V. CONSTRUCTION PLAN AND COST ESTIMATE

5.1 Construction Plan

5.1.1 Construction work

The civil works to be constructed under the Project may be broadly divided into two categories; irrigation and drainage facilities, and rural infrastructures. The irrigation and drainage facilities are in turn divided into two categories; major irrigation and drainage facilities, and on-farm development works. The main works for each category are as follows:

(1) Major irrigation and drainage facilities

- Headreach with related structures
- Main and secondary canals with related structures
- Main pump station
- Booster pump stations
- Regulation pond
- Main and secondary drains with related structures
- Farm roads to be provided alongside headreach, and main and secondary canals

(2) On-farm development work

- Tertiary and field canals with related structures
- Tertiary and field drains with related structures
- Farm roads to be provided alongside tertiary and field canals
- Land clearing and land levelling work for present forest land
- Land consolidation for the demonstration farm

(3) Rural infrastructures

- Village roads
- Extension of municipal water supply pipe line
- Tubewells and distribution pipe line

5.1.2 Construction plan

Orderly implementation of the Project is essential for obtaining maximum benefit from the Project as early as possible. With this in mind and also taking into account the scale of the Project, it is proposed to implement the Project in two stages. Stage-I will include all works related to the originally-planned area of 1,700 ha, while Stage-II will cover the works for the extension area of 1,000 ha. It is proposed to include the rural infrastructures in Stage-I, since their implementation is urgently needed. Major works to be implemented in each stage are itemized below:

Stage-I
- Main irrigation and drainage facilities for the originally-planned area
- On-farm development work for the originally-planned area including land clearing, land leveling and land consolidation for the demonstration work
- Rural infrastructures for the entire Project area

Stage-II
- Main irrigation and drainage facilities for the extension area
- On-farm development work for the extension area

All the construction works will be executed by qualified contractor(s) selected through international competitive tendering, except for the extension of the municipal water supply pipe line. This work only, will be made by Lao Water Supply Company (Bo Ly Sath Nam Papa Lao) under supervision of the Project office.

In general, mechanized construction methods will be employed since the construction work includes a large volume of earth work. Details of the work quantities are given in Annex IX. Annual workable days for the construction work are estimated at 269.

Construction work for main irrigation and drainage facilities, and on-farm development work will be carried out almost simultaneously so that the Project benefits may accrue immediately after the completion of the construction works.

In order to assist the Project office in detailed design, preparation of tender documents, technical guidance for prequalification and tendering works, and supervision of the construction works, competent foreign consultant(s) will be engaged.

The construction schedule prepared on the above-mentioned conditions is given in Fig. V-1. The construction work for Stage-I will commence in May 1990 and end in October 1992, taking a period of two and a half years. The construction work for Stage-II will

commence in May 1991 and end in April 1993. Consequently, the total construction period will be three years. Irrigation of the demonstration farm of 64 ha is scheduled to commence from November 1991. Irrigation of the originally-planned area of 1,700 ha will commence from May 1992, and the entire area of 2,700 ha will be brought under irrigation from May 1993.

Operation and maintenance of the main irrigation and drainage facilities, village roads, and farm tractors for the demonstration farm will be carried out by the Project office, while that of the on-farm facilities will be entrusted to the farmers concerned. Operation and maintenance of the potable water supply facilities will be entrusted to the Lao Water Supply Company or to the Project office.

5.2 Cost Estimate

5.2.1 General

Costs for implementation of the Project are estimated based on the following assumptions :

(1) The exchange rate as of October 1988 is used in the estimate as follows :

US$1 = Kip 450 = ¥130

(2) All construction works, except for extension of the municipal water supply pipe line for rural development will be carried out by contractor(s) selected through international tendering. Most of the construction machinery and equipment needed for the construction works will be available in Lao PDR. The extension of the municipal water supply pipe line will be made by Lao Water Supply Company.

(3) Taxes on the construction materials, machinery and equipment to be imported from abroad are exempted.

(4) Unit costs of the various works are estimated at price and wage levels prevailing in Vientiane as of October 1988, due reference being made to the costs actually incurred in implementation of the Tha Ngon Project. The unit costs are divided into foreign currency portion and local currency portion based on the following classification :

Local currency portion

- Labor force
- Wooden materials
- Sand and gravel
- Inland transportation
- Administration expenses

Foreign currency portion

- Reinforcing bar
- Depreciation of construction equipment and machinery
- Pumping plant and electrical facilities
- Steel gates
- Structural steel
- Cement
- Fuel
- International transportation
- General expense and profits for foreign contractor(s)
- Expenses and fees of engineering services by foreign consultant(s)

(5) Physical contingency is taken as 8% of direct construction cost.

(6) Price contingency is estimated based on a price escalation rate of 1% per annum for the foreign currency equivalent.

5.2.2 Cost Estimate

(1) Construction cost and annual disbursement schedule

The total construction cost for the Project is estimated at US$29.1 million equivalent, comprising US$26.1 million of foreign currency portion and US$3.0 million equivalent of local currency portion as summarized in Table V-1. The annual disbursement schedule is worked out based on the construction schedule as shown in Table V-2.

(2) Operation and maintenance costs

Operation and maintenance costs at the stage of full operation of the Project are estimated at US$238,000 equivalent including (i) operation and maintenance of

the Project office and (ii) operation and maintenance of the Project facilities. These costs are shown in Table V-3.

(3) Replacement cost of the Project facilities

Pumping equipment, electrical facilities and steel gates will have to be periodically replaced. The useful life and replacement costs are given in Table V-4.

VI. ORGANIZATION AND MANAGEMENT

6.1 Organization for Project Implementation

In order to proceed with construction of the Project facilities, the following works will have to be executed by the Government of Lao PDR:

- Detailed design including preparation of tender documents
- Prequalification and tendering
- Land acquisition
- Construction supervision

For smooth execution of the above works, an executing organization is proposed which is tentatively called " the Project office " under the minister of MAF. To coordinate, guide and assist the Project office in the implementation, a coordination committee is also proposed under the minister of MAF. The committee will consist of representatives of authorities concerned such as high-ranking officers of Vientiane Municipality administration, and Saysetha and Saythany Districts offices. One director of the Project office will be appointed by the minister of MAF, and he will be responsible for all the operation and management of the office. At the construction stage, the office will have five sections: (i) design section, (ii) construction section, (iii) equipment section,(iv) accounting section and (v) administration section. The design and construction sections will have three sub-sections, respectively (i) main facilities, (ii) rural infrastructures and (iii) on-farm work. The total number of required office staff is estimated at 64. The organization chart is given in Fig. VI-1.

For the location of the office, a place near the Saythany District office, where national roads, routes 10 and 13 join, is proposed to be central and conveniently situated.

6.2 Organization for Operation and Maintenance

After completion of Project construction, the Project facilities will be transferred to the governor of the Vientiane Municipality, and the Project office will be put under the authority of the governor. MAF will be a member of the coordination committee, and will assist and collaborate with the Project office in the operation and maintenance of the Project facilities. The director of the Project office will be appointed by the governor of the Vientiane Municipality. The Project office will have the following operation and maintenance responsibilities:

- Planning of the irrigation schedule
- Monitoring and record-keeping of meteorological data
- Operation of irrigation water supply
- Day-to-day administration relating to water management according to the operation rule
- Monitoring of irrigation water supply
- Maintenance and repair of the irrigation and drainage facilities
- Operation and maintenance of the equipment and machinery
- Technical guidance and training for farmers in water management
- Farming guidance for farmers
- Operation and maintenance of rural infrastructures
- Operation and maintenance of farm tractors

In order to carry out the above works, the Project office will be organized into four sections, namely (i) operation section, (ii) maintenance section (iii) accounting section and (iv) administration section. The operation section will have four sub-sections: (i) monitoring and planning, (ii) irrigation operation, (iii) rural infrastructures, and (iv) training and guidance. The maintenance section will have two sub-sections: (i) repair and maintenance, and (ii) equipment and store. The number of office staff is estimated at 54. The organization chart is given in Fig.VI-2.

At the farmers' level, irrigation water users' associations will have to be organized on a tertiary canal basis to manage water supply and maintain the on-farm facilities under the technical guidance of the Project office.

VII. PROJECT EVALUATION

7.1 Economic Evaluation

7.1.1 Basic assumptions

The economic evaluation of the Project from the point of view of the national economy, has been made based on the following assumptions :

(i) The economic useful life of the Project is 50 years after construction.
(ii) All prices are expressed at constant 1988 prices.
(iii) The exchange rate used is US$1.00 = Kip 450 = ¥130 as of October, 1988.
(iv) The costs for rural development, and land consolidation and farm machinery for the demonstration farm are excluded from the capital cost because they can be regarded as social investments that are not directly related to agricultural production.

7.1.2 Evaluation of economic prices

Economic prices for inputs and outputs of the Project are evaluated based on the following criteria:

(1) Direct transfer payment

Direct transfer payments such as taxes and direct subsidies are domestic monetary transfers with no resource expense. These have to be eliminated in the economic evaluation. Since the project cost is estimated based on tax exemption, no direct transfer payment is included in the cost.

(2) Standard conversion factor (SCF)

The value of all the domestic currency is multiplied by this factor in order to adjust the distortion of domestic prices occurring as a result of national trade policies such as tariffs and subsidies. A SCF of 0.90 is adopted in this evaluation, referring to the appraisal of the Rural Credit Project by IFAD in 1987.

(3) Traded goods and services

Economic prices of traded goods and services are based on border prices. Border prices of farm inputs and outputs are estimated on the basis of the World Bank's projections of world market prices for the year 2000. Additional domestic costs from the border are added to the price, and savings by import substitution and additional cost for export expansion are deducted in order to estimate import and export parity prices at the farm gate.

(4) Opportunity cost of labor

At present, most farm labor requirements are generally met by family labor. Seasonal labor demands for transplanting and harvesting are partly met by hiring from neighbors at a wage of Kip 400/man-day. However, farm work is scarce during the dry season. Economic farm labor costs are therefore estimated at Kip 400/man-day in the rainy season and Kip 100/man-day in the dry season. According to a study in the Vientiane area, in general labor is actively employed for about two thirds of a year. A shadow wage rate for construction labor is estimated at 0.37, which is derived from the ratio of a weighted average of farm labor cost to estimated labor wage (Kip 810). The wage rate in the cost estimation includes a premium to attract labor.

7.1.3 Economic benefit

(1) Economic prices for agricultural outputs and inputs

Of the four crops proposed, paddy and soybean are produced for import substitution, groundnuts for export and garlic for domestic consumption. Therefore, the economic prices of rice and soybean are based on import parity prices and that of groundnuts on export parity price. Though soybean is actually imported as a form of milled cake, price as a form of bean is adopted since a processing plant is planned. The present farm gate price is used for garlic prices.

Farm inputs such as fertilizers and agricultural chemicals are all imported and the prices are based on import parity prices. The estimated prices are as follows:

Item	Economic Price (Kip/ton)
Products	
Paddy	98,490
Soybean	155,170
Groundnuts	116,320
Garlic	200,000
Inputs	
Urea	132,990
Ammophos	158,220
Diazinon	1,037,700

Details of the derivation of import and export parity prices are given in Annex X.

(2) Net agricultural production value

The irrigation benefits are derived from the incremental crop production attributable to a stable irrigation water supply. These benefits are estimated as the difference in annual net crop production values under "with" and "without" project conditions as follows (for details, see Annex X):

(Unit: Kip million)

Description	Without Project	With Project	Increment
Gross Production Value			
Originally-planned Area	368.0	1,688.9	1,320.9
Extension Area	113.9	981.5	867.6
Total	481.9	2,670.4	2,188.5
Total Production Cost			
Originally-planned Area	130.2	400.6	270.4
Extension Area	42.6	242.1	199.5
Total	172.8	642.7	469.9
Net Production Value			
Originally-planned Area	237.8	1,288.3	1,050.5
Extension Area	71.3	739.4	668.1
Total	309.1	2,027.7	1,718.6
(US$1,000 equivalent)	686.9	4,506.0	3,819.1

(3) Accruement of benefit during build-up period

The irrigation benefits expected to accrue from the start of irrigation will increase year by year during the build-up period. The build-up period is assumed to be five years from the start of irrigation. Targeted production in the Project area will be fully attained in the tenth year from the start of construction. The irrigation benefits during the build-up period based on the construction schedule are estimated as follows :

Year in Order	Irrigation Benefit (US$ thousand)		Total
	Originally-planned Area	Extension Area	
1	0	0	0
2	0	0	0
3	0	0	0
4	277.1	0	277.1
5	1,211.5	269.7	1,481.2
6	1,544.5	838.5	2,383.0
7	1,834.6	1,027.4	2,867.0
8	2,161.9	1,194.4	3,356.3
9	2,334.5	1,383.3	3,718.8
10	2,334.5	1,484.6	3,819.1

7.1.4 Economic cost

The financial project costs estimated in Chapter 5 are converted into economic cost by the following procedures:

(i) The costs for rural development, land consolidation and farm machinery for the demonstration farm are excluded.
(ii) Contingency for price escalation is deducted from financial cost.
(iii) All the costs are divided into foreign currency portion and local currency potion.
(iv) Local currency portion is divided into unskilled labor costs and others.
(v) Unskilled labor costs are converted into opportunity costs by multiplying by the shadow wage rate of 0.37.
(vi) Total local currency portion is converted into economic price by multiplying SCF of 0.90 in order to adjust the distortion of local currency.
(vii) Converted local currency portion is added to foreign currency portion.

Derived economic cost is US$25,787,400 for capital cost, US$208,100 for annual operation cost, and US$610,000 and US$5,004,000 for every ten and 25 years of equipment replacement. The flow of economic costs is shown in Table VII-1.

7.1.5 Result of economic evaluation

Benefit and cost stream during the useful life of the Project are shown in Table VII-1. The economic internal rate of return (EIRR) is thereby calculated at 11.1%. The net present value (NPV) at a discount rate of 8% is estimated at US$8,382,200

In order to evaluate the soundness of the Project in the event of possible future changes in economic conditions, a sensitivity analysis was made for the following cases:

Case-1: The project costs increase by 10% due to unexpected increase of material cost beyond the physical contingency accounted.

Case-2: The project benefits decrease by 10% due to unexpected decrease in forecast price of farm products or in crop yields.

Case-3: The build-up period is prolonged by two years due to inefficient O&M management or agricultural extension service.

Case-4: The completion of construction is delayed for two years due to unexpected inefficiency of contractors or unforeseen reasons.

The effects of these changes on EIRR and NPV (discounted at 8%) are summarized as shown below:

Case	EIRR (%)	NPV 8% (US$ thousand)
Case-1	10.1	6,107.1
Case-2	10.0	5,268.9
Case-3	10.6	7,291.6
Case-4	10.2	6,256.6

As a consequence of the above evaluation, it is concluded that the Project can expect an acceptable economic return to investment with 11.1% of EIRR and US$8,382,200 of NPV at a discount rate of 8%. The sensitivity analysis indicates that economic feasibility of the Project is relatively insensitive to possible changes.

7.2 Impact on Farm Budget

7.2.1 Increase of farmers' disposable income

The farm budget analyses are made for two types of cropping patterns in order to evaluate the Project from the aspect of income to direct beneficiaries. The result of the farm interview survey was referred to for the estimation of present farm budget.

Farm income and farmers' disposable income (before payment of irrigation water charge) is expected to increase significantly under the Project. The future annual disposable income is estimated to be 2.4 to 4.4 times larger than at present, depending on farm size. Changes in farm budget with an average farm size of 1.6 ha are estimated as shown below (details are given in Annex X):

(Unit: Kip thousand)

Description	Farm Income	Total Income	Farm Expense	Disposable Income
Without Project	129.2	249.8	23.0	226.8
With Project				
Case-1	809.2	929.8	208.0	721.8
Case-2	867.1	987.7	269.8	717.9

Note: Farm expenses include farm input costs and agro-tax.
Cases represent the following cropping patterns.

Case-1; Paddy - Paddy
Case-2; Paddy - Soybean, Groundnuts, Garlic
(ratio of area for three crops is 350:160:40)

7.2.2 Farmers' capacity to pay and irrigation water charge

The farmers' capacity to pay for the irrigation water charge depends on the amount of incremental disposable income of farmers resulting from irrigated farming under the Project. If the water charge were too high, it would seriously impair the farmers' willingness to accept intensive cropping and modern farming techniques proposed under the Project, and would eventually make it difficult to realize the goal of increased agricultural production. With this in mind and also taking into consideration practices in similar projects in the world, the water charge for the Project is proposed at about 30% of incremental disposable income of farmers.

The following table shows incremental disposable income and water charges for a farm with an average farm size of 1.6 ha.

Cropping Pattern	Incremental Disposable Income (Kip/1.6 ha)	Annual Water Charge	
		per farm (Kip/1.6 ha)	per ha (Kip/ha)
Paddy-Paddy	495,000	148,500	92,800
Paddy-Upland Crops	491,100	147,300	92,100

Based on the above unit charges, the total amount of water charges to be collected from the farmers whose farms will be irrigated by the Project is estimated at Kip 250 million per annum, which will cover the estimated annual operation, maintenance and replacement costs of the Project (equivalent to Kip 225 million/year).

7.3 Financial Analysis

Financial analysis of the Project from the viewpoint of the Government budget and the executing organization of the Project is made based on the cost estimation shown in Chapter V.

7.3.1 Repayment of project costs

It is assumed that the capital costs required for the implementation of the Project will be arranged under the following conditions:

(1) The foreign currency portion of the capital cost will be financed by a loan from an international organization.
(2) The interest rate on the loan will be 1.00% per annum and the repayment period will be 30 years including 10 years of grace period.
(3) The local currency portion of the capital cost will be financed by the Government budget without repayment.

The repayment schedule for the foreign loan based on the above conditions is shown in Table VII-2.

7.3.2 Financial inflow and outflow

The financial inflow and outflow of the executing organization are estimated assuming that the organization has an independent budget. The inflow of the organization is the water charge collected from the Project beneficiaries. Outflow consists of total financial cost and the repayment of loan. Estimated financial cash flow is given in Table VII-2.

7.4 Socioeconomic Impacts

In addition to the direct project benefits assessed in the economic evaluation, various secondary and intangible benefits are expected from implementation of the Project. The following are among the major secondary and intangible benefits:

(1) Expediting economic and social activities

Local transportation will be much improved by the construction of both village roads and operation and maintenance roads along the irrigation canals. At present, the road network is not sufficient and existing rural roads are of poor quality. They impede the economic and social activities of villagers particularly in the rainy season. The improved road system will contribute to the improvement of economic activities by enhancing inter- and intra-regional accessibility and communication.

(2) Satisfaction of basic human needs

Potable water supply facilities will be developed in villages where at the moment there are problems because of shortage of water. The sanitary conditions of villages will be improved through expansion of potable water supply.

(3) Stable food supply

The Project will help to ensure self-sufficiency in rice, one of the main objectives of the national development plans. Adequate supply of food will be an important contribution to establishing the economic independence of Lao PDR.

(4) Increase of employment opportunities

There will be increased employment opportunities for local people as a result of the project and a favorable impact will be made on the national economy through the multiplier effect. Furthermore, employees will be able to gain experience, technical know-how, and skills in various fields of work. This experience can be applied to future development in the region.

(5) Foreign exchange saving

Upon completion of the Project, a significant increase in rice production is expected. The marketable production will be about 19,500 tons of paddy. The increased production would greatly reduce rice imports and consequently contribute to a foreign exchange saving, equivalent to around US$6.5 million per annum.

VIII. CONCLUSION AND RECOMMENDATIONS

The feasibility study shows that the Project is technically sound and economically viable. Further, the study has clarified that implementation of the Project will make favorable socio-economic impacts on the country as well as on the Vientiane Municipality, in line with the policy adopted by the Government of Lao PDR.

In order to implement the Project and to reach its goal as quickly as possible, the following recommendations are made to the Government of Lao PDR.

(1) The implementation of the Project requires a considerable amount of funding, which may be a heavy burden to the Government budget. To ease the burden, an arrangement should be made for obtaining a loan or grant aid from international organizations or possible donor countries.

(2) An executing agency (the Project office) should be established in order to co-ordinate the activities of different Government departments and offices concerned and to implement the Project in an efficient manner. The Project office should be staffed by an adequate number of qualified Laotian personnel, possibly supported by experienced foreign consultants.

(3) The success of the Project largely depends on the willingness and knowledge of farmers in practicing improved farming techniques. In this respect, the present agricultural support organization will need to be strengthened and their extension services intensified.

(4) Although the Government has long promoted agricultural development in the country, experience and know-how in this field are still limited. To cope with this situation, arrangements should be made for obtaining technical aid from various organizations of foreign countries including JICA. Such technical aid may involve the following:

- Technical assistance by foreign experts and volunteers:
  This would be made on a temporary basis for the initial five to ten-year period of the Project operation. At least, 1-irrigation expert, 1-agronomist, 1-agricultural extension expert, 1-agro-machinery expert and 5-volunteers will be needed.

- Overseas training of Laotian staff:

  Key staff of the Project Office and other concerned offices should be provided with an opportunity to participate in foreign training programs such as JICA's course training program.

TABLES

Table II-1 Net Material Product and GDP of Lao PDR

(Unit: Kip million in 1986 price)

Sector	1982	1983	1984	1985	1986	1987 (estimated)
Agriculture and forestry	31,324	32,292	34,638	37,292	40,026	37,824
Industry	3,440	3,569	3,785	4,469	5,298	4,187
Construction	1,023	1,378	1,613	2,261	2,050	2,255
Transportation and communications	575	642	687	725	741	873
Commerce	3,923	4,293	4,478	4,631	4,834	5,076
Others	344	357	378	447	530	726
Net Material Product	40,629	42,531	45,579	49,825	53,479	50,941
Depreciation	2,438	2,552	2,735	2,990	3,209	3,056
Government and other services	6,062	5,520	5,547	5,959	6,204	6,485
Estimated GDP	49,129	50,603	53,861	58,774	62,892	60,482
GDP deflator	20.2%	35.8%	48.2%	71.4%	100.0%	106.6%
GDP at current prices	9,924	18,116	25,961	41,965	62,892	64,474

Source : World Bank, *Lao PDR Country Economic Memorandum*, 1988

Remark : GDP is estimated through adding depriciation and government and non-material services to Net Material Product, which is adopted in socialist countries as a measure of economic activity of a country.

Table II-2 Official Exports and Imports

(Unit: US$ million)

Year	1976	1980	1985	1987 (estimated)	1988 (planned)
Exports	10.1	17.0	58.1	66.3	80.7
to Socialist Countries	-	1.2	13.2	30.5	31.0
to Capitalist Countries	10.1	14.8	31.9	18.8	30.7
Border trade	-	1.0	13.0	17.0	19.0
Imports	31.3	65.3	98.7	140.7	160.1
from Socialist Countries	13.9	21.7	64.7	96.9	117.7
from Capitalist Countries	17.4	42.2	21.0	26.8	23.4
Border trade	-	1.4	13.0	17.0	19.0
Balance of Trade	-21.2	-48.3	-40.6	-74.4	-79.4
between Socialist Countries	-13.6	-20.5	-51.5	-66.4	-86.7
between Capitalist Countries	-17.4	-27.4	10.9	-8.0	7.3
Border trade	-	-0.4	0	0	0

Source : Ministry of Economic Planning and Finance

Table II-3 Composition of Official Exports, 1986

(Unit: US$1,000)

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

Source: Ministry of Economic Planning and Finance

Table II-4 Composition of Official Exports, 1987
(estimated)

(Unit: US$1,000)

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

Source: Ministry of Economic Planning and Finance

Table II-5 Composition of Official Imports, 1986

(Unit: US$1,000)

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

Source: Ministry of Economic Planning and Finance

Table II-6 Composition of Official Imports, 1987 (estimated)

(Unit: US$1,000)

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

Source: Ministry of Economic Planning and Finance

Table II-7 Planted Area of Main Crops, 1976-1987

(Unit: 1,000 ha)

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

Sources:
1. MAFIC, *Agricultural Statistics 1976-1983*, 1984
2. State Planning Committee, *10 Years of Socio-Economic Development in the Lao PDR*, 1985
3. State Committee of Economy, Planning and Finance, *Basic Data about the Social and Economic Development of Lao PDR 1987*, 1988

Table II-8 Production of Main Crops, 1976-1987

(Unit: 1,000 ton)

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

Sources:
1. MAFIC, *Agricultural Statistics 1976-1983*, 1984
2. State Planning Committee, *10 Years of Socio-Economic Development in the Lao PDR*, 1985
3. State Committee of Economy, Planning and Finance, *Basic Data about the Social and Economic Development of Lao PDR 1987*, 1988

Table II-9 Unit Yield of Main Crops, 1976-1987

(Unit: ton/ha)

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

Sources:
1. MAFIC, *Agricultural Statistics 1976-1983*, 1984
2. State Planning Committee, *10 Years of Socio-Economic Development in the Lao PDR*, 1985
3. State Committee of Economy, Planning and Finance, *Basic Data about the Social and Economic Development of Lao PDR 1987*, 1988

Table III-1 Meteorological Data at Vientiane

(Average from 1968 to 1987)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
Mean temperature (°C)	22.4	24.7	27.4	29.0	28.7	28.4	28.1	27.6	27.6	27.0	24.9	22.3	26.5
Mean of daily maximum temperature (°C)	28.1	30.4	33.0	34.1	32.8	31.9	31.4	30.8	31.0	30.9	29.5	27.9	31.0
Mean of daily minimum temperature (°C)	16.7	19.0	21.8	24.0	24.6	25.1	24.9	24.8	24.2	23.2	20.3	16.8	22.1
Extreme minimum temperature (°C)	4.7	10.7	11.5	17.5	18.9	21.8	22.0	21.7	21.1	16.8	10.6	5.3	-
Mean relative humidity (%)	68	65	64	66	73	77	78	79	78	74	69	67	72
Mean of daily maximum humidity (%)	92	89	87	88	93	94	94	95	95	93	90	92	92
Mean of daily minimum humidity (%)	43	42	40	44	54	61	62	64	62	54	48	43	51
Evaporation from class A-pan (mm/day)	3.7	4.2	4.6	5.1	4.6	4.2	4.0	3.7	4.1	4.4	4.3	3.9	4.2
Wind velocity (m/sec) /1	1.6	1.6	1.6	1.9	2.0	1.8	1.8	1.8	1.6	1.5	1.6	1.6	1.7
Daily sunshine hours	8.3	7.6	7.0	7.5	6.7	5.0	4.7	4.3	5.7	7.3	7.9	8.3	6.7
Monthly rainy days /2	1	2	4	8	16	19	19	21	18	7	2	1	118
Monthly rainfall (mm)	7	12	36	77	228	269	295	302	290	79	11	3	1,608

/1 : 15m above ground surface
/2 : Excluding trace
Remark: Original data are provided by the Meteorological and Hydrological Department, MAF

Table III-2 Monthly Rainfall at Vientiane

(Unit:mm)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
1967	2.3	12.6	6.0	94.2	159.9	221.8	327.3	209.8	488.9	N	21.2	N	1,544.0
1968	0.9	N	100.6	88.8	301.8	243.5	258.2	206.8	272.0	27.7	T	N	1,500.3
1969	19.6	N	42.4	40.9	204.3	295.9	402.1	128.9	247.9	49.9	14.3	N	1,446.2
1970	0.5	N	31.2	56.9	306.4	377.2	215.8	624.9	420.5	53.8	T	0.1	2,087.3
1971	N	7.3	13.9	34.1	294.0	274.8	289.4	226.4	163.4	103.5	0.8	18.2	1,425.8
1972	N	6.8	36.8	167.6	115.6	312.8	246.1	306.7	166.3	148.4	8.2	5.8	1,521.1
1973	N	N	37.0	36.4	308.3	200.7	298.6	263.9	361.3	25.7	T	N	1,531.9
1974	T	1.6	36.7	97.4	100.5	159.2	255.7	368.4	187.1	92.6	29.7	0.2	1,329.1
1975	23.5	26.3	13.2	21.8	347.0	473.9	177.5	430.4	289.7	194.4	8.5	N	2,006.2
1976	N	23.0	111.9	126.9	121.7	167.3	167.6	403.1	416.7	76.7	N	N	1,614.9
1977	15.2	N	35.1	69.0	151.9	231.0	211.1	174.8	190.3	26.5	16.5	22.8	1,144.2
1978	1.6	17.8	51.1	145.9	328.4	254.9	354.6	293.6	381.4	128.9	28.5	N	1,986.7
1979	N	21.0	0.1	61.8	344.7	333.3	150.1	117.8	253.1	19.2	N	N	1,301.1
1980	N	18.6	68.8	61.0	319.5	611.0	461.5	342.9	353.4	54.7	T	N	2,291.4
1981	N	0.3	19.6	124.2	311.1	238.5	635.0	210.0	224.8	117.8	40.5	T	1,921.8
1982	N	6.1	60.8	69.6	239.3	95.4	253.8	484.0	319.5	90.2	22.2	0.6	1,641.5
1983	53.1	5.7	9.0	58.1	97.6	243.8	217.9	360.8	247.1	67.9	N	7.2	1,368.2
1984	N	10.6	3.4	88.9	148.3	148.1	421.0	388.9	267.1	142.1	17.3	N	1,635.7
1985	24.8	64.7	4.9	10.8	135.3	223.5	257.4	191.9	258.8	81.4	N	N	1,253.5
1986	N	3.2	1.5	118.8	383.4	256.2	308.9	318.3	275.3	66.7	N	21.0	1,753.3
1987	T	13.9	100.6	127.0	63.6	473.8	175.0	356.0	260.7	93.4	3.2	N	1,667.2
AVE.	7.4	11.7	35.9	76.5	228.2	268.8	294.8	301.8	290.0	79.0	10.9	2.9	1,607.9
%	0.5	0.7	2.2	4.8	14.2	16.4	18.3	18.8	18.0	4.9	0.7	0.2	100.0

T : trace N : nill

Remark: Original data are provided by the Meteorological and Hydrological Department, MAF

Table III-3 Existing Irrigation Projects

Project	Water Source	Area (ha)	Completion Year	Discharge (m^3/s)	Nos. of Pumps (HP x Unit)
1. Kao Liao II	Mekong	1,000	1982	2.4	175 x 4
2. Hong Seng II	Hong Seng	1,100	1985	0.9	100 x 3
3. Pakpa Sack	Mekong	-	1984	0.9	100 x 3
4. Hong Seng I	Hong Seng	100	1987	0.4	25 x 2
5. Vieng Chareun	Hong Seng	70	1987	0.2	25 x 1
6. Sok Noi	Bueng Khat Khao	200	1987	0.5	40 x 2
7. Sam Khe	Bueng Khat Khao	200	1987	0.8	25 x 4
8. Houa Khoua	That Luang	300	1984	0.6	100 x 2
9. Phanh Manh	Mekong	600	1982	1.6	125 x 4
10. Hong Thong	Mekong	150	1987	1.6	150 x 4
11. Tha Ngon	Nam Ngum	610	1974	1.6	220 x 3

Table III-4 Extent of Each Soil Unit

(Unit: ha)

Soil Unit	Texture	Originally-planned Area	Extension Area	Total
Acrisols	Sandy loam (b)	436	522	958
	Silty loam (c)	1,991	1,131	3,122
	Silty clay (d)	387	157	544
	Sub-total	(2,814)	(1,810)	(4,624)
Fluvisols	Silty clay (d)	68	-	68
Gleysols	Silty clay (d)	58	-	58
Total		2,940	1,810	4,750

Table III-5 Results of Land Classification

Name of Mapping Unit No.	Symbol of Factor for Assessment of Land Capsbility	t		d		g		p		l		r		(w) /3 w/4		f		n		i		a		s		e		Synthetical Assessment		Area Extent (ha) Originally planned area	Extension area	Total
		P/1	U/2	P	U	P	U	P	U	P	U	P	U	P	U	P	U	P	U	P	U	P	U	P	U	P	U	P	U			
1.	Acrisols sandy loam 1	I	I	I	I	I	I	I	I	II	-	II	-	-	II (IV)	II	II	II	II	I	I	I	I	-	I	-	I	II lrfn	IV (w)	110	48	158
2.	Acrisols sandy loam 2	I	I	I	II	I	I	I	I	II	-	II	-	-	II (IV)	II	II	II	II	I	II	I	I	-	I	-	I	II lrfn	IV (w)	-	3	3
3.	Acrisols sandy loam 3	I	I	I	II	I	II	I	I	II	-	II	-	-	II (IV)	II	II	II	II	I	II	I	I	-	I	-	I	II lrfn	IV (w)	112	71	183
4.	Acrisols sandy loam 4	I	II	II	III	II	III	I	I	II	-	II	-	-	II (IV)	II	II	II	II	II	III	I	I	-	I	-	II	II dglrfi	IV (w)	95	227	322
5.	Acrisols sandy loam 5	II	III	IV	IV	IV	IV	I	I	II	-	II	-	-	II (IV)	II	II	II	II	IV	IV	I	I	-	I	-	III	IV dgi	IV dg (w)	119	173	292
6.	Acrisols silty loam 1	I	I	I	I	I	I	II	II	II	-	II	-	-	III (IV)	II	II	II	II	I	I	II	II	-	I	-	II	II plrfna	IV (w)	1,014	251	1,265
7.	Acrisols silty loam 2	I	I	I	II	I	I	II	II	II	-	II	-	-	III (IV)	II	II	II	II	I	II	II	II	-	I	-	II	II plrfna	IV (w)	532	102	634
8.	Acrisols silty loam 3	I	I	I	II	I	II	II	II	II	-	II	-	-	III (IV)	II	II	II	II	I	II	II	II	-	I	-	II	II plrfna	IV (w)	48	409	457
9.	Acrisols silty loam 4	I	II	II	III	II	III	II	II	II	-	II	-	-	III (IV)	II	II	II	II	II	III	II	II	-	I	-	III	II dgplrfnia	IV (w)	349	254	603
10.	Acrisols silty loam 5	I	III	IV	IV	IV	IV	II	II	II	-	II	-	-	III (IV)	II	II	II	II	IV	IV	II	II	-	I	-	IV	IV dgi	IV dg (w) ie	48	115	163
11.	Acrisols silty clay 1	I	I	I	I	I	I	III	III	I	-	III	-	-	IV (IV)	II	II	II	II	I	I	III	I	-	I	-	II	III pra	IV (w) w	349	157	506
12.	Acrisols silty clay 3	I	I	I	II	I	II	III	III	I	-	III	-	-	IV (IV)	II	II	II	II	I	II	III	I	-	I	-	III	III pra	IV (w) w	38	-	38
13.	Fluvisols silty clay	I	I	I	I	I	I	III	III	I	-	III	-	-	IV (IV)	II	II	II	II	I	I	IV	IV	-	I	-	II	IV a	IV (w) wa	68	-	68
14.	Gleysols silty clay	I	I	I	I	I	I	III	III	I	-	III	-	-	IV (IV)	II	II	II	II	I	I	III	III	-	I	-	II	III pra	IV (w) w	58	-	58
	Total																													2,940	1,810	4,750

Remark: /1: Paddy field, /2: Upland crop field, /3: Dry season, /4: Rainy season

Table III-6 Population and Farm Households in the Project Area

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

Source: Saythany and Saysetha District Offices

Table IV-1 Alternative Plans

Items		Plan-I	Plan-II
1.	Main Pump Station		
1.1	Discharge (m^3/s)	4.86	4.86
1.2	Water level at the outlet of discharge pipeline (m)	EL 186.50	EL 175.50
1.3	Water head (m)	41.40	28.20
1.4	Pump diameter (mm)	600	600
1.5	Nos. of pumps (unit)	7 /1	7 /1
1.6	Required power (kW)	3,350	2,280
2.	Headreach		
2.1	Discharge (m^3/s)	4.86	4.86
2.2	Length (m)	11,200	11,400
2.3	Nos. of syphon (nos.)	4	4
2.4	Total syphon length (m)	4,850	400
3.	Regulation Pond		
3.1	HWL /2 (m)	EL 176.00	EL 171.00
3.2	LWL /3 (m)	EL 175.00	EL 170.00
4.	Booster Pump Station No.1		
4.1	Discharge (m^3/s)	-	1.85
4.2	Water head (m)	-	6
4.3	Pump diameter (mm)	-	700
4.4	Nos. of pumps (unit)	-	3 /1
4.5	Required power (kW)	-	160
5.	Booster Pump Station No.2		
5.1	Discharge (m^3/s)	-	0.56
5.2	Water head (m)	-	2.4
5.3	Pump diameter (mm)	-	400
5.4	Nos. of pumps (unit)	-	2
5.5	Required power (kW)	-	20
6.	Total Required Power (kW)	3,350	2,460
7.	Related Structures		
7.1	Turnout (nos.)	6	6
7.2	Check (nos.)	5	5
7.3	Culvert (nos.)	7	7
7.4	Footpath bridge (nos.)	6	6
7.5	Spillway/wasteway (nos.)	4	4
7.6	Cross drain (nos.)	9	9
7.7	Syphon (nos.)	4	4
7.8	Gate (nos.)	20	20

/1 : One stand-by pump is included
/2 : High water level
/3 : Low water level

Table IV-2 Land Demarcation for Future Land Use

(Unit: ha)

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

Table IV-3 Proposed Farm Input and Labor Requirement for Cultivation of Rice

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

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

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

Table IV-4 Proposed Farm Input and Labor Requirement for Cultivation of Upland Crops

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

Table V-1 Summary of Costruction Cost (1/2)

(Unit: US$ 1,000)

	Items	Originally-planned Area	Extension Area	Total
1.	Preparatory work	233	210	443
2.	Major irrigation and drainage facilities			
	- Headreach	5,600	-	5,600
	- Major canals	1,912	934	2,846
	- Major drains	975	288	1,263
	- Main pump station	2,118	1,516	3,634
	- Regulation pond	160	-	160
	- Booster pump stations	-	1,366	1,366
3.	On-farm development			
	- Tertiary canals	1,974	1,274	3,248
	- Tertiary drains	224	152	376
	- Field canals	1,385	764	2,149
	- Field drains	98	58	156
	- Land clearing and levelling	303	916	1,219
	Sub-total (1+2+3)	(14,982)	(7,478)	(22,460)
4.	Rural infrastructures			
	- Rehabilitation of village road	92	-	92
	- Extension of existing water supply pipe line	46	-	46
	- Drilling and construction of distribution pipe line	220	-	220
	Sub-total (4)	(358)	-	(358)
5.	Project office	154	-	154
6.	Demonstration farm			
	- Land consolidation	30	-	30
	- Warehouse	126	-	126
7.	O & M equipment	610	-	610
8.	Farm tractors for demonstration farm	91	-	91
9.	Engineering services and administration expenses	1,499	774	2,273
	Sub-total (5+6+7+8+9)	(2,510)	(774)	(3,284)
10.	Contingencies			
	- Physical contingency	1,428	660	2,088
	- Price contingency	540	347	887
	Sub-total (10)	(1,968)	(1,007)	(2,975)
	Total	19,818	9,259	29,077

Table V-1 Summary of Costruction Cost (2/2)

(Unit: US$ 1,000)

Items	Originally-planned Area			Extension Area		
	FC	LC	Total	FC	LC	Total
1. Preparatory work	126	107	233	114	96	210
2. Major irrigation and drainage facilities						
- Headreach	4,915	685	5,600	-	-	-
- Major canals	1,732	180	1,912	881	53	934
- Major drains	873	102	975	257	31	288
- Main pump station	2,084	34	2,118	1,479	19	1,516
- Regulation pond	147	13	160	-	-	-
- Booster pump stations	-	-	-	1,346	20	1,366
3. On-farm development						
- Tertiary canals	1,762	212	1,974	1,146	128	1,274
- Tertiary drains	199	25	224	138	14	152
- Field canals	1,265	120	1,385	694	70	764
- Field drains	96	2	98	57	1	58
- Land clearing and levelling	296	7	303	895	21	916
Sub-total (1+2+3)	(13,495)	(1,487)	(14,982)	(7,025)	(458)	(7,478)
4. Rural infrastructures						
- Rehabilitation of village road	87	5	92	-	-	-
- Extension of existing water supply pipe line	43	3	46	-	-	-
- Drilling and construction of distribution pipe line	209	11	220	-	-	-
Sub-total (4)	(339)	(19)	(358)	-	-	-
5. Project office	-	154	154	-	-	-
6. Demonstration farm						
- Land consolidation	28	2	30	-	-	-
- Warehouse	38	88	126	-	-	-
7. O & M equipment	610	-	610	-	-	-
8. Farm tractors for demonstration farm	91	-	91	-	-	-
9. Engineering services and administration expenses	1,157	342	1,499	622	152	774
Sub-total (5+6+7+8+9)	(1,924)	(586)	(2,510)	(622)	(152)	(774)
10. Contingencies						
- Physical contingency	1,261	167	1,428	612	48	660
- Price contingency	473	67	540	328	19	347
Sub-total (10)	(1,734)	(234)	(1,968)	(940)	(67)	(1,007)
Total	17,492	2,326	19,818	8,587	672	9,259

Table V-2 Annual Disbursement Schedule of Construction Cost

(Unit: US$1,000)

Items	Total		1989		1990		1991		1992		1993	
	FC	LC	FC	LC	FC	LC	FC	LC	FC	LC	FC	LC
1. Preparatory work	240	203	-	-	126	107	114	96	-	-	-	-
2. Major irrigation and drainage facilities												
- Headreach	4,915	685	-	-	983	136	2,949	413	983	136	-	-
- Major canals	2,613	233	-	-	329	35	1,183	117	908	70	193	11
- Major drains	1,130	133	-	-	88	10	463	53	527	69	52	1
- Main pump station	3,581	53	-	-	1,038	17	1,038	17	502	6	1,003	13
- Regulation pond	147	13	-	-	48	4	99	9	-	-	-	-
- Booster pump stations	1,346	20	-	-	-	-	-	-	336	7	1,010	13
3. On-farm development												
- Tertiary canals	2,908	340	-	-	18	2	1,616	75	1,047	174	227	89
- Tertiary drains	337	39	-	-	20	2	105	13	184	22	28	2
- Field canals	1,959	190	-	-	-	-	1,008	96	811	80	140	14
- Field drains	153	3	-	-	-	-	48	1	77	1	28	1
- Land clearing and levelling	1,191	28	-	-	-	-	237	6	775	18	179	4
4. Rural infrastructures												
- Village road	87	5	-	-	29	2	58	3	-	-	-	-
- Water supply pipe line	43	3	-	-	-	-	14	1	29	2	-	-
- Drilling and distri. pipe line	209	11	-	-	-	-	70	4	139	7	-	-
5. Project office	-	154	-	51	-	103	-	-	-	-	-	-
6. Demonstration farm												
- Land consolidation	28	2	-	-	-	-	28	2	-	-	-	-
- Warehouse	38	88	-	-	-	-	38	88	-	-	-	-
7. O & M equipment	610	-	-	-	-	-	610	-	-	-	-	-
8. Farm tractors	91	-	-	-	-	-	91	-	-	-	-	-
9. Engineering services and admini. expenses	1,779	494	475	114	267	114	415	114	415	114	207	38
Sub-total (1+2+..+8+9)	(23,405)	(2,697)	(475)	(165)	(2,946)	(532)	(10,184)	(1,108)	(6,733)	(706)	(3,067)	(186)
10. Contingencies												
- Physical contingency	1,873	215	38	13	236	43	815	88	539	56	245	15
- Price contingency	801	86	5	2	59	11	308	34	273	29	156	10
Total	26,079	2,998	518	180	3,241	586	11,307	1,230	7,545	791	3,468	211

Table V-3 Annual Operation and Maintenance Cost

Items	Calculation	Cost (US$)
1. Salaries & Wages		
- Staff salaries		61,320
- Labor wages	200 M/M x US$54	10,800
2. Operation cost		
- Electric charge	9,000,000 kWh x 0.015 US$	135,000
- Fuel, etc. for vehicles & equipment	US$1,000/Month	12,000
3. Office Expenses	US$400/Month	4,800
4. Maintenance Cost		11,000
5. Miscellaneous		3,080
Total		238,000

Table V-4 Replacement Cost and Useful Life (Irrigation and Drainage Facilities)

Items	Useful Life (Years)	Replacement Cost (US$1,000)
1. O & M Equipment	10	610
2. Project Facilities		
- Pumps & motors	25	4,265
- Transmission lines	25	217
- Gates	25	522

VII-1 Benefit and Cost Streams of the Project

(Unit: US$ 1,000)

Year in order	Year	Benefit	Costs				Balance
			Capital Cost	O&M Cost	Replacement Cost	Total Cost	
1	1989		627.5			627.5	-627.5
2	1990		3369.6			3369.6	-3369.6
3	1991		11034.6	6.5		11041.2	-11041.2
4	1992	277.1	7367.5	65.3		7432.7	-7155.6
5	1993	1481.2	3388.1	167.6		3555.7	-2074.5
6	1994	2383.0		208.1		208.1	2174.9
7	1995	2867.0		208.1		208.1	2658.9
8	1996	3356.3		208.1		208.1	3148.2
9	1997	3717.8		208.1		208.1	3509.7
10	1998	3819.1		208.1		208.1	3611.0
11	1999	3819.1		208.1		208.1	3611.0
12	2000	3819.1		208.1		208.1	3611.0
13	2001	3819.1		208.1		208.1	3611.0
14	2002	3819.1		208.1	610.0	818.1	3001.0
15	2003	3819.1		208.1		208.1	3611.0
16	2004	3819.1		208.1		208.1	3611.0
17	2005	3819.1		208.1		208.1	3611.0
18	2006	3819.1		208.1		208.1	3611.0
19	2007	3819.1		208.1		208.1	3611.0
20	2008	3819.1		208.1		208.1	3611.0
21	2009	3819.1		208.1		208.1	3611.0
22	2010	3819.1		208.1		208.1	3611.0
23	2011	3819.1		208.1		208.1	3611.0
24	2012	3819.1		208.1	610.0	818.1	3001.0
25	2013	3819.1		208.1		208.1	3611.0
26	2014	3819.1		208.1		208.1	3611.0
27	2015	3819.1		208.1		208.1	3611.0
28	2016	3819.1		208.1		208.1	3611.0
29	2017	3819.1		208.1	5004.0	5212.1	-1393.0
30	2018	3819.1		208.1		208.1	3611.0
31	2019	3819.1		208.1		208.1	3611.0
32	2020	3819.1		208.1		208.1	3611.0
33	2021	3819.1		208.1		208.1	3611.0
34	2022	3819.1		208.1	610.0	818.1	3001.0
35	2023	3819.1		208.1		208.1	3611.0
36	2024	3819.1		208.1		208.1	3611.0
37	2025	3819.1		208.1		208.1	3611.0
38	2026	3819.1		208.1		208.1	3611.0
39	2027	3819.1		208.1		208.1	3611.0
40	2028	3819.1		208.1		208.1	3611.0
41	2029	3819.1		208.1		208.1	3611.0
42	2030	3819.1		208.1		208.1	3611.0
43	2031	3819.1		208.1		208.1	3611.0
44	2032	3819.1		208.1	610.0	818.1	3001.0
45	2033	3819.1		208.1		208.1	3611.0
46	2034	3819.1		208.1		208.1	3611.0
47	2035	3819.1		208.1		208.1	3611.0
48	2036	3819.1		208.1		208.1	3611.0
49	2037	3819.1		208.1		208.1	3611.0
50	2038	3819.1		208.1		208.1	3611.0
51	2039	3819.1		208.1		208.1	3611.0
52	2040	3819.1		208.1		208.1	3611.0
53	2041	3819.1		208.1		208.1	3611.0

IRR= 11.06% NPV(8%)= 8382.2

VII-2 Financial Cash Flow of Executing Organization

(Unit: US$ thousand)

Year	Year in Order	Cash Outflow						Cash Inflow				Balance
		Project Cost	O&M Cost	Replace-ment Cost	Loan Repayment for Principal	Loan Repayment for Interest	Total Outflow	Foreign Loan	Govern-ment Budget	Irriga-tion Charge	Total Inflow	
1989	1	698				5	703	518	180		698	-5
1990	2	3,827				38	3,865	3,241	586		3,827	-38
1991	3	12,537	7			151	12,695	11,307	1,230		12,537	-158
1992	4	8,336	72			226	8,634	7,545	791	182	8,518	-116
1993	5	3,679	204			261	4,144	3,468	211	453	4,132	-12
1994	6		238			261	499			556	556	57
1995	7		238			261	499			556	556	57
1996	8		238			261	499			556	556	57
1997	9		238			261	499			556	556	57
1998	10		238			261	499			556	556	57
1999	11		238		1,304	248	1,790			556	556	-1,234
2000	12		238		1,304	235	1,777			556	556	-1,221
2001	13		238	610	1,304	222	2,374			556	556	-1,818
2002	14		238		1,304	209	1,751			556	556	-1,195
2003	15		238		1,304	196	1,738			556	556	-1,182
2004	16		238		1,304	183	1,725			556	556	-1,169
2005	17		238		1,304	170	1,711			556	556	-1,155
2006	18		238		1,304	156	1,698			556	556	-1,142
2007	19		238		1,304	143	1,685			556	556	-1,129
2008	20		238		1,304	130	1,672			556	556	-1,116
2009	21		238		1,304	117	1,659			556	556	-1,103
2010	22		238		1,304	104	1,646			556	556	-1,090
2011	23		238	610	1,304	91	2,243			556	556	-1,687
2012	24		238		1,304	78	1,620			556	556	-1,064
2013	25		238		1,304	65	1,607			556	556	-1,051
2014	26		238		1,304	52	1,594			556	556	-1,038
2015	27		238		1,304	39	1,581			556	556	-1,025
2016	28		238	5,114	1,304	26	6,682			556	556	-6,126
2017	29		238		1,304	13	1,555			556	556	-999
2018	30		238		1,304		1,542			556	556	-986
Total		29,077	6,234	6,334	26,079	4,462	72,185	26,079	2,998	14,535	43,612	-28,574

Remark: Condition of foreign loan; Annual interst of 1.00 % for repayment period of 30 years including 10 year of grace period

FIGURES

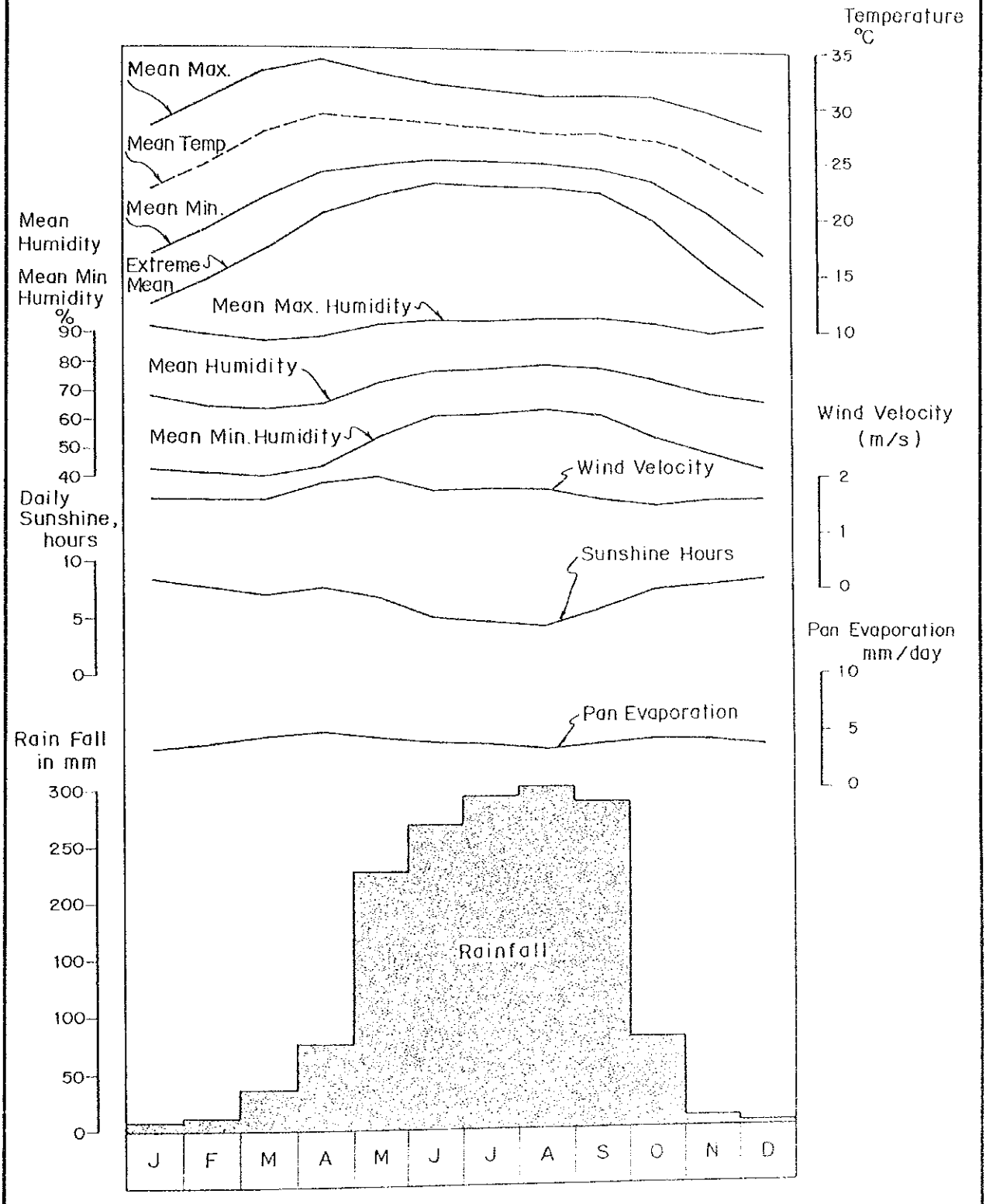


Fig. III-1 METEOROLOGICAL DATA

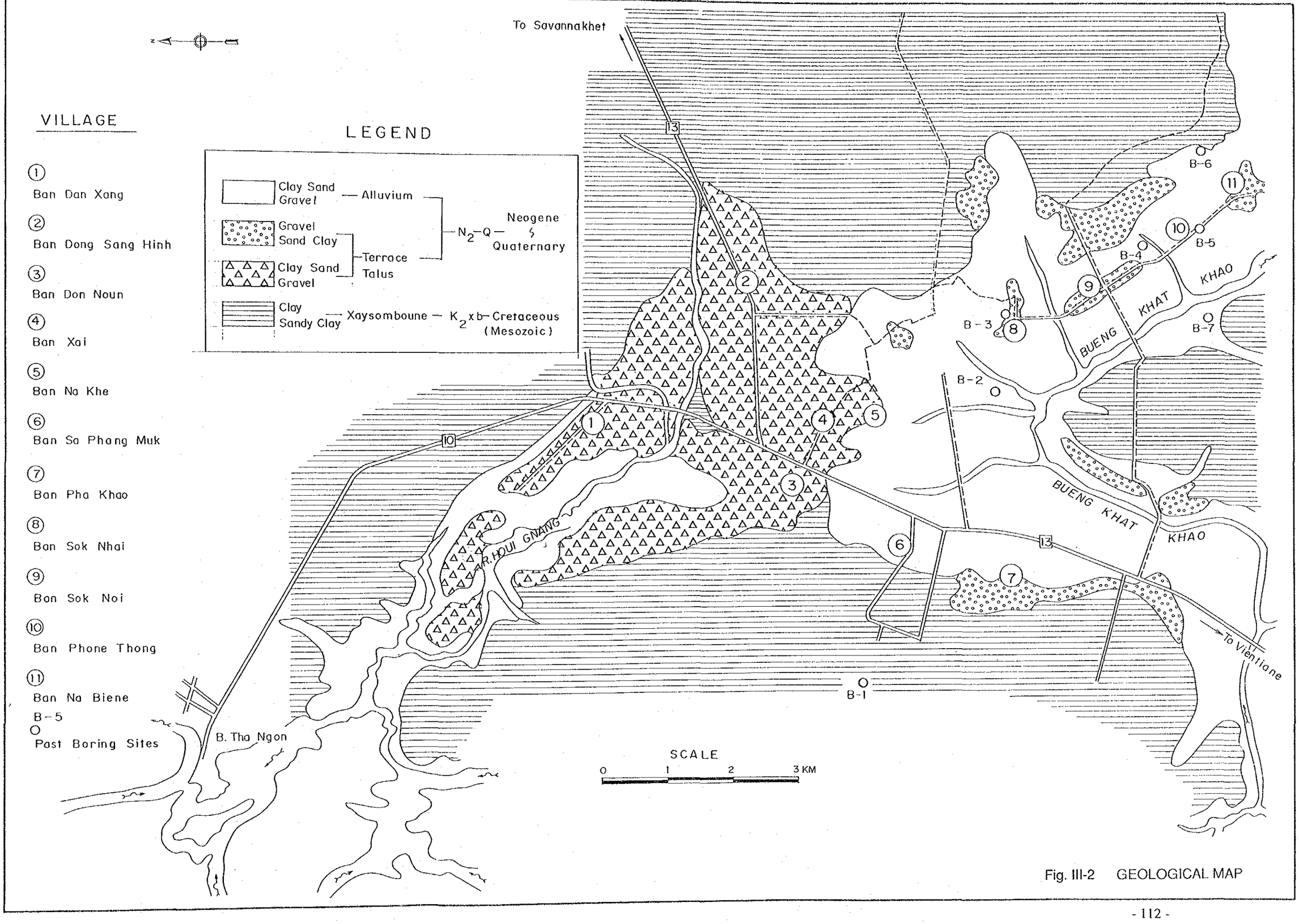


Fig. III-2 GEOLOGICAL MAP

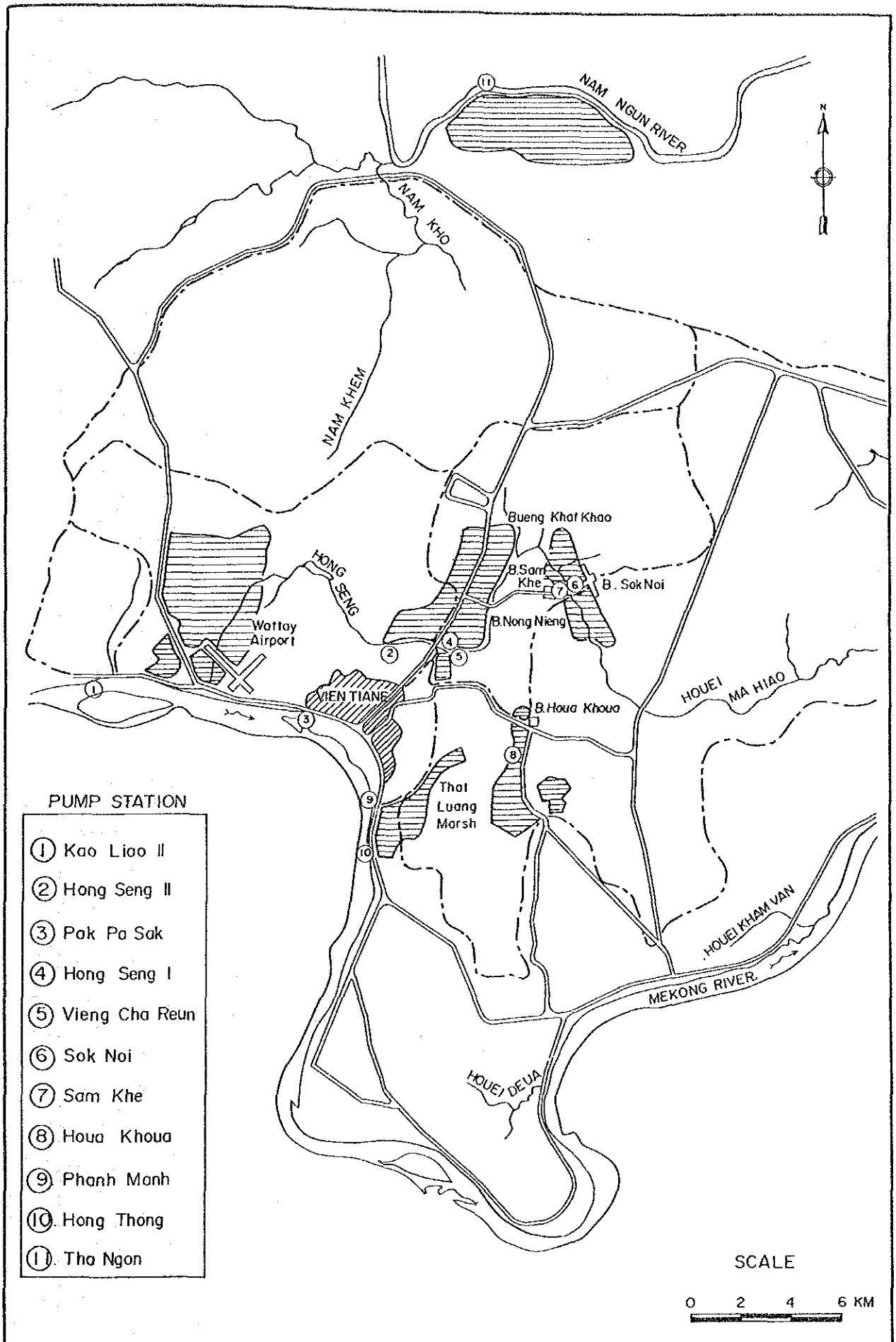


Fig. III-3 EXISTING IRRIGATION PROJECTS

LEGEND

SOIL CLASSIFICATION

X : Acrisols P : Fluvisols D : Gleysols

SURFACE SOIL TEXTURE	RELIEF CONDITIONS	SOIL DEPTH
a : Sand	⊥ Upper Pediment	1 : >100 cm
b : Sandy Loam	⊥ Medium Upper Pediment	2 : 70-100cm
c : Silty Loam	= Flat	3 : 50-70cm
d : Silty Clay	T̄ Medium Lower Pediment	4 : 25-50cm
e : Clay	T Lower Pediment	5 : < 25 cm

Relief → $=X_1^c$ ← Texture, Depth; Soil Class

: Boundary of Originally-planned Area

: Boundary of Extension Area

: Village

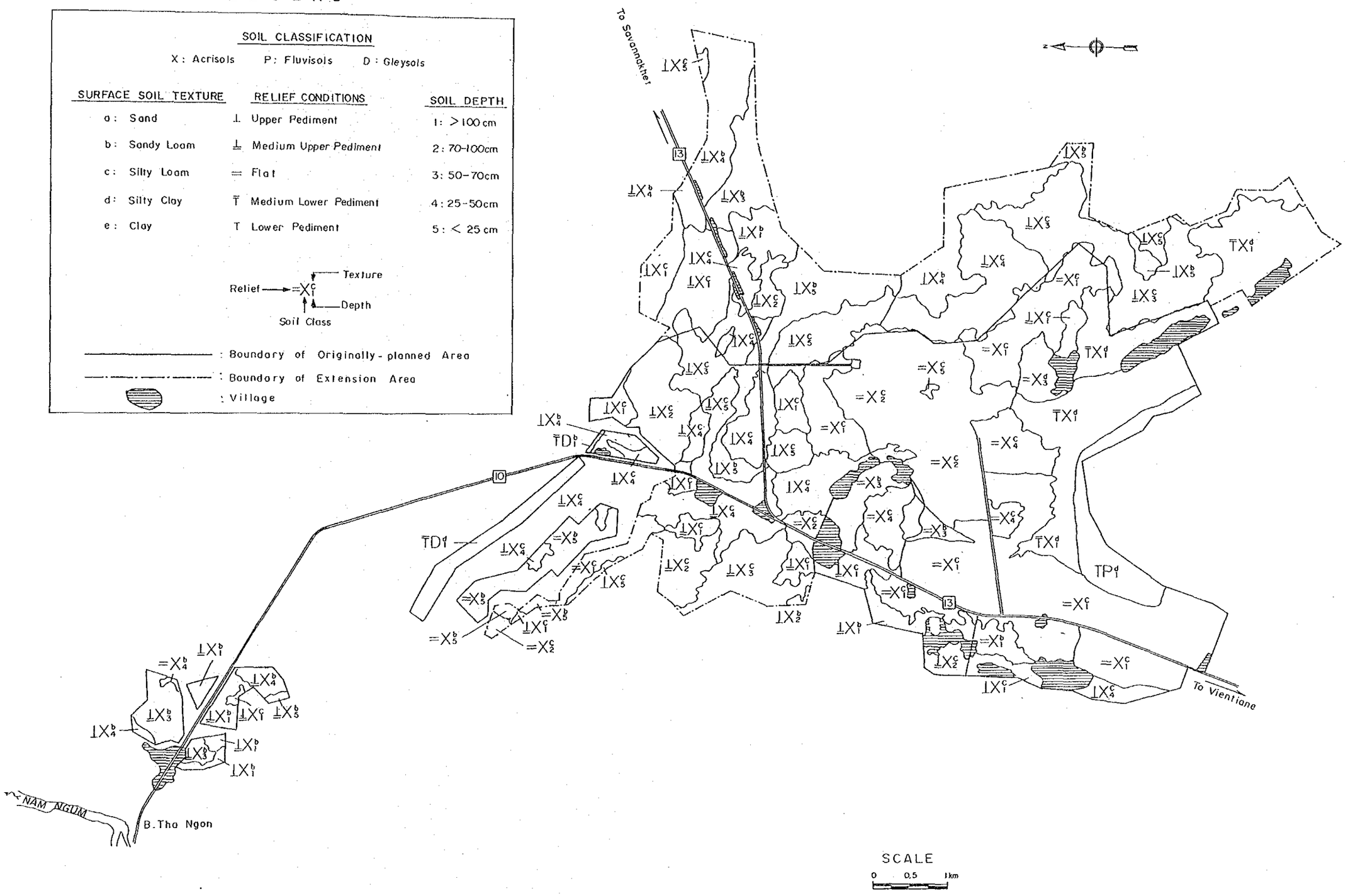


Fig. III-4 SOIL MAP

LEGEND

Mapping Symbol	Land Capability Class		Area Extent (ha)		
	Paddy	Upland	Originally-planned area	Extension area	Total
1	II lrfn	IV(w)	110	48	158
2	II lrfn	IV(w)		3	3
3	II lrfn	IV(w)	112	71	183
4	II dglrfni	IV(w)	95	227	322
5	IVdgi	IVdg(w)	119	173	292
6	II plrfna	IV(w)	1,014	251	1,265
8	II plrfna	IV(w)	532	102	634
9	II plrfna	IV(w)	48	409	457
10	II dgplrfnia	IV(w)	349	254	603
11	IVdgi	IVdg(w)ie	48	115	163
12	III pra	IV(w)w	349	157	506
13	III pra	IV(w)w	38		38
14	IVa	IV(w)wa	68		68
15	III pra	IV(w)w	58		58
Total			2,940	1,810	4,750

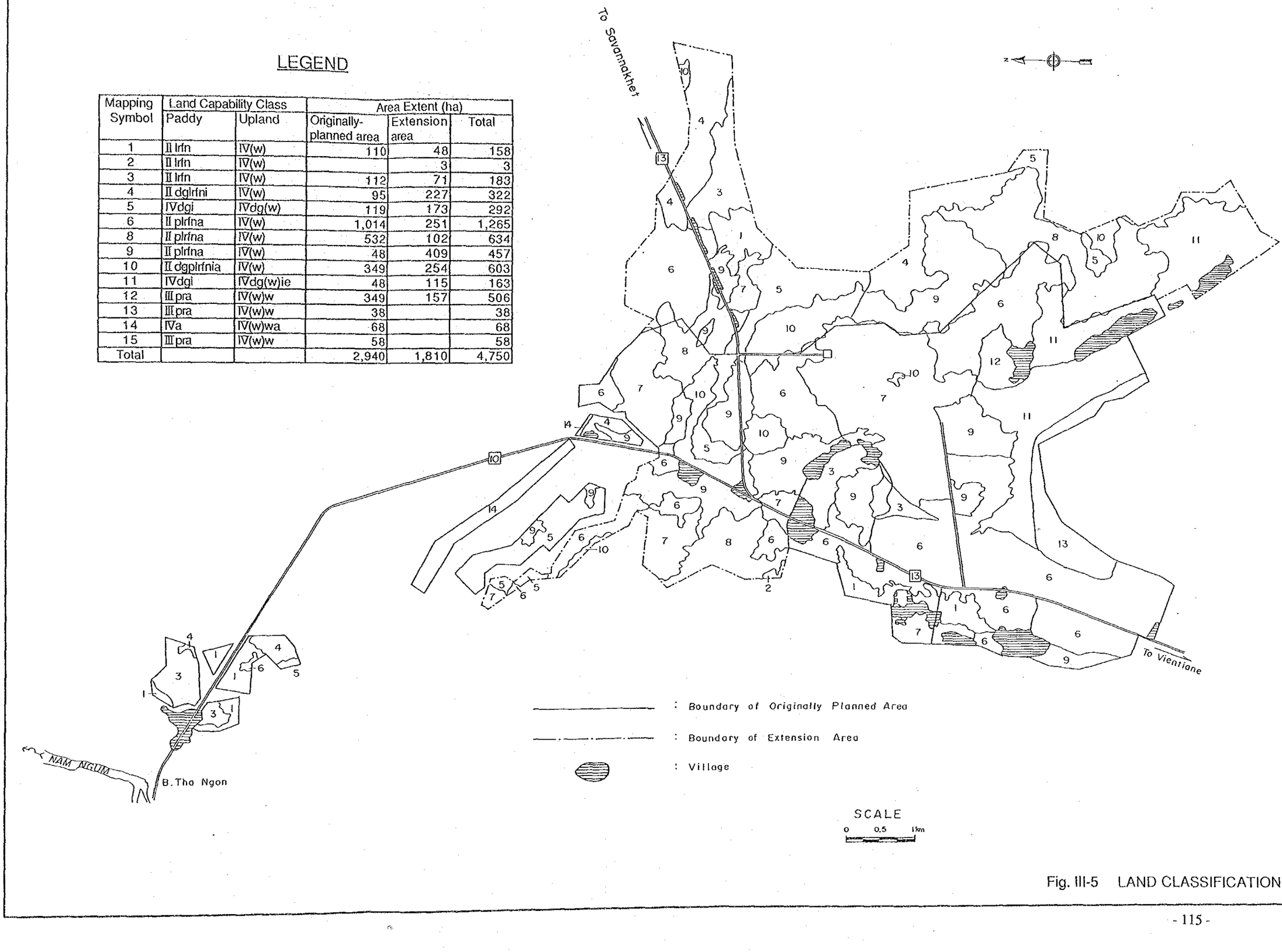


Fig. III-5 LAND CLASSIFICATION MAP

LEGEND

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

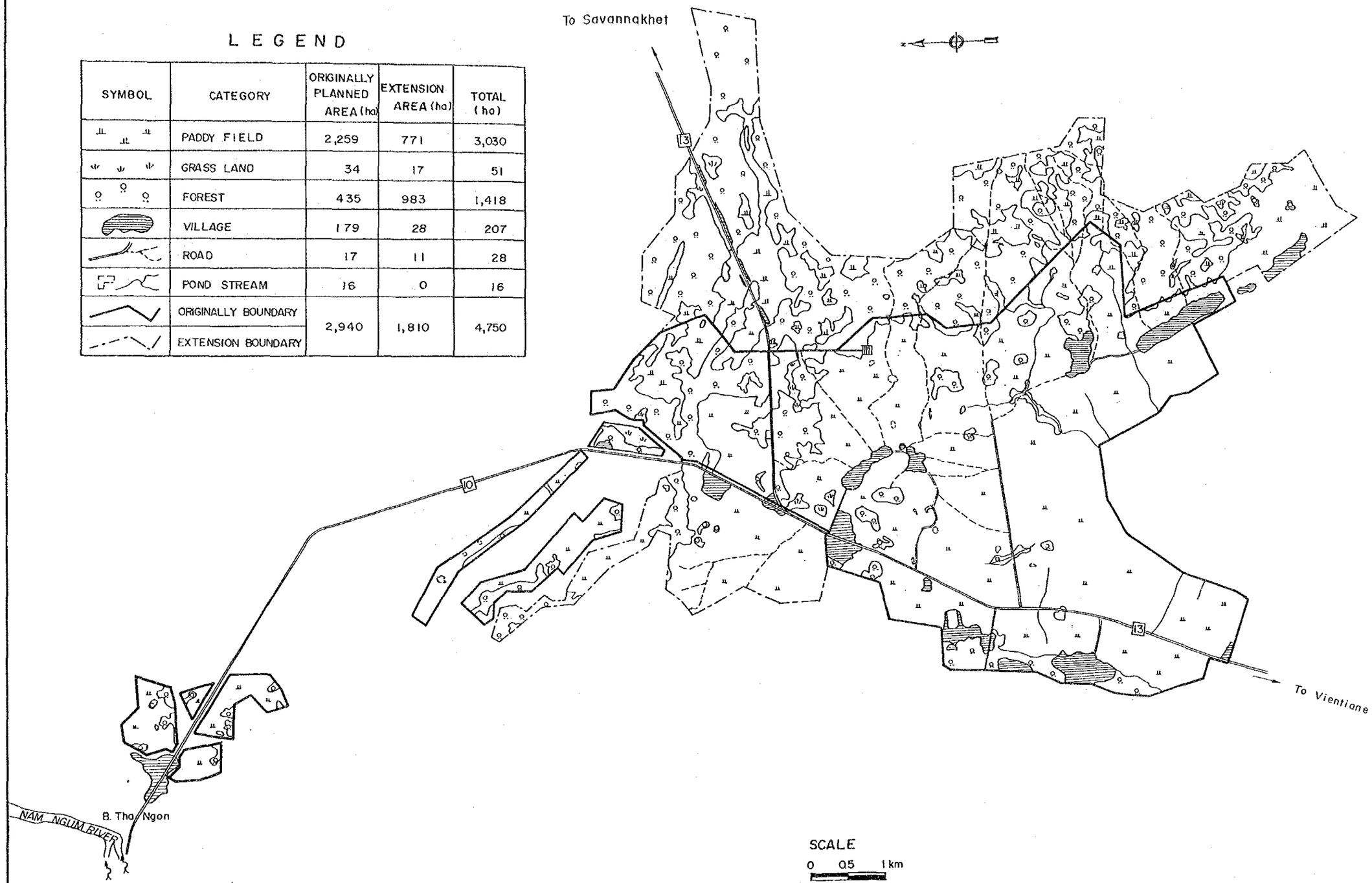


Fig. III-6 PRESENT LAND USE MAP

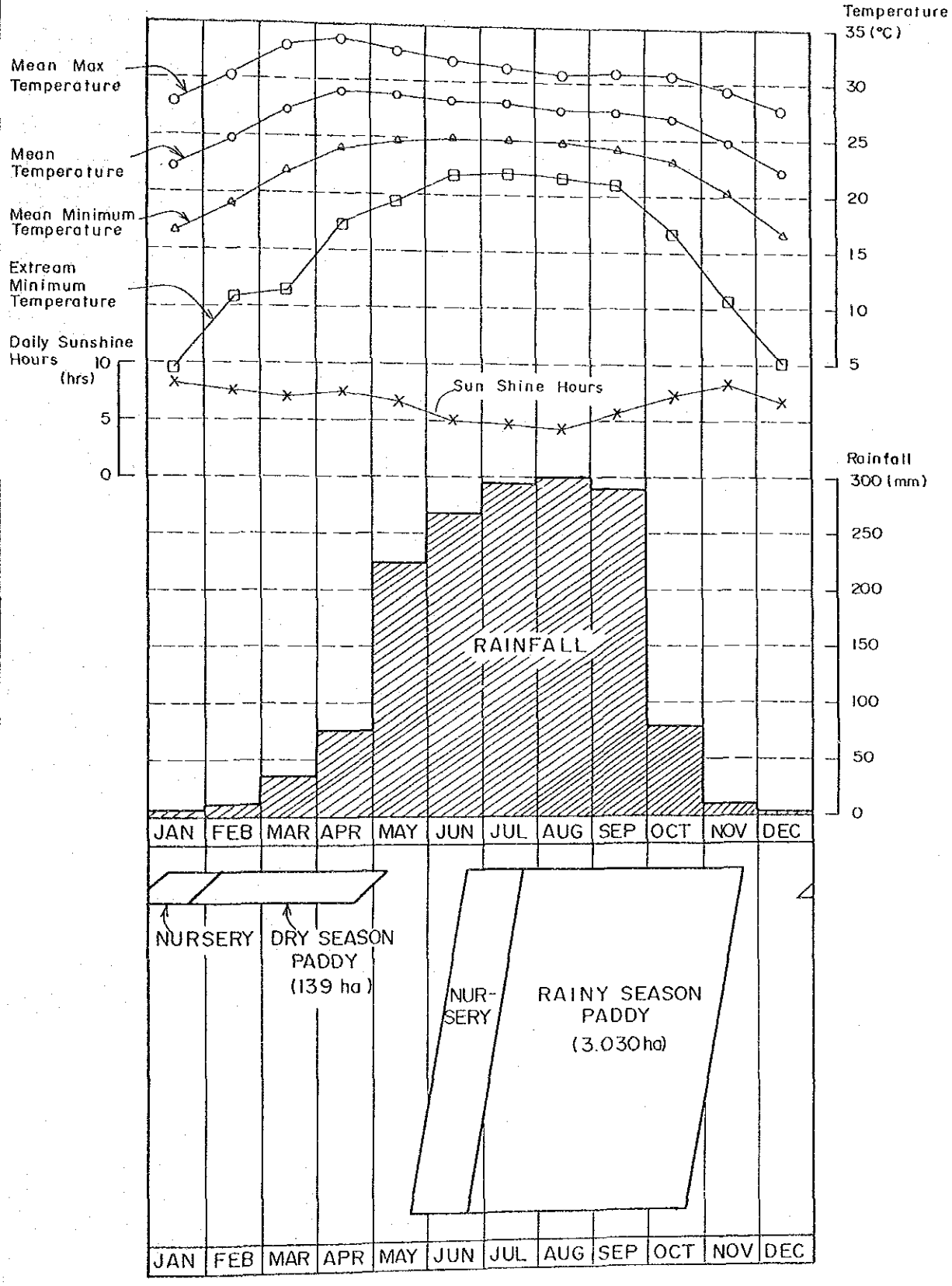


Fig. III-7 PRESENT CROPPING PATTERN AND CLIMATIC CONDITION

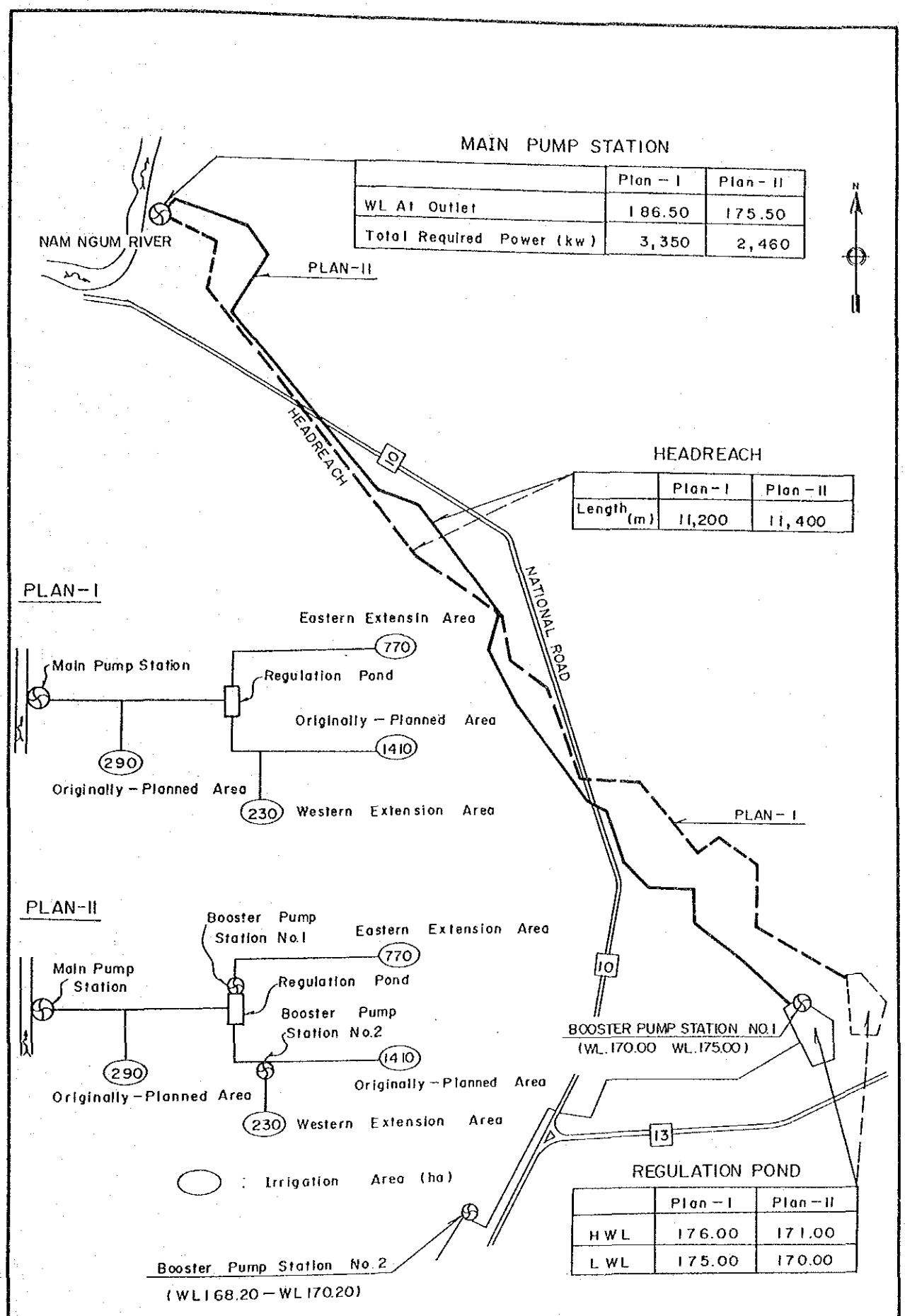


Fig. IV-1 ALTERNATIVE PUMP IRRIGATION LAYOUT

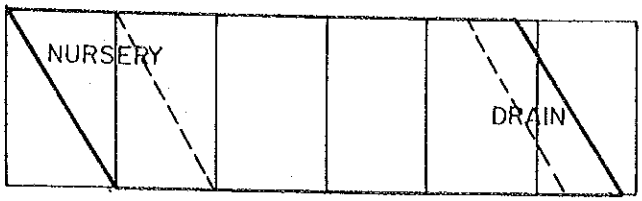
	J	J	A	S	O	N
						
(1) E To (mm)	—	138	132	138	141	88
(2) KC	—	1.13	1.14	1.12	1.09	1.03
(3) =(1)x(2) (mm)	—	156	151	155	154	91
(4) Percolation (mm)	—	45	45	45	45	90
(5) Effective Rainfall (mm)	—	185	195	185	50	—
(6) = (3) + (4) − (5) (mm)	—	16	1	15	149	181
(7) Area Factor	—	0.5	1	1	0.78	0.06
(8) = (6) x (7) (mm)	—	8	1	15	116	11
(9) Puddling Water (mm)	30	150	—	—	—	—
(10) Nursery Water (mm)	14	7	—	—	—	—
(11) NW(8)+(9)+(10) (mm)	44	165	1	15	116	11
(12) DW(11)÷EF (mm)	72	271	2	25	190	18
(lit/sec/ha)	0.28	1.05	0.02	0.09	0.74	0.07

Fig. IV-2 IRRIGATION WATER REQUIREMENT
(RAINY SEASON PADDY)

		D	J	F	M	A	M
			NURSERY		DRAIN		
(1) ETo	(mm)	108	123	141	162	183	–
(2) KC		–	1.21	1.30	1.29	1.28	–
(3) = (1)x(2)	(mm)	–	149	183	209	235	–
(4) Percolation	(mm)	–	90	90	90	90	–
(5) Effective Rainfall	(mm)	–	0	0	20	50	–
(6) = (3)+(4)–(5)	(mm)	–	239	273	279	275	–
(7) Area Factor		–	0.22	0.94	0.97	0.35	–
(8) =(6) x (7)	(mm)	–	53	256	271	97	–
(9) Puddling Water	(mm)	–	150	30	–	–	–
(10) Nursery Water	(mm)	7	14	–	–	–	–
(11) NW (8)+(9)+(10)	(mm)	7	217	286	271	87	–
(12) DW (11) ÷ EF	(mm)	12	356	469	445	159	–
(lit/sec/ha)		0.05	1.38	1.80	1.72	0.62	–

Fig. IV-3 IRRIGATION WATER REQUIREMENT
(DRY SEASON PADDY)

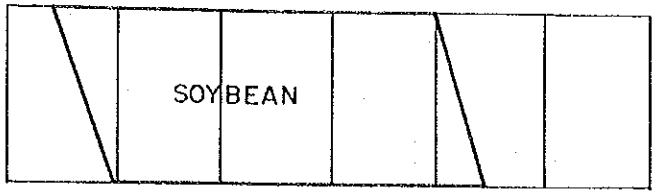
		D	J	F	M	A	F
							
(1) ETo	(mm)	108	123	141	162	183	174
(2) KC		0.20	0.80	1.03	0.97	0.40	
(3) = (1) x (2)	(mm)	22	99	145	157	74	
(4) Effective Rainfall	(mm)	0	0	0	20	50	120
(5) = (3) − (4)	(mm)	22	99	145	137	24	
(6) Area Factor		0.25	1	1	1	0.25	
(7) NW (5) x (6)	(mm)	6	99	145	137	6	
(8) DW (7) ÷ EF	(mm)	13	211	309	292	13	
(lit/sec/ha)		0.05	0.81	1.19	1.13	0.05	

Fig. IV-4 IRRIGATION WATER REQUIREMENT (SOYBEAN)

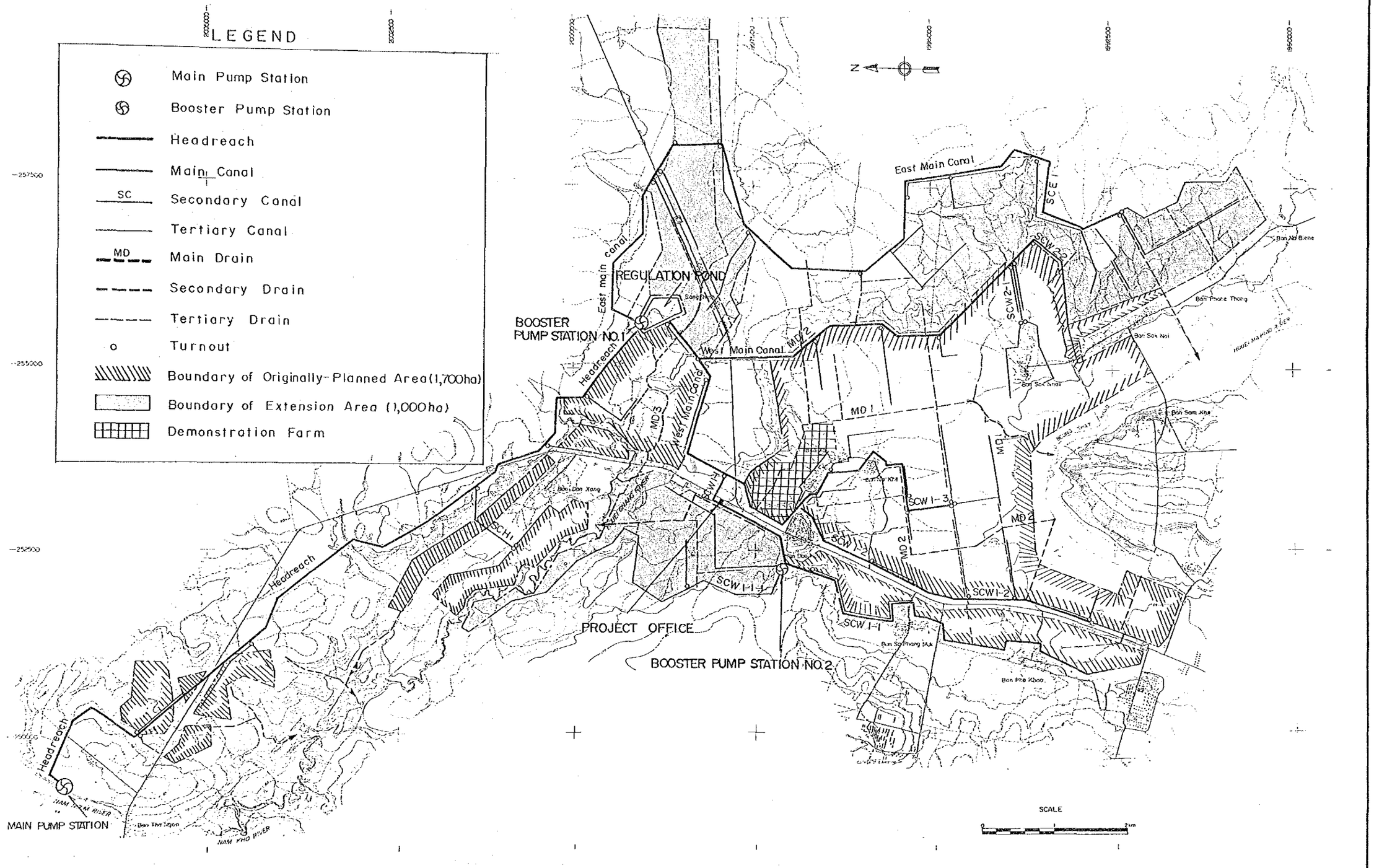
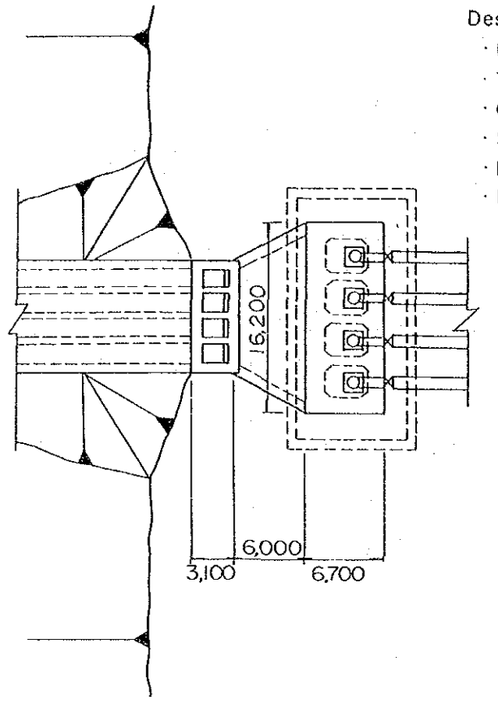
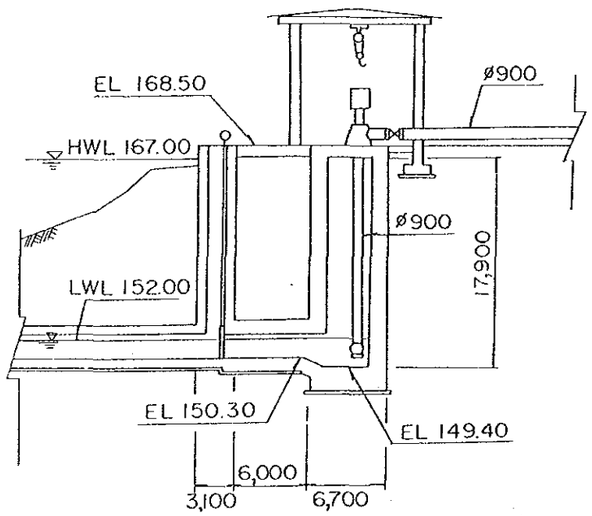


Fig. IV-5 GENERAL LAYOUT

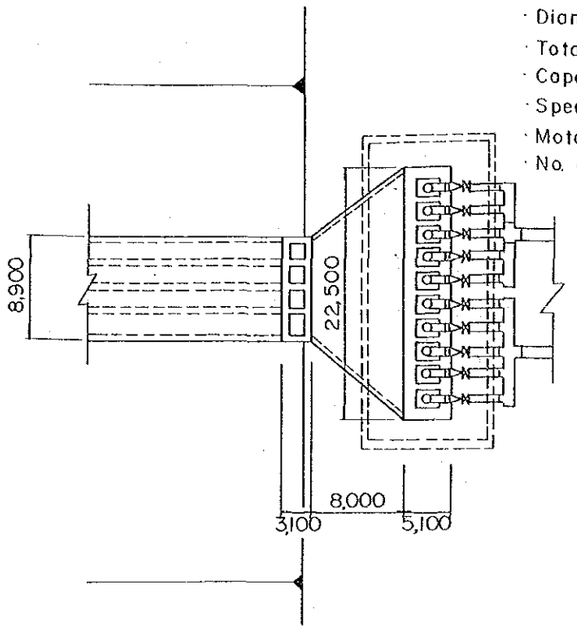
① MIXED FLOW PUMP (VERTICAL SHAFT TYPE)



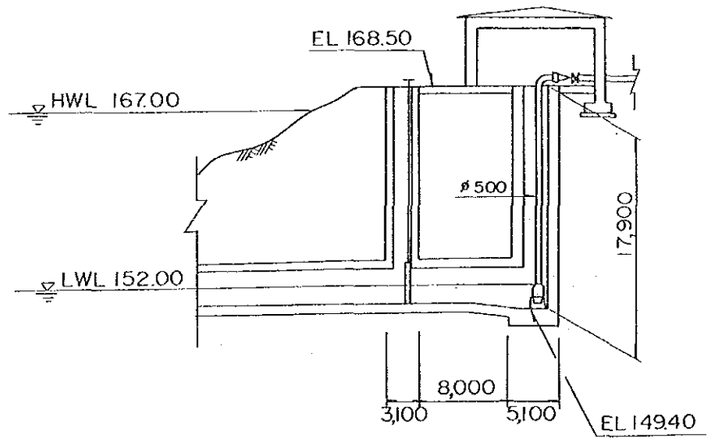
Design Data
- Diameter : 900mm
- Total Head : 28.2m
- Capacity : 97.2m/min
- Speed : 750rpm
- Motor : 710KW
- No. of pump : 4 nos



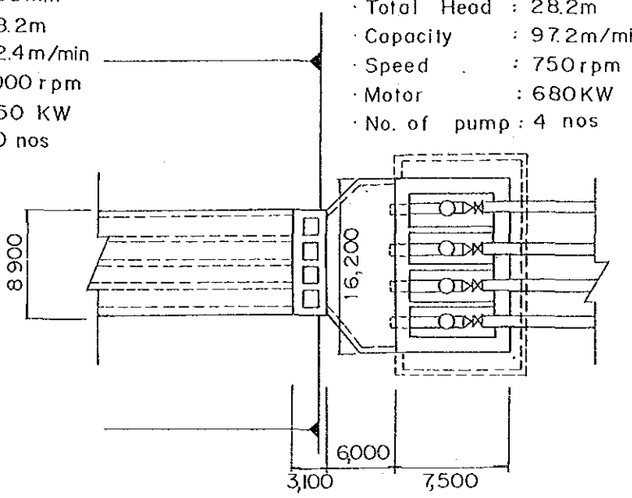
② SUBMERSIBLE PUMP



Design Data
- Diameter : 500mm
- Total Head : 28.2m
- Capacity : 32.4m/min
- Speed : 1000rpm
- Motor : 250 KW
- No. of pump : 10 nos



③ VOLUTE PUMP



Design Data
- Diameter : 900mm
- Total Head : 28.2m
- Capacity : 97.2m/min
- Speed : 750rpm
- Motor : 680KW
- No. of pump : 4 nos

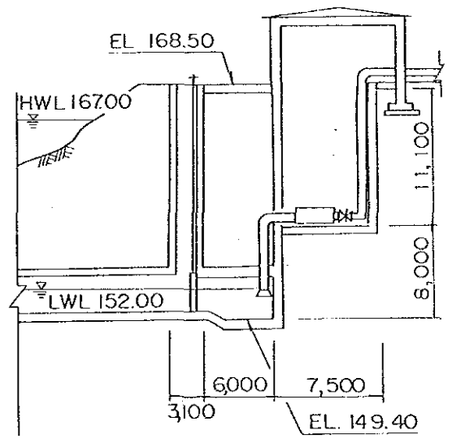
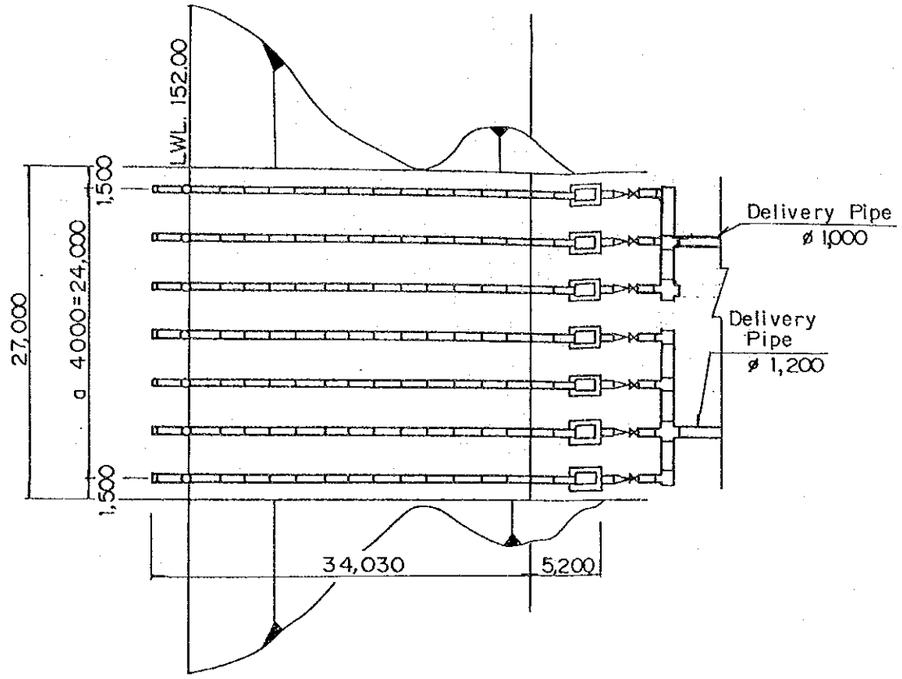


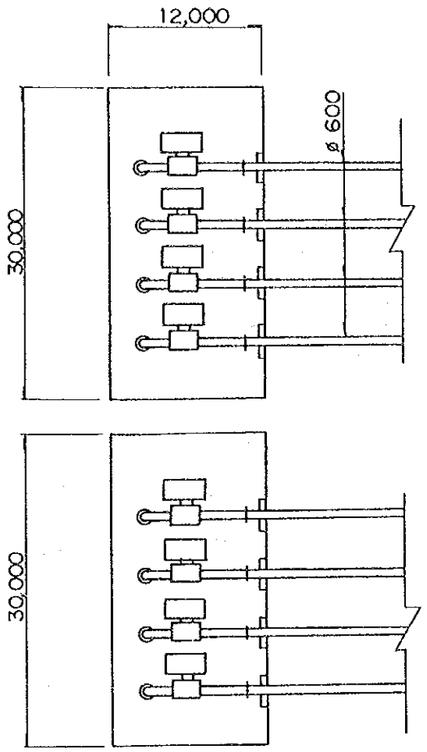
Fig. IV-6 MAIN PUMP STATION FOR ALTERNATIVE STUDY (1/2)

④ INCLINED PUMP

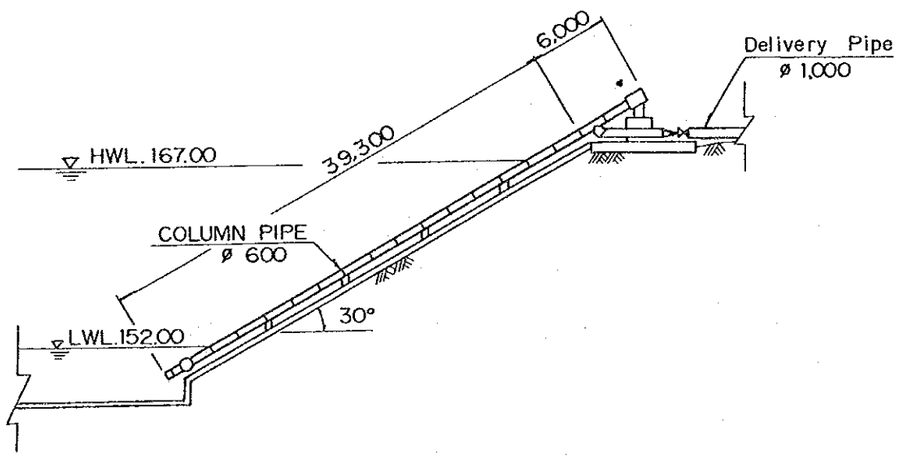


Design Data	
· Diameter	600 mm
· Total head	28.2 m
· Capacity	48.6 m³/min
· Speed	1000 rpm
· Motor	380 kw
· No. of pump	7

⑤ FLOATING PUMP STATION



Design Data	
· Diameter	600 mm
· Total head	28.2 m
· Capacity	48.6 m³/min
· Speed	1000 rpm
· Motor	350 kw
· No. of pump	8
	(2 UNITS)



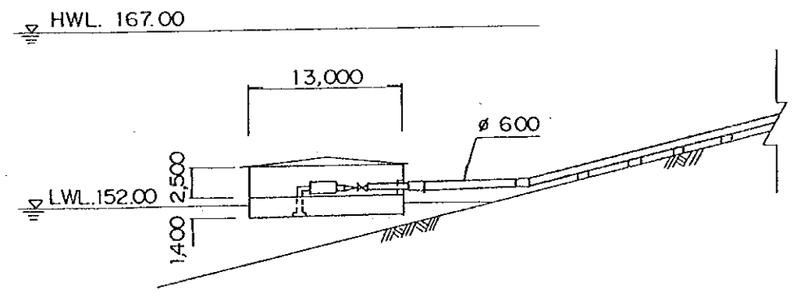
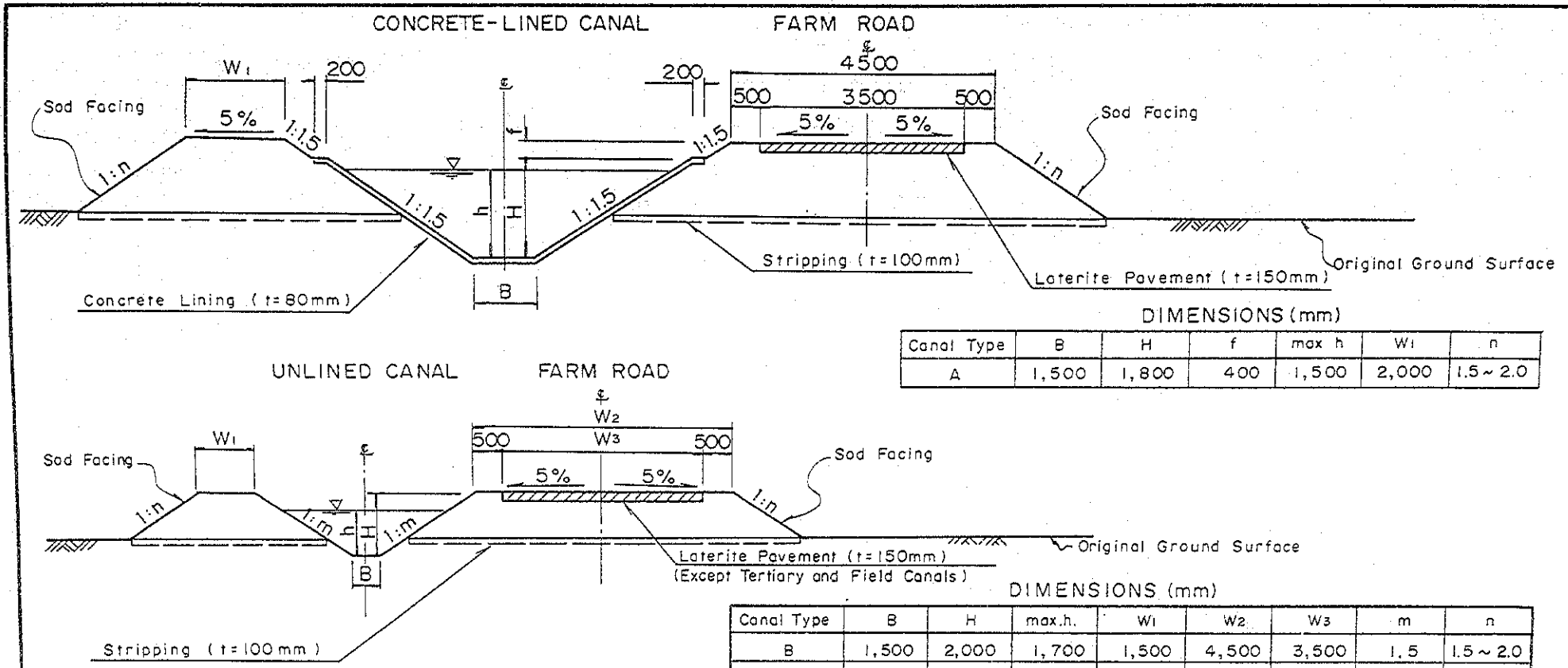


Fig. IV-6 MAIN PUMP STATION FOR ALTERNATIVE STUDY (2/2)



DIMENSIONS (mm)

Canal Type	B	H	f	max h	W1	n
A	1,500	1,800	400	1,500	2,000	1.5 ~ 2.0

DIMENSIONS (mm)

Canal Type	B	H	max.h.	W1	W2	W3	m	n
B	1,500	2,000	1,700	1,500	4,500	3,500	1.5	1.5 ~ 2.0
C	1,300	2,000	1,700	1,500	4,500	3,500	1.5	1.5 ~ 2.0
D	1,000	1,800	1,500	1,500	4,500	3,500	1.5	1.5 ~ 2.0
E	800	1,600	1,100	1,500	4,500	3,500	1.5	1.5 ~ 2.0
F	700	1,400	800	1,500	4,500	3,500	1.5	1.5 ~ 2.0
G	500	1,100	800	1,100	4,500	3,500	1.5	1.5 ~ 2.0
H	400	900	600	1,000	4,500	3,500	1.5	1.5 ~ 2.0
I	400	800	600	400	3,000	—	1.0	1.5
J	300	600	400	400	3,000	—	1.0	1.5
K	300	500	300	300	3,000	—	1.0	1.5

Fig. IV-7 TYPICAL CROSS SECTIONS OF CANALS AND FARM ROADS

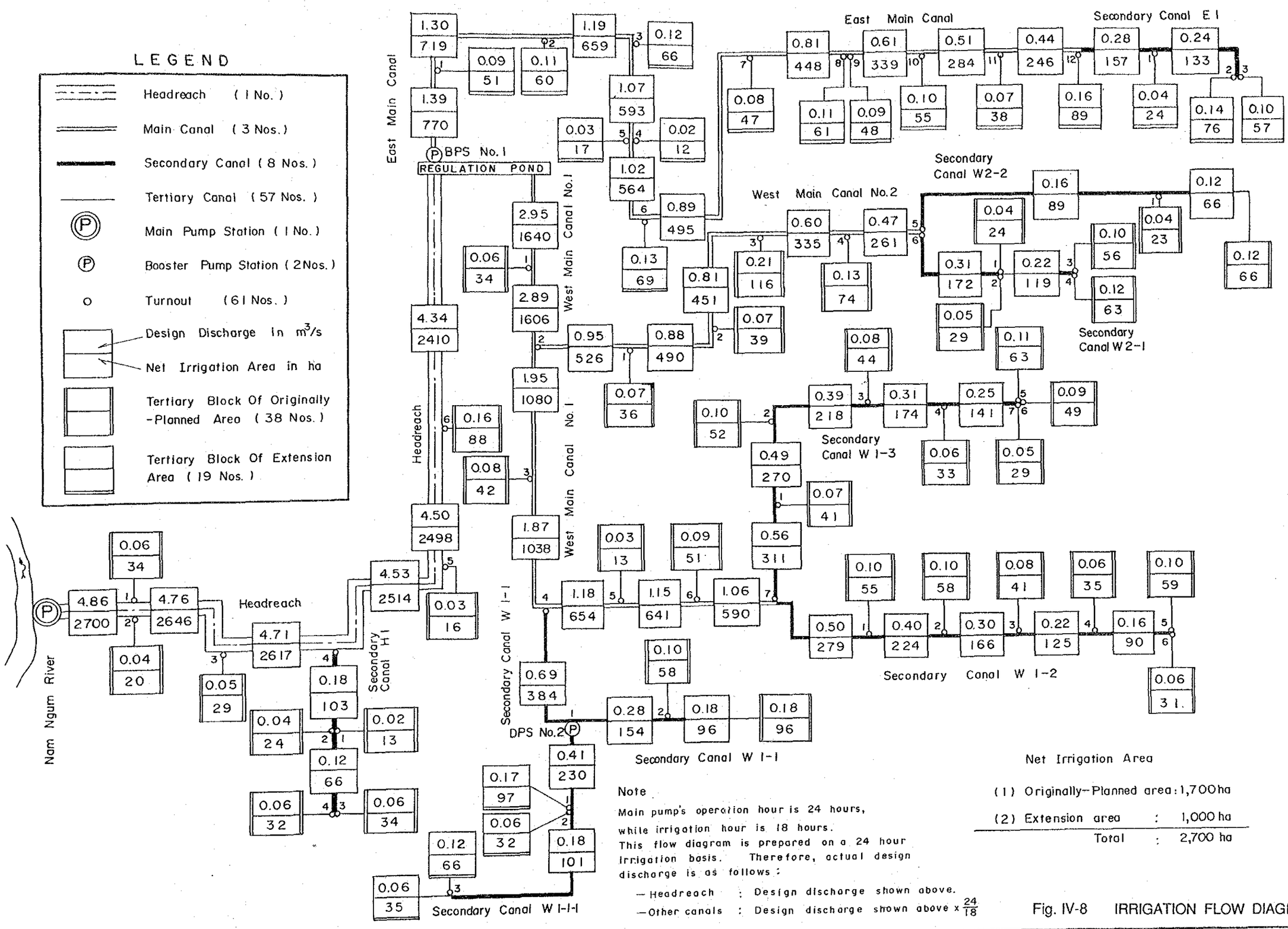
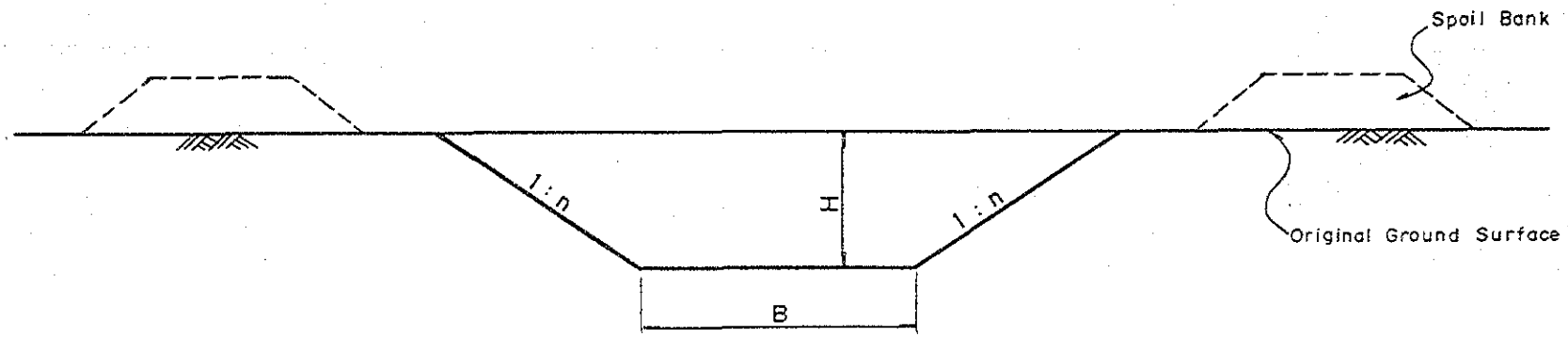


Fig. IV-8 IRRIGATION FLOW DIAGRAM



DIMENSIONS (mm)

Drain Type	B	H	n
A	5,000	2,000	1.5
B	4,000	2,000	1.5
C	3,500	1,800	1.5
D	3,000	1,500	1.5
E	2,500	1,200	1.5
F	2,000	800	1.5
G	500	500	1.0

Fig. IV-9 TYPICAL CROSS SECTIONS OF DRAINS

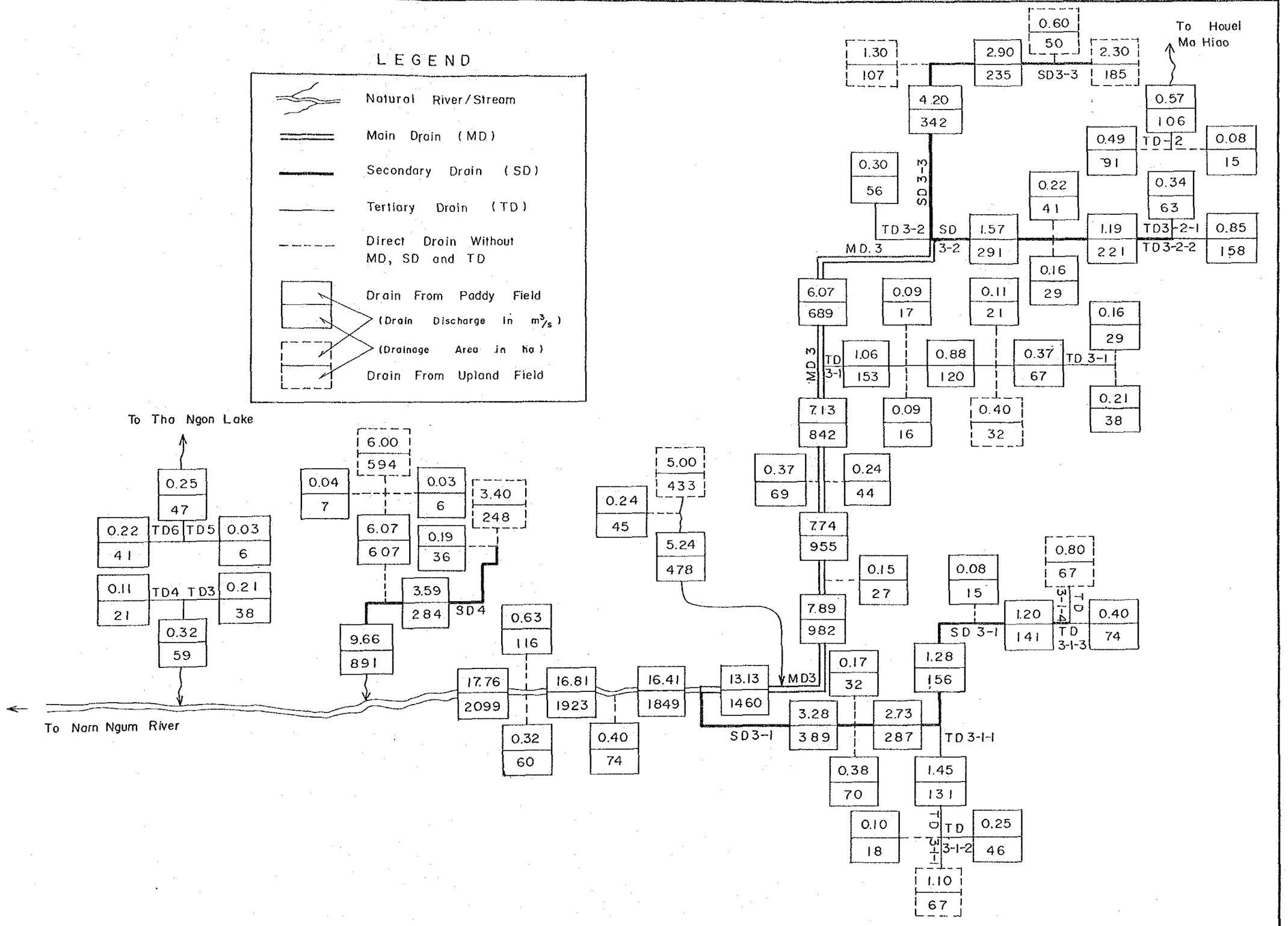


Fig. IV-10 DRAINAGE FLOW DIAGRAM (1/2)

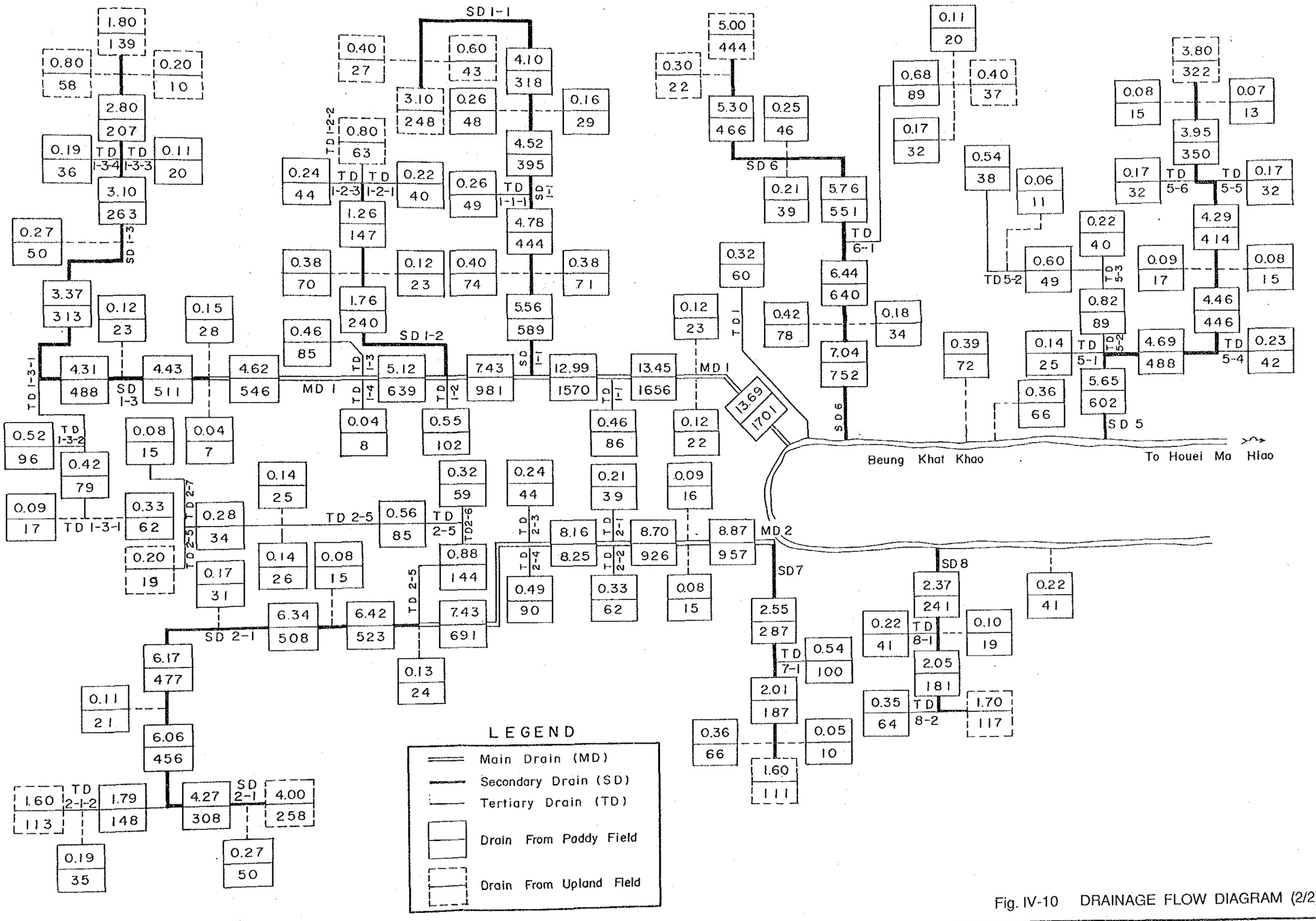


Fig. IV-10 DRAINAGE FLOW DIAGRAM (2/2)

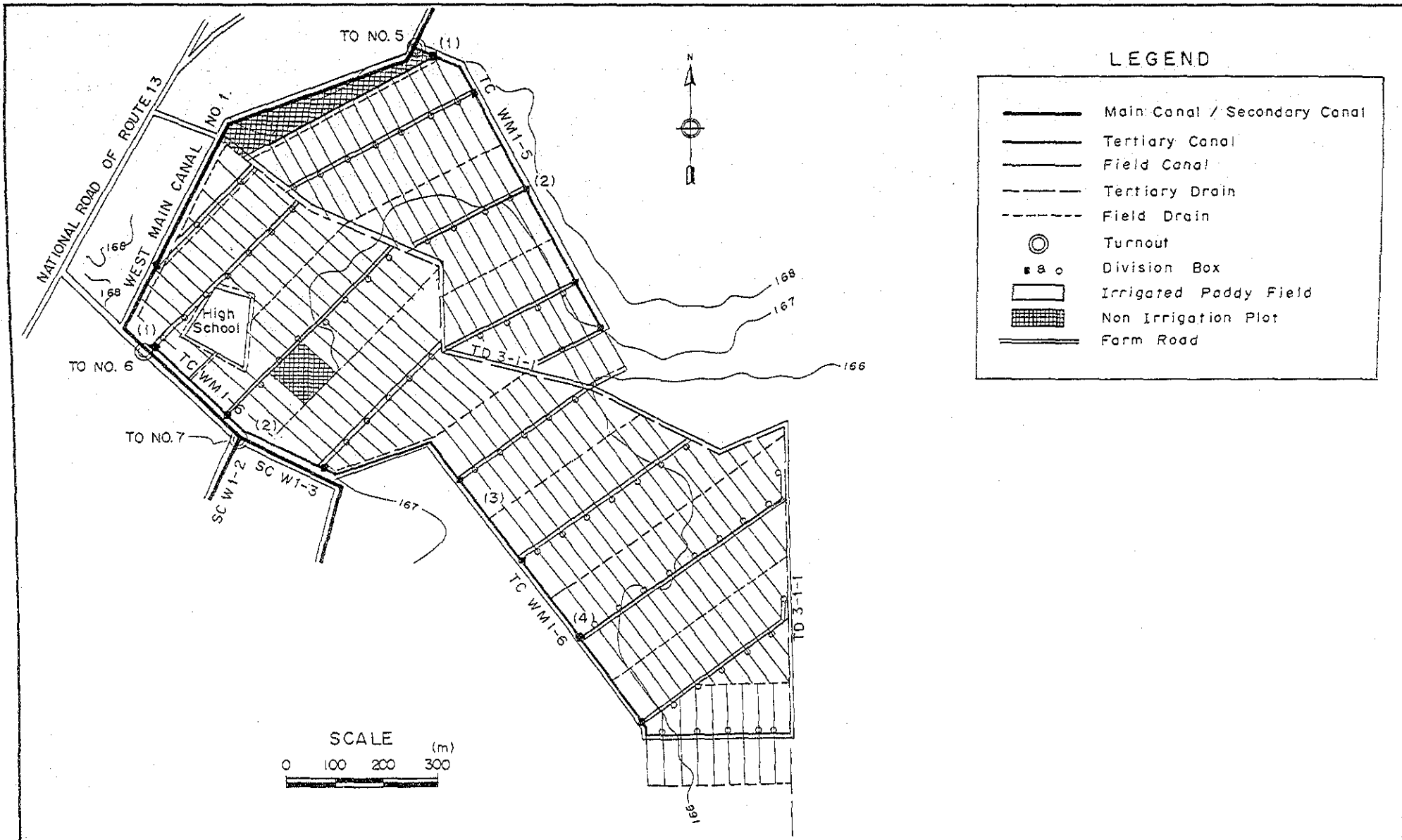


Fig. IV-11 GENERAL LAYOUT OF DEMONSTRATION FARM

LEGEND

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

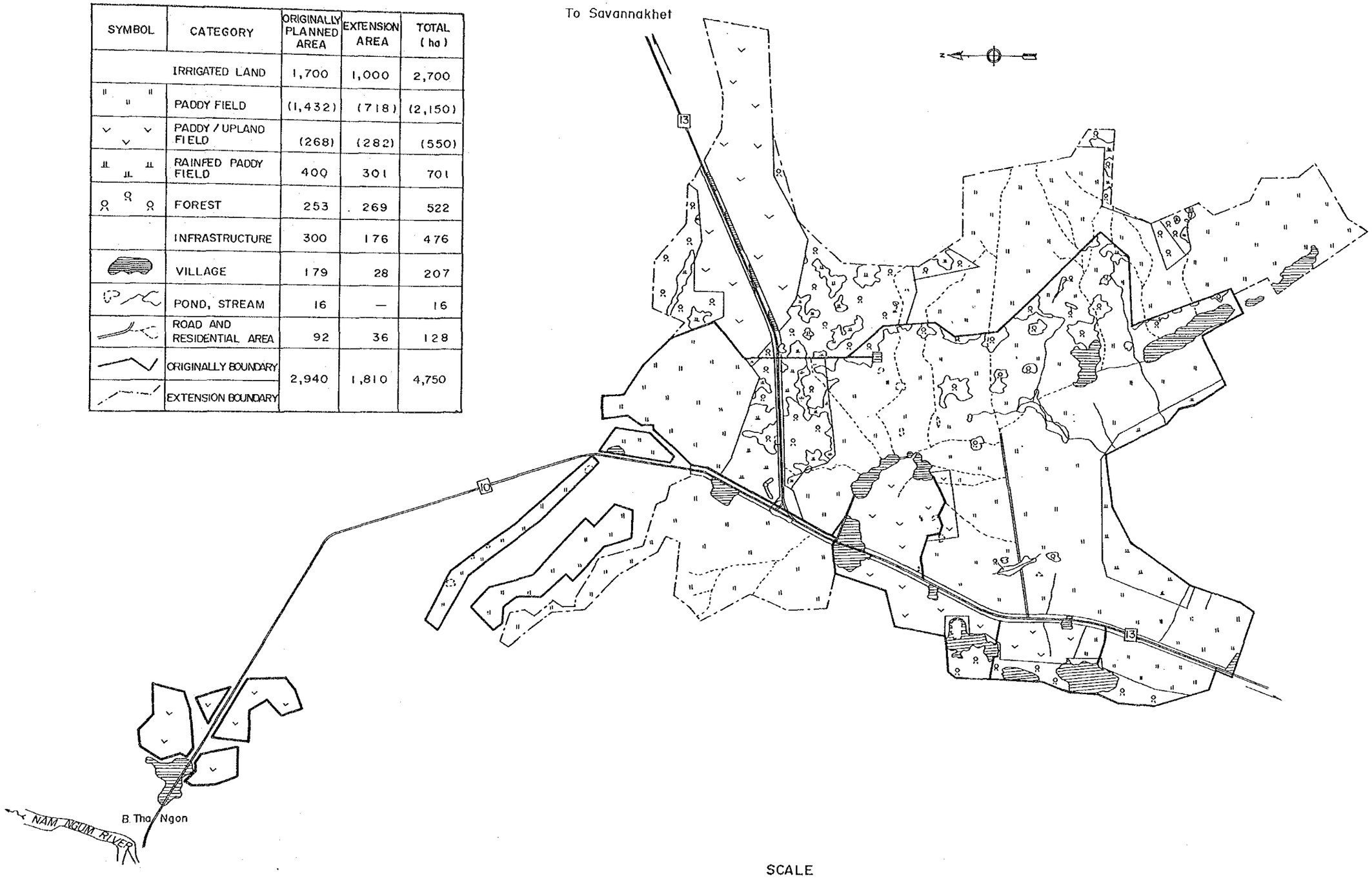


Fig. IV-12 PROPOSED LAND USE MAP

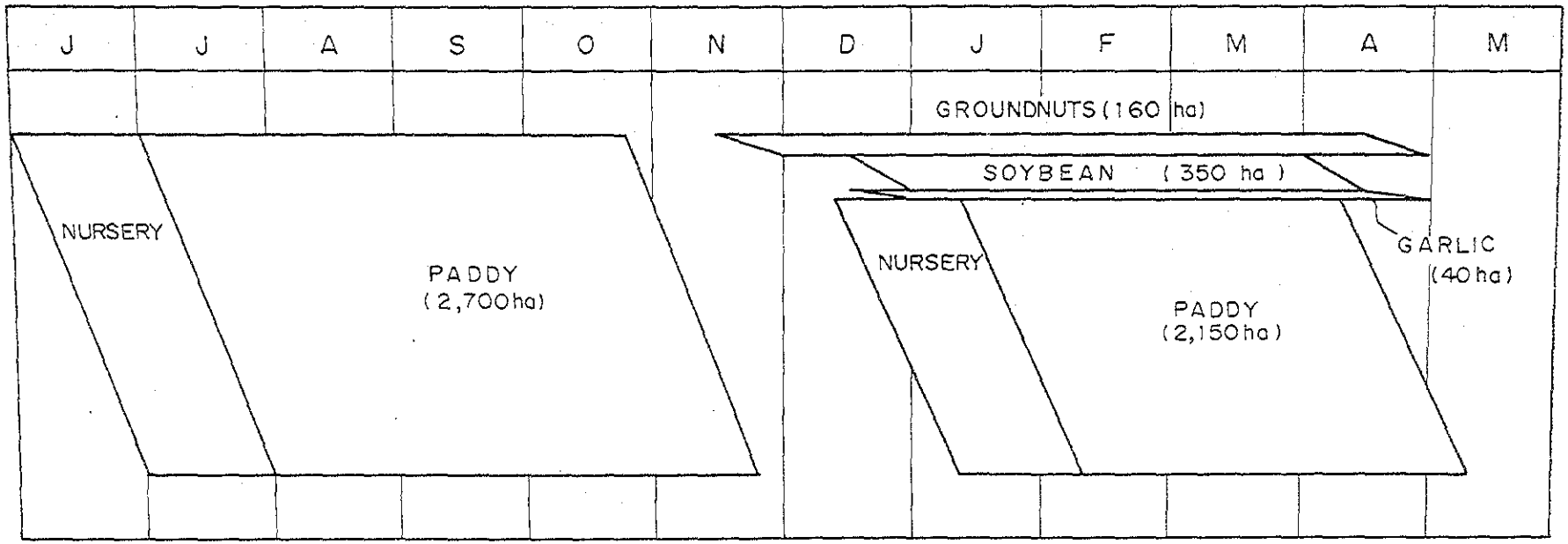
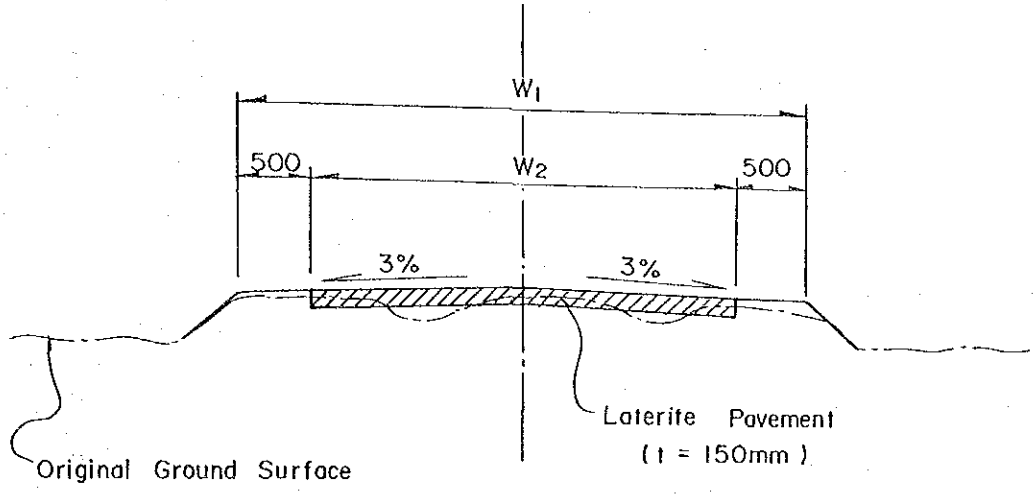


Fig. IV-13 PROPOSED CROPPING PATTERN



Location of Village Roads	Total Length (m)	W1 (mm)	W2 (mm)
*R 13 To Ban Pha Khao	500	7,000	6,000
*R 13 To Ban Sa Phang Muk	500	6,000	5,000
*R 13 To Ban Xai	400	5,000	4,000
Ban Sam Khe To Ban Sok Noi	1,250	7,000	6,000
Ban Sok Noi To Ban Sok Nhai	1,550	4,000	3,000
Ban Sok Noi To Ban Na Biene	2,500	4,000	3,000

*R13 Nationol Road of Route 13

Fig. IV-14 TYPICAL CROSS SECTIONS OF VILLAGE ROADS

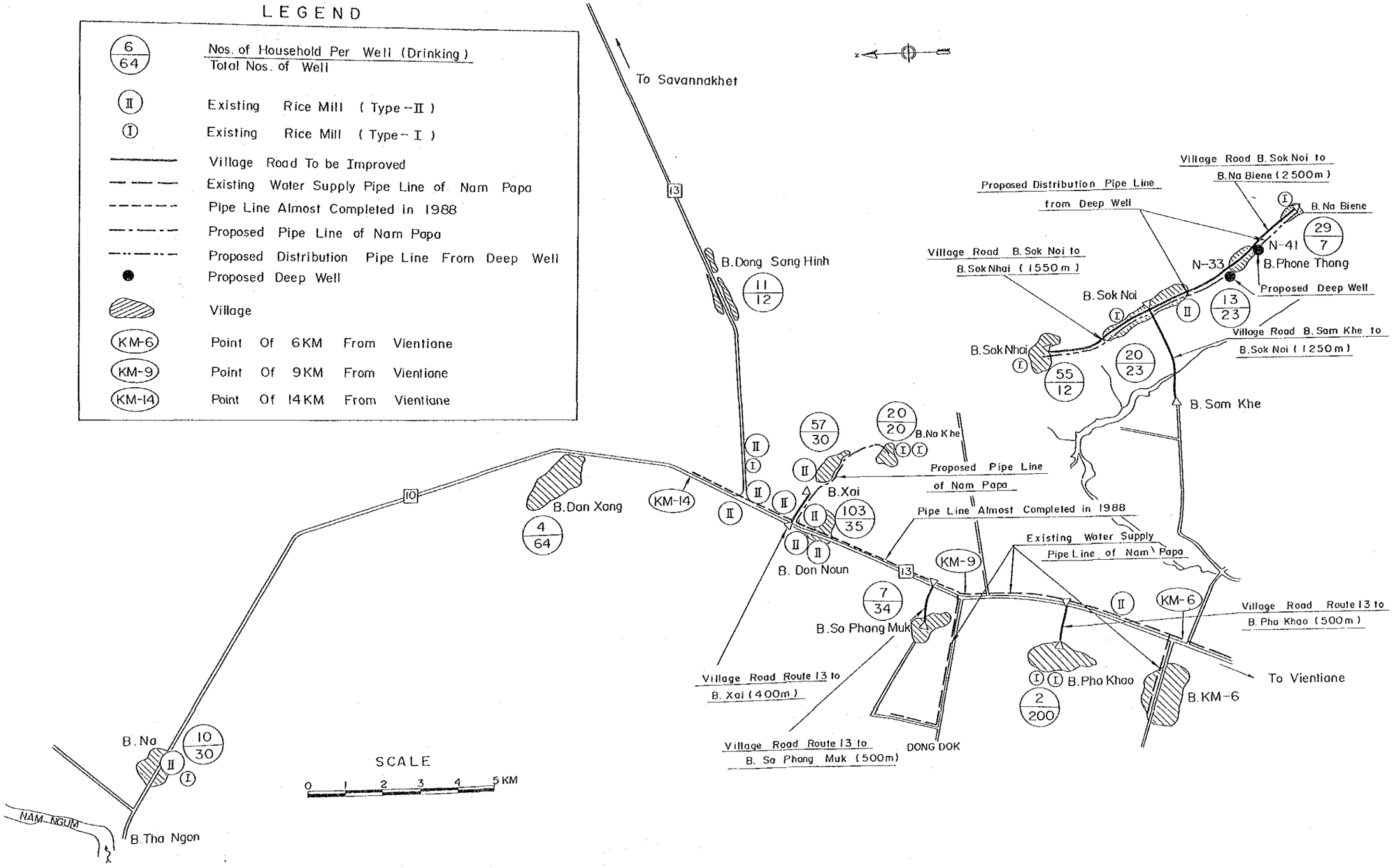


Fig. IV-15 EXISTING RURAL INFRASTRUCTURES AND PROPOSED DEVELOPMENT PLAN

WORKS	1989												1990												1991												1992												1993											
	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
I PREPARATORY WORK																									Irrigation to Demonstration Farm												Irrigation to Stage I Area												Irrigation to Stage II Area											
1 Detailed Design and Preparation of Tender Documents																																																										
2 Prequalification and Tendering																																																										
(1) Prequalification																																																										
(2) Construction work																																																										
(3) Procurement of equipment																																																										
3 Building of Project Office																																																										
II MAIN IRRI. AND DRAINAGE FACILITIES																																																										
1 Mobilization and Preparatory Works																																																										
2 Irrigation Canals																																																										
(1) Main pump station																																																										
(2) Booster pump station no.1																																																										
(3) Booster pump station no.2																																																										
(4) Regulation pond																																																										
(5) Headreach with structures																																																										
(6) Main canals with structures																																																										
(7) Secondary canals with structues																																																										
3 Drains																																																										
(1) Main drains with structures																																																										
(2) Secondary drains with structures																																																										
III ON-FARM DEVELOPMENT WORK																																																										
1 Tertiary Canals																																																										
2 Tertiary Drains																																																										
3 Field Canals																																																										
4 Field Drains																																																										
5 Land Clearing and Levelling																																																										
(1) Originally-planned area																																																										
(2) Extension area																																																										
IV RURAL INFRASTRUCTURES																																																										
1 Village Roads																																																										
2 Potable Water Supply Facilities																																																									
V DEMONSTRATION FARM																																																									

— Stage-I --- Stage-II

Fig. V-1 CONSTRUCTION SCHEDULE

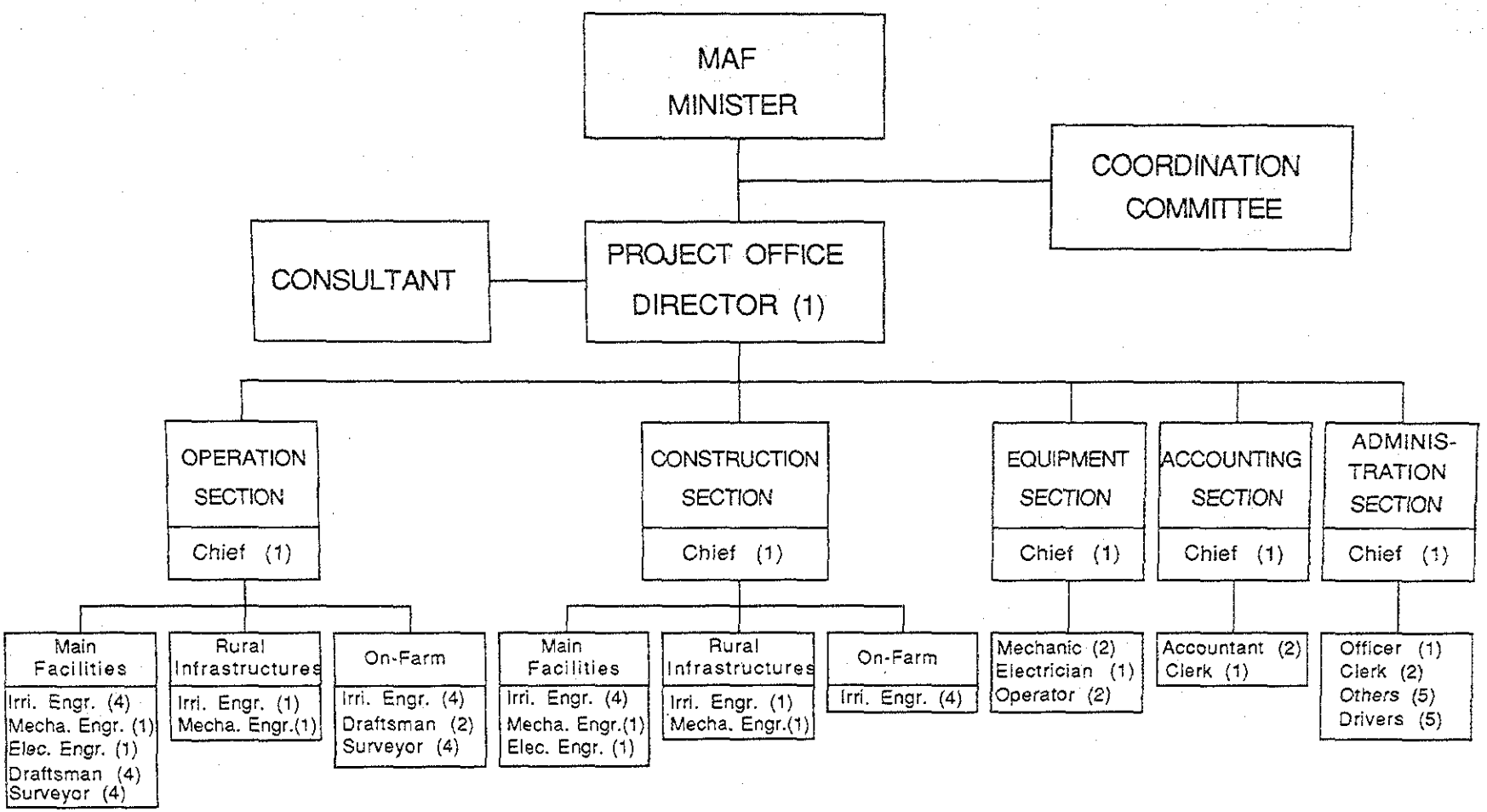


Fig.VI-1 ORGANIZATION CHART AT CONSTRUCTION STAGE

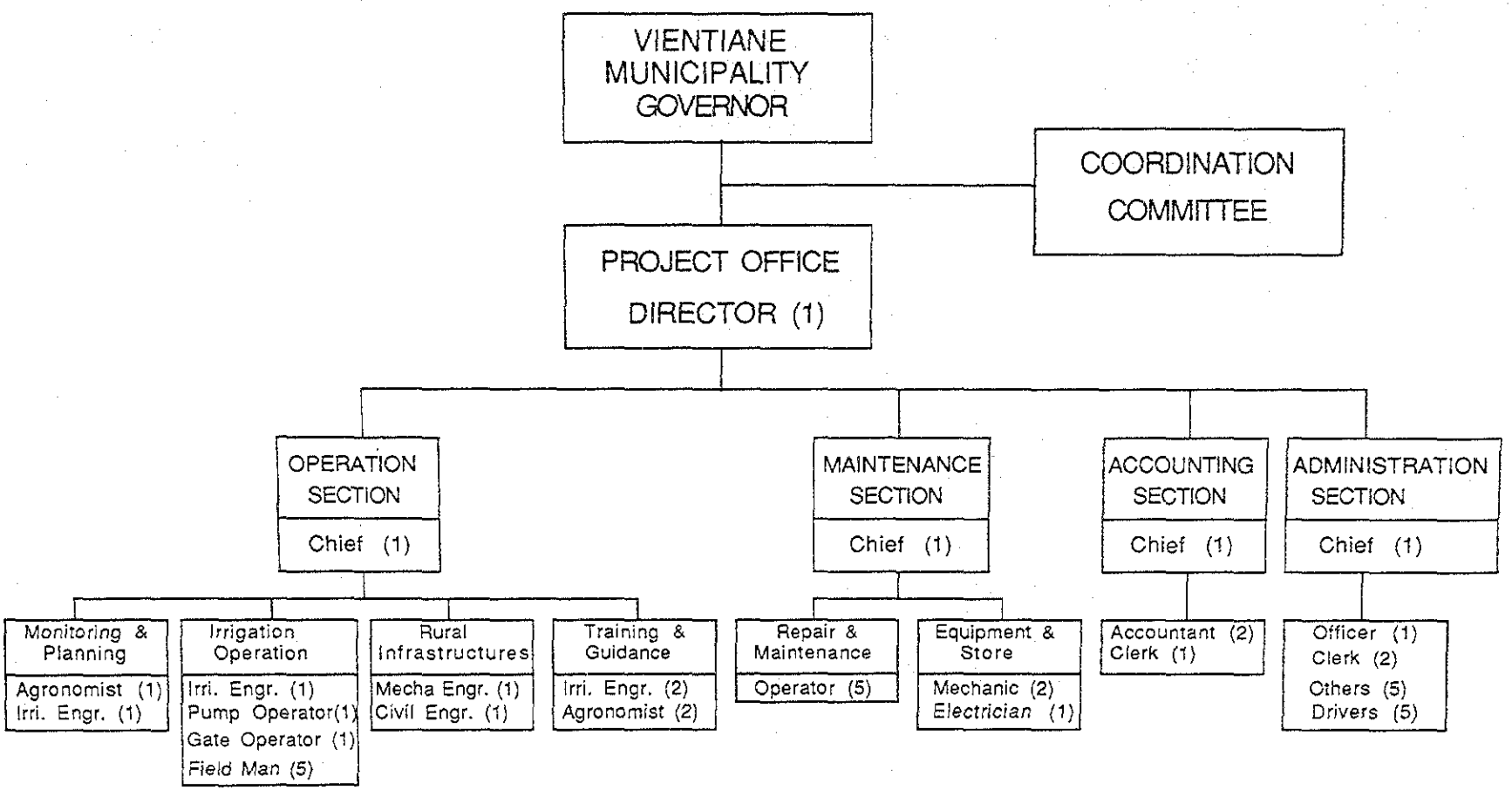


Fig.VI-2 ORGANIZATION CHART AT
OPERATION & MAINTENACE STAGE

ATTACHMENTS

SCOPE OF WORK

FOR

THE FEASIBILITY STUDY

ON

AGRICULTURAL, RURAL DEVELOPMENT PROJECT
IN
THE SUBURBS OF VIENTIANE

AGREED UPON BETWEEN

THE MINISTRY OF AGRICULTURE, FORESTRY, IRRIGATION AND COOPERATIVES

AND

JAPAN INTERNATIONAL COOPERATION AGENCY

Vientiane, March 28, 1988

Mr. Alom THAVONESOUK
Deputy-Director of Planning
Department,
Ministry of Agriculture, Forestry,
Irrigation and Cooperatives

Mr. Noriaki BARAKI
Leader of the Preliminary Survey
Mission
Japan International Cooperation
Agency

I. INTRODUCTION

In response to the request of the Government of Lao People's Democratic Republic(hereinafter referred to as" the Government"),the Government of Japan decided to implement the feasiblity study (hereinafter referred to as" the Study") on the Agricultural, Rural Development Project in the Suburbs of Vientiane (hereinafter referred to as" the Project)in accordance with the relevant laws and regulations in force in Japan.

Japan International Cooperation Agency (hereinafter referred to as "JICA"), the official agency responsible for the implementation of technical cooperation programs of the Government of Japan, will undertake the Study, in close cooperation with the authorities concerned of the Government.

The present document sets forth the Scope of Work for the Study.

II. OBJECTIVE OF THE STUDY

The objectives of the Study are;

1) to formulate the optimum pumping irrigation project, which emphasizes the irrigation and drainage development , agricultural development , and rural development, considering the expansion of the beneficial area to the maximum extent and to verify technical and economic feasibility of the project.

2) to undertake on-the-job training and transfer of knowledge to the Lao counterparts in the course of the Study.

III. SCOPE OF THE STUDY

1. Study Area will

1) lie on the right bank of the Nam Ngum river, a major tributary of Mekong river , and extend from the river to the area at North of Vientiane along the national roads of route 10 and 13

2) Cover a net irrigable area of about 2700ha comprising existing paddy field and extensible area.

2. Scope of the Study

The scope of works for the study will be broadly divided into the following three (3) items.

Work-I : Review of the existing topographic maps on a scale of 1/5,000 prepared by the Government and assistance in preparation of topographic maps covering the extensible area,

Work-II : Data collection, review of the previous preliminary study conducted by the Government, field survey and investigation, and establishment of basic concepts for the projects, and

Work-III : Analyses of the result of field survey and investigation and preparation of the feasibility study report.

The on-the-job training of the Government officials shall be carried out through the Work- I to III . Each of Work-I to III will consist of the following work items.

Work-I

(1) To Review the existing topographic maps on a scale of 1/5,000 prepared by the Government,

(2) To assist the Government in preparation of topographic maps on a scale of 1/5,000 covering the extensible gross area, of about 2,000ha

Work-II

(1) To collect and review the existing data and information relevant to the study on the following items:

(a) Topography,

(b) Meteorology and hydrology,

(c) Geology and soil mechanics,

(d) Soils,

(e) Vegetation,

(f) Agriculture,

(g) Agro-economy and institution including marketing,

(h) Land use,

(i) Irrigation and drainage condition,

(j) Infrastructure,

(k) Regional and national economy, and

(l) Regional and national development plans relevant to agricultural sector

(2) To review the previous preliminary study conducted by the Government in 1984,

(3) To carry out field survey and investigation on the following items:

(a) Geological and soil mechanic investigations,

(b) Meteo-hydrological investigations,

(c) Soil,land use and land suitability,

(d) Topographic survey of the proposed site of pumping station, major irrigation and drainage canals and related structures,

(e) Route alignment survey for main canals proposed,

(f) Agricultural survey including present farming practices and production and post harvest facilities,

(g) Agro-economic and institutional survey ,

(h) Irrigation and drainage survey including irrigation and drainage water requirements,irrigation operating practice in the existing schemes and water balance,

(i) Rural water supply,

(j) Regional economic and marketing survey, and

(k) Construction materials and cost survey.

(4) To establish basic concepts for the projects,

(a) Delineation of the project area,

(b) Outline of proposed agricultural development plan,

(c) Basic plan of major structures, and

(d) Strategy for implementation.

Work - III :

(1) To analyse results of field survey and investigation,

(a) Final delineation of the Project area,

(b) Land use planning ,

(c) Meteo-hydrological study,

(d) Alternative study on pumping station and conveyance of irrigation water,

(e) Layout of the Project works including preliminary design of major structures and demonstration farm(s),

(f) Formulation of agricultural development plan including establishment of most promising cropping pattern and farming practices,

(g) Formulation of institutional arrangements and facilities for operation and maintenance,

(h) Establishment of implementation plan and schedule,
(i) Cost and benefit estimate, and
(j) Economic evaluation.

IV. STUDY SCHEDULE

The Study will be executed in accordance with attached tentative work schedulte .

V. REPORTS

JICA will prepare and submit the following reports in English to the Government .

(1)Inception Report

Twenty (20) copies at the commencement of the field works .

(2)Interim Report

Twenty (20) copies at the end of the field works in the workII.

(3)Draft Final Report

Twenty (20) copies at the end of the work III .

The Government provides JICA with its comments on the Draft Final Report through the Embassy of Japan within one (1) month after the receipt of the Draft Final Report.

(4)Final Report

Fifty (50) copies within two (2)months after the receipt of the comments from the Government on the Draft Final Report.

VI. UNDERTAKING OF THE GOVERNMENT OF LAO PEOPLE'S DEMOCRATIC REPUBLIC

1.To facilitate a smooth conduct of the Study, the Government of Lao People's Democratic Republic takes necessary measures:

1) To secure the safety of the Japanese study team,
2) To permit the members of the Japanese study team to enter,leave and sojourn in Laos for the duration of their assignment therein, and exempt them from alien registration requirements and consular fees,
3) To exempt the members of the Japanese study team from taxes, duties, fees and any other charges on equipment, machinery and other materials brought into Laos for the conduct of the Study,
4) To exempt the members of the Japanese study team from income tax and

other charges of any kind imposed on or in connection with any emoluments or allowances paid to the members of the Japanese study team for their services in connection with the implementation of the study,

5) To provide necessary facilities to the Japanese study team for the remittance as well as utilization of the funds introduced into Laos from Japan in connection of the implementation of the Study,
6) To secure permission for entry into private properties or restricted areas for the conduct of the Study,
7) To secure permission to take all data and documents related to the Study including Aero photographs out of Laos to Japan,by the Japanese study team, and
8) To provide the medical services as needed. Its expenses will be chargeable on the members of the Japanese study team.

2. The Government of Lao People's Democratic Republic shall bear claims, if any arises, against the members of the Japanese study team resulting from, ocurring in the course of, or otherwise connected with the discharge of their duties in the implementation of the Study,except when such claims arise from gross negligence or wilful misconduct on the part of the members of the Japanese study team.

3. The Ministry of Agriculture Forestry, Irrigation and Cooperatives of the Government shall act as counterpart agency to the Japanese study team and also as coordinating body to other relevant organizations for the smooth implementation of the Study.

4. The Ministry of Agriculture Forestry , Irrigation and Cooperatives shall, at its own expense, provide the Japanese study team with the following, in cooperation with other relevant organizations.

1) Available data and information related to the Study,
2) Counterpart personnel to participate in the Study,
3) Suitable office space with necessary equipments,
4) Credentials or identification cards to the members of the study team ,
5) Topographic maps on a scale of 1/5000 with 0.5 meter contour interval for the extensible area.
6) Laboratory test on soil and soil mechanical test.

NB.

Ⅶ. UNDERTAKING OF JICA

For the implementation of the Study, JICA will take the following measures:

1. To dispatch, at its own expense, the study team to Laos, in accordance with the attached tentative work schedule, and

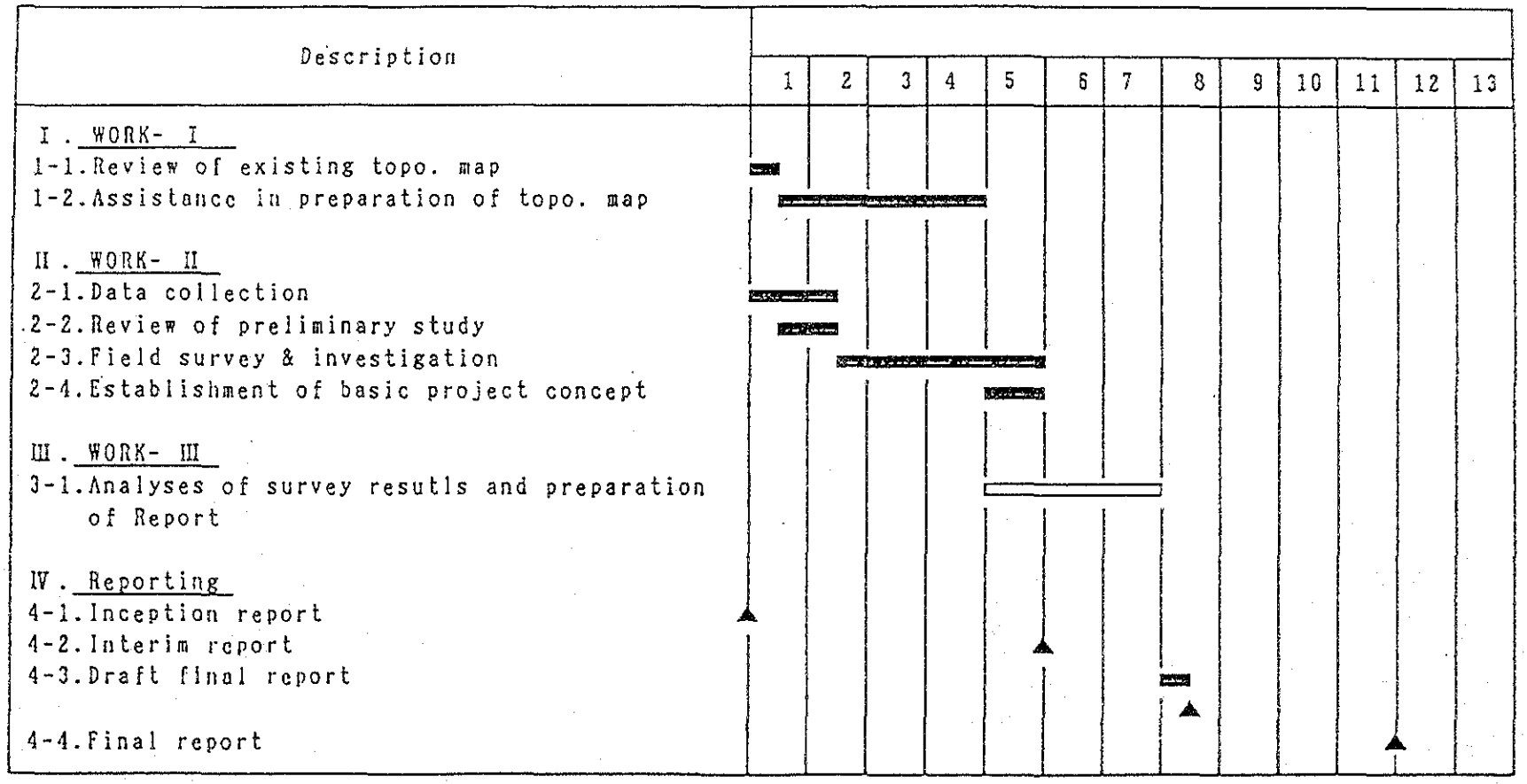
2. To pursue technology transfer to Lao counterparts in the course of the Study.

Ⅷ. OTHERS

JICA and Ministry of Agriculture, Forestry , Irrigation and Cooperatives will consult with each other in respect of any matter that is not agreed upon in this document and may arise from or in connection with the Study .

ATTACHMENT

Tentative Work Schedule



FEASIBILITY STUDY ON
AGRICULTURAL AND RURAL DEVELOPMENT PROJECT
IN THE SUBURBS OF VIENTIANE

Minutes of Meeting
on
Interim Report

1. Date : December 23, 1988
(9:00 - 12:00 a.m.)

2. Place : Meeting Room of Planning Department, Ministry of Agriculture and Forestry (MAF), Vientiane

3. Attendants : See Attached List

4. Summary of Discussion

At the request of the Chairman, Mr. Kou Chansina, Director of Planning Department, MAF, the Team Leader, Mr. Y. Toya, explained the Interim Report to attendants, laying stress on (1) pump irrigation layout, (2) agricultural production plan and (3) stagewise implementation schedule of the Project. Various discussions were then made between MAF and JICA Team on several issues proposed or raised in the Interim Report. Both sides confirmed the following through the discussions :

(1) MAF accepted and basically agreed to the Interim Report submitted by the JICA Study Team on December 22, 1988. Should MAF find any items to be modified through the further review of the Interim Report, MAF will inform the JICA Study Team of such items before the end of January 1989.

(2) MAF pointed out recent changes of the agricultural policy in Lao PDR and requested the JICA Team to take into account such changes in preparing the final feasibility report.

(3) MAF agreed to the stagewise development plan of the Project proposed in the Interim Report and expressed its intention to proceed to the implementation of Stage-I at the earliest time.

(4) MAF expressed that the proposed organization for the Project implementation and management will be further examined and discussed among the relevant authorities, and MAF will inform the JICA Team of its decision by the end of January 1989.

(5) MAF pointed out several values such as acreage of irrigated paddy fields in the country and growth rate of population, which seem incorrect. JICA Team agreed to reconfirm and correct such values.

December 26, 1988

Y. Toya
Team Leader
JICA Study Team

Kou Chansina
Director
Planning Dept., MAF

List of Attendants

Lao Government

(i)	Mr. Kou Chansina	:	Director of Planning Department, MAF
(ii)	Mr. Alom Thavonesouk	:	Deputy Director of Planning Department, MAF
(iii)	Mr. Soulasith Upravanh	:	Agricultural Service of Vientiane Municipality
(iv)	Mr. Anong Vinnua	:	Chief of Hydrological Service, Meteoro-hydrological Department, MAF
(v)	Mr. Oudon Sisongkham	:	Planning Department, MAF
(vi)	Mr. Pay Thoun	:	Irrigation Service of Vientiane Municipality
(vii)	Mr. Eravanh Boungnaphalom	:	Department of Mining, Ministry of Industry and Handicraft

JICA Team

(i)	Mr. Y. Toya	:	Team Leader
(ii)	Mr. T. Higashikawa	:	Irrigation and Drainage Engineer
(iii)	Mr. T. Matsuo	:	Agro-economist

FEASIBILITY STUDY ON
AGRICULTURAL AND RURAL DEVELOPMENT PROJECT
IN THE SUBURBS OF VIENTIANE

Minutes of Meeting
on
Draft Final Report

1. Date : March 13, 1989

2. Place : Meeting Room of Planning Department, Ministry of Agriculture and Forestry (MAF), Vientiane

3. Attendants : See Attached List

4. Summary of Discussion

After the opening of the Meeting by the Chairman, Mr. Alom Thavonesouk, Deputy Director of Planning Department, MAF, attendants from the Lao side and the JICA mission were introduced by the Chairman and Mr. T. Takahata, representative of the JICA mission, respectively. This was followed by the explanation on the Draft Final Report by the Team Leader, Mr. Y. Toya.

The explanation were made, placing emphasis on (1) irrigation development plan, (2) agricultural production plan and (3) items modified after the preparation of the Interim Report. Various discussions were then made between MAF and JICA mission on several issues raised in the Report. Both sides confirmed the following through the discussions:

(1) MAF accepted and basically agreed to the Draft Final Report submitted on March 10, 1989. Should MAF find any comments on the Report, MAF will inform JICA of the comments through the Embassy of Japan within one (1) month after the receipt of the Draft Final Report.

(2) MAF has agreed to the proposed functions and facilities of the Demonstration Farm, but expressed its intention to have additionally a small warehouse in the Farm for storage of selected seeds and equipment. JICA mission noted that this would be examined in preparing the Final Report.

(3) JICA mission stressed the importance of the supply of agricultural inputs including fertilizer, which would be one of the prerequisites for the successful management of the

Project. MAF stated that it realized this and would take necessary measures.

(4) MAF has already accorded its highest priority to the implementation of the Project, and the implementation of Stage-I is minimum requirement of MAF. MAF expressed his strong expectation to Japanese Government's aid for the early implementation of the Stage-I.

(5) JICA will prepare and submit to MAF fifty (50) copies of Final Report within two (2) months after the receipt of MAF's comments on the Draft Final Report.

(6) MAF requested that JICA provide vehicle and stationery for MAF which were used for investigation and study by the JICA study team.

March 14, 1989

Yusaku Toya
Team Leader for
JICA Study Team

Alom Thavonesouk
Deputy Director
Planning Department
Ministry of Agriculture
and Forestry

Witness

Tsuneo Takahata
JICA

List of Attendants

Lao Government

(i)	Mr. Alom Thavonesouk	:	Deputy Director of Planning Department, MAF
(ii)	Dr. Soulasith Upravanh	:	Agricultural Service of Vientiane Municipality
(iii)	Mr. Oudon Sisongkham	:	Planning Department, MAF
(iv)	Mr. Thattamanivong Vayaphat	:	Soil Department, MAF
(v)	Mr. Pay Thoun	:	Irrigation Service of Vientiane Municipality

JICA Team

(i)	Mr. T. Takahata	:	JICA Staff
(ii)	Dr. M. Yasuo	:	JICA Expert
(iii)	Mr. Y. Toya	:	Team Leader
(iv)	Mr. T. Higashikawa	:	Irrigation and Drainage Engineer