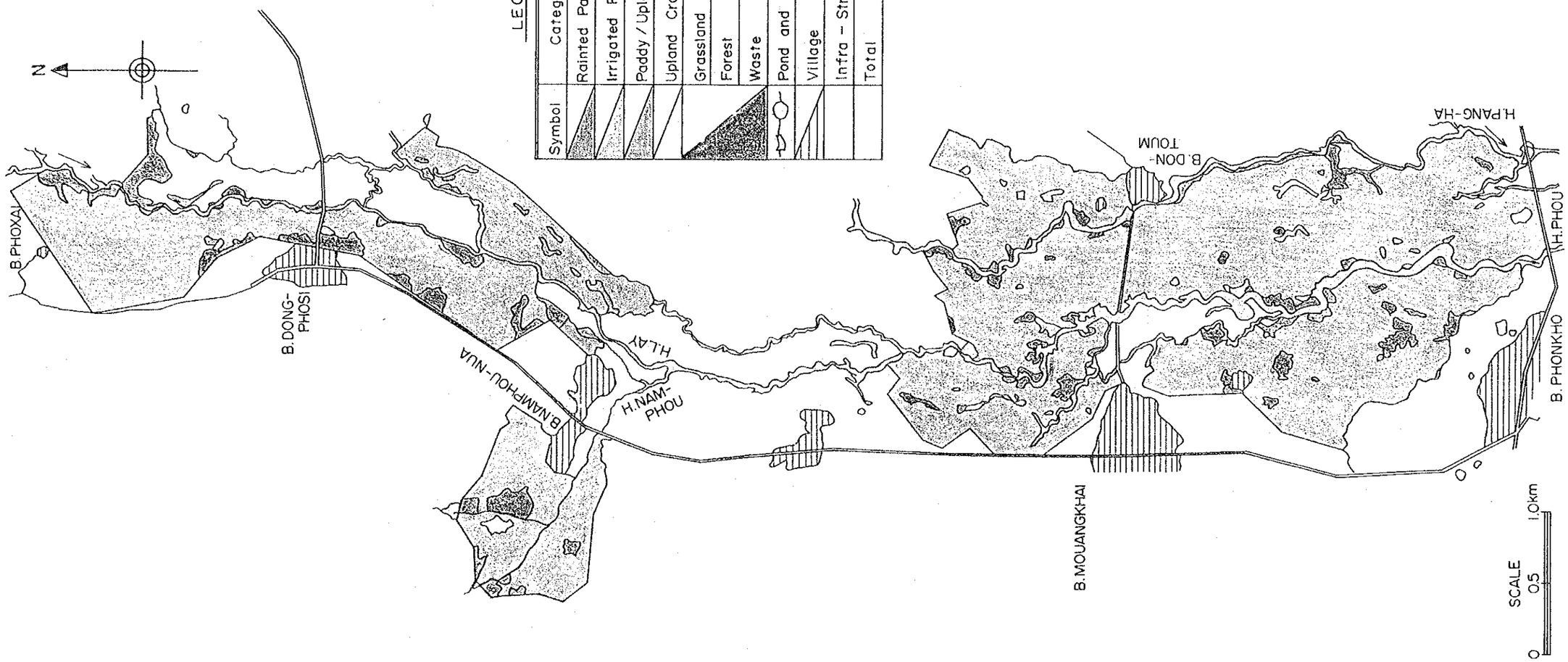


Fig. II - 6 Proposed Land Use (Namphou)

ANNEX III

SOCIAL AND FARMER'S ASSOCIATION

ANNEX Ⅲ

SOCIAL AND FARMER'S ASSOCIATION

Table of Contents

List of Tables

List of Figures

General

The Study Area consists of 2 districts, the Khantaboly District and the Champhone District.

Because no data were available in this Area, data were collected by interviewing farmers in Nhyod. H. Bak and Namphou Area. The total number of households is 287, and the total number of family is 204.

An Interview Survey was conducted based on the following points :

① Conditions of Farmers Income
② Population
③ Education & Medical Care
④ Present Condition of Agricultural Support System.

The results of the Interview Survey are compiled and examined in the following report.

1. Rural Society, Farmers' Organizations

1.1 Social Conditions

1.1.1 Beneficiary Villages in the Development Area

The administrative restrictions in the project areas for agricultural development are shown in Fig. 1.

The system of property in Laos (public maps, registers, ...) is not firmly established, particularly the administrative restrictions in each local village which have not been clearly stated. They have been adjusted and framed in respective subdistricts.

Consequently, it would be hardly an exaggeration to tell that land owned by private farmers are fixed according to relationship with neighbors. The area of paddy fields owned by private persons is presumed according to the quantity of seed rice required every year. The beneficiary villages of the agricultural development project are listed hereafter. However, it doesn't mean that all the families of the villages mentioned hereafter shall be beneficiaries; in fact, families owning paddy fields aside from the selected lands will be included.

Nhyod H. Bak Area

- Nataeuy Subdistrict
  B. Xianban, B. Nonghong
- Khamthao Subdistrict
  B. Sithong, B. Kho, B. Nongven B. Dongdokmai
- Vatthana Subdistrict
  B. Vatthana, B. Phailom, B. Phothan
- Nanokkhian Subdistrict
  B. Nanokkhian, B. Dongkhankhou, B. Nongkalong, B. Gnangsoung
  B. Dongkhamkhen B. Nonnadi (To be swallowed up due to the dam contruction)

Namphou Area

- Mouangkhai Subdistrict

B. Mouangkhai-Nua, B. Mouangkhai-Tai, B. Dontoum,
B. Dongmakfai
B. Donghouakham, B. Namphou-Nua, B. Namphou-Tai, B. Dongphosi,
B. Phoxai

1.1.2 Population

(1) Population Increase Rate

The population of each project village in the past 5 years and the evolution of labor force (16-50 years old) are shown in Table Ⅲ-1.

The total results of both areas and the estimated values for 2000 are shown in Table Ⅲ-2.

The average population increase rate in the Nhyod H. Bak Area and the Namphou Area is more than 3%.

With the increase of population, the working population from 16 up to 50 years old is markedly increasing too; the increase rate of 8%/year in the Namphou Area is particularly noticeable. However, if we consider the increase rate of population assessed for 2000, the ratio of the total population and the working population contradicts. As 50~60% of the total population is sensibly judged as the working population, the estimate for the working population of Namphou Area is 5,000.

Nevertheless, as mentioned above, the total estimated population here is not the population related to the land that benefits from the present Project. People who don't own paddy fields in the selected Area are included. Therefore, if we evaluate population related to the beneficiary Area, estimates are obtained by removing the total area to be developed from the total area of paddy fields in the Nhyod H. Bak and the Namphou Areas, and the ratio obtained is as follows:

$$\frac{\text{Total area to be developed}}{\text{Total area of paddy field in the 2 Areas}} = \frac{1,650}{1,589.25+1,138.03} = 0.605$$

(2) Population Composition

The calculation of the composition ratio of population which is shown in Table-3, was based on the survey on farm households in the 2 villages of the Nhyod H. Bak Area (2) and in other villages of Namphou Area (2).

2. Administrative Structures of Farm Villages

The general structure of the village is centered on the village chief who is assisted by 2 or 3 persons. (Fig. Ⅲ - 2)

The women's association, the senior association, Youth Association and the garrison of the village are mobilized in different occasions, varying from ceremonial occasions to restoration works of damages caused by calamities. In case there are important works to be made, such as repair of roads or reservoirs, they collaborate with other villages.

The villages do not have specific reserve of funds, instead, money is collected from village residents if the need arises.

The village is divided into collective units called "chu" which is composed of a group of 5~10 households, 2 or 3 "Chu's" gathered together will form a "nouy", and several "nouy" will compose a "kum", indicating a subtle communication network.

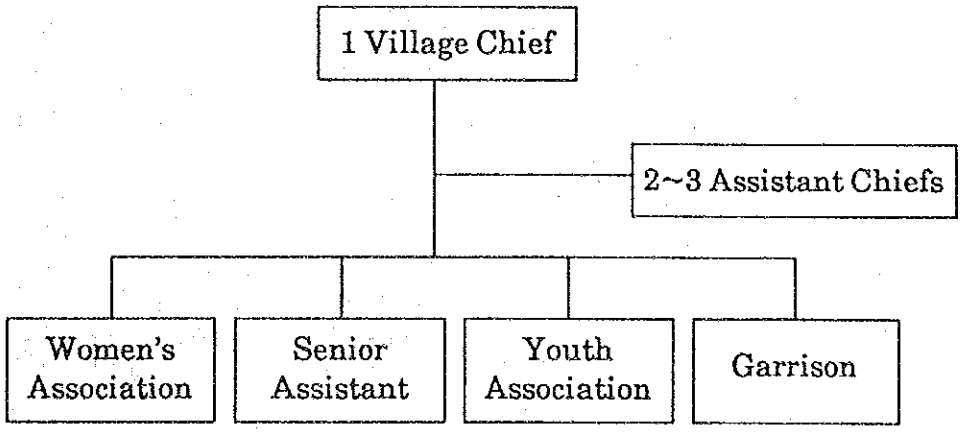


Fig. Ⅲ - 2

The village chief is generally elected, however in some subdistrict. The Chief is sometimes appointed and his term of office is not known. The village chief shall carry out his duties until he is no longer capable of doing so, for instance because of a disease. He is, however, not remunerated for his services.

3. Rural Life

1) Area of possessed farm land

Table -4 shows the calculation of the space area owned per family. The total area of farmland in each village is divided by the number of families.

Table Ⅲ - 4 - (1) Condacion of Rural Life (N.H. Bak)

Name of Village	Number of family	Total Area of Paddy Field (ha)	Area/family (ha)	Area including fields (ha)	Area/family (ha)
B. Xianban	104	86.74	0.83	88.24	0.85
B. Nonghong	80	67.10	0.84	68.60	0.86
B. Sithong	94	170.50	1.81	170.50	1.81
B. Kho	115	178.20	1.55	178.20	1.55
B. Nongveng	64	81.10	1.27	81.10	1.27
B. Dongdokmai	95	112.30	1.18	112.30	1.18
B. Vatthana	129	136.92	1.06	136.92	1.06
B. Phailom	67	95.92	1.43	95.92	1.43
B. Phonthan	48	46.79	0.97	46.79	0.97
B. Nanokkhian	90	112.74	1.25	112.74	1.25
B. Donghkankhou	168	176.54	1.05	178.04	1.06
B. Nongkalong	119	123.73	1.04	123.73	1.04
B. Gnangsoung	75	132.21	1.76	142.21	1.90
B. Dongkhamkhen	77	68.46	0.89	68.46	0.89
TOTAL	1,325	1,589.25	1.21	1,603.75	1.22

Table Ⅲ - 4 - (2) Condacion of Rural Life (Namphou)

Name of Village	Number of family	Total Area of Paddy Field (ha)	Area/family (ha)	Area including fields (ha)	Area/family (ha)
B. Mouangkhai-Nua	175	194.35	1.11	228.60	1.31
B. Mouangkhai-Tai	235	205.78	0.88	253.28	1.08
B. Dontoum	99	145.53	1.47	175.53	1.77
B. Dongmakfai	240	228.49	0.95	253.49	1.06
B. Donghouakham	42	43.21	1.03	51.71	1.23
B. Namphou-Nua	112	108.69	0.97	110.69	0.99
B. Namphou-Tai	92	59.06	0.64	64.29	0.70
B. Dongphosi	134	111.40	0.83	115.40	0.86
B. Phoxai	50	41.52	0.83	42.52	0.85
TOTAL	1,179	1,138.03	0.96	1,295.51	1.10

Source, Farm Interview Survey 1991.

2) Yield

The average yield of paddy field rice made by the farmers living in the beneficiary lands is shown in Table-5.

Table Ⅲ - 5 - (1) Paddy Yield (N. H. Bak Area)

Name of Village	Paddy (ha)	Product (t)	Product per 1 ha (t)
B. Xianban	86.74	242.874	2.8
B. Nonghong	67.10	187.880	2.8
B. Sithong	170.50	477.400	2.8
B. Kho	178.20	498.960	2.8
B. Nongveng	81.10	227.080	2.8
B. Dongdokmai	112.30	314.440	2.8
B. Vatthana	136.92	260.148	1.9
B. Phailom	95.92	172.656	1.8
B. Phonthan	46.79	-	-
B. Nanokkhian	112.74	121.341	1.1
B. Dongkhankhou	176.54	194.194	1.1
B. Nongkalong	123.73	136.103	1.1
B. Gnangsoung	132.21	146.091	1.1
B. Dongkhamkhen	68.46	75.306	1.1
TOTAL	1,589.25	3,054.473	2.0

Source, Farm Interview Survey 1991.

Table Ⅲ - 5 - (2) Paddy Yield (Namphou Area)

Name of Village	Paddy (ha)	Product (t)	Product per 1 ha (t)
B. Mouangkhai-Nua	194.35	213.185	1.1
B. Mouangkhai-Tai	205.78	246.936	1.2
B. Dontoum	145.53	290.830	2.0
B. Dongmakfai	228.49	274.180	1.2
B. Donghouakham	43.21	51.852	1.2
B. Namphou-Nua	108.69	130.428	1.2
B. Namphou-Tai	59.06	70.872	1.2
B. Dongphosi	111.40	133.680	1.2
B. Phoxai	41.52	49.824	1.2
TOTAL	1,138.03	1,461.787	1.28

Source, Farm Interview Survey 1991.

3) Taxes

Farmers are taxed in proportion to the harvest ratio of rice, they are collected according to 4 Ranks mentioned hereafter. The ranks are decided on land condition.

Rank Ⅰ	140 kg/ha
Rank Ⅱ	120 kg/ha
Rank Ⅲ	100 kg/ha
Rank Ⅳ	80 kg/ha

(These collected volume applies to fiscal year 1990)

The 1990 year taxes paid by each village in the Project Area are shown in Table-6.

In Nhyod H. Bak Area, Ranks Ⅲ and Ⅳ covered a 70% rate, while Rank Ⅰ covered almost nothing at all.

In the Namphou Area, however, a 30% rate was attributed to Rank Ⅰ. Nevertheless 50% went to Rank Ⅳ, clearly distinguishing the extreme land conditions in the area.

4. Medical Care

1) Situation

The health care condition in the Area is extremely poor, and only 3 villages have medical clinics.

	Nurses	Beds
B. Sithong	1	3
B. Dontoum	(not permanent)	3
B. Namphou-Tai	(not permanent)	4

Even the above mentioned clinics have no permanent doctors, and the round of visits is scheduled.

Based on the interview with farmers in 4 villages, the annual medical expenses per family are as shown below.

	Average medical expenses per family	Ratio of income
B. Nongkalong	9,700 Kip	7.9 %
B. Dongkhankhou	20,900 Kip	11.2 %
B. Namphou-tai	44,400 Kip	12.7 %
B. namphou-Nua	37,700 Kip	18.9 %

The above average medical expenses is based on the 1990 data, and almost correspond to medicare fees .

Furthermore, Some families have no medical expenses;

6 of the 123 families in the B. Dongkhankhou villages,
1 of the 88 families in the B. Nongkalong villages,
2 of the 93 families in the B. Namphou-Nua villages,

5 of the 87 families in the B. Namphou-Tai villages.
Out of a total of 391 families, 14 don't spend money for medical care.

2) Plan for Medical Care

The conditions of medical care are extremely poor. Medical care requires heavy expenses and as such will increasingly give impetus to a needy existence. This is why a full consideration must be given to construction of clinic facilities, permanent doctors are required, and qualified nurses, too, are to be employed.

The plan, if feasible, is to build a clinic with 10 beds in B. Lak 35, and to employ and station doctors and 3 nurses permanently.

5. Education

1) Situation

The number of schools, teachers and students in the villages which benefit from the Project are reported hereafter.

Table Ⅲ - 7 - (1) Education (N. H. Bak Area)

Name of Village	School		Teacher		Student	
	E. S.	J. H. S.	E. S.	J. H. S.	E. S.	J. H. S.
B. Xianban	1	1	5	8	162	95
B. Nonghong	1	0	2	0	62	0
B. sithong	1	1	4	9	164	100
B. Kho	1	0	2	0	117	0
B. Nongveng	1	0	2	0	100	0
B. Dongdokmai	1	0	1	0	58	0
B. Vatthana	1	0	5	0	116	0
B. Phailom	1	1	3	11	100	50
B. Phonthan	1	0	1	0	26	0
B. Nanokkhian	1	0	2	0	13	0
B. Donghkankhou	1	1	10	8	123	78
B. Nongkalong	1	0	4	0	84	0
B. Gnangsoung	1	0	1	0	30	0
B. Dongkhamkhen	1	0	1	0	44	0
TOTAL	14	4	43	36	1,199	323

Table Ⅲ - 7 - (2) Education (Namphou Area)

Name of Village	School		Teacher		Student	
	E. S.	J. H. S.	E. S.	J. H. S.	E. S.	J. H. S.
B. Mouangkhai-Nua	1	1	11	27	375	174
B. Mouangkhai-Tai	0	0	0	0	0	0
B. Dontoum	1	0	7	0	115	0
B. Dongmakfai	1	0	7	0	164	0
B. Donghouakham	1	0	3	0	15	0
B. Namphou-Nua	1	1	8	15	188	85
B. Namphou-Tai	0	0	0	0	0	0
B. Dongphosi	1	0	6	0	134	0
B. Phoxai	1	0	2	0	36	0
TOTAL	7	2	44	42	1,027	259

* Mouangkhai-Tai is included in Mouangkhai-Nua, and Namphou-Nua in Namphou-Nua.

The schools in the Area are only junior high schools; students who aim for higher education go to Savannakhet.

If we estimate the percentage of school attendance, including elementary schools and junior high schools, from the population composition (refer to Table-3) of B. Nongkalong, B. Dongkhankhou, B. Namphou-Tai, B. Napmphou-Nua, the figures will be as follows:

- B. Nongkalong (population between 7~15: 175 persons) — 84/175 = 0.48 (No junior high school)
- B. Dongkhankhou (population between 7~15: 269 persons) — 201/269 = 0.75
- B. Namphou-Tai, Nua (population between 7~15: 344 persons) — 273/344 = 0.79

Education in Laos is not compulsory, and school attendance nationwide is, therefore, low. However, we can not precisely state that the school attendance in the project areas is low.

The educational system of Laos faces problems such as lack of school facilities, teaching materials, teaching staff and well qualified teachers. This, however, does not concern the project area in particular, but extends nationwide.

2) Plan

In the light of what has been explained above, the problem of education doesn't concern only this Area. Therefore, headway must be made on the basis of a national priority policy.

Judging the situation from this point of view, a plan to build more schools and to increase the teaching staff in this area would result to more than 1 school, particularly a higher grade school, per village. It will be necessary to keep a sufficient number of highly qualified teachers for 20~30 schoolchildren.

It is also necessary to encourage children of school age, but out of school, to enter school.

3) Domestic Water

a) Situation

The area's source of domestic water is well water. The number and depth of wells in the villages of the Beneficiary Area are shown in Table-8.

Most of the wells are draw wells and children are mainly responsible for drawing water. They suspend buckets (10 liters of water) on a carrying pole and shuttle between the well and their homes. Water is

stored at home in big jars. The required water volume varies according to households, but according to the interviews, the shuttle frequency is 6~7 times/day, and 2 buckets of about 15 liters per shuttle are carried out, which means a total volume of 90~105 liters. The volume of water consumed per capita/day is estimated to be between 20 and 30 liters.

However, as the peoples way of living shall change, the volume of water consumption will increase too; it is, therefore, important to diffuse water supply facilities in the future.

Table Ⅲ - 8 - (1) Number of Well (N. H. Bak Area)

Name of Village	Number of wells	Depth (m)	Population/well	Families/well
B. Xianban	1	6	532	104 *
B. Nonghong	1	7	457	80 *
B. Sithong	2	10	280	47
B. Kho	1	10	712	115 *
B. Nongveng	1	12	392	64 *
B. Dongdokmai	6	6	86	16
B. Vatthana	2	No data	325	65 *
B. Phailom	1	No data	317	67 *
B. Phonthan		water of rivers		
B. Nanokkhian	1	2	455	90 *
B. Donghkankhou	4	2	229	42
B. Nongkalong	2	10	320	60 *
B. Gnangsoung	3	4	160	25
B. Dongkhamkhen	2	3	213	39

Table Ⅲ - 8 - (2) Number of Well (Namphou Area)

Name of Village	Number of wells	Depth (m)	Population/well	Families/well
B. Mouangkhai-Nua	8	10	121	22
B. Mouangkhai-Tai	10	12	132	24
B. Dontoum	2	5	308	50
B. Dongmakfai	3	4	384	80 *
B. Donghouakham	3	3	76	14
B. Namphou-Nua	2	5	315	56
B. Namphou-Tai	2	No data	284	46
B. Dongphosi	4	2	185	34
B. Phoxai	4	3	67	13
Total	65		289	52

* Village where 1 well must be built.

b) Plan for Domestic Water

The average number of well in the Project Area is 1 well for 50 families, that is to say, 1 well for a population of about 290.
The objectives of the water supply plan is to reach a standard number of families using a well, a population average of 50 per well.

A total of 9 wells must be built, for instance, 8 wells in Nhyod H. Bak Area and 1 in the Namphou Area.

6. Agricultural Supporting Center

1) Conception of the Center Establishment

An increase in the yield of paddy fields is expected by the beneficiaries based on (an increase of income) steady agricultural production activities, owing to the construction of water systems, such as the dams, weirs, water ways, etc.

Self-sufficiency is new to the farmers. This new change tends toward a free-distribution economy owing to the sale of surplus rice production. If the roads are improved and well maintained by the government or administration, the distribution system can be set up. Further, it can start between villages and will be centered in Savannakhet City.

But we must consider that each individual farmer is not acquainted with techniques and information concerning processes ranging from production to marketing. In the end, they will be swallowed by the urban economy which is not involved in the improvement of production and standard of living.

To avoid such a situation, the required organization will be able to really contribute in the improvement of the farmers' standard of living. It will be countered also by the beneficiary villages.

The organization to be built will provide different and useful information and services to improve the farmers' standard of living. It will fully rake into account the conditions above-mentioned, and will take charge of the operation and maintenance of canals for agricultural purposes.

1) Role of the Center

1) Functions

The objective of the Center is to steadily improve the farmers' standard of living in the Developed Area first, then in each districts and in the Savannakhet prefecture.

It's fundamental functions will be as follows :

- Collection of surplus rice, storage, rice polishing, Selling
- Compost, agricultural chemicals, selling of seeds, etc....
- To provide information related to farming, distribution,...
- Instruction concerning operation and maintenance of water supply facilities
- Technical training concerning the demonstration farms, and cultivation.
- Fish farm management and sale of handicraft work

2) Organization

The ultimate objective of the project is for farmers to do their own management of the Center. However, there is obviously a lack of competent staff able to conduct instructions about many techniques, and a lack of funds. To overcome these problems, it is essential to receive assistance (funds, qualified persons) from the Bureau of Agriculture of Savannakhet Prefecture.

The organization of the Center will consist of Board of Directors. It shall then be divided into the general affairs department, production department, the department of life improvement, the credit and loan department, and the chemical department (See Fig-3).
The work content and the required staff in each department are as follows:

- Board of Directors

  Discussions will be mainly related to the fundamental policy of the Centers activities and management. Measures are to be taken so that the center will be appropriately controlled. The Board meetings shall be periodically held 4 times a year.
  The Board is composed of the following Members :
  A staff member of the M.A.F., 3 employees of the Savannakhet Prefecture, one representative each from Tanthoboly and Champlror districts, and 4 farmers' representatives (representatives of the village chiefs), which makes 11 Members.
  This organization will have close connection with the Operation and Maintenance Office of the Prefecture, it will fully reflect the farmers point of view, and will really become an organization intended for farmers.
  Moreover, a general meeting will be held once a year.
  Besides the Members of the Board of Directors, all the union members of each water use block will also attend the general meeting.

- General Affairs Department

  The general affairs department will chiefly administer the accounts and personnel of the Center. In addition, it will realize the list of the Organization Members, and will be in charge of the proceedings of membership or resignation. There will be one person in charge.

- Production Department

  This is the head of the Center, and will both collect information. This will control the marketing and sale of the products. As the main product is rice, rice shall be collected by trucks during the harvest period in each village irrigation blocks, and stored. The department will be in charge of the fish farms and of the fish sale too.
  Three people shall be in charge of the collection and sale of rice,

including the truck drivers, plus 1 person in charge of the fish farm management and fish sale. The production Department shall have 4 personnel.

- Life Improvement Department

This department will provide many different information related to living improvement (sanitation, medical care, education). It will put into practice technical training for handicraft work (bamboo work, machine weave, others) and will make productivity and selling in the future progress according to intensive methods.
Besides compost and agricultural chemicals, medicines will also be sold. There will be 2 persons in charge, 1 for technical training, and another for the sales aspect.

- Credit and Loan Department

It will be responsible for the financing of farmers (at present, loan will be only related to agricultural production) and for credit loans for compost or chemicals, as well as for compensations of victims of damages due to flood, etc. There will be 1 person in charge.

- Technical Department

Different kinds of technical training and guidance will be offered on farming production.
An organization will be established for water control based on blocks. One block represents a tertiary unit of the water canals, (water ways are trisected into main canals, secondary canals and tertiary canals). The last one will form the block unit. This control procedure will pay careful attention to the smallest unit of the system.
The number of blocks in the Project Area is 31 in the Nhyod H. Bak Area, and 39 blocks in the Namphou Area. A block extends on an average of 22ha, and holds between 20 and 30 families.
A training program on improvement methods (like control) and on technicalities concerning the operation and maintenance of the

facilities (repair, etc.) shall be carried out. There will be 3 persons in charge of the crops, fishery and the machineries.
As a general rule, the water gate will be operated by the Block Chief who will be probably trained by the technical department. When the water gate operation is to be modified, it will be first referred to the technical department.
The technical department will plan to teach the use of arm tractors and machines.

2) Location of the Center

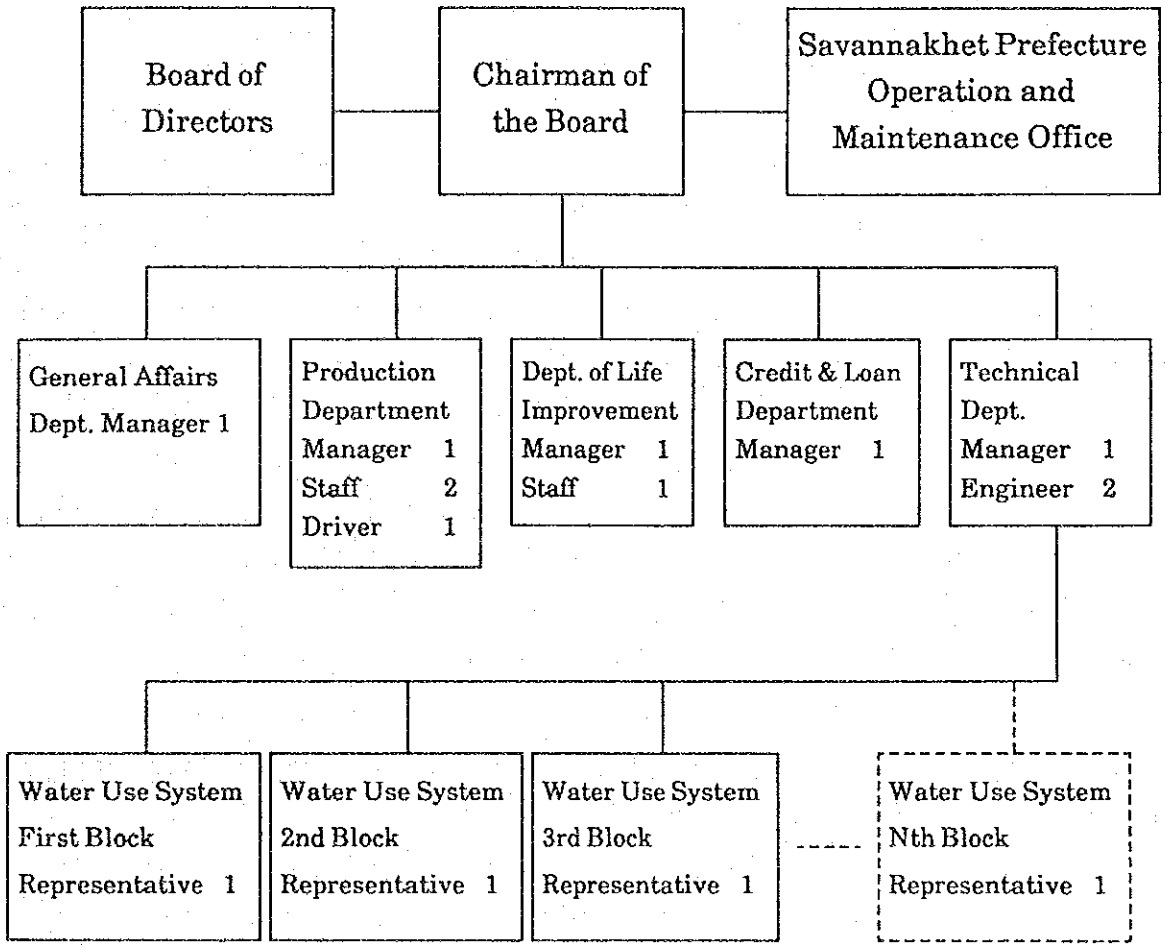
The Center must smoothly fulfill its function. It will aim to improve the life standards of the farmers, and will put various kinds of information at there disposal. It will give further priority to the gathering and purchase of essential goods, and to their distribution.
Therefore, the place where the Center will be established is of great importance. Basically, its location must be at a strategic point for communication, and at the same time it must be convenient for the farmers.
The Agricultural Supporting Center will be established at B. Lak 35 which is located at the intersection of route NO. 13 and the prefectural route NO. 11. Furthermore, this area is the central zone of the beneficiary villages.
B. Lak 35 is a very important traffic place with Vietiam in route No. 9 via B. Xeno Route No. 13. The population of the area shows signs of progress. According to the statistics of 1990, the B. Lak 35 population is 804. There are 137 families, a sign indicating the importance of the village.
The location decided for the Center is shown in Fig-4.

3) Center Management

The center will be basically run as an independent profit system. During the harvest period, a part of the rice produced (except surplus rice for family use) will be collected, stored and sold after it is correctly evaluated in the market system.
The commission sale of the industrial crops mainly practiced during the rainy season (peanuts, cotton, sesame, hemphs, etc...) will be carried on, as

well as the lending, purchasing of machines and materials (composts, chemicals, farming machineries...), and the purchasing of fry and adult fish in hatcheries. Loaning by the prefecture and from the farmers' capital will constitute a starting investment for the operational expenses of the Center.

This type of management for the facilities will not immediately click in Laos. Management is planned to be fully completed after a period of 5 years.



Nhyod H. Bak Area ..... 31 Blocks (Demonstration Farms included)
Namphou Area ..... 39 Blocks

(Fig. Ⅲ - 3 Organization Chart of the Agricultural Supporting Center)

7. Construction Operation and Maintenance of Facilities

1) Construction Work

The main agency in charge of the execution of the Project is the Laos Ministry of Agriculture and Forestry (MAF). The Ministry of MAF will create the Office of Construction, acting as a new section in charge of the Operations, supervised by the Minister of the general bureau. Furthermore, the Minister will appoint an Office Manager, which will make the work proceed, and will run the office too. The Minister will transfer his authority concerning the works and the management of the office to the Office Manager.

To smoothly control the Project, a Steering Committee will be formed and placed right under the Minister's authority. The Members will be the leading staff of the administrative machinery of the Savannakhet Prefecture. They will deliberate on the important items concerning the conduct of the work. The office manager will be in close touch with the Steering Committee and will further the work operations.

The construction office will not only supervise the construction work but will carry on various works, too, such as detailed planning ahead of the construction work, draft of Tender Documents, prior investigation on the requirements for Tender, examination of Tender, and securement of the building sites.

The construction office will be probably built in the Department of Agriculture and Forestry of Savannakhet. Shown in Fig. Ⅲ - 5.

2) Operation and Maintenance

After the construction work is completed, all the work facilities will be moved to the Savannakhet Prefecture for operation and maintenance.

The construction office will be changed into the "Operation and Maintenance Office." The manager appointed by the Governor shall be in charge of the operation and maintenance work and the management of the office.

The Steering Committee will be placed under the Governor's jurisdiction, and will deliberate on the important items concerning the execution of O/M work. Even after the completion of the construction work, the Ministry of Agriculture and Forestry, acting as the important Member of the Steering Committee, will give appropriate advice and support to the O/M Office to help smoothen the execution of the O/M work.

The fundamental policy of the O/M office is to necessitate a smooth management through the help of the Board of Directors of the Supporting Center and to make it known to all farmers.
The Contents of the business that must be carried out by the O/M Office will be as follows.

8. O/M Office

1) Draft of Water use Plan

The Plan for irrigation water distribution will be based on the storage capacity of the dam or the storage reservoir, and on weather conditions. It will take into consideration the cropping variety, the planted area, and the field conditions, too.

2) Hydrologic observations (amount of rainfall, water level), re-adjustment of the observation record, and analysis.

Observations will be set up on the amount of flowing water and water level, to grasp the storage capacity of the dam and to check the volume of irrigation water. The amount of rainfall in the watershed shall be observed also to properly control the dam.
The run off analysis will be based on these data in order to constantly improve the control system. The collected data will then be arranged.

3) Control of Irrigation Water

Farmers will be taught how to correctly hold and control a reasonable amount of water in accordance with the growth of the crops.
Manipulation of the water division gate in the field must match the water organization of the farmers, and will be reported to the Supporting Center. It is necessary to operate the main gates which divert water from the main canal to the secondary canals, in conformity with the water use plan of the O/M office. The operations will be executed by the engineers of the O/M Office and the Center.

4) Maintenance and Repair of Water Use Facilities

Maintenance and repair of the dam, the storage reservoir, as well as the main canal must be conducted immediately, otherwise the facilities malfunction. The operation and the water use organization of the farmers will be responsible for the operation and maintenance of canals, and will clean and repair even the main and secondary canals, when necessary.

5) O/M and Repair of Machines and Implements

O/M and repair of machines (trucks, bikes, hand-tractors,...) implements (rice mill, dryer, sprayer,..) apparatus (video camera, televisions,...) will be carried out at the Supporting Center .

6) Teaching of Water Management Techniques

Education and training of techniques related to the efficient use of water will take place in the demonstration farm, to improve the farmers cultivation and irrigation techniques.

7) Diffusion of Improved Farming Methods

Agricultural effectivity through mechanization shall be introduced and taught in the demonstration farm. Effectivity is also attributed to the

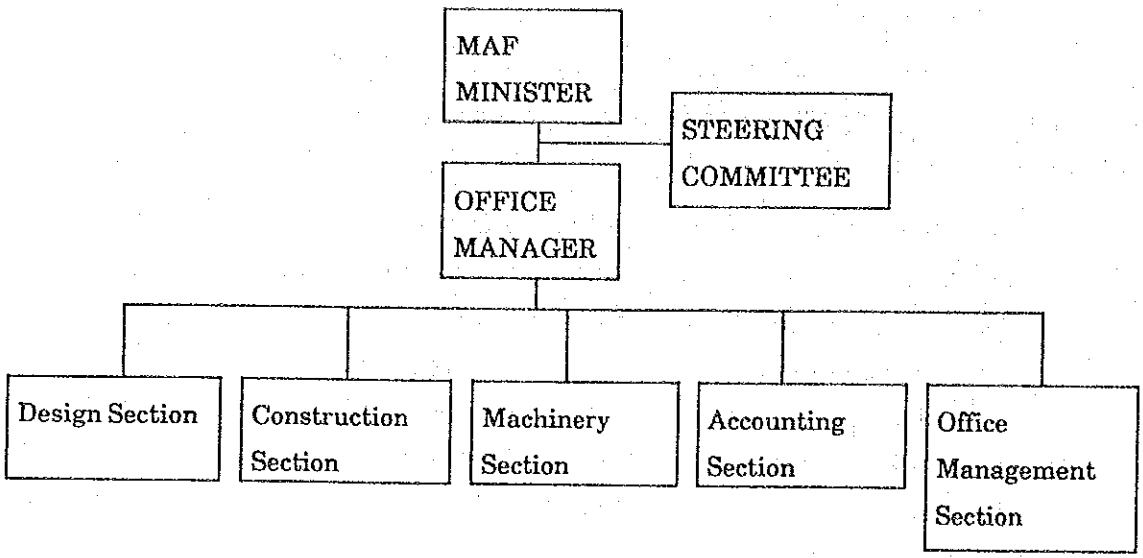
selection of cultivated varieties, fertilizer application techniques (proper use of chemical and organic fertilizer), knowledge of chemical effects, safe spraying methods, and so on.

8) Guidance on Demonstration Farm Management

Regarding the Management of the demonstration farm, each household should cultivate its unit independently, except for the test fields. The supporting Center will finance invested equipments until the farm management is set on its path. The Department in charge of development will cooperate with the Center, and must lead the running of the Center even in financing necessary funds to set the farm on its path.
The test fields will be managed by the Center which will supply equipments to be invested, too.

9) Organization

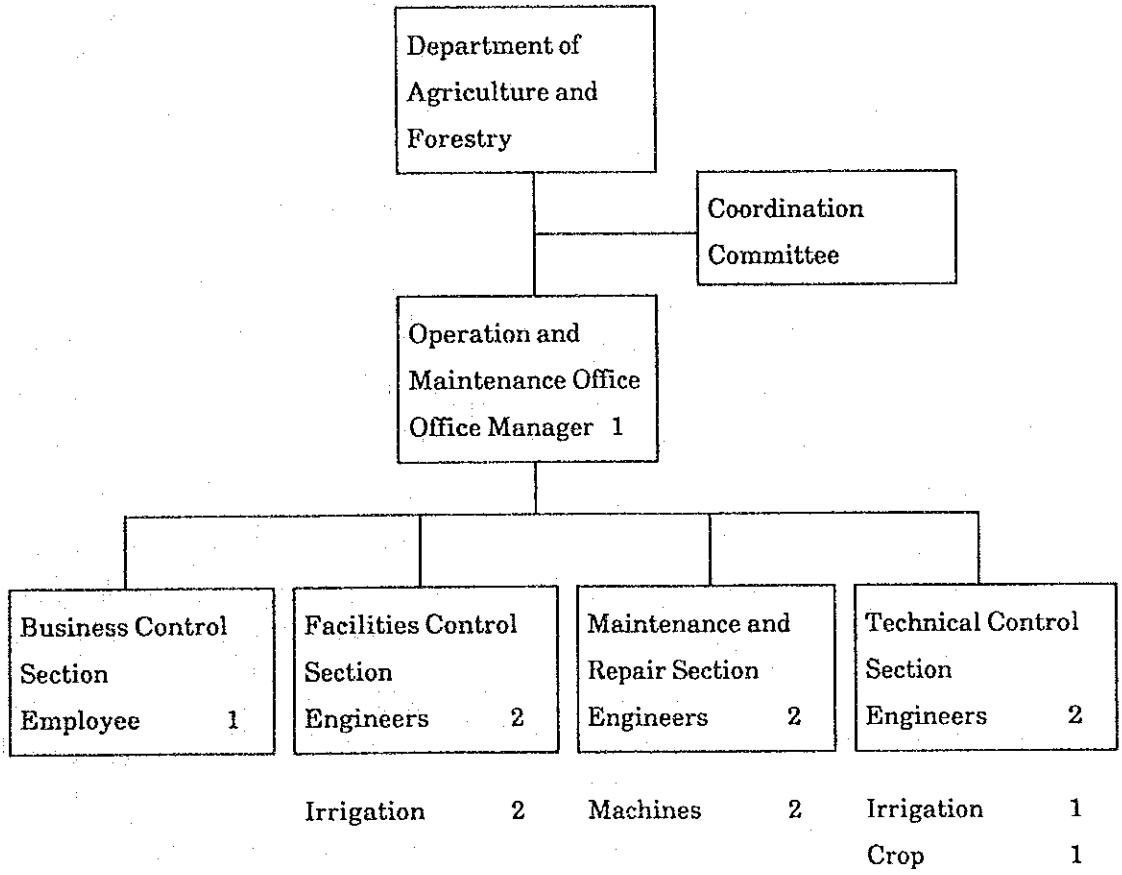
The staff required for the execution of the different operations will be stationed in the construction office and the operation and maintenance office.



Design Section		Construction Section		Machinery Section		Accounting Section		Office Management Section	
Section Head	1	Section Head	1	Section Head	1	Section Head	1	Section Head	1
Irrigation Engineers	4	Irrigation Engineers	4	Machine Engineers	1	Office accountant	1	Clerical Staff	1
Machine Engineers	2	Machine Engineers	1	Operation Engineer	1			Driver	1
Survey Engineer	1								
Draft men	1								

(Fig. Ⅲ - 5 Organization of Construction Office)

The Office of Operation and Maintenance will consist of 4 Sections:
Business Control Section, Facility Control Section, Maintenance and Repair Section and Technical Control Section



(Fig. Ⅲ - 6 Organization of Maintenance Office)

Chapter One: General Provisions

- Article 1 The objective of the Center is to increase the efficiency of agricultural production to improve the economic condition and to elevate the standard of living with the active cooperation of the farmers.

- Article 2 This Center will carry out the following works to assist the farmers :
  1. Transportation, processing, storage and distribution of the farmers' products.
  2. Supply of goods required for farmers' work and living.
  3. Facilities for village industries
  4. Machines and equipment to strengthen the farmers' cooperation in farm practices and to increase the efficiency of farm labor.
  5. Facilities for farmers' formation which is intended to develop farming techniques and management ; and facilities for the improvement of the standard of living and culture in villages.
  6. Lending of funds needed for the farmers' work and living
  7. Operation and maintenance of water use facilities for agriculture
  8. Work incidental to the different works mentioned from No 1 to No 8.

- Article 3 This Center will be called the B. Lak 35 Center

- Article 4 This center will be located in the Kanthaboly District and in the Champhone District Area.

- Article 5 The Center office will be established at B. Lak 35

Chapter 2 : Members of the Association

- Article 6
  ① The following individuals can be Members of the Center
  1. Individuals who hold cultivated land in the Kanthuboly and the Champhone Districts, and who practice farming ;
  2. Individuals who don't own their land but are left in charge of land cultivation in the Area ;

② If the qualification of an individual for membership is difficult, the chairman of the Board of Directors takes over and makes the decisions.

- Article 7
  ① Individuals wishing to apply for Membership must write an application for admission which will mention their contribution share and must submit it to the Chairman of the Board of Directors.
  ② When admission is agreed, it will be reported to the Applicant by letter. The Applicant will pay up his contribution share and will be recorded in the list of Members.
  ③ Individuals who applied for admission will pay a contribution to become a Member, as stipulated in the previous Article.

- Article 8 If a Member introduces changes to the items specified in the previous article he must notify the Chairman of the Board of Directors by letter.

- Article 9 A Member can't dispose of his share without the consent of the Center.

- Article 10 A Member will secede from the association for the following reasons :
  1. Disqualification
  2. Death
  3. Expulsion
  4. Transfer of total share.

- Article 11 A Member can be expelled from membership, on resolution of the board of directors, when he falls under the following items.
  1. When a member does not use any of the facilities for 1 year
  2. When a member hinders the work of the Center
  3. When a member violates the Rules or the Articles of Association of the Center and when he looses the trust of the Center because of a willful or a serious negligence.

Chapter 3 : Contribution

- Article 12 A Member must provide more than a share, but can not exceed 100 shares.

- Article 13 The amount of one contribution share is 3,000 kips, and this will be paid 3 times. However, a lump sum can be settled.

- Article 14 To meet the expenses required for the work incidental to the work plan mentioned in Article 2 as the 4th, 5th and 7th works, it is possible to assess the expenses of the Members.

- Article 15 If the Members don't carry out the payment of their contribution share and dues when the term expires, an additional payment will be imposed on them.

Chapter 4 : Personnel in Charge

- Article 16 7 directors and 4 Supervisors shall be employed and stationed in the Supporting Center.

- Article 17 The Governor of the Prefecture will appoint 7 officers to take charge of the Center (including 4 supervisors). The 4 remaining officers will be appointed during the General Meeting.

- Article 18 The officers can be re-elected even within their term of office (except for the 7 officers appointed by the Governor) if a fifth of the total members requests for it.

- Article 19 The Chairman of the Board of Directors will be one of the directors and will be one of the 7 officers appointed by the Governor.

- Article 20 The Chairman of the Board of Directors will represent the Center and will deal with its duty in accordance with the decisions of the Board of Directors.

- Article 21 The Supervisors will audit twice every business year the assets of the Center and the condition of business management. They will report the results in the General Meeting to the board of directors, and must receive approval during the General Meeting.

- Article 22 The directors will be convoked to attend board meetings. The majority of directors must be present and when the votes are equally divided, the chairman determines the final decision.

- Article 23 The officers will be remunerated according to the rules and regulations.

Chapter 5 : General Meeting

- Article 24
  ① The Directors will convoke an ordinary General Meeting once every business year.
  ② An extraordinary General Meeting can be convoked in the following cases.
    1. Whenever the Board of Directors consider it necessary.
    2. When more than a fifth of the total members agree with the convocation of the Meeting ; they will submit a letter to the directors stating the articles concerning the General Meeting and the reason for the convocation.
    3. When the Members request re-election in accordance with the rules specified in Article 18.
    4. When the supervisors have noticed illegalities regarding the assets or business management.
  ③ When a General Meeting is requested according to Item 2 mentioned above, the directors must convoke a General Meeting within 20 days from the day of the request.

- Article 25 If more than half of the members don't attend the Meeting, the session can't be opened.

- Article 26 The minutes of the proceedings will be taken during the Meeting, and the outlines of the progress of the session and the outcomes will be reported. The minutes will be signed by the directors attending the Meeting.

Chapter 6 : Business Management and Accounting

- Article 27 The business year of the Supporting Center will be from ... to

- Article 28 The items related to the policy and the methods of funds employment will be planned at the Board of Directors meeting for each business year.

- Article 29 The Chairman of the Board of Directors must periodically report the situation of the funds employments for the Center to the Board of Directors.

9. Demonstration Farm Project

1) Objectives of the Demonstration Farm

It is of the utmost importance to spread new techniques on irrigated cultivation among the inexperienced farmers of the Area. This is an essential requirement for the smooth implementation of the cultivation plan intended for the Project Area. The Project will plan the establishment of demonstration farms in Kernded to be a model for the other farms. Furthermore, a rational water management will be carried out. Afterwards, mechanization and other farming techniques will follow suit.

A demonstration farm of 60ha will be settled in the Houay Bay Ava, since the location is comparatively favorable. The demonstration farm will serve the following purposes :

- Test and exhibition of cropping methods for irrigated agriculture and of a rational water management.
- Training on civilization of agricultural machines, and basic techniques for repair.
- Test and exhibition of compost and weeding effects

2) Operation and Maintenance of Demonstration Farms

Operation and maintenance of the demonstration farm will improve owing to technical training provided by agricultural engineers of the prefecture. This formation will basically take into consideration farm households holding cultivated lands in the demonstration farm.

a) Cropping of Irrigated Agriculture and Water Management Methods

For the operation and maintenance of the fields, farmers will be guided by agents and will make a preliminary examination of cropping. Attention will be paid to farm households and their cultivation of the fields.
The field area in the Demonstration farm will be divided into lots.

As the use of machines will be introduced for field work in the future, the ridges between rice paddies will be widened along the shortest course of the lots. Thus, manure practice and rice seedling provision will be made easy. Damages will probably occur in fields where rotation crops have not yet been practiced, due to excessive watering and drought injuries. The cultivation techniques will be taught to the farmers by using audio-visual aids like videos.

The irrigation plan for rice culture is a necessity to reduce unnecessary moisture as much as possible, to show rational methods of water use, and proceed with the plan for irrigation water control which is suitable for the cropping plan.

b) Introduction of Agricultural Machines

To prospectively reduce labor and achieve efficiency, small-scale agricultural machines shall be required. However, mechanizing the whole process of cultivation (plowing, rice transplanting, harvest and storage) would be feasible only for the lots prepared in the demonstration farm. But to extend mechanization to others forms seems out of reach. Even if operations are mechanized in the demonstration farm, some work will still be conducted by draught animals and manpower.

Power threshers will be used for threshing, and it must be conducted early in the fields to guarantee a period long enough to prepare the following crop. Moving power thresher is motorized. A Hiresher set is planned to be put in a track, moved to the fields, then used to thresh the field. The maintenance of agricultural machines will be carried out by the organization units (blocks) set for irrigation canals.

As machine repairing is onerous, a travelling workshop will be purveyed. Tools will be transported in small tracks to the farm households adjacent to the Area.

c) Use and Exhibition of Compost and Chemicals

The topsoil of the development area is composed of microscopic earth granules with scarce organic matters. This indicates that soil conditions check the growth of crop roots, and lower the yield volume. Though putrefaction of hulls is difficult and though fertilizer is not directly effective, the soil will progressively aggregate, plant roots will develop better, and then the fertilizers effect will likely improve. Furthermore, the use of chemical fertilizers of quick acting capacity and those which are easy to carry, will increase the income of farm households.

The interviews clearly stated the ignorance of the farmers about chemical fertilizers and agricultural chemicals.

The restrained use of chemicals will not cause any problems now, still as chemicals will be increasingly used, it will be necessary to teach farmers how to safely spray them into fields. If the use of fertilizers is limited to chemical ones, their purchase will be a weight on the farmers budget, and also one can not expect chemical fertilizers to effectively enrich the soil.

A soil with a single gained structure will impede the growth of crop roots, thus, the manure practice plan will emphasize the balanced use of chemical fertilizers and organic fertilizer to raise soil permeability and to stimulate rooting.

With the diffusion of chemical fertilizers, the ratio of nitrogen in the soil will increase, too, and consequently make weeds grow. Weeding will be carried out by manpower, then, herbicides will be applied in zones covered densely with weeds.

Herbicide presently used in the Study Area is 24-D, but because of its high fish toxicity, spraying must be properly taught and audio-usual aids such as videos help give guidance and information.

Farmers are unacquainted with the compost production processes and, therefore,compost additives are wanted. Compost production takes very little time as it consists of deposit of cattle manure under the eaves.

Diffusion of compost practice is impeded due to the following reasons :

- Inexperience and ignorance about production of fully fermented compost

- Difficult carriage of large piles of compost
- Raw material supply for compost is difficult to secure.

According to the plan, a compost deposit will be made where the earth has been scantily removed, at the rate of 1 per 10 ha. Then, rice straw, peanut shells, cattle manure will be piled up. When moisture is available, the pile of compost will be reduced to half after one month making transportation and trans-shipment (changeover) easy. In addition, a new fully fermented compost will be then prepared near the previous one. Itinerary of the compost production is shown in fig.

A fully fermented compost is composed of approximately 0.79% nitrogen, 0.47% phosphoric acid, and 0.85% potassium. This composition is believed to effectively enrich the soil.

The production plan assumes that the present manure practice criteria for most efficient farmers is an amount of 100 kg/ha (N - 16%) of chemical fertilizers, the basal application of compost representing 50% and chemical fertilizers the remaining 50%.

The reduction cost for compost is estimated to be 3,500 kips/1,000kg, including compost delivery fees.

The quantity of injected compost will correspond to 1 ton for 1 ha of paddy field in the rainy season when decomposition gets fast. As for the dry season, compost volume will be 0.5 ton/ha.

The compost space will be large enough to match the produced quantity. This will be the place where earth has been simply removed. Management of the compost place will be deliberated and placed under the responsibility of the members of each tertiary irrigation canals block.

There is no effective transportation vehicle for the taking in and taking out of raw materials for compost ; trailers will be provided to carry and spread compost into the fields. This teamwork operations will be in charge of the tertiary irrigation blocks. Compost model shown Fig Ⅱ - 7.

Table Ⅲ - 1 - (1) Statistics on Population of Each Village (Cont)

· Nhyod H. Bak Area

		1986	1987	1988	1989	1990
Nateuy sub-district	B. Xianban	478	485	494	525	532
	B. Nonghong	420	425	445	450	457
	B. Sithong	300	320	400	500	560
Khamt hao sub-district	B. Kho	685	692	701	709	712
	B. Nongveng	324	352	374	385	392
	B. Dongdokmai	497	500	501	508	515
Vatthana sub-district	B. Vatthana	507	590	605	638	650
	B. Phailom	306	309	314	319	317
	B. Phonthan	211	218	220	225	225
Nanokkian sub-district	B. Nanokkhian	452	455	485	459	455
	B. Dongkhankhou	797	782	786	887	913
	B. Nongkalong	587	594	608	623	640
	B. Gnangsoung	445	455	462	474	479
	B. Dongkhamkhen	409	411	414	421	426
	TOTAL	6,418	6,588	6,809	7,123	7,273

Table Ⅲ - 1- (2) Statistics on Population of Each Village

· Namphou Area

		1986	1987	1988	1989	1990
Mouangkhai sub-district	B. Mouangkhai-Nua	857	899	920	942	965
	B. Mouangkhai-Tai	1,129	1,158	1,190	1,190	1,316
	B. Dontoum	542	610	636	646	616
	B. Dongmakfai	1,102	1,059	1,074	1,155	1,151
	B. Donghouakham	179	187	190	213	227
	B. Hamphou-Nua	548	567	620	610	630
	B. Namphou-Tai	502	529	550	550	568
	B. Dongphosi	601	650	650	655	740
	B. Phoxai	252	265	288	288	267
	TOTAL	5,712	5,924	6,118	6,249	6,480

Source, Farm Interview Survey 1991.

Table Ⅲ-1-(3) Statistics on Working Population of Each Village

· Nhyod H. Bak Area

		1986	1987	1988	1989	1990
Nateuy sub-district	B. Xoambam	270	275	280	300	308
	B. Nonghong	205	210	220	225	230
Khamt hao sub-district	B. Sithong	184	195	201	215	305
	B. Kho	307	312	340	348	360
	B. Nongveng	133	147	154	174	193
	B. Dongdokmai	299	301	317	357	378
Vattha na sub-district	B. Vatthana	293	295	302	319	331
	B. Phailom	118	123	131	140	144
	B. Phonthan	96	104	104	105	108
Nano-kkian sub-district	B. Nanokkhian	381	346	392	352	392
	B. Dongkhankhou	415	411	402	418	499
	B. Nongkalong	278	283	288	294	309
	B. Gnangsoung	210	212	215	219	223
	B. Dongkhamkhen	183	185	186	188	187
	TOTAL	3,372	3,399	3,532	3,654	3,967

Source, Farm Interview Survey 1991.

Table Ⅲ-1-(4) Statistics on Working Population of Each Village

· Namphou Area

		1986	1987	1988	1989	1990
Mouangkhai sub-district	B. Mouangkhai-Nua	450	470	510	550	615
	B. Mouangkhai-Tai	432	453	486	550	713
	B. Dontoum	197	254	261	275	324
	B. Dongmakfai	419	456	461	565	530
	B. Donghouakham	113	115	118	123	152
	B. Hamphou-Nua	265	276	320	320	345
	B. Namphou-Tai	213	221	228	232	240
	B. Dongphosi	227	276	276	284	300
	B. Phoxai	107	110	143	143	130
	TOTAL	2,423	2,631	2,803	3,042	3,349

Source, Farm Interview Survey 1991.

Table Ⅲ-2 Statistics on Population of Each Area

· Namphou Area

	1986	1987	1988	1989	1990	2000*
population	6,418	6,588	6,809	7,123	7,273	10,134
ratio		2.6%	3.4%	4.6%	2.1%	39.3%
working population	3,372	3,399	3,532	3,654	3,967	5,765
ratio		0.8%	3.9%	3.5%	8.6%	46.5%

* Estimations for 2000 (Exponential Function)

· Namphou Area

	1986	1987	1988	1989	1990	2000*
population	5,712	5,924	6,118	6,249	6,480	8,791
ratio		3.7%	3.3%	2.1%	3.7%	35.6%
working population	2,423	2,631	2,803	3,042	3,349	7,329
ratio		8.6%	6.5%	8.5%	10.1%	118.8%

* Estimations for 2000 (Exponential Function)

Table Ⅲ - 3 - (1) Population Composition (Nhyod H. Bak Area)

Age	B. Nongkalong			B. Dongkhankhou		
	Male	Female	TOTAL	Male	Female	TOTAL
0~6	72	76	148	103	112	215
	23.8%	22.3%	23.0%	22.3%	21.7%	22.0%
7~15	86	89	175	133	136	269
	28.4%	26.2%	27.2%	28.8%	26.4%	27.5%
16~50	129	153	282	201	240	441
	42.6%	45.0%	43.9%	43.5%	46.6%	45.2%
51~	16	22	38	25	27	52
	5.2%	6.5%	5.9%	5.4%	5.3%	5.3%
TOTAL	303	340	643	462	515	977
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table Ⅲ - 3 - (2) Population Composition (Namphou Area)

Age	B. Namphou-Nua			B. Namphou-Tai		
	Male	Female	TOTAL	Male	Female	TOTAL
0~6	69	65	134	72	57	129
	20.6%	19.4%	20.0%	26.4%	18.5%	22.2%
7~15	107	98	205	59	80	139
	31.9%	29.3%	30.6%	21.6%	26.0%	23.9%
16~50	131	142	273	138	164	302
	42.4%	40.7%	40.7%	50.5%	53.2%	52.0%
51~	28	30	58	4	7	11
	8.4%	8.9%	8.7%	1.5%	2.3%	1.9%
TOTAL	335	335	670	273	308	581
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table Ⅲ - 6 - (1) Pay Tax (N. H. Bak Area)

Name of Village		Rank Ⅰ	Rank Ⅱ	Rank Ⅲ	Rank Ⅳ
		Tax (kg)	Tax (kg)	Tax (kg)	Tax (kg)
		Area (ha)	Area (ha)	Area (ha)	Area (ha)
Nateuy sub-district	B. Xianban	404.6	3,637.2	3,514.0	1,472.0
		2.89	30.31	35.14	18.40
	B. Nonghong	210.0	1,320.0	3,644.0	1,452.8
		1.5	11.00	36.44	18.16
	B. Sithong	1,250.2	2,256.0	8,140.0	4,919.6
		8.93	18.80	81.40	61.37
Khamthao sub-district	B. Kho	280.0	744.0	9,200.0	6,240.0
		2.00	6.20	92.00	78.00
	B. Nongveng	196.0	288.0	4,780.0	2,360.0
		1.40	2.40	47.80	29.50
	B. Dongdokmai	826.0	2,712.0	5,920.0	1,968.0
		5.90	22.60	59.20	24.60
Vatthana sub-district	B. Vatthana	420.0	3,538.8	6,205.0	3,390.4
		3.00	29.49	62.05	42.38
	B. Phailom	280.0	1,020.0	4,459.0	3,265.6
		2.00	8.50	44.59	40.82
	B. Phonthan	280.0	2,184.0	1,904.0	604.0
		2.00	18.20	19.04	7.55
Nano-kkian sub-district	B. Nanokkhian	730.8	3,078.0	4,538.0	2,887.2
		5.22	25.65	45.38	36.09
	B. Dongkhankhou	533.4	5,192.4	7,105.0	4,672.8
		3.81	43.27	71.05	58.41
	B. Nongkalong	687.4	2,900.4	4,276.0	2,720.0
		4.91	24.17	42.76	34.00
	B. Gnangsoung	1,162.0	3,097.2	4,739.0	4,056.8
		8.30	25.81	47.39	50.71
	B. Dongkhamkhen	756.0	2,053.2	3,384.0	968.8
		5.40	17.11	33.84	12.11
Total		8,016.4	34,021.2	71,808.0	40,968.0
		57.26	283.51	718.08	512.10
Ratio (%)		5.2	22.0	46.4	26.4
					154,813.6
					1,570.95
					100

Table Ⅲ - 6 - (2) Pay Tax (Namphou Area)

Name of Village		Rank Ⅰ	Rank Ⅱ	Rank Ⅲ	Rank Ⅳ
		Tax (kg)	Tax (kg)	Tax (kg)	Tax (kg)
		Area (ha)	Area (ha)	Area (ha)	Area (ha)
Mouang-Khai sub-district	B. Mouangkhai-Nua	10,645.6	958.8	500.0	8,425.6
		76.04	7.99	5.00	105.32
	B. Mouangkhai-Tai	8,456.0	1,530.0	444.0	10,255.2
		60.40	12.75	4.44	128.19
	B. Dontoum	5,874.4	2,054.4	1,597.0	5,638.4
		41.96	17.12	15.97	70.48
	B. Dongmakfai	8,507.8	2,500.8	4,621.0	8,053.6
		60.77	20.84	46.21	100.67
	B. Donghouakham	3,087.0	678.0	484.0	853.6
		22.05	5.65	4.84	10.67
	B. Namphou-Nua	8,463.0	783.6	303.0	3,094.4
		60.45	6.53	3.03	38.68
	B. Namphou-Tai	977.2	667.2	604.0	3,238.4
		6.98	5.56	6.04	40.48
	B. Dongphosi	5,161.8	1,405.2	1,433.0	3,879.2
		36.87	11.71	14.33	48.49
	B. Phoxai	1,580.6	840.0	340.0	1,586.4
		11.29	7.00	3.40	19.83
	Total	52,753.40	11,418.0	10,326.0	45,024.8
		376.81	95.15	103.26	562.81
	Ratio (%)	33.1	8.4	9.1	49.4
					119,522.2
					1,138.03
					100

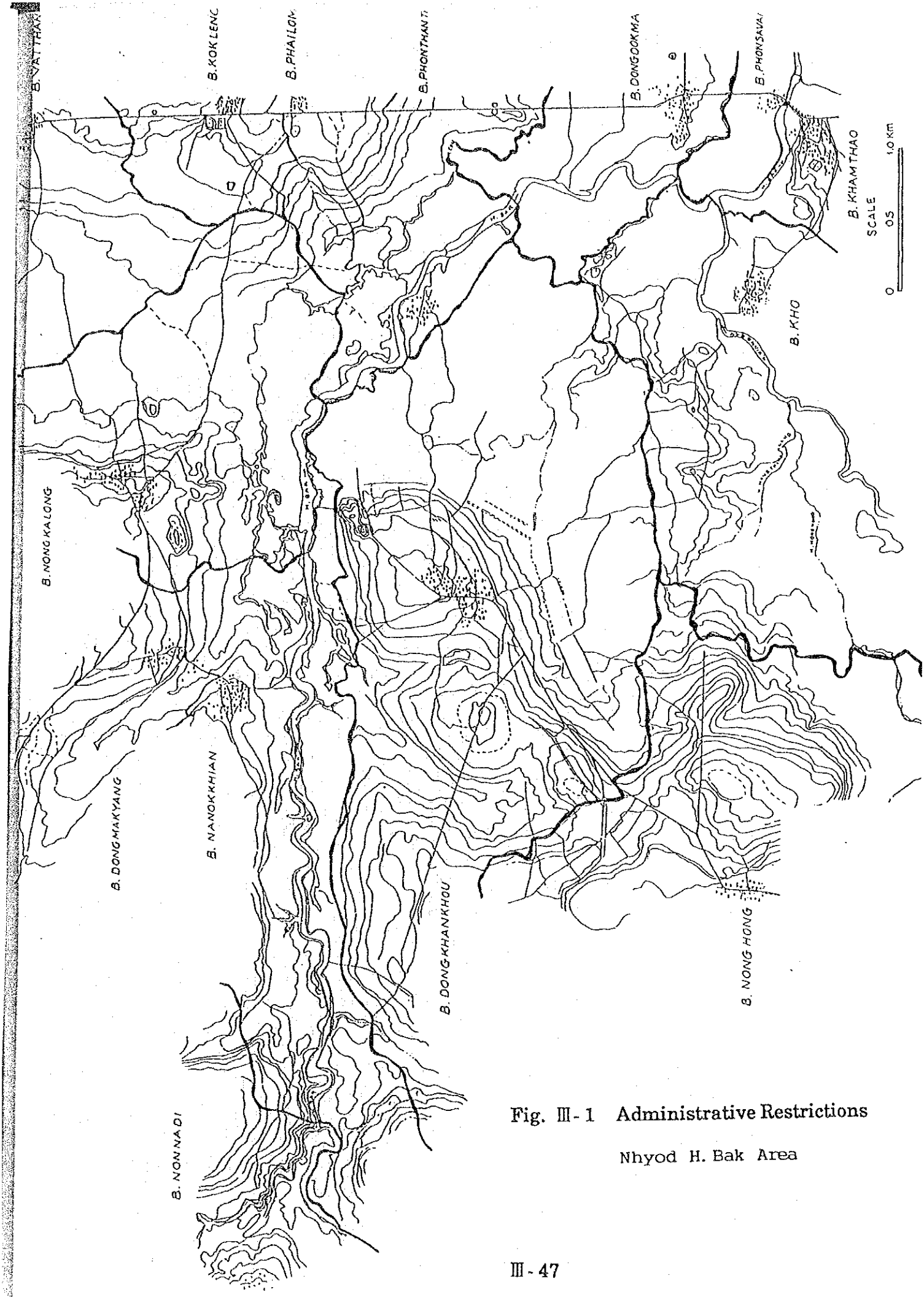


Fig. Ⅲ-1 Administrative Restrictions

Nhyod H. Bak Area

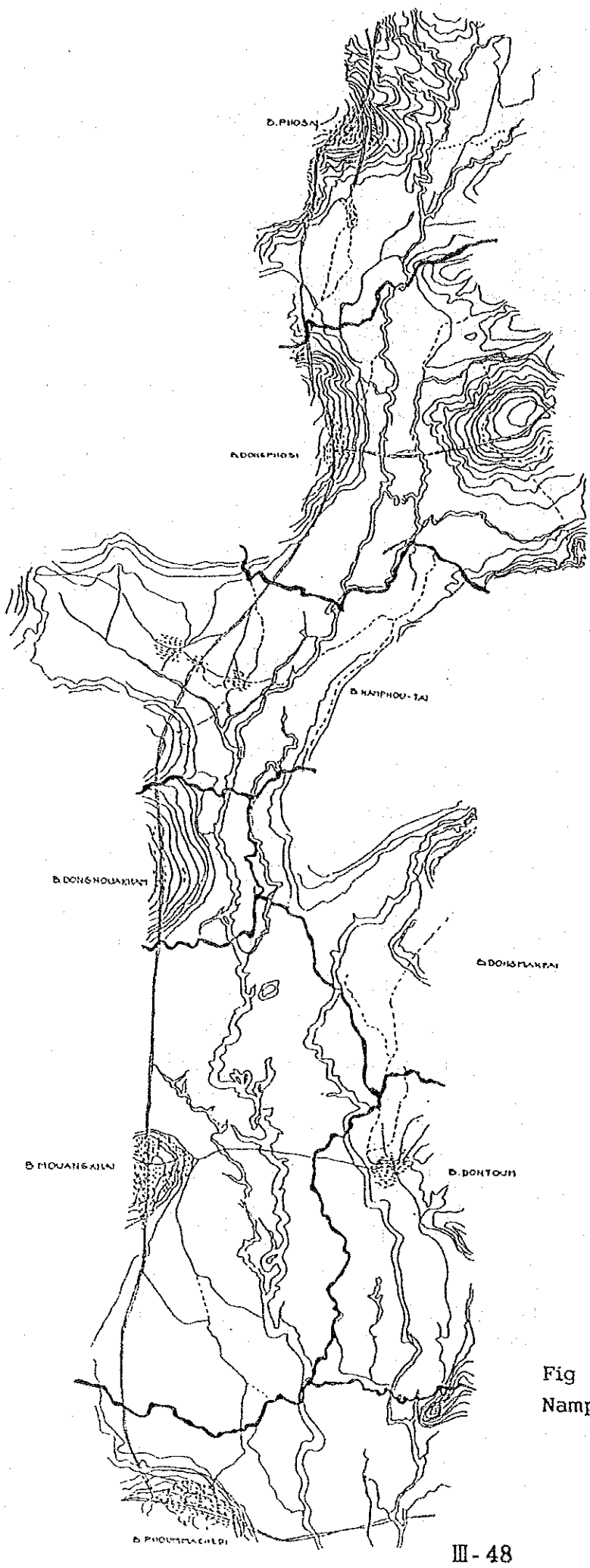


Fig III - 1 CONT
Namphou Area

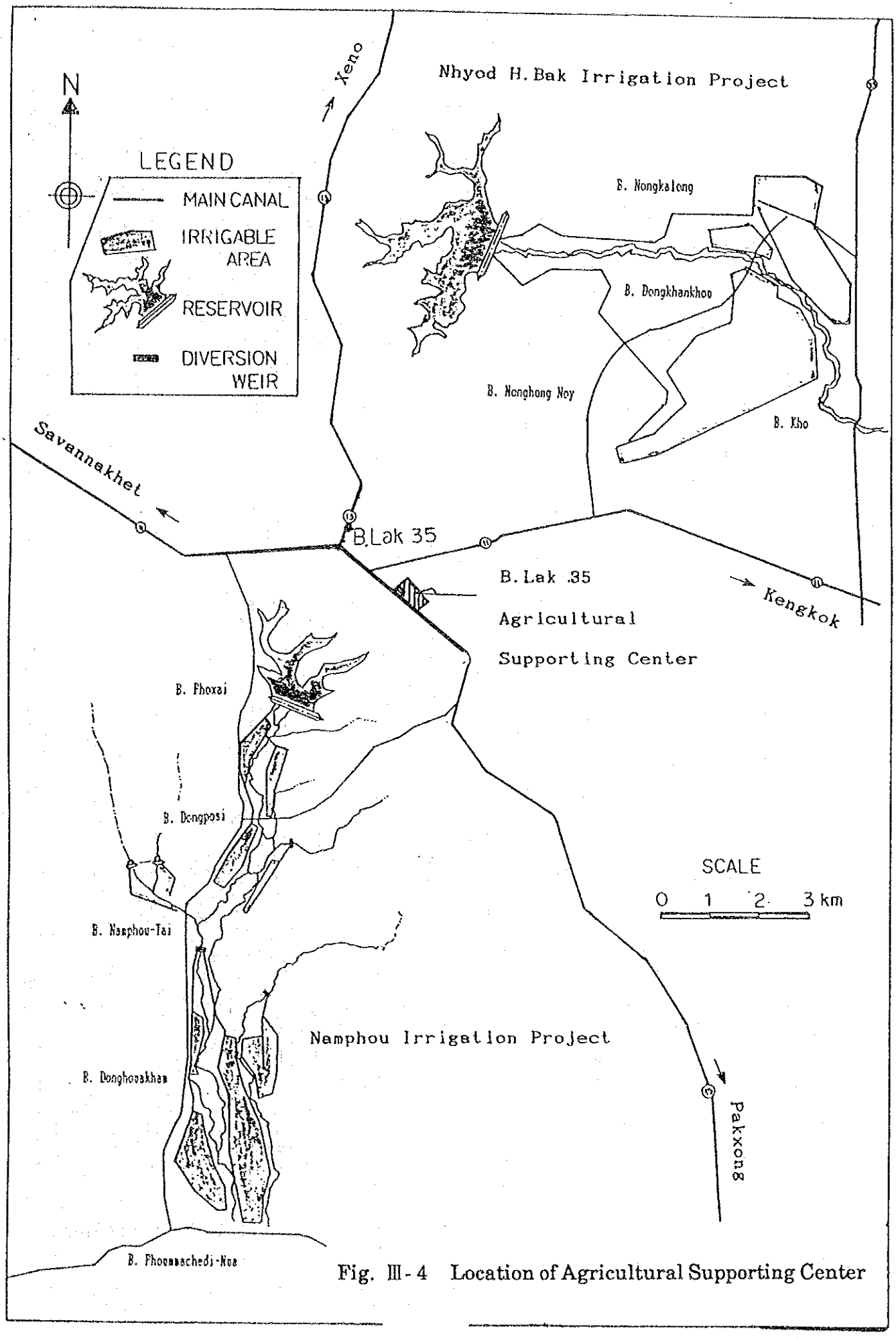


Fig. Ⅲ-4 Location of Agricultural Supporting Center

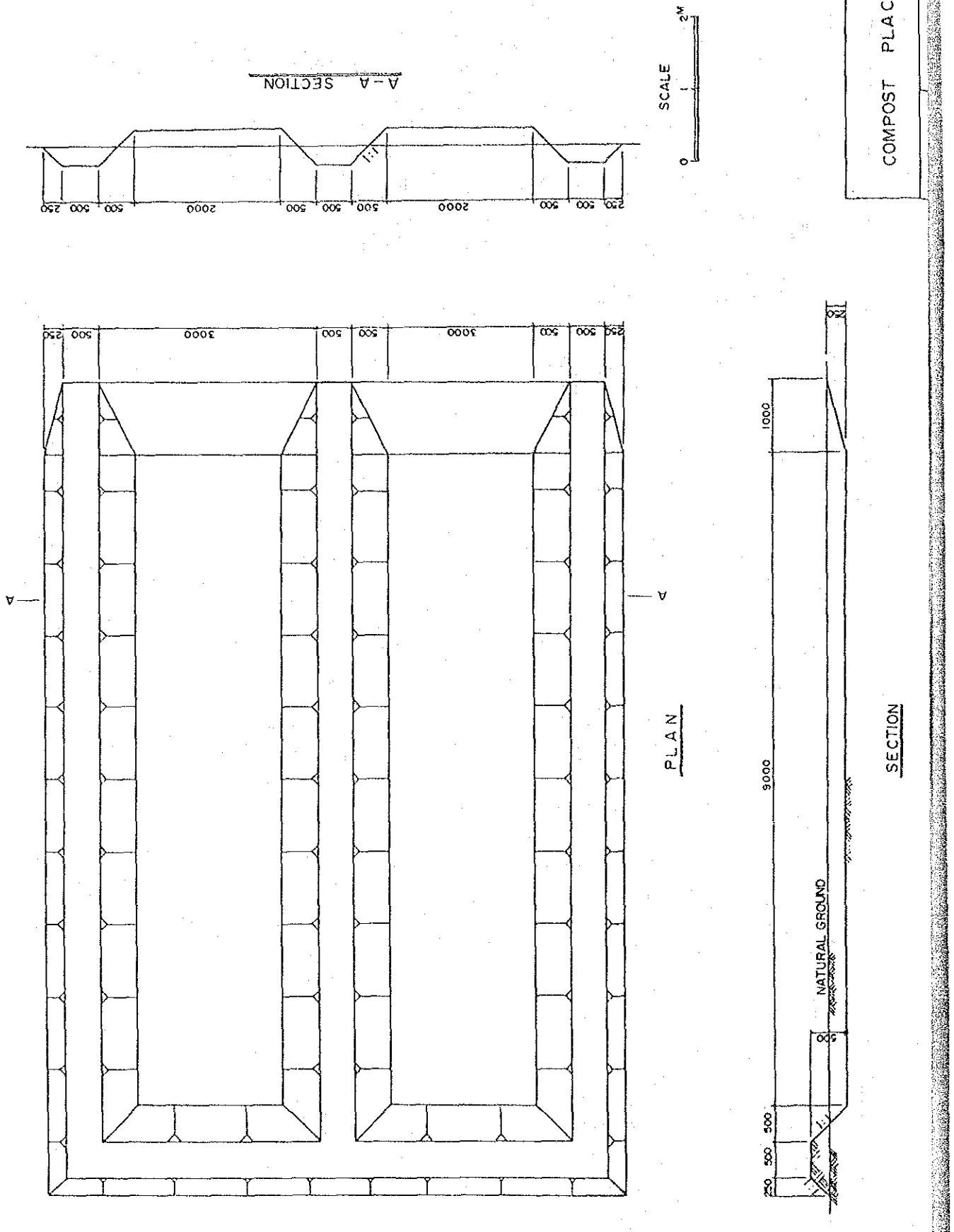
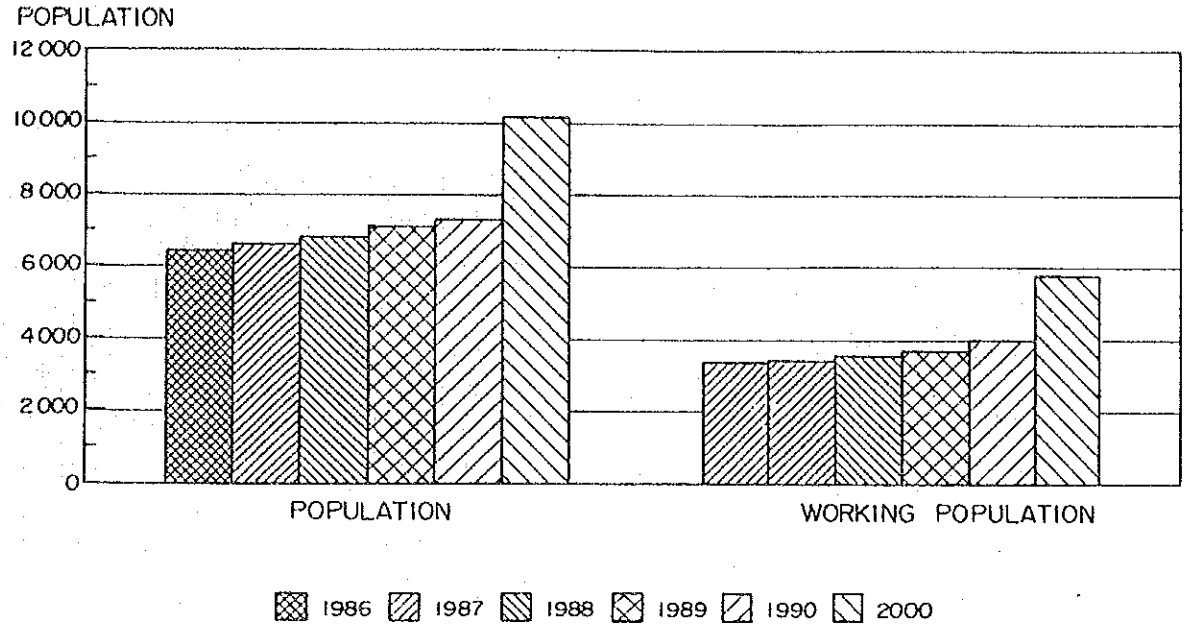


Fig. Ⅲ-7 Compost Model

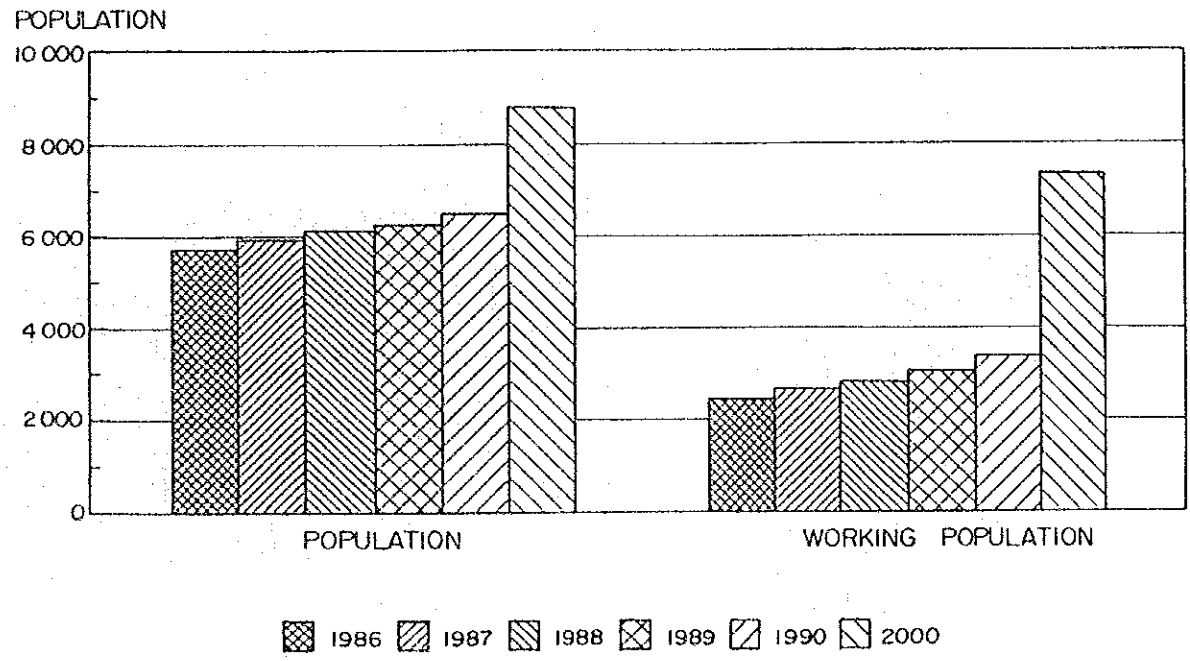
POPULATION

NHYOD H.BAK AREA



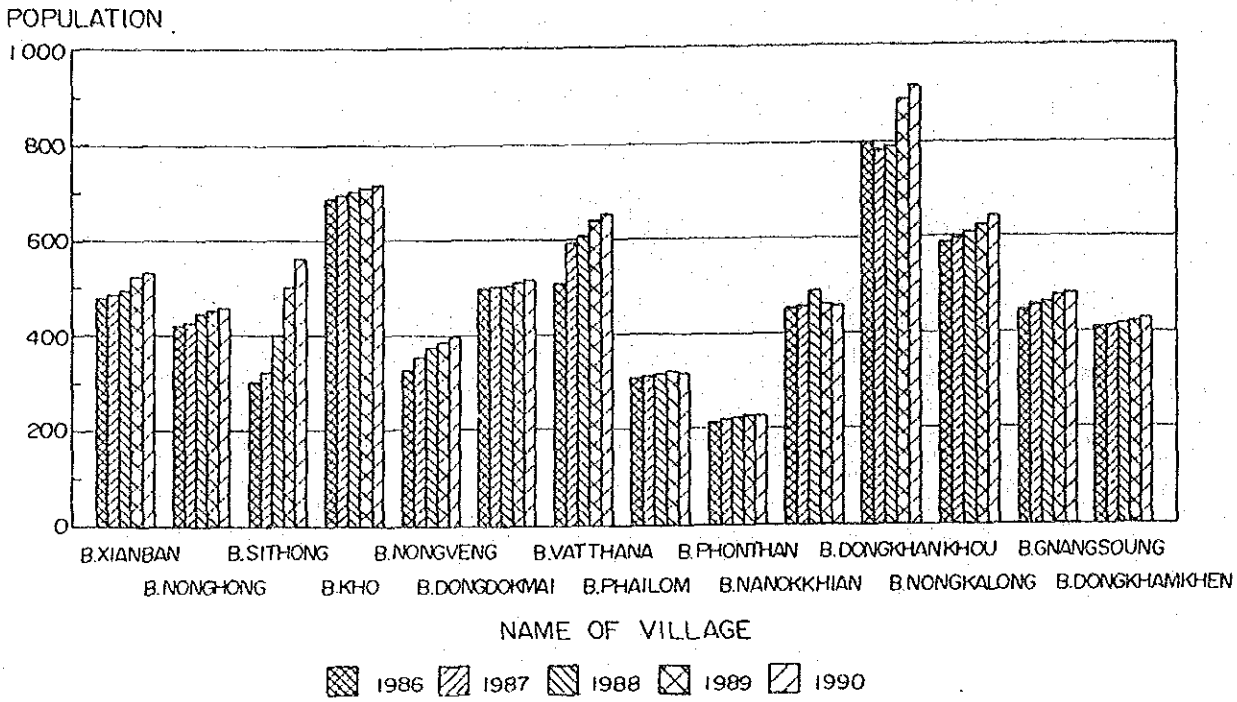
POPULATION

NAMPHOU AREA

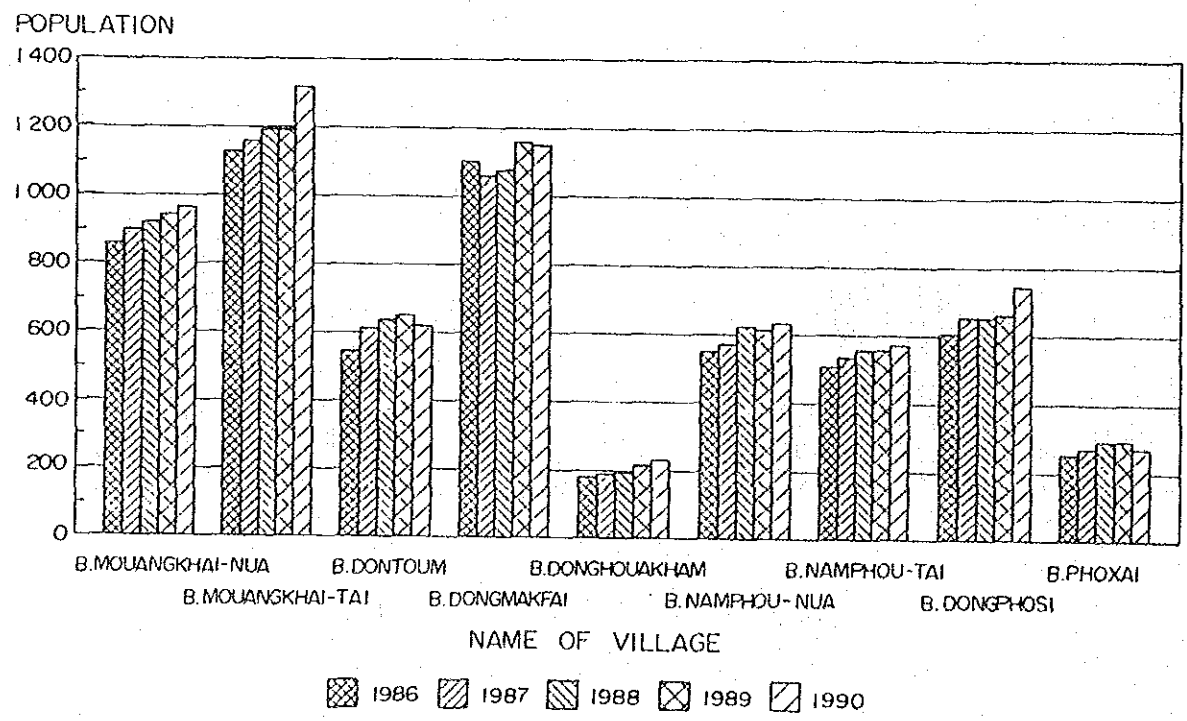


Summary of Population

NHYOD H.BAK AREA POPULATION



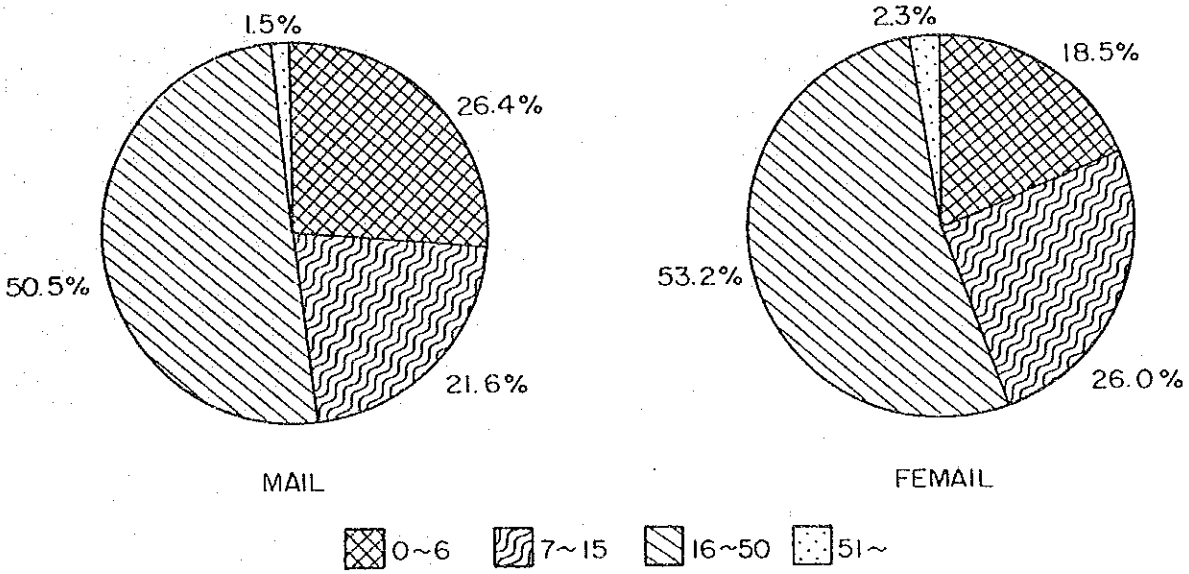
NAMPHOU AREA POPULATION



Summary of Population

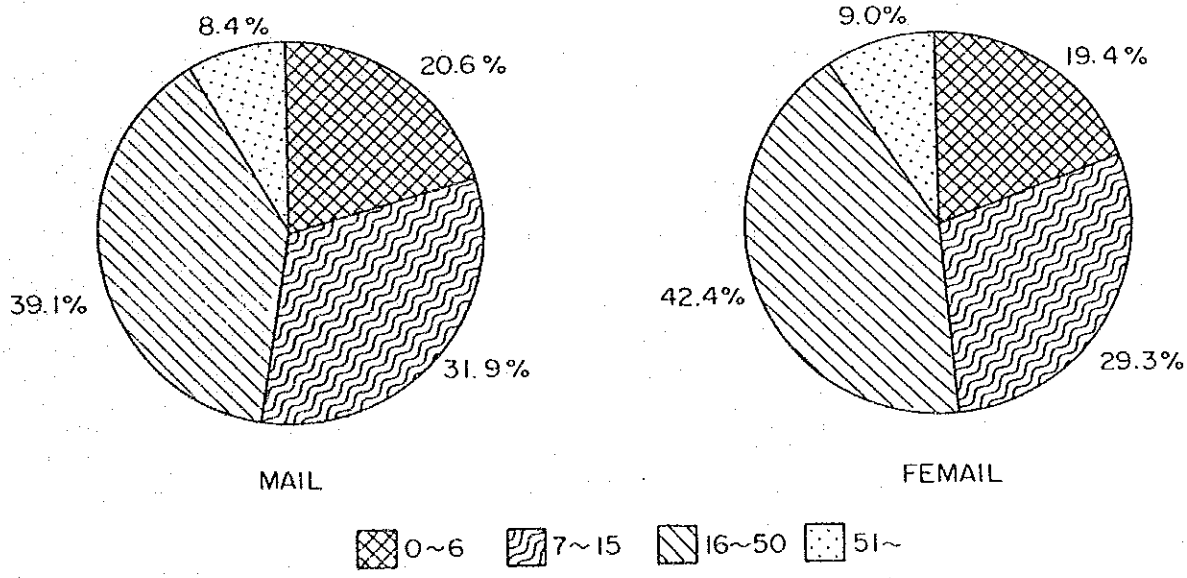
POPULATION BY AGE AND SEX

B. NAMPHOU-TAI



POPULATION BY AGE AND SEX

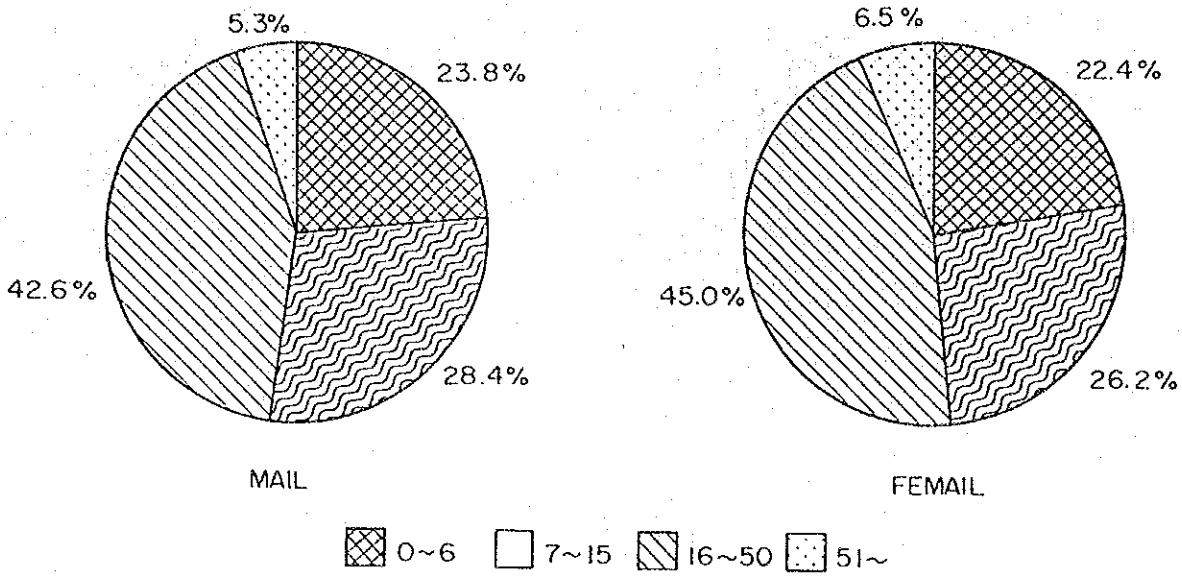
B. NAMPHOU - NUA



Summary of Age and Sex

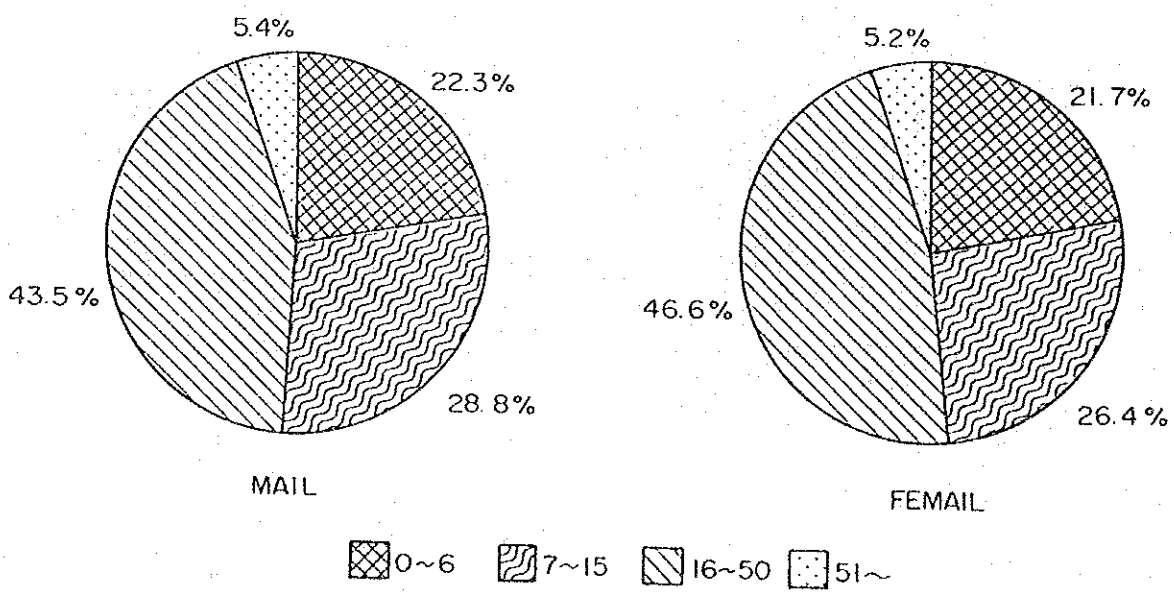
POPULATION BY AGE AND SEX

B. NONGKALONG

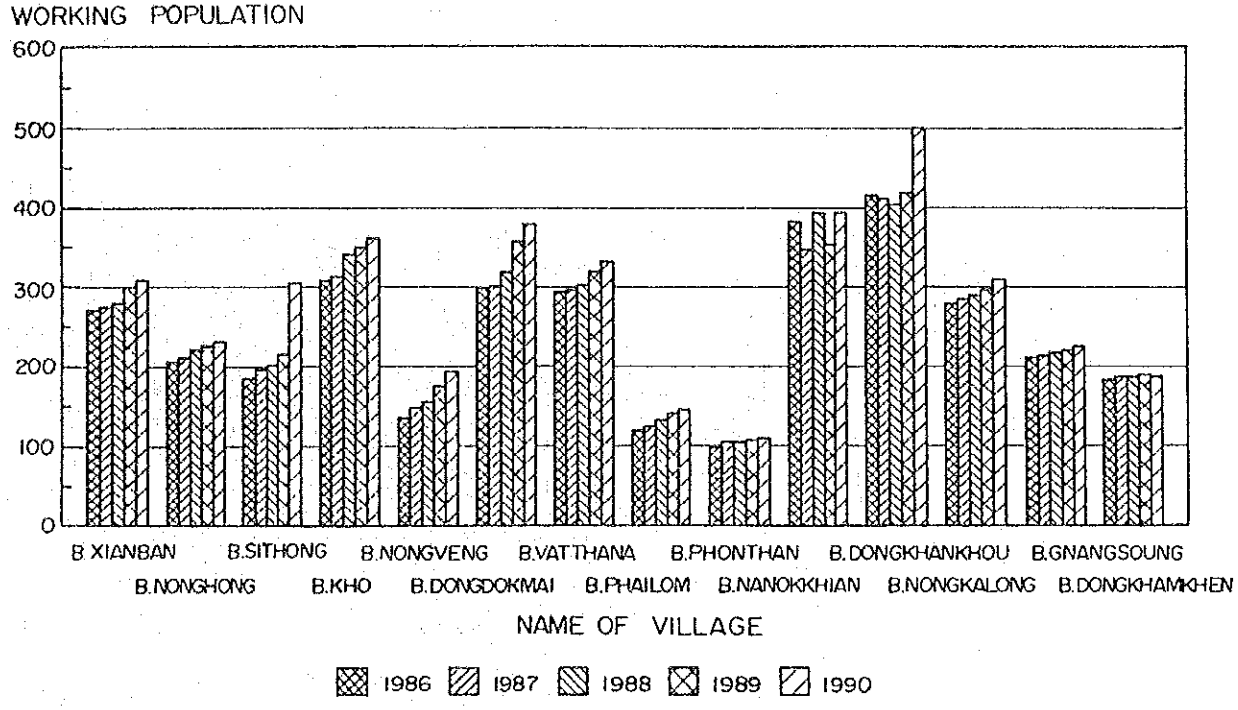


POPULATION BY AGE AND SEX

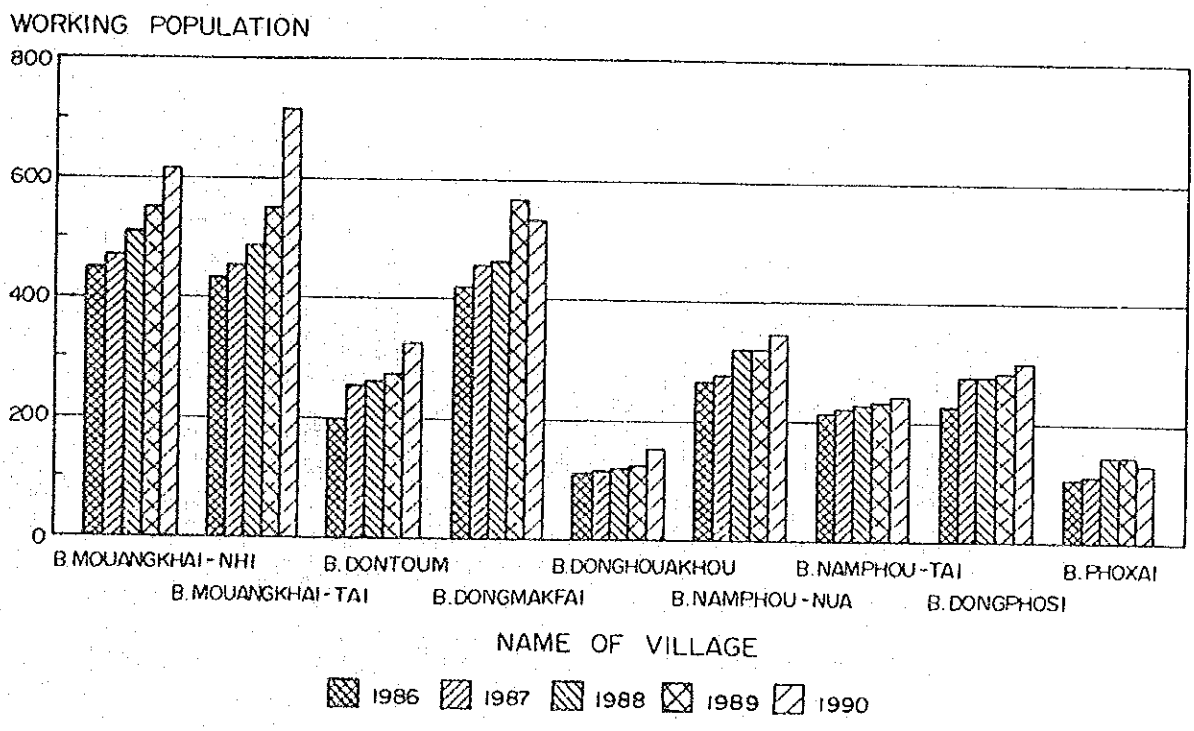
B. DONGKHANKHOU



NHYOD H.BAK AREA WORKING POPULATION

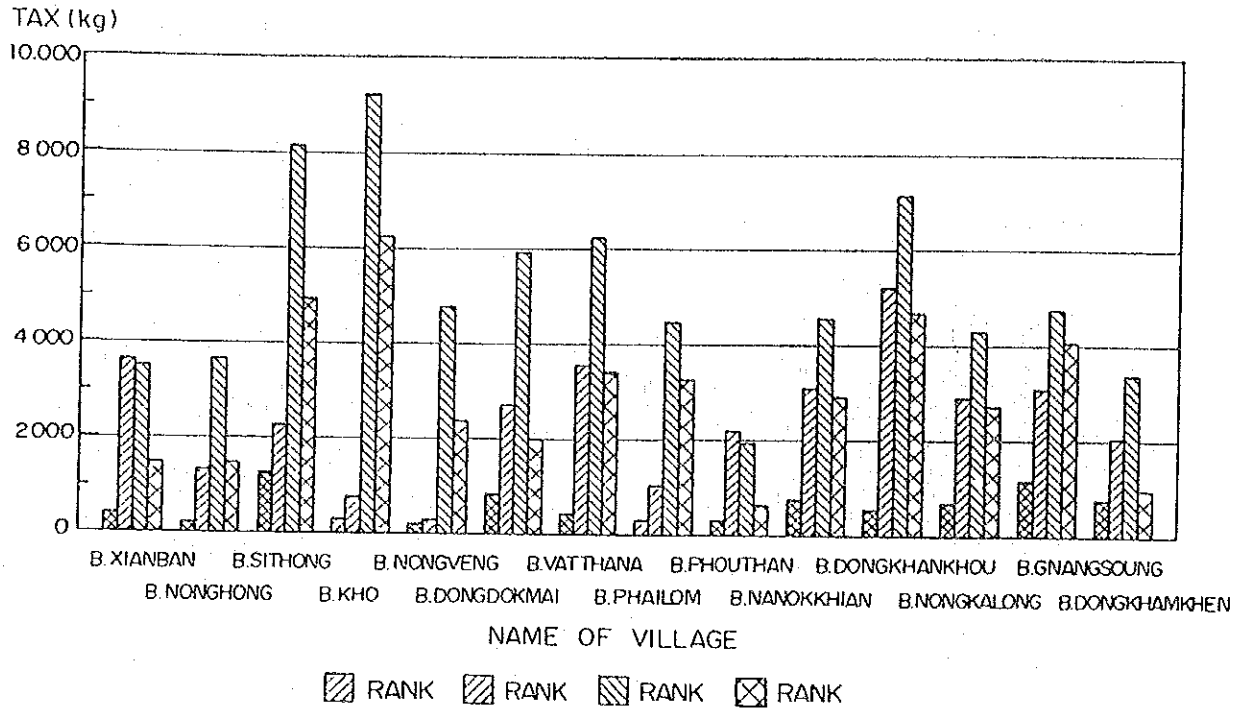


NAMPHOU AREA WORKING POPULATION

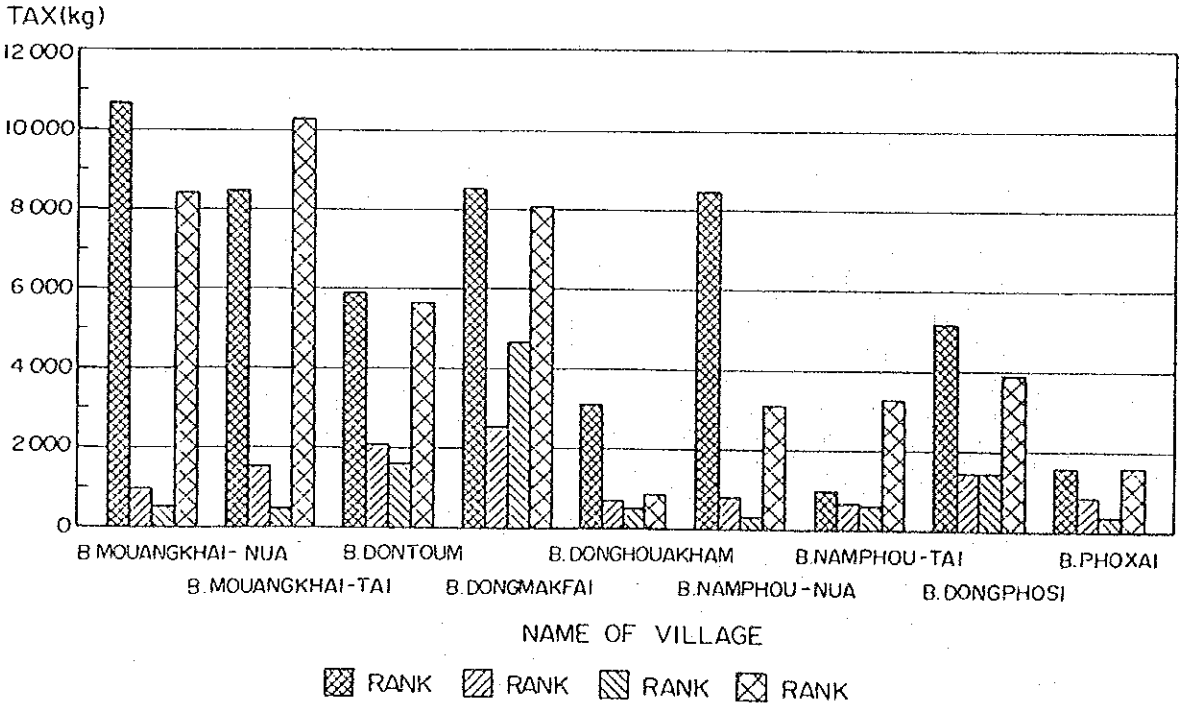


Summary of Working Population

TAX (NHYOD H.BAK AREA)



TAX (NAMPHOU AREA)



Summary of Agricaltual Tax

ANNEX IV

IRRIGATION AND DRAINAGE

ANNEX Ⅳ

IRRIGATION AND DRAINAGE

Table of Contents

List of Tables

List of Figures

1. Existing Irrigation Project

There are two irrigation projects in the project area. One is the H. Bak reservoir project in Champhon, and the other is the Kouthapho reservoir in Khanthabouly. The former was constructed in 1989 in B. Dong Nongkhoumk, 15 km downstream of the Bak river from B. Dongkhankhou, the future center of Nhyod H. Bak irrigation Project. The latter was constructed in 1988 in B. Phonthan, southeast of the Phoummachedy plain. H. Bak reservoir is inundated during the rainy season making the irrigation of 200 ha of land in and around the reservoir in the dry season, by manpower or small pumps using the water from 400 ha of reservoir area, possible. As for the Kouthapho reservoir, 10 to 30 ha of paddy fields are irrigated in the dry season by gravity with the water from 50 ha of reservoir area. Also, some 50 ha of paddy fields are irrigated in the rainy season when the rainy season starts belatedly.

Besides the two projects mentioned above, irrigation for dry season paddy cultivation was also conducted several times in B. Namphou by using a little of the annual flow of the H. Phou Noy river where a small earth dike and reservoir is constructed. The irrigated areas varied from 3 to 5 ha depending on the flow of the river. All these reservoirs have almost no irrigation facilities such as canals and diversion structures, except for the small canal of Kouthaphou reservoir. Plot to plot irrigation system is used with temporary canals which are constructed annually or installed with small pumps.

2. Irrigation Water Requirements

2.1 General

The crops proposed to be grown in the area are paddy rice and such field crops as groundnut, watermelon and other vegetables. The irrigation water requirement for them is separately estimated based on the proposed typical cropping pattern for rainy season paddy, dry season paddy and dry season peanut cultivation. The irrigation water requirement consists of crop water consumption, irrigation losses and ancillary water demands for respective crops.

The irrigation water requirement for the crops is estimated on a monthly basis, by using the climatic data observed at Xeno meteorological station for 24 years, from

1961 to 1988.

The irrigation water requirement is estimated by the following procedure.

Paddy Rice :

- Estimate of paddy rice water consumption (CU) from potential evapotranspiration calculated by using the climatic data and crop coefficients (Kc) varying with growth stages
- Estimate of percolation rate (P)
- Estimate of effective rainfall (ER)
- Estimate of nursery water (NW) and puddling water requirement (PW)
- Estimate of net irrigation water requirement (NR)
  $NR = CU + P - ER + NW + PW$
- Estimate of gross irrigation water requirement (GR) based on (NR) divided by irrigation efficiency

Field Crops :

- Estimate of crop water consumption (CU)
- Estimate of effective rainfall (ER)
- Estimate of net irrigation water requirement (NR)
  $NR = CU - ER$
- Estimate of gross irrigation water requirement (GR) based on (NR) divided by irrigation efficiency

2.2 Water Consumption

(1) Potential evapotranspiration

Crop water consumption is estimated as a product of potential evapotranspiration (ETo) and crop coefficient (Kc), which varies according to the crop growth stage. The potential evapotranspiration is calculated by the following modified Penman method recommended in "Crop Water

Requirements, FAO Irrigation and Drainage Paper No. 24, 1977 (FAO Paper)", a method generally accepted worldwide as most accurate.

$$ETo = C \times [W \times Rn + (1-W) \times f(u) \times (ea - ed)]$$

where ;

ETo = Potential evapotranspiration in mm/day

W = Temperature-related weighing factor

Rn = Net radiation in equivalent evaporation in mm/day

f(u) = Wind-related function

(es – ed) = Difference between the saturation vapor pressure at mean air temperature and the mean actual vapor pressure of the air, both in m bar

C = Adjustment factor to compensate for the effect of day and night weather conditions

Each factor mentioned above is shown in Table Ⅳ-1 and the calculated potential evaporations are as follows :

Potential Evapotranspiration (ETo)

(Unit : mm/day)

Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
4.7	5.1	6.1	6.4	5.5	4.6	4.6	4.2	4.5	4.9	4.9	4.5

(2) Crop coefficient

The proposed cropping pattern consists of rainy season paddy, dry season paddy and field crops. The crop coefficient varies with the kind of crop, time of planting or sowing, and stage of crop development. The determination of crop coefficient is made based on the said FAO paper. The estimated crop

coefficients vary from 0.95 to 1.1 for the rainy season paddy, 1.0 to 1.25 for the dry season paddy and 0.5 to 1.05 for the dry season peanut.

(3) Water Consumption

Water consumption by each proposed crop is calculated by multiplying potential evapotranspiration by the crop coefficient shown in Fig. Ⅳ-1, -2, -3.

2.3 Percolation

The field observation of the water requirement in depth in the existing paddy field during both seasons was carried out by using a water level recorder. The observation results show that (CU) + (P) (Evapotranspiration + Percolation) varies from 5 to 7 mm/day in the rainy season, and 7 to 9 mm/day in the dry season. The soil in the project area is mostly loamy-sand. Considering the observation results, soil type and the available information obtained from the existing irrigation projects, the percolation rate is determined at 1.5 mm/day for the rainy season and 3 mm/day for the dry season.

2.4 Other Water Demand

(1) Puddling water requirement

The puddling water requirement consists of water equivalent in soil moisture before and after puddling, standing water required in soil surface, and evaporation and percolation losses from paddy field, etc. Taking these factors into consideration, the puddling water requirement is estimated as follows :

i) Depth of soil and porosity
   Surface soil (15 cm) : 50 %
   Subsoil (15 cm) : 50 %

ii) Soil vapor phase after puddling : 5 %

iii) Soil moisture before water supply : 20 %

iv) Water to be supplied
   Water to be supplied to soil profile : 75 mm

Evaporation	:	40 mm
Percolation	:	30 mm
Standing water depth after puddling	:	30 mm
Total	:	175 mm, say 180 mm

(2) Nursery water requirement

The nursery water requirement refers to water needed for preparation of nursery bed, and evapotranspiration and percolation during nursery period. The nursery water requirement is estimated at 420 mm on the following conditions :

i) Nursery bed	:	1/20 of paddy field
ii) Nursery period	:	30 days
iii) Required water for 30 days		
Preparation of nursery bed	:	180 mm
Evapotranspiration (5 mm/day)	:	150 mm
Percolation (3 mm/day)	:	90 mm
Total	:	420 mm

2.5 Effective Rainfall

Design rainfall to estimate water requirement is probable minimum rainfall with a 6-year return period, corresponding to 1,252 mm in a year. The effective rainfall is estimated on a monthly basis, using "monthly effective rainfall curve" developed by the Committee for Coordination of Investigation of the Lower Mekong Basin (the Mekong Committee) as shown in Fig. Ⅳ-4. The estimated effective rainfall is as follows :

Effective Rainfall

(Unit : mm/day)

Rainfall	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
(1)	17	5	14	49	116	324	204	303	101	119	0	0	1,252
(2)	13	0	12	43	95	227	165	220	83	100	0	0	958
(3)	13	0	12	43	90	137	125	137	80	92	0	0	729

Note : 1) Design rainfall
2) Effective rainfall for paddy rice
3) Effective rainfall for field crops

2.6 Irrigation Efficiency

The irrigation loss refers to farm application loss, operation loss and conveyance loss. The farm application loss in paddy field is considered to be small, but that in field crop irrigation is significant since it includes percolation, surface run-off, etc. Taking into account the soil characteristics, topography, climate, irrigation practices and experience, etc. , the application efficiency is assumed to be 85 % for paddy rice irrigation and 65 % for field crop irrigation.

The operation loss is the irrigation water wasted due to improper canal gate operations and unskilled water management in the field. According to the actual results measured in the irrigated paddy field of South Asian countries, a total operation loss is 50 to 100 % of the net irrigation water requirement. Even after the canal operation practices and water management are improved through appropriate guidance, a certain amount of irrigation water requirement will be wasted. Considering these factors, the operation efficiency is assumed to be 80 %.

The canal conveyance loss is caused by seepage through the wetted perimeter of the canal and evaporation from the canals water surface. In order to measure the canal conveyance loss, the team went to the existing Thonhen canal on 25th January, 1990. As a result, an average conveyance loss of 0.11 % (the flow reduced from 0.495 m^3/s to 0.4945 m^3/s with a 1000 m of canal length) was measured. When

this value is applied to the irrigation canal, the conveyance loss of about 10 % of diversion water requirement is estimated considering an 89,470 m of total canal length. The conveyance efficiency is assumed to be 90 % based on this value.

Overall irrigation efficiency is estimated at 61 % for paddy rice irrigation and 47 % for field crop irrigation as shown below :

Efficiency	Paddy Rice	Field Crop
Application efficiency	85 %	65 %
Operation efficiency	80 %	80 %
Conveyance efficiency	90 %	90 %
Overall efficiency	61 %	47 %

2.7 Diversion Water Requirement

Diversion water requirement is estimated by dividing the total net irrigation water requirement by the overall irrigation efficiency. The total net irrigation water requirement refers to the net irrigation water requirements for paddy rice and field crops based on the cropping pattern. Unit diversion water requirements for rainy season paddy, dry season paddy and dry season field crops are shown in Fig. IV -1, -2, -3. Further, based on the cropping pattern for both Nhyod H. Bak and Namphou irrigation area, the diversion water requirements are as follows, showing the maximum diversion water requirement to be 1.3 m^3/sec for Nhyod H. Bak and 0.8 m^3/sec for Namphou area, respectively.

Diversion Water Requirement (m^3/sec)

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Nhyod H. Bak Irrigation Area												
Paddy (900ha)	-	-	-	-	-	0.3	1.0	0.0	0.6	0.5	0.07	-
Paddy (400ha)	0.7	0.7	0.7	0.2	-	-	-	-	-	-	-	0.1
Field (400ha)	0.3	0.5	0.6	0.2	0.02	-	-	-	-	-	-	0.01
Total	1.0	1.2	1.3	0.4	0.02	0.3	1.0	0.0	0.6	0.5	0.07	0.11
Namphou Irrigation Area												
Paddy (705ha)	-	-	-	-	-	0.2	0.8	0.0	0.5	0.4	0.05	-
Paddy (90ha)	0.2	0.2	0.2	0.03	-	-	-	-	-	-	-	0.02
Field (95ha)	0.08	0.1	0.2	0.05	0.0	-	-	-	-	-	-	0.0
Total	0.28	0.3	0.4	0.08	0.0	0.2	0.8	0.0	0.5	0.4	0.05	0.02

2.8 Design Discharge

In order to determine the design discharges for both Nhyod H. Bak and Namphou Irrigation areas, the proposed cropping patterns should be considered. As shown in Fig. Ⅳ-1, -2, -3, the maximum diversion requirements per ha are 1.1 lit/sec/ha for rainy season paddy, 1.87 lit/sec/ha for dry season paddy and 1.53 lit/sec/ha for dry season field crop. The proposed cropping plan is summarized below.

Proposed Cropping Plan

	Nhyod H. Bak	Namphou
Rainy season paddy	950 ha	705 ha
Dry season paddy	400 ha	90 ha
Dry season field crop	400 ha	95 ha

Considering the conditions above and aiming to avoid overdesign, the design discharges for both areas are determined as follows :

Nhyod H. bak
- Main canal : 1.43 lit/sec/ha
  (1.87 + 1.53) /2 ×800/950 = 1.43)
- Secondary, Turnout : 1.87 lit/sec/ha
  (Requirement for dry season paddy)

Namphou
- Main canal : 1.1 lit/sec/ha
  (Requirement for rainy season paddy, more area than limited dry season cultivation area)
- Secondary, Turnout : 1.87 lit/sec/ha
  (Requirement for dry season paddy)

3. Soil Characteristics and Irrigation Schedule

3.1 Available Soil Moisture

The available moisture in the soil is expressed as moisture amount held by the soil between field capacity and wilting point. The moisture level at 1/3 atmospheric pressure is usually considered to be the field capacity. The wilting point corresponds to the moisture held at 15 atmospheric pressure. The valuable moisture largely depends on soil type, soil texture and rooting depth of soil. The soil in the proposed field crop area is identified as loamy sand. The main crop is peanut. The available moisture is estimated at 130 mm/m from the relationship among soil type, kind of

crop and the available moisture which is shown in FAO paper. The readily available moisture is calculated at 39 mm as follows :

(1) Available soil moisture	:	130 mm/m
(2) Fraction of available soil moisture	:	0.5
(3) Rooting depth	:	0.6 m
(4) Readily available moisture	:	(1) × (2) × (3) = 39mm
(5) Application efficiency	:	65 %
(6) Depth of irrigation application	:	(4) / (5) = 60 mm

3.2 Irrigation Schedule

Irrigation interval for peanut is estimated according to the net depth of irrigation application and rate of evapotranspiration. Since evapotranspiration is 4.9 mm/day, the irrigation interval is 8 days as follows :

Irrigation Interval (day) = (1) / (2)
= 39 (mm) / 4.9 (mm/day) = 8 days

Note : (1) = Net depth of irrigation application (mm)
(2) = Evapotranspiration (mm/day)

4. Drainage Water Requirement

4.1 General

The project area will consist of paddy field and upland field. The upland field in the estimate of drainage water requirement is defined as non-paddy field such as fallow land, forest, etc. Since drainage characteristics of these lands are different, particularly in run-off time and run-off discharge, the drainage water requirement for paddy field and that for upland field are separately estimated. In this estimate, the daily maximum rainfall with a 10-year return period is adopted as design rainfall.

4.2 Drainage Water Requirement for Paddy Field

(1) Period for draining excess water from paddy field

In order to determine allowable period for draining excess water from paddy field, the frequency of rainfall that occurred before and after the occurrence of the annual maximum daily rainfall is examined, using daily rainfall data recorded at Xeno meteorological station during the past 10 years. This study result shows that a 2-day continuous storm with more than 50 mm/day rainfall scarcely occurs (no case in 10 years). The period for draining excess water from paddy fields is determined to be 2 days. The study result is as follows :

Frequency (1981 - 89)

Daily Rainfall	Number of Days after Annual Max. Daily Rainfall							
(mm/day)	-1	0	1	2	3	4	5	6
No Rainfall	2	-	3	5	4	3	3	4
Less than 50	7	-	6	2	5	6	5	5
More than 50	0	-	0	2	0	0	1	0

(2) Damage to paddy by inundation

Since a part of the design rainfall is stored in paddy fields, their effects to the yield of the paddy is studied, making reference to the "Hand Book on Estimating Yield Reduction rates of Summer Crop due to Various Causes" published by the Ministry of Agriculture, Forestry and Fisheries of Japan in 1975. The following are quoted from the book :

i) The submergence at the growing stage of young panicles formation seriously damages the paddy, while that at the maturing stage does not seriously damage the paddy.

ii) The duration of submergence within 1 to 3 days is insignificant, but the damage to paddy remarkably increases if the submergence lasts for more than 3 days.

Based on the above, it is concluded that a 2-day duration for draining excess water from the paddy field will not damage the yield of the paddy rice.

(3) Design rainfall

the probable annual maximum daily rainfall is analyzed by using the Gumbel-Chow formula. The annual maximum daily rainfall with a 10-year return period is estimated at 185 mm, which is adopted as design rainfall. the annual maximum daily rainfall with different return periods are as follows :

Annual Maximum Daily Rainfall

(Unit : mm/day)

10-year	20-year	50-year
185	211	245

(4) Drainage water requirement for paddy field

Based on the conditions mentioned above, the drainage water requirement is estimated at 6.1 lit/sec/ha as shown below.

Assumptions :

i) Design rainfall is 185 mm/day
ii) Effective water depth in the paddy field is 110 mm
iii) Standing water depth in the paddy field is 30 mm
iv) Excess rainfall to be drained from the paddy field within 48 hours is 105 mm

Calculations :

$Q = q \times A$

$q = RE24 \times 10m^2 / (3,600 \text{ sec} \times 48 \text{ hours})$

$= 105 \times 10 / (3,600 \times 48) = 6.1$ lit/sec/ha

$RE24 = R24 - (D1 - D2) = 185 - (110 - 30) = 105$ mm

Where :

Q = Design drainage water requirement (m^3/sec)
q = Unit drainage water requirement per ha
A = Drainage area
R24 = Design rainfall, 185 mm/day
D1 = Effective water depth in the paddy field, 110 mm
D2 = Standing water depth in the paddy field, 30 mm
RE24 = Excess rainfall to be drained, 105 mm

4.3 Drainage Water Requirement for Upland Field

Rainfall water runs off from the upland field immediately after rainfall. There is no storage function in the upland field. The drainage water requirement for the upland field is considered to be the peak runoff from the upland field. In order to estimate the peak runoff, the upland field including the outer drainage area of the project, is divided into 26 sub-areas for Nhyod H. Bak area and 17 sub-areas for Namphou area, considering the topography and future layout of the drains. the peak runoffs from these areas are individually estimated by the Rational formula shown below :

Calculations :

$Qp = (1/3.6) \times f \times r \times A$

$r = R24/24 \times (24/T)^{(2/3)}$

Where :

Qp = Peak runoff discharge (m^3/sec)
r = Rainfall intensity (mm/hr)

f = Runoff coefficient
A = Catchment area (Km^2)
R24 = Daily rainfall (mm)
T = time from start of rise to peak rate (hr)

In the estimate, the following assumptions are made :

i) R24 = 185 mm (Design maximum daily rainfall)
ii) f = 0.6 (undulating area or forest area)
iii) T = T1 + T2
T1 = time from start of rise to peak rate of surface runoff using the figure by the U.S.Army Corps of Engineers
T2 = time from start of rise to peak rate of river channel using the Rziha formula below :

$$T2 = L2/1{,}200/(H2/L2) \hat{} 0.6 \text{ (min.)}$$

where : L2 = length of river channel (m)
H2 = difference of elevations between the upper most and the lowest river channels

All the results thus computed are shown in Table Ⅳ = 2.

Table Ⅳ-1. Potential Evapotranspiration (ETo)

ETo by Penman Method
Altitude : 155 m (Savannakhet)
Latitude : 16°33'

	Unit	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
T mean	°C	21.6	25.1	27.6	29.5	29.1	28.2	28.4	27.7	27.5	26.4	23.9	20.9
ea	m bar	25.4	31.7	36.5	41.0	40.1	27.8	37.9	36.7	36.6	33.6	28.9	24.1
RH mean	%	67	68	64	67	74	79	79	82	78	75	71	68
ed	m bar	17.0	21.6	23.4	27.5	29.7	29.9	29.9	30.1	28.5	25.2	20.5	16.4
ea-ed	m bar	8.4	10.1	13.1	13.5	10.4	7.9	8.0	6.6	8.1	8.4	8.4	7.7
U mean	m/s	2.5	1.8	1.9	1.8	1.3	1.5	1.4	1.4	1.4	2.0	2.6	2.7
U	km/day	216	156	164	156	112	130	121	121	121	173	225	233
f(u)		0.85	0.68	0.70	0.68	0.57	0.62	0.59	0.59	0.59	0.73	0.87	0.89
1-w		0.29	0.25	0.23	0.22	0.22	0.22	0.22	0.23	0.23	0.24	0.26	0.30
w		0.71	0.75	0.77	0.78	0.78	0.78	0.78	0.77	0.77	0.76	0.74	0.70
Ra	mm/day	11.6	13.0	14.5	15.5	15.9	15.8	15.8	15.6	14.8	13.6	12.1	11.1
n	hr/day	8.9	8.8	8.1	8.1	7.3	5.4	5.6	4.6	5.7	7.3	8.6	8.7
N	hr/day	11.3	11.6	12.0	12.6	13.0	13.2	13.0	12.7	12.3	11.8	11.4	11.2
Rs	mm/day	7.4	8.1	8.5	8.8	8.4	7.1	7.3	6.7	7.1	7.6	7.5	7.0
Rns	mm/day	5.5	6.0	6.3	6.6	6.3	5.3	5.4	5.0	5.3	5.7	5.6	5.2
f(T)		15.0	15.9	16.3	16.7	16.6	16.4	16.5	16.3	16.2	16.0	15.4	14.8
f(ed)		0.15	0.13	0.12	0.11	0.10	0.10	0.10	0.10	0.11	0.12	0.14	0.16
f(n/N)		0.81	0.78	0.71	0.68	0.61	0.47	0.49	0.43	0.52	0.66	0.78	0.80
Rnl	mm/day	1.8	1.6	1.4	1.2	1.0	0.8	0.8	0.7	0.9	1.3	1.7	1.9
Rn	mm/day	3.7	4.4	4.9	5.4	5.3	4.5	4.6	4.3	4.4	4.4	3.9	3.3
RH max	%	96	94	88	89	93	93	93	94	94	93	92	93
c		1.01	1.02	1.03	1.04	1.02	1.00	1.00	1.00	1.01	1.02	1.02	1.02
ETo	mm/day	4.7	5.1	6.1	6.4	5.5	4.6	4.6	4.2	4.5	4.9	4.9	4.5
	mm/month	147	143	188	193	172	139	143	131	135	153	147	183

Table - 2 Peak Runoff Discharge of Upland Area

Block No.	Area (ha)	Surface Length L1 (m)	E.L. Difference H1 (m)	Slope H-1/L-1 (%)	Drain Length L2 (m)	E.L. Difference H1 (m)	T1 1) (min)	T2 2) (min)	T 3) (min)	r 4) (mm/hr)	Qp 5) (m^3/sec)
Nhyod h. Bak Area											
1	25	200	2	1.0	800	20	31	6	37	5.8	0.2
2	136	500	12	2.4	1,900	30	25	19	54	4.5	1.0
3	36	100	2	2.0	1,100	16	20	12	32	6.4	0.4
4	66	500	4	0.8	1,600	22	35	17	52	4.6	0.5
5	38	300	2	0.7	1,200	7	35	22	57	4.3	0.3
6	386	500	12	2.4	4,000	48	35	47	82	3.4	2.2
7	82	300	3	1.0	1,100	6	35	21	56	4.4	0.6
8	48	500	2	0.4	900	9	35	12	47	4.9	0.4
9	90	400	2	0.5	1,200	12	35	16	51	4.7	0.7
10	24	300	2	0.7	600	24	35	3	38	5.6	0.2
11	312	500	16	3.2	3,300	34	34	43	77	3.5	1.8
12	24	300	2	0.7	700	13	35	6	41	5.4	0.2
13	66	400	2	0.5	1,600	14	35	23	58	4.3	0.5
14	172	500	12	2.4	3,000	12	35	69	104	2.9	0.8
15	75	500	8	1.6	2,500	10	35	57	92	3.1	0.4
16	35	200	2	1.0	1,100	6	31	21	52	4.6	0.3
17	32	400	7	1.8	500	8	35	5	40	5.5	0.3
18	15	300	4	1.3	400	7	33	4	37	5.8	0.1
19	12	200	2	1.0	300	12	31	2	33	6.3	0.1
20	11	200	2	1.0	300	8	31	2	33	6.2	0.1
21	30	400	12	3.0	500	8	33	5	38	5.7	0.3
22	16	200	4	2.0	600	12	27	5	32	6.3	0.2
23	60	500	3	0.6	500	11	35	4	39	5.6	0.6
24	29	400	2	0.5	500	2	35	11	46	5.0	0.2
25	31	400	4	1.0	500	3	35	9	44	5.1	0.3
26	10	300	2	0.7	500	2	35	11	46	5.0	0.1
Namphou Area											
1	400	200	3	1.5	2,000	12	29	36	65	4.0	2.6
2	590	500	5	1.0	2,600	10	35	61	96	3.1	3.0
3	140	300	4	1.3	1,500	22	34	16	50	4.7	1.1
4	290	300	5	1.7	1,500	30	31	13	44	5.1	2.5
5	960	500	10	2.0	5,200	40	35	80	115	2.7	4.3
6	620	500	10	2.0	3,300	40	35	39	74	3.6	3.8
7	200	500	5	1.0	900	15	35	9	44	5.2	1.7
8	280	300	5	1.7	1,100	25	31	9	40	5.5	2.6
9	190	300	4	1.3	2,000	10	34	40	74	3.6	1.2
10	240	200	3	1.5	1,300	8	29	23	52	4.6	1.8
11	550	300	4	1.3	5,000	15	34	136	170	2.1	1.9
12	230	500	2	0.4	800	10	35	9	44	5.1	2.0
13	100	400	3	0.8	1,000	5	35	20	55	4.4	0.7
14	1,590	500	8	1.6	13,500	25	35	490	525	1.0	2.6
15	70	200	2	1.0	700	5	31	11	42	5.3	0.6
16	480	500	10	2.0	4,000	20	35	80	115	2.7	2.2
17	330	300	5	1.7	2,100	15	32	34	66	3.9	2.2

Note : 1) T1 = Lag time of surface runoff using the figures by U.S.Army Corps of Engineers 0.6
2) T2 = Lag time of river channel runoff using Rziha formula ; $T2 = L2/1200/(H2/L2)$
3) T = time from start of rise to peak rate (min.)
4) r = Rainfall intensity (mm/hr)
5) $Qp = (1/3.6) \times f \times r \times A$, $r = R24/24 \times (24/t)^{(2/3)}$, Rational formula, f=.6, R24=185 mm

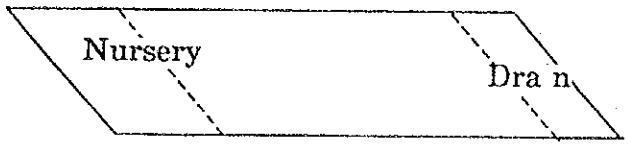
		Jun.	Jul.	Aug.	Sep.	Oct.	Nov.
CROPPING PATTERN (PADDY)							
(1) ETo	(mm)	-	143	131	135	153	147
(2) KC		-	1.1	1.1	1.05	1.05	0.95
(3) ET crop = (1) * (2)	(mm)	-	157	144	142	161	140
(4) Percolation	(mm)	-	47	47	45	47	45
(5) Effective Rainfall	(mm)	-	165	220	83	100	0
(6) = (3) + (4) – (5)	(mm)	-	39	-29	104	108	185
(7) Area Factor		-	0.5	1	1	0.78	0.06
(8) = (6) * (7)	(mm)	-	19	-29	104	84	11
(9) Puddling Water	(mm)	30	150	0	0	0	0
(10) Nursery Water	(mm)	14	7	0	0	0	0
(11) NW = (8)+(9)+(10)	(mm)	44	176	0	104	84	11
(12) DW = (11) / EF	(mm)	73	294	0	173	140	18
(lit/sec/ha)		0.28	1.10	0.00	0.67	0.52	0.07

Fig. Ⅳ - 1 Irrigation Water Requirement
(Rainy Season Paddy)

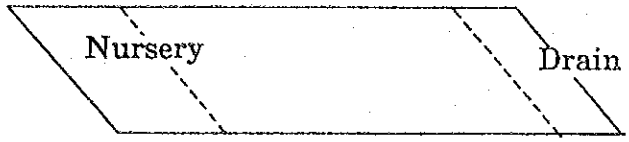
		Dec.	Jan.	Feb.	Mar.	Apr.	May.
CROPPING PATTERN (PADDY)							
(1) ETo	(mm)	-	147	143	188	193	—
(2) KC		-	1.1	1.1	1.25	1.0	—
(3) ET crop = (1) * (2)	(mm)	-	162	157	235	193	—
(4) Percolation	(mm)	-	93	84	93	90	—
(5) Effective Rainfall	(mm)	-	13	0	12	43	—
(6) = (3) + (4) – (5)	(mm)	-	242	241	316	240	—
(7) Area Factor		-	0.52	1.0	0.95	0.24	—
(8) = (6) * (7)	(mm)	-	126	241	300	58	—
(9) Puddling Water	(mm)	30	150	0	0	0	—
(10) Nursery Water	(mm)	14	7	0	0	0	—
(11) NW = (8)+(9)+(10)	(mm)	44	283	241	300	58	—
(12) DW = (11) / EF	(mm)	73	471	402	500	96	—
	(lit/sec/ha)	0.27	1.76	1.66	1.87	0.37	—

Fig. Ⅳ - 2 Irrigation Water Requirement
(Dry Season Paddy)

		Dec.	Jan.	Feb.	Mar.	Apr.	May.
CROPPING PATTERN (Peanut)							
(1) ETo	(mm)	138	147	143	188	193	172
(2) KC		0.5	1.0	1.05	1.05	0.6	0.6
(3) ET crop = (1) * (2)	(mm)	72	151	156	204	118	104
(4) Effective Rainfall	(mm)	0	13	0	12	43	90
(5) = (3) – (4)	(mm)	72	138	156	192	75	14
(6) Area Factor		0.05	0.78	1.0	1.0	0.92	0.5
(7) NW = (5)*(6)	(mm)	4	108	156	192	69	7
(8) DW = (7) / EF	(mm)	8	229	332	409	147	15
(lit/sec/ha)		0.03	0.86	1.37	1.53	0.57	0.06

Fig. Ⅳ - 3 Irrigation Water Requirement
(Dry season Field Crop = Peanut)

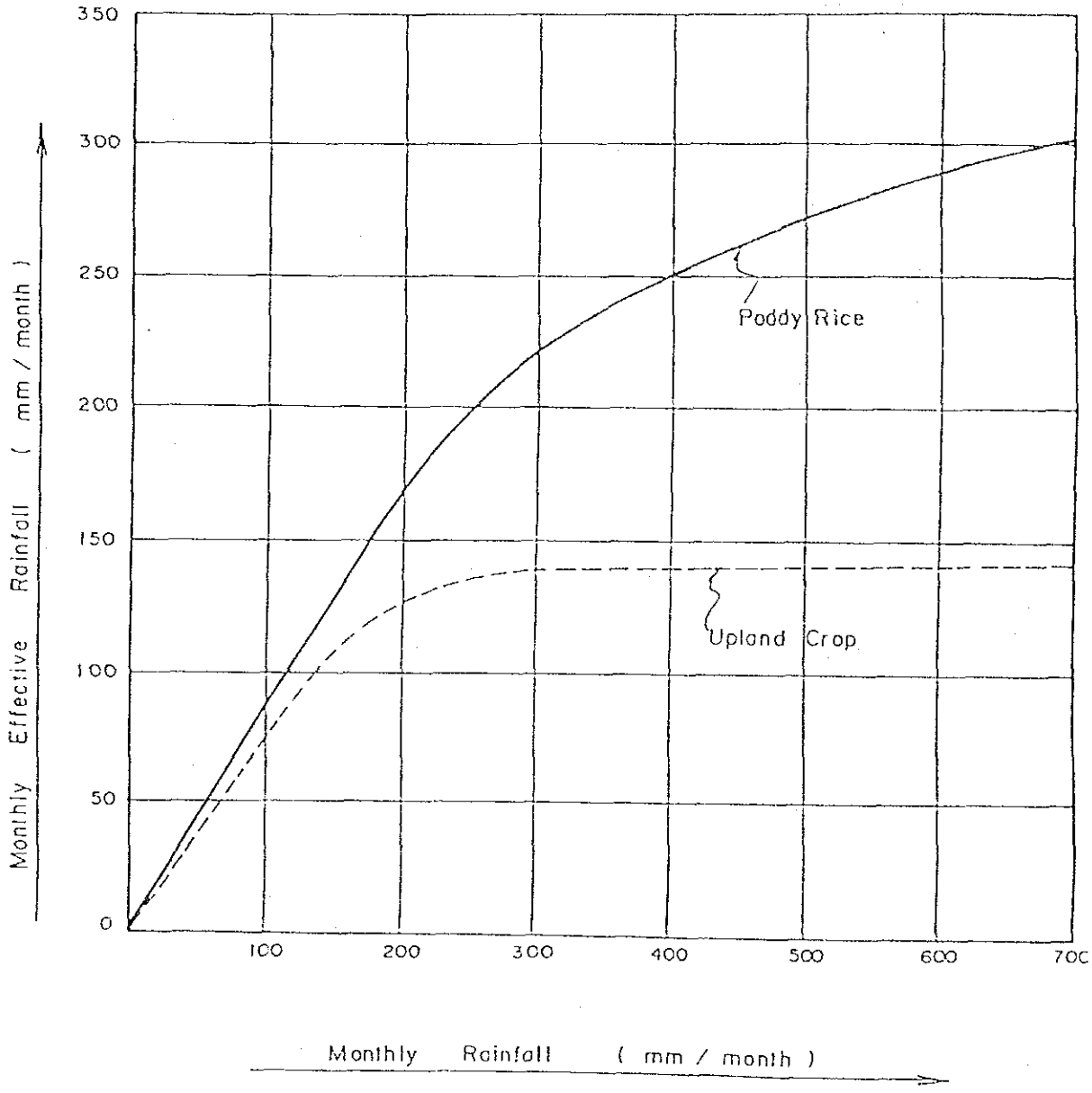


Fig. IV - 4 Effective Rainfall Curve

ANNEX V

AGRICULTURE

ANNEX V

AGRICULTURE

Table of contents

List of Tables

List of Figures

General

The agricultural field investigation and studies were carried out in and around the Project area to clarify the present agricultural conditions and to assess potential land productivity. For this purpose, data and information concerning land use, cropping patterns, yield and production of crops, farm inputs, etc, in the Project area were collected.

1. Present Agricultural conditions

1-1 Cropping Situation

The area mainly cultivates paddy fields. Industrial crops such as upland rice, cotton, hemps, etc. are also cultivated in the area. The Cropping percentage is estimated at 80% for paddy rice, 15% for upland rice, 5% for vegetables and industrial crops, while cultivation ratio corresponds to 100% for the rainy season cropping, and 2% for dry season cropping.

The present cropping situation in the Study Area is shown on Table V - 1.

1-2 Rice Cultivation

98% of the paddy rice are glutinous rice of which 20% are early maturing species, 30% are medium maturing species and 50% late maturing species. Paddy cultivation and rice planting starts in the downstream area where water circulation is good. Late maturing species are then planted in this area. It then proceeds to other paddy fields with good water circulation where the early maturing species are finally planted.

Regarding cultivation standards, the amount of seed rice used in the nursery beds is roughly estimated at 40 kg/ha, however, the area of paddy fields cultivated by each farmer can't be determined precisely.

According to the results of the interviews, the volume of urea spread onto the fields is 10 kg/ha, 25 kg/ha of ammonia and 50 kg/ha of compost. Paddy field

weeding is carried out twice per crop by hand, but is not required for paddy fields located in zones fully filled with water.

Rice damage is calculated by assessing total damage amount from the average yield. Damage amount of rice culture in the whole area is shown in Table V - 2.

1-3 Field Crop Cultivation

Cultivation is carried out by cutting and throwing the weeds after harvest and then burning and conducting direct seeding directly before the rainy season. The different crops cultivated during the rainy season are peanuts with a ratio of 65%, 25% for industrial crops such as cotton, sesame and hemps, and 25% for vegetables. The area of field crop cultivation in the Study Area. Peanut production (fresh seeds with shells) during the harvest season amounts to about 500 kg/ha, and water melon in the dry season amounts to 4,500 kg/ha.

1-4 Fruit trees

There are no fully settled orchards in the Study Area and only several trees are planted in the village surroundings. The impediments in orchard development in this Area are the following: 1) cultivation knowledge of the farmers are very poor; 2) transmission of market information are inadequate, and short supply of fruit trees. The tree species and cultivation quantity are shown in Table V - 3.

1-5 Livestock and Poultry Feeding

Livestocks usually gain weight during the rainy season, but lose weight during the dry season. The average birth rate of piglets is 5 heads, but a small number of baby pigs die within a year (about 2 heads); as for poultry, the brooding average is twice a year and each brooding consists of about 5 eggs, but a lot of chicks die soon. If we examine the data concerning the number of livestock in the past 5 years in the Study Area, it appears that cattle and poultry are making gross progress, as shown in Table V - 4.

1-6 Fish Farming

Aside from the inflow of cash, cheap protein resources can also be developed. The Savannakhet Bureau of Agriculture made a study on farming in paddy fields, however, the Project wasn't realized due to lack of funds. The government-run farm of Phukubou, which was the base for the supply of fries, had to stop producing young fishes because of poor management. Therefore, the supply of fries is only provided by small scale private water culture traders.

Before the Liberation, the main farming ponds were located at Dongphosi and at Nonghong Noy, the latter an army post at that time. These fish farming ponds were changed into paddy fields, and at present field farming is completely terminated. The market prices in Kenkoku market, located near the Study Area, are shown in Table V - 5.

1-7 Assistance to Farmers

An information counter has been established within the Savannakhet Agricultural Bureau to investigate the financing of farming funds intended for small farmers. However, in order to obtain a loan with low interest rate, it is necessary to draw up one's personal assets and method of repayment and to obtain the approval of the Bureau of Agriculture. Further, those who have never written documents shall have to design a plan and small scale farmers have never been granted loans with low interest rates as the formulation of these documents are difficult.

Although the area is afforded with technical assistance, the engineers stationed use diverse techniques. On top of that, there is also a shortage in the absolute amount of agricultural input such as compost, seeds and agricultural chemicals, which the farmers require. According to the survey conducted on farmers, the need for agricultural input materials are growing and although the sales policy is being hurriedly reformed, there are no signs of improvement.

1-8 Labor Force

Draught animals used as labor force hold 10% of the total volume of work; the majority of the work is executed by man power. Labor is most particularly required during the rice planting and harvest season. To ensure the labor force in this period, mutual assistance is practiced and priority is given to relatives. Shown in Table V - 6.

The standard volume of labor force in the Study Area can be converted as follows: male adult 1.0; female adult 0.8; child (10>15) 0.3. Rice planting and harvest periods involve the most intensive work in paddy field cultivation. The labor of a male adult is 45 days/man/ha in rice planting time and 17 days/man/ha in harvest time. Further, the use of machines is also expected to bring better results.

1-9 Land Consolidation and Land Conversion

Most of the cultivated lands are isolated from each other, and mutual cooperation is not evident between land users. Therefore, water circulation in plot-to-plot irrigation deteriorates and the unnecessary moisture drained from paddy fields straight to the rivers is increasing. The main reasons why land exchange is difficult to implement are as follows: 1) strong attachment to the land: 2) vagueness of the land evaluation norms.

1-10 Consumption of Agricultural Products

Except for rice, there are no data on the annual consumption rate of food per capita. The consumption rate of rice by grain is assumed to be 330 kg/man/year. According to the results of the interviews conducted in the Area on meat consumption, meat is also consumed at irregular ceremonies aside from the number of animals butchered in the slaughterhouse of Chiangphong district. In addition, the results also indicate that approximately 1.5 kg/man/year of meat is consumed per person/year, approximately 0.3 kg of fish and 3.3 kg/man/year of vegetables. Shown in Table V - 7.

1-11 Diffusion of Agricultural Machinery

The public enterprises under the control of the Bureau of Agriculture rent out agricultural machines and implements like tractors and trucks and promotes the mechanization of agricultural works. However, mechanization is obstructed by the following: 1) farmers can't afford the rental fees due to scanty farming capital, 2) the lagging improvement of cultivated lands and rural roads makes the delivery of machines difficult; 3) shortage of men experienced in the operation of the machines. The unresolved state of these problems hinder the rental and diffusion of agricultural machines and implements.

1-12 Use of Agricultural Chemicals and Composts

Compound fertilizers are remarkably effective and easy to transport, and therefore, are being widely used in the area. On one hand, the transportation cost of the supply coming from Vientiane is expensive that it is cheaper to purchase the fertilizers directly from Thailand than from the Area. Restrictions imposed on the exportation of fertilizers in Thailand, however, obliged the farmers in this area to use smuggled items.

Compound fertilizer is used as a basal fertilizer during the cultivation period. It is rarely used as a top dressing, the most effective use of compound fertilizers, because, 1) shortage in fertilizer application techniques causes uneven sprinkling of fertilizer which damages the growth and development of the crop, 2) lack of capital to purchase the compost used for top dressing.

The agricultural chemicals used are mainly insecticides, whereas bactericides and herbicides are scarcely used at all.

The amount of fresh supply of goods are given below, though the quantity used in the whole area is not precise.

Name of the District	*1987	*1988	*1989	*1990	*1991	Compound Fertilizers	Insecticides
Kanthaboly	90	144	106	150	71	65	32
Champhone	40	135	54	60	39	32	18

*Quantity of fresh supply of urea (ton)

2. Agricultural Development Plan

General

Self-sufficiency in rice production is not yet completely achieved. Crop yield is always unsteady and besides paddy fields, there are no others means to convert cash crops. The plan, therefore, aims to achieve a complete self-sufficiency in the production of agricultural products at an early stage, by using the limited arable land effectively and through the progress of cultivation techniques, and then to export agricultural products in the future.

2-1 Development Plan Method

Water is a very important factor in the stabilization of the yield. Accordingly, irrigation facilities shall be established and supplementary irrigation shall be planned.

As for dry season cropping, the effective use and the marketability of water resources will be examined and the cropping of rice and peanuts will be planned.

Rice is a basic crop. Accordingly, the plan proposes to renew the cropping system from long stem late maturing varieties to short stem early maturing varieties and considers the effects of fertilizer application and the steady increase of yield.

Farmers in the area are virtually inexperienced in cultivation activities. Therefore, more demonstration farms are to be established to popularize techniques which would enable the farmers to adapt flexibly to the future mechanization and cropping conversion plans.

Cultivars for the rainy season cropping are those particularly photo-periodically sensitive during this period, such as RD6, RD8 and Sampatong. However, RD10 and IR789, cultivars of low photo-periodic sensitivity, shall be cultivated in the dry season cropping period.

Rice seeds of low photo-periodic sensitivity, such as RD10 and IR789, are necessary in rice culture irrigation and are supplied by the Tasano seed farm. Cultivation farmers replace their rice seeds every after 3 years. As a result, the unit price of rice seeds has grown cheaper at about 92 Kips, that is, 38 kips cheaper than if the seeds were renewed every year.

The cropping plan entails 100% rice cultivation for the rainy season cropping and 50% paddy irrigation and another 50% field crop irrigation for the dry season cropping. Cropping is aimed to elevate the effectivity of irrigation, therefore, watering shall start from the paddies upstream and then shall progressively advance downstream.

The purpose of the cultivation plan is to change the wet season crop by planting improved varieties and to completely renew the seeds of the wet season crop in the whole Area in 5 years. A sowing rate of 40 kg/ha would be adequate if the rice seeds are carefully selected, as this would assure the improvement of the germination percentage.

2-2 Development Area and Input Materials

The total area to be developed is 1655 ha, 95 ha of Houay Bak and 705 ha of Namaphou. Supplementary irrigation shall be carried out in the whole 1655 ha in the rainy season, while paddy cultivation in the dry season shall be carried out in half of the whole area, that is a total of 950 ha.

Work program and work schedule for 1 ha of cultivated land:

-	Utilization of draught animals:	1) Land preparation:	5 days
		2) Leveling:	5 days

		3) Carriage:	5 days
		Total days planned:	15 days
-	Employed labor force:	1) Rice planting:	10 days
		2) Harvest:	20 days
-	Family labor force:	1) Cultivation:	25 days
		2) Seedling:	3 days
		3) Rice planting:	35 days
		4) Field management:	15 days
		5) Harvest:	45 days

The increase in work volume can be estimated at 8 men/day. The main works that are thought to increase in volume are: 1) water management, and 2) manuring practice. The Input materials are shown in Table V - 8.

2-3 Improvement Results

The target year of this project is 5 years after the completion of the dam construction. By this year, the yield developments are expected to be 4 t/ha for the mean yield of wet season crops and 4.5 t/ha for dry season crops.

The progress in the present agricultural techniques will bring about a yield increase of 1.8 tons/ha from 1.5 tons/ha. However, even if we consider the conditions prevailing during the cultivation periods, the yield of the area can only increase up to 1.8 tons/ha.

Although the area had sufficient margin for development, the development of the field crops was hampered by the 1) lag in the popularization of modern techniques for cultivation, and 2) weak organizing abilities. It can be concluded, therefore, that the drop in prices was caused by the imperfection of the formation of the producing districts and the sales structure. This project, therefore, aims to increase the production of field crops and to diffuse techniques.

2-4 Cultivation Method

Peanut has been chosen as the rotation crop after the farmers' experience in cultivation, existence of an effective market, soil suitability, watering volume, storage and processing were fully considered. Although the cultivation of beans and garlic were studied also, peanut cultivation was encouraged based on the factors below.

1) Soil suitability
2) Lowest water requirement
3) There is a market for peanuts and overproduction poses no problem as dry preservation is possible.

The present practice of peanut cultivation does not build rice-field ridges on the sharp slopes of cultivated lands used. Further, hoes are not used during harvest, instead, the farmers or the laborers get hold of the stem of the leaves to pull the crops, and by doing so, leave plenty of seedlings in the ground.

In peanut cultivation, watering is required from the sowing period upto the flowering period. It is better to leave the soil dry during fructification, in order to prevent the seeds from getting spoiled.

Interrow space irrigation shall be adopted and the cultivation of early maturing and high-yielding native varieties shall be popularized.

The following results can be expected from seed replacement:

- a sowing volume average of 60 kg/ha;
- an interhill space of 20 cm, and an interrow space of 30 cm;
- approximately 16,000 hills/ha.

To protect the seeds from birds, they shall be dipped into the waste oil of machines before they are sown.

A fertilizer application plan shall be made for manuring. This plan shall entail the use of 1000 kg of compost/ha as base/fertilizer and 50 kg. of compound fertilizer/ha.

The production cost and work distribution per hectare are shown in Table V - 9.

Recommended Seedboard Variety of Peanut

Variety	Seedling (kg/ha)	Yield (t/ha)	Shelling (%)	Maturity (day)
EG. Bunch	65 - 70	1.8 - 2.1	70	105 - 110
BPI- P9	60 - 65	1.8 - 2.1	60	104 - 110
UPL - Pn 2	60 - 65	1.8 - 2.1	70	90 - 100
UPL - Pn 4	60 - 65	1.8 - 2.1	72	95 - 100
UPL - Pn 6	60 - 65	2.0 - 2.5	65	105 - 110
	50 - 60	1.8 - 2.3	68	101 - 102

Sourse. Plant Industry Production Guido (40) Peanut 1986.

Soil Requirement

Peanuts grow best in deep soil and in light textured soil such as loam, slit loam, silty clayey loam.

The soil should be moderately to slightly acidic, with a PH ranging from 5.8 to 6.2. This PH range is favorable for nitrification of the Rhizobium bacteria that partly supplies the nitrogen need of peanuts.

The cultivation project will plan soil improvement by plentifully spreading compost in cultivated fields.

The field management plan shall be intended for farmers totally inexperienced in irrigated cultivation and as such, the following shall be given consideration.

1) Prevention against excessive watering;

2) The diffusion of the use of agricultural implements shall be planned due to the increase in manuring and weeding works brought about by the increased use or application of fertilizer.

Although fresh water fishes are the residents valuable source of protein, a stable catch is not maintained.

3) Preservation of Products

This propagation of techniques will be conducted at the demonstration farms under good guidance.

2-5 Yield Estimates

Farmers of the Area are unfamiliar with irrigated cultivation, thus it can only be assumed that the peanut harvest will become steady from the 5th stage crop.

The yield estimates are shown in Fig. V - 1.

3. Fresh Water Fish Development

General

This project, therefore, shall delve into the development of inexpensive protein resources and shall work on the expansion of additional sources of income and the improvement of the residents' diet.

3-1 Breeding Method of Fresh Water Fish

One of the development objectives of this project is to stock the new planned dam with fishes. A small-scale hatchery will be built and attached to the new Center planned. Aside from securing the stock of fries, they shall also be sold to aspiring fish farmers.

After duly considering the river environment of the area, it was concluded that Tilapia Nilofica and Common Carp ① have high propagating powers and grow fast, and ② are highly consumptible. Therefore, fry breeding shall be planned.

To protect slow, small and weak fries from natural enemies and to improve the life rate of stocked fries, they shall be stocked for approximately 3 weeks, and then transferred to the dam after they are fully grown.

Fries shall be purchased from Thailand for breeding, and those to be made as parent fishes shall be selected and then stocked in a small pond.

The nutritive elements of fry feed and chick feed are the same, and as such, fries will be bred with chick feed available in the market. Also, to increase the volume of feed enough for it to last for 3 days and to curtail feed expenses, bred fish feed shall be mixed with rice bran and chicken feed.

The depth of the fish ponds increases in the rainy season and decreases in the dry season. It is, therefore, necessary to guarantee a minimum depth averaging 45cm all throughout the year. Consequently, pipes will be laid below the ground in between fish ponds, and through these pipes, the required minimum depth can be acquired.

Tilapias are fresh water fishes vastly distributed in subtropical and tropical zones. These fishes are polyphagous and therefore, breeding them is easy as they can settle for rice bran, cattle manure, oil meal, etc.

When fully provided with feed, Tilapias bred in fish ponds grow fast from 8cm fries to an average of 200~250 grams after 3 months.

There are two kinds of Tilapia, the Tilapia Nilotica and Tilapia Mossambica. This project will, however, breed the fast growing Nilotica.

The most suitable water temperature for breeding Tilapia is 25°. A temperature of less than 20° will hamper the growth of the fries. Tilapias can adapt to different environments, that even in contaminated areas, their breeding is possible.

The breeding of female Tilapias is considered profitable as they grow fast. There will be no distinction between sexes in fish ponds as they shall not be bred in the said area.

Carps are fresh water fishes that inhabit subtropical and temperate zones. Except for Grass Carps, Silver Carps and Common Carps are polyphagous.

Parent fishes for reproduction must be renewed, otherwise their propagating power will deteriorate, especially Tilapias which can only be used for 2 years.

The male and female ratio of fries in fish ponds is 8:19 for Tilapia and 4:16 for Carps, respectively. Although these ratios have been standardized, the male ratio is raised when fertilization rate decreases.

3-2 Fry Production in the Hatchery

A hatchery consists of a breeding pond and a stocking pond. Parent fishes are placed in a dug pond while the pond for fries will be built in cement. Rainwater will be stored and used as water resources. Fig. V - 2 summarizes the outline of the pond.

The rough estimate of fry production is: 1 kg of Tilapia spawn contains 320,000 eggs, and a 250g female fish can spawn about 3,500 eggs. As for carps, 1 kg of spawn contains between 80,000 and 120,000 eggs, and a female can spawn about 1,000 eggs.

According to the data of the breeding farm, the death rate of 6 month-old fries averages from 7~10. On the other hand, 6 month-old fries in their natural habitat have very short life span with a death rate of 0.5~370.

The average number of incubated Tilapia eggs amounts to 3,500. A breeding pond of approximately 2 ares can accommodate 6 male fries and 14 female fries. A production of 49,000 eggs can be estimated, but given that 1070 of the eggs die, only approximately 41,650 eggs/spawn shall be produced.

As for Carps, about a 1,000 of the eggs are incubated and a breeding pond of about 2 ares can produce 16,000 eggs. Therefore, approximately 12,600 eggs shall be spawned.

Fish Species	Incubated Eggs Quantity	Male and Female Comparative Rate	Hatching Rate	Stopped Eggs Rate	Spawn Quantity
Tilapia	3,500	8:19	95%	10	56,858
Carp	1,000	4:16	90%	10	12,960

Source. Fish and Fisheries of India 1986

3.3 Fry Production

The last achievement period of the Project will be 5 years from the start of fry breeding, and the annual production of fries will be as follows:

Fish Species	Spawn Qnantity	Hatching Frequency	Annual number of hatched eggs (year)	Fry Production (total)	Fry Purchase Amount (fry)
Tilapia	56,858	*3	66,500	63,175	126,350 kip/year
Carp	12,960	*2	16,000	12,800	25,600 kip/year

3.4 Fry Purchase and Transportation

According to the existing prices, a fry costs 20 kip/piece, and the present Project applies the same prices for Tilapia and carp fries.

Fries are placed in nylon bags filled with oxygen and then transported. They are counted by using a graduated cylinder and are sold in fixed quantities. According to available data, the standard number of fries hatched per liter is

10,000/liter three days after hatching, 3,000/liter 7 days after hatching, and 2,000/liter 14 days after hatching.

The full-scale artificial feeding of fries usually begins 7 days after hatching.

3-5 Fish Catch

The meshes of nylon nets used to trap fries shall be enlargened to lessen the catch and consequently preserve fish resources. The standard number of adult (250~350g) fishes/are is 7~10 in farms not artificially provided with oxygen.

With the aim to establish a year-round catching period, a stocking plan shall be formulated. However, it is estimated that the catch shall only increase in the dry season when the water level of the dam decreases. Further, full scale catching activities shall commence a year after fries are stocked.

To maintain an annual catch of approximately 10,000kg, it is estimated that the annual stock of fries should be approximately 105,350.

Consequently, the project decided on an annual fry production scale of 150,500, an amount which will satisfy the securement of fries stocked in the dam and the 10% to sell.

This project aims to acquire a monthly catch averaging 900kg. It shall, therefore, require an average of 15 days work/month and a daily catch averaging 60kg.

Two temporary workers shall be assigned to take charge of the catching and selling aspect, and the latter shall be conducted every 15th of the month. Fish Trap model shown Fig. V - 3.

3-6 Outline of the Facility Plan

Three fish ponds shall be dug for breeding fishes (2 for Tilapia and 1 for Carps). Also, another pond will be planned for water storage. By rotation, the reserves in this pond will be used to clean and repair the 3 fish ponds.

Eight hatching facilities shall be made from concrete partitions. The facilities are summarized in Table V - 10.

3-7 Fish Feed Cost

Fry feed consists of 40% rice bran and 60% assorted chicken feed. The unit price for 1 kg is 142 Kips (40% x 55 Kips + 60% x 200Kips/100). On the other hand the feed of adult fishes contains 60% rice bran and 40% assorted chicken feed, with a unit price of 93 Kips/kg (60% x 55 Kips + 40% x 150 Kips/100).

Fishes to be bred usually weigh an average of 8 grams, then gets to weigh 35 g a month after breeding starts. From the onset of feeding upto a period of 8 months, the weight of the fishes progresses continuously.

The distribution standard of feed is once every 3 days, that is approximately 10 days/month and 120 working days a year. 20% of the feed is rationed for the 1st 8 months, and then subsequently decreased to 10%. The 20% feed covers 90 days of the 120 days/year feed distribution, while the 10% ration covers the remaining 30 days.

Once every 2 days feed distribution is commensurate to 1% of the total weight of a fry. Feed is distributed for 38 days in one hatching period. This project shall assume that 1 fry weighs 1kg, and that the feed/pond shall amount to 10g.

The average weight of parent fishes is 500g each. Twenty fishes shall be bred in one fishing pond. The required amount of feed during the spawning period is 2kg for 90 days, and 1kg for 30 days otherwise.