

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)  
MINISTRY OF AGRICULTURE AND FORESTRY  
LAO PEOPLE'S DEMOCRATIC REPUBLIC

AGRICULTURAL DEVELOPMENT PROJECT  
TO  
CONTROL SLASH AND BURN CULTIVATION  
IN  
OUDOMXAY PROVINCE

VOLUME I  
EXECUTIVE SUMMARY

AUGUST 1993

NIPPON KOEI CO., LTD.  
and  
CONSTRUCTION PROJECT CONSULTANTS, INC.

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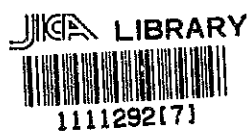
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## PREFACE

In response to a request from the Government of Lao People's Democratic Republic, the Government of Japan decided to conduct a master plan study on Agricultural Development Project to Control Slash and Burn Cultivation in Oudomxay Province and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Lao PDR a study team headed by Mr. Kunio Irie, Nippon Koei Co., Ltd., three times between March 1992 and May 1993.

The team held discussions with the officials concerned of the Government of Lao PDR, 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 Lao People's Democratic Republic for their close cooperation extended to the team.

August, 1993



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Kensuke Yanagiya  
President  
Japan International Cooperation Agency



August, 1993

Mr. Kensuke Yanagiya  
President,  
Japan International Cooperation Agency  
Tokyo, Japan

LETTER OF TRANSMITTAL

Dear Sir,

We are pleased to submit the master plan study report on the Agricultural Development Project to Control Slash and Burn Cultivation in Oudomxay Province (the Project) in the Lao People's Democratic Republic (Lao PDR), in accordance with the Scope of Work agreed upon between the Ministry of Agriculture and Forestry (the Ministry) and Japan International Cooperation Agency (JICA) in October 1991.

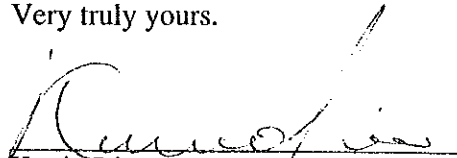
The Lao PDR has serious problems such as devastation of vast forest area, soil erosion, deterioration of potential water resources and land productivity, and environmental problems, which arise mainly from expansion of shifting agriculture due to increase in population. The Lao PDR is then making efforts to control shifting agriculture through increase in crop production and farm income of the farmers. In this connection, the Master Plans Study on the Project has been made with the principal aim of contributing to the control of shifting agriculture through introduction and expansion of improved farming, up-grading of agricultural and social infrastructures, strengthening of agricultural support services, and establishment of efficient marketing system of farm products in the Project area.

The Master Plan is formulated on the basis of the strategies and policies for agricultural development contained in the New Economic Mechanism being promoted by the Lao PDR, and includes action plans and programs for (i) increase and stabilization of agricultural productivity, (ii) development of agricultural production infrastructures, (iii) establishment of efficient marketing system, (iv) development of social infrastructures, (v) environmental problems, (vi) institutional improvement and strengthening, and (vii) support for women in development of the Project area. The Master Plan also proposes the stage-wise development of the Project, namely Short Term, Medium Term and Long Term Development Programs. In the Short Term Program, the Three Model Areas Development Scheme (the Scheme) is proposed to establish the Project base to demonstrate the effects of the integrated rural agricultural development as well as for further expansion of the development that will be carried out under the medium and long term programs. For a possible early implementation of the Scheme, the feasibility study is made to verify its technical and economic viability.

We believe that the implementation of the Project will contribute not only to the alleviation of environmental problems due to shifting agriculture but for achievement of more favorable and faster rate of national socio-economic development. In particular, early implementation of the Model Areas Scheme is recommended as the first step in the Project implementation.

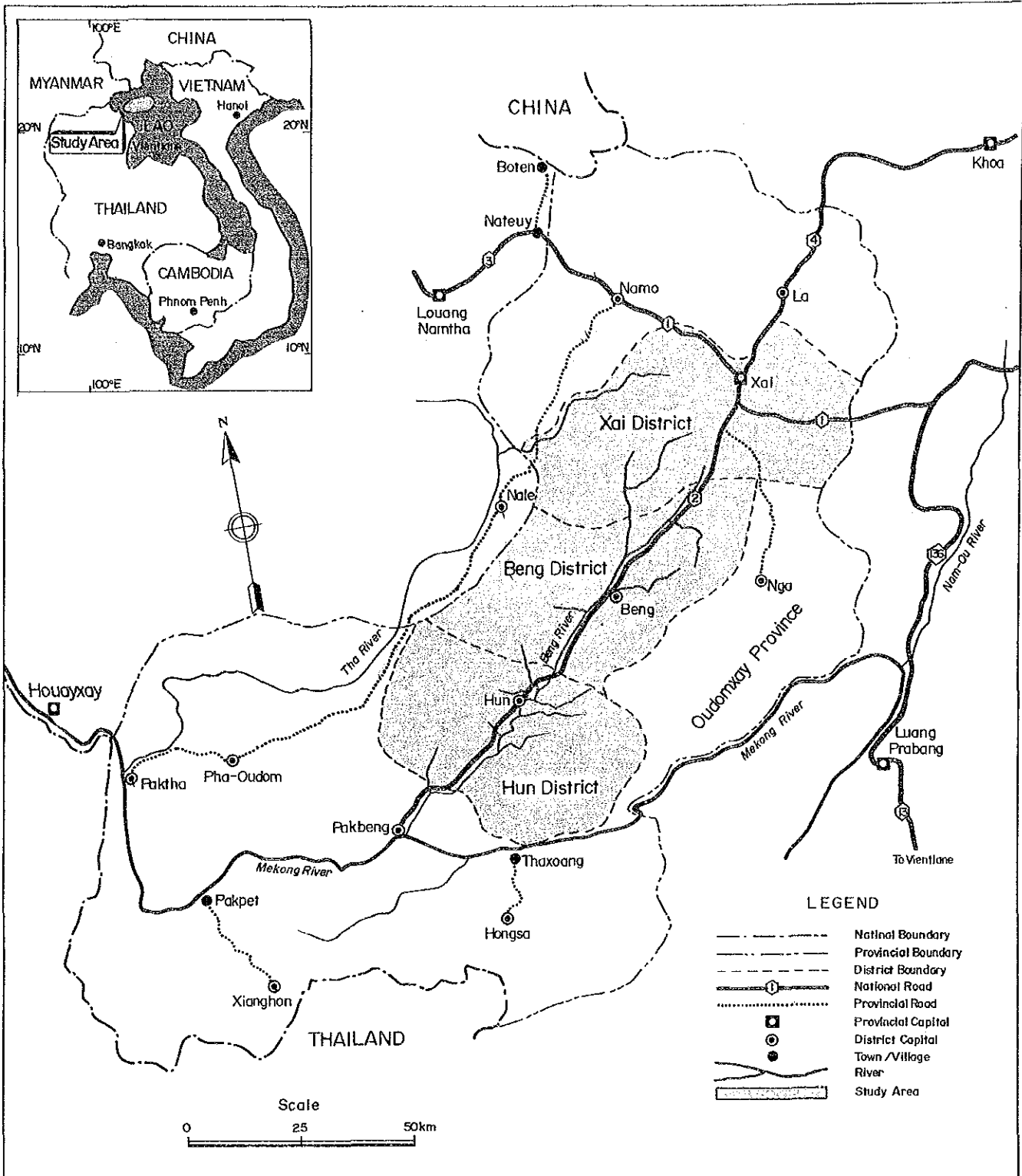
On this occasion, we wish to express our sincere appreciation and gratitude to the personnel concerned of JICA, the Embassy of Japan in Laos and the Lao Government Authorities concerned for the courtesies and cooperation extended during field surveys and studies.

Very truly yours.

  
Kunio Irie  
Team leader,  
Master plan study team  
Nippon Koei Co., Ltd.





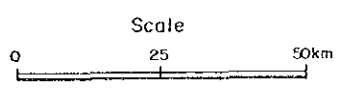
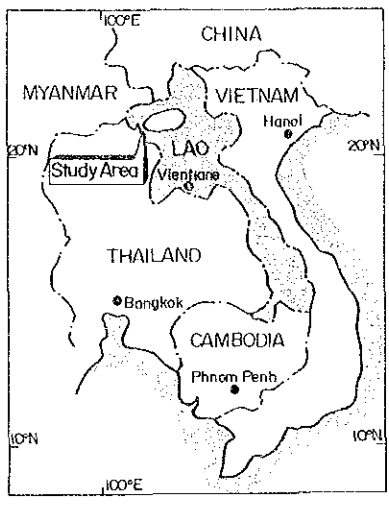
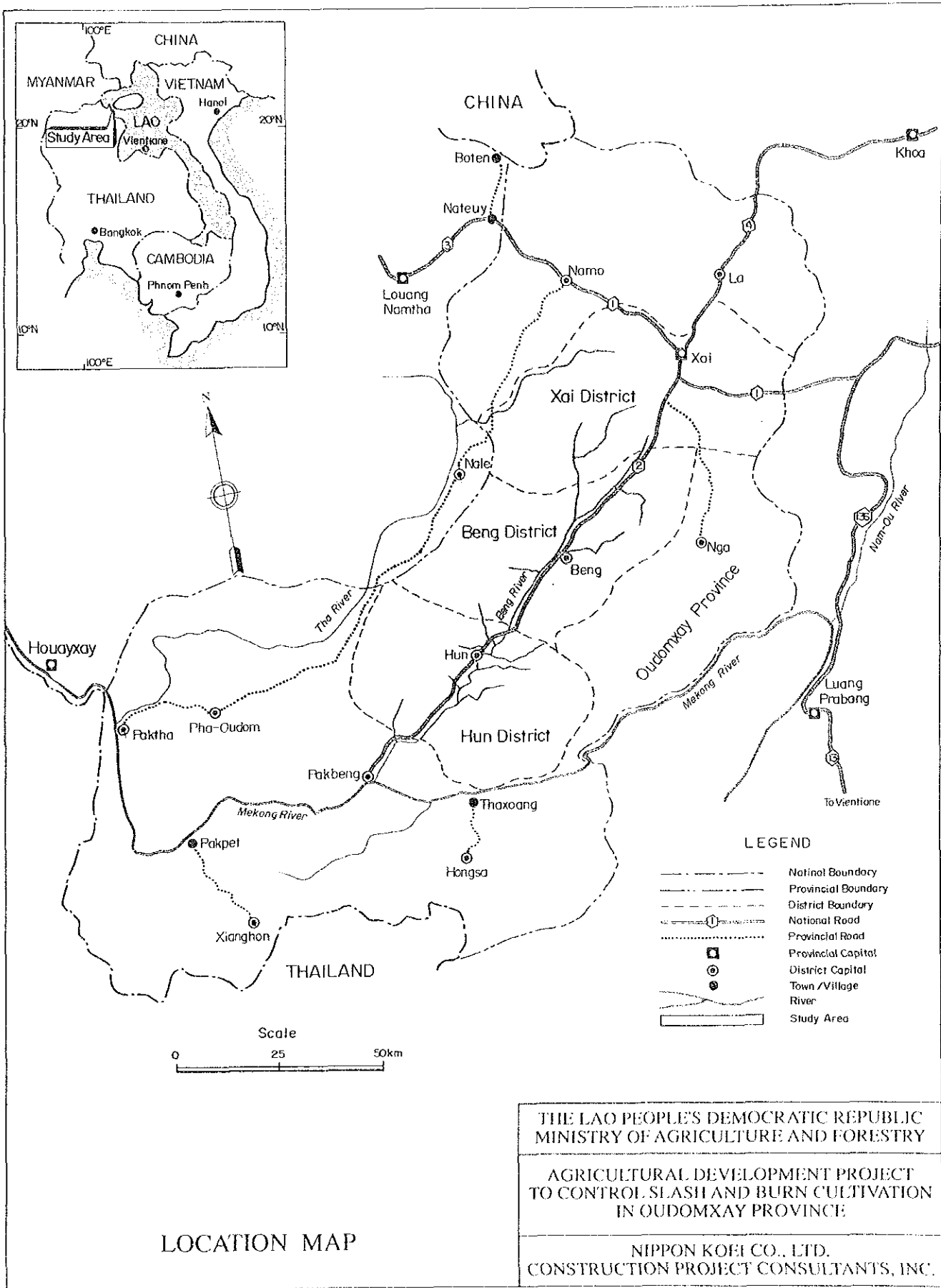


LOCATION MAP

THE LAO PEOPLE'S DEMOCRATIC REPUBLIC  
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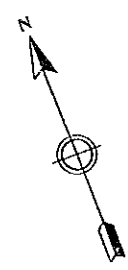
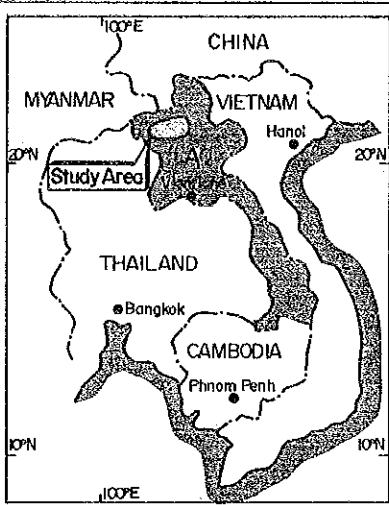
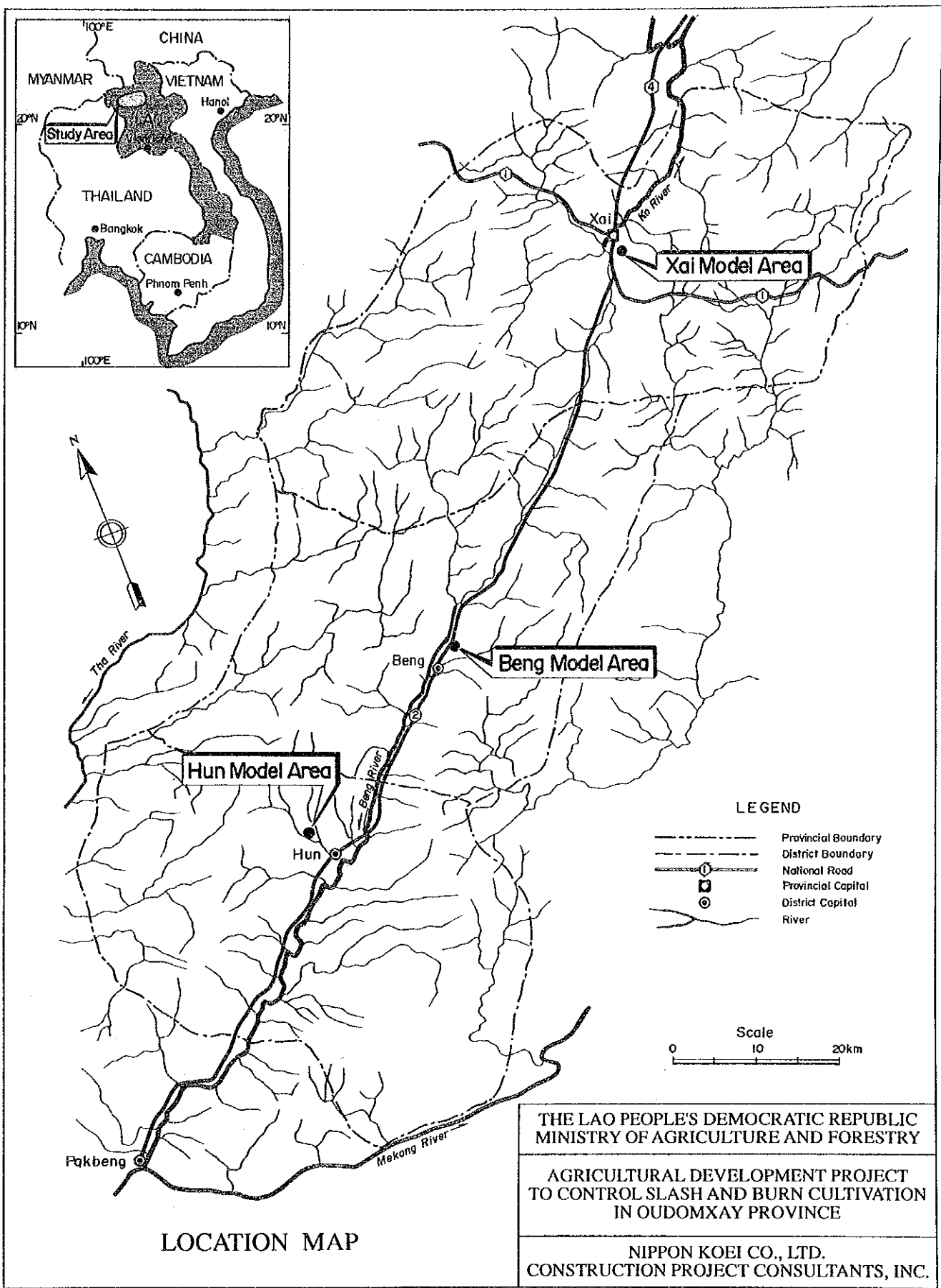
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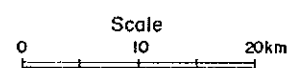


- LEGEND**
- National Boundary
  - - - - - Provincial Boundary
  - - - - - District Boundary
  - ①----- National Road
  - Provincial Road
  - Provincial Capital
  - ⊙----- District Capital
  - ⊙----- Town / Village
  - ~~~~~ River
  - ▭----- Study Area





- LEGEND**
- Provincial Boundary
  - District Boundary
  - (1)--- National Road
  - Provincial Capital
  - District Capital
  - ~ River

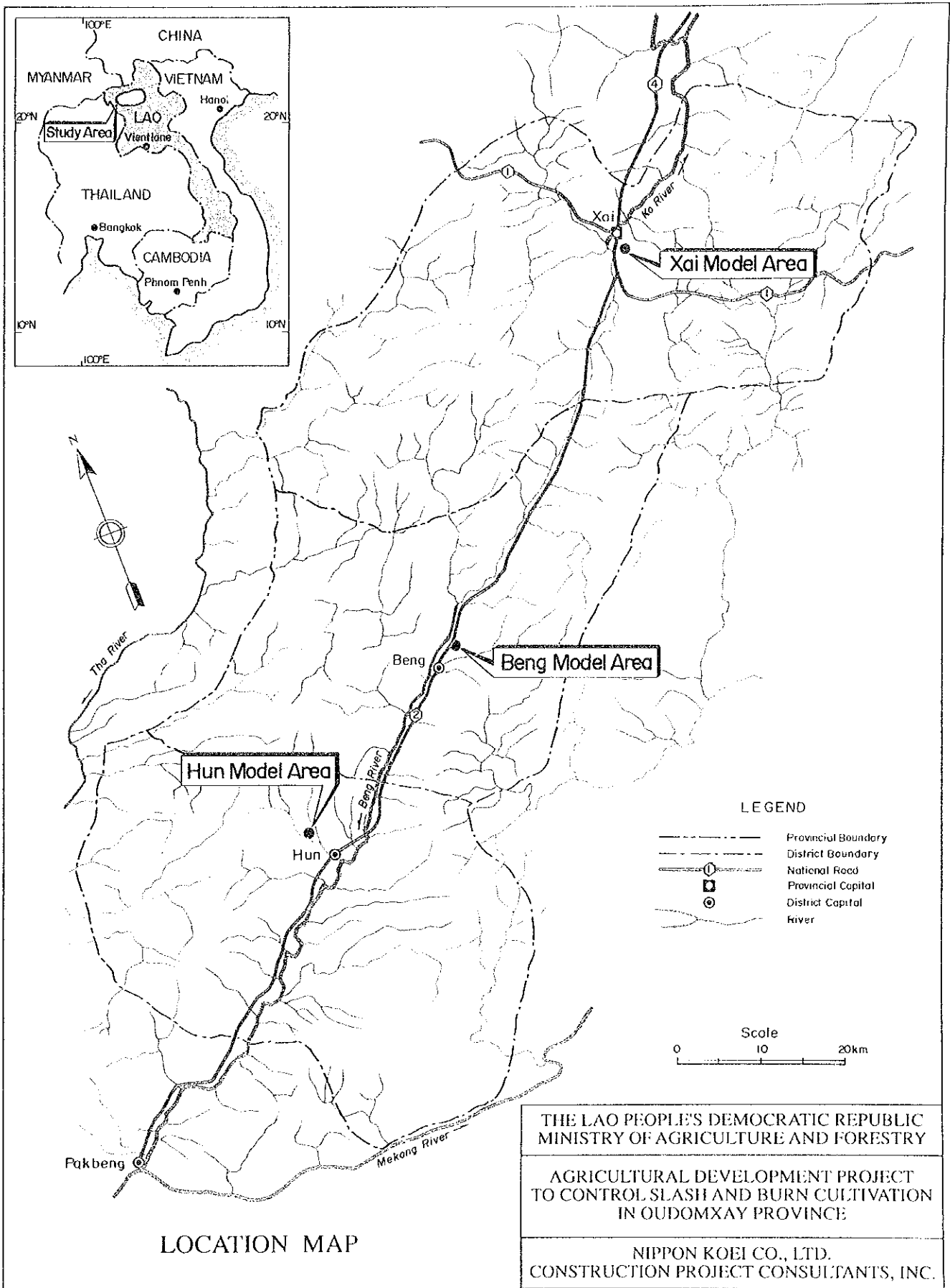


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# PROJECT DIGEST AND RECOMMENDATIONS

## 1. Background to the Project

Recently, the Lao People's Democratic Republic (Lao PDR) has had serious problems with the decrease of forest areas in the mountainous and hilly zones, especially in the northern and eastern parts of the country, which arise mainly from the expansion of slash-and-burn cultivation due to population increase. The problems also accelerate the devastation of vast forest areas, serious soil erosion, deterioration of potential water resources and land productivity, and environmental problems, which largely affect national socio-economic activities and development.

With the aim of implementing the agricultural development project in order to control slash-and-burn cultivation and to increase crop production, the Government of Lao PDR requested the Government of Japan, in 1989, to carry out a master plan study on agricultural development in Oudomxay Province. In response to the request of the Government of Lao PDR, the Government of Japan decided to conduct the Master Plan Study (the Study) on the Agricultural Development Project in Oudomxay Province. The Study was carried out from March 1992 to May 1993.

## MASTER PLAN STUDY

## 2. Strategy and Policy for Agricultural Development

Overall development strategy for agricultural development in the study area was examined in order to formulate the basis for the Master Plan Study on proposed agricultural development which will contribute to the increase in agricultural productivity as well as to the control of the present slash-and-burn cultivation in the study area.

The final targets of proposed agricultural development can only be achieved through comprehensive implementation of not only direct measures for increasing agricultural productivity but also other supporting measures such as strengthening of the government institutes, improvement of rural socio-economic conditions in the study area.

The essential policies and action plans to be followed, for this purpose, are described below:

- A. Increase and Stabilization of Agricultural Production
  - A.1 Improvement and strengthening of agricultural support services
    - Strengthening of agricultural extension services
    - Strengthening of veterinary services
    - Establishment of an efficient marketing system
  - A.2 Establishment of an Integrated Agricultural Station
- B. Development of Agricultural Production Infrastructure
  - B.1 Rehabilitation and upgrading of the existing irrigation system
  - B.2 Establishment of water users' associations
  - B.3 Improvement of the meteo-hydrological network
  - B.4 Construction of new irrigation systems
- C. Development of Social Infrastructures
  - C.1 Rehabilitation and upgrading of the district road network
  - C.2 Construction of rural water supply facilities
  - C.3 Rehabilitation and construction of a primary school





- D. Measures to Alleviate Environmental Problems
  - D.1 Integrated agricultural development
  - D.2 Control and management program for slash-and-burn cultivation
- E. Support Services for Women's Groups
  - E.1 Training of extension workers for improvement of people's living standards
  - E.2 Support services for promotion of health education for women
  - E.3 Support services for promotion of basic literacy education for women
  - E.4 Support services for encouraging women to participate and utilize the rice bank system
  - E.5 Demonstration and extension of sericulture

### **3. Implementation of Proposed Action Plans**

Setting 2010 as the final target year for the proposed development, the implementation of proposed action plans and programs was planned to be carried out in three stages, namely short-term (2000), medium-term (2005), and long-term (2010).

#### **(1) Short-term Development (Model Areas Scheme)**

The three model areas, one in each district, have been selected to be the cores to demonstrate the effects of integrated rural agricultural development and will also be the base for further expansion of the development that will be carried out under the medium and long-term programs. The objectives of short-term development are to establish the technical and operating base for expansion and settlement of improved and profitable agriculture in the future.

#### **(2) Medium-term Development**

Agricultural development under the medium-term program will have two main objectives: one is the expansion of improved farming techniques with irrigation to increase the yield of lowland rice with the related supporting services for the selected potential lowland; and the other is the accumulation of more technical data and information on and experience in the improved upland farming through continuous trial, demonstration activities, and pilot schemes.

#### **(3) Long-term Development**

It was planned that the strategy for development in this stage will continue the various programs included in the Master Plan by the efforts of government staff and farmers themselves, using fully their technologies and experience accumulated through the previous short and medium-term development stages.

### **4. Evaluation of Integrated Agricultural Development**

#### **(1) Agricultural Impacts**

The rise in rice production at each development stage will be about 2,600 tons/year (10% over the present production) in the short-term stage, 14,400 tons/year in the medium-term stage (56%), and 29,600 tons/year in the long-term stage (115%).

The production of other crops such as sesame, cotton, vegetables, wheat, soybean, rapeseed would also increase through the introduction of dry season farming and the establishment of an efficient marketing system.

Livestock production would also increase through the extension of veterinary services and the establishment of a marketing system.



With the Project implementation, the farmers in the study area, as well as in other potential areas, could improve their technical and managerial capability for profitable farm management through accumulation of experience in modern farming practices with irrigation in both lowland and upland gently sloping hills. The farmers would also be encouraged to implement more crop diversification with an incentive to generate more cash income.

## (2) Socio-economic Impacts

Since rice production in Laos is not sufficient to meet the domestic demand, 40,000 tons of milled rice were imported at a cost of US\$9.6 million in 1990. With the completion of the Project, the expected foreign exchange saving on rice imports would be US\$4.6 million, at the present price level.

The farmers' income would increase considerably due to the increase in agricultural production. Such an increase will contribute to the improvement of farmers' living standards as well as to the acceleration of regional economic activities.

The Project would improve and accelerate the women's activities through the establishment and operation of rice banks and periodical opening of women's schools.

The improved road network will facilitate the efficient marketing of farm products, inputs, livestock, and other commodities as well as contribute to the improvement of inter-regional accessibility and communication.

The increase in farmers' income would raise their purchasing power in rural markets. It is expected that markets of farm inputs and equipment will be more active and that the business opportunities of local non-farmers will be expanded indirectly. In addition, the increased crop production and improved road network would accelerate the business of millers, merchants, and transporters with respect to processing, marketing, and transportation.

The Project would generate employment opportunities for unskilled laborers during the construction period. In addition, the employees could obtain more experience and skills in various working fields. The accumulated experience and skills will be useful for operation and maintenance (O&M) work by the farmers and would also provide the motivation for further economic development in the study area and the Province.

## (3) Environmental Impacts

The rise in rice production in lowland rice fields would alleviate the dependence on rice production by slash-and-burn cultivation and would alleviate the pressure on forests due to slash-and-burn cultivation activities.

The Project would help to mitigate such environmental issues as poor road conditions, insufficient rural water and electricity supply systems both in quality and quantity, and poor sanitary conditions mainly due to the life-style of rural inhabitants, through improvement of social infrastructures and extension of services for improvement of living standards.

## **FEASIBILITY STUDY ON THE MODEL AREAS SCHEME**

### **5. The Model Areas Scheme**

For an early implementation of the Model Areas Scheme, the feasibility study from both technical and economic viewpoints was carried out, based on the data and information obtained from the field investigations and within the framework of the Master Plan. Three model areas, one in each district, were selected. They are Xai (Tham Nhuang area), Beng (Nam Hao area), and Hun (Nam Kham area).



## 6. Agricultural Development Plan

### (1) Basic Concept

- a) Increase agricultural production, especially in regard to rice in the existing lowland fields through various development models.
- b) Execute study and research works for development of appropriate farming techniques in upland gently sloping hill areas and second crop cultivation in lowland areas, in order to increase agricultural production and to promote crop diversification which will contribute to the control of slash-and-burn cultivation.
- c) Improve and strengthen the technical and managerial capability of the offices and staff through implementation of the model areas development.

### (2) Improvement of Lowland Rice Farming

The proposed cropping pattern in the model areas aims, firstly, to increase and stabilize wet season rice production by securing a stable supply of irrigation water; and secondly, to increase cropping intensity of lowland rice fields where irrigation water is available in the dry season. The cropping intensity in the Xai model area will increase to 141%. Unfortunately, dry season cultivation, especially for rice, could not be introduced in the Beng and Hun model areas, because no river water is available for irrigation. Therefore, the overall cropping intensity in the three model areas will be 115%.

The crop yields will increase because of the extension of improved rice farming and stable supply of irrigation water, and anticipated paddy yield was estimated as follows:

Model Area	Present Yield	Unit: ton-paddy/ha	
		Anticipated Yield	
		Glutinous	Non-glutinous
Xai area	2.4	4.0	4.0
Beng area	2.7	4.0	4.0
Hun area	2.6	4.0	4.0

### (3) Program for Strengthening the Agricultural Support Services

In line with the nationwide program, extension services for farmers in the model areas will be provided by the existing sections of Xai, Beng, and Hun district offices. In order to support their activities, the Scheme will provide the following facilities and equipment :

- a) Two (2) office buildings, including storage and a garage at Beng and Hun, each having 208 m<sup>2</sup> floor space (for the Xai model area, an agricultural station will be used for this purpose);
- b) Staff quarters at Hun with a total floor space of 280 m<sup>2</sup>;
- c) Supply of two (2) motorcycles and office equipment for each office.

Programs to be carried out in these extension offices will be as follows :

- a) Extension of improved rice cultivation farming including distribution of certified seeds, demonstration of pest-disease control and soil improvement techniques, and training of farmers' groups;
- b) Extension of improved sericulture;



- c) Services for improvement of people's living standards, promotion of health education, and basic literacy education through periodical opening of women's schools at each extension office in collaboration with the agricultural station in Xai.

(4) Improvement of the Marketing System

In order to improve the present marketing system in the model areas, three (3) farmers' organizations, tentatively called the rice bank, will be established by organizing the existing women's groups at the village level as a basis. The activities of the organizations will be processing and selling of rice, and collection, selection, and selling of sesame, as well as to provide more local credit services. To support these activities, the following buildings and equipment will be provided for each organization by the Scheme :

- a) An office building with a floor space of 104 m<sup>2</sup>;
- b) Storage with a floor space of 200 m<sup>2</sup>;
- c) A drying yard with a concrete floor space of 200 m<sup>2</sup>; and
- d) A small-scale rice mill (capacity: 500 kg/hr), a sesame cleaner (capacity: 300 kg/hr.), a weighing instrument (capacity: 200 kg), and office equipment.

(5) Establishment and Operation of the Integrated Agricultural Station

- a) Construction of buildings which will include :
  - a main office (650 m<sup>2</sup>), including storage (200 m<sup>2</sup>) and a garage (200 m<sup>2</sup>),
  - a research and training house (855 m<sup>2</sup>),
  - eight (8) staff quarters (1,825 m<sup>2</sup> in total), and
  - a workshop (300 m<sup>2</sup>);
- b) Civil works for development of test and demonstration plots which will include 5 ha of rice field within the station and 10 ha of upland in the hill adjacent to Xai model area;
- c) Supply of machinery and equipment necessary for O&M of the station and demonstration plots;
- d) Supply of O&M equipment for the model areas.

The station will consist of an administration section (14 staff), a research and trial section (8 staff), an extension and training section (4 staff), a seed multiplication section (9 staff), an O&M section (12 staff), and a study, planing and monitoring section (5 staff). With these sections and staff, the station will carry out the following programs in collaboration with national research institutes, international organizations and other economic cooperation organizations :

- a) Development and extension of intensified farming in lowland rice fields;
- b) Development and demonstration of year-round farming in hilly areas;
- c) Introduction and extension of improved sericulture in collaboration with the sericulture center in Vientiane;
- d) Selection and multiplication of certified seeds at the station and distribution of the seeds to farmers through the extension office in each district;
- e) Training of extension workers and staff of the rice banks;
- f) Post evaluation of the model areas development will be conducted, which will be useful for preparation of actual plans and programs to be executed in the medium





and long-term development stages. During the preparation, the staff of the provincial and district offices will be trained to improve their technical and managerial capability, for continuous rural agricultural development, on their own in the future.

## 7. Irrigation Development Plan

### (1) Rehabilitation and Upgrading of the Existing Irrigation System

The main purpose of irrigation development in the model areas is the stable supply of irrigation water for wet season rice cultivation, especially at the beginning of the rainy season and at the time of peak water requirement usually in July, because available river water for dry season irrigation is very limited. The basic concept for planning irrigation development is summarized as follows :

- a) Unit irrigation requirement for wet season rice will be 0.89 lit/sec/ha, which is the basis for design of the irrigation facilities;
- b) The traditional brushwood weir will be replaced by a concrete permanent weir;
- c) The water distribution network in each model area will be newly constructed, except for the main canals in the Beng area which will be rehabilitated. The networks will consist of main and secondary canals. On-farm canals to small irrigation blocks will be constructed by farmers' groups under the technical guidance of the project office. To facilitate irrigation supply to such small blocks, offtakes will be provided on the secondary canal, each of which will supply 4 to 5 ha of rice field;
- d) The main canal will be of the stone masonry lining type;
- e) An O&M road will be provided along a main canal;
- f) New drains will be constructed, where required topographically.

The main features of irrigation development in each model area are as follows:

Item	Xai model area	Beng model area	Hun model area
Net irrigation area	302 ha	270 ha	201 ha
Diversion weir	N.Mao, L=60m, H=4.2m	N.Hao, L=40m, H=1.6m	N.Ngat, L=22m, H=1.8m N.Kham, L=40m, H=2.1m
Irrigation canal			
- Main canal	6.9 km	9.3 km	5.7 km
- Secondary canal	12.9 km	13.9 km	13.6 km
Drainage canal	7.0 km	6.3 km	9.2 km
River improvement	-	0.9 km	-

### (2) Strengthening and Improvement of the Meteo-hydrological Network

The following programs for strengthening and improvement of the existing meteo-hydrological network in the study area will be executed under the Scheme :

- a) Supply of additional equipment and instruments to the Xai meteorological observation station. The additional equipment and instruments to be supplied will include an automatic rain gauge, a recording anemometer, and an A-class evaporation pan;
- b) Construction of an additional meteorological yard in Beng district;



- c) Installation of additional rainfall recorders, one in a 250 km<sup>2</sup> catchment area, nine (9) sites in total;
- d) Installation of additional water level gauges in the five (5) main rivers.

(3) Improvement and Establishment of Water Users' Associations

It is essential to establish efficient water users' associations by organizing the existing farmers' groups in connection with the proposed irrigation development in the model areas. Two (2) new water users' associations in the Xai and Beng model areas will be organized, and re-organization of an existing association in the Hun model area will be required to cover the whole lowland rice field in the area.

## 8. Development of Social Infrastructures

(1) Rehabilitation and Upgrading of the District Roads

Two district roads will be rehabilitated as a model in developing the district road networks in the study areas. The road width will be expanded to 6.0 m with a gravel pavement carriageway of 3.5 m. The length of the district roads proposed to be rehabilitated and upgraded is as follows:

Area	Xai area	Hun area
Location	B.Nasao - B.Nale	Hun center - B.Somphon
Road length	1.9 km	7.5 km

(2) Construction of Rural Water Supply Facilities

Construction of three (3) rural water supply systems, one in each district, will be included in the Scheme, taking into account available water sources, population of beneficiary areas, and urgency of supplying clean water to 12 villages in and around the model areas. The beneficiary areas are as follows:

Area	Nos. of village	Name of village
Xai area	3	Nasao, Nale, Houay Khoum
Beng area	4	Phokeo, Pangdua, Nalai, Gnjo
Hun area	5	Somphon, Nakham-nua, Nakham-tai, Na, Mai

(3) Rehabilitation and Construction of Primary Schools

Four (4) Thaohom schools and eight (8) village primary schools will be rehabilitated and supplied with the required number of desks, chairs and blackboards for each school.

Area	Nos. of Schools	Nos. of Villages	Village
Xai area	5	5	Nasao, Nale, Houay Khoum, Cheng, Nale
Beng area	3	3	Phokeo, Thakat, Benglouang
Hun area	4	6	Somphon, Nakham-nua, Nakham-tai, Na, Mai, Somxai

## 9. Measures to Alleviate Environmental Problems

The following direct measures are proposed for alleviation of environmental problems due to slash-and-burn cultivation activities :

- a) Program for evaluation of shifting cultivation
- b) Reserved forest establishment program
- c) Program for management of uncontrolled fire



- d) Program for analysis of the minimum rotation cycle

## 10. Implementation of the Scheme

Implementation and O&M of the proposed Model Areas Scheme will be managed by the Project Office to be newly established under the control of the Ministry of Agriculture and Forestry. Close cooperation between the Ministries, agencies, and offices concerned in the Province as well as in Vientiane is essential for successful implementation of the Scheme. It is, therefore, proposed that a Coordination Committee be organized under the leadership of the Ministry of Agriculture and Forestry.

For construction of the Project Office, the authorities in the Province have proposed a bareland area covering 32 ha which is located in the eastern suburbs of Xai city. After completion of the civil works for the Scheme, the Project Office will be reorganized to establish the proposed integrated agricultural station for execution of various development programs that maybe implemented in the Scheme as well as in the medium and long-term development stages.

## 11. Cost Estimate

Total project cost was estimated at US\$15.54 million, consisting of US\$10.27 million in foreign currency and US\$5.27 million in local currency, as summarized as below:

Unit : US\$ 1,000

Major Item	F/C	L/C	Total
1. Preparatory works	578	334	912
2. Irrigation system	3,766	2,161	5,927
- Xai area	1,498	858	2,356
- Beng area	1,298	730	2,028
- Hun area	970	573	1,543
3. Social infrastructures	951	490	1,441
- District roads	416	169	585
- Rural water supply	371	78	449
- Primary schools	164	243	407
4. Agricultural station	754	479	1,233
5. Extension office	139	90	229
6. Rice bank	168	120	288
7. Equipment	1,559	0	1,559
Subtotal (items 1 - 7)	<u>7,915</u>	<u>3,674</u>	<u>11,589</u>
8. Administration cost	0	232	232
9. Engineering services	927	0	927
Subtotal (items 1 - 9)	<u>8,842</u>	<u>3,906</u>	<u>12,748</u>
10. Physical contingency	442	195	637
11. Price contingency	984	1,167	2,151
Total	<u>10,268</u>	<u>5,268</u>	<u>15,536</u>

Note : F/C means foreign currency. L/C means local currency.

## RECOMMENDATIONS

### 12. Early Implementation of the Model Areas Scheme

The proposed Master Plan for integrated rural agricultural development in the study areas includes various project components such as increase in agricultural productivity, development of physical infrastructures, institutional improvement, including the training of staff and farmers. The implementation of the Master Plan should, therefore, be made under well-designed stagewise programs. Thus, the Model Areas Scheme is proposed as the short-



term development program of the Plan for the purpose of establishing the core to demonstrate and evaluate the effects of the proposed agricultural development as well as the base for further expansion of the Scheme that will be carried out under the medium and long-term programs in the Plan. Therefore, early implementation of the Model Areas Scheme is strongly recommended.

### **13. Establishment of the Project Office and Close Cooperation**

A new Project Office and a Coordination Committee should be established for implementation and subsequent O&M of the Project including the Scheme. During the Project implementation, close cooperation between the ministries, agencies, and offices concerned is essential at all times, especially between NAEC (National Agricultural Extension Centre), NARC (National Agricultural Research Centre), and the Sericulture Pilot Station in Vientiane, under the control of the Coordination Committee with guidance from the Ministry of Agriculture and Forestry.

### **14. Measures to Alleviate Environmental Problems**

Although the measures aimed at alleviating environmental problems, due to slash-and-burn cultivation activities, will be implemented mainly by the integrated agricultural station, it is recommended that close contact be kept with the national agencies as well as the international economic cooperation organizations concerned in order to obtain data and information useful for successful implementation of the programs.

### **15. Integrated Support for Women's Groups**

Some support programs for women's groups related to the model areas were proposed, which will be implemented by periodical opening of women's schools in the extension offices of the districts. In addition, establishment of rice banks was also proposed, organizing the existing women's unions at the village level as a basis. It is recommended that an integrated support service be provided by the Project, Province, district, and village authorities for implementation of the program, especially for successful O&M of the rice banks.





Agricultural Development Project to Control Slash-and-Burn Cultivation  
in  
Oudomxay Province

**Final Report**  
**Volume I Executive Summary**

Table of Contents

LOCATION MAP

PROJECT DIGEST AND RECOMMENDATIONS

	<u>Page</u>
<b>I. INTRODUCTION</b>	
1.1 Background of the Project.....	1
1.2 Works Performed .....	1
<b>II. BACKGROUND</b>	
2.1 National Land and Population.....	3
2.2 Development Strategy for Agricultural Sector .....	3
2.3 Provincial and Rural Economy.....	4
<b>III. THE STUDY AREA</b>	
3.1 Location.....	5
3.2 Population .....	5
3.3 Climate.....	5
3.4 Soils.....	5
3.5 Present Land Use .....	6
3.6 Land Tenure System and Holding Size.....	6
3.7 Present Agriculture .....	7
3.8 Marketing and Processing .....	8
3.9 Agricultural Support Services.....	8
3.10 Present Irrigation System and Services .....	9
3.11 Social Infrastructures .....	10
3.12 Environmental Problems.....	12
<b>IV. STRATEGY AND POLICY FOR AGRICULTURAL DEVELOPMENT</b>	
4.1 Constraints .....	14
4.2 Potential .....	15
4.3 Overall Development Strategy and Policy .....	16



<b>V.</b>	<b>ACTION PLANS AND PROGRAMS FOR AGRICULTURAL DEVELOPMENT</b>	
5.1	Increase and Stabilization of Agricultural Productivity.....	18
5.2	Development of Agricultural Production Infrastructures.....	21
5.3	Development of Social Infrastructures.....	23
5.4	Measures to Environmental Problems.....	24
5.5	Support Services for Women's Group.....	26
<b>VI.</b>	<b>IMPLEMENTATION OF PROPOSED ACTION PLANS AND PROGRAMS</b>	
6.1	Short Term Development (Model Areas Scheme) .....	27
6.2	Medium Term Development .....	27
6.3	Long Term Development .....	28
6.4	Action Plans and Programs at Each Stage .....	28
<b>VII.</b>	<b>EVALUATION OF INTEGRATED AGRICULTURAL DEVELOPMENT</b>	
7.1	Agricultural Impacts.....	30
7.2	Socio-economic Impacts.....	31
7.3	Environmental Impacts.....	32
<b>VIII.</b>	<b>FEASIBILITY STUDY ON MODEL AREAS SCHEME</b>	
8.1	Present Conditions of Model Areas .....	34
8.2	Proposed Agricultural Development Plan .....	35
8.3	Irrigation Development Plan.....	39
8.4	Development of Social Infrastructures.....	42
8.5	Measures to Environmental Problems .....	44
8.6	Implementation and O&M of the Scheme.....	44
8.7	Cost Estimates of the Scheme.....	45
8.9	Evaluation of the Scheme.....	46
<b>IX.</b>	<b>RECOMMENDATIONS</b>	
9.1	Early Implementation of the Model Areas Scheme .....	50
9.2	Establishment of the Project Office and Close Cooperation .....	50
9.3	Measures to Environmental Problems .....	51
9.4	Integrated Support for Women's Groups.....	51

## **Annex 1 Scope of Work**



### List of Tables

		<u>Page</u>
Table 1	Population, Number of Village and Family in Each District .....	T-1
Table 2	Present Land Use in Study Area .....	T-1
Table 3	Average Size of Land Holding by Ethnic Group .....	T-1
Table 4	Inventory of Existing Irrigation System .....	T-2
Table 5	Land Use Condition in Northern Region and Oudomxay Province.....	T-3
Table 6	Present Land Use in Each District .....	T-3
Table 7	Action Plans and Programs for Integrated Agricultural Development .....	T-4
Table 8	Anticipated Rice Production.....	T-6
Table 9	Calculation of Foreign Exchange Saving and Magnitude of Forest Degradation .....	T-7
Table 10	Existing Irrigation System Related to Each Model Area .....	T-8
Table 11	Main Features of Irrigation Development in Each Model Area.....	T-9
Table 12	Development Plan of Rural Water Supply System .....	T-10
Table 13	Rehabilitation Plan of Primary School .....	T-11
Table 14	Cost Estimates of Model Areas Scheme .....	T-12
Table 15	Farm Household Economy under Without-Project Condition .....	T-13
Table 16	Farm Household Economy under With-Project Condition .....	T-14

### List of Figures

Fig. 1	Overall Implementation Schedule of Integrated Agricultural Development .....	F-1
Fig. 2	Proposed Cropping Patterns in Model Areas .....	F-2
Fig. 3	Organization and Cooperation Line of Proposed Rice Bank .....	F-3
Fig. 4	Proposed Organization of Agricultural Station and Authorities Concerned.....	F-4
Fig. 5	Proposed Irrigation Development in Xai Model Area .....	F-5
Fig. 6	Proposed Irrigation Development in Beng Model Area.....	F-6
Fig. 7	Proposed Irrigation Development in Hun Model Area.....	F-7
Fig. 8	Development Plan of Social Infrastructures in and around Model Areas.....	F-8
Fig. 9	Proposed Organization of Project Office .....	F-9
Fig. 10	Implementation Schedule of Model Areas Scheme.....	F-10



## ABBREVIATIONS

ADB	:	Asian Development Bank
CTPC	:	Communication, Transportation, Post and Construction
GDP	:	Gross Domestic Product
EC	:	European Community
FAO	:	Food and Agriculture Organization, UN
FCM	:	Farmer and Community Managed (Irrigation Schemes)
HDP	:	High Density Polyethylene (Pipe)
JICA	:	Japan International Cooperation Agency
Lao PDR	:	Lao People's Democratic Republic
LXB	:	Lane Xang Bank
MAF	:	Ministry of Agriculture and Forestry
MCTPC	:	Ministry of Communication, Transportation, Post and Construction
NAEC	:	National Agricultural Extension Centre
NARC	:	National Agricultural Research Centre
NEM	:	New Economic Mechanism
NGO	:	Non-Government Organization
NOEP	:	National Office for Environment Protection
O&M	:	Operation and Maintenance
SIDA	:	Swedish International Development Agency
UNDP	:	United Nation Development Program
UNICEF	:	United Nation Children's Fund
4-WD	:	Four Wheel Drive





## ABBREVIATIONS OF MEASUREMENT

### Length

cm = Centimeter  
m = Meter  
km = Kilometer

### Area

cm<sup>2</sup> = sq.cm = Square centimeter  
m<sup>2</sup> = sq.m = Square meter  
km<sup>2</sup> = sq.km = Square kilometer  
ha = Hectare

### Volume

cm<sup>3</sup> = cu.cm = Cubic centimeter  
lit. = Litre  
m<sup>3</sup> = cu.m = Cubic meter

### Weight

mg = Milligram  
g = Gram  
kg = Kilogram  
ton = Metric ton

### Time

sec = Second  
min = Minute  
hr = Hour  
yr = Year

### Electric Measures

W = Watt  
kW = Kilowatt

### Other Measures

% = Percent  
°C = Degree in Centigrade  
10<sup>3</sup> = Thousand  
10<sup>6</sup> = Million

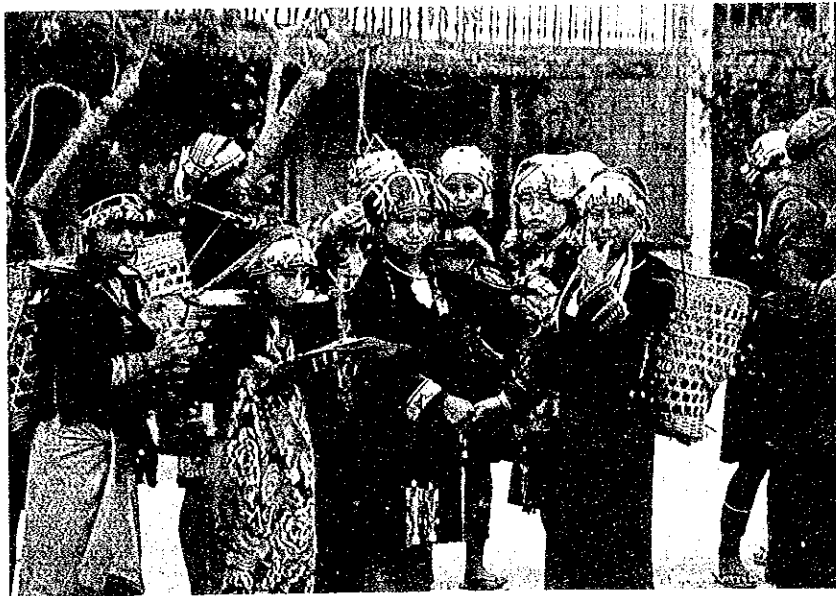
### Derived Measures

m<sup>3</sup>/sec = Cubic meter per second  
lit./sec = Litre per second

### Exchange Rate

US\$ 1 = Kip 715 = Yen 125





Lao Sung ladies



## **I. INTRODUCTION**

### **1.1 Background of the Project**

Recently, the Lao People's Democratic Republic (Lao PDR) has had serious problems with the decrease of forest areas in the mountainous and hilly zones, especially in the northern and eastern parts of the country, which arise mainly from the expansion of slash-and-burn cultivation due to increase in population. The problems also accelerate the devastation of vast forest areas, serious soil erosion, deterioration of potential water resources and land productivity, and environmental problems, which largely affect national socio-economic activities and development.

In order to cope with these situations, the Government of Lao PDR has decided to take various measures for control of slash-and-burn cultivation through increase in crop production and farm income of the farmers by introducing and expanding irrigated farming especially in lowland area, improvement and construction of both agricultural and social infrastructures, strengthening of agricultural support services, and improvement of marketing system of farm products. In order to support these measures, the Government requested the Government of Japan, in 1989, to carry out a master plan study on agricultural development in Oudomxay Province (the Province). In response to the request of the Government of Lao PDR, the Government of Japan decided to conduct the Master Plan Study (the Study) on the Agricultural Development Project in the Province, and the Japanese Government sent a JICA (Japan International Cooperation Agency) preliminary survey team in October 1991. The Scope of Work and Minutes of Meeting were thus agreed upon and signed on 10th October 1991 (see Annex 1 of this report).

### **1.2 Works Performed**

The Study was carried out in two phases, i.e. Phase-I and Phase-II. Phase-I field work, during the period from March to mid-June 1992, included various investigations and some study works for preparing the basic concept of the proposed agricultural development in the study area. Phase-I office work was made in Tokyo to prepare the Interim Report which included all the study results of Phase-I works. Phase-II field work was conducted for two and a half months from mid-October to the end of December 1992, which included additional collection of various data and information, and the field surveys required for the feasibility study on the model areas as well as to finalize the Master Plan.



The results of field surveys and studies so far made at the site were further elaborated in Tokyo and all the results are compiled in this Final Report. The Report consists of Volume I Executive Summary, Volume II Master Plan Study, Volume III Feasibility Study on the Model Areas Scheme and Volume IV Drawings.





## **II. BACKGROUND**

### **2.1 National Land and Population**

Lao PDR is a landlocked country. It occupies an area of 236,800 km<sup>2</sup> and is bordered by the People's Republic of China and Myanmar to the northwest, Vietnam to the north and east, Democratic Kampuchea to the south, and Thailand to the west. About 75% of the land surface is mountainous and in these areas only the narrow valleys are suitable for cultivation. About 380,000 ha are lowland rice field, and about 215,000 ha are for upland rice field including slash-and-burn cultivation areas. About 260,000 ha are for other crops, of which 20% is coffee. Pasture and range land is about 800,000 ha.

According to the 1985 census, the population was 3,618,000 in that year and growing at an annual rate of 2.8 to 2.9%. The estimated population in 1988 was 3.94 million, based on a 2.8% growth rate. Based on the same growth rate, the population in the year 2000 is expected to be 5.5 million. About 85% of the population is rural and widely dispersed in over 11,000 villages, with an average population density of 17 per km<sup>2</sup>. Despite this, about half the population is concentrated in the Vientiane plain and in Savannakhet, Champasak and Saravane provinces. The population comprises the three main ethnic groups. The lowland Lao or "Lao Loum" occupies about 50% of the population, and indigenous and immigrant minority groups make up the remaining 50%. The upland Lao or "Lao Theung" groups are migratory and mostly practice slash-and-burn cultivation. The highland Lao or "Lao Sung" is also engaged in shifting cultivation at higher elevations.

### **2.2 Development Strategy for Agricultural Sector**

Agriculture is the mainstay of the national economy, the sector produced, in 1990, about 60% of Gross Domestic Product (GDP) followed by services sector of about 24% and industry sector of about 16%, respectively. GDP per capita in 1990 is estimated at about US\$126 equivalent (1989 constant price). In 1985, the government initiated a reform of its system of economic management. The objectives under the New Economic Mechanism (NEM) are to improve the public sector enterprise management and increasing the role of the private sector. NEM is the basic foundation for the entire development strategy of Lao PDR.

The objectives of the agricultural sector contained in the development strategy under NEM are (i) to ensure food self-sufficiency and food security; (ii) to reduce the area subject to slash-and-burn cultivation; (iii) to properly manage and conserve forest resources; and (iv) to expand the agro-forestry based industrial processing sector. As the major share of



national production, agricultural production should further be expanded, especially to address the problem of food shortage and inadequate nutrition, while diversifying production through the promotion of cash crops cultivation. To this end, the area under irrigation should further be expanded, and efforts should also be continued to improve crop yields through research, extension services and use of modern farm inputs.

The strategy for irrigation development will be (i) to curtail the flow of resources into high cost larger-scale irrigation systems; (ii) to turn these public sector schemes to the farmers communities as much as possible; and (iii) to concentrate on a much more moderate level of resources on the support of water users associations which control their irrigation systems. In this connection, efforts will be made to improve the efficiency of existing irrigation systems through rehabilitation and maintenance.

### **2.3 Provincial and Rural Economy**

Agriculture is the main industry which employs more than 95% of the total population of the Province. Rice is the people's staple food and the main agricultural product, followed by sesame and other minor crops such as beans and some vegetables. Rice is cultivated in the lowland rice field with irrigation or under rainfed condition, and also cultivated in the upland rice field (slash-and-burn cultivation). The total area of lowland rice field in 1991 was about 9,800 ha and that of upland rice field was about 31,000 ha. The production of rice in the lowland and upland in the Province was about 26,600 tons and 41,000 tons in paddy, respectively. According to the study on food balance, paddy production in the Province is not sufficient to fulfill the consumption in the Province. About 9,000 tons of paddy is short per year on an average. The production of paddy in the study area is also short to fulfill the people's consumption in the area. The shortage of paddy has increased every year and the deficit was about 7,000 tons on an average in recent years.

Livestock such as buffalo and cattle is important product for export as well as for farm power and local consumption. The number of buffalo and cattle in 1990 in Oudomxay was about 80,400 and 57,000, respectively. Beside the products in the farms and of livestock, the people collect various kinds of forest products such as cardamom, benzoin, bamboo shoot, mushrooms, and many kinds of animals and fishes.



### **III. THE STUDY AREA**

#### **3.1 Location**

The Study covers lowland and hilly area, except for top mountain area, in three (3) districts of the Province, namely, Xai, Beng and Hun. The Province is located in the north of Laos and is bordered by five (5) provinces of Luang Namtha, Bokeo, Phongsali, Saiyabuli and Luang Prabang (see Location Map). The above three districts are located along the Nam Mao and Nam Beng rivers and have a total geographical area of about 558,000 ha. The National Road No.2 connects Xai, Beng and Hun districts from north to south, and reaches Ban Pakbeng located at the river side of the Mekong. The distance from Xai, which is the administrative and marketing center of the Province, to Beng and Hun district centers is about 60 km and 100 km, respectively, along the Road No.2.

#### **3.2 Population**

According to the basic statistics (1983-1991), the population of the Province in 1991 is 290,250, about 7% of total population of Laos. The population of the study area is estimated at 101,270 in 1991, consisting of 30% of Lao Loum, 58% of Lao Theung and 12% of Lao Sung. Details of the population, and number of villages and families in each district of the study area are shown in Table 1.

#### **3.3 Climate**

Mean annual rainfall is 1,221mm and 81% of it falls in monsoon season from May to September. Mean annual temperature is 23.4°C, which is cooler than those in Vientiane and Luang Prabang. The highest temperature of 36-38°C occurs in April or May. The period from December to February is cool, and the lowest of 4-6°C occurs during this period. No frosts have been reported in the study area. Relative humidity is high from June to September, and 80% of relative humidity is an annual average. Annual sunshine hour is 1,700 hours on an average (for details, refer to ANNEX-MA of the Master Plan Study, Volume II).

#### **3.4 Soils**

According to the physiographic condition, soils in the study area are broadly classified into three units, namely (i) alluvial fans, (ii) lower terraces, and (iii) steeply dissected mountain areas.



In general, the topography of alluvial fans is almost flat to gently sloping. The soils are deep and present good physical conditions. The texture class varies from sandy loam to clay. The natural fertility varies from moderate to low, and organic matter contained in the surface horizon is medium. Most of the alluvial fan areas are being used for lowland rice cultivation. The lower terraces are mostly located on the foot of hills or mountains, just in slightly higher position than the alluvial fans, and the topography is gently undulated. The soils present good physical conditions with well to moderate internal drainage. The lower terraces are used more intensive than the high mountain under slash-and-burn cultivation, and generally the shifting cycle is one year planting and three years fallow. The mountain areas present very rough topographic condition with steep slopes. The soils are shallow to moderately deep with loam to sandy clay texture, and are leached mostly with acidic reaction. The natural fertility is very low. These soils are being used for shifting cultivation (for details, see ANNEX-MB of the Master Plan Study, Volume II).

### **3.5 Present Land Use**

The Province is a mountainous area, and Xai, Beng and Hun districts as well. Some 86% of the Province is dominated by hills and mountains rising to more than 1,000 m in elevation. The remaining 14% is composed of the valley flat land and adjacent upland of the tributaries of the Mekong. Out of 5,580 km<sup>2</sup> of total land area of the three districts, about 201,405 ha (36.1%) are considered arable, of which the annual cropped area is estimated at about 19,355 ha, including 3,100 ha of lowland rice field, 12,750 ha of upland crops and 3,505 ha of other crops. The slash-and-burn cultivation areas being left fallow are estimated at about 140,000 ha (25.1%), and the remaining 398,545 ha (71.4%) are covered with forests and others. The present land use in the study area is summarized in Table 2.

### **3.6 Land Tenure System and Holding Size**

Officially, the basic principle is that land cannot be privately owned ; it can only be "the property of the national community represented by the State". According to the recent Decree No.117 on Management and Use of Forests and Forested Land published in 1989, the people have the right of usufruct or the right of use of the land, but no right to buy or sell the land.

The average holding size of lowland rice field by Lao Loum is about 0.4 to 0.5 ha per farm household, while the area of upland held by one farm household of Lao Loum is about 0.24 to 0.6 ha. The holding size of lowland rice field of Lao Theung and Lao Sung is very small as compared to that of Lao Loum. On the other hand, the holding size of upland





rice field is larger than that of Lao Loum (see Table 3). By these data, it is clear that the farmers' economy of Lao Loum largely depends on the lowland rice farming, but still needs to cultivate upland rice, while the economic activities of Lao Theung and Lao Sung are mostly dependent on the upland rice farming by slash-and-burn cultivation.

### 3.7 Present Agriculture

Similar to other districts in the Province, the main crop grown in the study area is rice, and cultivated area of both lowland and upland rice occupies more than 80% of total cropped area mainly for home consumption. The cultivated area of upland rice equals to about 83% of total rice cropped area. The glutinous rice is dominant throughout the study area, and non-glutinous rice is cultivated in the limited areas.

Maize, cassava, sweet potato and taro are grown mixed with upland rice. Especially, maize is the important food crop to supplement the shortage of rice. Cotton is also cultivated mainly by Lao Loum groups in small flat upland adjacent to the villages, mostly for home consumption. Cultivation of some cash crops such as sesame, legumes, tobacco and garlic is increasing in recent years.

Average yield of both lowland and upland rice is still very low, which is about 1.6 tons/ha in paddy. It is reported that average crop yield of lowland rice and upland rice is 2.8 tons/ha and 1.4 tons/ha in paddy, respectively. Production of rice in recent years is as follows:

Year	Harvested Area (ha)		Production (ton)		Yield (ton/ha)	
	Lowland	Upland	Lowland	Upland	Lowland	Upland
1987	2,360	13,460	5,990	18,150	2.5	1.4
1988	2,490	12,900	6,960	17,570	2.8	1.4
1989	2,490	11,990	7,460	16,240	3.0	1.4
1990	2,580	12,220	7,560	17,040	2.9	1.4
1991	3,050	12,750	8,600	16,620	2.8	1.3
Average	2,590	12,670	7,310	17,120	2.8	1.4

Note: Yield is estimated on the basis of data obtained from the district offices.

Similar to other northern provinces of Laos, livestock sector in the Province as well as the study area has a significant importance to the economy of farmers. The present livestock raising is dominated by small-holders who own small number of livestock as part of the subsistence agriculture. Livestock in the farmer's economy is used to supply animal protein, for farm works, to gain cash income, etc. The livestock production is also one of the main export items in the study area, especially to Thailand. Buffalo is the main livestock as draft animal for farming and also for sale. Cattle is usually not used for farming, but for sale



to get cash for special expenditures in the farmer's livelihood and also for export mostly to Thailand.

Detailed information on the present agriculture in the study area is presented in ANNEX-MD of the Master Plan Study, Volume II.

### **3.8 Marketing and Processing**

Under NEM policy, marketing and prices of farm inputs and outputs are not controlled by the government and market-oriented prices are prevailing. Main product in the study area is rice, and it is marketed through private channels mostly within the Province. The main agricultural products exported to Thailand from the area are buffalo, cattle, sesame and cardamom, and those exported to China are sesame and cardamom. The Province imports various kinds of daily consumables, construction materials, industrial products and medicines, etc. Marketing system of agricultural inputs in the area has not been established yet. Farmers are not accustomed to apply chemical fertilizers and other modern farm inputs, because the marketing channel and prices of farm inputs such as fertilizers and agro-chemicals have not been formulated yet.

Most important agro-processing activity in the study area is rice milling. There are privately owned rice mills in the villages. The number of rice mill in each village of the study area was surveyed and about 20% of villages in number has rice mill in their villages. Most of families are willing to use rice mill, but still pounding method is the major part of rice milling for home consumption in many villages.

### **3.9 Agricultural Support Services**

Actually, no extension services by the government institutes are being provided for agricultural improvement in the study area mainly due to lack of well-organized agricultural extension system and manpower as well as sufficient budget. At the central government level, Agricultural Extension Agency has been established under the Department of Agriculture and Extension in early 1992. All the provincial and district offices of agriculture and forestry will be centralized into this national system. These provincial and district offices will have a primary function for providing extension services for disseminating agricultural techniques and supplying planting materials improved through research and multiplication activities. Agricultural extension services in the study area are currently under the responsibility of agriculture and forestry section of each district. However, the section has no qualified extension workers and sufficient facilities.



There are no farmer's organizations established in the study area under the government arrangement other than village committee, village unit (Nuay in Lao) and women's union. The farmer's organization aiming at economic or social activities is also not formulated yet in the study area as well as in the Province.

There are formal and informal agricultural credit systems covering the study area. The formal credit system is handled by the Lane Xang Bank (LXB), while the informal credit system is operated by villages. LXB has Oudomxay provincial branch office located in Xai city and a district branch office in Hun town, and is lending rural credit covering the study area. There are informal credit systems such as rice bank and monetary fund for rural credit. The rice bank is customary system mostly operated by each village, and any family of village who is short in food is allowed to borrow paddy with some interest rates which vary village by village. Some villages have a monetary fund. The member of village can borrow money from the fund for purchase of food (mainly paddy) or for commercial activities with an interest rate of 3 to 5% per month.

### **3.10 Present Irrigation System and Services**

Most of the existing irrigation systems in the study area are farmer and community managed scheme (FCM scheme) with a small-scale indigenous brushwood weir constructed by users themselves. However, the brushwood weirs are easily washed away at flood times. The farmers' groups re-construct such weirs two times on an average during the operation period. The re-construction of weirs requires heavy labour input by the water users. The canal networks in these schemes are also constructed by the farmers and communities themselves, mostly without proper survey and design. Therefore, canal alignment and design are very primitive. Due to lack of canal structures, in addition, flow distribution is erratic and often affected by cross-drainage flows that may lead to canal breaches and/or silting. It can be said that all of these FCM schemes are in a great need of improvement and rehabilitation. The existing FCM schemes in the study area are 66 schemes in Xai district, 34 schemes in Beng and 22 schemes in Hun, covering 1,360 ha of lowland rice field in total. Since water availability in these schemes is limited to very small or nearly nil in the dry season, most of the schemes are not used for dry season farming.

In addition to FCM schemes, there are also medium size irrigation systems with more than 51 ha of command area. These systems include those with permanent concrete weir constructed by the Province and financial assistance from the Lao Quaker services, and also those with the people's brushwood weir constructed by farmers themselves. The command area of most of these systems is less than 100 ha. The weirs constructed by the Province and



other organizations, all of them are concrete permanent weir, are handed over to the village communities concerned. These medium systems in Xai, Beng and Hun districts are three, six and four, respectively, with a total irrigation area of 1,302 ha.

The total number of existing small-scale and medium size irrigation systems in the three districts is 135 with a total irrigation area of 2,662 ha (see Table 4), which means that an average command area of a system is estimated at about 20 ha.

The public services for irrigation development in Oudomxay are provided by the irrigation section in the Department of Agriculture and Forestry of the provincial administration. The irrigation section consists of three units for planning, survey/design and irrigation construction company (the state enterprise). Fifteen staff which include two engineers, nine assistant engineers and four technicians are working with the irrigation section. The activities of the irrigation section are still very limited because of budget problem and of the mountainous province where flat land suitable for irrigation development is also limited. The district offices also have irrigation staff. However, the services by each district are very limited mainly because of insufficient budget and lack of qualified technical staff.

It is policy in all provinces that the cost for O&M of the irrigation systems should be born by the water users. All of the existing irrigation systems in the study area are operated and maintained by the farmers and communities themselves. According to the recent information on the water users' organization, four (4) organizations are formally established and authorized by the district in the study area. Even in the irrigation systems where water users' organizations are not yet established, farmers participate in repair and maintenance of the weirs and canals under the leadership of the village community. These traditional system will be the base for establishing new water users' organizations after the existing irrigation systems are improved and up-graded under the Project.

ANNEX-MF of the Master Plan Study, Volume II, presents the detailed information on the existing irrigation systems and services in the study area.

### **3.11 Social Infrastructures**

National roads Route No.1, 2, 3, 4 and No.13-B connect Xai city directly and/or indirectly with the main cities in the adjacent provinces of the north. Especially, the Route No.2 (Xai to Pakbeng, a total length of 138 km) goes down approximately in the centre of the study area from north to south-west, playing a key role in all activities of the people in the study area. Because of little or almost no maintenance work, however, the road conditions





are very poor with many holes. In view of the importance of these national roads, the rehabilitation project for Routes No.1, 2, 3 and 4 has just started in 1992 with a finance of ADB and will be completed in 1995.

The total length of existing district roads in the three districts is 202 km, which are mostly constructed by the farmers' labour force with a technical supervision and some materials and tools from the provincial and district offices. However, the conditions of existing district roads are very poor. The necessity of these roads are very high especially for the remote people, because the road is the only one communication system for economic and other social-welfare activities. In addition to the existing district roads, new construction of district roads with a total length of 298 km is proposed as the future plan by the district offices. These planned roads are presently footpaths and almost are not yet surveyed for proper road alignment.

There are two types of water supply systems in the study area : one is operated by the water supply section of the Department of MCTPC, so-called "Nam Papa (urban water supply system)", in Xai city, and the other is "Rural Water Supply System" managed by the village and district office, which is under the supervision of the Department of Public Health. There are five (5) existing gravity flow pipe systems in the study area, which were constructed with an assistance from Quaker and UNICEF. Out of the total 435 villages in the study area, the people in 36 villages only can use domestic water from these existing rural water supply systems. Almost all lowland villagers along Route No.2 depend entirely on nearby streams and rivers for their drinking and domestic water. Only the limited lowland villages have access to spring sources, and shallow dug wells are also very rare. Most of these sources are facing to fecal pollution and other types of contamination problems from human and animal origins.

Only one public electricity supply system in Xai city is available in the study area. The electricity supply service is operated and managed under the provincial authority of the Department of Industry and Handicraft. The system started the electricity supply service in February 1991. The capacity of generator plant is 100 kW (two units of 50 kW generators). There is only one micro-hydropower plant for rural electricity supply in Beng town. The plant was completed in June 1992 with an economic assistance by the People's Republic of China. The total generating capacity is 6 kW (2 units of 3 kW), and continuous operation was started from early November 1992.

School facilities and education situation are very poor in the study area, especially in mountainous areas. Although the number of primary school seems to be sufficient, about



50% of the existing primary schools has only class I and/ or class II. And 70% of pupils entered the primary schools ceases to learn by class II, though the compulsory education period is five years in Laos. School houses and their equipment are also very poor because of lack of finance.

Community facilities (houses) exist almost in each village along Route No.2. In the villages which do not have such community facilities for their exclusive use, the villagers utilize a school or village leader's house as community facility, whenever necessary. The facilities are used for important village communications such as discussions about cooperative activities for farming practice, construction and maintenance of irrigation facilities, roads and schools, and transferring official announcements from the Province and districts, etc.

The detailed information on these existing social infrastructures is shown in ANNEX-MG of the Master Plan Study, Volume II.

### **3.12 Environmental Problems**

It is understood that the present major environmental issue in the northern region including the Province as well as the study area is the destruction of forests mainly due to slash-and-burn cultivation and its related activities of rural people. According to data on the extent of forest and slash-and-burn cultivation, the destruction of forest in the Province seems to be serious as compared with those in other provinces in the northern region, because the proportion of forest in the region accounts for 36% in 1988/89, but the Province accounts only for 29% even in 1981/82 (see Table 5). Some information on the situations of forest destruction in the study area is summarized as follows (for details, see ANNEX-MH of the Master Plan Study, Volume II) :

- (a) It seems that the destruction of forests by slash-and-burn cultivation in the study area is serious, but not critical at present. However, the forests in Xai and Hun districts will be affected directly by slash-and-burn cultivation activities because of limited extent of bamboo as a buffer (see Table 6). The forests will be considered to put themselves in danger of accelerated destruction without any measures to control the slash-and-burn cultivation area.
- (b) Useless burning of enormous lands is practiced by the rural people due to uncontrolled slash-and-burn activities in the study area. The lands under such a useless burning are estimated at more than 28,000 ha in 1989/90.



This may cause a rotation cycle more shorter in the study area and degradation of soil fertility.

- (c) The destruction of primary forests seems to be not so serious. According to the aerial photo interpretation, most of the primary forests are located on steep slopes in the mountainous area so that they could not be affected so seriously by slash-and-burn cultivation activities.



## **IV. STRATEGY AND POLICY FOR AGRICULTURAL DEVELOPMENT**

### **4.1 Constraints**

Most of the constraints which are crucial to profitable agricultural development in the study area are due to insufficient agricultural support services for the farmers that should be provided by the government offices concerned.

Despite the fact that the existing crop fields in both lowland and hill area have a potential of increasing crop yields especially rice, no packages of farming techniques have been developed, based on field trials of crop varieties, appropriate planting time and fertilizer practices suited to the differences in the physical conditions. Since there is no basis of researched techniques, credible extension services for increase in crop production by farmers could not be provided sufficiently by the offices concerned. In fact, almost all the farmers in the study area are presently isolated from receiving information and technology useful for increase in their crop production.

Availability of certified seeds is also very limited. Farmers are using their own seeds of local varieties. The shortage of improved seeds is a constraint to the increase in crop production by farmers. Because agricultural technicians and farmers are becoming aware of the benefits of fertilizer and agro-chemicals, demand for these farm inputs has increased and is expected to continue to increase. In the study area, however, such fertilizers and agro-chemicals are not used even for lowland rice as well as for upland crops, because actually no services for supply of these materials are provided by the government institutes.

Most of the existing lowland rice field is served by traditional irrigation facilities constructed by farmers themselves, except for very limited number of schemes with concrete permanent weir. The conditions of traditional irrigation facilities are very poor: the weirs are constructed using wood, bamboo and soils which are easily washed away at flood times, and the canal system constructed by farmers group is also very poor. In addition, most of the schemes have no secondary and tertiary canals as well as farm road network for O&M of the irrigation scheme. These poor conditions of the existing facilities are the constraint to stable and timely supply of irrigation water as well as to develop production potential.

Farmers presently consider that they are suffering from the unstable market needs, because no efficient organizations have been established yet to trade farm inputs especially fertilizers and agricultural chemicals as well as farm products. Because of poor road and transportation facilities especially for villages in the hilly areas, villagers live under very





isolated conditions, and they are not willing to introduce crop diversification because of poor access to markets. Due to lack of roads, communication facilities and organizations in order to disseminate accurate information on the market needs, in addition, farmers are kept without relation with the markets.

The main constraint to increased livestock production is the high mortality rate arising from a high incidence of diseases. Even though most livestock are not vaccinated and at considerable risk, there appears to be a largely unsatisfied demand for credit for livestock purchases.

#### **4.2 Potential**

In the study area, there is a potential for a substantial increase in agricultural production which results in the improvement of family incomes and living standards of the farmers.

The lowland fields have a high potential for increase in crop yields especially rice through the application of improved farming practices. Especially the productivity of the currently irrigated lowland could be improved by introducing improved varieties and use of fertilizer, and by increasing the intensity of land use through improvement and up-grading of the existing irrigation systems for both wet and dry season cultivation. In addition, construction of new irrigation systems will increase the productivity in lowland fields currently under rainfed farming as well as in the remaining unused lowland suitable for permanent agriculture. According to the irrigation section of the Province, 13 flat valley bottoms with a total irrigable area of about 438 ha being used for rice cultivation mostly under rainfed condition are identified in the study area for the future development. However, they are scattered in very wide area, and the access to such valley bottoms is very poor with small footpath only. In addition, some lands covered with bush in most cases are found in Hun district and are estimated at about 600 ha by using 1/50,000 topo-maps. These lands could be developed for irrigated lowland farming, depending on the availability of water from the adjacent rivers.

The uplands especially in gentle-sloping hill areas also have a potential to stabilize their agricultural productivity which could be developed by introducing the improved upland farming and appropriate varieties of crops suitable for physical and vegetative soil conservation. According to soil and land classification study, these uplands with a land slope of less than 12% are estimated at about 3,500 ha in the three districts.



The productivity of the present small livestock could also be improved by strengthening the present veterinary services especially for control of animal diseases.

#### **4.3 Overall Development Strategy and Policy**

The strategy and policy for successful implementation of the proposed rural agricultural development hinge on the elimination or alleviation of various constraints and should reflect the NEM policies. In addition, the final targets of the proposed agricultural development can only be achieved through comprehensive development of not only direct measures for increase in agricultural productivity but also other supporting measures such as strengthening of the government institutes, improvement of rural socio-economic conditions in the study area, etc. This suggests that the Master Plan be formulated in a form of "the integrated and balanced rural agricultural development". The essential policies to be taken for this purpose will be as follows :

- (a) Increase and stabilization of agricultural productivity
  - (b) Development of agricultural production infrastructures
  - (c) Development of social infrastructures
  - (d) Measures to environmental problems
  - (e) Support for women in development
- (1) The increase and stabilization of agricultural productivity through elimination or alleviation of various agricultural constraints that currently exist is considered to be the single most important factor in contributing to the control of slash-and-burn cultivation. The essential plans to achieve this purpose will be (i) improvement and strengthening of extension services; (ii) strengthening of veterinary services; (iii) establishment of efficient marketing system; and (iv) establishment and operation of an integrated agricultural station.
- (2) The development of agricultural production infrastructures should also have a high priority. The rehabilitation and upgrading of the existing traditional irrigation system including replacement of the existing brushwood weir by a permanent one and new construction of well-designed irrigation canal network are the basic requisite for increase and stabilization of crop production. In addition, new irrigation development should be considered in the existing flat valley bottoms being used for rice cultivation, unused



lowland suitable for permanent agriculture and uplands in gentle-sloping hills, depending on available river water for irrigation.

- (3) Further development of social infrastructures, especially the facilities for people's welfare, education and for promotion of farmers' progressive activities related to the increase in agricultural productivity, should also be taken into consideration in connection with the proposed rural agricultural development. Such a development will be the rehabilitation and grade-up of existing district road network, construction of additional rural water supply system, and improvement and construction of primary schools and village community facilities.
- (4) As already mentioned, the major environmental problem in the study area is the destruction of forest mainly due to slash-and-burn cultivation and its related activities of the farmers. To control such a destruction, some measures should be taken, which should also be the ones to expect favourable response with low input.
- (5) Women especially in rural areas play an important role in farming and in some cases they are working harder than men. Because the government services to support the women's activities are still limited, more effective services will have to be provided for acceleration of their socio-economic activities, as discussed in detail in the following Chapter V.



## **V. ACTION PLANS AND PROGRAMS FOR AGRICULTURAL DEVELOPMENT**

On the basis of the strategies and policies for the integrated rural agricultural development, action plans and programs for the development are proposed as shown below. Details of the action plans and programs proposed for integrated rural agricultural development in the study area are shown in Volume II "Master Plan Study".

### **5.1 Increase and Stabilization of Agricultural Productivity**

The action plans and programs to achieve the purpose of increase and stabilization of agricultural productivity will be as follows :

#### **(1) Strengthening of Agricultural Support Services**

This project component will include (i) strengthening of extension services; (ii) strengthening of veterinary services and its extension; (iii) improvement of marketing system and services; (iv) establishment of farmer's organization and (v) strengthening of the agricultural support sections in both the Province and district offices.

In order to provide more extension services for farmers, the Project will provide various supports (i) to strengthen the existing extension sections of Beng and Hun district offices; (ii) to station additional extension workers at such sections; (iii) to extend and settle the improved farming techniques for more rice production in lowland field; (iv) to arrange programs for women; and (v) to promote sericulture.

The present technical and managerial capability, staffing and facilities of the provincial and district offices are weak to provide appropriate extension services for the farmers that are inevitable to achieve the increase in agricultural productivity. A nation-wide plan for the institutional improvement has been studied by the international institutes in Laos. In line with such a nation-wide plan, the Project will provide the following support services (also refer to Sub-chapter 8.2, Section (2)) :

- (a) Office building with storage for exclusive use for extension services will be constructed at Beng and Hun district office to strengthen the activities for services to the farmers, including supply of some equipment such as motorcycle and office facilities. In this connection, additional extension workers at least two staff will be stationed at each office.





- (b) Services for distribution of certified seeds, demonstration of pest-disease control and soil improvement, and training of farmers groups will be provided for extension of improved and intensified farming in lowland rice field.
- (c) Women's school will be arranged and operated to provide various support services to accelerate their activities (for programs in the women's school, refer to Sub-chapter 5.5).

The plan for strengthening of veterinary services will be further extension of vaccine injection for disease control of livestock and promotion of veterinary services to the farmers.

The improvement of organization and system for marketing of farm inputs and outputs is one of the important factors for increase in agricultural productivity as well as for promotion of crop diversification. The Province has supporting sections for marketing activities, the Department of Commerce and Tourism in the provincial office and the Section of Commerce in the district office. Actually, however, the department as well as the section are not functioning efficiently because of the limited budget and low managerial capability. Improvement and strengthening of the office facilities and staffing of these institutes will be the first step to provide the support services for organization and establishment of efficient marketing system. Under the Master Plan, programs for improvement of the existing marketing system and services will include (i) training of the staff in the offices concerned; and (ii) improvement of the office facilities with supply of necessary equipment and instruments.

Under the free market system, it is essential to produce the commodities with good quality and appropriate quantity to meet the market requirements, and to ship constantly and/or timely every year according to the market situations. For these purposes, a well-rationalized marketing system will have to be established by organizing the farmers groups (as producer and user) to control quality and quantity of products so that the farmers can negotiate with traders on the appropriate prices of products as well as of inputs through the organization. Such a farmers organization will be called tentatively as rice bank and be established in each district in connection with the development of the model areas. For this purpose, office building, storage and drying yard will be constructed for each rice bank, including supply of equipment such as rice mill, sesame cleaner and office facilities (refer to Sub-chapter 8.2, Section (3)).



(2) Establishment and Operation of Integrated Agricultural Station

It is essential to establish and operate an integrated agricultural station in order to develop packaged farming techniques for both lowland rice and upland crops, based on various field trials of crop varieties, appropriate planting time, fertilizer practices, weeding, etc. suited to the differences in the physical conditions of the study area. This station will be opened in the suburbs of Xai city and near to Xai Model area, through re-organization of a project office to be established for the purpose of implementing the proposed model areas development. The activity programs to be carried out in this station will be as follows (refer to Sub-chapter 8.2, Section (4)) :

- (a) Study and research works for development of information and farming techniques on (i) lowland rice; (ii) upland crops in gentle sloping hills; (iii) alley cropping, agro-industry and other appropriate farming in steep sloping hills; and (iv) introduction and extension of improved sericulture.
- (b) Training of extension workers and the staff of rice banks, and multiplication and distribution of certified seeds and seedlings.
- (c) Operation and maintenance of the project facilities in the model areas such as irrigation system and road network.
- (d) Study and preparation of concrete action plans and programs to be executed at the medium and long term development stage for further improvement and strengthening of marketing system, veterinary services, preparation of measures to environmental problems, and further rehabilitation of existing irrigation system and social infrastructures.

(3) Development and Extension of Intensified Farming in Lowland Rice Field

The main purpose of the development and extension of intensified farming will be to develop and extend the most appropriate cropping system for increase in crop production in lowland rice field, based on the results of field trials and research works carried out in the above agricultural station. Especially for increase in productivity of rice field through introduction of second crops in the dry season, pilot demonstration schemes including training of the farmers will have to be carried out in the model areas. The schemes will include (i) introduction, selection and multiplication of improved varieties; (ii) soil improvement by



applying fertilizer and green manures; (iii) effective use of irrigation water; (iv) control of pests and diseases; and (v) proper post harvesting techniques.

(4) **Development and Demonstration of Year-Round Farming in Hill Areas**

In the study area, flat valley bottoms suitable for lowland farming is limited. For further increase in agricultural production in the area, consideration will have to be paid to the development of upland in gentle sloping hill areas. Then, the objectives of this program are to develop and demonstrate an appropriate farming technique for sustainable and profitable agriculture in upland which will contribute to alleviate slash-and-burn cultivation in the hill areas. The program will include (i) introduction, selection and multiplication of improved crop varieties; (ii) introduction of irrigated farming in upland where irrigation water is available; (iii) development of crop rotation system including alley cropping to maintain and improve soil fertility; (iv) demonstration of soil improvement by green manures and mulching technology; and (v) field trials of crop diversification.

## **5.2 Development of Agricultural Production Infrastructures**

The action plans and programs for the purpose of developing agricultural production infrastructures will include (i) rehabilitation and upgrading of the existing traditional irrigation systems; (ii) new irrigation development in rainfed lowland rice field, unused lowland currently covered with bush and upland in gentle-sloping hills; (iii) establishment and improvement of water users associations; and (iv) improvement and strengthening of meteo-hydrological network.

In the study area, there are 135 schemes with a total irrigation area of about 2,662 ha. However, these systems are very primitive without proper investigation and design. Especially, the intake weirs are easily washed away at flood times because of indigenous brushwood weir. Therefore, the first priority should be given to the rehabilitation and upgrading of these existing irrigation systems by constructing permanent weir together with well-designed canal network down to the tertiary irrigation block. In addition, consideration should also be paid for opening of new lowland rice field in the potential areas adjacent to the existing system, including the construction of new irrigation system or expansion of the existing canal network. The rehabilitation and upgrading of the existing systems will have to be carried out, through packaging of a number of the systems and package-wise implementation schedule with priority ranking which will be made, based on the topography, potentials for opening new paddy fields in and around the existing systems, available water resources, the number of water users, and accessibility. The package-wise



implementation program for rehabilitation and upgrading of the existing irrigation systems is studied in detail in ANNEX-MF of the Master Plan Study, Volume II.

Development plan of new irrigation systems will include three (3) categories such as (i) construction of new irrigation facilities in 13 flat valley bottoms being used for rice cultivation at present; (ii) development of new irrigation systems including opening of new farmland in 600 ha of currently bush and/or grass land; and (iii) new irrigation development in gentle sloping hills covering 3,500 ha of land. The preliminary plan of these irrigation development will be as follows, which is prepared mostly by using the available topographic maps on a scale of 1 to 100,000 and 1 to 50,000.

The existing flat valley bottoms already identified are five (5) sites in Xai district with a total irrigable area of 185 ha, five (5) sites (171 ha of total irrigable area) in Beng and three (3) sites (82 ha of total irrigable area) in Hun. These potential sites could be divided further into two groups : one includes seven (7) sites with a total irrigable area of 257 ha where access to each site could be secured by constructing a relatively short distance road, less than 10 km from the National Road No.2, and the other includes six (6) sites covering 181 ha of total irrigable land which would require the construction of long distance road. Then, it is proposed to implement the former group in the medium term development phase for which further investigations and study will be required to be carried out at the short term stage. The implementation of the latter group is planned to be executed at the long term stage. The irrigation facility such as diversion weir and canal network for all of them would be constructed newly, following the design standard applied for upgrading of the existing irrigation systems.

The irrigation development in the currently bush and/or grass lands covering 600 ha would require the construction of medium size of storage dams together with new diversion weirs and canal networks as well as opening of new farmland. According to the available topographic maps on a scale of both 1: 100,000 and 1: 50,000, in addition, there are narrow gorges suitable for construction of medium size storage dam (10 to 15 m in height) schemes mostly on the tributaries of the Nam Beng river. Since various investigations and study, especially for dam foundation, will be required to formulate the schemes for their implementation, the irrigation development in such lands will have to be included in the long term development programs, after further study on technical and economic feasibility of these dam schemes including the construction of new irrigation facilities and opening of farmland is made.





The irrigation development in upland of gentle sloping hills with a total potential of 3,500 ha would require construction of small-scale storage ponds on the foot of the hills to utilize available river water and rainfall as well to a maximum extent mainly in terms of their topography. In addition, a simple piped irrigation system may be considered for more effective use of limited water available from either the rivers or springs. Since data and information useful for preparation of concrete plan for the development are very limited, it is proposed that detailed investigations and studies be carried out at the medium stage development and that the implementation of the development be made gradually during the long term development, taking into account the progress of such investigations and studies.

Almost all the existing irrigation systems are operated and maintained by the farmers' group(s) organized on the basis of one village or several villages concerned. Because it is essential to establish more efficient water users' associations in connection with the upgrading of existing irrigation systems and new irrigation development, the programs will include (i) improvement and strengthening of existing water users' associations, and establishment of new associations; (ii) development of laws and regulations related to establishment and management of the association; (iii) training of farmers who will be the staff of the association; and (iv) demonstration and training of farmers' groups for extension of proper farm water management and O&M of the irrigation facilities in the model areas.

In connection with the rehabilitation and upgrading of the existing irrigation systems as well as the new irrigation development, the existing meteo-hydrological observation network in the study area will have to be strengthened also for supporting the implementation of the proposed agricultural development as well as for further acceleration of rural socio-economic development in the future. The activity programs for this purpose will be implemented at the short term development stage of the Master Plan (for details of the programs, refer to Sub-chapter 8.3, Section (4)).

### **5.3 Development of Social Infrastructures**

Action plans required for development of social infrastructures will include those for (i) rehabilitation and upgrading of district road network; (ii) construction of additional rural water supply facilities; and (iii) rehabilitation and construction of primary schools and community facilities, and the program for each plan will be as follows :

In the study area, there are 33 routes of district roads with a total length of 500 km, including 202 km of roads which are currently passable by 4-WD vehicles in the dry season only and 298 km of footpath-level roads. Up-grading and improvement of these



district roads will be carried out under the stage-wise development program, taking into consideration the priority of each route. The improved district roads will provide not only permanent access from the National Route No.2 to each sub-district as well as for local traffic services to accelerate agricultural and socio-economic activities of the people, but also access to the potential areas for future irrigation development.

Rural water supply facility is one of the basic human needs for the people, which also contributes to the people's health control, and lightening of workload of children and women to transport the water for domestic use as well as to acceleration of socio-economic activities by the people. The stage-wise construction of additional water supply facilities will be made, based mainly on availability of water resources and the number of beneficiary. The facility will be the gravity flow pipe system with a small-scale reservoir.

The Department of Education of the Province has a plan to construct the Class I & II primary school in each village and the Class III, IV & V primary school in each sub-district. In the study area, on the other hand, there are 195 schools for Class I & II against the total of 435 villages and 29 schools for Class III, IV & V, out of 41 sub-districts. The rehabilitation of existing schools and construction of additional primary schools, especially for Class I & II education, will be included in the integrated agricultural development to contribute to such a plan of the provincial office.

As for the community facility, rehabilitation of existing facilities and construction of new ones in the villages which do not have such facilities yet will be included in the development.

The action plans and programs for rehabilitation and upgrading of these social infrastructures to be included in the Master Plan are studied in detail in ANNEX-MG of the Master Plan Study, Volume II (also refer to Sub-chapter 8.4 of this report).

#### **5.4 Measures to Environmental Problems**

The following direct measures are proposed for alleviation of environmental problems due to slash-and-burn cultivation activities (for details, refer to ANNEX-MH of the Master Plan Study, Volume II) :

- (1) Program for Evaluation of the Shifting Cultivation: at present, there are very limited basic data for evaluation of slash-and-burn cultivation activities such as the extent of slash-and-burn cultivation area and its transition,



rotation cycle, cultivation method and pattern, relation to the race, land tenure, etc. In order to formulate a proper control and management plan for slash-and-burn cultivation activities, these basic data will be crucial. Therefore, the objectives of this program are to correct the basic data and to evaluate the slash-and-burn cultivation activities.

- (2) **Reserved Forest Establishment Program:** establishment of the reserved forest is considered to be one of the effective measures to conserve the potential water resources. Therefore, the objectives of this program are to establish a new reserved forest in the critical watersheds for conservation of the water resources. The location of a new reserved forest could be decided on the basis of the specific runoff through discharge measurement of rivers during the dry season. The specific runoff of less than one (1) litre/sec/km<sup>2</sup> is tentatively proposed as a standard in order to establish a new reserved forest.
- (3) **Management Program for Uncontrolled Fire:** in the study area, useless burning of enormous lands is practiced by the rural people due to uncontrolled slash-and-burn activities. Therefore, the objectives of this program are to train the fire control technique to the rural people and to reduce the useless burning lands and forests as well. At first, the foresters in each district office should know about sound fire control technique being practiced in Xai or Luang Prabang. Then the village chief and/or his assistants will be trained at the district office and demonstration plot in the district capital by the foresters of the district office. Initially, the training of rural people will be focused on the Lao Theung group, because about 80% of the shifting cultivation land is estimated to belong to this group in the study area.
- (4) **Program for Analysis of the Minimum Rotation Cycle:** at present, the rotation cycle in the study area is estimated at 6 to 8 years on an average. However, the rotation cycle in low altitude areas is becoming shorter, less than 3 years due to population pressure. Therefore, the objectives of this program are to analyze a relation between rotation cycle and crop yield by soil type and slope class and to clarify the minimum rotation cycle under several conditions. The periodical yield survey and soil sampling in the different rotation cycle lands will have to be carried out.



## **5.5 Support Services for Women's Group**

In order to accelerate and support the activities by the existing women's groups, the following plans and programs will be required in connection with the implementation of the integrated rural agricultural development, and will be carried out through more efficient activities by the existing Women's Unions :

- (a) Training of extension workers for improvement of people's life standard.
- (b) Support services for promotion of health education to women.
- (c) Support services for promotion of basic literacy education to women.
- (d) Support services for encouraging women to participate and utilize the rice bank system.
- (e) Demonstration and extension of sericulture.





## **VI. IMPLEMENTATION OF PROPOSED ACTION PLANS AND PROGRAMS**

The proposed action plans and programs required for agricultural development under the Master Plan will include various project components such as increase in agricultural productivity, development of physical infrastructures, institutional improvement including the training of staff as well as farmers, etc. The implementation should, therefore, be made under well-designed stage-wise programs with time enough for applying the result of previous stage for the next stage implementation, also taking into account the technical and managerial capability of the staff concerned and their accumulated experience in this type of development. On the basis of the final target year of 2010 for the proposed development, the implementation is planned to be carried out in three stages, namely short term (2000), medium term (2005) and long term (2010). The strategy and objectives at each stage are summarized as follows :

### **6.1 Short Term Development (Model Areas Scheme)**

The three model areas, one in each district, have been selected to be the cores to demonstrate the effects of integrated rural agricultural development and will also be the base for further expansion of the development that will be carried out under the medium and long term programs. It is planned, in this sense, that all the project's activities under the short term program be concentrated on the model areas, and various project components will be tested, demonstrated and evaluated through the implementation of the model areas. In addition, some research works, improvement and strengthening of the provincial and district offices and training of the project staff as well as farmers will be carried out in order to obtain data and information that can be applied for the next development programs as well as to accumulate the experience of the staff and farmers in the improved farming and its management. The objectives of short term development are therefore to establish the technical and implementing base for expansion and settlement of improved and profitable agriculture in the future.

In line with these strategies and objectives, the feasibility study on the Model Areas Scheme (the Scheme) is made as presented in Chapter VIII for possible early implementation of the Scheme, which will be the first step in the Project implementation.

### **6.2 Medium Term Development**

The implementation and operations of the model areas would provide various data and information useful for preparation and execution of concrete action plans and programs for extension and settlement of the intensive farming with the improved techniques in other potential areas of each district. In addition, the government staff as well as farmers will obtain



more experience in such an intensive farming, especially in lowland rice field, through its practices, training and extension services to be provided under the model areas scheme. However, these data and information, especially on upland farming in hill areas will still be the preliminary ones which should be confirmed and supplemented by continuous field trials, and the experience of the staff and farmers will also be at the initial stage. Although some research works and demonstration of intensive farming in upland on hill slopes adjacent to the model areas will also be carried out, in addition, these will still be limited to very small area at the trial stage.

Therefore, the agricultural development under the medium term program will have two main objectives: one is the expansion of improved farming techniques with irrigation for increase in yield of lowland rice with the related supporting services to the selected potential lowland; and the other is the accumulation of more technical data and information on and experience in the improved upland farming through the continuous trial and demonstration activities and pilot schemes.

With the completion of medium term development, more efficient organizations and systems in both the government institutes and farmers' groups supported by the improved technologies and accumulated experience in both the lowland and upland farming could be built up for successful execution of the next long term development program.

### **6.3 Long Term Development**

The long term development will be the last stage of this Master Plan, but not the final goal of the rural socio-economic development in the study area. It is planned that the strategy for development in this stage will continue the various programs included in the Master Plan by the efforts of government staff and farmers themselves, using fully their technologies and experience accumulated through the previous short and medium term development stages.

### **6.4 Action Plans and Programs at Each Stage**

Various action plans and programs proposed for the integrated rural agricultural development under the Master Plan may be classified into four (4) main categories such as (i) study and preparation of concrete action plans and programs; (ii) development of most appropriate technologies in various fields of the agricultural development; (iii) execution of various pilot model schemes; and (iv) execution of development schemes. On the basis of the development strategies and policies for stage-wise implementation of the Project mentioned



above, plans and programs to be implemented at each development stage by category are tabulated in Table 7 and shown in Fig.1.



## **VII. EVALUATION OF INTEGRATED AGRICULTURAL DEVELOPMENT**

The implementation of the Master Plan proposed for integrated rural agricultural development is planned to be carried out over the period of 16 years on the assumption that the short term development program will start from 1995. During such a period, some changes in socio-economic situations might be foreseen in the study area and the Province as well as in the country. In addition, reliable data and information useful for quantitative analysis for evaluation of the Project's effects are very limited at present. Therefore, the evaluation of the Project shown in this chapter is a trial mainly in terms of the qualitative analysis rather than quantitative one. Various effects and impacts on the agricultural and socio-economic situations in the study area and the Province would be expected from the implementation of the Project, as discussed below.

### **7.1 Agricultural Impacts**

#### **(1) Increase in Rice Production**

The main agricultural impact to be expected from the Project implementation will be the increase in rice production in both lowland and upland rice field through introduction of improved irrigation farming, modern farm inputs, appropriate extension services, etc. The rise in rice production at each development stage is estimated as shown in Table 8, and would be about 2,600 tons (10% over the present production) in the short term stage, 14,400 tons in the medium term stage (56%) and 29,600 tons in the long term stage (115%), respectively.

#### **(2) Increase in Other Crops Production**

The production of other crops such as sesame, cotton, vegetables, wheat, soybean, rapeseed, etc. would also increase through the introduction of dry season farming and the establishment of an efficient marketing system. The increased production of these crops will be used not only for local consumption but for export to Thailand, China, etc., and will also contribute to generate the farmers' cash income.

#### **(3) Increase in Livestock Production**

The livestock production would also increase through the extension of veterinary services and the establishment of a marketing system. In addition, crop residuals after harvest and by-products from processing of crops will improve the fertility of livestock. The





increased livestock production will contribute to increase the farmers' cash income through local marketing as well as from the export to Thailand, China, etc.

(4)           **Demonstration Effect**

With the Project implementation, the farmers in the study area, as well as in other potential areas, could improve their technical and managerial capability for profitable farm management through accumulation of experience in modern farming practices with irrigation in both lowland and upland gently sloping hills. The farmers would also be encouraged to implement more crop diversification with an incentive to generate more cash income.

**7.2           Socio-economic Impacts**

(1)           **Foreign Exchange Saving**

Since rice production in Laos is not sufficient to meet the domestic demand, 40,000 tons of milled rice were imported at a cost of US\$9.6 million in 1990. With the completion of the Project, the expected foreign exchange saving on rice imports would be US\$4.6 million at the present price level, as seen in Table 9.

(2)           **Increase of Farmers' Income**

The farmers' income would increase considerably due to the increase in agricultural production. Such an increase will contribute to the improvement of farmers' living standards as well as to the acceleration of regional economic activities.

(3)           **Acceleration of Women's Activity**

The Project would improve and accelerate women's activities through the establishment and operation of rice banks and periodical opening of women's schools. The increase in farm family's income will also contribute to more progressive activities by women who manage family budget in many cases.

(4)           **Improvement of Local Transportation**

The present poor local transportation will be much improved by rehabilitation and upgrading of the district road network. The improved road network will facilitate the efficient



marketing of farm products, inputs, livestock, and other commodities as well as contribute to the improvement of inter-regional accessibility and communication.

(5) Expansion of Business Opportunity

The increase in farmers' income would raise their purchasing power in rural markets. It is expected that markets of farm inputs and equipment will be more active and that the business opportunities of local non-farmers will be expanded indirectly. In addition, the increased crop production and improved road network would accelerate the business of millers, merchants and transporters with respect to processing, marketing, and transportation.

(6) Increase in Employment Opportunity

The Project would generate employment opportunities for unskilled laborers during the construction period. Most of the manpower will be supplied from the farmers' groups in and around the study area. In addition, the employees could obtain more experience and skills in various working fields. The accumulated experience and skills will be useful for O&M work by the farmers and would also provide the motivation for further economic development in the study area and the Province.

### **7.3 Environmental Impacts**

(1) Sustainability

The need for adjustment of land use system is increasing nationwide in order to improve the efficiency of land use and to prevent environmental degradation so that the natural resources can be managed in perpetuity for the benefit of successive generations. With a view to these situations, the Master Plan would contribute to sustainable land use over the study area.

(2) Conservation of Forest Area

The comparative study to evaluate the magnitude of forest degradation under without-project and with-project conditions shows that the estimated slash-and-burn cultivation area under without-project condition is remarkably large in contrast to that with-project condition (see Table 9). The increased rice production together with the direct measures to environmental problems in the Project would alleviate the pressure on the degradation of forest due to slash-and-burn cultivation activities.



(3) Improvement of Living Environment

The main living environmental issues in the study area are poor road conditions, insufficient rural water and electricity supply systems both in quality and quantity, and poor sanitary conditions mainly due to the life-style of rural inhabitants. These issues cause inefficient marketing of farm products, overburden on transportation of firewood and domestic water, incident of water born diseases, high infant mortality, etc. The Project would help to mitigate such environmental issues through improvement of social infrastructures and extension of services for improvement of living standards.



## **VIII. FEASIBILITY STUDY ON MODEL AREAS SCHEME**

For an early implementation of the Model Areas Scheme, the feasibility study from both technical and economic viewpoints was conducted, based on the data and information obtained from the field investigations and within the framework of the Master Plan. Details of the feasibility study on the Scheme are shown in Volume III "Feasibility Study on the Model Areas Scheme".

Selection of model areas to be proposed for the Scheme was made on the basis of data and information on physical, social and economic conditions of several potential sites in the study area. Then, the first screening of potential sites for the Scheme was made, and seven (7) sites in the three districts were taken for the final selection. Finally, three (3) sites, one in each district, were proposed for the feasibility study through further analysis of the data and information as well as discussions with the government institutes concerned (for details, refer to ANNEX-MI of the Master Plan Study, Volume II).

### **8.1 Present Conditions of Model Areas**

Xai model area (Tham Nhuang site) extends on both banks of the Nam Mao river, a tributary of the Nam Ko, and the National Road No.2 runs in the center of the area. The area is located near to Xai city, about 2 km south from the center of the city. The area has approximately pear-shaped topography and extends within a flat to gentle sloping valley bottom which is surrounded by hills. Lowland rice field in Xai model area is estimated at 310 ha in net, which is irrigated by two existing irrigation systems on the Nam Mao river. The intake weirs of both systems are of brushwood type constructed by farmers' groups, using bamboo, wood, stone and clay soil. The main canals are also constructed by farmers' groups. Total rice field irrigated partly by these two systems in the wet season in 1992 is estimated at 165 ha, and the beneficiary is 193 farm families in seven (7) Lao Loum villages. The remaining 145 ha of rice field are irrigated by using excess water from small streams in the adjacent hill areas. The two irrigation systems could be integrated into one system by constructing a permanent weir on the Nam Mao near Houay Khoum village to command the whole lowland rice field in this model area.

The farmers open some upland on the hills located at the eastern side of the model area, and are growing wide varieties of vegetable with irrigation by bucket, using excess water from two streams, Houay Hi Pi and Houay Phuk, which are the source of the Xai urban water supply system. In order to improve the irrigated upland agriculture on these hills, a simple





pipe system may be considered for more effective use of the limited water from these two streams for both irrigation and domestic use.

Beng model area extends on a narrow valley which elongates along the National Road No.2 and on the left bank of the Nam Beng river. The area is located at administrative centre of Beng district and about 62 km south from Xai city. The existing lowland rice field in Beng model area is estimated at 234 ha, most of which is irrigated by five (5) existing irrigation systems. The intake weirs of these systems are of brushwood type constructed by farmers' groups on the Nam Hao river, a tributary of the Nam Beng. Two main canals are also constructed by farmers' groups with an assistance from the provincial office. One canal goes towards north, and the other runs to the south along the National Road No.2. Total irrigation area by these existing systems in the wet season is estimated at 221 ha. Topographically, the whole rice field in this model area could be irrigated by one weir to be constructed on the Nam Hao, instead of the five existing weirs.

Hun model area (Nam Kham site) is located at about 8 km west from Hun town and about 100 km south from Xai city. The area extends within a narrow valley surrounded by hills. The existing irrigation systems related to Hun model area are five (5) with two water sources, the Nam Kham and Nam Ngat. Out of the five, three (3) systems already have concrete permanent weir constructed by farmers' groups with the financial assistance from the provincial office (one weir), district office (one weir) and Lao Quaker service (one weir). These permanent weirs are maintained in good condition, except for some parts for which small repair works will be required. The remaining two (2) brushwood weirs should be replaced by new permanent weir to be constructed, one on the Nam Kham river and the other on the Nam Ngat. At present, total irrigation area by these existing systems in the wet season is estimated at 164 ha. The beneficiary of the five irrigation systems is farmers in 8 villages, consisting of two (2) Lao Loum, four (4) Lao Theung, one Lao Sung and one mixed. Because of a lack of irrigation water in this model area, conflict of water distribution happens sometimes.

The existing irrigation systems related to each of the model areas are summarized in Table 10.

## **8.2 Proposed Agricultural Development Plan**

On the basis of the action plans and programs for the proposed agricultural development in the Master Plan, the basic concept of agricultural development in the model areas is set up as follows : Detailed study on the proposed agricultural development in the



model areas is given in ANNEX-FC of Feasibility Study on the Model Areas Scheme, Volume III.

- (a) Increase agricultural production, especially in regard to rice in the existing lowland fields through various development models.
- (b) Execute study and research works for development of appropriate farming techniques in upland gently sloping hill areas and for second crop cultivation in lowland areas, in order to increase agricultural production and to promote crop diversification which will contribute to the control of slash-and-burn cultivation.
- (c) Improve and strengthen the technical and managerial capability of the offices and of the staff through implementation of the model areas development.

On the basis of the above basic concept, the following programs are proposed for the Scheme :

(1) Improvement of Lowland Rice Farming

The proposed cropping pattern in the model areas aims, firstly, to increase and stabilize wet season rice production by securing a stable supply of irrigation water; and secondly, to increase cropping intensity of lowland rice fields where irrigation water is available in the dry season. As seen in the proposed cropping pattern shown in Fig. 2, the cropping intensity in the Xai model area will increase to 141%. Unfortunately, dry season cultivation, especially for rice, could not be introduced in the Beng and Hun model areas, because no river water is available for irrigation. Therefore, the overall cropping intensity in the three model areas will be 115%.

Selection of crops to be proposed is made, taking into account the present rice varieties used by farmers, people's food life, marketing and farmers' interest. As a result, the main crop will be glutinous rice. Since crop yield of non-glutinous rice such as IR variety is high, introduction of such a non-glutinous variety will be planned as a trial in 30% of rice field in each model area. The crop yields will increase by extension of improved rice farming as well as stable supply of irrigation water, and anticipated paddy yield is estimated as follows:



Model Area	Present Yield	Unit: ton-paddy/ha	
		Anticipated Yield	
		Glutinous	Non-glutinous
Xai area	2.4	4.0	4.0
Beng area	2.7	4.0	4.0
Hun area	2.6	4.0	4.0

(2) Program for Strengthening the Agricultural Support Services

This program will include (i) strengthening of the existing agricultural section of each district office; and (ii) improvement of marketing system.

In line with the nation-wide program, extension services for farmers in the model areas will be provided by the existing sections of Xai, Beng and Hun district offices. In order to support their activities, the Scheme will provide the following facilities and equipment :

- (a) Two (2) office buildings including storage and a garage at Beng and Hun, each having 208 m<sup>2</sup> floor space (for the Xai model area, an agricultural station will be used for this purpose).
- (b) A staff quarter at Hun with a total floor space of 280 m<sup>2</sup>.
- (c) Supply of two (2) motorcycles and office equipment for each office.

Programs to be carried out in these extension offices will be as follows :

- (a) Extension of improved rice cultivation farming including distribution of certified seeds, demonstration of pest-disease control and soil improvement techniques, and training of farmers' groups.
- (b) Extension of improved sericulture.
- (c) Services for improvement of people's living standards, promotion of health education, and basic literacy education through periodical opening of women's schools at each extension office in collaboration with the agricultural station in Xai.

To provide more extension services, additional two (2) staff especially for rice and second crops cultivation in lowland field will be stationed at each office, and training of these staff will be made by the agricultural station.



### (3) Improvement of the Marketing System

In order to improve the present marketing system in the model areas, three (3) farmers' organizations, tentatively called the rice bank (see Fig.3 Proposed Organization of Rice Bank), will be established by organizing the existing women's groups at the village level as a basis. The activities of the organizations will be processing and selling of rice, and collection, selection, and selling of sesame, as well as to provide more local credit services. To support these activities, the following buildings and equipment will be provided for each organization by the Scheme :

- (a) Office building with a floor space of 104 m<sup>2</sup>.
- (b) Storage with a floor space of 200 m<sup>2</sup>.
- (c) Drying yard with a concrete floor space of 200 m<sup>2</sup>.
- (d) A set of small-scale rice mill (capacity: 500 kg/hr), sesame cleaner (capacity: 300 kg /hr.), weighing instrument (capacity: 200 kg) and office equipment.

The integrated agricultural station will provide the services for training of the rice bank staff for proper management of business, accounting, etc.

### (4) Establishment and Operation of the Integrated Agricultural Station

For this purpose (refer to Sub-chapter 5.1 of this report), the following works will be carried out under the Scheme :

- (a) Construction of buildings which will include :
  - main office (650 m<sup>2</sup>), including storage (200 m<sup>2</sup>) and garage (200 m<sup>2</sup>);
  - research and training house (855 m<sup>2</sup>);
  - eight (8) staff quarters (1,825 m<sup>2</sup> in total); and
  - workshop (300 m<sup>2</sup>).
- (b) Civil works for development of test and demonstration plots which will include 5 ha of rice field within the station and 10 ha of upland in the hill adjacent to Xai model area.
- (c) Supply of machinery and equipment necessary for operation and maintenance of the station and demonstration plots.
- (d) Supply of O&M equipment for the model areas.





As seen in Fig. 4, the station will consist of administration section (14 staff), research and trial section (8 staff), extension and training section (4 staff), seed multiplication section (9 staff), O&M section (12 staff), and study, planing and monitoring section (5 staff). With these organization and staffing, the station will carry out the following programs in collaboration with national research institutes, international organizations and other economic cooperation organizations :

- (a) Development and extension of intensified farming in lowland rice fields (refer to Sub-chapter 5.1, Section (3)).
- (b) Development and demonstration of year-round farming in hilly areas (refer to Sub-chapter 5.1, Section (4)).
- (c) Introduction and extension of improved sericulture in collaboration with the sericulture center in Vientiane.
- (d) Selection and multiplication of certified seeds at the station and distribution of the seeds to farmers through the extension office in each district.
- (e) Training of extension workers in the district extension offices and the staff of the rice banks.
- (f) Post evaluation of the model areas development will be conducted, which will be useful for preparation of concrete plans and programs to be executed in the medium and long term development stages in cooperation with the Province and districts. During the preparation, the staff of the provincial and district offices will be trained to improve their technical and managerial capability, for continuous rural agricultural development by their own effort in the future. Details of the plans and programs to be prepared are shown in ANNEX-MD of the Master Plan Study, Volume II.

### **8.3 Irrigation Development Plan**

The main purpose of irrigation development in the model areas is the stable supply of irrigation water to wet season rice, especially in the beginning of rainy season as well as at the time of peak water requirement usually in July, because available river water for dry season irrigation is very limited. The basic concept for planning the irrigation development is summarized as follows :



- (a) Unit irrigation requirement for wet season rice will be 0.89 lit/sec/ha, which is the basis for design of the irrigation facilities.
- (b) The traditional brushwood weir will be replaced by a concrete permanent weir.
- (c) The water distribution network in each model area will be newly constructed, except for the main canals in the Beng area which will be rehabilitated. The networks will consist of main and secondary canals. On-farm canals to small irrigation blocks will be constructed by farmers' groups under the technical guidance of the project office. To facilitate irrigation supply to such small blocks, offtakes will be provided on the secondary canal, each of which will supply 4 to 5 ha of rice field.
- (d) The main canal will be of the stone masonry lining type.
- (e) An O&M road will be provided along a main canal.
- (f) New drains will be constructed, where required topographically.

(1) Xai Model Area

A concrete weir will be constructed on the Nam Mao near Houay Khoum village, integrating the two existing brushwood weirs, in order to irrigate 302 ha in net of existing rice field which include 108 ha on the left bank and 194 ha on the right bank of the Nam Mao. The weir would be of fixed type with 60 m of crest length and 4.2 m of height. The canal network will consist of two main canals with a total length of 6.9 km on both banks and secondary canals, 12.9 km in total length. New drains with a total length of 7.0 km will also be constructed to evacuate rains and excess water from rice field. The rehabilitated irrigation system could irrigate 125 ha in net of rice field during the dry season by using available river water from the Nam Mao.

For effective use of spring water from the adjacent hills, a gravity flow piped system will be constructed to irrigate 10 ha of upland on the hills. The upland will be used for field trials and demonstration of the year-round upland farming with irrigation. The system could also supply water for domestic use to a small village on the hills.



(2) Beng Model Area

In order to irrigate 270 ha in net of new command area including 36 ha of rice field to be opened newly in this model area, a concrete permanent weir will be constructed on the Nam Hao by integrating the two existing systems, all on the Nam Hao. The weir would be 40 m in crest length and 1.6 m in height. The two existing main canals, 5.3 km on the right bank (command area: 167 ha in net) and 4.1 km on the left bank (command area: 103 ha in net), will be rehabilitated with stone masonry lining, and new secondary canals with a total length of 13.9 km will be provided to serve the whole command area in the wet season. The required new drains will be 6.3 km in total length. In addition, some river training works on the Nam Hao, 0.9 km in length, will also be required to pass flood flows safely in connection with the construction of the concrete weir.

(3) Hun Model Area

As already mentioned, there exist five irrigation systems in this model area, of which four systems have already their own concrete weir. Therefore, the remaining two brushwood weirs will be replaced by concrete weir, one on the Nam Kham and the other on the Nam Ngat. The crest length and height of these weirs would be 40 m and 2.1 m, and 22 m and 1.8 m, respectively. For effective use of limited river water even in the wet season, the existing canal networks constructed by farmers will be replaced by four (4) new canal networks to irrigate 258 ha in net of rice field including 59 ha of newly opened rice field in the model area. The main and secondary canals to be included in the four networks would be 5.7 km and 13.6 km in total length. The required drains would be 9.2 km in total length.

The main features of the proposed plan for irrigation development in each model area are shown in Table 11 and illustrated in Figs. 5, 6 and 7. Detailed study on the proposed irrigation development in each model area is shown in ANNEX-FD of Feasibility Study on the Model Areas Scheme, Volume III.

(4) Strengthening and Improvement of the Meteo-hydrological Network

As mentioned in Sub-chapter 5.3, the following programs for strengthening and improvement of the existing meteo-hydrological network in the study area will be executed under the Scheme :

- (a) Supply of additional equipment and instruments to the Xai meteorological observation station. The additional equipment and instruments to be

