LAO PEOPLE'S DEMOCRATIC
REPUBLIC
MINISTRY OF AGRICULTURE
AND FORESTRY

JAPAN INTERNATIONAL
COOPERATION AGENCY
(JICA)

THE STUDY
ON
THE INTEGRATED AGRICULTURAL AND RURAL DEVELOPMENT PROJECT
IN
BOLOVEN PLATEAU

VOLUME-I

MAIN REPORT

September, 1996

NIPPON KOEI CO., LTD.
NAIGAI ENGINEERING CO., LTD.

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COMPOSITION OF REPORT

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LOCATION MAP & PHOTOS

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SUMMARY & RECOMMENDATION

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- PART II FEASIBILITY STUDY

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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 development study on the Integrated Agricultural and Rural Development Project in Boloven Plateau and entrusted the study to the Japan International Cooperation Agency (JICA).

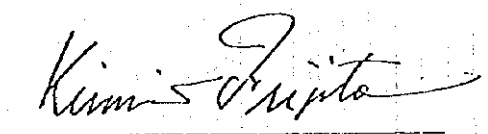
JICA sent to Lao a study team headed by Mr. Shinichi Yano, Nippon Koei Co., Ltd., four times between April 1995 and August 1996.

The team held discussions with the officials concerned of the Government of LAO, 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 for their close cooperation extended to the team.

September, 1996



Kimiro Fujita
President
Japan International Cooperation Agency

September, 1996

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

Letter of Transmittal

Dear Sir,

We have the pleasure of submitting the study report for the Study on the Integrated Agricultural and Rural Development Project in Boloven Plateau, in accordance with the Scope of Work agreed upon between the Ministry of Agriculture and Forestry, Lao People's Democratic Republic and the Japan International Cooperation Agency, Japan.

The study was carried out for a total period of 19 months from March 1995 to September 1996. The master plan for the integrated agricultural and rural development was basically formulated with principal aim of increase of agricultural production and improvement of rural life conditions, paying attention to environment conservation in the study area which covers about 7,000 km² of Boloven Plateau. The five priority development schemes were selected as core projects for the overall development plan in the master plan study and the feasibility study was carried out for the five development schemes.

The basic development plans of each development scheme consist of seven aspects ; (1) reduction of slash and burn cultivation system, (2) irrigation and drainage improvement, (3) agricultural production promotion, (4) improvement of rural life condition, (5) agricultural and rural infrastructure development, (6) strengthening of the agricultural support institute and service systems, and (7) improvement of marketing system, and these aspects are interlined each other to achieve the main target of the plan. The development plan was formulated on the basis of multi-sectoral components, which includes the establishment of dam, intakes and irrigation canals, strengthening of the agricultural support systems, improvement of roads, water supply system, clinics, schools and community holes, establishment of the Highland Vegetable Trial and Demonstration Station, wholesale market facility, etc. We believe that the project implementation will help to improve not only the living environment of rural people and also natural environment in the study area and would recommend that the project will be soon implemented in line with the consultations presented in this report.

We wish to express our deep appreciation and gratitude to the personnel concerned of your and other Agencies, your Laos Office, the Embassy of Japan in the Lao PDR., and the Authorities concerned of the Government of Lao PDR. as well as various NGOs for the courtesies and cooperation extended to us during our field surveys and studies.

Very truly yours,

Shinichi YANO
Team Leader of the Study Team for the Study on the Integrated Agricultural and Rural Development Project in Boloven Plateau

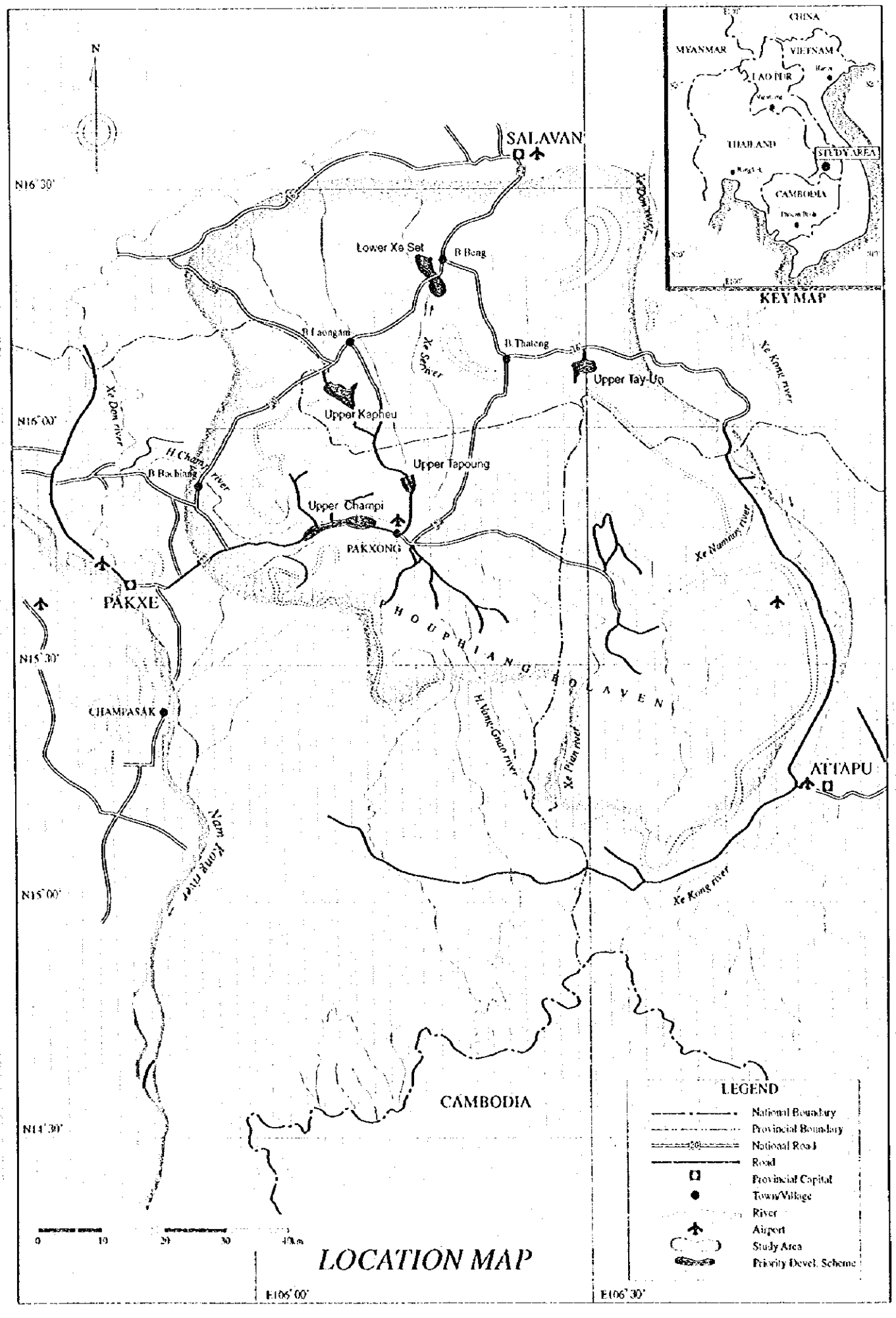

N
SALAVAN
N16°30'
Lower Xe Set
B Beng
B Laongam
Xe Sheer
B Thateng
Upper Tay-Uo
Xe Kong river
Xe Don river
N16°00'
Upper Kapheu
H Champi river
B Bachiang
Upper Tapoung
Upper Champi
PAKXONG
Xe Namnoy river
PAKXE
HOUPHIANG BOLAVEN
N15°30'
CHAMPASAK
H Vomi-Gnao river
Xe Pian river
ATTAPU
Nam Kong river
N15°00'
Xe Kong river
CAMBODIA
N14°30'
KEY MAP
CHINA
MYANMAR
VIETNAM
LAO PDR
THAILAND
STUDY AREA
CAMBODIA
LEGEND
National Boundary
Provincial Boundary
National Road
Road
Provincial Capital
Town/Village
River
Airport
Study Area
Priority Devel. Scheme
0
10
20
30
40km
LOCATION MAP
E106°00'
E106°30'

Photo-1 Proposed Intake Site of Upper Stream in Upper Champi Scheme

Photo-2 Proposed Intake Site of Lower Stream in Upper Champi Scheme

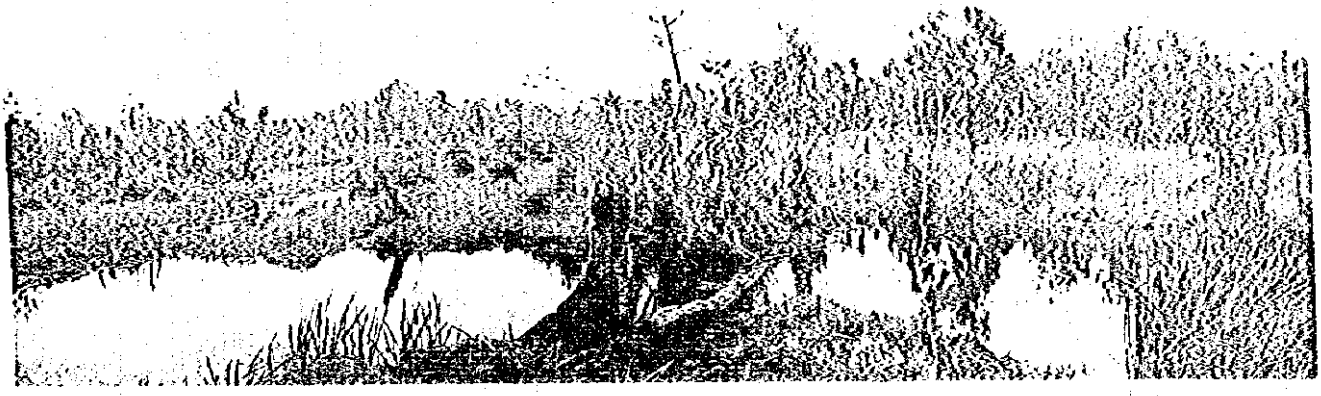


Photo-3 Proposed Dam Site in Upper Tapoung Scheme (Up Stream View)

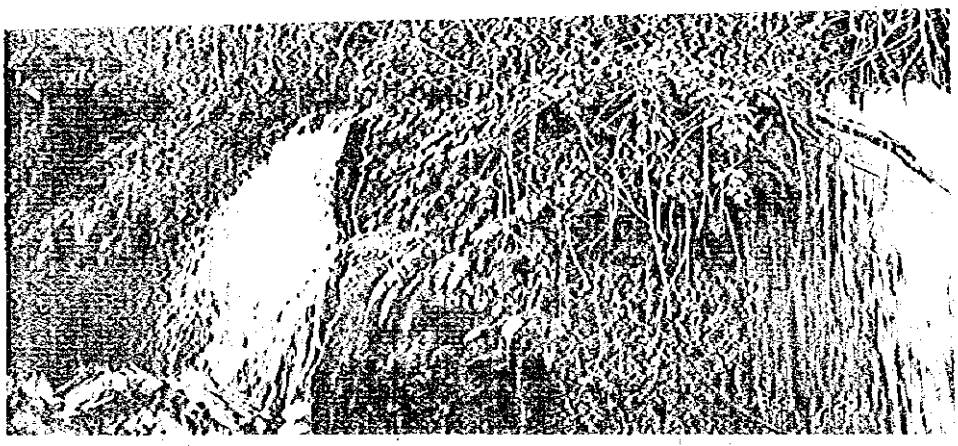


Photo-4 Proposed Intake Site in Upper Kapieu Scheme

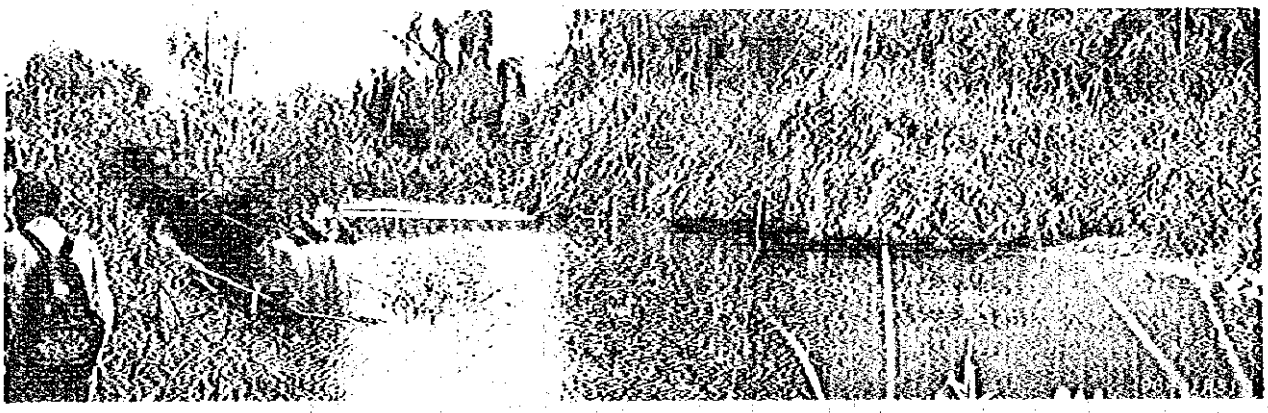


Photo-5 Proposed Intake Site in Lower Xe Set Scheme

Photo-6 Proposed Intake Site in Upper Tay-Un Scheme

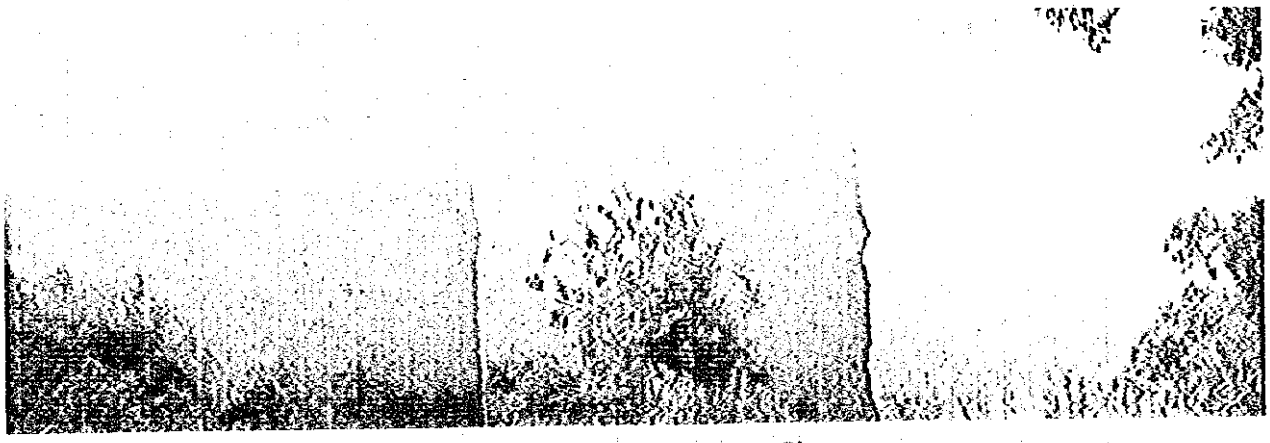


Photo-7 Distant View of Boloven Plateau

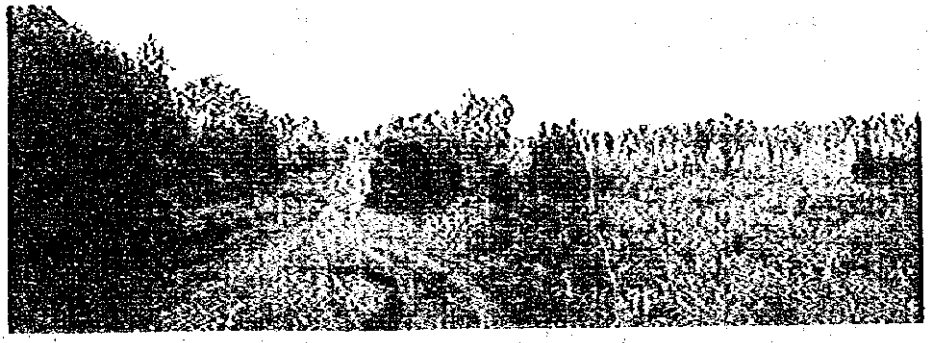


Photo-8 View of the Study Area

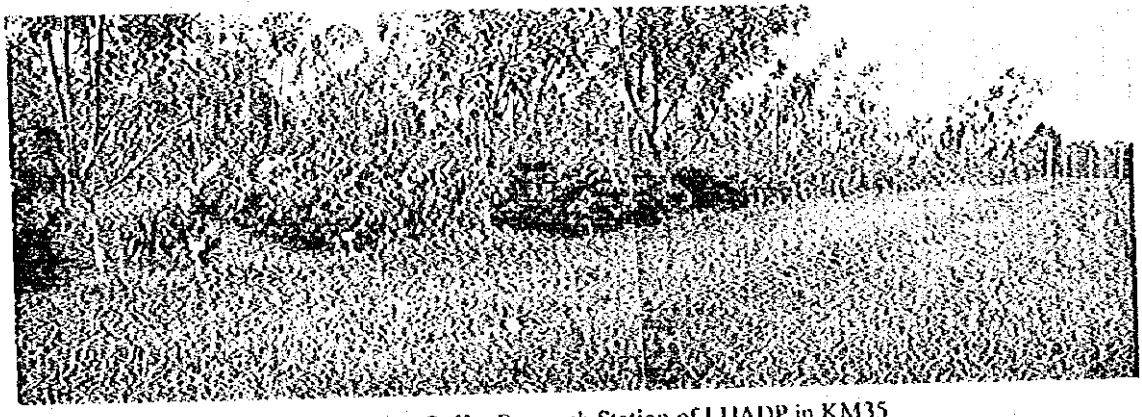


Photo-9 Coffee Research Station of LUADP in KM35

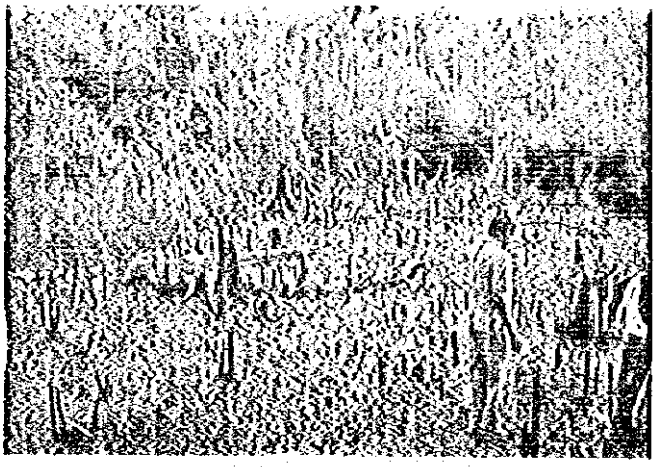


Photo-10 Slash & Burn Cultivation Area

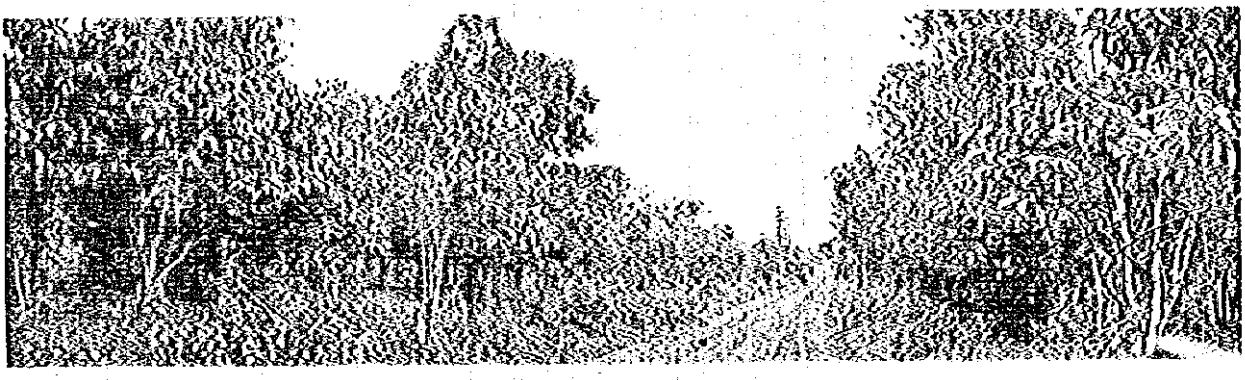


Photo-11 Existing Coffee Field

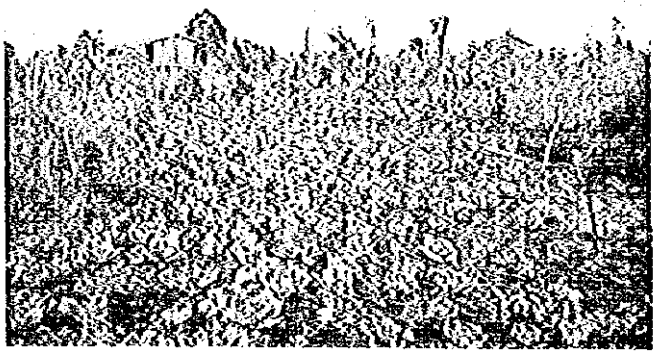


Photo-12 Cabbage Field under Slash & Burn Cultivation

Photo-13 Goundnut Field under Slash & Burn Cultivation

Photo-14 Existing Road

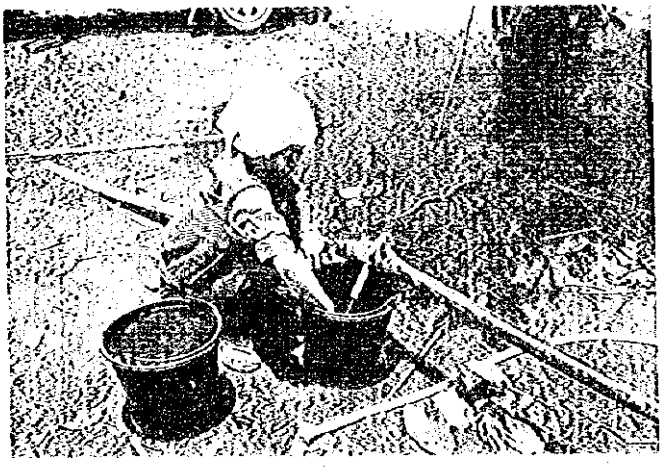


Photo-15 Existing Rural Water Supply System

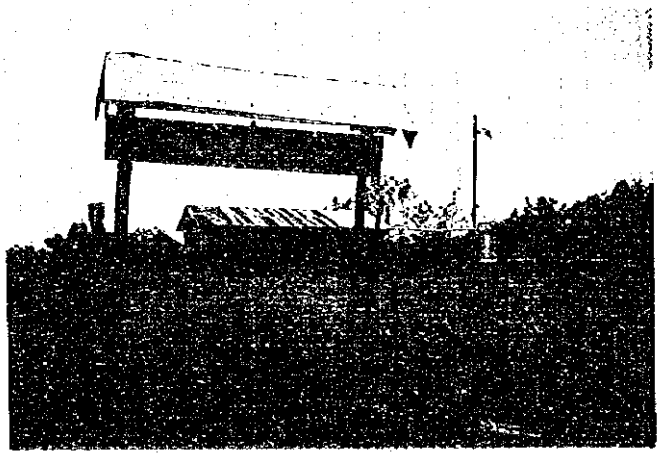


Photo-16 Existing Primary School

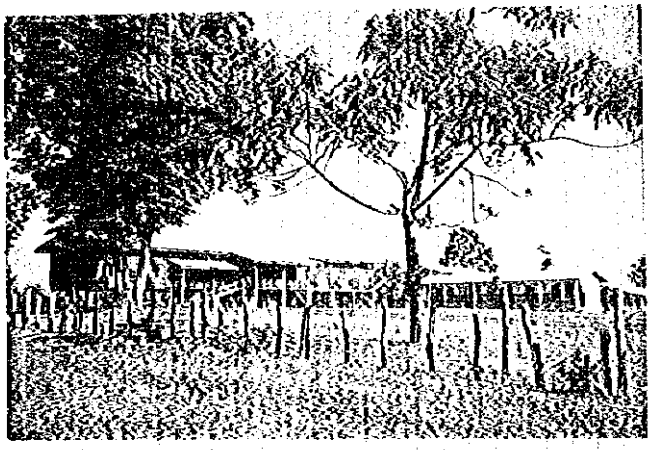


Photo-17 District Hospital

Abbreviations

Lao PDR	Lao People's Democratic Republic
MAF	Ministry of Agriculture and Forestry
MCTPC	Ministry of Communication, Transportation, Post and Construction
MPH	Ministry of Public Health
MES	Ministry of Education and Sports
MIH	Ministry of Industry and Handicraft
NARC	National Agricultural Research Center
EDL	Erectricite' Du Laos
CCI	Committee for Cooperation and Investment, MAF
CPC	Committee of Planning and Cooperation
NOFIP	National Office of Forest Inventory and Planning
ADB	Asian Development Bank
FAO	Food and Agriculture Organization
UNICEF	United Nations Children's Fund
WHO	World Health Organization
UNDP	United Nations Development Programme
IDA	International Development Association
IUCN	International Union for the Conservation of Nature and Natural Resources
IRRI	International Rice Research Institute
JICA	Japan International Cooperation Agency
SDC	Swiss Development Cooperation
SIDA	Swedish International Development Agency
USAID	United States Agency for International Development
USBR	United States Bureau of Reclamation
LUADP	Lao Upland Agriculture Development Project
NGO	Non-Governmental Organization
FHI	Food for the Hungry International
WVL	World Vision Lao PDR
LCEA	Lao Coffee Exporters Association
NEM	New Economic Mechanism
GDP	Gross Domestic Product
IEE	Initial Environmental Examination
NBCA	National Biodiversity Conservation Area
DHS	Dong Hua Sao
SFA	Special Forest Areas
IARDP	Integrated Agriculture and Rural Development Projects
NIERP	National Integrated Extension and Research Program
APB	Agriculture Development Bank
DAE	Department of Agriculture and Extension
NRRP	National Rice Research Program
AEA	Agricultural Extension Agency

SUMMARY

1 MASTER PLAN STUDY

Introduction

1 This Draft Final Report consists of the Main Report and Annexes. The Main Report presents the master plan of the entire Study area and the feasibility study of the selected priority development schemes based on the Study carried out during the field and office works in Phase I, Phase II and Phase III.

2 Agriculture is the main stay of the national economy. The productivity of the sector which provides three-fifths of national output, and supports 90 % of the national population, is still low due to the lack of rural and agricultural infrastructures and agricultural production technology. The stabilized growth of the sector is essential for development of the national economy. Despite its importance, agricultural productivity in Lao PDR is rather low mainly due to a traditional farming system which is susceptible to the adverse affect of climate, drought and flood. The farmers in the mountainous area are largely engaged in slash-and-burn cultivation and substantial amounts of logging operations which result in the serious problem of destruction of forest area and put significant pressure on bio-diversity.

The Boloven Plateau located at the central southern region of Laos is blessed with ample rainfall, cool climate, and suitable soils for farming, and has been recognized as having high potential for agricultural development, particularly coffee production. The productivity is however, rather low and remains vulnerable due to erratic weather conditions, lack of transport facilities, poor farming management and inadequate agricultural support services.

National Background

3 Lao PDR covers about 236,800 km² of land of which current forest area having a tree cover with a crowded density of at least 20% covers about 11. 2 million ha or 47.2% of the country. Although the Government has promulgated Decree 67, suspending all logging operations and initiating their country-wide audit in August 1991, the forest cover is declining steadily. Unsustainable commercial exploitation, characterised by destructive logging practices significantly contributes to forest degradation and reduces the overall productivity of watershed areas. The agricultural land covers approximately 1.0 million ha or only 4.3 % of the total area.

4 The harvested area of rice in 1994 is about 600 thousand ha of which about 219 thousand ha, 36.5%, upland rice, while about 381 thousand ha, 63.5%, lowland rice. Irrigated rice which is very limited in extent, about 11 thousand ha, is mainly located in Vientiane and Savannakhet Provinces. The other cereals, maize and root crops, cover only about 68 thousand ha, and are scattered throughout the country.
Coffee is mainly planted in three provinces, Champasak, Salavan and Sekong, which occupy about 96 % of total harvested area in 1994.

5 The population of Lao PDR in 1994 is estimated at about 4.6 million of which about 51% are female, and the annual growth rate is 2.62 %. Its population is diverse, as much as 68% being ethnic communities, engaged in mostly agricultural activities. The population in the three provinces, Champasak, Salavan and Sekong in 1994, is estimated at about 817,000 of which the female proportion is about 52% of the population. The population density is estimated at about 19.4 persons/km² for the entire country, but 24 persons/km in the three provinces.
The human resource base in Lao PDR is very scarce since the adult literacy rate in 1993 was still about 64 % and only 70% of children of primary school age are in school.

The working age population in 1993 was estimated at about 2.4 million, 52 % of total population. Because of rapid population growth, Lao PDR has a young labor force and their educational attainment in the rural areas is much lower than major urban areas due to inadequate educational facilities.

National Economy

6 Since launching the New Economic Mechanism(NEM) program initiated in 1986, the Government has achieved remarkable success in economy shifting the system from central planning and public ownership to a market-oriented economy. Under the NEM the Government has pursued and managed various improvements in bureaucratic procedures and has stabilized the national economy.

7 The Gross Domestic Product (GDP) at 1990 constant prices from 1989 to 1994 is summarized in the following table.

Item	1989	1990	1991	1992	1993	1994
1) GDP (in million of kips)	574,276	612,731	637,204	681,854	722,057	780,061
2) Growth Rates in %	14.3	6.7	4.0	7.0	5.9	8.1
3) Share of GDP (in million of kips)						
Agriculture	342,206	371,835	365,347	395,537	406,392	439,786
Industry	75,839	88,105	105,634	113,587	125,275	136,566
Services	148,103	147,427	157,038	163,093	175,667	187,070
Import duties	8,128	5,364	9,186	9,636	14,724	16,638
4) Share of GDP (in %)						
Agriculture	59.6	60.7	57.3	58.0	56.3	56.4
Industry	13.2	14.4	16.6	16.7	17.3	17.5
Services	25.8	24.1	24.6	23.9	24.3	24.0
Import duties	1.4	0.9	1.4	1.4	2.1	2.1

Source: Bank of Lao PDR Research Department

8 The export amount of Lao PDR totalled US$ 203 million in 1993, 350% of $57.9 million in 1988. Agricultural and wood products and timber contributed approximately 33 % in 1993, while hydro-power shared 8.4 %. Total imports amounted to US$ 353 million in 1993 of which machinery and raw materials (54%), rice and foodstuffs (9%) and petroleum (6) were the major import items.

9 The agricultural sector is expected to grow at an average annual rate of 5.7 %. The objectives of the agricultural sector in Third Five Year Plan are (1) to ensure food self-sufficiency and food security, (2) to reduce slash -and-burn cultivation, (3) to properly manage and conserve forest resources, and (4) to expand the agro-forestry based industrial processing sector. In order to achieve above target, the Plan envisages to introduce expansion of marketable cash crops diversified from the traditional crops, to improve yields of crops through provision of agricultural inputs, to expand livestock raising and fishery farms, to improve and expand such infrastructures as roads, irrigation, flood control facilities, and to strengthen the agricultural support services. The Government also intends to improve the rural life of people through providing rural infrastructure, domestic water supply either gravity or well, rural electrification facilities, and social infrastructure such as school and health facilities.

Present Conditions of the Study Area

Present Agricultural Activities in the Study Area

10 Present agricultural and rural development activities in the Study area are as follows:

1) Lao Upland Agricultural Development Project (LUADP) financed by the World Bank and Lao PDR with technical assistance of the Australian (terminated at the beginning 1996) and the French Governments. The major activities are;

   i) Improvement of upland farming system including coffee and field crops, vegetables, fruits and other economic trees,
   ii) Opening of feeder roads to ease the transportation of goods and agricultural inputs needed for the development of local market,
   iii) Upgrading and development of coffee culture on the Boloven Plateau, and
   iv) Technical assistance and training.

2) Swedish International Development Agency (SIDA)Project. Under SIDA two (2) irrigation projects have been implemented. The main purpose of SIDA is to provide agricultural infrastructures in order to reduce slash and burn cultivation and to prevent deforestation.

3) Road Pavement Project of National Road No. 20 and No. 23 under ADB fund. About 130 km of road was paved with asphalt by February 1996.

4) Coffee Roads in Laongam and Pakxong Districts financed by the World Bank. About 100 km of coffee feeder roads in Laongam District had been implemented by 1988, and about 315 km of road in Pakxong, Laongam, Thateng Districts are being constructed under LUADP.

5) Houay Ho Hydropower Development Project by BOT.
This project is under construction in the most south-eastern part of the Study area. The installed capacity will be 115 MW which will be completed by 1998.

6) Fishery Research Extension Station under the Champasak Provincial Government.
This station is located at KM 8 east of Pakxe along No. 13 National road.

7) Fruits tree Research Station under Champasak Provincial Government.
This station is located at KM 20 along road No. 20 and is producing improved seedlings of several kinds of fruit trees and distributing them to farmers.

8) Livestock Research Farm under the Department of Livestock and Veterinary.
This Farm is located at KM 49 along road No. 23 and the main purposes are research and experiment for improvement of breeding, forage and grasses and health of livestock.

9) Upland Crop Research Station at Palai under Champasak Province (under construction) .

10) Land concession.
There are substantial concessions of land, approximately 29,750 ha within the Champasak Province, occupied by the state company and various private sectors for forest development, livestock rearing and cash crop cultivation.

Population

11 Population in the Study area is estimated at 140,181 in 1994. The following are population and population density in each district.

Province	District	No. of H.H	Total Population	Avg. H.H Size	Percent of Farm H.H	Population Density
Champasak	Pakxong	7,746	41,758	5.4	95	10.6
	Bachiang	4,695	22,275	4.7	89	34.3
Salavan	Salavan	3,377	20,623	6.1	92	42.8
	Laongam	7,914	41,122	5.2	95	38.4
Sekong	Thateng	2,702	14,403	5.3	97	35.0
Total		26,434	140,181	5.3	94	21.4

Data source: CPCs, Champasak, Salavan and Sekong provinces.

Climate and Hydrology

12 Annual average rainfall in both Pakxe and Pakxong is 1,920 mm and 3,374 mm respectively of which approximately 90 % occurs in the rainy season. Average annual rainfall in the Study area would be about 2,417 mm. Average minimum monthly temperature in Pakxong is 10.1$_{o}$C, but frost occurred in some years at the Nikhom 34 observatory. Mean monthly relative humidity at Pakxong ranges from 71 % to 75 % in the dry season but 83 % to 90 % in the wet season, while at Pakxe ranges from 58 % to 63 % in the dry season and 75 % to 81 % in the wet season.

13 Based on average runoff coefficient of the Xe Set river, annual average runoff of the major nine (9) rivers were calculated at about 10,510 MCM, of which about 1,790 MCM flow during the dry season from November to April. Out of which about 830 MCM flow within the potential agricultural development areas. Both surface and ground water in the Study area is basically usable for irrigation and drinking purposes. The following table shows estimated annual average runoff of the 9 rivers.

River	River Basin (km2)	Runoff (MCM)
Xe Pian	3,331	4,222
H.Touay	368	514
H. Bangliang	505	772
H. Champi	639	847
H. Kapheu	375	370
Xe Set	1,129	1,271
H. Namsai	359	372
Xe Namnoy	1,523	1,731
H. Tay-Un	412	418
Total	8,641	10,517

Soils and Land Use

14 Approximately 60 % of soils in the Study area consist of basaltic soils and are fairly fertile. Soils derived from sand and clay stones are distributed in the south-eastern area in Pakxong district and some in the Laongam, Salavan and Thateng Districts, and account for about 30% of the area. The soil fertility is rather low.

Present land use in the Study area is as follows:

(Unit:ha)

Land use categories	Pakxong area	(%)	Bachiang area	(%)	Laongam area	(%)	Salavan area	(%)	Thateng area	(%)	Total area	(%)
Agricultural land	18,590	(2.84)	4,010	(0.87)	13,260	(2.03)	2,630	(0.40)	2,630	(0.40)	41,120	(6.29)
Coffee	16,100	(2.46)	560	(0.09)	6,700	(1.02)	50	(0.01)	970	(0.15)	24,380	(3.73)
Lowland rice	240	(0.04)	540	(0.08)	460	(0.07)	2,390	(0.36)	270	(0.04)	3,900	(0.60)
Upland rice	710	(0.11)	2,260	(0.34)	4,700	(0.72)	160	(0.02)	1,110	(0.17)	8,940	(1.37)
Cardamom	760	(0.12)	650	(0.10)	1,400	(0.21)	30	-	280	-(0.04)	3,120	(0.48)
Tea & Vegetable	780	(0.12)	-	-	-	-	-	-	-	-	780	(0.12)
Grass land	29,100	(4.45)	8,370	(1.28)	3,590	(0.55)	940	(0.14)	960	(0.15)	42,960	(6.57)
Dense forest land	218,790	(33.45)	24,480	(3.74)	7,270	(1.11)	18,410	(2.81)	15,220	(2.33)	284,170	(43.45)
Clear forest land	123,580	(18.89)	27,370	(4.18)	82,240	(12.57)	25,810	(3.95)	22,220	(3.40)	281,220	(42.99)
Other area*	2,650	(0.41)	700	(0.11)	630	(0.10)	450	(0.07)	150	(0.02)	4,580	(0.70)
Total	392,710	(60.04)	64.93	(9.93)	98,060	(14.99)	48,220	(7.37)	39,800	(6.09)	654,050	(100.00)

Agriculture

15 Crops grown in the Study area particularly vegetables, vary substantially according to the altitude and soil conditions as well as the transportation condition to the market. The cropped area and production of the major crops are as follows:

(Unit: Area in ha, production in ton)

District	Coffee		Tea		Upland rice		Lowland rice		Vegetables		Cardamom		Total
	Area	Prod	Area	Prod	Area	Prod	Area	Prod	Area	Prod	Area	Prod	Area
Pakxong	16,100	5,700	380	100	710	590	240	50	400	5,500	760	250	18,590
Bachiang	560	130	-	-	2,260	3,740	540	1,380	-	-	650	120	4,010
Laongam	6,700	1,140	-	-	4,700	7,050	460	1,150	-	-	1,400	130	13,260
Salavan	50	20	-	-	160	300	2,390	7,160	-	-	30	10	2,630
Thateng	970	260	-	-	1,110	1,990	270	540	-	-	280	60	2,630
Total	24,380	7,250	380	100	8,940	13,670	3,900	10,280	400	5,500	3,120	570	41,120

Note:The data for Pakxong, Bachiang, Laongam and Thateng are of whole district, and data for Salavan District include Zone 1,2,3 and 4.

Live stock farming is very important in the Study areas. Cattle and buffalo are raised mainly for the market, and draught power for field preparation and cart. The size of livestock and fishery activities in the Study area is given below.

(Unit: head)

District	Cattle	Buffalo	Horse	Pig	Poultry	Fishery	
						Pond	Prod.
Pakxong	17,900	2,220	530	5,930	22,000	170 ha	16 ton
Bachiang	5,660	2,110	-	5,150	21,000		
Laongam	10,430	2,450	-	9,700	39,200		
Salavan	4,130	4,630	-	3,700	29,700	78 ha	
Thateng	1,750	1,090	22	1,130	5,450	1 ha	
Total	39,870	12,500	552	25,610	117,350	249 ha	16 ton

The yield of rice is still low, about 1.5 ton / ha of upland rice and 2. 6 ton /ha of lowland rice on an average. Coffee Yield is also very low, 0.3 ton /ha. Generally fertilizer and chemicals are not used. Vegetables are grown in the dry season using manual irrigation and yields range from 8 to 10 ton /ha.

The most important agro-processing activities are rice milling and coffee milling. Average capacities of mills are about 200 to 300 kg / hr. for coffee and 300 to 400 kg

/hr for rice. A substantial number of hand tractor and milling machines were introduced in the Study area during these two years while some larges farmers have medium size tractors, they are still very limited.

16 International trade plays an important role in the development of the area because of the very limited domestic consumer market. The Pakxe market is the largest among the markets in the Study area. Most commodities of other markets are transported through the Pakxe market. There is substantial surplus in the food balance in Champasak Province. However, rice production falls for short of the demand of rice in the Study area. The following table shows the food balance of the five districts in the Study area in 1994.

District	Total Population	Rice demand (Paddy)	Production of paddy	Balance	
				Total	Per capita
	(person)	(ton)	(ton)	(ton)	(kg/person)
Pakxong	41,758	12,530	585	-11945	-286
Bachiang	22,275	6,680	7,990	1,310	59
Laongam	41,122	12,340	8,210	-4,130	-100
Salavan (4 zone)	20,623	6,190	7,230	1,040	50
Thateng	14,403	4,320	2,530	-1790	-124
Total	140,180	42,050	26.545	-15505	-111

17 Estimates of typical farm budgets for different farm families in the Study area, is shown below.

(Unit of currency: 1,000 kips)

	Coffee farming	Slash & Burn	Lowland rice farming
Average Farm Size (ha)	2.5	1.2	0.9
No. of H.Hold in Study area	11,480	10,180	4,860
1. Gross Income	940	424	417
(1)Farm income	940	374	324
(2)Non Farm Income	0	50	93
2. Production Cost	136	37	28
3. Net Income	804	387	389
(1)Living Expense	778	387	388
- Food items	490	308	292
- Non Food items	288	79	97
(2)Net Reserve	26	0	0

Note: * 1: Estimation is based on the weighted average of each farm type's figure
* 2: Income and expenses include the values of own consumption

Since coffee prices jumped suddenly about three times in 1994 from that in 1993, coffee farmer's economic circumstances are in considerably better condition, however rice cultivation farmers are still in a subsistence level economy.

Irrigation and Drainage

18 There are 35 existing irrigation schemes in and around the Study area, which totals about 2,700 ha. The main purpose of the schemes is to provide supplementary irrigation water for paddy fields in the rainy season. O&M of irrigation facilities are entrusted to village people (beneficiaries) after the construction is completed. The following table shows the existing irrigation schemes in each province located within the Study area.

Province	No. of Scheme	Irrigation Method	Area(ha)
Champasak	5	Gravity	640
Salavan	24	Gravity	1,600
Sekong	6	Gravity	460
Total	35		2,700

Rural Infrastructure

19 National roads No. 20 and 23 are passing through the Study area. Except for 55 km of road No 23 from Pakxong to B. Beng which is under construction, all roads are paved with asphalt. the Road to H. Ho dam site, 75km is laterite paved and maintained well. Rehabilitation of 55 km of road No 23 from Pakxong to B. Beng through Thateng and 124 km of road No. 16 from Thateng to Attapu via Sekong financed by ADB will be carried out soon and completed by 2000. 42 km of road No. 161 from Laongam to Khong Xedon and about 100 km of coffee feeder roads were constructed in 1988, financed by the World Bank.

There are about 315 km of coffee feeder roads within the Study area under construction also financed by the World Bank. In addition, district/village roads, about 736 km in total are providing communication and transportation among the villages in the Study area, but they are motorable only in the dry season. Approximately 843 km of from farm to village roads, are identified in the Study area, but they are only for ox-cart and/or hand tractors.

20 Most of the villages depend entirely on nearby streams and rivers for their domestic water. Only a few villages have access to spring water and particularly in Thateng area where people are benefited by plentiful clean spring water. Laongam town water supply system is using spring water from B. Takit and distributing water to the beneficiaries by pipeline system. There are 15 gravity flow piped water supply systems in the Study area mainly supported by the provincial public health services and UNICEF or AICF.

The extension of a 22kv transmission line is under construction from Pakxe to both Pakxong and Bachiang. EDL announced the 22kv line extension plan which would be implemented until 2000. The number of villages to be benefited by 0.4 kv distribution lines is as follows:

District	Pakxong	Bachiang	Laongam	Salavan	Thateng
No of village	11	12	7	4	14

21 There are 4 district hospitals and 26 village clinics in the Study area. District hospitals are entirely managed by the provincial public health services, but the village clinics are poorly operated due to limited budget. Health care facilities in the Study area are as follows:

District	Pakxong	Bachiang	Laongam	Salavan	Thateng	Total
District Hospital	1	1	1	0	1	4
Village Clinic	9	11	1	3	2	26

22 There are 237 primary schools, and 16 secondary schools in the Study area. School facilities include buildings, rooms, fixtures, and teaching materials which are very poor due to a limited budget. The school facilities in the Study area are as follows:

District	Pakxong	Bachiang	Laongam	Salavan	Thateng	Total
No. of Village	105	76	110	58	50	39
School						
Primary w/cl- 3	61	34	36	25	25	181
Primary w/cl- 5	30	13	7	5	1	56
Secondary	9	5	1	0	1	16

Agriculture Extension

23 Agricultural Support Services are offered by MAF at central level and Provincial Agricultural and Forestry Services at provincial level respectively. MAF is responsible for formulation of experiment plans at the national level and monitoring the food production in the country through the provincial agricultural services. In the southern region, there are five research stations related to the Study area for research and training. Among these stations, the Phongam Research Station is conducting lowland rice research and experimentation under the National Rice Research Program supported by the Lao-IRRI Project, and the Ban Itou Research Station of the LUADP financed by the World Bank with technical assistance from the Australian and French governments, conducts research and trials for coffee and upland crops.

Furthermore, the Fruit-trees Research Station of Champasak province carries out research and seedling production at km 20. The Fishery Research and Extension Station, located at km 8, is managed by the Livestock and Veterinary Section, Agriculture and Forestry Service. The Livestock and Veterinary Research Station is managed by Department of Livestock and Veterinary, MAF. Existing research stations have fundamental problems in lack of manpower and funds for sufficient research and training.

The extension activities in the Study area are not functioning properly due to insufficient funds, the shortage of extension officers and, inadequate training. Currently there is very little training in extension activities given to staff and extension officers of the district and provincial services.

24 On the other hand, the LUADP has established extension stations, located at B. Itou, B. Laongam and B. Thateng, for the purpose of extension work in the target villages of the project. Some farmer's groups have been formed by the beneficiaries, under the guidance of the projects extension officer. Agricultural extension by the project is mainly coffee production in Pakxong, Thateng and Laongam districts. In addition, extension activities for upland crops such as upland rice, legumes and fruit trees were also carried out in Bachiang, Laongam and Thateng districts by the project. In the Study area, the extension services for forestry are conducted in the special forest area and forest conservation area through staff and extension officers of the district and provincial services. The activities are conducted in cooperation with the Lao-Swedish Forest Cooperation Program.

There are some farmer's organizations established in the Study area, other than village committee, village unit (Nuay), elders groups including the National Front, youth association and women's union under the government patronage. Village Resource Management and Development Committees supported by the Lao-Swedish Forestry Cooperation Program are formed in villages under the SFA, aiming to push forward the program. On the other hand, in the Study area, 63 agricultural extension groups are organized in the target villages of the LUADP, and 385 production groups in 128 villages are formed in order to obtain agricultural credit from the APB.

25 Since 1994, in the APB, Pakxe and Salavan branches have provided agricultural credit to farmers as the public financing institution for agricultural sector. The object of credit is divided into three categories; for farmer's production group, for individual farmers

and for traders of agricultural products. Annual interest rate is 10% (short-term), 8% (medium-term) and 7% (long-term), for farmers with favorable credit condition. The total amount of loans to farmer's production groups within the area is estimated at 1,334 million kip in 1995. About 47% of the total amount will appropriate for coffee production. In case of informal credit, the farmer pays 20% of interest to lenders.

26 Usually the agricultural commodities produced by farmers are sold to a middleman (small trader) who visits individual farmers, or are sold to the retailer at the nearest market by farmers. Presently no farmer' s organization in the Study area provide for marketing services which include marketing and pricing of agricultural products. Because of no previous knowledge of thee matters, the farmer has less power to negotiate with the middleman on the price of products. In the case of coffee, however, the Lao Coffee Exporters Association (LCEA) was established in 1994 for the purpose of ensuring the farmers fare marketing system by advising of the Central Government. The association insists that all traders or exporters must belong to the association and are required to be authorized.

In the Study area, rice production is in substantial deficit so that the present surplus produced in Champasak is considered to be supplementary. In fact, there is an established exchange system in the Study area, where a certain number of farmers only grow coffee as a cash instead of rice and buy rice with cash.

WID

27 In general, women in rural areas are actively involved in every stage of agricultural production. Further, domestic activities are an essential part of the work of women. These activities have been a major obstacle to the improvement of working conditions and the status of women in rural area. The Study area is an ethnically diverse society. Upland farming (slash and burn cultivation) requires much more labor than lowland agriculture, particularly in weeding, which is usually done by women. From the socio-economic survey, it appears that women' s working hours on the farm are 4 to 6 hours. The Lao Women' s Union strives to improve the status of women and living conditions in the rural area, through a network extending from the central level down to the village level.

Environment

28 Shifting cultivation on steep slopes can lead to erosion. If the intensity of shifting cultivation is high in a particular catchment or if the cycle of reuse of the same plot of land is shorter than before, then erosion and sedimentation can assume serious proportions. Such a situation can be seen in a cluster of villages around Thongvay in Thateng district, where slopes of about 40 to 50 percent or more are being cleared. Effects of erosion can be significant in watersheds of special importance, as of the Xe Set river in Laongam district, where a run-of-the-river hydropower facility is operated. It is reported that about 5,000 ha of the catchment have been eroded.

A large number of springs as well as numerous lakes are found scattered around Pakxong. This is called a wetland ecosystem and in this instance, is of hydrological importance as the origin of a number of river systems. The springs feed a large number of small streams that make up the tributaries of the large rivers such as the Xe Set flowing north, the Houay Champi flowing west, the Makchan Gnai flowing east and the Xe Pian flowing southeast.

29 Forest conservation for a variety of reasons such as watershed management and biodiversity preservation has been initiated by the government in the past few years. Provincial administrations have also set apart forest areas for conservation values of hydrology, bio-diversity and traditional uses. However, the boundaries are not clear and no management takes place. In Thateng it was said that the youth association is

responsible for protecting the nearby conservation area of Phou Set/Phou Thiouom. In these areas people are allowed to collect non-timber household products but not kill animals and cut trees. Very few community forestry programs have been initiated although a number are said to be in the planning stage. There are only a few nurseries in the Study area. Reforestation carried out so far is small.

Dong Hua Sao (DHS) is one of the NBCA areas and lies for the most part within the Study area. It covers an area of 910 sq. km. The area supports a variety of lowland and mountain vegetation and is of great biological and biogeographical interest. Numerous streams and rivers drain the area and the Houay Touay and Houay Bangliang river systems lie within the central and eastern parts. The lowland areas consist mainly of semi-evergreen forest with some mixed deciduous species.

30 In the Study area, wildlife is rare near towns and villages because of hunting pressure and habitat destruction. A large variety of wildlife forms part of the human diet. Markets have on sale a range of live birds, reptiles, amphibians and mammals. However, at the Salavan market, there is a notice put up by the District Forestry Service indicating that the sale of 79 species is prohibited. While this is commendable, institutional limitations make field operations difficult and it will be quite some time before enforcement can be meaningful. The Governor of Champasak has by the decree of October 29, 1993, declared the drainage areas of the Houay Ho and Xe Pian Xe Namnoy reservoirs for the purposes of watershed management and bio-diversity conservation.

31 Government considers shifting cultivation as one of the more important natural resource management problems faced by the country. It is one that is interwoven with socio-cultural factors and is an age-old agricultural practice. Something more than agronomy alone may be necessary to resolve the issues. The figures made available to this Study have some discrepancies but it appears that Bachiang district has about 2,500 ha of shifting cultivated area and Pakxong about 500 ha. Laongam district has about 1, 500 ha and Salavan the least about 160 ha. Thateng has about 1, 000 ha and reportedly the highest conversion of primary forest. The cycle of fallow seems to be getting reduced to one of three to five years from the 15 to 20 years.

One hundred and eight families from the Houay Ho hydro-power project are to be relocated at Namtang, 2. 5 km north of Houaykong, and a further 337 families from the Xe Pian-Xe Namnoy project in due course. Houses are under construction at the relocation site. Each house will have electricity. Water will be supplied from dug wells; one for 22 families. A school and a dispensary will be provided. Two hectares of upland will be given to each family. The people are willing to move to the new location.

Development Constraints

32 While there are many constraints on agricultural and rural development in the Study area, the major constraints are as follows:

1) Soil structures which are easily eroded by heavy rainfall in slope areas,
2) Hard conditions of off-taking water for irrigation and domestic purposes,
3) Approximately 30,000 ha of concessional land for large scale use mainly located in the central Plateau, particularly for forest development, livestock and cash crop cultivation by state company and private sectors,.
4) Shortage of human resources for the development of agriculture as well as construction,
5) Inadequate preparation for water management and O&M works,
6) Few health services, and social infrastructures,
7) Lack of agricultural support services and improvement in techniques,
8) Inadequately developed distribution system for agricultural inputs and outputs, and

9) Insufficient support programs for ethnic minorities.

Basic Concept of Integrated Agricultural and Rural Development Plan

33 Integrated agricultural and rural development in the Boloven Plateau is to be implemented, taking into account the following Government policy; (i) food security and self sufficiency, (ii) promotion of export oriented crops and livestock, and (iii) farming stabilization and reduction of slash and burn cultivation. The ultimate objectives of the integrated agricultural and rural development plan in the Study area are to increase farming output through improvement and development of irrigation, drainage, and rural infrastructures together with appropriate support services, and to achieve substantial and sustainable improvement in the living conditions of the inhabitants.

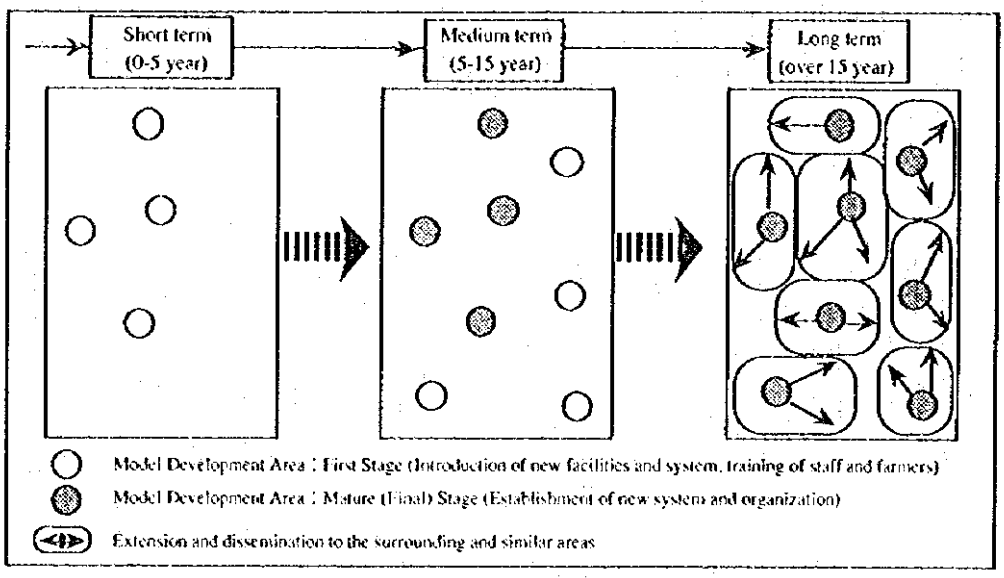
34 Practical approaches to development:

1) The raising of farmers' income levels through enhancement of stabilized farming and the introduction of profitable crops, particularly coffee, tea, vegetables, fruits, etc. combined with efficient utilization of land and water development potentials.
2) To increase food staff in the lowland area through providing irrigation systems and improved farming technology and practices, and
3) To raise living standard and improve rural life of people through provision and improvement of rural infrastructures as well as extension of living technology.

The envisaged agricultural development would be achieved in the first instance, through intensification of the existing diversified agriculture by improving husbandry technologies and development of infrastructure, and secondly through the expansion of agricultural area by establishing sustainable farming systems or by converting the remaining slash and burn cultivation to sustainable farming systems such as lowland rice, upland crop, etc.

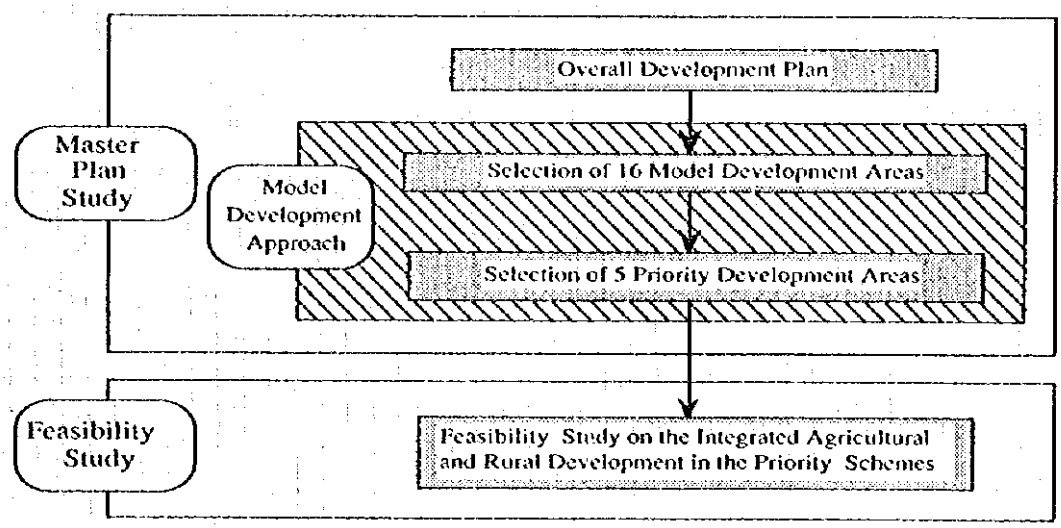
35 Agricultural activities in the Study area are varying according to topographical altitude and climatic conditions, and substantially conducting by slash and burn cultivation. Furthermore, the capacity of Lao Government is uncertain for the project implementation. Therefore, it is proposed that a stage wise development strategy including short, medium and long term development plans be applied as the development approach. It is assumed the short, middle and long terms will be approximately 0-5 years, 5-15 years and over 15 years respectively. The approaches of each development stage are included in the development strategy as shown in Table 1.15 (in Main text).

In addition, it is also proposed that "the model development approach" should be adapted as the main development strategy. The model development should integrate the various development components such as agricultural research work, extension services, improved marketing system and facilities, as well as rural and agricultural infrastructures. A conceptual figure of the stagewise development strategy (including the model development approach) is shown below:



Stage-wised Development Strategy with Model Development Approach

36 The work flow of the Study is summarized as follows :



Overall Development Plan: The overall development plan is to make a plan to develop comprehensively the entire Study area from the view point of basic integrated agricultural and rural development concepts and the government policy mentioned in Para.33.

Model Development Areas: The model development areas are selected taking into consideration the agricultural development suitability, effect of model development and locality of the Study area, etc. Since the model development areas function as core projects for smooth extension and efficient dissemination of agricultural development to surrounding areas, the projects for the model development areas will be implemented in the early stage.

Therefore, the implementation plan for the proposed development projects over the next 15 years (1996 - 2010) consists substantially of model development schemes. The implementation plan is divided into three (3) phases, phase I (1996-2000), phase II (2001-2005) and phase III (2006-2010). The model development projects will be

given priority based on, locality, potential for favorable results and value as a model and implemented accordingly.

Priority Development Area: The priority development areas, to be implemented in the phase I (1996-2000), are selected in the model development areas on the basis of locality project results, and the model developments.

Overall Integrated Agriculture and Rural Development Plan

Land and Water Resources

37 The Study area is blessed with ample water resources for agriculture, water supply, and hydropower development. Approximately 830 MCM of total annual runoff of about 10,500 MCM, flow during the dry season within the potential agricultural development area. In view of substantial short of water for dry season crops particularly paddy, coffee, and other annual and perennial crops, irrigation development is essential for increased and stable crop production.

Land for agricultural development is evaluated in terms of its suitability. The Study area covers about 650,000 ha of which approximately 390,000 ha are suitable for agricultural development. Out of the 390,000 ha, about 135,000 ha would be net land resources for agricultural development excluding forest conservation areas land concession area as well as areas for villages, roads, rivers, other structures etc. as shown in the following table.

Altitude	Study Area	Total Suitable Land	Forest Conservation Area	Potential Land	Land Concession Area	Land for Agri. Develop.	
						GrossArea	Net Area
Above 1000m	149,300	101,900	52,400	49,500	19,000	30,500	22,900
600-1000m	271,700	141,400	61,700	79,700		79,700	59,800
400-600m	77,300	48,000	21,800	26,200		26,200	19,700
Below 400m	155,800	95,100	39,900	55,200	11,000	44,200	33,200
Total	654,100	386,400	175,800	210,600	30,000	180,600	135,600

Agriculture Development

38 The proposed cropping patterns were formulated taking into account the crop suitability on the basis of soil conditions, altitude and the present land use as shown below:

Altitude	Cropping patterns	Wet season	Dry season
600<	A1	Lowland rice(135 days variety)	Lowland rice(120 days variety)
<600	A2	Lowland rice(150 days variety)	Lowland rice(135 days variety)
600<	B1	Lowland rice(135 days variety)	Cool season vegetables, general field crops
<600	B2	Lowland rice(135 days variety)	General field crops
600<	C	Upland crops, vegetables	Frost tolerant vegetables
400<1000	D	Coffee / tea	

39 Irrigation and drainage development program are worked out according to water availability and land suitability for crops taking into account the present land use. As the result of water balance calculations in the respective river basins, irrigation developments which off-take water in the Study area are divided into 2 irrigation methods, gravity and pumping up, and the maximum irrigable area is estimated to be about 90,700 ha. However, since about 36,000 ha of proposed irrigable areas are located outside the Study area, the irrigable areas within the Study area are estimated at 54,670 ha including the existing irrigated area of 1,600 ha.

40 The proposed cropping pattern in the potential area is set up based on the cropping pattern mentioned in Para. 38. The following table shows the proposed cropped area after implementation of the project in the entire Study area.

(Unit: ha)

Crops	Existing	Proposed					
		Irrigated		Non- irrigated		Total	
		Wet	Dry	Wet	Dry	Wet	Dry
Coffee	24,400	11,005	11,005	48,370	48,370	59,375	59,375
Tea	380	380	380	1,000	1,000	1,380	1,380
Upland rice	8,940	0	0	700	0	700	0
Lowland rice	3,900	40,275	10,240	0	0	40,275	10,240
Vegetables	400	480	8,255	5,230	1,500	5,710	9,755
Cardamom	3,120	0	0	800	800	800	800
Filed crops		2,530	12,360	19,830	2,000	22,360	14,360
Fruit trees		0	0	5,000	5,000	5,000	5,000
Total	41,140	54,670	42,240	80,930	58,670	135,600	100,910

41 It is necessary to introduce new high-yielding varieties or hybrid seeds with appropriate use of fertilizers and agro-chemicals (minimum use and environmentally sound chemicals) along with the provision of irrigation facilities where water is available. Furthermore, institutional support services are essential. The present farming practices in the Study area generally utilise animal power for land preparation and transportation, and manual operation of harvesting, etc. Some agricultural machinery have been introduced in places recently, however, rapid introduction of mechanization is not practicable in the present circumstances.

42 The target yield for crops at the full development stage is as follows:

Crops	Present (ton/ha)	Without irrigation (ton/ha)	With irrigation (ton/ha)
Coffee	0.3	1.0	1.5
Tea	0.3	0.5	1.0
Upland rice	1.5	2.0	3.0
Lowland rice			
Local variety	2.6	2.6	3.0
Improved variety		-	4.0
Field crops:			
Groundnut	1.0	1.0	2.0
Soybeans	1.0	1.0	2.0
Maize	1.0	1.0	3.0
Vegetables:			
Cabbage	8	10	20
Chinese cabbage	6	10	20
Potato	10	10	20

The target yield of each crop is estimated based on the average production rate under irrigation for the tropics, since there is no reliable data on the ultimate crop yield in and around the Study area.

43 After implementation of full development in the entire area of 135,600 ha, the anticipated crop production as well as incremental production are roughly estimated in the following table.

(Unit : ton)

Crops	Present	Proposed					
		Irrigated		Non- irrigated		Total	
		Wet	Dry	Wet	Dry	prod.	Increment
Coffee	7,250	0	16,508	0	48,370	64,878	57,628
Tea	100	190	190	300	200	880	780
Upland rice	13,670	0	0	1,400	0	1,400	-12,270
Lowland rice	10,280	161,100	40,960	0	0	202,060	191,780
Vegetables	5,500	9,600	165,100	52,300	15,000	242,000	236,500
Cardamom	570	0	0	240	0	240	-330
Filed crops		5,060	24,720	19,830	2,000	51,610	51,610
Fruit trees				20,000	0	20,000	20,000
Total	37,370	175,950	247,478	94,070	65,570	583,068	545,698

* The production of field crops and fruits is negligible small at present compare to that of other crops.

44 Livestock raising, cattle, buffalo, pig and poultry, play an important role in farmers' economy, particularly for earning cash income in the Study area. Cattle raising by the private enterprises are operated to some extent in the high land area surrounding Pakxong. Individual small farmers also practice the livestock raising with free range feeding system. An assessment of carrying capacities of communal grazing grounds is necessary to resolve the issue of overgrazing, damage to other crops and forests as well as the problem water pollution in wet land surrounding Pakxong.

There are approximately 250 ha in total of numerous natural ponds and springs scattered in the Plateau at an altitude of 1,000 m to 1,350 m, which can be utilized for fish culture. In view of short in animal protein in the Plateau, it is proposed to introduce a fish culture system through long term research and extension by the Government.

Rural Infrastructure Development

45 The improvement of rural road networks is essential to support agricultural development and rural economic activities as well as to improve socio- economic conditions. Proposed improvement / construction of village and farm roads in the entire Study area is shown below.

(Unit : km)

Category of Road	Study Area
Village road	736
Farm road	843

46 In the Study area, most of families are compelled to carry water from the nearest river or dug well, women doing most of this work. The improvement of the domestic water supply system therefore is very important. In order to cope with above problem, the following water supply system is proposed keeping in mind such conditions as hydro-geology, topography, availability of power and the number of beneficiaries:

- Gravity flow piped water supply system
- Tube well with overhead tank system, and
- Tube well with hand pump supply system.

Based on water availability and topography 12 schemes of gravity flow piped water supply are identified, which cover 61 villages with a combined population of about 33,000. A ground water supply system is proposed where gravity flow is not economically feasible.

47 There are many possibilities for micro-hydropower development in the Study area. As many villages are scattered throughout the entire area, micro- hydropower development in isolated areas is attractive. Based on the topographic maps together with field survey, 12 power potential sites totaling about 1,100 kw of generating capacity are identified for development.

Market Development

48 Marketing activities for agricultural products are not efficiently and properly functioning at present. If will be important to strengthen and improve market facilities and manpower following implementation of the projects. Marketing organization (marketing board) is to be established for proper management of marketing activities. A new farmers organization will be established with function of agricultural credit, technical assistance, farm inputs supply and marketing of farm products and will cooperate with and help the marketing organization.

Agriculture Extension and Social Development

49 In accordance, with implementation of the project, irrigation and drainage system will be provided in each of the development areas. In order to carry out smooth and effective operation and maintenance and water management of the irrigation facilities constructed, it will be important to establish water users group at the village level and water users' association at the irrigation scheme basis.

In order to cope with the problem of different living standards between urban and rural areas, comprehensive social development is required, particularly, health, literacy and community relationship. In this connection, raising family income in sustainable way is considered to be the most practicable way to improve living conditions as well as health status.

Environment Aspects

50 Rainfall in the Study area is usually of high intensity and a large amount of rain can fall over short time periods resulting in soil erosion process. It is suggested to practice mulch (crop residues or cover crops) on soil surface or inter cropping, which provide a benefits from the point of soil conservation, increasing infiltration by protecting the soils from the impact of rain drops and keeping the surface soil porous and absorbent.

Livestock rearing on the free range system in large numbers, is likely to cause environmental problems as carrying capacities per unit area of grassland have been exceeded. An assessment of carrying capacities of communal grazing ground is necessary to resolve the issue of overgrazing. A feeding system other than free range may have to be considered.

Land degradation in the mountain block of Phou Namtiang - Phou Hingkong declared as a conservation area, is likely continue unless improved farming practices are introduced. It is recommended that coffee farmers, as well as those of other crops, be required to adopt soil and water conservation measures as a priority. It is proposed that the upper basin of the Xe Katam where hydropower generation is planned, be declared as protection / conservation area in view of its fragile nature and economic importance.

51 The rolling grassland and its associated lakes, without ecological degradation by man, be a success of hydropower generation in zone 9. Therefore, it is proposed that this area be declared a conservation area, and be supported by a management plan to ensure limited human use and continuity of its basic hydrologic function. It should be preserved in its natural state as far as possible.

52 The issue of shifting cultivation in the upland area is very complex. Solutions have to be looked for within a diversity of ethnic-cultural backgrounds and from a multi-disciplinary technical aspect. Rice security is the one concern that compels people to farm the uplands. Some possible strategies may be found in a combination of some of the technical and institutional aspects. The following major points will be suggested:

1) Guaranteeing tenure-rights or title to land, making a farmer the sole beneficiary of the land he has been cultivating,
2) Providing irrigation water so that the farmer can overcome crop failure due to wet season drought and even do a dry season crop, if there is sufficient water,
3) Providing agricultural credit on easy terms,
4) Introducing farming systems that benefit from integration of livestock husbandry,
5) Introducing farming technology suitable for upland cultivation,
6) Involving people in participatory forest management,
7) Opening small industrial centers to provide employment alternatives to agriculture, particularly to the second generation, and
8) Introducing family planning programs to reduce the draw on resources.

Salient Feature of Overall Development

53 The overall development frames in the Study area are made as shown in Figure 1.20 (Main text), based on the land use plan including the soils, water quality, biological environment and forest conservation areas, land concession areas, Lao upland crop development projects areas, existing irrigation areas and the estimated potential irrigation areas. In view of rural development aspects, the village areas for domestic water supply development, village roads development, micro-hydropower and village electrification development are also involved. Furthermore, the strengthening of the existing research and demonstration stations for fruits trees, upland crops, fishery and livestock, and the establishment of trial and demonstration stations for vegetables, are proposed to reinforce agriculture extension and demonstration works.

The development plan for the entire Study area shall be implemented along lines expressed in the "model development approach" and will strive to efficiently extend the project effects.

Model Development Project

Selection of the Model Development Areas

54 The model development areas are selected, considering cheaper investment, easy O & M works of facilities the project scale, irrigation intake system and farmers' familiarity with irrigation farming. Among the irrigation development potential, approximately 54,700 ha in the entire Study area, 16 development schemes covering approximately 21,400 ha are selected as the model development projects with due consideration to the following points:

1) Accessibility of irrigation development scheme from the beneficiary farmers,
2) Advantageous location of scheme as the pilot and demonstration effects,
3) Possibility of coordination and cooperation among the members of water users group, and
4) Easy approach to the agricultural support services.

Salient Feature of the Selected Projects (Irrigation & Drainage and Rural Infrastructure Development)

55 The following tables show the salient features of agricultural and rural development plan for the 16 development areas.

(i) Irrigation Development

No.	Name	Location	Altitude	Water resources	Irrigated area (ha)	Design discharge (m3/sec)	Irrigation canal (km)	Drainage canals (km)	Farm road (km)
1	Upper Champi	Pakxong	900-1,200	H.Champi	730	0.53	26.6	13.4	30.1
2	Upper Tapoung	Pakxong	900-1,300	H.Tapoung	50	0.04	4.3	2.4	5.3
3	Lower Xe Pian	Pakxong	900-1,100	Xe Pian	750	0.54	18.5	12.1	19.4
4	Upper Makchan	Pakxong	900-1,200	H.Makchan	470	0.35	19.7	11.7	19.9
5	Middle Xe Katam	Pakxong	850-900	Xe Katam	620	0.87	13.7	6.7	13.7
6	Middle Namtang	Pakxong	800-900	H.Namtang	265	0.25	9.8	1.1	9.8
7	Lower Makchan Gnai	Pakxong	800-900	H.Makchan-Gnai	340	0.32	9.6	2.7	9.6
8	Lower Champi	Pakxong	100-200	H.Champi	2,600	3.52	62.9	25.5	65.1
9	Upper Kapheu	Pakxong	600-800	H.Kaphue	1,100	1.32	27.0	22.4	27.1
10	Middle Tapoung	Pakxong	700-1,000	H.Tapoung	450	0.49	13.1	6.8	13.1
11	Lower Tapoung	Pakxong	300-600	H.Tapoung	4,500	5.40	114.2	80.7	118.8
12	Lower Xe Set *1	Pakxong	300-400	Xe Set	1,800	2.39	47.6	42.5	57.1
13	Lower Namsai	Pakxong	100-200	H.Namsai	3,840	3.50	100.0	60.0	100.0
14	Upper Thon	Pakxong	200-300	H.Thon	640	1.32	15.6	13.9	18.1
15	Middle Lamphan *2	Pakxong	200-400	H.Lamphan	2,900	6.00	43.20	41.1	-
16	Upper Tayun	Pakxong	500-600	H.Tayun	350	0.40	5.8	4.5	5.8
Total (Average)					20,405	-	532	348	513

Remark: *1 A regulation pond shall be constructed.
*2 A rock fill type dam shall be constructed.

(ii) Rural Infrastructure

No.	Name	Beneficial villages (nos.)	Village farm road (km)	Water facility (nos.)			Extension trans. line (km)	Micro-hydro power (nos.)	Primary school (nos.)	Village clinic (nos.)	Community hole (nos.)
				gravity pipe	water tank	tube-well					
1	Upper Champi	7	3.0	1	-	-	-	-	7	1	4
2	Upper Tapoung	3	2.0	-	1	-	15.0	-	2	1	2
3	Lower Xe Pian	2	24.5	-	2	-	-	1	2	1	1
4	Upper Makchan	1	2.0	-	1	-	20.0	-	1	1	1
5	Middle Xe Katam *2	3	1.5	-	-	29	-	-	2	-	2
6	Middle Namtang	4	1.5	-	1	-	-	1	2	1	2
7	Lower Makchan Gnai	1	3.0	-	-	7	-	-	6	-	1
8	Lower Champi	6	7.0	-	-	6	14.0	-	6	-	3
9	Upper Kapheu	5	3.5	1	-	-	-	1	3	1	3
10	Middle Tapoung	2	-	1	-	-	13.0	-	1	-	1
11	Lower Tapoung	11	14.0	1	-	11	22.0	-	7	-	6
12	Lower Xe Set *1	6	13.0	2	-	-	8.0	-	2	-	3
13	Lower Namsai	13	20.0	-	-	19	23.0	-	11	-	7
14	Upper Thon	5	4.0	-	-	10	4.0	-	4	1	3
15	Middle Lamphan *2	5	8.5	-	-	15	19.0	-	2	1	3
16	Upper Tayun	1	2.0	1	-	-	-	-	1	1	1
Total (Average)		75	110	7	5	97	138	3	59	9	43

Agriculture Development and Anticipated Benefit

56 The project below are significant for the agricultural development plan for model development areas.

- to replace slash-and-burn cultivation with lowland rice or upland field crops other than upland rice,
- to promote vegetables and upland field crops particularly in the elevated land areas,
- to promote double cropping of rice in the lowest land where most of lowland rice is cultivated under rainfed at present,
- to expand coffee plantation, Arabica as well as Robusta, to the middle to high land, and
- to promote semi-intensive livestock raising especially for cattle by improving pasture land and veterinary services.

The proposed cropping area for the model development schemes is estimated as shown below;

(Unit : ha)

Crops	Present		With Project		Increment		
	Wet season	Dry season	Wet season	Dry season	Wet season	Dry season	Total
Coffee	2,980	2,980	3,730	3,730	750	750	750
Tea	90	90	90	90	0	0	0
Field crops	240	0	220	4,470	-20	4,470	4,450
Upland rice	1,380	0	0	0	-1,380	0	-1,380
Cardamom	290	290	10	10	-280	-280	-280
Lowland rice	1,730	0	17,070	5,560	15,340	5,560	20,900
Vegetables	0	0	290	850	290	850	1,140
Total	6,710	3,360	21,410	14,710	14,700	11,350	25,580

Note: These figures are of rounded off.

57 The anticipated agricultural production after implementation of the model development projects are estimated as shown in the following table.

(Unit : ton)

Crops	Without Project	With Project	Increment
Coffee*	890	5,600	4,700
Tea	23	90	67
Field crops**	240	9,400	9,160
Upland rice	2,070	0	-2,070
Cardamom	87	3	-84
Lowland rice	4,500	90,500	86,000
Vegetables***	0	22,800	22,800

* Production is in unhusked dried cherry.

** Counted as groundnut.

*** Counted as cabbage or potato.

58 Based on the anticipated agricultural production, the agricultural benefits for the selected model development projects are estimated as follows:

Project No.	Without Project Net Income ('000kip)	With Project Net Income ('000kip)	Incremental Benefit ('000kip)	Incremental Benefit ('000 US$)
1	138,400	726,600	588,300	806
2	0	96,300	96,300	132
3	98,600	1,073,500	974,900	1,335
4	26,500	754,900	728,500	998
5	67,200	1,021,100	954,000	1,307
6	55,900	363,300	307,400	421
7	6,700	469,400	462,700	634
8	70,400	1,978,500	1,908,100	2,614
9	219,800	1,052,000	832,100	1,140
10	89,700	636,800	547,100	749
11	309,000	2,030,900	1,721,800	2,359
12	47,900	1,120,000	1,072,100	1,469
13	470,500	2,302,900	1,832,400	2,510
14	47,000	344,100	297,100	407
15	34,500	2,246,100	2,211,600	3,030
16	3,500	266,600	263,100	360
Total	1,685,700	16,482,900	14,797,300	20,270

Project Implementation

59 The implementation program divided into the 3 phases of development over 15 years will execute 16 schemes, which consist of agricultural and rural infrastructure development, together with participatory management of beneficiaries themselves as well as strong extension support services from authorities concerned. The priority is given to the schemes bringing about the most efficient extension and demonstration effects. Besides, the projects are to be medium to small scale in the development area. Table 1.21 (in Main text) shows the implementation program for the future 15 years, in which the 16 selected Projects are included.

Cost Estimate (Project Cost)

60 The project cost consists of construction cost of civil engineering works, procurement of machinery, land acquisition cost, engineering and administration costs and contingency. The total cost required for 16 schemes is estimated to be US$ 242 million equivalent comprising US$ 191 million for irrigation and drainage development and US$ 51 million for rural infrastructures.

Preliminary Evaluation (Economic and Financial Evaluation)

61 In order to evaluate the whole economic feasibility and that of each of the selected 16 projects, the preliminary economic evaluation is made by using the Economic Rate of Return (EIRR). The EIRR is computed based exclusively on the incremental benefits and costs of agricultural development (Construction costs of agricultural infrastructure + O&M costs + Replacement costs). The following tables show the result of calculation of EIRR in each of the 16 projects and the whole.

Project No.	Location	EIRR (%)	Project No.	Location	EIRR (%)
1	Upper Champi	9.3	9	Upper Kapheu	13.1
2	Upper Tapoung	8.1	10	Middle Tapoung	13.9
3	Lower Xe Pian	16.0	11	Lower Tapoung	4.6
4	Upper Makchan	11.9	12	Lower Xe Set	5.1
5	Middle Xe Katam	16.5	13	Lower Namsai	5.0
6	Middle Namtang	12.8	14	Upper Thon	6.1
7	Lower Makchan-Gnai	13.9	15	Middle Lamphan	5.0
8	Lower Champi	7.9	16	Upper Tay-Un	8.8
	Whole 16 Project	7.9			

62 After the project is implemented predominantly slash and burn cultivators will change the nature of their farming should to lowland rice, vegetables and / or coffee farming, so that agricultural benefits increase drastically, resulting in substantial improvement of living conditions. The following table shows the typical farm budget with and without project conditions.

(Unit of income: '000kips)

	Without Project Condition				With Project Condition		
Main Cropping Type	Coffee	S & B	Low. R	Ave.	Coffee	Low. R	Ave.
Ave. Farm Size (ha)	2.1	1.2	1.0	1.9	2.4	2.5	2.5
No. of Benefit. (H.H)	1,634	1,012	2,025	4,671	1,740	8,244	9,984
1.Gross Income	564	417	432	475	3,572	2,454	2,694
(1) Farm Income	564	342	382	437	3,572	2,454	2,694
(2) Non-farm Income	0	75	50	38	0	0	0
2.Production Cost	125	26	35	65	643	814	777
3.Net Income	439	391	397	410	2,928	1,640	1,917
(1) Living expense	429	391	397	407	1,535	1,535	1,535
- Food Item	333	303	309	316	874	874	874
- Non-food Item	96	87	89	91	661	661	661
(2)Net Reserve	10	0	0	3	1,393	104	382

Remark: S&B is slash & Burn farming, Low.R is Lowland Rice farming.

Note: Average family size is 5.7 persons per household.
The future coffee price prospected by IBRD is used for the above estimation.

63 Although the selected model development schemes for all 16 areas are not fully feasible from the economical view points, each scheme should contribute significantly to drastic increases in farm income for beneficiary farmers as well as to rural life improvement in the area as a whole. Particularly, the implementation would result in reduction of slash and burn cultivation in the Study area. In fact, it is expected that a reduction of about 15,000 ha of slash and burn field, will be a direct result of the implementation of the projects. The stage wise development of the Study area is proposed, because the farming type, crop and practices in the Study area vary considerably with altitude and climate, and the areas to be developed are quite large.

Selection of Priority Development Projects

64 In order to select the priority development schemes for the feasibility study, the following major criteria are taken into account.

1) Effective agricultural extension and demonstration for rural development can be expected through implementation of the Projects.

2) Present agriculture development activities and existing projects in the Study areas, can be coordinated and the degree to which they complys with national and regional agriculture development programs.
3) Easy access to the proposed areas is sustainable.
4) Medium scale agriculture and rural developments are sustainable.
5) Typical agriculture development which can be specified by crops of model development projects grouped according to different climate conditions and land capability can be maintained and extended.
6) Farmers acquire knowledge and experience of introduced crops and are able to expect easy attainment of their agricultural objectives.
7) Ease of access to markets from the Project area.
8) Substantial increase of farm household economy and improvement of living standard of beneficial farmers can be expected following implementation of the Projects.
9) Better cooperation from the beneficial farmers can be expected through implementation of the Projects.
10) Government has a program and put a priority on the Project areas, and therefore the efficacy of government support that can be expected through implementation of the Projects.
11) The beneficial farmers have an experience of operation and maintenance of rural infrastructures such as rural road, and the degree to which future efficient operation and maintenance for rural infrastructures can be expected.
12) Reduction of slash and burn cultivation area can be achieved through implementation of the Projects.
13) Environmental impact of the Project is minimal and sustainable development is possible through implementation of the Projects
14) Future transmigration from slash and burn cultivation area can be accepted.
15) Economically feasible from EIRR can be calculated.
16) Outcomes from the promotion of crop diversification can be expected.
17) Self-sufficiency in food can be expected through implementation of the Projects

65 Using a matrix analysis which consists of the above criteria (as shown in Table 1.22 in Main text), the following five (5) schemes are selected and proposed for the feasibility study. The salient features are shown below:

Project	Upp. Champi	Upp. Tapoung	Upp. Kapheu	Low. Xe Set	Upp. Tay Un
Location	Pakxong	Pakxong	Laongam	Salavan	Thateng
Altitude	900~1200m	1200~1250m	600~800m	300~400m	550~620m
Water Reso.	H. Champi	H. Tapoung	H. Kapheu	Xe Set	H. Tayun
Main Crops	Coffee/Vegetables	Vegetables	Coffee/Up. crops	Rice/Up. crops	Rice/Up. crops
Irrigation Area	730 ha	50 ha	1,100 ha	1,800 ha	330 ha
Design Disch.	0.53 cms	0.04 cms	1.32 cms	2.39 cms	0.4 cms
Irri. Canal	26.6 km	4.3 km	27.0 km	47.6 km	5.8 km
Drai. Canal	13.4 km	2.4 km	22.4 km	42.5 km	4.5 km
Farm Roads	30.1 km	5.3 km	27.1 km	57.1 km	5.8 km
No. of Beneficial villages	7	3	5	6	1
Village farm roads	3.0 km	2.0 km	3.5 km	13.0 km	2.0 km
Extension of trans. line	-	15 km	-	8 km	-
Micro-hydro power	-	-	1	-	-
Primary school	7	2	3	2	1
Village clinic	1	1	1	3	1
Community hall	4	2	3	-	1

II FEASIBILITY STUDY

Natural Resources

66 Location , area and population in each priority scheme are presented as follows;

Scheme	Province	District	Village	Area(ha)	Population	Work Popu.	Farm Popu.
Upper Champi	Champasak	Paksong	8	820	4,731	2,206	93%
UpperTapoung	Champaasak	Paksong	3	90	1,478	792	91%
Upper Kapheu	Salavan	Laongam	5	1,240	2,393	1,332	97%
Lower Xe set	Salavan	Salavan	6	1,900	2,218	1,001	93%
Upper Tay-Un	Sekong	Thateng	3	370	871	364	98%

67 Climatically the Upper Champi and the Upper Tapoung Areas are situated around the Pakxong meteorological station, while the Upper Kapheu, Lower Xe Set and Upper Tay-Un areas are rather close to Salavan station. For the estimation of the irrigation requirement and agricultural study in each scheme, the following data was applied.

Scheme	River	Cath. A.(km2)	Ave. Flow(m3/s)	Low Flow(m3/s)	Min. Flow(m3/s)
Upper Champi	H. Champi	16	0.549	0.256	0.126
Upper Tapoung	H. Tapoung	4	0.137	0.064	0.03
Upper Kapheu	H. Kapheu	24	0.716	0.325	0.148
Lower Xe Set	Xe Set	413	9.987	3.714	2.015
Upper Tay-Un	H. Tay-Un	21	0.386	0.209	0.127
	H. Thong	8	0.166	0.078	0.058

68 The present land use in the five priority schemes areas was examined using the same procedure as in the master plan study and the results obtained, excluding uncultivatable land, are as follows;

Land Capability Class	Lowland rice	Upland rice	Upland Crop vegetable	Coffee	Tea	Fruit	Bush	Grass	Forest	Swamp	Total
Upper Champi				490	140		40	80	120		870
Upper Tapoung							90		10		100
Upper Kapheu		190		560			450		40		1,240
Lower Xe Set	100	140	90			20	420	100	380		1250
Upper Tay-Un	20	30					280	10	70	10	420
Total	120	360	90	1,050	140	20	1,280	190	620	10	3,880

69 Annual average rainfall in both Pakxe and Pakxong is 1,920 mm and 3,374 mm respectively of which approximately 90 % occurs in the rainy season. Average annual rainfall in the Study area, therefore is about 2,417 mm. Average minimum monthly temperature in Pakxong is 10.1 °C, but some frost occurs in some years at the Nikhom 34 observatory.

Based on the average runoff coefficient of the Xe Set river, annual average runoffs of the four(4) rivers were calculated as shown below.

River	River Basin (km2)	Runoff (MCM)
H.Tapoung	4	5.48
H.Champi	36	49.29
H. Champi	16	21.91
H. Kapheu	24	27.77
Xe Set	413	439.21
H. Tay-Un	21	14.17
H. Thong	8	5.51

70 A feature of the five schemes as they relate to the socio-economic conditions is the predominance of agriculture and the large contribution made by coffee and vegetables to highland economies. (lowland rice and upland rice in lowland areas) The areas have ethnically diverse societies which are composed of two main ethnic groups; Lao Loum and Lao Thueng. Cash family income is mainly derived from selling farm products such as coffee, tea, cardamom, vegetables, groundnut, chili and cotton, and some additional income from sale of pig and poultry . The economic level of households is relatively moderate in the majority of the schemes except for the Lower Xe Set area, where about 80% of households are in poverty. Literacy rate is extremely low ranging from 2 to 56%. Women's literacy rate is generally lower than that of men.

71 Cropping pattern in the priority schemes varies substantially depending on elevation, soils, climate and topography. The following table shows cropping area and production in each scheme.

(Unit : area : ha, production : ton)

Main crops	Upper Champi		Upper Tapoung		Upper Kapheu		Lower Xe Set		Upper Tay-un	
	Area	Prod	Area	Prod	Area	Prod	Area	Prod	Area	Prod
Coffee	460	138	-	-	540	162	-	-	-	-
Tea	130	39	-	-	-	-	-	-	-	-
Upland rice	-	-	-	-	180	270	130	273	30	42
Lowland rice	-	-	-	-	-	-	100	260	20	34
Upland crops	-	-	-	-	-	-	90	135	-	-
Fruits**	-	-	-	-	-	-	20	120	-	-

* Groundnut, Chilli and Cotton. ** Banana.

72 The average yield of crops is generally in low in all scheme areas. The average yield of the main crops in each area are as shown below:

(Unit : yield in ton/ha)

Crops	Upper Champi	Upper Tapoung	Upper Kapheu	Lower Xe Set	Upper Tay-un
Coffee	0.3	0.4	0.3	-	0.23
Tea	0.34	-	-	-	-
Upland rice	0.5	0.6	1.5	2.1	1.4
Lowland rice	-	-	3.0	2.6	1.7
Cabbage	-	10	-	-	-
Groundnut	-	-	-	1.5	-
Chilly	-	-	-	0.08	-
Cotton	-	-	-	0.5	-
Cardamom	0.04	-	-	-	0.04

(Coffee in green beans, rice in paddy, groundnut in shell and chilly in dried conditions)

73 Main livestock raised are cattle, pig, and poultry in the all schemes, and buffalo in the rice cultivation areas as shown in the following table.

(Unit: head)

Main crops	Upper Champi		Upper Tapoung		Upper Kapheu		Lower Xe Set		Upper Tay-un	
	Total	/Farmer	Total	/Farmer	Total	/Farmer	Total	/Farmer	Total	/Farmer
Buffalo	-	-	-	-	-	-	200	0.7	180	3.6
Cattle	490	2.5	-	2.9	430	1.0	430	1.5	50	0.9
Horse	20	0.1	-	0.7	-	-	-	-	-	-
Pig	240	1.2	-	0.6	820	1.9	490	1.7	70	1.3
Poultry	1350	6.8	-	6.5	4300	10.0	2200	7.8	340	6.7

74 Present production value in each priority area is estimated based on farm gate prices in 1995 as shown below.

	Upper Champi		Upper Kapheu		Lower Xe Set		Upper Tay-Un	
	Prod.	Value	Prod.	Value	Prod.	Value	Prod.	Value
Crops	(ton)	(000kip)	(ton)	(000kip)	(ton)	(000kip)	(ton)	(000kip)
Coffee	138	151,800	162	178,200	-	-	-	-
Tea	39	17,550	-	-	-	-	-	-
Upland rice	-	-	270	40,500	273	40,950	42	6,300
Upland crops	-	-	-	-	135	33,750	-	-
Lowland rice	-	-	-	-	260	39,000	34	5,100
Fruit	-	-	-	-	240	13,710	-	-
Total	177	169,350	432	218,700	908	127,410	76	11,400

Remark : Upper Tapoung area is excluded in the above table, because there is no farm land in the scheme area.

75 The existing national and provincial research stations mentioned in para.23 are responsible for agricultural research for crops, livestock and fishery. The existing research stations are facing fundamental problems of lack of manpower and funds for sufficient research and training. The extension activities in the Study area do not function inadequately properly due to insufficient funds and a shortage of extension officers. In addition, inadequately trained extension staffs currently very little training in extension activities is given to the staff and extension officers of the district and provincial services.

76 In general, women in the priority areas are actively involved in every stage of agricultural production. Further, domestic activities are an essential part of the work of women. Upland farming (slash and burn cultivation) requires much more labor than lowland agriculture, particularly in weeding, which is usually done by women. From the socio-economic survey, it appears that women's labour time on farms is 4 to 6 hours. The Lao Women's Union is trying to improve the status of women and living conditions in the rural area, through a network extending from the central level down to the village level.

77 Upper Champi, Lower Xe Set, and Upper Tay-Un areas have good accessibility, being connected with national roads, No.23, No.20, and No.16 respectively. Upper Tapoung area is located at about 10km from No.23 at Pakxong and is connected by a coffee feeder road. Also the Upper Kapheu area, is located at about 4km away from No.20 national road and is connected by a coffee road.

Almost all villages rely entirely on nearby streams or rivers for drinking and domestic water. Some villagers, however, are compelled to carry water for more than 1 to 2 km particularly during the dry season. Only limited villages, B.Lak40 and B. Lak38, enjoy the benefits of gravity flow piped water system. Tube well with hand pump in B. Chakam-mai, which are supported by the provincial public health services and UNICEF.

The acute shortage of health care facilities and equipment limit the provision of rural services both in quality and scope. Only one village clinic in the priority areas is located in B. Lak35 in Champi area, but it is operated poorly due to a limited budget.

School facilities including buildings, rooms, fixtures and teaching materials are very poor due to limited budgets. The following table shows the number of schools in the priority areas.

Priority Area	Upper Champi	Upper Tapoung	Upper Kapheu	Lower Xe Set	Upper Tay-Un	(Total)
Total No.of Villages in the Priority Area	8	3	5	6	3	25
Class-III Primary School	3	2	3	4	1	13
Class-V Primary School	4	1	1	0	0	6
(Total)	7	3	4	4	1	19
Secondary School	2	0	0	0	0	2

78 The demand and supply of paddy, in and around the priority areas for 1995 are tabulated below. Rice is short in the priority areas, while coffee produced in Upper Champi, Upper Tapoung and Upper Kapheu areas is largely exported. These farmers purchase their food with cash income earned from coffee, vegetables and other cash crops.

Scheme Area	Total Population	Rice demand (Paddy)	Production of paddy	Balance	
				Total	Per capita
	(person)	(ton)	(ton)	(ton)	(kg/person)
Upper Champi	4,731	1,420	10	-1,410	-298
Upper Tapoung	1,478	440	10	-430	-290
Upper Kapheu	2,393	720	400	-320	-174
Lower Xe Set	2,218	670	480	-190	-86
Upper Tay-Un	871	260	190	-70	-80

79 The average farm economy for each typical farmer in the schemes are summarized as follows :

Upper Champi & Upper Tapoung

Project Area	Upper Champi		Upper Tapoung		
Farm Type	Coffee only	Coffee & Tea	Coffee only	Coffee & Cabbage	Coffee & Upland R.
Holding Size (ha)	2.7	3.0	1.5	2.9	2.8
1. Gross Income	802	796	677	1,762	1,022
(1) Farm Income	802	796	677	1,762	1,022
(2) Non-farm Income	0	0	0	0	0
2. Production Cost	88	78	55	314	90
3. Net Income	713	718	621	1,448	932
(1) Living Expenses	609	612	581	1,145	779
(2) Net Reserve	105	106	41	303	153

Upper Kapheu, Lower Xe Set & Upper Tay-Un

Project Area	Upper Kapheu		Lower Xe Set		Upper Tay-Un	
Farm Type	Coffee only	Coffee & Upland R.	Lowland R & Upland Crops	Lowland R. & Upland Crops	Coffee & Lowland R.	Coffee & Upland R.
Holding Size (ha)	1.6	1.7	1.5	1.3	2.4	1.7
1. Gross Income	563	522	465	432	612	435
(1) Farm Income	563	522	465	369	612	390
(2) Non-farm Income	0	0	0	60	0	45
2. Production Cost	17	22	20	21	25	22
3. Net Income	546	500	444	408	587	413
(1) Living Expenses	455	437	439	403	537	387
(2) Net Reserve	92	64	6	5	50	25

Presently the farmers in Upper Champi and Upper Tapoung areas earn a significant income from coffee and/or vegetables, while the farmers in the Lower Xe Set area are somewhat poor, living at a subsistence level.

80 The predominant forest type in the locality is the Upper Mixed Deciduous forest. There are also small extents of Upper Evergreen, Lower Mixed Evergreen, Lower Mixed Deciduous and Gallery forest types. Much of the available forest land is of poor quality. The land use categories of bush and secondary forest are actually deforested land that is not properly utilized. Sometimes this land is allocated to sifting cultivation. Extents of this land area vary from 5 % in Upper Champi to 91 % in Upper Tapoung. The area in Upper Tay-Un is also particularly high, being about 66%. Forest land is assigned to village administrative authorities for management, including reforestation. They have authority to effectively manage and preserve forest, develop plans, educate people, monitor changes, organize forest protection and management, draw up rules to suit village needs and work towards eliminating shifting cultivation.

Large species of wildlife are extremely rare in and around the village areas in spite of the rich diversity of species reported to be present in Lao PDR. They are confined to the well forested areas due to hunting pressure. Wetlands of the Boloven Plateau are found in the area around Pakxong and are of great ecological value. Part of the Upper Tapoung scheme falls within the Pakxong wetlands area. Wetlands are also economically important. The people harvest varieties of fish, amphibians, reptiles and mollusks on a regular basis.

Shifting cultivation is considered undesirable in the present time but nevertheless provides the basis for the maintenance of cultural values of a large number of ethnic groups. It is most extensive in Upper Kapheu, 412ha, but the average holding size is highest in Upper Tay-Un with each family having an 1-ha holding. The fallow cycles are as short as one year in Upper Kapheu village, to a little over five years in some other villages of the same scheme.

Development Constraints

81 Certain coffee plantations suffer from frost, and also moisture stress during flowering and fruiting. Generally, the dry season brings about water deficits in all areas and for all crops water is a limiting factor. The Xe Set hydro-power facility has created unstable river flow and made the taking water for irrigation difficult.

A remarkable feature is that the extension services are almost non-functional. Apart from severe staff shortages, the existing staff have not had adequate basic training, nor are sufficiently conversant with modern technology. Research is also inadequate and research-extension links weak.

Some river valleys are deep and this makes access to intake sites difficult. Water availability may also be reduced depending on human activities in the watershed, for example shifting cultivation which can lead to erosion from forest, bush and grassland.

Water has to be fetched from deep valleys and some sources of water are inadequate during certain months. Village roads are in very poor condition. Some are almost impassable by car. Health facilities are very poor and non-functional in some villages due to insufficient staff, medicines and finances. Even when 22kv transmission lines are available, certain villages can not afford the 30% share of the transformer cost.

A low literacy rate is a major drawback in all schemes. Educational services are poor and human resources, funds and infrastructure are lacking for socio-economic development. Water supply is poor and piped water is generally not available. Inadequate technical and financial support is serious obstacle to better community development.

There are technical constraints peculiar to certain areas such as the destruction of wet land vegetation in Upper Tapoung and the use of extremely toxic pesticides for the control of cabbage caterpillars, also in Upper Tapoung.

Development Concept

82 The ultimate objectives of the integrated agricultural and rural development plan in the Study area are to increase agricultural output in the area through improvement / development of irrigation, drainage and rural infrastructure together with appropriate support services, and to achieve substantial and sustainable improvement in the living conditions of the inhabitants and their quality of life, taking into account the Government policy mentioned in para.34.

The basic agriculture development concept is to intensify the diversified agriculture in the existing agriculture areas of the five priority schemes which vary with altitude, climate conditions, current social needs, etc., improving suitable and profitable crops such as coffee, tea, vegetables and fruit and stabilizing agricultural management by providing irrigation and drainage facilities and extension of agricultural support services. Rural development aims at community involvement under voluntary participatory management of beneficiaries from the planning to O & M stages in environment agricultural and rural infrastructure, taking into consideration current social and cultural conditions of the ethnic groups.

83 Crops are selected on the basis of natural conditions such as the altitude and land capability. Vegetable cultivation is introduced in highland where elevation is above 1,000 m and coffee cultivation is not suitable due to frost, and also near the highland vegetable trial and demonstration station, and the wholesale market center to benefit from easy access of technical extension and marketing. Coffee cultivation is proposed to be developed in line with intensive farming practices with irrigation under the present condition with guidance from and technical cooperation from LUADP. Tea cultivation is to be intensified from the viewpoints of farming and processing technology. Rice and upland crops take into consideration the need for food production in the schemes.

Furthermore, inland fish culture is introduced to increase protein resources, using water reservoirs which will be constructed for irrigation.

84 Aims of irrigation and drainage development are

(i) Irrigation development for high land vegetable cultivation,
(ii) Supplementary irrigation for rainy season paddy and irrigation for dry season paddy cultivation
(iii) Irrigation for coffee and
(iv) Inland fishery development using irrigation ponds to be constructed.

Simple and economic irrigation facilities are provided for vegetable cultivation areas to get high yield, particularly in the dry season. Supplementary irrigation is planned for rainy season paddy and, irrigation for dry season paddy. Although no irrigation for coffee has been practiced so far on the Plateau, it is known that irrigation for coffee during the period from flowering to fruiting will bring about better yield and quality. Hence, irrigation is proposed to be provided for coffee cultivation for about 3 months from flowering to fruiting stage.

85 The following 5 components of agricultural support services will be strengthened in line with current national integrated extension and research programs (NIERP).

(i) agriculture research,
(ii) agricultural extension,
(iii) agricultural input supply, agricultural credit and insurance system,
(iv) farmers' organizations, and
(v) operation and maintenance of irrigation facilities

Rural development aims to improve the quality of rural life of people and to raise living standards through provision of rural infrastructure as well as agricultural infrastructure. To achieve this it is essential to strengthen support services by means of voluntary participation of beneficiaries.

In relation to vegetables and rice markets, a wholesale marketing system for vegetables will be established in Pakxong under the guidance of the local government, and for the rice, the existing rice bank system will be reinforced and given a wider role.

Development Plan

86 The proposed cropping patterns for the scheme areas were formulated taking into account the present condition of agricultural land use, crop suitability by altitude and the familiarity to farmers, present agro/socio-economic conditions, and the availability of irrigation water. The proposed cropping patterns for each area are as follows:

(Unit: ha)

Crops	Season	Up Champi	Up Tapoung	Up Kapheu	Lower Xe Set	Up Tay-Un
Coffee	Perennial	500		900		
Tea	Perennial	120				
Lowland rice	Wet season			100	1,000	330
Lowland rice	Dry season				200	70
Upland crops	Wet season		40			
Upland crops	Dry season	110	40	100	800	80
Vegetables	Wet season		40			
Vegetables	Dry season	110	40			
Total	Wet season	730	80	1,000	1,000	330
	Dry season	730	80	1,000	1,000	150

87 The farmers have much experiences with cabbages, chinese cabbages etc. but not much a reliable experience with new kinds of highland vegetables. The farmers are very familiar with growing local variety rice but not accustomed to growing improved varieties or double cropping with rice. It is inevitable that new varieties of lowland rice, upland crops as well as new kind of vegetables, are introduced to improve quality and yield as well as to meet market requirement of products.

Fundamentally, small holding farm practices presently prevailing in and around the scheme areas, such as animal power for land preparation and transportation, manual

operation for transplanting and harvesting, etc., will be applied. Farm mechanization has been gradually introduced into the areas, but rapid farm mechanization is not recommended in the proposed farming practices, due to consideration of the large investment outlay needed at once for the individual farmer.

88 After execution of the project, and once farms have become accustomed to irrigation farming practices supported by agricultural services, crops yields should be substantially increased and stabilised. The estimated target yield of crops at the full development stage shown below is based on common yields in tropical areas because of insufficient data available in the Study area.

Crops	Present (ton/ha)	With project (ton/ha)
Coffee	0.3	1.5
Tea	0.26	1.0
Upland rice	1.5	3.0
Lowland rice		
Local variety	2.6	3.0
Improved variety		4.0
Vegetables:		
Cabbage	8.0	20
Chinese cabbage	6.0	20
Potato	10.0	20
Upland crops		
Groundnut	1.5	2.0
Soybeans	1.0	2.0
Maize	1.0	3.0

89 The projects anticipated crop production in each area at the full target stage is summarized as follows:

(Unit: ton)

Scheme	Condition	Coffee	Tea	Lowland rice	Upland rice	Field crops	Vegetables	Fruits
Upper Champi	With	750	120			330	2,200	
	Without	138	39			0	0	
	Increment	612	81			330	2,200	
Upper Tapoung	With					240	1,600	
	Without					0	0	
	Increment					240	1,600	
Upper Kapheu	With	1,350		400	0	200		
	Without	162		0	270	0		
	Increment	1,188		400	-270	200		
Lower Xe Set	With			4,800	0	1,600		0
	Without			260	273	135		240
	Increment			4,540	-273	1,465		-240
Upper Tay-Un	With			1,600	0	160		
	Without			34	42	0		
	Increment			1,566	-42	160		

After implementation of irrigation facilities, reservoirs would be utilized for fish culture with potentially usable areas of 0.3 ha in Upper Champi area, 16 ha in Upper Tapoung area, 2.0 ha in Upper Kapheu area and 2.0 ha in Upper Tay-Un area. The estimated production of fish is as follows:

Schemes	Effective area (ha)	Production (kg)
Upper Champi	0.3	200
Upper Tapoung	16	8000
Upper Kapheu	2	1000
Lower Xe Set	0	0
Upper Tay-Un	2	1000

90 The support services in the scheme areas will be made taking into consideration the NIERP. The proposed agricultural services comprise (i) agricultural research, (ii) agricultural extension, (iii) agricultural input supply, agricultural credit and insurance system, (iv) farmers' organizations, and (v) operation and maintenance of irrigation facilities. The support services also extend to the field of rural life improvement.

The existing stations in Champasak province, Phone Ngam station, lowland rice and Palay station, upland field crops will provide for research to support agricultural production in the scheme areas. These stations will conduct research jointly with the extension staff of district AFSs. In relation to coffee, the research and extension activities are carried out by the LUADP.

91 The proposed agricultural extension services will be provided mainly for the crops and fish cultures mentioned previously, through provision of trained extension staff, vehicles, equipment and office buildings. In particular, it is essential to strengthen extension services for irrigated farming in order to achieve the scheme's goal and improve agriculture.

1) Extension Activities:

- Introduction of improved varieties;
- Supply of planting materials;
- Demonstration and guidance on cultivation techniques with irrigation;
- Information on marketing and distribution;
- Guidance on fish farming techniques;
- Introduction and guidance on agricultural credit and insurance;
- Guidance on agro-processing activities;
- Consultation and guidance on rural life improvement; and
- Monitoring and evaluation of extension activities.

2) Strengthening of Extension Services:

- Establishment of agricultural extension office at the district AFSs;
- Augmentation of extension staff and stationing of extension staff to take charge of the scheme areas, at the district AFSs;
- Training for extension staff to raise their capabilities in farming techniques;
- Formation of farmer working groups for improvement of farming, comprising volunteers of progressive farmers at village level, based on the NIERP;
- Establishment of on-farm demonstrations at the village level and with local co-operation, in the fields of progressive farmers;
- Conducting periodical farmer training in villages;
- Provision of extension materials and vehicles for transport of extension staff; and
- Collaboration with the LUADP, and existing stations in Champasak province.

A new agricultural extension section will be set up in the district AFSs, in order to concentrate on the services in the schemes.

92 No credit system of the APB exists for upland field crops and vegetables. Accordingly, the proposed supply system will supply necessary agricultural inputs to the scheme's

areas, through state owned agricultural materials companies and private traders that passed the more rigid financing of the APB. The proposed credit system will strengthen the source and expand the lending extent of APB's credit and in addition, expand APB's sub-branch network in the scheme areas.

93 Village farmer organizations will be set up having respect for farmers' autonomy which has arisen from farmer awareness of the development through village community programs. This organisation will take into consideration the culture of ethnic minorities, religion, customs and behaviors of ethnic groups. Formation of the farmers' organizations in the schemes will be based on the existing farmer groups such as the coffee extension groups, production groups of APB, rice banks and mutual funds in villages. Group formation will be promoted through the community development in villages where no such group exists at present.

94 The operation and maintenance of both of irrigation and water supply facilities will be transferred to beneficiaries in line with the national policies. Both the water user groups/associations for irrigation and for water supply will be organized by the beneficiaries under the guidance of the provincial agricultural and health authorities in accordance with the regulations, and then the groups/associations will collaborate on the implementation of scheme during the implementing period. After completion of the scheme, the administrative authorities shall legally hand over both facilities to the groups/associations for operation and maintenance.

95 The Boloven Plateau exceeding an elevation of 1,000 m has proved to be favorable for vegetable production which meets the physical features and climatic conditions. For the purpose of promotion and extension of vegetable production which could greatly improve the farm household economy and the development of regional economy, it is proposed to establish the highland vegetable trial and demonstration station. The station aims to improve production methods, to conduct extension activities and to distribute improved seeds. In addition, the station will conduct research on tea cultivation and its processing for the purpose of upgrading the quality of products.

The proposed station will be operated under the agricultural authorities (AFSs) of Champasak province, collaborating with the Department of Agriculture and Extension, MAF and the Hatdockeo agricultural research station. The organization is composed of the cultivation section, extension and training section, farm facilities section, laboratory of tea processing and administrative section, and has the necessary staff for smooth and effective operation.

96 Irrigation water requirement is estimated in the same way as the Master Plan Study, adopting rainfall data for ther past 10 years. Seasonal irrigation requirement of the each cropping pattern is estimated at approximately 300 mm to 730 mm for vegetables, 80 mm to 200 mm for coffee, 1,220 mm to 2,300 mm for double paddy cultivation and 800 mm to 1,700 mm for upland crops.

Irrigation is carried out by three (3) methods, furrow irrigation method for upland crops including vegetables, border irrigation method for coffee and surface irrigation method for paddy.

97 Eight (8) small impounding ponds are planned to supply irrigation water properly and to expand irrigation areas as much as possible in the rainy season. Storage capacity of reservoirs is determined to supply water to all irrigation areas during the drought years (80 % chance based on water balance calculation). The storage capacity of respective reservoir ranges from about 60, 000 m^3 to 240, 000 m^3.

Irrigation areas of all the schemes are determined taking into consideration the land suitability and results of water balance in the each scheme as shown below.

(1)	Upper Champi Scheme	Coffee & Type-C	730 ha
(2)	Upper Tapoung Scheme	Type-C	80 ha
(3)	Upper Kapheu Scheme	Coffee & Type-B 1	1,000 ha
(4)	Lower Xe Set Scheme	Type-A & Type-B 1	1,000 ha
(5)	Upper Tay-Un Scheme	Type-A, Type-A 1 & Type-B 1	330 ha
	Total		3,140 ha

98 The future market and price conditions are predicted based on the IBRD price forecast and the results of interview surveys. The results are summarized as follows:

Commodities	Marketability	Market place	Remarks (required actions)
Coffee	high	international	improvement of quality
Tea	medium	international	improvement of quality
Vegetable	high	domestic or Thai	low barrier & improvement of road condition
Upland crops	high	Thai	low barrier of Thai
Rice	high	domestic (Xe Kong)	improvement of quality

99 The market development plan is formulated by taking into consideration the basic development concepts. The following institutional development of marketing is proposed which includes construction of market facilities including warehouses and strengthening agricultural support and extension, farmers organization promotion, women's development and agricultural development.

The existing rice banks are set up with one each in Upper Kapheu, Lower Xe Set and Upper Tay-Un schemes respectively under the guidance of LUADP and supported by LWU. They are mainly concerned with distributing rice among the villagers concerned. The proposed rice bank would provide not only for bank activities (saving and credit) but also processing rice, storage and market information activities.

System	Proposed site	Activities	Installed facilities	Operated by	Covered area
Wholesale market	Pakxong town	Auction market Market information supply Market statistics Assistance of transporting training farmers Agro-input supply	Rice mill Storage Drying yard Office building	local government	Whole area of plateau
Rice Bank	B. Sengvang-gnai B. Houakhoua B. Sengvang-noi B. Khonleng B. Natou B. Chakamlit	Milling of paddy Saving and credit Market information supply (Commitment of selling)	Work space Storage Loading space Office building	Villagers (Women's Union)	Lower Xe Set scheme Upper Tay-Un scheme

Future Agro-economic Condition

100 The expected benefit of the irrigation development is the incremental benefit between future without and with project conditions. The financial irrigation benefit at full development stage in each of the priority scheme areas is summarized as follows :

(Unit: million in Kip, thousand in US $)

Crops	Without Project Condition			With Project Condition			Incremental Benefit	
	Pro.value	Pro.cost	Net Benefit	Pro.value	Pro.cost	Net Benefit	by Kip	By US$
1. Upper Champi	155	15	140	1,130	160	970	830	903
2. Upper Tapoung	0	0	0	185	50	135	135	149
3. Upper Kapheu	230	10	220	1,610	180	1,430	1,200	1,309
4. Lower Xe Set	120	5	115	1,230	340	890	770	839
5. Upper Tay-Un	10	0	10	290	80	210	200	219

101 After the implementation of the projects, the present farm types in each priority scheme would be changed to the following farm types:

Priority scheme	Farm type	Irrigated field (cropping pattern)	Non-irrigated fields	No. of H.H.
Upper Champi	Coffee	Coffee : 2.7 ha	0 ha	40
Upper Champi	Coffee + Tea	Coffee : 2.3 ha, Tea : 0.7 ha	0 ha	186
Upper Tapoung	Coffee + Vegetables -1	Vegetables - Upland crops : 0.3 ha	Coffee 1.5 ha	76
	Coffee + Vegetables -2	Vegetables - Upland crops : 0.3 ha	Coffee 2.5 ha, Vegetables 0.3 ha	160
	Coffee + Vegetables -3	Vegetables - Upland crops : 0.3 ha	Coffee 2.5 ha, Upland rice 0.3 ha	26
Upper Kapheu	Coffee + Lowland rice	Coffee : 1.6 ha, Lowland rice : 0.2 ha	0 ha	431
Lower Xe Set	Lowland -1	Lowland-Lowland : 2.5 ha	0 ha	80
	Lowland -2	Lowland-Upland crops : 2.5 ha	0 ha	320
Upper Tay-Un	Lowland + Coffee -1	Lowland- Lowland : 1.2 ha	Coffee 1.3 ha	17
	Lowland + Coffee -2	Lowland- Upland crops : 1.2 ha	Coffee 0.8 ha	17
	Lowland -1	Lowland- Upland crops : 2.5 ha	0 ha	29
	Lowland -2	Lowland- Fallow : 2.5 ha	0 ha	71

Remark : Natural increasing of population is taken into consideration in the Upper Kapheu, Lower Xe Set and Upper Tay-Un. In addition, future transmigration is also considered in the Upper Tay-Un scheme.

102 After the implementation of the projects, the present farm incomes in each priority scheme will be changed to the following incomes:

(Unit: 1,000 Kip)

Priority scheme	Farm type	Gross Farm Income	Net Farm Income	Net Reserve
Upper Champi	Coffee	2,714	2,113	670
	Coffee + Tea	2,672	2,033	590
Upper Tapoung	Coffee + Vegetables -1	1,256	1,077	119
	Coffee + Vegetables -2	1,815	1,464	390
	Coffee + Vegetables -3	1,556	1,280	206
Upper Kapheu	Coffee + Lowland rice	1,856	1,548	105
Lower Xe Set	Lowland -1	3,000	1,895	452
	Lowland -2	3,100	2,070	627
Upper Tay-Un	Lowland + Coffee -1	1,640	1,199	125
	Lowland + Coffee -2	1,611	1,160	86
	Lowland -1	3,100	2,175	732
	Lowland -2	1,500	1,0523	95

Remark : Future Coffee price (2005) is applied for the estimation.

Any households in the priority schemes would receive substantial income which is sufficient to pay annual living expense and also O&M cost including irrigation water charge, domestic water charge, etc. Especially living conditions of farmers in the Lower Xe Set scheme would be drastically improved. The income level of farmers in the Upper Tapoung scheme is presently rather high, so some of them may not get substantial benefit from the project. However, the constant benefits obtained from irrigation farming would stabilize their income and living standards.

103 In the area of socio-economic development, it is proposed that participatory management of the beneficiary concerned is needed for the implementation of the project from the beginning. The following are the proposed sequence of participation of beneficiaries on the efficient and sustainable irrigation and rural development.

1) At the initial construction stage, the village water user's groups for irrigation and domestic water supply (VWUG-irrigation, and -domestic water supply) and the water users' associations for irrigation and domestic water supply (WUA-irrigation, and -domestic water supply) will be organized by beneficiaries under the guidance of the provincial and district AFSs.

2) The groups for irrigation are responsible for the implementation of construction works for tertiary and quaternary canals. The groups for water supply will collaborate with engineers of the scheme and take the same procedure as they do with the final tap place in the village. All the activities will be determined by the collective agreement of all family units within the group.

In order to promote these procedures smoothly and effectively, a considerable amount of staff time of the provincial agricultural and health authorities should be spent on training and extension work for the beneficiaries. It is important that the beneficiaries are involved in the implementation of the scheme and the proposed activities. It is recommended that the water users' organizations established are to be engaged as labor units in unskilled work during the implementation stage.

Community development

104 Rural village infrastructures will be the foundation of general village development relying on effective use of facilities, and will gradually being about community development. Particularly, the people in the scheme area belongs to ethnic groups. Their educational level is low and they have traditional customs and cultural backgrounds. Therefore, the development program based on the people's needs will be executed. The community hall will be used effectively for community development programs. The proposed programs are as follows:

(1) Health and hygiene program

(2) Adult education program

(3) Rural handicraft program

(4) Environmental program

105 Rural society in the scheme area consists of mainly ethnic groups. Women's participation in social activities is limited. The involvement of women in the scheme and in the operation of irrigation and water supply, will be considered. This will contribute in the long term to enhance the awareness of women's role in irrigation and water supply. An improvement in the social status of women will be promoted by encouraging participation in social activities and incentive for community development. In addition women and girls will benefit through the construction of water supply systems which reduce such domestic cleans as fetching water and improve their health.

106 (1) Irrigation Canal Layout

The 5 planned scheme areas plan to off take for irrigation and domestic water supply, at 4 concrete diversion weirs and 2 dams. Irrigation canal networks generally consists of head race, main canal, secondary canal and tertiary canal. Total length of main and secondary canals is about 66 km. Head race and main canal are basically laid out at right angles to contour lines. Secondary canals are laid out to branch off from main canal, and generally to follow topographical contour lines. Canals are designed to have trapezoidal section, and concrete block lining is made from head race to secondary canals. Tertiary irrigation block is basically demarcated at about 30 ha. Major related structures are small scale impounding ponds in 8 sites, regulation ponds in 2 sites, about 120 farm ponds, numerous turnouts . Width of concrete diversion weir ranges from 14 m to 75 m, and volume of earthfill dams ranges from about 10,000 m^3 to 50,000 m^3. These canal layouts are shown in Figures 2.11 to 2.15.

(2) Canal Lining

Soils in the majority areas are Dystric Nitosols soils unit derived from basaltic rock. They are easily erased by rainfall. Therefore, thin concrete block lining is adopted to save seepage loss in irrigation canals, and to make for easy maintenance works by farmers themselves. Aggregates will be obtained from basaltic rocks and bolder near the sites.

(3) Drainage Canal Layout

Main drainage systems are laid out in river courses and / or existing drains as much as possible. If the laid out drainage length is too long, the main drain is connected with rivers and / or other drainage system located nearby in order to distribute large drainage discharge and present soil erosion. Total length of main drain system is about 12 km. General Layout of main drains in the each scheme are shown in Figures 2.11 to 2.15.

107 Operation and maintenance plan of irrigation facilities are made at the following 4 points:

(i) Construction and provision of O & M facilities
(ii) Establishment of O & M organization
(iii) Irrigation operation
(iv) Maintenance schedule

Measuring structures for discharge measurement of irrigation water, such as the broad crested weir and gauging staff are provided immediately downstream from the each intake gates, farm pond, turn out and division box. Facilities for irrigation operation and maintenance works such as (i) radio system, (ii) vehicle and motor cycle, (iii) maintenance equipment and (iv) O & M work office and gate keeper houses are also planned.

Water users' association and village water users' groups will be established for O & M organization. This organization will conduct the following 4 main activities and functions in consultation and cooperation with other government agencies, such as district agriculture services, provincial agriculture authority and MAF. The government agencies such as provincial agriculture authority and MAF are responsible for maintenance works on main canal system and the water users' association and village water users' group are responsible for tertiary and on-farm canal systems.

(i) Operation of irrigation water supply,
(ii) Maintenance works,
(iii) Establishment of irrigation schedule,
(iv) Monitoring work, and
(v) Collection of water charge

Irrigation hours is scheduled at 24 hours for paddy and 12 hours for upland crops and coffee. Irrigation of coffee aims to control the flowering to fruiting stage of coffee and indirectly to control labor requirement in the harvest period. To reach these goals, rotation of irrigation is scheduled to be implemented for about 3 months from the end of December to the beginning of March.

There will be periodical and emergency maintenance of works irrigation and drainage facilities. Ordinary main maintenance works are repairing works of gates at diversion weirs, disposal of sediment in settling basin, cleaning works of earthfill dam and impounding pond, cleaning works of farm pond of lining canal section, and scheduling periodically to carry out maintenance before starting of crop plantation.

108 It is proposed that district and village roads with a total length of 34.6 km be rehabilitated as a model in improving the district/village road network in the future, taking into account the function of these roads. The proposed roads will be of all-weather type. The proposed roads to be rehabilitated are summarized as follows:

Priority scheme area	Upper Champi	Upper Tapoung	Upper Kapheu	Lower Xe Set	Upper Tay-Un
Proposed road (km)	0	12.9	13.0	7.0	1.7

Based on topographical condition and water availability, the following nine (9) water supply systems are proposed, covering a total of 25 villages. An assumption of "60 lit./day/capita " and target year of 2010 are applied for the design.

Priority scheme area	Water supply system	No.of systems	No.of villages
Upper Champi	Gravity flow piped system	1	8
Upper Tapoung	Piped system with electric pump	2	3
Upper Kapheu	Gravity flow piped system,	1	5
Lower Xe Set	Gravity flow piped system,	1	6
Upper Tay-Un	Distribution tank with electric pump	4	3

It is proposed that the existing primary schools should be improved and new primary schools be constructed in the villages, where primary schools do not exist at present. The proposed primary schools to be renewed or newly constructed are summarized as follows:

Priority scheme area	Upper Champi	Upper Tapoung	Upper Kapheu	Lower Xe Set	Upper Tay-Un
Proposed primary school	7	3	4	5	2

Proposed village community halls will provide different village organizations with facilities to conduct their meetings. A village community hall is proposed to be newly constructed in each village of the priority scheme areas as follows:

Priority scheme area	Upper Champi	Upper Tapoung	Upper Kapheu	Lower Xe Set	Upper Tay-Un
Proposed community hall	8	3	5	6	3

109 A highland vegetable trial and demonstration station is proposed to be established to provide the following facilities. Area of the station is 50 ha consisting of 39 ha of trial and demonstration fields and 11 ha for building area.

(i) Construction of more than 7 buildings such as administrative office, laboratory, training room, workshop, storage and dormitory and 10 station facilities such as green house, net houses, manure shed, cow shed, pump house and water tanks.
(ii) Provision of farm machinery and vehicles such as tractors, tiller, etc.
(iii) Construction of trial and demonstration fields.

(iv) Supply of research and extension materials such as laboratory and observatory equipment, audio-visual equipment, office equipment, etc.

Trial and demonstration fields is also facilitated by green houses, net houses including provision of modernized irrigation facilities such as sprinkler, drip, hydrant and pipeline in order to research and make further extension programs and to confirm technical sound.

110 The proposed marketing facilities are summarized as follows:

1) Wholesale Market in Pakxong

The general plan of the proposed wholesale market is summarized as follows:

Items	Specification	No
Working space	30 x 20 m of concrete floor of plat form type about 80 cm higher than loading space, steel frame with shade.	2
Warehouse	100 m2 of concrete type	1
Loading space	along the working space, 30 x 10 m of asphalt pavement	4
Parking lot	800 m2 of gravel pavement	1
Building for office spaces	100m2 for marketing organization	1
	40 m2 for selling shop of farm inputs	1
	6 rooms of 3 x 4 m for buyers	2

2) Rice Bank in Lower Xe Set and Upper Tay-Un

The rice mill capacity installed is set up at 500 kg/hour of output (rice), taking into consideration the availability of market and future production. The number of rice mill and size of other facilities for each proposed site are summarized as follows:

Scheme	Proposed Site	Number of Mills	Storage Space	Drying Yard Space
Lower Xe Set	B. Sengvang-gnai	1	250	200
	B. Houakhoua	1	150	200
	B. Sengvang-noi	1	150	200
	B. Khonleng	1	100	200
	B. Natou	1	150	200
Upper Tay-Un	B. Chakamlit	1	250	200

In addition to the above facilities, the office building required for the bank should have a space enough for routine work of managing the bank by clerk, accountant, etc. The required floor space is about 50 m².

Environmental Assessment

111 Soil and water conservation constitutes an important area of resource management for which methodologies can be broadly grouped into two; agronomic methods and mechanical or engineering methods. Usually a combination of methods is the likely choice, as different stages of crop growth and different physical conditions require different approaches.

Lowlands being alluvial plains and usually cultivated in paddy, are not so much erosion-prone. The bunds that are an essential part of lowland paddy, are generally an insurance against soil movement unless during floods. Lowland paddy is the proposed crop for Upper Tay-Un where the topography is flat to one of mild gradients. Upland soils have a diverse occurrence -- undulating, as in Xe Set to steep slopes as in parts of Upper Champi and Upper Kapheu -- and when opened up are exposed to erosion. For the soil and water conservation in the priority schemes, the following methods are proposed to be introduced;

- Mechanical measures,
- Cultural measures,
- Mulching,
- Alley cropping,
- Cover crops,
- Tillage, and
- Incentive subsidy.

112 In order to maintain the sustainable agriculture in the schemes, the following measures are recommended;

1) Plant nutrient supply;

Manure is available in rural areas from livestock and plant parts, often in large quantities, but not put to good use. Some measures are urgently needed to remedy this situation. With extensive commercial livestock rearing by almost all households, it should be possible to bring about management systems that allow for collection of unitized waste for farm use. Rice straw is another organic source of nutrients, being a particularly good source of carbon, nitrogen, potassium and silicon. It can be used in the rice cropping systems.

2) Integrated farming systems

The integration of crop and livestock farming systems should be maintained in tropical agriculture. Animal waste provides large amounts of plant nutrients. Similarly, if poultry is reared on the deep litter system, the litter can be used in the field about once every 12-18 months.

3) Multipurpose trees and shrubs

There are many opportunities of growing trees and shrubs of utility value. Tree crop culture also fits in well with land rehabilitation programs. Many ecological benefits can also be expected.

4) Agrochemical use

As toxic pesticides in cabbage cultivation in Upper Tapoung are problem of agrochemical use, two recommendations are made: firstly, extension staff themselves should learn and then educate farmers in correct pesticide use and the dangers to themselves and to the community, including those who consume the harvested produce. An IPM program can reduce pesticide use, cost of production, health hazards to humans and animals and promote multiplication of natural predators and parasites.

5) Shifting cultivation

One of the objectives of providing irrigation water is to encourage settled farming systems and discourage shifting cultivation. Hence the potential land for shifting cultivation in all schemes is being converted into arable land. The total area is estimated at 2,560 ha within priority scheme areas. Besides, about 630 ha around the Lower Xe Set scheme, 320 ha around the Upper Tapoung scheme would be used for other than slash and burn cultivation such as reforestation and coffee plantation. Apart from shifting cultivation, these land categories are used by people for grazing their cattle and also to obtain firewood and minor forest produce.

113 There is only limited opportunity for forest conservation. In Upper Tapoung, there is very little forest, being less than 10 per cent and the largest extent of 30 per cent is in Lower Xe Set. Actually these areas are made up of small fragmented patches of varying quality. As the bush land is to be converted into agriculture, there is no land available for reforestation. However, in Lower Xe Set there is a substantial area made up of soils

and land forms not quite suitable for agriculture and this land area, although found in scattered extents, can be converted into forms of forestry. Therefore, at least for ecological reasons, these remaining forest patches should be protected and preserved.

Cost Estimate

114 Construction costs are estimated at the price level of December 1995 with the conditions of the international competitive bidding (ICB), taking into consideration the updated costs of labor, construction materials and equipment, the current price estimation method, tender method, local contractors' work capacities, etc..

1) Construction cost including physical contingency, administration cost and engineering cost is estimated at about US $ 39.7 million for the 5 schemes.

(Unit : US$)

Description	Foreign Currency	Local Currency	Total
1. Construction Cost (Agricultural & Rural Development Facilities and On-farm Development Cost)	21,021,000	9,009,000	30,030,000
2. Land Acquisition and Compensation		14,000	14,000
3. Engineering and Administration Cost (3x10%)	2,102,000	900,000	3,002,000
4. O & M Equipment	960,000		960,000
5. Highland Vegetable Trial and Demonstration Station	1,320,000	304,000	1,624,000
6. Marketing Facilities	777,000	205,000	982,000
7. Physical Contingencies (3x10%)	2,102,000	900,000	3,002,000
8. Grand Total	28,282,000	11,332,000	39,614,000

2) O & M Cost and Replacement Cost

O & M cost is estimated at about US $ 248,000 / a year. Replacement cost is estimated at US $ 2.8 million based on the quantities of construction facilities in each scheme. Purchasing cost of these O & M equipment such as vehicle, motor cycle and radio system, etc. are estimated at US $ 960,000.

3) Cost of Highland Vegetable Trial and Demonstration Station

Construction costs of the highland vegetable trial and demonstration station is estimated at US $ about 1.6 million, including procurement cost of machinery, equipment, etc.

4) Cost of Marketing Facilities

Construction costs of marketing facilities are estimated at about US $ 1.0 million for wholesale marketing facilities and rice banks. The purchasing cost of each rice mill is estimated at about US $ 240,000 for the 6 proposed villages.

Implementation Program

115 Construction of civil works in the each scheme is broadly divided into four (4) categories. These are agricultural and rural infrastructure, highland vegetable trial and demonstration station of agricultural extension facility, and marketing facilities. Civil works of agricultural infrastructure is further divided into main irrigation and drainage facilities and on-farm development facilities. Work items of rural infrastructure development consist of village roads, domestic water supply, communication hall and

school. The works items of highland vegetable trial and demonstration station are office, quarters, dormitory and research laboratory of timber buildings and land consolidation of 50 ha. Marketing facilities are wholesale marketing facilities and rice bank facilities, and work items are building areas of offices and asphalt pavement area of loading space, parking lot, etc.. Construction is scheduled to take place over 5 years on the assumption of international competitive tender of contractors and consultants, and mechanized construction method.

116 An organization, namely the Boloven Agricultural and Rural Development Authority is proposed to be established to implement the construction work of the priority schemes of the each province. After which all the facilities will be handed over to the provincial government concerned when the responsibility of O & M works is also handed over to the provincial government, the authority is wound up.

Each scheme is implemented, in consultation with village leaders and / or beneficiaries and local government agencies concerned so as to consider beneficiaries' opinions and responses to the implementation of the schemes. Development of the rural community through public consultation during implementation. The public consultation is conducted and managed by the Boloven agricultural and rural development authority as shown in the Feasibility Study Report.

The public consultation aims to make beneficiaries understand the development concept and the plan, and promote voluntary participation of beneficiaries in the scheme's implementation and furthermore, intensify communication on the development between beneficiaries and the government.

Project Impacts and Evaluation

117 The following impacts from each sector can be expected in future.

(1) Agriculture

Priority Schemes	Increase of prod.	Crop diversity	Food security	Reducing slash & burn	Expansion of effect	Remarks
Upper Champi	Coffee 750 ton (5 times) Tea 120 ton (3 times)	Highland vegetables 2,200 ton, Newly upland crops 300 ton	-	240 ha *	high	-
Upper Tapoung	Vegetables 1,600 ton Upland crops 240 ton (newly development area)	-	-	100 ha * 320 h* *	high	-
Upper Kapheu	Coffee 1,350 ton (8 times)	Rice 400 ton	-	680 ha *	high	-
Lower Xe Set	Rice 4,500 ton, Upland crops 1,500 ton	-	high	1,150 ha * 630 ha **	high	-
Upper Tay-Un	-	-	high	390 ha *	high	encouragement of transmigration

Remarks : * within scheme areas, ** around scheme areas.

(2) Rural and Social Development Impacts

The improvement of road condition, rural water supply, primary schools and community hall will contribute to the development of the project and the improved living standard of the people.

The increase of net farm income will provide motives for improving the living standards of the farmers as well as rural economic development. Employment opportunities for unskilled laborers will be increased during the construction period and also operation period as farm laborers. Through the rural development and community development, living conditions will improve. For example, literacy, improvement of public health, nutrition and housekeeping. Also Wider and more effective involvement of women's activities is expected.

(3) Environmental Impact

The project was qualitatively assessed in terms of its impact on the environment and accorded low, medium and high rankings. In view of the large number of anticipated beneficial impacts, it is concluded that the project will not cause any harm to the environment.

Economic Evaluation

118 An economic evaluation of the proposed agricultural plan of the each priority scheme has been made to confirm the viability of the plans. The following table shows the results of calculation.

Items	Upper Champi	Upper Tapoung	Upper Kapheu	Lower Xe Set	Upper Tay-Un	Whole Project
1. EIRR	7.3%	10.2%	6.9%	6.3%	6.1%	6.9%

Analysis of farm budgets for different farming types, presuming implementation of the project, were conducted in order to evaluate the project from the financial aspect of farmers. The following considerations were identified based on the farm budget evaluation.

Priority Schemes	Farm Income (net income)	Income increase and stabilization	Prospected net reserve
Upper Champi	2.5 million kip (2.0million kip)	substantially increase	0.6 million kip
Upper Tapoung	1.2 - 1.8 million kip (1.0-1.5million kip)	stabilization	0.1-0.4 million kip
Upper Kapheu	1.8 million kip (1.5million kip)	substantially increase	0.1 million kip
Lower Xe Set	3.0 million kip (1.9million kip)	substantially increase	0.5 million kip
Upper Tay-Un	1.5 - 3.0 million kip (1.1 -2.2million kip)	substantially increase	0.1 - 0.7 million kip

119 Based on the result of economic and financial evaluation for the proposed Projects, the Project is justified as summarized below :

a) Economic Internal Rate of Return (EIRR) is 6.1 to 10.2 % on each priority scheme and 6.9 % on whole 5 schemes. The Project is economically viable in view of the national economy.

b) The farm economy will be drastically improved and also stabilized compared with the without project condition. From the financial point of view, large benefit will accrue to the beneficial farmers after implementing of Project.

c) About 3,500 ha of slash and burn field in and around the 5 schemes will be changed to farm land or forest, thereby significantly reducing the extent of slash and burn cultivation.

d) It is expected a dissemination and expansion effect to the surrounding area will accrue from the implemented project, which will be functioned as the core project.

e) It is presumed that farmers will have the capacity to pay when the O&M charge is 30 % of the total cost of the main system.

Recommendation

120 Based on the overall development plan studied, it is proposed that the stage wise development (namely, short, middle and long terms) of the entire development of 135,000 ha is practical and attractive from the view point of the development scale, implementation ability of farmers concerned and the Government. Out of 135,000ha, about 21,400 ha of gravity irrigation schemes were selected as the model developments based on their development suitability for several farming system and modelling function for smooth extension and efficient dissemination of agricultural practices to surrounding and similar area.

In order to smoothly implement the model development area and surtain it, it is further proposed that some representative schemes of appropriate scale be urgently developed among the model development areas. Five (5) priority schemes, namely, Upper Champi, Upper Tapoung, Upper Kapheu, Lower Xe Set and Upper Tay-Un schemes, have been selected for feasibility study, in accordance with their effectiveness agricultural extension and modelling rural development and the regions typical farming system based on climate and soil conditions.

121 After careful field investigation and study carried out for the priority development schemes, the development plan was justified technically feasible and economically viable and will contribute to various social outcomes such as further life improvement and community development in the areas. Early implementation of the priority schemes is strongly recommended in order to establish both a core for demonstrating sustainable and self-reliant development, and a base for further development.

122 The proposed integrated agricultural and rural development plan consists of various development components such as: increase of agricultural production; development of agricultural and rural infrastructures, improvement in the living standards of rural people and agricultural and social support services. It also includes a wide range of soft and hard-ware technologies. It is suggested that MAF organize a coordination system under the Ministry in cooperation with the relevant agencies concerned for the efficient execution of the project implementation. For this purpose, an organization like the Boloven Agricultural and Rural Development Authority which is supported by Provincial AFS, Health, Education and CTPC, and Farmers' and Water Users' Association is recommended to establish. Moreover it is necessary to undertake proper water distribution and O & M of facilities through the establishment of water users associations for both irrigation and domestics water supply. The extension services for agriculture and rural life improvement would be implemented by strengthening provincial and district AFSs in line with the polices of NIERP.

The primary intention of the Project O & M is to sustain the development, and encourage operation and maintenance of facilities/programs by the beneficiaries themselves. In order to attain the objectives, it is indispensable to include the beneficiaries in the planning and implementation of the project. Further to facilitate participation, it is suggested that planning, design and construction of on-farm facilities be carried out by farmers with engineering and financial assistance from the Government.

123 As verified in the financial analysis, the economic situation of the beneficiary farmers will be greatly improved when full development is achieved. However, the estimated O & M costs may be rather difficult for small farmers particularly in the Lower Xe Set area. Accordingly, it is recommended Government assist the association on O & M works, particularly engineering aspects, so as to reduce the annual water charge.

The proposed highland vegetable trial and demonstration station is essential for the promotion and extension of vegetable production to the farmers and for the provision of adequate production methods for stabilized vegetable production and for the distribution

of improved seeds of vegetables. Besides the station would conduct research on tea cultivation and its processing for the purpose of upgrading products quality. The proposed station will be operated under the AFSs of Champasak province in collaboration with DAE of MAF.

124 It is strongly recommended that training opportunities of government staff water users and leading farmers selected for the establishment of the "associations", in order to accomplish sustainable development and improved rural life.

Project Description(1/3)

	Project / Items	Upper Champi	Upper Tapoung	Upper Kapheu	Lower Xe Set	Upper Tay-Un	Remarks
Background	(1) Province	Champasak	Champasak	Salavan	Salavan	Sekong	
	(2) District	Pakxong	Pakxong	Laongam	Salavan	Thateng	
	(3) No. of villages	8	3	5	6	3	Concerned villages
	(4) No. of farm household	770	240	440	360	110	
	(5) Population	4,730	1480	2390	2310	970	Climate data:
	(6) Altitude(m)	900~1200	900~1300	600~800	300~400	500~600	Champi. and Tapoung
	(8) Temperature(degree C)	Mean month. max. 24	Mean month. max. 24.3	Mean month. max. 32.1	Mean month. max. 31.8	Mean month. max. 32.7	(data of Pakxong)
		mini. 15	mini. 15.2	mini. 16.1	mini. 21.8	mini. 13.5	Kapheu(data of Laongam)
		mean 20	mean 19.7	mean 24.8	mean 26.8	mean 23.6	Xe Set(data of Salavan)
	(9) Rainfall(mm/year)	3,373	3373	1796	1926	2123	
	(1) Hydrology						
	a) Water resources	Houay Champi	Houay Tapoung	Houay Kapheu	Houay Xe Set	Houay Tay-Un & Thong	
	b) Basin area(Km2)	16.0(Lak47),36.0(Lak 43)	4.0	24.0	413.0	21.0 8.0	
	c) Basin rainfall(mm)	3291.0	3291.0	2942.6	2843.2	1993.8 2065.4	
	d) Basin runoff(MCM)	21.1 47	5.3	27.6	471.2	16.7 6.7	
	(2) Land resources(gross ha)						
	a) Total area	1000	110	1400	2000	470	
	b) Suitable land for agri.	870	100	1240	1250	420	
	(3) Agriculture						
	a) Crop & area	Coffee 460 ha	Most of the area is grass land	Coffee 540 ha	Lowland rice 100 ha	Lowland rice 20 ha	Cultivation of crops
		Tea 130 ha	at present.	Upland rice 180 ha	Upland rice 130 ha	Upland rice 20 ha	except trees is in
					Upland crops 90 ha		the rainy season only
					Fruits 20 ha		
	b) Farm type	Coffee : 1	Coffee+vegetables: 1.2	Coffee: 0.5	Upland rice+lowland rice 0.4	Coffee+Lowland ric 0.6	
	(income : mil. kip)	Coffee + tea: 1		Coffee+upland rice: 0.5	Upland rice+upland crops 0.3	Coffee+Upland rice 0.4	
	c) Agricultural constraints	Water deficit of coffee	Water deficit of vegetables	Water deficit of coffee	Water deficit of lowland rice	Water deficit of lowland rice	
		Low quality of coffee	Low quality of coffee	Lack of proper techniques	Lack of proper techniques	Lack of proper techniques	
		Frost problem some part	Lack of proper techniques		Pests damage on rice	Pes damage on rice	
		Lack of proper techniques				Low quality of coffee	
Present Condition	(4) Socio-economy						
	a) Organization						
	Elders' group	8	3	5	6	3	
	Women's group	8	3	5	6	3	
	Youth group	8	3	5	6	3	
	APB(loan group)	31	11	13	9	0	
	Rice bank	0	0	1	1	1	
	Mutual fund	2	0	0	0	0	
	b) Agricultural credit	Coffee	-	Coffee	Upland crops Cattle	-	
	c) Income level(%)						
	Poverty	9	20	39	79	19	
	Moderate	69	67	49	21	63	
	Better-off	22	13	12	0	18	
	d) Lighting(%)						
	Oil lamp	90	100	97	72	94	
	Electricity	10	0	3	28	6 (battery)	
	(5) Rural infrastructure						
	a) Road(km)						
	National road	13.8	0.0	0.0	4.4	1.6	
	District road	3.1	6.4	6.3	5.6	2.8	
	Village road	4.5	0.0	3.7	8.9	1.7	
	Farm road	8.8	3.5	10.2	0.0	7.7	
	b) Water sources(no. of village)						
	Gravity flow pipe	2	0	0	0	0	
	Developed spring	0	0	0	0	1	
	Shallow dug well	1	0	0	0	0	
	Tube well/hand pump	0	0	0	0	10	
	River/Stream/spring	5	3	5	6	1	
	c) School						
	Class-III primary	3	2	3	4	1	
	Class-V primary	4	1	1	0	0	
	Secondary	2	0	0	0	0	
	d) Village hall (existing buildings)	2	0	0	0	0	
	e) Village clinic	1	0	0	0	0	

Project Description(2/3)

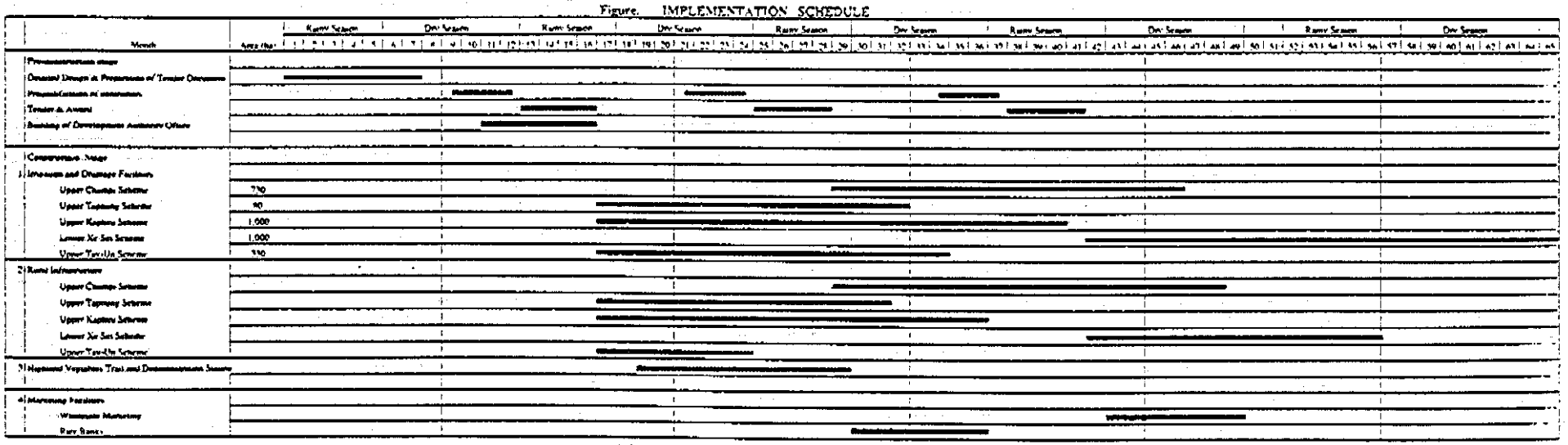
Development Plan

Items \ Project	Upper Champi	Upper Tapoung	Upper Kapheu	Lower Xe Set	Upper Tay-Un	Remarks
(1) Agriculture						
a) Beneficial area						
Whole year beneficial area	Coffee 500 ha	Upland crops 40 ha	Coffee 900 ha			
	Tea 120 ha	Vegetables 40 ha				
	Total 620 ha	Total 80 ha	Total 900 ha			
Rainy season beneficial area	Upland crops 110 ha		Lowland rice 100 ha	Lowland rice 1000 ha	Lowland rice 330 ha	
(include whole year beneficial area)	Total 730 ha	Total 80 ha	Total 1000 ha	Total 1000 ha	Total 330 ha	
Dry season beneficial area	Vegetables 110 ha		Upland crops 100 ha	Lowland rice 200 ha	Lowland rice 70 ha	
(include whole year beneficial area)	Total 730 ha	Total 80 ha	Total 1000 ha	Upland crops 800 ha Total 1000 ha	Upland crops 80 ha Total 150 ha	
b) Beneficial family	250	270	550	400	165	
c) Farm type	Coffee : 4	Coffee+vegetables: 1.7	Coffee+Lowland rice : 2.6	Lowland rice : 2	Lowland rice+Coffee : 1.3	
(Net-farm income : mil. kip)	Coffee + tea: 4				Lowland rice : 1.4	
(2) Agricultural support services						
a) Strengthening staff	2 person	1 person	1 person	1 person	1 person	Incharge of scheme
b) Mortar cycle	2 set	1 set	1 set	1 set	1 set	
c) Extension material	1 set	set	set	set	set	
(3) Market facility						
Rice bank	-	-	-	5	1	
(Village name)				B.Sengvan-gnai B.Houaichoua B.Sengvan-noi B.Khoulang B.Natou	B.Chakamlit	
(4) Social development						
Mutual fund (village)	8	3	5	6	3	
Health aid box (village)	8	3	5	6	3	
Installation of latrine (village)	8	3	5	6	3	
Literacy improvement (village)	8	3	5	6	3	
Agricultural credit (village)	Coffee,Field crop, Irrigation	Coffee,Vegetables,Irrigation, Handicraft	Coffee,Upland crop,Irrigation, Handicraft	Lowland rice,Field crop, Irrigation,Livestock,Handicraft	Lowland rice,Upland crop, Irrigation,Handicraft	
(5) Agricultural infrastructure						
a) Irrigation facilities						
Water sources	H. Champi	H. Tapoung	H. Kapheu	H. Xe Set	H. Tay-Un & Thon	
Intake facilities	Concrete weir	Concrete weir	Concrete weir	Concrete weir	Earthfill dam No. 1 & 2	
Earthfill dam	V=36,000 m3		V1=20,000m3,V2=16,000m3 V3=52,000m3,V4=142,000m3		V1=21,000m3,V2=49,000m3 V3=10,000m3	
Reservoir	Effective storage capacity = 105,000 m3	Effective storage capacity = 240,000 m3	Effective storage capacity = 1:137,000 m3, 2:66,000 m3 3:52,000 m3, 4:142,000 m3		Effective storage capacity = 1: - , 2:158,000 m3, 3:65,000 m3	
Design discharge	0.117	0.063	0.272	9.030	0.489 & 0.382	
Irrigation area(ha)	730	80	1,000	1000	330	
Main irrigation canal(km)	4.7	1.6	2.2	3.6	2.5	
Secondary irrigation canal(km)	13.0	0.8	11.8	11.0	2.3	
Secondary drainage canal(km)	3.0	0.2	1.1	7.6	0.1	
Regulation pond(place)	1	-	4	1	1	
Farm pond(place)	43	5	35	35	-	
Farm road(km)	21.2	5.3	15.3	26.0	5.0	
(6) Rural infrastructure						
a) Rural road(km)						
District road	0	12.9	9.3	3.2	0	
Village road	0	0	3.7	3.8	1.7	
b) Water supply (system)						
Gravity flow pipe	1	0	1	1	0	
Pump system	0	2	0	0	4	
c) Primary school building						
Class-III Primary school	3	2	3	5	2	
Class-V Primary school	4	1	1	0	0	
d) Village community hall						
Type -A	4	1	3	5	2	
Type -B	3	1	1	0	1	
Type -C	1	1	1	1	0	
(7) Project Cost (US$ 1,000)						
a)Direct Construction Cost						
Preparatory works	86	17	103	103	34	
Agricultural & rural facilities	4,043	1,140	3,720	8,796	2,181	
Rural development facilities	1,695	1,785	1,550	1,437	542	
b)On-farm development cost	543	70	817	1,040	328	
c) (Subtotal)	6,367	3,012	6,190	11,376	3,085	
d)Land acquisition	4	17	4	4	1	
e)Engineering services	637	301	619	1,138	309	
f)Purchasing Cost of O&M equipment	1,592	48	288	285	96	
g)Physical contingencies	637	301	619	1,138	309	
h)Grand total	9,235	6,692	13,910	13,943	6,885	
(8) Economic Evaluation						
EIRR	7.3 %	10.2 %	6.9 %	6.3 %	6.1 %	EIRR for whole 5 schemes is 6.9 %.

Project Description(3/3)

Extension and Marketing Development		Description (Remarks)	
1.	Establishment of Highland Vegetable Trial and Demonstration Station		
	(1) Location and Altitude	Ban Lak 45, 1200 m	
	(2) No. of Target Villages	Whole villages of vegetable production area in Boloven Plateau	
	(3) Area		
	- Demonstration fields	39 ha	
	- Other Irrigated fields	11 ha	
	Total	50 ha	
	(4) Buildings		
	- Administration office and study room, etc.	2 units	
	- Garage and pump room	3 units	
	- Agricultural buildings	4 units	(Green house, Net house, Manure house, Cowshed)
	- Quarters and others	over 3 units	
	(5) Farm machinery and Vehicles		
	- Tractors and Tillers	3 units	
	- Truck (4 ton)	8 units	
	- Other viecles	1 unit	
	- Mortorcycles	2 units	
		5 units	
	(6) Other equipment		
	- Research and extension materials	1 set	(Laboratory equipment, Pilot plant of tea processing, others)
	- Office equipment	1 set	(Copy machine, Personal computer with printer, Generator, etc.)
	(7) Project costs (US$)	US$ 1,624,000	
2.	Establishment of Vegetable Wholesale Market		
	(1) Location	Center of Pakxong town	
	(2) No. of Target Villages	Whole villages of vegetable production area in Boloven Plateau	
	(3) Area		
	- Wholesale market	0.8 ha	
	- Area for future expansion	1.2 ha	
	Total	2.0 ha	
	(4) Buildings		
	- Working space for wholesale	2 units	(30 x 20 m of concrete floor and plat form type about 80 cm higher)
	- Storage	1 unit	(100m2 of concrete type)
	- Loading space	4 units	(30 x 10 m of asphaltic pavement)
	- Office space	4 units	(market organization, buyers, sellers of farm inputs)
	Parking lot	1 unit	(800 m2 of gravel pavement)
	(5) Vehicles		
	- Truck (5 ton)	1 unit	
	(6) Other equipment		
	- Communication equipment	1 set	(Radio communication system)
	- Office equipment	1 set	(Personal computer with printer, Generator, etc.)
	(7) Project costs (US$)	US$ 239,000	

Figure. IMPLEMENTATION SCHEDULE



Part I Master Plan

THE INTEGRATED AGRICULTURAL AND RURAL DEVELOPMENT PROJECT IN BOLOVEN PLATEAU

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MASTER PLAN

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