

Ban Sok Noi) was irrigated and cultivated. No crops were grown in other lands during the dry season. The present cropping pattern is shown in Fig. V-2.

The rainy season paddy is planted in the onset of the rainy season, from May to June, and harvested from October to December. Transplanting is carried out from late June to late July. The cultivation of dry season paddy starts late December or early January and ends late April or early May. Transplanting is carried out late January or early February.

More than 70% of paddy field is grown glutinous rice, which is a staple food of Laotians. According to the information from Agricultural Service of Vientiane Municipality Office, the ratio of cultivated area between glutinous rice and non-glutinous rice during 1987-1988 is as follows:

Season	Glutinous Rice (%)	Non-glutinous Rice (%)
Rainy Season	80	20
Dry Season	20	80

The result of the farm interview survey shows that in the Project area, Sampatong (glutinous) is predominant variety being planted in 71% of paddy field, followed by Hom Mali (non-glutinous), which is planted in 23% of paddy field. Improved varieties such as RD-16 are grown only in irrigated area.

2.3 Farming Practices

The paddy cultivation is carried out in the form of labor intensive agriculture from seeding to harvesting. Farming works are generally practiced by family workers, though traditional labor exchange is commonly made. Animal power, mainly of buffaloes is extensively used for land preparation. Besides simple equipment like plow or stickle agricultural equipment is not commonly used. The number of buffaloes and cattle in the Project area is given in Table V-1.

New high yielding varieties have not yet been generally adopted. Local varieties are grown in almost all the paddy fields as mentioned in the previous section.

The use of fertilizer and farm-chemicals is generally scarce. The farm inputs and labor requirements for cultivation of paddy are estimated on the basis of the farm interview survey,

and are shown in Table V-2. One third of the interviewed farmers never use fertilizers nor farm-chemicals. The present seed rate of 66 kg/ha for rainy season paddy and 102 kg/ha for dry season paddy are rather high compared to Salakham Rice Research Station's standard of 40 kg/ha. It is possibly caused by low germination rate of seed led by poor storage condition and lack of seed selection.

2.4 Yield and Production

The crop yield and production under the present condition are estimated on the basis of the result of the farm interview survey and land use investigation, taking also the result of the below-mentioned paddy yield survey into account. There are no other data of agricultural production for the Project area.

Average yield of paddy is estimated at 1.5 tons/ha for rainy season paddy and 2.5 tons/ha for dry season paddy. Present paddy production is estimated as shown below through multiplying those unit yields by the area extent of paddy field.

Crops	Cultivated Area (ha)	Unit Yield (ton/ha)	Production Amount (ton)
Rainy season paddy	3,030	1.5	4,545
Dry season paddy	139	2.5	348
Total	3,169	-	4,893

The above-mentioned low yields are considered to result from irregular rainfall even in the rainy season, use of local varieties and lack of fertilization.

2.5 Result of Paddy Yield Survey

The paddy yield survey was conducted in the Project area during November 3 to 13 in order to identify the causes for hampering the increase of unit yield of paddy under the present condition. Samples were taken from 44 plots of rainy season paddy fields in total, at least three plots in each of 12 villages. The following components of yield were obtained for each sample as shown in Table V-3:

- (1) number of hills per m²
- (2) number of panicles per hill

- (3) number of grains per panicle
- (4) percentage (%) of ripened grains
- (5) 1,000 grain weight

The unit yield is expressed by the following equation:

$$\begin{aligned}
 & (1) \times (2) \times (3) \times (4) \times (5) \\
 & \div 1,000 \text{ (conversion to one grain weight)} \\
 & \times 10,000 \text{ (conversion to yield per ha)} \\
 & \div 1,000,000 \text{ (conversion to metric ton in weight)}
 \end{aligned}$$

The grain yield of rice can be increased by overcoming defects involved in each yield component. In order to find the causes for the present low rice yield, the relation between unit yield and each of yield component was examined (See Fig. V-3). There is a clear correlation between unit yield and number of grains per m² (nos. of hills per m² x nos. of panicles per hill x nos. of grains per panicle). While, there is no correlation between unit yield and other yield components. Consequently, the most important factor for increase of rice yield in the Project area is defined to be the number of grains per m².

The most decisive factor for the number of grains per m² is the number of grains per panicle, which is generally determined during the period of 25 days before flowering. The unfavorable conditions, like shortage of available water and lack of fertilization during this period make the number of spikelets low. The proper water management, fertilization and cropping schedule, considering the stage of plant growth, should be the key to increase the number of spikelets, and thereby to increase the unit yield.

The other yield component, the number of panicles per hill is determined in early stages of plant growth generally before maximum tiller number stage, and the measures to increase the number of panicles per m² are:

- (1) to raise healthy seedlings,
- (2) to apply basal fertilizers before transplanting,
- (3) to transplant in shallow depth,
- (4) to suppress non-bearing and late-emerging tillers, and
- (5) to make rice plant head at the optimum time when good weather lasts for 15 days before heading and 20 days after heading.

The task for achieving a high yield is to increase the number of grains per m² without lowering the percentage of ripened grains. Reduction of emerging non-productive tillers is the key to solving this problem. The generation of non-productive tillers can be minimized by drying practices and proper fertilization, considering the stages of plant growth.

3. Agricultural Development Plan

3.1 Proposed Land Use

As a result of land capability classification, as described in Annex II Soils and Land Classification, an area of 4,227 ha which is classified into Class I, II and III for either paddy or upland crops is evaluated as suitable for crop cultivation. Forest areas where soils are shallow and contain gravel in top soil, and inundated floating rice area are classified as unsuitable land for development.

Future land use plan is determined, taking the present land use and topographic conditions for irrigation into consideration in addition to the result of land classification. Some of the area which are classified as unsuitable but presently cultivated as paddy field are included in the irrigation area. Future net irrigation area will be 2,700 ha of which 1,700 ha is in the originally-planned area and 1,000 ha in the extension area. The area of 2,700 ha consists of 1,913 ha of existing paddy field, 749 ha of present forest and 38 ha of present grass land. Infrastructure including irrigation facilities will occupy 476 ha, consisting of 338 ha of present paddy field, 131 ha of forest and 7 ha of grass land. Land demarcation for the future land use in comparison with the present land use is given in Table V-4.

For the area of which soil texture is sandy loam (Mapping symbol 1 to 4 in Fig.II-3), rotational cropping of rice and upland crop is proposed considering fitness of soils, soil improvement and necessity of crop diversification. Net area proposed for rotational cropping is 550 ha, consisting of 268 ha in the originally-planned area and 282 ha in the extension area.

The proposed future land use map is given in Fig.V-4 and the land use area is summarized as follows :

(Unit: ha)

Future Land Use	Originally-planned Area	Extension Area	Total
Rainfed paddy field	400	301	701
Irrigated paddy field	1,432	718	2,150
Irrigated Paddy/Upland field	268	282	550
Forest	253	269	522
Village	179	28	207
Pond and Stream	16	0	16
Infrastructure	300	176	476
Road and residential area	92	36	128
Total	2,940	1,810	4,750

3.2 Proposed Cropping Pattern

3.2.1 Selection of crops

After completion of the Project construction, the existing rainfed paddy fields will be up-graded to year-round irrigation field and more intensive use of the farmland will become possible. Crop selection and determination of cropping pattern for the Project are made from the following viewpoints :

- Suitability of land and climate for crops
- Profitability of crops for both farmers and nation as a whole
- Marketability of products
- Acceptability to farmers
- Agricultural policy of both Central Government and Vientiane Municipality

In due consideration of the above factors, paddy rice is proposed as main crop, and soybean, groundnut and garlic are proposed as upland crops to be cultivated in the dry season.

(1) Rice

Paddy rice is the most suitable crop in major part of the Project area in view of the prevailing climate and soils. On account of its high expected yield and fairly stable price, rice is the most profitable crop for farmers. Farmers have long experience of rice cultivation and are eager to adopt irrigated rice cultivation to maximize the production.

Since Vientiane Municipality and its vicinity suffer from chronic rice shortage and Lao PDR is still rice importing country, the increase of rice production is expected to contribute to foreign exchange saving. Rice is consequently proposed as principal crop in both the rainy season and the dry season.

(2) Upland crops

Introduction of upland crops is proposed in the dry season on some 550 ha of land, of which the soils are sandy loam acrisols.

The rice shortage is expected to be considerably alleviated after the completion of the Project and crop diversification will be main subject for further agricultural development. Even now, to diversify agriculture by expanding production of non-rice crops is advocated as one of the objectives of the Government's agricultural policy as shown in Annex VII. In addition, demand for raw material for agro-industry has been increasing in accordance with promotion of agro-industry for import substitution.

As recommendable upland crops, the following three are selected.

i) Soybean

At present, soybean cake is imported from Thailand for making assorted livestock feed. The State Agro-processing Company, managing a feed mill at Ban Tha Ngon, plans to substitute domestic soybean cake for imported one, and is constructing a processing plant with a capacity of about 1,500 tons per year beside the feed mill. A promising demand can hence be expected for soybean. The area proposed to be cultivated to soybean is 350 ha, which can produce about a half of the annual requirements of the above processing plant.

ii) Groundnuts

A fairly large market is expected for this crop. Lao Government has received enquiries from some socialist countries on the export of groundnuts. Groundnuts are cultivated only for the domestic market as food at present. The Government plans to increase its production and export it for earning foreign exchange. The area proposed to be cultivated with groundnuts is 160 ha, which should produce 400 tons/year, the same amount as actual export inquiries of a few years ago.

iii) Garlic

Garlic is one of the most profitable vegetables owing mainly to its high market price as shown in Table V-5. At present, most of the garlic consumed in Vientiane comes from the northern high plateau of Lao PDR. Since the supply from the plateau is not enough to meet demand, some amount is imported from Vietnam. In addition to Vientiane, Thailand also could be a market with good prospects. The area proposed for garlic is 40 ha of which the expected production (280 tons) corresponds to the total consumption increase of Vientiane City if they consume 1 kg/capita/year more than at present.

Upland crops other than the above are not recommended for the Project for the following reasons :

- unsuitable climate (coffee, cardamon, tea, pepper)
- relatively shallow soils (maize, sugarcane etc.)
- small market scale (vegetables)
- no definite plans for processing plants (tobacco, mungbean)

Cultivation of upland crops is proposed in the dry season for a net area of 550 ha in total, where soils are of light texture and the groundwater table is relatively low. The heavy rainfall makes it difficult to grow upland crops during the rainy season even on light-texture soils.

3.2.2 Proposed cropping pattern

Cropping patterns under with-project condition were determined to achieve the highest yields of crops based on the above crop selection. The proposed cropping pattern is shown in Fig.V-5.

(1) Double cropping of rice

For designing an optimum cropping calendar for double cropping of rice, the first consideration is given to the weather conditions so that both maturity and harvesting of paddy will take place in the dry period. In this view, harvesting of dry season paddy is planned to be completed before mid May and maturity period of rainy season paddy is planned to be in the beginning of the dry season, i.e. early October.

Secondly, attention is paid to temperatures of less than 15°C, which may cause severe damages to paddy yield. Sowing of dry season paddy is planned to be carried out from mid December to early January to minimize the possibility of meeting such low temperatures during the generative growth period of rice plant.

High yielding varieties of rice are proposed to be introduced to maximize the beneficial effects of irrigation and intensive cultivation method. In the rainy season, glutinous rice varieties such as RD-8, RD-16, etc. are recommended, considering Laotian preference of taste. In the dry season, early matured varieties must be planted due to the limitation in the above mentioned cropping calendar. In consideration of resistibility against stembores and brown hoppers and higher expected yield as well as short growth duration, CR-203 is most recommendable in the dry season. Characteristics of the rice varieties available in Lao PDR are given in Table V-6.

(2) Rainy season paddy and upland crops in dry season

This cropping pattern is proposed for a net area of 550 ha as mentioned in the previous section. The cropping calendar of rainy season paddy will be the same as that of rainy season paddy proposed for the double cropping of rice. In framing cropping calendars for upland crops, the following average growth period of each upland crop is taken into account :

- Soybean	105 days
- Groundnuts	150 days
- Garlic	135 days

Of these three crops, groundnuts has the longest growth period and is therefore planned to be planted by the end of November and harvested before the end of April so as to avoid rain damage during the harvesting period. Accordingly, for planting of groundnuts, harvesting of rainy season paddy should be finished before early November. With soybean and garlic having shorter growth periods, cropping calendars are determined mainly to minimise peak labor requirements.

3.3 Proposed Farming Practices

Proper farming practices are essential for realizing full exploitation of the agricultural potential in the Project area. The farming practices to be introduced to the Project are proposed on the following conditions :

- i) Irrigation and drainage system is provided.
- ii) Animal power is main draft power.
- iii) Average farm labor(2.6 person/family at present) is available.
- iv) Farming work is mostly carried out by family members though some seasonal labor has to be employed.

3.3.1 Rice cultivation

(1) Seeding and nursery preparation

40 kg per ha of seeds will be sown on about 500 m² of nursery bed and seedlings will be grown for 25 days in the nursery. The nursery has to be made as flat as possible. Seed selection using saline solution is necessary.

(2) Field preparation

The field preparation will be carried out by animal power at least 10 days before transplanting. Harrowing and puddling of soil are also required after plowing. Prior to harrowing, basic fertilizer application, about one third of the total

requirements of nitrogen and all of the phosphate, has to be made to prepare a fertile soil foundation for transplanting.

(3) Transplanting

Transplanting will be done manually, with a spacing of 30 cm x 15 cm. Planting 2 to 3 seedlings per hill is recommendable. Irrigation water has to be drained just before transplanting so that transplanting is done in shallow depth to accelerate vigorous tillering. Irrigation water has to be supplied to the field again after rooting.

(4) Fertilizer application

Proper application of fertilizer is essential for full exploitation of the agricultural potential under irrigation. The soils in the Project area are generally poor in plant nutrients, especially nitrogen and phosphate. These chemical elements have to be supplemented by fertilizer. Taking into account the test results on crop fertilization made at Salakham Rice Research Station and the soil conditions of the Project area, the total fertilizer requirement is estimated as shown in Table V-7. Application of potassium is not required because the soils in the Project area have sufficient of this element. After the basic fertilizer application, top dressing will be done twice, i.e., just before the maximum tillering stage of about 15 days after transplanting and at the spikelet differentiation stage corresponding to 25 days before heading.

(5) Weeding

After transplanting, weeding will be carried out manually, depending on the condition of weed growth. Herbicides are not recommendable due to their high cost and toxicity to human beings, livestock and the natural environment.

(6) Plant protection

As regards the plant protection, intensive application of insecticide is required for control of plant hoppers, stem bores, etc. At present, damage to crops by insects and diseases is not serious because most farmers are growing local rice varieties which have a tolerance to them. However, when high yielding varieties, which are relatively vulnerable, are introduced, application of

chemicals will be necessary. It is recommended that plant protection works should be carried out in a systematic way, for example through cooperatives. Individual protection is not recommendable because insects and diseases are not limited to one farm. Unless systematic protection is undertaken, the farm will be re-infected.

The basic principle of plant protection is, however, to make the plant healthy. If the rice plant is strong and healthy, it will resist diseases and insect pests. In this sense, attention should be paid to proper water management and fertilization.

(7) Harvesting

Harvesting will be carried out manually. The harvested paddy will be dried on the ground. In future, introduction of artificial dryers will have to be considered because a considerable amount of harvested grain is being damaged after harvesting.

3.3.2 Upland crops

(1) Soil preparation

After harvesting rainy season paddy, plowing, harrowing and ridging will be carried out using animal power. The ridges will be trapezoidal in shape. The base width of the ridges will be 60 to 75 cm and the height of the ridges 25 to 30 cm for groundnuts and soybean. The base width will be 80 to 90 cm and height 20 to 25 cm for garlic. Spacing of furrows will be 80 cm for soybean and groundnuts, and 90 cm for garlic. Application of basic fertilizer is also necessary.

(2) Seeding

Soybean and groundnuts are sown directly on the apex of a ridge. Thinning and control of seedlings is required after establishing the seedlings on each hill. In the case of garlic, bulbs are planted by regular planting at 15 cm x 10 cm spacing. After planting it is recommended to lay rice straw on the top of ridges to protect the bulbs from birds and to reduce evaporation of irrigated water.

(3) Weeding, plant protection and fertilization

Weeding is carried out at least twice during the cropping period. Insecticide is sprayed at least twice for soybean and three times for groundnut. For soybean, application of additional calcium is recommendable. No insecticide is required for garlic. Suitable kinds of fertilizers and their amounts are shown in Table V-8.

(4) Harvesting

Harvesting of upland crops is carried out manually like that of rice.

3.3.3 Mechanization

As explained above, the proposed farming practices are based on the assumption that all farm practices will be carried out by manual labor and animal power. Rapid introduction of farm mechanization to the Project area would seem to be difficult for the following reasons:

- (1) Land consolidation works including construction of large farm plots, which make it possible to operate machinery efficiently, are not proposed under the Project.
- (2) Surplus labor force is available in villages especially in the dry season and labor costs are very low as compared with the price of farm machinery.
- (3) The research and experimental work for proper farm mechanization have not yet been fully carried out and there are no technical criteria for effective and efficient farm mechanization at present.
- (4) The agricultural support system for farm mechanization has not been developed yet. There are no guidance services for proper operation and maintenance of farm machinery.

However, some farmers having larger farmland have been introducing farm mechanization. For example, in the village of Ban Pha Khao, where the average farm size is the largest among 12 villages in the Project area (2.2 ha/household), some farmers entrust land preparation work to the Agricultural Machinery Company and threshing work to private threshing contractors. If family farm labor decreases in number and the labor force becomes

insufficient, mechanization will have to be introduced for increasing labor productivity. This may occur in future if a large part of labor force is absorbed into sectors other than agriculture as a result of Laotian economic development. From this viewpoint, it is recommended that research on appropriate farm mechanization and technical training of extension workers be started in the near future.

3.4 Farm Input and Labor Requirement

Based on the proposed farming practices mentioned above, farm input and labor requirement are estimated. The information from Salakham Rice Research Station and Agricultural Research Station at Hat Dok Keo is referred to for the estimation.

Farm input necessary for each crop is shown in Tables V-7 and V-8. As described in Annex VII, delivery systems are efficient and can supply required amount of fertilizers and agro-chemicals. Seeds of improved varieties are produced at research stations of MAF and Napok Seed Production Center as well as at the Demonstration Farm proposed under the Project, and will be distributed through the Project office.

Labor requirements for cultivation of crops per one hectare of farm land are estimated at 152 man-days for rainy season paddy, 155 man-days for dry season paddy, 97 man-days for soybean, 104 man-days for groundnut and 126 man-days for garlic. Labor requirement for each farming work is given in Tables V-7 and V-8. Compared with presently used man-days, the proposed farming work requires 25 man-days more for rainy season paddy and two man-days more for dry season paddy. Monthly labor requirement for average size farm of 1.6 ha in case of double cropping of paddy is estimated as follows:

Month	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Total
Man-days	38.4	86.4	10.5	6.7	16.7	83.1	17.9	88.3	28.0	5.6	62.8	44.6	489.0

Since available agricultural labor force per household is estimated at 2.6 persons as a result of the farm interview survey, maximum monthly labor capacity of one household is estimated at 78 man-days (2.6 x 30 days). Accordingly, family farm labor is not enough in July, November and January. In those months, farm labor will be hired or family members who are engaged in non-farm work will join farm work temporarily.

3.5 Expected Yields and Production

Expected yields of crops under with-project condition is estimated taking into account the information from Salakham Rice Research Station, Agricultural Research and Experiment Station at Hat Dok Keo and Agricultural Research Center at Napok as well as the yields of other similar areas in the world.

Expected yields of rice with Project is estimated at 4.5 tons/ha and 5.5 tons/ha respectively in the rainy season and the dry season. Expected yields of upland crops are estimated at 2.0 tons/ha for soybean, 2.5 tons/ha for groundnuts and 7 tons/ha for garlic. These yields premise supply of irrigation water, improved farming practices and intesitified agricultural extension services. On the other hand, under without-Project condition, the present low yields of rice could remain unchanged due to such constraints as rainfed condition and low level of farming technique.

Based on the proposed cropping pattern, cropping area and unit yield, future annual crop production under with- and without-project conditions is forecasted as follows:

Crop	Without Project			With Project		
	Area (ha)	Yield (ton/ha)	Production (ton)	Area (ha)	Yield (ton/ha)	Production (ton)
Rainfed Rainy Season Paddy	3,030	1.5	4,545	701	1.5	1,052
Irrigated Rainy Season Paddy	0	-	-	2,700	4.5	12,150
Irrigated Dry Season Paddy	139	2.5	348	2,150	5.5	11,825
<u>Paddy Total</u>	<u>3,169</u>	-	<u>4,893</u>	<u>5,551</u>	-	<u>25,027</u>
Soybean	-	-	-	350	2.0	700
Groundnuts	-	-	-	160	2.5	400
Garlic	-	-	-	40	7.0	280

Expected increase of agricultural production is 20,134 tons of paddy, 700 tons of soybean, 400 tons of groundnut and 280 tons of garlic.

Table V-1 Number of Buffaloes and Cattle

Village	Buffalo		Cattle	
	Total (Head)	Head/ Farm Household	Total (Head)	Head/ Farm Household
Ban Pha Khao	180	2.4	140	1.9
Ban Sa Phang Muk	90	0.7	136	1.3
Ban Don Noun	335	1.7	372	1.9
Ban Xai	414	2.8	374	2.5
Ban Na Khe	180	1.8	61	0.6
Ban Dan Xang	397	2.5	251	1.5
Ban Dong Sag Hinh	47	0.6	35	0.5
Ban Na	250	2.8	150	1.7
Ban Sok Nhai	198	1.3	330	2.2
Ban Sok Noi	306	1.6	313	1.6
Ban Phone Thong	120	1.8	123	1.9
Ban Na Biene	78	1.4	107	1.9
Total/Average	2,595	1.8	2,392	1.7

Source : Agriculture and Forestry Service, Saythany and Saysetha District Offices

- Remarks : 1. As animal power for agriculture, buffaloes are used for land preparation, while cattle are used for transportation.
2. According to the farm interview survey, the farmers who have no draft animals make a contract with the Agricultural Machinery Company or other farmers who can afford for the land preparation by buffaloes.

Table V-2 Present Farm Input and Labor Requirement

Description		(Unit)	Rainy Season Paddy	Dry Season Paddy
1.	<u>Farm Inputs</u>			
(1)	Seed	(kg/ha)	66	102
(2)	Fertilizer			
	Urea	(kg/ha)	7	-
	Ammophos	(kg/ha)	17	104
(3)	Insecticide			
	Diazinon	(g/ha)	8.8	2,400
	Sevin	(g/ha)	41.4	-
	Foridol	(cc/ha)	29.7	-
2.	<u>Labor</u>	(man-day/ha)		
	Land preparation		25	25
	Nursery growing		2	3
	Transplanting			
	Family labor		40	42
	Hired labor		5	3
	Fertilizer/weeding		4	8
	Irrigation		1	19
	Harvesting			
	Family labor		29	46
	Hired labor		7	7
	Threshing		14	(entrusted)
Total			127	153

Source: Farm interview survey carried out by JICA study team, 1988.

Table V-3 Result of Paddy Yield Survey

Sample No.	Sampling Place (Village)	Variety of Paddy	Nos. of Hills per m ²	Nos. of Panicles per Hill	Nos. of Grains per Panicle	Nos. of Grains per m ²	1,000 Grain Weight(gr)	% of Ripened Grains	Unit Yield (ton/ha)
1	B.Don Noun	Khao Dokmay	19.2	4	68.8	5284	32.2	78.8%	1.34
2	"	Kaset	20.7	4	65.7	5440	36.2	85.3%	1.68
3	"	Kaset	20.0	4	70.2	5616	35.2	77.1%	1.52
4	B.Sa Phang Muk	Khao Dokmay	17.7	4	83.9	5940	32.1	78.5%	1.50
5	"	Khao Dokmay	18.7	5	110	10285	34.2	82.1%	2.89
6	"	Khao Dokmay	17.0	4	103	7004	34.0	88.4%	2.11
7	B.Pha Khao	Khao Dokmay	30.2	4	62.8	7586	27.9	56.5%	1.19
8	"	Khao Dokmay	25.2	5	100	12600	31.4	80.5%	3.19
9	"	Khao Dokmay	24.7	3	73	5409	28.4	66.1%	1.02
10	B.Na Khe	Khao Dokmay	23.0	6	122	16836	35.8	71.7%	4.32
11	"	Khao Dokmay	18.2	5	106	9646	30.4	74.1%	2.18
12	"	Khao Dokmay	21.7	4	67.4	5850	28.4	61.1%	1.01
13	"	Khao Dokmay	16.5	4	105	6930	30.8	66.8%	1.42
14	"	Khao Dokmay	13.5	4	100	5400	28.7	62.1%	0.96
15	B.Dong Sang Hinh	Khao Dokmay	17.0	5	79	6715	33.7	84.5%	1.91
16	"	Khao Dokmay	23.5	5	82	9635	31.3	75.2%	2.26
17	"	Khao Dokmay	23.5	5	53	6228	31.5	82.5%	1.62
18	"	Khao Dokmay	24.0	5	72	8640	31.7	70.7%	1.94
19	"	Khao Dokmay	24.2	5	81.3	9837	32.6	76.4%	2.45
20	B.Dan Xang	Kaset	20.7	5	63	6521	35.0	79.2%	1.81
21	"	Khao Dokmay	23.2	3	60	4176	27.9	60.7%	0.71
22	"	Khao Dokmay	22.5	5	76.3	8584	33.6	74.8%	2.16
23	B.Na	Phokha	28.7	6	45.2	7783	21.2	78.0%	1.29
24	"	Phokha	41.5	5	77.6	16102	21.0	83.4%	2.82
25	"	Khao Dokmay	20.5	5	105.5	10814	29.5	63.7%	2.03
26	"	Khao Dokmay	19.7	4	91.6	7218	33.9	87.1%	2.13
27	B.Xai	Khao Dokmay	17.7	5	105	9293	31.0	82.4%	2.37
28	"	Khao Dokmay	21.5	5	99	10643	30.1	77.1%	2.47
29	"	Khao Dokmay	24.0	4	49	4704	28.5	61.2%	0.82
30	"	Khao Dokmay	28.0	5	48	6720	31.1	78.4%	1.64
31	B.Na Biene	Doktiou	54.5	5	25.2	6867	24.9	84.6%	1.45
32	"	Kaset	17.0	3	66.6	3397	32.8	80.3%	0.90
33	"	Doktiou	24.7	6	38.2	5661	23.8	83.6%	1.13
34	"	Khao Dokmay	24.5	4	57	5586	27.3	64.2%	0.98
35	B.Phone Thong	Khao Dokmay	24.5	5	127	15558	30.4	71.7%	3.39
36	"	Ko Kho	29.2	6	57.5	10074	22.4	71.4%	1.61
37	"	Ko Kho	27.7	8	62.2	13784	24.1	73.3%	2.44
38	"	Doktiou	36.5	8	45.8	13374	23.5	74.4%	2.34
39	B.Sok Nhai	Doktiou	22.2	8	55.8	9910	22.3	78.5%	1.74
40	"	Doktiou	29.0	7	59.3	12038	24.6	72.8%	2.16
41	"	Khao Dokmay	22.0	3	64.5	4257	24.4	58.4%	0.61
42	B.Sok Noi	Khao Dokmay	19.0	5	84.3	8009	28.3	71.6%	1.62
43	"	Phokha	25.0	4	87.2	8720	22.5	70.3%	1.38
44	"	Khao Dokmay	29.5	3	78.6	6956	30.1	69.2%	1.45

Table V-4 Land Demarcation for Future Land Use

(Unit: ha)

Future Land Use	Present Land Use						Total
	Rainfed Paddy	Grass Land	Forest	Village	Road	Pond & Stream	
Originally-planned Area							
Irrigated Paddy	1,258	29	145	0	0	0	1,432
Irrigated Paddy/Upland	268	0	0	0	0	0	268
Rainfed Paddy	400	0	0	0	0	0	400
Forest	0	0	253	0	0	0	253
Village	0	0	0	179	0	0	179
Pond & Stream	0	0	0	0	0	16	16
Infrastructure	270	5	25	0	0	0	300
Road and Residence	63	0	12	0	17	0	92
Sub-Total	2,259	34	435	179	17	16	2,940
Extension Area							
Irrigated Paddy	332	0	386	0	0	0	718
Irrigated Paddy/Upland	55	9	218	0	0	0	282
Rainfed Paddy	301	0	0	0	0	0	301
Forest	0	0	269	0	0	0	269
Village	0	0	0	28	0	0	28
Pond & Stream	0	0	0	0	0	0	0
Infrastructure	68	2	106	0	0	0	176
Road and Residence	15	6	4	0	11	0	36
Sub-Total	771	17	983	28	11	0	1,810
Total Project Area							
Irrigated Paddy	1,590	29	531	0	0	0	2,150
Irrigated Paddy/Upland	323	9	218	0	0	0	550
Rainfed Paddy	701	0	0	0	0	0	701
Forest	0	0	522	0	0	0	522
Village	0	0	0	207	0	0	207
Pond & Stream	0	0	0	0	0	16	16
Infrastructure	338	7	131	0	0	0	476
Road and Residence	78	6	16	0	28	0	128
Total	3,030	51	1,418	207	28	16	4,750

Table V-5 Market Price of Vegetables

Vegetable	Market Price		Area Produced
	Rainy season (Kip/kg)	Dry season (Kip/kg)	
Cucumber	80	40	Vientiane
Longbean	150	30 - 40	Vientiane
Eggplant	120	30 - 60	Vientiane
Leaf vegetables	300	30 - 40	Vientiane
Chilli (fresh)	300 - 400	200	Vientiane
Chilli (dry)	1500	800	Vientiane
Garlic	600 - 700	200 - 300	Xienkhuang
Red onion	300	300	Vientiane
Sweet potato	120	100	Vientiane
Tomato	500	30	Vientiane (dry season) Thailand (rainy season)
Onion	600	250	Thailand
Potato	200	100	Pakxe
Cabbage	200	100	Pakxe, Thailand
Carrot	300	100 - 200	Pakxe, Thailand
Chinese cabbage	300	-	Pakxe, Thailand
Green pepper	500 - 600	-	Pakxe, Thailand

Remark: Market prices at Vientiane markets in 1988 surveyed by the Study team

Table V-6 Characteristics of Rice Varieties

Variety	Photo-period (+/-)	Growth duration (days)	Fertilizer doses (N-P-K)	Expected yield (ton/ha)	Insect and Disease	Taste	Remarks
<u>Rainy Season</u>							
- Glutinous rice							
Sampaton	+	150	20-30-0	3	Susceptible to Blast, BLB and SB	Good	
RD-8	+	145	50-30-0	4.5	- ditto -	Good	Foundation seed released since 1985, Back cross of Banpaton
RD-16	-	130	50-30-0	4.5	- ditto -	Fairly good	
IR-848	-	140	50-30-0	4.5	Susceptible to BPH	Fairly good	
IR-253	-	150	50-30-0	4.5	Resistant to SB	Fairly good	Low milling quality
- Non-glutinous rice							
Hom Mali	+	150	20-30-0	3	Susceptible to Blast, BLB and SB	Good	
CR-203	-	125	50-30-0	4.5	Moderately resistant to BPH and SB	Fairly good	
IR-42	-	150	50-30-0	4.5	- ditto -	Fairly good	
<u>Dry Season</u>							
- Glutinous rice							
RD-16	-	125	60-30-0	4.5	Susceptible to Blast, BLB and SB	Fairly good	
IR-848	-	140	60-30-0	4.5	Susceptible to BPH	Fairly good	Low milling quality
IR-253	-	150	60-30-0	4.5	Resistant to SB	Fairly good	
- Non-glutinous rice							
CR-203	-	120	90-60-0	5.6	Moderately resistant to BPH and SB	Fairly good	
IR-42	-	145	90-60-0	5.6	- ditto -	Fairly good	

Remark : BLB - Bacterial Leaf Bright, BPH - Brown Plant Hopper, SB - Stemborer
Source : Salakham Rice Research Station

Table V-7 Proposed Farm Input and Labor Requirement for Cultivation of Rice

Description	(Unit)	Rainy Season Paddy	Dry Season Paddy
1. Farm Inputs			
(1) Seed	(kg/ha)	40	40
(2) Fertilizer			
Urea	(kg/ha)	100	100
Ammophos	(kg/ha)	250	250
(Total N-P-K)		(90-50-0)	(90-50-0)
(3) Insecticide			
Diazinon 13%	(kg/ha)	10	10
2. Labor			
	(man-day/ha)		
Land preparation		25	25
Nursery growing		2	2
Transplanting		45	45
Fertilizer/weeding		10	8
Irrigation		10	10
Harvesting		45	50
Threshing		15	15
Total		152	155

Remark : Labor requirement under with-project condition is estimated based on the following conditions.

- 1) Fertilizing and weeding become intensive, the labor requirement being increased from 4 man-days to 10.
- 2) Irrigation becomes more intensive.
- 3) Harvesting requires more labor.
- 4) Salakham Rice Research Station uses 140 mandays per ha as the standard requirement and assumes that mechanization of land preparation reduces labor to 113 man-days per ha.

Table V-8 Proposed Farm Input and Labor Requirement for Cultivation of Upland Crops

Description	(Unit)	Soybean	Groundnut	Garlic
1. <u>Farm Inputs</u>				
(1) Seed/Bulb	(kg/ha)	60	80	1,000
(2) Fertilizer				
Urea	(kg/ha)	60	40	78
Ammophos	(kg/ha)	200	200	150
(Total N-P-K)		(60-40-0)	(50-40-0)	(60-30-0)
(3) Insecticide				
Diazinon 13%	(kg/ha)	10	10	-
2. <u>Labor</u> (man-day/ha)				
Tillage		22	22	21
Planting		12	12	15
Fertilizing		3	3	3
Weeding		7	10	10
Irrigation		7	11	11
Pest control		6	6	6
Harvesting		40	40	60
Total		97	104	126

LEGEND

SYMBOL	CATEGORY	ORIGINALLY PLANNED AREA (ha)	EXTENSION AREA (ha)	TOTAL (ha)
	PADDY FIELD	2,259	771	3,030
	GRASS LAND	34	17	51
	FOREST	435	983	1,418
	VILLAGE	179	28	207
	ROAD	17	11	28
	POND STREAM	16	0	16
	ORIGINALLY BOUNDARY	2,940	1,810	4,750
	EXTENSION BOUNDARY			

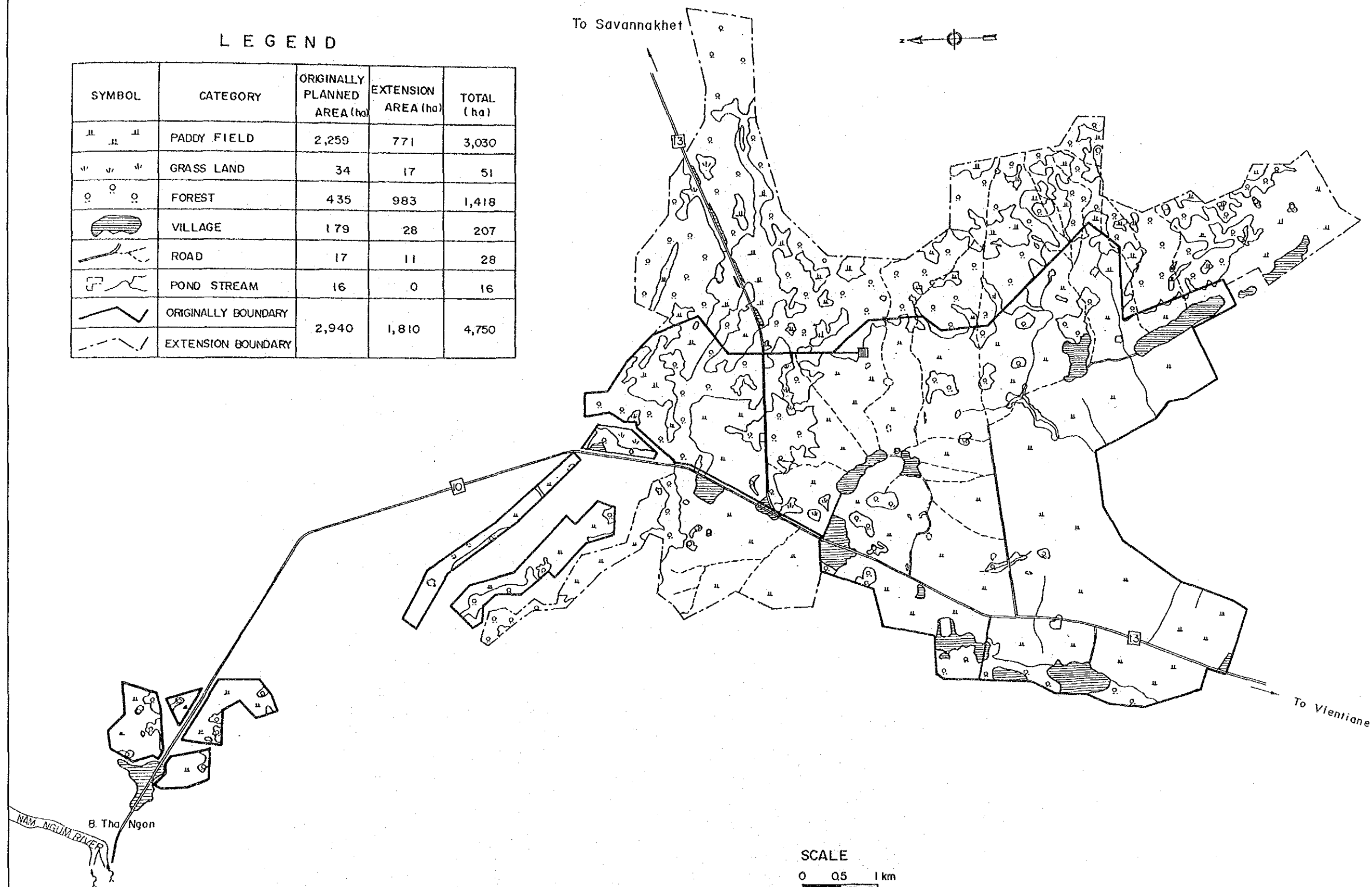


Fig. V-1 PRESENT LAND USE MAP

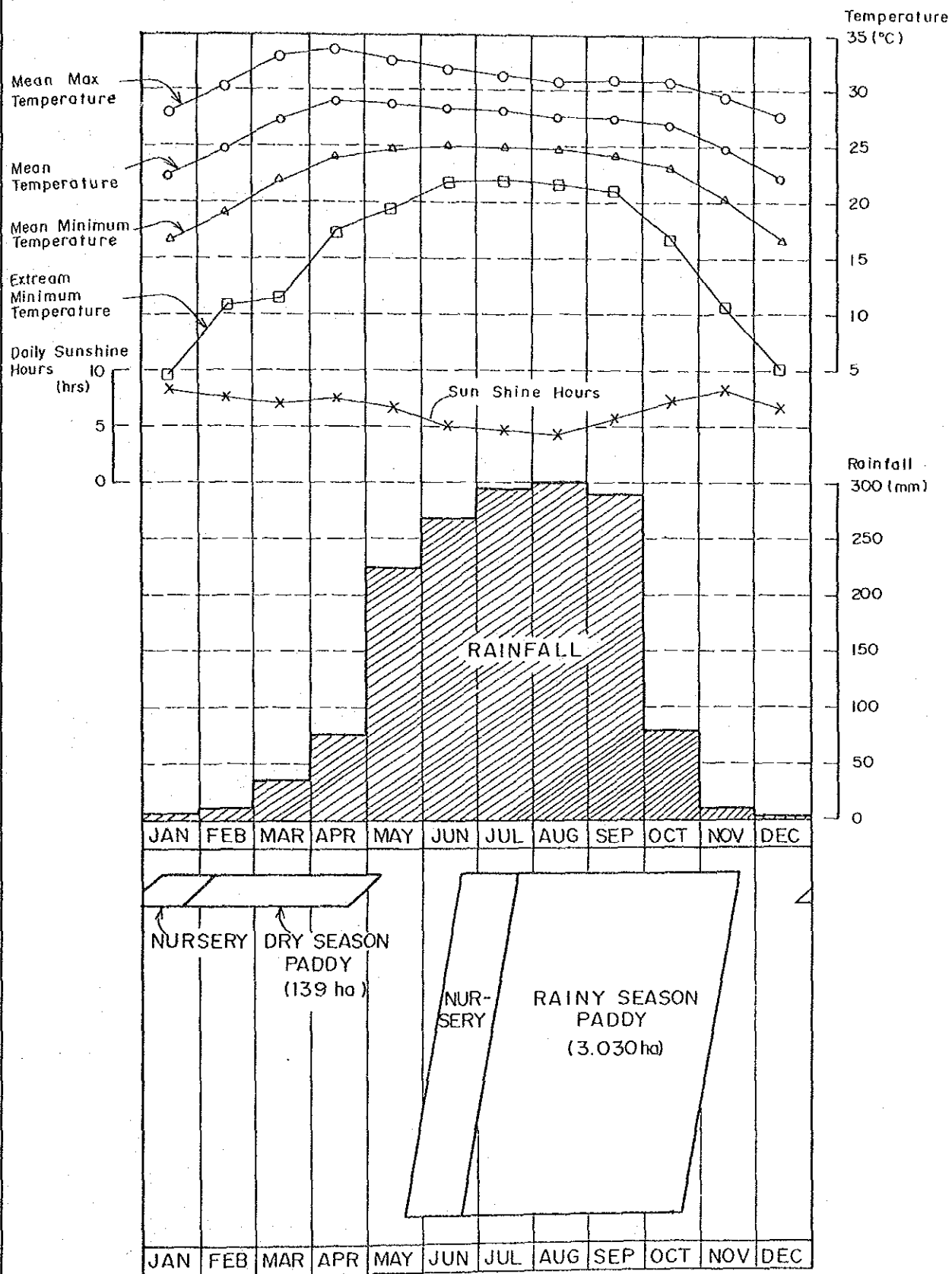


Fig. V-2 PRESENT CROPPING PATTERN AND CLIMATIC CONDITION

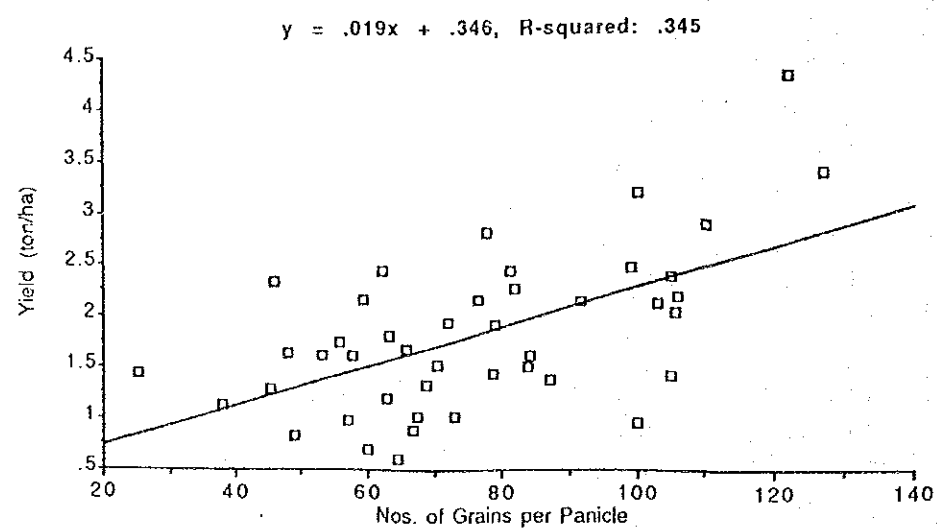
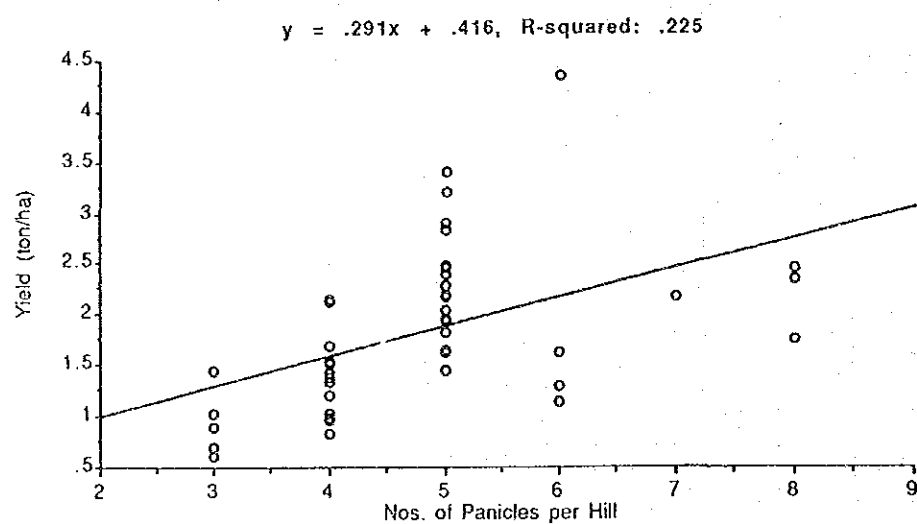
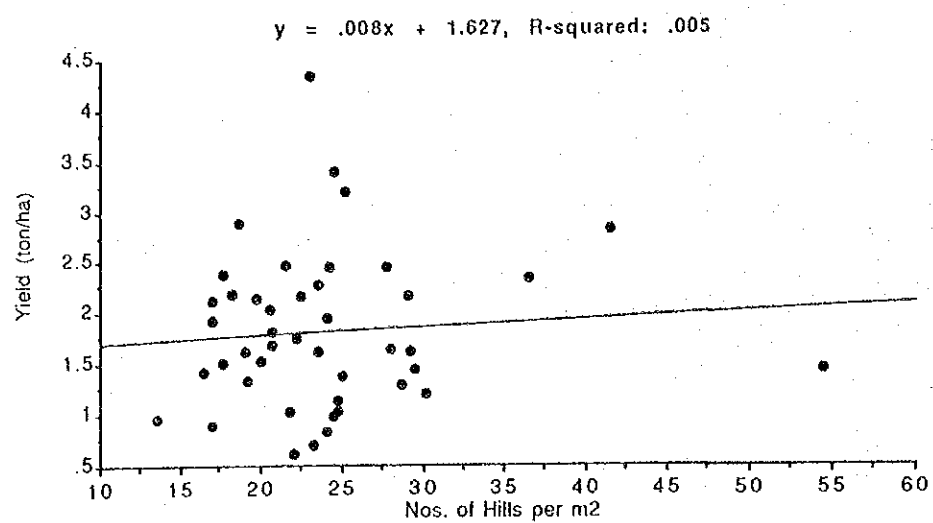


Fig. V-3 RELATION BETWEEN UNIT YIELD AND YIELD COMPONENTS (1/2)

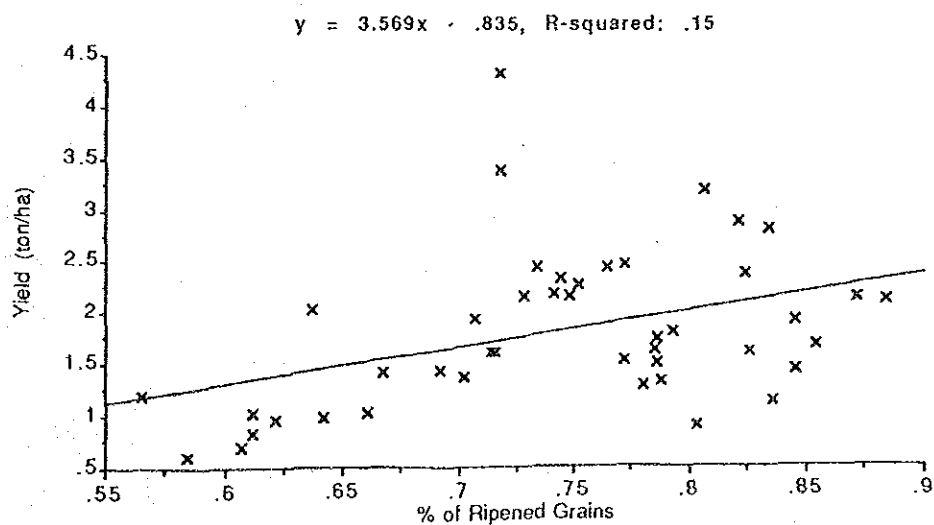
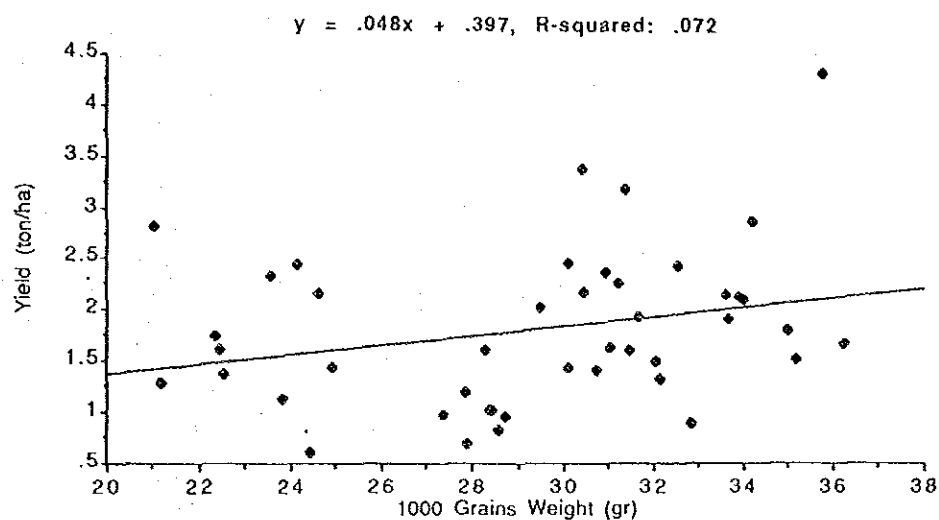
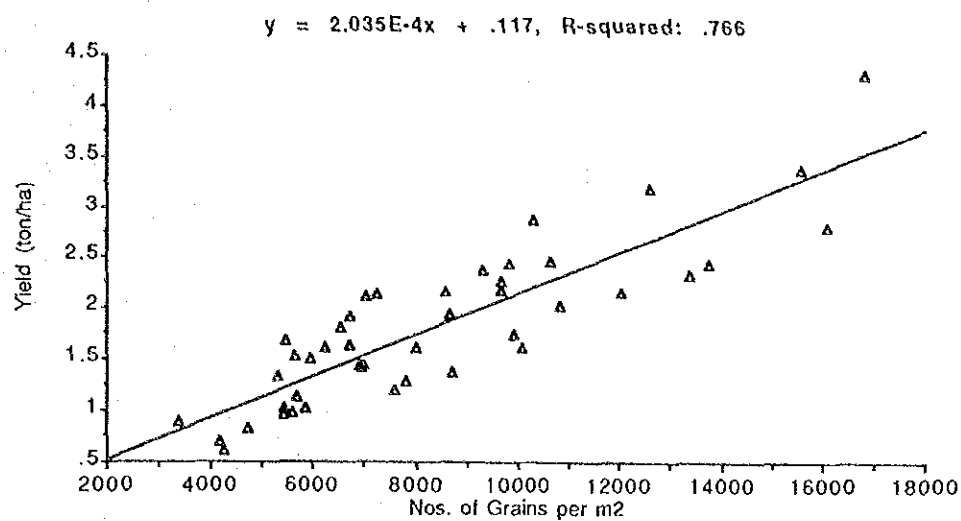


Fig. V-3 RELATION BETWEEN UNIT YIELD AND YIELD COMPONENTS (2/2)

LEGEND

SYMBOL	CATEGORY	ORIGINALLY PLANNED AREA	EXTENSION AREA	TOTAL (ha)
	IRRIGATED LAND	1,700	1,000	2,700
" "	PADDY FIELD	(1,432)	(718)	(2,150)
∨ ∨	PADDY / UPLAND FIELD	(268)	(282)	(550)
≡ ≡	RAINFED PADDY FIELD	400	301	701
⊙ ⊙	FOREST	253	269	522
	INFRASTRUCTURE	300	176	476
	VILLAGE	179	28	207
	POND, STREAM	16	—	16
	ROAD AND RESIDENTIAL AREA	92	36	128
	ORIGINALLY BOUNDARY	2,940	1,810	4,750
	EXTENSION BOUNDARY			

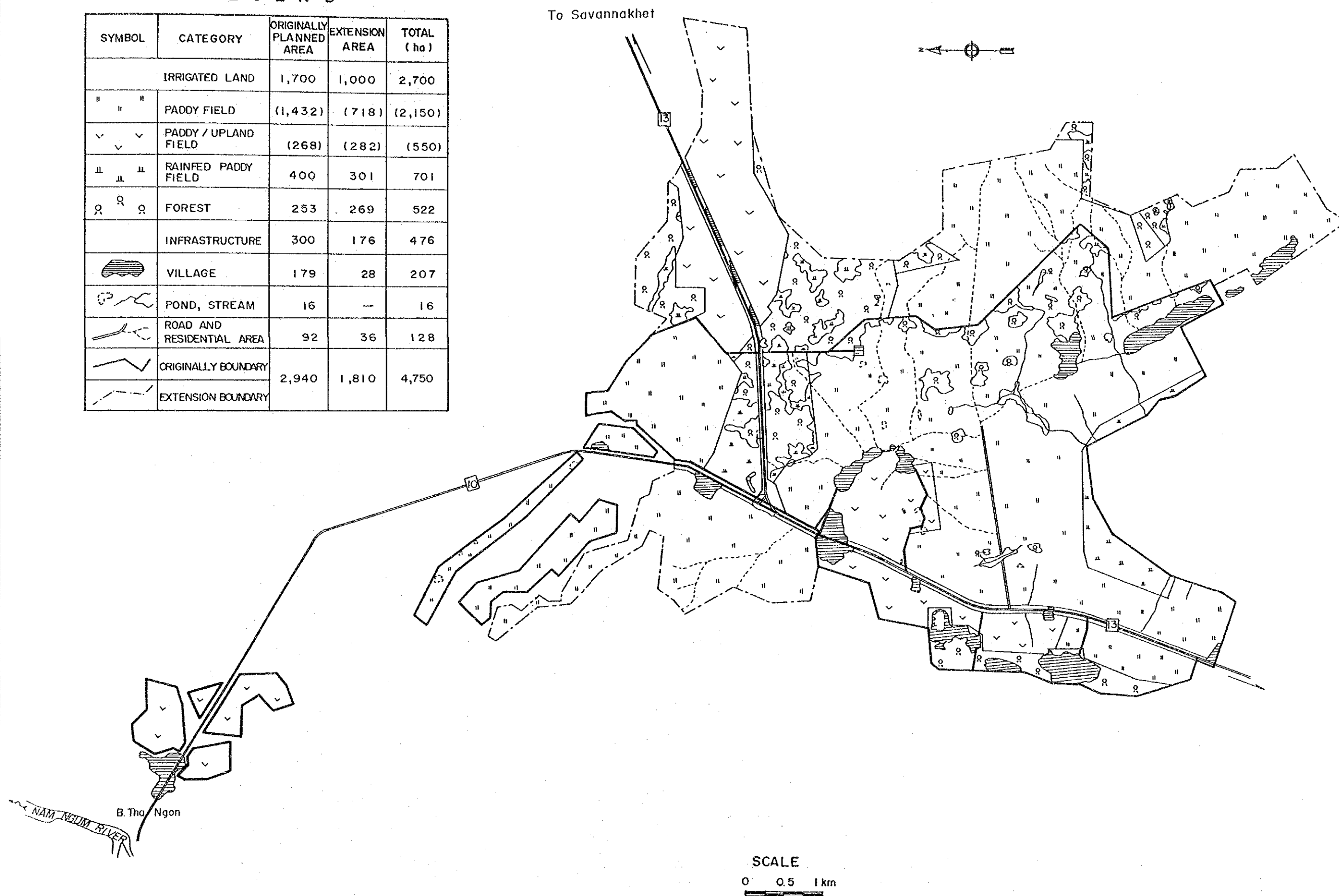


Fig. V-4 PROPOSED LAND USE MAP

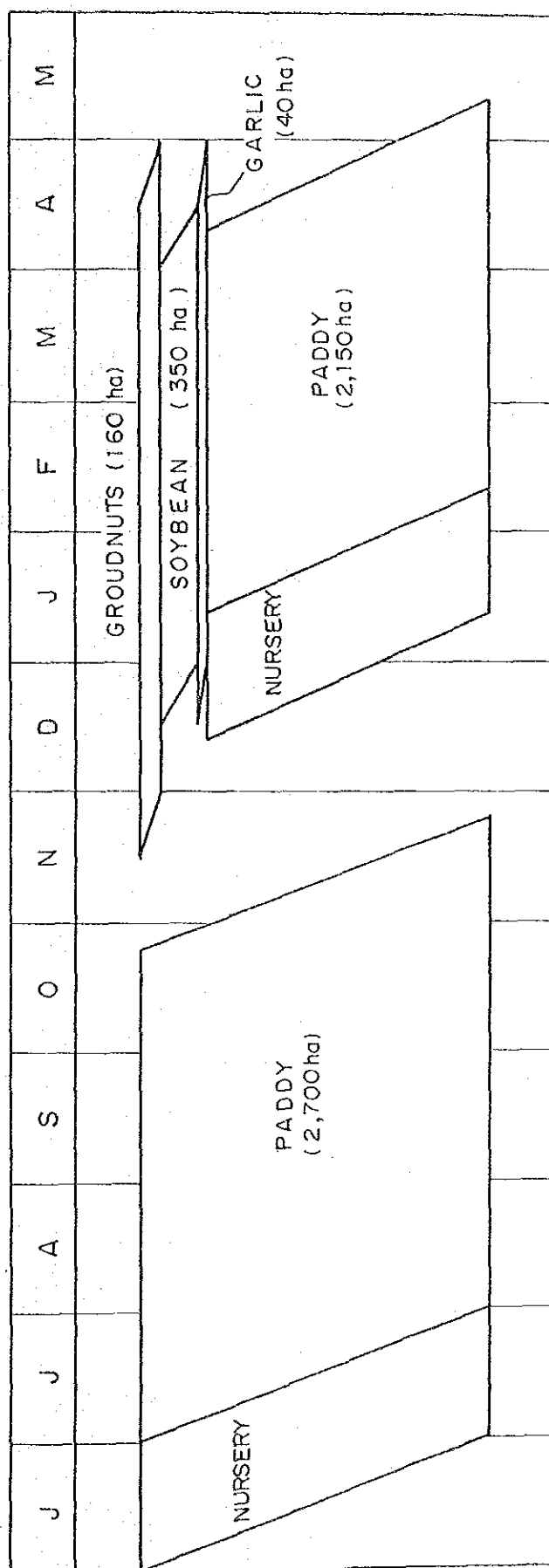


Fig. V-5 PROPOSED CROPPING PATTERN

ANNEX VI

RURAL INFRASTRUCTURES

ANNEX VI
RURAL INFRASTRUCTURES

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1. General

Rural development is one of the major objectives of the Project. It aims to improve and raise living standard of villagers through betterment or new construction of basic rural infrastructures. In preparing a rural development plan for the Project only such basic infrastructures as village roads, potable water supply facilities and post-harvest facilities are taken up for examination, since those facilities are closely related to and essential for the social and agricultural activities of villagers. The present conditions and capacities of existing facilities related to the said three items, and necessity of their improvement or new development are studied for 12 villages located in the Project area. Village names, and population, number of household, average family size and numbers of farm household of 12 villages are shown in the following table, and locations of those villages are shown in Fig. VI-1.

Villages in the Project Area

Village	Population	Nos. of Household	Average Family Size	Nos. of Farm Household
B. Pha Khao	1,925	311	6.2	75
B. Sa Phang Muk	710	149	4.8	101
B. Don Noun	1,263	206	6.1	199
B. Xai	1,326	170	7.8	149
B. Na Khe	655	101	6.5	101
B. Dan Xang	1,318	198	6.7	162
B. Dong Sang Hinh	691	117	5.9	77
B. Na	1,380	303	4.6	88
B. Sok Nhai	996	165	6.0	149
B. Sok Noi	1,129	197	5.7	197
B. Phone Thong	494	78	6.3	65
B. Na Biene	370	57	6.5	56
Total	12,257	2,052	6.0	1,419

Source: Saythany and Saysetha District Offices

As a result of rural infrastructure survey and study, rehabilitation of village roads and construction of potable water supply facilities are proposed in rural development plan for the Project. No construction of post-harvest facilities is proposed since the existing post-harvest facilities in the Project area such as rice mill and storage facilities have enough capacity for milling or storing expected production amount of paddy rice at full development stage of the Project. The study results and the proposed rural development plan are described hereinafter.

2. Village Roads

2.1 Present Conditions

The present road network in and around the Project area consists of asphalt-paved national roads of routes 13 and 10, and unpaved village roads. The village roads with a width of 4 to 7 m are branched off from two national roads, and function as "access" to villages located off from those national roads. At present, the village roads in the Project area are 8.2 km in total length and are insufficient in both quality and density. Existing road structures such as wooden bridges and culverts are also insufficient in numbers and most of them are deteriorated. Villagers are suffering from such poor conditions of the existing roads. In particular, in the rainy season, the roads become very muddy, hindering agricultural and social activities of the villages. The existing village roads in the Project area are listed below:

Existing Village Roads

Village Road	Length (m)	Width (m)
Route 13 to B. Pha Khao	500	7.0
Route 13 to B. Sa Phang Muk	500	6.0
Route 13 to B. Xai - Ban Na Khe	1,700	5.0
Route 13 to B. Dan Xang	200	6.0
B. Sam Khe to B. Sok Noi	1,250	7.0
B. Sok Noi to B. Sok Nhai	1,550	4.0
B. Sok Noi to B. Phone Thong - B. Na Biene	2,500	4.0
Total	8,200	-

2.2 Development Plan

Under the irrigation and drainage development plan of the Project, farm roads with a width of 3.0 to 4.5 m will be provided alongside all the proposed canals of 308 km in total length. Since they are very useful to solve the above-mentioned problem, only the rehabilitation of existing village roads is proposed under the rural development plan. The village roads are 8.2 km in its total length, out of which 6.7 km-long portion is proposed to be rehabilitated by reshaping road embankment and providing laterite pavement of 15 cm thick. In addition, replacement of existing bridges with culverts and new construction of culverts are proposed for 14 places on the roads. For the economic reasons, these culverts would be so designed as to have a flow capacity just sufficient to pass normal rainy season flows of related streams, allowing inundation of roads by floods a few times a year.

Typical cross sections of village roads are shown in Fig. VI-2. The village roads to be rehabilitated are listed below and their locations are shown in Fig. VI-1.

Village Roads to be Rehabilitated

Village Road	Length (m)	Nos. of Culverts			
		ø600mm	ø800mm	ø1000mm	ø1200mm
Route 13 to B. Pha Khao	500	-	2	-	-
Route 13 to B. Sa Phang Muk	500	-	4	-	-
Route 13 to B. Xai	400	2	-	-	-
B. Sam Khe to B. Sok Noi	1,250	-	-	-	-
B. Sok Noi to B. Sok Nhai	1,550	2	-	-	1
B. Sok Noi to B. Na Biene	2,500	1	-	2	-
Total	6,700	5	6	2	1

3. Potable Water Supply Facilities

3.1 Present Conditions

Villagers in the Project area use mainly groundwater from wells for their daily life. According to an inventory survey of the existing wells, there are 488 wells in 12 villages with a total population of 12,257 or 2,052 households as listed in Table VI-1. Out of 488, 287 wells are used for potable water supply and the remaining 201 wells are for non-potable water because of salty taste and contamination by surface water.

All the existing wells are shallow dug wells with a diameter of 1 to 1.5 m and a depth of 3 to 5 m. They are for common use of villagers. On average, one well for potable water supply is used by 7 households (42 persons), and one well for non-potable water supply is used by 10 households (60 persons). Villagers carry water from wells to their houses at a distance of 20 to 300 m (110 m on the average). The average yield of the wells is estimated at 5.7 m³/day in the rainy season and 2.3 m³/day in the dry season as shown in Table VI-2. For this seasonal variation of wells yields, villagers are forced to reduce the water consumption in the dry season.

For the 12 villages, the average per capita requirement of potable water from existing wells is estimated at 55 lit/day in the dry season, since one well with a yield of 2,300 lit/day is used by 7 households (42 persons) on the average. However, due to unbalanced distribution of wells, such an amount of supply is not secured particularly in the six villages of Ban Don Noun, Ban Xai, Ban Na Khe, Ban Sok Nhai, Ban Sok Noi and Ban Na Biene. One well for potable water supply in those villages is used by 20 to 103 households, averaging 32 households. The per capita supply of potable water in those villages is only 12 lit/day, which is far below the standard requirement. Thus, the present potable water supply for the said six villages is proved insufficient and proposed to be increased under the Project. For the remaining six villages, the present supply of potable water is considered to be at an acceptable level.

Water quality analysis of 17 samples taken from the existing wells were carried out at the laboratory of Lao Water Supply Company or Bo Ly Sath Nam Papa (Nam Papa). 13 samples were of potable water and 4 samples were of non-potable water. The tests were made on 13 items, following the standards of Nam Papa. The test items were turbidity, color, odor, taste, pH, total hardness, nitrite/nitrate nitrogen, iron, chlorine, KMnO₄ consumed, bacterial count, coliform group and EC.

The test results show that some samples have higher values of turbidity, KMnO_4 consumed and iron, and some samples have lower value of pH in comparison with the standards of Nam Papa though, they are still within the allowable range for potable water or could be improved by preventing surface water from entering wells.

The test results and the standard values recommended by Nam Papa are shown in Table VI-3, and are summarized below:

- i) Turbidity : The standard value of turbidity is less than 2. Thirteen (13) samples (76%) show higher values of 3-20 than the standard, indicating contamination by surface water.
- ii) Color : All the samples show the values within the acceptable range.
- iii) Odor : Three (3) samples (18%) show abnormal odor, supposed to be caused by contamination by surface water and foreign materials.
- iv) Taste : Three (3) samples (18%) show abnormal taste. It is assumed that abnormal taste of some well water is caused by contamination by surface water and foreign materials.
- v) pH : All samples are lower in pH (between 4.8-6.5) than the standard requirement in Lao (pH 6.6-8.5). But referring to the Japanese standard (5.8-8.5), these values of pH are within an acceptable range for drinking water.
- vi) Total Hardness : Almost all the samples show the values within the acceptable range. (<300 ppm)
- vii) Nitrite/Nitrate Nitrogen : All the samples show the values within the range of the standard (<10 ppm), and no ammoniac nitrogen is found.

- viii) Iron : Three (3) samples show 0.4 to 0.6 ppm, which are higher than the standard value of less than 0.3 ppm. It is assumed that these values are still within the acceptable range for drinking water.
- ix) Chlorine : The standard value is less than 200 ppm and the values of all samples are within the range of standard.
- x) KMnO_4 consumed : The standard value is less than 10 ppm and five (5) samples (30%) have slightly higher values (10.5-15.9 ppm) than the standard. This may be caused by organic materials and this item can be improved by protecting wall of wells from entering surface water.
- xi) Bacterial count : One (1) sample has much higher value of 759 than the standard requirement (<100). But there would be no serious problems because water of existing wells is normally boiled before drinking.
- xii) Coliform group : No samples contain coliform group.
- xiii) EC : Nam Papa has no standard value of EC. It is generally assumed that maximum EC value of 1,000 to 1,200 $\mu\text{S}/\text{cm}$ is allowable for potable water.

3.2 Lao Water Supply Company

Municipal water for Vientiane city and its neighbouring area is supplied by Nam Papa. Water is taken from the Mekong river at two intake sites; Kao Liao and Chinaimo, and the water is treated at two treatment plants; Kao Liao treatment plant with a capacity of 20,000 m^3/day and Chinaimo treatment plant of 40,000 m^3/day capacity. The water is distributed to consumers directly from the plants or through reservoirs. There are two distribution pipe line systems; Kao Liao and Chinaimo systems though, they are connected each other. These systems have five (5) water storage reservoirs with a total capacity of 10,000 m^3 . Three (3) of them are elevated storage reservoirs and the remaining two (2) are formed on the ground surface.

The general layout of distribution pipe line systems and locations of storage reservoirs are shown in Fig. VI-3. Capacity and type of storage reservoirs are shown below:

Storage Reservoirs of Nam Papa

Location	Capacity (m ³)	Type of Reservoir
Kao Liao Treat. Plant	4,000	Ground level
Chinaimo Treat. Plant	1,000	Ground level
Phone Kheng	2,000	Elevated
Phone Thanh	1,500	Elevated
Phone Tong	1,500	Elevated
Total	10,000	

Nam Papa had a plan of expanding its water supply system and already extended a distribution pipe line to KM-9 point along national road of route 13 in the Project area. Through this pipe line water supply service has been given to Ban KM-6 and Ban Dong Dok located in the southern part of the Project area. The general layout of this pipe line is shown in Fig. VI-3. In December 1988 this pipe line was further extended from KM-9 point to KM-14 point in order to supply water to the police school located at KM-14 point. Design discharge of the pipe line is 3.6 m³/min., which is supplied through KM-6 booster pump station. Water pressure at KM-6 and KM-14 points is 5-6 kg/cm² and 2-2.5 kg/cm², respectively. Size of the pipe line at KM-6 and KM-14 points is 250 mm and 100 mm in diameter, respectively. At present, the pipe line starting from KM-6 booster pump station covers mainly Ban KM-6 and Dong Dok area, however, it is planned by Nam Papa that Donk Dok area is covered by a new pipe line starting from Phone Tong reservoir instead of the present pipe line as shown in Fig. VI-3.

3.3 Development Plan

(1) General

Out of 12 villages, six villages of Ban Don Noun, Ban Xai, Ban Na Khe, Ban Sok Nhai, Ban Sok Noi, and Ban Na Biene are proposed to be provided with potable water supply facilities under the Project with the following objectives:

- i) To secure per capita supply of 60 lit/day in the year of 2,000, which is considered necessary to sustain normal life of villagers.
- ii) To reduce the numbers of users' household per well or tap to less than 20 households.

For three villages of Ban Don Noun, Ban Xai and Ban Na Khe, potable water is proposed to be supplied by extending the existing municipal water supply pipe line, while for the water supply to the remaining three villages of Ban Sok Nhai, Ban Sok Noi and Ban Na Biene, construction of deep tubewells and provision of distribution pipe lines are proposed.

(2) Extension of existing municipal water supply pipe line

One main pipe line of the municipal water supply pipe line starting from the KM-6 booster pump station was extended from KM-9 to KM-14 points along the national road of route 13 and 10 by Nam Papa in December 1988. The route of this pipe line is shown in Fig. VI-1 and VI-3. The pipe line has a capacity of 3.6 m³/min. with a water pressure of 5 to 6 kg/cm² at the KM-6 booster pump station.

Since three villages of Ban Don Noun, Ban Xai and Ban Na Khe are located very near the said extension pipe line, it is proposed to secure water supply to those villages from the extension line by providing distribution pipe lines. The water demand for the supply from the extension line is estimated at 250 m³/day in total as shown below:

Water Demand

	B.Don Noun	Village B. Xai	B.Na Khe	Total
Present conditions				
Nos. of well for drinking	2	3	5	10
Estimated yield (m ³ /day) (1)	5	7	12	24
Development plan				
Population in 2000 ^{/1}	1,780	1,868	923	4,571
Total water demand (m ³ /day) (2)	107	112	55	274
Additional demand (m ³ /day) [(2)-(1)]	102	105	43	250

^{/1} : Estimated based on an annual population growth rate of 2.9%.

Water demand for the existing pipe line (KM-6 to KM-9 points) is 3,480 m³/day for water supply to Ban KM-6 area and Dong Dok area, and water demand for newly extended pipe line (KM-9 to KM-14 points) is 122 m³/day for water supply to police school. The water demand for Ban Don Noun, Ban Xai and Ban Na Khe is 250 m³/day. Therefore, total water demand for the pipe line becomes 3,852 m³/day. Since the capacity of the pipe line has 3,888 m³/day on a 18-hour operation basis and 5,184 m³/day on a 24-hour operation basis, the total water demand can be covered by the present pipe line. In case that pipe line starting from Phone Tong reservoir is completely connected to Dong Dok area by Nam Papa, water demand for the existing pipe line starting from KM-6 booster pump station will decrease from 3,853 m³/day to 2,292 m³/day, and this will produce an additional water supply capacity of 1,560 m³/day to the Project area. The calculation of water demand is shown in Table VI-4.

The proposed distribution pipe line will be constructed using PVC pipe with a diameter of 25 to 100 mm. Total length of the proposed pipe line will be 4,050 m. Communal taps will be provided on the pipe line, each with a washing place of 1.5 m-wide x 1.5 m-long rectangular concrete slab, so that

the number of users' household per well or tap can be less than 20 including existing useful wells. The required number of communal taps is 26 in total; 13 for Ban Don Noun, 10 for Ban Xai and 3 for Ban Na Khe. Calculation of the required number of communal taps is shown below and the general layout of distribution pipe line is shown in Fig. VI-1.

Required Number of Communal Taps

	B. Don Noun	Village B. Xai	B. Na Khe	Total or Average
Present condition				
No. of households	206	170	101	477
No. of wells for drinking	2	3	5	10
No. of households per well	103	57	20	50
Development plan				
No. of households in 2000 ^{/1}	290	240	142	672
No. of taps (proposed)	13	10	3	26
No. of households per well & tap	19	18	18	19 ^{/2}

^{/1} : Estimated based on an annual population growth rate of 2.9%

^{/2} : $672 / (26 + 10) \div 19$

(3) Proposed deep tubewells and distribution pipe lines

Three villages of Ban Sok Nhai, Ban Sok Noi and Ban Na Biene are located far from the municipal water pipe line, and water supply from the said pipe line to those villages is judged uneconomical. Accordingly, water supply to those villages is proposed to be secured by drilling two deep tubewells and construction of distribution pipe lines. The water demand for the two tubewells is estimated at 175 m³/day in total as given below:

Water Demand

	Village			
	B.Sok Nhai	B.Sok Noi	B.Na Biene	Total
Present condition				
Nos. of well for drinking	3	10	2	15
Estimated yield (m ³ /day) (1)	7	23	5	35
Development plan				
Population in 2000 /1	1,403	1,591	521	3,515
Total water demand (m ³ /day) (2)	84	95	31	210
Additional demand (m ³ /day) [(2)-(1)]	77	72	26	175

/1 : Estimated based on an annual population growth rate of 2.9%

According to the hydro-geological investigation made by the JICA Team, there are two possible sites for tubewell drilling at Ban Phone Thong, i.e. N-33 and N-41 sites as shown in Annex III of this report. Ground water yield at N-41 site of more than 1.8 lit/sec or 155 m³/day was verified by pumping tests and that at N-33 site is assumed to be more than 1.8 lit/sec considering hydro-geological conditions of two sites. Therefore, it is concluded that the water demand of 175 m³/day could be sufficiently covered by two tubewells. Casing diameter of the proposed tubewells is 150 mm and the well depth is 30 m.

N-41 tubewell will supply water for Ban Na Biene having a water demand of 26 m³/day. The well will be provided with one concrete regulation tank with a capacity of 17 m³ and one 6 m-high elevated tank with a capacity of 1 m³. N-33 tubewell will supply water for Ban Sok Nhai and Ban Sok Noi having a water demand of 149 m³/day. The well will be provided with two concrete regulation tanks, each with a capacity of 42.5 m³, and one 15 m-high elevated tank with a capacity of 5 m³. Groundwater will be lifted from the wells to regulation tanks, and will be re-lifted to the respective elevated tanks by pumps. Water will be distributed to villages by gravity through PVC distribution pipe

line. Total length of the pipe line starting from N-41 well will be 860 m and that from N-33 well will be 3,660 m. Size of PVC pipe for both systems will be 25 to 100 mm in diameter. The proposed tubewell sites and general layout of distribution pipe lines are shown in Fig. VI-1. On these pipe lines, communal taps will be provided, each with a washing place of 1.5 m-wide x 1.5 m-long rectangular concrete slab, so that the number of users' household per well or tap can be less than 20. The required number of communal taps is 17 in total; 3 for Ban Na Biene, 9 for Ban Sok Nhai and 5 for Ban Sok Noi. Calculation of the required number of communal taps is shown in the following table.

Required Number of Communal Taps

	Village			Average
	B.Sok Nhai (N-33 Site)	B.Sok Noi	B.Na Biene (N-41 Site)	
Present condition				
No. of households	165	197	57	419
No. of wells for drinking	3	10	2	15
No. of households per well	55	20	29	28
Development plan				
No. of households in 2000 ^{/1}	232	278	80	590
No. of taps (proposed)	9	5	3	17
No. of households per well & tap	19	19	16	18 ^{/2}

^{/1}: Estimated based on an annual population growth rate of 2.9%.

^{/2}: $590 / (15 + 17) \div 18$

Quality of water taken from N-41 tubewell was examined at the laboratory of Nam Papa. The results show that the water is suitable for drinking, though pH value is slightly lower than the standard of Nam Papa and iron content is slightly higher than the standard. The test results and the standard of Nam Papa for potable water are as follows:

Water Quality

Item	Standard	Test Result
1. Turbidity	< 2	1
2. Color	< 5	2
3. Odor	-	normal
4. Taste	-	normal
5. pH	6.6 - 8.5	5.8
6. Total hardness	< 300 ppm	35 ppm
7. Nitrite/Nitrogen	< 10 ppm	0.02 ppm
8. Nitrate/Nitrogen	< 10 ppm	0.30 ppm
9. Iron	< 0.3 ppm	0.5 ppm
10. Chlorine	< 200 ppm	21.2 ppm
11. KMnO_4 consumed	< 10	1.2
12. Bacterial count	< 100	12
13. Coliform group	-	none
14. EC	-	190 $\mu\text{S/cm}$

4. Post-harvest Facilities

4.1 Rice Mills

(1) Present conditions

In the Project area there are 20 rice mills; 18 private rice mills including 2 under construction, and 2 Foodstuff Companies' rice mills. These Foodstuff Companies belong to Saythany and Saysetha districts and work for milling rice and supplying the milled rice to government's workers. All the milling equipment is made in Thailand and is classified into two; type I and type II. Type-I works for husking and polishing, while type II works for cleaning, husking, separating of paddy and brown rice, polishing and removing crushed brown rice. The recovery rate is 50 to 60% for type I and 60-70% for type II. Type-I is not popular among farmers mainly because of low recovery rate, and it tends to be replaced by type-II. The breakdown of the existing equipment is as follows:

Private rice mills	:	18
- Type I	:	8
- Type II	:	10
Foodstuff Company	:	2
- Type I	:	1
- Type II	:	1

The milling capacity of type-I is 200 to 300 kg/hr, while that of type-II is 600 to 800 kg/hr. At present, operation hour of the mill is 8 to 10 hours per day for rainy season paddy, and 2 to 5 hours per day for dry season paddy. Full time operation is only for a few months in a year. All the mills still have considerable milling capacity. Assuming that operation hour is 8 hours/day and operation day is 300 days in a year, annual rice milling capacity of the existing rice mills is estimated at 23,880 tons as follows:

- Type-I (9 units)

$$0.25 \text{ ton/hr} \times 8 \text{ hr} \times 300 \text{ days} \times 9 \text{ units} = 5,400 \text{ tons}$$

- Type-II (11 units)

$$0.7 \text{ ton/hr} \times 8 \text{ hr} \times 300 \text{ days} \times 11 \text{ units} = 18,480 \text{ tons}$$

Total : 23,880 tons

All the private rice mills are listed in Table VI-5, and locations of such mills are shown in Fig. VI-1.

(2) Milling capacity for the expected production of the Project

The expected production of paddy at full development stage of the Project is estimated at 25,030 tons/year. Since the present annual milling capacity is 23,880 tons, most of paddy produced under the Project could be milled in the existing rice mills. Shortage of milling capacity will be solved by increase of operation hour of rice mills. In addition, in Vientiane city there are 6 rice mills of Foodstuff Companies with annual milling capacity of 14,000 tons, and those mills also could be used. Therefore, no provision of new rice mills is proposed under the Project.

4.2 Storehouses

(1) Present conditions

In the Project area there are four types of storehouses, i.e. farmer's storehouse, communal storehouse, agricultural tax storehouse and Foodstuff Company's storehouse.

Farmer's storehouse is a storehouse owned by farmers and is provided at a yard of farmer's house. This storehouse is used to store paddy or rice for home consumption and some surplus for selling. There are 1,419 farmer's storehouses in the Project area, each having a floor size of 1.5 to 2.5 m x 2.5 to 3.5 m and a height of 2 m. The storage capacity of one unit of storehouse is 7-tons on the average at a conversion factor of 0.56 ton/m³. Therefore, total capacity of the farmer's storehouses is estimated at 9,933 tons.

Communal storehouse is a storehouse managed by village administration. It is mainly used to store communal paddy for mutual food aid among villagers. There are seven communal storehouses, i.e, one in each of seven villages of Ban Pha Khao, Ban Dan Xang, Ban Dong Sang Hinh, Ban Sok Nhai, Ban Sok Noi, Ban Phone Thong and Ban Na Biene. One unit of the storehouse has an average storage capacity of 11 tons with a floor size of 2 to 3 m x 3 to 5 m and a height of 2 m. The total storage capacity is estimated at 77 tons.

Agricultural tax storehouse is used to store paddy tax and managed by chief of sub-district. There are two agricultural tax storehouses in Ban Don Noun each with a floor size of 8 m x 20 m and a height of 2 m. The storage capacity is 180 tons per unit and the total capacity is 360 tons.

Foodstuff Company's storehouse is owned by Foodstuff Company of Saythany and Saysetha Districts. There are five Foodstuff Company's storehouses in the Project area. The floor size and height of the storehouse is 18 m x 10 m and 4 to 5 m respectively. The storage capacity is 450 tons per unit and 2,250 tons in total.

Thus, the total storage capacity of all the existing storehouses in the Project area is estimated at 12,620 tons as shown below:

Storage Capacity of Existing Storehouses

Storehouse	No. of storehouses	Capacity (ton)
Farmers' storehouse	1,419	9,933
Communal storehouse	7	77
Agri. tax storehouse	2	360
Food. Company's storehouse	5	2,250
Total	1,433	12,620

Most of the storehouses consist of elevated wooden floor, wooden wall and galvanized iron sheet roof, and they are relatively well-maintained, although paddy or rice in some storehouse are damaged by rodent or leakage of water from roof.

(2) Storage capacity for the expected production of paddy

The expected paddy production amount at full development stage of the Project is estimated at 13,200 tons for rainy season paddy and 11,830 tons for dry season paddy. Since the present storage capacity is 12,620 tons, most of paddy could be stored in storehouses of the Project area. In addition, in Vientiane city there are storehouses of Foodstuff Companies with a total storage capacity of 13,500 tons, and those storehouses also could be used. Therefore, construction of new storage facilities is not proposed under the Project.

Table VI-1 Existing Wells

Village	Number of Households	Total No. of Wells	No. of Wells for Drinking	No. of Wells not drying-up in dry season	Average Depth of Wells (m)	Average Walking Dist. (m)	No. of Households per Well (drinking)	No. of Households per Well (miscellaneous)	Remarks
Ban Pha Khao	311	200	160	180	4-6	20-40	2	2	Water enters wells from the field in the rainy season, making water of wells dirty.
Ban Sa Phang Muk	149	34	22 (D) 8 (R)	34	4-6	20-200	7	4	Eight (8) wells for drinking in the rainy season have dirty water.
Ban Don Noun <u>1</u>	206	35	2 (D) 18 (R)	little water	6-9	50-250	103 (D) 11 (R)	6	Unsuitable for drinking due to salty taste in the dry season.
Ban Xai <u>2</u>	170	30	3	little water	4-7	100-300	57	6	Unsuitable for drinking due to salty taste in the dry season.
Ban Na Khe	101	20	5	little water	4-7	100-200	20	5	Unsuitable for drinking due to salty taste.
Ban Dan Xang	198	64	49 (D) 59 (R)	49	5-7	20-50	4	4	Five (5) wells have salty taste water.
Ban Dong Sang Hinh	117	12	9	11	3-4	20-50	11	10	Water of two (2) wells has salty taste.
Ban Na	303	30	30	20	5-10	30-200	10	10	Ten (10) wells in higher place almost dry up in the dry season every year.
Ban Sok Nhai <u>2</u>	165	12	3	little water	5-7	100-300	55	14	Eight (8) wells are unsuitable for drinking in the dry season.
Ban Sok Noi	197	21	10	15	5-6	30-100	20	9	Water of some well becomes dirty in the dry season.
Ban Phone Thong	78	23	6	23	4-5	50-150	13	3	Taste problem
Ban Na Biene	57	7	2	5	4-7	50-200	29	8	Unsuitable for drinking due to salty taste in the dry season.
Total/Average	2,052	488	287		5.6	110	7	10	

(D) : Dry season

(R) : Rainy season

1 : Seventeen (17) wells have salty taste water.2 : All drinking water is from outside of the village area.

Table VI-2 Estimation of Yield Capacity of Existing Wells

Village	Population	Total No. of Wells	Yield Capacity ^{/1} in Rainy Season (m ³ /day/well)	Yield Capacity ^{/1} in Dry Season (m ³ /day/well)
B. Pha Khao	1,925	200	1.4 ^{/2}	0.6 ^{/2}
B. Sa Phang Muk	710	34	3.1	1.3
B. Don Noun	1,263	35	5.4	2.2
B. Xai	1,326	30	6.6	2.7
B. Na Khe	655	20	4.9	2.0
B. Dan Xang	1,318	64	3.2	1.3
B. Dong Sang Hinh	691	12	8.6	3.5
B. Na	1,380	30	6.4	2.6
B. Sok Nhai	996	12	12.5	4.5
B. Sok Noi	1,129	21	8.1	3.2
B. Phone Thong	494	23	3.2	1.3
B. Na Biene	370	7	7.9	3.2
Average	12,257		5.7	2.3

^{/1}: Water consumption per capita is estimated 150 lit/day in the rainy season and 60 lit/day in the dry season.

^{/2}: This figure does not mean the maximum capacity of the wells because the villagers have enough wells (2 households per well) and face no difficulties in getting water.

Table VI-3 Water Quality Analysis

Sample No.	Sampling Village	Turbidity	Color	Odor	Taste	pH	Total Hardness (ppm)	Nitrite Nitrogen (ppm)	Nitrate Nitrogen (ppm)	Iron (ppm)	Chlorine (ppm)	KMnO ₄ Consumed (ppm)	Bacterial Count	Coliform Group	EC (μS/cm)
(Standard in Lao)		< 2	< 5	None	None	6.6-8.5	<300		< 10	< 0.3	< 200	< 10	< 100	(None)	-
1	B.Pha Kao	0	0.65	Normal	Normal	5.5	2	None		0.01	9.57	0	10	None	60
2	B.SaPhang Muk	8	0.02	"	"	5.1	7	None		0.4	11.48	0	12	"	46
3	B.Don Noun	5	0.1	"	"	5.6	30	< 10		0.02	40.2	2.7	759	"	230
4	B.Don Noun 11	1	0.02	"	"	6.5	342	None		0.02	38.28	9.1	64	"	1,370
5	B.Xai	14	0.3	"	"	5.4	25	< 10		0.095	13.4	3.7	54	"	110
6	B.Xai 11	2	0.5	Not Normal	Not Normal	6.4	205	None		0.025	45.3	5.4	43	"	1,200
7	B.NaKhe	5	0.2	Normal	Normal	6.2	37	< 10		0.065	39.56	10.5	34	"	360
8	B.Dan Xang	4	0.08	"	"	5.3	15	< 10		0.065	19.14	4.4	40	"	165
9	B.Dan Xang	5	0.3	"	"	5.1	20	< 10		0.6	20.41	0	10	"	160
10	B.Dong Sang Hinh	8	0.05	"	"	5.2	13	< 10		0.1	8.29	6.1	2	"	50
11	B.Na	4	0.01	"	"	5.4	28	None		0.065	22.33	8.1	52	"	160
12	B.Sok Nhai 11	2	0.01	"	"	6.0	162	None		0.03	54.23	12.4	43	"	940
13	B.Sok Nhai	20	0.02	Not Normal	Not Normal	5.4	65	None		0.6	17.22	13.4	8	"	150
14	B.Sok Noi	3	0.01	Normal	Normal	5.6	28	None		0.07	8.29	15.9	5	"	640
15	B.Phone Thong	6	0.3	"	"	5.0	30	None		0.095	31.9	11.8	14	"	175
16	B.Phone Thong 11	5	0.4	Not Normal	Not Normal	4.8	136	< 10		0.005	31.9	7.7	2	"	630
17	B.Na Biene	4	0.8	Normal	Normal	5.8	80	< 10		0.065	51.0	4.4	23	"	340
18	B.Phone Thong 12	1	2.0	Normal	Normal	5.8	35	0.02	0.3	0.5	21.2	1.2	12	"	190

1 : Samples from the wells that the farmers are not using for drinking water due to abnormal taste or salty taste of water.

2 : Samples from the test boring well.

Table VI-4 Water Demand between KM-6 and KM-14 Points

Service Area	Present Daily Consumption (m ³ /day)	Population		Daily Water Demand (m ³ /day)
		1988 ¹	2000 ²	
Existing System (KM-6 to KM-9)				
Ban KM-6 area	1,600			1,920
Dong Dok area	1,300			1,560
Sub Total of Existing System	2,900 ³			3,480 ⁴
Extension System (KM-9 to KM-14)				
Ban Don Noun		1,263	1,780	102
Ban Xai		1,326	1,868	105
Ban Na Khe		655	923	43
Police School				122 ⁵
Sub Total of Extension System		3,244	4,571	372
Total				3,852 (2,292) ⁶
Supplying Capacity at KM-6 Booster Pump Station				
Discharge	3.6 m ³ /min	18-hour operation		3,888 m ³ /day
		24-hour operation		5,184 m ³ /day
Pressure	5.0-6.0 kg/cm ²			

¹: Saythany district office, 1988

²: Annual population growth rate of 2.9% is applied.

³: Estimated from the actual monthly consumption in September 1988.

⁴: An increase of 20% is applied because of the limited area.

⁵: Estimated by Nam Papa.

⁶: In case that pipe line starting from Phone Tong elevated reservoir is completely extended to Dong Dok area.

Table VI- 5 Existing Rice Mill Facilities

Village (Ban)	Number of House- holds	Total No. of Rice Mills	Type of Each Rice Mill	Capa- city (kg/hr)	Milling rate (%)	Con- struction Year	Paddy from	Distance (km) /1	Operating Hour (hr/day) Season		Remarks
									Dry	Rainy	
Pha Khao	328	3	II	800	65-70	1981	Pha Khao	1.0	8-10	3-4	Just constructed Almost no use
			I	320	50-60	1988	- do.-		No experience		
			I	300	50	1966	- do.-		1-2	0	
SaPhangMuk	136	0					-	2.0			Carried to Pha Khao, Don Noun
Don Noun	206	8	II	720	60-70	1983	Don Noun	0.5	8-10	2-3	Under construction Foodstuff Company Foodstuff Company Under construction
			II	640	60-70	1987	Sa Pang Muk		8-10	2	
			II	560	60-70	1985	Dan Xang		10	5-6	
			II	640	60-70	1988	Don Sang Hinh		8	4	
			II	640	60-70	1988	Other regions		8-10	4-5	
			II	700	60-70	1988			-	-	
			I	250	50-60	-	-		-	-	
			II	1,000	60-70	1988	-		-	-	
Xai	170	1	II	480	60-70	1988	Xai, Na Khe	0.5	No Experience		Just constructed
Na Khe	101	2	I	320	65	1981	-	1.0	-	-	Almost no use
			I	320	60	1983	Na Khe		8-10	4-5	
Dan Xang	199	0					-	2.0			Carried to Don Noun
D.SangHinh	110	0					-	3.0-4.0			Carried to Don Noun
Na	303	2	I	240	50	-	Na	1.0			Carried to Tha Ngone Almost no use Under construction
			II	700	60-70	1988					
Sok Nhai	165	1	I	200	50	1978	Sok Nhai	2.0	2-3	1-2	Carried to Sok Noi
Sok Noi	197	2	I	300	50	1985	Sok Noi, Nhai	0.5	2-3	1-2	
			II	800	70	1988	Pone Thong Na Biene		8-10	1-2	
PhoneThong	78	0					-	1.0			Carried to Sok Noi, Doung
Na Biene	55	1	I	-	-	1975	-	1.0-2.0			Carried to Sok Noi Almost no use (Engine)

/1: Average transportation distance from the village to rice mill facilities for milling rice.

LEGEND

- | | |
|----------------|---|
| $\frac{6}{64}$ | Nos. of Household Per Well (Drinking)
Total Nos. of Well |
| II | Existing Rice Mill (Type-II) |
| I | Existing Rice Mill (Type-I) |
| — | Village Road To be Improved |
| --- | Existing Water Supply Pipe Line of Nam Papa |
| - - - | Pipe Line Almost Completed in 1988 |
| - - - | Proposed Pipe Line of Nam Papa |
| - - - | Proposed Distribution Pipe Line From Deep Well |
| ● | Proposed Deep Well |
| ▨ | Village |
| KM-6 | Point Of 6KM From Vientiane |
| KM-9 | Point Of 9KM From Vientiane |
| KM-14 | Point Of 14KM From Vientiane |

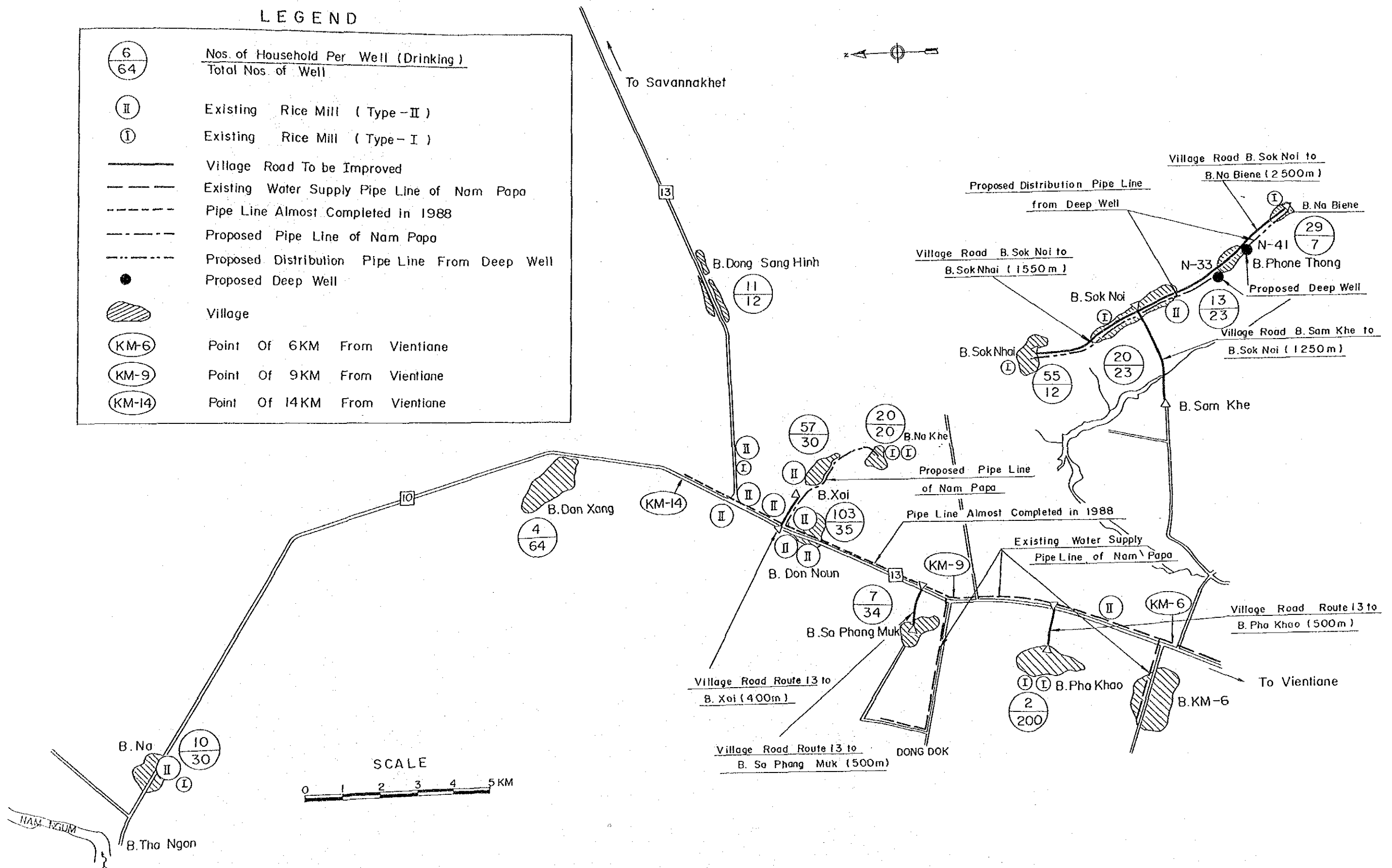
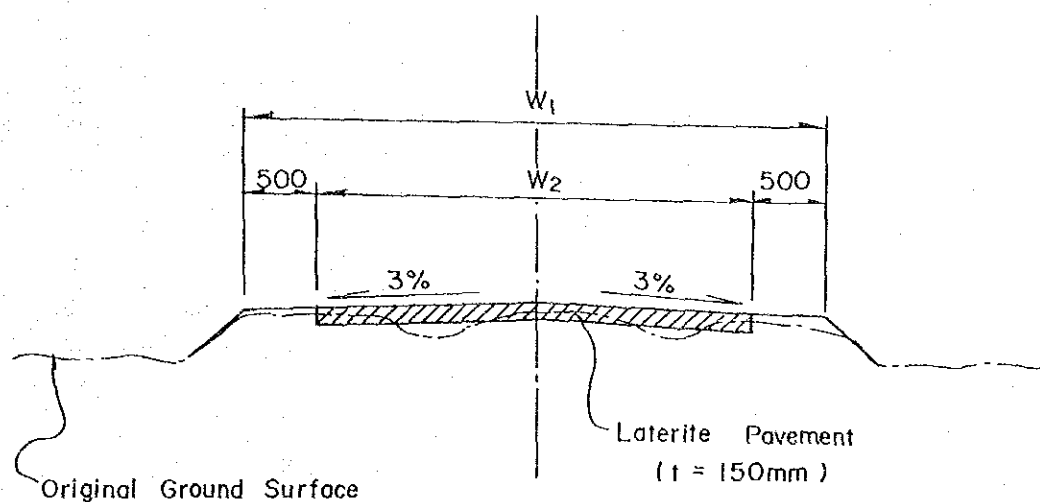


Fig. VI-1 EXISTING RURAL INFRASTRUCTURES AND PROPOSED DEVELOPMENT PLAN



Location of Village Roads	Total Length (m)	W_1 (mm)	W_2 (mm)
* R 13 To Ban Pha Khao	500	7,000	6,000
* R 13 To Ban Sa Phang Muk	500	6,000	5,000
* R 13 To Ban Xai	400	5,000	4,000
Ban Sam Khe To Ban Sok Noi	1,250	7,000	6,000
Ban Sok Noi To Ban Sok Nhai	1,550	4,000	3,000
Ban Sok Noi To Ban Na Biene	2,500	4,000	3,000

* R13 National Road of Route 13

Fig. VI-2 TYPICAL CROSS SECTIONS OF VILLAGE ROADS

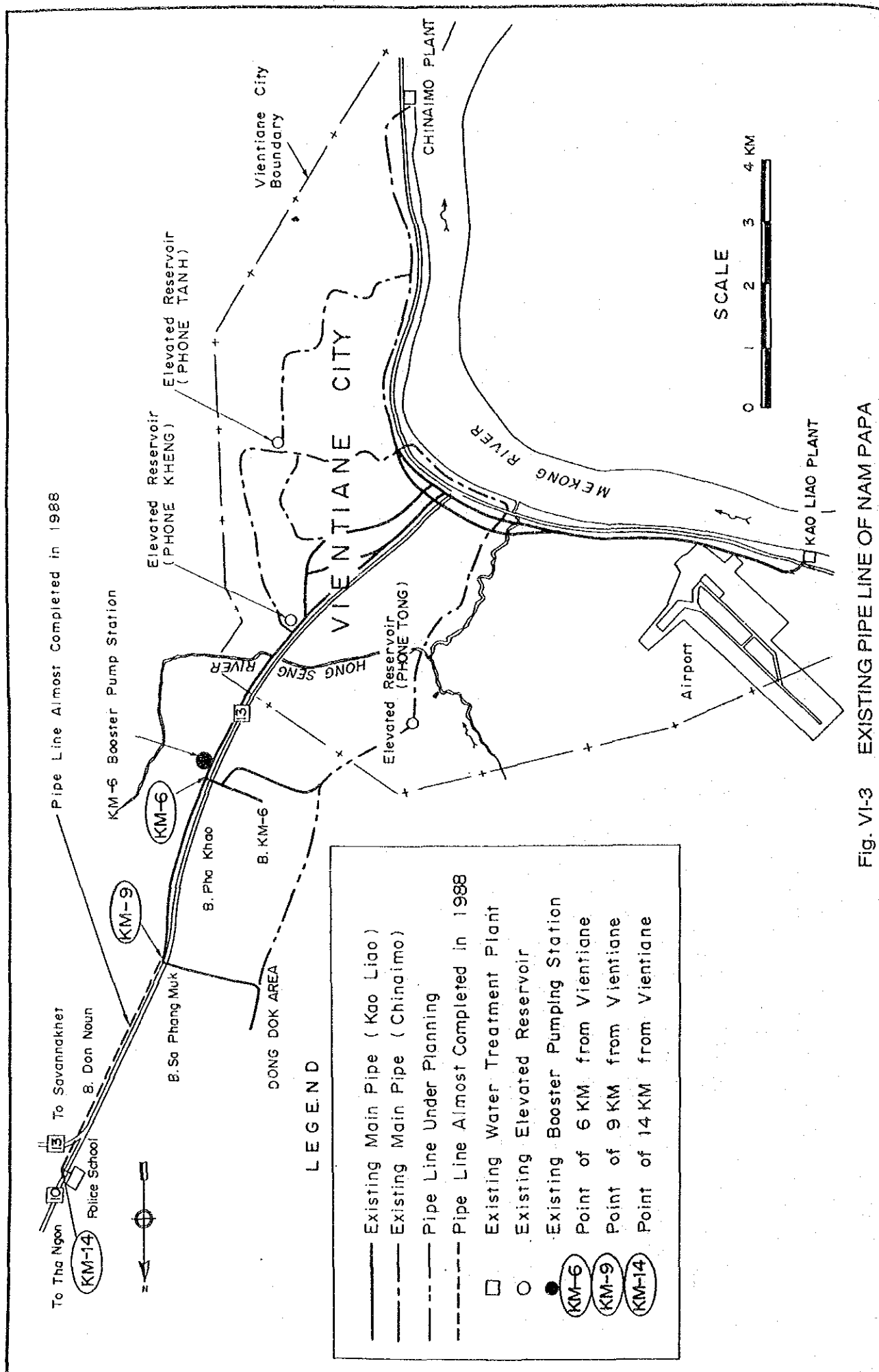


Fig. VI-3 EXISTING PIPE LINE OF NAM PAPA

ANNEX VII

AGRICULTURAL ECONOMY

ANNEX VII

AGRICULTURAL ECONOMY

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1. General

The present study on agricultural economy is designed to clarify the present condition of rural economy and to forecast future economy after the implementation of the Project.

In order to clarify the prevailing conditions, field investigation and data collection were made in and around the Project area. The data and information were mainly obtained from the government authorities concerned such as MAF, Vientiane Municipality, Saythany District, Saysetha District, State Company Agro-Impex Lao, etc.

In parallel with such data collection, a farm interview survey was carried out for 93 farm households in the study area during the period from September 6 to 13, 1988 so as to obtain detailed information on farm economy. Farm budget analysis was made mostly based on this survey result.

2. Agro-economical Background

2.1 Agriculture in Lao Economy

2.1.1 Employment and production

Agriculture is the backbone of national economy of Lao PDR. Approximately 80% of the labor force is engaged in this sector and its production constitutes more than 65 % of GDP as shown below.

Sectoral Distribution of Employment and GDP

Sector	Employment	GDP
Agriculture & Forestry	80.0%	65.2%
Industry	2.2%	14.0%
Services	17.8%	20.8%

Source: World Bank, 1988

Most of the agricultural production is carried out on a family smallholder basis and most land is cultivated under rainfed conditions permitting only single paddy or upland crop cultivation per annum. Yields are consequently low, among the lowest in Asia, though they have been steadily increasing.

Tables VII-1, VII-2 and VII-3 show planted area, production and unit yields of major crops from 1976 to 1987. Of all the produced crops in Lao PDR, rice is the predominant crop as a staple food of Laotian people. Apart from rice, the most significant edible crops are maize, root crops and vegetables. Coffee and tobacco are important crops with export potential. Forestry is also an important sector accounting for nearly 10% of the value of exports and providing the basis for wood processing industry. The composition of official export and import in the years of 1986 and 1987 is given in Tables VII-4 to V-7.

2.1.2 Rice production

Rice occupies more than 80% of cultivated area, and most of the rice grown consists of glutinous varieties. Rice is grown by almost every farmer and many farmers grow only rice. According to "BASIC DATA", the official national statistics, about 650,000 ha is

planted in the rainy season, 60% of which is in lowland and the remaining in upland. In the dry season, about 10,000 ha or 1.5% of the total rice area is planted with irrigation. The lowland rice areas are mainly located in the riverain plains of the southern and central regions. Upland rice production, some of which is produced through slash and burn method, predominates in most northern part of the country. Over 1985-87, yields of paddy averaged 2.7, 2.8 and 1.3 tons/ha respectively for lowland rainy season paddy, irrigated dry season paddy and upland paddy. The average production amounts during the same period are 1,018,000 tons, 28,000 tons and 304,000 tons respectively and in total 1,350,000 tons.

Because of the lack of irrigation and flood control facilities, rice production is vulnerable to drought or flood. About 90% of the paddy field is planted to a wide range of native varieties which are predominantly long-straw glutinous varieties adapted to low fertility conditions and traditional cultural methods. Intensive cultivation techniques such as input of fertilizer and farm chemicals are not yet adopted even in irrigated areas.

Though the production of rice has been steadily increasing and imported amount of rice has decreased comparing to that of 1970 s, the country constantly imports more than 20,000 tons of rice from Thailand as shown below.

Imported Amount of Rice

Year	1978-1980	1983	1984	1985	1986	1987
(ton)	72,300	26,500	38,000	23,000	20,000	29,300

Source: 1978-1986: FAO Trade Yearbook, 1987: BASIC DATA, Lao PDR

2.1.3 Other food crops

Maize is the most broadly grown food crop next to rice in Lao PDR. About 27,000 ha is grown annually and average yield is very low at 1.4 tons/ha. Average annual production during 1985-87 is about 37,000 tons. Almost 90% of the maize produced is vegetable maize. Most of maize is grown in some upland area for household consumption and forms an important component of the diet. Small but increasing amounts of maize are being purchased by government for processing into animal feed.

Other food crops such as root crops, vegetables and beans are confined largely to backyard production or on small plots around urban areas. They are grown for home

consumption or animal feed, with surplus production being sold in the local markets. The main production constraints are the lack of water supply in the dry season at the village level and the lack of adequate supply of good seed.

2.1.4 Industrial crops

The main industrial crops in Lao are coffee, tobacco, sugarcane and cotton. They are planted in the area of about 14,300 ha, 4,900 ha, 3,800 ha and 5,600 ha respectively. (see Tables VII-1, 2 and 3). Production of these crops is severely affected by the destruction of plantations and subsequent neglect during the war.

Coffee is the traditional export crop and grown almost exclusively on the Boliven Plateau located in Saravane and Champasak Provinces, in the southern part of Lao PDR. The area in plantation has been almost tripled owing to new plantings during 1980's, but yields on old trees have decreased and new trees are not yet in full production. Consequently, average yields have declined to be nearly half during the period from 1980 to 1987.

Tobacco is grown on the drainage-free levee soils of the Mekong River and its tributaries in the dry season, using hand watering techniques or small pumps. Yield and quality are rather low due to poor management and lack of inputs.

Sugarcane is grown on small plots by private farmers for sale in local markets. Insufficient facility for processing causes the small production and some 5,000 tons of sugar are imported every year. However, as sugar mills has been newly constructed since 1985, sugarcane production has been rapidly increasing recently.

Cotton is grown on small plots under rainfed conditions in the upland areas. Harvested seed cotton is currently ginned by hand using small, locally manufactured wooden roller gins. Much of the fiber is spun into yarn and used in cottage industries at the village level.

2.1.5 Livestock and fishery

Livestock also plays an important role in agriculture as a source of draft power and protein. Animals are kept in the backyards of farm houses, and they provide pork, chicken and eggs for home consumption and village level sales. Buffaloes are indispensable for land preparation and reclamation activities. In 1987, the livestock in Lao PDR is reported to consist of 1 million of buffaloes, 0.7 million of cattle and 1.4 million of pigs.

Fishery is carried on only in small scales though fishery resources such as fish and frogs are found throughout the country. Its production is rather small but one of the important cash income sources for many families.

2.1.6 Forestry

The forestry sector is of potentially enormous importance in Lao economy. Forestry products are the country's second largest foreign exchange earner after electricity as shown in Tables VII-4 and VII-5. It is estimated that Lao has approximately 11 million ha of forest and about 4.4 million ha is economically exploitable. Most of them are located in the lower Mekong river basin and their stock include redwood, mahogany, ironwood, teak and pine. Production of timber in 1987 was 365,000 m³ and showed significant increase from 54,512 m³ in 1980. Though the main part of forestry production is for domestic consumption, 20,000 m³ of timber, 5,900 m³ of lumber and 68,100 of plywood sheets were exported in 1987.

2.2 Development Policy for Agriculture

2.2.1 The Interim Three Year Development Plan

After the foundation of Lao PDR, the Government launched the Interim Three Year Development Plan (1978-1980) in order to restore deteriorated economy and increase production. The objectives of the plan were to develop the agricultural sector and reach self-sufficient of food by 1980, to expand exports of forestry products, to construct the national road of rout 9 as an alternative route to sea through Vietnam and to expand education and training.

Laotian economy achieved a substantial recovery and improvement of food self-sufficiency during this period. The paddy production increased by 15% per annum from 1977 to 1980. GDP is estimated to have grown at a rate of 7% per annum in real terms during the same period. However, the recovery was made only in limited areas, and the economic infrastructure was far from satisfactory.

2.2.2 The First Five Year Development Plan

In view of the unsatisfactory achievement of the previous Three Year Plan, the Government planned to continue the economic development along the same lines laid down

by the said Plan, and formulated the First Five Year Plan (1981-85). The major objectives of this Plan were:

- (1) To increase agricultural and forestry production so as to provide enough food for consumption and to increase exports of timber, coffee and tobacco
- (2) To increase industrial production
- (3) To improve basic infrastructure by expanding internal transport, constructing the national road of route 9, and by developing the distribution network for electricity
- (4) To improve the internal distribution of goods
- (5) To increase the number of state enterprises and state controlled cooperatives so as to consolidate the leading role of the socialist sector in the economy
- (6) To increase the mobilization of resources for investment through taxation, exports and foreign aid
- (7) To expand the education and training system and improve the health system
- (8) To improve economic management and organization

So far as agricultural sector is concerned, the Plan focussed on increasing production of rice by expansion of cultivation areas and introduction of irrigation.

During the period from 1981 to 1985, GDP is estimated to have increased at a rate of 5.4% per annum in real term. Agriculture was the major growth sector mainly because of the increase of paddy production, largely as a result of favorable climate condition. On the other hand, despite relatively large investment in the industrial sector, investment returns were much less than initially expected in the period. This is mainly due to inefficient state industrial sector and discouragement of private sector.

2.2.3 The Second Five Year Development Plan

In 1986, the Government commenced the Second Five Year Development Plan (1986-90). This Plan includes government commitment to a New Economic Mechanism (NEM) which involves a comprehensive series of economic reforms covering agricultural price

policy, adjustments of wage levels and introduction of cost-accounting and profit-oriented principles to public enterprises.

The objectives of the Plan are:

- (1) Agricultural diversification with emphasis on exportable products and change in agricultural price policies which will improve farmers' terms of trade
- (2) Maintenance of fiscal and monetary stability, giving priority to promotion of exports to improve the trade and payments balance and stabilization of debts
- (3) Strengthening of planning and economic management with emphasis on major public sector reforms
- (4) Small and medium-scale projects consistent with implementation
- (5) Expansion of implementation capacities through training of professional and technical specialists
- (6) Improvements of access to rural areas through rehabilitation of major roads and rural feeder roads
- (7) Control of inflation, giving priority to reduced monetary expansion, controlling public sector indebtedness, and expanding domestic savings

The objectives of the policy on agricultural sector in the Plan are:

- (1) To secure self-sufficiency in rice and maintain adequate security stocks
- (2) To diversify agriculture by expanding production of non-rice crops, livestock and fishery products for domestic consumption and for export
- (3) To increase exploitation and improve conservation of forest resources, with particular emphasis on controlling and gradually reducing slash-and-burn agriculture
- (4) To expand collectivization of agricultural production activities

The Second Five Year Plan gives priority to crop diversification and development of cash crops, livestock and forest products, while the First Five Year Plan focussed on increase of rice production.

The 4th Resolution of Government announced in 1986 put emphasis on the implementation of two main programs; namely, further production increase of foodstuffs and reduction of slash and burn cultivation for eliminating forest destruction.

In 1987, the New Economic Policy was enforced in which increase of agricultural production was stressed on in order to emerge from the subsistence economy to market economy by promoting the following types of economy:

- Subsistence and semi-subsistence
- Small goods production
- Private enterprises
- Joint-venture between the State and private sector
- State-enterprises and cooperatives

The above five types have the equal footing and no subsidies are given to any of them. The one price system which depends on market force and trade liberalization has been adopted in line with the new policy. Under the new policy, agricultural production is to be based on family farms.

The main objectives of agricultural development are to expand the production of food crop and industrial crops. Targets of production increase during 1986-1990 are 29% for rice, 71% for coffee, 200% for mungbean and soybean, 340% for tobacco and 90% for groundnut.

In order to achieve these targets, firstly an intensive cultivation method will be introduced by enhancing, intensity of land use and introducing high yielding varieties suitable for local conditions. Secondly, irrigation facilities are planned to be reinforced by rehabilitating existing facilities as well as by providing new facilities under this plan, small and medium size projects are given high priority. By 1990, the area irrigated during the dry season is planned to be expanded to three times of that in 1985.

2.3 Agricultural Marketing

2.3.1 Marketing system

Marketing policy of the Government of Lao PDR is now on the way of restructuring in accordance with afore-mentioned NEM. The Government has started to loosen its control on marketing and prices and to leave them to a certain degree to the system of market force.

Before 1987, the marketing and prices of rice and coffee had been completely controlled by the Government as strategic agricultural crops. Foodstuff Company (Sabien Ahan) was the only authorized organization which can deal with rice, and its purchase price was determined by the Government every year. Inter-provincial transportation of rice was restricted by the Government. Coffee, the greatest exported agricultural product, was controlled by the Coffee and Tea Committee under the Council of Ministry. The Committee was in charge of determination of price and planted area as well as extension service.

In addition to the above, for most of industrial crops such as sugarcane, soybean and mungbean were also determined both their purchase and retail prices by the Government. The prices thus set by the Government are generally low, discouraging farmers' intention and thereby causing slow growth of production. Vegetables were not under the official control and sold freely at markets.

In 1987, the Government started to revise its original policy and adopted a policy for lifting restrictions and facilitating expansion of private marketing. Official price control is abolished and crop prices come to be determined at open market or based on contracts between sellers (farmers or cooperatives) and buyers (traders, factories and others).

2.3.2 Surplus and deficit of rice

The surplus and deficit of rice at the national level is estimated based on the official statistics for the year of 1987. Per capita rice consumption of 180 kg (equivalent to 300 kg of paddy), handling and stage loss of 5% and seed stock of 66 kg/ha are assumed for the estimation based on the Standard Nutrient Requirement issued by MAF, estimation in FAO/UNDP Project Report on rice milling industry and the results of the farm interview survey.

It is estimated that Lao PDR had a deficit of rice amounting to about 38,000 tons in 1987 at national level. Regional unbalance of food supply between northern provinces and

southern provinces can be found as shown in Table VII-8. All the southern provinces except Sekong Province enjoyed surplus of rice, while all the northern provinces suffered from deficit.

2.4 Agricultural Support System

2.4.1 Agricultural research and seed multiplication

Agricultural research in Lao PDR is undertaken by Integrated Agricultural Development Project (IADP) under the cooperation of UNDP and FAO. This project is controlled directly by one of the four vice ministers of MAF. Research works are carried out at several stations and Agricultural Research Center. Seed multiplication is undertaken by Agricultural Department of MAF. Seeds are produced at the research stations and Seed Production Center.

Research on rice and other crops is centered around several stations located in Vientiane Plain. There are three main research institutions around Vientiane, namely, Salakham Rice Research Station, Agricultural Research and Experiment Station at Hat Dok Keo and Agricultural Research Center.

Salakham Rice Research Station, located at Salakham, about 13 km southeast from Vientiane, was established in 1955 for the purpose of collecting local rice varieties, testing and screening IRRI varieties for suitability under Laotian conditions and multiplying seed of suitable varieties. This station has about 45 ha of farm for experiment and seed production and 34 staff in total.

Agricultural Research Station at Hat Dok Keo is located at Hat Dok Keo, about 12 km south from Vientiane. This Station was established in 1962 for the purpose of research and seed multiplication of non-rice crops. The Station consists of 1.5 ha of experimental farm and 14 ha of seed producing farm, and has 83 staff including researchers, administrative staff and workers. Research section of this Station is now planned to be merged with Agricultural Research Center, making the Station specialized in seed multiplication.

Agricultural Research Center was established in 1985 at Napok, 27 km northeast of Vientiane, under the financial and technical cooperation of UNDP/FAO as a part of IADP. This Center undertakes research on both rice and non-rice crops and is operated with 16 ha of experimental farm by 25 staff. At present, rice, maize, mungbean, soybean, sugarcane and cassava are being experimented.

In the southern provinces, a national research facility for coffee and cardamon was established at Pakse in Champasak Province in 1985, and two research stations for rice and other crops are under construction at Phone Ngam in Champasak Province and Tha Sa No in Savannakhet Province.

2.4.2 Extension service

Agricultural extension service is in charge of the Department of Information and Communication of Agricultural Technology of MAF in national level, and agricultural section of Agricultural and Forestry Service (AFS) of provinces and districts in local level. Most of extension activities are provided by provincial and district staff. They periodically visit villages and give advice and information to farmers for intensive crop production and crop diversification.

Several aid-supported projects, e.g. IDA's Agriculture and Rural Development Projects, are under implementation to help strengthen and intensify both research and extension activities on staple and export crops. However, the number of extension works and their ability are still far from providing sufficient service.

2.4.3 Agricultural credit

The State Bank of Lao (SBL) is the only formal source of credit in Lao PDR. Informal sources of money lenders do not exist. Present loan interest rate of SBL for agricultural investment is 10% per annum for short term loan (one year) and 6% per annum for long term loan (three years) as shown in Table VII-9.

Agricultural credit is not yet popularized among farmers because of subsistence farming practiced by most of them. According to the farm interview survey, only four out of 93 farmers interviewed borrow an average amount of Kip 21,000 for purchasing agricultural inputs.

At present, SBL is preparing a new agricultural credit project named "Rural Credit Project" under the financial assistance of the International Fund for Agricultural Development (IFAD) aiming at extension of credit service in the rural areas. This project covers four provinces i.e., Vientiane Municipality, Vientiane Province, Champasak Province and Saravan Province, and is planned to start its service in 1989. It is also planned to expand the project area to cover additional three provinces, i.e., Savannakhet, Sekong and Attapeu Provinces. The credit will be extended to farmers through District State Bank (branch of SBL) at an

interest rate of 8% per annum for short term loan (one year) and 6% per annum for medium and long term loan (three years and seven years respectively). Services for procurement of farm inputs will also be provided under the project.

2.4.4 Farm inputs supply

All of inorganic fertilizers and agro-chemicals are imported in Lao PDR. Most of these imported items are procured by State Company Agro-Impex Lao, an agency of MAF, State-Private Lao Phathana Import Export Company and Societe du Commerce du Lao Import Export. The imported amount by Agro-Impex, which occupies about 80% of total imported amount, is given in Table VII-10. Farm inputs are distributed to farmers through the following three routes:

- (1) Provincial and district AFS through MAF
- (2) Cooperatives
- (3) Private retail shops

Generally, delivery systems are efficient but the quantities supplied are limited. Most of the imported inputs as well as machinery have been directed to state farms. This resulted in limited usage of farm inputs in private farms.

2.4.5 Agricultural Cooperatives

- (1) Cooperative movement since revolution

Laotian farmers have been keeping a traditional system of mutual assistance in the form of work exchange called "Samakhi". In this system, farmers lend labor to neighboring farmers and it will be repaid in the same way. This system can be considered as an ancient and initial form of joint work and principal form of cooperation among agricultural producers.

After the revolution in 1975, the newly formed socialist government of Lao PDR has attempted to encourage the cooperative movement among farmers. In 1978, the Government announced the "Resolution of the Collectivization of Agriculture of 17 May, 1978" and started to reorganize Laotian agriculture in accordance with this guideline. In this line, 1,480 agricultural cooperatives were registered in 1978 and the number increased to 3,703 in 1987. The number of families joining in cooperative is 202,886 or 63% of total agricultural families and

208,404 ha or 55% of total low land paddy field is cultivated by cooperatives in 1987 as shown in Tables VII-11 and VII-12.

An agricultural cooperative normally covers one village though, large villages have plural number of cooperatives. An average cooperative has 56 ha of farm land and 55 member families. There exist three types of cooperatives as follows;

- i) Traditional "Samakhi" type, which is called solidarity group. This is not a ordinary cooperative in fact but is of a pre-cooperative form.
- ii) Collective group in which labor and some equipment are jointly used. In this type, group members share a certain part of the income on the basis of work input.
- iii) Agricultural production cooperative in which all inputs such as labor, land and means of production are in collective use. Members are obliged to participate in the joint work and are remunerated for the work performed.

The third type is the most popular form of cooperative promoted by the Government. The first two types are meant to develop into this type.

The Department of Cooperatives of MAF and provincial and district AFS are responsible for administration of cooperatives. They promote cooperative movement, instruct and train cooperative staff, and supervise cooperative audits.

(2) New cooperative policy

In spite of the government promotion for collectivization, farmers faced difficulties in participating in cooperatives such as limited financial resources and lack of experience in joint production. In addition, the lower purchase prices of agricultural products by cooperatives than in free market as well as the point wage system adopted by cooperatives discouraged farmers' intention for production drive.

In 1988, the Government revised its policy on cooperative movement in accordance with NEM adopted by the Party Congress in 1986, which acknowledged a broader scope for economic activity by individuals. According

to this new policy, farm is to be managed by farmers themselves and cooperative is characterized as organization for common purchase of farm inputs, common use of farm machinery and sale of products. New type of cooperatives consists of the following three categories.

- i) Solidarity group (same as the former one)
- ii) Shop cooperative, which makes a contract with farmers' group for providing means of production to farmers and purchasing all products from farmers in return. Shop cooperative sells purchased products to the Government and/or private traders.
- iii) Family contract system of agricultural cooperative, in which individual farmer makes a contract with cooperative. Under this contract, the cooperative provides land preparation services, lends means of production and so on. Farmers pay charge for the provided services, and 7% of products as social welfare fee and agricultural tax. Agricultural tax is paid to district office through cooperative and cooperative is paid back 15% of tax as a subsidy. Farmers can sell their surplus product freely on their own responsibility.

The Government is giving instructions to existing agricultural cooperatives (except those running satisfactorily) so that they will adopt the family contract system.

3. Present Condition of Agricultural Economy in the Project Area

3.1 Population and Number of Household

The Project area is administratively located in Tha Ngon, Pha Khao and Ban Xai Sub-districts of Saythany District and Ban Doung and Non Niang Sub-districts of Saysetha District in Vientiane Municipality and covers 12 villages. Eight of them are in Saythany District and the remaining in Saysetha District. The administrative divisions are illustrated on Fig. VII-1. Present population and number of households of 12 villages are shown below:

Village	Population	Nos. of Household	Average Family Size
Ban Pha Khao	1,925	311	6.2
Ban Sa Phang Muk	710	149	4.8
Ban Don Noun	1,263	206	6.1
Ban Xai	1,326	170	7.8
Ban Na Khe	655	101	6.5
Ban Dan Xang	1,318	198	6.7
Ban Dong Sang Hinh	691	117	5.9
Ban Na	1,380	303	4.6
Ban Sok Nhai	996	165	6.0
Ban Sok Noi	1,129	197	5.7
Ban Phone Thong	494	78	6.3
Ban Na Biene	370	57	6.5
Total	12,257	2,052	6.0

Source: Saythany and Saysetha District Offices

The total population of the above 12 villages is almost identical with that of the Project area of 4,750 ha, and the population density is therefore calculated to be about 258 persons per km². The population growth rate is estimated at 2.9% per annum. According to the population census in 1985¹, the economically active population in the age group of from 15 up to 60 years old is about 48% of the total population. The total number of household is 2,052 and the average family size is estimated at 6.0 persons per family. Of all the households, 1419 or about 70% are engaged in farming. Average available labor force for agriculture is estimated at 2.6 persons per household based on the farm interview survey, assuming the coefficient of labor force to be 0.8 for female farmer and farmer above 60 years old and 1.0 for male farmer in the age between 15 and 60. The general feature of the

¹: Census data are available for only four villages of Saysetha District out of 12 villages.

demographic condition and number of household and farm household are given in Table VII-13.

3.2 Land Holding and Land Tenure System

Since ownership of all the land belongs to the National Community of Lao PDR, there is no land tenure system in Lao PDR. People is, however, authorized to own, rent and transfer land use right. Therefore, land ownership or land tenure mentioned hereinafter actually means the right of using land.

The average size of farm per household in 12 villages is estimated at 1.6 ha. This is only the area of paddy field, and grazing land and backyard field where vegetables or permanent crops are planted are not included.

The land tenure structure in the Project area is estimated based on the registration data of land for agriculture tax. Of all the registered owners in 12 villages, 87.7% of owners cultivate their own land by themselves, 7.8% live outside the village and rent their land to farmers in the village, and 4.5% live in the village and rent their land to farmers in the village. Details of the land tenure conditions are shown in Table VII-14. The distribution of farm holding size over all the owners in the 12 villages is shown in Table VII-15 and summarized below:

Land Holding size	Percentage Distribution
0.5 ha and less	10.3%
0.5 ha - 1.0 ha	19.2%
1.0 ha - 1.5 ha	17.1%
1.5 ha - 2.0 ha	15.1%
2.0 ha - 3.0 ha	21.2%
more than 3.0 ha	17.1%

Source: Saythany and Saysetha District Offices

Agricultural tax is levied on land owners at the following rates:

Land Category	Unit Yield (y) (ton/ha)	Tax Rate (kg/ha of paddy)
I	$3.5 < y$	160
II	$3 < y \leq 3.5$	140
III	$2.5 < y \leq 3$	120
IV	$y \leq 2.5$	100

Source: Policy of Tax of the State 1988, Counsel of the Minsters Office.

Most of land rent is of the production sharing system in Lao PDR. In the Project area, the tenant charge is generally 20% of total production.

3.3 Agricultural Support Service

Agricultural extension service in the Project area are undertaken by three AFS staff of Saythany District and two AFS staff of Saysetha District in association with seven AFS staff of Vientiane Municipality. Since they are offering the services for not only the Project area but whole districts or municipality, no intensive services could be expected in the Project area. The farm interview survey revealed that nearly 60% of the interviewed farmers have never received extension services and almost all farmers who have received services complain the insufficiency of the services.

There exist no agricultural cooperatives in the Project area. Village authorities are the only existing administrative organizations and are responsible for every aspect of village activities including land registration and collection of agro-tax.

3.4 Marketing and Prices

3.4.1 Demand and supply of rice

The main crop grown in the Project area is paddy and other crops are grown only in small scale in the backyard of farm houses. Most of the produced paddy is self-consumed by farmers and marketable surplus is only a small amount. The following is an estimation of marketable amount of 12 villages in the Project area:

For the estimation, the balance of surplus and deficit is examined on the basis of the following assumptions.

- (1) Family size of a farm household is the same as that of a non-farm household.
- (2) Production of dried paddy is estimated based on that in 1987.
- (3) Annual per capita consumption is estimated to be 350 kg per year of dried paddy based on the result of farm interview survey.
- (4) Handling and storage losses of paddy are assumed at 5% of the total production.
- (5) Seed stock is taken at 66 kg per ha based on the result of farm interview survey.
- (6) Agricultural Tax is levied at a rate of 100 kg per ha.

The total production of paddy in the 12 villages is estimated at 3,705 tons in 1987. Out of this amount, only 59 tons of paddy are estimated to be marketable surplus after deducting 163 tons of seed stock, 185 tons of handling and storage losses, 247 tons of agricultural tax and 3,051 tons of self-consumption. Details of the estimation are shown in Table VII-16. Considering the consumption of non-agricultural population in the Project area, the final balance shows a deficit of 1,003 tons per year.

Vientiane Municipality, having a population of 404,000 (1987) relatively high ratio of which is non-agriculture population, has a large demand for rice. According to the estimation of Vientiane Foodstuff Company State-Private Import Export, annual demand of non-agriculture population for paddy in Vientiane Municipality is 78,300 tons consisting of 48,000 tons for central government officials including the military, 7,500 tons for municipality officials, 4,800 tons for district officials, 12,000 tons for market and 6,000 tons for necessary stock. Vientiane Municipality faces a chronic rice deficit and most of imported rice amounting to more than 20,000 tons per year is supplied to the Municipality to supplement such a deficit.

3.4.2 Marketing and Prices

The surplus of paddy produced by farmers had been purchased exclusively by Foodstuff Company (district level) until 1987. However, as explained in Section 2.3.1, private traders have been allowed to buy paddy directly from farmers since 1988. Semi-governmental companies such as Vientiane Foodstuff Company State-Private Import Export also begin to deal with paddy. Marketing route of paddy and rice in Lao PDR is abstracted in Fig. VII-2.

Foodstuff Companies (district level) buy paddy directly from farmers as well as from district offices which collect paddy from farmers as agricultural tax. Part of the purchased paddy at district level is distributed to district officials through the same companies and the remaining are supplied to municipality officials and central government officials through Foodstuff Company of Vientiane Municipality and Central Foodstuff State Company. Private traders purchase paddy directly from farmers and sell at the market in Vientiane.

Crops other than rice are produced mainly for self-consumption, though some amount of these products are sometimes sold to private traders. Prices of vegetables seasonally fluctuate very widely as shown in Table VII-17. They soar in the rainy season due to shortage of supply, but slump during the dry season when many farmers grow them.

Farm inputs are distributed to farmers through provincial and district AFS, cooperatives and retail shops as described in Section 2.4.4.

The present farm gate prices of farm products and farm inputs are given in Table VII-18.

3.5 Agricultural Production Value

Present crop production cost is estimated only for paddy production because paddy is the only crop cultivated broadly in the Project area at present. The estimation was based on data obtained from MAF, State Company Agro-Impex and the result of the farm interview survey carried out in the Project area.

The paddy production cost is estimated in the form of primary production cost, in which land costs are not included, and it comprises the following items of expenses:

- (1) Cost of farm inputs consisting of seeds, fertilizers, and agro-chemicals
- (2) Labor cost (mainly family labor)
- (3) Indirect expenses for depreciation of farm houses, farm equipment, etc.

The present paddy production cost per hectare is estimated at about Kip 60,200 for rainy season paddy and Kip 85,100 for dry season paddy as shown in Table VII-19. The gross production value and production cost in the Project area under the present condition are estimated at about Kip 244.7 million and about Kip 194.2 million respectively as shown below:

Item	Rainy season paddy	Dry season paddy
Planted area (ha)	3,030	139
Average yield (ton/ha)	1.5	2.5
Total production (ton)	4,545	348
Gross production value (Kip 1,000)	227,250	17,400
Unit production cost (Kip/ha)	60,200	85,100
Total production cost (Kip 1,000)	182,406	11,829
Net production value (Kip 1,000)	44,844	5,571

As shown above, the annual net production value under the present condition within the Project area is estimated at Kip 50.4 million in total, after deducting total production cost from gross production value.

3.6 Present Farm Budget

In order to grasp economic activities of the farmers in the Project area, the farm interview survey was carried out for 93 farm households during the period from September 6 to 13, 1988. The analysis of interview results is made for three different farm size of farmers; i.e., 1 ha or less, 1 - 2 ha and more than 2 ha. The results of farm budget survey are summarized in Table VII-20.

Farmers in the Project area rely on non-agricultural sources for fairly high percentage of their income. In average, about 40% of total annual income is obtained from non-agricultural sources such as salary/wage and remittance. This is because the Project area is located in the suburbs of Vientiane and the inhabitants therefore have much opportunity of employment in non-agricultural sector. Nearly half of total income, which corresponds to 80% of farm income is earned by selling short term crops. According to the interview survey, only 15% of the short term crop income accrues from selling paddy. Short term crop income from non-rice crop is supposed to be earned from selling of surplus vegetables. The interview results on farmers' income are given in Table VII-21.

As regards farmers' living expenditures (except farm input expenses), the average annual expenditure per household is estimated at Kip 148,800, consisting of Kip 19,400 (or 13%) for rice, Kip 41,700 (28%) for other food, Kip 28,000 (19%) for cloth, Kip 5,100 (3%) for residence, Kip 5,100 (3%) for education, Kip 9,800 (7%) for medical care, Kip 39,700 (27%) for others. The interview results on expenditure are given in Table VII-22.

Taking average cost for farm input into account, annual cash balance of a farm household by each farm size is estimated as shown below:

(Unit: Kip/household/year)			
Farm scale	1 ha or less	1 - 2 ha	more than 2 ha
<u>Income</u>	<u>194,500</u>	<u>262,300</u>	<u>323,300</u>
Farm income	109,000	135,700	213,000
Off-farm income	88,500	126,600	110,300
<u>Expenditure</u>	<u>163,700</u>	<u>142,700</u>	<u>219,100</u>
Farm expense ¹	7,900	15,800	28,700
Agriculture Tax ²	4,200	8,400	15,300
Living expense	151,600	118,500	175,200
<u>Net reserve</u>	<u>30,800</u>	<u>119,600</u>	<u>104,100</u>

¹: (Production cost per ha of rainy season paddy deducted labor cost) x (average farm size of 0.84 ha, 1.68 ha and 3.05 ha)

²: Tax rate is assumed at 100 kg/ha (applied to the farm, in which yield is less than 2.5 tons/ha)

As is clear in the above table, farmers in the Project area rely on not only farm incomes but off-farm incomes for their living expenditures.

4. Forecast of Agricultural Economy

4.1 General

Future agricultural economic conditions after the completion of the Project are forecasted in this chapter. In this forecast, three aspects of agricultural economy i.e., demand and supply, value of agricultural production and farm budget, are analyzed, assuming that the basic economic conditions other than those created by the Project will remain unchanged.

4.2 Future Demand and Supply

According to the proposed agricultural development plan, future annual agricultural production is forecasted as follows:

Crop	Without Project			With Project		
	Area	Yield	Production	Area	Yield	Production
	(ha)	(ton/ha)	(ton)	(ha)	(ton/ha)	(ton)
Rainfed Rainy Season Paddy	3,030	1.5	4,545	701	1.5	1,052
Irrigated Rainy Season Paddy	0	-	-	2,700	4.5	12,150
Irrigated Dry Season Paddy	139	2.5	348	2,150	5.5	11,825
<u>Paddy Total</u>	<u>3,169</u>	<u>-</u>	<u>4,893</u>	<u>5,551</u>	<u>-</u>	<u>25,027</u>
Soybean	-	-	-	350	2.0	700
Groundnut	-	-	-	160	2.5	400
Garlic	-	-	-	40	7.0	280

Expected increase of agricultural production is 20,134 tons of paddy, 700 tons of soybean, 400 tons of groundnut and 280 tons of garlic. So far as upland crops are concerned, almost all the production amount will be marketable. As for paddy rice, the marketable amount of paddy is estimated on the basis of the following assumptions.

- (1) Projected production will be fully attained by the year of 1998.
- (2) Present agricultural population of 8,718 will increase at a rate of 2.9% per annum.

- (3) Per capita consumption of rice will be 300 kg/year.
- (4) Agro-Tax will be 160 kg/ha of paddy for irrigated field and 100 kg/ha of paddy for rainfed field.
- (5) Seed stock will be 50 kg/ha for each crop season (of which 40 kg/ha will be sown after seed selection).
- (6) Handling and storage losses will be 5% of production.

Annual marketable surplus of paddy is estimated at about 19,500 tons by deducting above-mentioned self-consumption, agro-tax, seed stock and losses from the total production as follows:

Item	Paddy amount (tons)	Note
Production	25,027	
Self-consumption	3,481	$8,718 \times 1.029^{10} \times 0.3$
Agro-Tax	502	$0.16 \times 2,700 + 0.1 \times 701$
Seed stock	278	$0.05 \times (2,700 + 2,150 + 701)$
Losses	1,251	$25,027 \times 0.05$
Marketable surplus	19,515	
Consumption by Non-agro population	1,413	$3,539 \times 1.029^{10} \times 0.3$
Net areal surplus	18,102	

Considering the consumption amount by non-agricultural population (3,539 and assumed to increase at the same rate as agricultural population), the net areal surplus is calculated at 18,100 tons.

Surplus marketable amount of paddy will be purchased by Foodstuff Company and/or private traders and marketed in Vientiane urban area, where rice is in deficit. Such amount of paddy will substitute for imported rice, which presently amounts to about 20,000 tons (equivalent to 33,000 tons of paddy). The population of Vientiane Municipality increased at a rate of 2.9% per annum during 1983-87, and is expected to increase more rapidly in future. Since the demand for rice will also increase in conformity with such population increase, the supply of rice in Vientiane urban area will still remain insufficient even after the completion of the Project.

4.3 Future Agricultural Production Value

Future agricultural production value is estimated on the basis of the above mentioned agricultural development plan and the present price level of farm inputs.

Estimated crop production cost comprises the following items of expenses.

- (1) Cost of farm inputs, consisting of seeds, fertilizers, and agro-chemicals.
- (2) Labor cost
- (3) Machinery cost for land preparation
- (4) Indirect expenses for depreciation of farm houses, farm equipment, etc.

As regards machinery cost, it is estimated based on the current land preparation charge set by Agricultural Machinery Company, assuming that only 20% of the Project land will be cultivated mechanically.

Future crop production cost per hectare is estimated at Kip 121,800 for rainy season paddy, Kip 123,000 for dry season paddy, Kip 101,200 for Soybean, Kip 107,100 for groundnut and Kip 610,500 for garlic as shown in Tables VII-23 and 24. The estimation of gross production value, production cost and net production value of each crop is given in Table VII-25 and the result is tabulated as follows:

(Unit: Kip 1,000/year)

Crop	Gross Production Value	Production Cost	Net Production Value
Irrigated Rainy Season Paddy	607,500	328,860	278,640
Irrigated Dry Season Paddy	591,250	264,450	326,800
Rainfed Rainy Season Paddy	52,575	42,200	10,375
Soybean	91,000	35,420	55,580
Groundnut	24,000	17,136	6,864
Garlic	56,000	24,420	31,580
Total	1,422,325	712,486	709,839

As seen above, the annual net production value under with project condition is estimated at Kip 709.8 million, which is about 14 times of the present net production value.

4.4 Future Farm Budget

In order to assess the effect of the Project on farmers' budget, future farm budget is forecasted. The assessment is made for three different sizes of farmers for the following two cropping patterns:

Case-1 : Double cropping of paddy a year

Case-2 : Rainy season paddy and upland crops in dry season

Further the basis of the following assumptions are made in estimating the future budget.

- (1) Non-farm income will be at the same level as the present one.
- (2) Propensity to consume of farmers will be at the same level as the present propensity ratio of farmers having more than 2 ha of farm..
- (3) Agricultural tax will be imposed at a rate of Kip 160/ha (equivalent to the rate currently imposed on the land, in which paddy yield is more than 3.5 tons/ha).

The result of the analyses under both with- and without-project conditions are shown in Table VII-27 and summarized as follows:

(Unit: Kip/household/year)			
Item	1 ha and less	1 - 2 ha	more than 2 ha
Without Project			
Total Income	194,500	262,300	323,300
Total Expense	163,700	142,700	219,200
Net Reserve	30,800	119,600	104,100
Disposable Income	182,400	238,100	279,300
With Project			
Case-1: Paddy-Paddy			
Total Income	551,500	976,300	1,619,600
Total Expense	349,300	540,000	1,163,700
Net Reserve	202,200	436,300	455,900
Disposable Income	442,300	757,900	1,223,100
Case-2: Paddy-Upland crops			
Total Income	581,900	1,037,100	1,730,000
Total Expense	380,600	603,100	1,276,900
Net Reserve	201,300	434,000	453,100
Disposable Income	440,300	753,800	1,215,700

Total incomes under with-project condition are expected to become 2.8 to 5.4 times those of under without-project condition, depending on farm size and cropping pattern. Though farm expense will also increase 13.0 to 17.1 times, annual disposable income (derived from deducting farm expense and agro-tax from total income) of each farmer is estimated to be 2.4 to 4.4 times of the present one. Thus, the living standard of farmers in the Project area will be evidently enhanced by implementation of the Project.

Table VII-1 Planted Area of Main Crops, 1976 - 1987

(Unit: 1,000 ha)

Year	1976-1979 average	1980	1981	1982	1983	1984	1985	1986	1987
Paddy Total	578.5	732.0	745.0	736.9	694.3	655.1	663.5	651.7	551.5
Rainfed paddy	352.3	426.9	433.2	435.0	396.4	360.3	383.1	385.0	356.7
Irrigated paddy	4.9	7.7	6.5	5.7	6.0	8.6	10.0	10.1	9.6
Upland paddy	221.3	297.4	305.3	296.2	291.9	286.2	270.4	256.6	185.2
Maize	20.8	28.3	30.9	31.5	29.8	28.6	26.9	29.6	24.8
Sweet potatoes and cassava	7.5	9.1	11.0	12.0	11.7	11.9	10.2	8.7	16.6
Mungbean	1.9	2.9	3.0	3.0	3.0	3.0	2.4	1.8	2.8
Soybean	3.0	4.8	5.5	5.5	4.8	5.2	3.1	3.5	4.9
Groundnuts	7.3	10.7	11.3	11.5	11.3	11.5	6.6	5.2	6.5
Tobacco	2.4	4.0	4.4	4.4	3.1	3.6	3.6	3.2	4.9
Cotton	5.3	7.0	7.1	7.2	7.2	7.2	5.2	4.2	5.6
Sugarcane	0.7	0.9	0.9	0.9	1.1	1.9	2.6	2.6	3.8
Coffee	4.8	6.5	7.7	7.7	8.2	11.1	12.6	13.1	14.3

Sources: 1. MAFIC, *Agricultural Statistics 1976-1983*, 1984

2. State Planning Committee, *10 Years of Socio-Economic Development in the Lao PDR*, 1985

3. State Committee of Economy, Planning and Finance, *Basic Data about the Social and Economic Development of Lao PDR 1987*, 1988

Table VII-2 Production of Main Crops, 1976 - 1987

(Unit: 1,000 ton)

Year	1976-1979 average	1980	1981	1982	1983	1984	1985	1986	1987
Paddy Total	729.6	1,053.1	1,154.7	1,132.4	1,063.2	1,321.0	1,395.1	1,449.1	1,207.1
Rainfed paddy	497.4	705.0	782.2	770.5	761.9	919.2	1,023.3	1,081.7	950.7
Irrigated paddy	6.8	11.1	12.3	12.4	12.5	21.4	26.5	27.3	28.7
Upland paddy	225.4	337.0	360.2	349.5	288.8	380.4	345.3	340.1	227.7
Maize	28.4	30.0	32.8	34.7	31.9	33.9	33.3	41.5	35.7
Sweet potatoes and cassava	64.0	80.3	97.1	95.8	95.7	96.6	85.5	65.5	118.6
Mungbean	1.0	1.6	1.7	1.8	1.7	1.8	1.5	1.0	1.9
Soybean	2.1	3.3	3.9	4.2	3.5	3.6	2.1	2.6	3.7
Groundnuts	5.4	7.9	8.7	9.2	8.7	8.9	5.2	4.2	5.6
Tobacco	10.1	16.6	19.1	19.7	15.5	16.5	15.7	14.0	24.7
Cotton	3.6	4.9	5.0	5.2	5.0	5.1	2.9	2.6	4.0
Sugarcane	19.2	23.5	24.1	25.7	28.8	54.5	73.0	72.3	112.8
Coffee	3.0	4.4	5.0	5.2	5.3	5.8	6.1	5.0	5.3

Sources: 1. MAFIC, *Agricultural Statistics 1976-1983*, 1984

2. State Planning Committee, *10 Years of Socio-Economic Development in the Lao PDR*, 1985

3. State Committee of Economy, Planning and Finance, *Basic Data about the Social and Economic Development of Lao PDR 1987*, 1988

Table VII-3 Unit Yield of Main Crops, 1976 - 1987

(Unit: ton/ha)									
Year	1976-1979 average	1980	1981	1982	1983	1984	1985	1986	1987
Paddy Total	1.26	1.44	1.55	1.54	1.53	2.02	2.10	2.22	2.19
Rainfed paddy	1.41	1.65	1.81	1.77	1.92	2.55	2.67	2.81	2.67
Irrigated paddy	1.39	1.44	1.89	2.17	2.08	2.48	2.65	2.70	2.99
Upland paddy	1.02	1.13	1.18	1.18	0.99	1.33	1.28	1.33	1.23
Maize	1.37	1.06	1.06	1.10	1.07	1.19	1.24	1.40	1.44
Sweep potatoes and cassava	8.53	8.82	8.83	7.98	8.18	8.12	8.38	7.53	7.14
Mungbean	0.53	0.55	0.57	0.60	0.57	0.60	0.63	0.54	0.66
Soybean	0.70	0.69	0.71	0.76	0.73	0.69	0.69	0.75	0.76
Groundnuts	0.74	0.74	0.77	0.80	0.77	0.77	0.79	0.80	0.86
Tobacco	4.21	4.15	4.34	4.48	5.00	4.58	4.36	4.38	5.06
Cotton	0.68	0.70	0.70	0.72	0.69	0.71	0.56	0.62	0.71
Sugarcane	27.43	26.11	26.78	28.56	26.18	28.68	28.08	27.81	29.68
Coffee	0.63	0.68	0.65	0.68	0.65	0.52	0.48	0.38	0.37

Sources: 1. MAFIC, *Agricultural Statistics 1976-1983*, 1984

2. State Planning Committee, *10 Years of Socio-Economic Development in the Lao PDR*, 1985

3. State Committee of Economy, Planning and Finance, *Basic Data about the Social and Economic Development of Lao PDR 1987*, 1988

Table VII-4 Composition of Official Exports, 1986

(Unit: US\$1,000)

Items	to Socialist Countries	to Capitalist Countries	Total	%
Electricity	0	27,759	27,759	56.3%
Logs	1,036	5,600	6,636	13.5%
Other wood products	2,024	0	2,024	4.1%
Coffee	5,914	0	5,914	12.0%
Tobacco	1,510	0	1,510	3.1%
Other agricultural products	363	1,054	1,417	2.9%
Tin ore	1,682	0	1,682	3.4%
Gypsum	2,244	0	2,244	4.6%
Others	2	89	91	0.2%
Total	14,775	34,502	49,277	100.0%

Source: Ministry of Economic Planning and Finance

Table VII-5 Composition of Official Exports, 1987
(estimated)

(Unit: US\$1,000)

Items	to Socialist Countries	to Capitalist Countries	Total	%
Electricity	0	14,817	14,817	30.0%
Logs	1,461	3,471	4,932	10.0%
Other wood products	10,584	89	10,673	21.6%
Coffee	10,423	80	10,503	21.3%
Tobacco	1,793	0	1,793	3.6%
Other agricultural products	845	373	1,218	2.5%
Tin ore	2,331	0	2,331	4.7%
Gypsum	2,477	0	2,477	5.0%
Others	637	23	660	1.3%
Total	30,551	18,853	49,404	100.0%

Source: Ministry of Economic Planning and Finance

Table VII-6 Composition of Official Imports, 1986

(Unit: US\$1,000)

Items	from Socialist Countries	from Capitalist Countries	Total	%
Machinery and Vehicles	26,757	2,740	29,497	30.7%
Petroleum products	26,105	7,873	33,978	35.4%
Raw materials	552	8,431	8,983	9.4%
Foodstuff	2,160	3,285	5,445	5.7%
Medicine and Medical equipment	6,272	800	7,072	7.4%
Electricity	404	925	1,329	1.4%
Construction materials	754	313	1,067	1.1%
Others	2,481	6,085	8,566	8.9%
Total	65,485	30,452	95,937	100.0%

Source: Ministry of Economic Planning and Finance

Table VII-7 Composition of Official Imports, 1987
(estimated)

(Unit: US\$1,000)

Items	from Socialist Countries	from Capitalist Countries	Total	%
Machinery and Vehicles	37,640	5,074	42,714	32.8%
Petroleum products	36,684	5,075	41,759	32.0%
Raw materials	2,271	8,751	11,022	8.5%
Foodstuff	3,475	8,690	12,165	9.3%
Medicine and Medical equipment	9,139	850	9,989	7.7%
Electricity	1,286	1,159	2,445	1.9%
Construction materials	1,910	452	2,362	1.8%
Others	4,522	3,316	7,838	6.0%
Total	96,927	33,367	130,294	100.0%

Source: Ministry of Economic Planning and Finance

Table VII-8 Estimation of Surplus and Deficit of Paddy by Province in 1987

Province	(1) Population (thousand)	(2) Planted Area (ha)	(3) Production of Paddy (ton)	(4) Seed Stock 66kg/ha (2)x0.066 (ton)	(5) Handling & Storage Losses (3)x5% (ton)	(6) Consumption of Paddy 300kg/person (1)x0.3 (ton)	(7) Total Demand (4+5+6) (ton)	(8) Deficit/ Surplus of Paddy (3)-(7) (ton)
Vientiane Muni.	404	37,790	109,122	2,494	5,456	121,200	129,150	-20,028
Phongsaly	131	9,832	15,755	649	788	39,300	40,737	-24,982
Luangnamtha	104	16,885	26,290	1,114	1,315	31,200	33,629	-7,339
Oudomxay	200	29,369	49,383	1,938	2,469	60,000	64,408	-15,025
Bokeo	59	5,811	13,067	384	653	17,700	18,737	-5,670
Luangphrabang	314	34,321	56,079	2,265	2,804	94,200	99,269	-43,190
Houaphanh	224	31,892	45,931	2,105	2,297	67,200	71,601	-25,670
Xayabouri	237	24,047	42,707	1,587	2,135	71,100	74,822	-32,115
Xiengkhuang	173	21,295	47,645	1,405	2,382	51,900	55,688	-8,043
Vientiane	284	51,198	97,308	3,379	4,865	85,200	93,444	3,864
Borikhamxay	132	22,700	47,036	1,498	2,352	39,600	43,450	3,586
Khammouane	228	32,451	83,146	2,142	4,157	68,400	74,699	8,447
Savannakhet	584	89,733	234,006	5,922	11,700	175,200	192,823	41,183
Saravane	198	35,530	88,163	2,345	4,408	59,400	66,153	22,010
Sekong	54	7,664	9,534	506	477	16,200	17,183	-7,649
Champasack	430	76,966	210,024	5,080	10,501	129,000	144,581	65,443
Attapeu	74	14,534	31,960	959	1,598	22,200	24,757	7,203
Total	3,830	542,018	1,207,156	35,773	60,358	1,149,000	1,245,131	-37,975

Source: State Committee of Economy, Planning and Finance, *Basic Data about the Social and Economic Development of Lao PDR 1987, 1988*

Table VII-9 Interest Rates, 1979-88

(Unit: percent)

Items	Until June 1979	June 1979- July 1985	July 1985- Oct. 1988	Since Oct. 1988
<u>Deposit Rates</u>				
Private Sector				
Savings deposits	1.2	3.6	5.4	7.2
Time deposits				
Three-year	-	-	15.0	-
Two-year	-	-	12.0	18.0
One-year	3.6	7.2	9.6	14.0
Six months	3.6	5.0	7.8	10.0
Three months	3.6	5.0	-	-
Public Enterprises	-	-	1.2	-
<u>Lending Rates</u>				
For Agriculture, Industry and Transportation				
- Short-term <u>/1</u> (working capital)	6.0	4.8	4.2-8.4	-
of which:				
Agriculture	6.0	4.8	4.2	10.0
Industry	6.0	4.8	4.2	12.0
Trade and Socio-culture	-	-	-	15.0
- Long-term <u>/2</u> (equipment)	3.0	3.0	3.0-4.2	
of which:				
Agriculture	3.0	3.0	3.0	6.0
Industry	3.0	3.0	3.0	8.0
Trade and Socio-culture	-	-	-	10.0
Loans in Foreign Exchange				
Private	-	12.0	15.0	-
Public	12.0	7.2	6.1-7.8	-

/1 : One year/2 : Three year

Source: State Bank of Lao

Table VII-10 Import of Agricultural Input by Agro-Impex

Items	Unit	Year				
		1983	1984	1985	1986	1987
Fertilizer						
Urea (46%)	ton	672	840	1,050	1,313	1,641
Ammophos (16-20-0)	ton	1,008	1,260	1,575	1,969	2,461
Insecticide						
Diazinon	kg	6,630	7,625	8,768	10,083	11,596
Azodrin	lit	11,484	13,511	15,895	18,700	22,000
Furadan	kg	8,874	10,440	12,283	14,450	17,000
Sevin (85%)	kg	8,352	9,826	11,560	13,600	16,000

Source: State Company Agro-Impex Lao

Table VII-11 Number of Cooperatives and Their Member, 1984 and 1987

Province	Nos. of Coopera- tives in 1984	Nos. of Coopera- tives in 1987	Nos. of Coop. Families in 1984	Nos. of Coop. Families in 1984	% in Total Families in 1987	Nos. of Working Members in 1984	Nos. of Working Members in 1987	No. of Labor Exchange or Mutual Aid Group	
								in 1984	in 1987
Vientiane									
Municipality	119	183	3,190	7,117	11.3%	9,412	24,375		
Phongsaly	167	167	6,375	6,375	97.8%	7,900	7,900		
Luangnamtha	74	65	3,272	2,920	33.6%	7,665	6,782		
Oudomxay	111	183	5,078	10,995	94.5%	15,574	32,048		
Bokeo	40	67	1,750	2,851	92.0%	4,480	7,670		
Luangphrabang	98	138	4,321	8,187	85.8%	13,836	21,589	245	1,400
Houaphanh	311	377	10,342	16,964	98.6%	36,200	47,150		
Xayabouri	160	154	9,361	9,949	50.7%	20,955	25,071		99
Xiengkhuang	251	173	9,035	4,885	85.0%	21,372	35,305		
Vientiane	93	200	3,123	11,381	22.4%	8,747	21,739	118	1,675
Borikhamxay	17	71	650	2,430	14.0%	1,720	10,786		
Khammouane	99	152	5,330	8,862	26.6%	12,360	28,865	17	270
Savannakhet	164	623	9,737	42,864	50.5%	24,170	168,955		
Saravane	216	348	8,640	18,086	68.8%	22,317	47,847	112	312
Sekong	10	120	400	4,341	65.0%	1,122	8,746		65
Champasack	597	670	58,663	44,191	80.2%	152,745	129,580		
Attapeu	19	12	852	468	4.8%	3,413	1,526		5
Total	2,546	3,703	140,119	202,866	62.6	363,988	625,934	492	3,826

Source: Department of Cooperatives of MAF

Table VII-12 Area Cultivated by Cooperatives, 1984 and 1987

(Unit: ha)

Province	Coop. Area of Paddy Field in 1984	(% in Total)	Coop. Area of Paddy Field in 1987	(% in Total)	Coop. Area of Upland Paddy Field in 1984	(% in Total)	Coop. Area of Upland Paddy Field in 1987	(% in Total)
Vientiane								
Municipality	4,618	12.7%	8,958	23.5%	179	0.3%		
Phongsaly	4,274	98.0%	4,274	99.6%	4,165	15.0%	4,165	75.2%
Luangnamtha	4,525	38.0%	2,751	57.3%	138	1.0%	2,101	49.1%
Oudomxay	3,615	91.5%	7,662	70.0%	780	2.0%	4,045	8.5%
Bokeo	2,416	27.0%	2,180	68.8%	80	27.0%		
Luangphrabang	3,690	30.9%	6,244	76.7%	1,245	0.7%	2,334	8.3%
Houaphanh	7,000	95.0%	6,424	97.7%	6,444	16.0%	4,486	17.8%
Xayabouri	13,485	81.0%	7,906	47.3%	400	1.7%	4,678	14.0%
Xiengkhuang	11,013	59.0%	5,055	75.0%	1,636	13.0%	568	25.0%
Vientiane	5,020	10.0%	5,457	17.1%	81	0.2%	377	1.7%
Borikhamxay	780	6.5%	2,254	19.0%			37	0.4%
Khammouane	5,445	12.2%	13,962	34.3%			6	0.2%
Savannakhet	13,587	16.3%	57,963	67.6%			468	4.9%
Saravane	9,800	34.0%	17,901	5.5%	1,355	10.0%	652	11.0%
Sekong			428	54.2%			4,700	68.4%
Champasack	61,827	78.0%	58,569	76.8%	600	10.7%	883	16.8%
Attapeu	828	8.9%	416	4.2%				
Total	151,923	38.0%	208,404	55.0%	17,103	5.0%	29,500	15.0%

Source: Department of Cooperatives of MAF

Table VII-13 Population and Farm Household in the Project Area

Village	Population			Nos. of Household	Average Family Size	Nos. of Farm Household	% of Farm Household	Area of Rice Field (ha)	Average Farm Size (ha)
	Male	Female	Total						
B. Pha Khao	982	943	1,925	311	6.2	75	24.1%	165.0	2.2
B. Sa Phang Muk	363	347	710	149	4.8	101	67.8%	108.8	1.1
B. Don Noun	577	686	1,263	206	6.1	199	96.6%	267.8	1.3
B. Xai	646	680	1,326	170	7.8	149	87.6%	302.6	2.0
B. Na Khe	352	303	655	101	6.5	101	100.0%	193.6	1.9
B. Dan Xang	626	692	1,318	198	6.7	162	81.8%	174.9	1.1
B. Dong Sang Hinh	344	347	691	117	5.9	77	65.8%	115.6	1.5
B. Na	670	710	1,380	303	4.6	88	29.0%	112.0	1.3
B. Sok Nhai	499	497	996	165	6.0	149	90.3%	286.2	1.9
B. Sok Noi	555	574	1,129	197	5.7	197	100.0%	389.0	2.0
B. Phone Thong	253	241	494	78	6.3	65	83.3%	133.5	2.1
B. Na Biene	181	189	370	57	6.5	56	98.2%	82.0	1.5
Total	6,048	6,209	12,257	2,052	6.0	1,419	69.2%	2,331.0	1.6

Source: Saythany and Saysetha District Offices

Table VII-14 Land Tenure Condition

Village	Land cultivated by Owners		Land Owned by Non-villagers		Intra-villagers Rent		Owners Total	
	(Nos.)	(ha)	(Nos.)	(ha)	(Nos.)	(ha)	(Nos.)	(ha)
B. Pha Khao	64	98.1	11	33.2	13	31.8	88	163.1
B. Sa Phang Muk	45	50.1	4	11.9	12	33.4	61	95.4
B. Don Noun	115	231.4	0	0.0	7	15.8	122	247.2
B. Xai	135	271.3	0	0.0	1	3.5	136	274.8
B. Na Khe	60	150.6	12	47.6	3	6.0	75	204.2
B. Dan Xang	87	122.4	0	0.0	10	10.3	97	132.7
B. Dong Sang Hinh	40	83.0	17	32.6	0	0.0	57	115.6
B. Na	79	123.8	0	0.0	4	15.2	83	139.0
B. Sok Nhai	115	226.6	26	59.6	0	0.0	141	286.2
B. Sok Noi	131	329.9	10	40.9	0	0.0	141	370.8
B. Phone Thong	65	112.7	7	10.8	0	0.0	72	123.5
B. Na Biene	38	53.6	0	0.0	0	0.0	38	53.6
Total	974	1,853.5	87	236.6	50	116.0	1,111	2,206.1
(%)	87.7%	84.0%	7.8%	10.7%	4.5%	5.3%	100.0%	100.0%

Source: Statistics of Area of Rice and Land Owners for Agro-Tax, Economic Planning and Finance Service, Saythany and Saysetha District Offices

Table VII-15 Distribution of Land Owners by Size

Villate	Average Farm Size (ha)	Distribution of Land Holding Size (ha)						Total (Nos.)
		0 -0.5 (Nos.)	0.5-1.0 (Nos.)	1.0-1.5 (Nos.)	1.5-2.0 (Nos.)	2.0-3.0 (Nos.)	3.0 - (Nos.)	
B. Pha Khao	2.2	17	19	11	6	16	19	88
B. Sa Phang Muk	1.1	15	9	7	11	14	5	61
B. Don Noun	1.3	14	18	20	17	31	22	122
B. Xai	2.0	13	21	21	25	32	24	136
B. Na Khe	1.9	7	8	7	6	24	23	75
B. Dan Xang	1.1	8	39	18	16	11	5	97
B. Dong Sang Hinh	1.5	8	15	8	4	8	14	57
B. Na	1.3	9	33	11	11	13	6	83
B. Sok Nhai	1.9	12	17	27	36	36	13	141
B. Sok Noi	2.0	3	14	21	26	38	39	141
B. Phone Thong	2.1	3	11	17	5	8	14	58
B. Na Biene	1.5	4	6	20	2	2	4	38
Total	1.6	113	210	188	165	233	188	1,097
(%)		10.3%	19.2%	17.1%	15.1%	21.2%	17.1%	100.0%

Source: Statistics of Area of Rice and Land Owners for Agro-Tax, Economic Planning and Finance Service, Saythany and Saysetha District Offices

Table VII-16 Estimation of Annual Surplus and Deficit of Paddy in the Project Area

Village	(1) Popula- tion of Farm House- hold (persons)	(2) Planted Area (including dry season) (ha)	(3) Production of Paddy (including dry season) (ton)	(4) Seed Stock 66kg/ha (2)x0.066 (ton)	(5) Hand- ling & Strage loss (3)x5% (ton)	(6) Agro- Tax 100kg/ha (2)x0.1 (ton)	(7) Consumption of Paddy 350kg/ person (1)x0.35 (ton)	(8) Market- able Amount of Paddy (3)-(4+5+6) (ton)	(9) Popula- tion of Non-farm House- holds (persons)	(10) Consumption of Paddy 300kg/ person (9)x0.3 (ton)	Total Balance in 12 Villages (ton)
B. Pha Khao	464	210	315	14	16	21	162	102	1,461	438	-336
B. Sa Phang Muk	481	109	164	7	8	11	168	-31	229	69	-100
B. Don Noun	1,220	268	402	18	20	27	427	-90	43	13	-103
B. Xai	1,162	303	454	20	23	30	407	-26	164	49	-75
B. Na Khe	655	194	290	13	15	19	229	14	0	0	14
B. Dan Xang	1,078	175	262	12	13	17	377	-157	240	72	-229
B. Dong Sang Hinh	455	116	173	8	9	12	159	-14	236	71	-84
B. Na	400	112	168	7	8	11	140	1	980	294	-293
B. Sok Nhai	899	286	429	19	21	29	315	46	97	29	17
B. Sok Noi	1,129	483	725	32	36	48	395	213	0	0	213
B. Phone Thong	412	134	200	9	10	13	144	24	82	25	-1
B. Na Biene	363	82	123	5	6	8	127	-24	7	2	-26
Total	8,718	2,470	3,705	163	185	247	3,051	59	3,539	1,062	-1,003

Remarks: 1. Assumptions are based on the results of the farm economic survey by the Study team
2. Population, paddy planted area and paddy production are obtained from Saythany and Saysetha District Offices