	Ducks	Chickens
Khon Kaen	243,897	151,881	65,826	423,552	2,629,057
Maha Sarakham	161,011	140,481	56,494	234,266	685,482
Sakon Nakhon	116,678	158,517	36,056	230,790	708,634
Mukdahan	57,211	99,844	22,827	70,376	466,862
Total	578,797	550,723	181,203	958,984	4,490,035

The patterns of livestock holding in four provinces concerned indicates that average herds kept per individual farm family are limited to 1 ~ 3 head for cattle and buffalo, 0 ~ 3 head of pig, of which buffalo herds have declined year after year in parallel with the decreasing demand for draught animals substituted by farm machinery, which has been observed throughout Thailand since 1970s. Notwithstanding, in two provinces, i.e.,

Mukdahan and Sakon Nakhon, buffalo herds still outweigh those of cattle.

The quantity of livestock production in the Northeastern Region centered by Khon Kaen has been marking a positive growth for these years, at an annual rate of 5.1% for pork and of 9.7% for beef, meanwhile the increment of herds kept by these provinces has recorded only half of the growth rate as much as that attained by meat production, due mainly to bullish prices of purchased feeds caused by the drop of exchange rate of baht. The increase of the herds of beef cattle has been concentrated only in Khon Kaen, whereas the trends in other three provinces merely indicate leveled-off or slightly increased herds of draught / beef cattle. The limiting factor in the expansion of beef cattle lies in lack of accompanied feed production base and staggered progress in the marketing system for raw meat and milk.

### 3) Sericulture

Sericulture in the four provinces is shown below:

Province	Number of Households	Area of Mulberry Cultivation (rai)	Weft Silk Production (kg)	Cocoon Production (kg)
Khon Kaen	37,882	36,363	152,485	54,517
Maha Sarakham	49,369	44,331	217,047	200
Sakon Nakhon	2,624	2,823	8,715	7,263
Mukdahan	115	1,312	632	32,934
Total	89,990	84,829	379,511	94,914

Sericulture is popular in the Study Area, particularly in Khon Kaen and Maha Sarakham, and provides income from 3,000 to 6,000 baht/year to about 20 % of the farm families lived in the Study Area. The sericulture is well supported by DOAE staff as it is recognized that silk production provides stable income. Silk weaving is popular in Maha Sarakham. Some women living in the Study Area are engaged in the silk weaving and gain an income of about 120 baht a day.

## 2-6. Agricultural and Rural Infrastructure

Because the Study Area is extended over relatively mid-to upstream side of the river basin concerned, existing water resources can hardly be available for LRAs. According to a result of the Study, current irrigation can benefit only 36,700 rai, equivalent to 2.7 % of the entire farmland in the Study Area. Likewise, construction progress of the small-scale farm pond (1,200 m<sup>3</sup>) promoted by MOAC has barely reached 1,500 accounting for only 1.9% of the total farm households. Since gentle slope predominates the topography of the Study Area, sites for reservoirs of suitable size are not easily found, and this difficulty has made farmers relying on traditional rain-fed farming, except for a part of the Study Area.

On the other hand, approximately 8 thousand wells have been drilled as of 1994 as far as groundwater in the Study Area is concerned, but most of the existing wells are used as a source of potable and domestic water, with very few cases utilizing them as the source of

irrigation. As there are few farm roads available to farmers to transport farm inputs, the on-farm development of the minimum extent will be necessary.

Major part of development of rural infrastructure constitutes rural roads, rural electrification and rural water supply. Rural roads consist of provincial highway and village link roads. Although the road network improvement in the Study Area has shown fairly fast progress for national and provincial highways that of village link roads still remains backward. Rural electrification has been completed as a whole within the Study Area, but rural water supply has been retarded; rate of rural water supply exceeded 95% in Khon Kaen and Mukdahan, whereas that in Maha Sarakham and Sakhon Nakhon still remains in around 64%. Besides, as to medical services and sewage water disposal, their level of improvement has remained in lower level than that of the whole country. Therefore, immediate measures for improving these situations are desirable.

## 2-7 Farming Practice

Mainly observed farming types in the Study Area can be classified into five categories comprising 1) paddy monoculture, 2) paddy + upland crops (cassava or sugarcane), 3) paddy + upland crops + beef cattle raising, 4) integrated farming (with a farm pond of small capacity, cultivating vegetables and fruit trees around it, and also breeding livestock) and 5) paddy + forestry. The second and the third categories are dominant in terms of share of farm land and household number. As regards the first category, or paddy monoculture, is run mostly by small holders, while the rest two categories, namely integrated farming and paddy + forestry are rarely found.

In so far as production/farming techniques of crop and animal husbandry are concerned, they still remain in traditional levels mainly because they have so far evolved on the basis of self consumption within farm household. A shift has been observed in the tillage practices for paddy, vegetables and other cereals, from draught power to power tillers on one hand, large sized tractors are being used in the fields of cassava and sugarcane etc., where tillage by draught animal is difficult due to the scale of tract or to soil conditions, on the other. Fertilizer doses are quite limitedly applied, and pest/disease control is seldom practiced except a portion of vegetable and fruit tree fields. All these have entailed in the lower productivity suffered by farmers in this area.

The major components of livestock comprise beef cattle raising, pig breeding and poultry, of which beef cattle is fed mainly with natural grasses in the forest reserve areas and pasture and paddy straw after reaping paddy. Pig breeding farms use rice bran and vegetable chip but a part of them feed blended concentrates. Chickens are as a rule reared in farmyard, but some farmers have employed battery system with concentrate feeds. The cases of presently practiced integrated farming have minor scale, run by very limited number of households, however, lower risk from drought damages and higher rate of improvement in productivity are expected by creating a complex farming including crop and livestock through

recycling of produced resources and diversifying farm management.

## **2-8. Agricultural Extension Services**

Provincial and Amphoe agricultural extension offices under the umbrella of DOAE constitute the major Government organizations responsible for agricultural extension services. The task of DOAE mainly consists of extension services for crop production, for which 742 extension workers have been assigned to cover around 430 thousand farm households in four provinces concerned. Moreover, in terms of particular and closer instruction towards farmers in LRAs, additional services are provided by ALRO network where extension activities are provided through closer collaboration between Training and Development Division of ALRO and PLRO, in close liaison with the provincial agricultural extension office. Aiming at rendering more fruitful dissemination services for grass root farmers, the extension wing has selected leaders for farmers' group capable of taking the leadership among beneficiary farmers, providing them with training for instructors.

With regard to other technical extension activities, particularly the instruction by specialists of fruit trees, sericulture, livestock, inland fisheries and forestry, they have been rendered, though within the limited discipline, through the assistance offered by Government institutes concerned and research organizations at provincial level.

## **2-9. Rural Communities and Organization**

The organizations related to LRAs are roughly classified into the national and provincial administrative organs, legislative and voluntarily/arbitrarily established people's organizations. The former consists of three administrative divisions, namely Amphoe, Tambon located under Amphoe and Muban (village) constituting the bottom of the national and provincial administrative organs. A village committee is the lowest level of the administrative organs. The committee is composed of members by position and members by election. Major functions of the village committee are an assistant to the Phu Yai Ban in development and administration of the village and administrative role at the village level for rural development programs.

The chief of an Amphoe and the governor of a province are assigned and dispatched from MOI, who are responsible for the coordination and cooperation with the schemes implemented by the Government organizations, the implementation of those run by themselves as well as responsible for administrative instruction for subordinate organizations.

While, the latter comprises various cooperatives established through the legislative procedures stipulated in the acts concerned, and voluntarily established organizations such as various farmers' groups as the units of agricultural production activities and water user's associations that manage irrigation water and maintain irrigation facilities, and so forth. Of

these organizations mentioned above, agricultural cooperatives play a role worth mentioning among farmers' activities. They are established at the level of Amphoe, and farmers in the Study Area affiliate with these cooperatives together with the farmers in the existing farmland out of the Study Area. From now onward, strengthening of the existing agricultural cooperatives, currently suffering from slack in their activities, attaches a special importance to allow them to positively perform their services including sales, purchasing and farming loans, in promoting integrated farm management within LRAs.

#### **2-10. Post-Harvest Handling and Marketing**

Rice in the Study Area is usually harvested manually by farmers and dried in the same field for two to three days. Almost all dried paddies are threshed in the field by hired machines with an operator, for immediate sale through local traders after enough has been secured for domestic consumption. Sometimes rice is stored in a farmer's storage bins or houses for timely sale.

Marketing of rice is conducted in the form of paddy at the provincial level and sometimes at the regional level by local traders, middlemen and large-scale rice millers. The marketing of rice is also carried out by agricultural cooperatives and the Bank for Agriculture and Agricultural Cooperatives (BAAC) for their member farmers at the provincial level. Farmers can select a buyer at any time, but, as small-scale farmers have not beneficial marketing route, they sell their produce from the field or at the farm gate for an unreasonably low price.

Harvested cassava is commonly sold immediately to traders or middlemen, not dried nor processed in the Study Area. Sugarcane is generally planted on a contract-farming basis, and is immediately loaded on a truck sent by the owner/contractor after harvested. Other agricultural crops such as vegetables, beans or fruits, livestock or fish are planted or cultivated, but they are generally used for domestic consumption.

#### **2-11. Farming Type and Farm Income**

Farm income of farm families who have a farm land of 20 rai depend on their farming type and are estimated as below:

	Type A		Type B		Type C		Type D1		Type D2		Type E	
	Paddy only		Paddy + Upland crops		Paddy + Cattle raising		Integrated Farming (1)		Integrated Farming (2)		Paddy, + Forest	
	Paddy	rai 20	Paddy Cassava (Sugarcane)	rai 10 10	Paddy Cassava Beef Cattle Chickens	rai 10 10 5 60	Paddy Forest Vegetables Fruits Ponds	rai 10 4.4 1 3 1.6	Paddy Forest Vegetables Ponds Beef Cattle Chickens	rai 10 8 1 1 8 60	Paddy Forest (Eucalyptus)	rai 10 10
Income	16,180		20,930		43,040		59,100		69,460		22,950	
Expend.	9,060		8,970		24,880		29,220		42,700		11,230	
Diff.	7,120		11,960		18,160		29,880		26,760		11,720	

Farming Type B in the above table is typical in the Study Area. The share of this type accounts for more than 50 % of all farm households. Beef cattle raising included in Type C have recently been promoted and about 30 % of all farm households are engaged in this farming type. Farm income from these types is estimated at 12,000 to 18,000 baht/year, equivalent to only one third of the total annual household income that comes to 40,000 to 52,000 baht/year including non-farm income amounting to 28,000 to 34,000 baht/year. This level of annual income indicates more or less the same one as the poverty line equivalent to 48,000 baht/year per household consisting of five members. However, about 40 % of the farm population in the Study Area do not gain any income during the dry season, so it is most probable that their actual farm household income remains below the poverty line.

## 2-12. Agricultural Credit

### 1) Kor Por Lor Fund

In 1994, the Government started the Kor Por Lor Fund, which is a restructuring program for agricultural production. The program targets on four crops: paddy cropped on poor grade field and unsuitable field, cassava, coffee, and pepper in order to reduce the acreage under these crops and to encourage conversion into more profitable and stable crops.

The basic guidelines are to promote the restructuring of agricultural production by providing a long-term loan with a low interest rate of 5% for 15 years to farmers who apply for Kor Por Lor. In the Study Area, some progressive farmers have practiced pig breeding, poultry and beef cattle raising by securing agricultural water in the farm ponds constructed by loans borrowed from Kor Por Lor fund.

### 2) ALRO Fund

ALRO also has its own fund for improving the agricultural situation in LRAs. It has provided deep wells of 59 Nos., forest trees plantation of 1,900 rai, farm pond excavation of 0.9 million cubic meters, and various training programs for farmers in LRAs in four provinces in 1996. These programs are free to farmers who applied for ALRO funds.

### **3) The Bank for Agriculture and Agricultural Cooperatives**

The Bank for Agriculture and Agricultural Cooperatives (BAAC) plays a key role in lending money to farmers. Total disbursement has reached 112,539 million baht as of fiscal year 1995, from which 4.65 million farm families, that is, 82 per cent of all farm households have borrowed money. The Bank lends money at a basic interest rate of 11 % to individual clients and at a basic interest rate of 9% to agricultural cooperatives and farmers' associations. In the four provinces related to the Study, the Bank lends 7,000 million baht to about 360,000 farm households. A loan per farm household amounts to 15,000 through 30,000 baht, and an average is about 20,000 baht.

### **2-13. Environmental Conditions**

An Initial Environmental Examination (IEE) is carried out to clarify the outline of the environmental impact of project implementation. It is judged that development projects will not bring negative impact to the natural environment as they are small-scale in the farmland.

### **2-14. Development Constraints and Factors affecting Development Plan**

Based on the filed survey, the development constraints, which can be commonly encountered in LRAs, and factors affecting development plan for each LRA are summarized as shown below:

#### **1) Development Constraints**

##### **a) Natural Constraints**

- Low productivity due to infertile soil
- The Study Area is characterized by a clear classification of climate with a rainy season and a dry season. About 90 % of annual rainfall fall in the rainy season. Even in the rainy season, dry days are frequent. Therefore, the dry season farming is generally impossible and supplementary irrigation is necessary for stable and increased production of major rice.
- Difficulty in securing water resources for irrigation due to lack of sufficient reservoir sites, etc.
- Groundwater resources are limited.

##### **b) Agro-economic Constraints**

- LRAs of more than 70 % of the Study Area have not a paddy field or have insufficient production of paddy for demand of such LRAs.
- Because of declining prices for major crops in the Study Area such as cassava, paddy,



etc., most farmers have a low income from agriculture. The restructure of agricultural production will be recommended to focus on growing crops of high value selected to suit available labour force, farmers' crop technology, demand, etc. Many of farm families earn farm household income of about 48,000 baht/year composed of farm income equivalent to 1/3 of total income and non-farm income equivalent to 2/3 of total income. Their incomes are much the same as the poverty for five person household.

#### c) Institutional Constraints

- The lands distributed to farmers are considerably small in many cases.
- Development to match the progress of the land distribution is expected, but , a target for LRAs development and budgetary allocation seems not to have been defined yet.
- The role and responsibility of ALRO in implementing integrated agricultural development in LRAs are limited. Therefore, ALRO should cooperate with the other agencies that have direct responsibility for the activities included in the development and should provide budget for such activities if necessary.
- In order to increase poor farmers' income and productivity, it will be necessary to provide sufficient supporting services and loans with low interest for such farmers.
- Farmers' organizations are too weak to spread the technology of new crops.

#### 2) Factors affecting Development Plan of each LRA

The factors affecting development plan of each LRA are summarized in the following table based on the analysis of existing condition of the Study Area.

Factors affecting Development Plan of Each LRA

LRA	Farmland (rai)	Buffer Zone	Economic Zone	Ratio of Cassava Field	Paddy Sufficiency	Paddy (%)	Cassava (%)	Sugarcane (%)	Other Crops (%)	Development Level	Income Level	Average Level	Paddy Productivity	Upland Crop Productivity	Area Slope ≤2% (%)	Area Slope ≥5% (%)	Potential Irrig. Area (ha)	Ratio Irrig. Area	Land Holding (rai)	Household (H.H) (Nos.)	Population	Buffaloes (head/H.H)	Cattle (head/H.H)	Power Tillers (Nos./H.H)	Pumps (Nos./H.H)	Lowland Type Soil (%)	Upland Type Soil (%)	Gravelly Soil (%)	Paddy Field/Lowland Soil	
KK-1	65,560		⊙	76.9%	65.9%	17.0%	60.1%	18.0%	4.9%	2.0	3.0	2.5	1.4	1.2	61.6%	1.7%	8,140	12.4%	20	3,382	16,910	0.89	2.17	0.28	0.15	6.5%	93.5%	0.0%	2.54	
KK-2	13,940		⊙	61.9%	38.6%	12.1%	51.1%	31.5%	5.2%	2.0	3.0	2.5	1.3	1.3	59.3%	0.0%	740	5.3%	16	875	4,380	0.79	1.25	0.37	0.29	42.0%	58.0%	0.0%	0.28	
KK-3	17,910		⊙	63.9%	112.5%	25.1%	45.0%	25.5%	4.4%	2.0	2.0	2.0	1.3	2.3	19.7%	0.0%	1,140	6.4%	23	800	4,000	1.13	2.14	0.40	0.16	50.0%	50.0%	0.0%	0.49	
KK-4	11,490		⊙	29.9%	20.7%	6.5%	26.2%	61.7%	5.6%	3.0	3.0	3.0	1.4	1.5	35.0%	5.0%	690	6.0%	16	724	3,620	0.76	0.88	0.28	0.27	30.0%	70.0%	0.0%	0.21	
KK-5	6,180		⊙	23.1%	56.3%	15.2%	18.4%	61.3%	5.0%	3.0	3.0	3.0	1.2	1.0	7.8%	0.0%	0	0.0%	19	335	1,670	0.59	1.22	0.58	0.26	50.0%	50.0%	0.0%	0.30	
KK-6	147,920		⊙	78.0%	70.9%	14.8%	62.5%	17.6%	5.0%	1.0	2.0	1.5	1.2	1.3	31.6%	0.0%	4,810	3.3%	24	6,167	30,830	1.08	1.65	0.35	0.15	27.0%	73.0%	0.0%	0.54	
MHS-1	2,640		⊙	94.0%	0.0%	0.0%	88.3%	5.7%	6.1%	1.0	1.0	1.0	1.0	1.0	5.0%	0.0%	20	0.8%	6	436	2,180	0.82	0.77	0.29	0.04	100.0%	0.0%	0.0%	0.00	
MHS-2	59,680		⊙	89.6%	0.0%	0.0%	84.2%	9.8%	6.0%	3.0	1.0	2.0	1.6	1.1	6.3%	6.7%	270	0.5%	21	2,877	14,380	0.76	2.93	0.43	0.23	5.5%	94.5%	0.0%	0.00	
MHS-3	3,080		⊙	94.1%	0.0%	0.0%	88.6%	5.5%	5.8%	3.0	2.0	2.5	1.4	1.0	49.9%	0.0%	0	0.0%	8	363	1,810	1.09	1.40	0.25	0.13	2.6%	97.4%	0.0%	0.00	
MHS-4	9,510		⊙	94.7%	0.0%	0.0%	89.1%	4.9%	6.0%	3.0	2.0	2.5	1.8	1.0	39.9%	0.0%	0	0.0%	17	559	2,800	1.13	1.41	0.25	0.12	10.0%	90.0%	0.0%	0.00	
MHS-5	14,600		⊙	71.9%	113.8%	45.8%	33.0%	12.9%	8.3%	2.0	1.0	1.5	1.2	1.5	14.3%	0.0%	340	2.3%	12	1,611	5,880	1.43	1.44	0.27	0.09	10.0%	90.0%	0.0%	3.68	
MHS-6	29,660		⊙	88.6%	140.2%	27.4%	60.5%	7.8%	4.3%	3.0	3.0	3.0	1.3	1.6	47.0%	3.0%	650	2.2%	25	1,158	5,790	1.58	1.34	0.29	0.15	24.0%	76.0%	0.0%	1.13	
MHS-7	10,940		⊙	98.6%	202.3%	71.4%	26.5%	0.4%	1.7%	2.0	3.0	2.5	1.5	1.4	75.0%	0.0%	0	0.0%	14	772	3,860	1.39	1.47	0.23	0.05	10.0%	90.0%	0.0%	7.13	
MHS-8	79,610		⊙	97.8%	50.2%	12.6%	80.3%	1.8%	5.2%	2.0	2.0	2.0	1.6	1.2	7.9%	8.9%	820	1.0%	20	4,007	20,040	1.28	1.93	0.35	0.07	5.5%	94.5%	0.0%	2.30	
MHS-9	310		⊙	93.1%	0.0%	0.0%	87.1%	6.5%	6.5%	2.0	3.0	2.5	1.4	1.4	0.0%	0.0%	0	0.0%	19	16	80	1.47	1.44	0.38	0.19	6.5%	93.5%	0.0%	0.00	
MHS-10	4,830		⊙	93.9%	23.5%	13.0%	76.8%	5.0%	5.2%	2.0	3.0	2.5	1.1	1.0	40.0%	0.0%	0	0.0%	9	535	2,680	0.82	0.77	0.29	0.04	100.0%	0.0%	0.0%	0.13	
SKN-1	22,560		⊙	91.4%	53.2%	12.5%	74.8%	7.0%	5.7%	1.0	3.0	2.0	2.5	1.0	50.0%	0.0%	1,170	5.2%	22	1,055	5,280	1.05	0.83	0.41	0.08	0.0%	100.0%	0.0%	-	
SKN-2	43,260		⊙	68.2%	184.1%	36.0%	40.8%	19.0%	4.2%	1.0	1.0	1.0	2.0	1.1	95.1%	0.0%	2,550	5.9%	26	1,689	8,450	0.91	0.76	0.40	0.12	25.0%	75.0%	0.0%	1.43	
SKN-3	118,470	⊙	⊙	96.0%	51.1%	23.4%	68.8%	2.9%	5.0%	1.0	2.0	1.5	1.7	1.2	66.6%	5.1%	15,460	13.0%	11	10,810	51,200	1.19	1.14	0.28	0.11	43.2%	56.8%	0.0%	0.53	
SKN-4	85,530	⊙	⊙	97.6%	100.5%	25.6%	67.9%	1.7%	4.9%	2.0	2.0	2.0	2.1	1.2	51.7%	0.0%	410	0.5%	20	4,354	21,770	1.19	0.80	0.28	0.12	50.0%	50.0%	0.0%	0.51	
SKN-5	81,890	⊙	⊙	97.9%	11.4%	3.9%	87.9%	1.9%	6.3%	1.0	1.0	1.0	2.1	1.0	9.8%	29.3%	10,500	12.8%	16	5,595	27,980	0.92	0.77	0.28	0.12	0.0%	97.2%	2.8%	-	
SKN-6	44,540	⊙	⊙	93.0%	221.5%	50.4%	43.1%	3.3%	3.3%	2.0	1.0	1.5	2.0	1.0	54.2%	18.1%	330	0.7%	22	2,026	10,130	1.69	1.56	0.26	0.14	53.4%	22.4%	24.2%	0.93	
SKN-7	13,200		⊙	100.0%	147.2%	23.6%	71.4%	0.0%	5.0%	1.0	1.0	1.0	2.0	1.0	70.0%	0.0%	1,000	7.6%	31	423	2,120	1.47	1.00	0.36	0.15	0.0%	100.0%	0.0%	-	
MKD-1	102,760	⊙	⊙	57.3%	77.4%	23.1%	41.2%	30.7%	4.9%	2.0	2.0	2.0	1.6	1.4	44.6%	10.5%	4,080	4.0%	17	6,136	30,680	2.79	1.29	0.18	0.14	25.0%	65.0%	10.0%	0.92	
MKD-2	74,900	⊙	⊙	57.7%	36.2%	10.9%	48.1%	35.3%	5.7%	2.0	1.0	1.5	1.4	1.4	38.8%	3.7%	5,270	7.0%	17	4,493	22,460	2.12	1.40	0.24	0.15	0.0%	100.0%	0.0%	-	
MKD-3	104,180	⊙	⊙	40.3%	101.0%	31.1%	26.0%	38.5%	4.4%	1.0	1.0	1.0	1.4	1.5	86.7%	3.2%	5,250	5.0%	17	6,407	32,040	1.73	1.20	0.23	0.16	0.0%	95.0%	5.0%	-	
MKD-4	1,760	⊙	⊙	77.9%	47.3%	14.8%	61.9%	17.6%	5.7%	1.0	1.0	1.0	1.3	3.0	0.0%	36.6%	610	34.7%	17	110	550	1.60	1.61	0.30	0.15	0.0%	65.1%	34.9%	-	
MKD-5	6,020	⊙	⊙	76.0%	69.8%	20.8%	56.3%	17.8%	5.1%	3.0	1.0	2.0	2.1	1.7	0.0%	28.9%	640	10.6%	17	357	1,790	1.66	1.80	0.26	0.13	0.0%	70.0%	30.0%	-	
MKD-6	710	⊙	⊙	75.4%	28.6%	8.5%	64.8%	21.1%	5.6%	3.0	1.0	2.0	2.2	1.8	0.0%	42.0%	0	0.0%	17	41	210	1.66	1.80	0.26	0.13	0.0%	70.0%	30.0%	-	
MKD-7	44,890	⊙	⊙	86.9%	145.6%	45.2%	44.6%	6.7%	3.5%	3.0	3.0	3.0	2.1	1.6	15.9%	17.3%	6,840	15.2%	17	2,786	13,930	1.62	1.50	0.23	0.11	45.0%	45.0%	10.0%	0.96	
MKD-8	57,040	⊙	⊙	80.6%	40.6%	12.3%	66.2%	15.9%	5.6%	1.0	1.0	1.0	1.4	1.5	18.6%	8.7%	16,140	28.3%	17	3,453	17,260	0.91	0.78	0.17	0.04	0.0%	90.8%	9.2%	-	
MKD-9	52,040	⊙	⊙	47.4%	53.3%	15.9%	37.3%	41.4%	5.4%	1.0	3.0	2.0	1.1	1.2	57.8%	9.5%	2,780	5.3%	17	3,055	15,470	3.16	1.32	0.18	0.16	0.0%	95.5%	4.5%	-	
MKD-10	1,180	⊙	⊙	80.4%	180.0%	53.4%	34.7%	8.5%	3.4%	3.0	3.0	3.0	1.5	1.5	99.5%	0.0%	510	43.2%	17	70	350	0.91	0.78	0.17	0.04	0.0%	100.0%	0.0%	-	
MKD-11	13,430	⊙	⊙	80.6%	47.2%	14.0%	64.9%	15.6%	5.5%	2.0	2.0	2.0	1.6	1.6	46.1%	9.8%	2,720	20.3%	17	796	3,980	0.91	0.78	0.17	0.04	0.0%	100.0%	0.0%	-	
MKD-12	11,480	⊙	⊙	80.6%	0.0%	0.0%	75.4%	18.1%	6.4%	1.0	1.0	1.0	1.5	1.0	0.0%	11.3%	4,500	39.2%	17	680	3,400	0.91	0.78	0.17	0.04	0.0%	90.0%	10.0%	-	
KK	263,000	0	6	72.4%	66.6%	15.1%	43.9%	35.9%	5.0%	2.17	2.67	2.42	1.30	1.43	39.4%	0.7%	15,520	5.9%	19.7	12,283	61,410	0.87	1.55	0.38	0.21	34.3%	65.8%	0.0%	0.61	
MHS	214,860	0	10	92.6%	56.0%	17.0%	71.4%	6.0%	5.5%	2.30	2.10	2.20	1.39	1.22	19.3%	5.5%	2,100	1.0%	15.1	12,364	59,500	1.18	1.49	0.31	0.11	27.4%	72.6%	0.0%	1.27	
SKN	409,360	4	6	94.0%	74.4%	25.1%	65.0%	5.1%	4.9%	1.29	1.57	1.43	2.06	1.07	52.3%	9.6%	31,420	7.7%	21.1	25,982	129,930	1.20	0.98	0.32	0.12	24.5%	71.6%	3.9%	0.74	
MKD	470,390	12	2	59.9%	73.1%	20.8%	51.8%	22.3%	5.1%	1.92	1.67	1.79	1.60	1.60	46.8%	8.5%	49,340	10.5%	17.0	28,424	142,120	1.66	1.25	0.21	0.11	5.8%	82.2%	12.0%	2.21	
Total	1,357,610	16	24																											
Average	38,789			77.8%	69.9%	19.6%	58.7%	16.5%	5.2%	1.94	1.94	1.94	1.58	1.36	37.3%	7.4%	2,811	8.5%	17.7	2,259	11,227	1.30	1.32	0.29	0.13	20.6%	74.5%	4.9%	0.95	
S.Deviation	39,053			19.7%	61.5%	16.9%	20.5%	15.7%	1.1%	0.79	0.86	0.67	0.37	0.40	28.6%	11.0%	4,108	11.3%	4.9	2,439	12,219	0.55	0.49	0.09	0.06	26.8%	26.8%	9.6%	1.61	
Variation	1.01			0.25	0.88	0.86	0.35	0.95	0.22	0.26	0.29	0.22	0.12	0.13	0.77	1.48		1.32	0.28	1.08	1.09	0.42	0.37	0.31	0.50	1.30	0.36	1.96	1.69	
Weight				0.153	0.430	0.033	0.120	0.026	0.001						0.107	0.008		0.010								0.055	0.200	0.005		

Note: \*1): Ratio = Cassava Field / (Cassava Field + Sugarcane Field), \*2): Average Level = (Development Level + Income Level)/2  
 Variation = Standard Deviation/Average but Standard Deviation/3 for Development Level, Income Level, Average Level, Paddy Productivity and Upland Crop Productivity  
 Weight = Average \* Standard Deviation (only items expressed in %)



### 3. DEVELOPMENT STRATEGIES

#### 3-1. National Agricultural Development Policy

The average growth target for the agricultural sector under the implementation of the 8th Plan has been set at 2.9% per annum. Concerning the 8th Plan, the main objectives of agricultural development can be summarized as follows:

- To maintain the capacity for competitiveness of agricultural commodities in the world market through advance in production efficiency, improving the quality of produce to satisfy market demand.
- To conserve natural resources through sustainable development without destruction of natural resources and the environment.
- To develop and strengthen human resources and farmers' organizations, and to upgrade their standard of living leading to better quality of life.

#### 3-2. Provincial Development Policy

Considering the geographic location, natural resources and development potential of the provinces involved, the strategies for the provincial development plan for the four provinces in the Study Area during the implementation of the 8th Plan can be summarized as follows:

**Strategies of Provincial Development Plan**

Items	Khon Kaen	Maha Sarakham	Sakhon Nakhon	Mukdahan
Policy for Vocational Training, etc.	- People's participation in development activities - Increase of capability of government officials	- Expansion of educational opportunities - Promotion of technical college for technician	- Development as a center of education including the establishment of vocational training center	- Development as an education center and expansion of skilled labor training institute
Agricultural Development Policy, etc.	- Development of domestic and agricultural water resources - Expansion of marketing and opportunity of employment	- Promotion of production of livestock, poultry, crops for agro-processing and fast growing trees	- Development of a small scale agro-industry and modern agriculture	- Encouragement of agricultural water resource - Increase of non-farm employment - Development of freshwater fisheries
Development Policy peculiar to each Province	- Increase of the security through formulation and implementation of accelerated comprehensive development projects - Eradication of narcotics	- Promotion of cottage industries - Upgrade of local industries - Development of tourism	- Conservation of natural resources and the environment - Development of tourism	- Development as a center of a communication system linked with Indochinese countries - Development of tourism

#### 3-3. Farmers' Needs

According to the social assessment results, it is confirmed that the majority of farmers are interested in changing cropping pattern from monoculture to integrated farming. For successful practice of the integrated farming, farmers' expectations of governmental agencies regarding both rice farming and upland crop farming are as follows in order of high priority.

- a) Water for agriculture
- b) Improvement of soil fertility
- c) Application of high yielding varieties
- d) Market demand of products and maintaining stable/good price
- e) Providing loans or credit

### **3-4. Development Strategies**

The development strategies can be summarized as follows :

- 1) Promoting introduction of integrated farming, livestock breeding, fruit trees cultivation, plantation of fast growing trees in both rainfed and irrigated areas and diversified cropping in irrigated areas. Implementation of agricultural infrastructure development projects to make such farming practices possible according to farmers' request. These projects include construction of farm ponds, well, farm roads, water resources facilities, irrigation facilities, etc.
- 2) Provision of training course of progressive farmers required for successful implementation of 1) above, including training for crop production, training for providing support to farmers in forming, managing and strengthening farmers' organizations, training for environmental coservation, etc.  
In addition, necessary low interest loans should be provided for farmers who intend to practice agricultural production activities mentioned in 1) above.
- 3) In addition to 1) and 2) above, training for cloth weaving, dyeing, small-scale agro-processing, sewing, etc. should be provided under systematic and effective collaboration among various relevant agencies, i.e. ALRO, DOAE, the Department of Industrial Promotion, etc. if necessary.
- 4) Providing rural infrastructure.

## **4. BASIC DEVELOPMENT PLAN**

### **4-1. Framework of Basic Development Plan**

The basic development plan of this Study is formulated herewith to pay due attention to improvement of land productivity and restructuring of agricultural production for the allotted farmland to hitherto land-less farmers in the Study Area through the Agricultural

Land Reform Act, with a view to provide agricultural infrastructure and necessary support for them and thus trying to stabilize their living standard. To this end, current status of farming and development constraints should be made clear, and these should be due reflected in the plan so as to make it sustainable. The basic development plan consists of the followings :

- Land use and agricultural development plan
- Promotion of livestock, inland fisheries and sericulture
- Agricultural infrastructure development plan
- Agricultural extension services
- Employment promotion
- Strengthening of people's organization
- Rural infrastructure development plan
- Supporting services for marketing and farmers' supporting fund
- Plan justification
- Project implementation program

#### **4- 2. Land Use and Agricultural Development Plans**

##### **1) Land Use Plan**

The land use plan is proposed as follows taking account of current land use pattern, pedological conditions, farm production and demand for farm products and for home-consumption etc.:

- Land use in paddy fields is proposed to concentrate on major paddy cultivation, sustaining current land use pattern but with improved productivity in order to meet demand for home consumption.
- Land use in sugarcane fields is proposed to rotate with three-year term followed by other upland crops such as leguminous ones in order to prevent land degradation and to sustain crop productivity. The planned area under cane is projected to maintain the current acreage taking on-going contract system into consideration.
- Land use in the tracts of cassava should be diversified into upland crop production with vegetable, fruit trees, grass pasture (or feed crops) and area for afforestation.

##### **2) Agricultural Development Plan**

###### **a) Cropping Plan**

- **Paddy** : regarding dietary habit in LRAs, a cropping proportion between glutinous and non-glutinous paddy is proposed at around 8 : 2, with due effort to improve rainfed yield by employing HYVs.
- **Sugarcane** : currently employed pattern should be basically sustained, but pursuance of a perfect rotation with other crops so as to prevent drop of yield levels is necessary.

- Cassava : except cassava field for which crop conversion is recommended, acreage under cassava can be sustained for effective use of land resources and to supplement animal feeds that often fall short of requirement.
- Vegetables : provided that water is secured for irrigation, a year round cropping of sweet corn, baby corn, watermelon, tomato, cucumber, and chili, Chinese kale, string bean, eggplant, Chinese morning glory, etc. is possible. It is proposed to formulate a cropping plan and supporting services for the production of perishable vegetables and those for processing taking local conditions and marketing situations into account.
- Fruit Trees : given the conditions of lack of regularly supplied irrigation water, it is proposed to employ species with deeper root zone and those which can be cultivated under the climate of the Study Area, such as mango, tamarind, guava, jackfruit, banana and papaya. In particular, mango and tamarind have promising outlet also as processing material in addition to fresh fruit consumption.

#### b) Livestock Promotion

- beef cattle for fattening and buffaloes :  
it is proposed that each farm household should keep at least 2 ~ 5 head of beef cattle for fattening regularly fed with rice straw, cassava, concentrates and pastured in woodland so as to gain cash income. Besides, buffaloes should be kept as draught animals.
- Piggery, poultry etc.:  
as limited scale for home consumption, current form of husbandry as farm-yard feeding with self supplied feeds is good enough, but for expanding husbandry scale it is required to employ battery, cage houses and to secure marketing outlet for the products.

#### c) Sericulture and Fishery Promotion

- Sericulture Promotion :  
together with the inheritance of traditional production of silk textile commonly observed in the Northeastern Region, sericulture should be sustained as a source of additional income for farm households. It is proposed to introduce HYV mulberry varieties that are recommended by DOAE, coupled with a conversion of silk worm varieties from traditional to improved ones so that both cocoon yield and quality can be ameliorated.
- Fishery Promotion :  
making use of existing reservoirs, swamps and regulating ponds for irrigation, it is proposed to culture Tilapia and carps to procure animal protein for home consumption and to sell the surplus in the market to obtain additional farm income.

d) Afforestation Promotion

- For the purpose of conserving forest reserve areas, it is proposed to promote the use of LRAs with buffer zone and economic forest for the production of bamboo shoot and bamboo wood, log wood of acacia and eucalyptus under a contract with forestry product enterprises, as well to utilize them as the place for pasturing area for cattle.
- It is advised to create community forests under a joint management of population living in the area concerned, to conserve natural environment as well to supply routine fuel wood through well-planned felling of planted trees.

4-3. Agricultural Infrastructure Development Plan

1) Water Resources Development

- As a result of the Study on the development feasibility for water resources as a base of agricultural development in the Study Area, it was found that irrigation has been practiced through reservoirs and pumps, though their sizes are small, covering 36,730 rai in 19 LRAs out of 35, and it is proposed to continue to use them.
- 15 LRAs out of 19 LRAs as stated above, it is planned to expand irrigated area through the development of additional water sources as well as by repairing existing facilities. Besides, it is planned to irrigate additional 14 LRAs without existing irrigation scheme through construction of reservoirs and pumps, covering about 61,650 rai.
- It follows that around 98,400 rai will be irrigated by surface water with existing water resources (46 MCM) and newly planned ones (59 MCM). The following gives the outline:

Potential Development of Surface Water Resources

Development Stage	Reservoirs			Rehabilitation	Pump Irrigation	Total	Irrigation Area	Ratio of Irrig. Area
	MSIPs	SSIPs	Total					
Present Irrigation Projects	5	39	44	-	2	46	36,730 rai 5,880 ha	2.7 %
Potential Development	15	95	110	39	14	163	61,650 rai 9,860 ha	4.5 %
- Conservation Forest	(7) *	(18) *	(25) *					
- Economic Forest	(4)	(38)	(42)					
- LRAs	(4)	(39)	(43)					
Total	20	134	154	39	16	209	98,380 rai 15,740 ha	7.2 %

(Note) \*: Some of surface of other reservoirs extends into the area of conservation forests.

2) On-Farm Development

a) Water resources development through farm ponds

- Currently available water resources of small and medium scale can irrigate only 7% of the whole agricultural land within the Study Area, as cited elsewhere.
- Introduction of an intensive and highly beneficial agriculture is expected in order to



accomplish successful conversion of upland crops oriented by national policy and stable, sound farm economy. To this end an irrigated farming focused on crop production in the dry season is planned by providing farm ponds storing rain-water within the allotted fields as far as land use allows the construction thereof. The scale of the proposed farm ponds ranges from 1,200 m<sup>3</sup> as specified in the context of the government subsidy to larger size than the standard 1,200 m<sup>3</sup> up to 6,000 m<sup>3</sup> according to the willingness of individual farm households. Farmers as a rule utilize farm credits applied by themselves for the provision of unsubsidized farm ponds.

- The planned framework as mentioned above can be tabulated as follows;

**Standard Criteria of On-farm Development**

Land Categories		Irrigation	Major Crops	On-farm Development	Major On-farm Facilities
Reservoir Dependent Land (7.2% of total area)		Extensive (Basin Irrigation)	Rice	Intensive	- On-farm roads - Irrigation ditches (along owner boundary)
		Extensive (Furrow Irrigation)	Sugarcane	Intensive	- On-farm roads - Small regulating ponds - Irrigation ditches (along owner boundary)
		Intensive (Micro Irrigation)	Fruit Tree Vegetables	Intensive	- On-farm roads - Small regulating ponds - Pipeline - Micro irrigation
Rainfed or Farm Pond Dependent Land (92.8 % of total area)	Rainfed Area	none	Rice (rainfed) Sugarcane (rainfed) Cassava Fast growing trees	Extensive	- Main farm roads - On-farm roads (only where integrated farming carried out) - Contour ditches
	Farm pond dependent Area	Intensive (Bucket Irrigation) or (Hose Irrigation)	Vegetables	Intensive	- Small farm ponds (1,200 m <sup>3</sup> ) - On-farm roads
	(Integrated Farming)	Intensive (Hose Irrigation) or (Micro Irrigation)	Fruit Tree Vegetables	Intensive	- Larger farm ponds (6,000 m <sup>3</sup> ) - On-farm roads - (Micro irrigation)

#### b) Farm Road Construction

- Main and lateral farm roads are designed as paved with laterite, the effective width of which is 4 m (the total width reaching 6 m), and they are laid in a way to connect to existing provincial highways, village link roads and on-farm roads.
- On-farm roads are designed at 2 m as an effective width (the total width reaching 4 m), and they are laid so that as many roads as possible run along the side of farm blocks.
- As a principle, main and lateral roads are provided and financed by ARLO, while on-farm roads are provided by the beneficiary farm households.

#### c) Soil Conservation

- With a view to preventing loss of fertility of the improved soils and of surface layers by sheet erosion, as well to conserving soils on the slope steeper than 5% (accounting for 7% of the entire area), it is recommended to construct contour ditches and to practice cropping along contour, thus aiming at efficient farm land conservation.

#### 4-4. Farming Plan

##### 1) Basic concept of farming plan

The land found in the Study Area can be classified into three topographic categories, i.e., area predominated by paddy field, upland area and area with steep slope. In all these areas, integrated farming should be introduced, comprising vegetables, orchard fruit trees, poultry and fish farming. In particular, livestock, fruit trees planting and plantation of fast growing trees constitutes the skeleton of this integrated farming, while another component, agro-forestry should be introduced in the area with steep slope. Even in the irrigated areas, integrated farming should play a key role, accompanying with the plan of supplemental irrigation during the rainy season for paddy, vegetables and orchard trees. Besides, in the LRAs where more water can be secured than to meet this water demand during the rainy season, not only vegetables and fruit trees but also soybeans and maize are planned for more drastic reduction of acreage under cassava. When the integrated farming is employed, the more farm income can be expected from a farm with the more irrigated acreage under vegetables that enables more intensive farming. However, a standard area 1 rai is taken as the unit of vegetable field that can be covered with a farm pond capable of storing 1,200 m<sup>3</sup> of water and that can be constructed within the amount of government subsidy. In this context, 60 ~ 70% of the entire households in the Study Area, including those in the existing irrigation schemes, will be able to practice integrated farming. From the self-supplied farm labor point of view, the size of irrigated field per farm household can be expanded up to about 4 rai (equivalent to the capacity of a farm pond of 6,000 m<sup>3</sup>).

##### 2) Farming Type

The twelve types of farming (A - L) as shown in the following table are planned according to three types of topography classified above.

**Recommendable Farming Type**

Type	Main	Secondary		
A	Paddy(12 rai)	I/F(V:1rai, F:5 rai)		
B	Paddy(12 rai)	I/F(V:1rai, F:2 rai)	Livestock(3 rai)	
C	Paddy(7 rai)	I/F(V:1rai, F:2 rai)	Upland Crop(5 rai)	Livestock(3 rai)
D	Upland Crop(15 rai)	I/F(V:1rai, F:2 rai)		
E	Upland Crop(12 rai)	I/F(V:1rai, F:2 rai)	Livestock(3 rai)	
F	Upland Crop(10 rai)	I/F(V:1rai, F:2 rai)	Livestock(3 rai)	Fast Growing tree(2 rai)
G	Upland Crop(13 rai)	I/F(V:1rai, F:2 rai)		Fast Growing tree(2 rai)
H	Rubber Tree(10 rai)	I/F(V:1rai, F:2 rai)	Upland Crop(5 rai)	
I	Agroforestry(10 rai)	Rice(5 rai)	Upland Crop(5 rai)	
J	Agroforestry(15 rai)	Livestock(5 rai)		
K	Fast Growing Tree(15 )	Fruit Tree(5 rai)		
L	Ecological Farming(15 )	I/F(V:1rai, F:2 rai)		

Note: For integrated farming, 1 rai for farm pond and 1rai for house, etc. is necessary.

I/F : integrated farming, V : vegetable, F : fruit tree

##### 3) Application of Farming Type

The farming types as defined above are applied to the LRAs distributed in three topographic categories, based on an application criterion that was prepared regarding such

factors as presence or absence of buffer zone and paddy field. Areas with higher priority put on livestock are confined to all those belonging to Khon Kaen where a large scale livestock market is located and to Maha Sarakham where the provincial development policy has been set to enhance livestock, as well to those where number of cattle head kept per farm household exceeds the average level of cattle holding within the Study Area. The basic application criterion of the farming types is summarized as follows:

- Types A and B are applied to the LRAs where paddy predominates, but Type C is also applied in Khon Kaen and Maha Sarakham where paddy and upland fields are co-existing owing to topographic reason,
- Types D, E, F and G are applied to upland areas without any buffer zone, while Types H and I are added to those accompanying with buffer zone,
- more Types B and E, including livestock component, are applied to those where higher priority is attached to livestock than those without priority on livestock,
- Higher application of Type L, including ecological farming, is made to LRAs with steep slope accompanying with buffer zone.

The following table shows the result of farming type application to all LRAs. Types more frequently applied are Types D and E in upland areas, and Types A and B in those predominated with paddy field. Given that 60% of the land within LRAs is available to projected development plan, the proposed project will be able to reduce cassava field to about two-thirds of the current level.

**Results of Farming Type Application**

Type	Paddy Prevailing Area	Upland Crop Prevailing Area	Steeply Sloped Area	Total
A	11.3%	-	-	11.3%(6.8%)
B	13.5%	-	-	13.5%(8.1%)
C	1.5%	-	-	1.5%(0.9%)
D	-	25.4%	-	25.4%(15.2%)
E	-	31.1%	-	31.1%(18.6%)
F	-	3.3%	-	3.3%(2.0%)
G	-	3.3%	-	3.3%(2.0%)
H	-	1.80%	-	1.8%(1.1%)
I	-	1.8%	0.4%	2.2%(1.3%)
J	-	-	1.8%	1.8%(1.1%)
K	-	-	1.8%	1.8%(1.1%)
L	-	-	3.0%	3.0%(1.8%)
Total	26.3%	66.7%	7.0%	100.0%(60%)

Note: Figures in parentheses are application rate in case that 60 % of the Study Area are developed.

#### 4-5. Rural Infrastructure Improvement

Rural infrastructure has been consolidated by the Government organizations concerned at the national scale, leading to less disparity among regions. Projects for improving infrastructure within the Study Area to be further implemented include rural water

supply for 102 villages where rural water supply has mostly not yet been available, improvement of local road network with a total mileage of about 970 km, and expansion or provision of facilities for medical treatments and public hygiene.

#### **4-6. Strengthening of People's Organization**

At present, the people's organizations in the rural areas include several models under promotion by various government agencies. Generally, many of the existing people's organization are not strong enough and there are very few organizations that are successful in operation. Therefore, in order to strengthen the people's organization in the Study Area, ALRO should take necessary measures under collaboration among relevant agencies such as CPD, ARD, etc. For successful implementation of agricultural development by ALRO, ALRO should provide training course of progressive farmers to support farmers in strengthening farmers' organization. The basic direction for strengthening farmers' organization are proposed as follows:

- a) Promote systematic and effective collaboration between various relevant local organizations in village, particularly that between farmers' organizations and local people's organizations.
- b) Provide communal facilities such as public parks, sports facilities, meeting hall and recreation centers to strengthen family and community ties.
- c) Encourage members of organization to take the initiative in forming organizations.
- d) Promote the establishment of community funds capable of multipurpose utilization to support community organizations and all types of popular organization.
- e) Promote training and development of administration and management capability for farmers' organization by organization training for managerial skills, business, know-how for production, marketing, finance and general administration.
- f) Encourage women's groups, and youth groups to play a greater role in integrated farming, cottage industries, handicrafts and home processing of agricultural products.
- g) Encourage and promote land reform agricultural cooperatives in LRAs where existing Agricultural Cooperatives are inactive in its operation performance.

#### **4-7. Necessary Supporting Services for Farmers**

In order to achieve the development objectives, the necessary supporting services for farmers, as shown below, should be considered.

#### 1) Agricultural Extension Services

DOAE is a main agency for agricultural extension services, which are carried out in order to enable agricultural workers to formulate their own farming program. ALRO should provide farmers' training including four categories i.e. training for crop production, training for animal production, training for integrated farming system and plant propagation, and training for leadership as a part of agricultural development in LRAs.

#### 2) Farmers Supporting Fund

For promotion of integrated farming and non-farming employment program in LRAs, provision of credit service and farmers supporting fund has been one of the most essential support of the government. As integrated farming is based on long term and sustainable point of view, farmers would need initial investment for new agricultural activities and for some living costs before they can get the benefit from trees and fruit trees products.

#### 3) Sustainable Agriculture Extension Project

There are several governmental agencies involved in agricultural and experiment activities directly or indirectly to the goal of promotion of agriculture and increase income of farmers. In addition to such activities, a sustainable agriculture extension project in LRAs in the Upper Northeastern Region should be implemented. The objectives of the project are to support farmers in introducing sustainable agriculture which aims at increasing farmers' income, upgrading the living standard of farmers and contributing to the conservation of the forest reserve areas adjacent to LRAs.

#### 4) Employment Promotion Activities

By introducing the integrated farming system in LRAs, the labor requirement will be increased by about 50 % more than that of the present farming system. Therefore, it can be said that the agricultural development in LRAs is effective for not only increase of farm income but creation of new farm employment. At present, such agencies as DOAE, CPD, the Department of Skill Development, the Department of Industrial Promotion, etc. carry out non-farm employment promotion. ALRO should provide effective supports for farmers in increasing non-farm employment opportunities including the following items under collaboration among relevant agencies.

- a) Promotion of cottage industry, handicrafts, small-scale agro-processing
- b) Promotion of sub-contracted jobs such as weaving, precious stone cutting and manufacturing a part of industrial product.
- c) Provision of occupational training courses in various fields.

#### 4-8. Environmental Considerations

The following is the synopsis of predictable negative and positive environmental impacts affecting environment of the Study Area:

1) Negative impacts on environment

- Resettlement may be necessary for construction of reservoirs.
- In the case that some components of the project will not be accepted by villagers, they will not participate in the project.
- In the case that no action is taken for soil conservation by villagers, soil erosion and deterioration of soil fertility will be serious.

2) Positive impacts on environment

- more stable and increased farm income can be expected from improved infrastructure for farm production,
- intake of animal protein is more available as a side effect of creating small scale farm ponds where fish farming is planned,
- practice of sustainable agriculture enables to prevent soil erosion and degradation, as well to alleviate illegal farming inside the forest reserve areas and illegal felling of protected standing wood

4-9. Project Cost

The total amount of investment and farm credits estimated in the whole Study Area is summarized in the following table. It is envisaged that the investment enables to improve land productivity of 770 thousand rai that is equivalent to around 57% of the Project Area of 1.35 million rai.

**Estimated Project Cost**

Project Area	Facilities	Area to be developed (rai)	Cost (million baht)
1.Present Irrigation	—	37,000	—
2.Potential Development	Water Resources Develop.	62,000	1,550
	Farm & Village Link. Road	62,000	155
	Sub-Total		1,705
3.Rainfed Area	Farm Pond (1,200 m <sup>3</sup> )	1,288,000×0.40	1,288
	Farm & Village Link. Road	1,288,000	3,091
	Sub-Total		4,379
4.Soil Conservation	Drainage Canal, etc.	96,900	204
	Community Pond	440Vilages×0.20	264
	Sub-Total		468
5.Investment			6,552
6.Loan Preparation	Support for Farming	1,350,000×0.57	1,847
	Enlarge. Pond (4,800 m <sup>3</sup> )	1,288,000×0.10	747
	Sub-Total		2,594
7.Engineering Cost		8% Investment	524
8.Project Cost			9,670

#### 4-10. Plan Justification

A paddy/cassava farm with a typical holding of 20 rai (which is most dominant in LRAs) is substantially compensating household expenses from non-farm income because one farm's total annual expense of 32,770 baht now far exceeds the income from agriculture of 20,930 baht. According to the proposed basic development plan, paddy/cassava farms can reorient their current farming to integrated farming through the provision of a farm pond per farm and a low-interest farm loan.

In order to understand a suitable size of integrated farming to be introduced the following two cases are analyzed.

Case 1 : Mango (5 rai) and Vegetable (1 rai) cultivation, having a farm pond of 1,200 m<sup>3</sup> prepared free of charge by ALRO.

Case 2 : Mango (3 rai) and vegetable (1 rai) cultivation, having farm ponds of 6,000 m<sup>3</sup> in total. Cost for a farm pond of 1,200 m<sup>3</sup> is subsidized by ALRO and a farmer pays cost for excavating farm pond of remaining 4,800 m<sup>3</sup> by borrowing a long-term loan with a 5 % interest.

#### Current Farming Type and Integrated Farming Type

Typical current farming	Integrated Farming w/ project		
		Case1	Case2
Paddy 10 rai	Paddy	12 rai	8 rai
Cassava 10 rai ⇒	Sugarcane	-	6 rai
	Fruit (mango)	5 rai	3 rai *
	Vegetables	1 rai *	1 rai *
	Farm Pond	1 rai	2 rai
	House, etc.	1 rai	1 rai

Note : \* = irrigated

In the Case 1 with farm pond of 1,200 m<sup>3</sup>, cash-saving would be about 50,000 baht annually. On the other hand, in the Case 2 with farm ponds of 6,000 m<sup>3</sup> in total, cash-saving would increase by about 105,000 baht annually.

#### Comparison of Income/Expenditure

(Baht/year/farm)	Paddy/cassava farm	Integrated farming Case 1	Integrated farming Case2	Difference of paddy/cassava farm and Case2
Agri Income	20,930	97,430	188,350	167,420
Agri Expenses	8,970	26,340	62,070	53,100
Net Agri Income	11,960	71,090	126,280	114,320
Non-Agri Expenses	23,800	21,300	21,300	-2,500
Total Income	20,930	97,430	188,350	167,420
Total Expenses	32,770	47,640	83,370	50,600
Cash-savings	-11,840	49,790	104,980	116,820

Note : Income and expenditure generated by the introduction of eucalyptus and mango is analyzed in the above table. Farm income and expenditure don't include the value of self-consumption of self-made agricultural produce.

Reorientation of current farming will need financial support for initial investment. Because fast-growing trees and fruit trees cannot benefit farmers until the trees have grown enough to sell.

Providing long-term loans with a low interest rate and farm ponds of 1,200 m<sup>3</sup> or about 6,000 m<sup>3</sup> will make it possible to reorient their agricultural practices and promote the settlement of farmers in their villages.

#### 4-11. Implementation Program

Development to match the progress of land distribution is expected, but a target for LRA development does not seem to have been defined yet. A target or master plan for developing all LRAs in the country should be prepared in the near future by ALRO and necessary budgetary allocation to the development projects should be secured. As ALRO's ability to implement the development projects can be strengthened largely by recruiting consulting firms, the budgetary allocation is key element for satisfactory progress of the development projects.

The implementation schedule of the development projects in the Study Area should be established according to the development target for all LRAs in the country and order of priority given to each LRA. However, the following implementation schedule has been prepared on assumption that the projects proposed in the Study Area of 1.38 million rai will be completed in ten years at the rate of project implementation of about 140,000 rai/year

**Implementation Schedule and Disbursement**

Item \ Year	Year											
	1	2	3	4	5	6	7	8	9	10	11	12
Stage 1 Project												
Stage 2 Project												
Stage 3 Project												
Stage 4 Project												
Stage 5 Project												
Disbursement Total (Mill)	29	567	702	1,218	700	1,218	700	1,218	700	1,218	700	700
Investment			657	655	655	655	655	655	655	655	655	655
Loan Preparation		522		518		518		518		518		518
Engineering Services	29	45	45	45	45	45	45	45	45	45	45	45

□ : Project Preparation  
 ■ : Construction Work



## **5. DEVELOPMENT CATEGORIES AND SELECTION OF PRIORITY AREAS**

### **5-1. Categorization of Basic Development Plan**

#### **1) General Description**

The categorization of basic development plans for 35 LRAs will be useful for understanding these plans as a whole, not separately and for utilizing these plans as one of guidelines when ALRO formulates basic development plans for LRAs out of the Study Area.

#### **2) Method of Categorization and Development Categories**

Type of agricultural practices will be affected largely by the field conditions such as a) irrigation water availability, b) soil condition and c) possible duration of sunlight, etc. Regarding conditions c), there is no difference in LRAs in the Study Area. Therefore, categorization of basic development plans will be made based on conditions a) and b). In addition, factors related to environmental conservation are adopted as factors for development categorization.

##### **a) Irrigation water availability**

Irrigation water availability will be expressed by percentage of possible irrigated area to corresponding LRA.

##### **<Water Resources Potential>**

Low: less than 5 %

Medium: 5 % - 15 %

High: more than 15 %

(Note) classified by the potential irrigation ratio.

##### **b) Soil condition**

Crops suitable to an area basically depend on its soil condition, therefore soil conditions are expressed by recommended crops and farming types for the area. Twelve types of farming have been recommended. Each LRA has a large area of about 40,000 rai (6,400 ha) in average and soil conditions vary every part within a LRA. Therefore, 4 to 12 recommended farming types will be applied to each LRA based on the soil conditions, existing land use, etc. (Recommended Farming Type)

##### **c) Factors related to environmental conservation**

As for factors related to environmental conservation, the existence of buffer zones and economic forests in LRAs will be adopted. (Existence of Buffer Zone, Existence of Economic Zone)

Twelve types of farming are recommended and 4 to 12 recommended farming types are applied to each LRA. In case the recommended farming types are adopted as a factor for development categorization, it is necessary to subdivide each LRA into several parts. Farming

types are basically recommended based on the soil conditions, existing land use, etc. but final decision for selection of farming types should be made by farmer themselves.

Based on the consideration mentioned above, simplified development patterns of LRAs are adopted as shown below.

Develop.Pattern = Develop. Category classified + Recommended Farming Types applied

The development categories are classified into 12 categories as shown in Table 5-1 and the development pattern is shown in Table 5-2.

**Table 5-1 Development Categories of the Study Area**

Development Category	Irrig. Water Availability	Existence of Buffer Zone	Existence of Economic Zone	Khon Kaen (KK)	Maha Sarakham (MHS)	Sakhon Nakhon (SKN)	Mukdahan (MKD)
I	<Low>	Yes	Yes			3-2,4	
II			None			6-1,6-2	1,6,9-1
III		None	Yes	5,6	1-10		
IV			None				
V	<Medium>	Yes	Yes			3-1,5-1,5-2	11-1
VI			None				2,3,5,9-2
VII		None	Yes	1,2,3,4		1,2,7	
VIII			None				
IX	<High>	Yes	Yes			3-3	7,11-2
X			None				4,8-1-8-4,10,12
XI		None	Yes				
XII			None				

The results of categorization are summarized as shown below:

Type	Nos. of LRA	Area	
I	2	93,170rai (6.7%)	<b>Irrigation water availability</b> Low : 19 LRAs 645,920rai (46.6%) Med. :15 LRAs 580,580rai (41.9%) High :10 LRAs 160,050rai (11.5%)
II	5	178,100rai (12.9%)	
III	12	374,650rai (27.0%)	
IV	-	-	<b>Existence of Buffer Zone</b> Yes :25 LRAs 820,430rai (59.2%) None :19 LRAs 566,120rai (40.8%)
V	4	177,040rai (12.8%)	
VI	4	212,070rai (15.3%)	<b>Existence of Economic Zone</b> Yes : 28 LRAs 922,440rai (66.5%) None : 16 LRAs 464,110rai (33.5%)
VII	7	191,470rai (13.8%)	
VIII	-	-	
IX	3	86,110rai (6.2%)	
X	7	73,940rai (5.3%)	
XI	-	-	
XII	-	-	
Total	44	1,386,550rai (100%)	

Table 5-2 Development Pattern of the Study Area

Study Area	Development Category	Recommended Farming Types														
		I. Paddy Prevaling Area					II. Upland Crop Prevaling Area					III. Steeply Sloped Area				
		A (%)	B (%)	C (%)	D (%)	E (%)	F (%)	G (%)	H (%)	I (%)	J (%)	K (%)	L (%)	Total		
Kroon Keon	VI	7.4%	11.1%	4.6%	27.1%	40.6%	3.8%	3.8%	0.0%	0.0%	0.2%	0.5%	0.5%	100.0%		
	VII	5.2%	7.9%	3.3%	30.1%	45.1%	4.2%	4.2%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%		
	VIII	10.9%	16.9%	6.8%	23.7%	33.6%	3.3%	3.3%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%		
	IX	2.8%	4.2%	1.8%	31.0%	46.5%	4.3%	4.3%	0.0%	0.0%	0.5%	1.5%	1.5%	100.0%		
	X	6.6%	9.9%	4.1%	28.6%	42.9%	4.0%	4.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%		
	XI	6.4%	9.6%	4.0%	28.8%	43.2%	4.0%	4.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%		
Maha Sankhram	Total	6.7%	10.1%	4.2%	28.2%	42.3%	3.9%	3.9%	0.0%	0.0%	0.1%	0.2%	0.2%	100.0%		
	MHS 1	0.0%	0.0%	0.0%	36.0%	54.0%	5.0%	5.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%		
	MHS 2	0.0%	0.0%	0.0%	33.6%	50.4%	4.7%	4.7%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%		
	MHS 3	0.0%	0.0%	0.0%	36.0%	54.0%	5.0%	5.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%		
	MHS 4	0.0%	0.0%	0.0%	36.0%	54.0%	5.0%	5.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%		
	MHS 5	19.9%	29.8%	12.4%	13.6%	20.5%	1.9%	1.9%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%		
	MHS 6	11.9%	17.8%	7.4%	21.5%	32.3%	3.0%	3.0%	0.0%	0.0%	0.3%	0.9%	0.9%	100.0%		
	MHS 7	31.0%	46.5%	19.4%	1.1%	1.7%	0.2%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%		
	MHS 8	5.5%	8.2%	3.4%	26.6%	40.0%	3.7%	3.7%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%		
	MHS 9	0.0%	0.0%	0.0%	36.6%	53.8%	4.8%	4.8%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%		
Sakhon Nakhon	MHS 10	5.6%	8.5%	3.5%	29.7%	44.5%	4.1%	4.1%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%		
	Total	6.7%	10.1%	4.2%	26.4%	39.6%	3.7%	3.7%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%		
	SKN 1	8.1%	12.1%	4.9%	37.7%	52.7%	4.2%	4.2%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%		
	SKN 2	23.4%	35.1%	13.9%	23.9%	35.8%	2.7%	2.7%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%		
	SKN 3	14.8%	22.2%	8.6%	26.1%	39.1%	3.3%	3.3%	0.0%	0.0%	0.3%	1.3%	1.3%	100.0%		
	SKN 4	16.3%	24.5%	9.4%	27.0%	40.5%	3.4%	3.4%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%		
	SKN 5	2.0%	3.0%	1.2%	25.6%	38.4%	3.2%	3.2%	0.0%	0.0%	1.6%	8.0%	8.0%	100.0%		
	SKN 6	26.2%	39.3%	15.1%	6.4%	9.6%	0.8%	0.8%	0.0%	0.0%	0.9%	4.6%	4.6%	100.0%		
	SKN 7	15.4%	23.1%	8.9%	31.2%	46.6%	3.5%	3.5%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%		
	Total	14.4%	21.6%	8.3%	24.6%	36.9%	3.0%	3.0%	0.0%	0.0%	0.5%	2.5%	2.5%	100.0%		
Muekdaan	MKD 1	14.7%	22.0%	8.6%	24.0%	36.0%	3.0%	3.0%	0.0%	0.0%	0.5%	2.7%	2.7%	100.0%		
	MKD 2	5.3%	7.9%	3.3%	26.6%	39.9%	4.1%	4.1%	0.0%	0.0%	0.2%	1.0%	1.0%	100.0%		
	MKD 3	19.9%	29.8%	12.4%	13.6%	20.5%	1.9%	1.9%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%		
	MKD 4	7.0%	10.5%	4.2%	14.0%	21.0%	2.2%	2.2%	0.0%	0.0%	0.2%	0.8%	0.8%	100.0%		
	MKD 5	10.4%	15.6%	6.0%	14.4%	21.6%	2.2%	2.2%	0.0%	0.0%	2.0%	9.7%	9.7%	100.0%		
	MKD 6	3.3%	5.0%	2.0%	15.7%	23.6%	2.6%	2.6%	0.0%	0.0%	1.4%	7.3%	7.3%	100.0%		
	MKD 7	23.4%	35.1%	13.9%	23.9%	35.8%	2.7%	2.7%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%		
Muekdaan	Total	7.5%	11.3%	4.5%	30.4%	45.6%	3.8%	3.8%	0.0%	0.0%	0.4%	2.3%	2.3%	100.0%		
	MKD 8	9.9%	14.8%	5.7%	28.3%	42.5%	3.5%	3.5%	0.0%	0.0%	0.5%	2.4%	2.4%	100.0%		
	MKD 9	34.3%	51.5%	19.7%	12.6%	18.9%	1.6%	1.6%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%		
	MKD 10	8.6%	12.9%	4.9%	29.2%	43.8%	3.6%	3.6%	0.0%	0.0%	0.5%	2.4%	2.4%	100.0%		
	MKD 11	0.0%	0.0%	0.0%	36.4%	54.6%	5.3%	5.3%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%		
	Total	13.2%	19.8%	7.6%	24.1%	36.3%	3.2%	3.2%	0.0%	0.0%	0.4%	2.2%	2.2%	100.0%		
Grand Total (%)	Total	11.3%	17.0%	6.5%	25.4%	38.1%	3.3%	3.3%	0.0%	0.0%	0.4%	1.8%	1.8%	100.0%		

## 5-2. Selection of Priority Areas for F/S

### 1) General Description

The Study Area is 35 LRAs in the four provinces of Khon Kaen, Maha Sarakham, Sakon Nakhon and Mukdahan. Because ALRO has a little experience in implementing integrated agricultural development projects, the results of this Study, which include the provision of guidelines for classification of LRAs into development categories, selection of priority areas and formulation of a development plan for each category, are expected to be one of the guidelines when ALRO formulates development plans for LRAs in the near future. Under such circumstances, one Priority Area is selected from each of the four provinces for the following reasons.

- Wider demonstration effects will be expected when the projects are implemented.
- One of the objectives of this Study is to carry out, in the course of the Study, technology transfer to Thai counterpart personnel concerned. As ALRO's development projects will be implemented under the control of Provincial Land Reform Office, the technology transfer to staffs in PLROs of the four provinces will be required. In order to accomplish this objective, the Priority Area should be selected from each of the four provinces.

### 2) Selection Criteria

The selection criteria of the priority areas for F/S have been adopted as shown below.

#### Selection Criteria of Priority Area for F/S

Step 1:	To select backward LRAs. For this, screening of LRAs using the "Development Level" and "Income Level" obtained from Kor Chor Chor 2 Khor data will be made as follows: <ol style="list-style-type: none"> <li>1) Calculate development level of each LRA.</li> <li>2) Calculate income level of each LRA.</li> <li>3) Calculate an average value for the above two levels.</li> <li>4) Select LRAs with an average value of less than 2 as backward LRAs.</li> </ol>
Step 2:	To select the priority areas by considering equitable distribution of development categories, and the intentions of PLROs.

For selection of the four Priority Areas for F/S in Step 2 of the selection criteria, the development categories are simplified by two factors, i.e., high or low potential of water resources development and the existence of buffer zones, as shown below.

#### Development Categories for Selection of Priority Area

Development Categories	Water Resources Development	Existence of Buffer Zone
A	high potential	exists
B	Irrigated Area $\geq$ 15%	does not exist
C	low potential	exists
D	Irrigated Area $<$ 15%	does not exist

Note: Development category is actually classified into three categories of A, C and D because there are no LRAs in the Study Area which are classified as Category B.

### 3) Priority Area for F/S

The selection of backward LRAs was made by applying Step 1 of the selection criteria, and backward LRAs in each province are classified into the development categories as shown below.

**Backward LRAs and Their Development Category**

Development Category	Khon Kaen	Maha Sarakham	Sakhon Nakhon	Mukdahan
A	-	-	No. 3-3	(No. 8-2), 8-3, 8-4, 12
B	-	-	-	-
C	-	-	(No. 3-1), 3-2, 6-1, 6-2	No. 2, 3
D	(No. 6)	(No. 5)	No. 2, 7	-
Area Proposed by PLROs as Priority Area	No. 6	No. 5	No. 3	No. 8

In the provinces of Khon Kaen and Maha Sarakham, only one LRA for each province remains as a backward LRA. These areas are the same as those proposed by the PLROs concerned and it should therefore be selected as a Priority Area for F/S. The Priority Areas in Khon Kaen and Maha Sarakham are classified as Category D. By considering equitable distribution of development categories, proposals by PLROs, etc., the Priority Areas in Sakhon Nakhon and Mukdahan are selected by the LRA belonging to Categories C and A respectively. Reasons for selection of Priority Areas in Sakhon Nakhon and Mukdahan are as follow;

#### Sakhon Nakhon

The backward LRAs in Category C in Sakhon Nakhon are in area Nos. 3-1, 3-2, 6-1 and 6-2. Nos. 6-1 and 6-2 are ordinary areas where only paddy is cultivated in the rainy season. In area No.3, there is a farmers' group which is engaged in ecological farming and is expected to be a leading model in expanding sustainable agriculture in LRAs, and it is assumed that the demonstration effects from development in No. 3 area will be very high.

Accordingly, it has been decided that the Priority Areas should be from area No. 3, and area No. 3-1, where there is a large acreage compared with area No.3-2, has been selected as the Priority Area in Sakhon Nakhon province.

#### Mukdahan

Area Nos. 8-2, 8-3, 8-4 and 12 remains backward LRAs belonging to Category A. Nos. 8-3 and 12 are excluded from Priority Area selection because water resources in these areas have been developed to a comparatively high level.

A main road passes through the center of area No. 8-2, but area No. 8-4 is far from the main road. Area No. 8-2 has been selected as the Priority Area in Mukdahan province because higher demonstration effects than area No. 8-4 can be expected.

## 6. RECOMMENDATIONS FOR BASIC DEVELOPMENT PLAN

- 1) ALRO should be responsible for development program in LRAs. Development to match the progress of land distribution is expected, but a target for LRA development does not seem to have been defined yet. Development target or a master plan for developing all LRAs should be prepared by ALRO in the near future.
- 2) For LRAs where natural conditions are least favorable in terms of production potential, it is deemed that large-scale development is not possible and should not be introduced, but small-scale integrated farming, livestock breeding, fruit tree cultivation, plantation of fast growing tree, etc. should be introduced. In order to make such farming possible, ALRO should provide necessary agricultural infrastructure, support for farmers in forming and strengthening farmers' organization and loan with low interest for farmers who intend to introduce integrated farming. Under the collaboration with DOAE, the Department of Industrial Promotion, etc., ALRO should also provide farmers' training for cloth weaving, small-scale agro-processing, sewing, etc. in order to increase non-farm employment opportunities.
- 3) Environmental degradation of the forest reserve areas adjacent to LRAs is recognized. Deforestation is frequently related to poverty. Therefore, backward LRAs adjacent to forest reserve area should be given high priority for development. In developing such LRAs, ALRO should take necessary measures to make known importance of forest conservation to farmers. A Kor Chor Chor 2 Khor database should be used for judging development level of LRAs and for planning the development projects in LRAs.
- 4) Because the proposed development project includes various components, i.e. agricultural extension services, supporting services in forming and strengthening farmers' organization, agricultural infrastructure development, non-farm employment promotion, etc., the project goal can be achieved only through the coordination of these activities with those activities of other agencies involved in the project. Therefore, coordinating committee should be established in order to assure smooth and successful implementation of the project. In implementing the project, special attention should be paid to the following:
  - a) Support for progressive farmers or farmers' groups in LRAs.
  - b) Farmers' participation in all stages of the development process.
  - c) Participation of women in farmers' training courses.
  - d) Collaboration with NGOs in development.