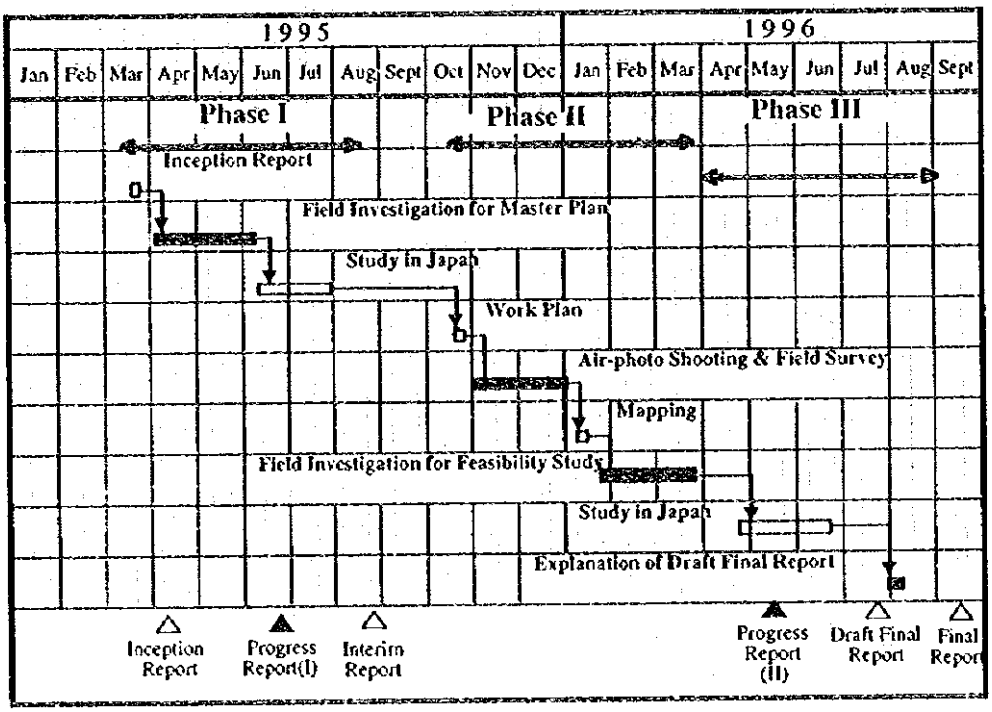
1. INTRODUCTION

1.1 Authority

This Draft Final Report on the Study for the Integrated Agricultural and Rural Development Project in Boloven Plateau (referred to as " the Study") is prepared in accordance with the Scope of Work for the Study on the captioned Project agreed upon between the Ministry of Agriculture and Forestry (hereinafter referred to as "the Ministry") of the Lao People's Democratic Republic (Lao PDR) and Japan International Cooperation Agency (hereinafter referred to as "JICA") on December 21, 1994.

The Study was carried out in three steps; Phase I, Phase II and Phase III. During the Phase I Study from the end of March 1995 to September 1995, the Master Plan Study of the integrated agricultural rural development on the entire Study Area was carried out and five (5) priority development areas, Upper Champi, Upper Tapoung, Upper Kapheu, Lower Xe Set and Upper Tay Un areas were subsequently identified. In the Phase II Study from October, 1995 to February 1996, aerial photography and preparation of topographic maps of the selected priority development areas was executed. Then, the Feasibility Study on the five selected priority development areas was carried out in Phase III from the mid January 1996 to August 1996. The process and progress of the Study are illustrated as follows;



The Draft Final Report consists of the Main Report and Annexes. The Main Report comprises the master plan (overall integrated agricultural development plan) of the entire Study Area and the feasibility study of the selected priority development schemes. The master plan study describes the present conditions of the Study area, constraints on the agricultural and socio-economic developments, the integrated agricultural and rural development plan and the selection of priority development schemes based on the study carried out in Phase I. The feasibility study presents the integrated agricultural and rural development plan as well as the technical, economical and financial viability for the selected priority areas based on the Study carried out during the field and office works in Phase II and III. The Annexes provide detailed analysis, explanation and results of the study, including the present features and conditions of study areas, and an assessment of the development plan for the entire area as well as selected development schemes, using alternative case studies.

1.2 Background

Agriculture is the main stay of the national economy. The productivity of the sector which providies three-fifths of national output, and supports 90 % of the national population, is still low due to the lack of rural infrastructure and agricultural production technology. Virtually, all agricultural production is in private hands, a large share of which is produced on almost subsistence levels. The stabilized growth of the sector is essential for development of the national economy. Despite its importance, agricultural productivity in Laos is rather low mainly due to a traditional farming system 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 problems of destruction of forest area and put significant pressure on biodiversity.

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 in the country. 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. In order to increase agricultural output and to stabilize the productivity in the Plateau area, the Government of Lao PDR requested the Government of Japan to extend technical assistance for master plan and feasibility studies on the integrated agricultural and rural development in the Boloven Plateau. In response to the request, the Government of Japan has decided to conduct the Study and entrusted it to JICA. JICA despatched the Preparatory Study Team, and agreed on the Scope of Work for the Study in December 1994, according to which this Study was undertaken.

1.3 Scope of the Study

The Scope of Works for the Study is summarized as follows:

(1) Objectives of the Study

The objectives of the Study are:

i) to conduct the Study in order to formulate a Master Plan for integrated agricultural rural development in Boloven Plateau,
ii) to conduct the Feasibility Study for the selected project area identified through the Master Plan, and
iii) to carry out technology transfer to the counterpart personnel of the Government of Lao PDR in the course of the Study.

(2) Study Area

The Study area covers the Boloven Plateau above the altitude 200m at mean sea level, and which extends over Champasak, Salavan and Sekong provinces with approximate area of 7,000 km^2 as shown in the location map attached.

(3) Scope of the Study

The Study is scheduled to be carried out in three (3) phases. The Study period lasts about 20 months from the end of March 1995 through the end of October 1996. The scope of work is summarized as follows:

i) Phase I Study

Phase I Study is to formulate a master plan for the integrated agricultural rural development in Boloven Plateau, which includes the selection of the priority development area. The Study is composed of field works in Laos and home office works in Japan.

ii) Phase II Study

Phase II work is to prepare a topographic map for the selected priority development area, and this includes aerial-photo shooting and ground control survey.

iii) Phase III Study

Phase III Study is to carry out the feasibility study on the priority development areas selected based on the Master Plan of the Study area, which is formulated in the Phase I Study. The Study is composed of the field works in Laos and the home office works in Japan.

2 NATIONAL BACKGROUND

2.1 Land and Population

2.1.1 Land

Lao PDR covers about 236,800 km² of land and the land use of Laos in 1989 is categorized as follows:

Land categories	Area (1,000 ha)	Share (%)
Total	23,685	100.0
Agricultural land	1,009	4.3
Rice Paddy	915	3.9
Permanent Crops	10	0.1
Other Agricultural	84	0.3
Current Forest	11,185	47.2
Potential Forest	8,805	37.2
Other Wooded Areas	1,552	6.5
Other Non-forest Land	1,134	4.8
Grass Land	634	2.7
Barren Land	112	0.5
Urban Areas	134	0.5
Swamp/water	253	1.1

Source: Department of Forestry, Forest Inventory Division (July 1991)

The forest area in Lao PDR covers about 20.0 million ha or 84% of the country, of which 11.2 million ha or 56% of the total forest area are the current forest having a tree cover with a crowded density of at least 20%. Although the Government has promulgated Decree 67, suspending all logging operations and initiated their country-wide audit in August 1991, the forest cover is declining steadily. Unsustainable commercial exploitation, featuring 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.

The harvested area of rice in 1994 is about 600 thousand ha of which about 219 thousand ha, 36.5%, are upland rice , while about 381 thousand ha , 63.5%, are lowland rice. The irrigated rice is of very limited extent with about 11,000 ha, mainly located in both Vientiane and Savannakhet Provinces. The other cereals, maize and root crops, cover only about 68 thousand ha. which are extended over the country. Coffee is mainly planted in three provinces, Champasak, Salavan and Sekong, which occupy about 96 % of total harvested area in 1994.

2.1.2 Population

According to the Basic Statistics, the National Statistical Center under Committee for Planning and Cooperation, 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/km^2 for the entire country, but 24.2 persons/km^2 in the three provinces.

The human resource base in Lao PDR is very weak that the adult literacy rate in 1993 was still about 64%. Only 70% of children of primary school age are in school, and its worthy of note, that less than 1 % of its population, have been educated at the tertiary level. The working age population of Lao PDR in 1993 was estimated at about 2.4 million, 52 % of total population. A young labor force increases because of rapid population growth, and their educational attainment in the rural areas is much lower than major urban areas due to inadequate educational facilities and higher attrition rates.

2.2 Current Situation of National Economy

2.2.1 Government Administration

The Government of Lao PDR is constituted as 15 Ministries, 5 National Committees, and 2 National Banks governed by the President under the Supreme People's Assembly.

2.2.2 National Economy

(1) New Economic Mechanism Program (NEM)

Since launching the NEM program initiated in 1986, the Government of Lao PDR 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 bureaucratic reforms as well as the stabilization of the national economy. The main policy measures reaping success for the Government are.

1) Land tenure: Providing long term land cultivation right to the user (Laotian nationalities and foreigner living in Lao PDR), but property of land still belong to the State.
2) Government revenues: Shifting the government revenue base away from direct state involvement in production and surpluses towards a system of income and trade taxes.
3) Trade : Introducing market-oriented economic system from the state monopolistic system except for such specific items as timber, tin, gypsum, etc.
4) Prices: All prices are to be determined by market forces except for public utilities, power supply, post and telecommunication services.
5) Banking system: Authorizing commercial banking activities, and unifying fully the exchange rate at a rate close to the parallel market rate.
6) State enterprise: Restructuring and/or privatizing the state enterprises under centralized planning and managing, through foreign and private leasing, outright sale, and joint venture agreements.

(2) GDP

The Gross Domestic Product (GDP) at 1990 constant prices from 1988 to 1994 is summarized in the following table.

Item		1988	1989	1990	1991	1992	1993	1994
1)	GDP (in million of kips)							
		502,587	574,276	612,731	637,204	681,854	722,057	780,061
2)	Growth Rates in %							
		- 2.1	14.3	6.7	4.0	7.0	5.9	8.1
3)	Share of GDP (in million of kips)							
	Agriculture	308,907	342,206	371,835	365,347	395,537	406,392	439,786
	Industry	56,173	75,839	88,105	105,634	113,587	125,275	136,566
	Services	129,328	148,103	147,427	157,038	163,093	175,667	187,070
	Import duties	8,178	8,128	5,364	9,186	9,636	14,724	16,638
4)	Share of GDP (in %)							
	Agriculture	61.5	59.6	60.7	57.3	58.0	56.3	56.4
	Industry	11.2	13.2	14.4	16.6	16.7	17.3	17.5
	Services	25.7	25.8	24.1	24.6	23.9	24.3	24.0
	Import duties	1.6	1.4	0.9	1.4	1.4	2.1	2.1

Source : Bank of Lao PDR Research Department

Real annual growth of the GDP between 1988 and 1994 has averaged 7.6 %. In 1988 a negative growth rate of 2.1% was observed due to a serious drought and subsequently reduced agricultural output. Since then, real growth rate has been favorable and reached 8.1 % in 1994 representing 2.2 % increase. While the share of agriculture in GDP has declined by nearly 5 % since 1988, from 61.5 % to 56.4%, the industrial share has grown from 11.2% to 17.5%. The service sector accounting for about 24% was relatively stable.

(3) Trade

Total exports of Lao PDR were valued at US$ 203 million in 1993, 350% of $57.9 million in 1988 and 153% of $132.6 million in 1992 as shown in Table 1. Agricultural and wood products and timber contributed approximately 33 % in 1993, while hydro-power shared 8.4 %. The total imports amounted to US$ 353 million in 1993 of which machinery and raw materials (54%), rice and foodstuffs (9%) and petroleum (6%) are the major import items as shown in Table 2.

2.3 Agricultural and Rural Development Policy and Plan of the Government

2.3.1 National Agricultural Development Policy

Agriculture is recognized as the highest priority sector in the national economic and social development program. About 85 % of the work force is engaged in the agricultural sector, while about 56% of GDP in 1994 were shared by agriculture and forestry. However, while the productivity of this sector is still low and erratic due to lack of rural and transport infrastructures and agricultural production technology as well as dependence on weather conditions, there is considerable potential for increasing and diversifying agricultural production in Lao PDR. The Government has taken effective efforts in the agricultural sector to increase productivity and thereby improve the living standard of farmers by introducing a market-oriented economic system and providing individual cultivation rights.

Table 3 shows the harvested area and production of major crops in Lao PDR from 1991 through 1994. Virtually, more than four fifths of the harvested area was rice, about

600,000 ha in 1994. Production of rice in both 1991 and 1993, was substantially reduced due to severe drought. Rice production in 1993 was 1.25 million tons (2.3 tons/ha), approximately 20% lower than the previous year, while 1.58 million tons (2.6 tons/ha) in 1994, about 25% up mainly due to good rainfall distribution. Rice cultivation is broadly classified into three systems. They are rainfed in lowland, irrigated land and rainfed upland crops. Coffee is mainly planted in Boloven Plateau, about 96% of the total area planted and is one of the important agricultural exports. Livestock husbandry is mainly characterized by small scale units. Most families keep a few cows and / or buffaloes as draught animals, and pigs and poultry for cash income.

Despite significant degradation of forest resources as a result of unsustainable levels of wood extraction and encroachment as well as shifting cultivation by the farming population, together with exploitation for extensive amounts of government revenue over the past two decades, Lao PDR still retains substantial area of intact forest. According to the National Reconnaissance Survey results recently carried out, approximately 11.2 million ha or about 47% of the total land area in 1989 remains covered with forest of which high density forest covers about 4.5 million ha or 19% of the total land. However, the increase of rapid degradation of forest resources puts significant pressure on the country's biodiversity. From the aspect of sustainable income generation and foreign exchange earning in the long run, as well as more effectively sustainable land use, government policy on forest and land resources management is set in the following key points:

1) Improved management of logging operation ,
2) Institutional strengthening ,
3) Community involvement in resource management,
4) Development of irrigation potential and water resource management, and
5) Improved upland farming system.

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 which are carry over from the Second Five Year Development Plan (1986 - 1990) are (i) to ensure food self-sufficiency and food security, (ii) to reduce slash -and-burn cultivation, (iii) to properly manage and conserve forest resources, and (iv) to expand the agro-forestry based industrial processing sector. In order to achieve the above target, the Plan, proposes to expand 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. In this context, the Government emphasizes improvement of human resources, particularly administrative and technical staffs at every level. The Government also intends to improve rural life of people through providing rural infrastructure, domestic water supply either gravity or well, rural electrification facilities, and social infrastructures such as schools and, health facilities.

2.3.2 Present Agricultural Development Activities in the Study Area

(1) Lao Upland Agricultural Development Project (LUADP)

The LUADP is financed by the World Bank and the Lao PDR with technical assistance of the Australian and the French Governments which are also providing some funding. The Project aims to (i) help the Lao government to increase farmers' income, (ii) reduce the area of shifting cultivation through introducing more sustainable production techniques acceptable to farmers, and increasing productivity of crops, and (iii) increase the level of food security and strengthen national agricultural research and training infrastructures. The present activities in the Study area are as follows:

i) Improvement of upland farming systems including coffee and field crops, vegetables, fruits and other economic trees, and animal health,
ii) Opening of feeder roads to ease the transportation of goods and agricultural inputs needed for the development of the local market,

iii) Upgrading and development of coffee culture on the Boloven Plateau, and
iv) Technical assistance and training

The research station of the project is located at B. Itou, KM35 of the road No. 23 from Pakxe to Pakxong, and the extension services for coffee and upland crops are conveyed to the farmers along road No. 20 from KM14 to B. Beng, road No. 23 from KM21 to Pakxong, and from B. Thateng to B. Beng, and road No. 16 from B. Thateng to B. Kafe.

(2) Swedish International Development Agency (SIDA) Project

Under SIDA, two (2) irrigation projects, one in Thongvay in Pakxong District, and the other in B. Len in Laongam District, have been implemented. Main purpose of SIDA projects is to provide agricultural infrastructures in order to reduce slash and burn cultivation and to prevent deforestation. The Selected Field Area Project (SFA) under the Lao-Swedish Forestry Program covers three pilot districts, namely, Laongam, Pakxong and Bachiang in the Study area. One of the goals of the project is to encourage farmers to implement of appropriate innovations aimed at improving shifting cultivation systems and eventually reducing the area under shifting cultivation while promoting where appropriate self-sufficiency in food production.

(3) Road Pavement Project of National Roads No. 20 and No. 23

A total length of 87 km in the whole stretch of No. 20 and about 42km of No. 23 have been paved with asphalt, 7.0 m wide under the ADB funding by March 1996. The remaining stretch of road No. 23 from Pakxong to Ban Beng through Thateng about 55km long is under construction and will be completed by the end of 1997.

(4) Coffee Feeder Roads in Laongam and Pakxong Districts

About 100 km of coffee feeder road with a 5.5 m width of laterite paved, in Laongam District has been constructed under the fund of the World Bank in 1988. In addition, about 315 km long of coffee feeder roads in Pakxong, Laongam, and Thateng Districts respectively are being constructed under the ADB fund.

(5) Houay Ho Hydropower Development Project

This hydropower development project at the tributary of the Xe Nammoy in the most south-eastern part of the Study area, is being constructed by enterprises from Korea, EDL, and Thailand under the BOT scheme. The installed capacity will be 115 MW with annual power output of about 555 GWh. The project is scheduled to be completed by 1998. In addition, about 75 km long of access road from Pakxong to the dam site was constructed with laterite pavement of 5m width.

(6) Fishery Research and Extension Station under the Champasak Provincial Government

This Station is located at KM8, about 8 km east of Pakxe along the road No. 13 and is producing and distributing fingerlings to the farmers and providing extension services.

(7) Fruit Trees Research Station under the Champasak Provincial Government

This Station is located at KM20, about 20 km east of Pakxe along the road No. 20. It's presently involved in producing improved seedlings of several kinds of fruit tree, and distributing those to farmers. However due to insufficient budget, it is not so active at present.

(8) Livestock Research Farm, KM49, under the Department of Livestock and Veterinary

This Research Farm is located at KM49, about 49 km from Pakxe along the road No.23, which is under construction. The main purpose of this farm is research and experimentation for improvement of breeding, forage and grasses, and health of livestock.

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

The Station is under construction at Palai Irrigation Project area.

(10) Land Concession

In the Boloven Plateau, there are substantial areas of concessional 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 such as fruit trees, sugarcane, and upland cash crops.

3. PRESENT CONDITIONS OF THE STUDY AREA

3.1 Natural Resources

3.1.1 Climate

The Study area and its surrounds are classified as savanna climate. Atmospheric dynamics are governed by monsoons, steady winds that blow alternately from the northeast and the southwest. These winds are caused by seasonal temperature and the resultant pressure changes over the Central Asia and the Indian Ocean. The southwest monsoon is characterized by heavy and frequent precipitation, high humidity, maximum cloudiness and tropical temperatures. Over 90% of annual rainfall in and around the Boloven Plateau including the Study area occurs from May to October when the southwest monsoon blows. This is called the wet season. In the remaining period, known as the dry season, when the northeast monsoon blows, little precipitation occurs, humidity is low, temperatures are relatively low and the sky is clear.

Fourteen (14) meteorological observatories in and around the Study area were selected for the study, however, observed climatic items are different in each observatory. Continuous observation is being carried out at most of the observatories, regarding rainfall, temperature and relative humidity. However in many instances there are no records for evaporation, sunshine hours and wind velocity due to trouble with observation equipment. The table below shows the average climatic statistics and those in 1995 at three (3) stations, Pakxe, Pakxong and Salavan. The climatic condition in 1995 was characterized as a low rainfall year compared with average annual rainfall. Meteorological data for estimation of potential transpiration is available only at these observatories. Pakxe may be considered representative of the west part of the lowland area in the Study, Pakxong for the highland area, and Salavan for the north part of lowland area.

Station: Pakxe

Item	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
Rainfall (mm)													
Ave.	2.4	8.5	14.1	59.4	201.3	324.6	376.3	500.5	296.9	116.7	17.5	2.2	1920.4
1995	0.0	0.1	33.0	17.5	158.5	320.6	646.3	160.0	210.0	92.8	35.0	0.6	1674.5
Temperature(oC)													
Max.	32.0	33.5	35.0	35.8	33.8	31.4	30.9	30.6	31.1	31.1	31.1	30.7	32.2
Min.	18.6	21.5	23.7	25.5	25.1	24.6	24.1	24.1	23.8	22.6	20.6	18.3	22.5
Mean	25.3	27.4	29.4	30.7	29.5	28.0	27.5	27.4	27.4	27.0	25.8	24.5	27.5
95Mea	25.2	26.6	29.9	31.6	29.7	28.9	27.7	28.1	27.6	27.3	25.5	24.2	27.7
Relative Humidity	(%)												
Ave	61	58	58	63	72	79	81	80	80	75	70	63	70
95Ave	57	55	52	55	69	77	80	79	79	75	69	61	67
Sunshine Hours	(hours)												
Ave	8.8	7.8	7.5	7.6	7.1	4.2	4.7	4.1	4.7	5.6	7.7	7.9	6.4
95Ave	8.6	7.9	8.2	7.5	5.6	5.9	5.4	5.3	4.4	6.1	6.7	8.2	6.7
Wind Speed	(m/s)												
Ave	2.5	2.6	2.9	2.8	2.8	2.4	2.2	2.2	2.0	2.3	2.6	2.7	2.5
95Ave	3.0	5.0	4.0	5.0	4.0	3.04	3.0	3.0	3.0	4.03	5.06	6.0	4.0
Evaporation	(mm)												
A-pan	193.3	194.8	224.4	220.7	184.4	120.7	105.9	102.2	122.5	162.9	176.9	191.2	2000.0
Piche	171.5	184.6	218.4	192.7	127.2	78.4	71.1	64.5	65.8	94.8	127.0	153.8	1549.7
95Pic	173.3	172.2	237.0	204.1	129.1	83.6	70.7	76.8	60.3	83.1	117.2	169.3	1576.7

Station: Pakxong

Item	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
Rainfall (mm)													
Ave	9.8	10.9	104.1	243.8	347.8	457.3	688.4	790.3	427	212.5	37.6	14.6	3374.1
1995	1.7	34.7	145.5	183.1	291.3	289.9	690.8	464.8	268.5	179.6	20.1	54.9	2624.9
Temperature (°C)													
Max.	24.2	25.2	25.7	26.4	25.4	23.6	23.1	22.9	24	23.9	23.6	23.2	24.2
Min.	10.1	11.8	15.1	17	18	17.8	17.5	17.2	16.8	16	13.6	11.5	15.3
Mean	17.1	18.5	20.4	21.7	21.7	20.7	20.3	20	20.4	20	18.6	17.4	19.5
95Mea	16.7	17.8	20.4	21.6	21.1	21.3	20.2	20.7	20.4	19.9	18.5	16.3	19.6
Relative Humidity (%)													
Ave	72	71	75	78	83	88	89	90	86	82	75	73	80
95Ave	71	73	77	81	85	87	88	87	88	82	79	74	81
Sunshine Hours (hours)													
Ave	7.6	7.1	6.2	6.8	4.5	3	2.8	2.4	3.4	4.3	7.6	6.9	5.1
95Ave	8.5	8.3	6.7	6.2	5.1	4.3	3.5	3.3	2.5	4.1	5.3	7	5.4
Wind Speed (m/s)													
Ave	2.3	2.7	2.6	2.6	3	3.4	3.3	3.2	2.5	3	3.1	2.9	2.9
95Ave	3	5	3	2	3	3	3	3	3	3	3	3	3
Evaporation (mm) (records at Nikhom34)													
Piche	67.7	54.3	57.4	48.6	44.8	38.8	33.8	33.3	28.6	39.1	47.5	56.6	550.5
1995	66	47.5	58.3	55.7	19.9	49.9	43.8	39.1	33.2	45.6	29.5	57.6	546.1

Station: Salavan

Item	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
Rainfall (mm)													
Ave	3.6	2	32.3	51.3	161.6	384.6	325.8	538.2	285.3	123.1	17.7	0.6	1926.1
1995	0	9.3	93.3	41.7	244.2	371.1	525.2	224.2	252.1	44.5	5	1.9	1812.5
Temperature (°C)													
Max.	30.7	33.5	35.6	35.1	33.7	30.8	30.6	29.7	30.8	30.8	30.4	29.7	31.8
Min.	15.4	19.1	22.7	24.4	24.2	24.4	23.9	23.8	23.5	22.4	19.7	18	21.8
Mean	23.1	26.3	29.3	30.2	29	27.5	27.3	26.7	27.2	27	25	23	26.8
95Me	24	25.5	29.2	30.6	29.1	28.3	27.2	27.7	27.4	26.8	24.7	22.4	26.9
Relative Humidity (%)													
Ave	65	61	59	63	72	81	80	86	82	79	74	68	73
95Ave	71	75	75	73	75	81	83	83	82	79	72	70	76
Sunshine Hours (hours)													
Ave	6.4	8.9	7.4	6.6	6.9	4.4	4.1	3.6	4.9	6.5	8.4	7.4	6.3
95Ave	4.5	4.6	7.9	8.3	6.6	4.4	4.7	5.5	5	5.9	6.8	8.6	6.1
Wind Speed (m/s)													
Ave	1.9	1.9	1.9	1.9	1.9	1.7	2	1.7	1.6	1.8	2.2	2.2	1.9
95Ave	3	3	4	4	2	2	2	2	2	3	3	4	2.8
Evaporation (mm)													
A-pan	184.3	210.2	243.3	248.5	229.7	139.7	118	108.3	105.6	146	165.4	173.3	2072.4
1995	139.2	128.8	245.4	248.5	203.1	131	145.5	171.5	148.9	183.8	203.3	266.9	2215.9

Recorded periods in the table are as follows;

Pakxe : 1989 to 1994 for evaporation (A-pan), Others are 1985 to 1994
Pakxong : 1991 to 1994 for sunshine hours, Others are 1986 to 1994
Salavan : 1991 to 1994 for sunshine hours, 1992 to 1994 for evaporation,
Others are 1981 to 1994 excluding 1985 to 1989.

(1) Rainfall

Boloven Plateau is an isolated tableland with an upper elevation of around 1,200m and is surrounded by the plain generated by the rivers such as Nam Khong, Xe Don and Xe Kong. The topographical conditions affect the dynamics of the monsoon and rainfall

distribution over the Study area as shown in Figure 1, Annual Isohyetal Map. During the wet season, the southwest monsoon hits the southwestern slope of the Plateau and causes high rainfall which reaches 3,300 mm annual average at the southern parts of the Plateau however at lower elevations this rainfall decreases. In the lowland areas elevations 100m to 200m surrounding the Plateau, annual average rainfall records from 1,600 mm to 2,000 mm. The peak of monthly rainfall in and around the Study area access in August and accounts for one fourth of annual rainfall. At the beginning of the wet season, its common for monthly rainfall over 200 mm to occur in the highland areas in April and in the lowland areas in May. At the beginning of the dry season monthly rainfall falls below 100 mm for most of the Study area in November but in the northwestern lowland area this occurs in October. In July, 1983, 533.5 mm of daily rainfall was recorded at Pakxong while 450.3 mm and 213 mm of daily rainfall were recorded at Pakse and Xelabam observatories, respectively.

Depending on location and period of kept data records, nine meteorological observatories were selected for the estimation of average annual rainfall in the Study area. With these selected observatories, Thiessen Polygon was delineated as shown in Figure 2 and average annual rainfall in the Study area was estimated at 2,417 mm as tabled below;

Observatory	Data Period (years)	Mean Annual Rainfall (mm)	Areal Ratio (%)	Areal Rainfall (mm)
Pakxe	35	2,060	2.5	51.5
Xelabam	21	1,929	4.2	81.0
Khongxedon	14	1,658	1.1	18.2
Laongam	6	1,856	20.1	373.1
Salavan	28	2,007	7.4	81.0
Sekong	3	1,803	13.7	247.0
Pakxong	16	3,412	31.8	1085.0
Attapu	5	2,153	18.7	402.6
Pathoumphon	16	2,088	0.5	10.4
Total			100.0	2417.3

(2) Temperature

Generally, maximum air temperature occurs at the end of the dry season, March to April, and minimum air temperature mid in dry season, December to January. The daily temperature range is about 10 °C in the wet season and 20 °C in the dry season. 7 to 8 °C difference in temperature occurs because of elevation which ranges from 100m to 1200m in the Study area. As described in the previous section, recorded air temperature at Pakxong and Pakxe may be considered as a representative of highland areas of the Plateau and its surrounding lowland areas, respectively. Differences of air temperature and elevation are shown below and from this air temperature change due to elevation can be calculated around 0.7°C per 100m.

Item	Pakxe	Pakxong	Difference
Mean Max.	32.2 °C	24.2 °C	8.0 °C
Mean Min.	22.5 °C	15.3 °C	7.2 °C
Average	27.5 °C	19.5 °C	8.0 °C
Elevation	100m	1,200m	1,100m

Air temperature records at Nikhom 34 observatory located 20km to the east of Pakxong town, show several years when 0 °C and/or close to 0 °C of minimum air temperature were observed. Frost lasting a few days occurred at those times. These conditions can only be found around Nikhom 34 and its outskirts.

(3) Relative Humidity

According to records of Pakxong observatories located in highland areas of the Plateau, mean annual relative humidity is 80%. A value of 70% or more relative humidity can be observed even in the middle of dry season. On the other hand, mean annual relative humidity in the lowland areas comes to 70% in Pakxe and 73% in Salavan and those values decreases down to 60% during the dry season. The value during the wet season rises to around 80% in lowland areas and 90% in highland areas.

(4) Evaporation

Using a Piche evaporator, annual total evaporation in the lowland area locations of Pakxe and Salavan, ranged from 1,400 mm to 1,800 mm. On the other hand, values on highland areas of the Plateau typified by Nikhom 34, are about one third of the lowland area amounts, ranging from 500 mm to 700 mm.

(5) Wind

Wind direction over the Study area is governed by monsoons. The northeast winds prevail during the dry season though the southwest winds are predominant in the wet season. The existence of the Plateau affects those prevailing wind directions and generating local changes in wind direction. During the wet season, southwest winds prevail at Pakxe located in the lowland areas to the west of the Plateau, while the north and/or northeast winds prevail in the dry season. At Salavan located in the lowland areas and to the north of the Plateau, the west and the east winds are predominant during the wet season and east winds with a northern influence blow in the dry season. In the highland areas of the Plateau, the east and/or the northeast winds prevail in the dry season though the west winds are predominant during the wet season.

Wind speeds in the lowland areas are from 2.0 to 2.5 m/sec on an annual average. From 2.5 to 3.0 m/sec on an annual average is observed in the highland areas of the Study area. No clear difference can be observed regarding the wind speeds between the dry and wet seasons.

3.1.2 Water Resources

The Study area is surrounded by Nam Khong and its major tributaries, Xe Don and Xe Kong. Hydrological characteristics of those rivers identified by the Mekong Committee are as follows;

River	Drainage Area km^2	Annual Rainfall mm	Annual Flow MCM	Annual Runoff mm
Nam Khong at Pakxe	545,000	2,000 at Pakxe	326,730	600
Xe Don	7,170	2,000	7,680	1,070
Xe Kong	28,500	2,250	32,200	1,130

Nine (9) major rivers in the Study area originate from the outskirts of Pakxong town and flows down in a radial manner to Nam Khong, Xe Don and Xe Kong. The river system relating to the Study area is shown in Figure 3 and is summarised as follows;

			Basin Area km²	Length (km)			Elevation (m)			Slope	
				L1	L2	Total	EL.1	EL.2	EL.3	S1	S2
Nam Khong	Xe Don	H.Champi	639	40	28	68	100	400	1,426	0.00750	0.03664
		H.Kapheu	375	41	22	63	110	600	1,288	0.01195	0.03127
		Xe Set	1,129	48	41	89	130	400	1,426	0.00563	0.02502
		H.Namsai	359	24	23	47	195	400	1,521	0.00854	0.04874
	Xe Kong	H.Tay-Un	412	28	25	53	150	500	1,620	0.01250	0.03448
		Xe Namnoy	1,523	16	58	74	140	200	1,086	0.00375	0.01528
		Xe Pian	3,331	106	46	152	80	400	1,422	0.00302	0.02222
		H.Bangliang	505	39	14	53	95	200	1,348	0.00269	0.08200
		H.Touay	368	44	11	55	90	300	1,348	0.00477	0.09527

L1 : Within a flat plain L2: Within a mountainous area EL.1: Junction point
EL.2 : Foot of mountainous area EL.3: Highest point S1: (EL.2-EL.1)/L1
S2 : (EL.3-EL2)/L2

(1) Basin Runoff

No continuous and long term river flow records are available within and adjacent to the Study area except the monthly basis flow regime of the Xe Set power station. Estimation of basin runoff for the major nine (9) rivers in the Study area regarding the average year, low-water year and high-water year is preliminary carried out using the monthly basis river flow records at Xe Set power station. Low-water year is defined as probability of non-exceedance with return period of 5 (five) years for the annual rainfall in the objective river basin. High-water year is also defined same manner as low-water year, however, the value on probability of exceedance is used instead of the non-exceedance value of the low-water year.

Average annual flow volume with monthly basis and distribution ratio of monthly flow at Xe Set power station are as follows;

Unit: MCM

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
AVERAGE	8.8	5.5	5.8	7.9	18.9	30.8	64.6	91.3	88.4	62.6	27.6	17.7	429.9
Ratio(%)	2.05	1.28	1.35	1.83	4.39	7.17	15.04	21.23	20.57	14.56	6.42	4.11	100.00

Annual basin rainfall and runoff coefficient of the Xe Set basin are as follows;

Year	Basin Rainfall (mm)	Basin Total Volume (MCM)		Coefficient
		Rainfall(a)	River Flow(b)	(b)/(a)
1989	2,223	722.5	519.6	0.72
1990	2,173	706.4	423.1	0.60
1991	2,579	838.3	530.6	0.63
1992	2,378	772.9	407.8	0.53
1993	1,712	556.6	301.2	0.54
1994	2,448	795.8	396.9	0.50
Average	2,252	732.1	429.9	0.59

Annual total flow volume of the respective rivers in the Study area can be estimated by the basin areal rainfall, basin area and runoff coefficient. Runoff coefficient of the Xe Set basin was examined at 0.59 on an average as tabulated above, however, minimum value of 0.50 among the examined values is employed in view of conservative estimation of annual total flow volume in the Study area. Those examined runoff coefficients show nearly the same value for adjacent river basins such as 0.54 for Xe Don and 0.50 for Xe Kong basins. With

these basic values, annual total flow of respective river is preliminary calculated at the boundaries of the Study area as follows;

River	Basin	Basin Areal Rainfall (mm)			Annual Rainfall Volume of Basin (MCM)			Annual Flow Volume of River (MCM)		
	km²	A	H	L	A	H	L	A	H	L
Xe Pian	3,331	2,535	3,129	2,110	8,444	10,422	7,029	4,222	5,211	3,515
H.Touay	368	2,794	3,458	2,383	1,028	1,272	876	514	636	438
H.Bangliang	505	3,059	3,705	2,710	1,545	1,871	1,368	772	935	684
H.Champi	639	2,652	3,222	2,238	1,693	2,058	1,430	847	1,029	715
H.Kapheu	375	1,977	2,302	1,674	740	863	627	370	431	314
Xe Set	1,129	2,251	2,593	2,013	2,541	2,927	2,272	1,271	1,463	1,136
H.Namsai	359	2,075	2,251	1,798	754	808	645	372	404	323
Xe Nammoy	1,523	2,273	2,768	1,973	3,462	4,215	3,004	1,731	2,107	1,502
H.Tay-Un	412	2,031	2,533	1,883	837	1,043	776	418	521	388
Total/Average	8,641	2,405	2,884	2,086	21,044	25,479	18,027	10,517	12,737	9,015

A : Annual average
H : High-water year (probability of exceedance, return period 5 years)
L : Low-water year (probability of non-exceedance, return period 5 years)

Monthly basis river flow volume of respective rivers can be generated with the distribution ratio of monthly flow at the Xe Set power station and annual average flow of respective rivers as shown below;

Preliminary estimation results of monthly flow volume in average year — Unit : MCM

River	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Xe Pian	86.6	54.1	56.8	77.1	185.3	302.8	634.9	896.8	868.4	614.8	271.0	173.4	4,222.0
H.Touay	10.5	6.6	6.9	9.4	22.6	36.9	77.3	109.2	105.7	74.9	33.0	21.1	514.1
H.Bangliang	15.8	9.9	10.4	14.1	33.9	55.4	116.2	164.1	158.9	112.5	49.6	31.7	772.4
H.Champi	17.4	10.8	11.4	15.5	37.2	60.7	127.3	179.8	174.1	123.3	54.3	34.8	846.7
H.Kapheu	7.6	4.7	5.0	6.8	16.2	26.6	55.7	78.6	76.1	53.9	23.8	15.2	370.2
Xe Set	26.1	16.3	17.1	23.2	55.8	91.1	191.1	269.9	261.3	185.0	81.6	52.2	1,270.7
H.Namsai	7.6	4.8	5.0	6.8	16.3	26.7	56.0	79.1	76.6	54.2	23.9	15.3	372.5
Xe Nammoy	35.5	22.2	23.3	31.6	76.0	121.4	260.3	367.7	356.0	252.0	111.1	71.1	1,730.9
H.Tay-Un	8.6	5.4	5.6	7.6	18.4	30.3	62.9	88.9	86.1	60.9	26.9	17.2	418.4
Total	215.8	134.7	141.5	191.9	461.5	754.3	1,581.0	2,263.2	2,163.2	1,531.5	675.1	432.0	10,517.8

From the table mentioned above, water resources in the Study area depending entirely on the nine (9) major rivers can be summarized as follows;

Major 9 (nine) rivers: Total basin area is 8,641 km²

Year	Basin Rainfall	Annual Total Flow (MCM)			Annual Total Runoff (mm)		
	(mm)	Total	Wet Season	Dry Season	Total	Wet Season	Dry Season
Average	2,610	10,517	8,754	1,763	1,217	1,013	204
Low-water	2,087	9,016	7,479	1,576	1,043	866	177
High-water	2,949	12,736	10,566	2,170	1,473	1,223	250

Wet Season : From May to October Dry Season : From November to April

(2) Water Quality

To understand water quality, water sampling of surface and well water at twenty-one (21) sites in the Study area was conducted during field studies and quality analysis carried out at the Laboratory of Water Quality Analysis, MAF in Vientiane. Items analyzed at the laboratory are; pH, electric conductivity (EC), suspended sediment (S.S.), coliform group,

chemical oxygen demand (COD) and chemical analysis for NO3-N, Ca2+, Mg2+, Mn2+, Fe2+, Cu,Cl- . Major results of analysis and MAF standard for drinking water are shown below;

Sample No.	pH	EC mS/m	S.S. mg/l	Coliform col./100ml	COD mg/l	NO3-N mg/l	Ca2+ meq/l	Mg2+ meq/l	Mn2+ mg/l	Fe2+ mg/l	Cu mg/l	Cl- meq/l
1	5.56	4.30	0	2	0.156	1.354	0.124	0.213	0.030	0.086	0.024	0.062
2	6.58	4.60	9	107	1.407	0.003	0.151	0.218	0.030	0.264	0.030	0.008
6	7.06	5.40	4	2	1.673	0.367	0.221	0.267	0.030	0.302	0.027	0.009
9	5.78	6.52	7	0	0.078	1.508	0.203	0.301	0.030	0.183	0.034	0.076
10	6.26	17.7	5	0	0.129	0.004	0.878	0.829	0.384	1.128	0.040	0.009
13	6.87	4.6	5	0	1.161	0.004	0.174	0.208	0.030	0.162	0.006	0.025
16	7.02	14.9	13	12	5.063	0.193	0.566	0.741	<0.001	0.400	0.001	0.057
17	7.15	8.7	6	0	1.650	0.054	0.320	0.395	0.030	0.389	<0.001	0.019
20	7.12	9.9	4	0	5.173	0.075	0.471	0.415	0.030	0.232	<0.001	0.006
21	6.20	7.9	1	0	1.099	0.152	0.285	0.507	<0.001	0.076	0.022	0.027
Standard	5.8-8.6	-	2	100	-	10	15(*1)	24.7(*2)	0.3	0.3	1.0	5.8(*3)

(*1) : 200ppm=(200/35.45)=5.8 meq/l (*2) : 300ppm=(300/20.04)=15 meq/l (*3) : 300ppm=(300/12.16)=24.7 meq/l

In summary, the water quality in the Study area, both surface and well water can be basically used for irrigation and drinking purposes. However, some well and surface water exceed the allowable Standard for drinking water, in relation to the coliform group, and dissolved ions especially iron and manganese, and treatment will be required if that water source is used for drinking.

(3) Groundwater

Ministry of Health is now carrying out the Study on Groundwater Development for Champasak and Salavan Provinces under the technical cooperation of JICA. Purpose of the study is to formulate a groundwater development plan for village water supply in Champasak and Salavan provinces. To grasp the groundwater potential of the Boloven Plateau and its adjacent areas, interim results of the study are quoted for the Study.

Geological feature of the Study area is characterized by basalt lava flows underlain by Jurassic shale. Basaltic rocks of Tertiary and Quaternary ages are sporadically distributed in Boloven Plateau. Rocks consisting of alkali basalt lava were formed during volcanic activities in Pliocene to Pleistocene age. Based on the topography and geology, ten (10) hydrogeologic units and four (4) ranks of qualitative groundwater potential are set up in the Study area. Table below shows those hydrogeologic units and the rank of groundwater potential.

Unit	Topography and Geology	Aquifer	I GL -m	II m^3/day/m	III A to D
Qf	Flood plain, Accumulation terrace.	Quaternary sand.	6-13	14-128	A
	Sand, Silt & Clay, Jurassic shales.	Jurassic sandstone.		-	
Qt	Alluvial fan, Talus slope	Sand.	7-8	-	C
	Sand, Silt, Jurassic shales.	Jurassic sandstone.		-	
Ba1	Basalt slope.	N-Q Basalt lava.	20-35	3-20	B-C
	Basalt lava flows, Ash, Loam, Lava.	Weathered basalt lava.		-	
Ba2	Basalt slope.	N-Q Basalt lava.	13-24	-	A
	Basalt lava flows.	Autobrecciated lava.		1700-1900	
Ba3	Basalt slope.	Pg Basalt lava.	4-12	-	B
	Basalt lava flows, Jurassic shales.	Jurassic sandstone.		19.1	
Ep	Erosional plain.	Jurassic sandstone.	7-12	3-166	B
	Jurassic red shale, Sandstone.	Sandyshale.			
Eh	Erosional hill.	Jurassic sandstone.	9-20	1-17.3	B-C
	Jurassic red shale, Sandstone.	Conglomerate.			
Et1	Erosional terrace.	Fissured aquifer.	8-15	4.6	B-C
	Triassic acidic welded tuff, Dacite.			-	
Et2	Erosional terrace.	Fissured aquifer.	8-17	36.9	B
	Paleozoic slate, Sandstone				
P	Plateau, High plain.	Sandstone.	Low	-	C
	Jurassic Creta, Sandstone, Shale.	Locally fissured aquifer.			
M	Mountains.	Fissured aquifer.	Low-High	-	C-D
	Metasediments, Plutonic rocks.	Sand, Silt in Valleys.			

I : Groundwater Level
II : Specific Capacity
III : Groundwater Potential (A: high, B: medium, C: low, D: no potential)

The entire part of the plateau, Pakxe, Batiang and the eastern part of Laongam belongs to Ba1 of hydrogeologic unit in the Study area. As for the other hydrogeologic units distributed in the Study area, Ba2 is the western part of Laongam, Ba3 is Thateng, Ep is Salavan and P for the Xe Namnoy basin.

3.1.3 Soils and Land Use

(1) Brief Review on Soil Features in the Lao PDR and the Study area ("Boloven Plateau")

All kinds of soil covering the entire Lao PDR are provided in the FAO-UNESCO Soil Map of the World, FAO-UNESCO, 1968. However, the semi-detailed description is limited to the Vientiane Plain and parts of Savannakhet and Champasak, including part of the Boloven Plateau.

The soils of Boloven Plateau are the most favorable highland ones. The soils are extensive, deep and reddish brown basaltic, and the topography of land is undulating to rolling. In this area, well structured clay loam overlies clay subsoils, so physical characteristics are such that water-holding capacity is good and soil drainage is reasonable. The soils are derived from basalt, which means the soil reaction is less acid (pH 5.0 - 6.3). Physical properties are excellent, cation exchange capacity is moderate, and base saturation is just under 50%. Nitrogen and carbon content are also generally higher than the soils classified into red yellow podsolic and or lateritic ones. In the FAO-UNESCO Map, the soils that distribute dominantly in Boloven Plateau are expressed by the symbol of Dystric Nitosols.

The land of Boloven Plateau covered with well-structured loamy soils has very high agricultural potential. Recently, the soil survey was done in close cooperation with the Ministry concerned in Lao PDR and the Government of USSR, and four sheets of "Boloven

Plateau Agro-Ecological Map (LAO PDR)" are compiled (1991). At the same time, the government agencies concerned with five districts, that is, Pakxong, Bachiang, Laongam, Salavan and Thateng, separately published under the direction of the Soil Research Center, Lao PDR the reports concerning the soils and land use of each district. These investigations are fundamentally made by the FAO-UNESCO Survey System.

(2) Soils

It is conceivable that Boloven Plateau was formed by which a lava flow of basalt covering a tableland of the Tertiary period. This is plausible because the soils which are derived from basalt extend over an extensive area ranging from 200 m height upto more than 1200 m.

The soils covering the "Boloven Plateau" are divided broadly into three types depending on geological origin, that is, (i) Alluvial soils, (ii) Soils derived from sand stone and clay stone, and (iii) Soils derived from basalt rock. These soils are further subdivided into nine soil units by effective depth, texture, reaction, fertility, etc. (Soil Survey and Land Classification: 1990-1991). Eight of these soil units are found In the Study area. Characteristics of the soils and their distribution are shown in Figure 4 and summarized as follows:

Soil Units in the Study Area

Geological Origin	Soil Unit (Association)	Soil code	Area (ha: %) Pakxong	Bachiang	Laongam	Salavan	Thateng	Total
Alluvial	Orthic Acrisols (Dystric Cambisol and Fululvisol)	1	500 0.08	-	-	-	-	500
	Gleyic Acrisols (Eutric and Dystric Gleysol)	2	300 0.05	-	-	-	-	300
	Orthic Acrisols (Ferric Acrisols)	3	-	-	-	-	-	
Sand stone+ Clay stone	Orthuc Acrisols (Dystric Cambisol)	4	2,200 0.34	1,950 0.30	-	840 0.13	-	4,990
	Lithic Acrisols (Lithosols)	5	145,490 22.24	490 0.08	1,090 0.17	5,210 0.80	4,770 0.73	157,050
Basalt	Dystric Nitosols	6	97,180 14.86	48,590 7.43	66,890 10.23	16,750 2.56	13,790 2.11	243,200
	Dystric Nitosols (Lithic Nitosols)	7	41,740 6.38	-	5,120 0.78	160 0.02	13,900 2.12	60,920
	Lithic Nitosols (Lithosols)	8	46,960 7.18	1,610 0.25	30,200 4.62	8,980 1.37	160 0.02	87,910
Steep land		9	58,340 8.92	12,290 1.88	3,690 0.56	16,300 2.49	8,560 1.31	99,180
Total			392,710 60.01	64,930 9.93	106,990 16.36	48,240 7.37	41,180 6.30	654,050 100.00

Land evaluation of surveyed area was made using a procedure for land capability classification. The results are shown in Figure 5, and summarized as follows:

Land Capability Classification of the Study Land

	/II (ha)	/III(ha)	/IV (ha)	/V (ha)	/VI (ha)	/VII (ha)	I/II (ha)	II/II (ha)	II/III (ha)	III/II (ha)	IV/V (ha)	Total (ha)
Pakxong	81,830	22,750	2,200	9,770	138,220	58,340	4,900	26,300	26,070	22,330		392,710
Bachiang	40,640	7,760	1,930	510		12,290		1,800				64,930
Laongam	65,260	3,140		1,080		3,850		33,660				106,990
Salavan	14,890	2,290	840	4,180		16,140		9,140			760	48,240
Thateng	5,190	6,210		1,980	3,000	8,550		15,440	590	220		41,180
Total ha	207,810	42,150	4,970	17,520	141,220	99,,170	4,900	86,340	26,660	22,550	760	654,050
%	31.77	6.44	0.76	2.68	21.59	15.16	0.75	13.20	4.08	3.45	0.12	100.0
Suitable Land	207,810	42,150	--	--	--	--	4,900	86,340	26,660	22,550	--	390,410

*Classes may be outlined as follows: II and III are arable if moderate requirement is satisfied; IV has very severe limitation for cropping; V to VII are not suitable for cropping. Numerator in fraction indicates the class under the condition of paddy field.

Total suitable land for agriculture is roughly estimated at about 390,400 ha excluding about 263,600 ha of severe land to unsuitable land for cropping. Out of 390,000 ha approximately 180,000 ha are covered by the forest conservation area delineated by the Government.

(3) Land Use

The results obtained for present land use are as follows: Crops which are cultivated covering a wide or small area are coffee, tea, sugar cane, cereal crops such as rice and maize, leguminous plants such as mungbean, groundnut and soybean, spice food such as cardamom, chili, etc. Fruit trees and drops such as banana, papaya, dorian, mango, pineapple, etc. are also planted. Vegetables such as cabbage, Chinese cabbage, cucumber, etc. are cultivated in scattered land. Besides, grassland is used for livestock over a considerable wide area. Forest land is spread over a large area. Although deep forest grows thickly on steeped land and there is considerable land in this wide state some sections of the forested land on steep slopes have been used for timber logging and shifting cultivation. The results obtained are shown in Figure 6 and summarized below.

Present Land Use

Land use categories	Pakxong area (%)		Bachiang area (%)		Laongam area (%)		Salavan area (%)		Thateng area (%)		Total area (%)	
Agricultural land	18,590	2.84	4,010	0.61	13,260	2.03	2,630	0.40	2,630	0.40	41,120	6.29
Coffee		16,100		560		6,700		50		970	24,380	3.73
Tea		380									380	0.06
Low land rice		240		540		460		2,390		270	3,900	0.60
Upland rice		710		2,260		4,700		160		1,110	8,940	1.37
Cardamom		760		650		1,400		30		280	3,120	0.48
Vegetables		400		-		-		-		-	400	0.06
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	64,930	9.93	106,990	16.36	48,240	7.38	41,180	6.30	654,050	100.0

3.2 Socio-economy and Administrative Setting

3.2.1 Administrative Jurisdiction

The Study area in the Boloven Plateau constitutes a part of three provinces; Champasak, Salavan and Sekong, which are situated in the Southern Region of Lao PDR. Champasak province occupying the majority of the Study area consists of 10 districts (muang). Two (2) districts, Pakxong and a part of Bachiang, are included within the Study area. In another province, Laongam district and a part of the Salavan district of Salavan, and the Thateng district of Sekong are included in the area. The administrative jurisdiction of the Study area is as follows;

Administrative Jurisdiction in the Study Area

Province (Khueng)	District (Muang)	Zone (Tasseng) *	Village (Ban)
Champasak	Pakxong	9	105
	Bachiang	6	76
Sub-total		15	181
Salavan	Salavan	4	58
	Laongam	10	110
Sub-total		14	168
Sekong	Thateng	4	50
Total		33	399

Note: * Zone (former sub-district) is out of administrative jurisdiction at present.

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

3.2.2 Population

According to the preliminary reports of the ceusus 1995, the population of the provinces related to in the Study area is: 500,994 with 84,230 households in Champasak;

256,550 with 42,381 households in Salavan; and 63,836 with 9,520 households in Sekong respectively. Annual population growth rate over the past ten years (1985/1995): is 2.4% (Champasak); 2.7% (Salavan); and 2.0% (Sekong) respectively. Average households size is: 5.9 (Champasak); 6.1 (Salavan); and 6.7 (Sekong) respectively.

The provincial reports of 1994 showed a population, relating to the Study area, of 140,181 and the number of households at 26,434. Average households size is 5.3 and the population density is 21.6 habitants per square kilometer. Zone 10 of Salavan district, Salavan province is an exception because of an uninhabited mountainous area. According to the CPCs of the relevant provinces, farm households in the area account for 94 percent of the total households, as shown in the following table. However, the rest of these households are also engaged in agricultural activities in addition to their principal.

Population and Households in the Study Area

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.

Details of the population and households in the Study area are shown in Table 4.

3.2.3 Education

Educational services are the responsibility of the Ministry of Education and the provincial education authorities. In the Study area, there are a large number of primary schools, several lower secondary schools, some upper secondary schools and one college. The provincial educational services related to the area mention that about 73% of primary schools in the area provide a three year schooling. Primarily school education consists of a five year program. However, most pupils complete only about 3 years. Overall these is a total of 237 primary schools (3 year school: 181; 5 year school: 56), but educational of facilities covers only 60% of villages in the area.

It is apparent there are problems of access to and quality of primary schooling are significantly affected by some inter-related factors such as geographical location, ethnic group and so on. The pupil per teacher ratio is relatively high (33.0) compared with the national level (27.4). The majority of the population in the area are the ethnic people. They live primarily in less accessible and sparsely populated hilly and remote areas. The number of classrooms per school in an upland minority village is usually no more than one or two, and the buildings are often made of bamboo and a thatched roof. The average child has to trek from his or her village. In order to improve education level of the children of various ethnic groups, teacher training course for students selected from the ethnic minorities in the college of Pakxong are being carried out by the government.

According to the provincial education services related to the area, the literacy rate is less than 50% among the ethnic groups. Therefore, the government strives to improve the education standards and to increase literacy of ethnic minorities.

3.2.4 Health

The provision of health services is the responsibility of the Ministry of Health and the provincial health authorities. At the district level, there are district hospitals supported

administratively by district public health services. District hospitals are supposed to be staffed by nurses and physician assistants able to give technical support to commune dispensaries and village clinics (health posts). However, most of district hospitals are actually poorly operated due to lack of fund, vehicles, medical supplies and essential drugs.

In the Study area, although the district hospital is already established in each district, there are existing village clinics in every district: 9 (Pakxong), 11 (Bachiang), 3 (Salavan), Laongam (1) and 2 (Thateng). There is no referral system (introduction of medical specialist), and the health network is very limited in both quality and efficiency. In case of Pakxong district, the number of physicians and physician assistants is only 4 and 14 respectively, which corresponds to 2,414 persons per one physician, and 43 patients per assistant nurse. This situation is very common in the area. There are only nine pharmacies in this district with 860 households per pharmacy.

According to the provincial health authorities related to the area, malaria and diarrhea are major diseases in the entire area. Malaria is responsible for about 80% of morbidity in many communities where it is hyperendemic. In particular, malaria is the worst single threat to child health, accounting for some 20% of all deaths in children per year. Acute respiratory infections and diarrhea related diseases are the next highest causes of death.

3.2.5 Rural Society and Living Conditions

(1) Ethnic Group

One characteristic of the Study area is an ethnically diverse society, which is composed of two main ethnic groups; Lao Loum and Lao Theung. Another ethnic group officially designated by the state as Lao Soung, has a small population, just 0.02% of the total for the region, in the refugee village in Bachiang district, Champasak province.

Although Lao Loum is the majority group of the country as a whole, Lao Theung dominates in the area. In particular most of the groups of Lao Theung inhabit the elevated area and practice traditional farming known as slash and burn cultivation. Most of Lao Loum ethnic group reside in the lowlands but may also be in the upland area. In the Boloven Plateau area, both groups are mainly engaged in coffee production. Some of Lao Loum practice vegetable production in the upland area. The farmers operating the slash-and-burn cultivation in the area are settled in a base village. Some of them have farm-sheds at the field some distance from the village.

The ethnic groups distributed in the Study area consist of the numerous tribes: the Tai and Phouthai of Lao Loum, and Suay, Laven, Lave, Taoi, Yahuen, Alak, Ngae, Katang, Talieng and Katu of Lao Theung. According to the rural socio-economic survey, the proportion of ethnic groups is estimated at about 54% (Lao Theung) and 46% (Lao Loum). However, the Lao Theung dominates the hilly terrain and plateau exceeding 600 m of elevation, i.e., 82 percent of the total population belong to this group. Generally, religious orientation of the Lao Loum is primarily Buddhism with a strong underpinning of indigenous animism (phi). The Lao Theung's religion centers on spirits called hrooy (the phi of the Lao Loum), the two most important and powerful being in the house and in the forest. Some Lao Theung have been evangelized by Christian missionaries. Particularly, it can be observed that some Lao Theung in the plateau have strong feelings of identity compared with that of Lao Loum. However, some groups have undergone considerable acculturation, or assimilation to Lao-tai (Lao Loum) norms. Matrilineal kinship systems predominate among the groups in the area except for Alak, Katu, Taoi and Talieng.

The government puts emphasis on the improvement of living conditions of the ethnic groups. The training of ethnic teachers to improve the educational standards, i.e., improved literacy and equity of education, and resettlement projects from remote areas, are being carried out in Pakxong district of Champasak province.

(2) Living Conditions

a. Occupation and Labour

Most of the family in the area engages in agriculture, such as coffee and upland crops production, with several members of the family performing household maintenance as well. The number of women performing both tasks is generally higher than that of men. In coffee production, weeding and harvesting are performed by hired labour. Other productive activities such as vegetable gardening, fruit trees and pig and poultry raising are predominantly performed by female members of the family. Domestic activities such as food preparation, rice hulling, water and fuelwood collection, are also tasks of mothers and children.

b. Income and Home Economy

Cash income in the family is mainly derived from selling farm products such as coffee, cardamom, tea, beans, potatoes, cabbage and bananas. Additional sources of income consist of the sale of pigs and poultry, followed by vegetables and fruit. A considerable amount of the income is spent on food purchasing particularly the common purchase of rice.

Based on the farm household survey conducted in the area, typical farmers are divided into three types: coffer farmer, upland farmer (slash and burn), and lowland rice farmer. The typical farm budget is roughly calculated in different 3 families as follows:

(Unit of currency: 1,000 kips)

	Coffee farming	Slash & burn	Lowland Rice
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
- Farm Income	940	374	324
- Non Farm Income	0	50	93
2. Production Cost	136	37	28
3. Net Income	804	387	389
3.1 Living Expense	778	387	389
- Food items	490	308	292
- Non Food items	288	79	97
3.2 Net Reserve	26	0	0

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

i) Coffee farmer: (average farm size: 2.5 ha)

Farmer earns about 1 million kip from only coffee production (2.5 ha).This farmer can afford to manage sufficiently and to maintain his living, through coffee production above. Its surplus income yields about 30 thousand kip.

ii) Upland farmer: (average farm size: 1.2 ha)

Using slash and burn cultivation, farmer earns about 420 thousand kip. It appears that only the lowest living standards can be maintained by farm income. Therefore, this farmer can not produce any surplus income.

iii) Lowland rice farmer: (average farm size: 0.9 ha)

It is very difficult to maintain living expenses based only on farm income (324 thousand kip). The living of the farmer is barely maintained by income from non farm income (i.e., a proportion of non farm income among gross family income (93thousand kip), reaches 22percent.). However, farmer produces very small amount of the surplus income (about 4 hundred kip) from rice production and non farm incomes.

Judging from the above, the income gap of farmers produces a great effect on the type of farming and area of farmland. Among these farmers, farm expenses are very low due to traditional farming.

c. Living Environments

Based on data from a materials survey, housing conditions in the area, even in the ethnic minority villages: consist of roof (thatch: 38.5%, iron sheet: 59.5%, and wood: 2.0%), wall (bamboo: 52%, and wood: 48%) and floor (bamboo: 20.5%, and wood: 79.5%). On the other hand, the report on Living Conditions in Lao PDR, surveyed by the CPC, shows that 73% of housing consists of wooden structures on the national level.

Electricity supply is limited to very few places within the Study area, and primarily exists in parts of Laongam and Pakxong districts. Most village farmers are using kerosene lamps for house illumination. Main sources of drinking and domestic water consist of natural water from rivers and springs in the dry season, and from rainwater in the rainy season, this does not include the urban area of Laongam district which has a water supply system. Firewood collected from forest surrounding villages is generally used for fuel for cooking. Almost none of the houses in the area have latrines (95%).

According to the data obtained on household assets in the area, nearly half of the total households have bicycle and radio, and 20% of the households also have TV set. In particular, coffee growers tend to buy motor-cycles and hand tractors because of the good returns from coffee.

As mentioned above, it can be said that living conditions in the area are characterize by the economic gap between the coffee farmer and the upland crop farmer.

3.3 Present Agricultural Setting

3.3.1 Land Holding and Land Tenure System

Since the government decreed the regulation of land use (No. 117) in 1989, it is authorized that officially, the land remains the national community's property and the people have the right of usufruct or the right of use of the land. By the Government Decree No. 99 at 1992, the land could be inherited, transferred, leased, or sold to Laotian national, all of which are legitimately recognized by the state. Each village is to maintain a land registry book for individual holdings, and submit this to the authority concerned.

Besides, the land taxation system also was changed in 1993 (No. 50). Before that, the tax on rice cultivated land was paid in kind, on the basis of assessed potential yield. On the other crops an agricultural income tax was paid in cash. Under the new system taxes are paid annually on all crops in cash, and the tax is applied to all categories of land. A different tax schedule is applied to each of four agricultural land types; land for rice field (irrigated and rainfed), for non-rice agricultural crops, for slash and burn cultivation, and other land uses.

3.3.2 Major Crops in the Study Area

The agricultural activities and kind of crops grown in the Study area are varied mainly because of altitude and soil conditions of locations as well as the condition of transportation(roads) to market, particularly in relation to vegetables. The cropped area and production of the major crops in the Study area are summarized 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	16100	5700	380	100	710	590	240	50	400	5500	760	250	18590
Bachiang	560	130	-	-	2260	3740	540	1380	-	-	650	120	4010
Laongam	6700	1140	-	-	4700	7050	460	1150	-	-	1400	130	13260
Salavan	50	20	-	-	160	300	2390	7160	-	-	30	10	2630
Thateng	970	260	-	-	1110	1990	270	540	-	-	280	60	2630
Total	24380	7250	380	100	8940	13670	3900	10280	400	5500	3120	570	41120

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

The main crops found in the Study area are, upland and lowland rice, coffee, tea, cardamom, fruit trees, vegetables and other field crops such as soybeans and ground nuts.

3.3.3 Cropping Pattern and Farming Practices

(1) Rice

In the Study area farmers grow lowland rice at the onset of the wet season using usually local varieties of around 150 days of growth duration, transplanting during June to July, and harvesting in November to December. The upland rice is grown mostly with slash and cultivation method. The cropping season is almost same as that of lowland rice. In Thongway village in Pakxong district, altitude about 900 m, farmers prepare nursery in August, transplant in September and harvest in November to December without applying any chemical fertilizers or compost.
The notable pests and disease affecting rice are stem borers, gall midge, army warm, rice blast and brown spot, according to information from farmers.

(2) Coffee

More than 90 % of coffee grown in the area is Robusta, and the main flowering season of coffee is March to April and harvested in December to February, but sometimes lasting until March to April. At the harvesting time, labor is hired from outside the Study area especially from districts located in low altitude rice growing areas after harvesting of rice. Usually no chemical fertilizers are applied and pruning is not properly done. Due mainly to ignorance, not only of farmers but also of traders of coffee, the present quality of coffee on the Boloven Plateau is rather low in spite of the very suitable land and climate for coffee production. The main reasons for the low quality are; excessive moisture content, (over the 12 % standard of EC market), harvesting of immature cherry at one time, too many days of drying directly on the ground causing fermentation of beans, and low milling and sorting quality mixed with broken and immature beans.

(3) Vegetables

The cabbage and Chinese cabbage season in Pakxong area begins with seeding in December to January and ends with the harvest in May to June. Potato is seeded in March and harvested in June in the Pakxong area. Farmers also grow vegetables during the rainy season, harvesting them in September to October. They generally use imported seed, chemical fertilizers such as compound(16-20-0), and urea, and apply insecticide to control pests especially at the nursery stage. Vegetables are grown with irrigation by watering can or small irrigation pump during the dry season.

(4) Other crops

Other crops such as ground nut, soybeans, etc. are also seeded mostly in the mixing or rotation with the upland rice, and inter cropping with young coffee tree. This system is recently introduced mainly by the LUADP activities. Ground nut is seeded in May and harvested in September to October, while soybeans are seeded in July and harvested in

November to December. Tea is found in very limited places around villages from KM 35 to KM 43, where they grow tea which seems to be the Shan of Assam variety. Cardamom is planted with upland rice under the mixed cropping system just one or two years before the rice field is abandoned, and requires little attention after that.

3.3.4 Crop Yield

The yield of rice is still very low, about 1.5 ton/ha of upland rice, 2.6 ton/ha of lowland rice on an average. The lowland rice farmers always complain of the shortage of irrigation water and less availability of fertilizers.

Unit yield of coffee is around 0.3 ton/ha on an average in the Study area. The yield of cabbage, Chinese cabbage and potato is 8 to 10 ton/ha, 5 ton/ha and 10 ton/ha, respectively. The yield of Chinese cabbage is very low. This appears to be due to lack of proper cultivation techniques of farmers, and partly to shortage of irrigation water. Yield of potato is fairly good.

The present farming practices and crop yield in the Study area is given in Table 5.

3.3.5 Livestock

Livestock raising is also important farming activities in the area, most of farmers keep cattle, buffalo, pig and poultry. The cattle and buffalo are raised mainly for meat, and draught power for field preparation and cart. Horses are also kept in the high altitude area for the purpose of transportation of materials, where carts are impractical. The number of livestock in the Study area is given below.

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

Large scale cattle raising has been attempted in Pakxong area, but from the view point of protection of water resources and environment, the local government is going to reconsider development of large scale cattle farming in the area. Animal raising practices are still primitive. Farmers keep them on free range natural grass land and even in the forest areas. Care of the animals is minimal, and during the dry season, grass for cattle becomes scarce. The most common problem for livestock raisers is disease control, especially foot and mouth disease.

3.3.6 Fisheries

Inland fisheries are an important source of protein supply for the people of the rural area. Fisheries activity is whenever possible primarily catching (natural propagated) fishes with cast net, traps, or scoop net in the rivers, small streams, canals, ponds and lakes. Recently fish cultivation in constructed fish ponds has been promoted by the government, but the extent of this is still limited. The kind of fish cultivated is mainly common carp and tilapia, for which fingerings are supplied from the Fishery Research and Extension Station located at KM 8.

3.3.7 Agro-processing

The most important agro-processing activity in the Study area is milling of rice and coffee. Most of villages are equipped with privately owned mills in their villages. At present almost all villagers use rice mill for milling rice, instead of pounding method. The milling charge is about 10 Kip/kg (out put). The average capacity of mill is about 200 to 300

kg/hr of coffee (output), and 300 to 400 kg/hr of rice (output). The recovery rate of milling is about 60 to 62 % for rice, and about 50 to 60% for coffee from dried cherry according to the millers respectively. A private coffee processing enterprise established recently is carrying out coffee processing at KM 25 along No. 23 National Road and exporting the husked beans abroad. Processing of tea access in very limited places around villages from KM 35 to KM 43. Non fermented tea is produced at the individual tea farmers home by roasting method which uses a hot iron plate.

3.3.8 Agricultural Machinery

A considerable number of hand tiller and milling machine have been imported from Thailand, China and Taiwan in the past two years. Most of the hand tillers are used for transportation of materials, rather than tilling fields. Some large farmers such as those operating cattle ranches, have medium scale of tractors (30-45 HP) but the number is very limited. Some farmers ask the tractor owners to prepare their fields. (about 70,000 Kip/ha a time, for ploughing and harrowing.)

3.3.9 Agricultural Production Value

The 1994's gross production value of major crop productions at farm gate is estimated as follows :

Item	Pakxong		Bachiang		Laongam		Salavan		Thateng		Study Area	
	(US$)	(%)	(US$)	(%)	(US$)	(%)	(US$)	(%)	(US$)	(%)	(US$)	(%)
Coffee & Tea	11,250	76	260	10	2,250	39	40	1	510	34	14,300	52
Rice(Up&Low)	130	1	1,040	42	1,670	29	1,520	55	520	35	4,890	18
Vegetable	750	5	0	0	0	0	0	0	0	0	750	3
Cardamom	510	3	250	10	270	5	20	1	120	8	1,160	4
Tea	70	1	0	0	0	0	0	0	0	0	70	0
Livestocks	2,040	14	960	38	1,570	27	1,190	43	350	23	6,110	23
Total	14,740	100	2,510	100	5,760	100	2,770	100	1,500	100	27,280	100

Note : 1 : Annual production of animals is estimated as assumption based on the total number of animals, applying 15% of cattle and buffalo, 150% of pig and poultry.

2 : Exchange rate applies 735 kip as 1 US$

The above table shows the different production trends and characteristics in each district. As for the Study area, 52% of annual farm production value derives from coffee planting, while livestock and rice production contribute 23 % and 18 %, respectively.

3.4 Agricultural Support Services

3.4.1 Government Organization

The provision of agricultural support services is the responsibility of the MAF and the provincial agricultural and forestry authorities. Agricultural and forestry services are organized into three levels: central, provincial and district. The central level consists of the Ministry itself with its departments, various institutions, research stations, and of rice seeds production. Agricultural and forestry services at the provincial level follow national policy and guidelines. The provincial authorities provide technical support for the district service units administrated by district offices.

However, there exist substantial institutional constraints, including the shortage of skilled manpower, inappropriate distribution of staff, lack of budgetary resources and lack of adequate financial services in the rural areas.

3.4.2 Agricultural Research

The National Agricultural Research Centre (NARC), MAF is responsible for research at the central level, and works in cooperation with the MAF's Department of Agriculture and Extension (DAE) and the provincial agricultural and forestry services. In the southern region, there are two agricultural research stations for research and training. One is Phone Ngam

Research Station in Pakse, Champasak province, carrying out lowland rice research and experimentation under the National Rice Research Program (NRRP) supported by the Lao-IRRI Project financed by the Swiss Development Cooperation (SDC). The other one is Ban Itou Research Station of the LUADP financed by the IDA with technical assistance from the Australian and French Governments, which conducts research and trials for coffee and upland crops. At the end of February, 1996, technical assistance for upland crops by the Australian government was phased out.

Further the Fruit-tree Research Station of Champasak province carries out research and seedling production at KM 20. In addition, the Fishery Research and Extension Station, located at KM 8, east of Pakse, managed by the Livestock and Veterinary section, AFS of Champasak province and supported by the Mekong Commission, concentrates on producing fingerling of carp and telapia to be distributed to the fish farmer. The Palay Upland Crop Research Station of Champasak Province which is still under construction, will conduct upland crop research and trials. The Livestock and Veterinary Research Station managed by Department of Livestock and Veterinary, MAF, is under construction in Pakxong District. In the future, this will shoulder an important role as the livestock research centre of the southern region of Laos.

The MAF is striving to strengthen agricultural research based on the integrated research and extension program project. However, the shortage of manpower and funds for sufficient research and training, and deteriorated facilities impose substantial constraints on the smooth operation of these stations..

3.4.3 Agricultural Extension and Support Services

The agricultural extension activities at the central level are the responsibility of the Agricultural Extension Agency (AEA) established in 1992 and are administered in cooperation with the NARC and Department of Agriculture and Extension. In the Study area, the activities are carried out by the district AFSs in cooperation with the AFSs of Champasak, Salavan and Sekong provinces. But the activities have not functioned well due to insufficient funds, a shortage of manpower, i.e., inadequately prepared and insufficient extension officers, and inappropriate distribution of staff. Currently there is very little training in extension work given to extension officers and staff of the district and provincial services.

Actually, few extension services are being provided for the improvement of agricultural production by technical assistance, consultation and training due to the unavailability of transportation by motorcycles. Visits to and observations of each village have been conducted only one or twice a year. According to the survey results, about 40 percent of the farmers participate in training courses on the farm.

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 (63 villages) of the project. Some farmer's groups have been formed by the beneficiaries, under the guidance of a project extension officer of. Agricultural extension by the project is mainly coffee production in Pakxong, Laongam and Thateng districts. Moreover, extension activities for upland crops such as upland rice, legumes and fruit trees had been also carried out in Bachiang, Laongam and Thateng districts by the Project, but were terminated at the beginning of 1996.

The provincial and district AFSs are also responsible for extension services on livestock production and its management and veterinary (animal health), as well as freshwater fishery. Activities relating to vaccination and disease control for livestock in the Study area, are only partially functional because of poor organization, inadequate training, and incomplete or non-existent vaccine cold chains.

The extension services for forestry are carried out in both the special forest area (SFAs) and forest conservation area by extension officers and staff of the district and provincial

services. The activities are executed in cooperation with the Lao-Swedish Forest Cooperation Program (SIDA), which aims to promote the introduction of cash crop production, lowland rice cultivation and freshwater fish culture to changeover to sustainable agriculture from shifting cultivation.

3.4.4 Agricultural Credit Services

The Agricultural Promotion Bank (APB), Pakxe and Salavan branches provide agricultural credit to farmers as the public financing institution for the agricultural sector since 1994. The credit recipients consist of farmer groups, individual farmers and traders of agricultural products. Currently small and medium scale farmers can receive credit only through group lending arrangements. Therefore, the APB strives to form farmer groups for credit lending in the village in cooperation with extension officers and the staff of the district and provincial services. The groups will be formed by farmers (7 to 10 members) from within the same village and who will be jointly liable for the loan.

According to APB, Pakxe branch, the total amount of loans to be released in 1995 to farmer groups (301) in the Study area excepting Salavan district (total group: 94) is estimated at 1,127 million kip for crop production, land clearing, purchasing of draft animal and farm machinery, and livestock production. Annual interest rate of APB is set at 10% (short-term), 8% (medium-term) and 7% (long-term), with favorable credit terms for farmers compared with the credit terms of commercial and industrial sectors. The interest rates of the latter are 14% to 22% of annually.

From the rural socio-economic survey, it appears that the loan amount from the APB is 75,000 kip to 1,500,000 kip per households. In case of small loans, there is credit through farmer's group. Only about 27 farm households, (13.5%) of 200 sample households are benefiting from the APB's credit. The recipient of APB's loan are mainly coffee farmers who obtain extension work from The LUADP to promote coffee production. Futhermore borrowers of large amounts are small scale livestock holders. Most of the formal credit is short term (up to one year).

In the Study area, a farmers' association, modelled on Grameen-style operations (mutual financing by money collected from villager) was established recently for the purpose of providing mutual assistance to village farmers. The village farmers can borrow money from the fund for medical expenses, purchase of a paddy, and other emergency cases at an interest rate of 5% per month.

3.4.5 Farmers' Organization

There are some farmers' organizations established in the Study area, such as the village committee, the village unit (nuay), elders groups including the National Front, youth association and women's union under the government patronage.

In the Study area, 63 extension groups are organized in the target villages of the LUADP in order to smoothly conduct extension activities for agricultural improvement. As mentioned above, 301 farmer groups for credit lending in 86 villages (except for Salavan district) are formed in order to obtain formal credit from the APB. On the other hand, in the villages located in the SFA or FCA, Village Resource Management and Development Committees supported by the Lao-Swedish Forestry Cooperation Program, SIDA, are established to push forward adequate resource management at the village level.

On the other hand, the autonomous farmers' association have been established in some villages in Pakxong district for the purpose of mutual assistance to village farmers, without any support or guidance from the authorities. The Women's Union strives for the establishment of rice banks and cattle banks to improve living conditions in rural areas in collaboration with NGOs, through the grouping and strengthening of women's groups at the village level. In the Study area, the provincial women's union is now conducting a rice and a cattle bank pilot project in each district.

3.4.6 Women's Role in Agriculture

In general, women in rural areas are actively involved in every stage of agricultural production. In addition, domestic activities, i.e., housekeeping, and child care, are an essential part of women's work. The domestic activities also include rice hulling, food preparation, fetching water, firewood collection, and washing cloths. According to the report of UNICEF, 1992, 16 % of girls and 7 % of boys in the 11 - 15 years group were also involved in the agricultural activities. These unproductive activities constrain the improvement of working conditions and the status of women in rural area.

The Study area is an ethnically diverse society distributed widely of the Lao Loum and Lao Theung. Gender based division of labor varies among these ethnic groups by farming patterns such as coffee growing and upland agriculture(slash and burn cultivation) and is linked to the social status of the women. Most activities related to capital acquisition and maintenance are the responsibility of men. The sources of wealth controlled by women are few and more related to household consumption. Upland farming (slash and burn cultivation) requires much more labor for a given yield than lowland agriculture, particularly in weeding, which is usually done by women. The daily tasks of feeding the pigs and poultry, taking care of the vegetable gardens, checking the fruit trees, and collecting firewood from forest are generally responsibility of women. From the rural socio-economic survey, it appears that women's working hour on the farm is 4 to 6 hours daily.

The Lao Women's Union encourages the improvement of the status of women and living conditions in the rural areas, through a network extending from the central level down to the village level.

3.4.7 Water Users' Association

There is no water users' association established in the Study area under the Government arrangement. Few independent water users' groups exist in the small scale irrigation schemes of the area but are not well-operated owing to a lack of funds for operation and maintenance and irrigation techniques.

In Champasak province, the provincial agricultural authorities initiated the organization of water user groups in the lowland rice production areas in 1994, and conducted training courses of irrigation management for beneficiaries. However, water user groups are not yet properly-organized in these areas, due to lack of understanding of irrigation management among the beneficiaries.

3.5 Agro-economy and Marketing

3.5.1 Marketing System and Organization

(1) Agricultural Products

Usually the agricultural commodities produced by farmers are sold to a middleman (small trader) who visits individual farmers, or are sold to a retailer at the nearest market. Presently no farmer's organization provides marketing or pricing services for agricultural products in the Study area. Because of no prior knowledge of market and prices, the farmer has little 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 of a fare marketing system by advising by the Central Government. The association insists that all traders or exporters must belong to the association and are required to be authorized. One of the criteria of the association for business approval is that traders must pay to the coffee farmers a "fare price" fixed by the association. (this price is fixed according to the world market price).

The other products, such as vegetable and rice, are marketed through private channels, as mentioned above. The products are first collected together at the Pakxe market, and then distributed to other local markets by middleman (small trader).

(2) Agricultural inputs

After the NEM economical revolution, the private sector now dominants the importation, production, and distribution of agricultural inputs with a few exceptions. There are two channels of input supply to the farmers in the Study area, one is donor-supported fertilizers supply (basically KR II), and the other, private basis supply. Distribution in the former channel, is done by the Government service office, either provincial level or district level.

Distribution of donor-supported fertilizers such as KR II is also happens through two channels. In Champasak, one large state trading company functions as wholesaler for donor-supported fertilizers, and there is a provincial trade service office in Salavan province. The Government supply channel is cheaper than the private channel because of subsidy support. However, it can be argued that the involvement of the Central Government and/or provincial Government in the importation and distribution of fertilizers under the donor-supply system, hampers development of an efficient marketing system for fertilizer.

It is thought that both distribution systems for agricultural inputs in the Study area are presently inefficient. Most fertilizers and agro-chemicals are sold at Pakxe. These inputs are scarce in the local markets, where they are rather expensive and limited in amount.

3.5.2 Import and Export of Agricultural Commodities

(1) Import

Imported items are mainly industrial products, such as motorcycles, medicines, construction materials and some agricultural products (raw materials) for export are imported from Thailand and Vietnam. Most agricultural commodities imported are agro-inputs (fertilizers, chemicals, agricultural tools), livestock (cattle and buffalo) and woods officially, fruits and vegetables unofficially.

The Lao government prohibits the importation of vegetables, however the following vegetables found in Pakxe market are imported unofficially by the small traders from Thailand and at times from Vietnam.

Commodities	Imported from	Portion at Pakxe market
Vegetable		
1) onion	Thailand and Vietnam	all
2) garlic	Thailand	all
3) chilli	Thailand	all
4) carrot	Thailand	some
5) tomato	Thailand	some
6) potato	Vietnam	all
Fruit (lambutan, mangostin, apple, orange)	Thailand	all

(2) Export

The main export agricultural commodities of the Study area are coffee, cardamom and livestocks. Notably more than 80% of the total amount of coffee produced for expert, passes through Pakxe. Statistics for major agricultural commodities in the Study area for 1990 to 1994 are summarized as follows:

(unit : '000 kip)

Major Exported Commodities	1991	1992	1993	1994
Agricultural Product				
1) Coffee	2,974,420	1,687,110	2,179,890	1,885,860
2) Soybean	84,640	54,540	5,950	19,050
3) Groundnut	7,780	21,290	2,860	7,930
4) Cotton	14,960	8,730	0	2,330
5) Cardamom	161,640	394,850	425,460	252,690
6) Livestocks	360,010	391,380	251,900	112,240
Total	3,603,450	2,557,900	2,866,060	2,280,100

Source : Trade Service Office in Champasak, Salavan, Sekong Provinces

In addition, some unofficial exporting to Thailand is carried out by the small Lao traders. For example, banana, cabbage and potato are exported to Thailand in the harvest season without being declared at the trade office. Also livestocks is thought to be unofficially exported to Thailand.

3.5.3 Prices and Quality

(1) Market Price

The farm gate price of commodities is influenced by the market price, e.g. In accordance with world market price escalation the price of coffee soared about three times in 1994. The current market price of each agriculture commodity in the Pakxe market was surveyed by interview to retailer, and summarized as follows :

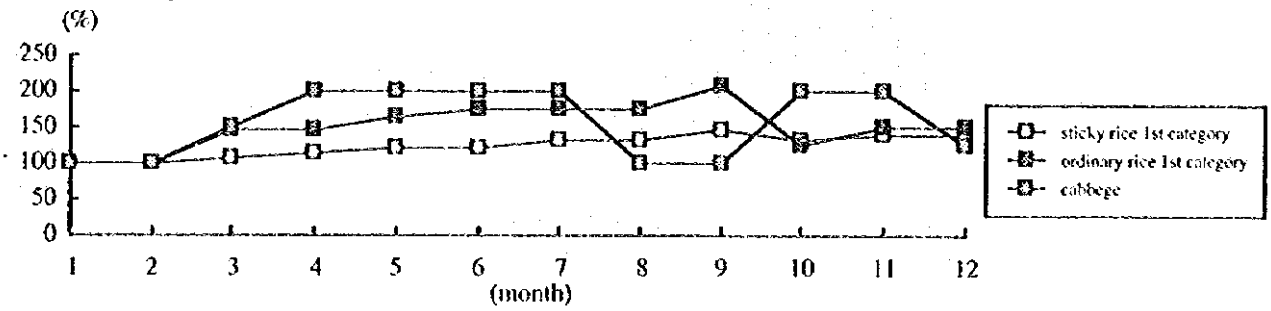
Average Retail Price of Agricultural Products at Pakxe Market (may 1995)
(unit : kip/kg)

Commodities	Price	Commodities	Price
Vegetables		Rices	
Cabbage	261	Ordinary category 1	295
Chinese Chabbage	400	Ordinary category 2	260
Carrot	675	Sticky category 1	258
Potato	588	Sticky category 2	238
Big Onion	657	Thai Rice	480
Red Onion	750	Beans	
Tomato	833	Groundnut	700
Gerlic	1,130	Black Bean	650
Ginger	438	Meat	
Chili (green)	900	Beef category 1st	1,900
Chili (dried)	2,575	Beef category 2nd	1,683
		Pork category 1st	1,700
		Pork category 2nd	1,350

Source : Surveyed by JICA study team

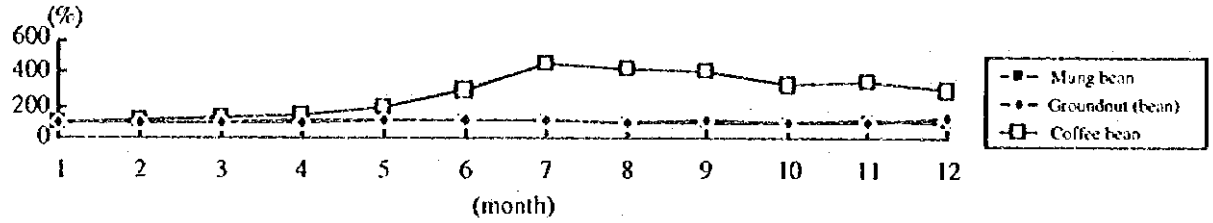
The following figures shows price fluctuation for some crops throughout the year in 1994 at Pakxe market.

1) Rice and Vegetable



Price Fluctuation in Pakxe Market at 1994 (Rice , Cabbage)

2) Beans and Coffee (beans)



Price Fluctuation of Pakxe Market at 1994 (mung bean, peanut, coffee)

The prices of vegetables (such as cabbage, potato, etc.) and rice fluctuate seasonally depending upon availability. The highest prices occur just before the harvest season and may be double the lowest price is the production cycle. On the other hand, the prices of beans and meat are stable throughout the year, because they are sufficiently available in the market.

In 1994, coffee price jumped three times from 500 kip/kg to 1,600 kip/kg, compared to once in the previous year. Consequently, the household economy of the most coffee producers improved greatly but in the 1995 harvest season fell back slightly.

(2) Farm Gate Prices

A weighted average for farm gate prices of crops was calculated on the basis of information gathered by farm household survey which interviewed 200 households, and information from such related agencies as the provincial and district trade service offices, and the agricultural service office.

Production	Average price(kip/kg)
Paddy	150
Coffee (husked beam)	1,450
Cabbage	100
Potato	113
Soybean	156
Maize	103
Banana	300

Source : JICA Study Team and Provincial & District Trade Service office

While the above prices are the annual average ones, it must be remembered that market price fluctuates according to the season. Especially the price of vegetables varies remarkably. For example in the case of cabbage the maximum price was 600 kip/kg at the Lao new year in 1995, but at the harvest season the price fell to around 10 kip/kg.

(3) Quality

Farmers and also traders (exporters) at present, have no concept of a quality standard. Even in case of coffee, exporters check only the broken beans, and the government following checks of moisture condition and phytosanitary only, authorize coffee beans as Lao standard coffee. The standard moisture condition of coffee in Lao is 14% to 7%, however the standard of the EC is under 12%. Additionally, there is no taste checking system. Hence, Lao coffee is classified into the low quality class in the European market, and is given at low price 10 to 20 % below the world market price.

Vegetables are also sold freely in the market by farmers and/or retailers, and prices are set by weight, not qualities. Only the price of rice is graded into two categories, i.e. non-broken rice and broken rice. Since there is no marketing facility and organization in the Study area, the farmers are compelled to go to the local market or to wait for middlemen to come to them. Therefore, the farmers are products often wasted, especially in the rainy season due to the poor transportation.

3.5.4 Demand and Supply

A rough analysis of the food balance in the region and Study area, 1994, is summarized as follows, respectively.

Province	Total Population	Rice demand (Paddy)	Prod. of rice (1993)	Balance	
				Total	Per capita
	(person)	(ton)	(ton)	(ton)	(kg/person)
Champasack	504,000	151,200	204,030	52,830	105
Salavan	250,000	74,700	73,800	-900	-4
Sekong	63,000	18,900	11,830	-7,070	-112
Total	817,000	244,800	289,660	44,860	55

Source : Ministry of Agriculture and Forestry

The food balance is in substantial surplus in Champasak province, resulting in overall surplus in the three provinces on balance. It is thought that the surplus in Champasak is transported to Salavan and Sekong to supplementing their shortage.

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	-11,945	-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	-1,790	-124
Total	140,181	42,050	26,545	-15,505	-111

Source : CPC and Agriculture and Forestry Service of each district

The production of rice in the Study area, although showing a slight surplus in Bachiang and Salawan districts, is in deficit condition overall. It is considered this shortage is supplemented from the Champasak surplus. In fact, there is an established exchange system in the Study area , where a certain number of farmers in the coffee growing areas grow coffee instead of rice for the cash income and buy rice by the cash.

3.5.5 Farm Household Economy

(1) Labor Balance

Labor shortage will be one of the limitations for the future development stage. The labor balance study was made in order to assess the demand and supply of labor force on the cropping patterns in the Study area.

The peak of labor requirement on present cropping pattern appears at the time of the coffee harvest. Most coffee farmers hire the labor from the lowland areas surrounding the Study area, Salavan, Champasak, Khong provinces. The labor requirements of the other crops including upland crops, lowland paddy, vegetables etc., are met by family labor, because the cultivated area is comparatively small.

(2) Average Farm Type and Size of the Study Area

The main farm types operated in the Study area are coffee farming, lowland rice farming and slash and burn cultivation. The dominant farm type is summarized as follows :

Farm types	Main crops*1	Average farm size (ha)	No. of H.H	Ratio in Total H.H(%)
Coffee Farming	Coffee	2.5	10,480	41
Slash & Burn	Upland crops	1.2	10,180	40
Paddy Farming	Lowland rice	0.9	4,860	19
Total		1.7	25,520	100

Remarks : *1 : Upland crops include upland rice, soybeans, groundnut, cardamom, etc.

The farm income consists of mainly three crops, coffee, lowland paddy and upland crops. The dominant farm types of the Study area are the monocultivation types of coffee or slash & burn, and the combination of coffee and slash & burn (upland crops) cultivation. There are some farmers who cultivate vegetables such as cabbages, Chinese cabbages and potatoes with coffee. Coffee farming is mainly found in the Pakxong district, and slash & burn farming including combination type is dominant in the Laongam, Bachiang and Thateng districts. Paddy farming is mainly operated in the Salavan district.

The farm size was also estimated by each farming type based on the data of agriculture service offices in each district. Coffee farming which is one of the dominant types in the Study area is operated at about 2.5 ha of farm size. Besides, the farm size of slash and burn cultivation, the other dominant types, is about 1.2 ha and that of lowland rice farming is 0.9 ha, respectively. The average farm size in the Study area is about 1.7 ha.

(3) Present Farm Household Economy

The present farm household economy for each farming type in the Study area is assessed based on the results of the farm household survey and estimation of the crop budget. The following table shows the present farm budget of three typical farm households.

(Unit of currency: kip)

	Coffee farming	Slash & Burn	Lowland rice farming
Average Farm Size (ha)	2.5	1.2	0.9
No of H.H in Study Area	11,480	10,180	4,860
1. Gross Income	940,100	423,900	416,600
- Farm Income	940,100	373,900	324,000
- Non Farm Income	0	50,000	92,600
2. Production Cost	136,400	37,000	27,800
3. Net Income	803,700	386,900	388,800
3.1 Living Expense	778,000	386,900	388,400
- Food items	490,100	308,400	291,900
- Non Food items	287,900	78,500	96,500
3.2 Net Reserve	25,700	0	400

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

The total annual income of the coffee farmers is estimated at about 940 thousand kip, while expenses of sash & burn and lowland rice farmers are about 420 thousand kip. The study on farm budget makes it clear that farm economy for the sash & burn and lowland rice farmers is at a very subsistence level. However, as mentioned in the previous chapter, the coffee farmers' household economy is probably exceptional because of the extra high price in 1994. In the case of low prices such as say, 500 kip/kg, annual incomes will drop to about 0.4 million kip.

3.6 Agricultural Development

3.6.1 Existing Irrigation and Drainage Development Projects

The existing irrigation projects of 35 sites are found out in and around the Study areas, and financed by the Central and Local Governments, NGO and Foreign Aid such as SIDA and USAID. Total irrigation area of the 35 projects is estimated at about 2,700 ha, and the main irrigated crop is paddy. The main purpose of those projects is to provide supplementary irrigation water for paddy field in the rainy season. The irrigated paddy areas are drastically decreased in the dry season because of limited available water.

Off take facilities of irrigation water for the projects are mainly small scale concrete weirs with intake gates. Irrigation water is conveyed through small earth canals by gravity method. Canal networks are generally established by secondary and/or sub secondary canals. Tertiary canal systems are not provided at the on-farm level, where irrigation water is supplied with plot to plot practices.

Main drainage canals usually using natural drains are found in some areas. Drainage canals have double functions of water conveyance such as drainage functions to evacuate excess water from paddy fields and to convey water for irrigation to lower paddy fields.

Maintenance works of irrigation facilities are mainly entrusted to village people after the construction. Minor maintenance works of irrigation facilities such as maintenance works of earth canals and rehabilitation works of small related structures are only carried out by village people. Extension works on maintenance works and water management are not properly carried out by the district offices concerned.

Access roads to main irrigation facilities of the projects are generally maintained well by village people, but in some cases, maintenance works of access roads are abandoned, and access roads are not jeepable.

Table 6 and Figure 7 give a summary of existing irrigation and drainage projects in the Study area. Principal feature of the existing irrigation and drainage projects are summarized below for each province.

(1) Champasak Province

The 3 existing irrigation areas were constructed by the Central and Local Governments and NGO and separately located are in the Study area of two districts, Paksong and Bachiang. The total irrigation area of these projects is estimated at about 140 ha. The main crop is paddy, and furthermore, irrigation of coffee trees, vegetables, fruit trees and nursery trees for reforestation is also carried out on small farms.

The Provincial Agriculture and Forestry Service is carrying out the construction of two irrigation projects, Palai irrigation project of about 400 ha. in Bachiang District and the irrigation project covering about 100 ha. in Pakxong District.

Palai irrigation project is financed by the Central Government and the Provincial Agriculture and Forestry Service. The main purpose of the project is to develop paddy field of about 400 ha in rainy season and about 150 ha in dry season including existing paddy fields. The water resource is Palai river. Irrigation area is extended in the hilly area with EL 300 m to 340 m. The off-taking method utilises a simple concrete weir. Head race of canal is lined by concrete with a rectangular section. Design discharge is 0.5 m3/sec. Weir and head race of canal system were constructed in 1995 by a local contractor. Canal systems from main to tertiary canals are under construction.

Thongvay irrigation project is located on the high land plain at an elevation of about 950 m. The water source is Xe Katam river. The project is financed by SIDA and Provincial Agriculture and Forestry Service. Main purpose of the project is to supply irrigation water for existing paddy field through rehabilitation works of existing irrigation facilities. Irrigation area is estimated at about 100 ha in the rainy season and about 48 ha in the dry season. The off-taking facility is simple concrete weir.

(2) Salavan Province

There are 24 irrigation schemes in both districts, 11 in Salavan and 13 in Laongam respectively. Total irrigation area is approximately 1,600 ha of paddy land in the wet season. Nong Deng Irrigation Scheme covering about 500 ha constructed in 1987 is located at the lower end of the Xe Set basin in Salavan District. Irrigation water from the Xe Set is diverted to the area by concrete weir, but in the dry season no water can be smoothly diverted due to hydro-power generation activities in Xe Set Power Station, resulting in only 70 ha of paddy cultivation. Nakhoysoa irrigation Scheme constructed in 1954 is located along the lower reach of the H. Khalong, which command approximately 170 ha of paddy irrigation in the wet season. however, no irrigation can be made during the dry season due to drying up of the river. The irrigation facilities are substantially deteriorated at present. Houay Soung Scheme covering about 119 ha of paddy land in the wet season is located at about 8 km northeast of Ban Beng. Due to lack of available river water is, H. Soung river, no irrigation is practiced during the dry season. Another eight (8) irrigation schemes in Salavan District are scattered along the tributaries of either Nam Sai or Xe Set. These irrigation schemes mostly function in the rainy season as supplementary irrigation.

Ban Lɛn Irrigation Scheme in Laongam District covering in the wet season about 70 ha of paddy and upland crops, and an inland fishery were constructed in 1994 by using the Fund of SIDA. Irrigation activities commenced at the beginning of 1995. Water sources for the Scheme are mainly springs located near the village. Main purpose of the Scheme is to decrease slash and burn cultivation in the area and to supply animal protein through encouraging inland fishery activities. Dongmon Irrigation Scheme constructed in 1987 commands about 250 ha of paddy land in the lower reach of the H. Tapoung. Because of limited water available and deterioration of canal facilities, only about 20 ha of land are irrigated during the dry season.

Remaining eleven (11) schemes are mostly constructed on a temporary or seasonal basis for supplementary irrigation of paddy cultivation during the rainy season.

According to the information of Laongam District Agriculture and Forestry Service, primitive temporary irrigation facilities have been constructed at about 26 village areas by farmers themselves for cultivation of upland paddy in the rainy season. However, the exact irrigated area is not confirmed by the District Agriculture and Forestry Service.

(3) Sekong Province

Six(6) irrigation schemes exist in the Study area in Thateng District. Total irrigation area is about 460 ha. The main crop is paddy, but coffee trees are irrigated in a few areas.

In the hill side area of Thateng District, artesian wells are found in 4 villages, namely, Thateng, Houase, Sen Tai and Kapu villages. Ground water of artesian wells is used for domestic purposes by village people and to irrigate coffee trees and other upland crops in the villages.

The Nam Sai irrigation project is the latest constructed project in the area and financed by NGO. The water resource of the project is Nam Sai river, and its irrigation area of 86 ha is scattered in 4 village areas, namely, Nonglao, Kapu, Khamkok and Nong Nok villages. Each irrigation scheme comprises main and secondary canals which are constructed by the village farmers.

3.6.2 Current Plans of Irrigation and Drainage Development Projects

According to the information of provincial and district agriculture and forestry services, 14 irrigation and drainage development projects are newly proposed in the Study area. The development plans are mainly prepared by provincial and district agriculture and forestry services.

Main purposes of new irrigation development projects are to supply water to coffee trees before and after flowering stage of coffee in the Pakxong District of Champasak Province and to increase paddy production in Salavan, Laongam and Thateng Districts and to improve a living standards of coffee growers in Thateng District. Table 7 gives a summary of the irrigation and drainage development projects mentioned above.

As the results of field surveys on the existing projects in the Study area, it was possible to indicate the necessity for rehabilitation works on some existing facilities.

3.6.3 Existing Upland Crop Development Projects

(1) Lao Upland Agriculture Development Project

The upland crop development project currently being undertaken is financed by World Bank and the Governments of Australia and France. The main features of these existing development projects are described below.

The purpose of the project is to increase farmers' s income and to up-grade farmers' living standard through research work of upland crops, extension works and technical training plantation cropping. The main crop of research and extension works through the project is coffee trees, and crops of agriculture extension works are coffee, soybeans, groundnut, maize, fruit trees and vegetables.

Main components of the project implementation are:

i) Establishment of an upland crop research station for coffee trees, fruit trees, vegetables and upland paddy, and
ii) Extension and training in upland crops plantation through some branch offices of the project.

The research station of the project which is located at KM 35 of the road No.23 from Pakxe to Pakxong has an experimental farm of 210 ha.

The project areas are extended in the Provinces of Champasak, Salavan and Sekong Province. The project areas of about 5,500 km2 extend from EL 400 m to EL 1,200 m on the Boloven Plateau, except for in the south-eastern part of the Plateau.

The extension works of coffee trees and other upland crops are carried out by creating pilot villages along road No.20 from Pakxe to near the crossing point on Xe set river on, one section of road No. 23 from near Pakxe to Pakxong, on the other section of road No. 23 from B. Thateng to B. Beng and on road No.16 from B. Thateng to B. Kafe.

Irrigation and drainage development activities are scheduled to be implemented as a future phase of the project. The project will be implemented by the middle of 1995. The future program of implementation is not decided yet.

(2) Swedish International Development Agency (SIDA) projects

Activities of SIDA are also located at the 2 existing irrigation project sites of the Study area, Thongvay irrigation project in Pakxong District and B. Len irrigation project in Laongam District.

Main purpose of SIDA projects is to provide agriculture infrastructures in order to decrease slash and burn cultivation and to prevent deforestation.

In case of the Thongvay project, rehabilitation work of existing irrigation facilities are being carried out to provide stable water supply to paddy field of about 100 ha. Water resources of the project is Xe Katam. B. Len project has small weir, main canal and farm ponds cum inland fishery ponds. Irrigation area is about 150 ha in the rainy season and about 20 ha in the dry season. Water resources of the project are some springs which are located near the B. Len. Upland crops such as vegetables, soybeans, ground nut, etc. and paddy are currently planted in the irrigation area.

(3) Lao - IRRI research and training project

The project has been implemented since 1990 for the purpose of research and development, support of paddy, and training of officers and recipient farmers in Lao. The project is monitored by IRRI, and financed by SDC. The implementation of project has been extended to 1996.

The main activities of the project are not located in the Study area. However, Phone Ngnam Centre was set up for research works on lowland rice in Champasak Province.

3.7 Rural Infrastructure

3.7.1 Road Networks

(1) Trunk road

National road No. 23 runs approximately in the center of the Study area from west to east, connecting Pakxong town with Pakxe city, a distance of 50 km. Road No.23 further extends northwards to Thateng town over a distance of about 37 km and connects with road No. 20 at B. Beng 19 km away. From Pakxong town one more trunk road extends to the east, reaching national road No.16 at B.Khoumkham 72 km long. On the way to B.Khoumkham (Road No.16), an access road to Houay Ho dam site branches out at B.Thaot and is 75 km from Pakxong town.

National road No. 20 branches off road No.23 to the north at B. Lak 21, and goes to Salavan via Laongam. From Thateng town, road No.16 branches eastward, going to Sekong and Attapu.

At present, a whole stretch of road No.20 and a part of road No. 23 (B. Lak 8 to Pakxong), totalling 129 km in length, are asphalt-paved, providing excellent communication for the people concerned. The roads to Houay Ho dam site and to road No.16 from Pakxong town are laterite paved and well maintained by Daewoo (Korean contractor of Houay Ho Hydropower Project). It is in good condition and motorable throughout the year.

The stretch of road No. 23 from Pakxong to Thateng is seriously damaged and impassable during the rainy season. Rehabilitation of this road is already financed by the ADB and asphalt pavement works were started in the beginning of 1995 and are scheduled to be completed by 1997. The road No.16 from Thateng to Attapu via Sekong is a gravel road and at present is motorable throughout the year. The rehabilitation and asphalting of this road is also financed by the ADB, and will be completed by 2000.

The distances of trunk roads in and around the Study area are summarized below and illustrated in Figure 8.

Trunk roads in and around the Study area

Road No.	Distance of Sections	Total (km)
Road No.23	Pakxe - (50 km) - Pakxong - (55 km) - B.Beng (Road No. 20)	105
Road No. 20	Lak 21(Road No. 23) - (50 km) - Laongam - (37 km) - Salavan	87
Road No.16	Thateng - (50 km) - Sekong - (74 km) - Attapu	124

(2) Feeder road

In the Study area, there are a total length of 736 km of district roads/village roads. Almost those district roads are earth roads, 3.0 to 5.0 m wide. No drainage facilities such as pipe culvert and road side ditch are provided. The provincial authorities are responsible for maintenance work of these district roads. However, because of the limited budgets, little or no maintenance works are carried out in the Study area. These roads are motorable only in the dry season. Because of the poor condition of village roads, farmers have difficulty, not only for transportation of agricultural products but even for daily communication among themselves especially in the rainy season.

Laongam Coffee Roads which exceptionally good on, were constructed in 1988 financed by The World Bank and have a total length of about 100 km. In addition to the Laongam Coffee Roads, Coffee Feeder Roads Construction is now being undertaken under the Upland Agriculture Development Project financed by The World Bank. Presently, the responsibility of the coffee feeder road construction is transferred to the provincial transportation services. The total length of the coffee feeder roads is about 315 km. It is expected that the coffee feeder roads will be completed within two (2) years.

In addition to the district roads/village roads, farm roads (farm to village road) are identified in the Study area. These are all earth roads with a width of 2.0 to 4.0 m, are usually constructed by farmers themselves. In the dry season these roads are utilized mainly for transportation of farm input and output by ox-cart or hand tractors. The total length of farm road is estimated at 843 km in the Study area. The condition of these roads is very poor; in other words, almost like footpaths.

The total length of both village and farm road, and coffee feeder road construction, planned by UADP, are summarized below and illustrated in Figure 9 and 10.

(km)

	Pakxong	Bachiang	Laongam *)	Thateng	Total
Village road	252	58	349	77	736
Farm road	303	137	355	48	843
Coffee road	117	0	91	107	315

Note: *) Including some part of Salavan district

(3) Transportation

i) Public transportation

A public transportation service under the supervision of the provincial authority, CTPC service is available. If comparises privately operated individual taxi and truck bus. Pick-ups (1 to 2 ton-class with 12 seats) are commonly used for people transportation over short distances and truck bus (6 to 8 ton-class with 45 seats) are sometimes used for long distance transportation.

ii) Transportation of farm products

Various means of transportation are used to convey farm products from farm to village. Human labor, ox-cart, horse and hand tractor/small tractor with trailer may be used depending on the topographical condition, farm road condition and the farmers' economic means. Almost all farmers depend on human labor or ox-cart to transport coffee from fields to the village.

3.7.2 Domestic Water Supply

Almost all villages in the Study area depend entirely on nearby streams and rivers for their drinking and domestic water. These villages are usually located near perennial streams and rivers, which are no more than a few hundred meters away. However, some villagers have difficulty because they may have to carry water for more than 3 km especially in the dry season. Generally, these water sources are affected by fecal pollution and other types of contamination of human and animal origin. Only limited villages have access to spring water. Most are not protected against surface run-off contamination. In the outskirts of some areas in the Boloven plateau, especially the Thateng area, people benefits from clean water from springs which they enjoy for drinking. Primitive piped water systems are provided there. Shallow dug wells are very rare and most of the existing ones are not properly protected and maintained. Tubewells with hand pumps are gradually being developed in the Study area by the provincial public health service, with support from UNICEF.

Features of existing domestic water supply facilities are summarized below:

(nos.)

Facilities	Pakxong	Bachiang	Laongam	Salavan	Thateng	Total
Piped Water	3	1	4	0	7	15
Tubewell	19	11	3	1	3	36
Dug well	13	0	0	0	6	19

3.7.3 Power Supply

The extension of 22kV transmission lines is being carried out in and around the Study area based on the Provincial Grid Integration Project (PGI) by MIH and EDL. Presently, a 22 kV transmission line reaches Laongam town from Xe Set and another one comes to B.Itou (Lak 35) from Pakxe. By 1996/2000 the lines will be extended to Pakxong, Bachiang and Thateng. In the above areas, 48 villages will be supplied with 0.4 kV distribution lines in 1996/2000.

An extension plan for 22 kV transmission lines up to the year of 2000 has already been announced by EDL. The plan proposes that the extension work will be concentrated in the southern part of Champasak after reaching Pakxong, Bachiang and Thateng.

There are two (2) micro-hydropower plants for rural electricity supply in the Study area; one is operating at Pakxong town but the other at B.Phakout (Laongam district), has broken down and not operated since 1990. The Pakxong micro-hydro power station was constructed in 1987, supported by East Germany. Two (2) units of generators with a capacity of 60 kW and 25 kW are installed in Pakxong. Because of insufficient water only 8 hours operation is possible in the dry season. The total number of beneficiary is 220 households, paying an electricity charge of 37 kip/kWH. At present, the facility is operated with difficulty, because of problems getting spare parts. According to district officers, the operation of the power station will be stopped after the transmission line to Pakxong town is constructed.

A micro-hydro power station with a capacity of 30 kW in B.Phakout was constructed in 1988 by a Vietnam company. The funds for construction were provided by the villagers themselves. However, after 2 years use, the generator broke down and has not been used since because of insufficient maintenance service and technical support to the villagers.

3.7.4 Social Infrastructure

(1) Health care facility

Health care situations in the Study area are as follows:

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

District hospitals are entirely managed by the provincial public health service, however the village clinics are not supported sufficiently or effectively by the province because of limited budget. Almost all village clinics are in poor condition, having 1 to 3 rooms and furnished with 0 to 5 beds and no clean water supply systems. Provincial officers state that one village clinic is proposed to be provided for a population of 1,500. However, when compared with the minimum requirement, present village clinics are insufficient in number and below standard in facilities. Both institutional and budgetary support for the village clinics are weak.

(2) School facilities

The school facilities situation in the Study area is summarized below:

School	Pakxong	Bachiang	Laongam	Salavan	Thateng	Total
Primary school w/class-3	61	34	36	25	25	181
Primary school w/class-5	30	13	7	5	1	56
Secondary school	9	5	1	0	1	16
Teacher's college	1	0	0	0	0	1

School facilities such as buildings, desks, benches and blackboards are very inadequate. Construction and maintenance of primary schools are the responsibility of the village people. Therefore, conditions of primary schools vary substantially among the villages. In order to improve the present poor condition of school facilities, the provincial education service is providing the people with construction materials such as zinc roofs, nails and cement. This is supported by UNICEF. The budget of supporting organizations is also limited so the progress of primary school rehabilitation is always considerably slower than the annual target of the province. Almost all primary schools are equipped with no water supply facilities, which are so essential. Both institutional and budgetary supports for the primary schools are considerably weak.

(3) Community hall

No community halls in good condition are found in the Study area, however some community activities are undertaken at some places. The farmers generally use such facilities as temples, schools or social meeting places.

3.8 Environmental Aspects

3.8.1 Soil Erosion

The rainfall in the Boloven Plateau is markedly seasonal, with 90 percent of annual rain experienced between May and September, during the southwest monsoon. High rainfall like that on the plateau, can be almost completely absorbed into the soil under natural systems of forests and grasslands. However due to man's intervention, natural balances have become disturbed and it is highly likely that this had contributed to increased surface runoff.

Soil erosion is largely a function of farming technique, just as it is a function of land form, land use and climate. Sound land use and correct farming techniques offer the widest scope for controlling erosion. In the Lao PDR, soil loss under different farming systems was not quantified in the past. It is only recently that some measurement is being attempted.

Physical loss of soil will not be apparent in the present time or in the near future, but over the years, there can be expected a gradual loss of soil, soil fertility, general land degradation and, consequently productivity. Often fields are clean weeded; hence cultivated land becomes a source of sediment generation. Most cultural practices adopted in field crop and tree crop agriculture do not favor attainment of sustainable farming objectives.

Shifting cultivation can be another source of sediment generation, particularly on steep slopes. If the cultivated plot is surrounded by vegetated land, the latter will act as a trap for moving sediment. The issue assumes significance if the intensity of shifting cultivation is high in a particular catchment, or if the cycle is shorter than about at least 10 years.

Large scale road construction work can cause serious sedimentation damage on adjacent arable land and nearby streams and rivers. This is seen on sections of road No.23, where widening and resurfacing are taking place at the time of this writing.

Erosion of watersheds that support hydroelectricity such as that of the Xe Set, can lead to impacts that have national economic significance. It has been reported that about 5,000 ha of the catchment are eroded in varying degrees. The right bank of the catchment is mountainous and well forested and the provincial administration has declared this area as a conservation area. The left bank by contrast, is almost entirely under agriculture and land management is poorly practiced.

3.8.2 Forests and Grasslands

According to the National Office of Forest Inventory and Planning, the 1989 forest cover, in the three provinces, Champasak, Salavan and Sekong is 61.4, 54.3 and 54.3 percent respectively. Table 8 provides information on land use in the three provinces. District data provided by the District Forest Services is shown in Table 9.

The category described as "current forest" is that forest land which has a canopy cover of over 20 percent. "Potential forest" is land that had been deforested and is presently unstocked. It is suitable for forestry and certain agricultural purposes. Deciduous species make up the bulk of the forested land. In Sekong province it is as high as 42 percent. Evergreen forests make up about 6-8 percent. Dry dipterocarp forest covers 17 percent in Champasak province. Table 10 gives the extent of different forest types in the three provinces. Forest harvesting is presently under the supervision of the Department of Forestry, unlike in the 1980s, when provincial administrations had the liberty to determine logging quotas. Logging was then quite liberally done, with little regard to environmental consequences. Logging quotas in the

current year for the three provinces vary from 7,000 - 10,000 m^3. Inventory and data collection are now in progress with the objective of introducing good management for reforestation.

The level of reforestation remains low, for reasons which are sometimes beyond the control of the provincial and district forestry services (Table 11). The "potential forest" area, totaling 733,500 ha in the three provinces, is therefore very much underutilized. Insufficient financial resources is one of the main constraints to higher levels of reforestation. State nurseries have given preference to raising teak (Tectona grandis). Table 11 lists some of the species in government nurseries.

Recently the private sector has shown interest in forestry activities and has obtained land from government for afforestation. Two nurseries have been established in Laongam district and one in Pakxong.

According to article 11 of the decree on the management and use of forests, no. 169/PM, there are five categories of forest land. These are:

i) Protection forest

- allocated for the protection of water sources, soil erosion, steep slopes, national defense, natural disasters and environment;

ii) Conservation forest

- allocated for preservation of life, nature and others that hold special value for environment, education and culture;

iii) Production forest

- allocated to meet requirements of national economic development and supply of forest produce without causing impact on the environment;

iv) Regenerated forest

- land which should be turned into production forest or other forest category; and,

v) Degraded forest

- allocated to forestry, agriculture or livestock production because it is land without forest cover or where the cover is seriously damaged.

Exploitation including hunting, is not allowed within categories i and ii.

Reduction of the national forest estate has been due mostly to logging, shifting cultivation, settlements and agricultural development. Annual fires and bombing during the war years have also contributed. Often fires get out of control and spread into the adjacent undisturbed vegetation which can be primary forest. So the area of forest destroyed is bigger than originally intended. It has been estimated that about 100,000 ha of forest nationwide, get destroyed annually by this means.

Besides timber, forests provide many other ecological and economic benefits to people living nearby. In a recent study in a village in Savannakhet province, the non-timber value of village forests was documented. Of a total of 81 animals and 201 plants identified, 94 percent of the animals and 99.5 percent of the plants were of known economic value to the people. Eighty-seven percent of these plants and animals had uses in the household only.

Pakxong district has extensive areas of grassland 16,200 ha. This is generally flat to rolling land with isolated hillocks. Grass also occupies some of the hill slopes. Associated with

the grassland are numerous lakes and springs from which many rivers begin, and flow in all directions. The distribution of grasslands in the three provinces is as follows:

Province	Extent(ha)	% of land area
Champasak	29,800	2.0
Salavan	15,400	1.4
Sekong	40,700	4.4

Source : Provincial CPCs

3.8.3 Protected / Conservation Areas

Forest conservation for a variety of reasons, such as watershed management and biodiversity conservation, has been initiated recently by the government. Legal protected status has been given to 18 forest areas representing the four biogeographic zones in the country. These are called National Biodiversity Conservation Areas. A large part of one of the NBCAs -- Dong Hua Sao (DHS), covering 910 km2 -- lies in the Study area. The area supports a variety of lowland and mountain vegetation types and is of much biological and biogeographical interest.

Provincial administrations have also set apart six forest areas for conservation benefits of hydrology, biodiversity and also for traditional values. These are shown in Figure 11. In Salavan province there are four such, and one each in the other two. The Governor of Champasak, has in 1993, declared the catchments of the Houay Ho, and Xe Pian-Xe Namnoy hydroelectricity reservoirs, as protected areas, for purposes of watershed management and biodiversity conservation.

Traditional conservation beliefs of people also contribute to some degree of forest protection, e.g.. belief in spirits associated with certain forest areas. A government priority is, "the clarification of rights and responsibilities of local communities in issues of resource tenure and management, including demarcation and protection of forests." The government believes in the rights of villagers to use forests, forest land and forest produce in accordance with their customs. Customary or traditional rights are those held by an individual, group or community, and are based in custom. Pursuant to decree No. 169, 102 and 99, being those for management and use of forests and forest land, organization and administration of the village, and for land respectively, the Minister for Agriculture and Forestry has issued an order on customary rights and the use of forest resources.

3.8.4 Wetlands

Two inter-connected groups of wetlands, identified in recent surveys, lie in Pakxong district. The first group is seen around Pakxong town and extends on either side of the road, east to Houaykong. Lying at an altitudinal range of 1,000 to 1,350 m, these wetlands cover several hundred square kilometers (Figure 12). The second group lies to the southwest and northeast of Houaykong, in the valleys of the Xe Pian and Xe Namnoy rivers, covering an area of about 80 km2. A threat to the wetlands is from siltation due to agricultural activities in the catchments.

The components of this wetland ecosystem are springs, marshy areas, ponds, lakes, streams and seasonally flooded grasslands. This study identified 18 ponds and lakes, ranging in size from 1.5 - 12 ha (Table 12). The numbers in the table refer to those on the map in Figure 12. There are also numerous unidentified much smaller ponds and lakes as well. Wetlands provide a variety of economic benefits to the people. Most of the lakes are stocked with tilapia and common carp.

The Pakxong wetlands in particular, have the unique ecological characteristic of serving as the nursery ground for some important rivers; namely, Houay Champi, Xe Set, Makchan Gnai, Xe Pian and Houay Touay. There appears to be an equilibrium between the grassland and its aquatic components, which if disturbed for agricultural development without

adequate supporting data, can lead to drastic changes in the water regime. Reports of large land concessions for forestry and livestock in these wetland areas are a threat to the hydrological resources and to the power projects being undertaken in zone 9 of Pakxong district.

3.8.5 Biodiversity

Biodiversity means the variety of living organisms, both plant and animal, found in a particular area. The Lao PDR is said to be home to over 10,000 species of mammals, reptiles, amphibians, birds, fish, insects, plants and lower forms.

Wildlife is rare near towns and villages due to hunting pressure and habitat destruction. Even elsewhere numbers are said to have been reduced. A large variety of wildlife forms part of the human diet. Markets have on sale a range of live birds, reptiles, amphibians and mammals all. However, at the Salavan market, the District Forest Service has put up a notice indicating that the sale of 79 species of wildlife is prohibited. The notice includes 36 species of mammals, 29 species of birds, six species of fish, four species of amphibians and four species of reptiles.

The Minister for Agriculture and Forestry, in a decree issued in 1989, prohibits the killing or capturing of 21 species of mammals, 14 species of birds, and six species of reptiles. A further 24 species of mammals, 28 species of birds, five species of reptiles and seven species of fish are protected during the closed season from July to November.

3.8.6 Shifting Cultivation

Government considers shifting cultivation as one of the more important natural resource management issues presently facing the country. It is a problem that is interwoven with socio-cultural factors and is an age-old agricultural practice, undertaken by all three major groups - with traditional variations. Rice, the staple food of the Lao people, is the major driving force toward shifting cultivation as each family looks to rice security.

The Lao Loum or lowlanders encroach on the upland when their lowland fields register low yields and this can be due to a variety of reasons. They are not shifting cultivators in the traditional sense. Given solutions to their problems, they would however, prefer to farm the lowland. The Lao Theung farm the upland of medium elevation, which usually involve fallow of 5 - 15 years.

3.8.7 Hydropower Generation

Within the master plan area there is only one hydroelectricity facility -- the 45 MW, run-of-the-river station on the Xe Set in Laongam district. Government attaches much importance to the development of hydropower. As of this writing, the 126 MW, Houay Ho project is under construction. A feasibility study has been completed for the 200 MW, Xe Pian-Xe Namnoy project. Memoranda of understanding have been signed by the government for three other projects to enable preliminary studies.

The Houay Ho and the Xe Pian-Xe Namnoy catchment, which together cover more than 800 km2, has been declared a protected area by the Champasak provincial administration. The vegetation of this new protected area consists of good quality deciduous forest which serves as habitat to a wide variety of wildlife.

One of the major adverse impacts of large dams is the likely disruption to human livelihood. One hundred and eight families from the Houay Ho catchment are to be relocated in the village of Namtang, 2.5 km north of Houaykong, along with an additional 337 families from the Xe Pian-Xe Namnoy project. At the time of the field study, houses were under construction at the relocation site. Each household will have the benefits of electricity, clean water, school, dispensary and two hectares of upland.

Other adverse impacts associated with these dams are loss of wildlife habitat and forest, altered river flow and modified aquatic habitat, and likely sedimentation. Environmental impact assessments were said to have been undertaken. Post-project monitoring should serve as an indicator of environmental changes.

3.8.8 Archeological / Aesthetic Sites

Both the Ministry of Information and Culture in Vientiane and its provincial counterpart in Pakxe, indicated that there are no known sites of archeological interest in the master plan area. Enquiries made during field visits did not turn up new information either. However, a number of aesthetically appealing sites are found; many of them associated with waterfalls. Such as one on the Xe Set, near the hydropower facility, which has been developed to some extent for tourism.

An area of great aesthetic charm is Pakxong district. It has a very agreeable climate and a number of potential attractions that can be developed into economic ventures. There is scope for both small-time non-formal, and formal tourism. The potential within a convenient range includes the hydropower projects and the associated extensive protected area with good wildlife habitat. Other potentials for tourism are the wetland areas around Pakxong, Dong Hua Sao protected area, coffee gardens and also outdoor adventure. Presently there is no visitor accommodation.

3.8.9 Water Quality

The water quality in the master plan area is satisfactory. There are no polluting industries and agricultural productivity is at a low level. Use of external inputs such as fertilizer and agrochemical, is very limited. Furthermore low population density is also responsible for the absence of pollution.

4. DEVELOPMENT CONSTRAINTS

4.1 Physical Constraints

4.1.1 Soils and Soil Erosion

Approximately 310,000 ha of shallow soils (47.5%) in the study extend throughout the Pakxong and Laongam areas, where rocks substantially out crop. The parent materials of the soils are sand stone, clay stone and basalt. Soils have high permeability and drainability, and they are easily eroded in heavy rainfall on the slope areas.

4.1.2 Irrigation and Drainage

(1) Topographical Constraint for Off-taking of Irrigation Water

The majority of rivers and streams in the Study area are steep and soil erosion of river banks are accelerated by floods. Moreover, huge amounts of big stones and rocks and weathered rock layers are found in the river bottoms and banks. Water falls and rapids exist at many places in the rivers. Deep river gorges thus result in hard conditions for off-taking water by gravity methods.

(2) Poor Co-ordination between Main Canals and On-Farm Development

In the majority of existing irrigation projects, off-taking facilities and main canals are generally constructed by the Government, and construction works of on-farm facilities are entrusted to farmers groups without technically suitable guidance. Consequently, much loss of irrigation water was found to be due to the poor co-ordination of canal network. Technical extension works of O & M are not properly carried out in the field.

(3) Water Management and O & M Works

Water users groups have been forming in the existing irrigation projects in the Study area since 1994, and their activities concentrate on maintenance works of canals only without any technical guidance from provincial and district agriculture and forestry services. The main reason of these constraints is the shortage of human resources and insufficient extension activities of the Government offices concerned.

(4) Quality Control of Works

The quality control of construction works are not executed in the majority of irrigation development projects in the Study area, especially earth works and concrete works because of the shortage of human resources such as the qualified and sufficient numbers of project engineers and technicians. The laboratories for soils, construction materials and concrete tests are not available in and around the Study area.

(5) Construction Materials

a. Shortage of Construction Materials

Most of construction materials except for timber, gravel and sands in the Study area are imported from Thailand so the stock supply and conditions are not stable.

b. Transportation Cost

At present, transportation costs of construction materials are being monitored by the local Government through the issuance of information notes on new prices of construction for irrigation project in the Champasak province. The information note is issued in November 1994. The recommended transportation costs are estimated, using some steps - percentages of the shop prices for materials based on the district areas. However, the actual transportation cost still to be added, is the amount from market area to project sites based on the ton-km system.

4.1.3 Land Use and Land Concessions

In the south-eastern part of the Study area, two (2) hydropower development projects; one is under construction at Houay Ho and the other will be executed within a few months on the Xe Pian-Xe Nam Noy under the supervision of MIH. In connection with these activities of the projects, the Local Government has already proposed the watershed conservation plans around both project areas to reinforce the policy of reforestation. The forest conservation area is estimated at approximately 80,000 ha.

Furthermore, in the Champasak province area, land concessions to state company and private sector are accelerating for forest development, livestock and cash crop cultivation such as fruit trees, sugarcane and upland crops. No land concession exists in the 2 provinces of Sekong and Salavan Provinces.

In accordance with the information of Champasak Provincial Agriculture and Forestry Service and CPC, the land concessions of about 29,750 ha were approved in the 2 district areas by the Central Government by the year 1995. Table 13 shows a summary of the land concessions in the Study area. The majority of the lands are located in the central area of the Boloven Plateau near Pakxong village and the areas along road No. 20 from Pakxe to Bachiang village. Social infrastructures such as main roads and electric power supply are generally established around the lands. Figure 13 shows the location of the land concessions in the Study area.

At present, further land concessions of about 6,200 ha are being claimed of the Central Government, but the Government's approval of these applications has not been issued. Table 14 and Figure 14 show a summary of application for the land concessions and the location of the lands.

As shown in Figures 13 and 14, there are much ambiguity of locations of the lands. The land concessions areas near Pakxong village may affect water pollution through livestock authorities and free range cattle farming. The locations of land concessions in the southern part of Bachiang District is quite ambiguous and would result in some trouble when planning future land use and water resources development.

4.1.4 Rural Infrastructure

The main constraints of rural infrastructure which will affect directly and/or indirectly the profitable of agricultural development are summarized as follows:

a. The village road network (district road) is of limited number and is also in poor condition.
b. Almost no maintenance work of village roads is done.
c. Effective telecommunication facilities are of limited number and are also in poor condition.
d. Availability of electricity is limited in the Study area.
e. Water quality for drinking purposes is unsatisfactory in some places especially in the rainy season, when compared with the minimum requirement, and
f. Both institutional and budgetary support for the basic public service facilities such as village clinic and primary schools are weak.

4.2 Agricultural and Socio-economic Constraints

4.2.1 Agriculture

Most of the constraints which are crucial to profitable and sustainable agricultural development in the Study area, are due to insufficient agricultural services and infrastructures. Major constraints to further development of agriculture are summarized as follows:

a. Irrigation Water Deficit

The farmers have suffered from shortage of irrigation water for cultivating rice in the wet season, particularly at the beginning of the wet season due to irregularity of rainfall. To reduce slash-and-burn cultivation of upland rice, development of a stabilized base for agricultural production with effective irrigation water supply is inevitable to achieve the goal of sustainable development of agriculture.

b. Lack of Supporting Services and Improved Techniques

The constraints are: no packages of farming techniques, no basis of researched techniques, lack of credible extension services for increasing crop and livestock production. Also the shortage of qualified manpower, facilities and equipment, and operational fund for research and extension work. Furthermore there is a lack of appropriate credit opportunities at reasonable cost/interest rates.

c. Insufficient Marketing System of Agricultural Input and Output

The shortage of agricultural inputs such as fertilizers and chemicals, as well as improved seed and seedlings, is a major constraint in the Study area. The farmers also have less accessibility to market information, especially on export-oriented products, and have less power of negotiation with traders due to the lack of a marketing organization for farmers.

4.2.2 Socio-economy

There are many socio-economic constraints for agricultural and rural development in the Study area due to flawed public institutions, lack of farmers organizations, low literacy, and insufficient basic health services. Major constraints to further rural development are summarized as follows:

(1) Weakness of Public Institutions

The weaknesses of the public institutions in the area are mainly due to insufficient governmental officers and staff, lack of training for human resource development, inadequate and prejudiced posting of staff, and shortage of funds for operating, etc. Further the deteriorated physical infrastructure and lack of transporting facilities constrain the public services for people. In particular, as mentioned in section 3.2, the public institutions for agricultural extension, public health, and education as the base of socio-economic development are confronted with several difficulties, namely, lack of trained and experienced extension officers and staff, a shortage of physicians and staff, weak physical infrastructure for health services, unqualified teachers and poor facilities for education, and insufficient funds for these services.

(2) Lack of Farmers' Organization

Although some farmers' organizations are established for the purpose of agricultural extension and agricultural credit supported by specific projects such as LUADP and APB, in the area, there is no agriculture-based farmers' organization supported by public institutions such as the provincial and district agricultural services. Consequently, the majority of farmers experience numerous disadvantages of farm management from production to marketing. They include technical assistance, marketing, credit, mutual assistance, etc. These disadvantages prevent farmers obtaining stability of livelihood with sustainable agriculture and the progress of the rural economy.

(3) Insufficient Support Programs for Ethnic Minorities

The majority of farmers in the area are diverse ethnic minority groups which consist of diversified traditional cultures which observe their own customs. These groups are left behind in the socio-economic development. Disparities of living conditions between urban and rural (especially in the plateau) are enlarged. In the ethnic minorities villages at present, there is

insufficient community development supported by the public and grassroots organizations to solve such disparities.

(4) Low Quality of Education and Low Literacy

Low quality of education and low literacy in the area are partly the result of unqualified teachers, poor instructional materials and school facilities as well as geographically remote locations. Further, the low quality of education is caused by the low stability of teachers in the ethnic villages and low salary. Low literacy of the ethnic minorities brings about a strong ethnic identity and the difference of education standards constrains the progress of development in the area.

(5) Weakness in Basic Health Services

The low level of health services in the area are the result of a shortage of medical and health staff, poor health facilities and equipment and limited medical supplies and pharmaceuticals. Moreover, lack of education on basic disease prevention methods in the villages causes high morbidity in the case of malaria and diarrhea related diseases. These circumstances constrain the living conditions of rural areas.

4.2.3 Environmental Constraints

The ultimate goal of agricultural production is to have continuity over the production processes without degrading the resource base. From an environmental viewpoint, sustainable use of natural resources should be the ultimate goal, while optimizing productivity from the soil, water and other natural systems. The under-mentioned constraints are briefly discussed.

(1) Hydrology of the Pakxong wetlands

The Pakxong wetlands are a fragile and complex ecosystem where an ecological relationship between the grassland, springs and lakes, and river flow, has developed over a long period of time. The water originating in this wetland flows into many rivers, e.g.. Houay Champi, Xe Set, Makchan Gnai, Xe Pian and Hoay Touay which are being utilized for hydroelectricity and for irrigation at different elevations on the way to the plains. Besides, many people depend on these waters for their domestic supply.

Any disturbance to this complex system will have an impact on hydrology. If infiltration is interfered with in anyway, runoff will increase and there will be less water to feed the springs, which in turn will fail to feed the rivers. Such a situation can arise if the grassland is overgrazed or if it were to be replaced by a different vegetation. Hence, there are limits on how much can be extracted out of this land.

(2) Land use policy

The absence of a national land use policy prevents provincial and district level decision-makers from taking the most rational decisions when allocating land. Land should be considered as a scarce resource although the low population density will give a high land-man ratio. State interventions are urgently required to bring about rational land use at all levels.

(3) Soil and water conservation

Soil and water conservation does not appear to be practiced in upland farming. Current cultural practices also do not contribute in any way to the conservation of soil and water. Although not quantified, it would be reasonable to assume that the absence of soil and water conservation on farm land is a factor contributing to low productivity. If not arrested soon, it will lead to land degradation.

(4) Shifting cultivation

Shifting cultivation is an age-old practice that does not seem to lend itself to recognition as a sustainable farming practice in the present day. In spite of many efforts, no

lasting solution has been found. The practice is intimately linked to the socio-cultural factors of the numerous ethnic groups practicing it. This makes resolution all the more difficult.

(5) Uncontrolled fire

Arising out of the practice of land preparation for shifting cultivation, good forest adjacent to the plot being cultivated is also destroyed when fire gets out of control. It is estimated that about 100,000 ha are lost annually by this means in the country.

(6) Reforestation

The longer logged land is kept fallow, the greater is the loss to the economy. In the master plan area, "potential forest" varies from 11 percent in Champasak to 37 percent in Sekong province. Reforestation is inadequate to meet the demands of ecological stability.

(7) Institutional capability

Weak institutional and staff capability is evident. Implementation programs naturally do not keep to target and have difficulty achieving desired results. There is also little attention paid to integrated regional planning or environmental planning.

(8) Economic reforms

The change over from central control to a free market economy also requires changes at village level, e.g.. land tenure, marketing and communications. These are not clearly identified or defined. A word of caution in the alienation of state land for agriculture, is that it should not be made without consideration of environmental values of the natural systems that are being replaced.

5. BASIC CONCEPT OF INTEGRATED AGRICULTURAL AND RURAL DEVELOPMENT PLAN

5.1 Basic Development Concept

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 crops and livestock, production 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 in the area 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 and their life improvement.

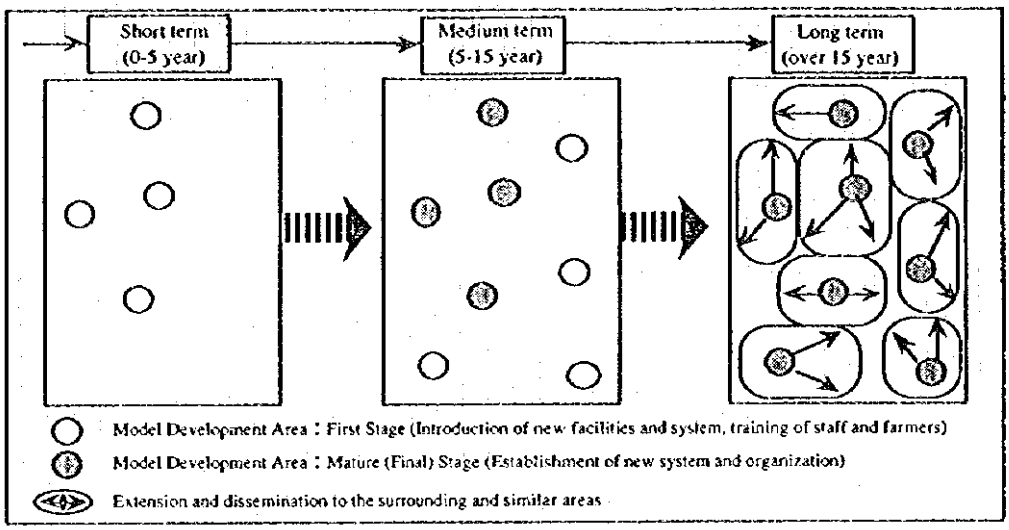
Reflecting the development need and above policy, the following practical development approaches are to be taken in order to attain the development objectives:

1) To raise farmers' income level through enhancement of stabilized farming and introducing profitable crops, particularly coffee, tea, vegetables, fruits, etc. with efficient utilization of the land and water development potentials.
2) To increase food staff in the lowland area through providing irrigation system 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.

5.2 Principal Approach to the Master Plan

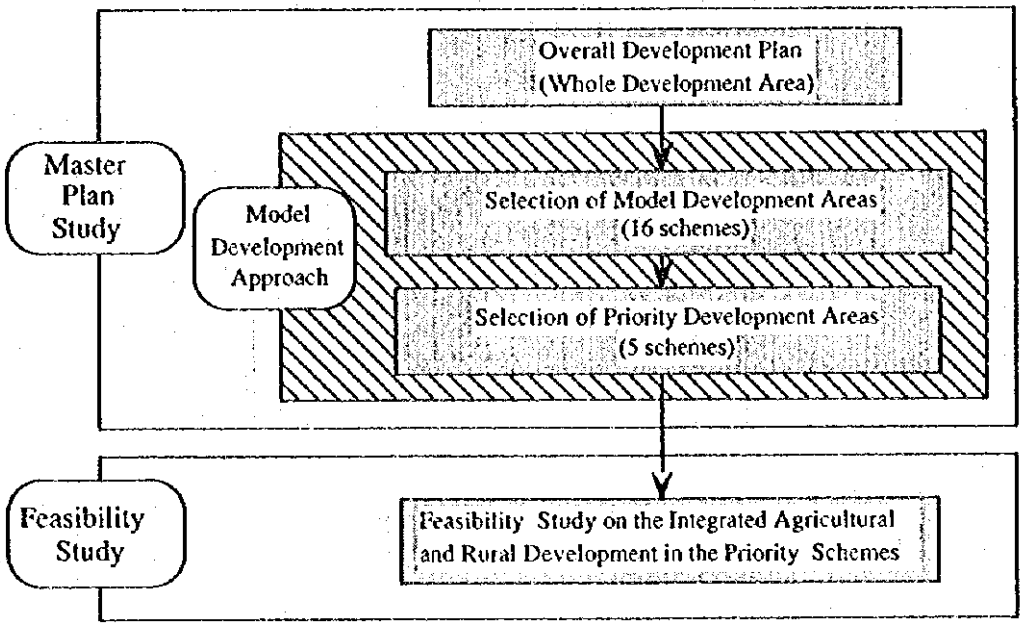
The envisaged agricultural development would be achieved through at first intensification of the existing diversified agriculture by improving husbandry technologies and development of infrastructure, and secondly by the expansion of agricultural area by establishing sustainable farming systems or by converting from slash and burn cultivation (which still remains in the Study area) to a sustainable farming system such as lowland rice, upland crop, etc.

Largely on account of knowledge that the agricultural activities vary greatly with topographical altitude and climatic conditions and are quite primitive, and the implementation ability of Lao Government is unsteady, it could be proposed that the stage wised development strategy such as the short, medium and long term development is applied as the development approach . The terms of the short, middle and long will be assumed approximately 0-5 years, 5-15 years and over 15 years respectively, and the approaches of each development aspect are also included in the development strategy as shown in Table 15. In addition, it could be also proposed that "the model development approach" should be put on the development approach as the main strategy. The model development should integrate the various development components such as the agricultural research work and the extension services, and the improved marketing system and facilities as well as rural and agricultural infrastructures. The conceptual figure of the development strategy (including the model development approach) is shown below :



Stage-wised Development Strategy with Model Development Approach

Meanwhile, in the integrated development of the entire Boloven Plateau, it is proposed that the model development areas are firstly identified based on the master plan study, and then the priority development schemes in appropriate scale be further selected for initial stage development among the model development areas. The feasibility study is carried out for the priority development schemes. The following is the work flow of both studies.



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 concept and the government policy as mentioned above.

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

(Therefore, The implementation plan of the proposed development projects for the next 15 years (1996 - 2010) is substantially for the model development schemes. The implementation plan is divided into three (3) phases by 5 years, such as phase I (1996-2000), phase II (2001-2005) and phase III (2006-2010). According to the priority of the model development projects based on the project effects, locality in the Study area, effects of the model development, etc, the model development projects will be carried out by turn in each phase.)

Priority Development Area: The priority development areas, which will be implemented in the phase I (1996-2000), are the selected areas among the model development areas based on the project effects, locality in the Study area, effects of the model development, etc. The feasibility study on the priority development areas was made for possible early implementation of projects.

5.3 Development Objectives

The development strategies in the Study area will accelerate the achievement of the following development objectives as soon as possible.

i) to provide the effects of the integrated agriculture and rural development to the surrounding areas of the Boloven plateau through the implementation of the demonstration and pilot projects,
ii) to reduce the slash and burn cultivation and stabilize agriculture activities in the Study area through the provision of irrigation and drainage facilities,
iii) to increase agricultural production, especially coffee, rice, soybeans, ground nut and maize, fishery production and livestock through the provision of irrigation and drainage facilities,
iv) to strengthen the capabilities and functions of local markets, trading and export,
v) to reduce hard works of women in farming and home living activities, and
vi) to up-grade the living standards of village people through the provision of water supply system and village electrification.

6. OVERALL INTEGRATED AGRICULTURAL AND RURAL DEVELOPMENT PLAN

6.1 Land and Water Resources Development Potentials

6.1.1 Land Resources

Land resources for agriculture development are evaluated from the land capability. 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 180,000 ha are covered by the forest conservation area declared by the central and provincial government. Accordingly, the potential areas for agricultural land development are estimated at about 210,000 ha as shown in Figure 15.

Recently, the land concessions of about 30,000 ha occupied by the state company and private sectors also extend over the potential areas of 210,000 ha. The land concession areas are deleted from the potential area development, because the development programs of land concession areas are entrusted to, and being implemented by those enterprises. Therefore, the potential areas are estimated at 180,000 ha in gross.

Since the potential areas of 180,000 ha also involve the village areas, roads, rivers, etc., the land resources for agriculture development can be concluded to be 135,000 ha in the Study area which correspond to about 75 % of the potential areas.

The development potential of agricultural land in the Study area is assessed with land capability classification based on the results of soils, land use and land capability survey, and crop suitability to the climatic condition which varies substantially depending on altitude of the land. The land for agriculture in the Study area is widely categorized into four groups based on altitude, and the agricultural development is assessed as shown below.

Suitable Land for Agriculture

Altitude	Study Area	Total Suitable Land	Forest Conservation Area	Potential Land	Land Concession Area	Gross Area	Net Area
Above 1000m	149,300	102,900	53,400	49,500	19,000	30,500	22,900
600-1000m	271,700	142,900	63,200	79,700		79,700	59,800
400-600m	77,300	48,500	22,300	26,200		26,200	19,700
Below 400m	155,800	96,100	40,900	55,200	11,000	44,200	33,200
Total	654,100	390,400	179,800	210,600	30,000	180,600	135,600

6.1.2 Water Resources

(1) Water Resources in the Study Area

The Study area is divided into nine (9) major river basins. Around 2,600 mm of annual average basin rainfall generates 10,500 MCM of annual average runoff in the Study area. Out of the annual average runoff, 1,791 MCM (17% of total runoff) flows during the dry season from November to April. Two river basins, Xe Namnoy and Xe Pian are scheduled to be utilized for new hydropower development projects according to the MIH1s development plans. Available water resources for the future regional development program excluding the hydropower component in the Study area, thus, can be estimated 4,560 MCM as the annual average runoff and about 780 MCM for the dry season. As for the low-water year with return period of 5 years, those runoff volume comes 4,000 MCM for annual runoff and 680 MCM for dry season runoff, respectively.

(2) River Runoff at Selected Site

Through the overall basin study of the Project, sixteen (16) sites for irrigated agricultural development were selected for model development. Available water resources in such specified river basins is preliminary calculated using the estimated monthly flow of major rivers in the Study area. River flow regime on average and low-water years at the intake sites of the proposed irrigation schemes is as follows;

Monthly flow volume in average year

Unit : MCM

	Proposed Project	River basin	Basin Area	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
1.	Upper Champi	H.Champi	37km2	1.01	0.63	0.66	0.90	2.15	3.52	7.38	10.41	10.09	7.14	3.15	2.02	49.04
2.	Upper Tapoung	Xe Set	4km2	0.09	0.06	0.06	0.08	0.20	0.32	0.68	0.96	0.93	0.66	0.29	0.19	4.50
3.	Lower Xe Pian	Xe Pian	43km2	1.12	0.70	0.74	1.00	2.39	3.91	8.20	11.57	11.21	7.94	3.50	2.24	54.50
4.	Upper Makchan	Xe Namnoy	31km2	0.72	0.45	0.48	0.64	1.55	2.53	5.30	7.48	7.25	5.13	2.26	1.45	35.23
5.	Middle Xe Katam	Xe Namnoy	174km2	4.05	2.53	2.67	3.62	8.68	14.18	29.74	41.99	40.68	28.79	12.70	8.13	197.76
6.	Middle Namtang	Xe Namnoy	51km2	1.19	0.74	0.78	1.06	2.54	4.16	8.72	12.31	11.92	8.44	3.72	2.38	57.97
7.	Lower Makchan-Gnai	H.Makchan-gnai	65km2	1.51	0.95	1.00	1.35	3.24	5.30	11.11	15.68	15.20	10.76	4.74	3.04	73.88
8.	Lower Champi	H.Champi	249km2	6.77	4.22	4.46	6.04	14.49	23.66	49.64	70.07	67.89	48.06	21.19	13.57	330.05
9.	Upper Kapheu	H. Kapheu	24km2	0.49	0.30	0.32	0.43	1.04	1.70	3.56	5.03	4.87	3.45	1.52	0.97	23.68
10.	Middle Tapoung	Xe Set	59km2	1.36	0.85	0.90	1.22	2.92	4.76	9.99	14.10	13.66	9.67	4.26	2.73	66.42
11.	Lower Tapoung	Xe Set	103km2	2.38	1.48	1.57	2.12	5.09	8.31	17.44	24.62	23.85	16.88	7.44	4.77	115.95
12.	Lower Xe Set	Xe Set	325km2	7.50	4.68	4.94	6.70	16.06	26.23	55.03	77.68	72.56	53.27	23.49	15.04	365.88
13.	Lower Namsai	H. Namsai	160km2	3.40	2.12	2.24	3.03	7.28	11.89	24.94	35.20	34.10	24.14	10.64	6.81	165.79
14.	Upper Thon	H. Namsai	42km2	0.89	0.56	0.59	0.80	1.91	3.12	6.55	9.24	8.95	6.34	2.79	1.79	43.52
15.	Middle Lamphan	H. tay-Un	147km2	3.06	1.91	2.01	2.73	6.55	10.69	22.43	31.66	30.68	21.71	9.57	6.13	149.14
16.	Upper Tay-Un	H. tay-Un	22km2	0.46	0.29	0.30	0.41	0.98	1.60	3.36	4.74	4.59	3.25	1.43	0.92	22.32

Monthly flow volume in low-water year

Unit : MCM

	Proposed Project	River basin	Basin Area	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
1.	Upper Champi	H.Champi	37km2	0.85	0.53	0.56	0.76	1.82	2.97	6.23	8.79	8.52	6.03	2.66	1.70	41.40
2.	Upper Tapoung	Xe Set	4km2	0.08	0.05	0.05	0.07	0.18	0.29	0.61	0.85	0.83	0.59	0.26	0.17	4.03
3.	Lower Xe Pian	Xe Pian	43km2	0.93	0.58	0.61	0.83	1.99	3.25	6.82	9.63	9.33	6.61	2.91	1.86	45.37
4.	Upper Makchan	Xe Namnoy	31km2	0.63	0.39	0.41	0.56	1.34	2.19	4.60	6.49	6.29	4.45	1.96	1.26	30.58
5.	Middle Xe Katam	Xe Namnoy	174km2	3.52	2.20	2.32	3.14	7.54	12.31	25.82	36.44	35.31	24.99	11.02	7.05	171.65
6.	Middle Namtang	Xe Namnoy	51km2	1.03	0.64	0.68	0.92	2.21	3.61	7.57	10.68	10.35	7.33	3.23	2.07	50.31
7.	Lower Makchan-Gnai	H.Makchan-gnai	65km2	1.31	0.82	0.87	1.17	2.81	4.60	9.64	13.61	13.19	9.34	4.12	2.64	64.12
8.	Lower Champi	H.Champi	249km2	5.71	3.57	3.76	5.10	12.23	19.98	41.90	59.15	57.31	40.57	17.89	11.45	278.61
9.	Upper Kapheu	H. Kapheu	24km2	0.41	0.26	0.27	0.37	0.88	1.44	3.02	4.27	4.13	2.93	1.29	0.83	20.09
10.	MiddleTapoung	Xe Set	59km2	1.22	0.76	0.80	1.09	2.61	4.26	8.93	12.61	12.22	8.65	3.81	2.44	59.38
11.	Lower Tapoung	Xe Set	103km2	2.13	1.33	1.40	1.90	4.55	7.43	15.59	22.01	21.32	15.09	6.66	4.26	103.67
12.	Lower Xe Set	Xe Set	325km2	6.71	4.19	4.42	5.99	14.36	23.45	49.20	69.45	67.29	47.63	21.00	13.44	327.11
13.	Lower Namsai	H. Namsai	160km2	2.95	1.84	1.94	2.63	6.32	10.32	21.64	30.54	29.59	20.95	9.24	5.91	143.87
14.	Upper Thon	H. Namsai	42km2	0.77	0.48	0.51	0.69	1.66	2.71	5.68	8.02	7.77	5.50	2.42	1.55	37.77
15.	Middle Lamphan	H. tay-Un	147km2	2.84	1.77	1.87	2.53	6.08	9.93	20.82	29.39	28.48	20.16	8.89	5.69	138.44
16.	Upper Tay-Un	H. tay-Un	22km2	0.42	0.27	0.28	0.38	0.91	1.49	3.12	4.40	4.26	3.02	1.33	0.85	20.72

(3) Flood Discharge

Estimation of flood discharge of the river is made with return period of 5 and 10 years taking the design condition of project facilities into account. As for the H. Lamphan, flood discharge of return period 200 years was also estimated because the site has possibility to construct the dam facilities for intake. Due to the lack of historical flood records, rational formula is employed for estimation of flood discharge at the proposed intake site.

Peak flood discharge at selected site

Project Site	Probable Daily Rainfall min/day			Arrival Time of Flood Hour			Rainfall Intensity mm/hour			Peak Flood Discharge m^3/sec		
	1/5	1/10	1/200	L (km)	H (km)	T (hour)	1/5	1/10	1/200	1/5	1/10	1/200
1. Upper Champi	226.4	283.5	-	12	0.19	2.0	32.7	41.0	-	168.3	210.7	-
2. Upper Tapoung	206.5	257.6	-	3	0.02	0.8	48.5	60.5	-	27.0	33.6	-
3. Lower Xe Pian	189.3	227.1	-	18	0.38	2.5	24.3	29.2	-	145.3	174.3	-
4. Upper Makchan	148.7	179.0	-	10	0.20	1.5	25.1	30.3	-	108.3	130.4	-
5. Middle Xe Katam	148.7	179.0	-	29	0.72	3.7	15.8	19.0	-	381.4	459.1	-
6. Middle Namtang	148.7	179.0	-	18	0.31	2.9	17.9	21.6	-	127.2	153.1	-
7. Lower Makchan-Gnai	148.7	179.0	-	27	0.47	4.3	14.7	17.7	-	132.7	159.7	-
8. Lower Champi	226.4	283.5	-	46	1.21	2.6	19.4	24.3	-	670.9	840.1	-
9. Upper Kapheu	192.1	238.7	-	15	0.36	2.0	28.1	34.9	-	93.5	116.2	-
10. Middle Tapoung	206.5	257.6	-	16	0.42	2.0	30.1	37.5	-	246.6	307.6	-
11. Lower Tapoung	206.5	257.6	-	26	0.69	3.2	23.7	29.5	-	338.4	422.2	-
12. Lower Xe Set	206.5	257.6	-	45	0.98	6.2	16.9	21.1	-	764.1	953.1	-
13. Lower Namsai	176.3	210.8	-	31	1.34	2.8	21.4	25.6	-	475.1	568.1	-
14. Upper Thon	176.3	210.8	-	12	0.44	1.2	32.7	39.1	-	190.7	228.1	-
15. Middle Lamphan	122.0	153.2	314.9	20	0.60	2.3	16.5	20.7	42.6	337.3	423.5	870.6
16. Upper Tay-Un	122.0	153.2	-	13	0.58	1.2	23.1	29.0	-	70.6	88.7	-

6.2 Rural Infrastructure Improvement Plan

6.2.1 Rural Road Networks

(1) Village roads (District roads)

Improved village roads will provide not only permanent access from Road No's. 20, 23 and 16 to each village, but also allow continued access to light traffic to serve the agricultural and social needs of the people. These roads will also provide access to potential areas for future irrigation development. In the Study area, there are 736 km long of village roads under poor conditions described in the previous chapter. One hundred (100) km of Laongam Coffee Roads completed in 1988 and 315 km of Coffee Feeder Roads presently under construction by UADP, will hopefully be a model for the proposed village road development program in this master plan.

(2) Farm roads (Farm to village road)

There are farm roads, mostly constructed and maintained by farmers themselves with a total length of 843 km in the Study area. The condition of these roads is very poor; in other words, almost like foot paths. Improvement of these roads is also important for the transport of farm inputs and outputs.

(3) Design standard

The following design standard, commonly applied to rural tertiary roads in Laos, is applied for the master plan study:

- Design speed : 20 - 40 km/hour
- Carriage way width : 3.5 m (Village road)
  : 3.0 m (Farm road)
- Shoulder width : 1.0 m x 2 sides
- Pavement : Laterite pavement

(4) Overall development plan

Based on the availability of budget for the provincial communication services, the target for village/farm road improvement (reconstruction) is proposed at 50 km/year. Considering the importance of these roads to the economic development of the villages, it is also proposed that there should be periodical maintenance at least every 3 years. The network of existing village/farm roads which are proposed to be rehabilitated is shown in Figure 10. The plan of development is shown in Table 16. The followings are summary of road improvement:

- Target of annual completion for village/farm road development: 50 km
- Total length of proposed village road construction: 736 km
- Total length of proposed farm road construction: 843 km
- Village road construction in selected priority project area: 85 km
- Farm road construction in selected priority project area: 24.5 km
- Periodical maintenance: every 3 years

Based on the target of 50 km/year, the village/farm road development program expects to complete 750 km at the end of 15 years. This road development will also take place to some extent outside the boundaries of the priority area in order to encourage development of the surrounding villages. Periodical road maintenance is also very important to minimize maintenance cost. It is proposed to strengthen/organize the road maintenance system in the districts and involve the village people also. It is also proposed to seek more budgetary support from the province. Periodical maintenance should be done every three (3) years as a minimum requirement. After completion of 1,579 km of total length of proposed village/farm road, the average an annual length for maintenance will be about 500 km.

6.2.2 Domestic Water Supply

Three (3) water supply systems are proposed, considering such conditions as hydro-geology, topography, availability of electricity and number of households in a region or village. These are :

- Gravity flow piped water system;
- Village water supply system by tubewell and elevated tank using electricity; and,
- Tube well with hand pump.

(1) Gravity flow piped water supply system

Among these water supply systems, "gravity flow piped water system" is the most suitable if the water is available within an economical distance from the village. In the Study area, 12 sources of water are identified for gravity flow piped supply, covering 61 villages with about 33,000 people. The table below summarizes the development potential of each water source in the Study area.

Summary of Potential Gravity Flow Piped Water Development

	Water source	District	Available water (lowest flow) (m3/sec)	No. of villages	No.of households	Predicted population in 2010
1.	H. Champi	Pakxong	0.03	10	1,054	7,630
2.	H. Last	Bachiang	0.005	6	484	3,368
3.	H. Kouang	Bachiang	0.26	9	661	3237
4.	H. Makngeo	Bachiang	0.12	1	57	401
5.	H. Lapi	Bachiang	0.23	1	117	841
6.	H. Palai	Bachiang	0.17	4	363	2,793
7.	H. Kapheu	Laongam	0.04	9	842	6,620
8.	H. Tapoung	Laongam	0.05	9	443	3,314
9.	H. Pao	Laongam	0.06	5	706	4,446
10.	Xeset	Salavan	1.73	5	358	3,082
11.	H. Latan	Salavan	0.005	1	22	176
12.	H. Kaphouy	Thateng	0.005	1	28	206
	(Total)			61	5,136	33,059

In the piped water system, the construction of an intake structure with a sand filter tank is proposed for a continuous supply of clean water. It is also recommended to construct

one distribution tank in each village for a stable supply. Unit domestic water consumption of 60 lit./day/person will be applied as a minimum requirement for planning and design of the village water supply system, making reference to the standard of MPH. A population in 2010, based on a 2.7% annual growth rate, was applied in designing the water demand. A communal stand tap is proposed for each of five (5) households to reduce women's daily chore of carrying water.

Where a gravity flow system is not suitable due to topographical conditions, a village water supply system with elevated tank using electricity should be considered. Water from the river/stream or spring is pumped up to an elevated tank and then distributed to communal stand taps by gravity.

(2) Ground water

Where a gravity flow piped system is not suitable because of inadequate water availability and/or difficult topographical conditions, the possibility of ground water development should be considered. Recently, "The Study on Ground water Development for Champasak and Salavan Provinces" was carried out by a JICA study team in an area partly covering Bachiang, Laongam and Salavan districts. Preliminary Ground water Potential Map of the above study and the yield data of existing wells indicate that ground water development is possible in certain areas, although more detailed study will be done before implementing. It is considered that ground water development is generally possible in the Study area. Two (2) types of water supply system by tube well, namely (i) village water supply system by tube well and elevated tank using electricity and (ii) tube well with hand pump are proposed as follows:

i) Village water supply system by tube well and elevated tank using electricity

This village water supply system is proposed under the following conditions from the economical view point.

- Availability of electricity; and,
- More than 50 households per village.

Water from the tube well is pumped up to an elevated tank and then distributed by gravity to communal stand taps, each for five (5) households in the village.

ii) Tube well with hand pump

Where the above village water supply system is not possible, tube well with hand pump is preferable. Tube wells will be constructed with washing bases each for ten (10) households.

Numbers of beneficial people group according to water supply system, in the whole Study area, is approximately estimated and summarized below:

Water Supply System	No. of Beneficial People
Gravity Flow Piped Water System	33,000
Tube well with elevated tank and pipeline system	64,000
Tube well with hand pump	43,000
Total Population	140,000

6.2.3 Rural Power Supply

In the formulation of power supply system, two (2) components are considered, they are 1) extension of existing high voltage transmission line from Xe Set Hydropower Station, and 2) development of micro-hydropower generation.

(1) Extension of existing high voltage transmission line from Xe Set Hydropower Station

As mentioned in Chapter III, the EDL plans to supply electricity to a total of 48 villages with 0.4 kV distribution lines by 2000. Further extension of high voltage transmission line will be studied in future by MIH and EDL, based on an economic comparison with local micro-hydropower development. However, a rough estimate of required length of transmission line network is made for covering almost all the villages in the Study area , as indicated below:

Overall Development Plan of Extension of Transmission Line Network (Unit : km)

District	Pakxong	Bachiang	Laongam	Salavan	Thateng	Total
Length	250	90	180	70	80	670

It is estimated that high voltage transmission lines will be constructed along the trunk roads and main district roads so as to minimize the total length of the line. The line is expected to cover more than 90 % of a total of 373 villages in the Study area.

(2) Development of micro-hydropower generation

At present, no detailed data is available about micro-hydropower development potential in the Study area. The provincial industry services are responsible for the development and investigated only two (2) potential sites such as Houay Xe at B.Setkhot in Pakxong district and Houay Tapoung at B.Houayseng in Laongam district. Based on interviews with provincial officials and field surveys by the JICA study team, twelve (12) potential sites are proposed for micro-hydropower development, including one (1) rehabilitation site of B. Phakkout, which has broken down and not been used since 1990.

Potential generation capacity is calculated based on such factors as the lowest discharge and effective head, in combination with other usage purposes of irrigation, domestic water supply and maintenance flow. However, tentative estimation is made based on a discharge, ensured at least 275 days a year with 1/5 probability of the water resources for this master plan. The estimated potential generation capacity of proposed sites varies from 20 kW of Houay Palai to 160 kW of Houay Xe in both Pakxong district, totaling approximately 1,100 kW of potential generation. Micro-hydropower potentials of each proposed site are summarized in Table 17 and their locations are shown in Figure 16.

6.2.4 Social Infrastructure

(1) Rehabilitation and/or construction for primary school

As described in Chapter III, there are 237 primary schools among total 399 villages in the Study area, of which 181 schools are "Pathomsomboun" (primary school with class 3) and 56 schools are "Munpathom" (primary school with class 5). In order to improve the present poor condition of school facilities, the provincial education services are providing the people with construction materials however, the progress of primary school rehabilitation is always far behind the schedule, to the annual target of the provinces. The proposed target of primary schools rehabilitation is 60 % of present primary schools, which includes sufficient space, necessary equipment, water supply facilities and latrines. The total number of primary schools to be rehabilitated is 143, of which class-3 primary schools are 109, and class-5 schools are 34, respectively. These are summarized below:

Overall Development Plan of Primary School

District	Pakxong	Bachiang	Laongam	Salavan	Thateng	Total
No. Villages	105	76	110	58	50	399
Existing Primary School						
- with class-3	61	34	36	25	25	181
- with class-5	30	13	7	5	1	56
Proposal to be rehabilitated						
- with class-3	37	20	22	15	15	109
- with class-5	18	8	4	3	1	34

(2) Rehabilitation and/or construction of village clinic

There are four (4) district hospitals and 23 village clinics in the Study area. The district hospitals are entirely managed by the provincial public health service, though the village clinics are not supported sufficiently or effectively by the province because of limited budget. Provincial officers state that one village clinic is proposed to command a population of 1,500. The proposed target of village clinic' rehabilitation or new construction will be in the ratio of one (1) clinic to 1,500 people. Rehabilitation will provide sufficient space, necessary equipment, water supply facilities and latrines. The total number of village clinics to be rehabilitated/constructed is 94, summarized below:

Overall Development Plan of Village Clinic

District	Pakxong	Bachiang	Laongam	Salavan	Thateng	Total
No.of Villages	105	76	110	58	50	399
Population	41,758	22,275	41,122	20,623	14,403	140,181
Existing Village Clinic	9	11	1	3	2	26
Proposal to be Strengthened	28	15	27	14	10	94

(3) Construction of community hall

Community halls in good condition are not found in the Study area, but some activities are undertaken at some places. The farmers generally use such facilities as temples, schools and even open spaces for village level communication. Community halls at village level are not only for social communication among the villagers, but for agricultural development activities such as marketing of agricultural outputs, farmers' training and farmers' association. It is proposed that one community hall should be constructed in each village with necessary equipment and furniture such as tables, benches, blackboards. The total number of community halls to be constructed is 399, and is summarized below:

Overall Development Plan of Community hall

District	Pakxong	Bachiang	Laongam	Salavan	Thateng	Total
No.of Villages	105	76	110	58	50	399
No.of Community halls						
- Existing	0	0	0	0	0	0
- Proposal	105	76	110	58	50	399

6.3 Agricultural Development Plan

6.3.1 General

The ultimate objectives of the Master Plan is to achieve a substantial and sustainable life improvement of the people in the Study area. The basic agricultural development concept adopted within the framework of the Master Plan is to increase agricultural output to contribute to the life improvement through raising the family income. The proposed agricultural development in the Study area would be achieved through at first intensification of the existing diversified agriculture by improving husbandry technologies and development of infrastructure,

and secondly the expansion of agricultural area with establishment of sustainable farming systems together with developing lowland rice field changing from the slash-and-burn cultivation where applicable.

The unit yield of the main crops cultivated in the Study area is stagnated at rather low level in general, on the other hand the natural conditions in the Study area are quite suitable for wide range of crops. The following table shows the present crop yield and anticipated yield with appropriate agricultural inputs and technologies provided.

Crops	Existing Area (ha)	Present Yield (ton/ha)	Anticipated Yield (ton/ha)	Yield Increment (ton/ha)
Coffee	24,380	0.3	1 to 2	0.7 to 1.7
Tea	380	0.26	1 to 2	0.7 to 1.7
Upland rice	8940	1.5	3 to 4	1.4 to 2.4
Lowland rice	3900	2.6	4 to 5	1.6 to 2.6
Vegetables:				
Cabbage	180	8	20	12
Chinese cabbage	50	6	20 to 30	14 to 24
Potato	80	10	20	10

Notes: The anticipated 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. The anticipated yield of coffee is assumed at rather conservative level referred to 5 t/ha of potential yield under irrigation(Gordon Wrigley, 1988. Netherlands MAF1989).

The following table shows the irrigable land (see Section 6.4.3) including the existing irrigated area of about 1,600 ha and non-irrigable area in the Study area out of 135,600 ha of suitable for agriculture.

Altitude(m)	Proposed cropping pattern	Suitable area for agriculture (ha in net)	Irrigable area (ha in net)	Non irrigable area (ha in net)
above 1,000	C(change slash-and-burn to permanent cropping system) D(existing area) A1(existing area) B1(existing and new area)	22,900	2,450	20,450
600 ~ 1,000	C(change slash-and-burn to permanent cropping system) D(Robusta, existing area) D(Arabica, new area, change from slash-and-burn) A2(existing and new area)	59,800	16,120	43,680
400 ~ 600	B2(existing and new area) D(Robusta, existing area) A2(existing and new area)	19,700	8,030	11,670
below 400	B2(existing and new area) D(Robusta, existing area)	33,200	28,070	5,130
Total		135,600	54,670	80,930

6.3.2 Proposed Cropping Pattern

The proposed cropping patterns for the Study area was formulated taking into account the crop suitability by altitude, the present condition of agricultural land use, and the following basic objectives:

- to replace slash-and-burn cultivation(upland rice) with lowland rice or upland field crops other than upland rice
- to promote vegetable and upland field crops especially in the elevated land
- to promote double cropping of rice in the lowland with irrigation where most of lowland rice is under rainfed cultivation at present, and
- to expand coffee(Arabica) plantation in the elevated land

The proposed cropping patterns are summarized as follows:

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	

The following table shows the proposed cropping area after implementation of the entire Study area based on the cropping pattern mentioned above.

(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

As seen in the above table, the total cultivated area could be expanded to about 135,600 ha if fully developed, about 2.4 times of the 41,140 ha of the existing area. Out of which about 54,800 ha are fully irrigable. About 9,000 ha of upland rice under slash-and-burn cultivation will be reduced to about 700 ha while existing 3,900 ha of the rainfed lowland rice field will be expanded and converted to about 41,100 ha of irrigated rice field in the wet season and 20,600 ha will be cultivated in the dry season respectively. Existing 24,400 ha of coffee field is expanded to about 58,800 ha of which 10,400 ha will be irrigated. Area for vegetables irrigated will be about 500 ha in the wet season and 8,190 ha in the dry season while the non-irrigated vegetable area will be about 5,100 ha and 1,500 ha in wet season and dry season, respectively.

6.3.3 Proposed Farming Practices

Proper farming practices are essential for realizing the full exploitation of agricultural potential in the Study area. It is necessary to introduce new high-yielding and high quality varieties of crops with appropriate techniques of fertilizers and agro-chemicals usage along with the supply of irrigation water and institutional support services. The present small holding farming practices prevailing in the Study area are applied basically, such as animal power for land preparation and transportation, manual operation for transplanting and harvesting, etc. Although farm mechanization is now gradually introduced in the area, the rapid farm mechanization is not recommended in the proposed farming practices in due consideration of the large amount of investment needed at once for the individual small holding farmers.

Regarding plant protection, proper application of chemicals will become necessary for safe and effective control of insects and diseases taking into account the selection of attractive and non-harmful agro-chemicals. The minimum use of pesticides is recommended to avoid disastrous damages by pests if necessary with introduction of the environmentally sound practices and under a proper guidance of the agricultural services. The inputs and labor requirements for the proposed farming practices for each crop are summarized in Table 18.

The farming practices to be paid attention to are management and improving of soil fertility in the area. Covering or mulching practices with leguminous crops or cut and dried grass as well as application of organic materials as compost etc. are recommended.

Proper management of livestock is essential to promote livestock production as well as to keep a clean living environment in the Study area. It is recommended to develop managed grazing lands by improving fodder which could be done with minor modification of the traditional grazing management instead of depending only on natural grass. It is also essential to promote disease control by extension of veterinary services.

6.3.4 Anticipated Crop Yield and Production

After implementation of the Project, the yield of crops would substantially increase and stabilize having become accustomed to irrigation farming practices accompanied by agricultural support services. The increase of yield without the Project is considered to be insignificant. The anticipated crop yield is based on general information achieved in the tropics due to insufficient research or actual results regarding the ultimate crop yield in the Study area. The proposed target yield is as shown below:

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 estimated target yield of each crop is 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.

The build-up period is assumed to be 5 years after completion of the each Project. The anticipated crop production and incrementation by the Project at full target stage in the entire development area of 135,600 ha is summarized as follows:

(Unit : ton)

Crops	Present	Proposed					
		Irrigated		Non- irrigated		Total prod.	Increment
		Wet	Dry	Wet	Dry		
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 at present compared to that of other crops.

The increment of coffee, rice, vegetables is about 58,000, 180,000 and 240,000 tons, respectively. Field crops such as maize, groundnut and soybeans will be increased by about 52,000 tons, while Cardamom will be decreased along with the reduction of slash-and burn cultivation.

6.3.5 Livestock and Fisheries

There are about 9,100 heads of cattle and 3,800 heads of buffalo in the Project area at present. The anticipated production of livestock is based on the assumed number of present livestock in the Project area which is mostly grazed on natural lands with livestock unit of about one head/ha. By improving the grazing lands with introduction of forage and the care of veterinary services, the livestock unit is expected to double that of the present level. Also by increasing lowland rice cultivation, it will become necessary to increase buffalo for soil preparation by increasing forage and increased rice by-products as well as by extending veterinary services.

There is about 40 ha of fish ponds in the Project area and the expected fish production will be increased to about 40 tons per year. Besides the existing pond, about 500 ha of regulation pond for irrigation will be constructed in the Lower Xe Set project area, which may have a potential to produce 500 tons of fish per year.

6.3.6 Agro-industry

At present, coffee cropping is popular and prevailing in the Study area. The farmers intend to grow coffee wherever suitable land is available, but coffee prices are erratic. Therefore, the farmers' economy would also be unstable depending on the coffee price. Tea development is one of the alternatives for economical stabilization of farm household economy. It can be said that the Study area has a high potential for tea plantation from the view point of natural environment such as soil condition and climate. In fact, about 380 ha of tea plantation surroundings KM 35 to KM 40 along No. 23 National Road is cultivated at present and the products are sold at local market and some of them are exported to Vietnam as well. In addition, tea prices are stable and would be going up according to the World Bank price forecast.

Present processing activities of tea are rather conventional. Quality and quantity of tea so far produced would cause obstruction of expansion of the export. Therefore, modernized processing equipment should be installed and the production should largely increase to a certain extent. A farmers organization of tea products should also be established, together with

implementation of processing facilities, which will have functions for operating processing factories, buying farmers' products, trading as exporter and wholesaler, technical support services for farmers, and financial services for expansion of tea plantation.

6.3.7 Market and Price Forecast

The population of the Study area at 2005 is estimated to be 30 % up from the present one, applying the growth rate of 2.6% from 1990 through 1994. The gap between the total requirement of consumption and the total production of each crop in the Study area can be fully supplied by the production within the Study area. In addition, if the road condition from Pakxe to Vientiane is improved, the domestic market for the product of the Study area will be largely expanded, for instance, the transportation of vegetables to Vientiane will be promising. Consequently, potato, onion, chilies, etc. as import substitute crops can be expected, especially at the Vientiane market, since most of these crops are imported from Vietnam unofficially at present.

Presently, the same commodities, such as bananas, cabbages, groundnuts and potatoes are exported to Thailand unofficially. It is expected that, despite the still remaining problem of duty barrier, the market of Thailand is promising and the export volume should continue to increase.

Exportable commodities such as coffee and cardamom could be considered to be marketable crops. However, coffee is the most fluctuating commodity in price. In fact, the price rose sharply in July, 1994 due to a decrease of Brazil's production in June 1994. Therefore the price of coffee may be declined in the future, although it is still high at present. Based on the World Bank Price Prospect Report Commodity Market and the Developing Countries(February, 1995), financial coffee price at 2005 is forecasted as follows:

	1994	2005
World market price (US$/ton) *1	3,357	2,136
Farm gate price *2 (kip/kg)	1,,400 - 1,500	820 - 900

Remarks : 1 : in constant 1994 price.
2 : Transferring to farm gate price from world market price is calculated based on the formulation of LCEA.

Note : Price in world market is of husked coffee (green been), and that in farm gate is of unhusked one.

From the above estimation, the future farm gate price of coffee is prospected to be less than two third of the current farm gate price. However, it is thought that coffee is still profitable compared with other commodities. In fact, most of the annual production of coffee is exported, even at the present quality. When the quality of coffee is improved, in terms of harvesting and processing activities, coffee marketing in future would be quite promising.

According to the said World Bank Report, tea price could increase significantly in the future, if Russia would import a substantial amount of tea from India under their bilateral agreement. Another factor that could raise tea prices would be the lifting of the trade embargo on Iraq. Taking into consideration that tea is reported to be smuggled into Iraq, its import would increase substantially if the embargo is lifted.

6.3.8 Marketing Development Plan

(1) Strengthening of Supporting Services

Trade Service Offices of Champasak, Salavan and Sekong Provinces as well as each district in the Study area should be strengthened providing office facilities, and manpower improvement is essential.

(2) Improvement of Marketing System

Whole sale system should be introduced to the marketing system in the area.

(3) Market organization and facility development

Establishment of a trading point for vegetables is one of main items for a future marketing development plan. Through the wholesale market, operated by the marketing board, farmers can trade in their products with a middleman at a fare price. In addition, the competitive marketing system can be introduced smoothly.

It is recommended that the trading point be set up at Pakxong, Laongam and Thateng town first, from the viewpoint of accessibility of farmers and the effect of the model project. About 236,000 tons of vegetables will be produced in the Project areas. Taking the future production into consideration, the facilities to be installed are planned as follows :

Items	Specification (draft)
Working and storage space	Area is about 300～1000 m², platform type, 0.8 m height of Parking lot.
Building	Steel frame structure
Parking lot	5m in width and 10m length
Wash basin	With 2 faucets for vegetable washing
Office space	Office space for marketing board stuff and some buyers
Communication facility	Telephone or wireless radio, motorcycle
Other office equipment	Weighing machine and office tool

With the above facilities, the market organization (marketing board) also should be established. Marketing board is operated by the district government staff, to functioning as a farmers' organization as summarized below :

i) collecting and delivery of farmers' product (vegetables),
ii) operating of wholesale market,
iii) agro-input supply,
iv) market information supply,
v) introduction of grading system and quality control, and
vi) training of government staff of district and provincial level.

(4) Farmers' Organization

There is no farmers' organization in the Study area, hence the farm input supply and farm product delivery have been inefficient for the farmer. Market information supply, farm input delivery, dissemination of grading system, etc. will be carried out by the farmers' organization. Farmers' organizations are planned to be established in each district. This farmers' organization has a deep relationship with the marketing organization. As the marketing organization has many functions, the first step of action of the farmers organization is to cooperate with and help the marketing organization in their activities. Through on-the-job training, the farmers' ability will improve and the organization itself will be consolidated. From the next phase, when the farmers have confidence of the operation of the organization, the marketing organization will be incorporated with the farmers' organization.

(5) Tea Product Organization

As mentioned previously, tea is one of the exportable commodities in the future. Farmers' organization for tea product is proposed to be set up at Pakxong or km 40 with a tea processing facility. It will have functions for operating a processing factory, buying farmers' products, trading as exporter and wholesaler, technical support services for farmers, and financial services for the expansion of a tea plantation. The capacity of equipment to be installed will be about 1.0 to 2.0 ton /day of tea (output), based on the tentative estimation of future production. These plans will be implemented at a medium term phase.