6.4 Irrigation and Drainage Development Plan

6.4.1 Irrigation Water Requirement

Irrigation water requirement is estimated by using the following formula.

$$IWR = (ETc + Pr + Pd + Nr - ER)/Ei$$

where :

IWR	:	gross irrigation water requirement
Ei	:	overall irrigation efficiency
ETc	:	crop consumptive use of water
Pr	:	percolation for paddy
Pd	:	puddling requirement for paddy
Nr	:	nursery requirement for paddy
ER	:	effective rainfall

Crop consumptive use of water (ETc) is estimated to multiply crop factors by potential evapo-transpiration (ETo) in the Study area estimated by the modified Penman method, using monthly meteorological data of three (3) stations, namely, Pakxong, Pakxe and Salavan. Irrigation requirements are calculated based on four (4) proposed cropping patterns. As for coffee, crop coefficient is based on a technical report on coffee in Kenya. The effective rainfall is estimated on a monthly basis, based on " the monthly effective rainfall curve " developed by the Committee for Co-ordination of Investigation of the Lower Mekong Basin (the Mekong Committee). Overall irrigation efficiency consists of conveyance and application efficiencies. Conveyance efficiency will be assumed at 85 % because of canal linings of main and secondary canals, and application efficiency is assumed at 70 % for paddy field and 60 % for upland crops field. Overall irrigation efficiencies are assumed at 60 % for paddy field and 51 % for upland crops field. Seasonal irrigation requirements for each of the proposed cropping patterns are estimated below.

(Unit : mm/month)

Cropping Pattern	Irrigation Requirement
Pakxong Area	
Type A	919
Type B	588
Type C	460
Coffee	771
Laongam Area	
Type A	2,162
Type B1	1,215
Type B2	1,543
Type C	1,363
Coffee	1,561
Salavan Area	
Type A	2,163
Type B	1,546
Type C	1,203
Coffee	1,378

6.4.2 Drainage Water Requirement

(1) Drainage water requirement of paddy field

The drainage requirement of paddy field is estimated to evacuate the surplus rain water for the drainage period of the 3 days by using the probable daily rainfall which has a

dependability of 80%. The drinage requirements are estimated at 4.7 l/sec/ha to 8.7 l/sec/ha, based on each river basin.

(2) Drainage water requirement of upland field

The drainage requirement of upland crops field is estimated by using the rational method because the projects areas mainly range from 10 km^2 to 50 km^2. The runoff coefficient is assumed at 0.5, taking into consideration the proposed crops, crop farming system and soil conservation plan at on-farm. The drainage requirements are estimated at 7.1 l/sec/ha to 12.0 l/sec/ha at each the river basin.

6.4.3 Irrigation Development Potentials

(1) Water Balance Study

Since the land capability evaluation and land use plan are made from the view points of soils, topographical conditions including elevation, crop growth conditions/characteristics of crops and present land use aspects, the potential of irrigation development will be estimated through making the water balance study based on the land resources.

As for the water resources development for hydro-power development in the Study area, there is one (1) existing, one (1) under construction and three (3) proposed reservoirs. However, the existing Xe Set reservoir with a storage capacity of about 350,000 m^3 is mainly for daily peak power generation, so that no use of water for irrigation is taken into account. The Houay Ho Hydro-power Development Project which is under construction, has a huge reservoir capacity of approximately 500 MCM effective. Since irrigable land from the hydro-power station is located at outside of the Study area, no irrigation plan is included. The other three dam reservoirs proposed are hardly possible to be utilized for irrigation development, because no suitable land for agriculture is extended in the down stream.

Because of a very small amount of domestic water demand compared with irrigation requirement, water balance calculation is made based on the irrigation requirement commanded by each river basin. For the water balance calculation, the Study area is divided into the three block areas, taking into account the rainfall and runoff conditions.

The water balance is made in the critical period of seasonal irrigation requirements at each river. In Laongam and Salavan areas, critical conditions of irrigation water requirement occur in two seasons, first in the transition period between the dry and wet seasons and the other in the dry season. The concept of supplementary irrigation for the wet season crops cultivation is adopted in both areas, Laongam and Salavan. As the Pakxong area has comparatively sufficient rainfall for wet season crops cultivation, the critical periods of seasonal irrigation requirements occur during the transition period from dry season to wet season only. Accordingly, water balance in the Pakxong area is made in the transition period of the seasons.

Laongam area	low lands locating in the elevation of less than 400 m and extended from H. Champi river basin to H. Tapoung river basin,
Salavan area	areas extended from H. Tapoung river basin to H. Lamphan river basin, and
Pakxong area	elevated lands locating in the elevation of more than 400 m and extended from Champi river basin to H. Xe Pian river basin, Xe Namnoy and Xe set river.

The conditions of water balance calculation are summarized below.

i) Water use of existing irrigation projects are estimated based on the proposed cropping pattern. Total irrigation areas of the 35 existing projects are estimated at about 2,700 ha, and assumed to have a double rice cultivation.

ii) The irrigation requirements in the potential areas are estimated under the following conditions of the altitude in topography and land use.

- Areas with the altitude of more than 1,000 m.
  Present planted areas of coffee is sustained and considered not to extend. Farm lands of cropping pattern Type-C are extended. The other 2 cropping pattern Type-A and Type-B are not considered to be applied.

- Areas with the altitude of 600 m to 1,000 m.
  Present planted areas of paddy and coffee are sustained, and extension of cropping pattern Type-B and Type-C are carried out. Extension of the planted areas for both the cropping patterns is even, 1.0 : 1.0.

- Areas with the altitude of 400 m to 600 m.
  Present planted areas of coffee are sustained, and extension of cropping pattern Type-C areas are not applied. Extension of cropping pattern Type-A and Type-B are carried out. Extension of the planted areas for both the cropping patterns are assumed at even, 1.0 : 1.0.

- Areas with the altitude of less than 400 m.
  Present planted areas of coffee are sustained, and extension of cropping pattern Type-C areas are not considered to be applied. Extension of cropping pattern Type-A and Type-B are carried out. Extension of the planted areas for both the cropping patterns are assumed to be 2.0 : 1.0.

iii) Return flows are estimated at 10 % of the irrigation water from the existing and proposed irrigation areas.

iv) Minimum maintenance flows of rivers and streams are estimated at 5 % of the runoff at the off-take sites.

Figure 17 shows the concept mentioned above.

(2) Potential Areas of Irrigation Development

As a result of water balance calculation, the maximum irrigation areas which can be irrigated from the viewpoints of maximum water use during critical season of agriculture farming are estimated at approximately 90,710 ha (see detail Table 19). The areas are also screened again based on the land capability and future land use plans, and the potential irrigation development areas are finally estimated.

The estimated potential areas for irrigation development are approximately 54,670 ha in the Study area excluding irrigation areas of 36,040 ha for which irrigation water can be off-taken within the Study area, but the irrigation areas are located outside of the Study area. The detailed information are shown in Table 19 and Figure 18. The potential irrigation area can be classified as summarized below by the types of cropping pattern and the topographical altitudes.

Unit : ha

Cropping Pattern	Altitude > 1,000 m	Altitude 1,000 - 600 m	Altitude 600 - 400 m	Altitude < 400 m	Total
Coffee	1,970	6,255	3,160	0	11,385
Type A	0	2,090	515	7,635	10,240
Type B	0	5,245	3,555	8,805	17,605
Type C	480	2,530	0	0	3,010
Fallow-Paddy	0	0	800	11,630	12,430
Total	2,450	16,120	8,030	28,070	54,670

(3) Potentials by Gravity Irrigation Method

The potential irrigation areas where water can be supplied by gravity irrigation method are estimated at approximately 36,000 ha of 30 projects including some of existing projects. Irrigation water can be off taken by weir and intake gates from the rivers and conveyed into the potential irrigation areas. The potential areas are summarized below.

Cropping Pattern	Altitude > 1,000 m	Altitude 1,000 - 600 m	Altitude 600 - 400 m	Altitude < 400 m	Total
Coffee	1,700	2,815	2,700	0	7,215
Type A	0	140	45	3,025	3,210
Type B	0	2,010	3,085	6,545	11,640
Type C	350	1,160	0	0	1,510
Fallow-Paddy	0	0	800	11,630	12,430
Total	2,050	6,125	6,630	21,200	36,005

(4) Potentials by Pump Irrigation Method

The potential irrigation areas by pump system are estimated at 18,670 ha. Recommendable irrigation method for the potential areas are pump irrigation because the erosion of river banks are deeply accelerated and it has the hard conditions to off-take irrigation water by gravity method. The potential areas to be irrigated by pumps are summarized below.

Unit : ha

Cropping Pattern	Altitude > 1,000 m	Altitude 1,000 - 600 m	Altitude 600 - 400 m	Altitude < 400 m	Total
Coffee	270	3,440	460	0	4,170
Type A	0	1,950	470	4,610	7,030
Type B	0	3,235	470	2,260	5,965
Type C	130	1,370	0	0	1,500
Fallow-Paddy	0	0	0	0	0
Total	400	9,995	1,400	6,870	18,665

6.5 Agricultural Support Services

6.5.1 General

As mentioned in Chapter V, the agricultural support services for farmers in the Study area are very weak. Therefore, the comprehensive support services including agricultural

credit, training for extension workers and farmers, supply of improved seeds, farm inputs, and marketing of farm products are needed. In order to provide sufficient agricultural support services in the area, the following programs are essential.

(1) Strengthening the services for agricultural and livestock and veterinary based on the NIERP supported by ADB,

(2) Improvement and strengthening of existing research stations,

(3) Establishment of Vegetable Trial and Demonstration Farm, and

(4) Formation of farmers' organization.

On the other hand, it is expected that sufficient services for livestock and veterinary in the future will be conducted by the strengthening of facilities and staff of the Livestock and Veterinary Research and Extension Station which are under construction in Pakxong district by DLVS, MAF.

Accordingly, implementation of these programs will be done in the short period of the development plan. These programs are summarized below:

6.5.2 Agricultural Research and Extension

(1) Agricultural Research

The activation of existing Fruit-tree Research Station at KM 20, and Fishery Research and Extension Station at KM 8, located at the east of Pakse, in which the activities are stagnated due to deteriorated and weak facilities and manpower, will be planned through the improvement and strengthening of these issues. In addition, the Highland Vegetable Trial and Demonstration Station will be established at an altitude of more than 1,000 m in the plateau aiming to promote vegetable production in the area. This program should materialize in the course of a short period of the development plan.

a. Rearrangement and Strengthening of Fruit-tree Research Station

Based on the agricultural development plan, introduction and promotion of upland crops production will be planned. The development of the package farming technology for upland crops is indispensable in order to achieve the target of the plan. Accordingly, establishment of new Fruit-tree and Upland Crops Research and Extension Station will be planned through rearrangement and strengthening of the existing Fruit-tree Research Station, located at KM 20, by installing research facilities for upland crops and increasing the research staff. For this purpose, the program will provide the following facilities and equipment to support their activities:

i) Reconstruction of administrative office with storage and garage,
ii) Construction of laboratory and training house,
iii) Construction of trial and demonstration farms,
iv) Construction of irrigation and drainage facilities (reservoir, canal, pipeline, etc.),
v) Rehabilitation of nursery bed for fruit-tree seedling,
vi) Supply of farm machinery, and
vii) Construction of staff quarters, if necessary.

In order to strengthen the operation of this station, the following works will be considered.

i) Training of technical and management capacities for staff, and
ii) Adequate relocation and increase of staff.

The station will carry out the following programs in collaboration with NARC, MAF, international organizations and NGOs.

i) Development of fruit-tree and upland crops farming techniques,
ii) Demonstration and extension of fruit-tree and upland crops,
iii) Production and distribution of improved fruit-tree seedlings,
iv) Selection, distribution and extension of improved seeds of upland crops,
v) Training of the provincial and district extension staff and farmers, and
vi) Monitoring and evaluation of fruits and upland crops production.

b. Improvement of Fishery Research and Extension Station

Although freshwater fishery promotion is conducted for the purpose of improvement of farmers' nutrition and increasing their income, the support services for farmers are insufficient because of deteriorated facilities and lack of staff. In the program, improvement of deteriorated facilities and strengthening of staff will be done as follows.

i) Training of research staff,
ii) Strengthening of staff, including extension workers,
iii) Reconstruction of administrative office, laboratory and renovation of facilities, and
iv) Improvement of water resource facilities.

The station will carry out the following programs in collaboration with DLVS, MAF, international organizations and NGOs.

i) Research of freshwater fishery production,
ii) Production and distribution of fingerling,
iii) Extension activities of freshwater fishery, and
iv) Monitoring and evaluation of freshwater fishery production.

c. Establishment of Highland Vegetable Trial and Demonstration Station

In order to promote vegetable production in availing favorable physical conditions, the Highland Vegetable Trial and Demonstration Station will be established near at, Pakxong town. Having road access and water resources, this area is to be a convenient location for a demonstration farm. The station aims to achieve adequate production methods for stabilized vegetable production, to conduct extension activities of production technology, and to distribute improved seeds of vegetables. Accordingly, the following works will be carried out in this program.

i) Construction of administrative office, laboratory, training room , work shop and storage,
ii) Construction of water resources and irrigation and drainage facilities,
iii) Supply of farm machinery, and
iv) Construction of trial and demonstration fields.

The farm will carry out the following programs in collaboration with DOAE, MAF, international organizations and NGOs.

i) Trial development of vegetables cultivation,
ii) Extension activities of vegetables cultivation method,
iii) Training of extension staff in the provincial and district agricultural services and farmers in the area,
iv) Selection and distribution of improved seeds of vegetables, and
v) Monitoring and evaluation of vegetable production.

In the future, when vegetable production in the area has been successfully achieved, a vegetable seeds multiplication plant could be installed in this farm in order to secure stabilized distribution at low cost, and increase the self-sufficiency of improved seeds.

d. Strengthening of Livestock and Veterinary Research and Extension Station

At present, the station is under construction in KM 49, Pakxong district, by DLVS, MAF. The objectives of this station are; (1) to train small holders (farmers), (2) to promote technical aspects of breeding for the farmer, (3) to analyze problems concerning the breeding system, (4) to supply improved grass seeds and cattle breeds, and (5) to research animal health. Further, extension works for small holders (farmers) on effective use of animal excretion such as compost and barnyard manure for vegetable production, maintenance of soil fertility, bio-gas for energy and so on, through the improvement of raising method, would be added. Therefore, the extension activities of this station should be carried out in close collaboration with the agricultural extension officers and staff of the provincial and district agricultural services.

(2) Strengthening of Agricultural Extension Services

In order to provide appropriate and effective extension services in the area, improvement and strengthening of AFS in the district level will be made based on the NIREP supported by ADB. The following works will be provided for support in the extension activities.

a. Provision of equipment and vehicles needed to extension works,
b. Adequate predisposition and increase of extension staff,
c. Establishment of training program for the development of technical and management capacities of extension staff,
d. Technical and management training in Phone Ngam station in Pakse, fruit-tree and upland crops research station at KM 20 and vegetable trial and demonstration farm for extension staff, and
e. Introduction and employment of women's extension staff for guidance of rural life improvement.

6.5.3 Farmers' Organization

In order to develop effective and profitable agricultural production in the Study area, establishment of a farmers' organization which has a function of agricultural credit, technical assistance, supply of farm inputs and marketing of farm products, is indispensable. For this purpose, a new farmers' organization based on the existing organization will be formed. In particular, formation of new farmer's organization will be made by pushing forward community development on the village level, and taking into account the characteristics of ethnic minorities such as culture, custom and behavior.

On this account, permanent and effective farmers' organization will be formed through the following steps.

i) To arrange the field of communication between existing farmer groups on commonly shared problems;
ii) To lead recognition of the problems by farmer themselves and to work out a solution to the problems with the assistance of the extension staff;
iii) To guide group formation by farmers themselves in order to solve problems and expectations in regards to a progressive farmer's leadership, and to conduct the farmer's training for the purpose of autonomous group operation;
iv) To approach the establishment of agricultural association in village level from village leaders and extension staff to farmers. In order to promote farmers' awareness to set up the association. Incentives should be given to farmers, such as subsidies for purchasing raw materials and operating funds of the

association from relevant authorities, in order to promote the establishment; and

v) To establish agricultural association at the village level after the above steps.

On the other hand, through the development of the farmer's consciousness to operation and maintenance for irrigation facilities constructed by the Project; water user's association and/or groups will be formed under the guidance of provincial and district agricultural services, in order to operate and smoothly maintain the facilities. Formation of the organization will be made in accordance with regulations, but this organization will be managed by the beneficiaries' autonomy. Accordingly, in order to give aggressive awareness to form the groups and/or association for beneficiaries, incentives from the establishment authorities and supporting services will be considered, as well as preferrential treatment of agricultural credit systems.

(1) Farmers' Association

A farmers' association (organization) autonomously managed by farmers themselves will be proposed. For a short period in the initial stage of the plan, namely, the association will be set up in a village of the model area to be developed as one unit, comprising of four sections: agricultural credit, technical assistance, marketing of farm products and supplies of input and instrument. A chief elected by a member of the village farmers association will take the responsibility for operation of the association under the guidance of the district agricultural services. Members of the association will take charge of each section mentioned. The collecting and shipping facilities of farm products, as storage or deposit, will be constructed by the association. The members of the association will contribute capital and pay annual membership fees.

In the long run, a central farmers' association will be established at the center of a district to strengthen activities on the village level and its branch office will be set up in the main village of each zone. This central association will support the activities of village association.

(2) Water Users' Association

Along with the project implementation, irrigation facilities will be provided in the development area. In order to operate effectively and maintain the irrigation facilities, formation of a water users' group in the village level and in the irrigation district level is essential. As mentioned in 3.4.7, the AFS in Champasak province has initiated to organize water user groups in the lowland rice production area and conducted a training course of irrigation management for beneficiaries in 1994. For this purpose, the formation of these organizations will be proposed as follows:

a. Formation of water users' group in the village level

Water users' groups by the beneficiaries will be organized in each village of the irrigation district. A chief elected by the beneficiaries will take responsibility of managing the group activities. A village water users' group will set up its own chief, water-man and water charge collector. The water-man will operate the water distribution to farm fields and the water charge collector will collect the water charge (for O/M).

b. Formation of water users' association in the irrigation district level

In order to manage the entire irrigation district, a water users' association will be organized. The association will: carry out water distribution and control, operate and maintain irrigation facilities, calculate and collect water charges, and other operating costs. Management of the association will be done by the managing committee comprising the chief of the village groups. The association will set up its own chief, secretary, accountant and water-man. The chief will take the responsibility of managing of the entire irrigation district. The secretary and accountant will be assigned by the committee members. The association will employ a water-man who has a knowledge of irrigation.

Management and operation of this organization will be conducted under the guidance and support of irrigation engineers of the provincial and district agricultural services. The provincial agricultural authorities will hold regular training courses on irrigation and water control techniques, and operation and maintenance of the facilities for beneficiaries.

6.6 Rural Life Improvement Plan

6.6.1 Food and Nutrition

Rice produced in the Study area is substantially insufficient for the self-consumption of the farmer. According to the results of the rural socio-economic survey, the self-supply rate of rice in the Study area is about seven months a year on average, and only around three months in Pakxong and Thateng districts. It can be said that the stability of food supply in the area is very low. The consumption of rice as a staple food is 500 grams/person/day. This is almost the equivalent of consuming 1,746 kcal (492 grams)/person/day, on a national level, if rice supplies 75% of the daily energy intake. However, such an unstable supply of rice in the area reflects the chronic malnutrition status of the people in this area.

In order to secure a stable food supply throughout the year, an increase in rice production is essential. The rice bank as a community-based credit scheme, promoted by women's union and the LUADP, is being introduced to every village to ease the shortage. The establishment of the rice bank has been proposed as one of the activities of the farmers' organization.

6.6.2 Living Environment

Urban and rural disparities are evident in health, education and other aspects of life. The Living environment in the Study area is considerably inferior compared with that of the surrounding urban area. In order to cope with these problems, comprehensive social development, including the improvement of basic health condition, literacy, and community development are needed. In connection with this, improving the family income in a sustainable way is generally perceived as the most practical way of improving living and health conditions. The following are the essential elements of a conceivable improvement plan.

(1) Improving the Family Income

The main source of income in the area derives from agriculture and livestock husbandry. In order to increase farm income as a means of improving the standard of living, the following methods are being considered.

i) Increase in agricultural productivity through introduction of improved varieties of crops to increase the yield,
ii) Diversification for profitable crops, and
iii) Introduction of appropriate technology for livestock husbandry.

(2) Improvement of Health Status

The health service in the Study area, particularly at the village level, is insufficient due to inadequate health facilities and health personnel. The strengthening of the health services and improvement of the facilities are the most urgent issues. Accordingly, health status in the village level will be improved through the establishment of a village clinic and basic health education for the villagers. In addition, community health workers will be assigned and trained for a community-based approach.

Emphasis is placed on educating about health, hygiene, nutrition, child care, as well as birth spacing for rural women who are responsible for the food, nutrition and health of her family. This activity will be carried out in collaboration with the authorities concerned, the Lao Women's Union, international organizations and NGOs.

(3) Water and Sanitation

With the exception of urban areas of the Laongam district which has a water supply system, the main source of domestic water in the Study area is natural water from rivers and springs in the dry season, and rainwater in the rainy season. Women and girls spend inordinate amounts of time drawing water during the dry season. This type of heavy labor not only prevents women from doing more productive activities, but also strains their health. In order to solve this problem, a piped water supply system is the most suitable solution. However, at the minimum well and hand pumps should be installed in every village. Increased environmental health awareness programs will be promoted.

According to the survey, most rural households have no latrines. Therefore, an appropriate human waste disposal system will be introduced in the village, and hygienic training for the villager will be implemented.

(4) Strengthening of Primary Education

Though there are a large number of primary schools in the area, they cover about 60% of the villages. The majority of these schools are on a three year schooling. In order to attain equality in the educational standard, the strengthening of primary education should be carried out by the appropriate authorities collaborating with international organizations and NGOs. The following are major activities for strengthening primary education.

i) Reorganization of primary school network to create more favorable conditions for access,
ii) Intensive teacher training, improved facilities and teaching materials,
iii) Support to parent's associations and to encourage pupils enrolled in other community schools for increasing the rate of enrollment, and
iv) Introduction of health care and nutrition services.

(5) Others

A mini-hydropower plant will be installed in the villages located in remote rural areas where appropriate power sites are located, and to promote rural electrification.

In the village level, there are no telecommunication facilities, resulting in a lack of information and communication in the rural area. To address this problem, a public telephone will be installed in every village.

6.6.3 Community Development

As mentioned in 3.2.5 (1), the rural society in the Study area is composed of diverse ethnic groups. In general, it is said that the ethnic groups in the area can easily assimilate to other cultures and customs in comparison with the Lao Soung group. However, it often causes difficulty in community work, especially in the mixed ethnic village, owing to a lack of cooperativeness and social solidarity arising from strong identification and low literacy. In order to improve rural life in the area, community development to enlighten cooperativeness and social solidarity in the village are essential. Community development programs are composed of the improvement of the living standard, such as food and nutrition, hygiene, etc., increase in cash income, and the security of water resources for domestic use and irrigation. Accordingly, it is desirable to implement development programs and construction of facilities in collaboration with the provincial and district agricultural services, Lao women's union, international organizations and NGOs. The following procedure is considered for implementation.

i) Organization of groups with the same interest,
ii) Development of cooperation through group activities,
iii) Increase awareness of problems and attempts towards solution,
iv) Increase community activities through the raising of a sense of solidarity with other groups,

v) Planning of a community development program in the initial stage of the organization of the group, consisting of agricultural extension, adult education for the farmer, women and youth including practical life-skills, health care, nutrition, sanitation, family planning, and literacy education by a supporting teacher volunteer, and installation of a well and hand pump in the village,

vi) Implementing of community development program, and

vii) Construction of a village community hall for village administration and these community activities.

6.6.4 Life Improvement Extension Work

As mentioned in Chapter V, people with their own traditional culture and customs live in the Study area. Their living environment is considerably low compared with lowland people (Lao Loum), and is not improving due to low social status and low literacy of women. In order to improve living conditions in the rural area, adaptation of women's extension workers is proposed. The extension activities of rural life improvement will be carried out in collaboration with Lao women's union and the NGOs.

The role of a woman's extension worker consists of consultation and guidance regarding nutrition, food, health care, farming, agricultural and domestic bookkeeping, vegetable gardening, small livestock raising, and handicrafts.

6.7 Environmental Aspects

6.7.1 Land Use, Soil and Water Conservation

i) Land use planning

Appropriate land use, in combination with good soil and water conservation, is necessary for sustained crop production. Failure to pay attention to these fundamental principles of crop husbandry, can prove to be costly and will be reflected in terms of low productivity and degraded ecosystems. The first step toward sustainable production stems from a well planned national land use policy. If land use is inappropriate, conserving soil and water can be difficult or costly when attempted later.

ii) Soil and water conservation

In the tropics, rainfall is usually of high intensity and a large amount of rain can fall over short time periods. The exposure of bare soil to rain drops, start the erosion process. The energy of the rain drops break up surface soil and causes a surface-sealing effect in the beginning. This then reduces infiltration, begins runoff and physically moves sediment from one place to another. Some soils are more likely to erode than others.

Infiltration can be increased by protecting the soil from the impact of rain drops, as when there is natural vegetation or a mulch on the soil surface. Mulches can be non-living or living, and be of different types, such as crop residues or cover crops. Work carried out on, alfisols at the International Institute of Tropical Agriculture at Ibadan, Nigeria, supports the benefits of mulching. It had been based on comparison of runoff and soil losses from bare plots and those covered with 6 tons of straw mulch per ha. The runoff from the bare plots had been 16 times more than that from the mulched plots. The annual soil loss from the bare plots had been 1,160 times more than that from the mulched plots.

Similar work had been reported from Sri Lanka almost 50 years ago; when, use of mulch was shown to prevent surface compacting by intercepting and dispersing rain drops. Trash mulches in Sri Lanka had increased chili yield by 24 percent and cotton yield by 35 percent, when compared with cultivated unmulched plots.

Live mulches, also called cover crops, have been used for a long time in plantation agriculture -- more in rubber, oil palm and coconut. Species that are currently in use are *Pueraria, Desmodium, Centrosema* and *Psophocarpus*. Each of these species has its own characteristics, and is utilized according to the needs of a particular location.

Tree leaves and large amounts of organic material from the cover crop, will increase the litter on soil surface and humus in the top soil. This will keep the surface soil porous and absorbent. In certain instances, such as where the land is steep, it may be necessary to combine the above with engineered measures for retaining eroding soils.

Another method of soil conservation is avenue or alley cropping, which provides a number of benefits. Avenues of deep-rooted, fast growing multi-purpose tree species are grown at convenient intervals on the contour. In effect it is a form of agro-forestry. Leguminous species such as *Leucaena, Gliricidia, Albizzia, Casuarina, Calliandra*, or any other suitable multi-purpose tree species can be grown. *Leucaena* is known to fix as much as 500 kg N/ha/year.

The space between the tree rows is grown to seasonal crops with cultivation done on the contour. At the beginning of the growing season, trees are pruned to provide more sunlight to the inter-row space. Prunings can be used as mulch on seasonal crops or as green manure. Additional benefits of avenue cropping are recycling of nutrients from deeper soil layers, and protecting the inter-row crop from strong wind. There are disadvantages as well, such as competition for water, nutrients, space and light. However, it is believed that the advantages outweigh the disadvantages.

The tea crop on the plateau, although covering only a small land area, is very poorly managed. In the case of seasonal crops, cropping systems can be selected to bring about benefits of soil conservation. The objective is to have the ground covered as quickly as possible. Inter cropping and mixed cropping, for reasons of faster and longer ground coverage, have an advantage over single cropping.

Other beneficial aspects are from methods of tillage, e.g.. contour cultivation. But cultivation has its drawbacks in that it can bring about adverse impacts on physical soil characteristics. The practice of zero tillage is greatly advantageous from the point of soil conservation. Here, seeding is done directly into the ground through a surface mulch of weeds and crop residues without soil inversion. The method brings about benefits in moisture conservation, weed control and soil temperature. Work again in Nigeria had shown that over a 2-week period, soil loss was nil in plots of cowpea on a 15 percent slope with zero tillage, when compared with a loss of 33 tons/ha from bare ploughed plots. The main disadvantages of adopting zero tillage are problems encountered in initial seeding and subsequent fertilizing of the crop.

iii) Sustainable land management

A drop in fertility in lowland paddy soils is believed to be a reason for declining yield and perhaps it could also be the same for low coffee yield. FAO (1983) introduced the concept of integrated nutrient supply and its applicability in the Lao context is worthy of trial. It involves the integration of plant and animal husbandry, correct nutrient balance in fertilizer use, combinations of organic and inorganic and exploitation of biological sources such as nitrogen fixation. The supply of mineral fertilizers alone will not be able to sustain the productivity of the soil.

Cultural practices such as the use of organic matter in different forms will be helpful in improving infiltration and promoting rapid shoot growth for a quick soil cover. Farming systems that combine plant and animal components play useful complementary roles. Livestock rearing on the free range system in large numbers, is likely to cause environmental problems as

carrying capacities per unit area of grassland have been exceeded. The grassland has also lost its nutritive value by the invasion of the fern bracken. The aspect of livestock raising should be reviewed and an assessment of carrying capacities of communal grazing grounds is necessary to resolve the issue of overgrazing. Feeding systems other than free range may have to be considered.

In the Lao PDR, the use of fertilizer is very limited because of inadequate technical know-how, unavailability, and lack of farm capital. Use of manure is also not a widespread practice, and livestock husbandry, although practiced by almost all farmers, does not complement crop husbandry. Given the situation where manure is presently under-utilized and soil fertility is reportedly decreasing, its maximum use should be encouraged, besides experimenting with other traditional practices of supplying plant nutrients.

The under-mentioned possibilities are briefly presented.

i) Nutrient recycling: Recycling of all organic material produced on the farm;
ii) Nutrient pumping: Deep rooted trees and shrubs pick up nutrients from deep soil layers and transfer to the top soil through plant litter;
iii) Biological nitrogen: Fixation by micro-organisms in combination with legumes, certain tree species and Azolla;
iv) Nutrient harvesting: Nutrients in eroded sediment are put back to the fields; and,
v) Addition from external sources: Where nutrient losses cannot be recycled, manure and fertilizer from outside the farm may be used to make good the loss.
iv) Institutional aspects:

Besides the technical aspects enumerated above, as likely features in a soil and water conservation program in the Bolovens, there are institutional aspects which also determine achievement of objectives. Land tenure is important, i.e.. legal ownership and title to land for those who are farming. Individual ownership encourages higher productivity.

In order to effectively implement programs, information is necessary. Data has to be generated mostly by the central government, although provincial, district and even village organizations have roles to play in data gathering and information dissemination. At the central level, data gathering can be undertaken through techniques such as aerial photography, remote sensing, geographical information systems, erosion risk mapping, land capability assessment and land use planning. The data obtained should assist in formulating field level implementing programs.

6.7.2 Forest Conservation

The present level and extent of protection and conservation can be increased to cover other important ecological areas. For example, the entire extent of "potential forest". Over the three provinces, 733,500 ha remain to be put to some useful purpose. A variety of uses ranging from forestry and tree crop farming, to livestock and pasture development, are possible on this land.

National tree planting ceremonies should be made more productive; for example, to rejuvenate degraded land in important areas such as river banks. Also called the gallery forest, these river bank strips of vegetation are essential components of a natural ecosystem and keep river banks erosion-free and stable.

Reforestation has the following objectives that apply in the master plan area.

- restoring degraded watersheds;
- conserving soil;
- restoring fertility;

- providing industrial products;
- providing firewood;
- combining in agro-forestry systems; and,
- improving aesthetic and recreational values.

6.7.3 Protected / Conservation Areas

Preliminary surveys carried out during this Study have identified certain areas in need of protection/conservation for purposes of erosion control, watershed management, biodiversity and hydrology. The degree of protection / conservation has to be determined on the basis of more detailed field surveys. The proposed areas are briefly discussed below and shown in Figure 19.

i) Phou Namtiang - Phou Hingkong

This mountain block is already declared a conservation area by the Champasak provincial administration. However, conservation aspects can be more purposeful if it is enlarged on the southern side to include the steep slopes of that section of the right bank of the Houay Champi which is adjacent to the existing conservation area. On these southern slopes, i.e.. the right bank of the Houay Champi, coffee is grown extensively and there are scattered patches of evergreen forest. The proposed extension is from about Ban Dongsang, upstream along the river to Ban Houaychiat, a distance of about 20km. A similar area along the left bank, north of road no. 23, should also be included.

Notwithstanding declaration as a conservation area, land degradation will continue unless improved farming practices are introduced. Therefore, it is recommended that coffee farmers, as well as those of other crops, be required to adopt soil and water conservation measures as a priority. Special conservation programs have to be set up, including an assessment of rates of erosion under various land use practices.

ii) Phou Tayun - Phou Kadeup

In the northeast of the master plan area, there are extensive mountains with elevations ranging from 200m in the southeast to over 1,500m in the northwest. This land is rugged with steep escarpments in certain places. Many streams drain this mountain land, either into the Xe Katam and then into the Xe Namnoy in the southwest, or into the Houay Lamphan Gnai and then into the Houay Tay-Un in the northeast.

Hydropower generation is planned in the Xe Katam basin and possibly elsewhere also in the future. It is proposed that this entire area be declared a protection/conservation area, in view of its fragile nature and economic importance. If no action is taken, shifting cultivators may gradually move in and a slow degradation will follow.

iii) Pakxong wetlands

The rolling plain around Pakxong is the focus here for one primary purpose, i.e.. hydrology. The continuity of this grassland and its associated lakes depends on the success of the hydropower generation in zone 9 without being degraded by man in an ecological sense. Therefore it is proposed that this area be declared a conservation area, and be supported by a management plan to ensure continuity of its basic hydrologic function with limited human use. It should be preserved in its natural state as far as possible.

If the area above the 1,200m contour is considered as the boundary of the conservation area, it covers 402.5 km^2. On the map, this land area appears

heart-shaped, and its functions seem synonymous with those of the human heart. Therefore, it is referred here as the "heart of the Boloven Plateau."

The extensive land concessions in this area for livestock raising and forestry, are a cause of worry to the future of continuing hydrological benefits. It is proposed that a detailed ecological study be undertaken to determine land use and hydrological potential before final decisions are made.

iv) Micro-hydropower catchments

At the selected sites, river flow and other considerations, favor this kind of a power generation. In order to ensure a continuing supply of water and therefore electricity, it is proposed that the catchment in each priority area listed for development, be examined from the aspect of land use, and appropriate measures be taken to remedy any incorrect practices. An environmental impact assessment will provide the data required for a catchment conservation management plan.

v) River banks

It is proposed that all river banks be protected by prescribing a suitable width on each bank and implementing it as a land use regulation. No activities, agricultural or otherwise should be allowed on this strip of bank. The existing gallery forest should be preserved. Where no such vegetation is found, it should be planted again.

6.7.4 Shifting Cultivation

The issue of shifting cultivation in the upland areas is very complex. Solutions have also to be looked for within a diversity of ethno-cultural backgrounds and from a multi-disciplinary technical aspect. Rice security is the one concern that compels people to farm the uplands. How can this form of agriculture be stabilized? Some possible strategies may be found in a combination of some of the technical and institutional aspects very briefly outlined below.

- guaranteeing tenurial rights or title to land, making a farmer the sole beneficiary of the land he has been cultivating, as benefits of certain capital outlays are available only much later;
- providing irrigation water so that the farmer can overcome crop failure due to wet season drought and, even do a dry season crops if there is sufficient water. This assurance of water will hopefully induce him to remain in one place;
- providing agricultural credit on easy terms.
- making available good quality agricultural inputs;
- farming systems that benefit from integration of livestock husbandry;
- providing avenues for marketing farm produce and this is one of the most important needs;
- introducing multi-purpose tree crop species which can stabilize farming on hilly land;
- introducing farming technology suitable for upland cultivation;
- providing income generating activities outside agriculture;
- allowing people to exercise traditional rights to the use of natural resources;
- involving people in participatory forest management;
- opening small industrial centers to provide employment alternatives to agriculture, particularly to the second generation;
- introducing family planning programs to reduce the draw on resources; and,
- introducing applied research to problems.

6.7.5 Watershed Management

Hydropower generation is a direct function of river flow and in this context watershed management assumes the greatest importance, as the Boloven Plateau has a large hydropower

potential. Government is currently reviewing policies and laws relating to land tenure and water resources in catchments.

Desired levels of land management depend upon state policies on natural resource use and the capacity to implement the many decrees that are issued from time to time. Watershed management can be a complex activity that demands the resources of a number of institutions and a coordinated effort. Some components that directly or indirectly have a bearing on the state of the watershed include land use planning, land tenure, farming systems, credit, marketing, employment generation and diversification of economic activities.

The highest rates of infiltration are achieved when the catchment has a multi-layered vegetation cover with a soil cover of plant litter in varying stages of decomposition, high soil organic matter levels, and a favorable complement of soil organisms. These conditions will maximize underground storage.

Priority areas may include those that provide social and economic benefits, e.g. the catchment of the Houay Thon, from where drinking water is gravity-fed to Sekong town and the Xe Set watershed because it serves hydropower generation. Another important area is the land classified as "potential forest" which has to be put to some productive use as soon as possible. It should not be allowed to degrade.

Measures for rehabilitation will vary according to the level of degradation in each watershed, and the nature of ongoing human activities. Sometimes it may be necessary to relocate people, as will occur in the Houay Ho project. But this is not possible in Xe Set as people have lived and farmed this part of the basin for a long time. Hence, in Xe Set, the focus will have to be on providing for erosion control through sustainable systems of farming based on a modified land use plan if necessary. Examples of such are agro-forestry, alley cropping, and sloping agricultural land technology which have proved successful in a number of countries.

Management programs have to be supported by a variety of baseline surveys and these are the joint responsibility of central and local administrations. Some of the recent decrees on natural resource management have incorporated segments on watershed management issues.

The following are some of the recommendations which have already been made in relation to watershed management:

- implementing measures concerning land use planning and land allocation guidelines incorporated in the watershed management strategy;
- incorporating participatory rights issues in forest management;
- incorporating self-building terracing technology in rural development programs designed for the rehabilitation of shifting cultivation land;
- implementing the findings of the ADB Livestock Sector Review, encouraging live fences for control of grazing animals, stall feeding and the integration of animal and crop husbandry;
- amending land and tax laws to motivate land owners into methods of sustainable farming; and,
- training of field staff.

6.7.6 Cultural and Aesthetic Aspects

In the master plan study area, there are no known cultural or archeological sites that require conservation. However, although not in the terms of reference, some thoughts and ideas on eco-tourism are presented here, with the hope that they will generate further interest and evaluation for economic benefits.

The biggest potential lies in the Pakxong district, contributed by its mild climate, high elevation, interesting geomorphology, extensive forests, wetlands, protected areas, grasslands,

swift-flowing rivers, and varied wildlife. The current development provides the potential for tourism. The hydropower development of zone 9 will be a major point of interest. The catchments of the new reservoirs have been declared protected areas and present the opportunity of developing as wildlife attractions which command high visitation from affluent people. Provision of accommodation, motorable tracks, nature trails and tour guides are all part of the infrastructure development necessary within a parks system. The same type of tourism potential is available in Dong Hua Sao. Fees will be levied for entry into the parks and the use of facilities.

Geographically the Pakxong district is central to southern Laos, and easily accessible overland from northern Thailand, from where tourist arrivals already take place. Pakxong town is presently only a market town. Road access from Pakse is good and there are equally good links with the eastern zone 9, through the newly constructed roads of the hydropower projects. Also to the north, coffee roads lead to extensive coffee holdings, and to the south, it is possible to travel to the edge of the plateau. Most of these minor roads are being presently improved.

Accommodation has to be developed in and around Pakxong. It is very important that this be done under appropriate guidelines and strict controls of urban planning, so that the town will become a planned urban center and not be turned into a congested tourist slum. Parallel with organized growth, an informal side of tourism will also grow. By this is meant, accommodation being made available on a small scale, e.g.. in private houses or small inns, at cheaper rates than in the larger hotels. While this is inevitable and also welcome, its growth should be under guidelines that fit into a tourism master plan. With the growth of tourism, there will also develop supporting industries such as handicrafts, food production and transportation. These will add to overall economic development of the district, and finally of the country.

Pakxong does not experience the oppressive heat of the lowlands and hence, will be attractive all year round. The mean annual temperature is 19.5°] C. The average annual rainfall is 3,374 mm but November to April is relatively dry. The fascination of observing the origins of a number of rivers in such close proximity, will in itself be an unique experience to all visitors. The coffee, fruit and vegetable areas in the district will be further attractions.

The wetlands around Pakxong and Houaykong and the associated grasslands will interest the naturalist. Opportunities are there for fishing, hiking, bird watching and cycling. The fascination of observing the origins of a number of rivers in such close proximity, will in itself be an unique experience to all visitors. The coffee, fruit and vegetable areas in the district will be further attractions.

6.8 Salient Features of Overall Development Projects

Based on the development plan of each sector for the integrated agriculture and rural development, the salient features of the overall development in the Study area are summarized below and illustrated in Figure 20.

i) The areas for the integrated agriculture and rural development are defined as the plateau areas extended basically with the elevation of more than 200 m. The suitable land for agriculture development are identified about 135,000 ha in net.

ii) For conservation of soils, water quality and biological environment, forest conservation areas are delineated to sustain more strictly than the current forest condition, especially watershed conservation forest areas, bio-diversification forest areas and soil erosion conservation area. The forest conservation areas are identified about 180,000 ha in gross.

iii) Land concession areas extended near B. Bachiang and B. Pakxong, of which total areas are identified about 30,000 ha in gross, are deleted from the

overall development areas because the development programs of the areas have already been entrusted to the private investors.

iv) Lao upland crop development projects areas are to be incorporated in the overall development area.

v) Existing irrigation schemes of 16 sites will sustain as long as the current programs of irrigation and agriculture development are smoothly operated.

vi) Irrigation potential areas will be basically divided into 2 irrigation methods such as gravity and pump irrigation methods. The gravity irrigation areas of about 28,600 ha in net and the pump irrigation areas of about 26,200 ha in net are identified in the Study area.

vii) Village water supply (domestic use) plans of 12 sites for 33,000 people is to be taken into account along with irrigation development proposed.

viii) Micro-hydropower development with total potential capacity of 1,110 kw for rural electrification at 12 sites is also to be conceived where appropriate head available in the river concerned.

ix) Development plans of village and farm roads cover the village road improvement of 736 km and the farm road improvement of 843 km.

x) The ultimate target of rehabilitation for primary school, village clinic and community hall are 143 nos., 94 nos. and 339 nos. respectively.

xi) Strengthening of the existing research and demonstration stations for fruit trees, upland crops, fishery and livestock, and establishment of vegetable stations are proposed in the Study area to make the reinforcement of extension and demonstration works.

7. MODEL DEVELOPMENT APPROACH

7.1 Strategy of Model Development

The strategies for integrated agriculture and rural development in the Study area are to give advantageous points at cheaper investment for the agriculture and rural infrastructures development, the sustainability of easy maintenance works for the infrastructures and the pilot development for demonstration of the integrated agriculture and rural development.

On the other hand, the provision of agriculture infrastructures could be recognized as the most significant step and foundation for the integrated agriculture and rural development in the Study area. Taking into account the present condition of the farmers' living standard, farm economy, framers financial fundamentals and farmers' familiarity with irrigation, the main strategy of the integrated agriculture and rural development could be determined based on the development strategies of agriculture infrastructure.

Since the gravity irrigation method has, in general, the advantageous points in cost comparison with pump irrigation method because of easy and cheaper operation and maintenance works, the development priority will give the gravity irrigation method.

In the Study area, it is verified that 30 schemes of gravity irrigation areas are identified including the existing irrigation areas based on the water balance study. Selection of the model development projects under gravity the irrigation method is made taking into account the following viewpoints.

i) The optimized scale of irrigation and drainage development projects as the medium scale projects: the area scales of the projects are appreciated to have the ranges from 500 ha to 2,000 ha, taking into consideration the areas of existing irrigation projects ranging 30 ha to 400 ha, scales of provincial budgets of O & M works and human resources such as engineers, technicians and extension workers.

ii) The advantageous locations as the pilot and demonstration projects: the project areas are located near the center of regional areas and / or can be expected to become the representative situation of regional economy.

iii) The easy access for water operation: the land owners (farmers) and water users association are to be in and around the projects areas and they can have higher possibility to provide the access roads to project areas with cheaper investment,

iv) Sustaining implementation programs of O&M works for the existing irrigation and drainage development projects: the majority of the existing projects in the Study areas have been constructed recently. Presently the O & M works of the projects are properly carried out by the Local Government, so that only reinforcement is necessary in the future.

v) Expection of the positive activities of water users associations including excellent maintenance activities: higher and excellent co-ordination and corporation among the members of water users associations will be expected, and social co-ordination and corporation among ethnic groups in the same project are highly desirable.

vi) The easy approach to establishment for agriculture support system including the strengthening of farmers' fundamental finances: the social co-ordination and corporation among the ethnic groups in the same project area are highly

desirable, and the activities of agriculture support system can be found at present.

vii) Representative locality for farming type: the farming type is a representative, according to climate, soil, altitude and also administrative.

viii) The advantageous location as marketing station: the area has an easy access to the main market and also to other countries for exporting.

ix) Scale of beneficiary population: effectiveness of proposed facilities to some scale of the beneficiary population is to be rather high and desirable from economical viewpoints

x) Availability of water resources for gravity flow of domestic water supply and micro-hydropower development: high priority will be given to the areas available for gravity flows domestic water supply and for micro-hydropower development.

Table 20 shows the selection of the model projects. The 16 selected projects with total potential areas of approximately 24,800 ha are shown in Figure 21.

7.2 Salient Features of the Selected Projects

7.2.1 Irrigation & Drainage and Rural Infrastructures

The salient features of the 16 selected projects are summarized below.

(i) Irrigation Development

No.	Name	Location	Altitude	Water resources	Irrigated area (ha)	Design discharge (m3/sec)	Irrigation canal (km)	Drainage canals (km)	Farm road (km)
1	Upper Champi	Pakxong	900-1,200	H.Champi	730	0.53	26.6	13.4	30.1
2	Upper Tapoung	Pakxong	900-1,300	H.Tapoung	50	0.04	4.3	2.4	5.3
3	Lower Xe Pian	Pakxong	900-1,100	Xe Pian	750	0.54	18.5	12.1	19.4
4	Upper Makchan	Pakxong	900-1,200	H Makchan	470	0.35	19.7	11.7	19.9
5	Middle Xe Katam	Pakxong	850-900	Xe Katam	620	0.87	13.7	6.7	13.7
6	Middle Namtang	Pakxong	800-900	H Namtang	265	0.25	9.8	1.1	9.8
7	Lower Makchan Gnai	Pakxong	800-900	H Makchan-Gnai	340	0.32	9.6	2.7	9.6
8	Lower Champi	Pakxong	100-200	H.Champi	2,600	3.52	62.9	25.5	65.1
9	Upper Kapheu	Pakxong	600-800	H.Kaphue	1,100	1.32	27.0	22.4	27.1
10	Middle Tapoung	Pakxong	700-1,000	H.Tapoung	450	0.49	13.1	6.8	13.1
11	Lower Tapoung	Pakxong	300-600	H.Tapoung	4,500	5.40	114.2	80.7	118.8
12	Lower Xe Set *1	Pakxong	300-400	Xe Set	1,800	2.39	47.6	42.5	57.1
13	Lower Namsai	Pakxong	100-200	H Namsai	3,840	3.90	100.0	60.0	100.0
14	Upper Thon	Pakxong	200-300	H.Thon	640	1.32	15.6	13.9	18.1
15	Middle Lamphan *2	Pakxong	200-400	H Lamphan	2,900	6.00	43.20	41.1	-
16	Upper Tayun	Pakxong	500-600	H.Tayun	350	0.40	5.8	4.5	5.8
Total (Average)					21,405	-	532	348	513

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

(ii) Rural Infrastructure

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

7.2.2 Agriculture

(1) Agriculture Development Strategies of the 16 Selected Projects Areas

The following strategies will be adopted for agriculture development in the 16 selected project areas.

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

(2) Proposed Cropping Pattern

The cropping patterns for the 16 selected project areas are formulated as follows:

(Unit : ha)

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

Note: These figures are rounded off.

Planted area of coffee is increased by 750 ha, about 25 % of the present area while the area of tea remains as it is. Field crops such as groundnut, soybeans etc. are increased by about 4,500 ha for the dry season in the lower altitude area. Most of Cardamom area combined with upland rice is decreased, but Cardamom cultivated in the elevated area as upland crop would remain as it is. Lowland rice is increased especially in the lower area. Vegetables

are increased in the elevated land. The increment of the lowland rice cropping area is about 21,000 ha and that of vegetables about 1,100 ha.

(3) Anticipated Crop Production

The anticipated crop production in the 16 selected projects are estimated below based on the cropping patterns mentioned above:

(Unit : ton)

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

* Production is in husked dried beans.

** Counted as groundnut.

*** Counted as cabbage or potato.

7.3 Anticipated Agricultural Benefit

(1) Crop Budget with and without the Project Condition

Crop production costs and value per ha with and without the Project conditions are estimated basically by using the financial prices as of 1994. However, since the present coffee price is an exceptional case, coffee price is re-applied to the future price based on the World Bank Price Prospect, as mentioned is Section 6.3.7. Incremental financial crop budget per ha is summarized as follows :

(Unit : kip/ha)

Crops	Without Project	With Project	Increment
Lowland Rice	356,000	391,000	35,000
Coffee	197,300	1,093,900	759,900
Tea	126,000	285,000	159,000
Cardamom	448,000	598,000	150,000
Cabbage	549,300	1,689,900	1,140,600
Potato	947,500	1,861,200	913,700
Maize	73,000	255,000	182,000
Soybean	156,000	169,500	13,500
Groundnut	234,200	335,600	101,400

(2) Anticipated Agricultural Benefit

The anticipated agricultural production value increased by the project is evaluated as the agricultural benefit for the selected priority projects. Firstly, the financial incremental benefits of each 16 project are estimated below :

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

7.4 Farm Household Economy

The farm budget was analyzed to assess whether the 16 projects would bring about sufficient income increase in the farmers' economy. The farm budget analysis was carried out on the typical farmers in all the Project area. On this estimation, the coffee price at 2005, indicated by IBRD prospect, is re-applied as the future coffee price and the farm budget is re-calculated based on that price. The result is summarized as follows :

(unit of currency : '000kip)

	Without Project Condition				With Project Condition		
Main cropping type	Coffee	S & B	Low. R	Ave.	Coffee	Low. R	Ave.
Ave. farm size (ha)	2.1	1.2	1.0	1.9	2.4	2.5	2.5
No. of benefit. (H.H)	1,634	1,012	2,025	4,671	1,740	8,244	9,984
1.Gross Income	564	417	432	475	3,572	2,454	2,694
- Farm income	564	342	382	437	3,572	2,459	2,694
- Non-farm income	0	75	50	38	0	0	0
2.Production Cost	125	26	35	65	643	814	777
3.Net Income	439	391	397	410	2,928	1,640	1,917
3.1 Living expense	429	391	397	407	1,535	1,535	1,535
- Food item	333	303	309	316	874	874	874
- Non-food item	96	87	89	91	661	661	661
3.2 Net reserve	10	0	0	3	1,393	104	382

Remark : S&B is Slash & Burn farming, Low.R is Llowland Rice farming.
Note : Average family size is 5.7 persons per household

After implementing the project, the slash and burn farmers will shift the farming type to lowland rice farming and/or coffee farming from the view points of sustainability and productivity. Net farm income for the farmer is drastically increased after implementation of the project. Living expenses also drastically increase, consequently, the living condition of beneficial farmers will substantially improve, encouraging farmers to operate intensive farming.

7.5 Basic Approach to the Project Implementation

In order to smoothly implement the 16 schemes, the program is divided into three (3) phases; Phase I consisting of 5 schemes with about 4,000 ha providing the most effective demonstration and extension to the surroundings, Phase II consisting of 5 schemes with about 6,800 ha in total providing mainly substantial benefits and return as well as social life improvement to the benefitiary farmers, and Phase III consisting of 6 schemes with approximately 10,000 ha in total which are rather costly. The required implementation is estimated to be approximately 15 years (1997 - 2011).

As for the water resource development, during the first 10-years, the O & M for newly developed and existing water resource facilities such as dams, small reservoirs, farm ponds, tube wells and pumps shall be reinforced, and after the first 10-years, the new scale water resource development for irrigation such as the Middle Lamphan projects will be implemented.

Implementation strategies of irrigation and drainage facilities and farm roads during the first 5-years are to give the extension of O & M for the existing facilitie, and to start the development of new facilities. After the first 5-years, the strengthening of O & M and the development of new facilities will be carried out.

As for water management, the extension of proper water management technology in the existing project areas and the establishment of water users association for both irrigation and domestic water development are essential during the first 5-years. After the first 5-years, the strengthening of the extension on water management technology and proper activities of the water users associations will be carried out in new project areas.

7.6 Project Implementation

The proposed implementation programs, divided into three phases, for the overall projects are presented in Table 21, and the 16 projects will be implemented along the following schedule and the detailed schedule is shown in Figure 22.

First phase (1996-2000)	5 Projects such as Upper Champi, Upper Tapoung, Upper Kapheu, Lower Xe Set and Upper Tayun
Second phase (2001-2005)	5 Projects such as Lower Xe Pian, Middle Tapoung, Lower Tapoung, Upper Thon and Upper Makchan
Third phase (2005-2010)	6 Projects such as Lower Champi, Lower Namsai, Middle Lamphan, Middle Xe Katam, Middle Namtang and Lower Makchan-Gnai

7.7 Agriculture Extension Development Projects

For the efficient acceleration and successful achievement of the above projects, proper extension services and marketing development are strongly recommended to be implemented in the earliest phase. The following activities are recommended to be implemented urgently.

i) Highland Vegetable Trial and Demonstration Station at Pakxong.
ii) Livestock Research and Extension Station at KM49.
iii) Fruit-tree Research Station at KM20.
iv) Fishery Research and Extension Station at KM8.
v) Vegetable Trading Post and Market Organization at Pakxong.

7.8 Cost Estimate

Construction costs are estimated at the price level of May 1995 taking into consideration the survey results on the costs of labor, construction materials and equipment, the current price estimation method, tender method, local contractors' work capacities, etc.

In the Study, construction costs are estimated with the conditions of International Competitive Bidding (ICB), and the following conditions and assumptions.

i) Local portions of costs consists of labor costs, material costs of timber, gravel, sand and stone, and the remaining covered by foreign costs.
ii) Construction materials are assumed to be transported from Pakxe to the respective project sites, and the transportation costs are estimated broadly to be divided into 4 price steps in the areas by the areas.
iii) Working ratio and work capabilities of equipment are estimated based on the present prevailing conditions in the Study area.
iv) Land acquisition costs are estimated at US $ 5.0 / ha, based on the present land concession fee in the Study area.
v) Physical contingency is assumed at 15% of the direct construction costs.
vi) Overhead and profit of contractors are assumed at 15 % of the construction costs including the physical contingency.
vii) Administration costs are assumed at 2% of the sum of construction costs and land acquisition costs.
viii) Engineering costs are assumed at 10% of the sum of construction cost and physical contingency.
ix) Exchange rate is applied as follows; US $ 1.0 = Kip 730

The construction costs for 16 projects are estimated at US $ 242 million. The costs for irrigation and drainage development is about US $ 191 million, and the costs of rural infrastructure is estimated at approximately US $ 51 million. The project costs are summarized below.

	Projects	Construction Cost (US $ Million)		
		Irrigation & Drainage	Rural Infrastructure	Total
Phase I				
i)	Upper Champi Project	7.94	4.84	12.78
ii)	Upper Tapoung Project	1.35	1.60	2.95
ix)	Upper Kapheu Project	7.95	4.07	12.02
xii)	Lower Xe Set Project	15.94	3.09	19.03
xvi)	Upper Tayun Project	2.62	1.29	3.87
Phase II				
iii)	Lower Xe Pian Project	6.76	6.03	12.79
iv)	Upper Makchan Project	7.33	1.34	8.67
x)	Middle Tapoung Project	4.89	1.83	6.72
xi)	Lower Tapoung Project	31.12	6.35	37.47
xiv)	Upper Thon Project	4.61	2.01	6.62
Phase III				
v)	Middle Xe Katam Project	6.64	1.59	8.24
vi)	Middle Namtang Project	2.95	4.68	7.63
vii)	Lower Makchan Gnai Project	4.01	0.93	4.94
viii)	Lower Champi Project	20.80	2.85	23.65
xiii)	Lower Namsai Project	30.39	5.92	36.31
xv)	Middle Lamphan Project	36.10	2.27	38.36
	TOTAL	191.38	50.66	242.04

Furthermore, estimated procurement cost of O & M equipment is based on the work quantity of each Phase as follows;

Phase I	US $1.24 million
Phase II	US $1.04 million
Phase III	US $1.99 million

Estimated replacement costs as for gates and pumps for domestic water supply and transmission lines are based on 25 year life span of the equipment.

Development costs of the district extension works of agriculture and the four research and demonstration stations of fruit trees and upland crops, fishery, livestock and vegetables are estimated below, based on the facilities and apparatus to be required for each station.

i)	Development costs of district extension offices (district AFS)	US $	49,000
ii)	Fruit trees and upland crop research station	US $	655,000
iii)	Fishery research and extension station	US $	700,000
iv)	Vegetable trial and demonstration farm	US $	364,000
v)	Livestock and veterinary station	US $	500,000
	Total	US $	2,268,000

The costs for marketing facilities are estimated based on the projection of marketing volume in the Study area as follows;

Phase I	US $109,000
Phase II	US $109,000
Phase III	US $61,000

8. PROJECT IMPACT AND EVALUATION

8.1 Agricultural Impacts

The major direct agricultural impacts expected to be brought about at the full target stage of the 16 model area development schemes are summarized as follows:

- Self Sufficiency in Food(rice) will be much improved through substantial increase of lowland rice which accounts for about 85,000s ton per year,
- Reduction of slash-and-burn cultivation and promotion of crop diversification will be achieved through the introduction of stabilized sustainable cropping system, which is under irrigation, by increasing land for coffee plantations, field crops and vegetables, as well as lowland rice field,
- Live stock raising activities will be improved and promoted through grazing land improvement and semi-intensive raising method, together with appropriate veterinary services.
- Inland fish culture will be promoted by improving farming method through effective extension work based on research technologies.

8.2 Rural Infrastructure Development Impacts

Agricultural development will achieve its target through both direct measures for increasing production and indirect ones for improving rural infrastructure and living conditions. The impact according to improvement on rural infrastructure is recognized in various forms described below:

(1) Road improvement

Good transportation facilities, especially a well functioned road network encourages farmers to expand and improve farming and crop diversification, as well as marketing of farm inputs and outputs. Improved roads will also contribute largely to people's socio-economic activities.

(2) Water supply development

Provision of rural water supply will ease the burden of women and children who currently bring water from streams or rivers. Good water also means better health. In addition, water supply facilities will improve the functions of such public facilities as clinics, schools and markets.

(3) Electricity supply

Rural electrification is one of the main requisites for the people as well as for the development of rural socio-economic activities. Furthermore, the electricity supply will improve such facilities as clinics, markets and village community halls.

(4) Primary school improvement

Rehabilitated schools will offer better conditions to both teachers and children. Those schools will encourage the children to go to school more often and continuously, resulting in increasing literacy rate of children.

(5) Village clinic improvement

Improved village clinics with both water and electricity supply will contribute greatly to the people's health.

(6) Village community hall

The hall can be used for several purposes such as cooperative work, agricultural extension services, farmer training, health care services, meeting, propagation of rural life and

improvement of women's social status, day care, social education to adult people, entertainment, etc. Therefore, it will contribute largely to the improvement of rural life.

8.3 Social Impacts

(1) Increase of farm income

Farmers have to live upon limited as well as unstable agriculture output due to inefficient farming practices such as slash and burn farming and rainfed rice farming. However, the farmers' income will be increased considerably after implementing of the Projects, because of increased crop production and improvement of the marketing system. The increase of the net farm income will provide motivation in the improvement of living standards of the farmers as well as rural economic development.

(2) Improvement of rural life and correction of living differentials

The direct effect on the improvement of the health and living conditions in the Project areas will be seen by the progress of the rural water supply system for supplying clean and safe water for villagers. In addition, it is expected that the community development will improvement the literacy rate, public health, nutrition and home keeping. This in turn will progress and stabilize rural living conditions. The improvement of living conditions translates to a rise in the social status of women, which is expected to contribute to the rural socio-economy. These circumstances will promote better rural living conditions and expand the living differentials with the surrounding urban areas.

(3) Expansion of women's activities

In addition, women's activities will improve and expand through community development, establishment of water supply system and clinics, and the improvement of road and schools. An increase in the farmers' income will also improve women's activities in the farm families of the Project area and also other families throughout the economic chain, since housewives in many cases are said to manage family budget.

(4) Improvement of local transportation

The local transportation within the Study area will be improved considerably by the improvement of existing roads. This will not only enhance the marketing activities of farm products but also contribute to the improvement of accessibility and communication between villages and towns.

(5) Increase in employment opportunities

The project implementation will increase employment opportunities in the Study area in farm labor and construction workers. In addition, enhancement of marketing activities will also generate employment in related sectors.

(6) Room for future transmigration

After implementation of the selected 16 projects, agricultural land will be developed at about 15,000 ha. This not only expands the area of individual farms but allows room for future transmigration. Taking into consideration the proposed average holding size of 2.5 ha for existing and new farmers, about 4,100 households will be able to transmigrate to the area in the future.

8.4 Environmental Impacts

(1) Reducing of the Slash and Burn cultivation practice

The Project can not only prevents further deterioration of land resources in the Study area but also improves agricultural land productivity by changing farming practices to

permanent agriculture. By this Project, about 15 thousand ha of slash and burn cultivation area will be shifted to the permanent farming area.

(2) Water quality

Promotion of soil conservation and environmentally friendly farming practices by the Project will result in improving water quality and water quantity in the downstream area.

(3) Improvement of living environment

The living environment problems in the Study area are low farm income due to inefficient farming practices, poor marketing condition, poor road condition, poor rural water supply, and insufficient social facilities both in quality and in quantity. The implementation of the Projects will contribute to mitigate these problems by the improvement of social infrastructures and extension services as well as increase the farmer's income.

8.5 Other Impacts

Since the Project has a function as a model project to demonstrate the other areas, the effects of the Project will be expanded in and around the Study area after its implementation and improvement of support service systems, as mentioned above. In addition, since the Project will be implemented in the area of diverse ethnic minorities, it will become an example to incorporate diverse ethnic minorities into the project.

8.6 Preliminary Economic Evaluation

8.6.1 Basic Assumption

The economic justification was carried out on the basis of Economic Internal Rate of Return (EIRR), based on the estimated project costs and incremental project benefits. The justification was carried overall and for each proposed Project. Major assumptions for the estimation of EIRR are summarized below:

i) The economic life span of each Project is 50 years,
ii) All prices are expresses at April 1995 price in kip,
iii) The exchange rate of US$ 1.00 = Kip 730 as an average during April to May, 1995 is applied,
iv) A standard conversion factor (SCF) of 0.97 is applied to domestic cost elements such as transport, handling and processing for estimation of economic value, and
v) The transfer payment such as tax, duty, subsidy and interest are excluded for the estimation of economic costs and prices.

8.6.2 Economic Benefit

The net incremental benefits were calculated based on the agricultural benefits in this evaluation. Benefits accrued from the agriculture development are estimated by an increase in crop yields and cropping intensity. The net economic production values in the future without and with overall Projects are estimated at 1,091 million kips and 14,057 million kips, respectively. The economic incremental irrigation benefit will be 12,965 million kips or 18 million US $ in total for an irrigation area of 21,408 ha, and will be US $830 /ha.

8.6.3 Economic Cost

In this preliminary evaluation, the cost for rural roads, water supply and micro hydro power developments and establishment of some facilities were excluded from the project costs, since the benefits from them were not included as a direct project benefit. Consequently, the financial project costs excluding the transfer payment and price contingencies consist of the following items, relating to irrigation and drainage development.

i) Construction cost for project works,
ii) O&M equipment,
iii) Administration costs,
iv) Engineering services,
v) Land acquisition, and
vi) Physical contingency

The financial costs were converted to economic costs by applying a standard conversion factor (SCF) for the local currency portion. The economic cost of the overall Project is estimated at US$ 190 million.

The annual operation and maintenance costs consist of salaries of project staff, project office expenses, operation and maintenance costs of facilities and equipment. The financial O&M costs were converted to the economic costs by using SCF and a shadow wage rate for the local currency portion. The annual economic O&M costs of the overall Project is estimated at US$ 1.4 million as summarized below:

The replacement term of equipment is estimated at 25 years for the each Project and the total replacement cost of the overall Project is about US$ 9.3 million.

8.6.4 Economic Evaluation

Based on the economic costs and benefits, EIRR was calculated for the economic evaluation of the overall and each Project. The EIRR of the overall Project is estimated at 7.9 %, and the results are shown in Table 23, and summarized as follows;

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

In order to evaluate soundness of the overall Project to possible changes in the economic condition in the future, a sensitivity analysis was made as follows :

Case			EIRR (%)
Case I	:	Project cost overrun by 10 %	7.0
Case II	:	Benefit decrease by 10 %	6.9
Case III	:	Combination of Case I and II	6.1

8.7 Financial Evaluation

In order to assess the farm household economy in the Project area from the financial aspect, a budget analysis on different farming types is with and without the Project, as shown in Table 24 is summarized below:

(unit of currency : '000kips)

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

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

Note : Average family size is 5.7 persons per household

The farm budget was re-calculated by using, the coffee price at 2005.

After implementing the Project, the slash and burn farmers will shift to lowland rice farming and/or coffee farming from the view point of sustainability and productivity. The farmers will get about 7~10 fold farm income after implementation of the Project. Living expenses should also drastically increase; consequently, the living conditions of beneficial farmers will be substantially improve and they will be able to try to operate intensive farming.

8.8 Justification

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

i) Economic Internal Rate of Return (EIRR) is 9.7% which substantially varies from 4.6% to 16.5% in the model areas. It is not easy to say that each Project is fully economically feasible in view of the national economy, as it is apparent from the result of sensitively analysis.

ii) The farm economy will drastically increase to about 7~10 times compared with the condition the without project as shown in Table 1.24. From the financial point of view, the large benefit will be born to the beneficiary farmers after implementing the Project. Accordingly, the implementation of the Project should be accelerated as early as possible.

iii) Since about 15 thousand ha of slash and burn field will be changed to farm land by the implementation of the Project, a significant effect for reduction of slash and burn could be expected.

iv) It is easily anticipated that the dissemination and expansion effect to the surrounding area will be born from the implemented project, which will be functioned as core project. The following effects are positively expected, so it is recommended to implement the Project at an early stage;

- reduction of slash and burn cultivation,
- improvement of the farming practices,
- improvement of living conditions and rural life, and
- improvement of the marketing system.

9. SELECTION OF PRIORITY DEVELOPMENT AREAS

9.1 Selected Criteria and Result of Selection

For the selection of the priority development projects, the following criteria is adopted by using the matrix table as shown on Table 22.

i) A demonstration of rural development's effectiveness can be much expected through implementation of the Projects.

ii) Better co-ordination among existing agriculture development activities in the Study areas. The national and regional agriculture development programs and the Projects shall be sustainable.

iii) Easy access to the proposed areas is sustainable.

iv) Medium scale agriculture and rural developments are sustainable.

v) Effectiveness of agricultural extension can be anticipated through implementation of the Projects.

vi) The typical agriculture development, which recommends suitable crops for different climates and areas in the Study, is sustainable.

vii) The beneficiary farmers already have the experience and the know-how to raise the introduced crops, easy attainment of the agricultural goals is anticipated.

viii) Easy access to the market from the Project area is to be expected.

ix) A substantial improvement of the beneficiary farmers' household and their living standard is expected after implementation of the Projects.

x) Better cooperation from the beneficiary farmers can be expected through implementation of the Projects.

xi) The government has put priority on the Project areas, therefore their efficient support can be expected.

xii) The beneficiary farmers are experienced in the operation and maintenance of rural infrastructures, as in the electricity supply system and rural roads. Efficient operation in the future and maintenance for the rural infrastructures can be expected.

xiii) Reduction of the slash and burn cultivation area is anticipated through the implementation of the Projects.

xiv) The environmental impact of the Projects is minimal and sustainable development can be expected through its implementation.

xv) Future transmigration from slash and burn cultivation areas can be accepted.

xvi) Economic feasibility is calculated from the EIRR.

xvii) Extension of effect promotion of crop diversification is expected.

xviii) Contribution of self-sufficiency is expected through implementation of the Projects.

As a result of the evaluation, the following five IARDP are selected and proposed for the feasibility study.

i) Upper Champi Project
ii) Upper Tapoung Project
iii) Upper Kapheu
iv) Lower Xe Set
v) Upper Tayun

9.2 Summary of the Selection of the Priority Development Areas

(1) Out of the total Study area of 654,000 ha, suitable land for agriculture of about 390,400 ha is identified through land use capability classification based on the soil survey.

(2) Then gross cultivable land in the Study area is estimated at 180,600 ha declared by the Government and 30,000 ha of land concession occupied by the private sector and state companies. The net potential agricultural development area is estimated to be 135,600 ha, deducting other land uses such as village roads, rivers, etc.

(3) Net suitable agricultural land is further divided into two, irrigable land areas of 54,670 ha and non-irrigable land of 80,930 ha.

(4) Irrigable land is composed of about 36,000 ha of by gravity method and about 18,670 ha by pumping method.

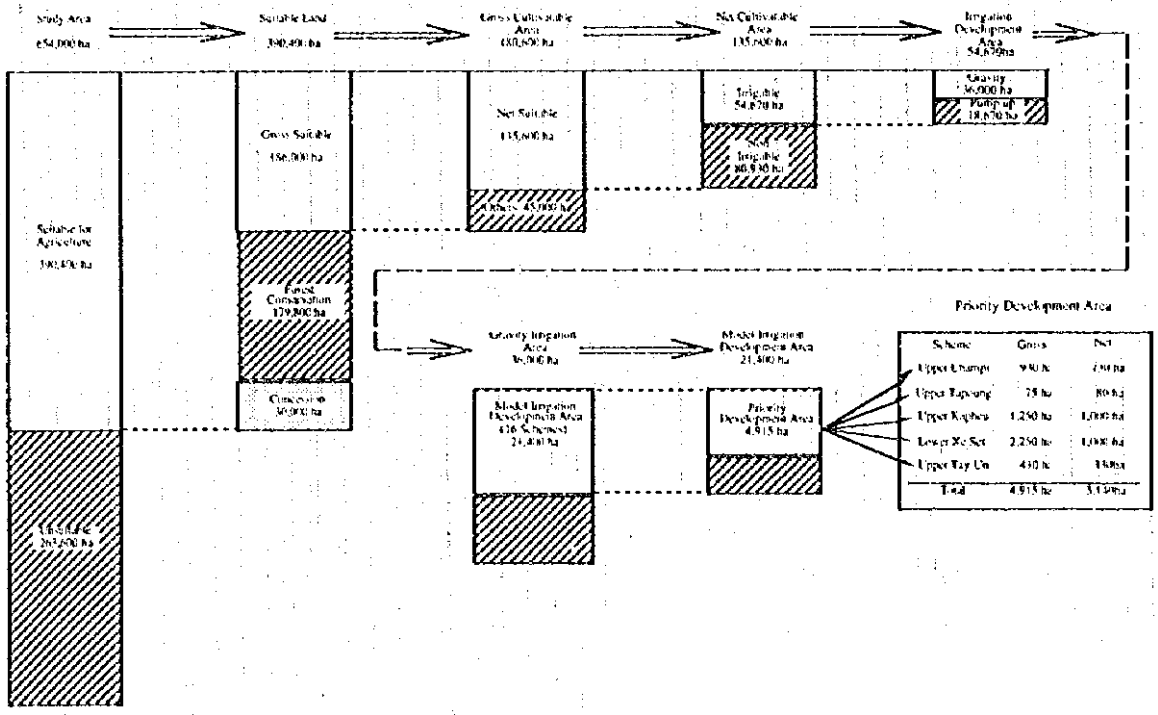
(5) From about 36,000 ha of the gravity irrigation system, 16 schemes with about 21,400 ha are selected for the model development in view of the following points.

(6) Since agricultural practices in the Study area substantially vary from the climatic and topographical conditions, and the irrigation develop potentials are rather large and scattered, stage wise development (short, medium, long term development) is recommended.

(7) From the above development strategy, the following five schemes with about 4,900 ha are selected for F/S and as priority development which will be implemented within 5 years.

(8) In the course of the F/S investigation & study, it was concluded that the net development area in the five schemes was reduced to 3,140 ha due to land use capability and topographical condition.

The following figure shows the selection process of the priority development area



Tables

Table 1.1 Composition of Official Exports

Unit : Million US$

Item	1988	1989	1990	1991	1992	1993
1. Convertible Area						
Electricity	11.3	15.0	19.2	21.3	17.7	17.1
Timber	18.2	4.0	3.2	3.0	9.7	8.5
WoodProducts	2.6	11.6	15.4	37.9	33.0	38.2
Coffee	0.5	3.6	1.4	2.2	2.4	3.3
Metals	-	-	-	1.3	2.2	4.0
Garments / Textiles	-	4.0	7.0	15.1	27.3	37.0
Agriculture/Forestry Products	0	9.	7.0	3.7	7.3	9.2
Motor bikes	-	-	-	-	19.5	22.0
Reexports						
Logs, Wood Products	-	-	4.9	9.7	5.4	8.1
Cars	-	-	-	-	6.4	20.7
Others	4.2	-	-	-	-	35.0
Sub-total	36.8	47.2	58.1	94.2	130.2	203.1
2. Non Convertible Area						
Coffee	6.8	5.2	7.2	0.9	0	0
Logs / Wood Products	9.3	5.8	7.3	0.8	0	0
Metals	3.2	3.1	3.0	0.4	0	0
Others	1.8	2.0	3.1	0.3	2.4	0
Sub-total	21.1	16.1	20.6	2.4	2.4	0
Total	57.9	63.3	78.7	96.6	132.6	203.1

Source : Research Department , Lao PDR Central Bank

Note : - Not available
Figures in 1993 are estimated amounts.

Table 1.2 Composition of Official Imports

Unit : Million US$

Item	1988	1989	1990	1991	1992	1993
1. Convertible areas						
Rice and other foods	5.7	9.2	7.1	13.0	31.6	30.5
Provincial imports	9.2	15.4	11.3	15.4	0.0	35.3
Petroleum products	5.3	12.2	7.3	21.1	24.3	19.7
Machinery / raw materials						
Garment industry	-	-	-	-	20.4	31.5
Re exports	-	-	-	-	22.0	97.0
Other	8.8	11.2	29.2	61.3	52.3	62.7
Other imports	25.0	19.7	9.9	30.1	25.4	49.6
Aid-related imports	29.2	57.1	55.4	64.6	68.4	26.9
(% of total)	18.2	27.2	27.7	28.6	28.0	7.6
Sub-total	54.0	67.7	64.8	140.8	176.0	326.3
2. Non Convertible area	36.4	51.1	62.9	1.2	0	0
Aid-related imports	29.8	17.9	2.3	3.0	0	0
(% of total)	18.6	8.5	1.2	1.3	0	0
Total cash imports	101.3	134.7	142.3	158.4	176.0	326.3
Total aid-related imports	59.0	75.0	57.7	67.6	68.4	26.9
Total of all imports	160.3	209.7	200.0	226.0	244.4	353.2

Table 1.3 Harvested Area and Production of Crops

	Harvested Area (1,000 ha)				Production (1,000 tons)			
	1991	1992	1993	1994	1991	1992	1993	1994
Rice	557	566	539	600	1,223	1,502	1,251	1,577
Maize	34.2	32	27.2	46.4	68.6	59	47.6	55.8
Starchy roots	16.6	14	14.3	21.9	132.1	105	112.9	159.5
Vegetables/Beans	16.6	-	15.0	16.5	51.2	-	125.1	141.4
Soybeans	6.1	6	5.5	6.3	5.5	5	4.5	6.0
Peanuts	5.6	8	5.9	5.0	5.6	7	5.3	5.0
Tabacco	10.2	-	7.1	7.3	45.3	-	29.2	31.8
Cotton	8.0	8	7.9	7.2	4.8	-	6.0	5.9
Sugarcane	2.8	3	3.4	2.8	80.5	94	89.6	65.1
Coffee	22.8	18	18.9	20.0	8.0	7	7.6	7.6
Tea	0.4	1	2.3	2.0	1.7	2	1.5	1.5

Source : Ministry of Agriculture & Forestry
Note : Data in 1992 are obtained from FAO Yearbook, 1993

Table 1.4 Population and Households in the Study Area

Province	District	Zone	No. of Village	Number of Households	Total Population	Female	Population Density
Champasak	Pakxong	1	15	1,016	5,884	2,930	25.0
		2	12	1,215	6,688	3,345	29.6
		3	12	1,143	6,443	3,220	47.9
		4	10	948	4,820	2,386	34.8
		5	8	645	3,760	1,679	13.8
		6	11	834	4,640	2,348	7.5
		7	12	662	3,481	1,758	9.6
		8	13	814	3,820	1,958	6.4
		9	12	469	2,222	1,157	1.6
	Total		105	7,746	41,758	20,781	10.4
Champasak	Bachiang	1	14	906	4,308	2,073	44.7
		2	8	693	3,380	1,700	15.7
		3	20	1,183	5,843	2,971	41.9
		4	18	1,010	4,765	2,509	66.3
		5	10	430	2,038	1,069	112.0
		6	6	473	1,941	1,024	15.2
	Total		76	4,695	22,275	11,346	33.3
Salavan	Salavan	1	7	503	3,230	1,738	33.4
		2	14	1,030	6,305	3,248	46.6
		3	21	833	5,110	2,636	57.2
		4	16	1,011	5,978	3,087	52.0
	Total		58	3,377	20,623	10,709	47.3
Salavan	Laongam	1	16	1,623	8,435	4,077	143.5
		2	13	748	3,672	1,820	99.5
		3	11	835	4,285	2,266	51.3
		4	11	797	4,342	2,246	50.4
		5	10	582	3,095	1,570	14.8
		6	12	892	4,625	2,320	26.9
		7	9	573	3,138	1,644	20.4
		8	11	461	2,349	1,171	66.5
		9	8	426	2,128	1,124	64.5
		10	9	977	5,053	2,608	45.2
	Total		110	7,914	41,122	20,846	41.9
Sekong	Thateng	1	4	294	1,628	772	29.9
		2	17	1,057	5,687	2,705	39.9
		3	14	695	3,643	1,733	26.7
		4	15	656	3,445	1,638	53.7
	Total		50	2,702	14,403	6,848	36.2
	Grand Total		399	26,434	140,181	70,530	21.6

Note: * Population density = Person/square kilometer

Data Source: CPCs, Champasak, Salavan and Sekong Provinces.

Table 1.5 Present Farming Practices

Inputs:	Unit	Rice		Coffee*	Tea	Cardamon**	Cabbage	Potato	Groundnut	Soybeans	Maize	Pineapple ****
		Upland	Lowland									
Yield	t/ha	1.6	2.4	*0.3	0.26	0.3	8	10	1	1	1	25
1 Nursery/seedling												
Seed	Kg	80	50				0.8	700	45	60	15	
Seedling	No./ha		0	625	4000	20000						10000
Fertilizer	Kg		0	0	0							0
Chemicals	Kg			0	0							0
2 Labour force:	man/day											
Field preparation		43	37			5	20	20	40	40	40	40
Fencing		16	0				10	10	10	10	10	
Nursery		0	10				10					
Transplanting/seeding		17	28			10	10	7	10	10	5	
Weeding		56	17	90	90	20	20	20	10	15	10	10
Irrigation/watering		0	0	0	0		10					
Harvesting/threshing		66	56	50	70	20	15	10	20	15	10	15
Drying				20	20	5						
Pruning				10	10							
sub-total		198	148	170	190	60	95	67	90	90	75	65
3 Animal power												
Plowing/harrowing		0	15	0	0	0	10	10	0	0	0	0
Transportation		0	3	1	0	0	3	4	2	2	2	10
4 Material:												
Fertilizers	Kg	0	***100	0	0	0	***400	150	0	0	0	0
Chemicals	Lit.	0	0	0	0	0	2	1	0	0	0	0
5 Others												

Spacing: Coffee 4mx4m Groudnut 0.3mx0.3m
Cardamom 0.7mx0.7m Soybeans 0.7mx0.7m
Cabbage 1mx1m
Pineapple 1mx1m,
Tea 4000 trees/ha

* Robusta shares 90% of the coffee in the area, unhulled dry cherry.
** Mix-culture with upland rice, yield is with cupsle.
*** N:P:K=16:20:0
**** 85% of plant is harvested

Table 1.6 Existing Irrigation Projects in and around the Study Area

No.	No. of Locations	Project	Water Resources	Location: Village	Location: District	Method of off-take	Actual Irrigation Area (ha): Rainy Season	Actual Irrigation Area (ha): Crops	Actual Irrigation Area (ha): Dry Season	Actual Irrigation Area (ha): Crops	Construction Year	Construction Cost: Kip Million	Construction Cost: US $ Thousand	Fund	Implementation Agency: Construction	Implementation Agency: O & M	Remarks
CHAMPASAK PROVINCE																	
1	1	Houay Set (Kong Toua)	Houay Set	Katoua	Paksong	Weir	50	Coffee trees	-	Coffee trees	1986	8.40	185.60	Province/District	Province	District	
2	2	Thong Houng	Thoang Houng	Nong Mek	Paksong	Weir	20	Paddy	20	Paddy	1993	34.50	49.40	Province	Province	District	
3	3	Thoeg Vay (Xe Katam)	Xe Katam	Xe Katam	Paksong	Weir	100	Paddy	48	Paddy	under const.	50.00		Province/SIDA	Province/District	-	Rehabilitation works of the old USAID
4	4	Houay Palay	Houay Palay	Thong kim	Bachiang	Weir	400	Paddy	150	Paddy	1992	723.50	1,039.30	Ministry/Province	Province	District	project
5	5	Houay Ngang (KM 12)	Houay Ngang	Chiengsan	Bachiang	Weir	70	Paddy	35	Paddy	1993	30.28	43.27	NGO	Province	Village	
		SUBTOTAL					640		253								
SALAVAN PROVINCE																	
1	6	Nong Deng	Xe Set	Houng Sai	Salavan	Weir	500	Paddy	70	Paddy	1987	274.6		Province	Province	Village	
2	7	Nakhoyaoda	H. Khalong	Nakogsou	Salavan	Weir	170	Paddy	0	Paddy	1954						
3	8	Nasay Soung	Vangloth	Nasay	Laongam	Weir	50	Paddy	30	Paddy	1987	0.40					
4	9	Soutavadi	Xe Set	Soutavadi	Salavan	Weir	15	Paddy	10	Paddy	1990	4		Village	Village	Village	
5	10	Houng Soung	H. Soung	B. Saung	Salavan	Weir	119	Paddy	0	Paddy	1993	14.96		CAA/USAID	CAA/USAID	Village	
6	11	B. Viang Kham	H. Laha	B. Vrang Kham	Salavan	Weir	30	Paddy	10	Paddy	1990	0.7		Village/USAID	Village/USAID	Village	
7	12	B.Len	H. Tounsan/Spring	B.Len	Laongam	Weir	70	Paddy	0	Paddy, Vegetable	1994	40		SIDA	Province	Village	
8	13	Dongmon	H.Tapoung	B. Dongmon	Laongam	Gates	250	Paddy	20	Paddy	1987	42.10		Gov./ Village	Gov.	Village	
9	14	B. Katene		B.Katene	Laongam	Weir	20	Paddy	5	Paddy	1995	4.67		Gov./ Village	Gov.	Village	
10	15	B. Lalay	H. Meung	B.Lalay	Salavan	Weir	50	Paddy	30	Paddy	1994	6.85		Gov./ Village	Gov.	Village	
11	16	B. La-Hang	Pa Luo	B. La-Hang	Laongam	Weir	30	Paddy	10	Paddy	1994	3.62		Gov./ Village	Gov.	Village	
12	17	B. A Vao	A.Vao	B. A Vao	Salavan	Weir	30	Paddy	10	Paddy	1994	3.62		Gov./ Village	Gov.	Village	
13	18	Nasay Gnay	Houa Pou	B. Nasay Gnay	Salavan	Weir	21	Paddy	21	Paddy		0.5		Village	Village	Village	
14	19	Nasaun	Houa Pou	B. Nataun	Salavan	Weir	28	Paddy	0	Paddy		1.00		Village	Village	Village	
15	20	Dongko	H. Soung	B. Dongko	Salavan	Weir	10	Paddy	0	Paddy		0.30		Village	Village	Village	
16	21	Senvang Gnai	H. Lavang	B.Senvang Gnai	Laongam	Weir	5	Paddy	0	Paddy		0.50		Village	Village	Village	
17	22	Goung Khan	H. Lat	B.	Laongam	Weir	25	Paddy	0	Paddy		0.50		Village	Village	Village	
18	23	Keng Kuhao	H. Leng	B. Leunhou	Laongam	Weir	15	Paddy	0	Paddy		0.30		Village	Village	Village	
19	24	Leun Leng	H. Leng	B. Leun Leng	Laongam	Weir	10	Paddy	0	Paddy		0.80		Village	Village	Village	
20	25	H. Pao	H. Pao	B. Houa Pao	Laongam	Weir	25	Paddy	0	Paddy		0.30		Village	Village	Village	
21	26	Khanuane	H. Khanuane	B. Khanuane	Laongam	Weir	45	Paddy	5	Paddy		0.50		Village	Village	Village	
22	27	Nkalone	H. Set	B. Nakalone	Laongam	Weir	40	Paddy	20	Paddy		0.50		Village	Village	Village	
23	28	Namy Neua	Tingking	B. Namy Neua	Salavan	Weir	35	Paddy	15	Paddy		0.40		Village	Village	Village	
24	29	Namy Tay	Cha Houa	B. Namy Tay	Laongam	Weir	30	Paddy	10	Paddy		0.40		Village	Village	Village	
		SUBTOTAL					1,623		266								
SEKONG PROVINCE																	
1	30	H. Dakang (1)	H.Dakang	Hoa Xe	Thateng	Weir	150	Paddy	6	Paddy	1993	15.00		Province	Province	Village	
2	31	B. Nong hok	H.Dakang	B. Nong Nok	Thateng	Weir	150	Paddy	30	Paddy	1992	13.10		Province	Province	Village	
3	32	Nam Sai	Nam Say	Nonglou, Kapu, Khamkok, Nong Nok	Thateng	Weir	86	Paddy/Coffee	0	Paddy/Coffee	1992	8.20		CAA (NGO)	District/Village	Village	
4	33	B.Loumna(B. Kuh)	H. Thone	B.Loumna	Thateng	Weir	48	Paddy	0	Paddy	1993	28.70		Province	Province	Village	
5	34	B.Nonglao	H. Tanyun	B.Nonglao	Thateng	Weir	12	Paddy	0	Paddy	1994	7.30		Province	Province	Village	
6	35	H. Tapot	H. Tapot	B. Kafe	Thateng	Gate	12	Paddy	0	Paddy	1988			Village	Village	Village	
		SUBTOTAL					458		36								
		TOTAL					2,721		555								

Table 1.7 Irrigation Development Plans in and around the Study Area

No.	Project	Water Resources	Location		Method of off-take	Off-take discharge (m3/sec)	Resevior Capacity (1,000 m3)	Irrigation Area (ha)				Remarks
			Village	District				Rainy Season	Crops	Dry Season	Crops	
CHAMPASAK PROVINCE												
1	Xepian or Houayxang	Xepian	Xepian or Houayxang	Paksong	Weir			???		???	Coffee	Being Planed by Provincial Office
2	KM 40	Houay Champi	KM 40	Paksong	Weir			???		???	Coffee & Cabbage	Being Planed by Provincial Office
3	MaKchan	Houay Makchan	KM 15	Paksong	Weir			???	Coffee	???	Coffee	Being Planed by Provincial Office
	SUBTOTAL											
SALAVAN PROVINCE												
1	Nam Sai Irrigation	H. Nam Sai	-	Salavan	Weir				Paddy		Paddy, Upland crop	Being Studied by Provincial Office
2	Senvang Noy	H. Thon	Senvang Noy / Beng	Salavan	Weir				Paddy		Paddy, Upland crop	Being Planed by Provincial Office
3	Sixiangmai	H.H.Kapheir	Sixiangmai / Phouak Noy	Laongam	Weir				Upland crop		Coffee / Upland crop	Plan by Vietname Expert
	SUBTOTAL											
SEKONG PROVINCE												
1	B. Caphe	H. Tapout	B. Caphe	Thateng				8	Paddy	-	-	Being Planed by District Office
2	B.Torlork	H. Pavangai	B.Torlork	Thateng				70	Paddy	-	-	Being Planed by District Office
3	B. Thong Yao	H. Lanphanh	B. Thong Yao	Thateng				225	Paddy	-	-	Being Planed by District Office
4	B. Don Xa	H. Par	B. Don Xa	Thateng				30	Paddy	-	-	Being Planed by District Office
5	B. Thong Kong	H. Thong Kong	B. Thong Kong	Thateng				15	Paddy	-	-	Being Planed by District Office
6	B. Thateng	H. Nanong	B. Thateng (Paleng)	Thateng				200	Paddy	-	-	Being Planed by District Office
7	B. Yokthong	H. Tit	B. Yokthong	Thateng				100	Paddy	-	-	Being Planed by District Office
8	B. Kalam	H. Don	B. Kalam	Thateng				50	Paddy	-	-	Being Planed by District Office
	SUBTOTAL											

Table 1.8 Land Use in Three Provinces

(Unit : '000 ha)

Category	Champasak		Salavan		Sekong	
	Area	(%)	Area	(%)	Area	(%)
Current Forest	878.5	61.493	562.4	54.370	494.9	54.317
Potential Forest	153.2	10.725	242.1	23.401	338.2	37.114
Other Wooded Area	132.6	9.285	128.6	12.437	22.7	2.491
Permanent Agric.	183.2	12.821	71.1	6.871	10.0	1.103
Other Non-forest Land	81.1	5.676	30.2	2.921	45.3	4.974
(Total)	1,428.6	100	1,034.4	100	911.1	100

Source : Final Report of NOFIP

Table 1.9 Forest Cover in Districts

District	Land Area (ha)	Area under Forest (ha)	% of Land Area
Salavan	168,000	84,000	50.0
Laongam	94,872	18,979	20.0
Thateng	64,000	34,000	53.1
Bachiang	82,800	50,955	61.5
Pakxong	353,228	40,500	11.4

Source : District Forest Services

Table 1.10 Forest Cover by Vegetation Type

(unit : '000 ha)

Forest Type	National		Champasak		Salavan		Sekong	
	Area	(%)	Area	(%)	Area	(%)	Area	(%)
Dry Dipterocarp	1,206.5	5.0	239.3	16.7	109.4	10.5	13.3	1.4
Lower Dry Evergreen	85.5	0.3	5.6	0.3	7.4	0.7	3.8	0.4
Upper Dry Evergreen	1,061.0	4.4	84.9	5.9	61.6	5.9	59.9	6.5
Lower Mixed Deciduous	866.0	3.6	248.8	17.4	40.1	3.8	1.5	0.1
Upper Mixed Deciduous	7,448.0	31.4	304.2	21.2	340.9	32.9	381.8	41.9
Gallery Forest	87.5	0.3	10.9	0.7	11.3	1.0	3.8	0.4
Coniferous	132.3	0.5	0.0	0.0	2.8	0.2	11.2	1.2
Mixed Broad-leaved and Coniferous	280.5	1.1	1.8	0.1	1.1	0.1	30.4	3.3
Total	11,167.9	47.1	895.4	62.6	574.7	55.5	505.7	55.5

Source : Final Report of NOFIP

Table 1.11 Nurseries and Reforestation

District	No.of Nurseries		Reforested Area (ha) 1994	
	government	private	government	private
Salavan	0	0	42	0
Laongam	1	2	289	0
Thateng	0	0	1	10
Bachiang	1	0	215	0
Pakxong	1	1	10	0

Source : District Forest Services

Table 1.12 Some Ponds/lakes in Pakxong Wetlands

No.	Name of Pond / Lake	Extent (ha)
1	Nong Chanh	10
2	Nong Lak 49	3
3	Nong Beuang	7
4	Nong Phaktheam	7
5	Nong Houakhoua	7
6	Nong Hinh	3
7	Nong Poy	1.5
8	Nong Khoume	2.5
9	Nong Say	8
10	Nong Song Hong	10
11	Nong Xepian	10
12	Nong Chanhsavang	2
13	Nong Pong	12
14	Nong Kheuang	2
15	Nong Hkeuang Noy	4
16	Nong Phanouan	7
17	Nong Lom	8
18	Nong Ioy	3

Source : District Forest Service, Pakxong and field visits

Table 1.13 Land Concessions in the Study Area

No.	Company	Location District	Area (ha)	Land Use	Commencement
1	Patanahgasicam Company	Bachiang	1,500	Upland crops, Fruit trees	1993
				Forest development	
2	Asia Tech.	Bachiang	300	Sugarcane	1994
3	DAFI	Bachiang	1,500	Upland crops, Fruit trees	1991
			5,500	Forest development	1991
4	Mr. no.1	Bachiang	200	Upland crops, Forest development	1992
5	Mr. no.2	Bachiang	200	Upland crops, Forest development	1992
6	Mr. no.3	Bachiang	200	Upland crops, Forest development	1992
7	Mr. no.4	Bachiang	200	Upland crops	1992
8	Mr. no.5	Bachiang	200	Fruit trees	1992
9	Mr. no.6	Bachiang	700	Live stock, Fishery	1991
10	Mr. no.7	Bachiang	200	Upland crops, Forest development	1991
				Fishery	
11	Mr. no.8	Bachiang	400	Live stock	1991
	SUBTOTAL		11,100		
12	Asia Tech.	Pakxong	16,000	Forest development	1995
13	Mr. no.9	Pakxong	400	Live stock	1991
14	Mr. no.10	Pakxong	350	Live stock	1990
15	Mr. no.11	Pakxong	400	Live stock	1992
16	Mr. no.12	Pakxong	600	Live stock	1992
17	Mr. no.13	Pakxong	400	Live stock	1992
18	Mr. no.14	Pakxong	200	Live stock	1992
19	Mr. no.15	Pakxong	300	Live stock	1992
	SUBTOTAL		18,650		
	TOTAL		29,750		

Table 1.14 Application for Land Concessions in the Study Area

(The Government's approval are not issued as of April 1995)

No.	Company	Location			Area	Land Use	Remarks
		Village	District	Province	(Ha)		
1	Mr. no.1	Nong Poy	Pakxong	Champasak	1,000	Live stock	Application of land concession have
2	Mr. no.3	Kong Toon	Pakxong	Champasak	300	Live stock	Approval are not issued by April 1995
3	Mr. no.4	Makchane	Pakxong	Champasak	350	Live stock	
4	Mr. no.6	Phou Kok	Pakxong	Champasak	120	Live stock	
5	Mr. no.7	Daseua	Pakxong	Champasak	200	Live stock	
6	Mr. no.8	Being	Pakxong	Champasak	200	Live stock	
7	Mr. no.9	Keing Do	Pakxong	Champasak	800	Live stock	
8	Mr. no.10	Meug Phay	Pakxong	Champasak	300	Live stock	
9	Mr. no.12	Being	Pakxong	Champasak	300	Live stock	
10	Mr. no.14	Champi	Pakxong	Champasak	100	Live stock	
11	Mr. no.15	Phoukok	Pakxong	Champasak	600	Live stock	
12	Mr. no.16	Thong ka Long	Pakxong	Champasak	300	Live stock	
13	Mr. no.17	Km 20	Pakxong	Champasak	400	Live stock	
14	Mr. no.18	Hinlab	Pakxong	Champasak	300	Live stock	
15	Mr. no.20	Thong Chat	Pakxong	Champasak	400	Live stock	
16	Mr. no.23	Makchan	Pakxong	Champasak	200	Live stock	
	TOTAL				5,870		

Table 1.15 Short, Middle and Long Term Development Strategy (1/2)

I. AGRICULTURAL SUPPORT SERVICES		
- Short term	:	Facility Development (Research and/or Demonstration Station of Fam about Vegetable, Livestock, Fruit-tree and Fishery)
		Strengthening of extension works in model areas
		Human resource development (extension staff and farmers) in model areas
- Middle term	:	Establishment and extension of new and improved technology
		Formation of farmers' group
		Strengthening of extension works in and around model areas
- Long term	:	Training of farmers
		Extension to the surrounding areas
		Strengthening and re-organization of the research and/or demonstration station/farm
II. AGRO-ECONOMY AND MARKETING		
- Short term	:	Facility development
		Introduction of wholesale market system
		Organization development
		Establishment of farm input system
- Middle term	:	Dissemination of wholesale market system
		Preparation of operation manual for the organization
		Establishment of market information system and dissmination of commercialism
		Organization development
- Long term	:	Training and strengthening of government staff
		Training of farmers
		Transferring of market organization sytem to farmers' organization
III. AGRICULTURAL INFRASTRUCTURE (Irrigation and Drainage)		
- Short Term	:	To sustain the current implementation of the existing irrigation projects
		To make a reinforcement of O & M works for existing water resources facilities
		To develop the small and gravity irrigation projects with the area of less than 3,000 ha
		To extend O & M works of the existing farm roads
		To develop pilot irrigation development projects involving typical agriculture development in the plateau area.
		To establish water management system in the existing projects together with the establishment of water user associations
- Middle Term	:	To develop the new water resources for irrigation projects with a development of high technology
		To develop the middle scale and gravity irrigation projects with the areas from 3,000 ha to 10,000 ha
		To stabilize water management technology
- Long Term	:	To develop the middle scale and pump irrigation projects in combination with gravity irrigation projects
		To develop low land irrigation projects with the gravity irrigation method in the skirts portion of Boloven Plateau

Table 1.15 Short, Middle and Long Term Development Strategy (2/2)

IV. RURAL INFRASTRUCTURE		
(1) Village/Farm Road		
- Short term	:	Repair of existing damaged roads according to the traffic volumes
- Middle term	:	Introduction of periodical maintenance system (from unperiodical repair to periodical maintenance system)
- Long term	:	Road improvement of 50 km/year and periodical maintenance at least every 3 years (total length of road improvement : village road = 736 km, farm road = 843 km)
(2) Rural Water Supply		
- Short term	:	Maximum development of gravity flow piped water supply system (12 of total potential sites) Development of tubewell with hand pump as an urgent program in small villages or where electricity is not available (one well per 10 households)
- Middle term	:	Development of pipeline water supply system with elevated tanks where electricity is available
- Long term	:	Development of pipeline water supply system with elevated tanks according to electrification development
(3) Rural Power Supply		
- Short term	:	Maximum development of micro-hydropower potential considering economical view points Extension of existing high voltage transmission lines considering economical view points
- Middle term	:	Detailed survey of the proposed micro-hydropower potential and feasibility study on these implementation
- Long term	:	Development of transmission line networks whole the study area
(4) Primary School		
- Short term	:	Rehabilitation of existing primary schools in the proposed priority areas with provision of necessary furniture, equipment and facilities
- Middle/ Long term	:	Ultimate target = rehabilitation of 60 % of existing primary schools, considering present supporting conditions from provincial and district education services togeter with improvement of teachers' quality and their payments
(5) Village Clinic		
- Short term	:	Rehabilitation of existing village clinics in the proposed priority areas with provision of necessary furniture, equipment and facilities
- Middle/ Long term	:	Ultimate target = establishment of village clinic at the rate of one village clinic per 1,500 people, together with improvement of medical workers' quality and their payments, and stable support of medical materials and equipment
(6) Village Community Hall		
- Short term	:	Establishment of village community halls in the proposed priority areas with provision of necessary furniture, equipment and facilities
- Middle/ Long term	:	Ultimate target = one community hall in every village, considering possibility of their multipurpose utilization such as for strengthening of farmers' organization and its importance

Table 1.16 Overall Village/Farm Road Development Plan

No.	Year	Reconstruction/New construction		Annual Maintenance Length 3) (km)
		Annual Completion 1) (km)	Cumulative Length 2) (km)	
1	1996	50	50	-
2	1997	50	100	-
3	1998	50	150	-
4	1999	50	200	50
5	2000	50	250	50
6	2001	50	300	50
7	2002	50	350	100
8	2003	50	400	100
9	2004	50	450	100
10	2005	50	500	150
11	2006	50	550	150
12	2007	50	600	150
13	2008	50	650	200
14	2009	50	700	200
15	2010	50	750	200
16	2011	50	800	250
17	2012	50	850	250
18	2013	50	900	250
19	2014	50	950	300
20	2015	50	1000	300
21	2016	50	1050	300
22	2017	50	1100	350
23	2018	50	1150	350
24	2019	50	1200	350
25	2020	50	1250	400
26	2021	50	1300	400
27	2022	50	1350	400
28	2023	50	1400	450
29	2024	50	1450	450
30	2025	50	1500	450
31	2026	50	1550	500
32	2027	50	1600	500

Note : 1) 50 km/year
2) Total length of proposed village road construction = 736 km
Total length of proposed farm road construction = 843 km
Village road construction in selected priority project area = 85 km
Farm road construction in selected priority project area = 24.5 km
3) Periodical maintenance every 3 years

Table 1.17 Potential Micro-hydropower Development

No.	Village	District	River	Potential Generating Capacity (kW)	Lowest Discharge, 1) (m3/sec)	275 days full Discharge, 2) (m3/sec)
1	B. Houay seng	Laongam	Houay Tapoung	60	0.154	0.223
2	B. Setkhot, B. Phokhem	Paksong, Laongam	Houay Xe	160	0.399	0.578
3	B. Lak 38	Paksong	Houay Hen (Branch of H.Bangliang)	130	0.351	0.377
4	B. Phakkout , 3)	Laongam	Houay Namhok (Branch of H.Tapoung)	30	0.074	0.108
5	B. Houayxang	Paksong	Xe Pieng	100	0.262	0.362
6	B. Namthan	Paksong	Houay Namthan	130	0.282	0.468
7	B. Katouat	Paksong	Houay Set	70	0.165	0.239
8	B. Houayciat	Paksong	Houay Champi	160	0.349	0.455
9	B. Houaytao	Paksong	Houay Palai	20	0.041	0.054
10	B. Khot-gnai	Paksong	Houay Hai	70	0.148	0.193
11	B. Hanagphou-noy	Thateng	Houay Namsai	130	0.925	0.478
12	B. Sixiangmai	Laongam	Houay Kapeu	50	0.107	0.185
			(Total)	1,110		

Source : Provincial Industry and Handicraft Service and JICA Study Team
Note : 1) 1/5 probability
2) Discharge, ensured at least 275 days in a year
3) Rehabilitation of existing facility

Table 1.18 Proposed Farming Practice

Inputs:	Unit	Lowland rice	Coffee*	Tea	Cardamom**	Cabbage	Potato	Groundnut	Soybeans	Maize	Pineapple
Yield	t/ha	4	*3	1	0.4	20	20	2	2	3	25
1 Nursery/seedling											
Seed	Kg	50				0.8	1500	45	60	15	
Seedling	No./ha	0	625	12000	20000						10000
Fertilizer	Kg	0	0								0
Chemicals	Kg		0								0
2 Labour force:	man/day										
Field preparation		37				20	20	20	20	20	40
Fencing		0				10	10	10	10	10	
Nursery		10				10					
Transplanting/seeding		28			10	10	10	10	10	5	
Weeding		17	90	10	20	20	20	20	20	20	10
Irrigation/watering		5	5	5		5	5	5	5	5	
Harvesting/threshing		56	50	130	20	20	15	20	15	15	15
Drying			20	40	5						
Pruning			40	30							
sub-total		153	205	215	55	95	80	85	80	75	65
3 Animal power											
Plowing/harrowing		15	0	0	0	10	10	20	20	20	0
Transportation		3	3		0	10	7	5	5	5	10
4 Material:											
Fertilizers	Kg	***270	0	****300	0	***400	300	350	350	****300	****400
Chemicals	Lit.	4	0	0	0	4	4	4	4	4	0
5 Others											

Spacing: Robusta 2mx4m; Arabica 1mx2m; Cabbage 0.7mx0.7m; Cardamom 2mx2m; Groudnut 0.3mx0.3m; Soybeans 0.5mx0.2m; Pineapple 1mx1m

* Robusta shares 90% of the coffee in the area, unhulled dry cherry.
** Uplnad crop without mixing upland rice
*** (16:16:16)x200kg, Urea x 70kg
**** (16:16:16)

Table 1.19 Potential of Irrigation Development(1/2)

(Unit : ha)

Locaiion and River Basin	No. of Location	More than 1000 m				1000 m ~ 600 m				600 m ~ 400 m				Less than 400 m				TOTAL			Remarks	
																			Study Area		(Outside of Study Area)	
		A	B	C	Coffee	A	B	C	Coffee	A	B	C	Coffee	A	B	C	Coffee	River Basin	Gravity	Pump	Gravity	Pump
Pakxong																						
Xe Pian																						
Gravity Lower Xe Pian	1				750														750			
Pump New Area	P1,P2			130	270		530	530	540											2,000		
Sub-total		0	0	130	1,020	0	530	530	540	0	0	0	0	0	0	0	0	2,750				
H.Makchan																						
Gravity Upper Makchan	2			140	330														470			
Lower Makchan	3						340												340			
Pump New Area	P3							50	120											170		
Sub-total		0	0	140	330	0	340	50	120	0	0	0	0	0	0	0	0	980				
H.Namtang																						
Gravity Middle Namtang	4						265												265			
Pump New Area	P4						15	40	50											105		
Sub-total		0	0	0	0	0	280	40	50	0	0	0	0	0	0	0	0	370				
Xe Katam																						
Gravity Thonvay	5						30	30	40										100			
Thong Hong	6						10	10											20			
Middle Xe Katam	7					620													620			
Pump New Area	P5						50	50	60											160		
Sub-total		0	0	0	0	620	90	90	100	0	0	0	0	0	0	0	0	900				
H.Chuang																						
Gravity Thonvay	8													50	30				80			
Pump New Area																				0		
Sub-total		0	0	0	0	0	0	0	0	0	0	0	0	50	30	0	0	80				
Laonyam																						
H.Tapoung																						
Gravity Upper Tapoung	9			20	30														50			
Middle Tapoung	10								450										450			
Lower Tapoung	11										1,800		2,700						4,500			
New Area	12													4,700	2,300				7,000		8,000	
Pump New Area																				0		
Sub-total		0	0	20	30	0	0	0	450	0	1,800	0	2,700	4,700	2,300	0	0	12,000				
H.Kapbeu																						
Gravity Upper Kapbeu	13					360	360		380										1,100			
Pump New Area	P6					1,950	1,950		1,950					3,700	1,800					11,350		
Sub-total		0	0	0	0	2,310	2,310	0	2,330	0	0	0	0	3,700	1,800	0	0	12,450				
H.Palai																						
Gravity Houay Palai	14													160	80				240			
Pump New Area																				0		
Sub-total		0	0	0	0	0	0	0	0	0	0	0	0	160	80	0	0	240				
H.Champi																						
Gravity Upper Champi	15				730														730			
Lower Champi	16														1,500				1,500		1,100	
New Area	17													0	0				0		1,300	
Pump New Area	P7													910	460					1,370		
Sub-total		0	0	0	730	0	0	0	0	0	0	0	0	910	1,960	0	0	3,600				

Table 1.19 Potential of Irrigation Development(2/2)

(Unit : ha)

Location and River Basin		No. of Location	More than 1000 m				1000 m ~ 600 m				600 m ~ 400 m				Less than 400 m				TOTAL			Remarks (Outside of Study Area)	
			A	B	C	Coffee	A	B	C	Coffee	A	B	C	Coffee	A	B	C	Coffee	River Basin	Study Area Gravity	Study Area Pump	Gravity	Pump
Salavan																							
Xe Set																							
Gravity	Houay Set	18			20	30														50			
	Lower Xe Set	19										1,800								1,800			
Pump	New Area	P8													5,000	2,500					7,500		20,500
Sub-total			0	0	20	30	0	0	0	0	0	1,800	0	0	5,000	2,500	0	0	9,350				
H.Thon																							
Gravity	Upper Thon	20													640					640			
	New Area	21													1,700	800				2,500			
Pump	New Area																				0		
Sub-total			0	0	0	0	0	0	0	0	0	0	0	0	2,340	800	0	0	3,140				
H.Tay - Un																							
Gravity	H.Nonglao	22						50	50	50										150			
	Upper Tay - Un	23										250		100						350			
	Middle Lanphao	24													250					250		2,660	
Pump	New Area	P9,P10						530	530	540	470	470		460							3,000		
Sub-total			0	0	0	0	0	580	580	590	470	720	0	560	250	0	0	0	3,750				
H.Laha																							
Gravity	B.Vinane Kham	25													25	15				40			
	B.Phao - Gnai	26													30	20				50			
	B.Soung	27													40	10				50			
Pump	New Area																				0		
Sub-total			0	0	0	0	0	0	0	0	0	0	0	0	95	45	0	0	140				
H.Namsai																							
Gravity	Namsai	28						870	870	850										2,590			
	Houay Xai	29						190	200	200										590			
	Lower Namsai	30														1,350				1,350		5,850	
Pump	New Area	P11						160	170	180											510		
Sub-total			0	0	0	0	0	1,220	1,240	1,230	0	0	0	0	0	1,350	0	0	5,040				
Total	River Basin		0	0	310	2,140	2,930	5,350	2,530	5,410	470	4,320	0	3,260	17,205	10,865	0	0	56,790				
	Gravity		0	0	180	1,870	980	2,115	1,160	1,970	0	3,850	0	2,800	7,595	6,105	0	0		28,625		18,910	
	Pump		0	0	130	270	1,950	3,235	1,370	3,440	470	470	0	460	9,610	4,760	0	0			26,165		20,500

Table 1.20 Selection of the Irrigation Development Projects

No.	Location and River basin		Potential Area (Ha) Study area	Outside	(i) Project scale	(ii) Location of demonstration	(iii) Easy access for water operation	(iv) Activities of water users association	(v) Easy approach of agriculture support	(vi) Locality of Farmers	(vii) Location of marketing station	(ix) Scale of beneficiary	(x) Village pattern	(xi) Gravity water for domestic	Total	(iv) Present Status of Areas	Selection of Projects
	Paksong																
	Xe Pian																
1	Gravity	Lower Xe Pian	750		3	1	3	2	2	3	2	3	2	1	22		O
	H.Makchan																
2	Gravity	Upper Makchan	470		3	3	3	2	2	2	2	3	3	1	24		O
3		Lower Makchan	340		2	3	3	2	2	2	1	3	2	1	21		O
	H.Namlang																
4	Gravity	Middle Namlang	265		2	3	3	2	2	2	1	3	2	1	21		O
	Xe Katam																
5	Gravity	Thonvay	100		2	2	2	3	2	2	1	2	2	1	19	Existing Project	
6		Thone Kone	20		1	1	2	3	2	2	1	1	1	1	15	Existing Project	
7		Middle Xe Kata	620		3	3	3	3	2	2	1	3	1	1	22		O
	H.Chuang																
8	Gravity	Thonvay	80		1	2	2	2	2	2	3	2	1	1	18	Existing Project	
	Lamam																
	P.Tanoune																
9	Gravity	Upper Tanoune	50		1	3	3	2	2	3	3	2	3	1	23		O
10		Middle Tanoune	450		2	3	3	2	2	2	3	3	2	3	26		O
11		Lower Tanoune	4,500		2	3	3	2	2	2	2	3	2	3	24		O
12		New Area	7,000	8,000	1	2	2	2	2	3	1	3	2	1	19		
	H.Kanneu																
13	Gravity	Upper Kanneu	1,100		3	3	3	3	3	3	3	3	2	3	29		O
	H.Palau																
14	Gravity	Houay Palau	240		2	2	3	3	3	2	2	3	2	1	23	Existing Project	
	H.Champi																
15	Gravity	Upper Champi	720		3	3	3	2	2	3	3	3	3	3	28		O
16		Lower Champi	1,500	1,100	2	3	3	2	2	2	2	3	2	1	22		O
17		New Area	0	1,300	3	1	2	2	2	2	1	3	2	1	19		
	Salavan																
	Xe Set																
18	Gravity	Houay Set	50		1	2	2	2	2	2	2	2	2	1	18	Existing Project	
19		Lower Xe Set	1,800		3	3	3	2	2	3	3	3	2	3	27		O
	H.Thoe																
20	Gravity	Upper Thoe	640		3	3	3	2	2	3	3	3	2	1	25		O
21		New Area	2,500		2	2	2	2	2	2	2	3	2	1	20		
	H.Tav - On																
22	Gravity	H.Nongiao	150		2	2	3	3	3	2	2	2	1	2	22	Existing Project	
23		Upper Tav - On	350		2	2	3	2	2	3	2	3	2	3	24		O
24		Middle Lamphai	250	2,660	2	3	2	2	2	3	1	3	2	2	22		O
	H.Lane																
25	Gravity	B.Vinang Khai	40		1	2	3	2	3	2	2	1	1	1	18	Existing Project	
26		B.Phan - Gnai	50		1	2	3	2	3	2	2	2	1	1	19	Existing Project	
27		B.Noung	50		1	2	3	2	3	2	2	2	1	1	19	Existing Project	
	H.Namtay																
28	Gravity	Namtay	2,500		2	2	2	2	2	2	2	3	2	2	21	Existing Project	
29		Houay Xai	500		3	2	3	2	2	3	2	3	2	2	24	Existing Project	
30		Lower Namtay	1,350	5,850	2	2	3	2	2	3	3	3	2	1	23		O
	Total	Gravity	28,625	18,910													

Table 1.21 Implementation Program for the Next 15 Years (1/2)

	Phase I (1996-2000)	Phase II (2001-2005)	Phase III (2006-2010)
I. Model Development Project			
5 site (U. Champi, U. Tapoung, U. Kapheu, L. Xe Set, U. Tavun)	▬ ▬ ▬		
5 site (L. Xe Pian, M. Tapoung, L. Tapoung, U. Thon, U. Makchan)		▬ ▬ ▬	
6 site (L. Champi, L. Namsai, M. Lamphan, M. Xe Katam, M. Namtang, L. Makchan-Gnai)			▬ ▬ ▬
1. Agricultural Infrastructure			
(1) Water Resources Development			
- Strengthening of O&M work (existing facility)	▨▨▨	▨▨▨	
- Strengthening of O&M work (new facility)		▨▨▨	▨▨▨
(2) Irrigation & Drainage Development	▬ ▬ ▬	▬ ▬ ▬	▬ ▬ ▬
	5 site (4,000 ha)	5 site (7,000 ha)	6 site (10,000 ha)
(3) Farm Road Development			
- Strengthening of O&M work (existing facility)	▨▨▨	▨▨▨	▨▨▨
- Development of new farm road	▬ ▬ ▬	▬ ▬ ▬	▬ ▬ ▬
(4) Water Management Development			
- Establishment of water users association	▬ ▬ ▬	▬ ▬ ▬	▬ ▬ ▬
- Extension of water management technology (existing areas)	▨▨▨	▨▨▨	
- Extension of water management technology (new areas)		▨▨▨	▨▨▨
2. Rural Infrastructure			
(1) Village Farm Road Development	▬ ▬ ▬	▬ ▬ ▬	▬ ▬ ▬
	23.5 km	44.5 km	41.5 km
(2) Rural Water Supply Development	▬ ▬ ▬	▬ ▬ ▬	▬ ▬ ▬
- Gravity flow piped water supply	5 system	2 system	none
- Piped water with elevated tank	1 system	12 system	20 system
- Tubewell with Hand pipe	none	12 place	57 place
(3) Rural Power Supply Development	▬ ▬ ▬	▬ ▬ ▬	▬ ▬ ▬
- Micro-hydropower development	1 site	1 site	1 site
- Extension of existing 22 kV transmission line	23 km	59 km	56 km
(4) Primary School Development	▬ ▬ ▬	▬ ▬ ▬	▬ ▬ ▬
	15 places	15 places	24 places
(5) Village Clinic Improvenment	▬ ▬ ▬	▬ ▬ ▬	▬ ▬ ▬
	4 places	3 places	2 places
(6) Village Community Hall Establishment	▬ ▬ ▬	▬ ▬ ▬	▬ ▬ ▬
	13 places	12 places	18 places

▬: Development works will be implemented continuously.

▬ ▬: Development works will be implemented in each area at phase by phase.

▨▨▨: Development works will be implemented in each area at phase by phase and also continuously.

▭▭▭: Priority development projects

Table 1.21 Implementation Program for the Next 15 Years (2/2)

II. SUPPORT SERVICES AND COMMON USE FACILITIES DEVELOPMENT			
1. AGRICULTURAL SUPPORT SERVICES			
(1) Agricultural Extension			
- Training of extension staff and farmers			
- Strengthening of agricultural extension			
(2) Vegetable Trial and Demonstration Farm			
- Establishment of vegetable trial and demonstration farm			
- Provision of nursing seedling facility			
- Strengthening of nursing seedling facility			
- Strengthening of extension and promotion of vegetable production			
- Production and distribution of improved seedlings			
(3) Livestock Research and Extension Station			
- Completion of livestock research and extension station (Km 49)			
- Establishment of technology of living rasing and animal health			
- Extension of living rasing, animal health, improved grass seeds			
- Training of small-holder farmers			
(4) Fruit-tree Research Station			
- Reorganization of existing station to fruit-tree and upland crop research station			
- Establishment of farming technology of upland crops			
- Extension of farming technology of upland crops			
- Training of extension staff and farmers			
- Distribution of improved fruit-tree seedlings			
(5) Fishery Research and Extension Station			
- Rehabilitation of fishery research and extension station (Km 8)			
- Establishment of improved fresh water fish culture technology			
- Extension of fish culture and distribution of fingerlings			
- Training of extension staff and farmers			
(6) Agricultural Credit			
- Strengthening of Agricultural Promotion Bank, Pakxe			
- Strengthening of capital for credit, training of bank and extension staff			
- Fromation of farmers' group for credit			
- Increase in financing and credit line			
2. AGRO-ECONOMY AND MARKETING			
Marketing System Development			
- Establishment of market organization and trading point for vegetables (including introduction of wholesale system and market information system)	Pakxong, 300 m2	Laongam, 300 m2	Thateng, 150 m2
- Establishment of tea product organization with installation of facility (Pakxong)			
- Establishment of farmers' oraganization (Pakxong)			

: Development works will be implemented continuously.

: Development works will be implemented in each area at phase by phase.

: Development works will be implemented in each area at phase by phase and also continuously.

: Priority development projects

Table 1.22 Selection of the Priority Development Projects

		Project No.															
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	Effectiveness of Demonstration	3	3	3	1	2	1	1	1	3	2	3	3	3	3	3	3
2	Condition with Existing Project	3	3	3	1	1	1	1	2	3	3	3	3	1	1	2	3
3	Accessibility to Project Area	3	3	1	3	1	1	1	2	3	3	2	3	2	3	1	3
4	Scale of Development	3	2	3	3	3	3	3	3	3	2	3	3	3	3	3	3
5	Agricultural Extension	3	3	2	3	1	1	1	3	3	3	3	3	1	1	1	3
6	Typical Farming Type / Suitable Crops	3	3	3	2	2	2	2	2	3	2	2	3	3	3	3	3
7	Farmers' Experience for Proposed Cropping Pattern	3	3	2	1	2	2	1	2	2	2	2	2	2	2	1	2
8	Accessibility to Market	3	3	2	2	1	1	1	2	3	3	2	3	3	3	1	2
9	Impact to Farm Household Economy	3	3	3	3	2	2	3	2	3	3	2	2	1	2	2	2
10	Cooperation of Social Development	2	2	3	3	2	2	3	3	3	3	2	2	2	2	1	3
11	Government Willingness and Program	3	3	2	3	2	2	2	1	3	2	3	3	2	2	2	3
12	Existing Infrastructure	3	2	2	2	2	2	2	3	2	2	3	3	3	3	2	2
13	Reduction of Slash and Burn	2	2	3	2	2	2	3	3	3	3	3	3	3	3	3	3
14	Impact to Environment	3	3	2	2	2	3	2	1	3	3	1	2	1	2	1	2
15	Room for Future Transmigration	2	2	3	3	3	2	3	3	2	2	3	3	3	3	3	3
16	EIRR	2	2	3	3	3	3	3	2	3	3	1	2	1	2	1	2
17	Extension of Effect Promotion of Crop Diversification	3	3	3	3	3	3	3	2	3	3	3	2	2	2	2	2
18	Contribution of Rice Self-sufficiency	2	2	2	2	3	3	3	3	2	2	3	3	3	3	3	3
	Total	49	47	45	42	37	36	38	40	50	46	44	48	39	43	35	47

: Implemented in Phase I (Priority Development Projects)

: Implemented in Phase II

: Implemented in Phase III

Table 1.23 Economic Cost and Benefit Stream of the Whole Project

(Unit:US$.1000)

Year	Cost				Irrigation Benefit	Balance
	Construction	O & M	Replacement	Total		
1	7,635			7,635		-7,635
2	9,443	29		9,471	65	-9,407
3	7,896	57		7,953	1,170	-6,784
4	7,896	102		7,999	1,738	-6,260
5	2,599	148		2,747	2,779	32
6	9,411	181		9,592	3,165	-6,427
7	11,956	214		12,170	4,045	-8,124
8	11,262	267		11,529	4,889	-6,640
9	12,336	332		12,668	6,106	-6,562
10	9,252	385		9,637	6,698	-2,939
11	25,782	447		26,229	8,030	-18,199
12	22,685	550		23,234	9,154	-14,081
13	23,734	660		24,395	10,179	-14,216
14	17,460	791		18,251	11,960	-6,290
15	10,306	933		11,239	13,921	2,682
16		1,045		1,045	16,181	15,136
17		1,138		1,138	17,264	16,126
18		1,232		1,232	17,761	16,529
19		1,306		1,306	17,761	16,455
20		1,373		1,373	17,761	16,388
21		1,373		1,373	17,761	16,388
22		1,373		1,373	17,761	16,388
23		1,373		1,373	17,761	16,388
24		1,373		1,373	17,761	16,388
25		1,373		1,373	17,761	16,388
26		1,373	249	1,622	17,761	16,139
27		1,373	1,152	2,525	17,761	15,236
28		1,373		1,373	17,761	16,388
29		1,373	717	2,090	17,761	15,671
30		1,373	223	1,596	17,761	16,165
31		1,373	1,755	3,128	17,761	14,633
32		1,373	804	2,177	17,761	15,584
33		1,373	314	1,687	17,761	16,074
34		1,373		1,373	17,761	16,388
35		1,373	402	1,775	17,761	15,986
36		1,373	244	1,617	17,761	16,144
37		1,373	276	1,649	17,761	16,112
38		1,373	1,601	2,974	17,761	14,787
39		1,373	472	1,845	17,761	15,916
40		1,373	1,091	2,464	17,761	15,297
41		1,373		1,373	17,761	16,388
42		1,373		1,373	17,761	16,388
43		1,373		1,373	17,761	16,388
44		1,373		1,373	17,761	16,388
45		1,373		1,373	17,761	16,388
46		1,373		1,373	17,761	16,388
47		1,373		1,373	17,761	16,388
48		1,373		1,373	17,761	16,388
49		1,373		1,373	17,761	16,388
50		1,373		1,373	17,761	16,388
51		1,373		1,373	17,761	16,388
52		1,373		1,373	17,761	16,388
53		1,373		1,373	17,761	16,388
54		1,373		1,373	17,761	16,388
55		1,373		1,373	17,761	16,388
	189,653	59,251	9,300	258,204	792,259	534,055

EIRR = 7.9%

Table 1.24 Average Farm Household Economy wihtout and with Project Conditions

(unit : '000 kip)

	Without Project Condition				With Project Condition		
Main crop	Coffee	Slash&Burn	Lowland Rice	Average	Coffee	Lowland Rice	Average
No. of H.H.*1	(1,634)	(1,012)	(2,025)	(4,671)	(1,893)	(6,898)	(8,791)
Farm size	2.07 ha	1.19 ha	1.00 ha	1.91 ha	2.46 ha	2.50 ha	2.49 ha
1. Gross Income	(564)	(417)	(432)	(475)	(3,572)	(2,454)	(2,694)
- Farm Income	564	342	382	437	3,572	2,454	2,694
- Non-farm Income	0	75	50	38	0	0	0
2. Production Cost	125	26	35	65	643	814	777
3. Net Income	439	390	397	410	2,928	1,640	1,917
4. Living Expenses	(429)	(390)	(397)	(407)	(1,535)	(1,535)	(1,535)
- Food item	333	303	309	316	874	874	874
- Non-food item	96	87	89	91	661	661	661
5. Net Reserve	10	0	0	3	1,393	104	382

Note : Average is weight average based on No. of household (H.H)
Coffee price is using the 2005 future price based on the World Bank Price Prospect, 1994

Remarks : No. of H.H. is the number of beneficial farmers.
The living expense of farmers with project condition are applied the data of present average household expenditure in Urban area. (source : Agricultural Sector Memorandum, IBRD, 1995)

Figures

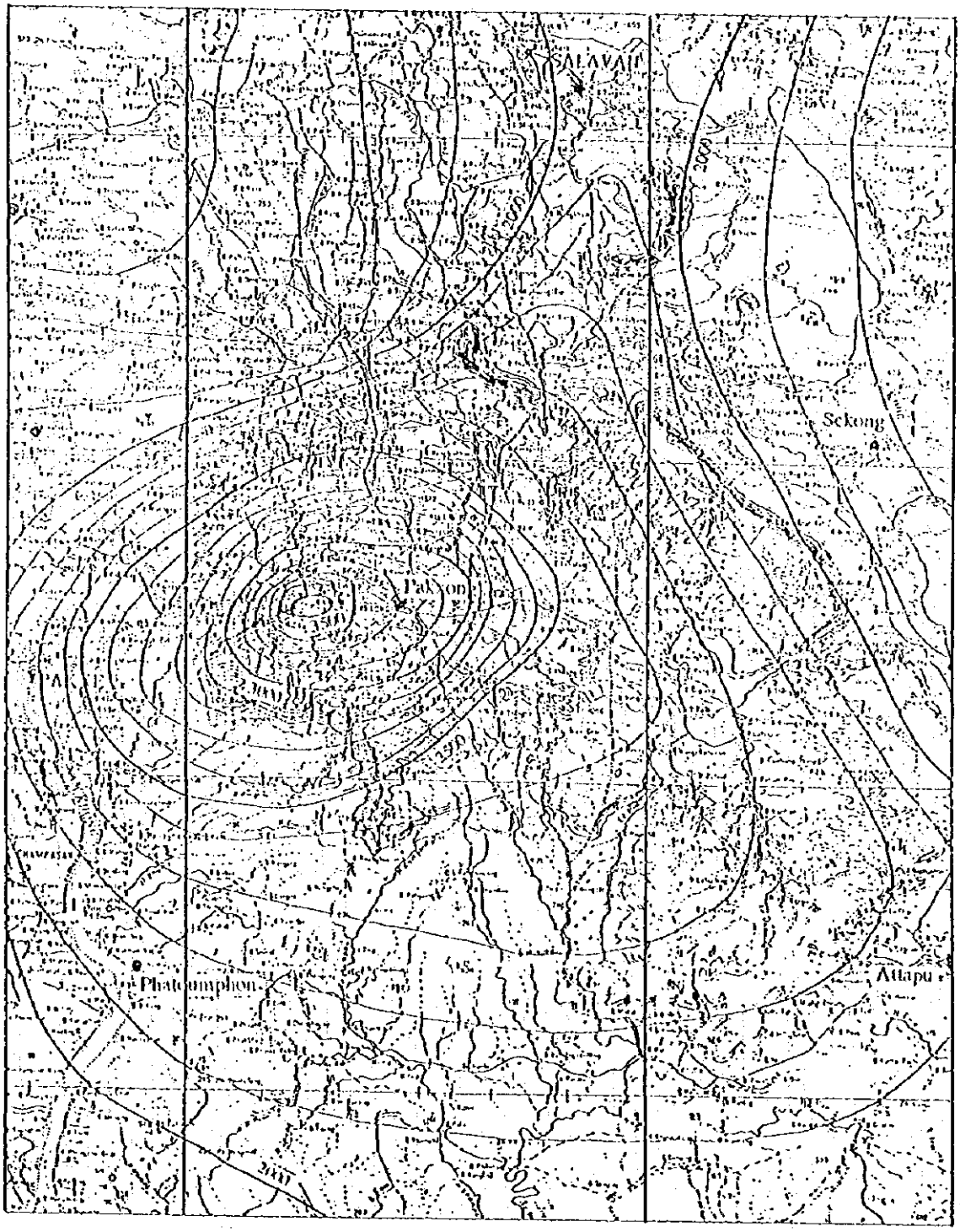


Figure 1.1 Annual Average Isohyetal Map

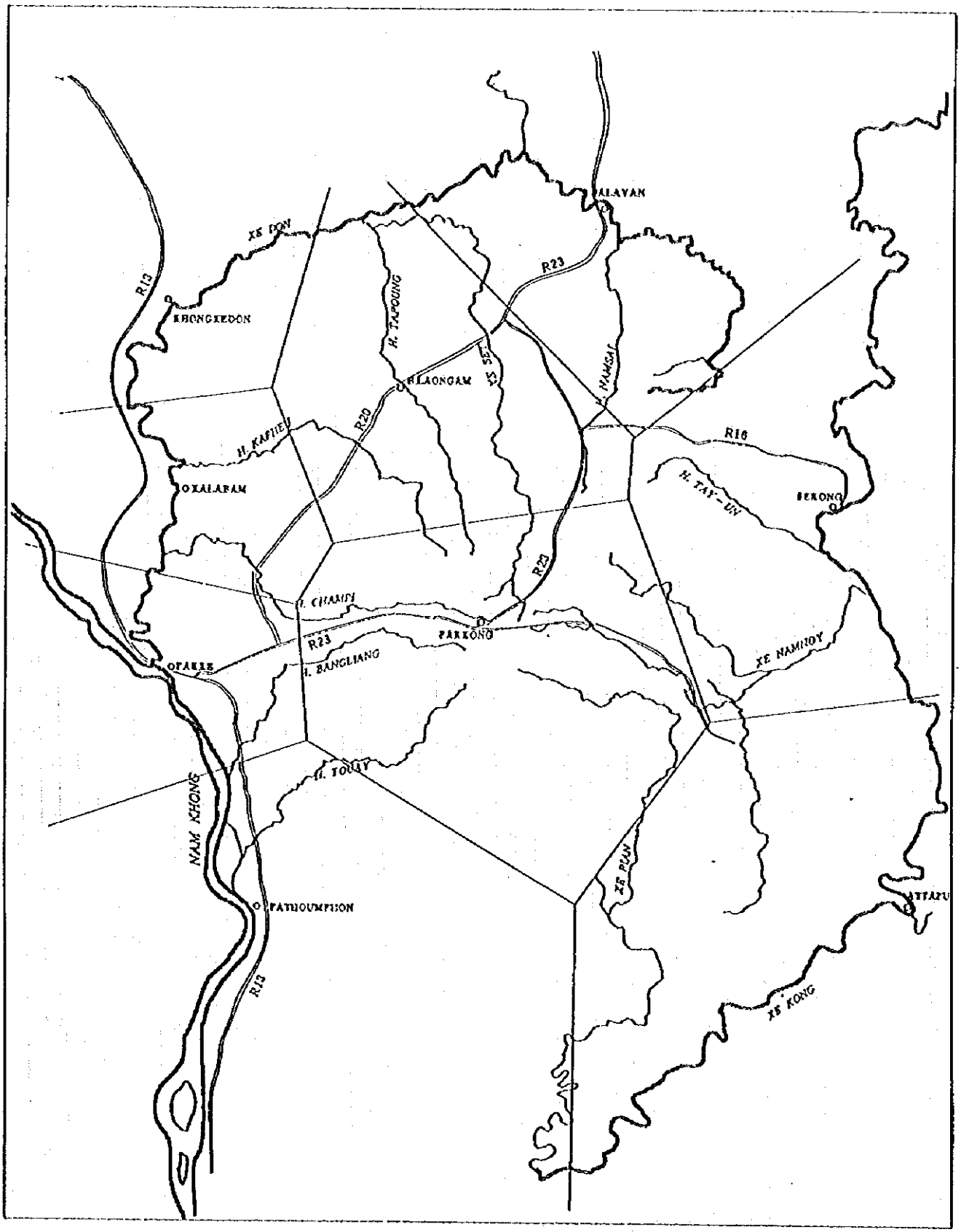


Figure 1.2 Thiessen Polygon

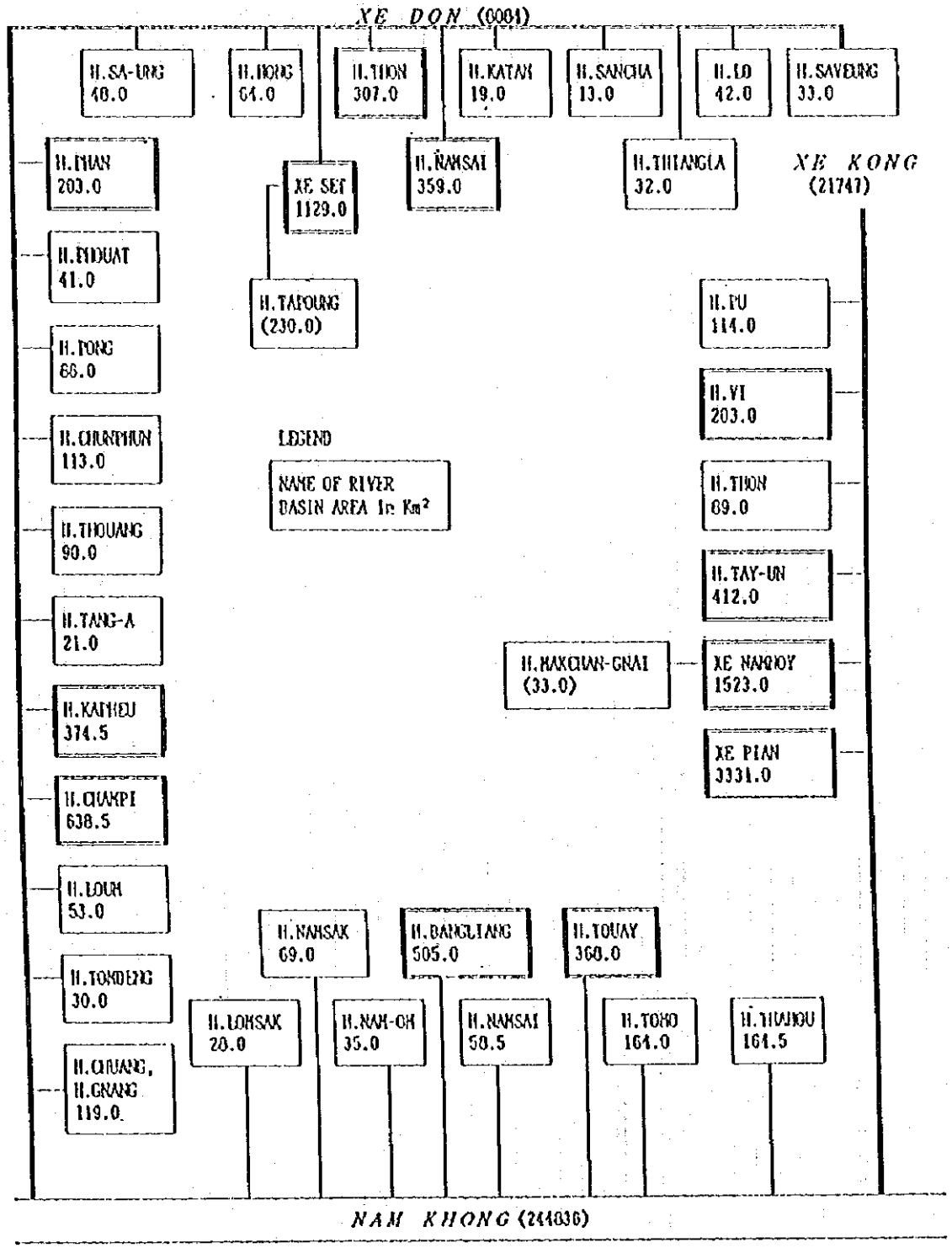


Figure 1.3 River System

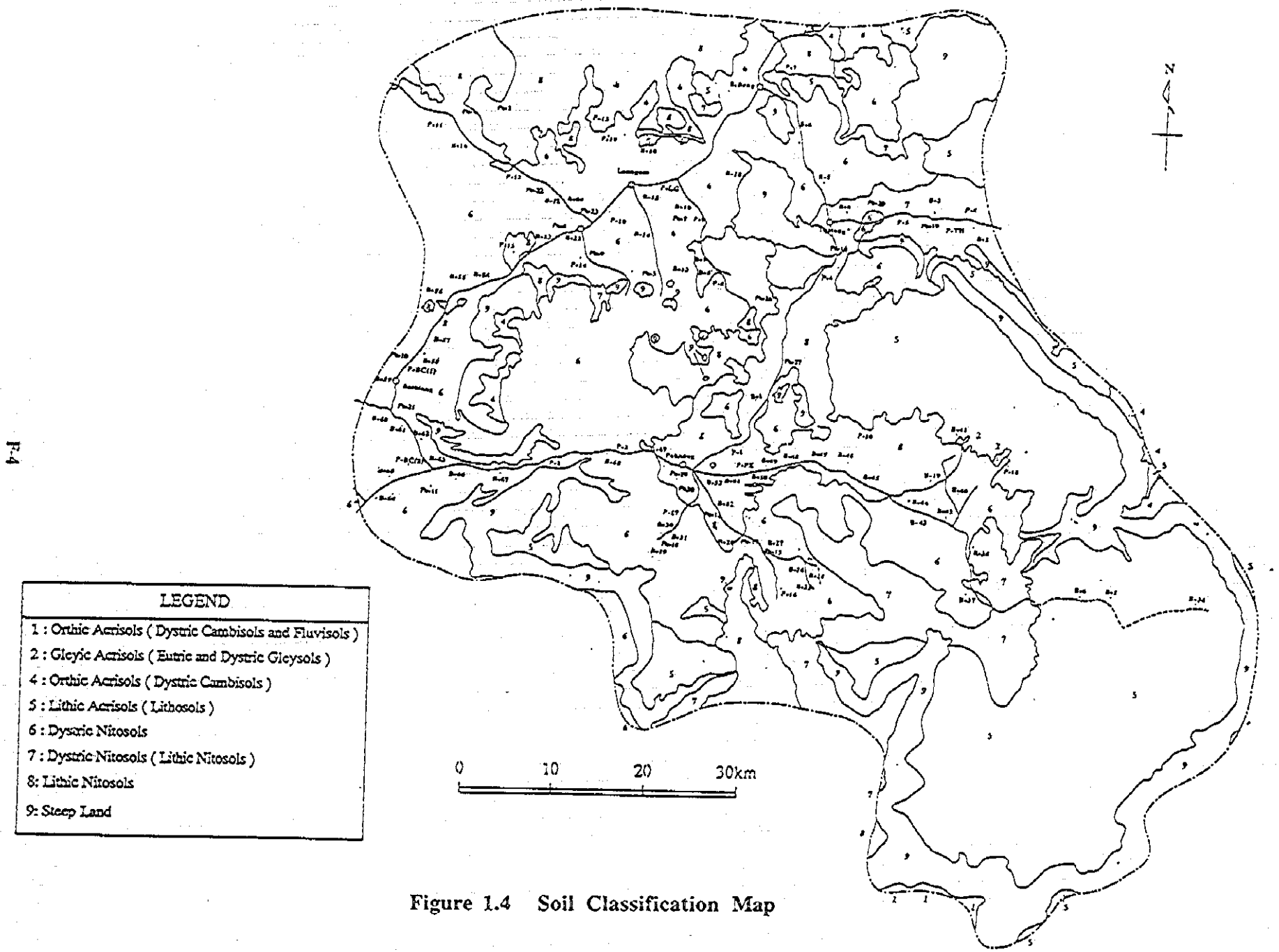


Figure 1.4 Soil Classification Map

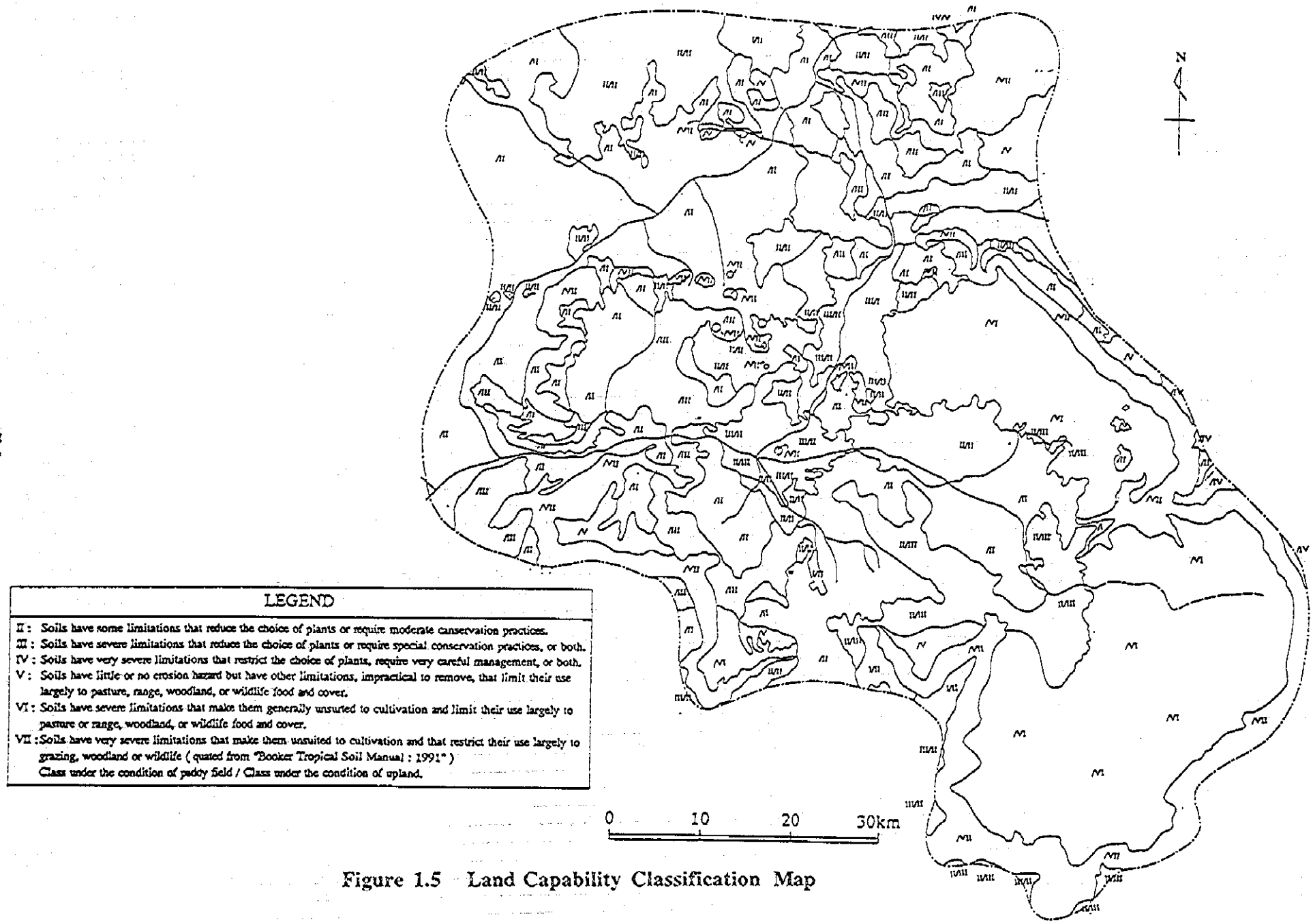


Figure 1.5 Land Capability Classification Map

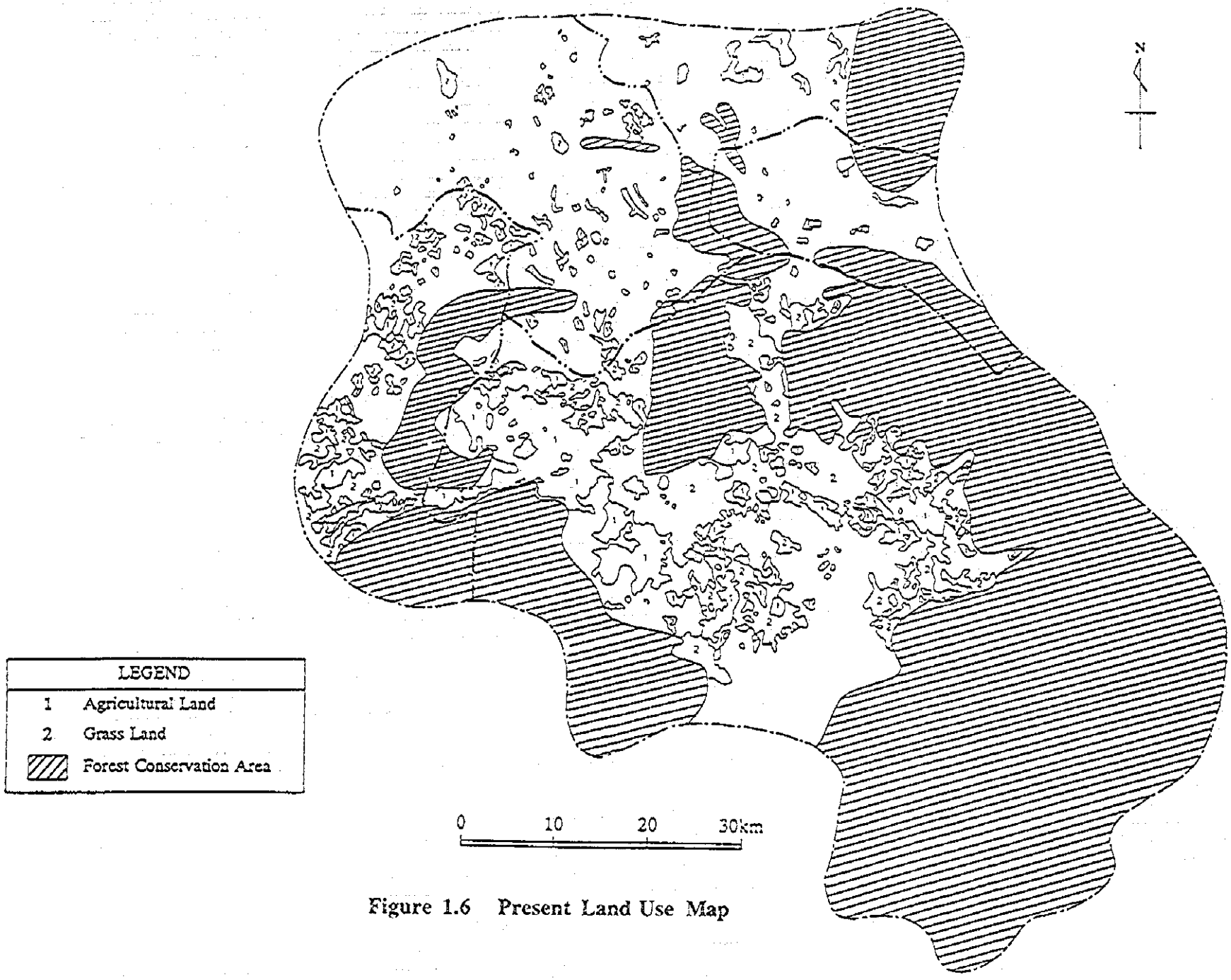


Figure 1.6 Present Land Use Map

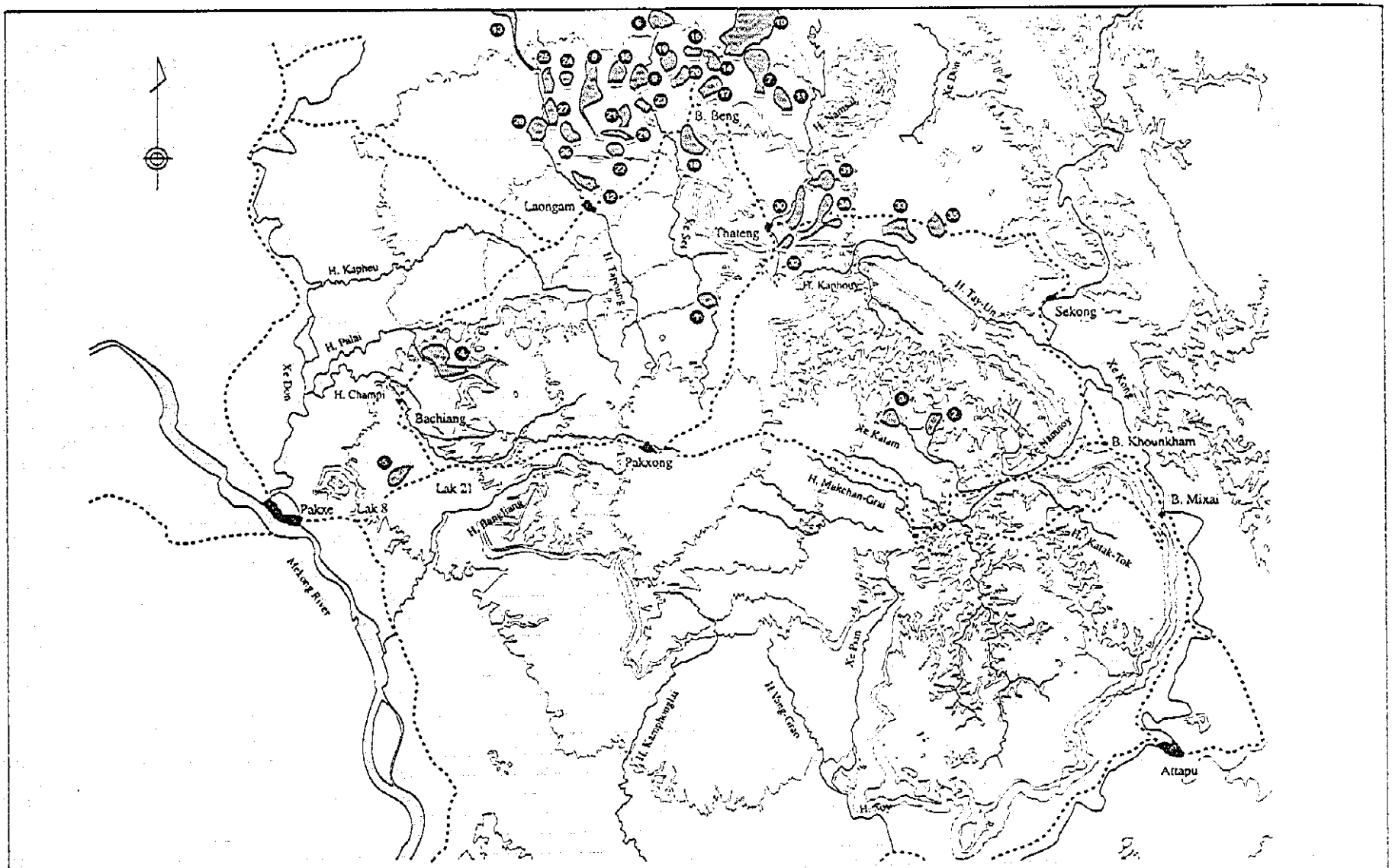


Figure 1.7 Existing Irrigation Projects in and around the Study Area

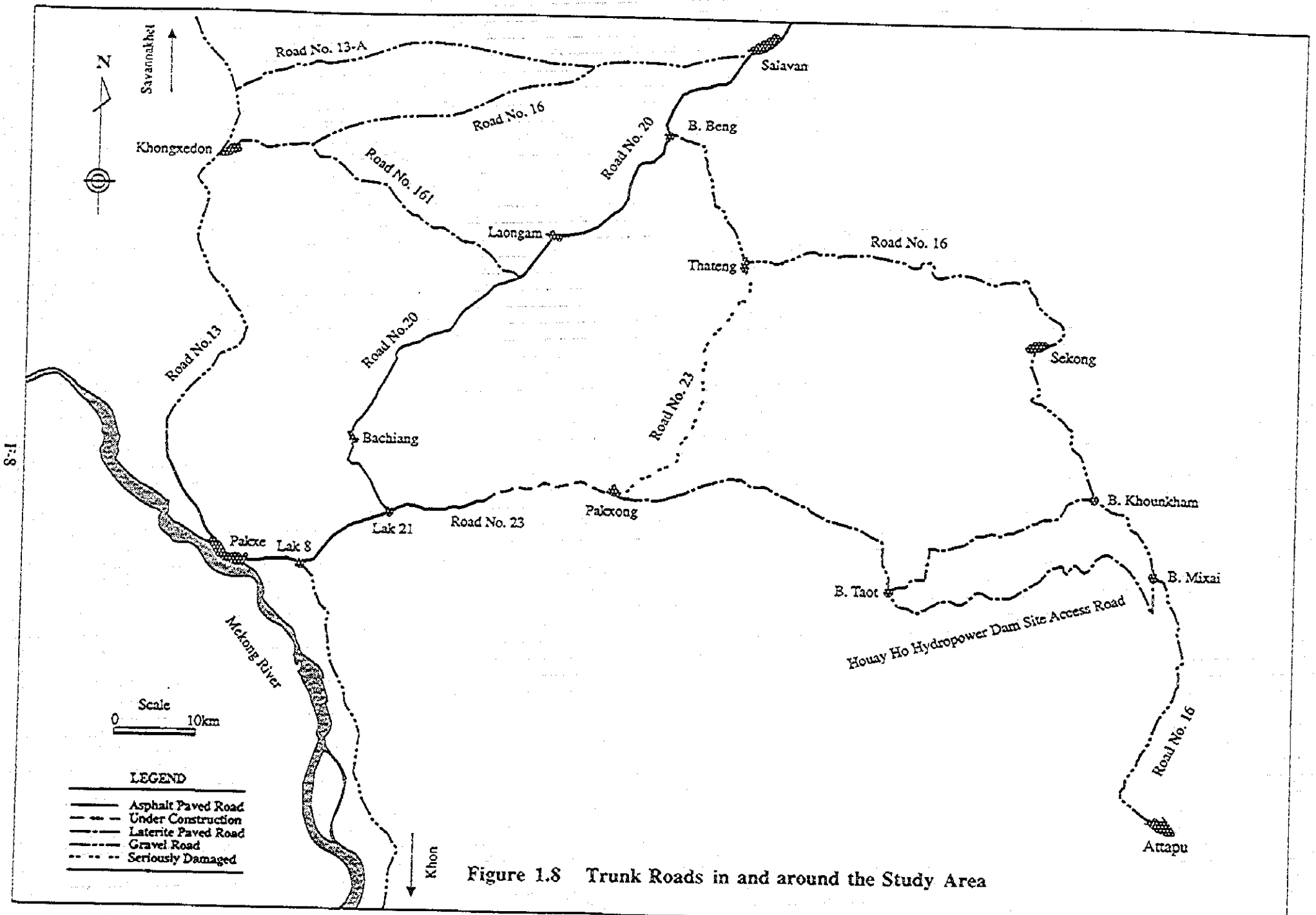


Figure 1.8 Trunk Roads in and around the Study Area

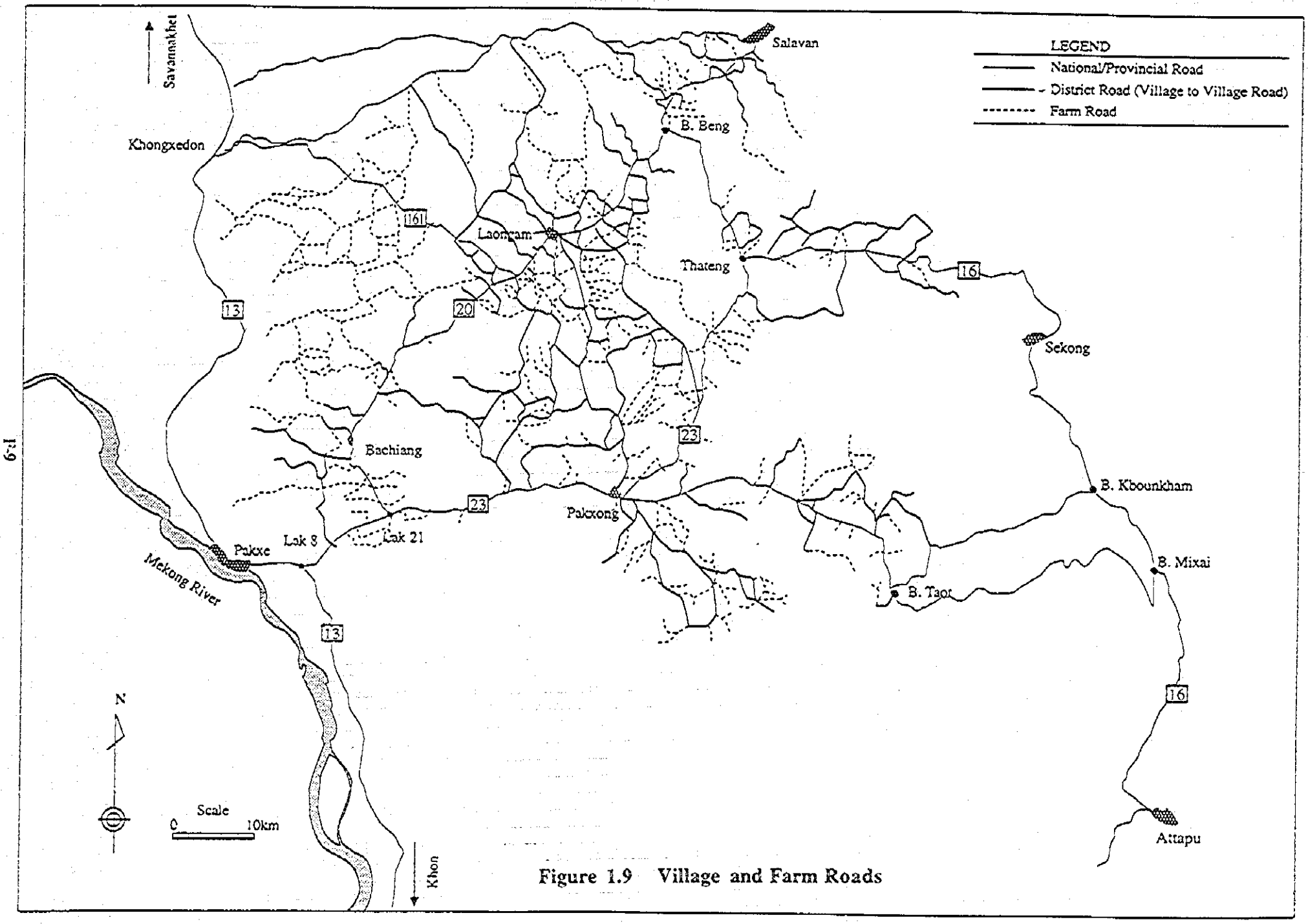


Figure 1.9 Village and Farm Roads

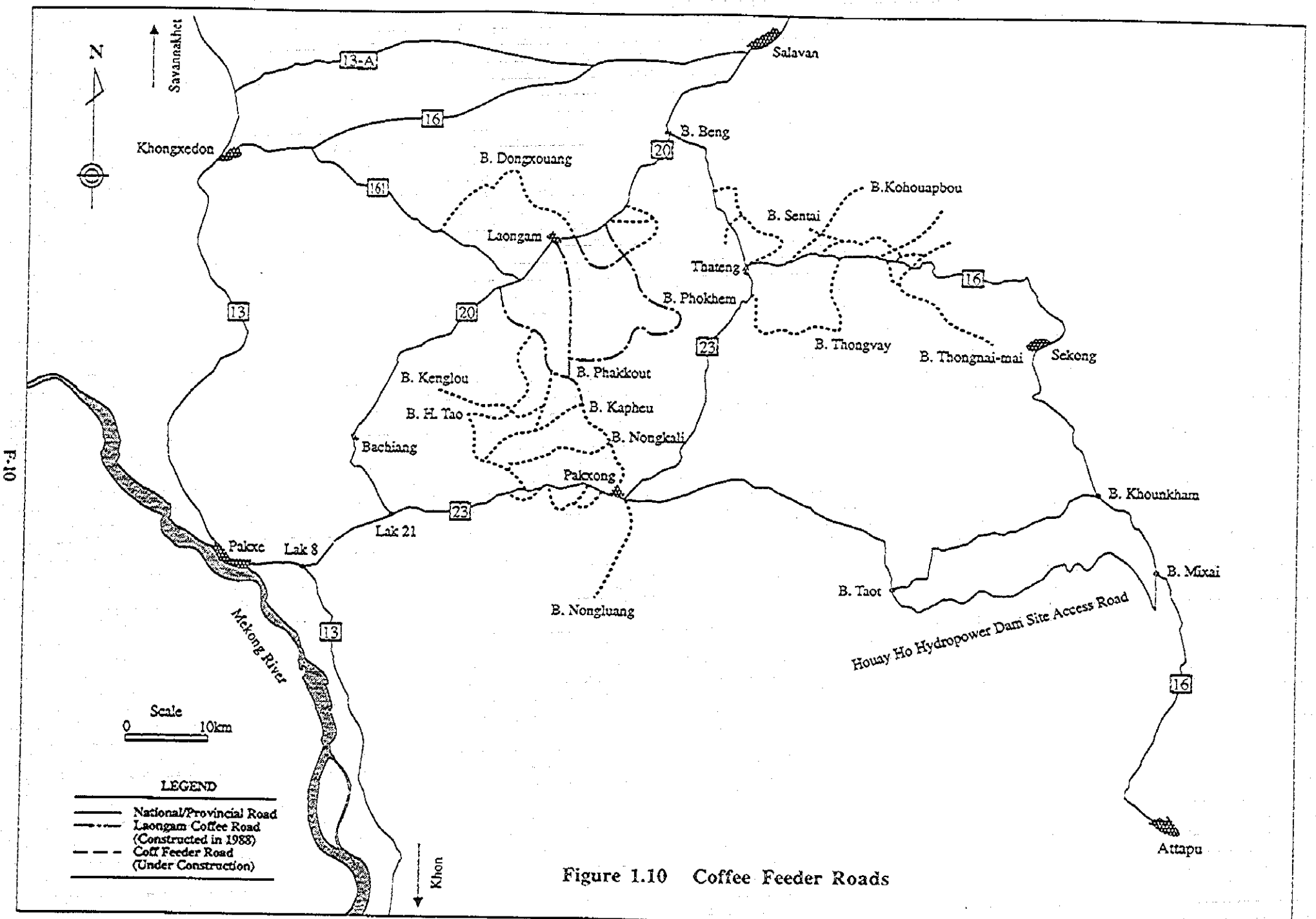


Figure 1.10 Coffee Feeder Roads

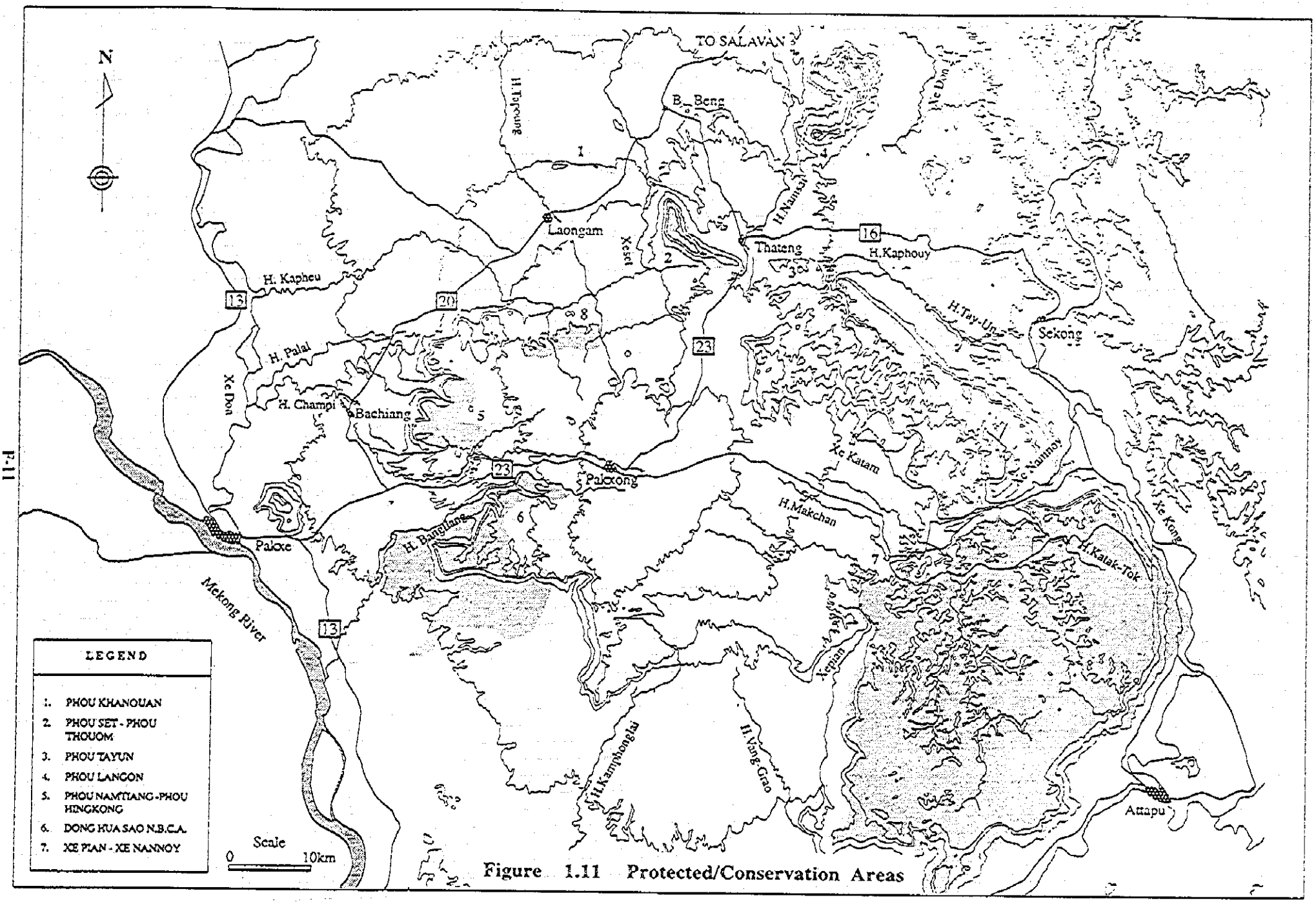
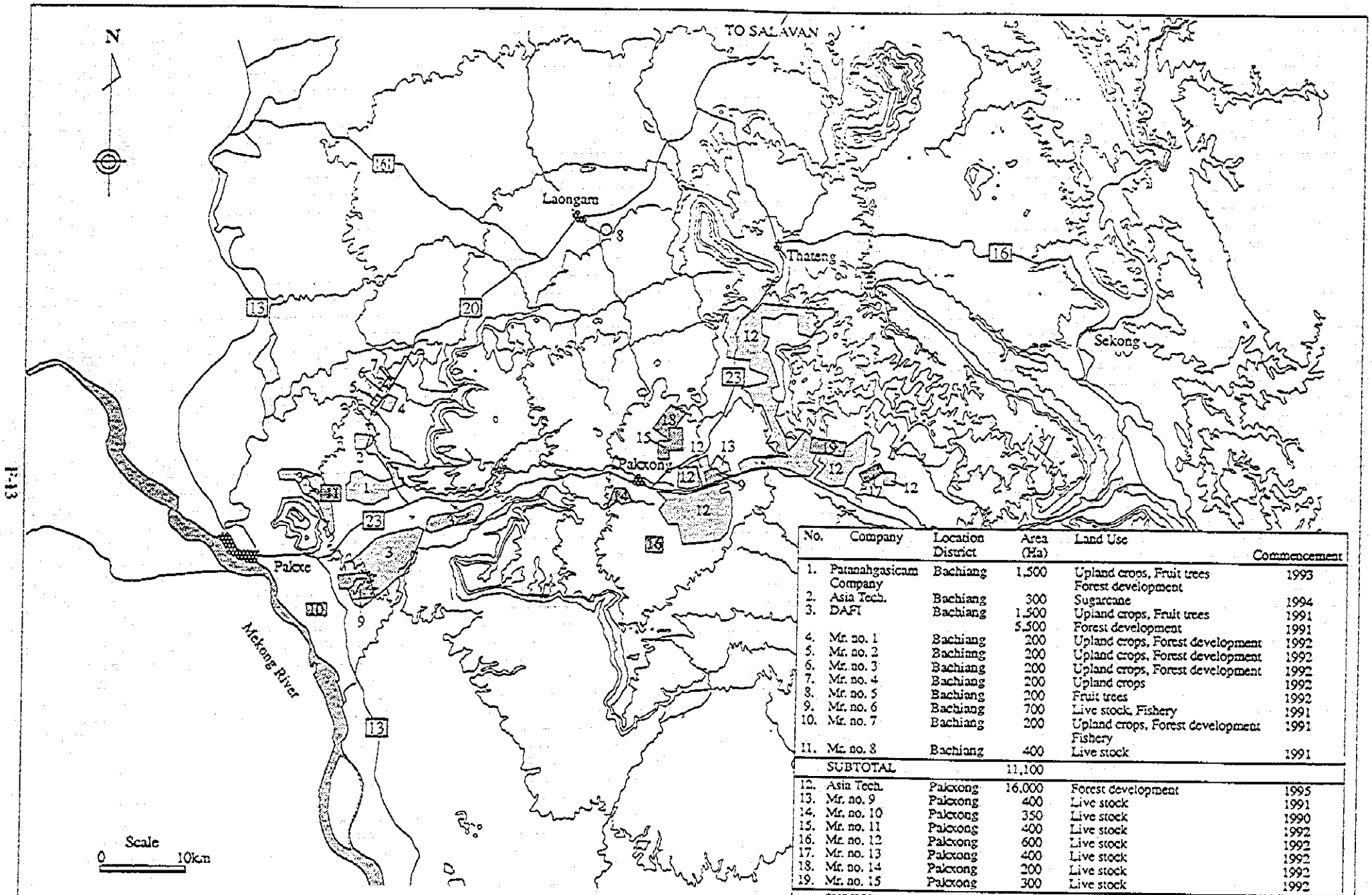


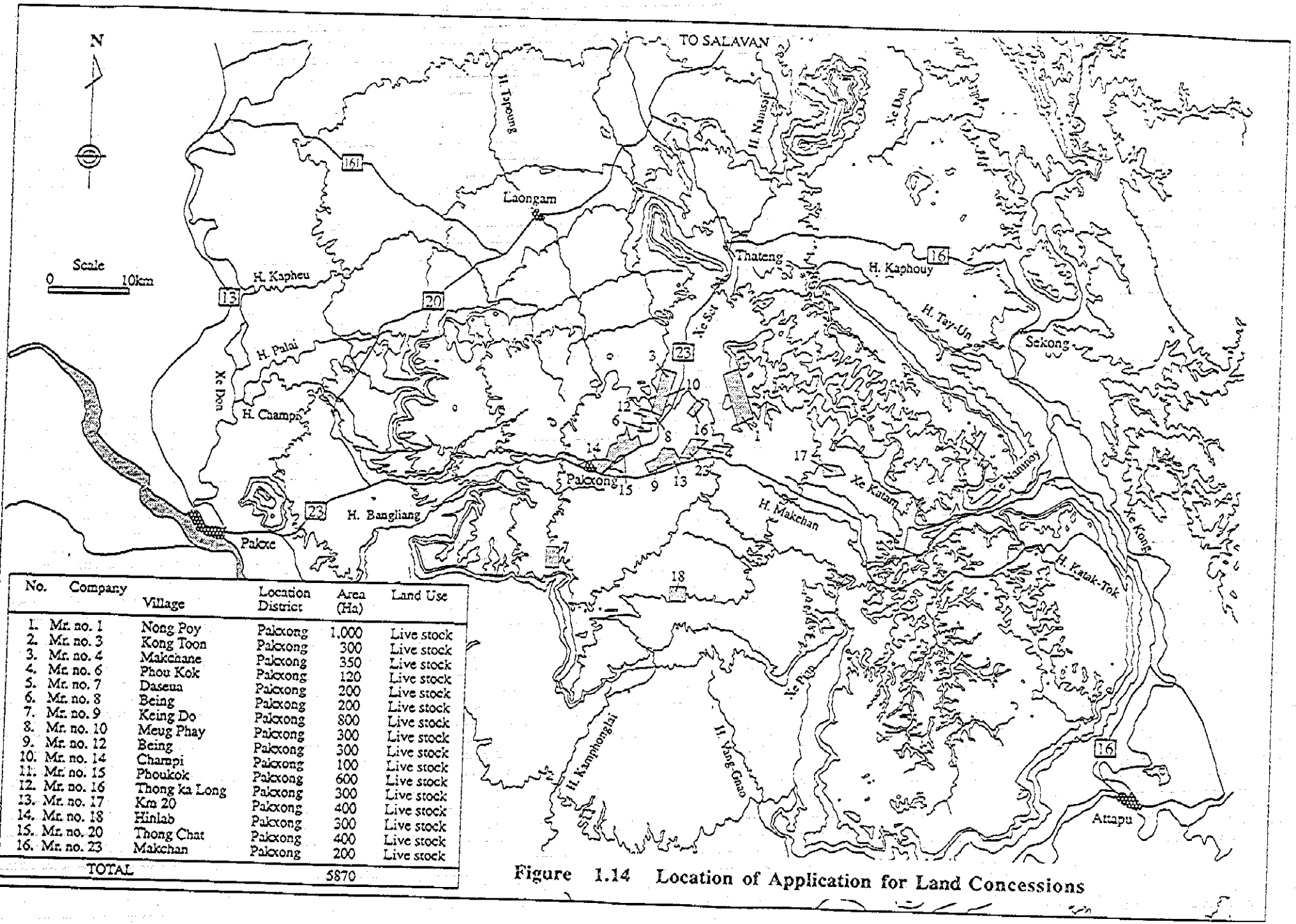
Figure 1.11 Protected/Conservation Areas

Figure 1.12 Pakxong Wetlands



No.	Company	Location District	Area (Ha)	Land Use	Commencement
1.	Patanahgasicam Company	Bachiang	1,500	Upland crops, Fruit trees Forest development	1993
2.	Asia Tech.	Bachiang	300	Sugarcane	1994
3.	DAFI	Bachiang	1,500	Upland crops, Fruit trees	1991
			5,500	Forest development	1991
4.	Mr. no. 1	Bachiang	200	Upland crops, Forest development	1992
5.	Mr. no. 2	Bachiang	200	Upland crops, Forest development	1992
6.	Mr. no. 3	Bachiang	200	Upland crops, Forest development	1992
7.	Mr. no. 4	Bachiang	200	Upland crops	1992
8.	Mr. no. 5	Bachiang	200	Fruit trees	1992
9.	Mr. no. 6	Bachiang	700	Live stock, Fishery	1991
10.	Mr. no. 7	Bachiang	200	Upland crops, Forest development Fishery	1991
11.	Mr. no. 8	Bachiang	400	Live stock	1991
	SUBTOTAL		11,100		
12.	Asia Tech.	Paksong	16,000	Forest development	1995
13.	Mr. no. 9	Paksong	400	Live stock	1991
14.	Mr. no. 10	Paksong	350	Live stock	1990
15.	Mr. no. 11	Paksong	400	Live stock	1992
16.	Mr. no. 12	Paksong	600	Live stock	1992
17.	Mr. no. 13	Paksong	400	Live stock	1992
18.	Mr. no. 14	Paksong	200	Live stock	1992
19.	Mr. no. 15	Paksong	300	Live stock	1992
	SUBTOTAL		18,650		
	TOTAL		29,750		

Figure 1.13 Location of Land Concessions



No.	Company	Village	Location District	Area (Ha)	Land Use
1.	Mr. no. 1	Nong Poy	Paksong	1,000	Live stock
2.	Mr. no. 3	Kong Toon	Paksong	300	Live stock
3.	Mr. no. 4	Makchane	Paksong	350	Live stock
4.	Mr. no. 6	Phou Kok	Paksong	120	Live stock
5.	Mr. no. 7	Daseua	Paksong	200	Live stock
6.	Mr. no. 8	Being	Paksong	200	Live stock
7.	Mr. no. 9	Keing Do	Paksong	800	Live stock
8.	Mr. no. 10	Meug Phay	Paksong	300	Live stock
9.	Mr. no. 12	Being	Paksong	300	Live stock
10.	Mr. no. 14	Champi	Paksong	100	Live stock
11.	Mr. no. 15	Phoukok	Paksong	600	Live stock
12.	Mr. no. 16	Thong ka Long	Paksong	300	Live stock
13.	Mr. no. 17	Km 20	Paksong	400	Live stock
14.	Mr. no. 18	Hinlab	Paksong	300	Live stock
15.	Mr. no. 20	Thong Chat	Paksong	400	Live stock
16.	Mr. no. 23	Makchan	Paksong	200	Live stock
TOTAL				5870	

Figure 1.14 Location of Application for Land Concessions

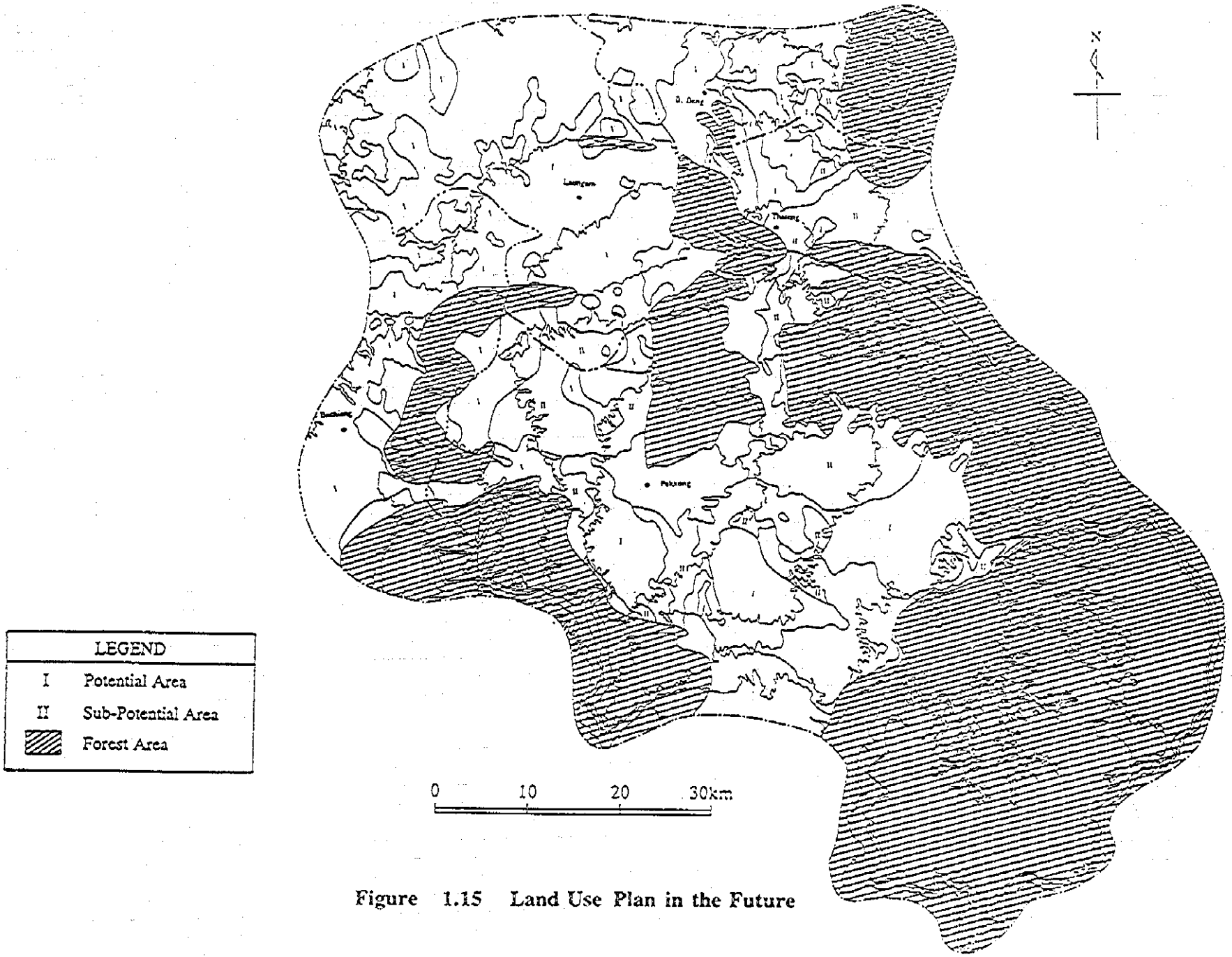


Figure 1.15 Land Use Plan in the Future

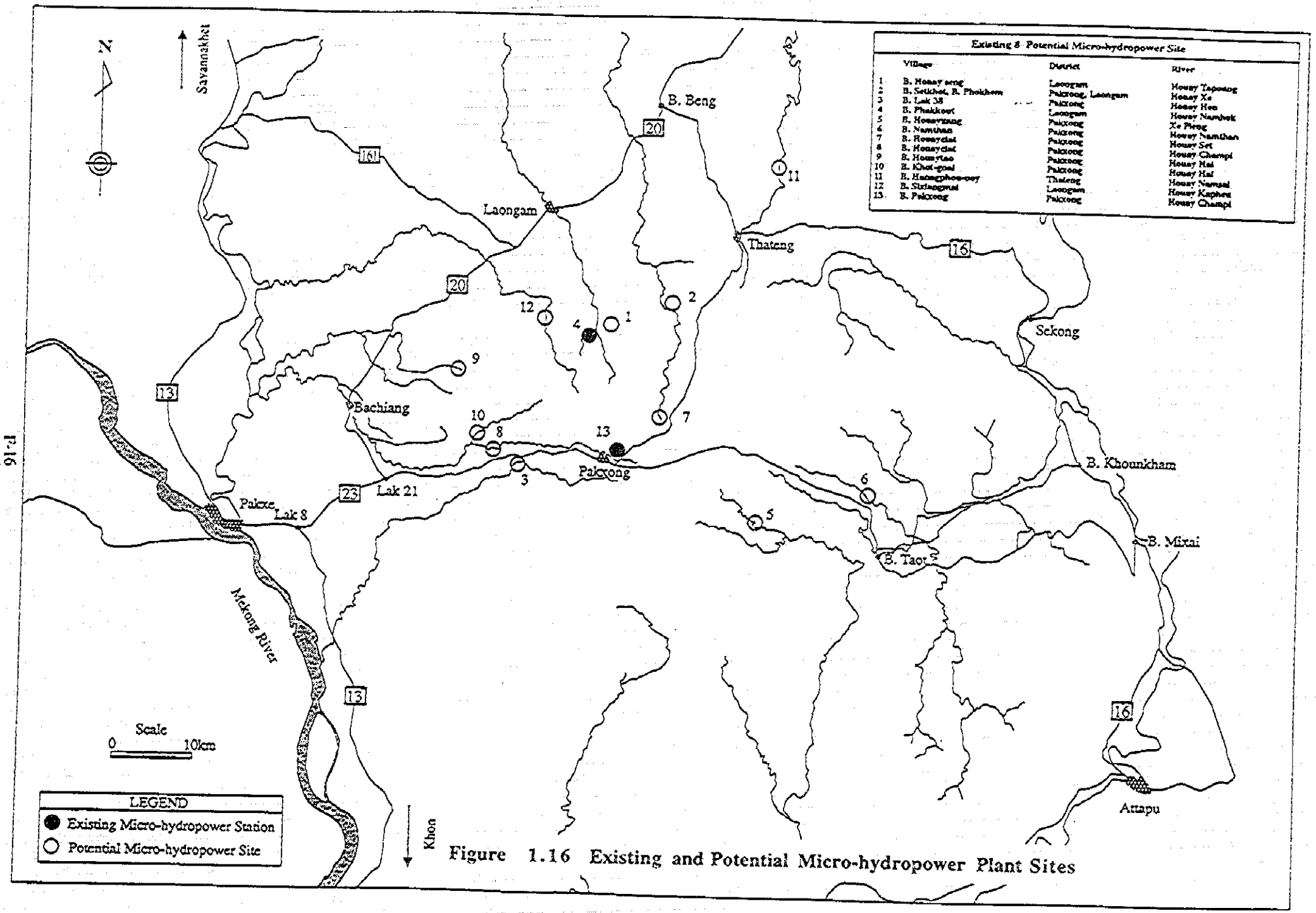


Figure 1.16 Existing and Potential Micro-hydropower Plant Sites

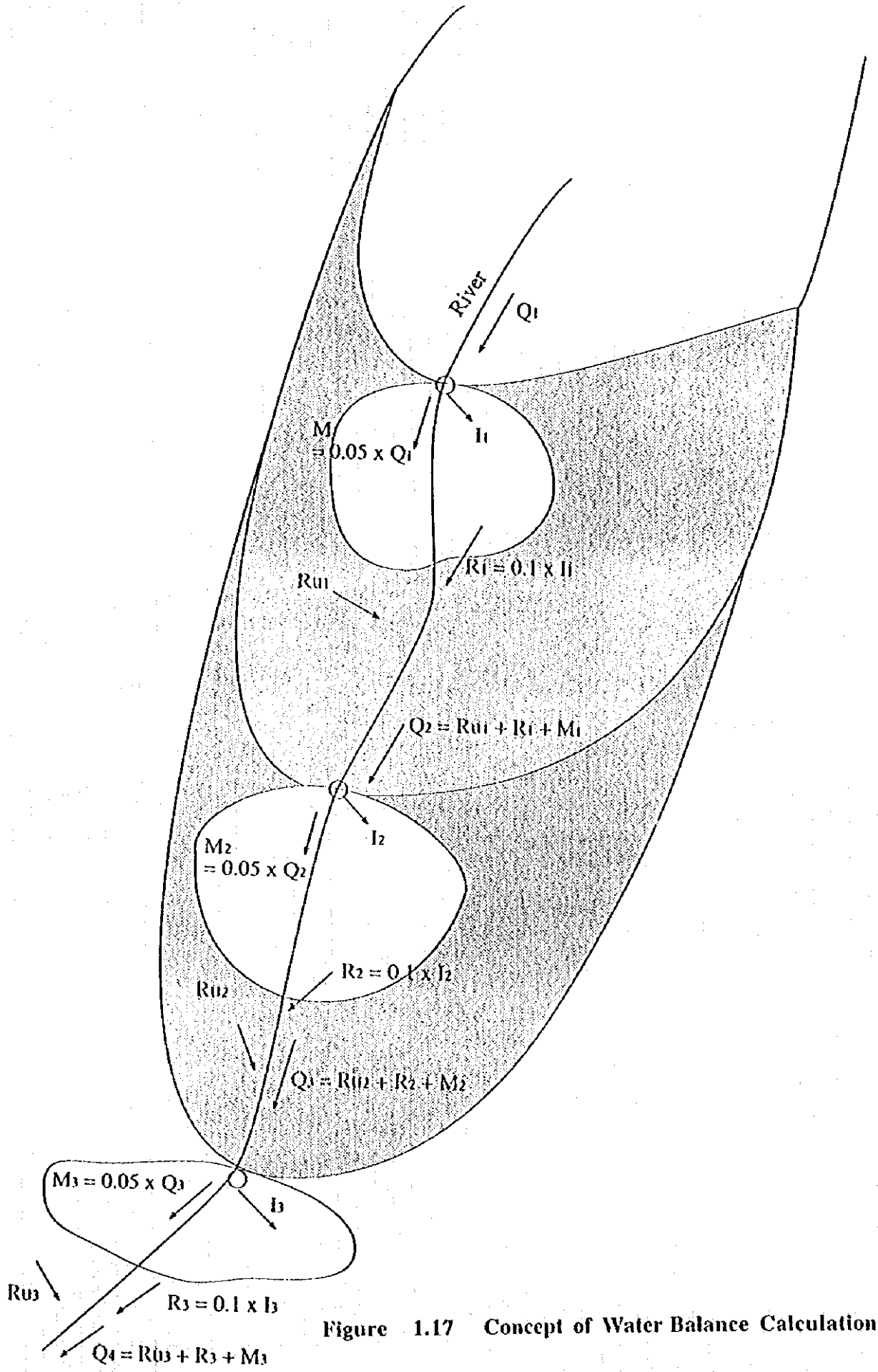


Figure 1.17 Concept of Water Balance Calculation

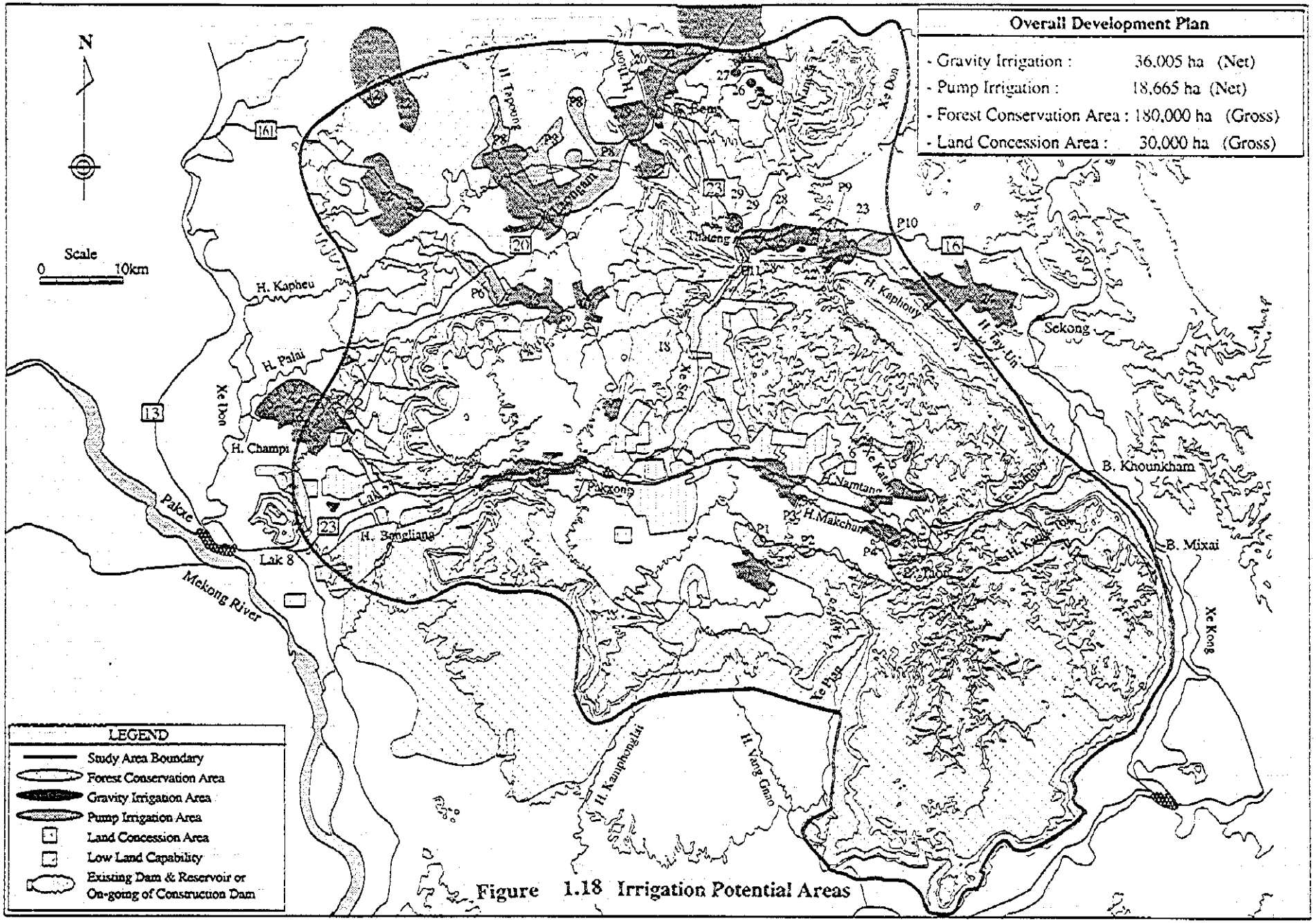


Figure 1.18 Irrigation Potential Areas