

CHAPTER 3

GENERAL CONDITIONS OF THE STUDY AREA

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3.1 Location of the Study Area

The electricity generated by the hydroelectric power plant at the Nam Ngum Reservoir is one of Lao PDR's most important export products; this prominent importance of hydroelectric power as an export product is expected to continue in the coming years. Accordingly, the construction of hydroelectric power stations in many parts of the country, including those for the No. 2 and No. 3 Reservoirs upstream of Nam Ngum Reservoir, is planned.

Under these circumstances, it is crucially important for Lao PDR to secure a plentiful supply of water which forms the basis for hydroelectric power generation. The traditional slash and burn cultivation and recent expansion of farmland, etc. have aggravated the deterioration of forests, causing concern in regard to a decline of the water yield function and land productivity throughout the country today. The conservation of forests to improve the water yield function with a view to securing a stable supply of water is consequently one of Lao PDR's most pressing tasks in order to establish stable hydroelectric power generation in the future.

Slash and burn cultivation is traditionally popular in mountain areas in the Vangvieng District, causing gradual degradation of the forest quality. In addition, there is population pressure in the district, originating from not only a natural increase but also from migration from the northern provinces as well as from the neighbouring Sai Somboun Special Zone and the return of refugees from Thailand. This population increase has prompted slash and burn cultivation in mountain areas by those local people who have no farmland in areas of flat land, accelerating the process of forest degradation. This process has been witnessed throughout the 1970's and 1980's in the form of the replacement of forest land by grassland with an accompanying decline of the land productivity.

The Study Area almost overlaps the Nam Xong Watershed which occupies the Vangvieng District and its surrounding area. Nam Xong flows from north to south in almost the centre of the Study Area and joins Nam Lik some 15 km south of the Study Area. Nam Lik flows further south to join Nam Ngum in the lowerstream of the Nam Ngum Reservoir. From the viewpoint of the natural river system, the watershed of Nam Xong differs from that of the Nam Ngum Reservoir. The completion of diversion work designed to increase the rate of inflow to the Nam Ngum Reservoir by linking Nam Xong and Nam Ngum Reservoir at the end of 1995 means that the watershed of Nam Xong has been integrated to the catchment area of the Nam Ngum Reservoir.

The Study Area is characterised by the simultaneous presence of many important issues to be dealt with by the Government of Lao PDR, including the need to improve the water yield function in view of the fact that it constitutes the catchment area for the hydroelectric power generation reservoir which play on important role in Lao PDR's exports and also the need to improve the productivity of forest areas in view of the progress of forest degradation due to slash and burn cultivation.

Management of the entire watershed is deemed to be crucial to achieve such improvement of the water yield function and restoration of the productivity of forest areas. In this context, the Study Area is expected to become a model area for reservoir watershed management for the implementation of watershed management throughout the country.

In addition, the Study intends to formulate of guidelines which can be used by the Government of Lao PDR for the formulation of its own watershed management plan for the Study Area in the future. It is hoped that the techniques used to formulate such a plan will be applied to other watersheds with the end result of stabilising watersheds across the country.

3.2 Natural Environment

3.2.1 Climate

Areas with annual rainfall of more than 3,000 mm are observed in northern, central and southern Lao PDR. The Vangvieng District where the Study Area is located belongs to the high rainfall area in central Lao PDR.

According to data provided by the Lao Meteorological and Hydrological Department, the recorded annual rainfall level for the period from 1989 to 1995 varied between 2,800 mm and 3,800 mm at Vangvieng. As the annual rainfall at Vientiane during the same period varied between 1,300 mm and 2,000 mm, the annual rainfall level at Vangvieng appears to be double that at Vientiane.

The rainfall level is particularly high from June to August with a strong monsoon presence, resulting in monthly rainfall of around 700 mm. In some years, the monthly rainfall during this period exceeds 1,000 mm. Ninety percent of the annual rainfall is concentrated in the six-month period from June to November. The dry season with an extremely low rainfall level is from December to April although mean monthly rainfall of 10 - 30 mm is still recorded in the dry season.

The mean annual temperature at Vangvieng is approximately 25°C which is approximately 1°C lower than the mean annual temperature at Vientiane. April is the hottest month near the end of the dry season with a mean monthly temperature of around 28°C. The mean monthly temperature drops to some 21°C in December and January which is the most pleasant period of the year.

3.2.2 Topography, Geology and Soil

The Study Area is situated in the upper reaches of Nam Xong and the elevation is high in the northern and eastern parts of the Study Area which form mountainous areas where a number of 2,000 m class mountains, including Ph. Pakhao (El. 2256 m), are located. The mountains in the western and southern parts of the Study Area are relatively low with an elevation of generally lower than 1000 m. The northwestern side of the Nam Ngum Reservoir is a hilly area with an elevation of 300 - 500 m.

Nam Xong runs from north to south in almost the centre of the Study Area. The right bank is marked by limestone mountains with a series of steep cliffs, the difference in relative height of which is as large as 1,000 m, producing a unique landscape.

The geological formation in the north of Vangvieng is distinctively different from that in the south of Vangvieng. The northern area consists of such sedimentary rocks as conglomerate, sandstone, slate and limestone which belong to the Carboniferous Permian System of the Paleozoic Group. As all rocks other than limestone are strongly weathered deep under the ground's surface, fresh rocks are seldom observed except for outcrops of sandstone along mountain valleys or at eroded steep slopes.

The southern area also consists of such sedimentary rocks as conglomerate, sandstone, slate and limestone of the Triassic System of the Mesozoic Group. As in the case of the sedimentary rocks in the northern area, all of these are strongly weathered and stones are seldom observed near the ground's surface. Outcrops and boulders of mainly sandstone are observed in eroded areas at summits and steep slopes and near valley bottoms.

Six major soil groupings and 10 soil units have been identified in the Study Area. The parent materials of the local soils are the weathered sedimentary rocks described earlier. Because of the extremely advanced weathering of these rocks, except limestone, the properties of the parent materials do not strongly reflect on the soils.

The most widely distributed soil group in the mountains and hills of the Study Area is Acrisols which are characterised by a yellow to yellowish brown colour, the presence of a B horizon with clay accumulation, a low cation exchange capacity due to the loss of bases caused by strong leaching, a low degree of base saturation and a low pH value.

The next most widely distributed soil group is Alisols which also have a B horizon with clay accumulation as in the case of Acrisols but which also have a large cation exchange capacity due to weak leaching. Alisols also contain a large quantity of exchangeable aluminium but show a low pH value.

The distribution of Ferralsols is observed at the summits and gentle slopes of mountains and hills at an elevation below some 1,000 m in areas where Acrisols and Alisols are distributed. This type of soil is strongly reddish and thick. The cation exchange capacity is small and both the degree of base saturation and pH value are low.

In addition, Leptosols, Cambisols and Fluvisols are observed in some areas. Among these soil types, Cambisols have the best soil texture for plant growth even though the area of distribution is small.

3.2.3 Land Use and Vegetation

Vangvieng and its surrounding area where the Study Area is located has high annual rainfall and temperature levels and belongs to the tropical monsoon forest zone which is characterised by the growth of Dipterocarpaceae and other trees. However, the area covered by such potential vegetation is being increasingly reduced due to the adverse impacts of commercial cutting and slash and burn cultivation.

Based on the aerial photographs, primeval forests with large diameter trees which resemble the potential vegetation are only observed around Ph. Lo and Ph. Nampia in the uppermost reaches of Nam Xong in the north and around Ph. Kho and Ph. Kaykon in the upper reaches of Nam Ngat in the south of the Study Area. Areas where primeval forests have survived are remote areas located on the high backbone of mountain ranges. In other areas, most forests are secondary forests which have grown following intervention by such human activities as slash and burn cultivation.

In areas around Vangvieng located at almost the centre of the Study Area, irrigated paddy fields have been developed on flat land along Nam Xong and also on basin-like flat land in the sub-watersheds of Houay San, Nam Koang and Nam Ngat, all of which are tributaries of Nam

Xong. At Ban Naduang located in the mountain area to the east of Vangvieng, terraced khet land is observed with irrigation water being channelled from smaller streams. The practice of using the limited flat land in the transitional areas from flat land along major rivers to mountain slopes as khet land is also observed at Ban Namon-Nua and Ban Nalao.

Vegetables and pulses are cultivated on small areas of bari land near houses. While peanuts and others are cultivated during the dry season using khet land as bari land, the actual cultivation size is rather small.

In general, slash and burn cultivation is conducted on mountain slopes far from dwelling areas, partly because of the growing tendency to preserve forests near dwelling areas as water conservation forests and/or communal forests and partly because of the need to prevent crops from being eaten by domestic animals which are raised near houses. The principal reason for the use of remote land for slash and burn cultivation is, however, the shortage of suitable land nearby as a result of the long-standing practice of slash and burn cultivation.

Former slash and burn sites tend to be invaded by bamboo and such sites with the mixed growth of trees and bamboo can be seen everywhere. Some sites are completely covered by bamboo and these are particularly noticeable in the remote area of Phatang which is located in the upper reaches of Nam Xong. The most frequently observed bamboo species at former slash and burn sites is May Shoth (*Oxytenanthera parvifolia*). As this species has little use value for local people at present, however, its presence is used as an index for low productivity land.

The continuous use of land for slash and burn cultivation leads to the dominant presence of such gramineous grasses as Kok Lao and Nya Ka. The appearance of such grasses indicates a further decline of the land productivity. Such sites in the Study Area are widely observed along the shores of the Nam Ngum Reservoir in the south. Forest fires are said to be another reason why forests become grassland. As it is difficult to establish the frequency of forest fires and the size of the burned area at specific sites, it is unclear how much forest fires affect the process of forests becoming grassland.

Table 3-2-1 shows the analysis results of the SPOT satellite images (1989) provided by the Lao National Office for Forest Inventory and Planning (NOFIP). Forests account for some 52% or 93% when potential forest areas (41%) are included. Among potential forest areas, many bamboo forests and treeless land areas are believed to have been forest land which has been degraded, mainly due to slash and burn cultivation.

Table 3-2-1 Current Land Use in the Study Area

Category	%	Category	%
< Forest >	92.6	< Farmland >	1.8
Currently Forest	51.9	Paddy Field	1.8
- Mixed Deciduous Forests	51.9	< Others >	5.6
Potential Forest	40.7	Shrub	1.2
- Bamboo Forest	1.3	Grassland	1.7
- Slash and burn	1.4	Urban Area	0.0
- Unstocked Forest	38.0	Water Body	2.7
Total			100.0

3.3 Socioeconomic Environment

3.3.1 Administration

The Study Area is under the jurisdiction of Vientiane province, and falls mostly in the Vangvieng district. The Vangvieng district is located at the center of the eastern border of Vientiane province sharing boundaries with the Kasy district to the north, Mead and Fuang districts to the west to southwest, Keo Oudom district to the south and Xai Somboun Special Zone to the east. According to the administration boundary map prepared by the Vangvieng District Head Quarter, some land areas of the Study Area are also covered by these districts and special region. However, the district boundary is unclear as far as the JICA Study Team has confirmed. The district boundaries drawn by the Vientiane Province Head Quarter and the Vangvieng District Head Quarter are not consistent as shown in Fig. 3-3-1. The present study for socioeconomy has been carried out based on the district boundary drawn by the Vangvieng District Head Quarter as it was agreed by the Lao PDR side in the meeting on the Field Report (I) held on February, 1997.

Institutional arrangements in the district administration are similar to those at the central level. All such district offices are available covering the fields of agriculture and forestry; communications, transport, posts and construction; industry-handicrafts; commerce; information and culture; labor and social welfare; education; and health.

Under the jurisdiction of the Vangvieng district, there are five sub-districts and 76 villages. Although sub-districts are administratively non-functional at present, relevant district offices usually divide the district into five sub-districts, i.e. Phatang (with 13 villages), Vangvieng (21 villages), Namon (14 villages), Namuang (13 villages), and Somboun (15 villages). Out of the

76 villages in the Vangvieng district, each of 74 villages has a Village office, but not the remaining two villages (Hatsongkhon and Phoudindeng).

A new district of Hinheup was established in January 1997, and six villages in Somboun sub-district administratively moved to this new district. These include Sivilai, Somsanouk, Nampat, Vangkhi, Phonthong, and Taothan. As a result, the number of villages in Somboun sub-district, the Model Area and the Study Area has become 9, 23 and 70, respectively. In the present study, however, the number of villages to be covered in the survey is 76 in the Study Area and 29 in the Model Area. In order to avoid confusion between the administrative and study boundaries, the term "Area" is used instead of "sub-district" hereinafter.

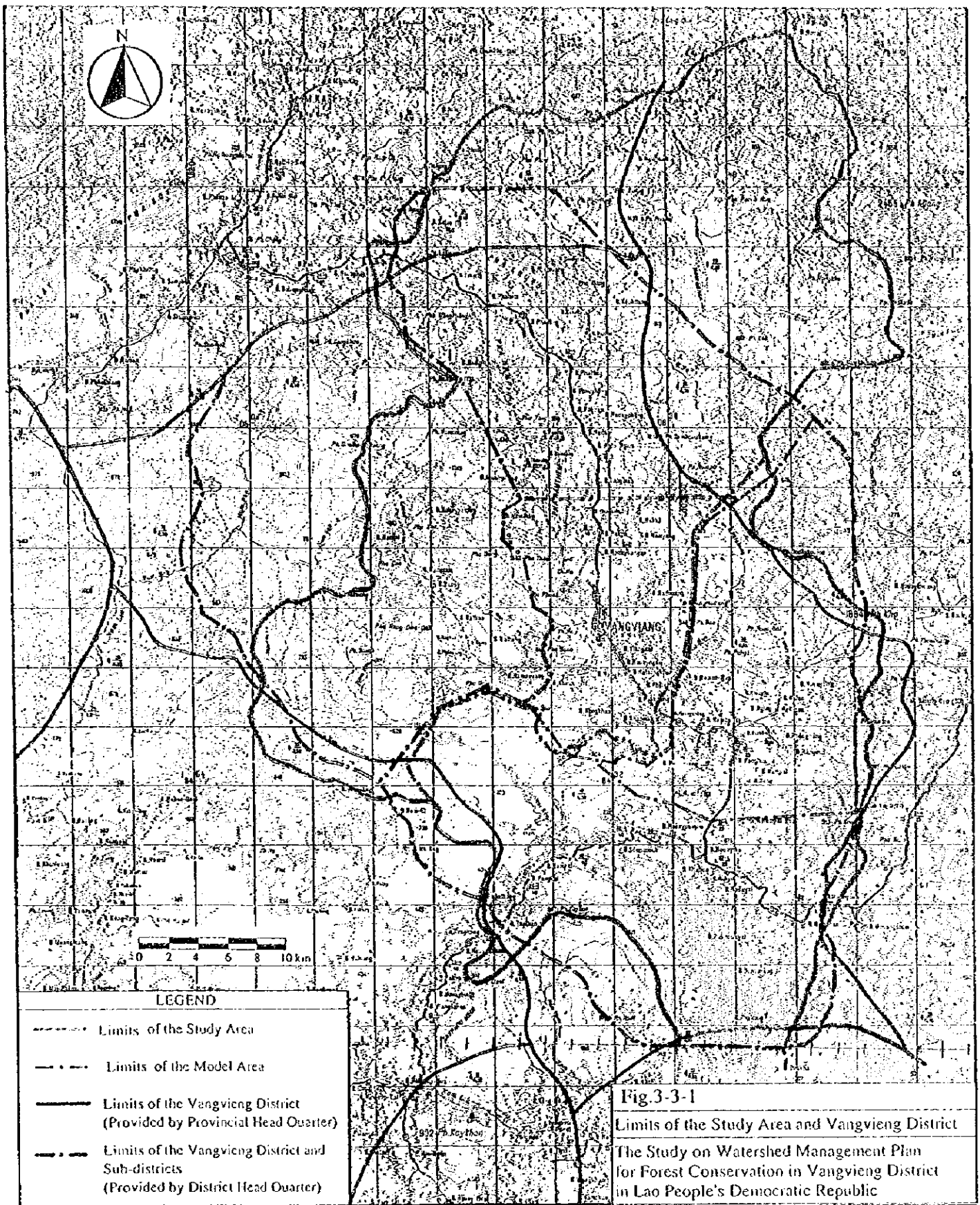


Fig 3-3-1
 Limits of the Study Area and Vangvieng District
 The Study on Watershed Management Plan
 for Forest Conservation in Vangvieng District
 in Lao People's Democratic Republic

3.3.2 Population

The population in the Vangvieng district is 41,860 as of July 1996 according to the data from the statistics office in Vangvieng District Head Quarter. This population corresponds to about 0.9% of the total population in Lao PDR or 14.6% of that in the Vientiane province. On the other hand, the land area of the Vangvieng district (1,750 km²) corresponds to about 0.7% of the total land of Lao PDR or 11% of that of Vientiane province, and accordingly the population density of the Vangvieng district (23.9 persons/km²) is 27% higher than that of Lao PDR (19.4 persons/km²) and 37% higher than that of Vientiane province (18.0 persons/km²). The total number of households is 6,822 in the district, and the average size of household is 6.14 persons/household, showing similar figures with those in Lao PDR (6.09 persons/household) and Vientiane province (6.07 persons/household).

Of the population in the district, about 35% live in the Vangvieng Area having the highest population density of 83 persons/km². On the other hand, the population density is the lowest in the Namon Area (12.9 persons/km²) followed by the Namuang Area (15.5 persons/km²), since the proportion of mountainous land is considerably high in these areas.

The population in the Model Area is 16,158 persons or about 39% of that in the Study Area (or Vangvieng district). The population density in the Model Area is 16.9 persons/km², about 29% lower than that in the Study Area. In the Somboun Area, however, the population density is 22.2 persons/km² which is the second highest density in the Study Area. There is little difference in the sex ratio between the Model Area and the Study Area.

In the Study Area, the proportion of Lao Lum population is the highest at 70% of the total population, and proportion of other minority groups such as Lao Theung and Lao Sung is comparatively small at about 15.1% and 14.8%, respectively. Among the five areas, the proportion of Lao Theung population is the highest at 27.3% in the Somboun Area, and the lowest at 9.5% in the Vangvieng Area. The proportion of Lao Sung population is the highest at 28.5% in the Phatang Area, and the lowest at 3.0% in the Vangvieng Area. The population increase rate in the Study Area is estimated at 2.8% p.a. during the 1991-1996 period. During the same period, the increase of Lao Sung population is remarkable in the Phatang (26.5% p.a.) and the Vangvieng Areas (19.4% p.a.) as well as in the Study Area (13.0%) as a whole. In the Model Area, the proportion of Lao Lum, Lao Theung and Lao Sung population are 60%, 20.9%, and 19.1% of the total population, respectively. The Lao Lum population shows a decreasing trend (-0.1% p.a.), a small increase in Lao Theung (1.0% p.a.) and a large increase in Lao Sung (10.2% p.a.) during the 1991-1996 period in the Model Area (more detailed data on the population statistics are presented in Annex 2).

3.3.3 Economic Conditions

(1) Agriculture

Agriculture is the principal economic sector in the Study Area. Data from the statistics office in Vangvieng District Head Quarter show that about 88% of the working population are engaged in agriculture which is broadly defined to include livestock, fisheries and forestry. In general, however, its productivity is low and vulnerable to the vagaries of the weather. Most of the crops are cultivated for home consumption and small amounts of surpluses are marketed. Livestock probably are the second-most important sub-sector in terms of economic return to the villagers. Returns from fishery and forestry are considered to be smaller than those from crops and livestock. However, these sub-sectors also play an important role both in the economy and livelihood of the villagers in the Study Area (refer to Annex 2 for more details on agricultural production in the Study Area).

1) Crop production

The present condition of crop production in the Study Area is analyzed based on data from DAFO at the preliminary level. According to the data, the most important crop grown in the Study Area and the Model Area is paddy. This crop alone occupies about 90% of the total crop cultivation area in the district. Other crops cultivated are maize, cassava, and vegetables, but generally on a small scale.

According to the information from DAFO, cash crops such as cucumber, cabbage and watermelon have expanded in area and production in recent years for the Vientiane markets. Fruit trees grown in the district are banana, coconuts, papaya, mango, jackfruits, oranges, etc.

Paddy in the Study Area is cultivated in three production systems, i.e. wet season lowland paddy, dry season lowland paddy and slash and burn paddy. Among these, wet season lowland paddy is the major system. It produces about 89% of the total paddy in the district according to the data from DAFO. Dry season lowland paddy is practiced in a limited area. It produces only 1% of total paddy in the district, indicating lower availability of water or fewer irrigation facilities for dry season cultivation. Slash and burn paddy is cultivated in a large area and produces 10% of the district's paddy.

2) Livestock

The major livestock raised in the Study Area are cattle, buffalo, pig, goats and poultry. These animals are playing an important role in the economy of villagers as well as in the district. The official data obtained from the district office of commerce show that the district exported 386 heads of cattle/buffalo, 36 heads of pig and 7,000 kg of hides, and the total value of these exports was estimated at Kip 3.15 million in 1995. Since it is generally said that unofficial exports are 2.5 to 3 times as much as the official ones, this value of livestock exports could be around Kip 8.0 to 9.5 million.

According to the data from DAFO, in 1995, livestock populations in the district are 8,207 buffaloes, 10,148 cattle, 8,058 pigs, 667 goats, 445 horses and 73,329 poultry, and the average head of livestock per household is 1.2 head for buffalo, 1.5 head for cattle, 1.2 head for pig, 0.1 head both for goat and horse, and 10.7 head for poultry.

Many villagers keep cattle and buffalo as their assets. They sell these animals when they need cash income for particular occasions, e.g. a marriage ceremony, or maybe for purchasing rice in case of need. Selling of pigs is done more regularly. Chicken, duck and turkeys raised are mainly for meat for home consumption and sale. Eggs are kept as is to rear chicks for the next production of meat. As far as the JICA Study Team expert confirmed, all eggs handled by retailers in the district were imported from Vientiane municipality.

3) Fishery

Reliable data on present fishery in the district are not available. As a result of the field reconnaissance, however, findings on the present situation of fishery are summarized as follows:

- In general, fisheries are practiced on a small scale, both capture fisheries and fish culture.
- The main systems for capture fisheries are the rivers, reservoirs, swamps and paddy fields. Of these, the Nam Ngum reservoir is considered to be the most important system in the district. Fish sale is done on a comparatively large scale in Thahua-Nua market located just beside the reservoir. Fishing gears commonly utilized are several kinds of nets and bamboo baskets. According to the information from the market, fish catches in the reservoir have been decreasing in recent years.

- Pond fish culture is also practiced mostly under paddy field/pond systems. Fishes are usually cultivated for the six-month period during the wet season.

4) Forestry

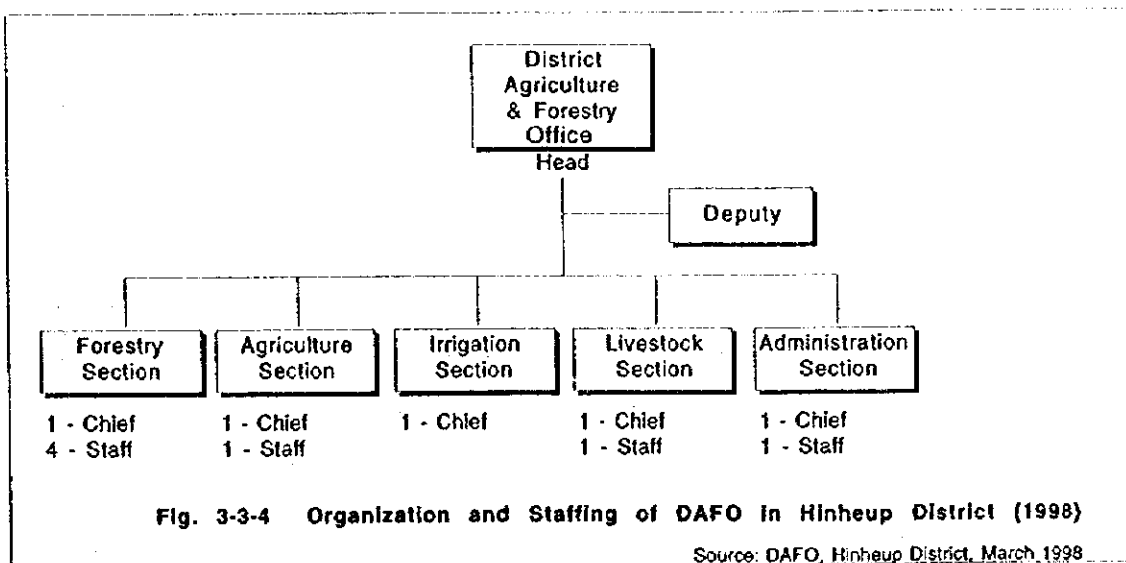
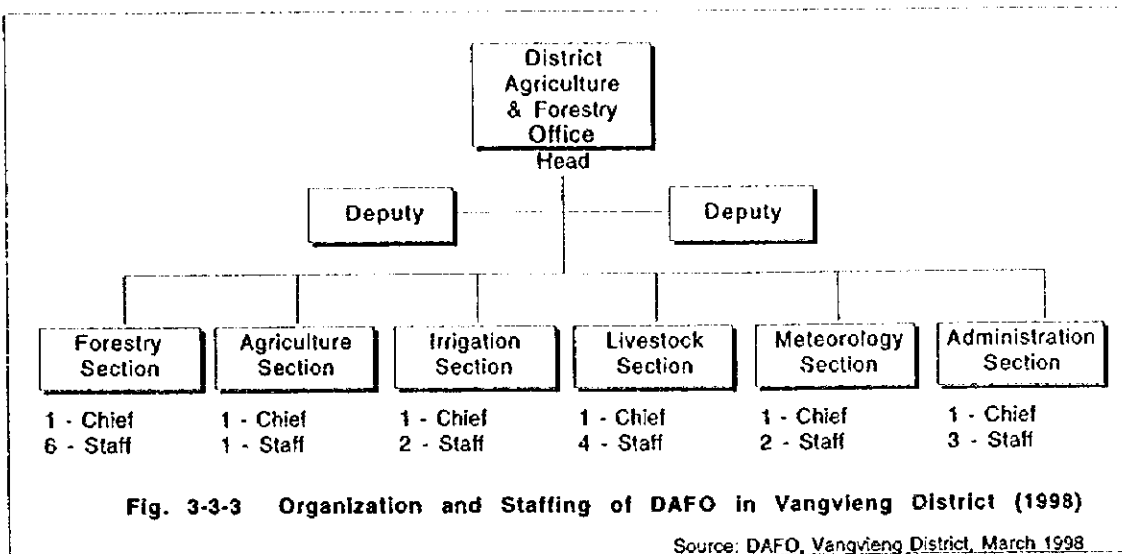
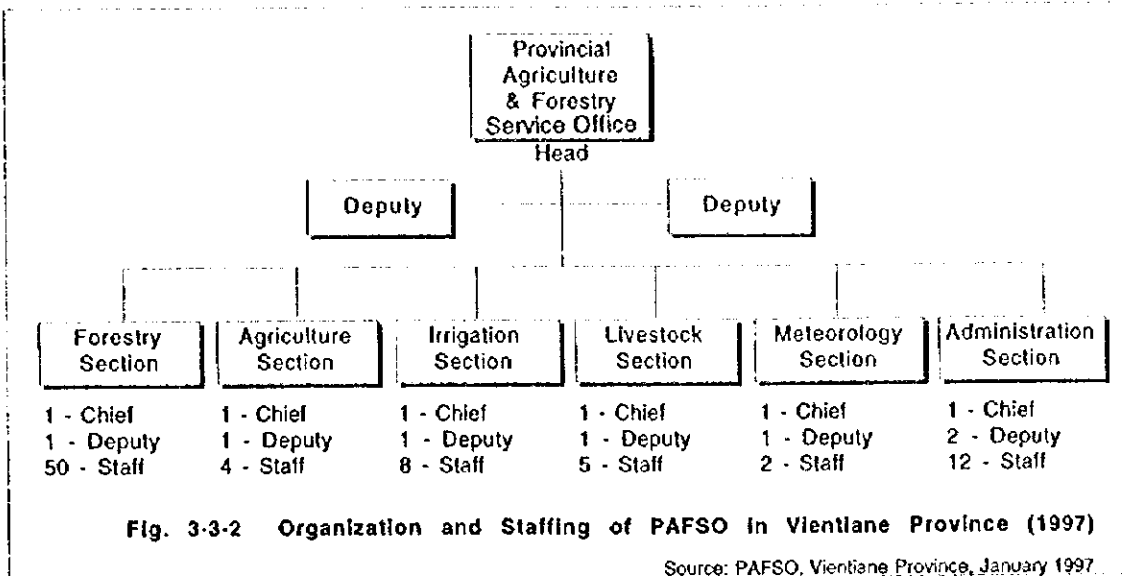
According to the forest map prepared by PAFSO, there is a protection forest extending over the northwest border of the district and a regenerated forest around the southwest border, although the area of these forests in the district is unknown.

Because of a ban on tree felling in the district, timber production in the forest is not commercially carried out. However, forests play an important role in the economy and livelihood of villagers. Nearly 100% of domestic energy depends on fuelwood, the collection of which is closely related with slash and burn cultivation (slashed trees are usually collected for fuelwood), about 31% of villagers are engaged in slash and burn cultivation (data from the district statistics office), which produce about 10% of total paddy in the district (data from DAFO). In addition, non-wood forest products such as bamboo, mushrooms, and cardamom are important cash income sources, particularly for the ethnic minority.

5) Supporting agencies for the development of agriculture

The organizations of PAFSO in Vientiane province and DAFO in Vangvieng and Hinheup districts are presented in Fig. 3-3-2 to 3-3-4. As seen in the figures, a total of 20 technical staff is assigned to DAFO in Vangvieng covering the fields of agriculture, forestry, irrigation, livestock and meteorology. This number of staff is insufficient to provide extension services effectively to the villagers. Related equipment and transportation means are also insufficient for their daily activities. Insufficient technical background of extension staff seems to be another constraint.

Aside from PAFSO and DAFOs, the data and information were collected from the Agricultural Promotion Bank (APB), Vangvieng. This APB was established by the end of 1993. APB, as the public financing institution, provides subsidized credit schemes to the villagers. APB promotes group-based loans. In general, recipients are requested to organize themselves into a group for a certain project for which a loan is needed. The loan amount varies from the minimum of Kip 50,000 to the maximum of Kip 500,000 both for short- and long-term loans. Interest rates also vary based on the type of project, i.e. 10% p.a. for agriculture and livestock, 12% p.a. for handicraft, and 18% p.a. for commerce. The amounts of loans disbursed from the district APB in 1995 and 1996 were 150 million Kip (for 124 groups or 822 households) and 156 million Kip (for 113 groups or 710 households), respectively.



(2) Other Economic Sectors

1) Industry

According to the data from the district industry office, the total number of factories in the district is 35 of which one factory is categorized as large scale with more than 100 employees, eight factories are medium scale with 10 - 99 employees and 26 factories are small scale with 1 - 9 employees (refer to Annex 2 for more details).

The one factory categorized as large scale is Lao Vangvieng Cement Plant located in the Vangvieng Area. This factory was established in late 1994 with the maximum production capacity of 250 ton/day with 24 hours operation or 75,000 ton/year with 300 days operation. There are about 60 management staff including section chiefs and 180 permanent workers plus 150 temporary workers, who work in 3 shifts a day. Both coal and fuelwood are used as energy sources for cement production. In 1996, according to the factory, about 2,800 m³ of fuelwood were consumed. Fuelwood is collected on a contract basis mainly from villagers in the Somboun Area. The price of fuelwood is Kip 4,000/ La (about 0.5 m³) at the factory gate. Thus, it is estimated that about Kip 22.4 million of cash was paid for fuelwood by the factory in 1996.

In addition to the cement factory, there are eight limestone processing factories of which five are medium and the remaining three are small in scale. They mainly produce lime and marble. Other factories listed are drinking water bottling factories, ice plants, etc.

The district industry office estimates that the value of industry and manufacturing production in the district was Kip 3,624 million in 1995/96, although this value does not include all the products. It was noteworthy that the cement factory alone produces 96% of this value. There are many cottage weaving industries in the district, but the district industry office does not know their actual production or the value at present.

2) Services

According to the data from the district commerce office, a total of 112 establishments of traders/retailers are listed. Based on the distribution of these traders/retailers, the major marketing centers in the district are considered to be Vangvieng town, Thahua-Nua / Thahua-Tai village area, and Phonsavang village.

The total value traded was 92.2 million in 1995/96, although the value of cement is not included in the table. Live cattle/buffalo account for 59% of the total value,

followed by limestone (27%) and lime (7%). Other important products traded are hide, tree fiber, paddy and cardamom.

(3) Land Tenure and Holdings

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

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

For the district, the paddy land holding size per household is estimated at a preliminary level based on the data from the district statistic office and DAFO. As a result, the land holding characteristics vary among areas. The average size of wet season paddy land is the largest in the Namuang Area (1.28 ha/household), but is only 0.07 ha/household in the Somboun Area. On the other hand, the average size of slash and burn paddy land is the biggest in the Somboun Area (0.39 ha/household).

(4) Marketing

As already mentioned above, three major markets have been formed in the Study Area, i.e. Vangvieng town, Thahua-Nua/Thahua-Tai village area (Somboun Area), and Phonsavang village (Namon Area). Among these, Vangvieng town is the biggest market followed by Thahua-Nua/Thahua-Tai village area in terms of number of retailers. It can be roughly said that the Vangvieng market covers three sub-district located in the northern part of the district, i.e. Phatang, Vangvieng and Namuang Areas, while that of Thahua-Nua/Thahua-Tai market covers Somboun Area. The Phonsavang market is small and basically serves peoples in the Namon Area, but this market may function as a branch market of both the Vangvieng and Thahua-Nua/Thahua-Tai markets. More broadly, the district including these three markets is considered to be under the sphere of the markets of Vientiane municipality.

Agricultural commodities, which are major products in the villages, are generally sold to middlemen who visit farmers during the season, and in the case of livestock, middlemen periodically visit villages to collect live animals.

3.3.4 Social Services

(1) Education

According to the data from the district education office, there are 65 primary schools, 10 secondary schools, and one high school as of 1996. Out of 65 primary schools, 28 schools (43% of the total) are incomplete for only 2- or 3-year schooling (usually for ages from 6 to 7 or 6 to 8 years old). Accordingly, pupils in an incomplete primary school have to go to a complete primary school for higher classes of primary education up to class five (refer to Annex 2 for more details).

The number of teachers in the primary schools is 451 persons in the district, of which 170 or 38% are female. In terms of ethnic group composition, 93% of teachers are Lao Lum, 4% are Lao Theung, and 3% are Lao Sung. In primary education, the pupils per teacher ratio is 21.5 in the district. This figure is the highest in Somboun Area (27.7) and the lowest in the Namuang Area (17.9). School districts both for primary and secondary schools by villages are illustrated in Fig. 3-3-5 (refer to Annex 2 for more details).

(2) Health

Institutional health services in the district are provided by the Vientiane Provincial Hospital and five health centers. The hospital has 30 beds for inpatients. The number of inpatients was about 1,680 in 1995 and 1,610 in 1996. Malaria, lung-disease and bladder-disease were major diseases of the inpatients. Some 20 kinds of basic drugs are kept in the hospital, but drugs other than those have to be purchased at 31 pharmacies in the district, which are inspected every three months by the provincial health office.

The health center is placed in each area except for the Vangvieng Area in which there is a Provincial Hospital. In each health center, three to five medical assistants are attached, who serve directly their command villages. At the village level, volunteers take an active part in medical care and birth control under the guidance of the hospital and health centers. Due to lack of medical supplies, however, their activities are restricted in most of the villages.

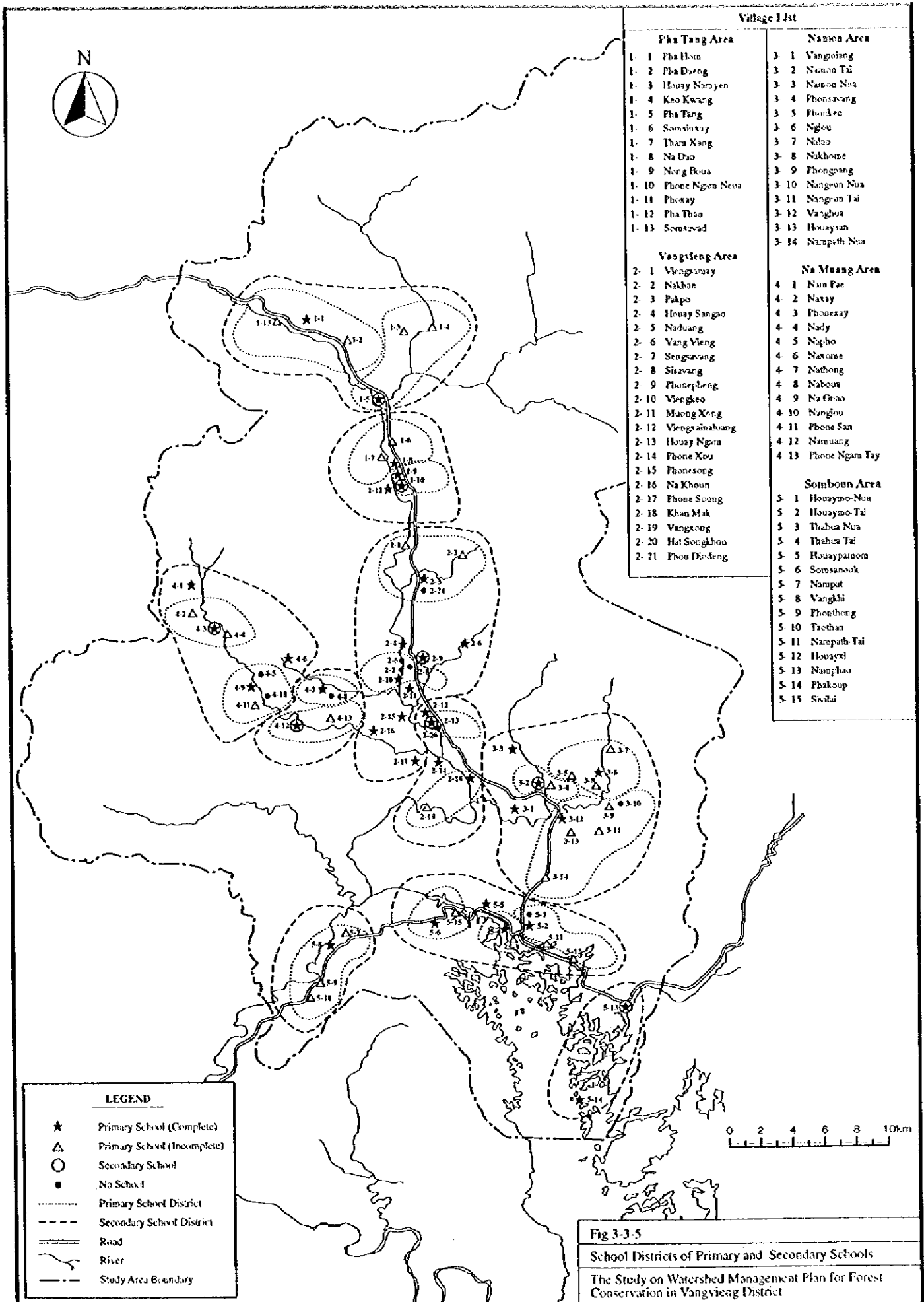


Fig 3-3-5
 School Districts of Primary and Secondary Schools
 The Study on Watershed Management Plan for Forest Conservation in Vangvieng District

3.3.5 Infrastructure

(1) Transportation and Communication

1) Road networks

Roads in this country are classified by their function into three categories: national road traversing provinces; provincial road running within a province; and local road connecting villages in the local area.¹⁾ From physical conditions, there are classified into: paved road, gravel road, unpaved earth road and cart road.

Two national roads run in the Study area. One is Route 13 (R-13) and the other is Route 13B (R-13B). R-13 with a passable width of 8m asphalt pavement road, starting from Vientiane, is in good condition and plays an important role in the country's economy as one of the trunk roads of the country. R-13B graveled for a passable width of 5m, branching off from R-13 at Houaymo-Tai village, runs about 18km toward the south east and enters the Xai Somboun Special Zone. R-13B is well maintained by the Vangvieng District Bureau of the Ministry of Communication, Transport, Post and Construction (CTPC) with budgets allotted by the Ministry.

Construction and maintenance of the local road in the Study area is the responsibility of the CTPC Vangvieng District Bureau, according to which the following local roads have been constructed or were under construction as of November 1996 (see Fig. 3-3-6).

¹⁾ Road Design Manual (Provisional Use), Department of Communication Ministry of Communication, Transport and Construction, 1996

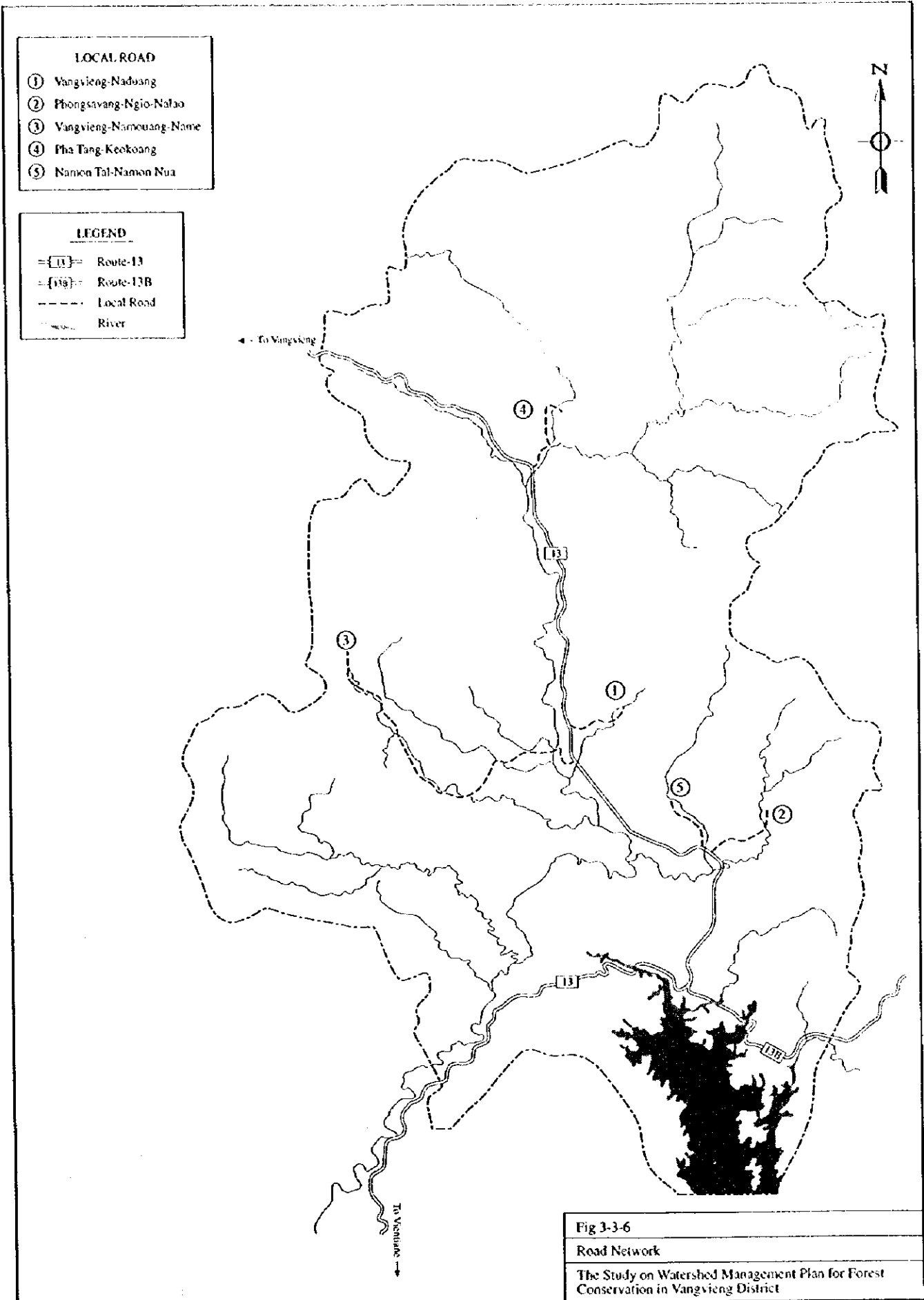


Fig 3-3-6
 Road Network
 The Study on Watershed Management Plan for Forest Conservation in Vangvieng District

Table 3-3-1 Existing and under Construction Local Roads in the Study Area

Route	Length (km)	Width (m)	Current Conditions
(1) Vangvieng - Nadouang	8	5	Earth road
(2) Phonsavang - Ngiou - Nalao	8	6	Earth road; Bridges not constructed yet.
(3) Vangvieng - Namouang - Nampe	18	5	Graveled road under construction; Bridges not constructed yet
(4) Phatang - Keokoang	5	6	Under construction
(5) Namon Tai - Namon Nua	4	6	Under construction

Source: CTPC Vangvieng District Bureau

2) Public transport

The Vangvieng area, the center of the Vangvieng district, is connected to Vientiane and Kasi by road (R-13). A state transportation company based in Vientiane, Vientiane Municipality Bus Company, runs buses connecting those cities and villages. In addition, private companies residing in Vientiane run buses between Vientiane and Vangvieng and between Vientiane - Vangvieng - Kasi.

For local transportation, generally-used vehicles are small tricycle (Sam Lo) driven by motor cycle, tricycle (Tuk Tuk) and mini-bus (Son Keo) which used to be made by remodeling pickup trucks into passenger cars.

3) Water transport

The Nam Xong, forming a major river system in the Study Area, originates from the northern most part of the Study Area, flows down toward the south and joins the Nam Lik in the neighboring Mun Fuang District of Vientiane Province. Several tributaries such as Nam Pamon, Nam Noy, Nam Ka, Nam Koang and Nam Ngat meet the Nam Xong in the Study Area. Construction of the Nam Xong diversion dam in 1996 stopped navigation of the Nam Xong at the trans-diversion point.

This river system plays an important role in local transportation for canoes with a 5.5 Hp portable gasoline engine because no bridges have been constructed across the major rivers/streams except for R-13 and the road network has been scarcely established in the Study Area. In the Nam Ngum reservoir, this kind of canoe is utilized mainly for transporting local people, the necessities of life and products from the area.

4) Telecommunication

In the Study Area, there is one telecommunication office, the Vangvieng Telecommunication Office, at Sisavang village. This telecommunication office currently has a subscriber station with a capacity of 24 subscribers. Of the 24 subscribers, 6 were government agencies such as the District Head Quarter, District Bureau for Finance, District Bureau for Education, District Bureau for Agriculture and Forestry, Water Supply Project Office and a Hospital, 6 for the Telecommunication and Post Offices including 2 vacant lines, 4 for home use and 8 for private companies or factories as of November 1996. No public telephones are available in the Study area.

5) Post

In the Study Area, there is only one post office in the same building as the Vangvieng Telecommunication Office mentioned above.

(2) Water Supply and Sewerage

1) Rural water supply

In the Vangvieng District in 1996, according to the Vangvieng District Health Bureau, some 35 % of inhabitants utilized gravity fed pipe water supply systems (the rural water supply system) relying on small streams, 5 % utilized shallow dug wells lined with precast concrete pipes and 22 % utilized earthen shallow dug wells as a source of domestic water, while the rest depended entirely on nearby streams and rivers. Any of the above cases neither filtration nor chlorination is conducted.

The rural water supply system relying on stream flow was available for 19 villages in 1996, of which 14 systems have been constructed by the Ministry of Health with financial and technical assistance from the United Nation Children's Fund (UNICEF) under the Water Supply and Environmental Sanitation Programme, 2 systems have been constructed with technical and financial assistance from NGO (CAA and UNSCR), while 3 systems have been constructed with financial assistance from the USA before the revolution in 1975.²⁾

The rural water supply systems were constructed under the sanitation programme of the Ministry of Health and are distinguished from the urban water supply system

²⁾ : Name of villages with the rural water supply system is given in the Progress Report of WATMAP, July 1997

(Nam Papa) programme being implemented by the Water Supply Project Office under the Ministry of Communication, Transport, Posts and Construction (CTPC).

The system consists generally of a small dam across a stream, an intake, conveyance and distribution PVC pipe or high density polyethylene pipe lines and 6 tapstand units. The resource streams generally have sufficient perennial flow except for the one for the system in Naxom village, the water source of which dries up during the dry season, and the other one in Phonsoung village, which used to suffer from water shortage in the dry season.

The equipment of the 14 rural water supply systems was provided by UNICEF. Construction of the systems was implemented by the Vientiane Provincial Health Service of the Ministry of Health by using local contractors.

Shallow tube wells equipped with a hand pump have been constructed with a boring machine provided by UNICEF at two sites in Sivilai and one each in Phonsoung, Phatao and Viengkeo (at nursing school) villages.

2) Urban water supply (Nam Papa)

In the Study area, one urban water supply system (Nam Papa), the so-called Vangvieng Water Supply system, was completed in 1996 by the Vangvieng Water Supply Project Office, which was one of the branch offices of the Water Supply Authority under management of the Ministry of CTPC.

The water source of the system relies on surface flow of the Nam Lao. Its intake site is 472 m above sea level and is located 6.1 km northeast of Vangvieng village. The system includes an intake structure, chlorination facilities before and after a filtration chamber, a concrete reservoir and a pipe line system consisting of a main pipeline 7 km long and distribution lines.

3) Sewerage

No sewerage systems have been installed in the Vangvieng District. According to a survey carried out by the Vangvieng District Health Bureau in October 1996, 31 % of inhabitants of the District were using either flushing type (UNICEF standard; Ø 0.8 m × 1.2 m depth tank without bottom) or dry type (using ash) toilet for excrement. Slops are generally drained to rivers/tributaries or only to backyards by individuals without any treatment. Use of septic tanks is not widespread yet.

(3) Electricity Supply

ELECTRICITE DU LAOS (EDL), a state electric company, is responsible for electricity supply in Lao PDR. EDL Service Center No.4 located at Phonhong is responsible for the electric supply in most of Vientiane province except for an area on the right bank of the Nam Lik and southern part of Phonhong District.

A 115 kV transmission line, starting at Thalat Sub-station near the Nam Gum Hydroelectric Power Station, traverses the Study Area from south to north and reaches Luangprabang. In the Study Area there is one sub-station at Vangvieng village (Vangvieng Sub-station) and a 22 kV feeder line has been erected between the sub-station and the Nam Xong diversion dam. Tapping from the 22 kV feeder line, 380/220 V distribution lines have been erected in six villages and, as of November 1996, were being erected with a schedule to be completed before the end of December 1996 for the other 16 villages. Those villages are tabulated below:

Table 3-3-2 Villages with Electricity Supply

Village	Area	Village	Area
<u>a) Constructed</u>		<u>b) Under construction</u>	
Phonpheng	Vangvieng	Houaysangao	Vangvieng
Vangvieng	Vangvieng	Sengsavang	Vangvieng
Namon-Tai	Namon	Sisavang	Vangvieng
Vanhua	Namon	Viengkeo	Vangvieng
Houaymo-Tai	Somboun	Muongxong	Vangvieng
Somsanouk	Somboun	Khouanamlao	Vangvieng
		Viengxai	Vangvieng
		Houayngam	Vangvieng
		Hatsongkhon	Vangvieng
		Phonxou (Pakkouang)	Vangvieng
		Hinkhanmak	Vangvieng
		Phongsoung	Vangvieng
		Vangmiang	Namon
		Thahua Nua	Somboun
		Thahua-Tai (Phonhai)	Somboun
		Houaypamon	Somboun

Using the existing towers for the 115 kV transmission line, installation of two 25 kV feeder lines and 220 V distribution lines was planned as of November 1996. The 25 kV feeder lines were of those between the Vangvieng Sub-station and Kasi (46.7 km long) and the Sub-station and Hinheup village (37.9 km long). The construction of the

distribution lines was planned, as of November 1996, to cover the following 9 villages with more than 100 households in the District.

Table 3-3-3 Villages with Electrification Schedule

Village	Area	Village	Area
Phahom	Phatang	Nampat	Somboun
Phadeng	Phatang	Vangkhi	Somboun
Phatang	Phatang	Phonthong	Somboun
Nadao	Phatang	Taothan	Somboun
Pakpo	Vangvieng		

(4) Hospitals and Health Centers

There is one hospital having 30 beds for inpatients, Vientiane Provincial Hospital, and four Health Centers in the Vangvieng District. At the village level, medical volunteers render services to villagers for health and obstetrics. However, no health posts for those volunteers have been constructed yet. There are neither private hospitals nor clinics in the District.

The building of the Hospital including appurtenant offices was constructed in Vangvieng village in 1965 with financial assistance from the USA, and has now become considerably superannuated. Medical appliances and/or examination equipment and apparatus are also insufficient or out of order.

As of November 1996, a nurse school adjacent to the Hospital was scheduled to be opened in June 1997. The school was expected to accommodate 40 students at maximum for a 2-year course.

The four health centers are located in the following villages in the 4 areas except for the Vangvieng Area where there is the Hospital.

Phatang Area	Phatang
Namon Area	Phonsavang
Namouang Area	Nagnao
Somboun Area	Houaymo-Nua

(5) Schools

School buildings in the district are classified into permanent and temporary ones. The former ones, consisting of mortar surfaced brick walls and zinc roof, account for 2 primary schools, 2 secondary schools and one high school, while the latter ones are generally of bamboo walls and thatched roof. Writing desks and chairs are generally not uniform in size and shape, having been contributed by local people.

(6) Community Facilities

There are no particular public facilities at the district level except for one gymnasium located in Vangvieng village.

At the village level, generally no community halls are available. Community meetings are held using either the residence of the village chief, school, or temple (35 temples in the District).

(7) Irrigation Facilities

There are 77 small scale irrigation systems with a total area of 4,242 ha including possible extension area of 293 ha in the Study Area. These systems are classified into three categories by the type of diversion weir as follows:

a) System with permanent (concrete) diversion weir

- Number of systems:	16 systems
- Irrigable area in the wet season:	2,206 ha
- Irrigable area in the dry season:	246 ha
- Possible extension area:	120 ha

b) System with semi-permanent (gabion) diversion weir

- Number of systems:	4 systems
- Irrigable area in the wet season:	143 ha
- Irrigable area in the dry season:	0 ha
- Possible extension area:	158 ha

c) System with temporary (wooden) diversion weir

- Number of systems:	57 systems
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- Irrigable area in the wet season: 1,600 ha
- Irrigable area in the dry season: 30 ha
- Possible extension area: 15 ha

Six systems in category (i), one system in category (ii) and 3 systems in category (iii) have a command area of over 100 ha. Those schemes are:

Table 3-3-4 Sizable Irrigation Systems in the Study Area

Name of System	Type of Weir	Irrigation Area		Possible Extension Area
		Wet Season	Dry Season	
Nam Phamon II	Concrete	320	30	—
Houay Nampat	Concrete	327	10	—
Nam Po	Concrete	200	25	--
Nam Ka	Concrete	150	5	--
Namon	Concrete	350	50	—
Nam Koang I	Concrete	476	120	120
Nam Xang-Phatao	Gabion	101	0	158
Nam Lao I	Wood/cobble	158	0	—
Nam Koang 10	Wood/cobble	210	0	--
Nam Nga	Wood/cobble	113	5	—

A gated intake structure is attached to all the permanent (concrete) diversion weirs and one semi permanent (gabion) diversion weir. The irrigation system with semi permanent and temporary (wood/cobble) diversion weirs has no intake gate. Permanent discharge control structures such as diversion structures, turnouts and cross regulators (check) have not been constructed except only for those systems stated above and a few other systems.

According to a list of the existing irrigation systems provided by the Vangvieng District Bureau of the Ministry of Forestry and Agriculture, the irrigable area during the dry season is negligibly small. This is most probably attributed to: i) insufficient river discharges; ii) very low intake efficiency of the temporary type diversion weir (gabion and wood/cobble); and/or iii) low irrigation efficiency in the irrigation system due to lack of discharge regulating structures, lack of interest in cropping during the dry season, lack of the sense of water management both among beneficiary farmers and government staff and lack of agriculture extension workers.

Since the land suitable for irrigated agriculture in the Study Area seems to have been mostly developed as paddy field and cannot be expanded to new paddy field, vertical

development of the existing paddy land by increasing cropping intensity and crop yield as well would be prerequisite to increase agriculture production in the Study Area.

(8) Land Conservation Facilities

Limestone outcrops in and on the Nam Xong course between the estuary of the Nam Ngat and Nam Po. Torrents appear in the upstream part of the Nam Xong from the junction of the Nam Po tributary. No river protection works were seen except for a very small part on the left bank at Vangvieng. At Houay Ngam and Hatsongkhon villages, the left bank of the river seems to be progressively eroded at high water stages.

3.4 Problems in Watershed Management

The problems of watershed management in the Study Area are as follows:

- (1) In the Study Area, although the watershed is large in the northern part, all the rivers there flow into Nam Xong. Nam Xong turns the flow in the Nam Xong Dam and will flow into the Nam Ngum Reservoir. In order to continue stable hydroelectric power generation, continuous water supply is required in this watershed even in the dry season.
- (2) Although the main crop is rice produced by farmers in paddy rice cultivation, the scope for paddy field development is limited due to lack of flatlands, which resulted in the popularity of up land rice cultivation using the slash and burn method in mountainous areas. Repeated slash and burn cultivation devastated forests, and productivity of the slash and burn cultivation has declined. Devastated forests have become gramineous grassland which has low water yielding function. Consequently, it is a task to introduce a new method for producing farm products in place of the slash and burn cultivation and to recover forests.
- (3) Repeated slash and burn cultivation degrades the soil and lowers the productivity in slash and burn fields. Slash and burn fields were expanded to cover the low productivity. It is required to find measures to keep fertility and make continuous cultivation possible. While the need to convert slash and burn cultivation to a sustainable cultivation method is recognised by both the administration and local people, this conversion process has so far been slow due to the absence of a practically viable conversion method and insufficient techniques and extension system to support a new cultivation method.
- (4) The northern part of the Study Area, the watershed of Nam Xong, is a place where few people live now. This area is also affected by slash and burn cultivation and forests have

deteriorated. It is required to recover forest resources in this watershed. Positive intervention of the administration is especially necessary to make use of resources continuously.

- (5) One of major features in this area is that the west side of National Route 13 is mainly composed of limestone. Because there is originally little sediment and low water retainability due to the nature of the soil, it floods suddenly when it rains. It is normally required to develop man-made forests, but the growth of forests can be hardly expected because of the thin soil, and it is extremely difficult to hope for good results. In contrast, there is a possibility of creating forests on the east side of National Route 13 by means of planting at former slash and burn sites. However, many problems of infrastructure and so on are anticipated because there are few roads and few villages. Secondary bamboo forests are observed continuously at former slash and burn sites in mountainous areas close to the national route, therefore, planting bamboos in these areas is possible under the current site conditions. As many bamboos are cut down and placed along roadsides or riverbeds, bamboo planting has the prospect of becoming a new industry. As Acrisol of high soil acidity is distributed widely, planting useful bamboos should be effective.

CHAPTER 4

CURRENT CONDITIONS OF THE MODEL AREA

CHAPTER 4 CURRENT CONDITIONS OF THE MODEL AREA

4.1 Location of the Model Area

The Model Area is situated in the southern part of the Study Area and is adjacent to the Nam Ngum Reservoir. The Model Area has a total area of approximately 60,000 ha, including water bodies, and occupies about one-third of the Study Area.

Table 4-1-1 shows the land use conditions in the Study Area and Model Area based on the results of the analysis of the SPOT satellite images (1989) conducted by the NOFIP.

Table 4-1-1 Land Use

Land Use Category	Proportion (%)	
	Study Area	Model Area
< Forest >	92.6	91.6
Present Forest	51.9	39.2
- Mixed Deciduous Forests	51.9	39.2
Potential Forest Land	40.7	52.4
- Bamboo Forest	1.3	-
- Slash and Burn	1.4	3.2
- Unstocked Forest	38.0	49.2
< Farmland >	1.8	-
Paddy Field	1.8	-
< Other >	5.6	8.4
- Bush	1.2	0.4
- Grassland	1.7	-
- Urban Area	-	-
- Water Body	2.7	8.0
Total	100.0	100.0

The proportion of forests is approximately 92% in both the Study Area and Model Area. When forests are further classified as present forests and potential forest land, the proportion of present forests is much lower than that of potential forest land in the Model Area. As this potential forest land consists of slash and burn sites and former slash and burn sites, the Model

Area can be assumed to be more dependent on slash and burn agriculture than other parts of the Study Area.

From the viewpoint of the objective of the Study, i.e. establishment of a suitable watershed conservation method while achieving the sustainable use of forest resources, the decision to select this area as the Model Area is appropriate for the model formulation of a watershed management plan, because repeated slash and burn agriculture has been a major cause of forest degradation and the Model Area has a high dependence on the agriculture system.

4.2 Natural Environment

4.2.1 Climate

The meteorological records at the Nam Xong diversion work site in the Somboun Area for the period from April, 1994 to November, 1995 constitute the available daily rainfall data for the Model Area. The records of the Lao Department of Meteorology and Hydrology for Vangvieng located next to the Model Area are referred to for rainfall, temperature and relative humidity data for a longer period.

The rainfall levels at the above-mentioned work site during the said period are shown in Table 4-2-1. The maximum daily rainfall of 120.5 mm was recorded on August 29, 1994 while the maximum monthly rainfall of 1,016.5 mm was recorded in August, 1995. Table 4-2-2 compares the rainfall levels between this work site and Vangvieng during the same period, with Vangvieng appearing to have recorded a slightly higher rainfall level.

Table 4-2-1 Maximum Daily Rainfall by Month and Monthly Rainfall (Somboun)

(Unit: mm)

Year		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
1994	Max. Daily Rainfall	No Data	No Data	No Data	51.0	98.0	85.0	72.0	120.5	103.0	30.0	18.0	73.0
	Monthly Rainfall	No Data	No Data	No Data	79.0	707.5	493.6	450.5	748.0	389.1	98.5	18.0	119.0
1995	Max. Daily Rainfall	3.5	0.0	17.0	32.0	63.0	87.0	87.0	110.0	32.0	16.0	13.5	No Data
	Monthly Rainfall	5.0	0.0	23.0	132.0	353.0	519.5	1,005.0	1,016.5	194.0	101.0	16.0	No Data

Table 4-2-2 Comparison of Rainfall between Vangvieng and Somboun

Period	Vangvieng	Somboun
April - December, 1994	3,224.6 mm	3103.2 mm
January - November, 1995	3,698.0 mm	3,365.0 mm

Table 4-2-3 shows the annual rainfall at Vangvieng for the seven-year period from 1989 to 1995, ranging from some 2,800 mm/year to some 3,800 mm/year with average rainfall of 3,200 mm/year.

Table 4-2-3 Monthly Rainfall (Vangvieng: 1989 - 1995)

(Unit: mm)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1989	156.8	0.0	175.9	133.9	258.6	493.4	725.3	316.5	404.7	145.1	10.0	10.2	2,830.4
1990	10.0	26.0	146.7	81.5	425.4	1,054.9	678.9	538.1	282.4	151.0	203.5	10.2	3,808.6
1991	0.0	0.0	83.7	9.1	259.1	615.1	537.4	815.8	482.7	182.7	0.0	10.2	2,995.8
1992	93.2	63.8	0.0	18.8	191.4	634.6	803.4	481.0	385.8	137.9	6.3	55.4	2,871.4
1993	0.0	80.7	25.6	119.2	428.7	781.3	965.8	396.5	304.7	39.2	0.0	0.0	3,141.7
1994	0.0	40.9	116.2	121.7	189.8	667.8	841.2	716.3	529.8	158.2	0.0	0.0	3,383.7
1995	0.0	0.0	66.8	66.0	184.7	761.8	701.2	1,336.7	407.4	136.5	37.5	0.0	3,698.6
Average	37.1	30.2	88.1	78.8	276.8	715.6	779.0	657.3	399.6	135.9	36.8	12.3	3,247.2

The average temperatures at Vangvieng in the 12-year period from 1972 to 1983 were 30.1°C, 25.4°C and 20.7°C for the maximum, mean and minimum temperatures, respectively. The most recent data obtained was for 1995, giving maximum, mean and minimum temperatures of 30.7°C, 25.1°C and 19.1°C, respectively. In short, the average annual temperature at Vangvieng is approximately 25°C.

Table 4-2-4 Average Monthly Temperature (Vangvieng)

(Unit: °C)

Period		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Annual Mean
1972 - 1983 Average	Max. Temp.	26.6	29.2	31.9	33.1	31.8	32.0	30.0	29.3	30.6	30.5	28.9	27.0	30.1
	Mean Temp.	20.7	22.7	25.8	27.6	27.5	27.6	26.8	26.6	27.0	26.4	24.2	21.5	25.4
	Min. Temp.	14.9	16.7	18.4	22.0	23.3	24.1	23.8	24.0	23.5	22.0	19.1	16.3	20.7
1995	Max. Temp.	27.8	29.5	33.6	35.4	32.1	30.1	30.3	29.8	31.3	31.6	29.0	27.9	30.7
	Mean Temp.	21.7	21.9	26.6	24.3	27.6	28.5	27.3	26.2	27.2	26.3	23.0	20.2	25.1
	Min. Temp.	15.5	14.3	19.7	13.2	23.0	23.4	23.5	22.7	23.2	21.1	17.1	11.9	19.1

In regard to the relative humidity, the monthly average figures for the 12-year period from 1972 to 1983 at Vangvieng are shown in Table 4-2-5. Comparatively speaking, the period from May to October shows a high relative humidity while the period from November to April shows a low relative humidity, indicating a similar trend to the monthly rainfall data.

Table 4-2-5 Average Monthly Relative Humidity (Vangvieng: 1972 - 1983)

(Unit: %)

Month	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Relative Humidity	67	64	63	65	74	79	82	84	78	73	69	67

Table 4-2-6 shows the average amount of monthly evaporation for a 12-year period, consisting of the 10-year period from 1976 to 1985, 1994 and 1995. The annual amount of evaporation is 1,104.6 mm with a relatively low level of evaporation from June to November and a relatively high level of evaporation from December to May.

Table 4-2-6 Average Monthly Amount of Evaporation (Vangvieng: 1976 - 1985, 1994 - 1995)

(Unit: mm)

Month	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
Evaporation	101.6	117.1	136.0	133.0	107.9	73.0	62.8	53.8	56.1	78.0	83.6	101.8	1,104.6

The annual rainfall at Vangvieng is approximately 3,200 mm as shown in Table 4-2-3 while the annual amount of evaporation is 1,104.6 mm. Although the subject years of observation for these two figures differ, the annual amount of evaporation of 1,104.6 mm represents some 35% of the annual rainfall based on the assumption that these two figures show the average rainfall and amount of evaporation. As observation of the amount of evaporation was conducted at an instrument shelter, the natural amount of evaporation in an open field is believed to be higher than the figures given in Table 4-2-6.

4.2.2 Topography

The Model Area is situated between an elevation of some 200 m (lower reaches of Nam Xong) and an elevation of 1864 m (Ph. Kho). The area around Ph. Kho in the northeastern part of the Model Area is characterised by a series of mountains with a peak elevation of 1,000 m or more, forming the most steep mountainous area in the Model Area. Along the southern edge of the Model Area lies a continuous ridgeline which stretches from Ph. Kaykon (El. 987 m) and the hills spreading from this ridgeline are very steep. Ph. Thai Khan (El. 972 m) formed by limestone lies in the northwestern part of the Model Area, creating steep rocky cliffs. Ph. Houat (El. 801 m) is found at almost the centre of the Model Area.

Based on topographical factors, the Model Area is divided into three zones, i.e. the lowland/hill zone (El. 200 m - El. 300 m), intermediate zone (El. 300 m - El. 500 m) and highland zone (El. 500 m and more).

The lowland/hill zone consists of the right bank area of Nam Xong, through which such smaller rivers as Nam Houm and Nam Ken flow, the lower reaches of Nam Ngat and the area surrounding the Nam Ngum Reservoir. The rivers flowing in this zone are marked by a very gentle gradient and, therefore, these rivers meander through the lowland. Settlement areas and surrounding paddy fields are found in this zone.

The gradient of Nam Houm and Nam Ken is less than 1% but their banks are steep cliffs with a difference in elevation of 2 - 3 m. The hills found in the watersheds of these two rivers are not particularly high but are characterised by a series of very undulating small peaks.

The zone above an elevation of 500 m consists of the above-mentioned areas where Ph. Kho, Ph. Kaykon, Ph. Thai Khan and Ph. Houat are located. In each area, the hillside slopes suddenly steeper just above an elevation of 500 m, forming a highland area of difficult access. The area between El. 300 m and El. 500 m belongs to the intermediate zone between the lowland/hill zone and the highland zone, and the hillside gradient gradually increases.

In remote areas of Ban Namon-Nua and Ban Nangeun-Nua, although slash and burn agriculture is unusually conducted in areas between an elevation of 700 m and 800 m; slash and burn cultivation is mainly conducted here in areas up to an elevation of 500 m. The reason for this practice at a low altitude may be the use of sites with easy access or gently sloping sites as slash and burn sites by local farmers.

4.2.3 Land Use and Vegetation

Field reconnaissance was conducted during the second field survey period to grasp a general condition of the land use and vegetation distribution in the Model Area. The information obtained by this field reconnaissance was then used to interpret the aerial photographs and the interpretation results were transcribed onto the topographical map (scale: 1/20,000).

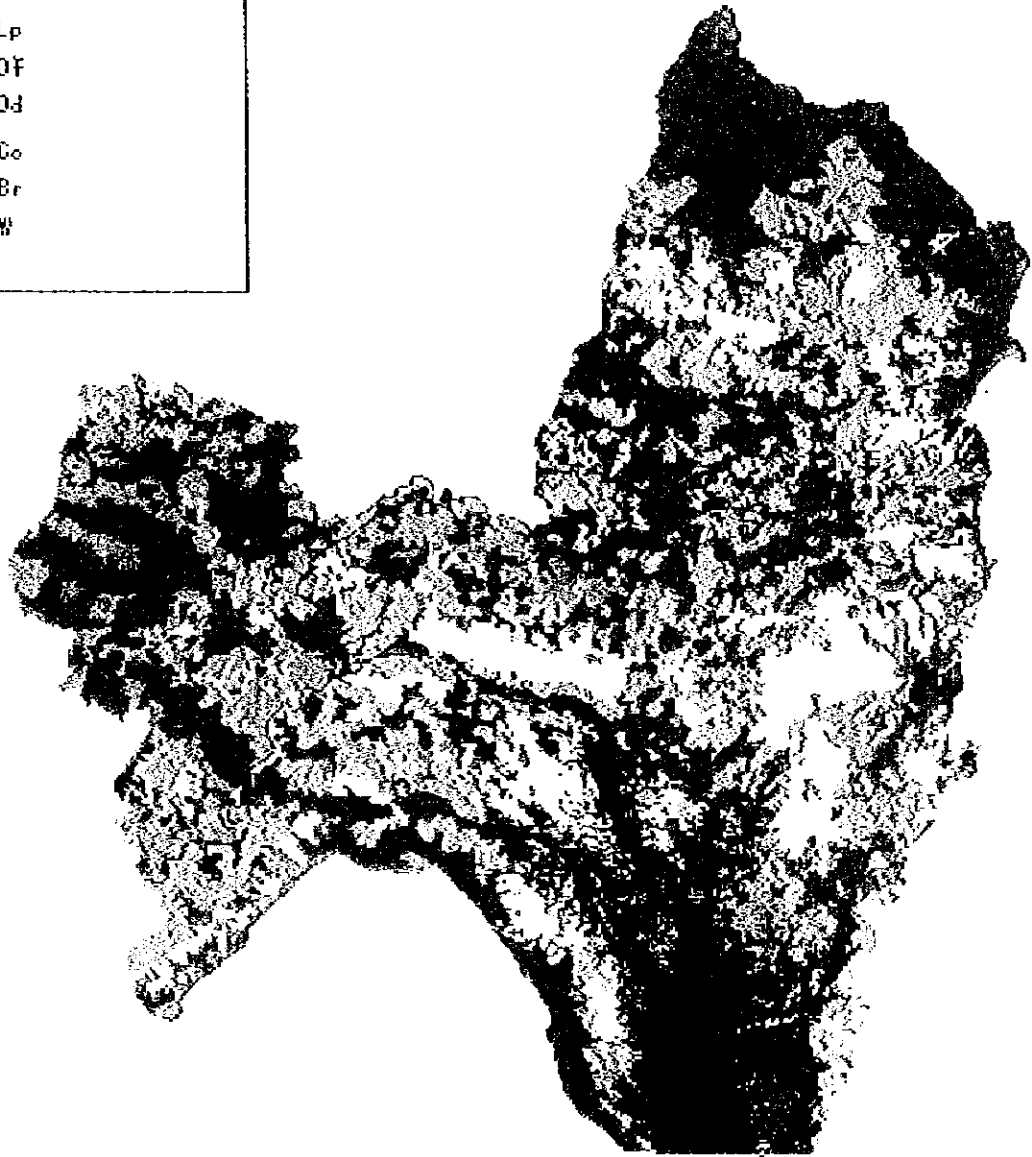
Land use and vegetation were categorized as indicated in Table 4-2-7 (1). Results of interpretation are shown in Fig. 4-2-1. Also, the area size and percentage for each type of land use are given in Table 4-2-7 (2).

Table 4-2-7 (1) Interpretive Categories

Category		Symbol	Criteria	
Forest	Man-Made Forest	Mf	teak forest; brown on photograph	
	Natural Forest	Primary	Np	forest with high, large diameter trees
		Secondary	Ns	regenerated forest on former slash and burn site with tree height of 5 m or more
	Bamboo Forest (1)	B1	mixed with primary natural forest or along river banks	
Shrub Land		S	mainly distributed along ridge lines	
Slash and Burn Site and Former Slash and Burn Site	Slash and Burn Site (Hay)	Hy	exposed ground surface with dotted small cabins	
	Bush	Bh	regenerated bush on former slash and burn site with a tree height of less than 5 m	
	Bamboo Forest (2)	B2	bamboo forest on former slash and burn site; yellow green on photograph	
	Grassland	G	covers a fairly large area on a former slash and burn site; liver brown on photograph	
Permanent Farmland	Lowland Paddy Field	Lp	spreads over a relatively large area compartmented by ridges	
	Dry Farmland	Df	located near houses and encircled by fencing	
	Orchard	Od	located near houses with bananas and pineapples, etc.	
Settlement		Co	group of houses	
Bare Land		Br		
Road		Rd		
Water Body		W		

LEGEND

- RF
- Np
- Nc
- B1
- S
- Hy
- Bh
- B2
- G
- Lp
- DF
- Od
- Co
- Br
- W



0 5 km

Fig. 4-2-1
Present Land Use & Vegetation Map (Year of 1996)
The Study on Watershed Management Plan for
Forest Conservation in Vangvieng District

Table 4-2-7 (2) Present Land Use and Vegetation in the Model Area

Landuse/Vegetation Type		Code	Area (ha)	%	
Forest	Man-Made Forest		Mf	27.5	0.0
	Natural Forest	Primary	Npd1	455.3	0.8
			Npd2	1,490.4	2.5
			Npd3	5,004.8	8.4
			Npd4	1,463.1	2.5
		Secondary	Nsd1	42.8	0.1
			Nsd2	842.3	1.4
			Nsd3	4,766.2	8.0
			Nsd4	6,232.8	10.5
	Bamboo Forest (1)		B1	1,851.9	3.1
Shrub Land		S	136.5	0.2	
Total			22,313.5	37.6	
S/B Site and Former S/B Site	Slash and Burn Site		Hy	2,293.6	3.9
	Bush		Bh	8,012.4	13.5
	Bamboo Forest (2)		B2	9,997.9	16.8
	Grassland		G	8,276.6	13.9
	Total			28,580.5	48.1
Permanent Farmland	Lowland Paddy Field		Lp	1,127.5	1.9
	Dry Farmland		Df	32.6	0.1
	Orchard		Od	28.0	0.0
	Total			1,188.1	2.0
Settlement		Co	508.0	0.9	
Bare Land		Br	367.4	0.6	
Water Body		W	6,417.6	10.8	
Grand Total			59,375.0	100.0	

Note: The following crown density categories have been adopted based on the area covered by the crown of dominant trees of Natural Primary Forest (Np) and Natural Secondary Forest (Ns)
 20% or lower: d1; 21%~39%: d2; 40%~69%: d3; 70% or higher: d4

The category with the largest land coverage in the Model Area is current and former slash and burn sites, accounting for almost half (48%) of the total area. This category includes land used for slash and burn agriculture at the time of the aerial photographs (November to December, 1996). Bamboo forests at former slash and burn sites have a particularly large coverage. The most prominent species is May shoth (*Oxytenanthera parvifolia*) which quickly grows at former slash and burn sites but which is disliked by local farmers because of its low use value. Local farmers consider this species to be an indicator of land with poor productivity.

Bush and grassland emerging at former slash and burn sites share second place in terms of land coverage with approximately 8,000 ha each. Bush mainly consists of broad-leaved trees but bamboo is also present. Bush will provide sites for slash and burn agriculture in the future. In contrast, grassland has resulted from slash and burn agriculture which has deteriorated the soil

conditions. The grass species observed are predominantly Gramineae, such as Kok Lao (*Pennisetum* spp.), Kok Khem (*Thysanolaena maxinia*) and Nya Ka (*Imperata cylindrica*). Local farmers are aware of the fact that Nya ka represents the lowest level of soil fertility, but they believe that slash and burn agriculture is still possible at grassland covered by Kao Lao or Kok Khem. Some actually conduct slash and burn agriculture at such grassland but the yield of upland rice is extremely low. By weight, the yield, formerly 50 - 60 times the weight of the sown seeds, has now dropped to some 20 times or even eight times in some cases, indicating a productivity decline of upland rice cultivation using the slash and burn method.

Many farmers say that they were free to choose slash and burn sites in the past without worrying about rotation as forests were abundant around villages. The existence of some 2,000 ha of current slash and burn sites and some 8,000 ha of bush which can be regarded as reserve slash and burn sites as shown in Table 4-2-7(2) indicates the feasibility of five-year rotation. If bamboo forests which cover 10,000 ha are added, 10-year rotation is possible. The main practice today, however, is three-year rotation although some farmers are engaged in five-year rotation. This three-year rotation is the result of a new regulation enforced in the 1990's which restricts cultivation to those sites which were last used three years or more previously. The original purpose of this regulation was to turn cultivated land into permanent farming land by prohibiting the cutting of trees in forests to create new farming land, while allowing cultivation at only those sites which were last used for cultivation three years or more previously. This regulation appears to have been incorrectly interpreted that slash and burn agriculture may be conducted with a three-year rotation.

Another reason for the short rotation may be the unbalanced distribution of vegetation in the Model Area (some villages have much grassland and little bush, while some villages have little grassland and much bush land) even though 10-year rotation is theoretically possible using bamboo forests as feasible slash and burn sites based on the overall figures for the Model Area. In addition, bamboo forests dominated by May Shoth are unsuitable for slash and burn agriculture, further limiting the areas suitable for this type of agriculture. There is concern that the further continuance of such a short rotation will rapidly deteriorate the land productivity, pushing current bush and bamboo forests down to the final stage, i.e. grassland with poor productivity.

Fig. 4-2-2 shows the current state of land use by village. Compared to the Namon Area, the ratio of bush in the Somboun Area is smaller despite its high dependence on slash and burn agriculture. The relatively large distribution ratios of bamboo forests and grassland indicate the lower availability of suitable land for slash and burn agriculture in the Somboun area.

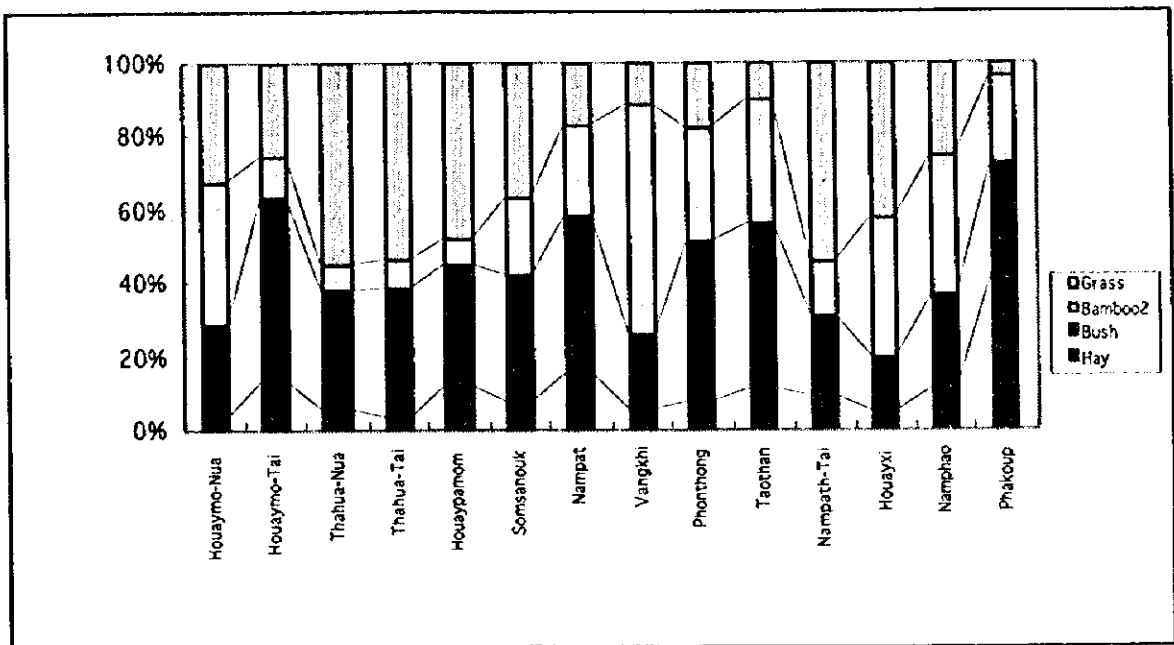
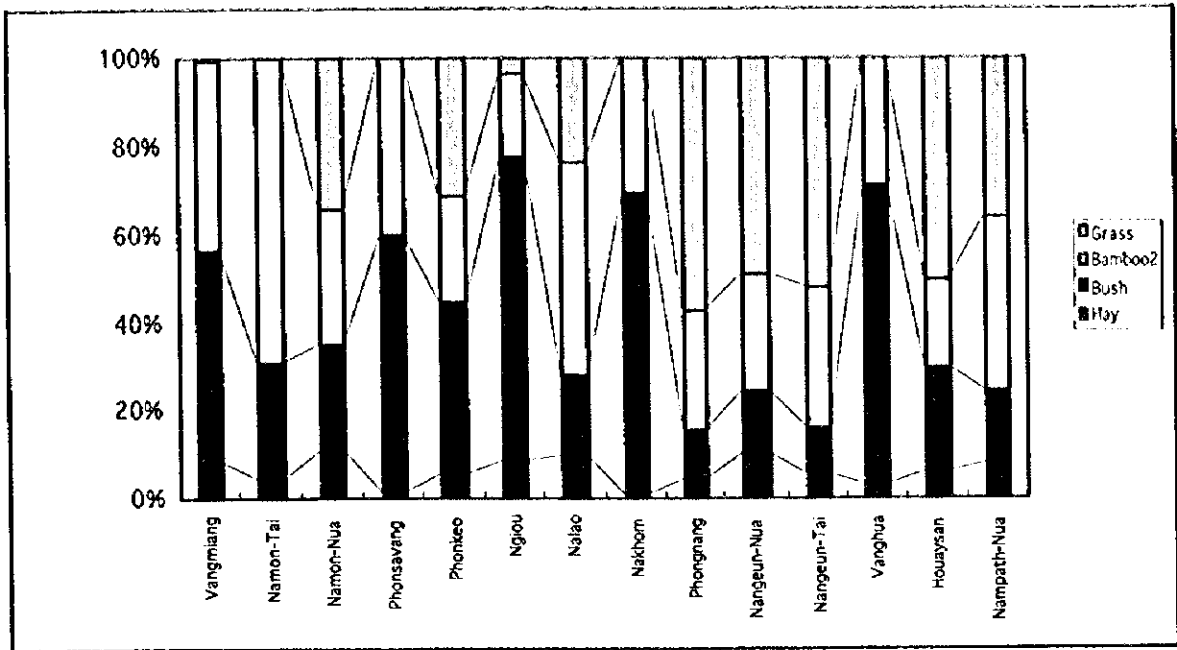


Fig. 4-2-2 Scale of Slash and Burn Agriculture and Land Use at Former Slash and Burn Sites by Village (upper: Namon, bottom: Somboun)

Among forests in the Model Area, primary natural forests and secondary natural forests account for 10% and 20% respectively, resulting in a total share of natural forests of 30%. Primary natural forests are those forests which have hardly been affected by human activities, except possibly hunting, and are observed in the upper reaches of Nam Ngat and the watershed of Nam Ken. Secondary natural forests are naturally regenerated forests after the disappearance of

primary natural forests due to human interference, including slash and burn agriculture, in the past. These are observed around settlements and at lowland, such as the watershed of Nam Houm. Many secondary natural forests near settlements are protected by the village authorities and slash and burn agriculture is prohibited in these forests.

Bamboo forests (B1) classified in the category of forests are composed of large bamboo trees and are seen in areas dominated by primary natural forests. Compared to May Shoth growing at former slash and burn sites, May Her (*Thyrosostachys* spp.), which is dominant in bamboo forests in the B1 category, is much larger in terms of both diameter and height. May Her is used for various purposes, including as a roof and wall material. B1 bamboo forests tend to be seen in remote areas far from settlements. Natural environment of Lao PDR is suitable for bamboo growth and, while there are many bamboo species which grow in Lao PDR, few man-made bamboo forests have so far been created.

The available volume in the Model Area is calculated below. For primary natural forests, data established for the Fuang District (near the Model Area) by the NOFIP is used for reference purposes. The volume per ha is set at the 70% level of the volume for the Fuang District based on the medium crown density and medium stem class, taking the differences between the Fuang District and the Model Area into consideration. In the case of secondary natural forests, the single tree volume formula prepared by the NOFIP is used. The figures used for the calculation are 8 - 12 cm for the DBH, 6 - 8 m for the tree clear length and 1,000 - 1,200 trees/ha which are believed to represent an average stand observed in the Model Area.

- Primary natural forests : $V = 171.549 \text{ m}^3/\text{ha} \times 70\% = 120 \text{ m}^3/\text{ha}$
- Single tree volume formula : $V = \pi/4 \times D^2 \times H \times 0.65 = 0.01959\text{m}^3 \sim 0.07348 \text{ m}^3$
 D: DBH = 0.08 – 0.12 m
 H: clear length = 6 – 8 m
- Secondary natural forests : $V = v \times 1,000 - 1,200 \text{ trees} = 24 \sim 73 \text{ m}^3/\text{ha}$
 (average: 49 m^3/ha)

The volume per ha for primary natural forests and secondary natural forests is multiplied by the respective area to obtain the total volume in the Model Area. The results are 406,000 m^3 for primary natural forests and 456,000 m^3 for secondary natural forests, totalling 860,000 m^3 (see Table 4-2-8).

The daily collection of firewood by local people is believed to take place in nearby secondary natural forests rather than in primary natural forests in remote areas.

The socioeconomic baseline survey has found that the annual firewood consumption per capita in the Model Area is 0.9 m³ which converts to 14,500 m³ for the entire Model Area. Assuming a constant population and the entire consumption of the volume established in Table 4-2-8 as firewood, the Model Area has firewood equivalent to 32 years of consumption.

Interpretation of the aerial photographs has established the total area of paddy fields in the Model Area to be approximately 1,100 ha. However, this figure does not accurately reflect the cultivated area as it also covers land around paddy fields. The actual area of paddy fields is estimated to be some 70% or approximately 700 - 800 ha.

Paddy fields are frequently observed, particularly in lowland areas along Nam Ngat and Nam Ga, a tributary of Nam Ngat. In other areas, paddy fields are merely scattered in lowland areas along Nam Xong and Nam Phao and in valleys between hilly land.

Table 4-2-8 Volume of Primary and Secondary Natural Forests by Village

		Primary Forest		Secondary Forest	
		Area(ha)	Volume(m ³)	Area(ha)	Volume(m ³)
Namon Area					
1	Vangmiang	156.47	18,776	693.42	33,977
2	Namon-Tai	0.00	0	385.34	18,881
3	Namon-Nua	164.82	19,778	850.69	41,684
4	Phonsavang	0.00	0	102.28	5,012
5	Phonkeo	44.32	5,318	618.83	30,323
6	Ngjou	0.00	0	187.30	9,178
7	Nalao	242.82	29,138	868.19	42,541
8	Nakhom	0.00	0	129.04	6,323
9	Phongnang	188.25	22,590	482.71	23,653
10	Nangeun-Nua	163.98	19,678	238.18	11,671
11	Nangeun-Tai	8.17	980	264.24	12,948
12	Vanghua	134.95	16,193	175.04	8,577
13	Houaysan	46.32	5,558	211.98	10,387
14	Nampath-Nua	16.07	1,928	114.75	5,623
Total		1166.16	139,939	5321.98	260,777
Somboun Area					
1	Houaymo-Nua	29.10	3,492	230.54	11,296
2	Houaymo-Tai	0.00	0	184.61	9,046
3	Thahua-Nua	30.12	3,614	37.79	1,851
4	Thahua-Tai	30.02	3,602	38.01	1,862
5	Houaypamon	21.81	2,617	140.05	6,862
6	Somsanouk	415.89	49,907	647.55	31,730
7	Nampat	94.45	11,334	136.79	6,703
8	Vangkhi	1138.85	136,662	1182.73	57,954
9	Phonthong	15.00	1,800	42.94	2,104
10	Taothan	5.66	679	128.11	6,277
11	Nampath-Tai	3.37	404	221.78	10,867
12	Houayxi	60.97	7,316	355.71	17,430
13	Namphao	231.32	27,758	440.63	21,591
14	Phakoup	138.74	16,649	188.54	9,238
Total		2215.30	265,836	3975.77	194,813
GrandTotal		3381.46	405,775	9,297.75	455,590

4.2.4 Soil

(1) Soil Classification in Model Area

Using the FAO/UNESCO soil classification criteria, the distribution of the nine soil groupings and 13 soil units shown in Table 4-2-9 is found in the Model Area.

Table 4-2-9 Soil in Model Area

Major Soil Groupings	Soil Units
1. Fluvisols (FL)	1. Dystric Fluvisols (FLd)
2. Gleysols (GL)	2. Dystric Gleysols (GLd)
3. Regosols (RG)	3. Dystric Regosols (RGd)
4. Leptosols (LP)	4. Dystric Leptosols (LPd) 5. Eutric Leptosols (LPe) 6. Rendzic Leptosols (LPk)
5. Cambisols (CM)	7. Eutric Cambisols (CMe) 8. Dystric Cambisols (CMd)
6. Ferralsols (FR)	9. Haplic Ferralsols (FRh) 10. Rhodic Ferralsols (FRr)
7. Acrisols (AC)	11. Haplic Acrisols (ACh)
8. Alisols (AL)	12. Haplic Alisols (ALh)
9. Luvisols (LV)	13. Chromic Luvisols (LVx)

Some of these soil units are tropical soils found only in the tropics and sub-tropics while others are much more widely distributed. Examples of tropical soils are Ferralsols (FR), Acrisols (AC), Alisols (AL) and Luvisols (LV), all of which are widely distributed in the hilly and mountainous areas of the Model Area. In the case of these soils, fine clay is dominant due to strong weathering. Some show strong acidity due to leaching of the base while others show an illuvial clay horizon due to the movement of clay. Examples of the latter are Eutric Cambisols (CMe) and Rendzic Leptosols (LPk), both of which are found in the limestone area in the northwestern part of the Model Area, Dystric Cambisols (CMd) with a relatively large quantity of organic matters and Fluvisols (FL) of which alluvium is the parent material.

(2) Soil Properties

1) Tropical soils

Ferralsols (FR)

Ferralsols generally have a reddish colour and a thick clayey horizon. They also have iron granules in some cases. The soil properties show little difference regardless of the depth. The reddish colour and occasional presence of iron granules indicate loss of the base due to progressive weathering and leaching and a low level of organic matter accumulation. Because of the low cation exchange capacity of clay, they have a low level of nutritive elements and the nutrition retention capability is weak, constituting a major shortcoming of this soil group.

Acrisols (AC)

Acrisols are an acidic soil with highly progressed weathering and leaching. In the case of this soil group, clay is lost in the top layer and is concentrated in the lower formations. This can be partly explained by the fact that the high dispersibility of clay due to the relatively low presence of iron makes clay highly mobile. The properties of clay are similar to those of Ferralsols, i.e. low level of nutritive elements, low nutrition retention capability and poor chemical properties. The low level of clay in the top layer makes the soil structure unstable and the resistance of this soil group to erosion under strong tropical rain is poor.

Alisols (AL) and Luvisols (LV)

Both soil groups are characterised by advanced weathering and leaching and the B horizon shows the accumulation of clay as in the case of Acrisols. While Alisols have a higher cation exchange capacity than Acrisols, the base saturation is low due to leaching of the base. Instead of base, aluminium acts as the exchangeable cation. Consequently, Alisols have a high aluminium content. Compared to Acrisols and Alisols, Luvisols have a higher clay content, showing relatively high levels of the cation exchange capacity and base saturation. Because of clay movement within the soil profile, the surface soil is unstable with a relatively low resistance to erosion.

As briefly described above, tropical soils are generally poor in terms of the physical and chemical properties, resulting in low productivity.

2) Other soils

The Eutric Cambisols (CMe) and Rendzic Leptosols (I.Pk) distributed in limestone areas have a high base content, particularly calcium. Humus combined with calcium ensure a high organic content of soil. Weathered limestone is generally clayey but the physical and chemical properties are generally good due to the mixture of organic matters. Other than limestone areas, scattered small areas of Dystric Cambisols (CMd) with a relatively large quantity of humus in the A horizon and a brownish B horizon are found at colluviums distributed in natural forests, stable forest beds of secondary natural forests, slope bottoms and concave sites. This soil unit has also undergone leaching of the base, resulting in a pH value of 4 - 5. The productivity is high next to the soils found in limestone areas.

Fluvisols (FL) are found at alluviums and the flood plains of rivers. This soil group is formed by the sedimentation of parent materials which are transported by river water or floods. The texture and stratigraphic profile vary depending on the timing and place of sedimentation even at the same flat land as materials from clay to gravel are sedimented in various combinations. In general, alluviums tend to have higher sandy loam and sandy clay contents with the inclusion of a small to medium pebble layer in some cases. Flood plains show the sedimentation of sand and sandy loam and relatively new deposits show immature soils with undeveloped soil stratification. Areas with these soils are widely used for farming but are said to have been highly productive forests producing large diameter, useful trees in the past. All of these soils are found in many places throughout the world and, compared to tropical soils, tend to show a higher level of productivity due to a high organic content.

(3) Productivity Potential of Soil

The soil productivity potential is mainly determined by the physical and chemical properties. The productivity potential of the 13 soil units found in the Model Area is graded in terms of five grades based on the soil survey results and is shown in Table 4-2-10.

Table 4-2-10 Productivity Potential of Soil

Soil Units	Productivity Potential
Eutric Cambisols (CMe) Dystric Cambisols (CMD)	5
Dystric Fluvisols (FLd) Rendzic Leptosols (LPk) Haplic Ferralsols (FRh)	4
Rhodic Ferralsols (FRr) Eutric Leptosols (LPe) Haplic Acrisols (ACh)	3
Chromic Luvisols (LVx) Dystric Gleysols (GLd) Haplic Alisols (ALh)	2
Dystric Regosols (RGd) Dystric Leptosols (LPd)	1

4.2.5 Landslide Sites

Landslide sites in the Model Area are shown in Table 4-2-11 based on the field reconnaissance findings and aerial photograph interpretation results. A total of 23 landslide sites has been confirmed. Two of these are new sites which appeared after the second field survey and which were confirmed during the third field survey, one of which is located along National Route 13. Emergency work to remove the collapsed soil was conducted at this site in early 1997 but a new landcreeping has since occurred.

The total area of landslide sites is 5.64 ha with an average area per site of 0.25 ha. The number of devastation sites is extremely small in view of the actual size of the Model Area and the scale of devastation is equally small. The slope gradient at devastation sites is an average of 29°. The vegetation at devastation sites is primary natural forest in some cases but predominantly grassland at former slash and burn sites.

Table 4-2-11 List of Landslide Sites in Model Area

No.	Area (ha)	Slope Gradient (°)	Surrounding Vegetation	River Governing Relevant Watershed
1	0.16	27	Grassland at former slash and burn site	Nam Hum Noy Nam Ngat (Nam Mon) Nam Ngat Nam Ngat (Houay Hok) Nam Ngat (Houay Kabak) Nam Ngat (Houay Kabak) Nam Ngat (Houay Kabak) Nam Ngat (Nam Nga) Nam Ngat (Nam Nga) Nam Ngat (Nam Nga) Nam Path Nam Path Nam Path Nam Path Nam Path Nam Path
2	0.20	31	Bamboo forest at former slash and burn site	
3	0.36	45	Grassland at former slash and burn site	
4	0.18	11	"	
5	0.34	40	"	
6	0.24	22	"	
7	0.25	11	Primary natural forest; crown density class 3	
8	0.18	35	"	
9	0.12	27	Bamboo forest at former slash and burn site	
10	0.20	27	"	
11	0.32	36	"	
12	0.28	31	Secondary natural forest; crown density class 4	
13	0.27	39	Grassland at former slash and burn site	
14	0.20	34	Primary natural forest; crown density class 3	
15	0.19	17	Grassland at former slash and burn site	
16	0.13	27	"	
17	0.24	26	"	
18	0.20	28	"	
19	0.26	40	Natural bamboo forest	
20	0.23	40	"	
21	0.45	27	"	
22	0.16	20	Bamboo forest at former slash and burn site	
23	0.50	34	Primary natural forest; crown density class 3	
Total	5.64	-		
Average	0.25	29		

4.2.6 River System and Hydrology

Observation data on the water level of Nam Ngat flowing through the Namon area was obtained as data to show the flow regime in the Model Area. While observation only commenced in January, 1997, data up to August is available and the maximum and mean water levels for each month are shown in Table 4-2-12. The correlation between changes of the monthly rainfall and average water level at Vangvieng for the same period is shown in Fig. 4-2-3.

Table 4-2-12 River Water Level (Nam Ngat)

(Unit: m)

Item	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.
Maximum	0.87	0.8	0.76	0.86	1.3	1.3	2.4	1.6
Mean	0.82	0.77	0.73	0.75	0.83	0.9	1.46	1.27

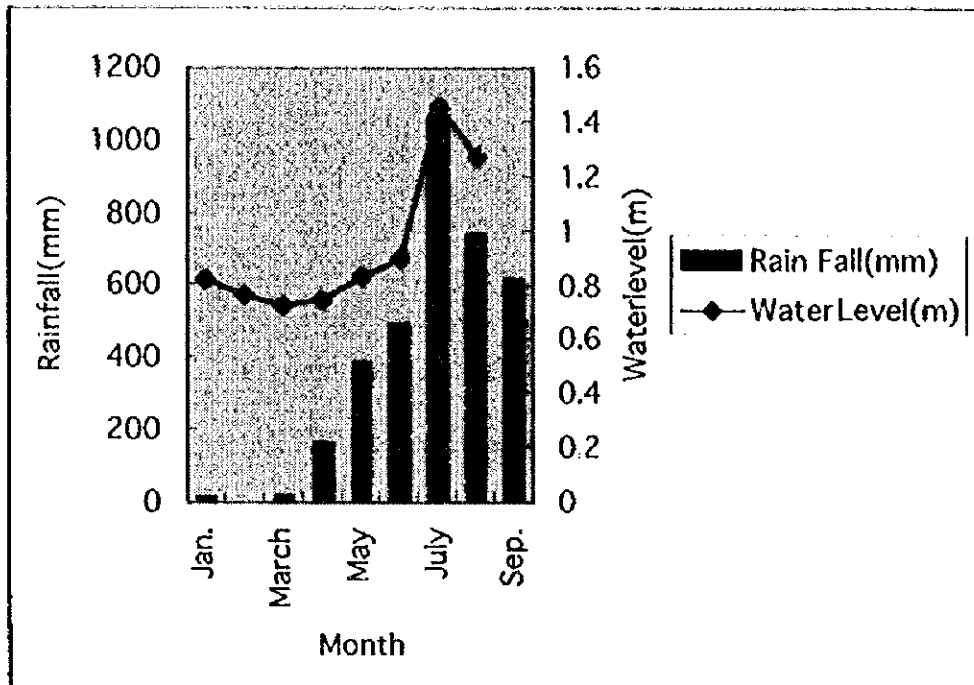


Fig. 4-2-3 Correlation between Rainfall and Water Level

As the above data covers only a short period of time, it is unsafe to draw any definite conclusions. However, the trends shown are generally identical to those of the water level of Nam Xong and the monthly rainfall fluctuations for the seven-year period at Vangvieng included in the earlier Progress Report. To be more precise, the water level is the lowest in March and April following the dry season and rapidly rises in June and July which constitute the flood season.

By measuring the flow rate during the dry season when the water level is at its lowest, it is possible to determine the level of the water retaining capacity of a watershed. In other words, if the flow rates of rivers in the Model Area are measured during the dry season, it is possible to compare the water retaining capacity level of each watershed based on the measured flow rate per unit area. A high flow rate during the dry season suggests that a watershed retains rainwater from the rainy season within its boundaries and gradually releases water to maintain a certain flow rate level during the dry season. Conversely, a negligible flow rate during the dry season implies that the rainwater which fell during the rainy season has been quickly discharged without being sufficiently retained in the watershed. The former watershed has an excellent water yielding function while the latter has a poor water yielding function. During the second field survey which was conducted during the local dry season, a simplified flow rate survey was conducted on small rivers in the Model Area and the findings are given in Table 4-2-13.

The surveyed flow rates are those during the dry season and, therefore, are called "dry flow rates" here. The watershed area and land use in the upstream of each observation site where the flow rate survey was conducted were determined based on the relevant land use and vegetation maps. The water yielding function of each land use category was then given an evaluation grade to calculate the average land use grading weighted by area. The flow rate measuring sites and grading by land use category are shown in Annex Fig. 1-4-1 and Annex Table 1-4-1, respectively. The correlation between the weighted average land use grading and dry flow rate per km² is compiled in the graph in Fig. 4-2-4.

Table 4-2-13 River Flow Rates

Site No.	Catchment Area (ha)	Flow Rate		Land Use Grading	Site No.	Catchment Area (ha)	Flow Rate		Land Use Grading
		(Litres/Sec)	(Litres/Sec/km ²)				(Litres/Sec)	(Litres/Sec/km ²)	
1	3,166.35	535.7	16.9	3.63	12	115.42	8.9	7.7	2.71
2	2,549.56	473.8	18.6	3.82	13	131.12	0.8	0.6	2.52
3	656.22	90.0	13.7	3.49	14	1,654.96	102.5	6.2	3.48
4	549.51	99.8	18.2	2.97	15	39.90	5.9	14.8	3.79
5	1,255.76	216.3	17.2	3.13	16	51.92	2.4	4.6	2.77
6	152.21	20.6	13.5	3.72	17	47.42	1.4	3.0	3.62
7	27.83	10.3	37.0	3.97	18	48.06	4.9	10.2	3.51
8	85.69	28.3	33.0	3.99	19	3,292.68	232.3	7.1	3.87
9	41.02	15.8	38.5	3.84	20	6.93	0.1	1.4	2.6
10	1,616.27	359.6	22.2	2.92	21	466.09	80.4	17.0	3.96
11	338.92	104.7	30.9	3.74					

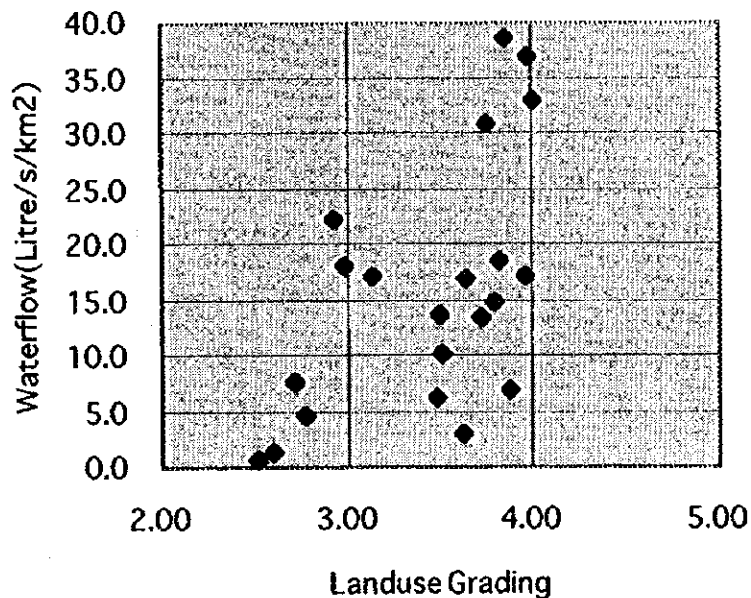


Fig. 4-2-4 Land Use and Flow Rates

Fig. 4-2-4 shows the tendency for a higher land use grading, i.e. large forest ratio with high quality stands in terms of land use, to produce a higher flow rate during the dry season. Assuming that the rainfall level is uniform throughout the Model Area, those watersheds which have preserved their forest state appear to restrict the outflow of rainwater during the rainy season and to release the retained water during the dry season.

Confirmation that watersheds which have preserved a good forest state have a high dry flow rate supports the comment made by local people that the river flow rate was high during the dry season some 20 - 30 years ago when the Model Area was still covered by forests.

The forest function of delaying the outflow of rainwater is called the water yielding function which is not the direct work of a forest but which is the result of the work of litter and top soil formed by a forest over a long period of time. In this sense, the mere existence of a forest does not guarantee a good water yielding function. As the stands' conditions alone cannot fully explain the mechanism of this function, it is important to examine the forest floor conditions. Nevertheless, the preservation of good forest conditions is essential for the natural formation and maintenance of an excellent water yielding function. The crucial issue is how to manage forests in a sustainable manner.

The dry flow rate measurement results reconfirm that forest restoration will lead to an increase of the river flow rate during the dry season. In the Model Area, there appears to be a shortage of water for domestic use during the dry season while there is a desire among local people to cultivate crops during the dry season. The restoration of forests through improved land use will improve the water shortage during the dry season and should prove extremely beneficial for the lives of local people.

The river system in the Model Area can be largely classified into three catchment areas, i.e. the catchment area of Nam Ngat which runs through the centre of the Namon Area, the catchment area around Nam Ngum Reservoir and the lower reaches of Nam Xong.

The Nam Ngat catchment area has a half-mortar shape and is formed by Nam Ngat and water is drains to Nam Xong. This catchment area is linked to the Nam Ngum Reservoir via Nam Xon and the Nam Xong Diversion.

The catchment area of the Nam Ngum Reservoir consists of the area immediately around the reservoir and water directly drains to the reservoir. This catchment area has Nam Path and Nam Phao, etc., both of which are generally short.

The lower reaches of Nam Xong consist of the area in the lowerstream of the Nam Xong Diversion. As water drains to Nam Lik, it does not reach the Nam Ngum Reservoir.

4.3 Socioeconomic Environment

4.3.1 Characteristics of Villages and Areas (Sub-districts)

This section presents the results of the Socioeconomic Baseline Survey (SEBS) which was conducted during November 1996 - February 1997 period under the present study. Tabulated outcomes of the survey compiled at the village level are presented in a separate volume, Socioeconomic Baseline Survey Report.

(1) Demography

1) Establishment of villages

Within the 14 villages in the Namon Area, Namon-Tai is the oldest village having 211 years' history. Other villages having more than 100 years' history are Vanghua (established 200 years ago) and Nalao (established 108 years ago). On the other hand, Nampath-Nua is the newest village (established 2 years ago) followed by Phonkeo (established 9 years ago) and Namon-Nua (established 18 years ago).

In the Somboun Area, Vangkhi is the oldest village with 200 years' history, and the other villages are comparatively new within the range from 2 years (Sivilai) to 35 years (Houaymo-Tai). There are two special villages in this Area, Sivilai and Somsanouk. The former village is a Lao Sung village established by returned refugees from Thailand, and the latter is a village established for lepers for medical treatment and self-support.

2) Population and households

The total population in the Model Area is 16,157 of which 6,779 or 42% live in the Namon Area and 9,378 or 58% are in the Somboun Area. The total number of households is 1,069 in the Namon Area, 1,530 in the Somboun Area and 2,599 in the Model Area, and the average size of household is thus calculated at 6.3 persons, 6.1 persons and 6.2 persons, respectively. In the Namon Area, there are six large villages with more than 500 population. They are Vangmiang, Namon-Tai, Namon-Nua, Phonsavang, Phonkeo and Vanghua. In the Somboun Area, the number of large villages is eight. They are Houaymo-Tai, Thahua-Nua, Thahua-Tai, Houaypamom, Somsanouk, Vangkhi, Namphao and Phakoup. Among these large

villages in Somboun Area, Thahua-Nua, Houaypamom and Namphao are the villages with more than 1,000 population.

As for the migration in the last five years (1992-1996), out-migrants from the Model Area were 200 households and in-migrants were 255 households. In the Namon Area, in-migrant households were considerably larger than out-migrant households, and the excess of in-migrant households is 46 households in the last five years. In- and out-migrant households were almost balanced in the Somboun Area (the excess of in-migrants was only nine households in the last five years). Major destinations of the out-migrants from the Namon Area were other districts within Vientiane province and other villages within the Vangvieng district including Vangvieng town. In addition to these destinations, many of them went to Vientiane municipality in case of out-migrants from Somboun Area. Original places of in-migrants were other districts within Vientiane province and other villages within the Vangvieng district including Vangvieng town. In addition, considerably large numbers of in-migrants of the Namon and Somboun Areas are from Xieng Khouang province and Xai Somboun Special Zone.

3) Ethnic groups

Almost all villages in the Model Area can be ethnically classified as ones with dominancy of particular ethnic groups, i.e. Lao Lum, Lao Theung and Lao Sung. In the Namon Area, there are seven Lao Lum villages (Vangmiang, Namon-Tai, Phonsavang, Ngiou, Nakhom, Phongnang, and Vanghua), four Lao Sung villages (Namon-Nua, Phonkeo, Nangeun-Nua and Nangeun-Tai) and two Lao Theung villages (Houaysan and Nampath-Nua). Each of these 13 villages has households belonging to a particular ethnic group accounting for more than 70% of the total households. The remaining one village of Nalao is ethnically more mixed with 64% of Lao Lum and 36% of Lao Theung households. It is noteworthy that both Namon-Tai and Vanghua villages with more than 200 years' history are classified as Lao Lum villages.

In the Somboun Area, according to the same criterion, there are seven Lao Lum villages (Houaymo-Tai, Thahua-Nua, Thahua-Tai, Houaypamom, Vangkhi, Phonthong and Phakoup), four Lao Theung villages (Houaymo-Nua, Nampat, Taothan and Nampath-Tai) and one Lao Sung village (Sivilai). The remaining three villages (Somsanouk, Houayxi and Namphao) are ethnically more mixed. The oldest village of Vangkhi (established 200 years ago) is classified also as a Lao Lum village. Lao Lum are considered to be the oldest inhabitants in the Model Area.

They may have settled down on good farming areas where flat land and water were comparatively readily available. They increased their population and expanded their area along rivers. Then, about 20 years ago, peoples of other ethnic groups came to the Area mainly from the northern provinces escaping from disturbances due to the revolution.

4) Education status

Among the economically active population (EAP, 15 - 60 years old), the proportion of non-educated population is 27% of EAP in the Model Area. This proportion is nearly the same in each district, 29% in the Namon Area and 26% in the Somboun Area. However, the education levels between male and female are considerably different as shown in Table 4-3-1. The proportion of the non-educated population is much higher among females (39%) than males (14%). The proportion of the population who gave up primary school is 25% among males and 26% among females showing small differences between them. It can be said that 65% of female EAP are non-educated and/or non-graduates of primary schools.

Table 4-3-1 Education Level of Economically Active Population (Overall)

Unit: % of EAP

Area	Male			Female			Average		
	(1)	(2)	Total	(1)	(2)	Total	(1)	(2)	Total
Namon Area	13.6	26.1	39.7	43.1	22.9	66.0	28.6	24.5	53.1
Somboun Area	13.4	23.5	36.9	37.1	27.3	64.4	25.6	25.5	51.1
Model Area	13.5	24.6	38.1	39.4	25.6	65.0	26.8	25.1	51.9

(1): No formal education

(2): Some classes of primary school

As for the ethnic groups, the proportion of the non-educated population is remarkably high in the Lao Sung and Lao Theung populations. In addition, the proportion of the population who gave up primary school is high in Lao Theung compared to other ethnic groups (see Table 4-3-2).

Table 4-3-2 Education Level of Economically Active Population by Ethnic Groups

Unit: % of EAP

Area	Lao Lum			Lao Theung			Lao Sung			Average		
	(1)	(2)	Total	(1)	(2)	Total	(1)	(2)	Total	(1)	(2)	Total
Namon Area	14.9	22.4	37.3	40.0	35.6	75.6	52.9	26.4	79.3	28.6	24.5	53.1
Somboun Area	17.4	24.5	41.9	37.9	31.1	69.0	53.1	17.7	70.8	25.6	25.5	51.1
Model Area	16.5	23.7	40.2	38.2	31.7	69.9	52.9	23.8	76.7	26.8	25.1	51.9

(1): No formal education

(2): Some classes of primary school

5) Involvement in organizations

Among several community organizations, the Women's Unions, Youth Organizations and Elder's Groups are the major ones in the Model Area. As a whole, about 44% of the sample population are involved in at least one of these three organizations. Since Women's Unions are well organized in the Model Area, the involvement ratio of females in the community organizations is as high as the ratio of males (Male: 27%, Female: 25%).

6) Occupation

Regarding the occupation of EAP, the proportion of farmers is the highest in both areas, i.e. 65% in the Namon Area and 70% in the Somboun Area, 5% higher in the latter area. On the contrary, the proportion of salary workers is higher in the Namon Area (8%) than Somboun Area (4%). The proportion of unemployed is low at 4% in the Model Area. However, there are three villages in which the proportion of unemployed is more than 10%.

Table 4-3-3 summarizes the proportion of the major three occupations (farmer, private business and salary worker) by area and ethnic group. As seen in the table, the proportion of farmers in Lao Sung and Lao Theung is about 20% higher than that in Lao Lum. On the contrary, the proportion of private business and salary workers in Lao Lum is higher than that in other ethnic groups.

Table 4-3-3 EAP by Major Occupations by Areas and Ethnic Groups

Area	Lao Lum			Lao Theung			Lao Sung			Average		
	Farmer	Private Busine.	Salary Worker	Farmer	Private Busine.	Salary Worker	Farmer	Private Busine.	Salary Worker	Farmer	Private Busine.	Salary Worker
Namon Area	53.4	9.7	12.0	80.0	2.2	8.9	85.5	2.6	0.9	65.3	7.0	8.3
Somboun Area	64.1	10.3	4.7	84.1	0.8	2.7	79.2	1.0	2.1	70.3	7.1	4.0
Model Area	60.0	10.1	7.5	83.5	1.0	3.6	83.6	2.2	1.2	68.3	7.1	5.7

(2) Cash Income Sources

It is evaluated that, among several cash income sources, livestock/poultry is the most important cash income in the Model Area, and shows the highest score¹⁾ in many villages.

¹⁾ : The importance of cash income sources of sample households is evaluated by calculating Score using the following formula.

$$(A*3 + B*2 + C*1) / T / 3 * 100 \quad (\text{Max. score}=100, \text{Min. score}=0)$$

where: A: number of answer for 1st priority
 B: number of answer for 2nd priority
 C: number of answer for 3rd priority
 T: number of total answer for the question

The number of villages with a high score of more than 70 for livestock/poultry is seven in the Namon Area and four in the Somboun Area. Other important cash income sources after livestock/poultry are fishes, vegetables, forest vegetables/crops, handicrafts, and salary in order of importance. However, the order of importance of these cash income sources varies greatly in different villages.

Some sample households are getting cash income from lowland paddy (Kao Na), and there are five villages in which the score of lowland paddy is more than 20 in the Namon Area. In addition, a few sample households sell upland paddy (Kao Hai) as one of their cash income sources, and there are three villages in which the score of upland paddy is more than 10 in the Somboun Area.

As for the income sources relevant to forests, there are three villages in which the score of fuelwood is more than 20. In these villages, fuelwood harvesting is considered to be carried out on a certain scale for supply to Lao Vangvieng Cement Plant. Since tree felling is not allowed in the district, the score of timber as an income source is zero in most of the villages except for one village of Sivilai (score of timber is 14). It is noteworthy that the importance of forest vegetables/crops is ranked fifth in the Model Area, and the number of villages in which the score of forest vegetables/ crops is more than 20 is seven in the Namon Area and four in the Somboun Area.

In terms of amount of cash income, the important cash income sources are private business, livestock/poultry, fishes, salary, wages, handicrafts, vegetables and forest vegetables/crops in order of cash value, which differ from the order of importance in terms of score analyzed above. The average cash income is comparatively large in the villages having markets. In these villages, many households are getting cash income from trading and/or retailing. On average, the annual cash income per household is Kip 716,200 in the Model Area, the highest cash income is in Phonsavang (Kip 1,541,400), and the lowest is in Nampath-Nua (Kip 60,800). It is evaluated that the difference between rich and poor is becoming wider in the Model Area at the village level as well as at the individual level.

There is a significant difference in the amount of cash income by ethnic group. As shown in Table 4-3-4, the annual average cash income in minority groups is nearly half of that in Lao Lum. It is thus evaluated that there are many households under the self-supported production system in the minority groups.

Table 4-3-4 Annual Cash Income by Ethnic Group

Unit: Kip 1,000

Area	Lao Lum	Lao Theung	Lao Sung	Average
Na Mon Area	864.5	316.2	524.2	696.1
Som Boun Area	869.6	486.5	363.6	729.1
Model Area	867.8	454.3	479.0	716.2

(3) Living Conditions

1) Drinking water

There are great differences between the villages in water sources. Significant differences are also found between the areas. In the Namon Area, many households depend on wells (68% in the wet season and 67% in the dry season), while in the Somboun Area, many of them are reliant on piped water (35% in the wet season and 41% in the dry season), rivers (24% in the wet season and 29% in dry season) and wells (18% in the wet season and 14% in the dry season). There are 7% of households using rain water in the wet season in the Somboun Area, but no such household in the Namon Area.

In the Namon Area, the average time required to reach major water sources is comparatively short and is less than 30 minutes in many villages. In the Somboun Area, however, the proportion of households which take more than 30 minutes is considerably high, and the number of villages in which such households is more than 50% of the total households is one for wells, three for piped water, and another three for rivers in the wet season, and three for wells, four for piped water and another four for rivers in the dry season.

Based on the above analysis, it can be said that many villages and/or households face difficulties in getting drinking water in the Somboun Area.

2) Fuel source

Fuelwood is the most important fuel source, and the importance of other fuel sources is negligible for most of the sample households. The importance level of fuelwood is almost the same in all the villages and in all the ethnic groups.

On average, the annual consumption of fuelwood is 11.1 La/ household in the Model Area (1 La is equivalent to about 0.5 m³). The average consumption per household in the Somboun Area is double that in the Namon Area. The per capita consumption of fuelwood in the Model Area is calculated at 1.8 La based on the above average

consumption per household. Since the population in the Model Area is 16,157²⁾, the total consumption of fuelwood in this area is estimated at about 29,000 La/year (14,500 m³/year).

Most households harvest fuelwood by themselves, and the proportion of purchasing volume in the total consumption is small at 13% in the Namon Area and 4% in the Somboun Area. Even in self-harvesting, 27% of the households in the Namon Area pay for labor, around Kip 865/ La for its collection. In the Somboun Area, however, most households harvest fuelwood using family labor. The average price of fuelwood to purchase is Kip 2,825/ La in Namon, Kip 2,450/ La in Somboun and Kip 2,687 in the Model Area.

The degree of fuelwood availability stated by the sample households is also analyzed. The proportion of households who answered "very difficult" in getting fuelwood is negligible (2% in the Namon Area and 0% in the Somboun Area), although there are eight villages in which the average time required to reach the fuelwood forests is more than 60 minutes. The proportion of households who answered "difficult" in getting fuelwood is higher in the Namon (25%) than in the Somboun Area (17%), and the proportion of households who answered "easy" is higher in the Somboun Area (88%) than in the Namon Area (72%). As for ethnic group comparison, the proportion of households who answered "easy" is comparatively high in Lao Theung (95%) in the Namon Area and in Lao Sung (97%) in Somboun Area. Spending about 60 minutes to reach fuelwood forests is probably common for most people in the Model Area, and they may feel difficulty in getting fuelwood even under such circumstances.

3) Food

Table 4-3-5 summarizes the proportion of households who answered "not enough" in cereals, roots and tubers, vegetables, meat and fishes.

Table 4-3-5 Proportion of Household Food Shortage by Item

Unit: % of HH

Area	Cereals	Roots & Tuber	Vege-tables	Meat	Fishes
Namon Area	48.7	10.5	11.8	84.2	30.7
Somboun Area	74.0	37.8	41.7	94.1	27.2
Model Area	62.9	27.2	30.1	90.3	28.6

²⁾ : This population is clarified in the village profile survey. According to the data from the statistic office, Vangvieng, the population in the Model Area is 16,158 in 1996.

In the Model Area, many households answered that there are "not enough" cereals and meat, but few households answered that there are "not enough" roots and tubers, vegetables and fishes. The proportion of households which have a deficit in foods is high in the Somboun Area (e.g. 72% of households in cereals and 94% in meat), comparing to that in the Namon Area.

In the villages getting cash incomes from paddy and vegetables, the proportion of food deficit households in these food items is small. However, the degree of food sufficiency in meat is low in many villages, even though livestock/poultry is one of their important income sources. It can be evaluated that many households raise livestock/ poultry for cash income and do not consume meat usually.

4) Health and sanitation

The most common disease is a cold followed by malaria, diarrhoea, eye disease and dysentery. Few sample households answered "no disease", which indicates the high incidence of disease among the villagers. The results of ethnic group-wise analysis show that the proportion of households getting diarrhoea is the second highest in Lao Sung. This proportion is comparatively low in other ethnic groups.

To the question about treatment when they catch diseases, many households selected the answer of "buy medicine". This is probably because of the high incidence of a slight disease of cold. Few sample households answered "any treatment not be done" when they catch a disease. They may select the facilities in accordance with the degree of their illness among pharmacies, health centers and Vientiane Provincial Hospital in Vangvieng.

The proportion of sample households who own a toilet is 28% in Namon, 21% in Somboun and 24% in the Model Area. This proportion is slightly higher in the Namon Area. However, it differs much from village to village, and even in the Namon Area there are seven villages in which no sample households own a toilet.

Table 4-3-6 shows the availability of toilets by ethnic group. As seen in the table, the availability is the highest in Lao Lum households (31%) followed by Lao Sung (15%) and Lao Theung (8%). It can be evaluated that the toilet availability is low in general, and it is particularly low in the minor ethnic groups.

Table 4-3-6 Toilet Availability by Ethnic Group

Unit: % of HH

Area	Lao Lum	Lao Theung	Lao Sung	Average
Na Mon Area	42.2	14.3	8.9	28.1
Som Boun Area	25.4	6.7	32.3	21.3
Model Area	31.3	8.1	15.5	23.9

5) Family planning

Of the sample households, 76% in the Namon Area and 13% in the Somboun Area are visited by family planning workers, showing their inactivity in the latter area. For the answers of contraceptive methods used by sample households, the proportion of households answering "not used" for any method is 38% in the Namon Area and 55% in the Somboun Area, showing also inactiveness of family planning workers in the latter area. Among the several contraceptive methods asked in the questionnaire, use of pills is the most popular among the sample households followed by traditional methods. The proportion of households using other methods such as surgical methods and condoms is negligible.

(4) Crop Production

1) Cropping pattern

The major crop cultivated in the Model Area is paddy both in the slash and burn area and the lowland paddy area. As other crops, cassava and maize in the slash and burn area, and groundnuts and vegetables in the lowland paddy area are also cultivated in limited areas. In the upland areas, fruit trees are also cultivated in addition to vegetables and groundnuts. The major cropping patterns including these crops are illustrated in Fig. 4-3-1.

	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Slash and Burn												
Pattern 1		S		B	← Paddy →							
Pattern 2		S	B			Cassava						
Pattern 3		S	B	← Maize →								
Paddy Land												
Pattern 1						← Paddy →						
Pattern 2								← Paddy →				
Pattern 3		Groundnut				← Paddy →						←
Pattern 4		Vegetables				← Paddy →						←
Upland												
Pattern 1						← Groundnut →						
Pattern 2		Vegetables										←
Pattern 3						Fruits						

Legend : S : Slash
 B : Burn

Fig. 4-3-1 Cropping Pattern of Major Crops

2) Farm land area

There is a big difference between the Namon Area and the Somboun Area in use of farm land. The proportion of households having lowland paddy area is high in the Namon Area, and on the contrary this proportion for slash and burn (paddy) area is high in the Somboun Area. The number of villages in which more than 50% of the sample households own lowland paddy area is 12 in the Namon Area and only one in the Somboun Area. On the other hand, the number of villages in which more than 50% of sample households operate slash and burn (paddy) area is seven in the Namon Area and 12 in the Somboun Area. A village in which many households operate slash and burn (paddy) area has a few households operating lowland paddy area. These results reveal that paddy production is one of the most important farming activities for many villagers, whether done in lowland or slash and burn areas. On average, owner households cultivate 0.7 ha in the Namon Area and 1.2 ha in the Somboun Area for slash and burn (paddy) area, and 0.8 ha in the Namon Area and 0.6 ha in the Somboun Area for lowland paddy area.

The results of ethnic group-wise analysis for farm land area are presented in Table 4-3-7. As seen in the table, the proportion of households depending on slash and burn area is generally high in the minority groups in the Model Area. For lowland paddy

area, there are big differences between the areas, i.e. the proportion of Lao Lum households cultivating this type land is 81% in the Namon Area and only 18% in the Somboun Area. Since the availability of lowland paddy area is low in the Somboun Area, the proportion of households having this type land in this area is low in all the ethnic groups. As an other characteristic, the average size of lowland paddy area is large in Lao Lum households in the Namon Area compared to that in other ethnic groups.

Table 4-3-7 Crop Cultivator Households and Cultivated Areas by Ethnic Group

	Cultivator Hhold (%) a/				Cultivated Area (Ha)			
	Hai for Paddy	Hai for Others	Lowland Paddy	Upland	Hai for Paddy	Hai for Others	Lowland Paddy	Upland
Overall								
- Namon Area	37.3	8.8	69.7	22.8	0.70	0.34	0.78	0.35
- Somboun Area	69.5	9.2	17.6	21.3	1.20	0.35	0.63	0.55
- Model Area	56.9	9.1	37.9	21.9	1.07	0.35	0.74	0.47
Lao Lum								
- Namon Area	18.8	3.9	80.5	27.3	0.55	0.31	0.85	0.32
- Somboun Area	63.6	8.9	18.2	22.0	1.13	0.33	0.64	0.61
- Model Area	47.8	7.1	40.1	23.9	1.05	0.32	0.78	0.49
Lao Theung								
- Namon Area	71.4	4.8	23.8	4.8	0.89	0.40	0.42	0.80
- Somboun Area	76.7	12.2	21.1	22.2	1.13	0.38	0.63	0.45
- Model Area	75.7	10.8	21.6	18.9	1.08	0.38	0.59	0.46
Lao Sung								
- Namon Area	58.2	17.7	64.6	20.3	0.71	0.35	0.68	0.39
- Somboun Area	93.5	3.2	3.2	12.9	1.70	0.60	0.60	0.20
- Model Area	68.2	13.6	47.3	18.2	1.10	0.37	0.68	0.36

Note: a/; 100% = Number of households belong to each ethnic group

The characteristics of land ownership are different between types of farm lands and villages. As a whole, however, the characteristics can be summarized as follows:

- a) Many households have privately owned lowland paddy area (99% of the sample households) and upland (78% of the same), and
 - b) The land tenure for slash and burn area for paddy and other crops is more complicated, and the major tenure systems are privately owned (36% of the sample households), traditionally cultivated with a right (34% of the same) and just cultivated without knowing the land title (34% of the same).
- 3) Utilization of slash and burn area

Regarding average time required (one way) to slash and burn area, it takes 1.13 hours in the Namon Area and 1.44 hours in the Somboun Area on average. However, the

average time differs much from village to village, and there are seven villages with households who take more than 3 hours to their slash and burn area in the Somboun Area (only one such village in the Namon Area).

Since the slash and burn area is insufficient in the Model Area, it is difficult to keep the proper rotation period for many households. The survey results show that only 7% of 1996 slash and burn paddy cultivators utilize the land with more than a 5-year rotation period. On average, the period of rotation is 2.56 years in the Namon Area and 2.61 years in the Somboun Area for 1996 slash and burn cultivators. In both areas, however, about 40% of 1996 slash and burn cultivators were going to re-use the same land in the next year. These results reveal that the land availability for slash and burn cultivation differs from villager to villager, i.e. some cultivators use the land with a longer rotation period and some do not do so.

Table 4-3-8 summarizes the average rotation period and the proportion of households who re-use the slash and burn area in the next year by ethnic groups. As shown in the table, there is less land for slash and burn cultivation for Lao Theung households, since nearly half of them have to re-use the same land in the next year and their average rotation period is the shortest among the ethnic groups.

Table 4-3-8 Average Rotation Period of Slash and Burn Cultivation by Ethnic Group

Area	Lao Lum		Lao Theung		Lao Sung		Average	
	To be Used in the Next Year (%)	Average Period of Rotation (Year)	To be Used in the Next Year (%)	Average Period of Rotation (Year)	To be Used in the Next Year (%)	Average Period of Rotation (Year)	To be Used in the Next Year (%)	Average Period of Rotation (Year)
Namon Area	42.9	2.4	45.5	2.3	39.5	2.7	41.3	2.6
Somboun Area	36.6	2.6	50.0	2.3	36.0	3.2	40.3	2.6
Model Area	37.3	2.6	49.2	2.3	38.1	2.9	40.6	2.6

For 1996 slash and burn (other crops) area, the average period of rotation is 2.1 years in the Namon Area and 1.9 years in the Somboun Area. The proportion of households who will re-use the same land in the next year is 50% in the Namon Area and 89% in the Somboun Area.

The questionnaire asked the 1996 slash and burn (paddy) cultivator households whether they would re-use the same land in the future or not. As a result, more than 70% of the households in the Model Area answered that they would re-use it again in the future. This result reveals that many slash and burn cultivator households re-use

the same land with a certain period of rotation. The questionnaire also asked the households who had no plan to re-use the 1996 slash and burn (paddy) land whether new land is easily available for slash and burn cultivation. As a result, 68% and 55% of the households answered that new land is difficult to find in Namon and Somboun, respectively.

4) Cultivated crops

The major crop cultivated in slash and burn areas in the wet season is paddy, and 79% of slash and burn cultivator households grow this crop. For other crops, the proportion of cultivator households is small at 10% for cassava, 6% for maize and 1% for chili. There are a few cultivator households in the slash burn area in the dry season and only 4% of slash and burn cultivator households in the wet season grow chili, cucumber, cassava, etc.

In the lowland paddy area in the wet season, paddy is also the major crop, and 95% and 98% of the lowland paddy area cultivators grow paddy in the Namon and Somboun Areas, respectively. Crops cultivated in the lowland paddy area are somewhat diversified in the Namon Area, and there are some households cultivating chili, watermelon and other vegetables. However, in the Somboun Area, such households cultivating other crops are few. In the dry season, the cultivator households for lowland paddy area are small in proportion, i.e. 24% and 3% of the cultivator households in the wet season in the Namon Area and the Somboun Area, respectively. There are few households cultivating paddy in the low land paddy area in the dry season. However, a higher proportion of the cultivator households grow groundnuts in both areas. As other dry season crops in the lowland paddy area, cucumbers and other vegetables are cultivated mainly in the Namon Area.

5) Crop area and production

Table 4-3-9 summarizes the results of the survey on the number of cultivator households, average cultivation area and yield, and production of major crops in the slash and burn and lowland paddy areas. The number of cultivator households analyzed here is different from that analyzed in Sub-section 4.3.1 (4), since the year of crop cultivation was not fixed in the questionnaire on crop production.

Table 4-3-9 Number of Cultivator Households, Average Cultivation Areas, and Crop Yields, and Production of Major Crops in Slash and Burn and Lowland Paddy Areas

		Namon Area	Somboun Area	Model Area
Slash & Burn Area (Ha)				
Paddy				
H/hold	(No.)	83	247	330
Area	(ha/HH)	0.70	1.19	1.06
Yield	(kg/ha)	1,139	896	936
Production	(kg/HH)	798	1,063	996
Cassava				
H/hold	(No.)	11	37	48
Area	(ha/HH)	0.24	0.35	0.33
Yield	(kg/ha)	2,923	2,871	2,880
Production	(kg/HH)	691	1,011	938
Lowland Paddy (Na)				
Paddy				
H/hold	(No.)	162	64	226
Area	(ha/HH)	0.80	0.59	0.74
Yield	(kg/ha)	2,416	1,856	2,289
Production	(kg/HH)	1,925	1,091	1,688
Groundnut				
H/hold	(No.)	20	0	20
Area	(ha/HH)	0.26	-	0.26
Yield	(kg/ha)	1,937	-	1,937
Production	(kg/HH)	495	-	495

The average crop yields evaluated in the above table are compared with those in the Vangvieng district, Vientiane province and Lao PDR. As a result, the average crop yields in the Model Area are lower than those in the other regions except for groundnuts as shown in Table 4-3-10.

Table 4-3-10 Comparison of Crop Yields between Model Area and Other Regions

Crop	Unit: ton/ha			
	Model Area	VangVieng District	Vientiane Province	Lao PDR
Slash and Burn Paddy	1.00	1.20	1.44	1.65
Cassava	2.88	3.00	9.02	7.06
Lowland Paddy	2.29	2.60	3.25	2.92
Groundnut	1.94	1.50	1.20	1.02

Source: Statistic Office of Vang Vieng District Head Quarter, 1996
Agricultural Statistics, 1995, Ministry of Agriculture and Forestry

Regarding the use of chemical fertilizer, no households apply fertilizer to crops cultivated in slash and burn areas. In the lowland paddy area, many households apply it to vegetables, but only few households use it for paddy.

Among several crops cultivated in slash and burn areas and lowland paddy areas, crop damages are serious to both upland and lowland paddy. The proportion of

households who have crop damages to lowland paddy is 93% in the Namon Area and 78% in the Somboun Area. The most serious damage to upland paddy is by animals such as rats (68% of the sample households in the Model Area) followed by insects (10% of the same). The crop damages to lowland paddy are more various, and animals (30%), insects (25%) and diseases (24%) are listed as major ones. To cassava (in slash and burn areas), damages are light in Namon and heavy in Somboun where 62% of sample households suffered damage by animals. To groundnuts (in lowland paddy areas), a total of 56% of sample households is suffered damage by insects and diseases, although the answers on this crop were obtained only from the Namon Area.

6) Sale of crop products

Regarding the crop marketing status of sample households, a large part of groundnuts and vegetables produced in lowland paddy areas is sold. The proportion of households who sale these crops is 23% in the Namon Area. In the Somboun Area, however, cash crops are cultivated in a limited area and few households sell these crops. In the Namon Area, almost all chili produced in the slash and burn area are also sold. Considerable amounts of lowland paddy are marketed in the Namon Area (26% of the production of sample households), but only a small amount of upland paddy is sold (2% of the production of sample households in Namon, 4% of the same in Somboun and 3% of the same in the Model Area). It is evaluated that the status of crop production surplus is much better in the Namon Area than that in the Somboun Area, not only for paddy but also for cash crops.

7) Consumption of paddy rice

There are few villages with a production surplus of paddy either from slash and burn areas or lowland, and all the villages in the Somboun Area show a deficit of paddy. Annual average production per paddy farm household is 1,811kg in Namon and 1,181kg in the Somboun Area, and 630kg higher in the Namon Area. On the other hand, annual average consumption per sample paddy farm household is 1,785kg in the Namon Area and 1,680kg in the Somboun Area, and there is only a 105kg difference between the two areas.

In the Model Area, annual average production is 1,447kg per paddy farm household and annual average per capita consumption is 273kg (177kg in terms of rice). Using these figures, the food the balance of paddy in the Model Area (2,599 households with 16,157 population) is roughly calculated. The result reveals that the total paddy production is 3,210 tons, consumption is 4,420 tons, and the deficit is 1,210 tons.

The above per capita consumption of rice (177kg) is 9% lower than the estimates of FAO for Lao PDR which is 195.4 kg (average of 1992 - 94). The people in the Model Area may consume other food crops (e.g. cassava and maize) more than that in other regions.

(5) Livestock and Fishery

1) Livestock population

Except for poultry, pig is the most commonly raised animal (67% of sample households) followed by cattle (45% of the same) and buffalo (37% of the same). The proportion of households who raise goat is small at 6%. The proportion of households who raise buffalo is considerably high at 61% in the Namon Area, because this animal is used for land preparation for lowland paddy cultivation. However, the proportion is only 21% in the Somboun Area where there is less lowland paddy area.

For poultry, the proportion of households who raise chicken is the highest at 85% followed by duck (28%) and turkey (9%). Many households raise chicken both in the Namon Area (93%) and the Somboun Area (80%). However, a few households raise duck and turkey particularly in the Somboun Area. The average population of poultry per farmer households is 16.9 heads for chicken, 5.8 heads for duck and 5.0 heads for turkey in the Model Area.

2) Livestock feed and its sufficiency

Grass is the most popular feed for cattle and buffalo, and nearly 100% of the livestock farmer households feed it in both seasons. Grass is also popular feed for goat. However, 11% of the households feed tree fodder in both seasons in the Model Area.

There are a few households facing a feed shortage in the wet season. In the dry season, however, the proportion of households who answered feeds are "short" or "very short" is considerably high at 21% for cattle, 24% for buffalo, and 20% for goat. According to the results of area-wise analysis, the sufficiency of livestock feeds in the Somboun Area is inferior to that in the Namon Area.

3) Fish culture

The proportion of sample households who own a fish pond is 26% in the Namon Area and 4% in the Somboun Area, showing better conditions in fish culture in the former area. In all the villages in the Namon Area, there are households who own a

fish pond. In the Somboun Area, however, the number of villages with fish pond owner households is only eight. The differences between the Namon Area and the Somboun Area in the fish pond availability may depend on the availability of lowland paddy area which is usually converted into fish ponds.

(6) Private Forest

The survey results on private forest reveal that there is no household who owns private forest in the most of villages with the exception of three villages in the Namon Area and four villages in the Somboun Area. Even in the villages in which some households have private forest, the proportion of owner households is small at 3 to 5% in the Namon Area. However, this proportion is 14 to 29% in the Somboun Area within three villages among four which have private forests. The average land area of private forest per owner household is 0.7 ha in the Namon Area and 1.0 ha in the Somboun Area.

(7) Horticulture Trees

Regarding, horticulture trees, the proportion of owner households is high in mango (51% in the Namon Area and 29% in the Somboun Area), coconut (46% in the Namon Area and 25% in the Somboun Area), banana (40% in the Namon Area and 30% in the Somboun Area), and tamarind (38% in the Namon Area and 16% in the Somboun Area). As other horticulture trees, about 10 to 20% of households cultivate papaya, orange and lemon. The average number of trees per each horticulture household is the largest in banana (19 trees in the Namon Area and 67 trees in the Somboun Area) followed by papaya (7.6 trees in the Namon Area and 12.2 trees in the Somboun Area) and guava (6.2 trees in the Namon Area and 12.1 trees in the Somboun Area). For other trees, the average number per each horticulture household is small at 1 to 2 trees. Because many kinds of horticulture trees are grown in the Model Area, fruit development would have high potential, although fruit is not a major income source of the villagers at present.

(8) Cash Expenditure

The average cash expenditure differs much in the villages, and is large in the villages with large average cash income. However, there is little difference in the cash expenditure between the areas, i.e. Kip 506,000/ month in the Namon Area and Kip 505,000/ month in Somboun Area. In general, the proportion of cash expenditure for food is high in the villages in which the average cash income is large. This means that the households getting a large cash income from private business, etc. purchase a lot of food. The cash expenditure for food is small in the villages in which the average cash expenditure is small, indicating the high degree of self-sufficiency of food in these villages.

Table 4-3-11 summarizes the average cash expenditure by category and ethnic group. In general, the cash expenditure is large in Lao Lum and small in the minority groups, and its amount of Lao Sung is nearly the half of that of Lao Lum. As for cash expenditure for each category, the proportion of food in Lao Sung is lower than that in other ethnic groups, indicating a higher self-sufficiency rate in this ethnic group. The proportion of expenditure for education is lower in Lao Sung in the Somboun Area, showing a lower school attendance rate of children of this ethnic group in this area.

Table 4-3-11 Average Cash Expenditure by Category and Ethnic Group

Area	Food	Clothes	Edu- cation	Others	Total or Average
Average Cash Expenditure/ Month					
Overall					
- Namon Area	27,46	6,593	3,126	5,018	42,20
- Somboun Area	27,89	6,170	1,862	6,138	42,06
- Model Area	27,72	6,335	2,355	5,702	42,12
Lao Lum					
- Namon Area	37,23	7,330	4,038	5,255	53,86
- Somboun Area	32,37	6,732	2,202	6,855	48,16
- Model Area	34,08	6,942	2,847	6,292	50,16
Lao Theung					
- Namon Area	21,51	4,333	2,200	3,205	31,25
- Somboun Area	20,03	5,133	1,326	4,027	30,51
- Model Area	20,31	4,982	1,491	3,871	30,65
Lao Sung					
- Namon Area	13,20	5,997	1,896	5,116	26,21
- Somboun Area	16,67	4,900	837	6,810	29,22
- Model Area	14,18	5,688	1,598	5,594	27,06
Comparison of Ave. Cash Expenditure (Ave. of Model Area =					
Overall					
- Namon Area	99.0	104.1	132.7	88.0	100.2
- Somboun Area	100.6	97.4	79.1	107.6	99.9
- Model Area	100.0	100.0	100.0	100.0	100.0
Lao Lum					
- Namon Area	134.3	115.7	171.5	92.2	127.9
- Somboun Area	116.7	106.3	93.5	120.2	114.3
- Model Area	122.9	109.6	120.9	110.3	119.1
Lao Theung					
- Namon Area	77.6	68.4	93.4	56.2	74.2
- Somboun Area	72.2	81.0	56.3	70.6	72.5
- Model Area	73.3	78.6	63.3	67.9	72.8
Lao Sung					
- Namon Area	47.6	94.7	80.5	89.7	62.2
- Somboun Area	60.1	77.3	35.5	119.4	69.4
- Model Area	51.2	89.8	67.9	98.1	64.3
Percentage Distribution of Ave. Cash Expenditure (total					
Overall					
- Namon Area	65.1	15.6	7.4	11.9	100.0
- Somboun Area	66.3	14.7	4.4	14.6	100.0
- Model Area	65.8	15.0	5.6	13.5	100.0
Lao Lum					
- Namon Area	69.1	13.6	7.5	9.8	100.0
- Somboun Area	67.2	14.0	4.6	14.2	100.0
- Model Area	67.9	13.8	5.7	12.5	100.0
Lao Theung					
- Namon Area	68.8	13.9	7.0	10.3	100.0
- Somboun Area	65.6	16.8	4.3	13.2	100.0
- Model Area	66.3	16.3	4.9	12.6	100.0
Lao Sung					
- Namon Area	50.4	22.9	7.2	19.5	100.0
- Somboun Area	57.1	16.8	2.9	23.3	100.0
- Model Area	52.4	21.0	5.9	20.7	100.0

(9) Forest Utilization

In the survey, the existence of two kinds of village forests was asked to leader(s) in each village, one was a forest in which tree felling was not allowed among the villagers and the other was a forest for the use of all villagers. Simultaneously, the existence of slash and burn areas and man-made forests was also confirmed in each village.

1) Village forest in which tree felling is not allowed

In the Namon Area, 10 villages have forest in which tree felling is not allowed. As for the status of this type forest, boundaries in seven villages were delineated by the villagers themselves and those in three villages were decided by the government. In the Somboun Area, this type of forest exists in 13 villages of which boundaries in 10 villages were delineated by villagers themselves, those in two villages were decided both by the villagers and the government, and the status of the village forest is unknown in the remaining one village.

2) Village forest for the use of all villagers

It was reported that all the villages in the Namon Area have forest for the use of all villagers. As for the status of this type of forest in the Namon Area, boundaries in nine villages were delineated by the villagers themselves, those in three villages were decided by the government, and those in two villages are not fixed yet. In the Somboun Area, this type of forest exists in 14 villages of which boundaries in 10 villages were delineated by villagers themselves, those in two villages were decided by villagers and the government, those in one village were delineated by the government, and the status is unknown in the remaining one village. The only village which does not have this type forest is Sivilai. As already mentioned above, this village was established by returned refugees from Thailand, and basically no forest and agriculture lands are allocated to this village.

As for the utilization of this type of forest, in the Namon Area, six villages are mainly for fuelwood harvesting, three villages for slash and burn cultivation, another three villages for timber production, and the remaining one village for livestock grazing. In the Somboun Area, nine villages utilize this type of forest mainly for fuelwood harvesting, two villages for slash and burn cultivation, another two villages for timber production, and the remaining one village the for non-forest products harvesting. In the survey, the existence of regulations on the use of this type of forest was also confirmed in each village. As a result, in the Namon Area, there are regulations in 12 villages of which written documents are available in five villages, while, in the

Somboun Area, there are regulations in 11 villages of which written documents are available in seven villages.

3) Slash and burn area and man-made forest

As for regulations on the use of slash and burn areas, all 14 villages have regulations in the Namon Area (of which 9 villages have written documents), and 10 villages have it in the Somboun Area (of which 4 villages have written documents). As for the existence of man-made forest, three villages in the Namon Area and six villages in the Somboun Area have this type of forest.

(10) Development Activities

Development projects which are now completed, on-going and planned in each village were asked to the villages. As a result, most villages have certain development projects except for three villages in the Somboun Area. The sources of fund differ from project to project. They are the Lao PDR government, foreign governments' aid agencies, international aid agencies and NGOs. There are also some projects funded by villagers themselves.

Table 4-3-12 summarizes the development projects by simple category. According to the table, the project categories having many completed and on-going projects are related to agriculture, irrigation, school and drinking water. In the Namon Area, there are many agriculture and irrigation related projects, and many school and drinking water related projects in the Somboun Area. Leaders in six villages in the Somboun Area answered that reforestation projects under JICA would be commenced in the future in their villages. This perception of the village leaders is probably because of recent study activities of FORCAP frequently made in the Somboun Area.

Table 4-3-12 Completed, On-going and Planned Development Projects in Model Area

Project Category	Namon Area				Somboun Area				Model Area			
	Completed	On-going	Planned	Total	Completed	On-going	Planned	Total	Completed	On-going	Planned	Total
1. Agriculture a/	3	7	0	10	1	1	1	3	4	8	1	13
2. Irrigatio	5	1	0	6	1	0	0	1	6	1	0	7
3. Reforestatio	0	0	1	1	0	0	6	6	0	0	7	7
4. Drinking	1	0	3	4	4	0	0	4	5	0	3	8
5. Roads	0	1	(1)	2	0	0	1	1	0	1	2	3
6. Electrificatio	0	0	0	0	1	1	1	3	1	1	1	3
7. Handicraf	0	2	0	2	0	0	0	0	0	2	0	2
8. School	2	1	(1)	4	2	4	0	6	4	5	1	10
9. Health	1	2	0	3	0	0	0	0	1	2	0	3
10. Toilet	0	0	0	0	1	2	0	3	1	2	0	3
Total	12	14	4	32	10	8	9	27	22	22	13	59

Note: a/ Including crops, livestock and
(); Project status is unknown.